INSTRUCTION MANUAL

TECO

INVERTER

TECO INVERTER

F510 Series

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Preface

The F510 product is an inverter designed to control a three-phase induction motor. Please read this manual carefully to ensure correct operation, safety and 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 http://industrialproducts.teco.com.tw/.

Available Documentation:

1. F510 Start-up and Installation Manual
2. F510 Instruction Manual

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

Ensure you have sound knowledge of the inverter and familiarize yourself with all safety information and precautions before proceeding to operate the inverter.

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.

Chapter 1 Safety Precautions

Users are advised to carefully read the safety precautions required in this chapter before installing, testing and repairing the system. Any personnel injury and equipment loss caused by illegal operation are irrelevant to the company and bear any responsibility.

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 panel, 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.
- Over temperature protection function on motor is provided, please follow the description of control circuit terminals, and refer to the parameter group 08.

1.2 Wiring

Warning

- Always turn OFF the power supply before attempting inverter installation and wiring of the user terminals.
- 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. (200V Class: Grounding impedance shall be less than 100Ω. 400V Class: Grounding impedance shall be less than 10Ω.) It is required to disconnect the ground wire in the control board to avoid the sudden surge causing damage on electronic parts if it is improperly grounded.
- 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 or this will result in inverter damage to the semiconductor components.

Caution

- The line voltage applied must comply with the inverter's specified input voltage.
- Connect braking resistor and braking unit to the designated terminals.
- 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.
- 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 before supplying power.
- Reduce the carrier frequency (parameter 11-01) If the cable from the inverter to the motor is over 80 ft (25m). 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 an 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.
- An external emergency stop switch is enabled when parameter 08-30 is set for the run permissive function.
- It provides an independent external hardware emergency switch, which emergently 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 5 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. Wait a minimum of 15 minutes while inverter is over 20HP.
- 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. (Take off 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 required 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.

Equipment containing electrical components may not be disposed of together with domestic waste. It must be separately collected with electrical and electronic waste according to local and currently valid legislation.

1.8 Guaranteed liability exemption

- Loss of opportunity caused by the company's products, damage to customers of your company or your company, damage to non-company products, or compensation for other businesses, whether within the warranty period or not, is not covered by the company.

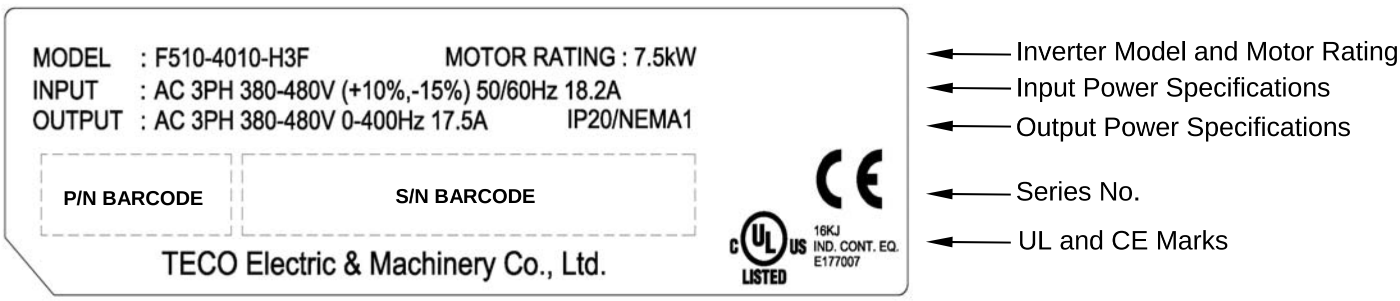
Chapter 2 Model Description

2.1 Nameplate Data

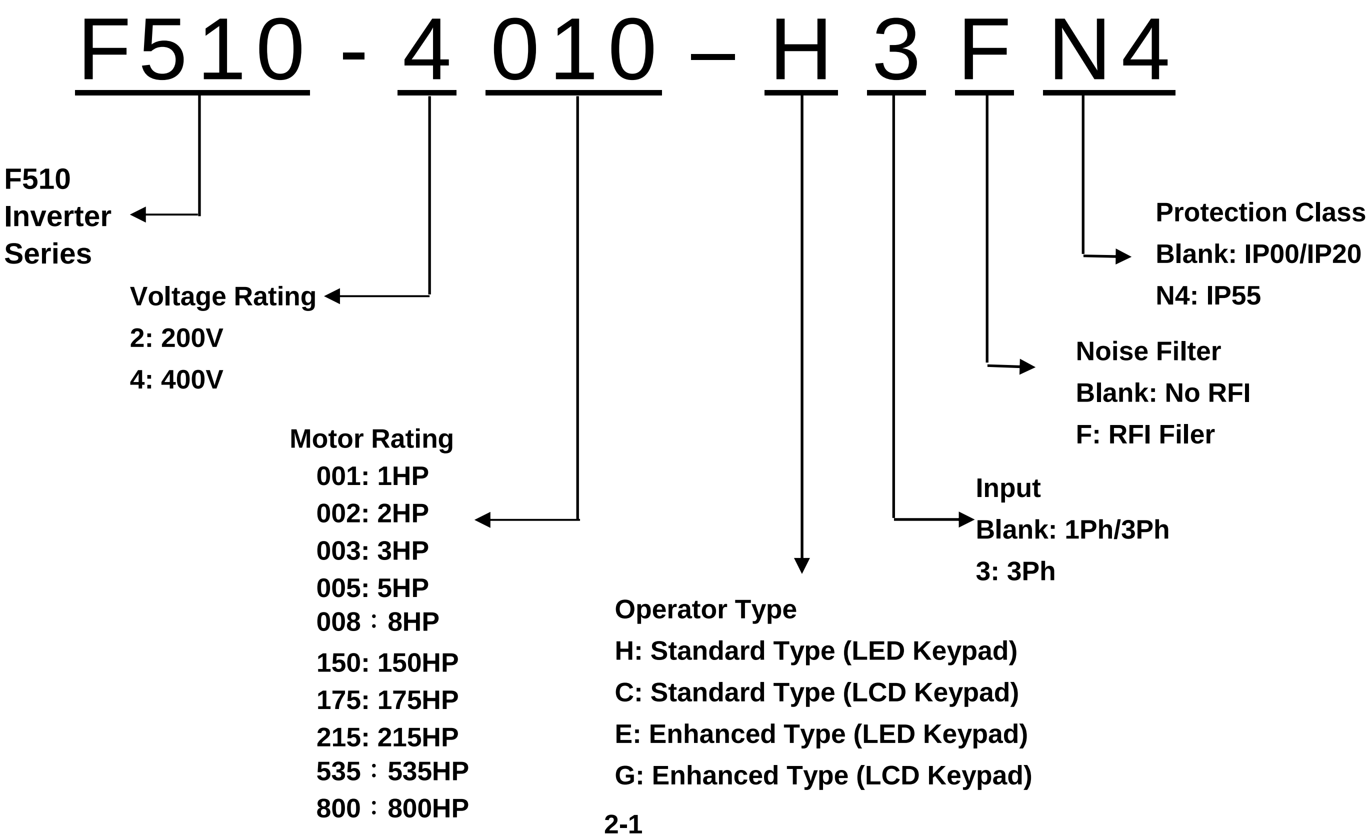
It is essential to verify the F510 inverter nameplate and make sure that the F510 inverter has the correct rating so it can be used in your application with the proper sized AC motor.

Unpack the F510 inverter and check the following:

(1) The F510 inverter and quick setting guide 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 type you ordered. You can 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 HP matches the motor rating of the inverter.



2.2 Model Identification



Inverter Models – Motor Power Rating：

200V Class

Voltage (Vac) & Frequency (Hz)	F510 Model	Motor Power (Hp)	Applied Motor (kW)	Filter		Protection Class (IP55)
				with	without	
3ph 200~240V +10%/-15% 50/60Hz	F510-2001-□	1	0.75		◎	
	F510-2002-□	2	1.5		◎	
	F510-2003-□	3	2.2		◎	
	F510-2005-□	5	3.7		◎	
	F510-2008-□	7.5	5.5		◎	
	F510-2010-□	10	7.5		◎	
	F510-2015-□	15	11		◎	
	F510-2020-□	20	15		◎	
	F510-2025-□	25	18.5		◎	
	F510-2030-□	30	22		◎	
	F510-2040-□	40	30		◎	
	F510-2050-□	50	37		◎	
	F510-2060-□	60	45		◎	
	F510-2075-□	75	55		◎	
	F510-2100-□	100	75		◎	
	F510-2125-□	125	94		◎	
	F510-2150-□	150	112		◎	
	F510-2175-□	175	130		◎	

400V Class

Voltage (Vac) & Frequency (Hz)	F510 Model	Motor Power (Hp)	Applied Motor (kW)	Filter		Protection Class (IP55)
				with	without	
3ph 380~480V +10%/-15% 50/60Hz	F510-4001-□3	1	0.75		◎	
	F510-4001-□3F	1	0.75	◎		
	F510-4001-C3FN4	1	0.75	◎		◎
	F510-4002-□3	2	1.5		◎	
	F510-4002-□3F	2	1.5	◎		
	F510-4002-C3FN4	2	1.5	◎		◎
	F510-4003-□3	3	2.2		◎	
	F510-4003-□3F	3	2.2	◎		
	F510-4003-C3FN4	3	2.2	◎		◎
	F510-4005-□3	5	3.7		◎	
	F510-4005-□3F	5	3.7	◎		
	F510-4005-C3FN4	5	3.7	◎		◎
	F510-4008-□3	7.5	5.5		◎	
	F510-4008-□3F	7.5	5.5	◎		
	F510-4008-C3FN4	7.5	5.5	◎		◎
	F510-4010-□3	10	7.5		◎	
	F510-4010-□3F	10	7.5	◎		
	F510-4010-C3FN4	10	7.5	◎		◎
	F510-4015-□3	15	11		◎	
	F510-4015-□3F	15	11	◎		
	F510-4015-C3FN4	15	11	◎		◎
	F510-4020-□3	20	15		◎	
	F510-4020-□3F	20	15	◎		
	F510-4020-C3FN4	20	15	◎		◎
	F510-4025-□3	25	18.5		◎	

Voltage (Vac) & Frequency (Hz)	F510 Model	Motor Power (Hp)	Applied Motor (kW)	Filter		Protection Class (IP55)
				with	without	
3ph 380~480V +10%/-15% 50/60Hz	F510-4025-□3F	25	18.5	◎		
	F510-4025-C3FN4	25	18.5	◎		◎
	F510-4030-□3	30	22		◎	
	F510-4030-□3F	30	22	◎		
	F510-4030-C3FN4	30	22	◎		◎
	F510-4040-□3	40	30		◎	
	F510-4040-□3F	40	30	◎		
	F510-4040-C3FN4	40	30	◎		◎
	F510-4050-□3	50	37		◎	
	F510-4050-□3F	50	37	◎		
	F510-4050-C3FN4	50	37	◎		◎
	F510-4060-□3	60	45		◎	
	F510-4060-□3F	60	45	◎		
	F510-4060-C3FN4	60	45	◎		◎
	F510-4075-□3	75	55		◎	
	F510-4075-□3F	75	55	◎		
	F510-4075-C3N4	75	55		◎	◎
	F510-4100-□3	100	75		◎	
	F510-4100-C3N4	100	75		◎	◎
	F510-4125-□3	125	94		◎	
	F510-4150-□3	150	112		◎	
	F510-4175-□3	175	130		◎	
	F510-4215-□3	215	160		◎	
	F510-4250-□3	250	185		◎	
	F510-4300-□3	300	220		◎	
	F510-4375-□3	375	280		◎	
	F510-4425-□3	425	317		◎	
	F510-4535-□3	535	400		◎	
	F510-4670-□3	670	500		◎	
	F510-4800-□3	800	600		◎	

Chapter 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/ IP21/ NEMA 1, IP00
	IP55/ NEMA 12
Ambient Environment	
Operating Temperature	IP20/IP21/IP55: -10°C - +40°C (14 -104 °F) IP00 (Without Cover): -10°C - +50°C (14-122 °F) Enhanced type frame 5 is 50°C without de-rating. The maximum operating temperature is **60°C,** but it is required to derate 2% of current at each additional 1°C. If several inverters are placed in the same control panel, provide a heat removal means to maintain ambient temperatures
Storage Temperature	-20°C - +70°C (-4 -158 °F)
Humidity	95% non-condensing Relative humidity 5% to 95%, free of moisture. (Follow IEC60068-2-78 standard)
Altitude	Altitude: Below 1000 m (3281 ft.) It is required to derate 1% of current at each additional 100 m. The maximum altitude is **3000 m**.
Installation Site	Avoid direct sunlight.
	Avoid exposure to rain or moisture.
	Avoid oil mist and salinity.
	Avoid corrosive liquid and gas.
	Avoid dust, lint fibers, and small metal filings.
	Avoid electromagnetic interference (soldering machines, power machines).
	Keep away from radioactive and flammable materials.
	Avoid vibration (stamping, punching machines etc.). Add a vibration-proof pad if the situation cannot be avoided.
Shock	Maximum acceleration: 1.2G (12m/s²), 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

3.2.1 Installation Spaces

- 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

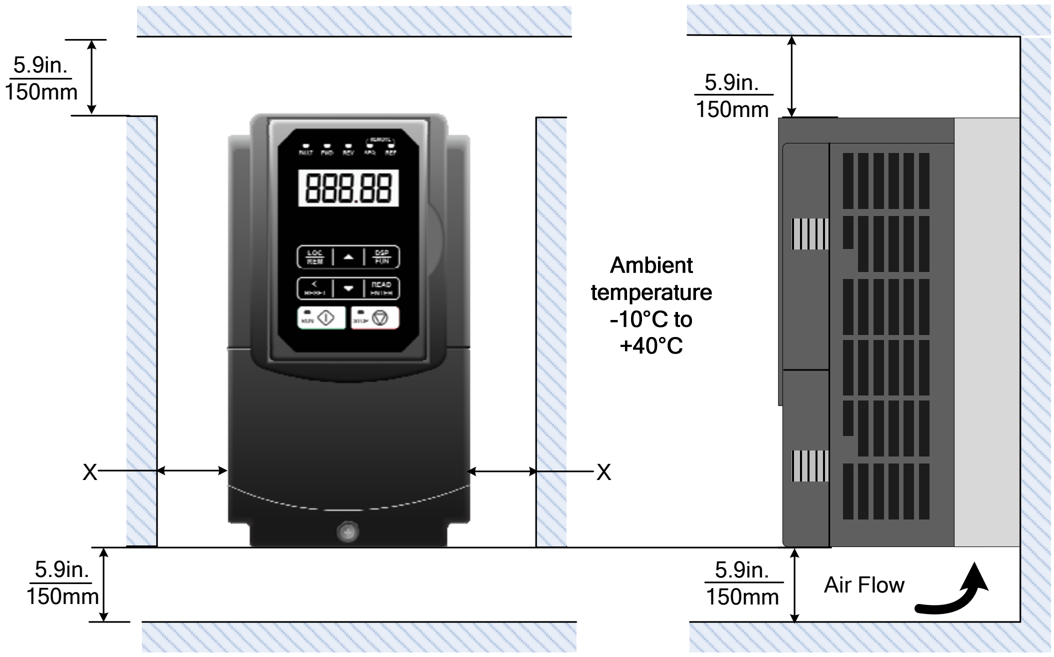


Fig 3.2.1: F510 Installation space

X = 1.18” (30mm) for inverter ratings up to 18.5kW

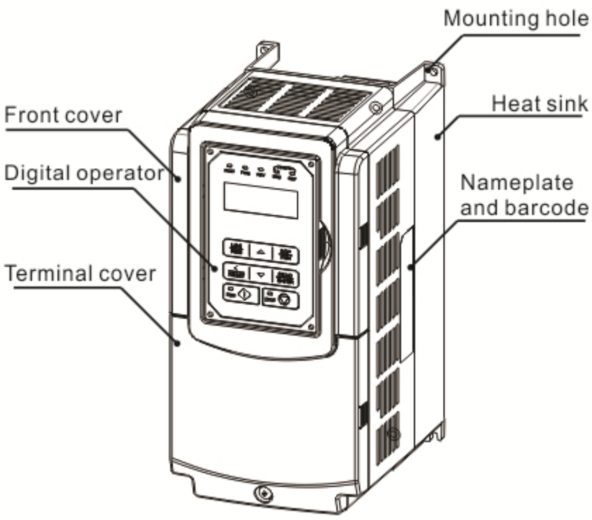
X = 1.96” (50mm) for inverter ratings 22kW or higher

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

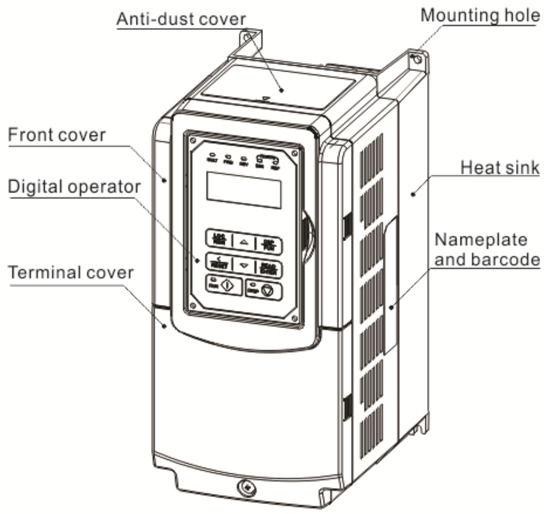
3.2.2 External View

3.2.2.1 External View (IP00/ IP20)

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

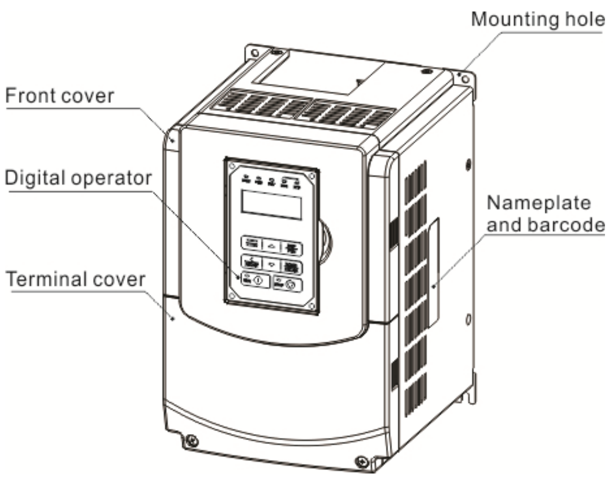


(Wall-mounted type, IEC IP00)

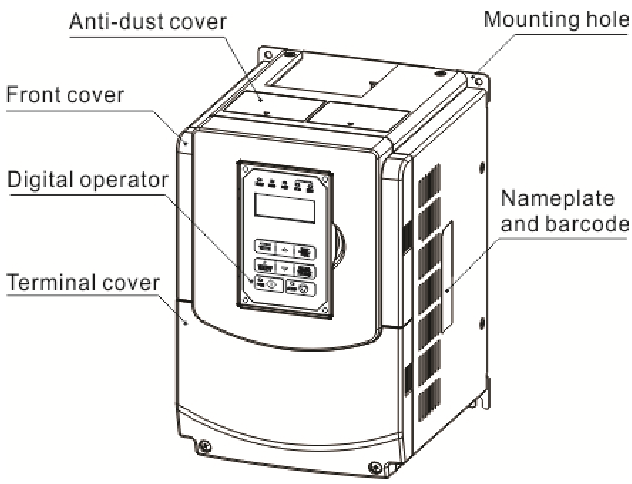


(Wall-mounted type, IEC IP20, NEMA1)

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

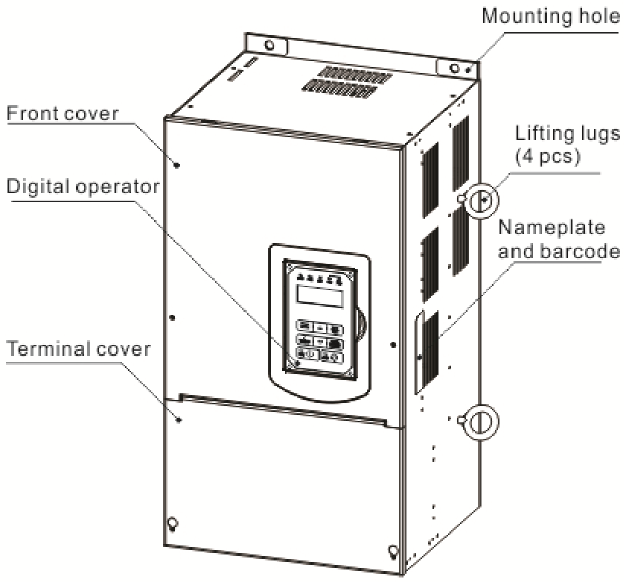


(Wall-mounted type, IEC IP00)



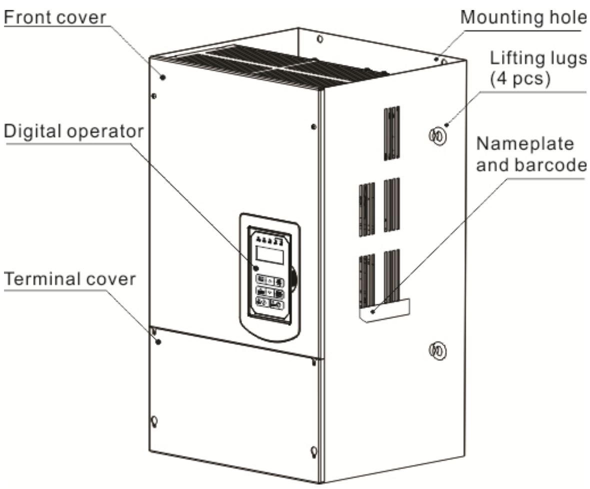
(Wall-mounted type, IEC IP20, NEMA1)

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

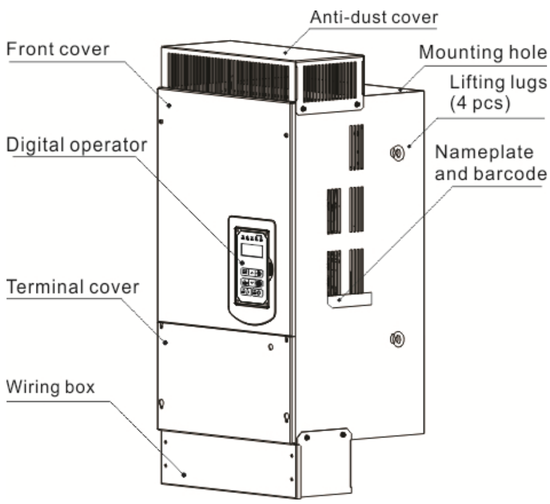


(Wall-mounted type, IEC IP20, NEMA1)

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

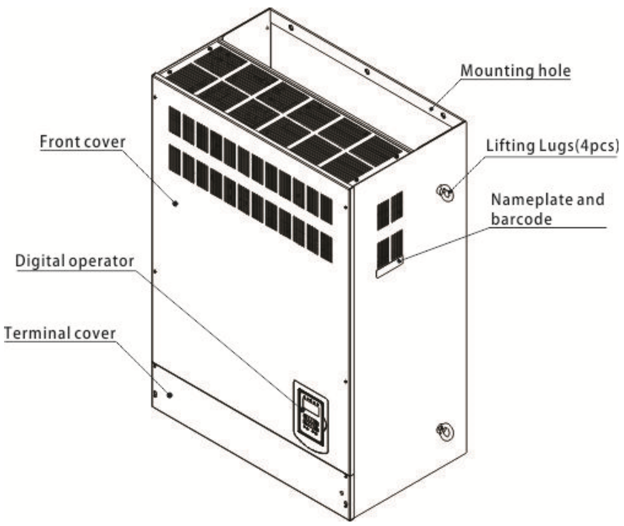


(Wall-mounted type, IEC IP00)

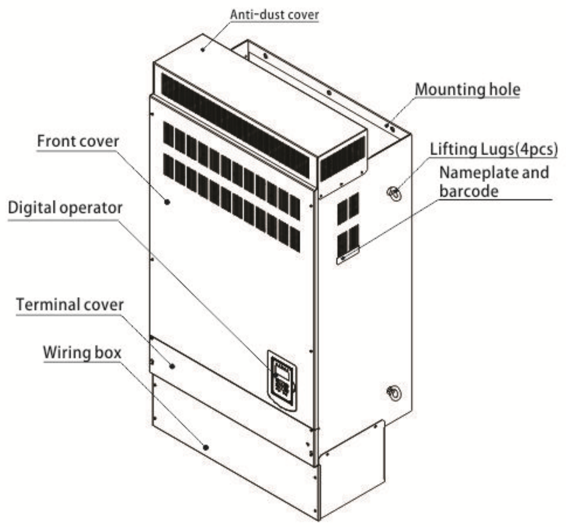


(Wall-mounted type, IEC IP20, NEMA1)

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

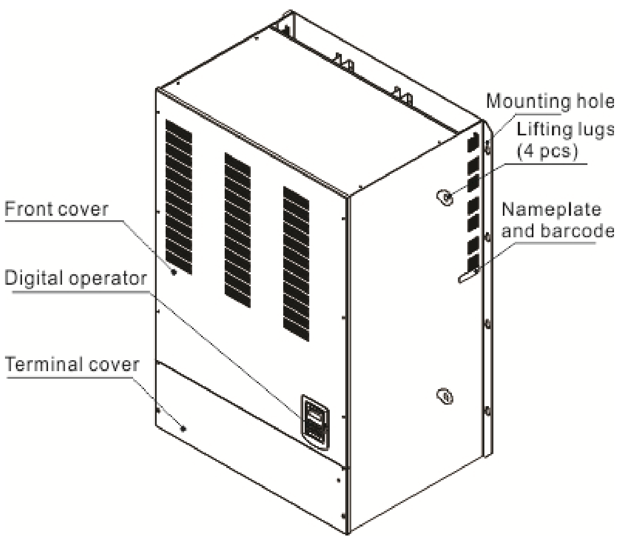


(Wall-mounted type, IEC IP00)

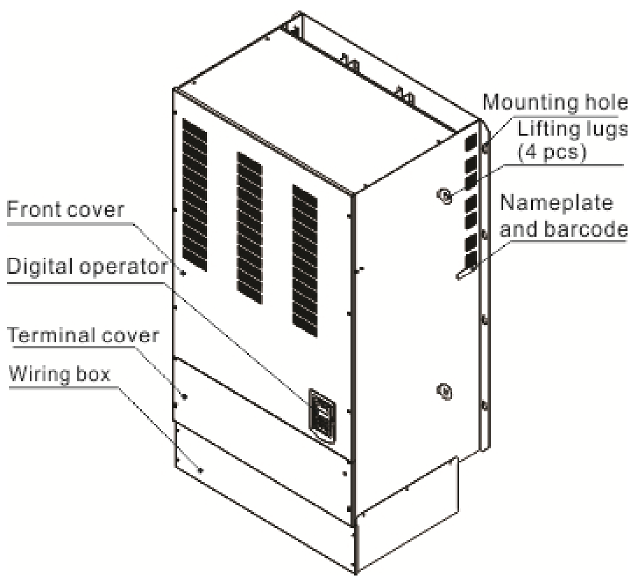


(Wall-mounted type, IEC IP20)

(f) 400V 535-800HP



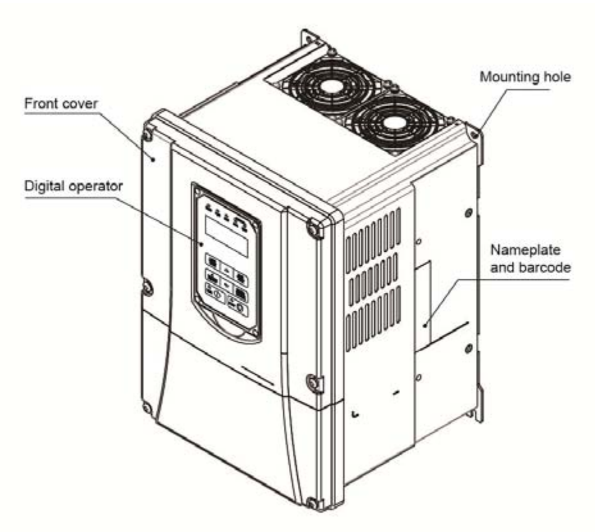
(Wall-mounted type, IEC IP00)



(Wall-mounted type, IEC IP20)

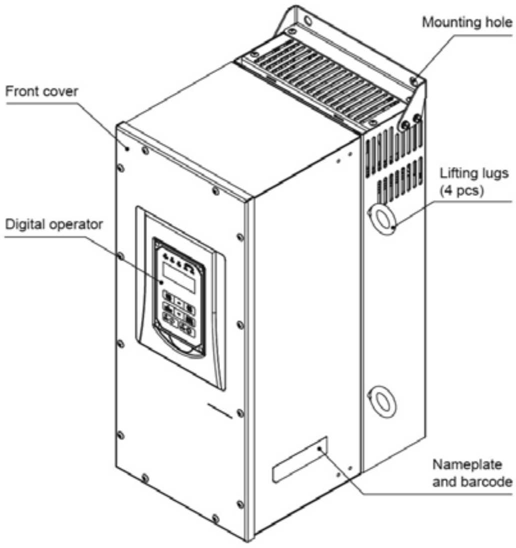
3.2.2.2 External View (IP55)

(a) 400V 1-25HP



(Wall-mounted type, IEC IP55)

(b) 400V 30-100HP



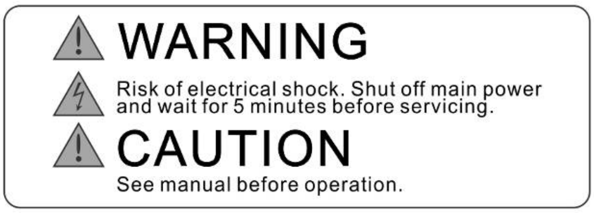
(Wall-mounted type, IEC IP55)

3.2.3 Warning Labels

Important:

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

(a) 200V: 1-7.5HP/ 400V: 1-10HP (IP20)



(b) 200V: 10-15HP/ 400V: 15-20HP (IP20)

(c) 200V: 20-175HP/ 400V: 25-800HP(IP20)

(d) 400V：1-100HP (IP55)

3.2.4 Removing the Front Cover and Keypad

■ Before making any wiring connections to the inverter, the front cover needs to be removed.

IP00/ IP20 Type

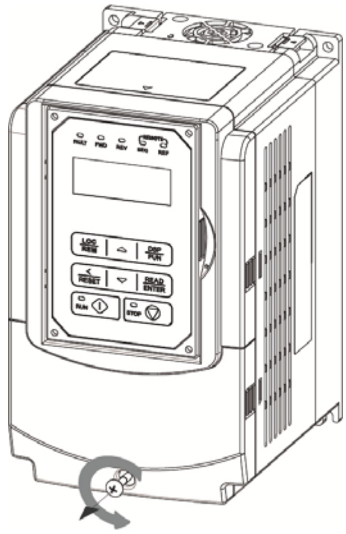
Caution
• It is not required to remove the digital operator before making any wiring connections. • Models 200V,1– 30 HP and 400V, 1 – 40 HP have a plastic cover. Loosen the screws and remove the cover to gain access to the terminals and make wiring connections. Place the plastic cover back and fasten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

IP55 Type

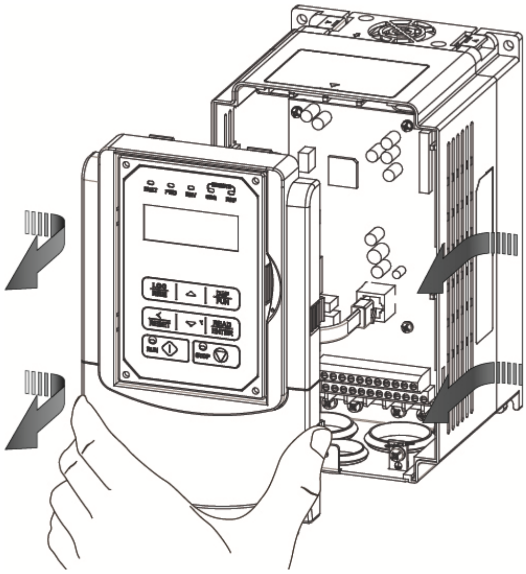
Caution
• It is essential to remove the digital operator before making any wiring connections. • Model 400V, 1 – 25 HP has a plastic cover. Loosen the screws and remove the cover to gain access to the terminals and make wiring connections. Place the plastic cover back and fasten screws when wiring connections have been made, suggested screw locking torque is 8 kgf-cm. • Models 400V, 30 - 100HP has 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, suggested screw locking torque is 8 kgf-cm.

3.2.4.1 IP00/ IP20 Type

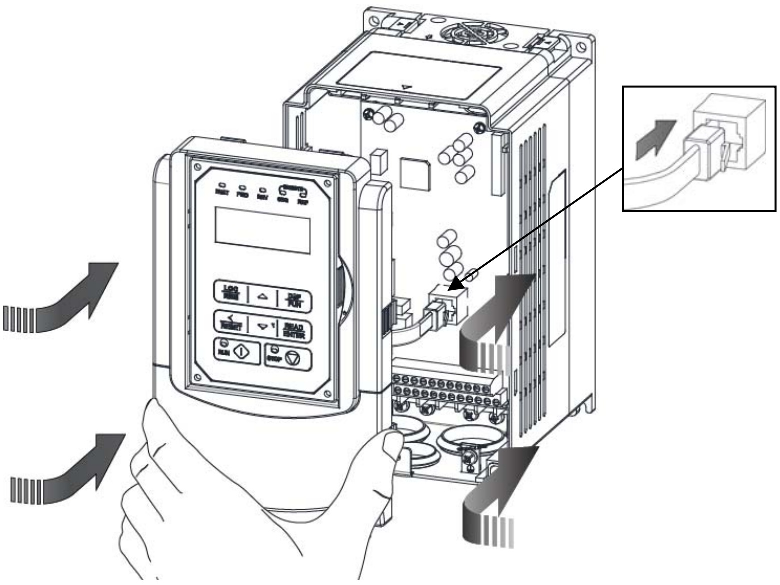
(a) 200V 1-3HP/ 400V 1-3HP



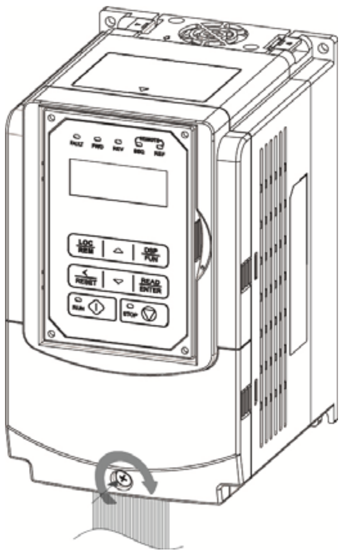
Step 1: Unscrew



Step 2: Remove whole top cover, and unlock RJ45 connector

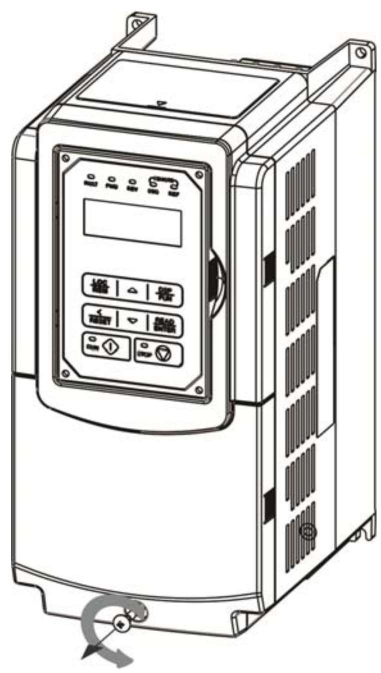


Step 3: Make wire connections, lock RJ45 connector and place top cover back

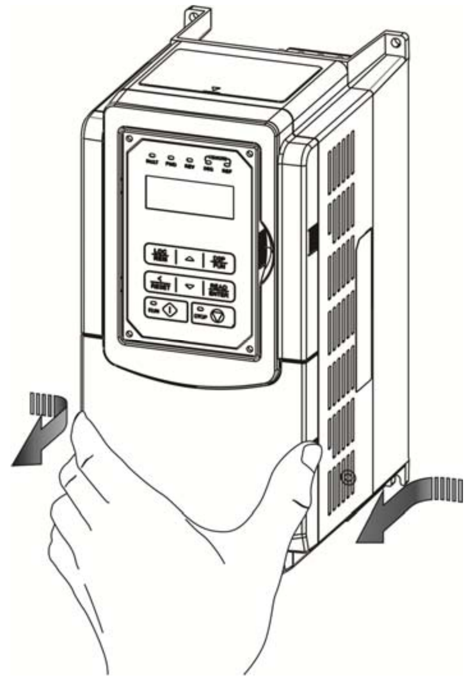


Step 4: Fasten screw

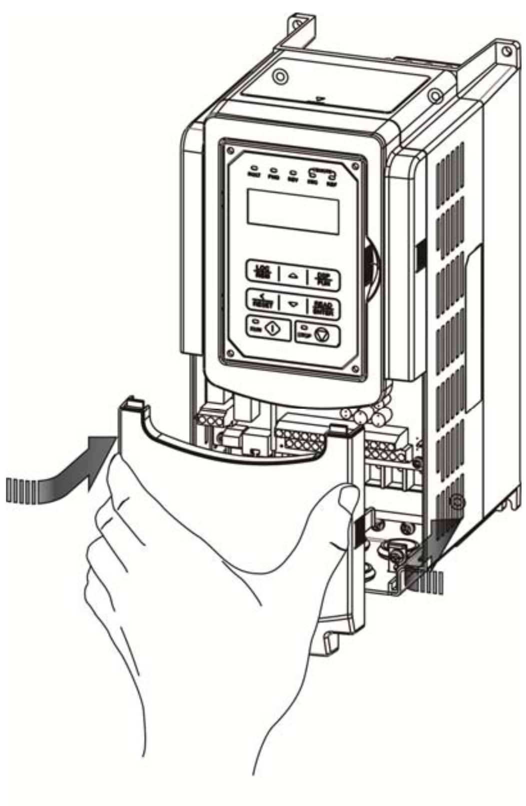
(b) 200V 5-7.5HP(Standard Type) 5~10HP (Enhanced Type) /400V 5-10HP



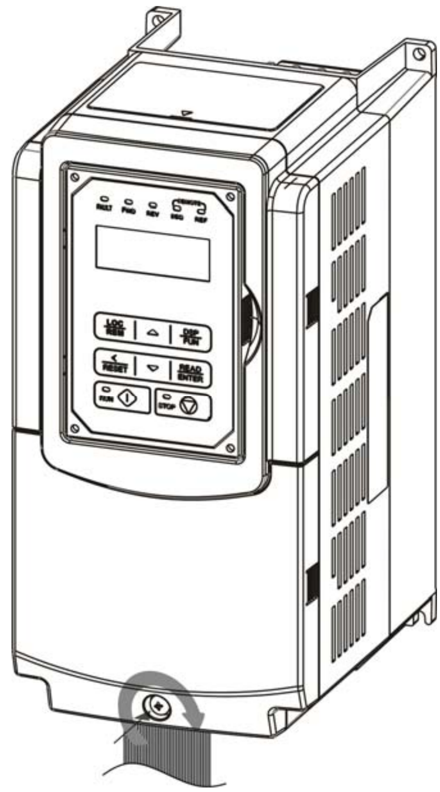
Step 1: Unscrew



Step 2: Remove cover

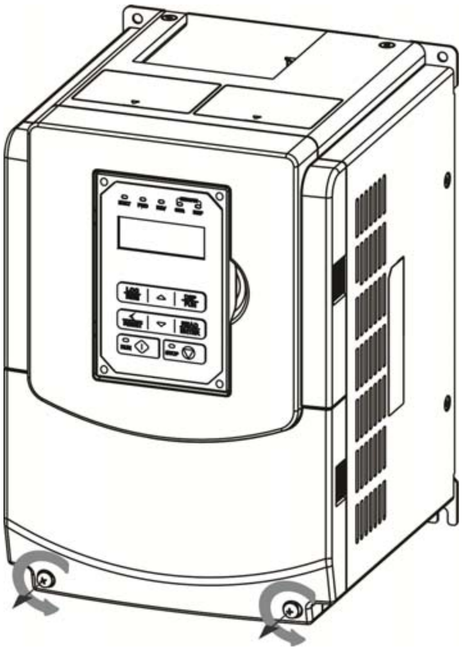


Step 3: Make wire connections and place cover back

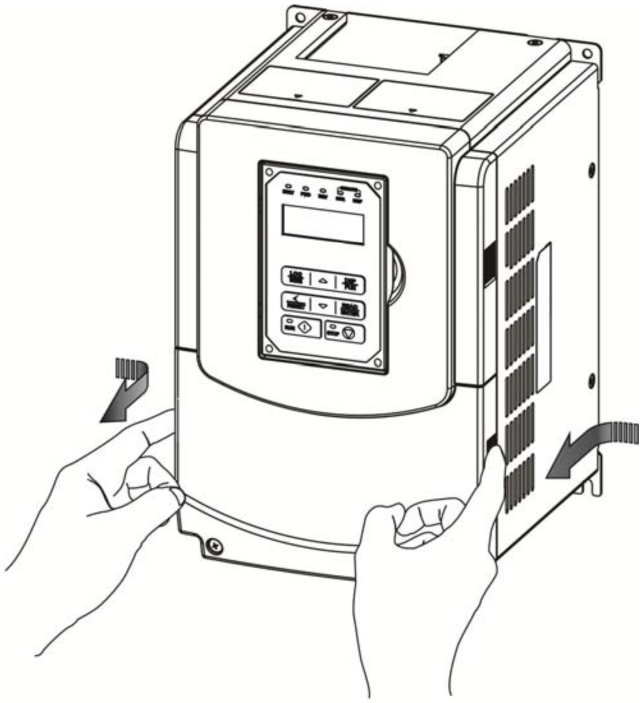


Step 4: Fasten screw

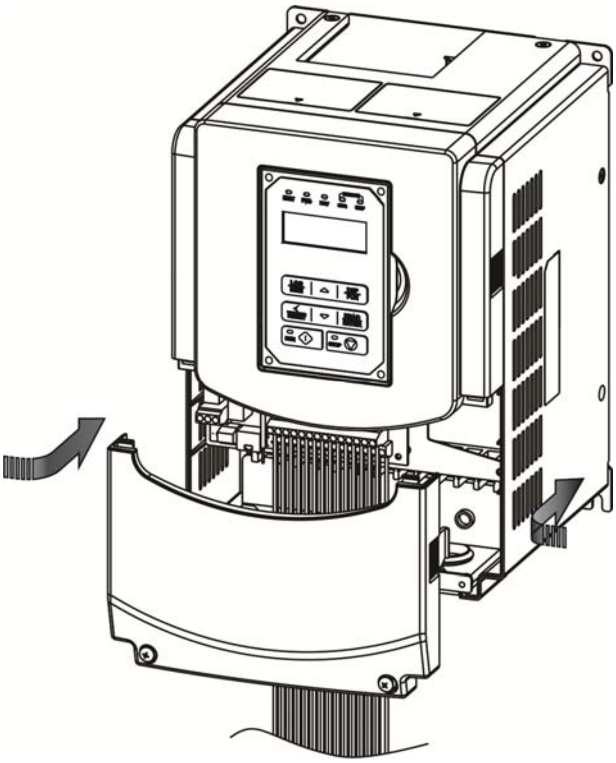
(c) 200V 10-30HP/ 400V 15-40HP



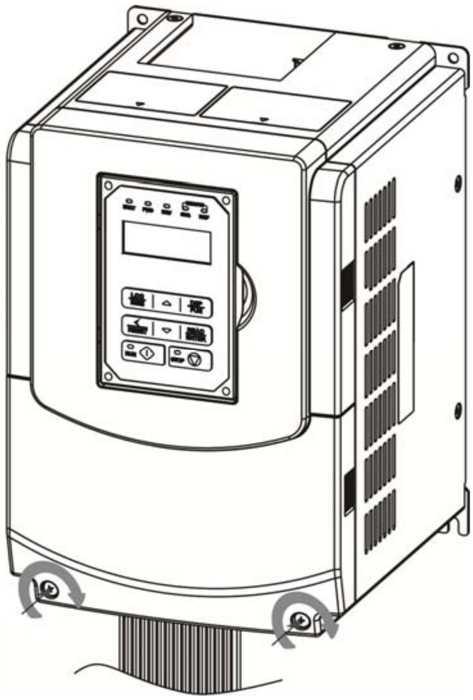
Step 1: Unscrew



Step 2: Remove cover

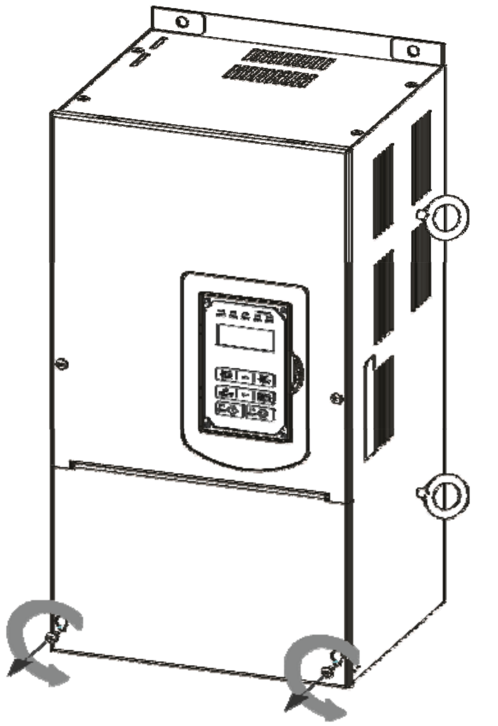


Step 3: Make wire connections and place cover back

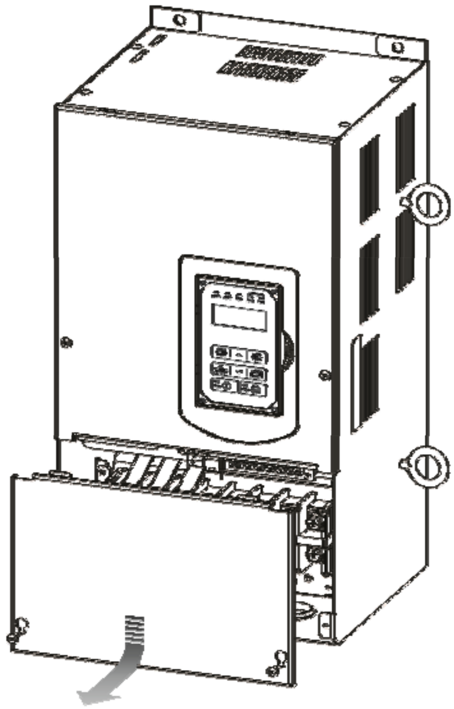


Step 4: Fasten screw

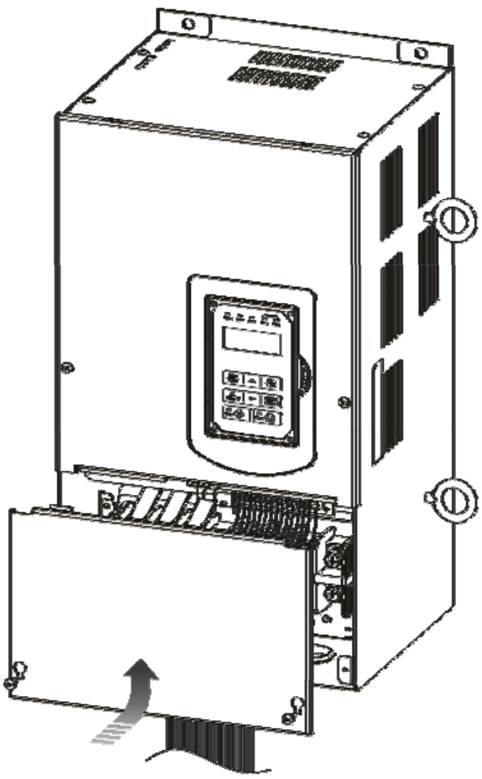
(d) 200V 40-50HP/ 400V 50-75HP (Standard Type) 50~100HP (Enhanced Type)



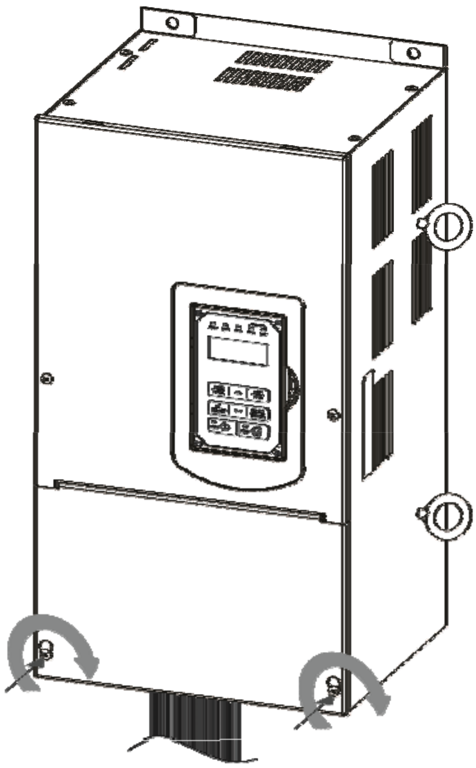
Step 1: Unscrew cover



Step 2: Remove cover



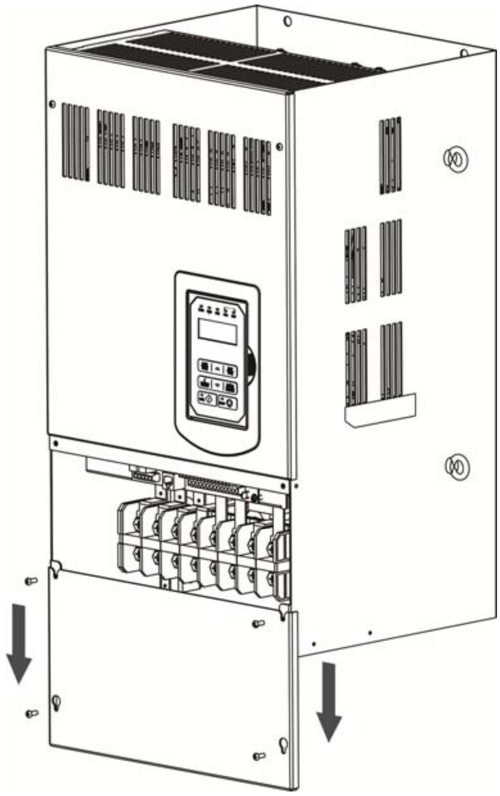
Step 3: Make wire connections and place cover back



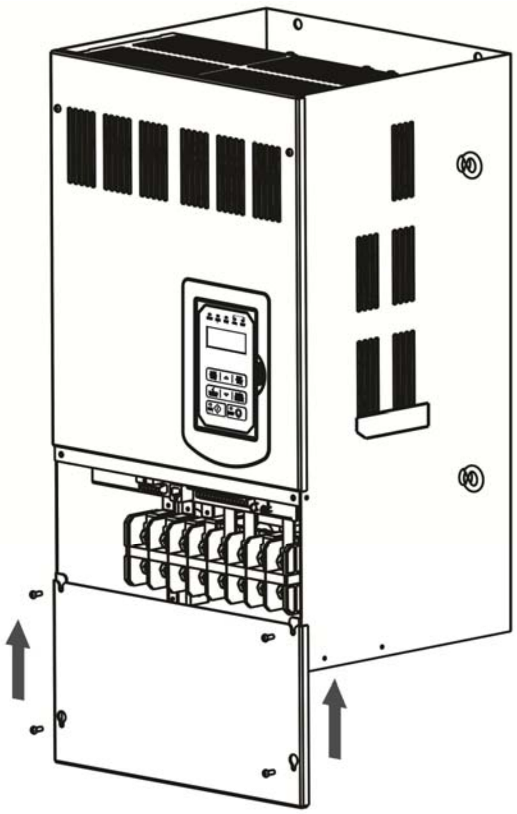
Step 4: Fasten screw

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

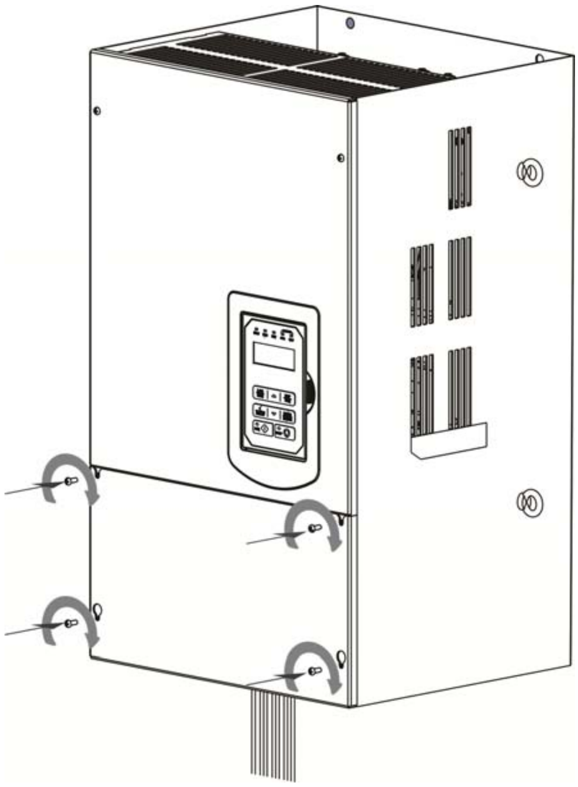
Step 1: Unscrew cover



Step 2: Remove cover

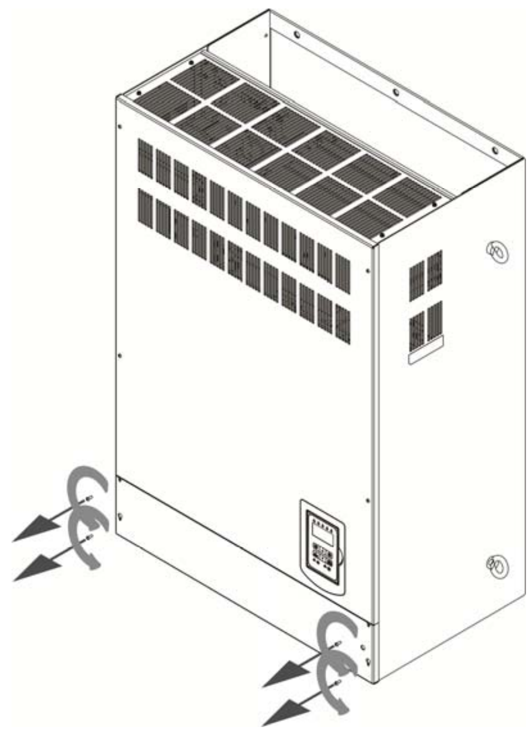


Step 3: Make wire connections and place cover back

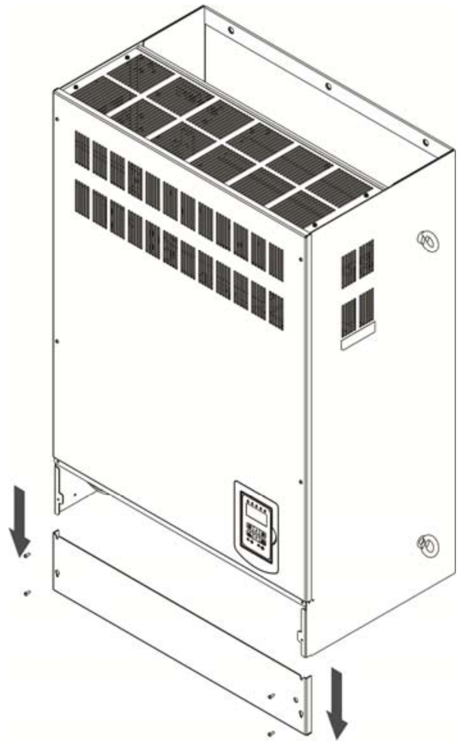


Step 4: Fasten screw

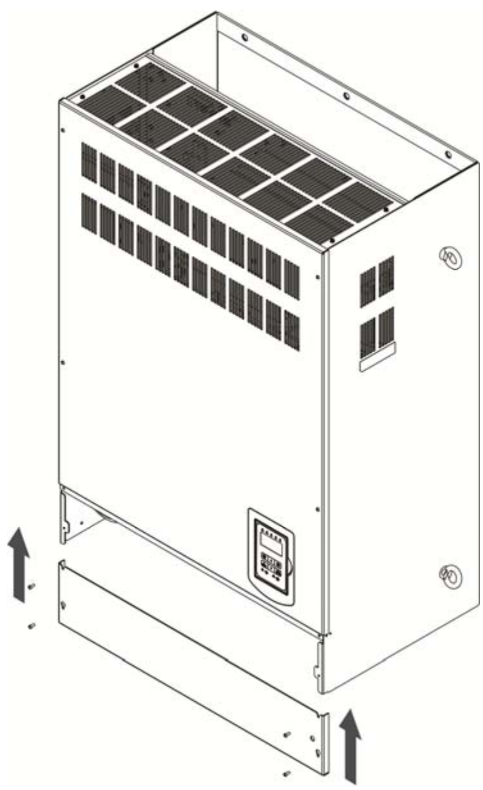
(f) 200V 150-175HP/ 400V 300-425HP



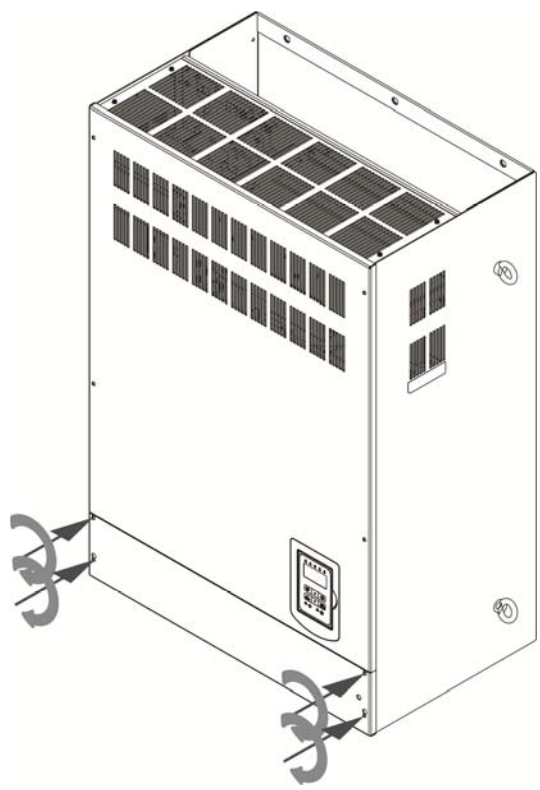
Step 1: Unscrew cover



Step 2: Remove cover

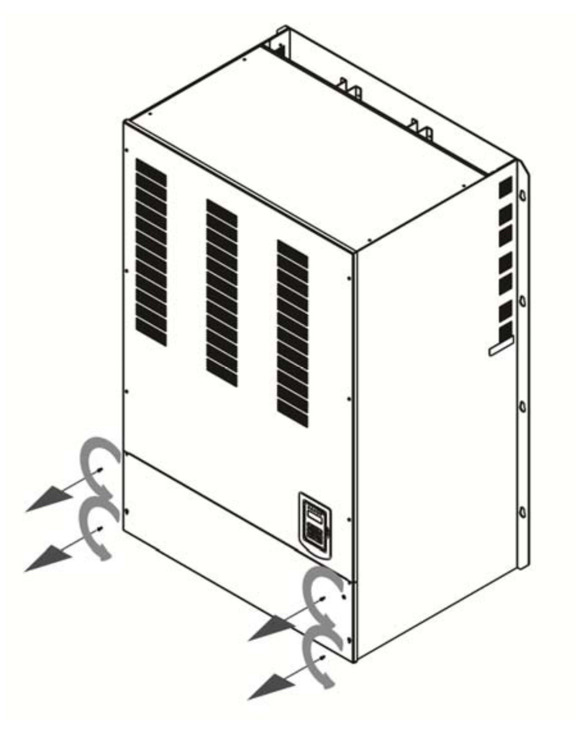


Step 3: Make wire connections and place cover back

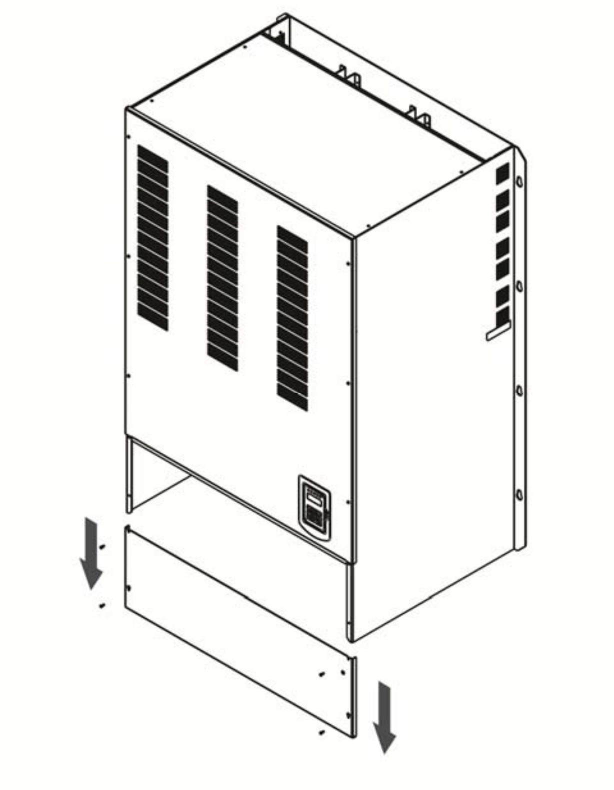


Step 4: Fasten screw

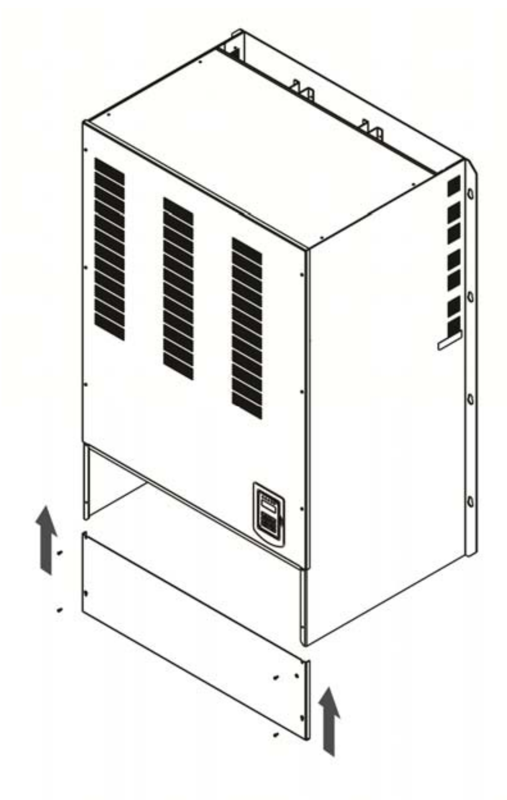
(g) 400V 535-800HP



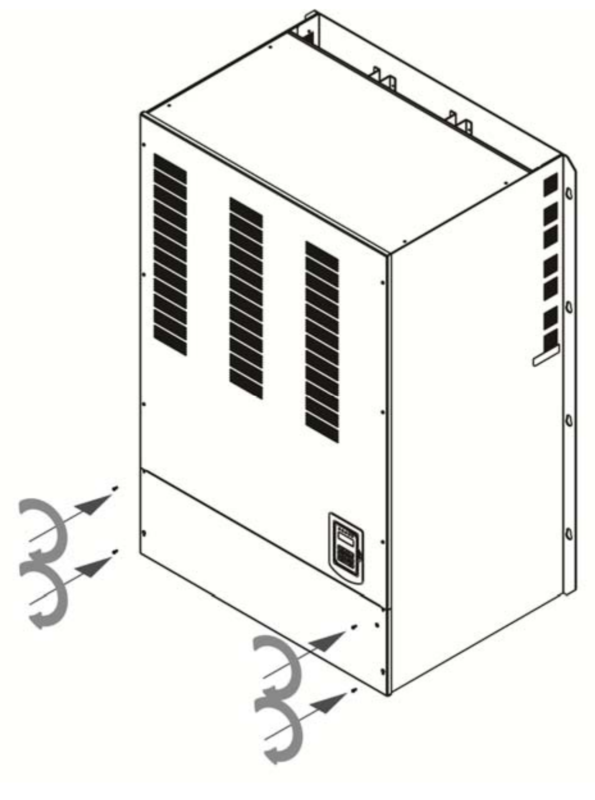
Step 1: Unscrew cover



Step 2: Remove cover



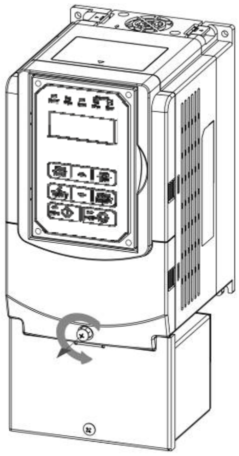
Step 3: Make wire connections and place cover back



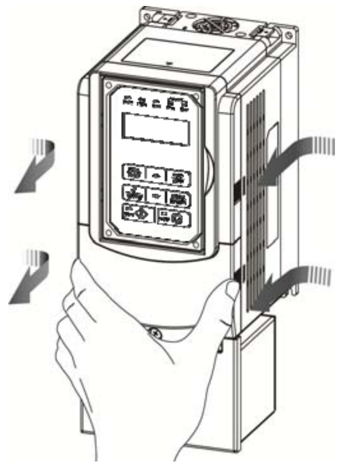
Step 4: Fasten screw

3.2.4.2 Built-in Filter Type (IP20/ IP00)

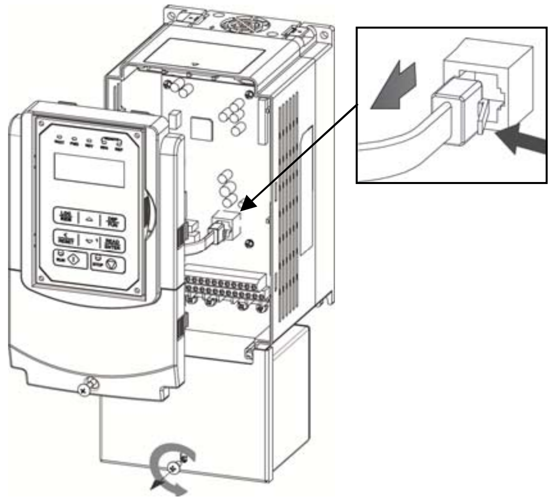
(a) 400V 1-3HP



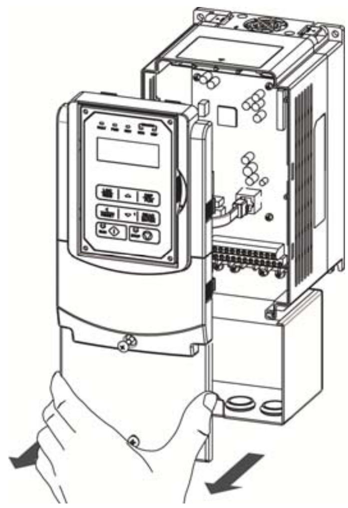
Step 1: Unscrew cover



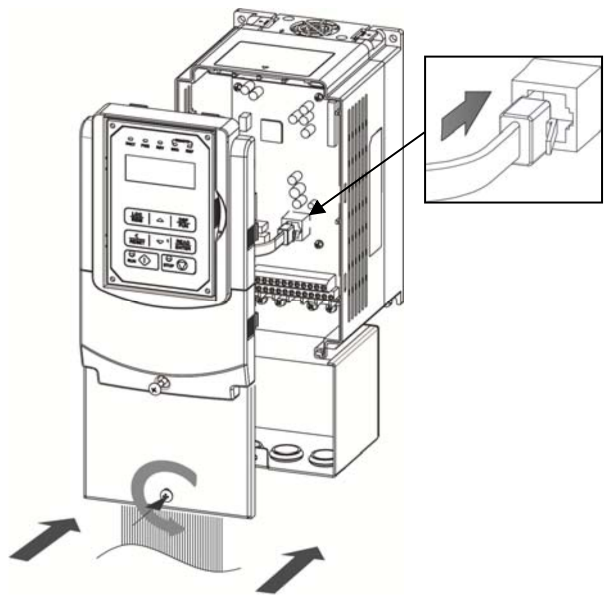
Step 2: Remove whole top cover



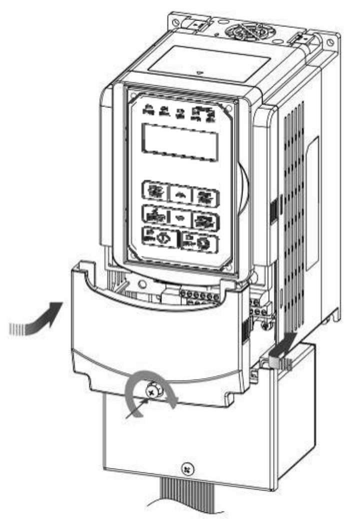
Step 3: Unlock RJ45 connector, Unscrew filter section



Step 4: Remove filter cover

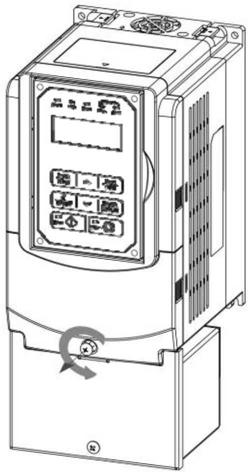


Step 5: Make wire connections, lock RJ45 connector and place top cover back

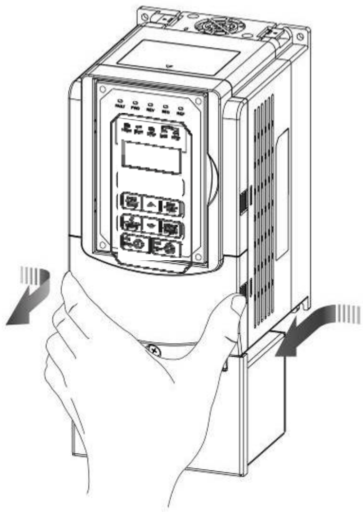


Step 6: Fasten screw

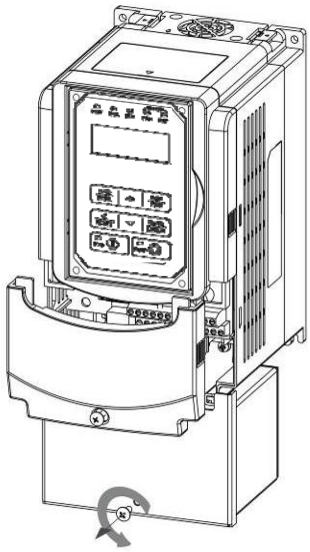
(b) 400V 5-75HP



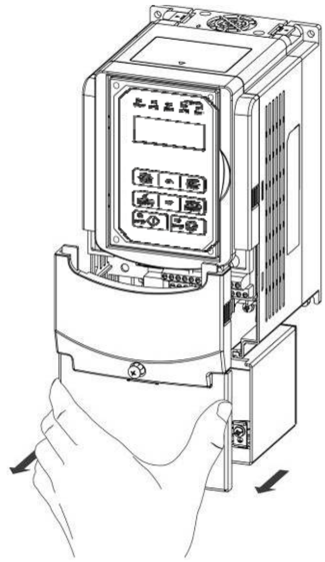
Step 1: Unscrew cover



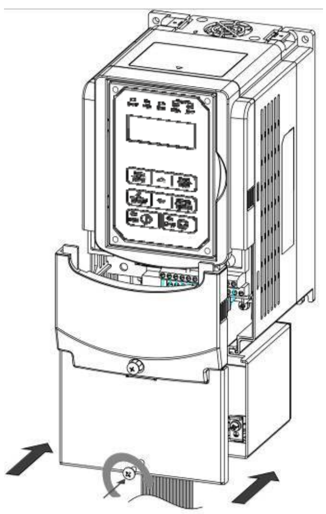
Step 2: Remove cover



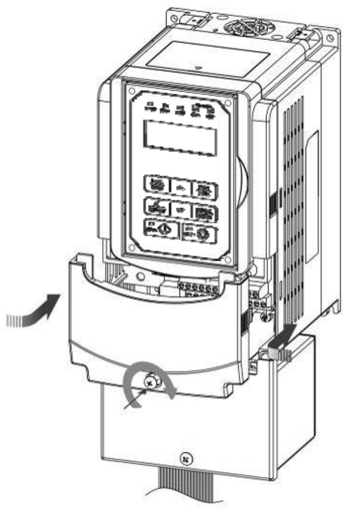
Step 3: Unscrew filter section



Step 4: Remove filter cover



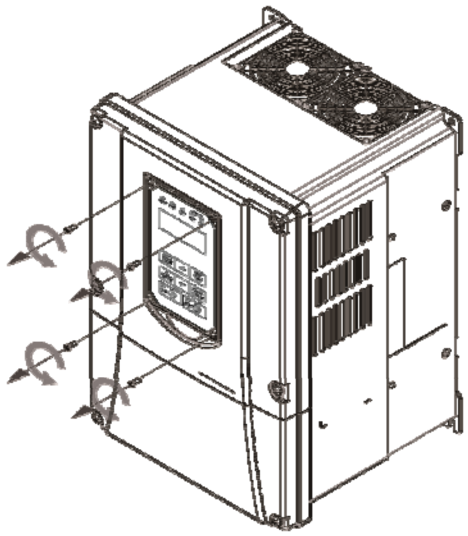
Step 5: Make connections and place filter cover back



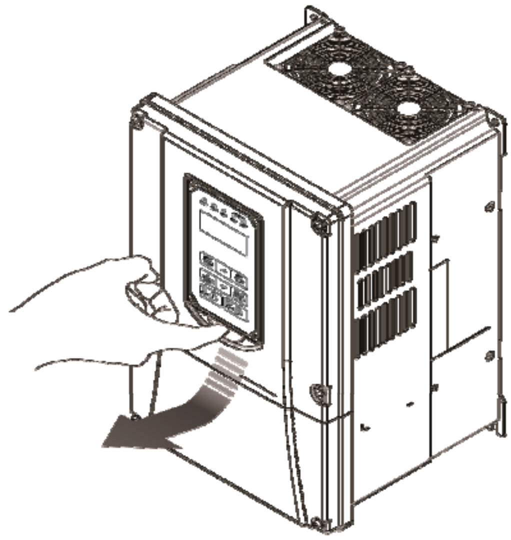
Step 6: Fasten screw

3.2.4.3 Water proof Type (IP55)

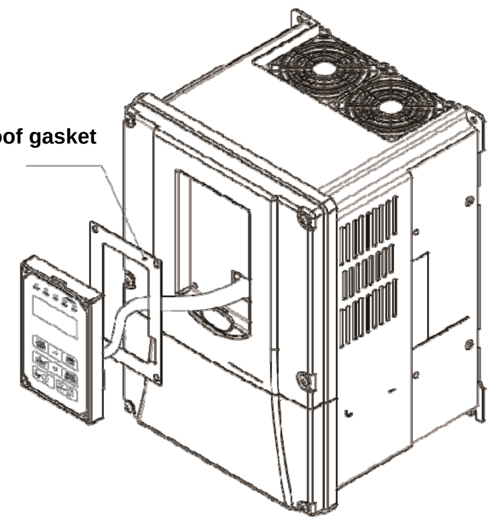
(a) 400V 1-25HP



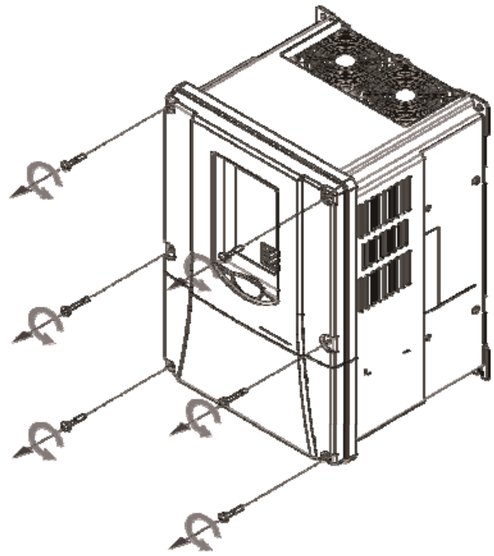
Step 1: Unscrew operator



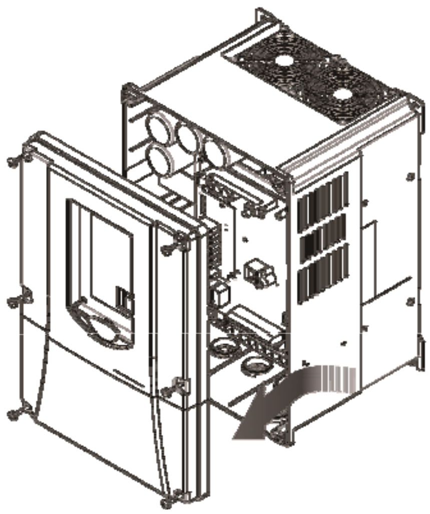
Step 2: Remove operator



Step 3: Pull out operator and remove power line

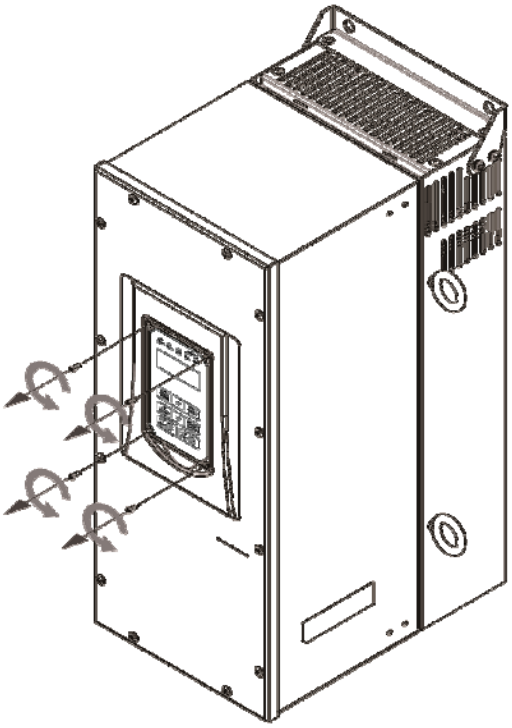


Step 4: Unscrew cover

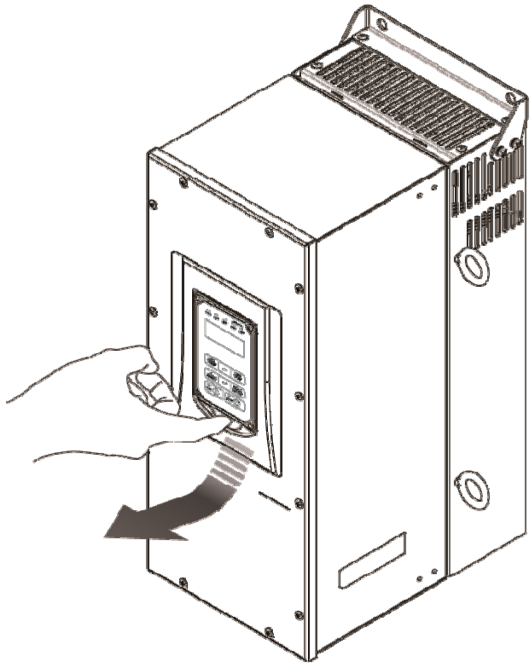


Step 5: Check the inside waterproof gasket is not pulled away from cover while opening the cover

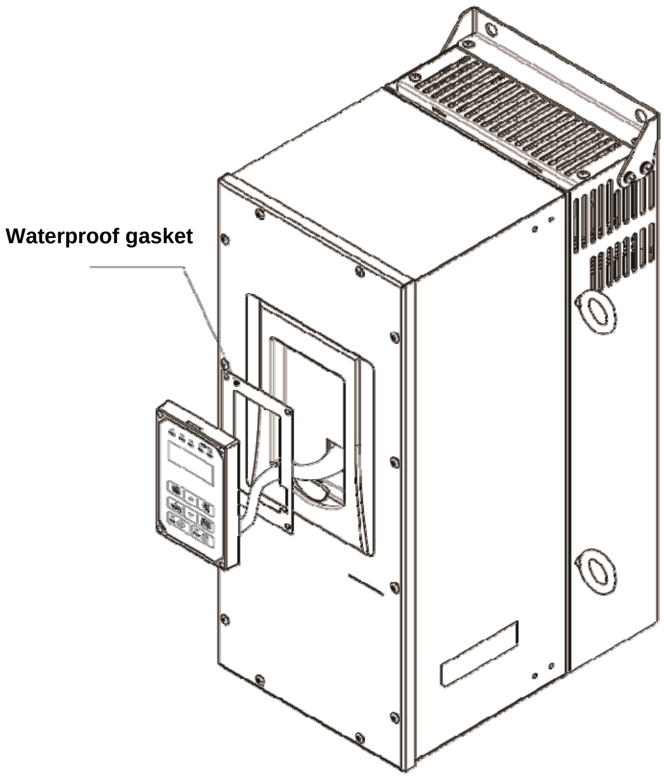
(b) 400V 30-100HP



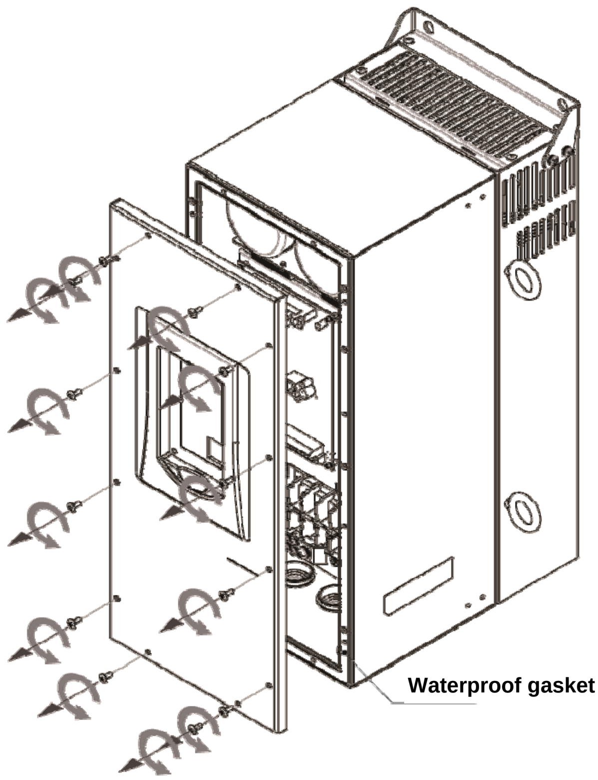
Step 1: Unscrew operator



Step 2: Remove operator



Step 3: Pull out operator and unlock RJ45 connector



Step4: Unscrew cover and remove it

3.3 Inverter Wiring

3.3.1 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.

Table 3.3.1.1 Wire gauges and tightening torque terminal screw size

Wire size mm^2 (AWG)	Terminal Screw size	Model of round crimp terminal	Tightening torque kgf.cm (in.lbs)	Model of insulating sleeve	Model of crimp tool
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

● Main Circuit Terminal Wiring

UL approval requires crimp terminals when wiring the drive'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 drives models with crimp terminals and insulation caps.

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.
2001/2002/2003	2 (14)		M4	R2-4	Nichifu NH 1 / 9	TIC 2
	3.5 (12)			R5.5-4		TIC 3.5
	5.5 (10)					TIC 5.5
2005/2008	5.5 (10)		M4	R5.5-4	Nichifu NH 1 / 9	TIC 5.5
2010/2015	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
2175	152 (300)*2		M12	R150-12*2	Nichifu NOP 150H	TIC 150
4001/4002/4003	2 (14)		M4	R2-4	Nichifu NH 1 / 9	TIC 2
	3.5 (12)			R5.5-4		TIC 3.5
	5.5 (10)					TIC 5.5
4005/4008/4010	5.5 (10)		M4	R5.5-4	Nichifu NH 1 / 9	TIC 5.5
4015/4020	8 (8)		M6	R8-6	Nichifu NOP 60	TIC 8
4025/4030/4040	22 (6)		M6	R22-6	Nichifu NOP 60 / 150H	TIC 14
4050/4060/4075	60 (2)		M8	R60-8	Nichifu NOP 60 / 150H	TIC 38
4100/4125	150 (3/0)		M8	R150-8	Nichifu NOP 150H	TIC 80
4150/4175/4215/4250	300 (4/0)*2		M10	R150-10	Nichifu NOP 150H	TIC 100
4300	203 (400)*2		M12	R200-12S*2	Nichifu NOH 300K	TIC 200
4375/4425	253 (500)*2		M12	R325-12S*2	Nichifu NOH 300K	TIC 325
4535/4670	152 (300)*4		M10	R150-10*4	Nichifu NOP 150H	TIC 150
4800	203 (400)*4		M10	R200-10S *4	Nichifu NOH 300K	TIC 200

3.3.2 Wiring Peripheral Power Devices

Caution

- After power is shut off to the inverter, the capacitors will slowly discharge. Do NOT touch 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 by properly grounded. Use terminal E to connect earth ground and comply with local standards.
- It is required to disconnect the grounded wire in the control board when the inverter is not grounded or floating ground power system.
- 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

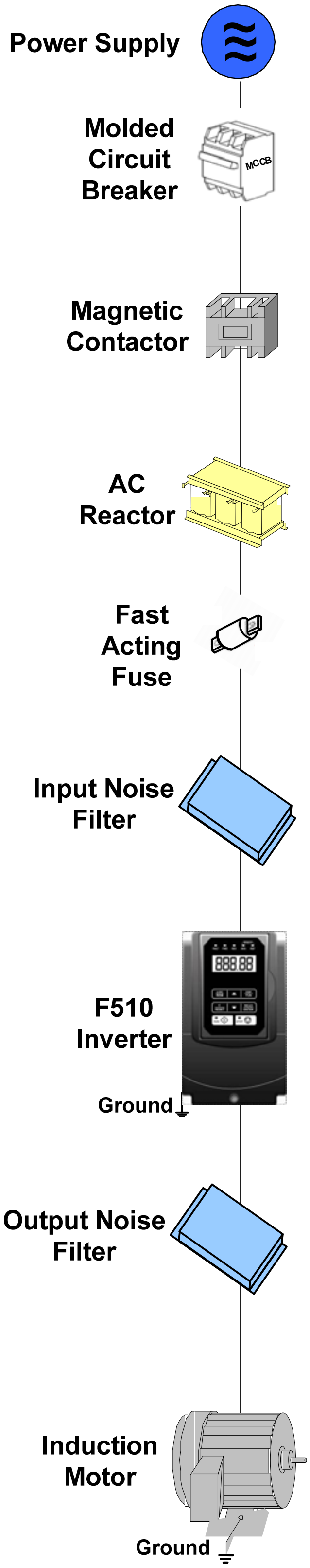
- Refer to the recommended wire size table for the appropriate wire to use. The voltage between the power supply and the input of the inverter may not exceed 2%.

  Phase-to-phase voltage drop (V) = $\sqrt{3}$ ×resistance of wire (Ω/km) × length of line m) × current×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:

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

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.
- 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.

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.

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.

Install Fast Acting Fuse:

- To protect peripheral equipment, install fast acting fuses in accordance with the specifications in section 11.4 for peripheral devices.

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 11.3 for peripheral devices.

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: Rg <100Ω; 400V series: Rg <10Ω.)

Output Noise filter:

- An output noise filter may reduce system interference and induced noise.

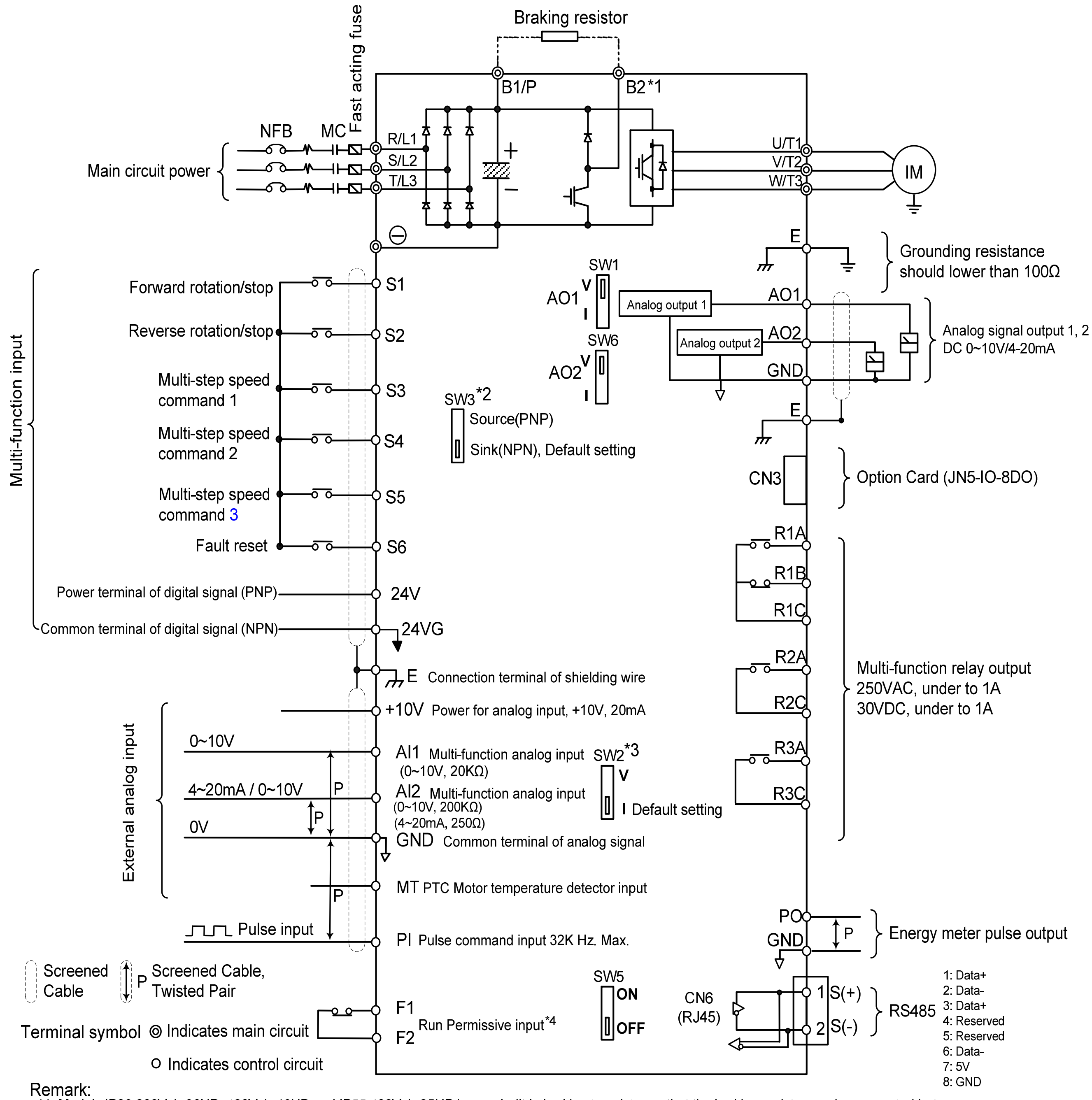
Motor:

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

3.3.3 General Wiring Diagram

3.3.3.1 General Wiring Diagram (For Standard H & C type)

The following is the standard wiring diagram for the F510 inverter (◎ indicates main circuit terminals and ○ indicates control circuit terminals). Locations and symbols of the wiring terminal block might be different due to different models of F510. The description of control circuit terminals and main circuit terminals can be referred to Table 3.3.5.1, 3.3.6.1 and 3.3.6.2



Remark:

*1: Models IP20 200V 1~30HP, 400V 1~40HP and IP55 400V 1~25HP have a built-in braking transistor so that the braking resistor can be connected between terminal B1 and B2.

*2: The multi-function digital input terminals S1~S6 can be set to Source (PNP) or Sink (NPN) mode via SW3.

*3: Use SW2 to switch between voltage (0~10V) and current (4~20mA) input for Multi-function analog input 2 (AI2). Besides please also check parameter 04-00 for proper setting.

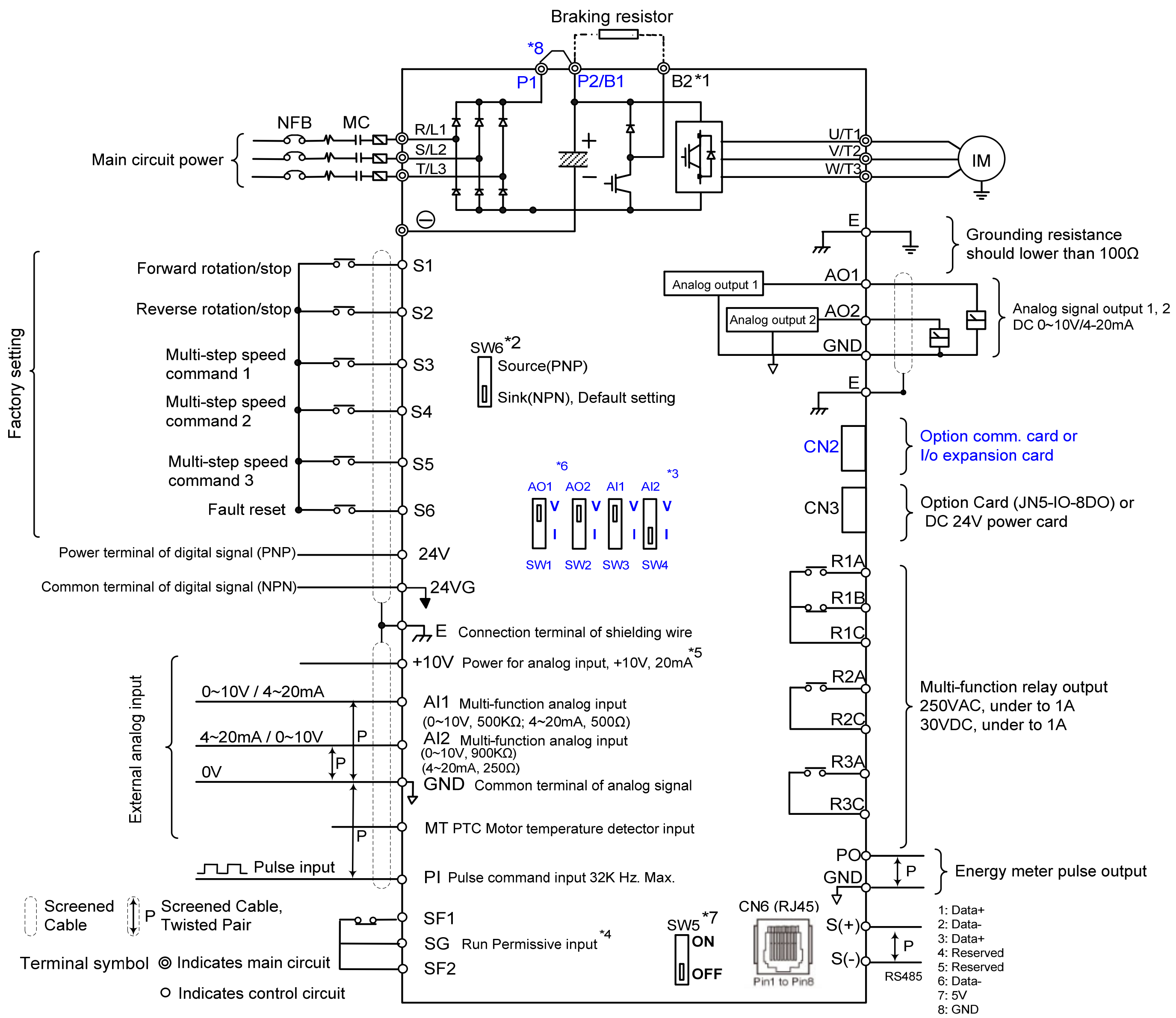
*4: Run permissive input F1 & F2 is a normally closed input. This input should be closed to enable the inverter output. To activate this input, open the link between F1 and F2.

*5: IP20 1~3HP don't support option card.

*6: 200V 60~175HP and 400V 100~425HP have built-in DC reactors.

3.3.3.2 General Wiring Diagram (For Enhanced E & G type)

The following is the standard wiring diagram for the F510 inverter (◎ indicates main circuit terminals and ○ indicates control circuit terminals). Locations and symbols of the wiring terminal block might be different due to different models of F510. The description of control circuit terminals and main circuit terminals can be referred to Table 3.3.5.1, 3.3.6.1 and 3.3.6.2



Remarks:

*1: Models IP20 200V 1~30HP, 400V 1~40HP have a built-in braking transistor so that the braking resistor can be connected between terminal B1 and B2.

*2: The multi-function digital input terminals S1~S6 can be set to Source (PNP) or Sink (NPN) mode via SW6.

*3: Use SW3/SW4 to switch between voltage (0~10V) and current (4~20mA) input for Multi-function analog input 2 (AI2). Besides please also check parameter 04-00 for proper setting.

*4: Run permissive input SF1 & SF2 is a normally closed input. This input should be closed to enable the inverter output. To activate this input, open the link between SF1/ SF2 and SG.

*5: When using the open collector for pulse input, it doesn't need resistance because of built-in pull-up resistance.

*6: AO1 / AO2 default setting is 0~+10V.

*7: It need turn on the switch for the terminal resistor RS485 in the last inverter when many inverters in parallel connection.

*8: Only the model 200V 5~50HP and 400V 5~100HP provide P1 terminal, for external DCL connected between P1 and P2, P1 and P2 are short-circuited before shipping out from the factory.

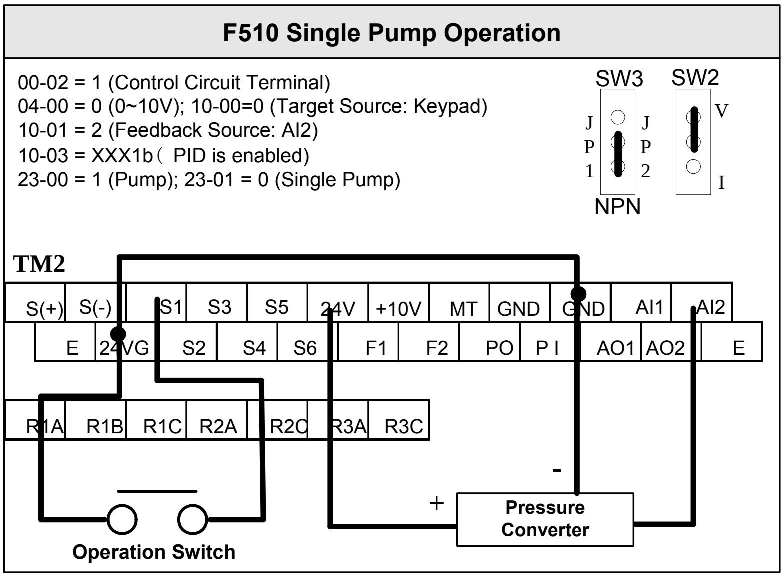
*9: Both 200V class 60HP~175HP and 400V class 125HP~425HP have built-in DC reactors.

3.3.4 Single/ Multi- Pump Dedicated Wiring Diagram

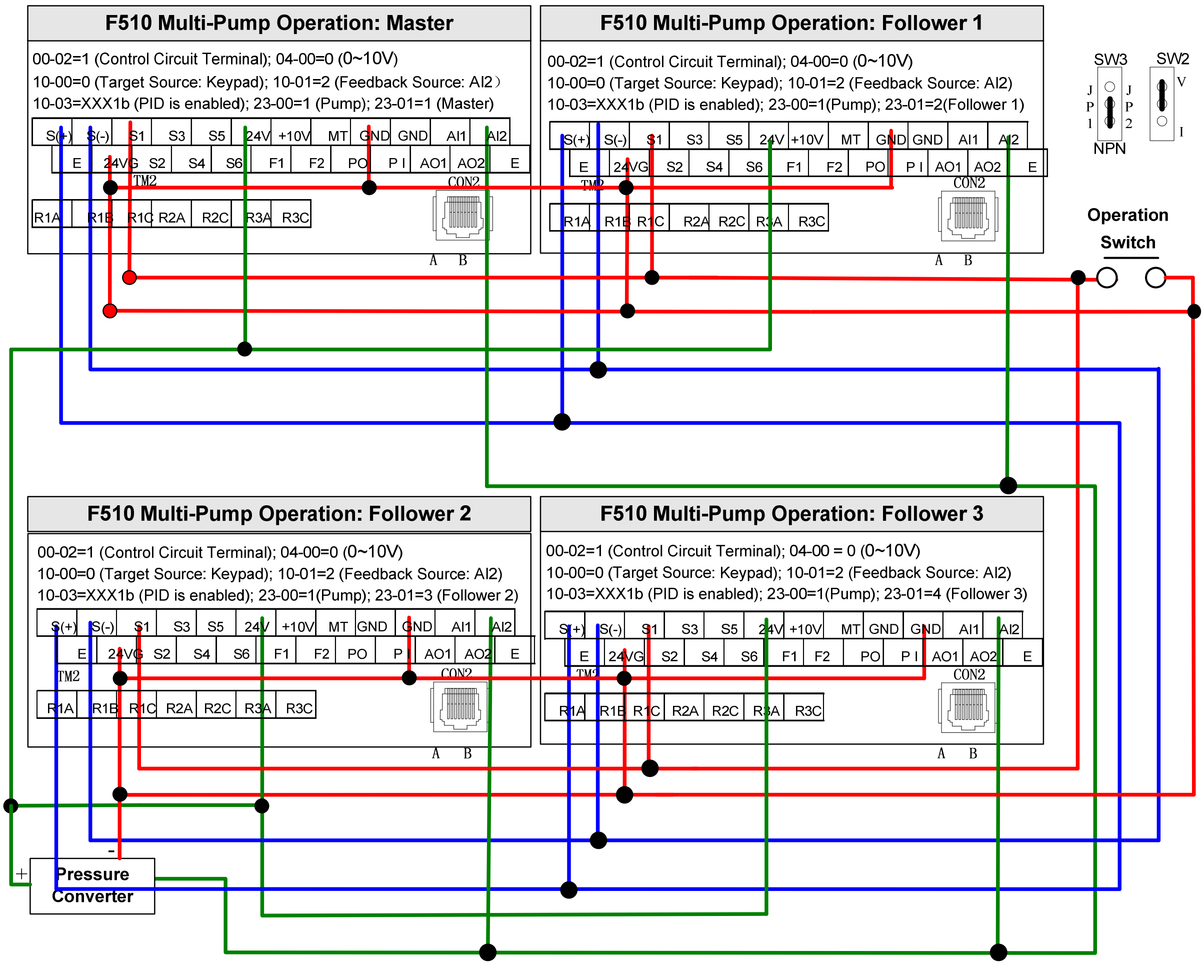
3.3.4.1 Single/ Multi- Pump Dedicated Wiring Diagram (For Standard H & C type)

■ PUMP Wiring Diagram for Pressure Sensor of Voltage Type

Single Pump:

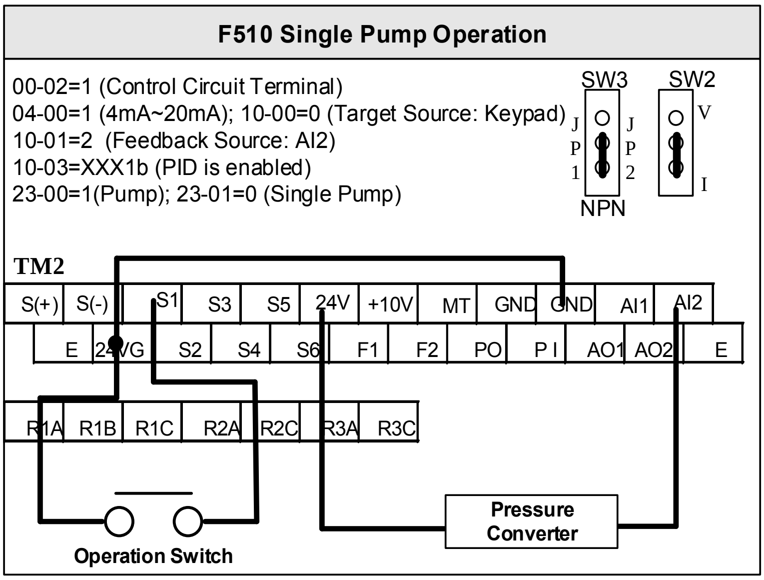


Multi-Pump:

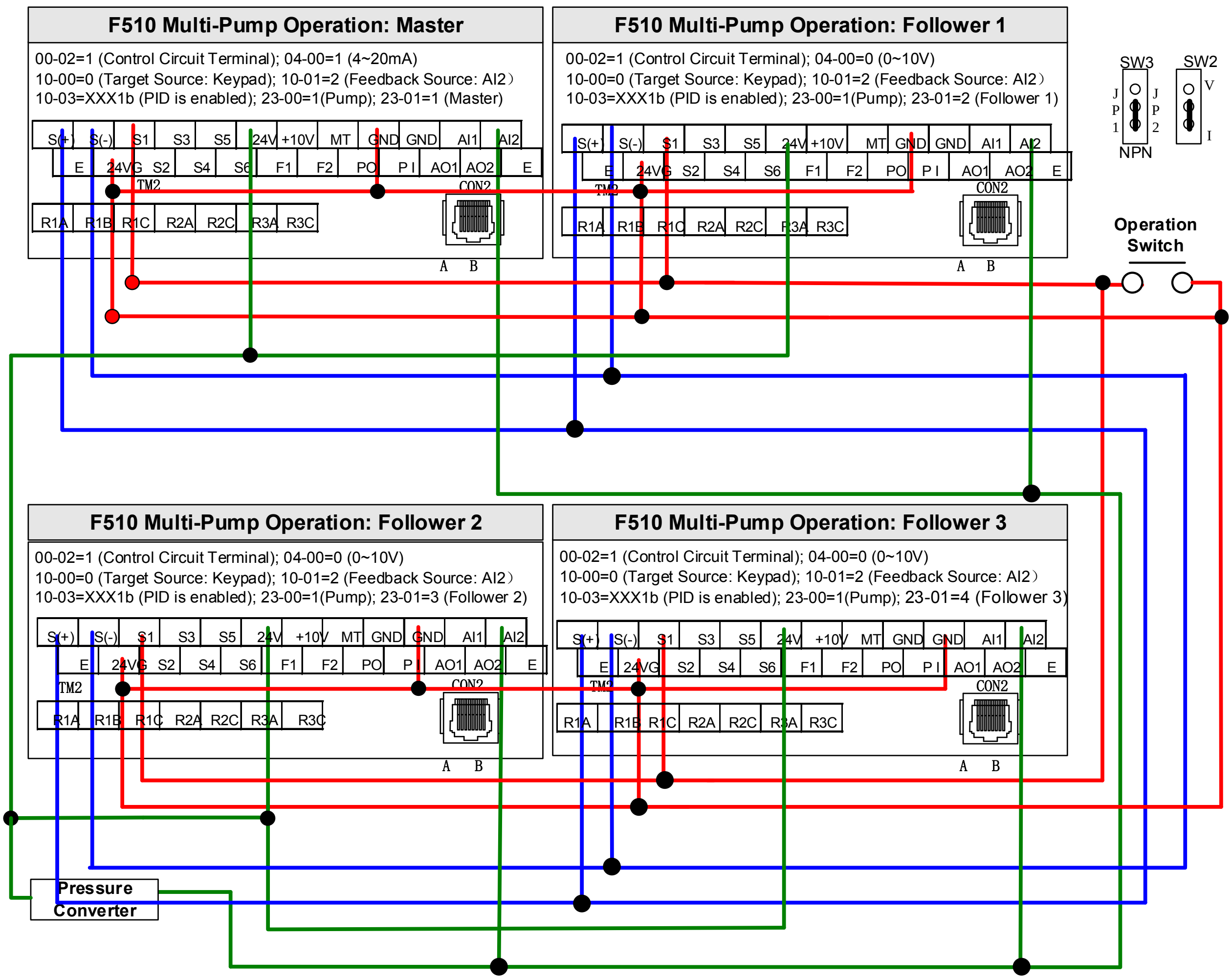


■ PUMP Wiring Diagram for Pressure Sensor of Current Type

Single Pump:



Multi-Pump:



Notes: 1. The position of dip switch requires being correct (SW2, SW3).

2. It is required to reconnect after setting Master/ Slave.

3. 24VG and GND require short circuit.

4. When the communication modes is selected to be multiple pumps in parallel connection (09-01=3), the baud rate settings (09-02) of Master and Slave are required to be consistent. Refer to parameter 23-31 for the actions in parallel connection modes.

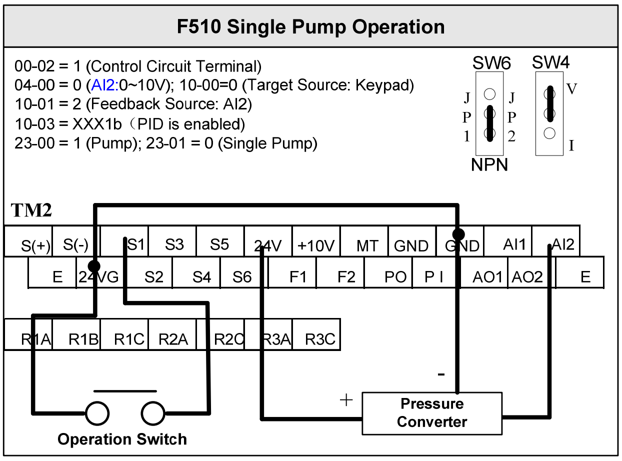
5. In the wiring of multi-pump current type pressure sensor, it is required to adjust Slave to be 04-07(AI2 Gain) =252.0% and 04-08(AI1 Bias) =25.0%.

6. In multi-pump operation, if one of the inverter does not Power ON, the 24V of connection is also need to dis-connect to avoid magnetoresistance effect.

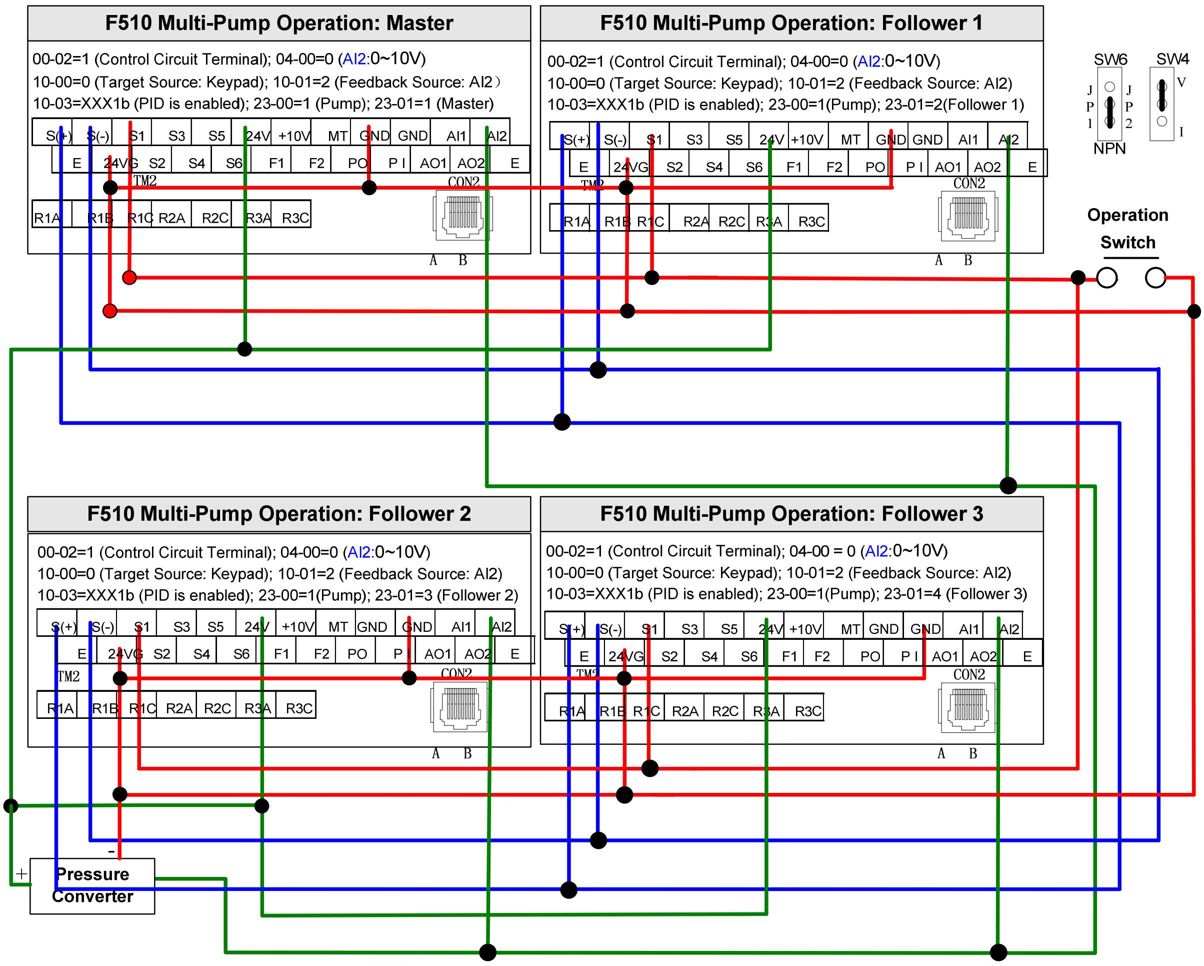
3.3.4.2 Single/ Multi- Pump Dedicated Wiring Diagram (For Enhanced E & G type)

■ PUMP Wiring Diagram for Pressure Sensor of Voltage Type

Single Pump:

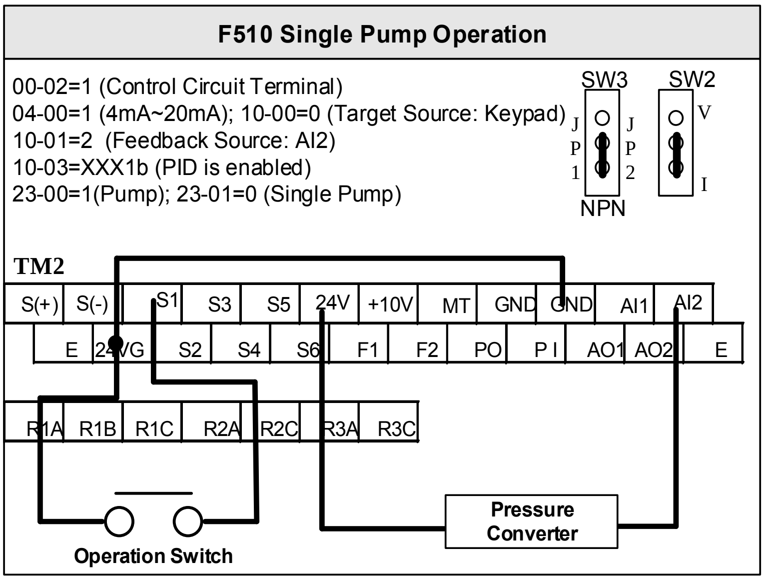


Multi-Pump: (For Enhanced type)

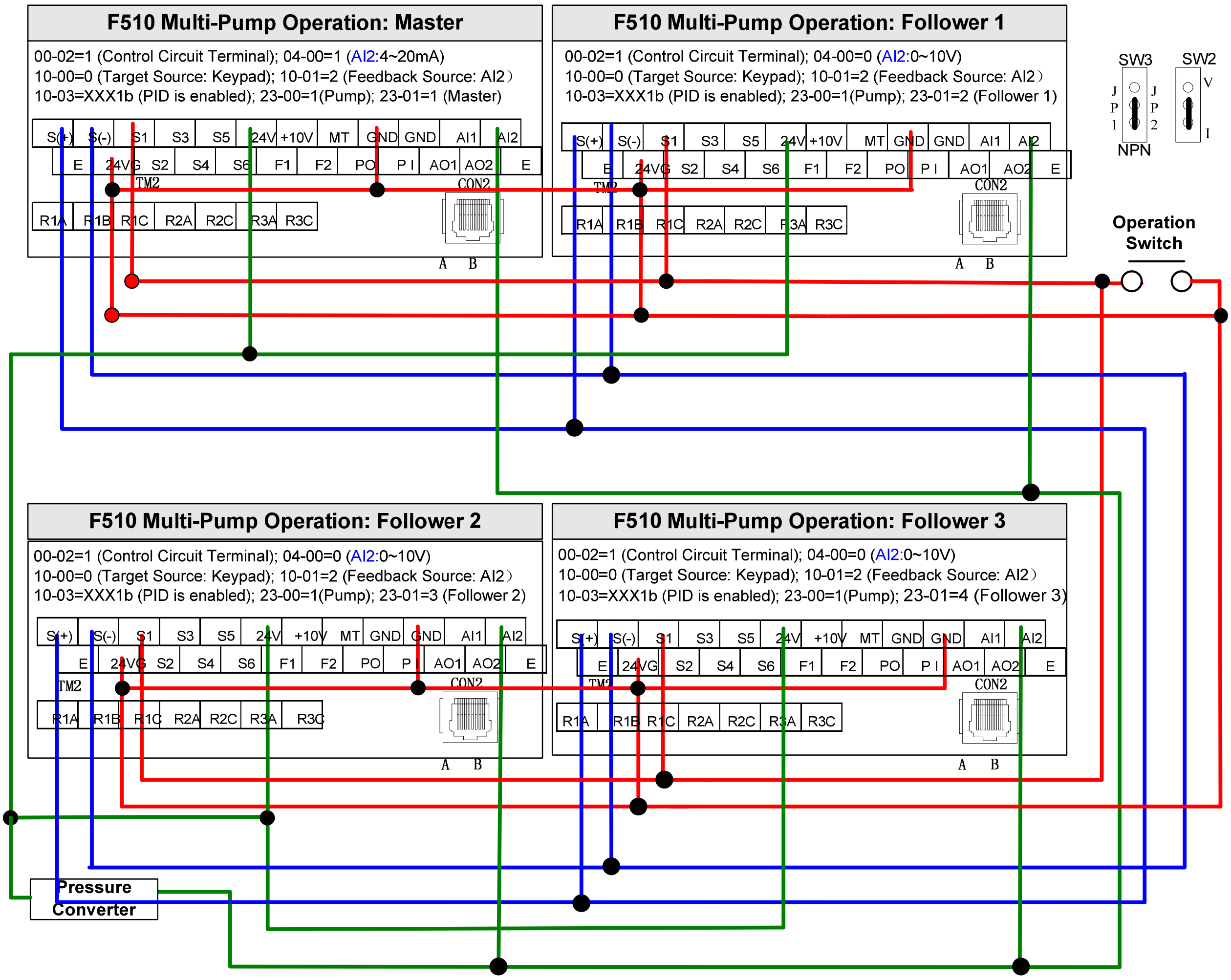


■ PUMP Wiring Diagram for Pressure Sensor of Current Type

Single Pump: (For Enhanced type)



Multi-Pump: (For Enhanced type)



Notes: 1. The position of dip switch requires being correct (SW6, SW4).

2. It is required to reconnect after setting Master/ Slave.

3. **24VG and GND require short circuit.**
4. **When the communication modes is selected to be multiple pumps in parallel connection (09-01=3), the baud rate settings (09-02) of Master and Slave are required to be consistent. Refer to parameter 23-31 for the actions in parallel connection modes.**
5. **In the wiring of multi-pump current type pressure sensor, it is required to adjust Slave to be 04-07(AI2 Gain) =252.0% and 04-08(AI1 Bias) =25.0%.**
6. **In multi-pump operation, if one of the inverter does not Power ON, the 24V of connection is also need to dis-connect to avoid magnetoresistance effect.**

3.3.5 Wiring for Control Circuit Terminals

3.3.5.1 Wiring for Control Circuit Terminals (For Standard H & C type)

■ **Control circuit terminals identification**

◆ **IP00/IP20 type**

- 200V: 1-3HP，400V: 1-3HP

R2A	R2C

R3A	R3C

R1A	R1B	R1C

S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
E	24VG	S2	S4	S6	F1	F2	PO	PI	AO1	AO2	E

- 200V: 5HP~50HP，400V: 5HP~75HP

S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
E	24VG	S2	S4	S6	F1	F2	PO	PI	AO1	AO2	E

R1A	R1B	R1C	
R2A	R2C	R3A	R3C

- 200V: 60HP~125HP，400V: 100HP~800HP

S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
E	24VG	S2	S4	S6	F1	F2	PO	PI	AO1	AO2	E

R1A	R1B	R1C	R2A	R2C	R3A	R3C

◆ **IP55 type**

- 400V: 1HP~100HP

S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
E	24VG	S2	S4	S6	F1	F2	PO	PI	AO1	AO2	E

R1A	R1B	R1C	
R2A	R2C	R3A	R3C

Table 3.3.5.1 Description of control circuit terminals

Type	Terminal	Terminal function	Signal level/ information
Digital input signal	S1	2-wire forward rotation/ stop command (default), multi-function input terminals * 1	Signal Level 24 VDC (opto-isolated) Maximum current: 8mA Maximum voltage: 30 Vdc Input impedance: 4.22kΩ
	S2	2-wire reversal rotation/ 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 (default), multi-function input terminal * 1	
24V Power supply	24V	Digital signal SOURCE point (SW3 switched to SOURCE)	±15%, Max. output current: 250mA (The sum of all loads connected)
	24VG	Common terminal of Digital signals Common point of digital signal SINK (SW3 switched to SINK)	
Analog input signal	+10V	Power for external speed potentiometer	±5% (Max. current: 20mA)
	MT	Motor temperature detector of externally connecting PTC	Refer to group 08 setting
	AI1	Multi-function analog input for speed reference (0-10V input)	From 0 to +10V Input impedance: 10KΩ Resolution: 12bit
	AI2	Multi-function analog input terminals *2, can use SW2 to switch voltage or current input (0~10V)/(4-20mA)	From 0 to +10V Input impedance: 200KΩ From 4 to 20 mA Input impedance: 250Ω Resolution: 12bit
	GND	Analog signal ground terminal	----
	E	Shielding wire's connecting terminal (Ground)	----
Analog output signal	AO1	Multi-function analog output terminals *3 (0~10V/ 4-20mA output)	From 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	
Pulse output signal	PO	Pulse output, Band width 32KHz	Max. Frequency: 32KHz Open Collector output Load: 2.2 KΩ
	GND	Analog signals ground terminal	----
Pulse input signal	PI	Pulse command input, frequency width of 32KHz	L: from 0.0 to 0.5V H: from 4.0 to 13.2V Max. Frequency: 0 - 32KHz Impedance: 3.89 KΩ
	GND	Analog signals ground terminal	----

Table 3.3.5.1 Description of control circuit terminals (Continued)

Type	Terminal	Terminal function	Signal level/ information
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 more functional descriptions.	Rating: 250Vac: 10 mA ~ 1A 30Vdc: 10 mA ~ 1A
	R2A-R2C	With the same functions as R1A/R1B/R1C	Rating: 250Vac: 10 mA ~ 1A 30Vdc: 10 mA ~ 1A
	R3A-R3C	With the same functions as R1A/R1B/R1C	
Safety input	F1	On: normal operation. Off: emergency stop. (Jumper wired has to be removed to use external safety function to stop.)	24Vdc, 8mA, pull-high
	F2	Safety command common terminal	24V Ground
RS-485 port	S (+) S (-)	RS485/MODBUS	differential input and output
Grounding	E (G)	Grounding to earth Shield the connecting terminal	----

Notes:

*1: Multi-function digital input can be referred to in this manual.

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

*2: Multi-function analog input can be referred to in this manual.

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

*3: Multi-function analog output can be referred to in this manual.

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

Caution

- Maximum output current capacity for terminal 10V is 20mA.
- Multi-function analog output AO1 and AO2 are for use for an analog output meter. Do not use these output 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.

3.3.5.2 Wiring for Control Circuit Terminals (For Enhanced E & G type)

■ Control circuit terminals identification

IP00/IP20 type

- 200V: 1-3HP，400V: 1-3HP

R1A	R1B	R1C	R2A	R2C	R3A	R3C
			RJ45			

S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
E	24VG	S2	S4	S6	SF1	SG	SF2	PO	PI	AO1	AO2

- 200V: 5HP~50HP，400V: 5HP~75HP

R1A	R1B	R1C					
		R2A	R2C	R3A	R3C	RJ45	

S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
E	24VG	S2	S4	S6	SF1	SG	SF2	PO	PI	AO1	AO2

- 200V: 60HP~125HP，400V: 125HP~800HP

R1A	R1B	R1C	R2A	R2C	R3A	R3C

S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
E	24VG	S2	S4	S6	SF1	SG	SF2	PO	PI	AO1	AO2

Table 3.3.5.2 Description of control circuit terminals

Type	Terminal	Terminal function	Signal level/ information
Digital input signal	S1	2-wire forward rotation/ stop command (default), multi-function input terminals * 1	Signal Level 24 VDC (opto-isolated) Maximum current: 8mA Maximum voltage: 30 Vdc Input impedance: 4.22kΩ
	S2	2-wire reversal rotation/ 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 (default), multi-function input terminal * 1	
24V Power supply	24V	Digital signal SOURCE point (SW6 switched to SOURCE)	±15%, Max. output current: 250mA (The sum of all loads connected)
	24VG	Common terminal of Digital signals Common point of digital signal SINK (SW6 switched to SINK)	
Analog input signal	+10V	Power for external speed potentiometer	±5% (Max. current: 20mA)
	MT	Motor temperature detector of externally connecting PTC	Refer to group 08 setting
	AI1	Multi-function analog input for speed reference, use SW3 to switch voltage and current input (0~10V) / (4-20mA)	From 0 to +10V Input impedance: 500KΩ From 4 to 20 mA Input impedance: 500KΩ Resolution: 12bit
	AI2	Multi-function analog input terminals *2, can use SW4 to switch voltage or current input (0~10V)/(4-20mA)	From 0 to +10V Input impedance: 900KΩ From 4 to 20 mA Input impedance: 250Ω Resolution: 12bit
	GND	Analog signal ground terminal	----
	E	Shielding wire's connecting terminal (Ground)	----
Analog output signal	AO1	Multi-function analog output terminals *3, use SW1 to switch voltage and current output (0~10V) / (4-20mA)	From 0 to 10V Max. current: 2mA From 4 to 20 mA
	AO2	Multi-function analog output terminals *3, use SW2 to switch voltage and current output (0~10V) / (4-20mA)	
	GND	Analog signals ground terminal	
Pulse output signal	PO	Pulse output, Band width 32KHz	Max. Frequency: 32KHz Open Collector output Load: 2.2 KΩ
	GND	Analog signals ground terminal	----
Pulse input signal	PI	Pulse command input, frequency width of 32KHz	L: from 0.0 to 0.5V H: from 4.0 to 13.2V Max. Frequency: 0 - 32KHz Impedance: 3.89 KΩ
	GND	Analog signals ground terminal	----

Table 3.3.5.2 Description of control circuit terminals (Continued)

Type	Terminal	Terminal function	Signal level/ information
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 more functional descriptions.	Rating: 250Vac: 10 mA ~ 1A 30Vdc: 10 mA ~ 1A
	R2A-R2C	With the same functions as R1A/R1B/R1C	Rating: 250Vac: 10 mA ~ 1A 30Vdc: 10 mA ~ 1A
	R3A-R3C	With the same functions as R1A/R1B/R1C	
Safety input	F1	On: normal operation. Off: emergency stop. (Jumper wired has to be removed to use external safety function to stop.)	24Vdc, 8mA, pull-high
	F2	Safety command common terminal	24V Ground
RS-485 port	S (+) S (-)	RS485/MODBUS	differential input and output
Grounding	E (G)	Grounding to earth Shield the connecting terminal	----

Notes:

*1: Multi-function digital input can be referred to in this manual.

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

*2: Multi-function analog input can be referred to in this manual.

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

*3: Multi-function analog output can be referred to in this manual.

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

Caution

- Maximum output current capacity for terminal 10V is 20mA.
- Multi-function analog output AO1 and AO2 are for use for an analog output meter. Do not use these output 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.

3.3.6 Wiring for Main Circuit Terminals

3.3.6.1 Wiring for Main Circuit Terminals (For Standard H & C type)

Table 3.3.6.1.1 Description of main circuit terminals (IP00/IP20 Type)

<table>
<tr><th>Terminal</th><th>200V : 1~30HP
400V : 1~40HP</th><th>200V : 40~175HP
400V : 50~800HP</th></tr>
<tr><td>R/L1</td><td colspan="2" rowspan="3">Input Power Supply</td></tr>
<tr><td>S/L2</td></tr>
<tr><td>T/L3</td></tr>
<tr><td>B1／P</td><td rowspan="3">• B1／P－B2：External braking resistor</td><td rowspan="2">-</td></tr>
<tr><td>B2</td></tr>
<tr><td>⊖</td><td rowspan="2">• ⊕ -⊖ ：Connect braking module</td></tr>
<tr><td>⊕</td><td>-</td></tr>
<tr><td>U/T1</td><td colspan="2" rowspan="3">Inverter output</td></tr>
<tr><td>V/T2</td></tr>
<tr><td>W/T3</td></tr>
<tr><td>E</td><td colspan="2">Ground terminal</td></tr>
</table>

Table 3.3.6.1.2 Description of main circuit terminals (IP55 Type)

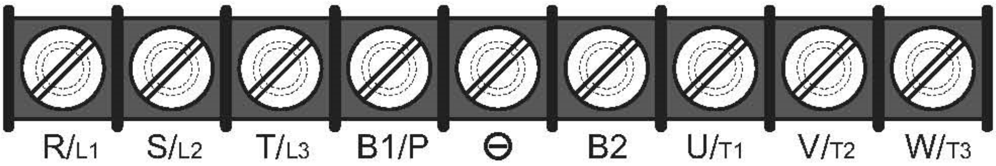
Terminal	400V
	1~100HP
R/L1,S/L2, T/L3	Input Power Supply
U/T1,V/T2, W/T3	Inverter output
B1, B2	Braking resistor connecting terminal *1
⊕1, ⊕2	DC reactor connecting terminal*2
B1, B2, ⊖	DC power supply (DC+, DC-) Braking module connecting terminal
⏚ (PE)	Ground terminal

*1. The model of 400V 25HP (18.5KW) or below is built-in braking transistor.
*2. Before connecting DC reactor, please remove short circuit between terminal ⊕1 and ⊕2.

■ Main circuit terminals identification and screw size

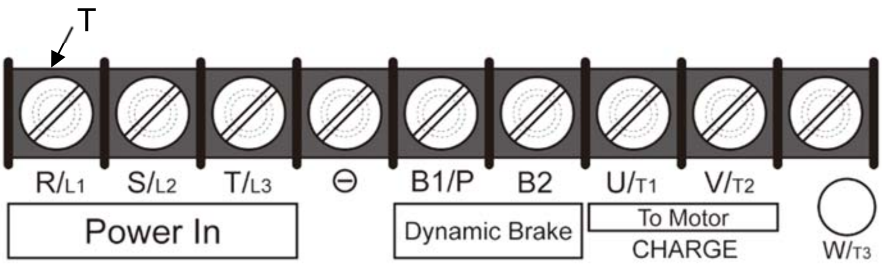
◆ IP20 Type

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



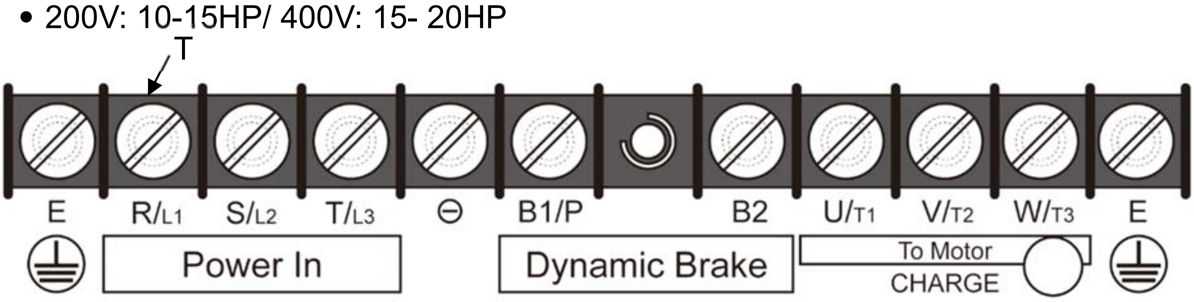
Terminal screw size	
T	⏚
M4	M4

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



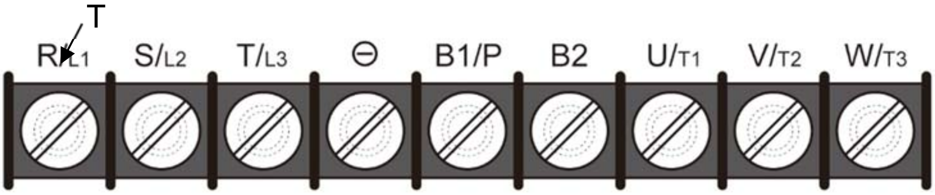
Terminal screw size	
T	⏚
M4	M4

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



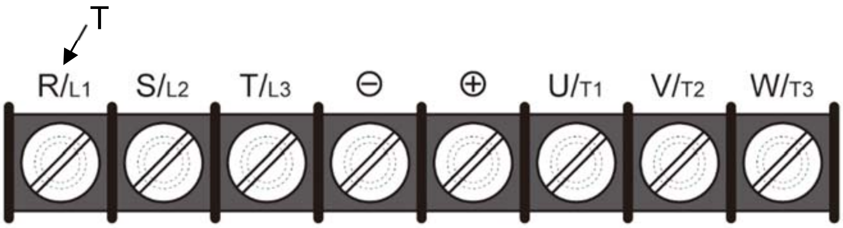
Terminal screw size	
T	⏚
M4	M4

• 200V: 20-30HP/ 400V: 25-40HP



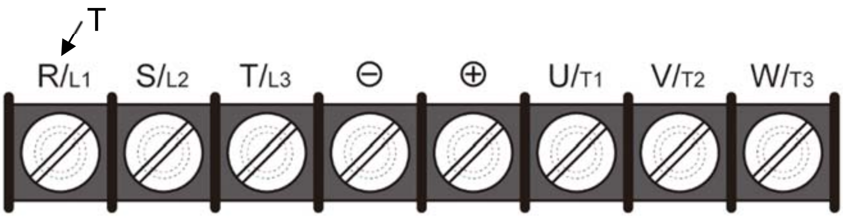
Terminal screw size	
T	⏚
M6	M6

• 200V: 40-50HP/ 400V: 50-75HP



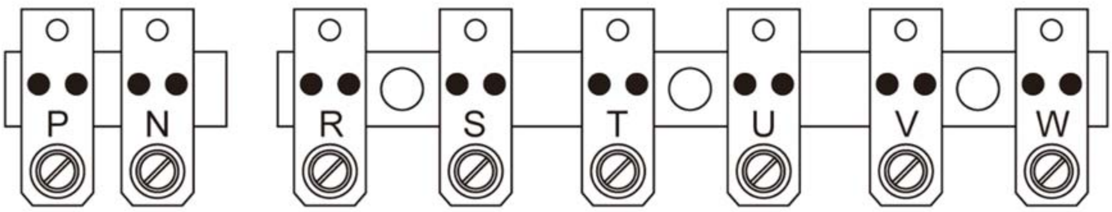
Terminal screw size	
T	⏚
M8	M8

• 200V: 60-75HP/ 400V: 100-125HP



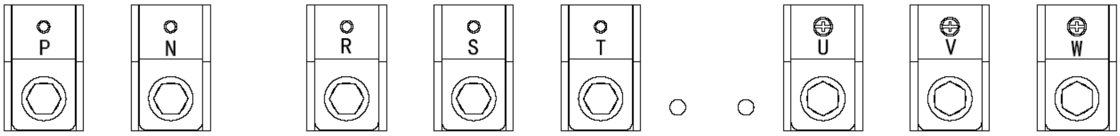
Terminal screw size		
Power supply	T	⏚
400V 100HP	M8	M10
200V 60-75HP/ 400V 125HP	M10	M10

• 200V: 100-125HP/ 400V: 150-250HP



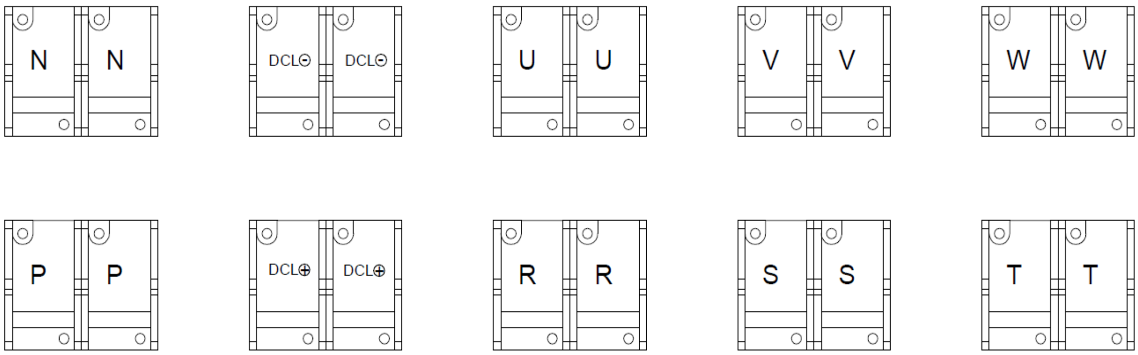
Terminal screw size	
T	⏚
M10	M10

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



Terminal screw size	
T	⏚
M12	M10

- 400V: 535-800HP

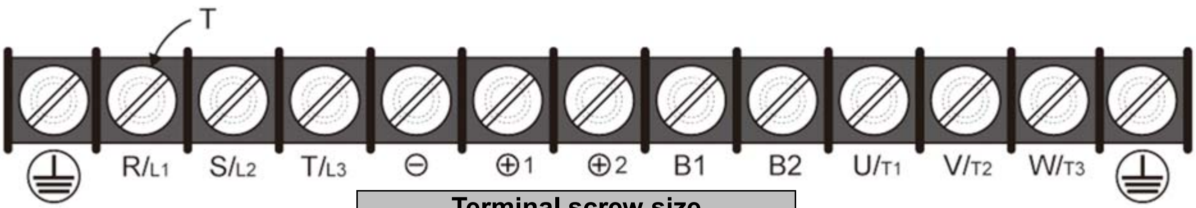


Terminal screw size	
T	⏚
M10	M10

Note: For 400V 535~800HP, the terminal separate to two, to share the current.

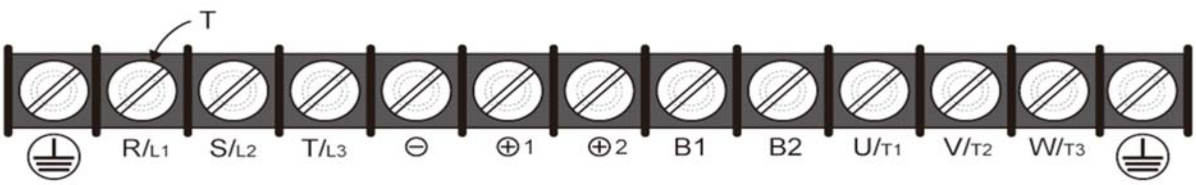
IP55 Type

- 400V: 1-7.5HP



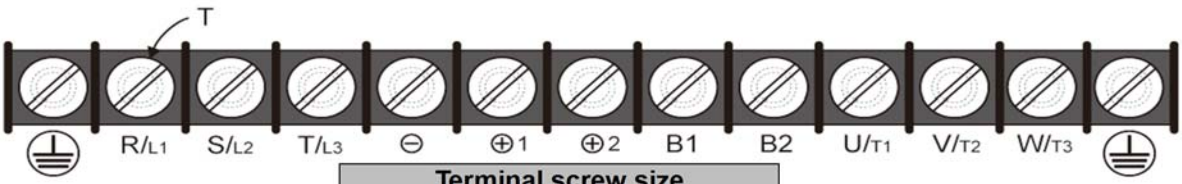
Terminal screw size	
T	⏚
M4	M4

- 400V: 10-15HP



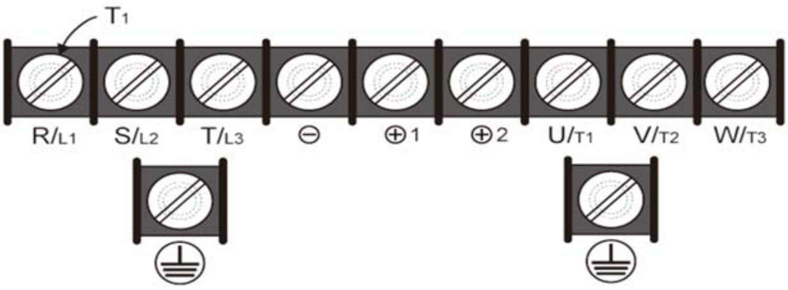
Terminal screw size	
T	⏚
M4	M4

• 400V: 20-25HP



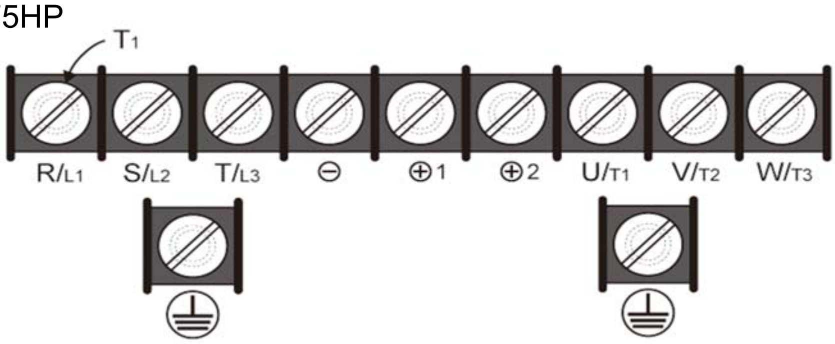
Terminal screw size	
T	⏚
M6	M6

• 400V: 30-50HP



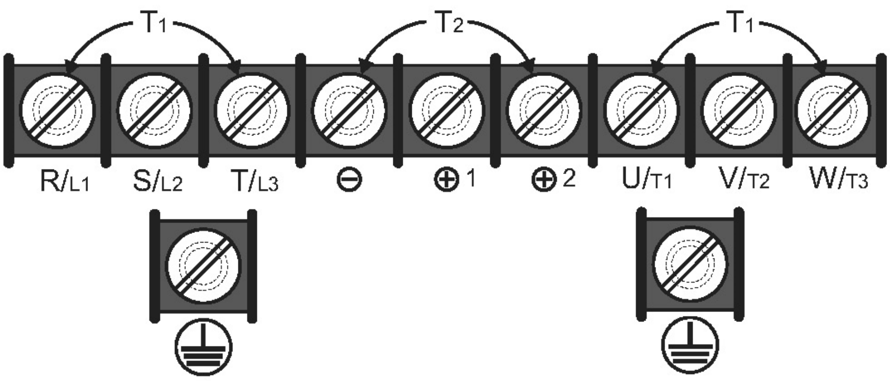
Terminal screw size	
T1	⏚
M6	M6

• 400V: 60-75HP



Terminal screw size	
T1	⏚
M8	M8

• 400V : 100HP



Terminal screw size		
T1	T2	⏚
M8	M10	M8

3.3.6.2 Wiring for Main Circuit Terminals (For Enhanced E & G type)

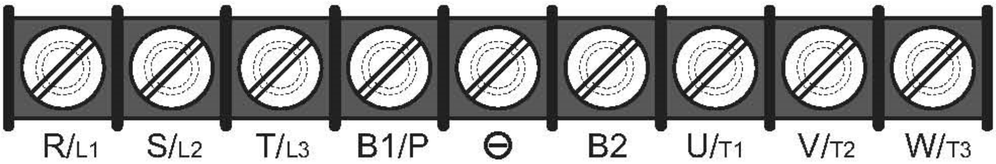
Table 3.3.6.2.1 Description of main circuit terminals (IP00/IP20 Type)

Terminal	200V : 1~30HP 400V : 1~40HP	200V : 40~175HP 400V : 50~800HP
R/L1	Input Power Supply	
S/L2		
T/L3		
B1／P2	• B1／P－B2：External braking resistor	-
B2		
⊖		• ⊕ -⊖：Connect braking module
⊕／P1	• ⊕／P1－B1／P2：External DCL	
U/T1	Inverter output	
V/T2		
W/T3		
E	Ground terminal	

■ Main circuit terminals identification and screw size (For Enhanced E & G type)

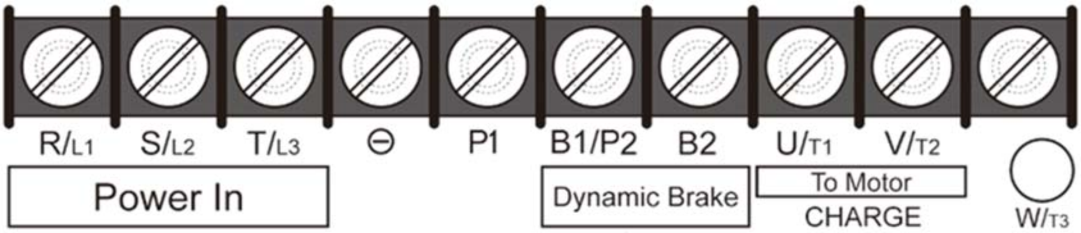
◆ IP20 Type

• 200V : 1-3HP/ 400V: 1-3HP



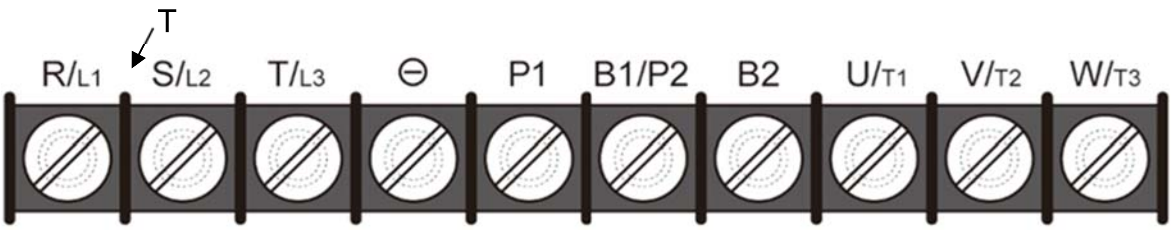
Terminal screw size	
T	⏚
M4	M4

• 200V: 5-15HP/ 400V: 5-25HP



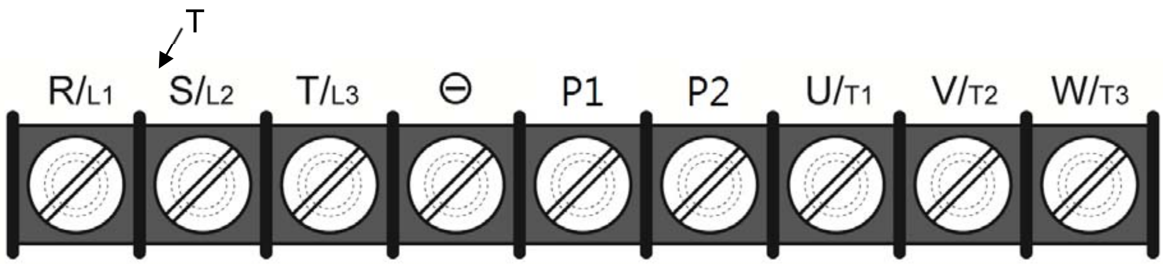
Terminal screw size	
T	⏚
M4	M4

• 200V: 20-30HP/ 400V: 30-40HP



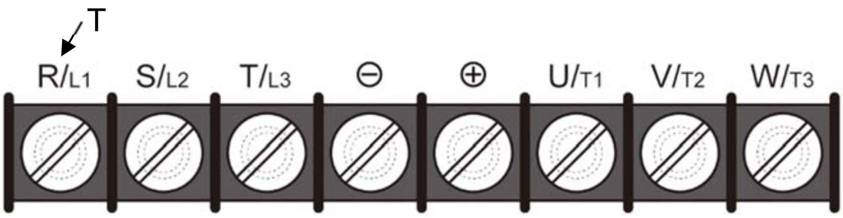
Terminal screw size	
T	⏚
M6	M6

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



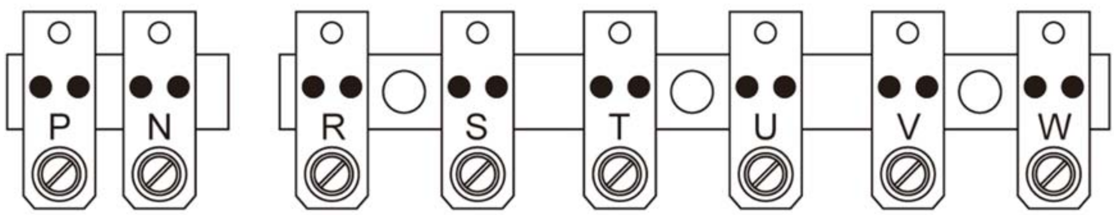
Terminal screw size	
T	⏚
M8	M8

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



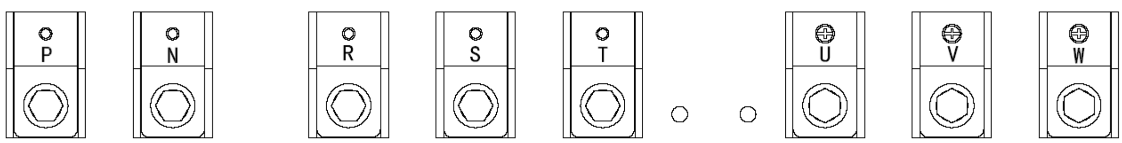
Terminal screw size		
Power supply	T	⏚
400V 100HP	M8	M10
200V 60-75HP/ 400V 125HP	M10	M10

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



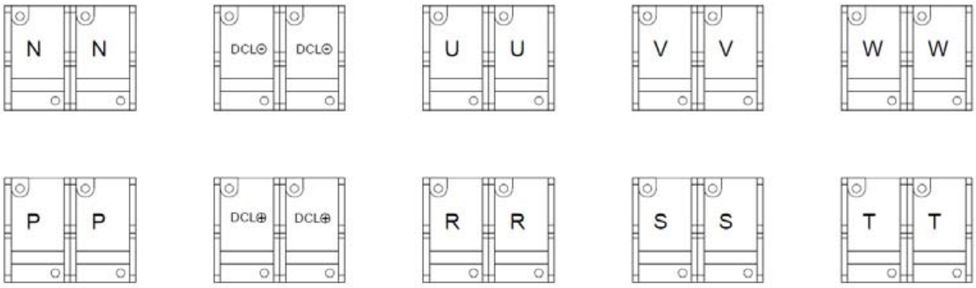
Terminal screw size	
T	⏚
M10	M10

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



Terminal screw size	
T	⏚
M12	M10

• 400V: 535-800HP



Terminal screw size	
T	⏚
M10	M10

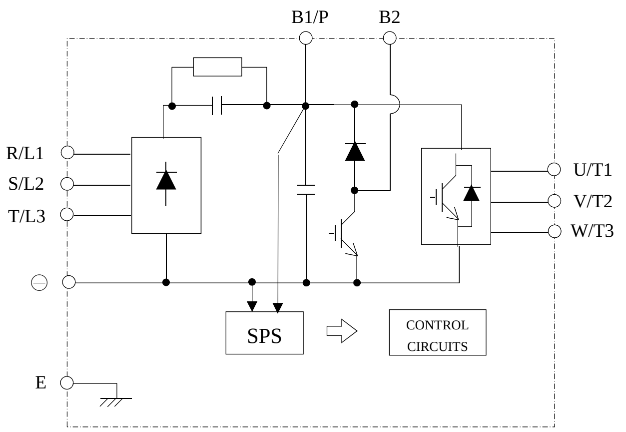
Note: For 400V 535~800HP, the terminal separate to two, to share the current.

■ Input / Output Power Section Block Diagram

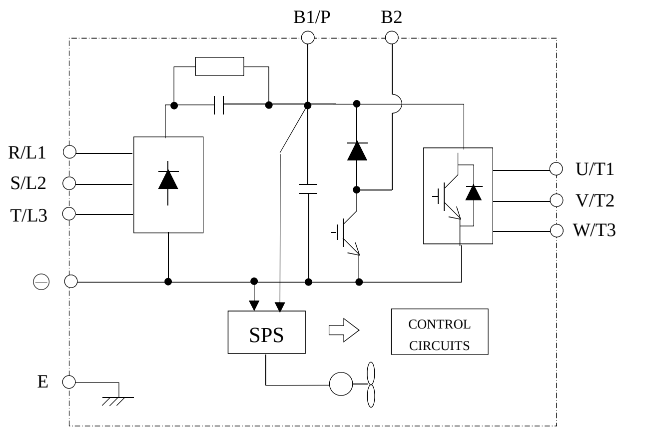
The following diagrams show the basic configuration of the power sections for the range of horsepower and input voltages. This is shown for reference only and is not a detailed depiction. (For Enhanced E & G type frame 2~5, which can connect option DC reactor, please refer to General Wiring Diagram)

◆ IP00/IP20 Type

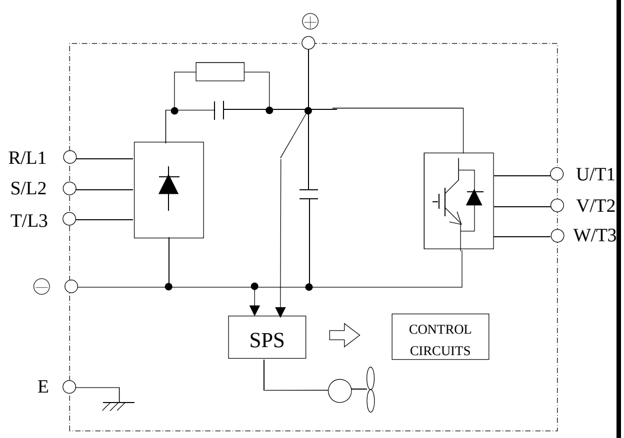
1. IP20 200V: 1HP 400V: 1~2HP(Standard) 400V:1HP(Enhanced)



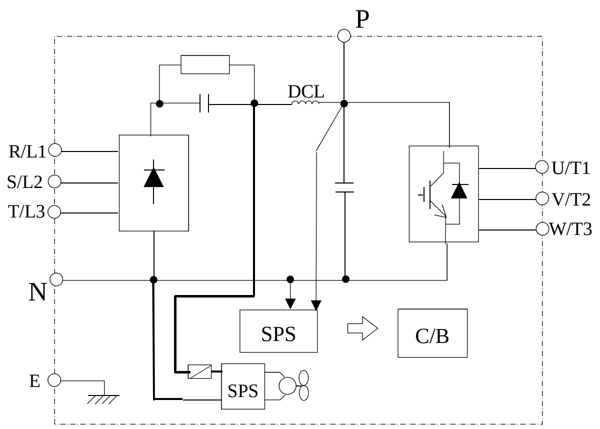
2. IP20 200V: 2~30HP 400V: 3~40HP(Standard) 400V:2~40HP(Enhanced)



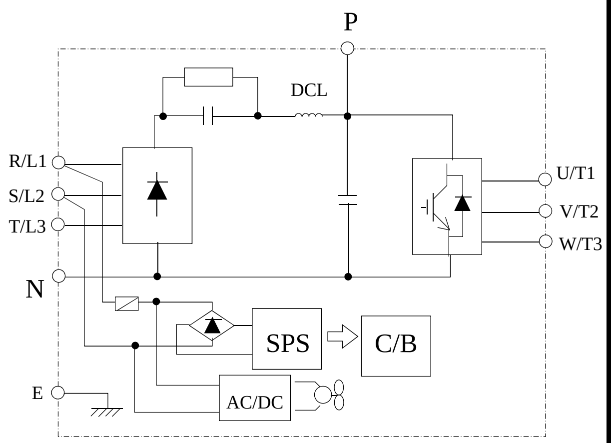
3. IP20 200V: 40~50HP 400V: 50~75HP



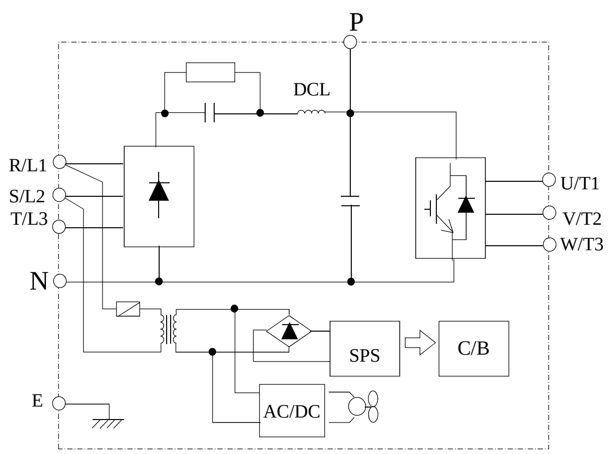
4. IP00/IP20 200V: 60~75HP 400V: 100~125HP



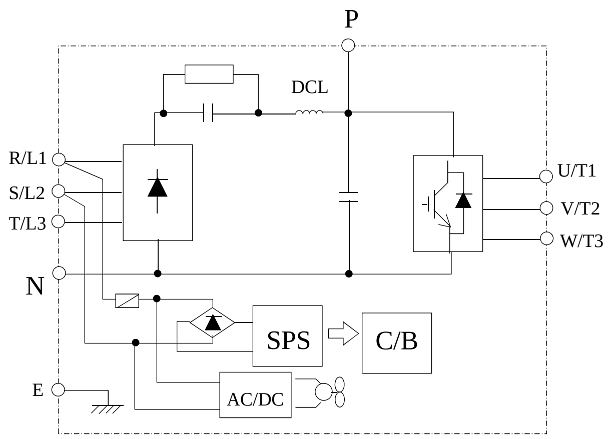
5. IP00/IP20 200V: 100~125HP



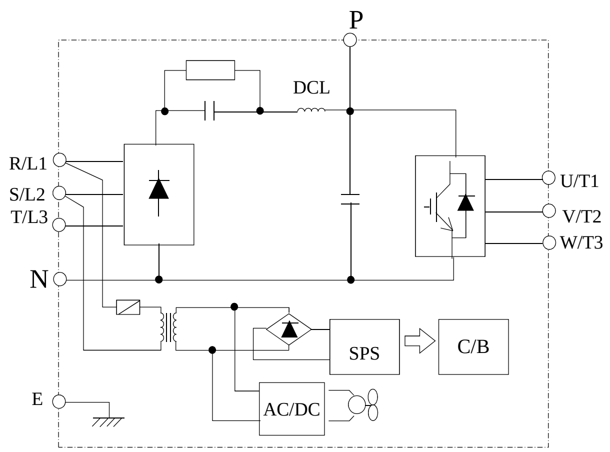
6. IP00/IP20 400V: 150~250HP



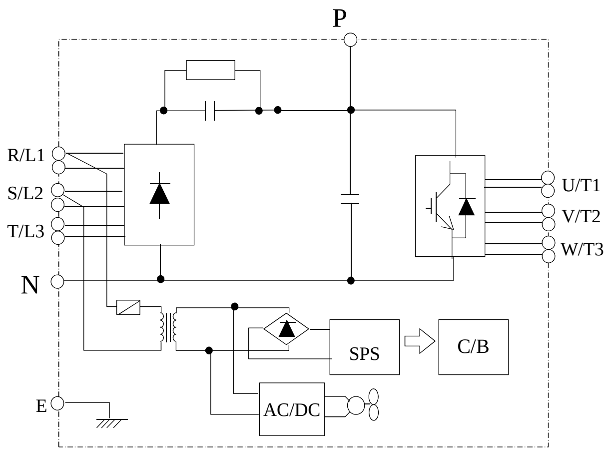
7. IP00/IP20 200V: 150~175HP



8. IP00/IP20 400V: 300~425HP

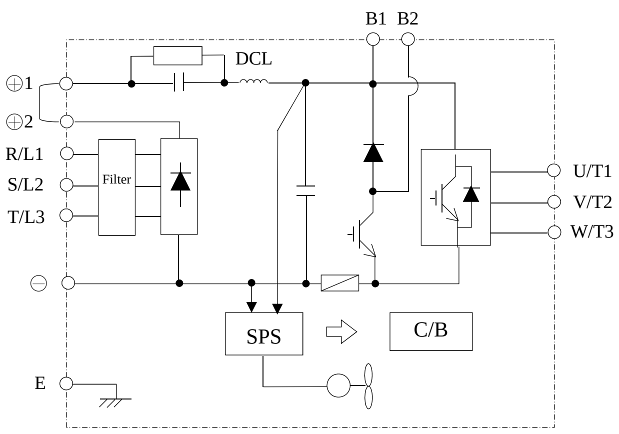


9. IP00/IP20 400V: 535~800HP

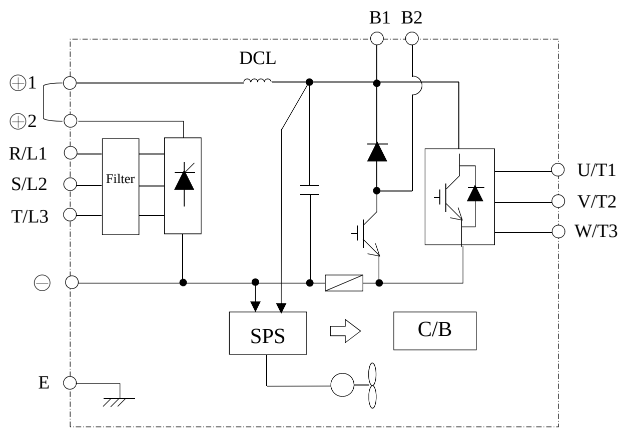


◆ IP55 Type

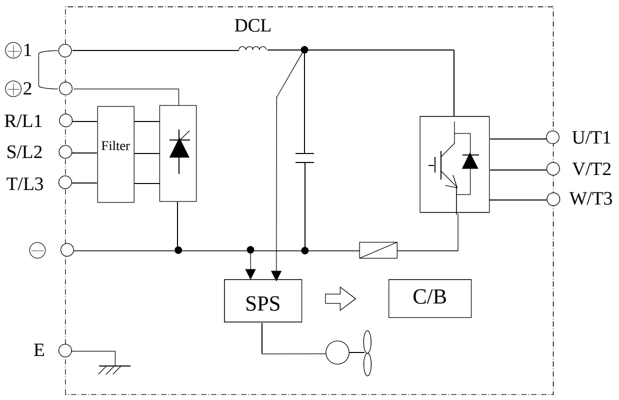
1. IP55 400V: 1~15HP



2. IP55 400V: 20~25HP



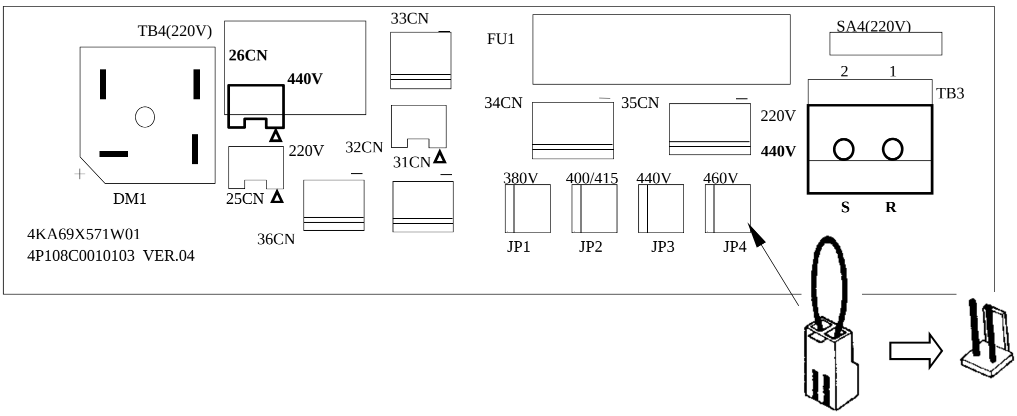
3. IP55 400V: 30~100HP



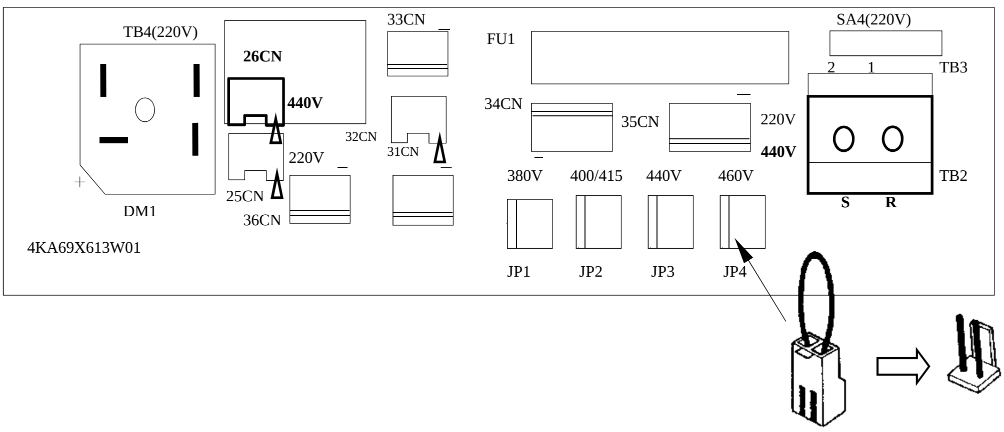
■ Cooling Fan Supply Voltage Selection (400V class)

The inverter input voltage range of the F510 400V class models ranges from 380 to 460Vac. In these models the cooling fan is directly powered from the power supply. Inverter models F510-4150/ 4175/ 4215/ 4250/ 4300/ 4375/ 4425/ 4535/ 4670/ 4800-H3 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 460Vac, select the “460V” position.

(1) 400V： 150HP～250HP



(2) 400V：300HP～800HP



■ 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 a ground protection, make sure the current setting is above 200mA and trip delay time is 0.1 sec of higher.

Table 3.3.6.3 Wiring Instrument for 200V／400V class (IP00/IP20 type)

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		
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
	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

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		
	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 rated specification of other brands may be used. To reduce electrical noise interference, ensure that a RC surge absorber (R: 10Ω/ 5W, C: 0.1μf/1000VDC) is added to both sides of MCB coil.

Table 3.3.6.4 Wiring Instrument for 400V class (IP55 type)

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		
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-27
	20HP	24	31	8	8	0.5～2	TO-100EC(50A)	CU-27
	25HP	29	38	8	8	0.5～2	TO-100EC(50A)	CU-38
	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

*1. The main circuit terminals: R(L1), S(L2), T(L3), ⊖, ⊕1, ⊕2, U(T1), V(T2), W(T3),B1, B2 (Polyethylene power line of 600V is recommended to be used.)

*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 rated specification of other brands may be used. To reduce electrical noise interference, ensure that a RC surge absorber (R: 10Ω/ 5W, C: 0.1μf/1000VDC) is added to both sides of MCB coil.

3.3.7 Wiring Precautions

❗ **Danger**	• 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. (Take off metal jewelry such as watches and rings and use insulated tools.), otherwise **electric shock or injury may result.**

(A) Wiring for control circuit:

(1) Separate the wiring for control circuit terminals from main circuit wiring for terminals (R/L1, S/L2, T/L3, U/T1, V/T2, and W/T3).

(2) Separate the wiring for control circuit terminals (R1A, R1B, R1C / R2A, R2C /R3A, R3C) from wiring for terminals S1～S6, A01, A02, GND, +10V-, AI1, AI2, and GND wiring.

(3) Use shielded twisted-pair cables (#24 - #14 AWG / 0.5 -2 mm²) shown in Fig. 3.3.7.1 for control circuits to minimize noise problems. The maximum wiring distance should not exceed 50m (165 ft).

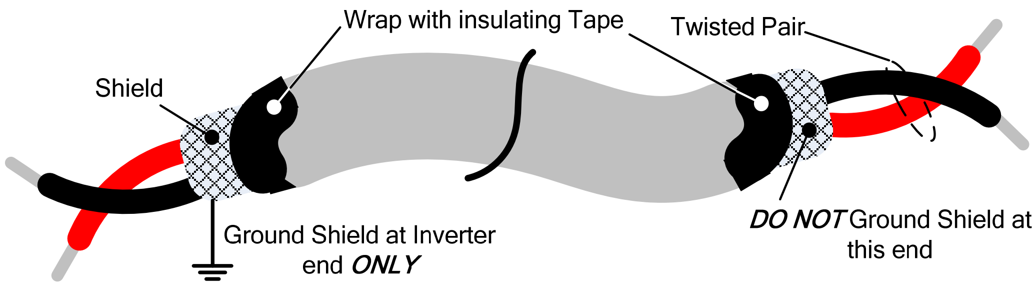


Figure 3.3.7.1 Shielded Twisted-Pair

(B) Wiring for main circuit:

(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.

(C) 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, as shown below in Fig. 3.3.7.2.

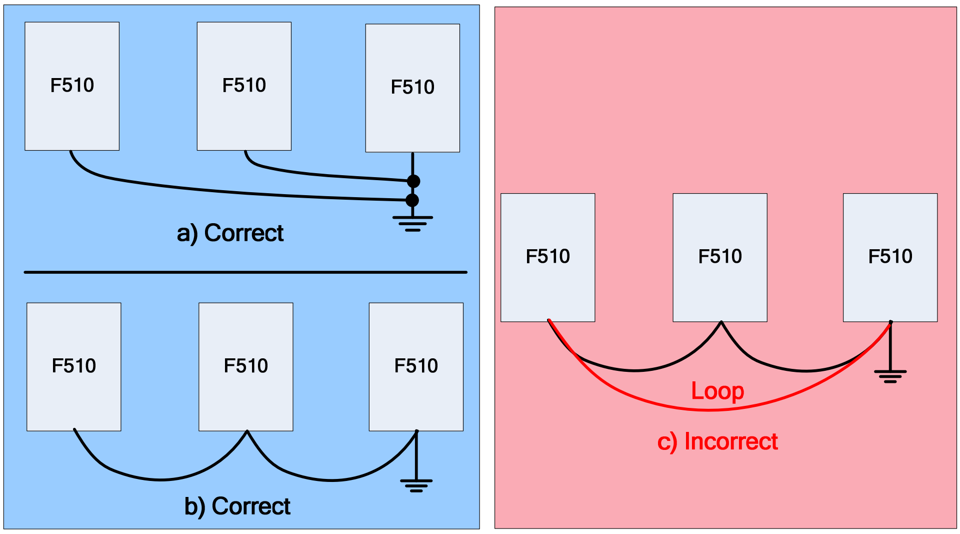


Figure 3.3.7.2 F510 Inverter Grounding

3.3.8 Input Power and Cable Length

■ Cable size

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 3.3.6.3 & 3.3.6.4 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 tot phase voltage drop, apply the following formula:

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

(km=3280 x feet)

(m=3.28 x feet)

■ 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 3.3.8.1.

Table 3.3.8.1 Cable Length vs. Carrier Frequency

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

■ Installing an AC line reactor

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

3.4 Inverter Specifications

■ Basic Specifications

(a) 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 0.1~599.0 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%																	

(b) 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 0.1~599.0 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 0.1~599.0 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 in normal duty (ND), whose overload capability is 120% for 1 min.

*3: If it is greater than default carrier frequency, you need to 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 larger than 80 Hz, the carrier frequency range is 2~8Hz.

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

Control mode	Other settings	Maximum output frequency
V/F	Unlimited	599Hz
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	599Hz

■ 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～599.0Hz
	Output Frequency Accuracy (Temperature change)	Digital references: ±0.01%(-10 to +40℃), Analog references: ±0.1% (25℃±10℃)
	Speed Control Accuracy	±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, 30 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.；3HP below for 1sec
	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 50V, the CHARGE LED turns on.
	Input Phase Loss (IPL) Protection	If the IPL is detected, the motor stops automatically.
	Output Phase Loss (OPL) Protection	If the OPL is detected, the motor stops automatically.
	Short-circuit current rating (SCCR)	Per UL 508C, the drive is suitable for use on a circuit capable of delivering not more than 100KA symmetrical amperes (rms) when protected by fuses given in the fuse table.
Environment Specifications	**Installation Location**	Indoor (protected from corrosive gases and dust)
	Ambient Temperature	-10~+40℃(14℉~104℉) (IP20/NEMA1 or IP55/NEMA12), -10~+50℃(14℉~122℉) (IP00 or top anti-dust cover removed) without de-rating; with de-rating, its maximum operation temperature is 60℃(140℉). (Enhanced type frame 5 is 50°C without de-rating
	Storage Temperature	-20~+70℃(-4℉~+158℉)
	Humidity	95%RH or less (no condensation)
	Altitude	Altitude: Below 1000 m (3281 ft.), It is required to derate 1% of current at each additional 100 m, the maximum altitude is 3000 m.
	Vibration	$9.8m/s^2$ (1.0G), meet IEC 60068-2-6
	Pollution Degree	IP00/IP20/IP21 meet IEC 60721-3-3 Class 3C2, IP55 meet IEC 60721-3-3 Class 3C3

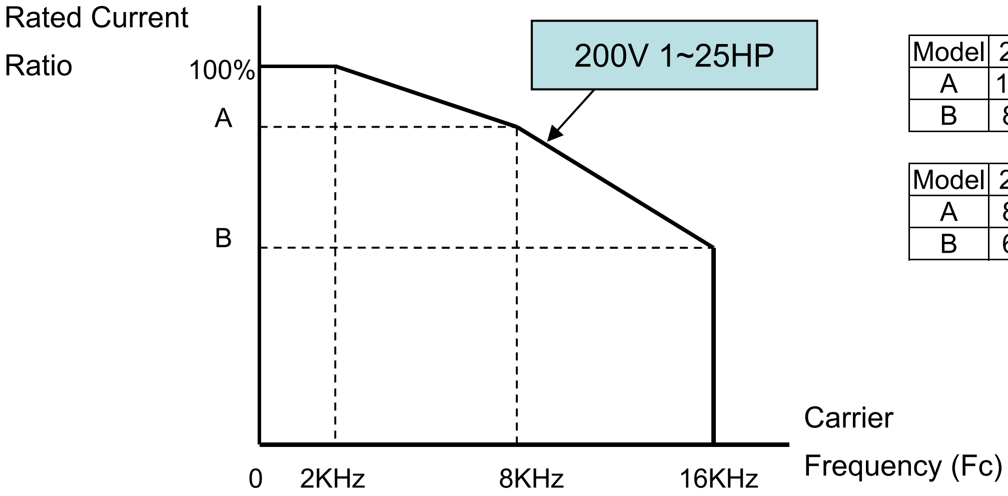
Communication Function		Built-in RS-485 as standard (Modbus protocol with RJ45/ BACnet/ Metasys N2)
PLC Function		Built-in
EMI Protection		The built-in noise filter complies with EN61800-3 available for inverters 400V 75HP or below (IP20) / 400V 60HP or below (IP55)
EMS Protection		in compliance with 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		Please refer to chapter 11

***1: Speed control accuracy will be different from the installation conditions and motor types.**
***2: The factory default carrier frequency is different from models.**

3.5 Inverter De-rating Based on Carrier Frequency

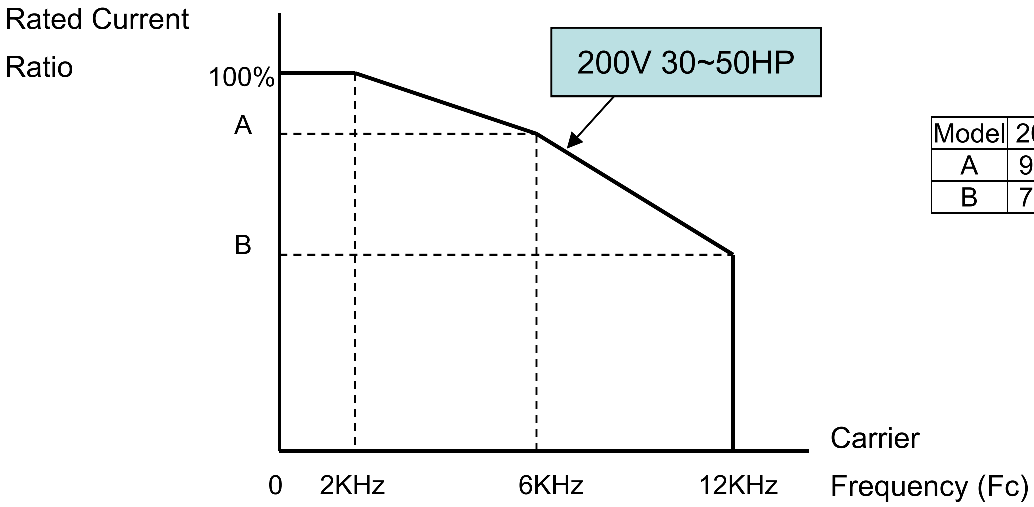
Note: De-rating curve current of carrier frequency means inverter rated current.

(a) 200V Models

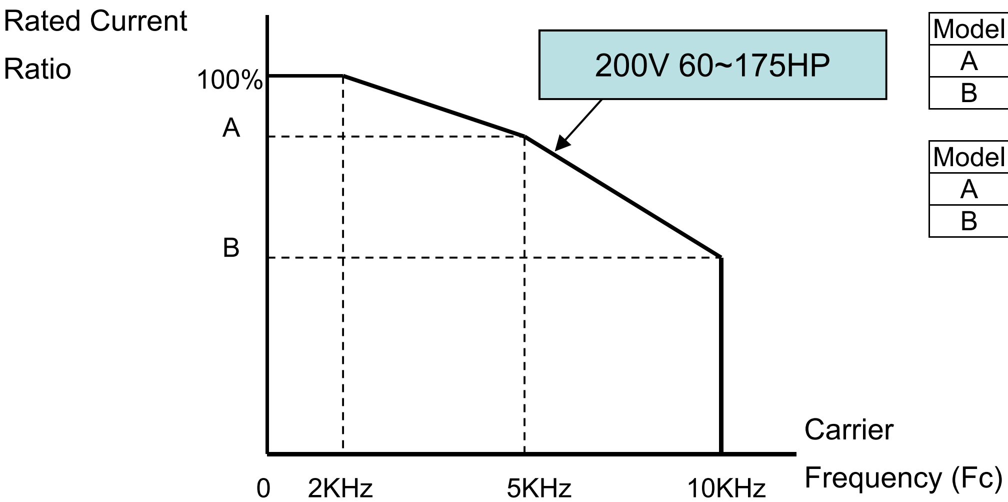


Model	2001	2002	2003	2005	2008
A	100%	67%	76%	76%	80%
B	80%	53%	60%	61%	68%

Model	2010	2015	2020	2025
A	83%	79%	84%	87%
B	67%	67%	67%	70%



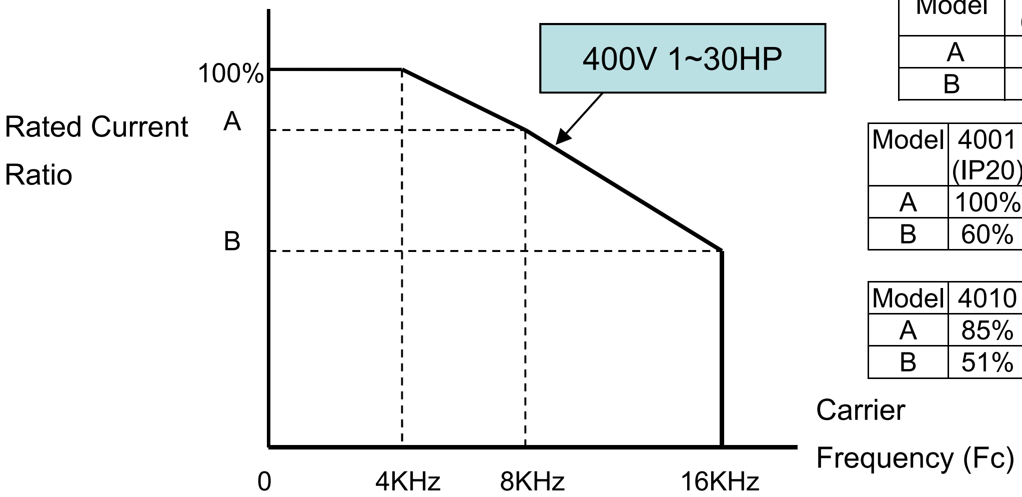
Model	2030	2040	2050
A	92%	77%	83%
B	74%	62%	67%



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

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

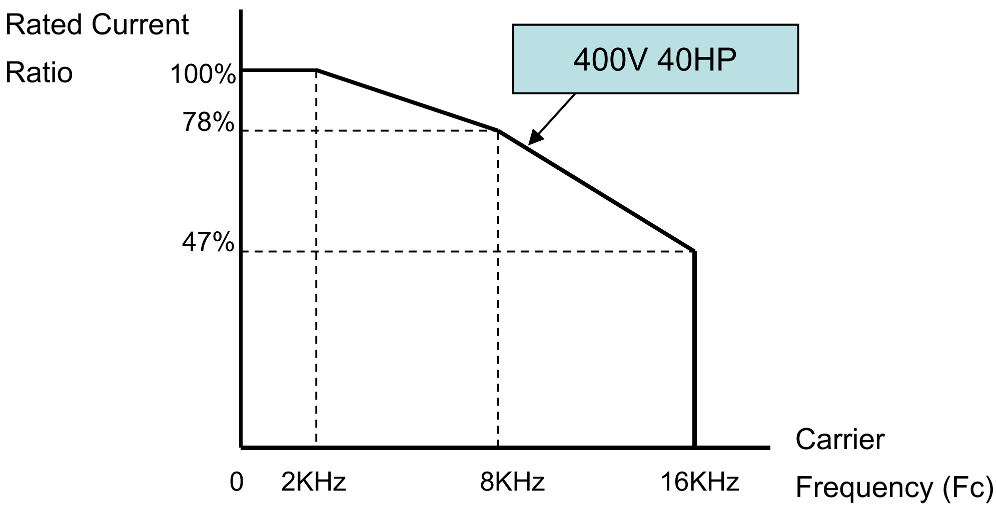
(b) 400V Models

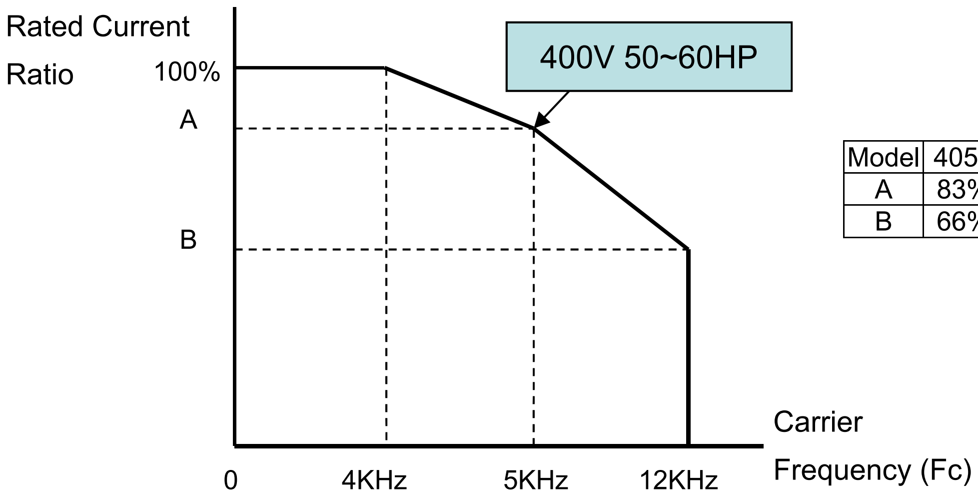


Model	4001 (IP55)	4002 (IP55)	4003 (IP55)
A	100%	100%	100%
B	60%	60%	60%

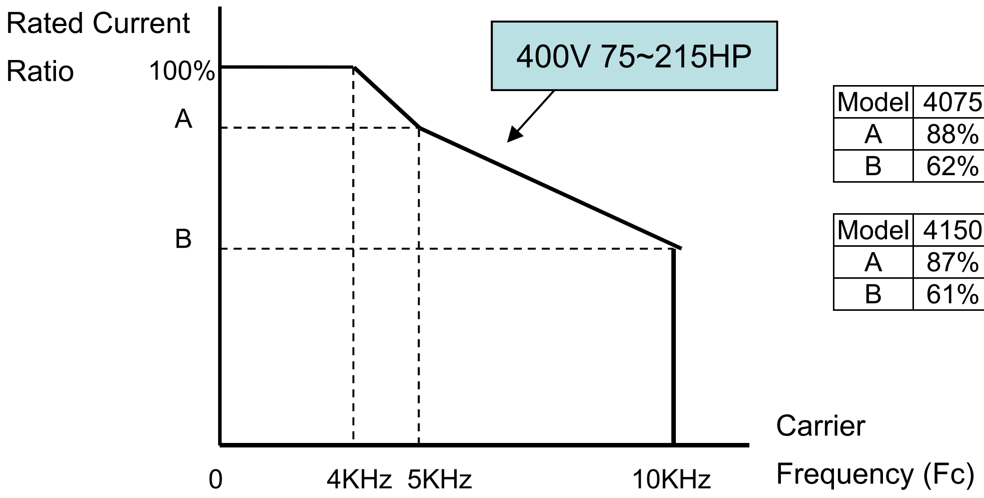
Model	4001 (IP20)	4002 (IP20)	4003 (IP20)	4005	4008
A	100%	83%	78%	100%	76%
B	60%	50%	47%	60%	46%

Model	4010	4015	4020	4025	4030
A	85%	78%	77%	82%	89%
B	51%	47%	46%	49%	53%



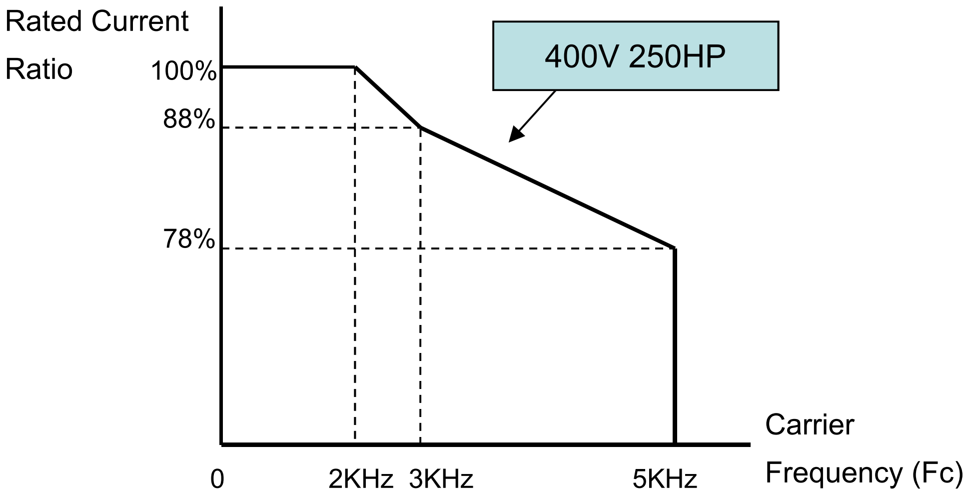


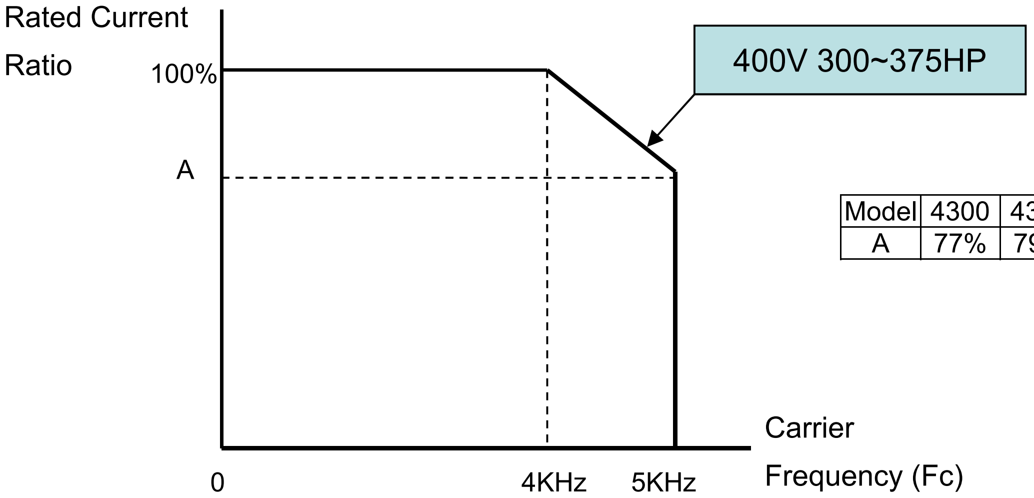
Model	4050	4060
A	83%	85%
B	66%	68%



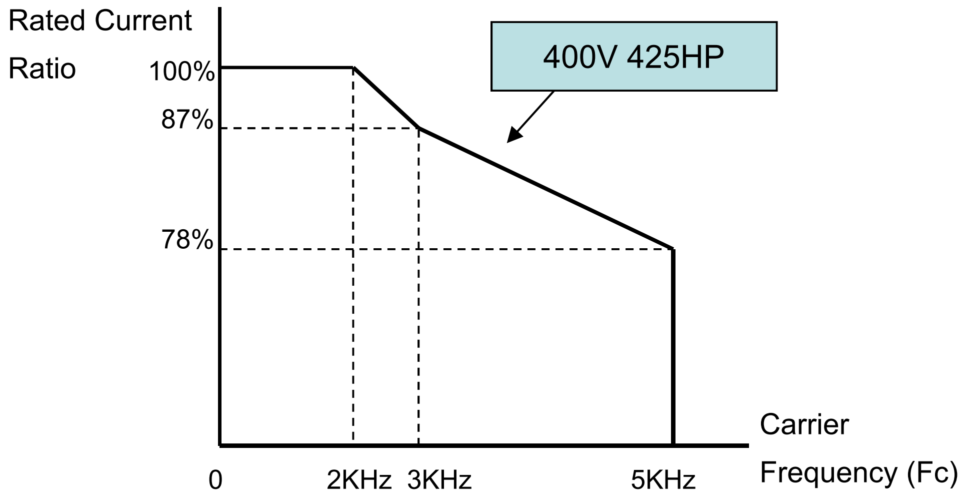
Model	4075	4100	4125
A	88%	81%	89%
B	62%	57%	63%

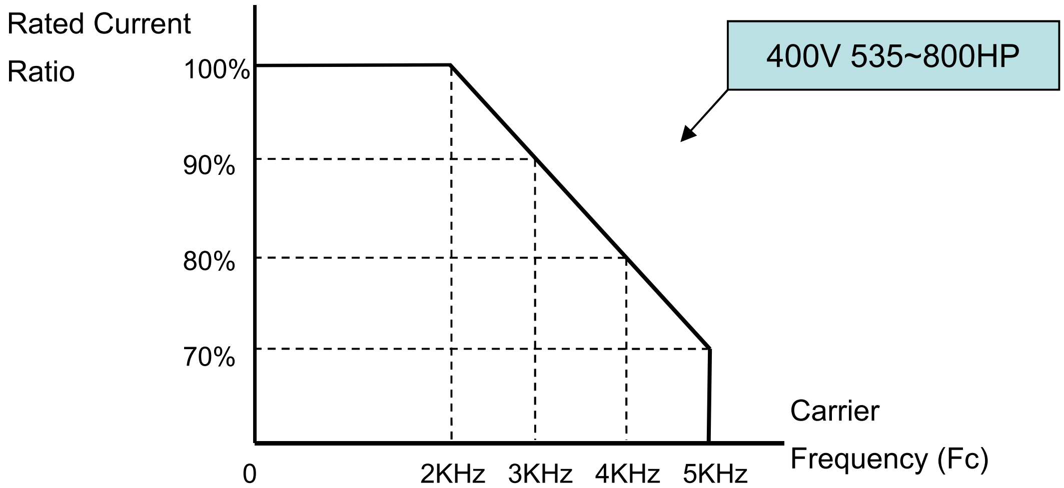
Model	4150	4175	4215
A	87%	86%	88%
B	61%	60%	61%



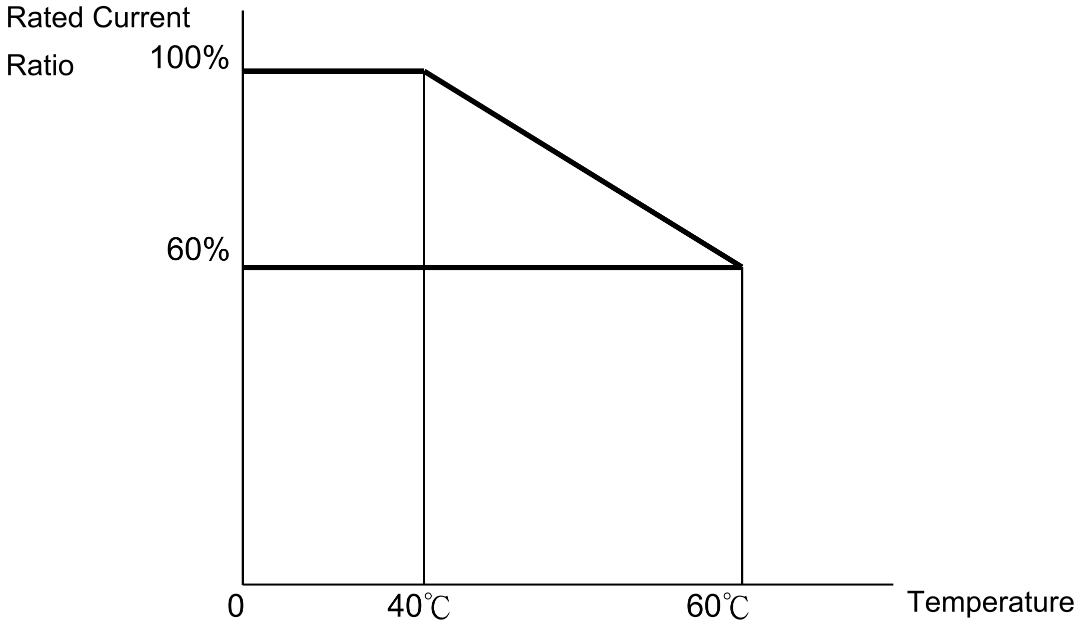


Model	4300	4375
A	77%	79%


Rated Current
Ratio
100%
87%
78%
400V 425HP
Carrier
Frequency (Fc)
0
2KHz
3KHz
5KHz


Rated Current
Ratio
100%
90%
80%
70%
400V 535~800HP
Carrier
Frequency (Fc)
0
2KHz
3KHz
4KHz
5KHz

3.6 Inverter De-rating Based on Temperature



Note: User needs to adjust the inverter rated current depending on ambient temperature to ensure the appropriate industrial application.

◆ Notes for using the PM motor

1. The inverter carry frequency (11-01) need to set upper than 6KHz.
2. The rating current of the inverter at 6KHz carry frequency (11-01) (need refer to the de-rating curve) must be bigger than the PM motor rating current.

◆ Capacitor reforming Guide after long storage

For correct performance of this product after long storage before use it is important that Inverter Capacitors are reformed according to the guide below:

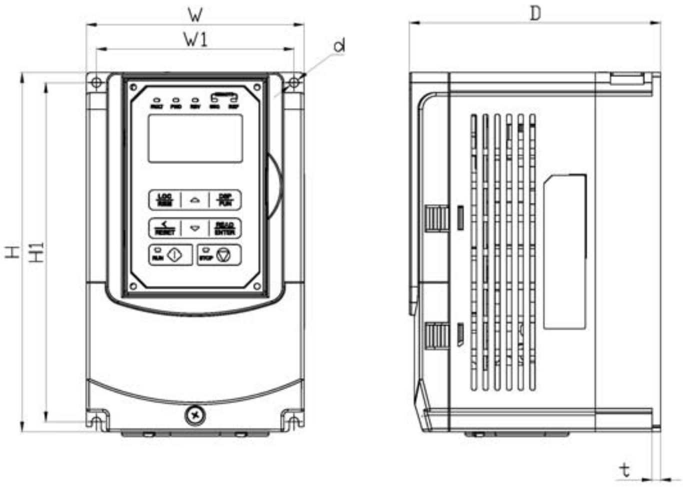
Storage time	Procedure to re-apply voltage
≦1year	Apply rated voltage(*1) of inverter in the normal way
Between 1-2 years	Apply 100% rated voltage of inverter to the product for one hour
≧2 years	Use a variable AC power supply to 1. Connecting 25% of inverter rated voltage for 30 minutes. 2. Connecting 50% of inverter rated voltage for 30 minutes. 3. Connecting 75% of inverter rated voltage for 30 minutes. 4. Connecting 100% of inverter rated voltage for 210 minutes. Once the procedures completed, inverter just can be used normally.

*1：Rated voltage: please connects rated voltage according to model label of inverter.

3.7 Inverter Dimensions

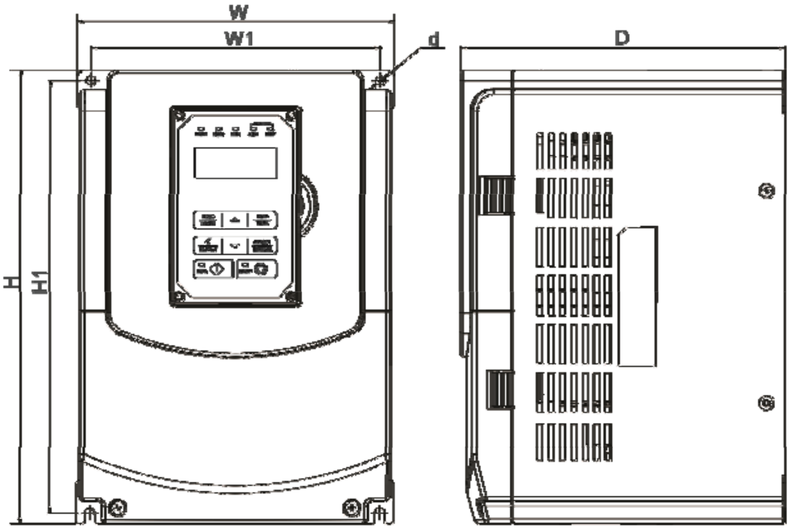
3.7.1 Standard Type (IP00/IP20)

(a) 200V: 1-7.5HP(Standard H & C type) 1-10HP (Enhanced E & G type)/ 400V: 1-10HP



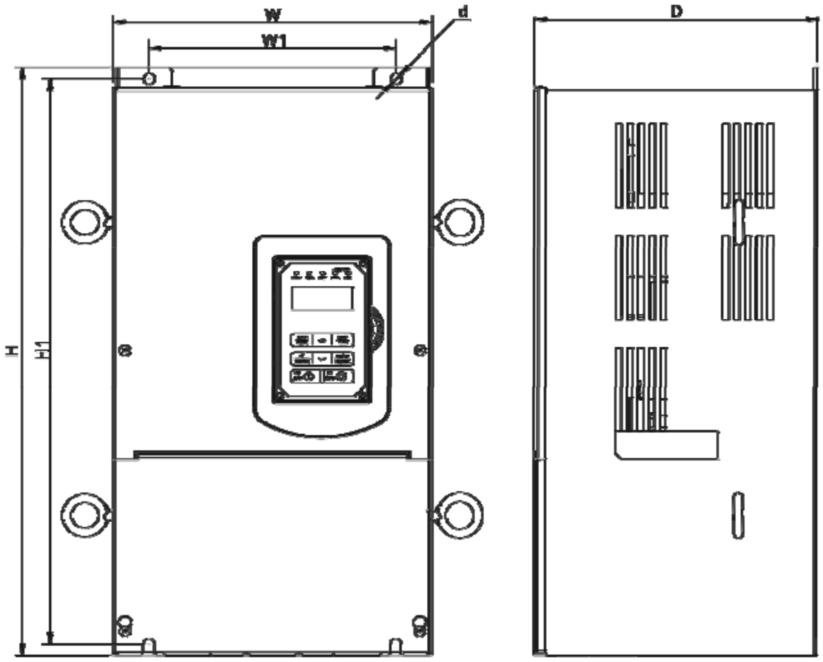
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2001-□	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-2002-□	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-2003-□	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-2005-□3	140 (5.51)	279 (10.98)	177 (6.97)	122 (4.80)	267 (10.51)	7 (0.28)	M6	3.8 (8.4)
F510-2008-□3	140 (5.51)	279 (10.98)	177 (6.97)	122 (4.80)	267 (10.51)	7 (0.28)	M6	3.8 (8.4)
F510-2010-E3/G3	140 (5.51)	279 (10.98)	177 (6.97)	122 (4.80)	267 (10.51)	7 (0.28)	M6	3.8 (8.4)
F510-4001- □3	130 (5.12)	215 (8.46)	150 (5.91	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-4002- □3	130 (5.12)	215 (8.46)	150 (5.91	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-4003- □3	130 (5.12)	215 (8.46)	150 (5.91	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-4005- □3	140 (5.51)	279 (10.98)	177 (6.97)	122 (4.80)	267 (10.51)	7 (0.28)	M6	3.8 (8.4)
F510-4008- □3	140 (5.51)	279 (10.98)	177 (6.97)	122 (4.80)	267 (10.51)	7 (0.28)	M6	3.8 (8.4)
F510-4010- □3	140 (5.51)	279 (10.98)	177 (6.97)	122 (4.80)	267 (10.51)	7 (0.28)	M6	3.8 (8.4)

(b) 200V: 10-30HP(Standard H & C type) 15~30HP (Enhanced E & G type) / 400V: 15-40HP



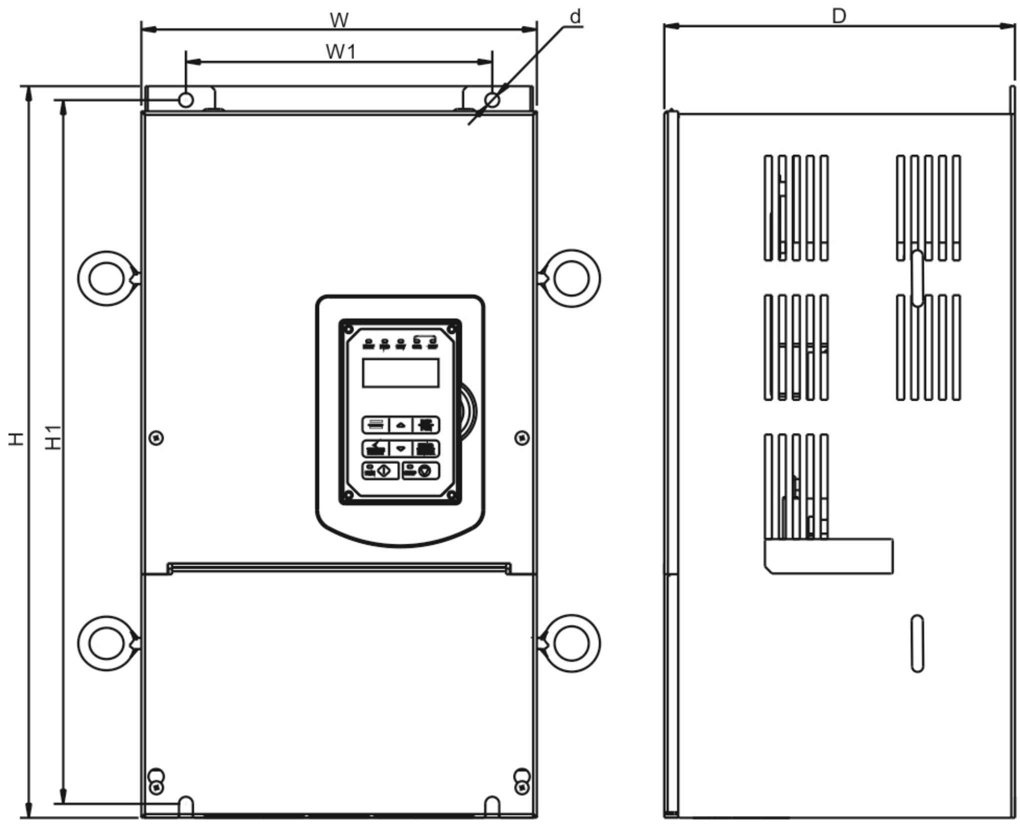
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2010-H3/C3	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-2015-□3	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-2020-□3	265 (10.43)	360 (14.17)	225 (8.86)	245 (9.65)	340 (13.39)	1.6 (0.06)	M8	10 (22.05)
F510-2025-□3	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-□3	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-□3	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-□3	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-E3/G3	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-H3/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-□3	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-□3	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 (Standard H & C type) 50~100HP (Enhanced E & G type)



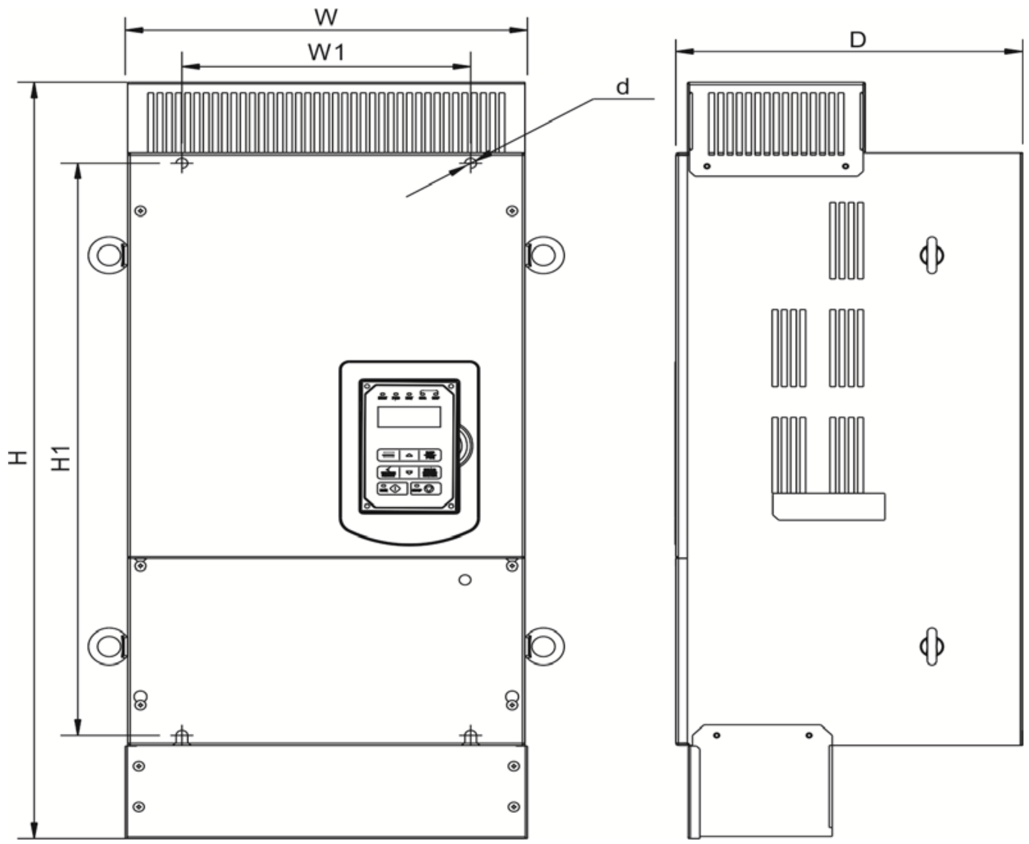
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2040-H3/C3	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-2050-H3/C3	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4050-H3/C3	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4060-H3/C3	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4075-H3/C3	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-2040-E3/G3	286.5 (11.28)	525 (20.67)	272 (10.71)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-2050-E3/G3	286.5 (11.28)	525 (20.67)	272 (10.71)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4050-E3/G3	286.5 (11.28)	525 (20.67)	272 (10.71)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4060-E3/G3	286.5 (11.28)	525 (20.67)	272 (10.71)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4075-E3/G3	286.5 (11.28)	525 (20.67)	272 (10.71)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4100-E3/G3	286.5 (11.28)	525 (20.67)	272 (10.71)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)

(d) 200V: 60-125HP/ 400V: 100-250HP (Standard H & C type) 125~250HP (Enhanced E & G type) (IP00)



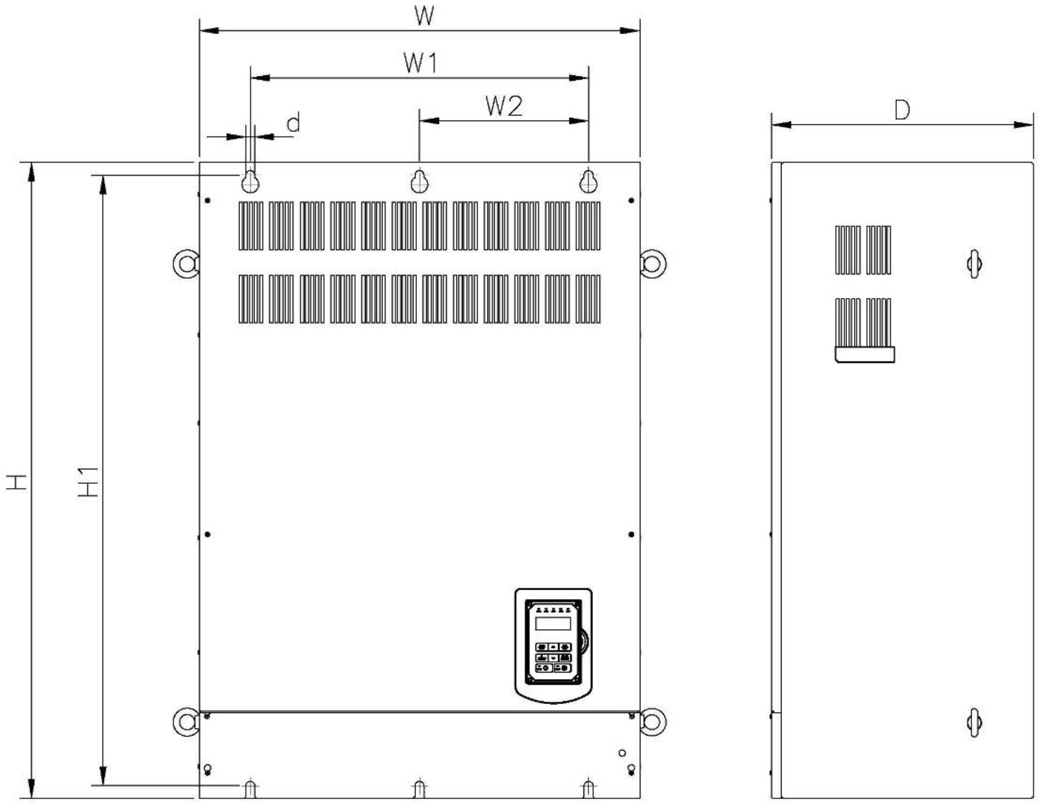
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2060-□3	344 (13.54)	580 (22.83)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	40 (88.18)
F510-2075-□3	344 (13.54)	580 (22.83)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	40 (88.18)
F510-2100-□3	459 (18.07)	790 (31.10)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	74 (163.14)
F510-2125-□3	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-H3/C3	344 (13.54)	580 (22.83)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	40 (88.18)
F510-4125-□3	344 (13.54)	580 (22.83)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	40 (88.18)
F510-4150-E3/G3	344 (13.54)	580 (22.83)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	40 (88.18)
F510-4150-H3/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-□3	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-□3	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-□3	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 (Standard H & C type) 125~250HP (Enhanced E & G type) (IP20)



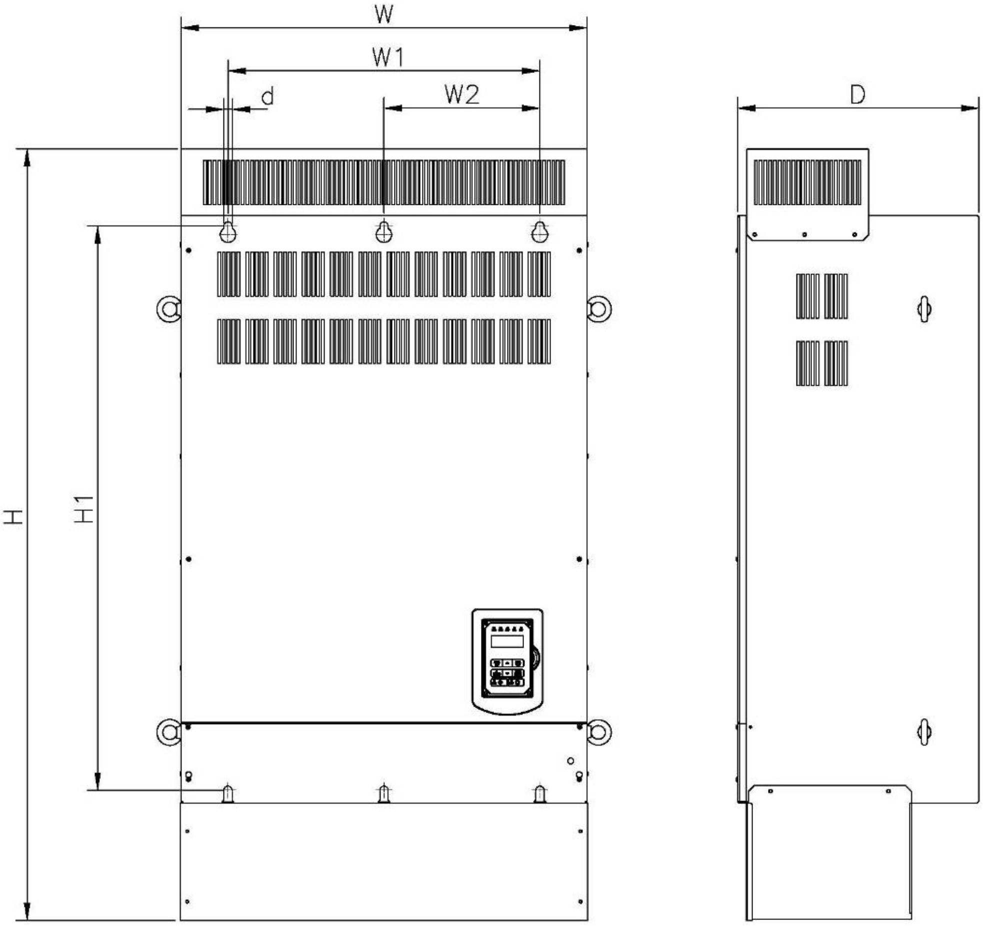
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2060-□3	348.5 (13.72)	740 (29.13)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	44 (97.00)
F510-2075-□3	348.5 (13.72)	740 (29.13)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	44 (97.00)
F510-2100-□3	463.5 (18.25)	1105 (43.50)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	81 (178.57)
F510-2125-□3	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-H3/C3	348.5 (13.72)	740 (29.13)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	44 (97.00)
F510-4125-□3	348.5 (13.72)	740 (29.13)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	44 (97.00)
F510-4150-E3/G3	348.5 (13.72)	740 (29.13)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	44 (97.00)
F510-4150-H3/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-□3	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-□3	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-□3	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)

(f) 200V: 150-175HP/ 400V: 300-425HP (IP00)



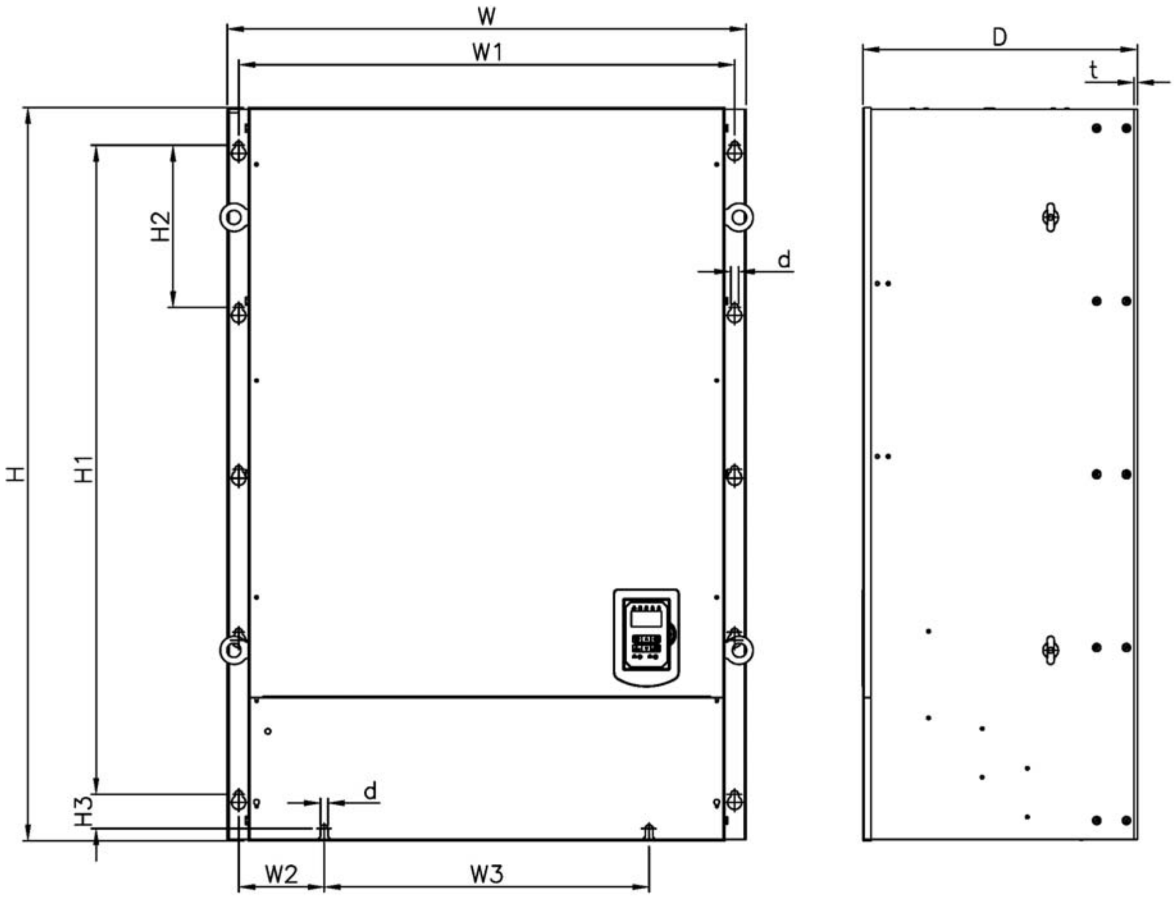
Inverter Model	Dimensions in mm (inch)								NW in kg(lbs)
	W	H	D	W1	W2	H1	t	d	
F510-2150-□3	692 (27.24)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	184 (405.65)
F510-2175-□3	690 (27.17)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	184 (405.65)
F510-4300-□3	690 (27.17)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	184 (405.65)
F510-4375-□3	690 (27.17)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	184 (405.65)
F510-4425-□3	690 (27.17)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	184 (405.65)

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



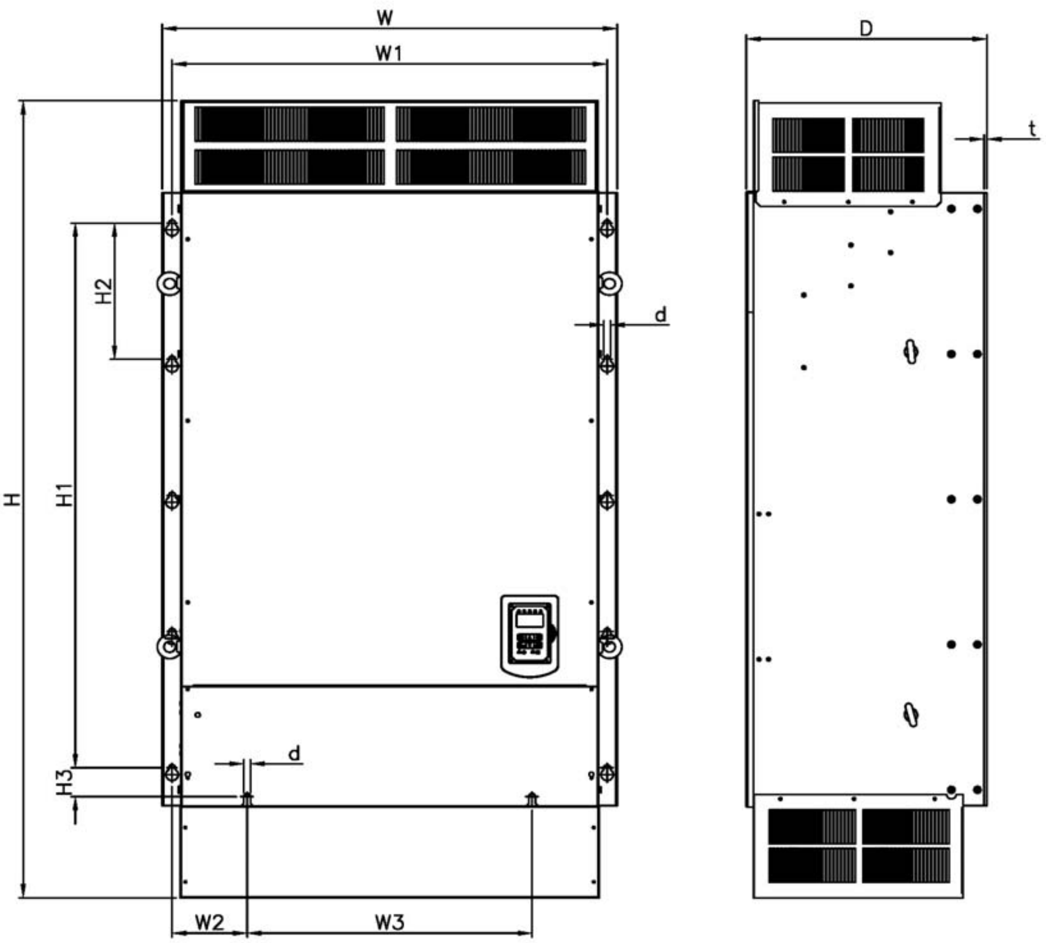
Inverter Model	Dimensions in mm (inch)								NW in kg(lbs)
	W	H	D	W1	W2	H1	t	d	
F510-2150-□3	692 (27.24)	1313 (51.69)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	194 (427.70)
F510-2175-□3	692 (27.24)	1313 (51.69)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	194 (427.70)
F510-4300-□3	692 (27.24)	1313 (51.69)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	194 (427.70)
F510-4375-□3	692 (27.24)	1313 (51.69)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	194 (427.70)
F510-4425-□3	692 (27.24)	1313 (51.69)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	194 (427.70)

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



Inverter Model	Dimensions in mm (inch)											NW in kg(lbs)
	W	H	D	W1	W2	W3	H1	H2	H3	t	d	
F510-4535-□3	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-□3	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-□3	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)

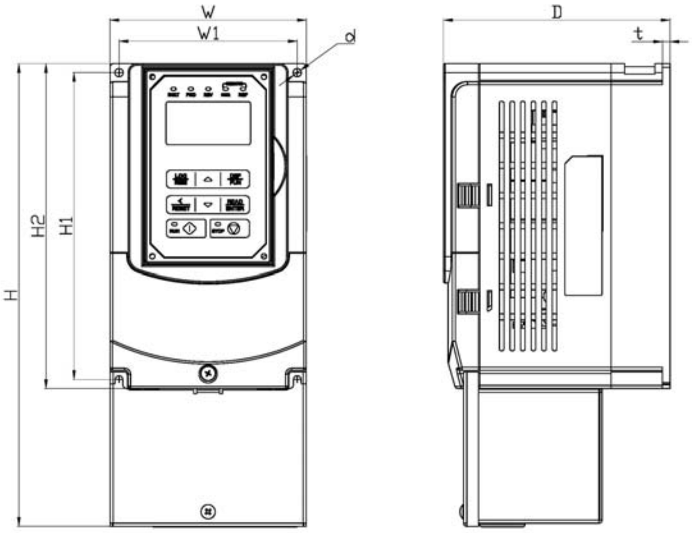
(i) 400V: 535-800HP (IP20)



Inverter Model	Dimensions in mm (inch)											NW in kg(lbs)
	W	H	D	W1	W2	W3	H1	H2	H3	t	d	
F510-4535-□3	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-□3	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-□3	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)

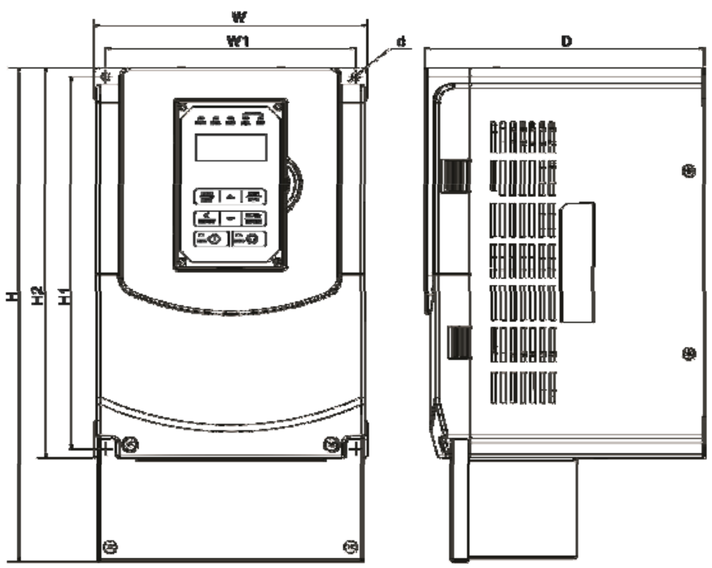
3.7.2 Standard Type with Built-in Filter (IP00/IP20)

(a) 400V: 1-10HP



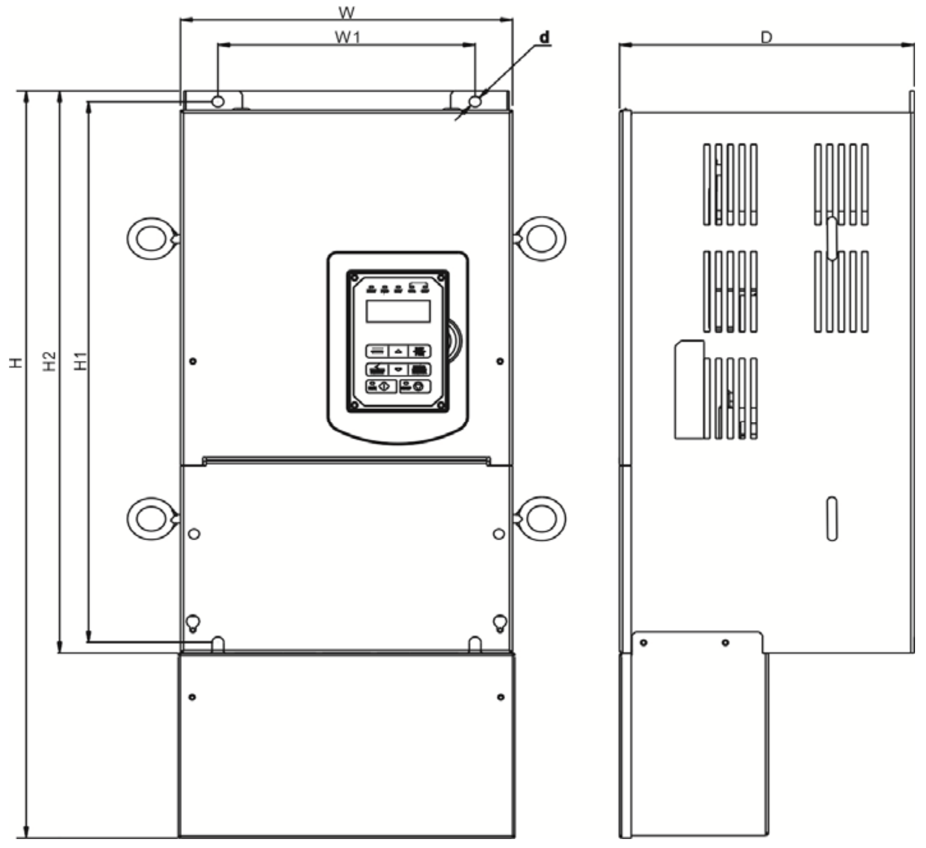
Inverter Model	Dimensions in mm (inch)								NW in kg(lbs)
	W	H	D	W1	H1	H2	t	d	
F510-4001-□3F	130 (5.12)	306 (12.05)	150 (5.91)	118 (4.65)	203 (7.99)	215 (8.46)	5	M5	3.5 (7.71)
F510-4002-□3F	130 (5.12)	306 (12.05)	150 (5.91)	118 (4.65)	203 (7.99)	215 (8.46)	5	M5	3.5 (7.71)
F510-4003-□3F	130 (5.12)	306 (12.05)	150 (5.91)	118 (4.65)	203 (7.99)	215 (8.46)	5	M5	3.5 (7.71)
F510-4005-□3F	140 (5.51)	400 (15.75)	177 (6.97)	122 (4.80)	267 (10.51)	279 (10.98)	7 (0.28)	M6	5.5 (12.13)
F510-4008-□3F	140 (5.51)	400 (15.75)	177 (6.97)	122 (4.80)	267 (10.51)	279 (10.98)	7 (0.28)	M6	5.5 (12.13)
F510-4010-□3F	140 (5.51)	400 (15.75)	177 (6.97)	122 (4.80)	267 (10.51)	279 (10.98)	7 (0.28)	M6	5.5 (12.13)

(b) 400V: 15-40HP



Inverter Model	Dimensions in mm (inch)								NW in kg(lbs)
	W	H	D	W1	H1	H2	t	d	
F510-4015-□3F	210 (8.27)	416.5 (16.40)	215 (8.46)	192 (7.56)	286 (11.26)	300 (11.81)	1.6 (0.06)	M6	8.0 (17.64)
F510-4020-□3F	210 (8.27)	416.5 (16.40)	215 (8.46)	192 (7.56)	286 (11.26)	300 (11.81)	1.6 (0.06)	M6	8.0 (17.64)
F510-4025-□3F	265 (10.43)	500 (19.69)	225 (8.86)	245 (9.65)	340 (13.39)	360 (14.17)	1.6 (0.06)	M8	12.5 (27.56)
F510-4030-□3F	265 (10.43)	500 (19.69)	225 (8.86)	245 (9.65)	340 (13.39)	360 (14.17)	1.6 (0.06)	M8	12.5 (27.56)
F510-4040-□3F	265 (10.43)	500 (19.69)	225 (8.86)	245 (9.65)	340 (13.39)	360 (14.17)	1.6 (0.06)	M8	12.5 (27.56)

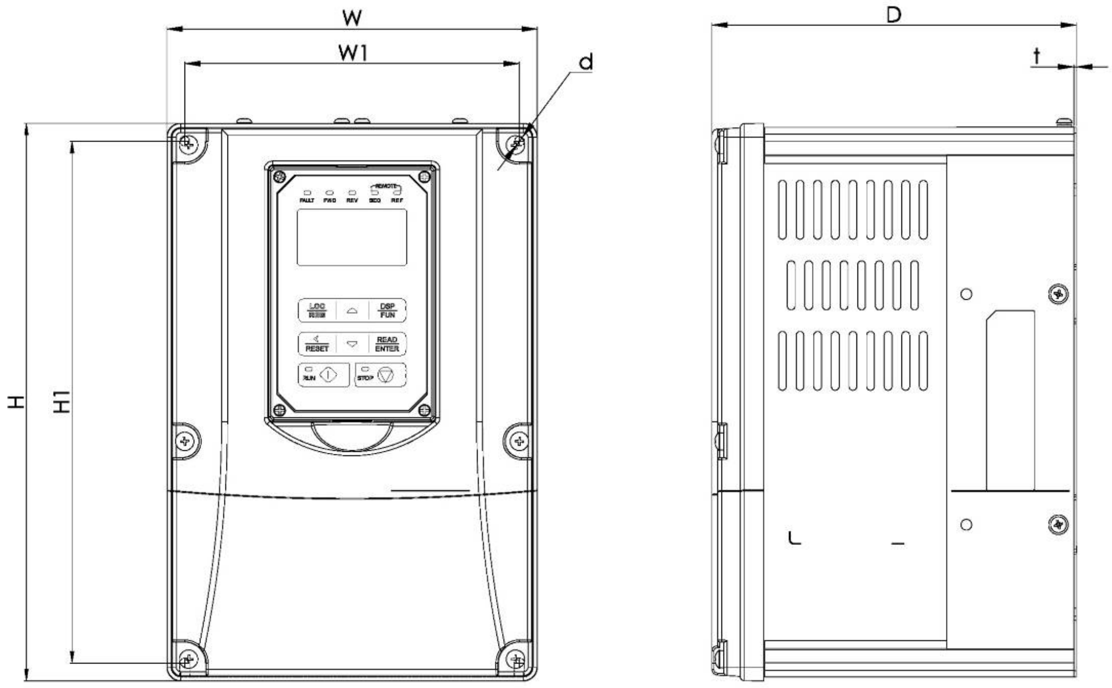
(c) 400V: 50-75HP



Inverter Model	Dimensions in mm (inch)								NW in kg(lbs)
	W	H	D	W1	H1	H2	t	d	
F510-4050-□3F	286.5 (11.28)	679 (26.73)	252 (9.92)	220 (8.66)	505 (19.88)	525 (20.67)	3.3 (0.13)	M8	29.5 (65.04)
F510-4060-□3F	286.5 (11.28)	679 (26.73)	252 (9.92)	220 (8.66)	505 (19.88)	525 (20.67)	3.3 (0.13)	M8	29.5 (65.04)
F510-4075-□3F	286.5 (11.28)	679 (26.73)	252 (9.92)	220 (8.66)	505 (19.88)	525 (20.67)	3.3 (0.13)	M8	29.5 (65.04)

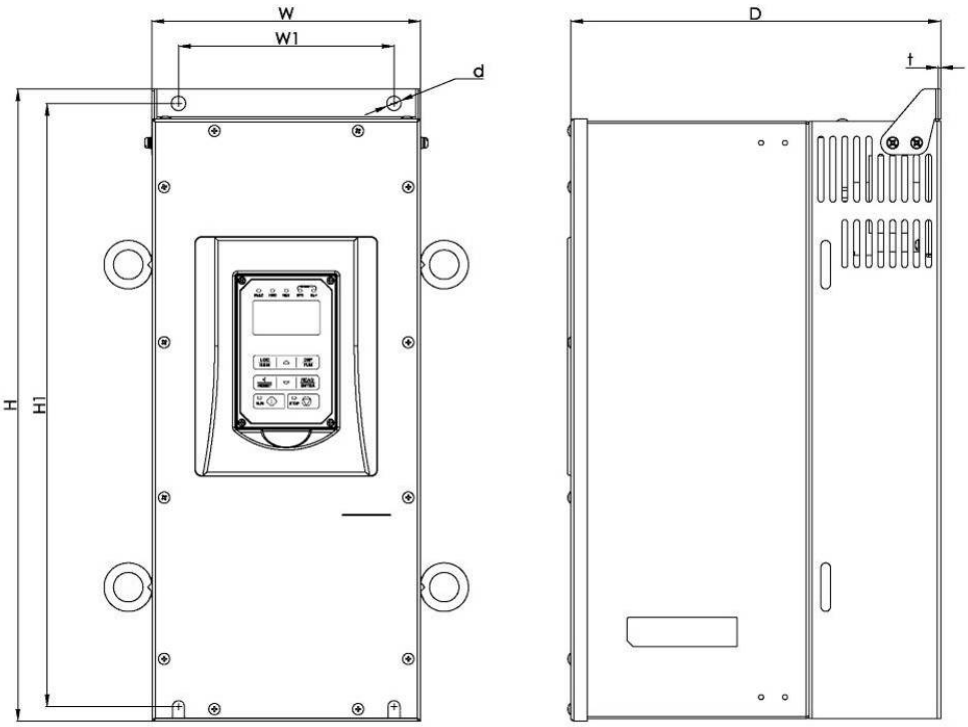
3.7.3 Water proof Type (IP55)

(a) 400V: 1-25HP



Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-4001-C3FN4	189 (7.44)	284 (11.18)	186 (7.32)	171 (6.73)	266 (10.47)	1.2 (0.05)	M5	5.1 (11.3)
F510-4002-C3FN4	189 (7.44)	284 (11.18)	186 (7.32)	171 (6.73)	266 (10.47)	1.2 (0.05)	M5	5.1 (11.24)
F510-4003-C3FN4	189 (7.44)	284 (11.18)	186 (7.32)	171 (6.73)	266 (10.47)	1.2 (0.05)	M5	5.1 (11.3)
F510-4005-C3FN4	189 (7.44)	284 (11.18)	186 (7.32)	171 (6.73)	266 (10.47)	1.2 (0.05)	M5	5.1 (11.3)
F510-4008-C3FN4	189 (7.44)	284 (11.18)	186 (7.32)	171 (6.73)	266 (10.47)	1.2 (0.05)	M5	5.1 (11.3)
F510-4010-C3FN4	230 (9.06)	320 (12.60)	210 (8.27)	210 (8.27)	305 (12.01)	2 (0.08)	M5	8.6 (19.0)
F510-4015-C3FN4	230 (9.06)	320 (12.60)	210 (8.27)	210 (8.27)	305 (12.01)	2 (0.08)	M5	8.6 (19.0)
F510-4020-C3FN4	265 (10.43)	396 (15.59)	227 (8.94)	249 (9.80)	380 (14.96)	2 (0.08)	M5	17 (37.5)
F510-4025-C3FN4	265 (10.43)	396 (15.59)	227 (8.94)	249 (9.80)	380 (14.96)	2 (0.08)	M5	17 (37.5)

(b) 400V: 30-100HP



Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-4030-C3FN4	224 (8.82)	527 (20.75)	311 (12.24)	180 (7.09)	505 (19.88)	2 (0.08)	M10	32.5 (71.7)
F510-4040-C3FN4	224 (8.82)	527 (20.75)	311 (12.24)	180 (7.09)	505 (19.88)	2 (0.08)	M10	32.5 (71.7)
F510-4050-C3FN4	224 (8.82)	527 (20.75)	311 (12.24)	180 (7.09)	505 (19.88)	2 (0.08)	M10	32.5 (71.7)
F510-4060-C3FN4	326 (12.83)	695 (27.36)	343 (13.50)	276 (10.87)	671 (26.42)	2.3 (0.09)	M10	55 (121.3)
F510-4075-C3N4	326 (12.83)	695 (27.36)	343 (13.50)	276 (10.87)	671 (26.42)	2.3 (0.09)	M10	55 (121.3)
F510-4100-C3N4	326 (12.83)	695 (27.36)	343 (13.50)	276 (10.87)	671 (26.42)	2.3 (0.09)	M10	55 (121.3)

Chapter 4 Keypad and Programming Functions

4.1 LED Keypad

4.1.1 Keypad Display and Keys

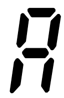
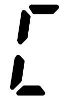
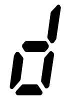
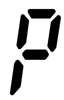
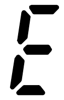
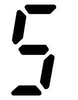
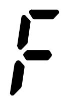
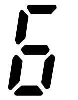
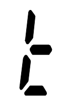
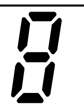
DISPLAY	Description
5 Digit LED Display	Monitor inverter signals, view / edit parameters, fault / alarm display.
LED INDICATORS	
FAULT	LED **ON** when a fault or alarm is active.
FWD	LED **ON** when inverter is running in forward direction, flashing when stopping.
REV	LED **On** when inverter is running 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.

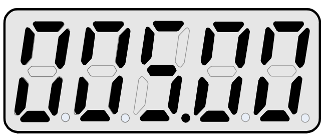
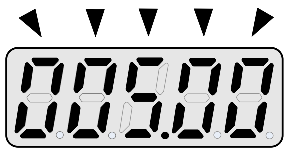
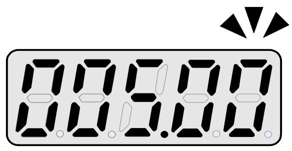
KEYS (8)	Description
RUN	RUN inverter
STOP	STOP inverter
▲	Parameter navigation Up, Increase parameter or reference value
▼	Parameter navigation down, decrease parameter or reference value
LOC/REM	Used to switch between Local Mode and Remote Mode REMOTE Mode: Set by parameters, controlled by control circuit terminals, communication or other ways. LOCAL Mode: Controlled by operator. It displays REMOTE Mode at power-up. Users can switch between LOCAL and REMOTE Mode if they press LOC/ REM keys when the inverter stops. Parameter of 23-41 can determine if LOC/REM keys are enabled or not.
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.

4.1.2 Seven Segment Display Description

Actual	LED Display	Actual	LED Display	Actual	LED Display	Actual	LED Display
0		A		L		Y	
1		B		n		-	
2		C		o		°	
3		D		P		_	
4		E		q		.	
5		F		r			
6		G		S			
7		H		t			
8		I		u			
9		J		v			

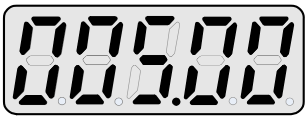
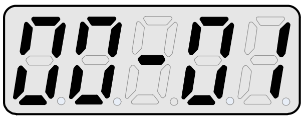
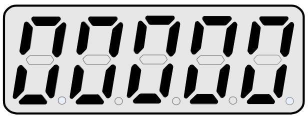
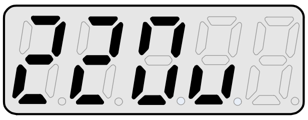
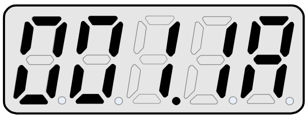
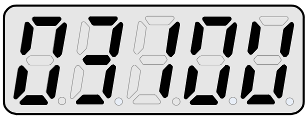
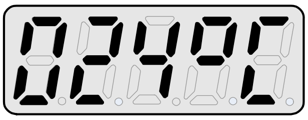
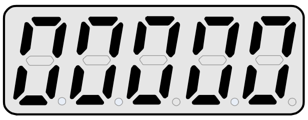
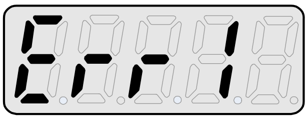
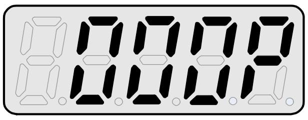
Display output frequency	Frequency Reference	Set Frequency Reference
LED lights on	**LED flashes**	**Flashing digit**
		

- ◆ At power-up, the display will show the frequency reference setting and all LEDs are flashing. Press the ▲ (UP) or ▼ (DOWN) key to enter the frequency reference edit mode, use the **◄/RESET** key to select which digit to edit (flashing). Use the ▲ (UP) or ▼ (DOWN) key to modify the value and press the READ / ENTER key to save the frequency reference and switch back to the frequency reference display mode.

- ◆ During run operation, the display will show the output frequency.

Note: When in edit mode and the READ / ENTER is not pressed within 5 sec, the inverter will switch back to the frequency reference display mode.

LED Display Examples

Seven Segment Display	Description
	1. Displays the frequency reference at power-up. 2. Displays the actual output frequency during run operation.
	Displays parameter code.
	Displays the setting value of parameter.
	Displays input voltage.
	Displays inverter current.
	Displays DC Bus Voltage.
	Displays temperature.
	Displays PID feedback value; The displayed digit is set by 12-01.
	Error display; refer to chapter 5 Troubleshooting and Maintenance.
	Displays AI1/ AI2 input (0～100%)

4.1.3 LED Indicator Description

- **Fault LED**

State	Description	FAULT LED
Off	No Fault Active	
Illuminated	Fault Active	

- **Forward LED**

State	Description	FWD LED
Off	Inverter in reverse direction	
Illuminated	Inverter is running in forward direction	
Flashing	Forward direction active, no run command	

- **Reverse LED**

State	Description	REV LED
Off	Inverter in forward direction	
Illuminated	Inverter is running in reverse direction	
Flashing	Reverse direction active, no run command	

- **RUN LED**

State	Description	RUN LED
Off	Inverter stopped	
Illuminated	Inverter running	
Flashing	Inverter stopped or stopping	

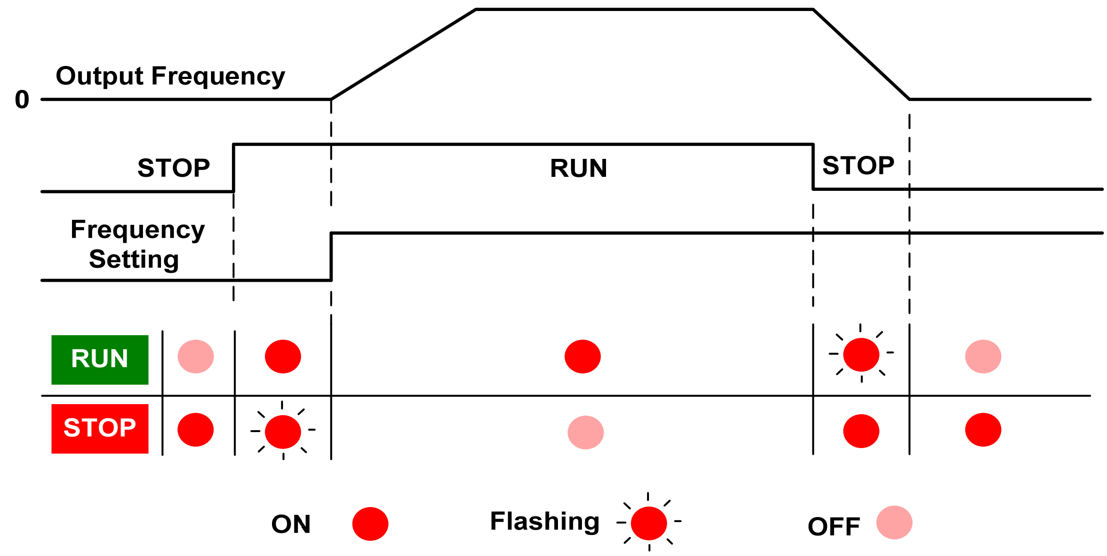
- **SEQ LED**

State	Description	SEQ LED
Off	Sequence controlled from keypad	
Illuminated	Sequence set from external source	

- **REF LED**

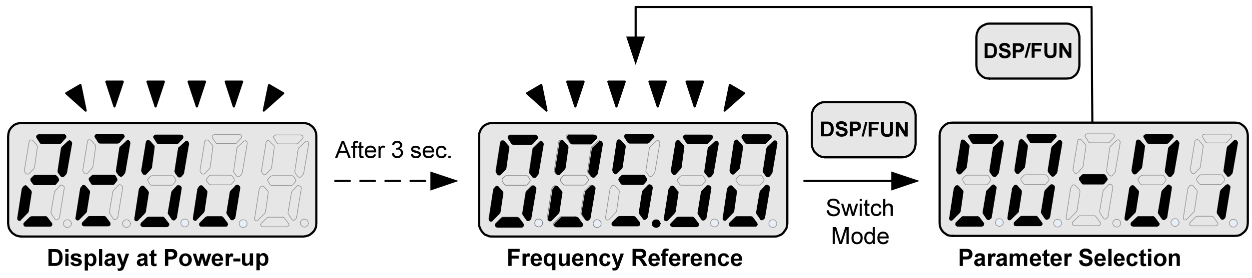
State	Description	REF LED
Off	Frequency reference set from keypad	
Illuminated	Frequency reference set from external source	

Run / Stop Status Indicators



4.1.4 Power-up Monitor

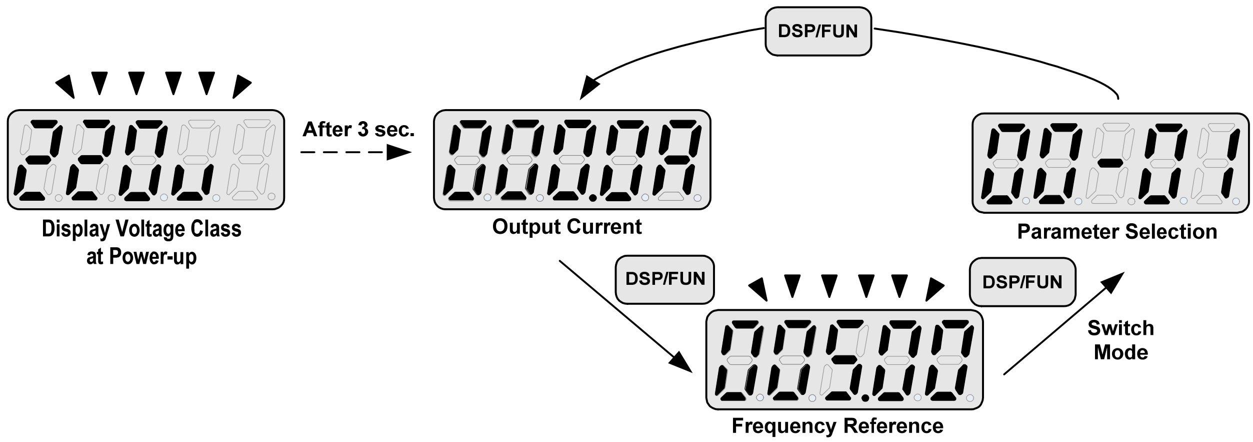
◆ **Power-up**



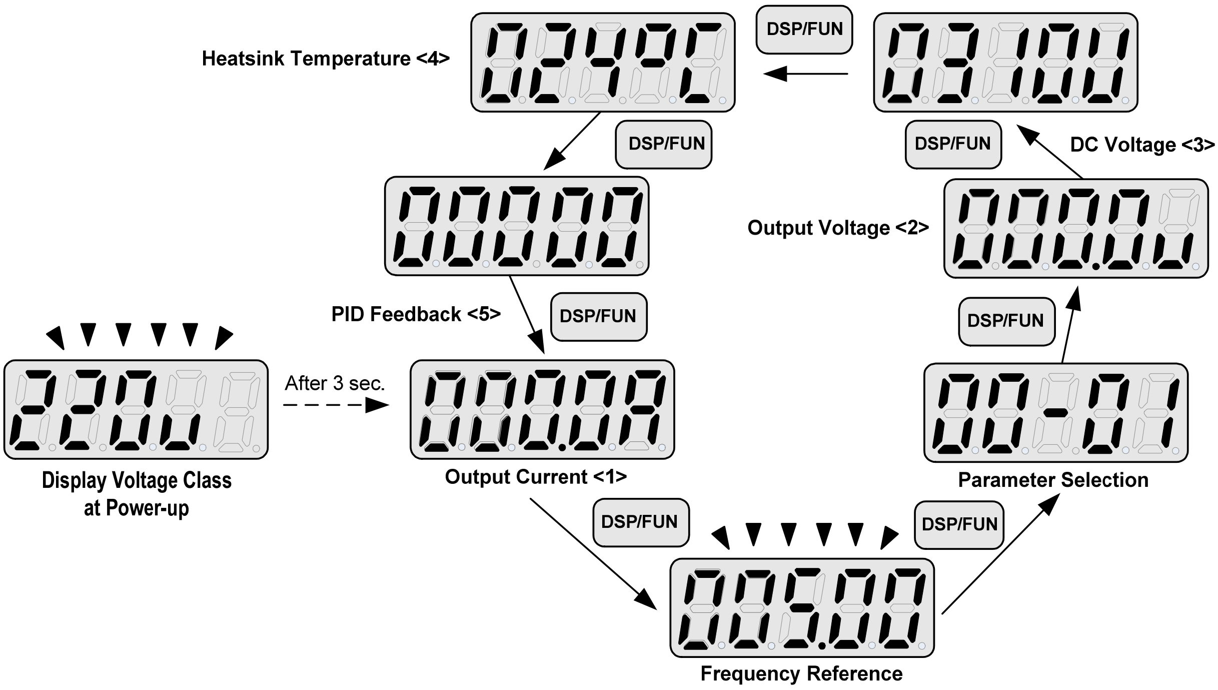
◆ **Changing Monitor at Power-up**

12- 00	Display Selection	
Range	**Highest bit -> 0 0 0 0 0 <- Lowest bit** The setting range for each bit is **0 ~ 7** from the highest bit to the lowest bit**.**	
	0: No display	**4:** Temperature
	1: Output current	**5:** PID feedback
	2: Output voltage	**6:** AI1 value
	3: DC voltage	**7:** AI2 value

Example: 12- 00=【10000】

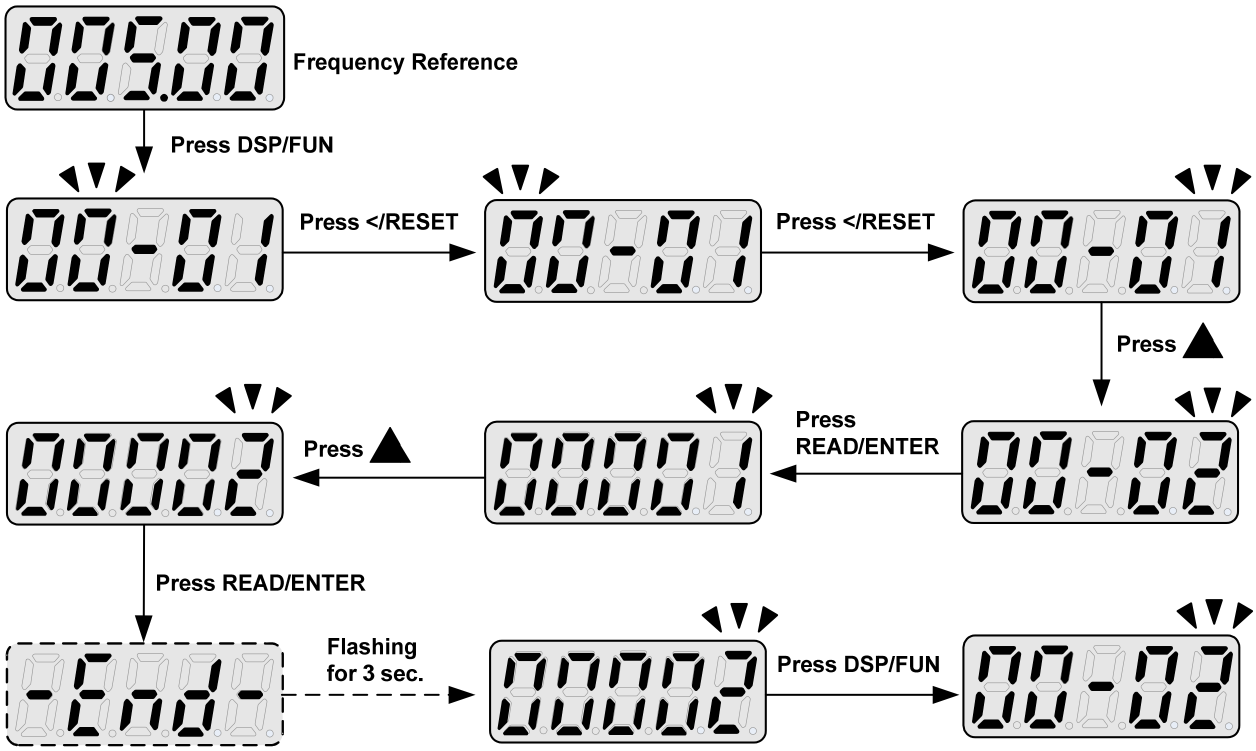


Example: 12- 00=【12345】



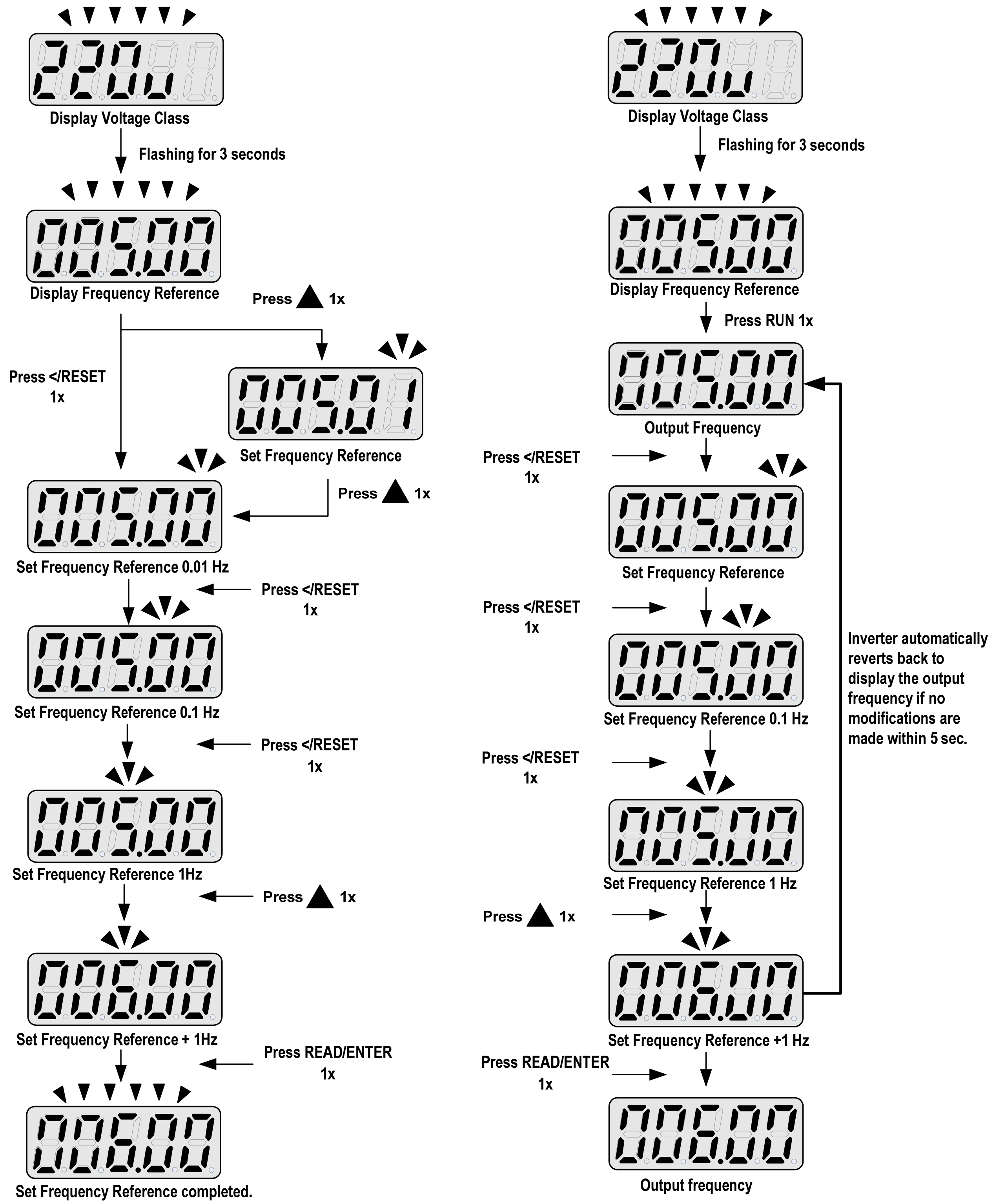
4.1.5 Modifying Parameters/ Set Frequency Reference

Example: Modifying Parameters



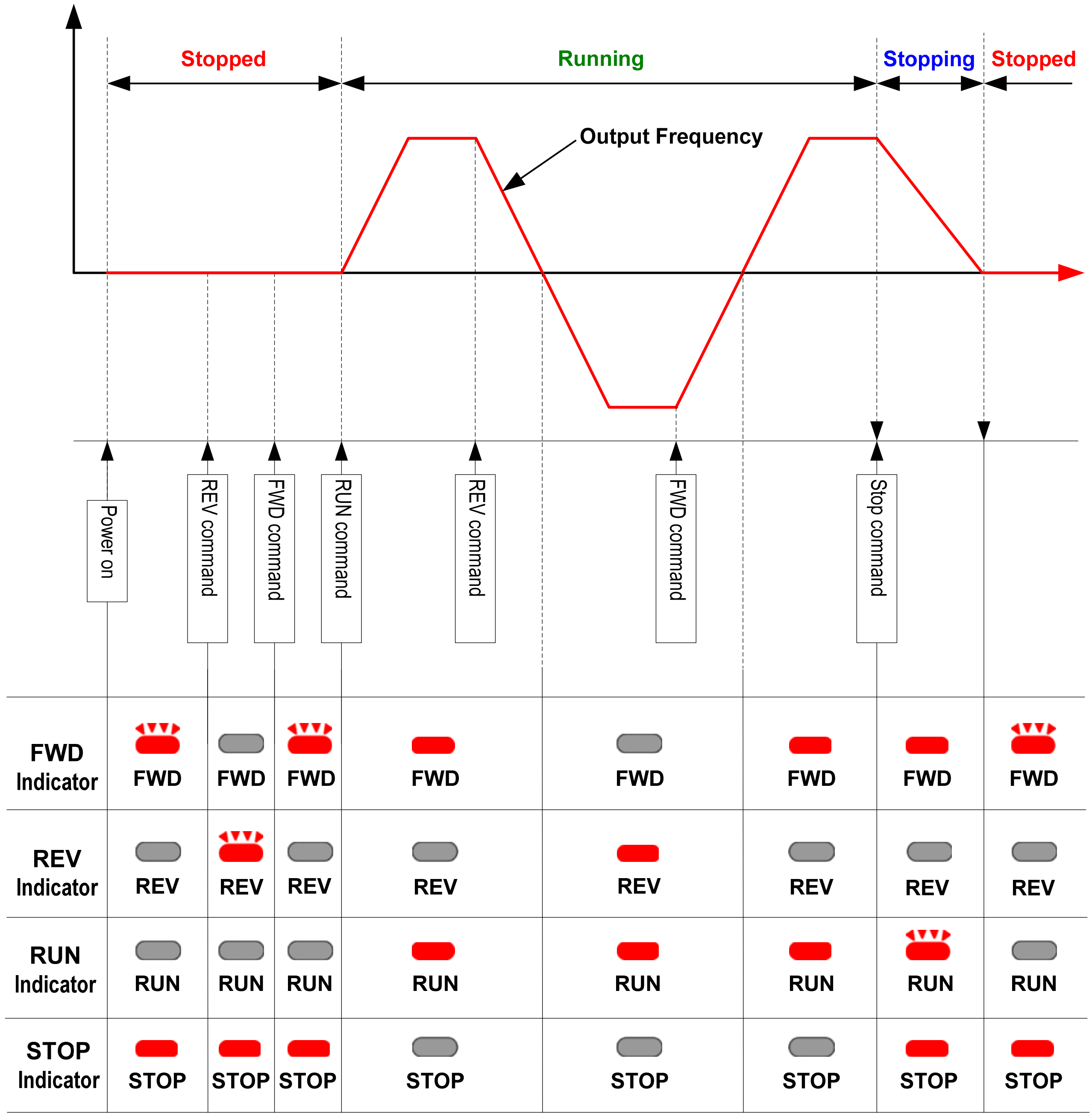
Example: Set Frequency Reference

Inverter stopped: **Inverter is running:**



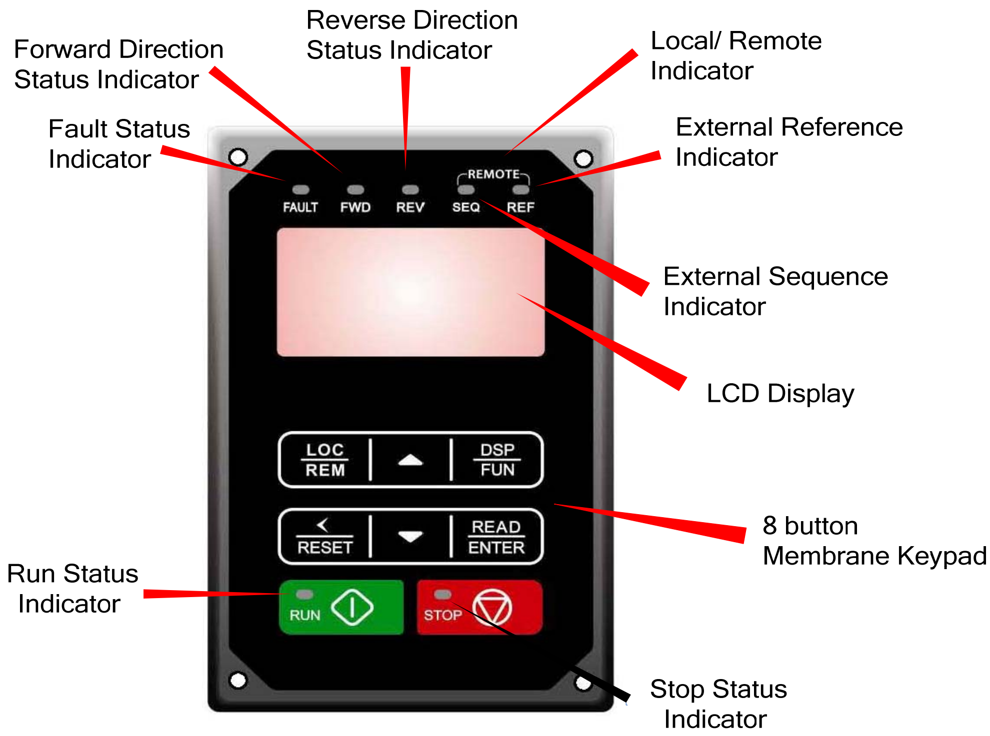
Note: When upper or lower limit is reached during editing of the frequency reference, the edit value will automatically rollover from the lower limit to the upper limit or from the upper limit to the lower limit.

4.1.6 Operation Control



4.2 LCD keypad

4.2.1 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	LED **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
STOP	STOP inverter
▲	Parameter navigation Up, Increase parameter or reference value
▼	Parameter navigation down, decrease parameter or reference value
LOC/REM	Used to switch between Local Mode and Remote Mode REMOTE Mode: Set by parameters, controlled by control circuit terminals, communication or other ways. LOCAL Mode: Controlled by operator. It displays REMOTE Mode at power-up. Users can switch between LOCAL and REMOTE Mode if they press LOC/ REM keys when the inverter stops. Parameter of 23-41 can determine if LOC/REM keys are enabled or not.
DSP/FUN	Used to scroll to next screen Frequence 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

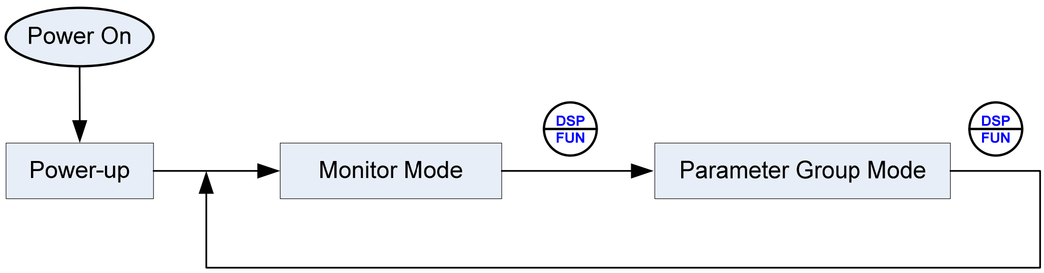
Holding the ▲UP or ▼DOWN key for a longer period of time will initiate the auto-repeat function resulting in the value of the selected digit to automatically increase or decrease.

Note: HOA LCD keypad is available with an optional accessory.

4.2.2 Keypad Menu Structure

◆ **Main Menu**

The F510 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. Refer to Figure 4.2.2.1.



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 to access its parameters.

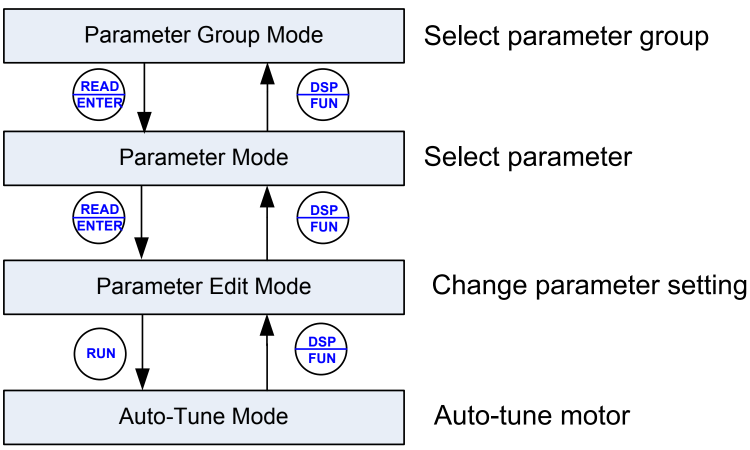


Fig. 4.2.2.1 Parameter Group Structure

Notes:

- Always perform auto-tune on the motor before operating the inverter in vector control (sensorless vector or flux 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 4.2.2.2 for keypad navigation.

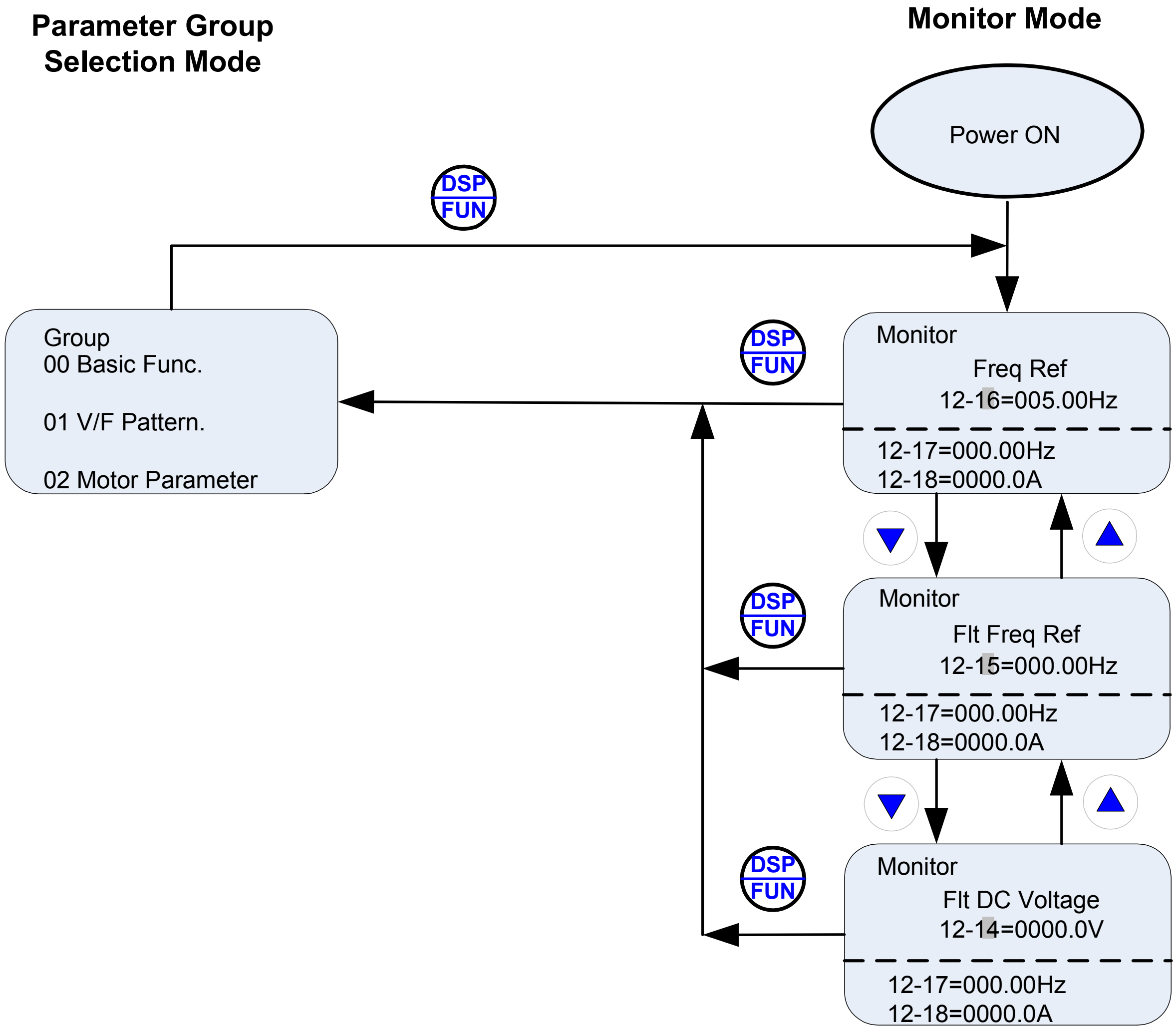


Fig 4.2.2.2 Monitor Mode

◆ **Programming Mode**

In programming mode inverter parameters can be read or changed. See Fig 4.2.2.3 for keypad navigation.

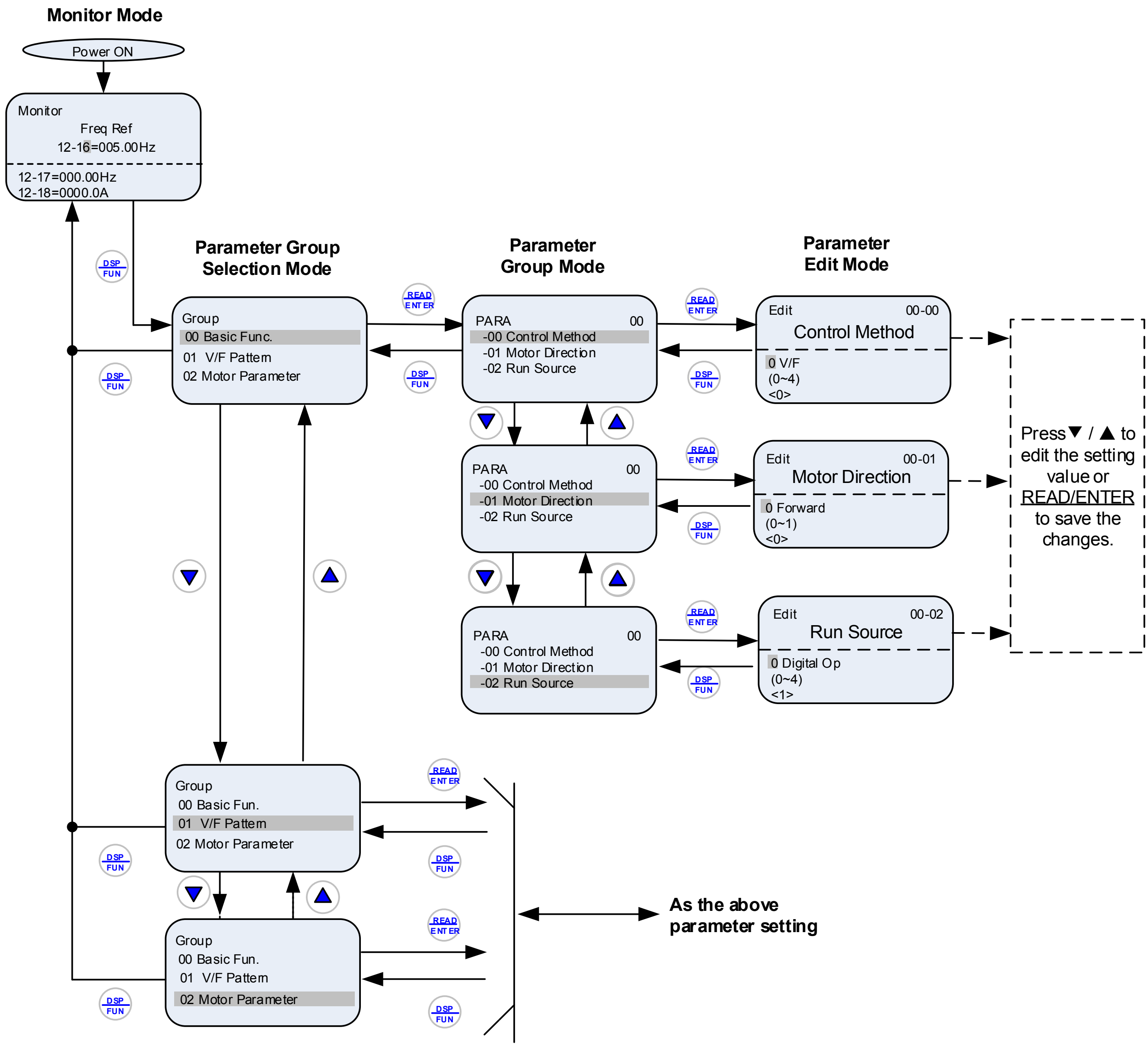


Fig 4.2.2.3 Programming Mode

Notes:

- **The parameters values can be changed from the data set/read screen with the ▲ (up) or ▼ (down) and < / RESET shift key.**
- **To save a parameter press the READ/ENTER key. Return to the previous sub-menu screen press DSP/FUN key.**
- **Press the ▲ (up) or ▼ (down) key to scroll parameter groups or parameter list. When pressing DSP/FUN in the parameter edit mode, it will return to the previous screen of parameter group mode; when pressing DSP/FUN in the parameter group mode, it will return to the previous screen of parameter group selection mode.**
- **Refer to section 4.4 for parameter details.**

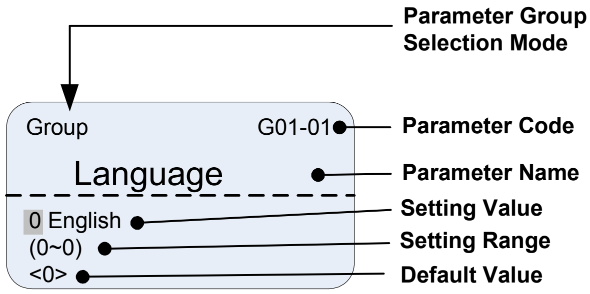


Fig 4.2.2.4 Parameter Group Selection Mode Screen

4.3 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

Parameter Attribute		
*1	Parameters can be changed during run operation	Note1: New added or modified parameters in V1.41 Note2: New added or modified parameters in V1.43 Note3: New added or modified parameters in V1.50 Note4: New added or modified parameters in V1.51 Note5: New added or modified parameters in V1.52 Note6: New added or modified parameters in V1.53 Note7: Parameter edit available for V1.53 above Note8: New added or modified parameters in V1.55 Note9: New added or modified parameters in V1.58
*2	Read-only parameters for communication	
*3	Parameter will not reset to default during a factory reset	
*4	Read-only parameter	
*5	Only displayed in using LED keypad	
*6 *7	Modified(*6) and New added (*7) parameters in software V1.4	
*8	The value will be modified depend on the setting of 13-08	
*9	For enhanced E type & G type only	
*10	Only available after I/O expansion card installed	

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	-	O	O	O	*3
		1: Reserved						
		2: SLV						
		3~4: Reserved						
		5: PM SLV						
00-01	Motor's Rotation Direction	0: Forward	0	-	O	O	O	*1
		1: Reverse						
00-02	Main Run Command Source Selection	0: Keypad	1	-	O	O	O	
		1: External Terminal (Control Circuit)						
		2: Communication Control (RS-485)						
		3: PLC						
		4: RTC						
00-03	Alternative Run Command Source Selection	0: Keypad	0	-	O	O	O	
		1: External Terminal (Control Circuit)						
		2: Communication Control (RS-485)						
		3: PLC						
		4: RTC						
00-04	Language Selection (for LCD only)	0: English	0	-	O	O	O	
		1: Simple Chinese						
		2: Traditional Chinese						
		3: Turkish						
00-05	Main Frequency Command Source Selection	0: Keypad	1	-	O	O	O	
		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	-	O	O	O	
		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	-	O	O	O	
		1: Main Frequency + Alternative Frequency						
00-08	Communication Frequency Command Range	0.00-599.00 (Note8)	0.00	Hz	O	O	O	
00-09	Communication Frequency Command Memory Selection	0: Do not save when power is off.	0	-	O	O	O	
		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	-	O	O	O	Note2
00-11	Selection of PID Lower Limit Frequency	0: PID is bound to lower limit frequency when inverter sleeps. 1: PID is bound to 0Hz when inverter sleeps.	0	-	O	O	O	Note1
00-12	Upper Limit Frequency	0.1~109.0	100.0	%	O	O	O	
00-13	Lower Limit Frequency	0.0~109.0	0.0	%	O	O	O	
00-14	Acceleration Time 1	0.1~6000.0	-	s	O	O	O	*1
00-15	Deceleration Time 1	0.1~6000.0	-	s	O	O	O	*1
00-16	Acceleration Time 2	0.1~6000.0	-	s	O	O	O	*1
00-17	Deceleration Time 2	0.1~6000.0	-	s	O	O	O	*1
00-18	Jog Frequency	0.00~599.00 (Note8)	6.00	Hz	O	O	O	*1
00-19	Jog Acceleration Time	0.1~0600.0	-	s	O	O	O	*1
00-20	Jog Deceleration Time	0.1~0600.0	-	s	O	O	O	*1
00-21	Acceleration Time 3	0.1~6000.0	-	s	O	O	O	*1
00-22	Deceleration Time 3	0.1~6000.0	-	s	O	O	O	*1
00-23	Acceleration Time 4	0.1~6000.0	-	s	O	O	O	*1
00-24	Deceleration Time 4	0.1~6000.0	-	s	O	O	O	*1
00-25	Switch-Over Frequency of Acc/Dec Time 1 and Time 4	0.0~599.00 (Note8)	0.0	Hz	O	O	O	
00-26	Emergency Stop Time	0.1~6000.0	5.0	s	O	O	O	
00-27	Reserved							
00-28	Main Frequency Command Characteristic Selection	0: Positive Characteristic (0~10V/4~20mA is corresponding to 0~100%) 1: Negative Characteristic (0~10V/4~20mA is corresponding to 100~0%)	0	-	O	O	O	
00-29 ~ 00-31	Reserved							
00-32	Application Selection Presets	0: General 1: Water Supply Pump 2: Conveyor *7 3: Exhaust fan 4: HVAC 5: Compressor *7 6: Reserved 7: Reserved	0	-	O	O	O	
00-33	Modified Parameters (only for LCD)	0: Enable 1: Disable	0	-	O	O	O	
00-34 ~ 00-40	Reserved							

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: 00-01 ~24-17, but except 00-41~00-56 and group 17 (only used in LCD keypad)	-		O	O	O	
00-42	User Parameter 1		-		O	O	O	
00-43	User Parameter 2		-		O	O	O	
00-44	User Parameter 3		-		O	O	O	
00-45	User Parameter 4		-		O	O	O	
00-46	User Parameter 5		-		O	O	O	
00-47	User Parameter 6		-		O	O	O	
00-48	User Parameter 7		-		O	O	O	
00-49	User Parameter 8		-		O	O	O	
00-50	User Parameter 9		-		O	O	O	
00-51	User Parameter 10		-		O	O	O	
00-52	User Parameter 11		-		O	O	O	
00-53	User Parameter 12		-		O	O	O	
00-54	User Parameter 13		-		O	O	O	
00-55	User Parameter 14		-		O	O	O	
00-56	User Parameter 15		-		O	O	O	

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	4.8~599.00 (Note8)	50.0/ 60.0	Hz	O	O	O	*6*8
01-03	Maximum Output Voltage	200V: 0.1~255.0	-	V	O	X	X	*8
		400V: 0.2~510.0	-					
01-04	Middle Output Frequency 2	0.0~599.00 (Note8)	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	0.0~599.00 (Note8)	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	0.0~599.00 (Note8)	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	Note1
		1: Torque Compensation Mode 1						
01-12	Base Frequency	4.8~599.00 (Note8)	50.0/ 60.0	Hz	O	O	O	*8
01-13	Base Output Voltage	200V: 0.0~255.0	-	V	O	X	X	*8
		400V: 0.0~510.0	-					
01-14	Input Voltage Setting	200V: 155.0~255.0	-	V	O	O	O	*8
		400V: 310.0~510.0	-					
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	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	-	V	O	O	X	*8
		400V: 100.0~480.0	-					
02-05	Rated Power	0.01~600.00	KVA	kW	O	O	X	
02-06	Rated Frequency	4.8~599.00 (Note8)	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	
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)			O	O	O	
03-01	Multi-function Terminal Function Setting-S2	2: Multi-Speed Setting Command 1	1		O	O	O	
		3: Multi-Speed Setting Command 2			O	O	O	
		4: Multi-Speed Setting Command 3			O	O	O	
03-02	Multi-function Terminal Function Setting-S3	5: Multi-Speed Setting Command 4	2		O	O	O	*6
		6: Forward Jog Run Command			O	O	O	
03-03	Multi-function Terminal Function Setting-S4	7: Reverse Jog Run Command	3		O	O	O	*6
		8: UP Frequency Increasing Command			O	O	O	
03-04	Multi-function Terminal Function Setting-S5	9: DOWN Frequency Decreasing Command	4		O	O	O	*6
		10: Acceleration/ Deceleration Setting Command 1			O	O	O	
		11: Acceleration/ Deceleration Inhibition Command			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	
03-05	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			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			-	-	-	
		33: DC Braking			O	X	X	
		34: Speed Search 2 (from Frequency Command)			O	X	O	
		35: Timing Function Input			O	O	O	
		36: PID Soft Start Disable						
		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)			O	O	O	
		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			-	-	-	

Group 03 External Digital Input and Output Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
		65: Short-circuit braking			X	X	O	
		66~67: Reserved			-	-	-	
		68: Ext. Fault 2 (Note6)			O	O	O	
		69: Ext. Overload (Note6)			O	O	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 xx0xb:S2 A Contact xx1xb:S2 B Contact x0xxb:S3 A Contact x1xxb:S3 B Contact 0xxxb:S4 A Contact 1xxxb:S4 B Contact	0000b	-	O	O	O	
03-10	Multi-Function Terminal (S5-S6 Selection)	xxx0b:S5 A Contact xxx1b:S5 B Contact xx0xb:S6 A Contact xx1xb:S6 B Contact x0xxb: Reserved x1xxb: Reserved 0xxxb: Reserved 1xxxb: Reserved	0000b	-	O	O	O	
03-11	Relay (R1A-R1C) Output	0: During Running 1: Fault Contact Output 2: Frequency Agree	1	-	O	O	O	*6
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)			O	O	O	
		5: Frequency Detection 2 (＜03-13+03-14)			O	O	O	
		6: Automatic Restart			O	O	O	
		7~8: Reserved			-	-	-	
		9: Baseblock			O	O	O	
		10~11: Reserved			-	-	-	
		12: Over-Torque Detection 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 24: Source of Frequency Command 25: Low Torque Detection 26: Frequency Reference Missing 27: Timing Function Output			O	O	O	
		28~31: Reserved			-	-	-	

Group 03 External Digital Input and Output Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		32: Communication Control Contacts			O	O	O	
		33: RTC Timer 1			O	O	O	
		34: RTC Timer 2			O	O	O	
		35: RTC Timer 3			O	O	O	
		36: RTC Timer 4			O	O	O	
		37: Detection Output of PID Feedback Loss *7			O	O	O	
		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	
		58: Frequency Deceleration Detection Note5			O	O	O	
		59: Over Temperature Detection Note6			O	O	O	
03-13	Frequency Detection Level	0.0~599.00 (Note8)	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 Detection	0.1~10.0	0.1	s	X	O	X	*7
03-17	Setting of Mechanical Brake Release Level Note1	0.00~599.00 (Note8)	0.00	Hz	O	O	O	
03-18	Setting of Mechanical Brake Operation Level Note1	0.00~599.00 (Note8)	0.00	Hz	O	O	O	
03-19	Relay(R1A-R3C)Type	xxx0b: R1 A Contact xxx1b: R1 B Contact xx0xb: R2 A Contact xx1xb: R2 B Contact x0xxb: R3 A Contact x1xxb: R3 B Contact 0xxxb: R4 A Contact 1xxxb: R4 B Contact	0000b	-	O	O	O	*10 (0xxxb/1xxxb only)
03-20	Relay (R4A-R4C) Output	Range and definition are the same as those of 03-11, 03-12	2	-	O	O	O	*10
03-21	Photo-coupler Output Selection (DO2-DOG)	Range and definition are the same as those of 03-11, 03-12	3	-	O	O	O	*10

Group 03 External Digital Input and Output Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
03-22 ~ 03-26	Reserved							
03-27	UP/DOWN Frequency Hold/ Adjust Selection	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.	0	-	O	O	O	
03-28	Reserved							
03-29	Photo-coupler Output Selection (DO2-DOG)	xx0xb: Photo-coupler 2 A Contact xx1xb: Photo-coupler 2 B Contact	0000b	-	O	O	O	*10
03-30	Pulse Input Selection	0: Common Pulse Input 1: PWM (Pulse Width Modulation)	0	-	O	O	O	*7
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 1: Acceleration/ Deceleration Time 2	0	-	O	O	O	Note1
03-44	Frequency Detection Level 2	0.0~599.00 (Note8)	0.0	Hz	O	O	O	Note2
03-45	Frequency Detection Width 2	0.1~25.5	2.0	Hz	O	O	O	Note2
03-46	Frequency Detection Level 3	0.0~599.00 (Note8)	0.0	Hz	O	O	O	Note2
03-47	Frequency Detection Width 3	0.1~25.5	2.0	Hz	O	O	O	Note2
03-48	Low Current Detection Level	0.0~999.9	0.1	A	O	O	O	Note3
03-49	Low Current Detection Delay Time	0.00~655.34 (Note6)	0.01	Sec	O	O	O	Note3
03-50	Frequency Detection Level 4	0.0~599.00 (Note8)	0.0	Hz	O	O	O	Note4
03-51	Frequency Detection Level 5	0.0~599.00 (Note8)	0.0	Hz	O	O	O	Note4
03-52	Frequency Detection Level 6	0.0~599.00 (Note8)	0.0	Hz	O	O	O	Note4
03-53	Current Agree Level 2	0.0~999.9	0.0	A	O	O	O	Note6

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: AI1: 0~10V AI2: 0~10V	1	-	O	O	O	
		1: AI1: 0~10V AI2: 4~20mA						
		2: Reserved						
		3: Reserved						
		4: AI1: 4~20mA AI2: 0~10V						*9
		5: AI1: 4~20mA AI2: 4~20mA						*9
04-01	AI1 Signal Scanning and Filtering Time	0.00~2.00	0.03	s	O	O	O	
04-02	AI1 Gain	0.0~1000.0	100.0	%	O	O	O	*1
04-03	AI1 Bias	-100.0~100.0	0	%	O	O	O	*1
04-04	Negative AI	0: Disable 1: Enable	0	-	O	O	O	Note6
04-05	AI2 Function Setting	0: Auxiliary Frequency	0	-	O	O	O	
		1: Frequency Reference Gain			O	O	O	
		2: Frequency Reference Bias			O	O	O	
		3: Output Voltage Bias			O	X	O	
		4: Coefficient of Acceleration and Deceleration Reduction			O	O	O	
		5: DC Braking Current			O	O	X	
		6: Over-Torque Detection Level			O	O	O	
		7: Stall Prevention Level During Running			O	X	X	
		8: Frequency Lower Limit			O	O	O	
		9: Jump Frequency 4			O	O	O	
		10: Added to AI1			O	O	O	
		11: Positive Torque Limit			X	O	O	
		12: Negative Torque Limit			X	O	O	
		13: Regenerative Torque Limit			X	O	O	
		14: Positive / Negative Torque Limit			X	O	O	
		15: Reserved			-	-	-	
		16: Torque Compensation			X	O	X	
		17: Reserved			-	-	-	
04-06	AI2 Signal Scanning and Filtering Time	0.00~2.00	0.03	s	O	O	O	
04-07	AI2 Gain	0.0~1000.0	100.0	%	O	O	O	*1
04-08	AI2 Bias	-100.0~100.0	0	%	O	O	O	*1
04-09	AI Input Signal Type of I/O card	0: AI3:0~10V 1: AI3:-10~10V 2: AI3:4~20mA	0	-	O	O	O	*10
04-10	AI3 Function Setting	Range and definition are the same as those of 04-05	10	-	O	O	O	*10

Group 04 External Analog Input and Output Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
04-11	AO1 Function Setting	0: Output Frequency	0	-	O	O	O	
		1: Frequency Command			O	O	O	
		2: Output Voltage			O	O	O	
		3: DC Voltage			O	O	O	
		4: Output Current			O	O	O	
		5: Output Power			O	O	O	
		6: Motor Speed			O	O	O	
		7: Output Power Factor			O	O	O	
		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	
		26~27: 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
04-21	AI3 Signal Scanning and Filtering Time	0.00~2.00	0.03	s	O	O	O	*10
04-22	AI3 Gain	0.0~1000.0	100.0	%	O	O	O	*10
04-23	AI3 Bias	-100.0~100.0	0	%	O	O	O	*10

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 1: Acceleration and Deceleration Time are set by 05-17 ~ 05-48	0	-	O	O	O	
05-01	Frequency Setting of Speed-Stage 0	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*1
05-02	Frequency Setting of Speed-Stage 1	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-03	Frequency Setting of Speed-Stage 2	0.00~599.00 (Note8)	10.00	Hz	O	O	O	*7
05-04	Frequency Setting of Speed-Stage 3	0.00~599.00 (Note8)	20.00	Hz	O	O	O	*7
05-05	Frequency Setting of Speed-Stage 4	0.00~599.00 (Note8)	30.00	Hz	O	O	O	*7
05-06	Frequency Setting of Speed-Stage 5	0.00~599.00 (Note8)	40.00	Hz	O	O	O	*7
05-07	Frequency Setting of Speed-Stage 6	0.00~599.00 (Note8)	50.00	Hz	O	O	O	*7
05-08	Frequency Setting of Speed-Stage 7	0.00~599.00 (Note8)	50.00	Hz	O	O	O	*7
05-09	Frequency Setting of Speed-Stage 8	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-10	Frequency Setting of Speed-Stage 9	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-11	Frequency Setting of Speed-Stage 10	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-12	Frequency Setting of Speed-Stage 11	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-13	Frequency Setting of Speed-Stage 12	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-14	Frequency Setting of Speed-Stage 13	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-15	Frequency Setting of Speed-Stage 14	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-16	Frequency Setting of Speed-Stage 15	0.00~599.00 (Note8)	5.00	Hz	O	O	O	*7
05-17	Acceleration Time Setting of Multi Speed 0	0.1~6000.0	10.0	s	O	O	O	
05-18	Deceleration Time Setting of Multi Speed 0	0.1~6000.0	10.0	s	O	O	O	
05-19	Acceleration Time Setting of Multi Speed 1	0.1~6000.0	10.0	s	O	O	O	
05-20	Deceleration Time Setting of Multi Speed 1	0.1~6000.0	10.0	s	O	O	O	
05-21	Acceleration Time Setting of Multi Speed 2	0.1~6000.0	10.0	s	O	O	O	

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

Group 05 Multi-Speed Function Group								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
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 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.	0	-	O	O	X	
06-01	Frequency Setting of Operation-Stage 1	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-02	Frequency Setting of Operation -Stage 2	0.00~599.00 (Note8)	10.00	Hz	O	O	X	*1
06-03	Frequency Setting of Operation -Stage 3	0.00~599.00 (Note8)	20.00	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	
06-04	Frequency Setting of Operation -Stage 4	0.00~599.00 (Note8)	30.00	Hz	O	O	X	*1
06-05	Frequency Setting of Operation -Stage 5	0.00~599.00 (Note8)	40.00	Hz	O	O	X	*1
06-06	Frequency Setting of Operation -Stage 6	0.00~599.00 (Note8)	50.00	Hz	O	O	X	*1
06-07	Frequency Setting of Operation -Stage 7	0.00~599.00 (Note8)	50.00	Hz	O	O	X	*1
06-08	Frequency Setting of Operation -Stage 8	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-09	Frequency Setting of Operation -Stage 9	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-10	Frequency Setting of Operation -Stage 10	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-11	Frequency Setting of Operation -Stage 11	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-12	Frequency Setting of Operation -Stage 12	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-13	Frequency Setting of Operation -Stage 13	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-14	Frequency Setting of Operation -Stage 14	0.00~599.00 (Note8)	5.00	Hz	O	O	X	*1
06-15	Frequency Setting of Operation -Stage 15	0.00~599.00 (Note8)	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

Group 06 Automatic Program Operation Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
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 -Stage 15	0.0~6000.0	0.0	s	O	O	X	*1
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 1: Enable	0	-	O	O	O	
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: When the external run command is enabled, unable to direct start at power-up.	1	-	O	O	O	
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			O	O	O	
		2: DC Braking Stop			O	O	X	
		3: Coast to Stop with Timer			O	O	O	
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 Search Selection	0: Disable 1: Enable	1	-	O	O	X	
07-25	Low voltage Detection Time	0.00~1.00	0.02	Sec	O	O	O	

Group 07: Start /Stop Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	Control Mode SLV	Control Mode PM SLV	Attribute
07-26	SLV Speed Search Function	0: Enable 1: Disable	0	-	X	O	X	
07-27	Start Selection after Fault during SLV Mode	0: Speed search start 1: Normal Start	0	-	X	O	X	
07-28	Start Selection after External Base Block	0: Speed search start 1: Normal Start	0	-	X	O	X	
07-29	Run Command Available during DC Braking	0: Disable (Run command isn't available until the DC braking is completely done) 1: Enable	0	-	O	X	X	Note1
07-30 07-31	Reserved							
07-32	Speed Search Mode Selection	0: Disable 1: Mode1: Start a Speed Search at Power on 2: Mode 2: Start Speed Search upon the Motor Run	0		O	O	O	Note2
07-33	Start Frequency of Speed Search Selection	0: Maximum Output Frequency of Motor 1: Frequency Command	0		O	O	X	Note2
07-34	Short-circuit Braking Time at Start	0.00~100.00	0	Sec	X	X	O	Note2
07-35	Short-circuit Braking Time at Stop	0.00~100.00	0.5	Sec	X	X	O	Note2
07-36	Short-circuit Braking Current Limited Level	0.0~200.0	100	%	X	X	O	Note2
07-42	Voltage limit gain	0.0~50.0	0	%	X	O	X	Note3
07-43	Short-circuit Braking Time of PM Motor Speed Search	0.00~100.00	0.00	Sec	X	X	O	Note4
07-44	DC Braking Time of PM Motor Speed Search	0.00~100.00	0.00	Sec	X	X	O	Note4
07-45	STP2 Function Selection	0:STP2 Enable 1:STP2 Disable	0	-	O	O	O	Note6
07-47	PM Speed Switching Frequency Mode	0: Disabled 1: Mode 1 2: Mode 2	0	-	X	X	O	Note9

Group 08 Protection Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	Control Mode SLV	Control Mode PM SLV	Attribute
08-00	Stall Prevention Function	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	0000b	-	O	O	O	
08-01	Stall Prevention Level in Acceleration	20~200	120	%	O	O	O	
08-02	Stall Prevention Level in Deceleration	200V: 330~410 400V: 660~820	385 770	V	O	O	O	
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 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	0001b	-	O	O	O	
08-06	Start-up Mode of Overload Protection Operation (OL1)	0: Stop Output after Overload Protection 1: Continuous Operation after Overload Protection.	0	-	O	O	O	
08-07	Motor Overload (OL1) Protection Level	0: Motor overload (OL1) Protection 0 1: Motor overload (OL1) Protection 1 2: Motor overload (OL1) Protection 2	0	-	O	O	O	Note3

Group 08 Protection Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
08-08	Automatic Voltage Regulation (AVR)	0: Enable 1: Disable	0	-	O	O	O	
08-09	Selection of Input Phase Loss Protection	0: Disable 1: Enable	0	-	O	O	O	
08-10	Selection of Output Phase Loss Protection	0: Disable 1: Enable	0	-	O	O	O	
08-11 08-12	Reserved							
08-13	Selection of Over-Torque Detection	0: Over-Torque Detection is Disabled. 1: Start to Detect when Reaching the Set Frequency. 2: Start to Detect when the Operation is Begun.	0	-	O	O	O	
08-14	Selection of Over-Torque Operation	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	0	-	O	O	O	
08-15	Level of Over-Torque Detection	0~300	150	%	O	O	O	
08-16	Time of Over-Torque Detection	0.0~10.0	0.1	Sec	O	O	O	
08-17	Selection of Low-Torque Detection	0: Low-Torque Detection is Disabled. 1: Start to Detect when Reaching the Set Frequency. 2: Start to Detect when the Operation is Begun.	0	-	O	O	O	
08-18	Selection of Low-Torque Operation	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	0	-	O	O	O	
08-19	Level of Low-Torque Detection	0~300	30	%	O	O	O	
08-20	Time of Low-Torque Detection	0.0~10.0	0.1	Sec	O	O	O	
08-21	Limit of Stall Prevention in Acc over Base Speed	1~100	50	%	O	O	O	
08-22	Stall Prevention Detection Time in Operation	2~100	100	ms	O	O	O	
08-23	Ground Fault (GF) Selection	0: Disable 1: Enable	0	-	O	O	O	

Group 08 Protection Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
08-24	Operation Selection of External Fault	0: Deceleration to Stop 1: Coast to Stop 2: Continuous Operation	0	-	O	O	O	
08-25	Detection selection of External Fault	0: Immediately Detect when the Power is Supplied. 1: Start to Detect during Operation	0	-	O	O	O	
08-26 ~ 08-29	Reserved							
08-30	Selection of Run Permissive Function	0: Deceleration to Stop 1: Coast to Stop	0	-	O	O	O	
08-31 ~ 08-34	Reserved							
08-35	Fault Selection of Motor Overheat	0: Disable 1: Deceleration to Stop 2: Coast to Stop	0	-	O	O	O	
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 1: Permanent Start 2: Start at High Temperature	0	-	O	O	O	
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	Note1
08-43	PTC Reset Level	0.1~10.0	0.3	V	O	O	O	Note1
08-45	PTC Disconnection Detection	0: Disable 1: Warning 2: Fault	0	-	O	O	O	Note3
08-46	Temperature Agree Level	0~254°C	0	°C	O	O	O	Note6
08-47	Temperature Reset Level	0~254°C	0	°C	O	O	O	Note6
08-48	Selection of Fire Mode	0: Disable 1: Enable	0	-	O	O	O	Note6
08-49	Multi-Function Input Terminal Status of Fire Mode	0：Reset after Power Off 1：Reset after Terminal Removed	0	-	O	O	O	Note6
08-50	Multi-Function Terminal Status of Fire Mode	XXX0b: S6 A contact XXX1b: S6 B contact	0000b	-	O	O	O	Note6
08-51	Motor Speed Setting Source of Fire Mode	0：Fire Mode Speed(08-52) 1：PID Control 2：AI2	0	-	O	O	O	Note6
08-52	Motor Speed of Fire Mode	0.00~100.00	100.00	%	O	O	O	Note6
08-53	PID Detection Level of Fire Mode	0~100	0	%	O	O	O	Note6
08-54	Delay Time of Fire Mode PID Loss	0.0~10.0	1.0	s	O	O	O	Note6
08-55	PID Feedback Loss Detection	0：Keep Running	1	-	O	O	O	Note6

Group 08 Protection Parameters								
Code	**Parameter Name**	**Setting Range**	**Default**	**Unit**	**Control Mode**			**Attribute**
					V/F	**SLV**	**PM SLV**	
	Selection of Fire Mode	1：Fire Mode Speed (08-52) 2：Maximum Output Frequency (01-02)						
08-56	Detection Level of Fire Mode AI2 Signal	0.0~100	80.0	%	O	O	O	Note6
08-57	Delay Time of Fire Mode AI2 Signal Loss	0.0~10.0	1.0	s	O	O	O	Note6
08-58	Selection of Fire Mode AI2 Signal Loss	0：Keep Running 1：Fire Mode Speed (08-52) 2：Maximum Output Frequency (01-02)	1	-	O	O	O	Note6
08-59	Fire Mode Motor Direction	0：Forward 1：Reverse	0	-	O	O	O	Note6
08-60	Fire Mode Password	00000~65534	0	-	O	O	O	Note6

Note: 1. Standard H & C type, IP20 frame 6~9 do not have 08-37 function.

2. Enhanced E & G type, IP20 frame 6~8 do not have "Start at High Temperature" function.(08-37=2)

3. Enhanced E & G type, IP20 frame 9 do not have 08-37 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 1: BACNET 2: METASYS 3: PUMP in Parallel Connection	0	-	O	O	O	
09-02	Baud Rate Setting (bps)	0:1200 1:2400 2:4800 3:9600 4:19200 5:38400	4	-	O	O	O	*2 *6
09-03	Stop Bit Selection	0:1 Stop Bit 1: 2 Stop Bit	0	-	O	O	O	*2
09-04	Parity Selection	0: No Parity 1: Even Bit 2: Odd Bit	0	-	O	O	O	*2
09-05	Communications Data Bits Selection	0: 8 bits data 1: 7 bits data	0	-	O	O	O	Note1
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	3	-	O	O	O	

Group 09: Communication Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		Deceleration Time 1 when Communication Fault Occurs.						
		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 parameter 13-08 (initialization).

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: AI1 Given 2: AI2 Given 3: Reserved 4: 10-02 Given 5: Reserved [Note] 6: Frequency Command (00-05) [Note] 7: Multi-speed Frequency Command [Note4]	1	-	O	O	O	
10-01	PID Feedback Value Source Setting	1: AI1 Given 2: AI2 Given 3: Reserved 4: AI1 - AI2 Given	2	-	O	O	O	
10-02	PID Target Value	0.0~100.0	0.0	%	O	O	O	
10-03	PID Control Mode	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	0000b	-	O	O	O	

Group 10: PID Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		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 1: Warning 2: Fault	0	-	O	O	O	
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							
10-17	Start Frequency of PID Sleep	0.00~599.00 (Note8)	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	0.00~599.00 (Note8)	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	0.00~599.00 (Note8)	0.00	Hz	O	O	O	Note2
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 1: Allow Reversal Output	0	-	O	O	O	
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: Enable 2: Set by DI	1	-	O	O	O	
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 1: PID2 2: Set by DI 3: Switch to PID2 when RTC Timer Enables	0		O	O	O	
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

Group 10: PID Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		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						
		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	00.00~599.00 (Note8)	30.00	Hz	O	O	O	*6
10-40	Compensation Frequency Selection of PID Sleep	0: Disable 1: Enable	0	-	O	O	O	Note1
10-41 ~ 10-43	Reserved							
10-44	Precharge Frequency	0.0~120.0	0	Hz	O	O	O	Note3
10-45	Precharge Time	0~250	0	Sec	O	O	O	Note3
10-46	Precharge Target Level	0~10000	0	-	O	O	O	Note3
10-47	Proportional Gain 3(P)	0.00~10.00	3.00		O	O	O	Note6
10-48	Integral Time 3(I)	0.00~100.00	0.50	Sec	O	O	O	Note6
10-49	Differential Time 3(D)	0.00~10.00	0.00	Sec	O	O	O	Note6

Group 11: Auxiliary Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
11-00	Direction Lock Selection	0: Allow Forward and Reverse Rotation 1: Only Allow Forward Rotation 2: Only Allow Reverse Rotation	1	-	O	O	O	
11-01	Carrier Frequency	0: Carrier Output Frequency Tuning 1: 1~16: 1~16KHz	KVA*a	-	O	O	O	
11-02	Soft PWM Function Selection	0: Disable 1: Soft PWM Function 1 2: Soft PWM Function 2	1(V/f) 0(SLV&PMSLV)	-	O	O	O	
11-03	Automatic carrier lowering selection	0: Disable 1: Enable	0	-	O	X	X	
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 End of Acceleration	0.00~2.50	0.20	s	O	O	O	
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	0.0~599.00 (Note8)	0.0	Hz	O	O	O	
11-09	Jump Frequency 2	0.0~599.00 (Note8)	0.0	Hz	O	O	O	
11-10	Jump Frequency 3	0.0~599.00 (Note8)	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	0.00~599.00 (Note8)	0.00	Hz	O	X	X	
11-19	Automatic Energy Saving Function	0: Disabled 1: Enabled	0	-	O	X	X	
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	Note4

Group 11: Auxiliary Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
11-29	Auto De-rating Selection	0: Disable 1: Enable	0	-	O	X	X	
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	Note4 *1
11-34	Fall Amount of DC Voltage Filter	0.1~10.0	5.0	Vdc	O	X	X	Note4 *1
11-35	Dead band Level of DC Voltage Filter	0.0~99.0	10.0	Vdc	O	X	X	Note4 *1
11-36	Frequency Gain of OV Prevention	0.000~1.000	0.050	-	O	X	X	Note2 *1
11-37	Frequency Limit of OV Prevention	0.00~599.00 (Note8)	5.00	Hz	O	X	X	Note2
11-38	Deceleration Start Voltage of OV Prevention	200V: 200~400V 400V: 400~800V	200V: 300 400V: 700	V	O	X	X	Note2
11-39	Deceleration Stop Voltage of OV Prevention	200V: 300~400V 400V: 600~800V	220V: 350 440V: 750	V	O	X	X	Note2
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	Note2
11-41	Reference Frequency Loss Detection	0: Deceleration to Stop when Reference Frequency Disappears 1: Operation is Set by 11-42 when Reference Frequency Disappears	0	-	O	O	O	
11-42	Reference Frequency Loss Level	0.0~100.0	80.0	%	O	O	O	
11-43	Hold Frequency at Start	0.0~599.00 (Note8)	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	0.0~599.00 (Note8)	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 400V: 380~420	200 400	V	O	X	X	

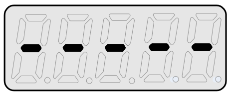
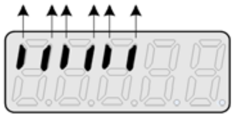
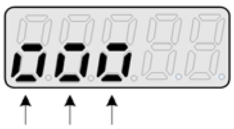
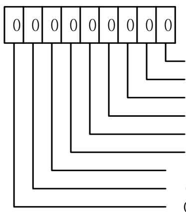
Group 11: Auxiliary Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
11-49 11-50	Reserved							
11-51	Braking Selection of Zero Speed	0: Disable 1: Enable	0	-	O	X	X	
11-52 11-53	Reserved							
11-54	Initialization of Cumulative Energy	0: Do not Clear Cumulative Energy 1: Clear Cumulative Energy	0	-	O	O	O	*1
11-55	STOP Key Selection	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.	1	-	O	O	O	
11-56	UP/DOWN Selection	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.	0	-	O	O	O	
11-57	Reserved							
11-58	Record Reference Frequency	0: Disable 1: Enable	0	-	O	O	O	*1
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: Enable	1		X	O	X	**Note1**
11-64	Acceleration Speed Gain Adjustment	0.1~10.0	1.0	-	O	X	X	**Note3**
11-65	Target Main Circuit Voltage	200V: 200V~400V 400V: 400V~800V	370 740	-	O	X	X	**Note3**
11-66	2 Phase/ 3 Phase PWM Switch Frequency	6.00~60.00	20	Hz	O	O	O	**Note3**
11-67	Detection Range at Soft PWM Function 2	0~12000	0	Hz	X	O	O	**Note3**
11-68	Detecting Start Frequency at Soft PWM Function 2	6.00~60.00	20	Hz	X	O	O	**Note3**
11-69	Gain of Preventing Oscillation 3	0.00~200.00	5.00	%	O	X	X	**Note2**

Group 11: Auxiliary Parameters								
Code	**Parameter Name**	**Setting Range**	**Default**	**Unit**	**Control Mode**			**Attribute**
					V/F	**SLV**	**PM SLV**	
11-70	Upper Limit of Preventing Oscillation 3	0.01~100.00	5.00	%	O	X	X	**Note2**
11-71	Time Parameter of Preventing Oscillation 3	0~30000	100	ms	O	X	X	**Note2**
11-72	Switch Frequency 1 for Preventing Oscillation Gain	0.01~300.00	30.00	Hz	O	X	X	**Note2**
11-73	Switch Frequency 2 for Preventing Oscillation Gain	0.01~300.00	50.00	Hz	O	X	X	**Note2**

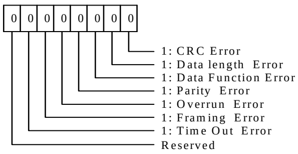
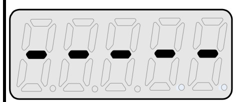
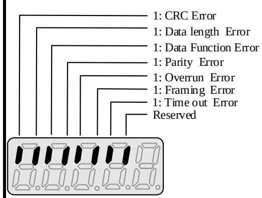
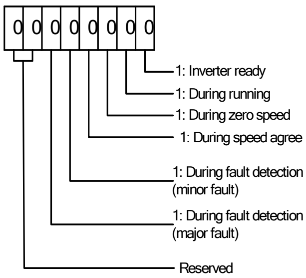
***a: KVA means the default value of this parameter will be changed by different capacities of inverter.**

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	-	O	O	O	*1 *5
12-01	PID Feedback Display Mode (LED)	0: Display the Feedback Value by Integer (xxx) 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)	0		O	O	O	*5
12-02	PID Feedback Display Unit Setting (LED)	0: xxxxx (no unit) 1: xxxPb (pressure) 2: xxxFL (flow)	0		O	O	O	*5
12-03	Line Speed Display (LED)	0~60000	1500/ 1800	RPM	O	O	O	*5
12-04	Line Speed Display Mode (LED)	0: Display Inverter Output Frequency 1: Line Speed Display at Integer.(xxxxx) 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)	0		O	O	O	*1 *5

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)	LED display is shown as below no input  correspondences to input and output   LCD display is shown as below  	-	-	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	
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	

Group 12: Monitoring Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
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.	-	℃	O	O	O	
12-42	RS-485 Error Code	LCD Display:  LED Display: (without any error)  LED Display: (with certain error)  	-	-	O	O	O	*7
12-43	Inverter Status	LCD Display:  LED Display: Inverter ready 1 Running 2 Zero Speed 4 Frequency Agree 8 Warning 16 Error 32 Inverter status display is the summed up value. Ex: Display of the value 6 means the inverter is running in zero speed.	101B	-	O	O	O	

Group 12: Monitoring Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
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	
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	

Group 12: Monitoring Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
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		GPM	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	-	GPM	O	O	O	*7
12-78	Reserved							
12-79	Pulse Input Percentage	0.0~100.0	-	%	O	O	O	*7
12-81	Relay Card Display	ON: LCD display is 1 OFF: LCD display is 0	-	-	O	O	O	Note5
12-82	Motor Load	0 ~ 200.0	-	%	O	O	O	Note6
12-85	AI3 Input	Display the current AI3 input (-10V corresponds to -100%, 10V corresponds to 100%)	-	%	O	O	O	*10

*** Models of inverter ratings above 200V 60HP (including 60HP) and 400V 100HP (including 100HP) in IP20 enclosure do not support functions of heatsink temperature display. All models in IP55 enclosure support functions of heatsink temperature display.**

*** Maximum upper limit in motor speed (rpm) of parameter 12-22 is 65534**

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	-	-	O	O	O	*4
13-01	Software Version	0.00-9.99	-	-	O	O	O	*4
13-02	Clear Cumulative Operation Hours Function	0: Disable to Clear Cumulative Operation Hours 1: Clear Cumulative Operation Hours	0		O	O	O	*1
13-03	Cumulative Operation Hours 1	0~23	-	hr	O	O	O	*4
13-04	Cumulative Operation Hours 2	0~65534	-	day	O	O	O	*4
13-05	Selection of Accumulative Operation Time	0: Accumulative time in power on 1: Accumulative time in operation	0		O	O	O	*1
13-06	Parameters Locked	0: Only parameter 13-06 and frequency setting parameters in main screen are writable 1: Only user parameter is enabled. 2: All parameters are writable.	2		O	O	O	*1

Group 13 Maintenance Function Group								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
13-07	Parameter Password Function	00000~65534	00000	-	O	O	O	
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 (220/380V, 50Hz) Note4	0	-	O	O	O	
13-09	Fault History Clearance Function	0: Do not Clear Fault History 1: Clear Fault History	0	-	O	O	O	*1
13-10	Parameter Password Function 2	0 ~ 9999	0		O	O	O	
13-11	C/B CPLD Ver.	0.00~9.99	-		O	O	O	*7
13-12	Option Card Id	0~255	0		O	O	O	*7
13-13	Option Card CPLD Ver.	0.00~9.99	-		O	O	O	*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		O	O	O	Note1
13-15 ~ 13-20	Reserved							
13-21	Previous Fault Message	Display Previous Fault Message	-	-	O	O	O	Note2

Group 13 Maintenance Function Group								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
13-22	Previous Two Fault Message	Display Previous Two Fault Message	-	-	O	O	O	Note2
13-23	Previous Three Fault Message	Display Previous Three Fault Message	-	-	O	O	O	Note2
13-24	Previous Four Fault Message	Display Previous Four Fault Message	-	-	O	O	O	Note2
13-25	Previous Five Fault Message	Display Previous Five Fault Message	-	-	O	O	O	Note2
13-26	Previous Six Fault Message	Display Previous Six Fault Message	-	-	O	O	O	Note2
13-27	Previous Seven Fault Message	Display Previous Seven Fault Message	-	-	O	O	O	Note2
13-28	Previous Eight Fault Message	Display Previous Eight Fault Message	-	-	O	O	O	Note2
13-29	Previous Nine Fault Message	Display Previous Nine Fault Message	-	-	O	O	O	Note2
13-30	Previous Ten Fault Message	Display Previous Ten Fault Message	-	-	O	O	O	Note2
13-31	Previous Eleven Fault Message	Display Previous Eleven Fault Message	-	-	O	O	O	Note2
13-32	Previous Twelve Fault Message	Display Previous Twelve Fault Message	-	-	O	O	O	Note2
13-33	Previous Thirteen Fault Message	Display Previous Thirteen Fault Message	-	-	O	O	O	Note2
13-34	Previous Fourteen Fault Message	Display Previous Fourteen Fault Message	-	-	O	O	O	Note2
13-35	Previous Fifteen Fault Message	Display Previous Fifteen Fault Message	-	-	O	O	O	Note2
13-36	Previous Sixteen Fault Message	Display Previous Sixteen Fault Message	-	-	O	O	O	Note2
13-37	Previous Seventeen Fault Message	Display Previous Seventeen Fault Message	-	-	O	O	O	Note2
13-38	Previous Eighteen Fault Message	Display Previous Eighteen Fault Message	-	-	O	O	O	Note2
13-39	Previous Nineteen Fault Message	Display Previous Nineteen Fault Message	-	-	O	O	O	Note2
13-40	Previous Twenty Fault Message	Display Previous Twenty Fault Message	-	-	O	O	O	Note2
13-41	Previous Twenty One Fault Message	Display Previous Twenty One Fault Message	-	-	O	O	O	Note2
13-42	Previous Twenty Two Fault Message	Display Previous Twenty Two Fault Message	-	-	O	O	O	Note2
13-43	Previous Twenty Three Fault Message	Display Previous Twenty Three Fault Message	-	-	O	O	O	Note2
13-44	Previous Twenty Four Fault Message	Display Previous Twenty Four Fault Message	-	-	O	O	O	Note2
13-45	Previous Twenty Five Fault Message	Display Previous Twenty Five Fault Message	-	-	O	O	O	Note2

Group 13 Maintenance Function Group								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
13-46	Previous Twenty Six Fault Message	Display Previous Twenty Six Fault Message	-	-	O	O	O	Note2
13-47	Previous Twenty Seven Fault Message	Display Previous Twenty Seven Fault Message	-	-	O	O	O	Note2
13-48	Previous Twenty Eight Fault Message	Display Previous Twenty Eight Fault Message	-	-	O	O	O	Note2
13-49	Previous Twenty Nine Fault Message	Display Previous Twenty Nine Fault Message	-	-	O	O	O	Note2
13-50	Previous Thirty Fault Message	Display Previous Thirty Fault Message	-	-	O	O	O	Note2

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	-	O	O	O	Note7
14-01	T1 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-02	T2 Set Value 1	0~9999	0	-	O	O	O	Note7
14-03	T2 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-04	T3 Set Value 1	0~9999	0	-	O	O	O	Note7
14-05	T3 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-06	T4 Set Value 1	0~9999	0	-	O	O	O	Note7
14-07	T4 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-08	T5 Set Value 1	0~9999	0	-	O	O	O	Note7
14-09	T5 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-10	T6 Set Value 1	0~9999	0	-	O	O	O	Note7
14-11	T6 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-12	T7 Set Value 1	0~9999	0	-	O	O	O	Note7
14-13	T7 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-14	T8 Set Value 1	0~9999	0	-	O	O	O	Note7
14-15	T8 Set Value 2（Mode 7）	0~9999	0	-	O	O	O	Note7
14-16	C1 Set Value	0~65534	0	-	O	O	O	Note7
14-17	C2 Set Value	0~65534	0	-	O	O	O	Note7
14-18	C3 Set Value	0~65534	0	-	O	O	O	Note7
14-19	C4 Set Value	0~65534	0	-	O	O	O	Note7
14-20	C5 Set Value	0~65534	0	-	O	O	O	Note7
14-21	C6 Set Value	0~65534	0	-	O	O	O	Note7
14-22	C7 Set Value	0~65534	0	-	O	O	O	Note7
14-23	C8 Set Value	0~65534	0	-	O	O	O	Note7
14-24	AS1 Set Value 1	0~65534	0	-	O	O	O	Note7
14-25	AS1 Set Value 2	0~65534	0	-	O	O	O	Note7
14-26	AS1 Set Value 3	0~65534	0	-	O	O	O	Note7
14-27	AS2 Set Value 1	0~65534	0	-	O	O	O	Note7
14-28	AS2 Set Value 2	0~65534	0	-	O	O	O	Note7
14-29	AS2 Set Value 3	0~65534	0	-	O	O	O	Note7
14-30	AS3 Set Value 1	0~65534	0	-	O	O	O	Note7

Group 14: PLC Setting Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
14-31	AS3 Set Value 2	0~65534	0	-	O	O	O	Note7
14-32	AS3 Set Value 3	0~65534	0	-	O	O	O	Note7
14-33	AS4 Set Value 1	0~65534	0	-	O	O	O	Note7
14-34	AS4 Set Value 2	0~65534	0	-	O	O	O	Note7
14-35	AS4 Set Value 3	0~65534	0	-	O	O	O	Note7
14-36	MD1 Set Value 1	0~65534	1	-	O	O	O	Note7
14-37	MD1 Set Value 2	0~65534	1	-	O	O	O	Note7
14-38	MD1 Set Value 3	0~65534	1	-	O	O	O	Note7
14-39	MD2 Set Value 1	0~65534	1	-	O	O	O	Note7
14-40	MD2 Set Value 2	0~65534	1	-	O	O	O	Note7
14-41	MD2 Set Value 3	0~65534	1	-	O	O	O	Note7
14-42	MD3 Set Value 1	0~65534	1	-	O	O	O	Note7
14-43	MD3 Set Value 2	0~65534	1	-	O	O	O	Note7
14-44	MD3 Set Value 3	0~65534	1	-	O	O	O	Note7
14-45	MD4 Set Value 1	0~65534	1	-	O	O	O	Note7
14-46	MD4 Set Value 2	0~65534	1	-	O	O	O	Note7
14-47	MD4 Set Value 3	0~65534	1	-	O	O	O	Note7

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	-	O	O	O	
15-01	T1 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-02	T2 Current Value 1	0~9999	0	-	O	O	O	
15-03	T2 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-04	T3 Current Value 1	0~9999	0	-	O	O	O	
15-05	T3 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-06	T4 Current Value 1	0~9999	0	-	O	O	O	
15-07	T4 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-08	T5 Current Value 1	0~9999	0	-	O	O	O	
15-09	T5 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-10	T6 Current Value 1	0~9999	0	-	O	O	O	
15-11	T6 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-12	T7 Current Value 1	0~9999	0	-	O	O	O	
15-13	T7 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-14	T8 Current Value 1	0~9999	0	-	O	O	O	
15-15	T8 Current Value 2 (Mode 7)	0~9999	0	-	O	O	O	
15-16	C1 Current Value	0~65534	0	-	O	O	O	
15-17	C2 Current Value	0~65534	0	-	O	O	O	
15-18	C3 Current Value	0~65534	0	-	O	O	O	
15-19	C4 Current Value	0~65534	0	-	O	O	O	
15-20	C5 Current Value	0~65534	0	-	O	O	O	
15-21	C6 Current Value	0~65534	0	-	O	O	O	
15-22	C7 Current Value	0~65534	0	-	O	O	O	

Group 15: PLC Monitoring Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
15-23	C8 Current Value	0~65534	0	-	O	O	O	
15-24	AS1 Results	0~65534	0	-	O	O	O	
15-25	AS2 Results	0~65534	0	-	O	O	O	
15-26	AS3 Results	0~65534	0	-	O	O	O	
15-27	AS4 Results	0~65534	0	-	O	O	O	
15-28	MD1 Results	0~65534	0	-	O	O	O	
15-29	MD2 Results	0~65534	0	-	O	O	O	
15-30	MD3 Results	0~65534	0	-	O	O	O	
15-31	MD4 Results	0~65534	0	-	O	O	O	
15-32	TD Current Value	0~65534	0	-	O	O	O	

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	5~82 (Parameter 12-05~12-82) When using LCD to operate, the monitored item displays in the first line. (default is frequency command)	16	-	O	O	O	*1 *6
16-01	Sub-Screen Monitoring 1	5~82 (Parameter 12-05~12-82) When using LCD to operate, the monitored item displays in the second line. (default is output frequency)	17	-	O	O	O	*1 *6
16-02	Sub-Screen Monitoring 2	5~82(Parameter 12-05~12-82) when using LCD to operate, the monitored item displays in the third line. (default is output current)	18	-	O	O	O	*1 *6
16-03	Selection of Display Unit	0~39999: Determine the display way and unit of frequency command 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%.	0	-	O	O	O	
16-04	Selection of Engineering Unit	0: No Unit 1: FPM 2: CFM 3: PSI 4: GPH 5: GPM 6: IN 7: FT 8: /s 9: /m	0	-	O	O	O	*6

Group 16: LCD Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		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	-	O	O	O	*1
16-06	Reserved							
16-07	Copy Function Selection	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.	0	-	O	O	O	
16-08	Selection of Allowing Reading	0: Do not allow to read inverter parameters and save it to the operator. 1: Allow to read inverter parameters and save it to the operator.	0	-	O	O	O	
16-09	Selection of Operator Removed (LCD)	0: Keep operating when LCD operator is removed. 1: Display fault to stop when LCD operator is removed	0	-	O	O	O	*1
16-10	RTC Time Display Setting	0: Hide 1: Display	0		O	O	O	
16-11	RTC Date Setting	12.01.01 ~ 99.12.31	12.01.01		O	O	O	
16-12	RTC Time Setting	00:00 ~ 23:59	00:00		O	O	O	
16-13	RTC Timer Function	0: Disable 1: Enable 2: Set by DI	0		O	O	O	
16-14	P1 Start Time	00:00 ~ 23:59	08:00		O	O	O	
16-15	P1 Stop Time	00:00 ~ 23:59	18:00		O	O	O	
16-16	P1 Start Date	1:Mon, 2:Tue, 3:Wed, 4:Thu,:5:Fri,:6:Sat,	1		O	O	O	
16-17	P1 Stop Date		5		O	O	O	

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

Group 16: LCD Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
16-36	Selection of RTC Speed	0: Off 1: By Timer 1 2: By Timer 2 3: By Timer 3 4: By Timer 4 5: By Timer 1+2	0		O	O	O	
16-37	Selection of RTC Rotation Direction	xxx0b: RTC Run1 Forward Rotation 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	0000b		O	O	O	

Group 17: IM Motor Automatic Tuning Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
17-00	Mode Selection of Automatic Tuning	0: Rotational Auto-tuning 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	VF:2 SLV:6	-	O	O	X	
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 400V:100.0~480.0	- -	V	O	O	X	
17-04	Motor Rated Frequency	4.8~599.00 (Note8)	50.0/ 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							

Group 17: IM Motor Automatic Tuning Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
17-08	Motor No-load Voltage	200V: 50~240 400V: 100~480	KVA*a	V	O	O	X	
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 1: Enable	0	-	O	O	X	
17-11	Error History of Automatic Tuning	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	0	-	O	O	X	
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 1: Vector Mode	0	-	O	O	X	Note1

***a: KVA means the default value of this parameter will be changed by different capacities of inverter.**

■1: It can be set when 17-00=1, 2, 6.

Group 18: Slip Compensation Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
18-00	Slip Compensation Gain at Low Speed	0.00~2.50	VF: 0.00 SLV: 1.00	-	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 1: Enable	0	-	O	X	X	
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	

Group 19 Reserved

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: Speed control is enabled either in constant speed or accel/ decel.	1	-	X	O	X	
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	0.0~599.00 (Note8)	4.0	Hz	X	O	O	
20-16	ASR Gain Change Frequency 2	0.0~599.00 (Note8)	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 is enabled in SLV and PMSLV modes.**

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- only available when PM Control Mode is selected								
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	PM Motor Rated Voltage	200V: 50.0~240.0 400V: 100.0~480.0	220.0 440.0	V	X	X	O	Note8
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	4.8~599.00 (Note8)	75.0	Hz	X	X	O	
22-07	PM Type Selection	0:SPM 1:IPM	0		X	X	O	Note8
22-08 ~ 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	10 ~ 100%	10.0	%	X	X	O	Note2
22-12 22-13	Reserved (Note6)							
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	PM No-Load Voltage	200V: 0~250 400V: 0~500	150 300	V	X	X	O	Note8
22-18	Flux-Weakening Control	0~120	90	%	X	X	O	Note1
22-19 22-20	Reserved							
22-21	SLV PM Motor Tuning	0: Disable	0	-	X	X	O	

Group 22: PM Motor Parameters- only available when PM Control Mode is selected

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		1: Enable						
22-22	Fault History of SLV PM Motor Tuning	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 Timeout 12: Reserved	0	--	X	X	O	*4
22-25	Detection Mode Selection of Default Magnetic Pole	0: Angle before Stop 1: Mode 1 2: Mode 2	2 (Note8)	--	X	X	O	Note4
22-26	Estimator Mode	0~1 (in PMSLV mode)	0	-	X	X	O	Note6
22-27	Mode 2 Voltage Command	5~120 (Note8) (22-25=2 or 22-26=1is enabled)	50	%	X	X	O	Note4
22-28	Mode 2 Frequency Division Ratio	0~8 (Note8) (22-25=2 or 22-26=1is enabled)	2		X	X	O	Note4
22-29	Field-Weakening Voltage Control	80~110 (Note8)	100	%	X	X	O	Note4
22-30	SPM Speed Estimation Gain	1~150	85	%	X	X	O	Note6
22-31	SPM Speed Estimation Filter Value	1~2000	60	HZ	X	X	O	Note6
22-32	MTPA Selection	0: Disable 1: Mode 1	0	-	X	X	O	Note8
22-33	MTPA Gain	0~400%	200	%	X	X	O	Note8
22-34	IPM Estimator Gain	1~300	180	-	X	X	O	Note8

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 1: Pump 2: HVAC 3: Compressor *7	0	-	O	O	O	
23-01	Setting of Single & Multiple Pumps and Master & Slave Machines	0: Single Pump 1: Master 2: Slave 1 3: Slave 2 4: Slave 3	0		O	O	O	
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

Group 23 Pump & HVAC Function Parameters								
Code	**Parameter Name**	**Setting Range**	**Default**	**Unit**	**Control Mode**			**Attribute**
					V/F	**SLV**	**PM SLV**	
23-04	Pump Pressure Command Source	0: Set by 23-02 1: Set by AI	0		O	O	O	
23-05	Display Mode Selection	0: Display of Target and Pressure Feedback * 1: Only Display Target Pressure 2: Only Display Feedback Pressure	0	%	O	O	O	
23-06	Proportion Gain (P)	0.00~10.00	3.00	-	O	O	O	
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 ~ 599.00 (Note8)	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	Time of Loss Pressure Detection	0.0 ~ 600.0	0.0	Sec	O	O	O	
23-19	Proportion of Loss Pressure Detection	0 ~ 100	0	%	O	O	O	
23-20	Switching of Pressure and Percentage	0:Pressure 1:Percentage	1	-	O	O	O	Note4
23-21	Reserved							
23-22	Slave Trip Frequency	0.00 ~ 599.00 (Note8)	45.00	Hz	O	O	O	Note2
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 ~ 599.00 (Note8)	0.00	Hz	O	O	O	
23-29	Switching Time of Multiple Pumps in Parallel	0 ~ 240	3	Hr/ min	O	O	O	

Group 23 Pump & HVAC Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
23-30	Detection Time of Multiple Pumps in Parallel Running Start	0.0 ~ 30.0	0.0	Sec	O	O	O	
23-31	Synchronous Selection of Multiple Pumps in Parallel	0: Disable 1: Pressure Setting and Run/Stop 2: Pressure Setting 3: Run/Stop	1		O	O	O	
23-32 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	O	O	O	Note1
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		O	O	O	Note2
23-36	PUMP Unit Display	0:PSI 1:inW 2:Bar 3:Pa	0		O	O	O	Note4
23-37	Leakage Detection Time	0.0~100.0	0.0	Sec	O	O	O	*7
23-38	Pressure Variation of Leakage Detection Restart	23-20=0 : 0.01 ~ 65.00 23-20=1 : 1~10	1	%/ PSI	O	O	O	*7
23-39	Pressure Tolerance Range of Leakage Detection Restart	23-20=0 : 0.01 ~ 650.00 23-20=1 : 1~100	5	%/ PSI	O	O	O	*7
23-40	Reserved							
23-41	Local/ Remote Key	0: Disable 1: Enable	1		O	O	O	
23-42	Energy Recalculating	0: Disable (Energy Accumulating) 1: Enable	0		O	O	O	
23-43	Electricity Price per kWh	0.000 ~ 5.000	0.000	$	O	O	O	
23-44	Selection of Accumulative Electricity Pulse Output Unit	0: Disable 1: Unit for 0.1kWh 2: Unit for 1kWh 3: Unit for 10kWh 4: Unit for 100kWh 5: Unit for 1000kWh	0		O	O	O	
23-45	Given Modes of Flow Meters Feedback	0: Disable 1: Analog Input 2: Pulse Input	1		O	O	O	
23-46	Maximum Value of Flow Meters	1 ~ 50000	10000	GPM	O	O	O	
23-47	Target Value of Flow Meters	1 ~ 50000	5000	GPM	O	O	O	
23-48	Maximum Flow Value of Feedback	0.01 ~ 99.00	80.00	%	O	O	O	

Group 23 Pump & HVAC Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
23-49	Maximum Flow Warning Time of Feedback	0.0 ~ 255.0	3.0	Sec	O	O	O	
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 1: PID Error Value 2: Current 3: Current and PID Error Value	0		O	O	O	
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 1: Warning 2: Fault 3: Fault & Restart	0		O	O	O	
23-59	Source of HVAC Pressure Command	0: Set by 23-47 1: Set by AI	0		O	O	O	
23-60	HVAC Unit Display	0: GPM 1: FPM 2: CFM 3: GPH	0		O	O	O	Note4
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	Note3
23-72	Switching Time of Alternation in Parallel	0: Hour 1: Minute	0		O	O	O	Note4
23-73	Slave Wake-up Selection	0: Disable 1: Enable	0		O	O	O	Note4
23-74	High Pressure Setting	0: Disable 1: High Pressure Warning 2: High Pressure Warning or Error	2		O	O	O	Note5
23-75	Low Pressure Setting	0: Disable 1: Low Pressure Warning 2: Low Pressure Warning or Error	0		O	O	O	Note5
23-76	High Flow Setting	0: Disable 1: High Flow Warning	2		O	O	O	Note5

Group 23 Pump & HVAC Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
		2: High Flow Warning or Error						
23-77	Low Flow Setting	0: Disable 1: Low Flow Warning 2: Low Flow Warning or Error	2		O	O	O	Note5
23-78	Selection of Loss Pressure Detection	0: Disable 1: Loss Pressure Warning 2: Low Pressure Error	0		O	O	O	Note5

Group 24 Pump Control Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode V/F	SLV	PM SLV	Attribute
24-00	Selection of Pump Control Function	0: Function of 1 to 8 Pump Card is Disabled 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	0	-	O	O	O	
24-01	Selection of Relay 2-4 Function	xxx0b: Reserved xxx1b: Reserved xx0xb: Relay 2 Disable xx1xb: Relay 2 Enable x0xxb: Relay 3 Disable	0000b		O	O	O	

Group 24 Pump Control Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		x1xxb: Relay 3 Enable 0xxxb: Relay 4 Disable 1xxxb: Relay 4 Enable						
24-02	Selection of Relay 5-8 Function	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	0000b		O	O	O	
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	Note1
24-09	Frequency/ Target Switch	0: Disable 1: Enable	0		O	O	O	Note3
24-10	Stop Mode Selection on Mode 6/7/9	0: Disable 1: Enable	0		O	O	O	Note3
24-11	High Pressure Limit Level	0~10000	500	-	O	O	O	Note4
24-12	Delay Time of High Pressure Warning	0.0 ~ 600.0	10.0	Sec	O	O	O	Note4
24-13	Delay Time of High Pressure Error	0.0 ~ 600.0	20.0	Sec	O	O	O	Note4
24-14	Low Pressure Limit Level	0~10000	0	-	O	O	O	Note4
24-15	Delay Time of Low Pressure Warning	0.0 ~ 600.0	0.0	Sec	O	O	O	Note4
24-16	Delay Time of Low Pressure Error	0.0 ~ 600.0	0.0	Sec	O	O	O	Note4
24-17	PID Control during Increasing/ Decreasing pumps	0: PID Control is disabled during increasing/ decreasing pumps 1: PID Control is enabled during increasing/ decreasing pumps	0	-	O	O	O	Note6

4.4 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 22-21 for details on PM Motor tuning. A braking resistor is recommended to be used to prevent drive from getting regenerative energy. A braking module is required for Inverters ratings 200V 30HP, 400V/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.

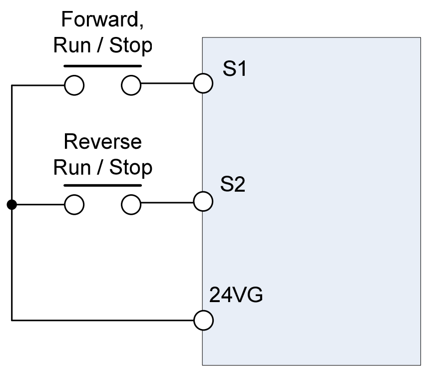


Figure 4.4.1 Wiring example of 2-wire

■ **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.

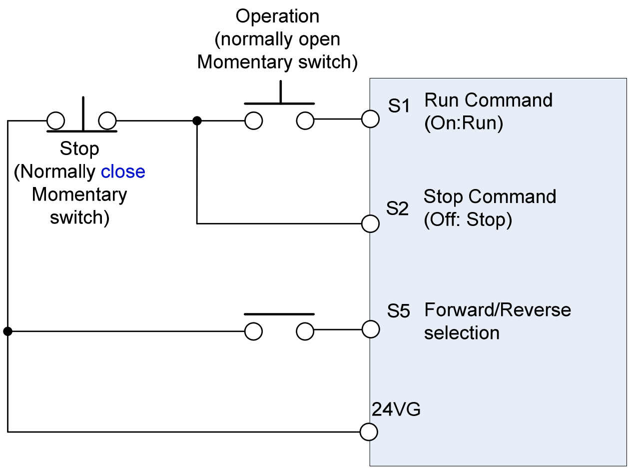


Figure 4.4.2 Wiring example of 3-wire

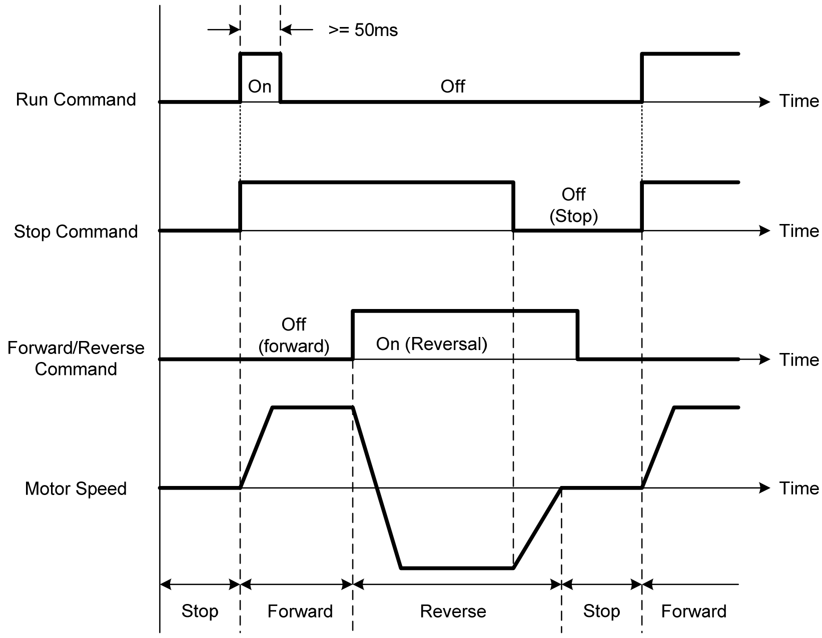
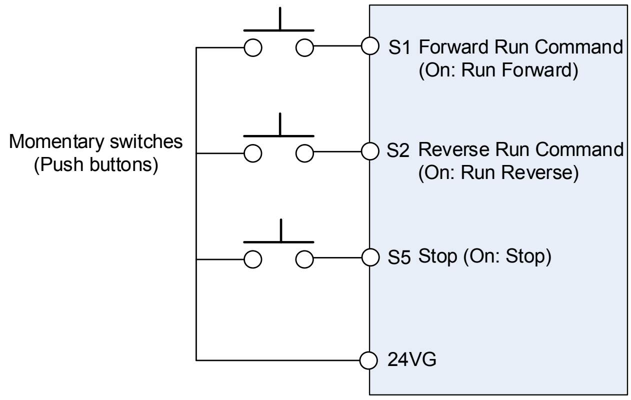


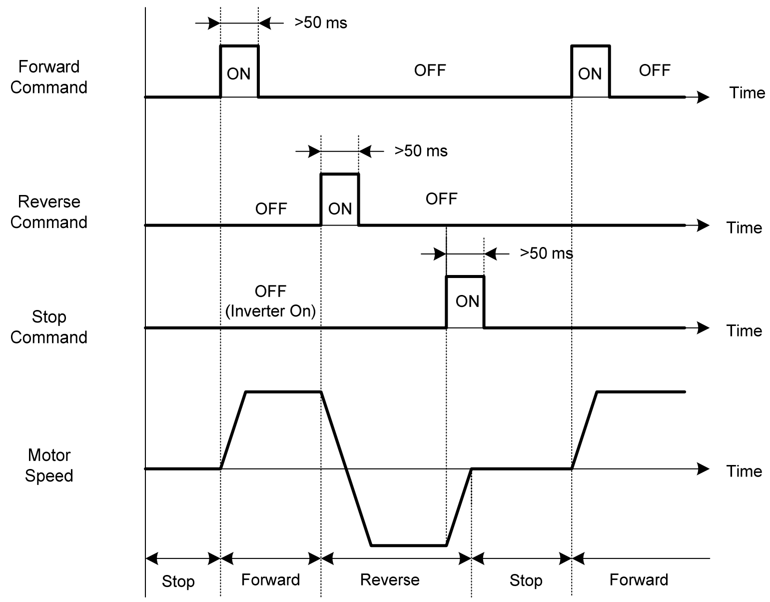
Figure 4.4.3 Timing chart of 3-wire operation

■ **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.



00-02=2: Communication control

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

00-02=3: PLC control

The inverter is controlled by the inverter built-in PLC logic. Refer to section 4.4.

00-02=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**

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 4.4.4). 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.

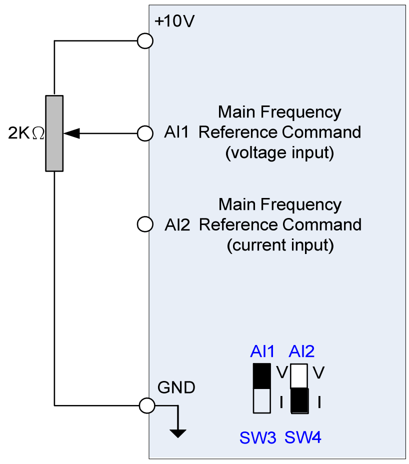


Figure 4.4.4 Analog input as main frequency reference command (For Enhanced E&G type)

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 the parmeters of 03-00~03-07 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 SE01 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	【0.00~599.00】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 effective in communication mode.

00-10	Minimum frequency detection
Range	【0】:Show warning if lower than minimum frequency 【1】:Run as minimum frequency if lower than minimum frequency

00-10=0:
When frequency command is lower than 01-08 (Minimum Output Frequency of Motor 1), it shows STP0 warning.

00-10=1:
When frequency command is lower than 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】%
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 frequency parameter 01-02.

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.
- 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.

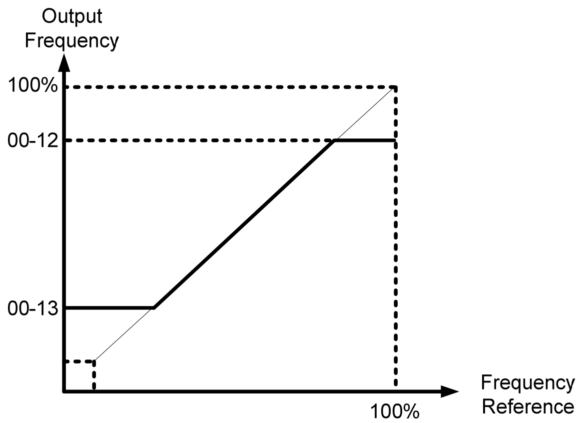


Figure 4.4.5 Frequency reference upper and lower limits

Note: The maximum frequency setting in the keypad is according to parameter 01-02 (Maximum Output Frequency) and 00-12 (Upper Frequency limit). The upper frequency limit is not over than 599Hz and maximum limit for AI frequency is 100% to parameter 01-02.

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	【0.00~599.00】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 4.4.1 Acceleration / deceleration time selection

Accel/decel time 2 (Set 03-00 ~ 03-05 = 30)	Accel/decel time 1 (Set 03-00 to 03-05 = 10)	Acceleration time	Deceleration time
0	0	Taccc1 (00-14)	Tdec1 (00-15)
0	1	Taccc2 (00-16)	Tdec2 (00-17)
1	0	Taccc3 (00-21)	Tdec3 (00-22)
1	1	Taccc4 (00-23)	Tdec4 (00-24)

0: OFF, 1: ON

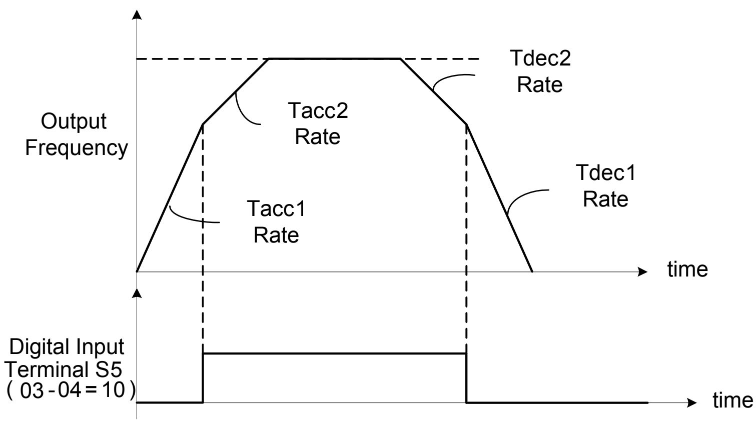


Figure 4.4.6: Terminal S5 switch between Tacc1/Tacc2 and Tdec1/Tdec2

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 4.4.7 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.

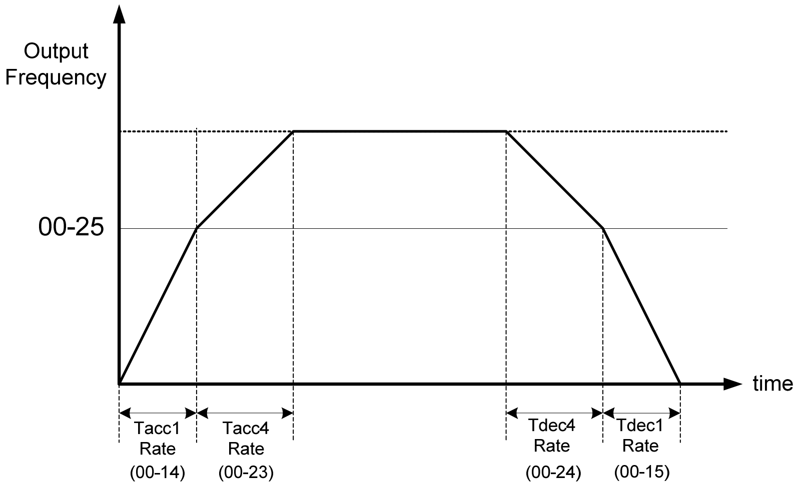


Figure 4.4.7 Automatic acceleration / deceleration time switch-over based on output frequency

00-18	**Jog Frequency**
Range	**【0.00~599.00】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 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 4.4.8. 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.

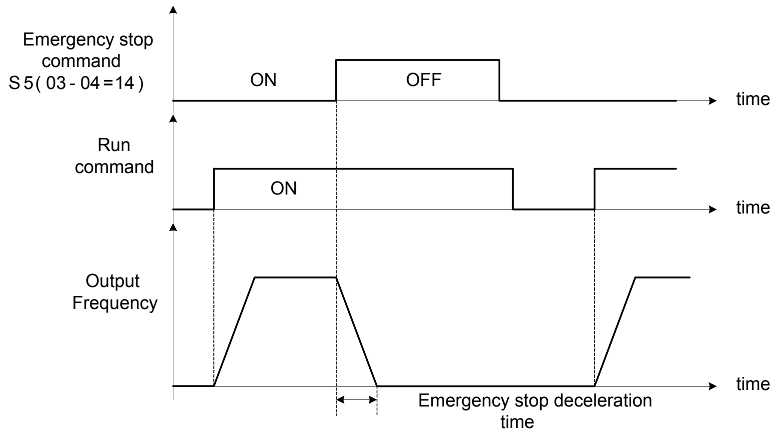


Figure 4.4.8 Emergency stop example

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.

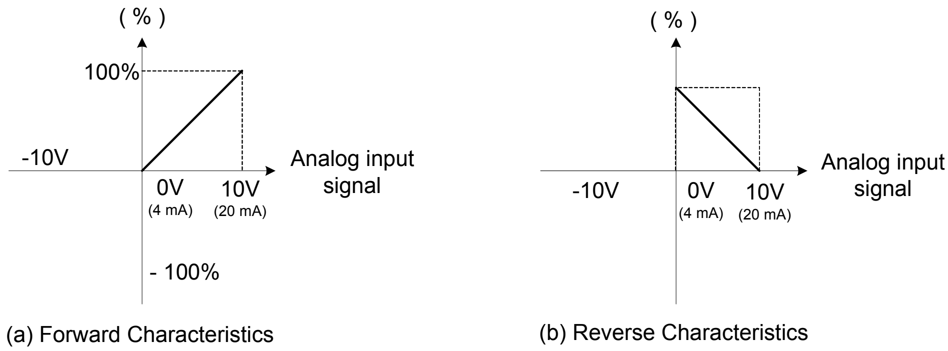


Figure 4.4.9 Positive/negative analog input as main frequency reference command.

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

Note: If set 00-32 back to 0, 2 wire initialization (60Hz)(230/400V) setting (13-08=11) will be executed.
Note: Before setting up 00-32 Application, it should do initialized setting (parameter 13-08) first.
Warning: When setting 00-32, the I/O port function changed automatically. To avoid accident,be sure to confirm the I/O port signal of inverter and external terminal control

(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 keypad.

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 (group 00 ~ 24, but except 00-00/ 00-41~00-56/ group 17) 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.

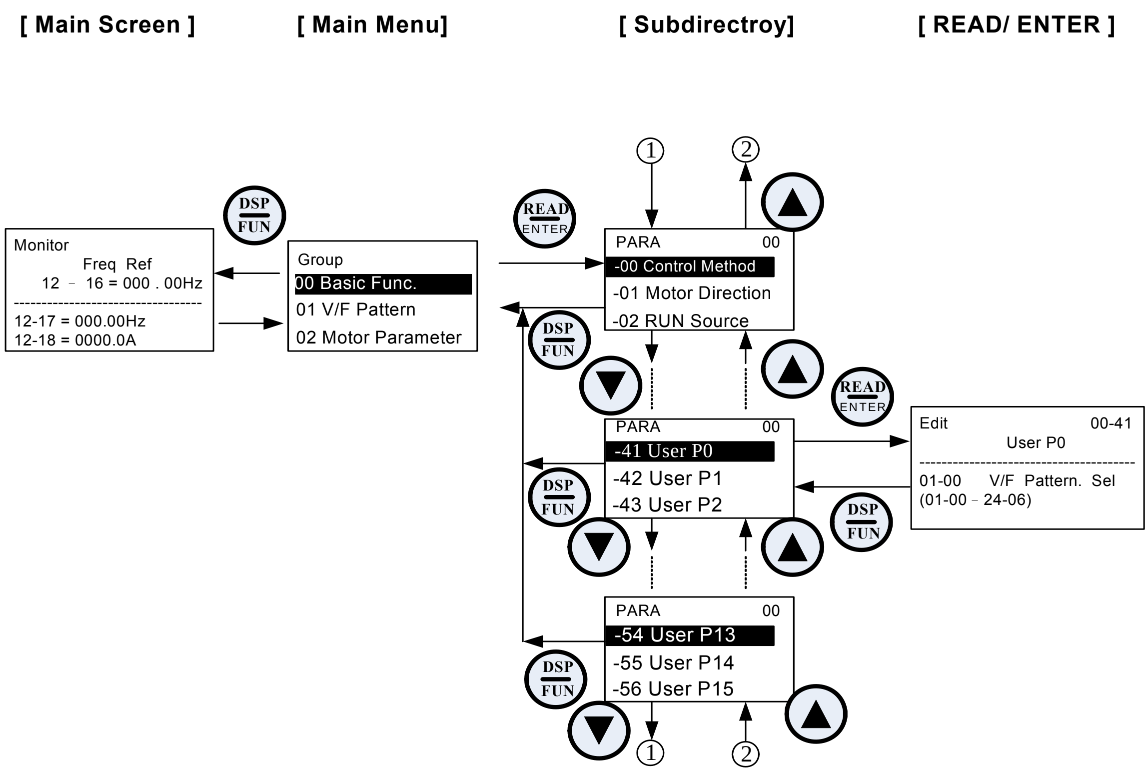
Example 2: After one or more parameters in 00-41 ~ 00-56 are set, user parameters settings are as follows.

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 00 -41. S1 Function Sel	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.

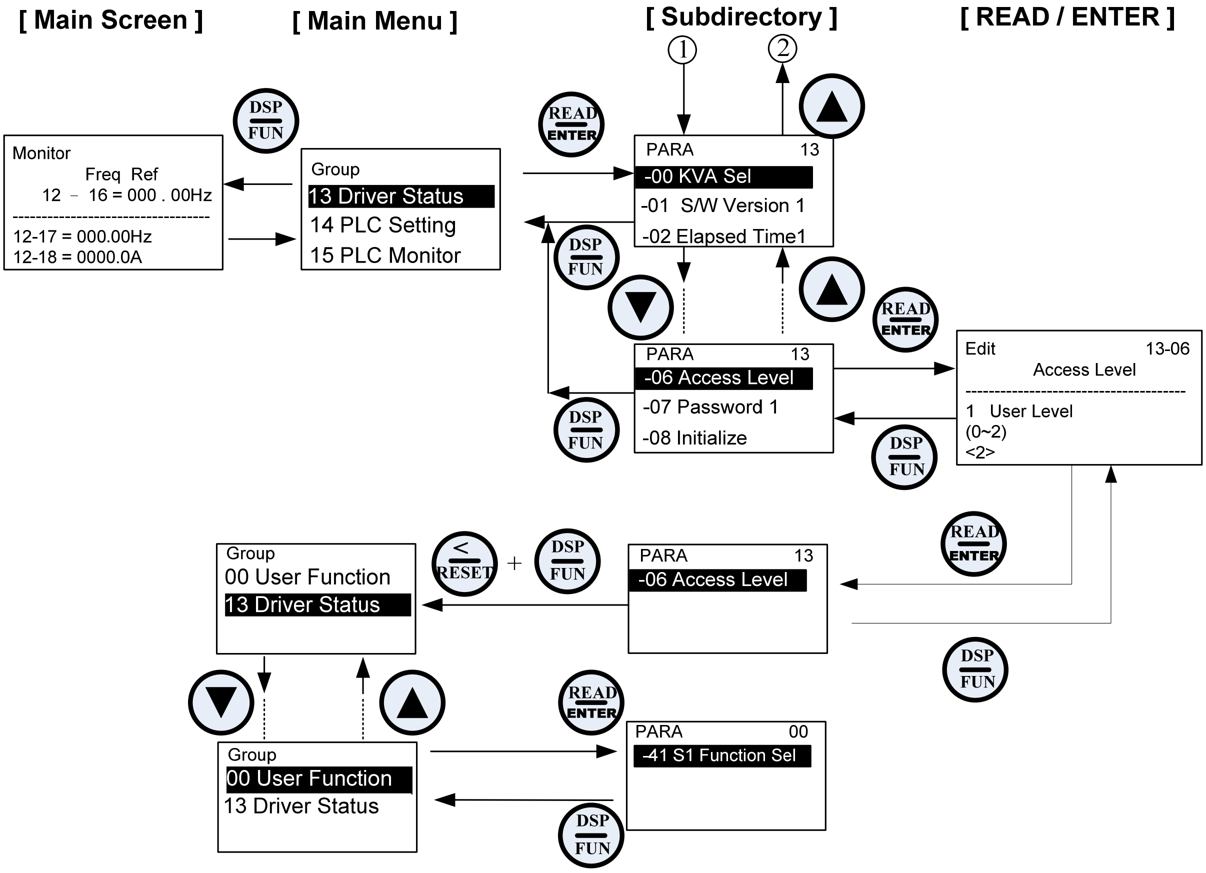
Step	LCD Display	Descriptions
11	Edit 00-41 S1 Function Sel 06 FJOG (00~57) < 00 > < 03-00 >	Press ▲ (Up) / ▼ (Down) key to change the setting value to 2. Use (READ/ ENTER) key to save the setting value. When the selected setting value does not flash again, the setting value will be saved to 00-41 and 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.


[Main Screen]
[Main Menu]
[Subdirectory]
[READ / ENTER]
①
②
Monitor
Freq Ref
12 – 16 = 000 . 00Hz
12-17 = 000.00Hz
12-18 = 0000.0A
DSP FUN
Group
13 Driver Status
14 PLC Setting
15 PLC Monitor
READ ENTER
PARA 13
-00 KVA Sel
-01 S/W Version 1
-02 Elapsed Time1
PARA 13
-06 Access Level
-07 Password 1
-08 Initialize
Edit 13-06
Access Level
1 User Level
(0~2)
<2>
Group
00 User Function
13 Driver Status
< RESET
+
PARA 13
-06 Access Level
PARA 00
-41 S1 Function Sel

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.

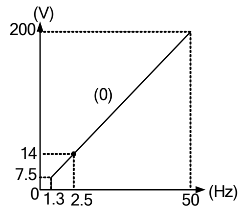
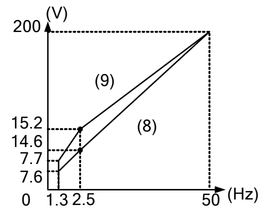
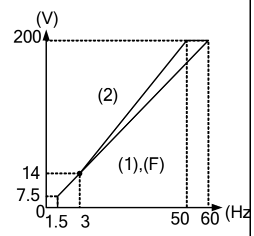
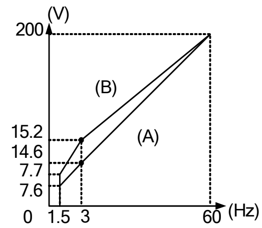
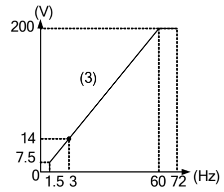
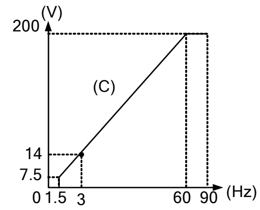
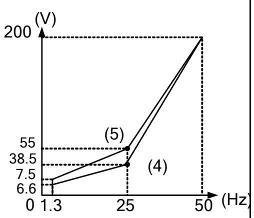
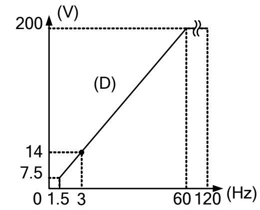
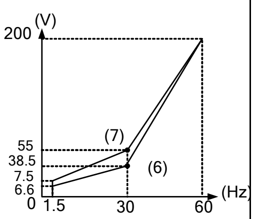
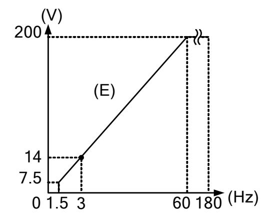
The default parameters (01-02 ~ 01-09 and 01-12 ~ 01-13) are the same when 01-00 is set to F (default) and 01-00 is set to 1.

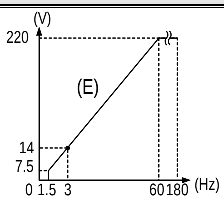
Parameters 01-02 ~ 01-13 are automatically set when any of the predefined V/F curves are selected.

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 4.4.2 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 Staring Torque‡	50Hz	Low Starting Torque	8	
			F				High Starting Torque	9	
	60Hz	60Hz Saturation	1			60Hz	Low Starting Torque	A	
			F (Def. Value)						
		50Hz Saturation	2				High Starting Torque	B	
Variable Torque Characteristic	72Hz		3		Constant-power torque(Reducer)	90Hz		C	
	50Hz	Variable Torque 1	4 (Def. Value for 50Hz)			120Hz		D	
		Variable Torque 2	5						
	60Hz	Variable Torque 3	6 (Def. Value for 60Hz)			180Hz		E	
		Variable Torque 4	7						

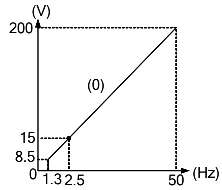
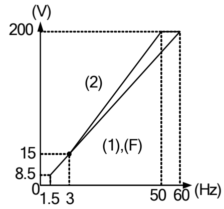
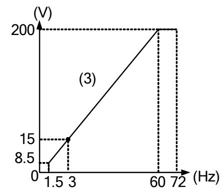
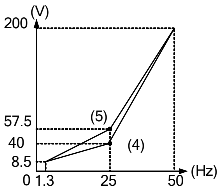
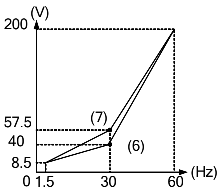
Type	Specification	01-00	V/F curve[*1]
Rated Horsepower Torque (Reducer)	180Hz	F	

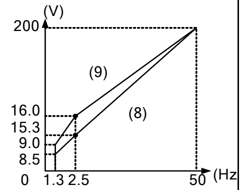
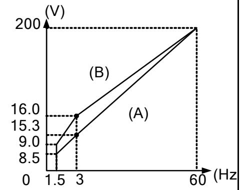
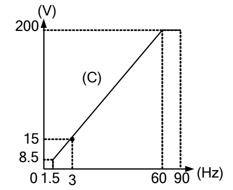
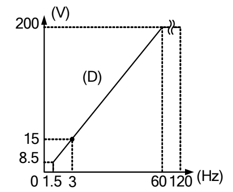
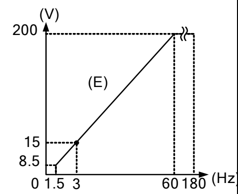
*1. Values shown are for 200V class inverters; double values for 400V class inverters.

‡: 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 4.4.3 40HP and above V/F curve selection

<table>
<tr><th>Type</th><th colspan="2">Specification</th><th>01-00</th><th>V/F curve*1</th></tr>
<tr><td rowspan="5">General purpose</td><td colspan="2" rowspan="2">50Hz</td><td>0</td><td rowspan="2">
</td></tr>
<tr><td>F</td></tr>
<tr><td rowspan="3">60Hz</td><td rowspan="2">60Hz Saturation</td><td>1</td><td rowspan="3">
</td></tr>
<tr><td>F (Def. Value)</td></tr>
<tr><td>50Hz Saturation</td><td>2</td></tr>
<tr><td rowspan="5">Variable Torque Characteristic</td><td colspan="2">72Hz</td><td>3</td><td>
</td></tr>
<tr><td rowspan="2">50Hz</td><td>Variable Torque 1</td><td>4 (Def. Value for 50Hz)</td><td rowspan="2">
</td></tr>
<tr><td>Variable Torque 2</td><td>5</td></tr>
<tr><td rowspan="2">60Hz</td><td>Variable Torque 3</td><td>6 (Def. Value for 60Hz)</td><td rowspan="2">
</td></tr>
<tr><td>Variable Torque 4</td><td>7</td></tr>
</table>

<table>
<tr><th>Type</th><th colspan="2">Specification</th><th>01-00</th><th>V/F curve*1</th></tr>
<tr><td rowspan="4">High Staring Torque‡</td><td rowspan="2">50Hz</td><td>Low Starting Torque</td><td>8</td><td rowspan="2">
</td></tr>
<tr><td>High Starting Torque</td><td>9</td></tr>
<tr><td rowspan="2">60Hz</td><td>Low Starting Torque</td><td>A</td><td rowspan="2">
</td></tr>
<tr><td>High Starting Torque</td><td>B</td></tr>
<tr><td rowspan="3">Constant-power torque(Reducer)</td><td colspan="2">90Hz</td><td>C</td><td>
</td></tr>
<tr><td colspan="2">120Hz</td><td>D</td><td>
</td></tr>
<tr><td colspan="2">180Hz</td><td>E</td><td>
</td></tr>
</table>

*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	**【4.8~599.0】Hz**
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	**【0.0~599.0】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	**【0.0~599.0】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	**【0.0~599.0】Hz**
01- 09	**Minimum Output Voltage**
Range	**200V:【0.0~255.0】V** **400V:【0.0~510.0】V**
01- 12	**Base Frequency**
Range	**【4.8~599.0】Hz**
01- 13	**Base Output Voltage**
Range	**200V:【0.0~255.0】V** **400V:【0.0~510.0】V**

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.

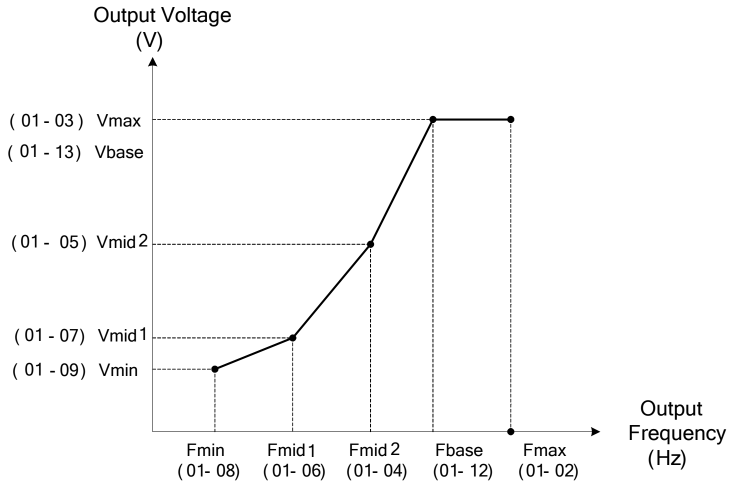


Figure 4.4.10 Custom V/F curve

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

F_{max} ≧	F_{base} >	F_{mid2} >	F_{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 (Fmax), base frequency 01-12 (Fbase) or minimum output frequency 01-08 (Fmin) can be adjusted but the voltage is automatically adjusted by the internal current controller.

Set the base frequency (01-12, Fbase) 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 4.4.11.

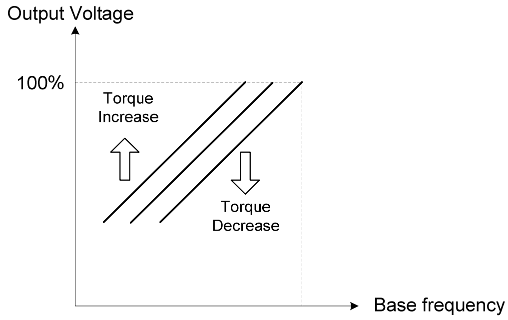


Figure 4.4.11 Torque compensation gain to increase/decrease output torque

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	**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	**【4.8~599.0】Hz**
02-07	**Poles**
Range	**【2~16】(Even)**
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**

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)

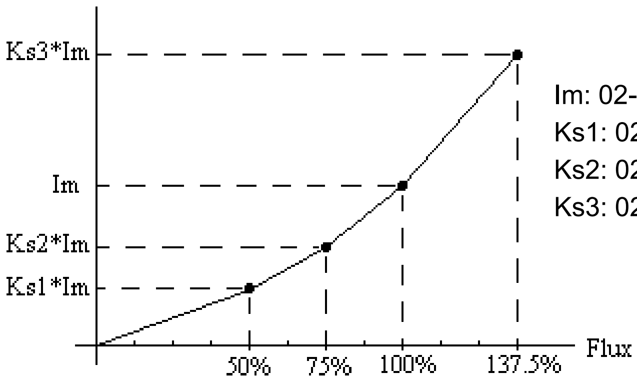
Parameter determines the rated flux during motor's rated rotation in SLV control mode. Set the value of this parameter to the same value as parameter 17-08 (02-19 for motor 2). A value of 10~50V below the input voltage level ensures that the motor is capable of providing adequate torque performance when 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%.



Im: 02-09 Motor Excitation Current
Ks1: 02-10 Motor Core Saturation Coefficients 1
Ks2: 02-11 Motor Core Saturation Coefficients 2
Ks3: 02-12 Motor Core Saturation Coefficients 3

(10) Motor core loss (02-13)
Set motor core loss as the percentage of the motor rated power.

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

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.

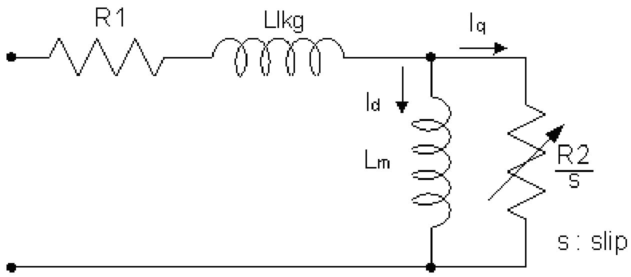


Figure 4.4.12 Y-equivalent model of an induction motor

(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:

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

- 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 $N = \frac{120 \times Frequence}{Pole} = \frac{120 \times 60}{4} = 1800$ rpm and the rated speed in the motor nameplate is 1700 rpm, then $Slip = \frac{1800 - 1700}{60} = 1.67\,Hz$.

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 which marked <1> will renew the value. 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	【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 【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** **【66】: Reserved** **【67】: Reserved** **【68】: External Fault 2** **【69】: External Overload**

***1: It can not be selected on the items 15, 19, 33, and 34 while using the permanent magnetic (PM) motor**.

Refer to the multi-function digital input and related parameters in the following Fig. 4.4.13

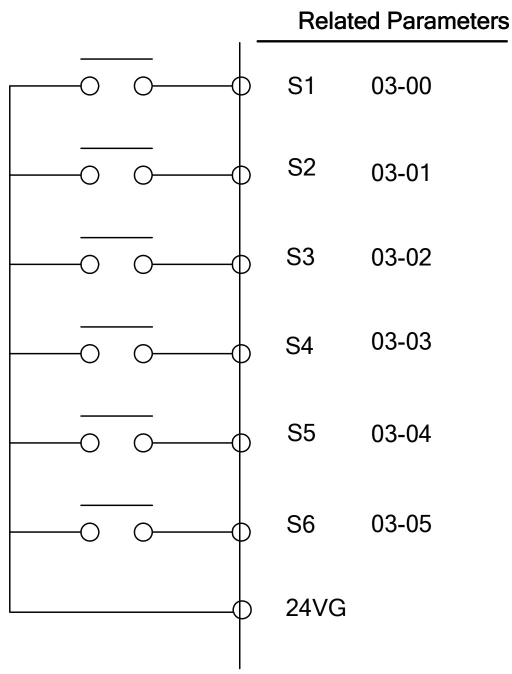


Figure 4.4.13 Multi-function digital input and related parameters

Table 4.4.4 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. Baseblock	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
18	Reserved	Reserved	Reserved	-	-	-
19	Speed Search 1(from the maximum frequency)	Speed Search 1	ON: Search the speed from the maximum output frequency	O	O	X

Value	Function		Description	Control mode		
	Name	LCD Display		V/F	SLV	PM SLV
20	Manual Energy Saving Function	Energy saving	ON: Manual energy saving control is based on the settings of 11-12 and 11-18.	O	X	X
21	PID Integral Reset	PID I-Reset	ON: PID integral value reset	O	O	O
22~23	Reserved	Reserved	Reserved	-	-	-
24	PLC input	PLC Input	ON: Digital PLC input	O	O	O
25	External fault	Ext. Fault	ON: External fault alarm	O	O	O
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.	O	O	O
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)	O	O	O
28	Remote Mode Selection	Remote Mode Sel	ON: RS-485 communication OFF: Control circuit terminal	O	O	O
29	Jog Frequency Selection	JOG Freq Ref	ON: Selection jog frequency command	O	O	O
30	Acceleration/ Deceleration Setting Command 2	Acc/Decel Time Selection 2	Acceleration/deceleration time selection command2	O	O	O
31	Inverter Overheating Warning (OH2)	Overheat Alarm	ON: Inverter overheat alarm (OH2) input(will display OH2)	O	O	O
32	Reserved	Reserved	Reserved	-	-	-
33	DC Braking	DC Brake Command	ON: Perform DC braking	O	X	X
34	Speed Search 2 (from Frequency Command)	Speed Search 2	ON: Search speed from set frequency	O	X	O
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	O	O	O
36	PID Soft Start Disable	PID SFS Disable	ON: PID slow-start off	O	O	O
37~40	Reserved	Reserved	Reserved	-	-	-
41	PID Sleep	PID Sleep	ON: PID Sleep	O	O	O
42~46	Reserved	Reserved	Reserved	-	-	-
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.	O	O	O
48	KEB Acceleration	KEB Accel.	ON: KEB acceleration start	O	X	X
49	Parameters Write-in Allowed	Write Enabled	ON: All parameters are writable. OFF: Except reference frequency (00-05) all parameters are write-protected.	O	O	O

Value	Function		Description	Control mode		
	Name	LCD Display		V/F	SLV	PM SLV
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.	O	O	O
51~52	Reserved	Reserved	Reserved	-	-	-
53	2-Wire Self Holding Mode (Stop Command)	2-Wire (STOP)	2-Wire Self Holding Mode (ON: Stop Command).	O	O	O
54	Switch PID1 and PID2	PID 2 Enable	ON: PID1 enabled OFF: PID2 enabled	O	O	O
55	RTC Time Enable	RTC Timer Switch	ON:RTC Time Function Enabled	O	O	O
56	RTC Offset Enable	Offset Time Switch	ON:RTC Offset Enabled	O	O	O
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)	O	O	O
58	Run Permissive Function	Safety Function	ON: Stop on the setting of 08-30	O	O	O
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	O	O	O
64	Reserved	Reserved	Reserved	-	-	-
65	Short-circuit braking	SC Brk	ON: Excute short-circuit braking	X	X	O
66	Reserved	Reserved	Reserved	-	-	-
67	Reserved	Reserved	Reserved	-	-	-
68	External Fault 2	Ext. Fault 2	ON: the alarm of external Fault	O	O	O
69	External Overload	Ext. Overload	ON: the input of external overload	O	O	O

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 4.4.5 Multi-speed operation selection

Speed	Multi-function digital input (S1 ~ S6)					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
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 as default setting. It is necessary to set 04-05≠0 to switch 05-02 to be for Frequency command 1. When PID control mode is enabled (10-03= xxx1b), Frequency of Speed - Stage 1 can not switch auxiliary speed frequency even though Multi-function Terminal Function Setting (03-00~03-05)=16 (PID control disable).

Wiring Example: Fig. 4.4.14 and 4.4.15 show an example of a 9-speed operation selection.

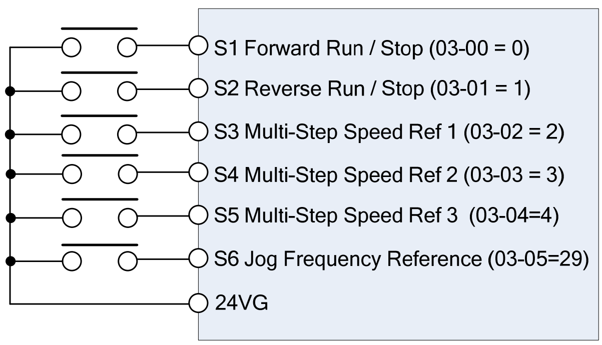


Figure 4.4.14 Control Terminal Wiring Example

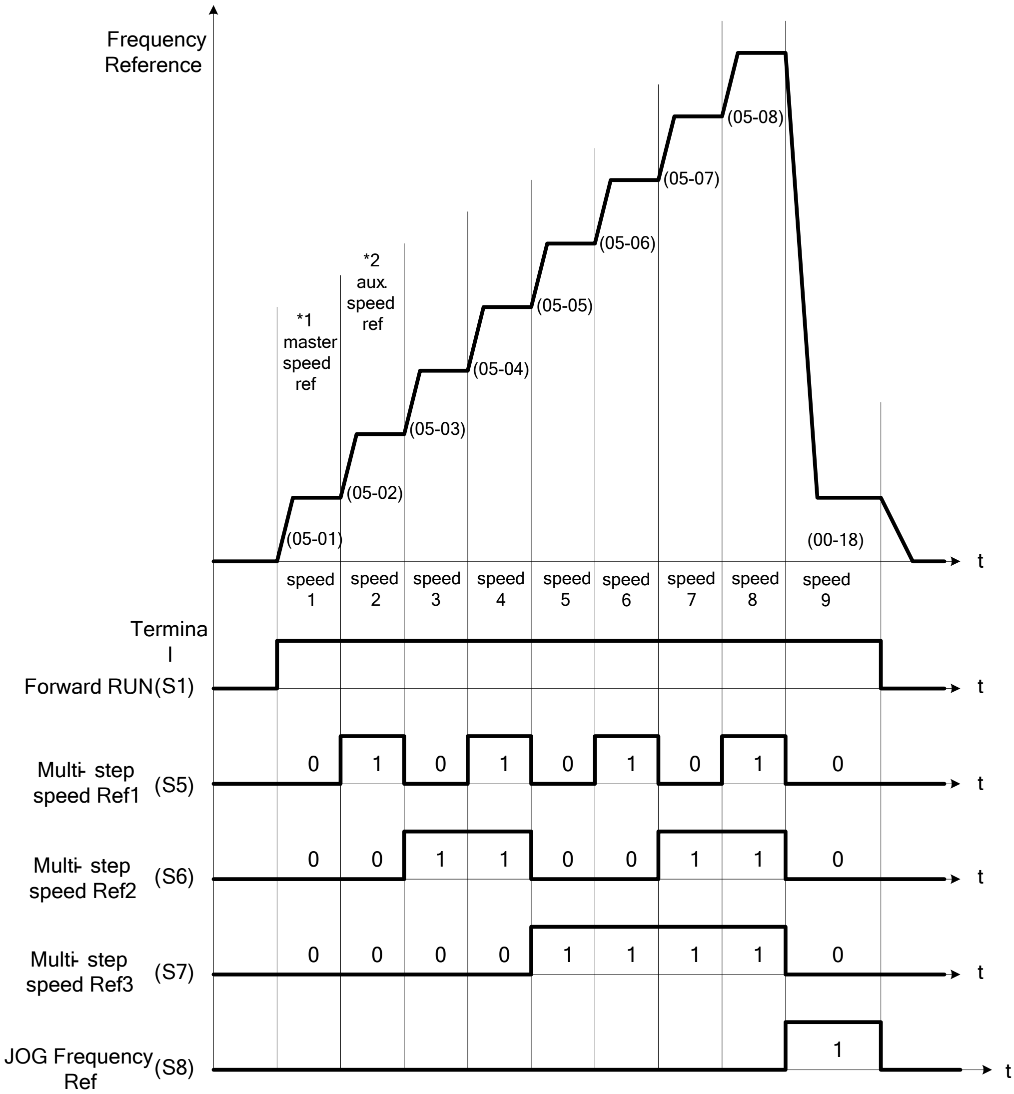


Figure 4.4.15 9-speed timing diagram

*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 excute the Forward jog or Reverse jog command need to set 00-02=1 at first.
- 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:

- The inverter operates the variation of increasing/ decreasing output frequency via keypad (refer to parameter 11-56) / external multi-function digital input (terminal S1to S6) when the motor is running.

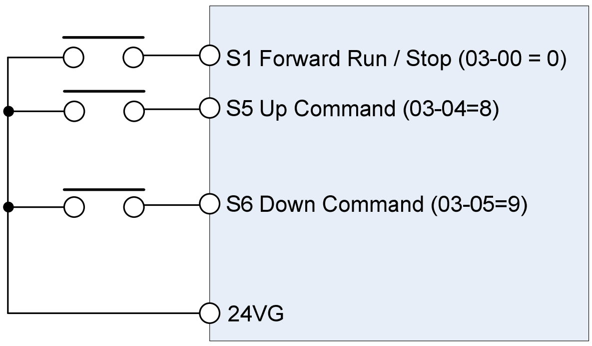
- It is required to use two terminals to run UP/ DOWN command when the inverter runs this command via the external multi-function digital input terminal and 00-02=1 (external terminals) & 00-05=2 (terminal command UP/DOWN) & 03-00~03-05=8 (UP command)/ 9 (DOWN command).
- The inverter output frequency runs UP/ DOWN command with the setting of acceleration/ deceleration time.

.

Note: SE02 DI terminal Error will be 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 4.4.16 and 4.4.17.



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

Figure 4.4.16 UP/DOWN wiring and operation example

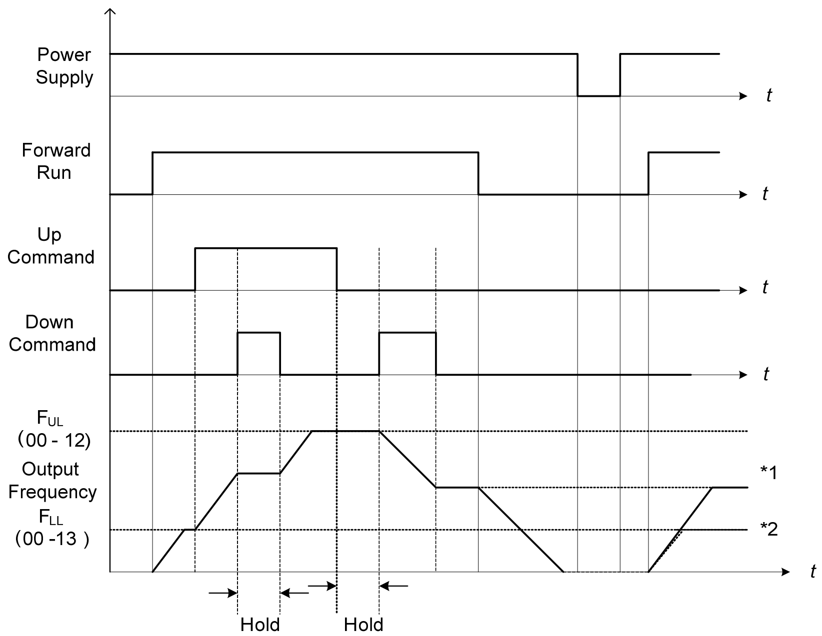


Figure 4.4.17 Up / Down command timing diagram

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 4.4.1 and Figure 4.4.6.

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 = 1, the frequency reference value is saved when the acceleration/deceleration inhibition command is active and even when powering down the inverter.

Refer to Fig.4.4.18. for an example.

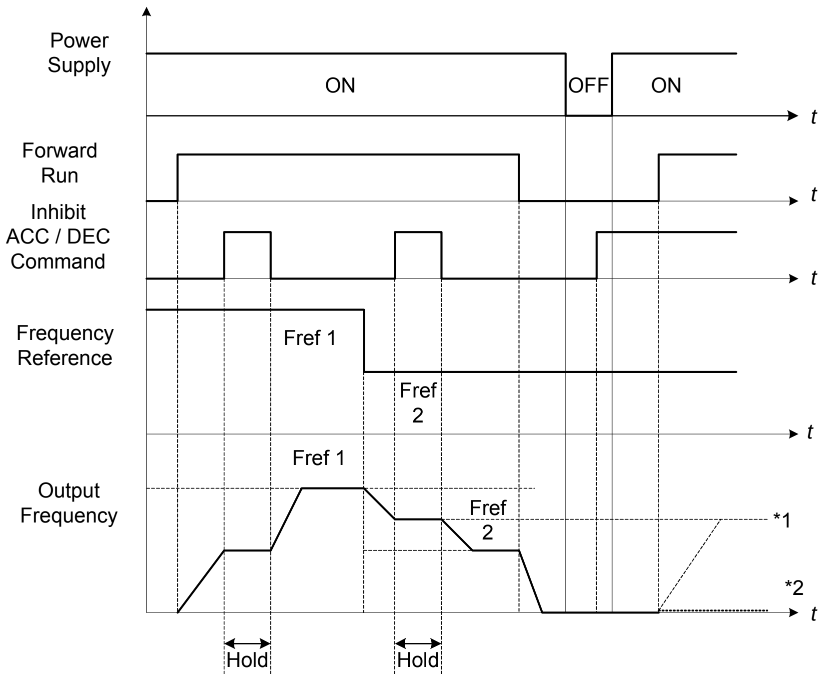


Figure 4.4.18 Acceleration / deceleration inhibition command operation

*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 "deceleration time of emergency stop" of 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 seach 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 seach 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.

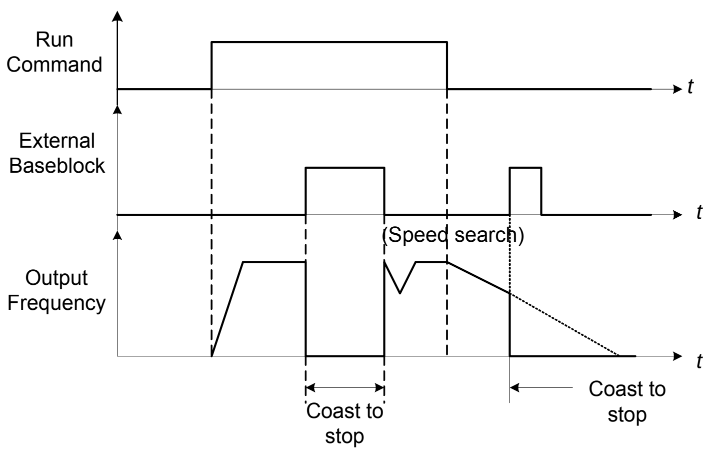


Figure 4.4.19 External base block operation

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).

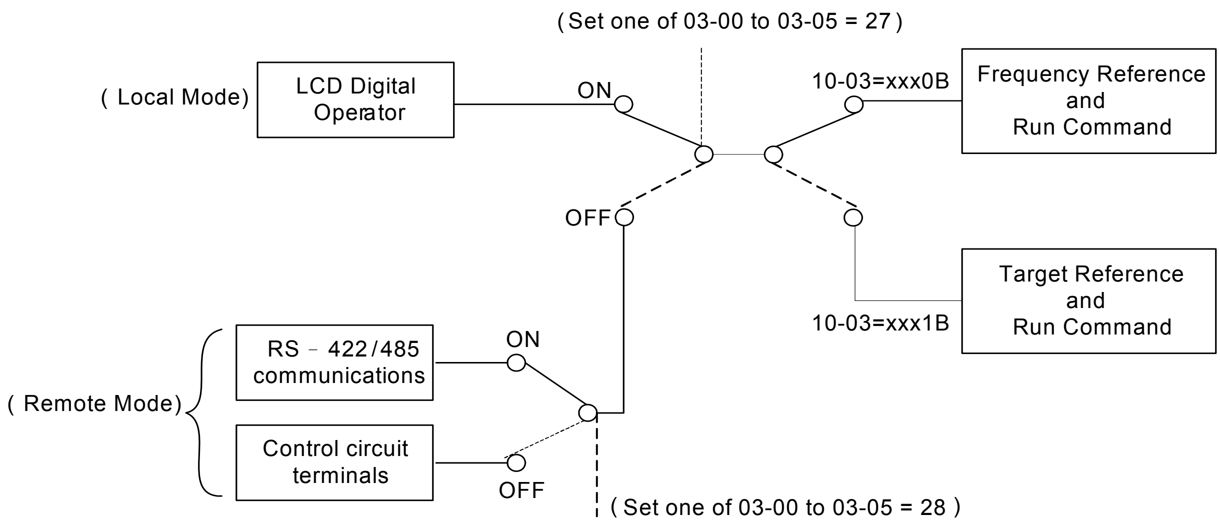


Figure 4.4.20 Remote mode operation selection

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.4.4.2.

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: Either short-circuits braking command or DC braking command is selected. If these two modes are both selected, SE02 error (DI Terminal Error) will occur.

Refer to the DC braking time diagram in Fig.4.4.21.

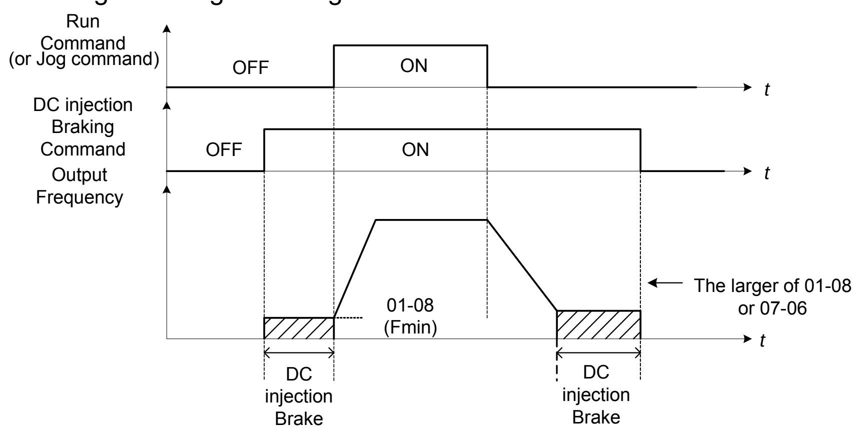


Figure 4.4.21 DC braking timing diagram

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 (Foreced 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.4.4.21a for more details.

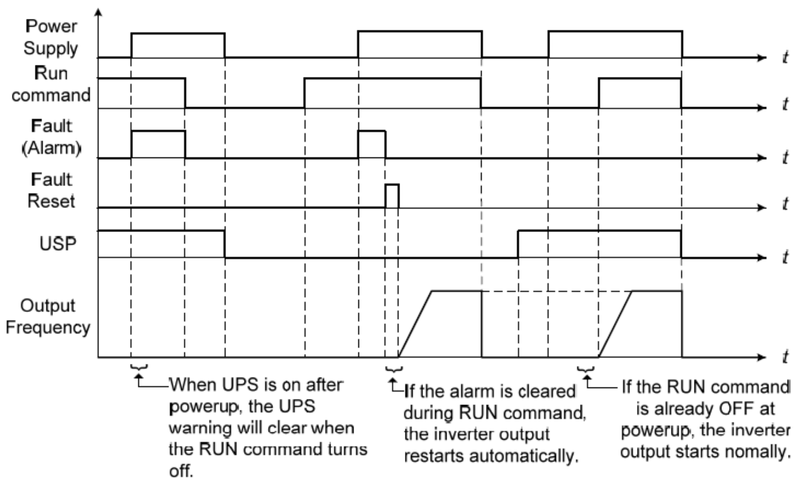


Figure 4.4.21a Unattended Start Protection

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 of10-03 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.

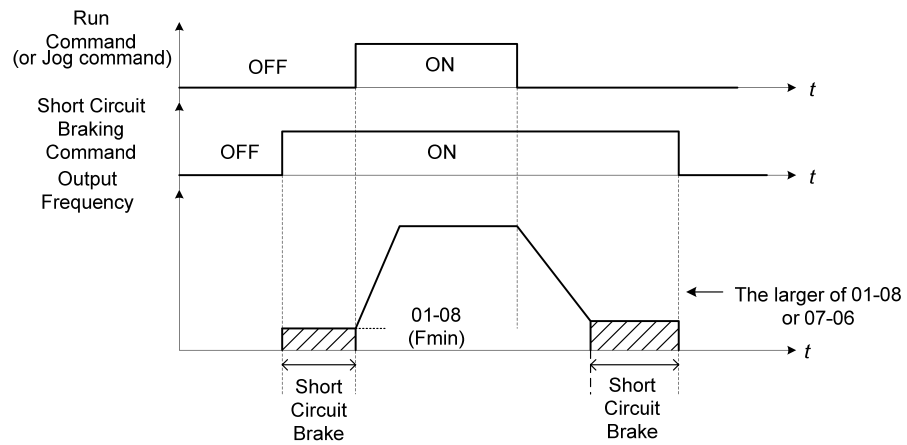
03-0X =58: Run Permissive Function

When digital input terminal enables, inverter will stop via the set of parameter 08-30 after Run Permissive Function function is active.

03-0X =63: Switch to Tolerance Range of Constant Pressure 2
When using in PUMP mode (23-00=1), the tolerance range of constant pressure (23-09) will be used for waking up the inverter. When digital input terminal enables, the tolerance range of constant pressure 2 (23-34) will be used.

03-0X =65: Short-circuit breaking
To stop inverter by turning on Short-circuit breaking with setting terminal. If executing run command or jog command, short-circuit breaking command will erased and start to run. The following picture is short-circuit breaking time process.

Note: Either short-circuits braking command or DC braking command is selected. If these two modes are both selected, SE02 error (DI Terminal Error) will occur.



03-0X =68: External Fault 2

- When an external fault occurs, the external fault 2 input terminal is turned on, the inverter will be turned off and the motor will free run to stop.
- If external input terminal S3 is set (03-02 = 68) as external fault, the message “EF3 Ext. Fault (S3)” (EF3) will be displayed.
- All six input terminals (S1 to S6) can be designated as external fault input.

03-0X =69: External Overload, Input Terminal is Normally Closed Switch.

- When external overload occurs, the external overload input terminal closed, the inverter will be turned off and the motor will decelerate to stop.
- If the external input terminal S5 is set (03-04 = 69) to external overload, “TOL Ext. OverLoad” message will be displayed.
- To enable the external overload function, the fire mode must be enabled first (08-48 =1), only the external input terminal S5 can be designated as External Overload Input.
- Setting the external input terminal as External Overload will set the input terminal as the normally closed, therefore, before setting the external overload function, do not set the operation command from the external terminal, otherwise, it will cause unnecessary damage.

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 【0xxxb】：S4 A contact 【1xxxb】：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
03-20	Relay(R4A-R4C) Output *1
03-21	Photo-coupler(DO2-DOG) Output *1
03-39	Relay (R3A-R3C) Output
Range	【0】: During Running 【1】: Fault Contact Output 【2】: Frequency Agree 【3】: Setting Frequency Agree (03-13±03-14) 【4】: Frequency Detection 1 (≧ 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 【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** 【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 (≧ 03-44+03-45)** 【51】: **Frequency Detection 4 (< 03-44)** 【52】: **Frequency Detection 5 (≧ 03-46+03-47)** 【53】: **Frequency Detection 6 (< 03-46)** 【54】: **Turn on short-circuit braking** 【57】: **Low Current Detection** 【58】: **Frequency Deceleration Detection** 【59】: **Overheat Detection**

*1: The parameters are available when the I/O expansion card installed.

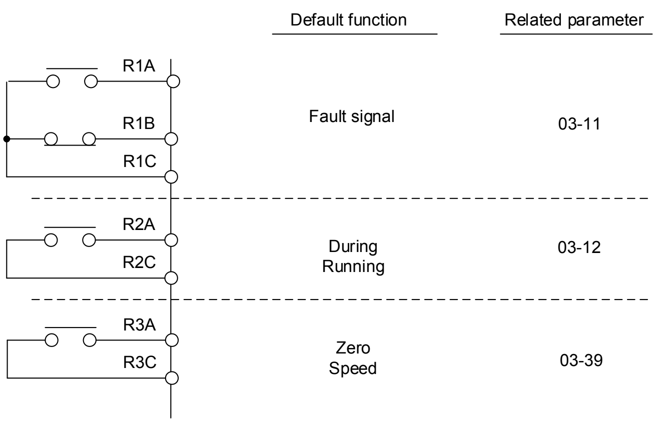


Figure 4.4.22 Multi-function digital output and related parameters

Table 4.4.6 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)	O	O	O
1	Fault Contact Output	Fault	ON: Fault contact output (except CF00 and CF01)	O	O	O
2	Frequency Agree	Freq. Agree	ON: Frequency agree (frequency agree width detection is set by 03-14)	O	O	O
3	Setting Frequency Agree	Setting Freq Agree	ON: Output frequency = allowed frequency detection level (03-13) ± frequency bandwidth (03-14)	O	O	O
4	Frequency Detection 1	Freq. Detect 1	ON: Output frequency ≧ 03-13 + 03-14	O	O	O
5	Frequency Detection 2	Freq. Detect 2	OFF: Output frequency ≧ 03-13 + 03-14	O	O	O

Value	Function		Description	Control Mode		
	Name	LCD Display		V/F	SLV	PM SLV
6	Automatic Restart	Auto Restart	ON: the period of automatic restart	O	O	O
7~8	Reserved	Reserved	Reserved	-	-	-
9	Baseblock	Baseblock	ON: During baseblock	O	O	O
10~11	Reserved	Reserved	Reserved	-	-	-
12	Over-Torque Detection	Over Torque	ON: Over torque detection is ON	O	O	O
13	Current Agree	Current Agree	ON: Output current > 03-15	O	O	O
14	Mechanical Brake Control (03-17~03-18)	Mechanical Brake Control	ON: Mechanical brake release frequency OFF: Mechanical brake operation frequency	O	O	O
15~17	Reserved	Reserved	Reserved	-	-	-
18	PLC Status	PLC statement	ON: when 00-02 is set to 3 (PLC operation command source)	O	O	O
19	PLC Control	Control From PLC	ON: Control from PLC	O	O	O
20	Zero Speed	Zero Speed	ON: Output frequency < Minimum output frequency (Fmin)	O	O	O
21	Inverter Ready	Ready	ON: Inverter ready (after power on, no faults)	O	O	O
22	Undervoltage Detection	Low Volt Detected	ON: DC bus voltage = < Low-voltage warning detection level (07-13)	O	O	O
23	Source of Operation Command	Run Cmd Status	ON: Operation command from LED digital operator (local mode)	O	O	O
24	Source of Frequency Command	Freq Ref Status	ON: Reference frequency from LED digital operator (local mode)	O	O	O
25	Low Torque Detection	Under Torque	ON: Low-torque detection is ON	O	O	O
26	Frequency Reference Missing	Ref. Loss.	ON: Reference frequency loss	O	O	O
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	O	O	O
28~31	Reserved	Reserved	Reserved	-	-	-
32	Communication Control Contacts	Control From Comm	ON: DO is set by communication control.	O	O	O
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.	O	O	O
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.	O	O	O
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.	O	O	O
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.	O	O	O
37	Detection Output of PID Feedback Loss	PID Fbk Loss	ON: PID Feedback Loss	O	O	O

Value	Function		Description	Control Mode		
	Name	LCD Display		V/F	SLV	PM SLV
38	Brake Release	Brake Relase	ON: Brake Release	X	O	X
42	Over-High Pressure	High PSI	ON:High PSI Warning/Fault	O	X	X
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 > 03-44，Hysteresis range :03-45	O	O	O
51	Frequency Detection 4	Freq. Detect 4	OFF: output frequency > 03-44，Hysteresis range :03-45	O	O	O
52	Frequency Detection 5	Freq. Detect 5	ON: output frequency > 03-46，Hysteresis range :03-47	O	O	O
53	Frequency Detection 6	Freq. Detect 6	OFF: output frequency > 03-46，Hysteresis range :03-47	O	O	O
54	Turn on short-circuit braking	SC Brk	ON: Turn on short-circuit breaking	X	X	O
57	Low Current Detection	Low Current Detect	ON: Output Current ≦ 03-48 Low current detection level	O	O	O
58	Frequency Deceleration Detection	Freq. Decel to	ON: Output Frequency < Frequency Command – parameter 03-14 in deceleration	O	O	O
59	OH Detection	OH Detect	ON: Heat Sink Fin Temperature >08-46, hysteresis Zone 08-47	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 (o3-14) and deactivates when the output frequency falls below frequency detection level (o3-13).

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 >=minimum output frequency (01-08, Fmin)
Off	Output frequency is <=the minimum output frequency

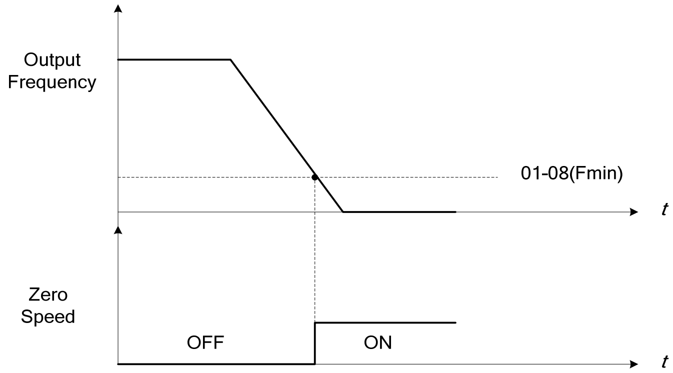


Figure 4.4.23 Zero-speed operation

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
When output current ≦ 03-48, the relay is active.

03-1X=58: Frequency Deceleration Detection
When output frequency < frequency command- 03-14 in deceleration, the relay is active.

03-1X=59: Over Temperature Detection
The Heat Sink Temperature > 08-46, the relay is active, the Magnetic Hysteresis Zone is set by 08-47.

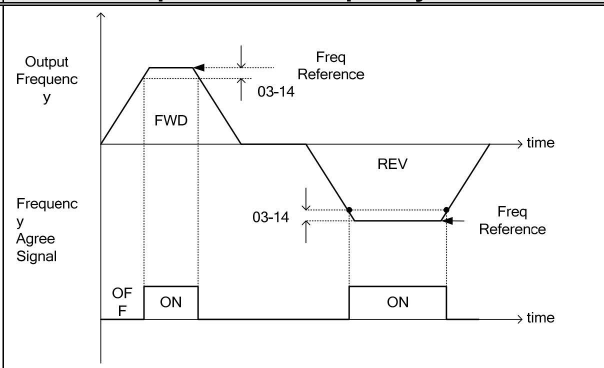
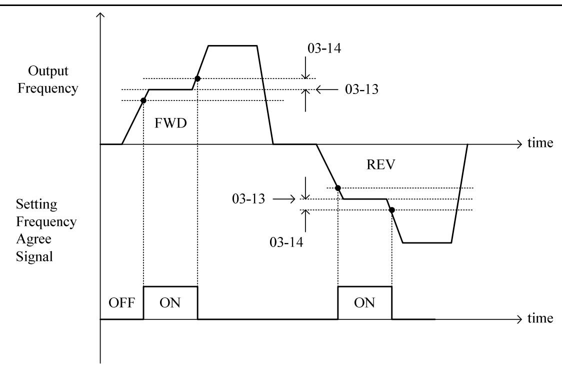
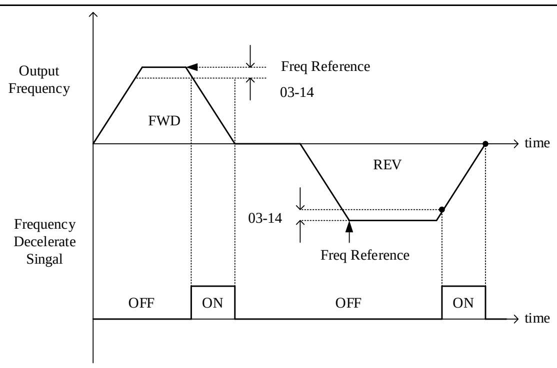
03-13	Frequency Detection Level
Range	【0.0~599.0】 Hz
03-14	Frequency Detection Width
Range	【0.1~25.5】 Hz
03-44	Frequency Detection Level 2

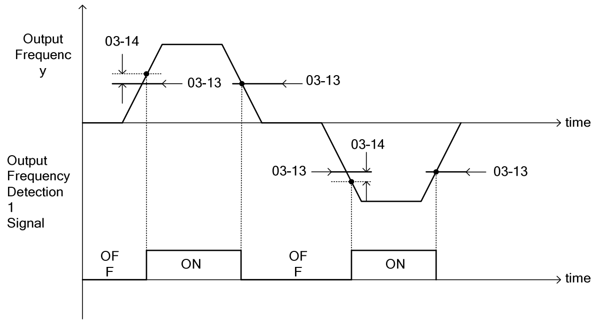
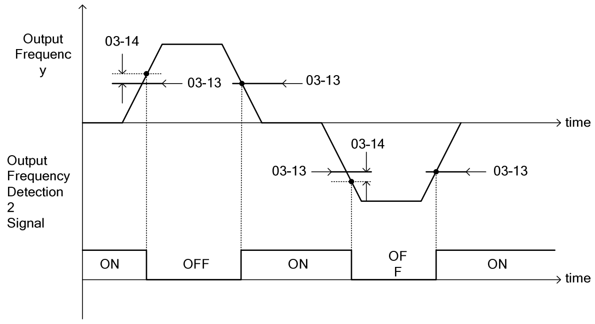
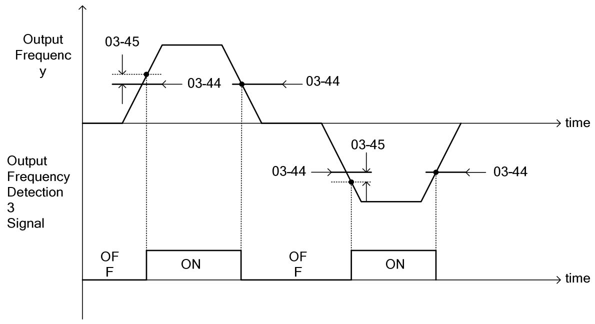
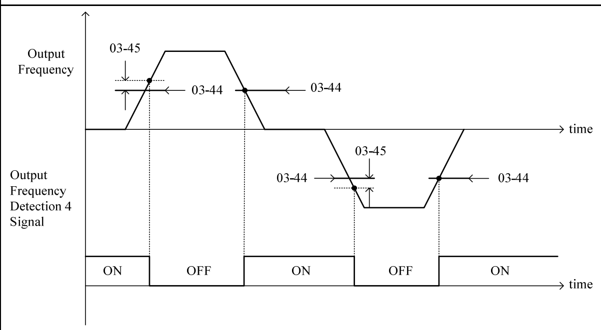
Range	【0.0~599.0】 Hz
03-45	Frequency Detection Width 2
Range	【0.1~25.5】 Hz
03-46	Frequency Detection Level 3
Range	【0.0~599.0】 Hz
03-47	Frequency Detection Width 3
Range	【0.1~25.5】 Hz
03-50	Frequency Detection Level 4
Range	【0.0~599.0】 Hz
03-51	Frequency Detection Level 5
Range	【0.0~599.0】 Hz
03-52	Frequency Detection Level 6
Range	【0.0~599.0】 Hz

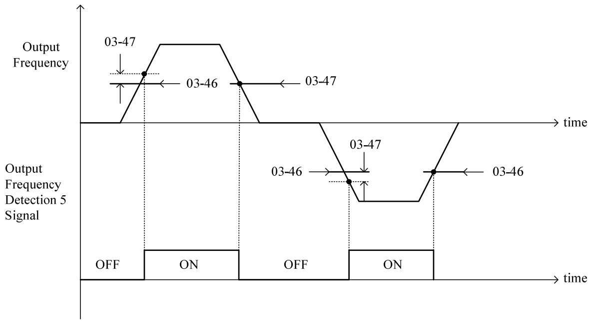
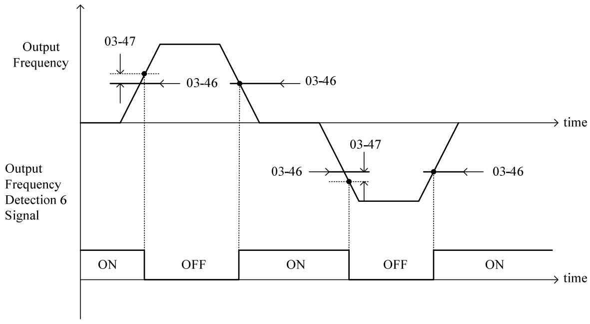
Frequency Detection Level: set the multi-function output terminals R1A-R1C, R2A-R2C or R3A-R3C (03-11, 03-12 or 03-39) to the output frequency detection signal. Set frequency and output frequency detection 1 and 2.

The time charts for the Frequency Agree Detection operation are shown in the following Table 4.4.7.

Table 4.4.7 Frequency Detection Operation

Function	Detection operation of frequency confirmation	Description
Frequency agree		• 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).
Set 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). • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 3 (Set frequency agree)
Frequency Deceleration Detection		• Signal of frequency deceleration is ON when output frequency is out of the range between frequency reference minus frequency detection width (03-14) • Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 58 (Frequency Deceleration Detection)

Function	Detection operation of frequency confirmation	Description
Output frequency detection 1		• 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).
Output frequency detection 2		• 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).
Output frequency detection 3		• 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		• 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).

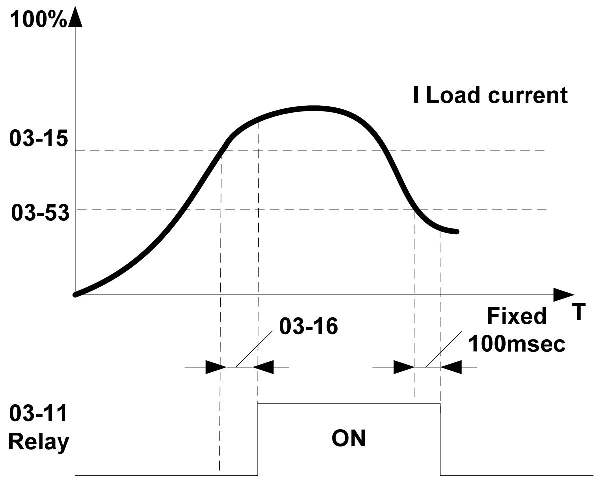
Function	Detection operation of frequency confirmation	Description
Output frequency detection 5		• Output frequency detection 5 signal is ON in acceleration when the output frequency rises above the frequency detection level 3 (03-46) + frequency detection width 3 (03-47). • Output frequency detection 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		• 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
Range	【0.1~999.9】 A
03-16	Delay Time of Current Agree Detection
Range	【0.1~10.0】 Sec
03-53	Current Agree Level 2
Range	【0.0~999.9】A

Note: The Maximum Value of 03-53 will be limited by Setting Value of 03-15

- 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. In addition, when the Output Current is ≤ 03-53, the delay time of relay signal from ON to OFF is 100ms (constant).

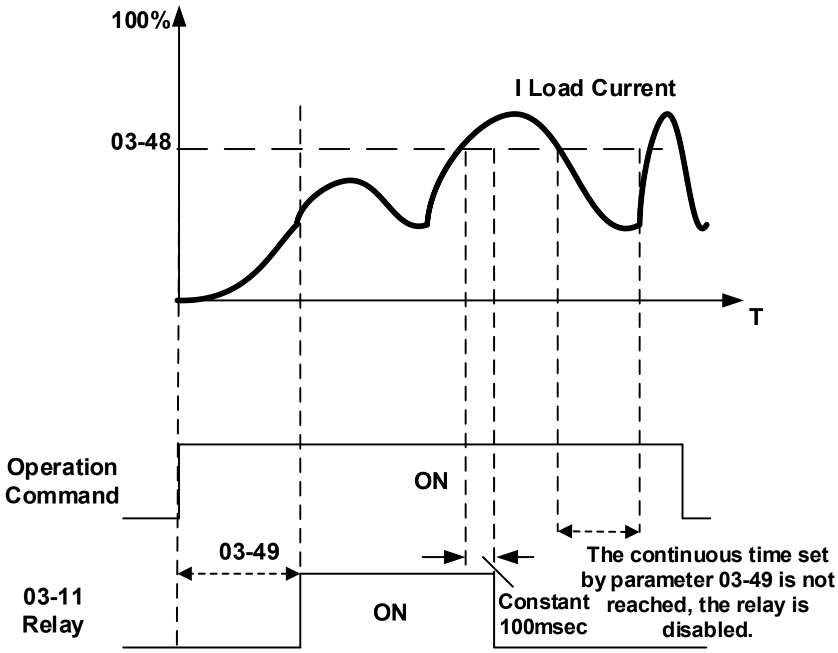
Timing Diagram:



03-48	Low Current Detection Level
Range	【0.1~999.9】 A
03-49	Low current Detection Delay Time
Range	【0.00~655.34】 Sec

- 03-11 =57: Relay is active when output current is lower than that in 03-48.
- 03-48: Setting value: 0.1~999.9; when it is 0.0, function of low current detection is disabled.
- 03-49: Setting value: 0.00~655.35 (unit: sec); when the current is continuously lower than the setted value of parameter 03-48 within the setted time of parameter 03-49, the relay is enabled. The delay time of relay signal from ON to OFF is 100ms (constant).

Timing Diagram:

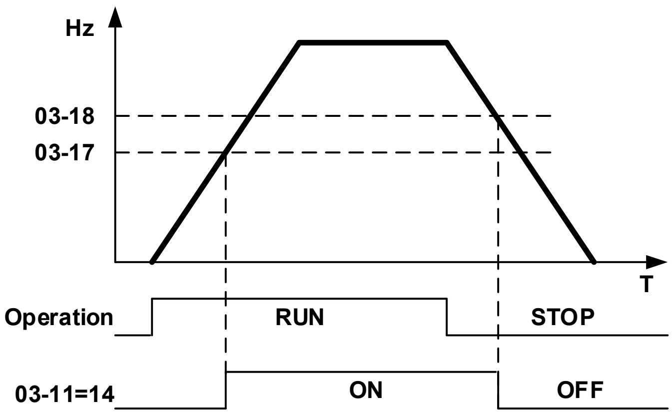


03-17	Setting of Mechanical Brake Release Level
Range	0.00~599.00 Hz
03-18	Setting of Mechanical Brake Operation Level
Range	0.00~599.00 Hz

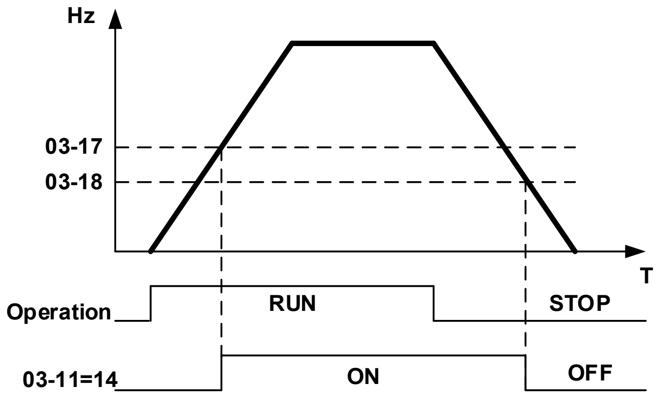
When 03-11=14,

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	【xxx0b】: R1A normally open 【xxx1b】: R1A normally close 【xx0xb】: R2A normally open 【xx1xb】: R2A normally close 【x0xxb】: R3A normally open 【x1xxb】: R3A normally close 【x0xxb】: R4A normally open 【x1xxb】: R4A normally close *1
03- 29	Photo-coupler Output Selection (DO2-DOG) *1
Range	【xx0xb】: Photo-coupler 2 A Contact 【xx1xb】: Photo-coupler 2 B Contact

*1: The parameters are available when the I/O expansion card installed.

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)

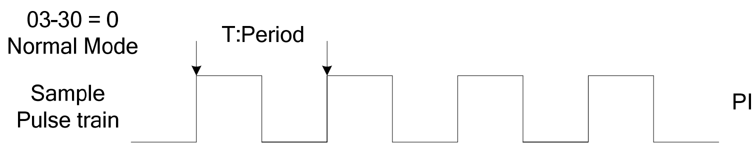
It is required to input the correct frequency.

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.

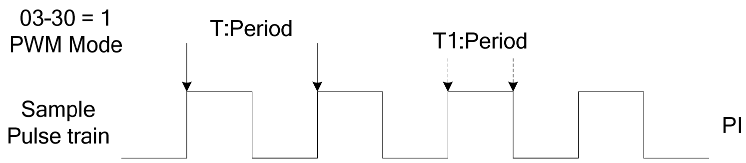
Note: Tolerance range of pulse time period in PWM modes is ±12.5%. If it is over than the range, it is inactive.

Diagram of pulse input selection:



$$\text{Frequency} = \frac{1}{\text{T:Period}}$$

$$\text{Pulse Input Command} = \frac{\text{Frequency}}{\text{Scaling factor (using 03-31)}} \times 100\%(01\text{-}02)$$



$$\text{Pulse Input Command} = \frac{\text{T1:Period}}{\text{T:Period}} \times 100\%(01\text{-}02)$$

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.4.4.24 for the pulse input specification.

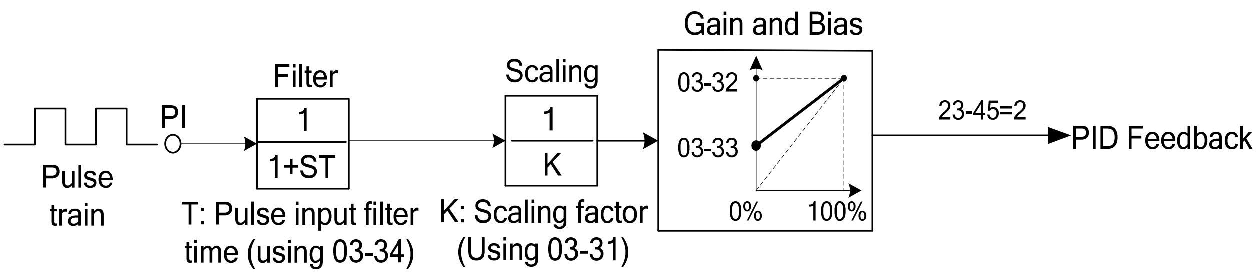


Figure 4.4.24 Pulse input adjustment

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

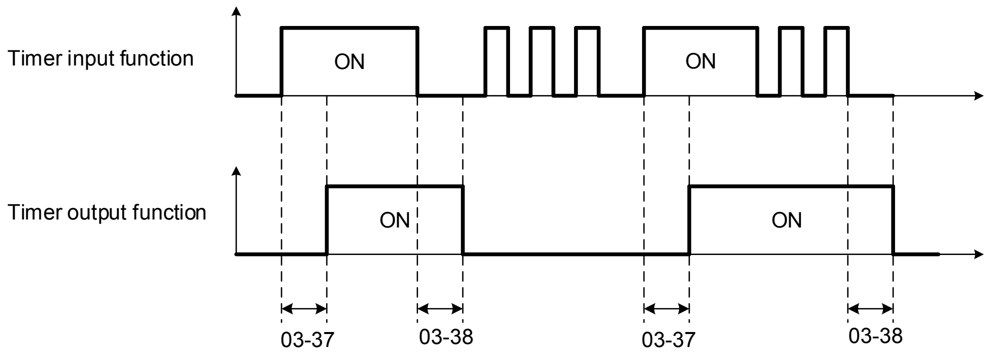
Enable the timer function be setting one of multi-function input parameters 03-00~03-05 (S1 to S6) to 35 (timer function input) and one of multi-function output parameters 03-11, 03-12, 03-39 (R1A-R1C to R3A-R3C) to 27 (timer function output).

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:

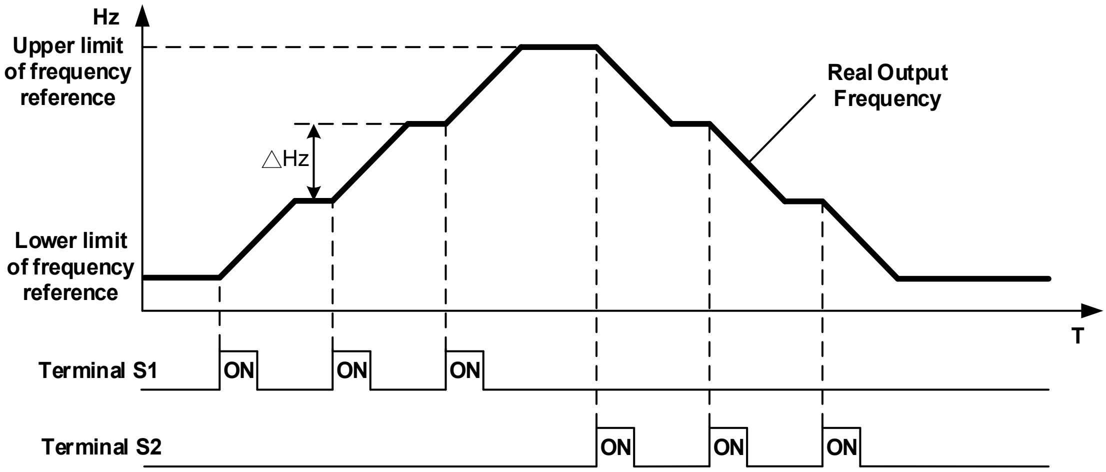


03- 40	Up/down Frequency Width Setting *1
Range	【0.00~5.00】Hz

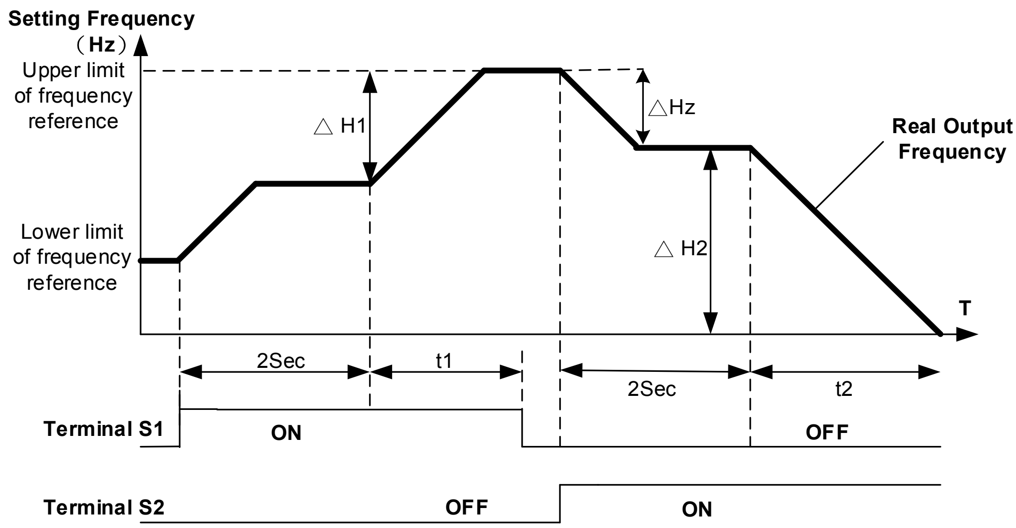
***1: It is new added in inverter software V1.4.**

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

Mode1: When 03-40 is set to 0Hz, it will maintain the original **up/down** function, shown **as** Fig. 4.4.20.
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 △**Hz** (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:

△H1: setting frequency increment in acceleration, t1: terminal conduction time in acceleration,

△H2: setting frequency increment in deceleration, t2: terminal conduction time in deceleration.

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

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

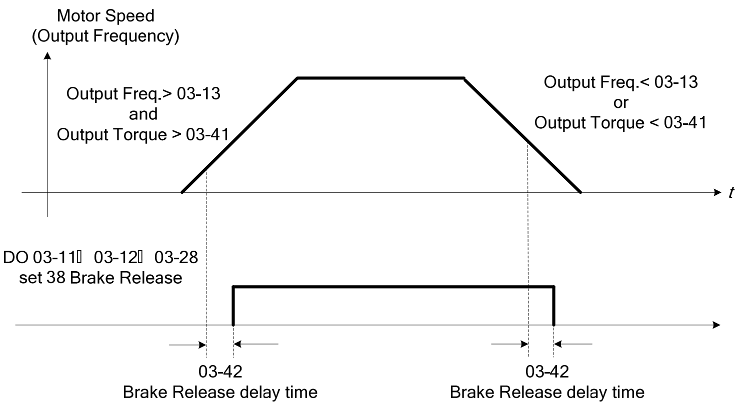
03- 41	**Torque Detection Level** *1
Range	**【0~150】%**
03-42	**Delay Time of Braking Action** *1
Range	**【0.00~65.00】Sec**

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

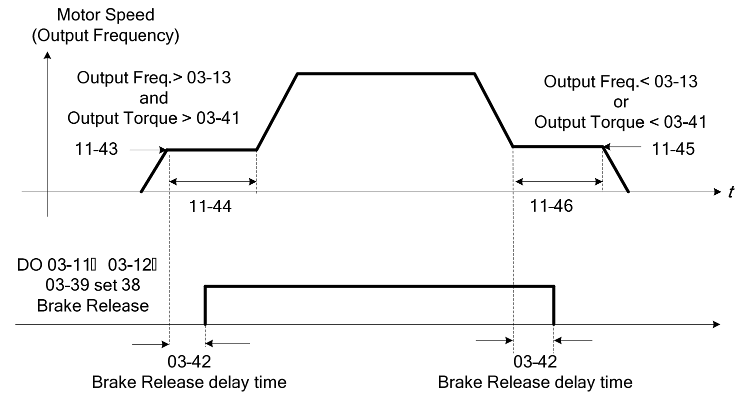
Function of Brake Release:

It requires function of frquecny 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:

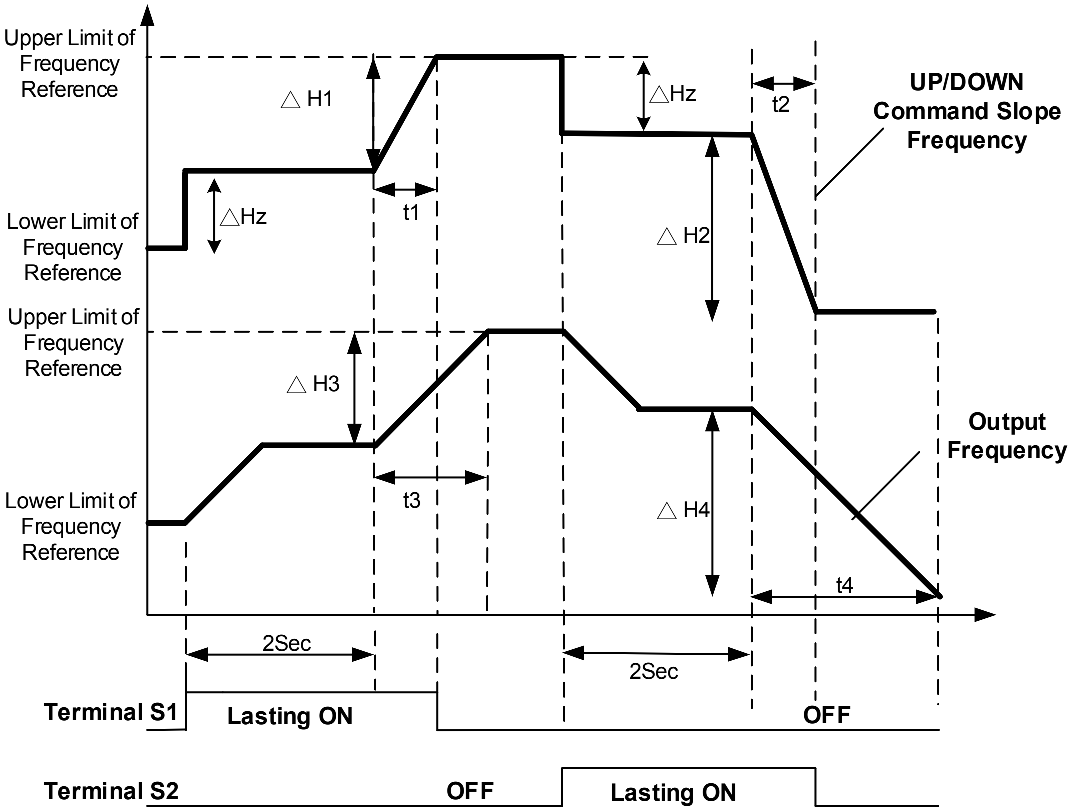


03-43	**UP/DOWN Acceleration/ Deceleration Selection**
Range	**【0】: Acceleration/Deceleration Time 1** **【1】: Acceleration/Deceleration Time 2**

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

Ex 1：

- 03-43=1(**Acceleration/ Deceleration Time 2**)
- Acceleration/ Deceleration Time 1 ＞ Acceleration/ Deceleration Time 2



Notes:

ΔH1: Frequency augmentation setting in acceleration, **t1:** Terminal conduction time in acceleration

ΔH2: Frequency augmentation setting in deceleration, **t2:** Terminal conduction time in deceleration

t3: Acceleration time in output

ΔH3: Output frequency augmentation in acceleration, **t4:** Deceleration time in output

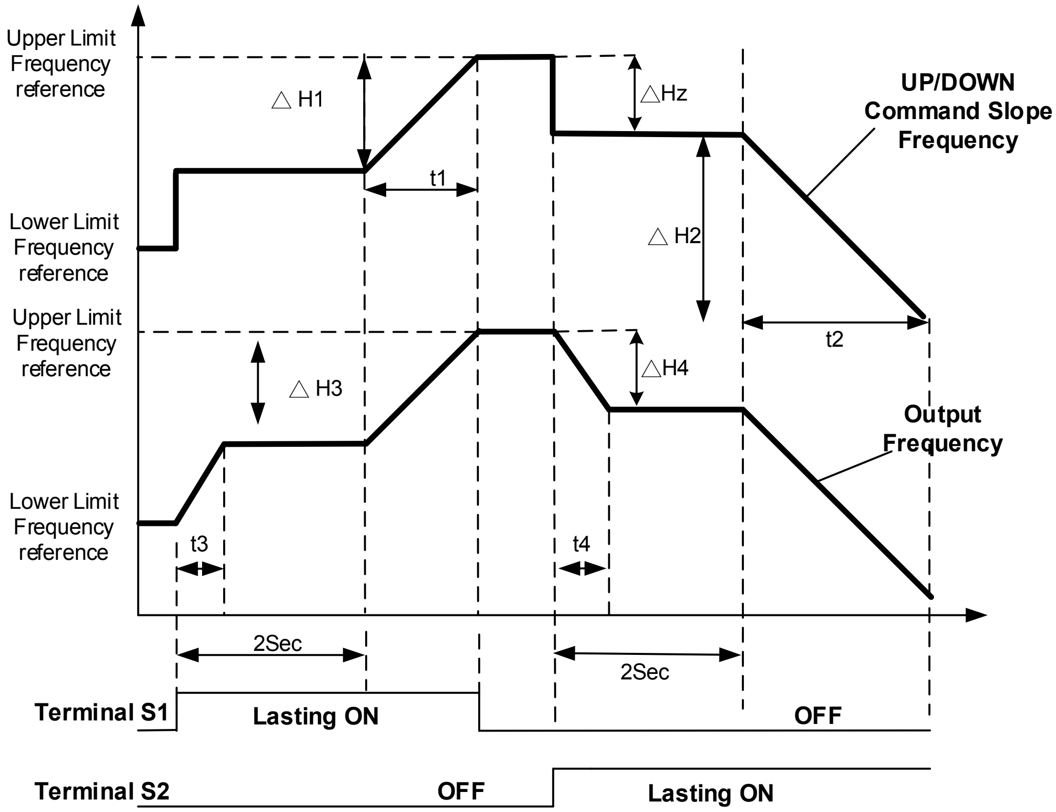
ΔH4: Output frequency augmentation in deceleration

$$\Delta H1 = \frac{\text{Upper limit Frequency}}{\text{Acceleration Time 2}} \times t1 \qquad \Delta H3 = \frac{\text{Upper Limit Frequency}}{\text{Acceleration Time 1}} \times t3$$

$$\Delta H2 = \frac{\text{Upper limit Frequency}}{\text{Deceleration Time2}} \times t2 \qquad \Delta H4 = \frac{\text{Upper Limit Frequency}}{\text{Deceleration Time1}} \times t4$$

Ex2：

- 03-43=1(**Acceleration/ Deceleration Time 2**)
- Acceleration/ Deceleration Time 1 ＜ Acceleration/ Deceleration Time 2



Notes:

ΔH1: Frequency augmentation setting in acceleration **t1:** Terminal conduction time in acceleration

ΔH2: Frequency augmentation setting in deceleration **t2:** Terminal conduction time in deceleration

t3: Acceleration time in output

ΔH3: Output frequency augmentation in acceleration, **t4:** Deceleration time in output

ΔH4: Output frequency augmentation in deceleration

$$\Delta H1 = \frac{\text{Upper limit Frequency}}{\text{Acceleration Time 2}} \times t1$$

$$\Delta H3 = \frac{\text{Upper Limit Frequency}}{\text{Acceleration Time 1}} \times t3$$

$$\Delta H2 = \frac{\text{Upper limit Frequency}}{\text{Deceleration Time2}} \times t2$$

$$\Delta H4 = \frac{\text{Upper Limit Frequency}}{\text{Deceleration Time1}} \times t4$$

Group 04 External Analog Input and Output Parameters

04- 00	**AI Input Signal Type**
Range	【0】: AI1 0~10V AI2 0~10V 【1】: AI1 0~10V AI2 4~20mA 【2】: Reserved 【3】: Reserved 【4】: AI1 4~20mA AI2 0~10V 【5】: AI1 4~20mA AI2 4~20mA
04- 09	**AI Input Signal Type on I/O expansion card** *1
Range	【0】: AI3 0~10V 【1】: AI3 -10~10V 【2】: AI3 4~20mA
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- 04	**AI negative Characteristics**
Range	【0】：Disable 【1】：Enable
04- 05	**AI2 Function Setting**
04- 10	**AI3 Function Setting** *1
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】%
04- 21	**AI3 Signal Scanning and Filtering Time** *1
Range	【0.00~2.00】Sec
04- 22	**AI3 Gain** *1

Range	【0.0~1000.0】%
04- 23	**AI3 Bias** *1
Range	【-100.0~100.0】%

*1: The parameters are available when the I/O expansion card installed.

For Standard H & C type:
Refer to the followings for the details of parameter 04-00 (AI input signal type)
AI2=0~10V, Set 04-00=0, tune SW2 on the control board ro V.
AI2=0~20mA, Set 04-00=0, tune SW2 on the control board to I.
AI2=4~20mA, Set 04-00=1, tune SW2 on the control board to I.
AI2=2~10V, Set 04-00=1, tune SW2 on the control board to V.

For Enhanced E & G type:
Refer to the followings for the details of parameter 04-00 (AI input signal type)
AI1=0~10V, Set 04-00=0 or 1, tune SW3 on the control board to V.
AI1=4~20mA, Set 04-00=4 or 5, tune SW3 on the control board to I.
AI2=0~10V, Set 04-00=0 or 2 or 4, tune SW4 on the control board to V
AI2=4~20mA, Set 04-00=1 or 3 or 5, tune SW4 on the control board to I.

For I/O expansion card:
Refer to the followings for the details of parameter 04-09 (AI input signal type)
AI3=0~10V, Set 04-09=0, tune SW7 on the I/O expansion card to V.
AI3=-10~10V, Set 04-09=1, tune SW7 on the I/O expansion card to V.
AI3=4~20mA, Set 04-09=2, tune SW7 on the I/O expansion card to I.

(1) Analog Input Level Adjustment AI1, AI2, AI3 (04-02, 04-03, 04-04, 04-07, 04-08, 04-22, 04-23)

Each analog input AI1and 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, Analog input signal AI3 can be adjusted with parameter 04-22 and 04-23. Refer to Fig.4.4.25.

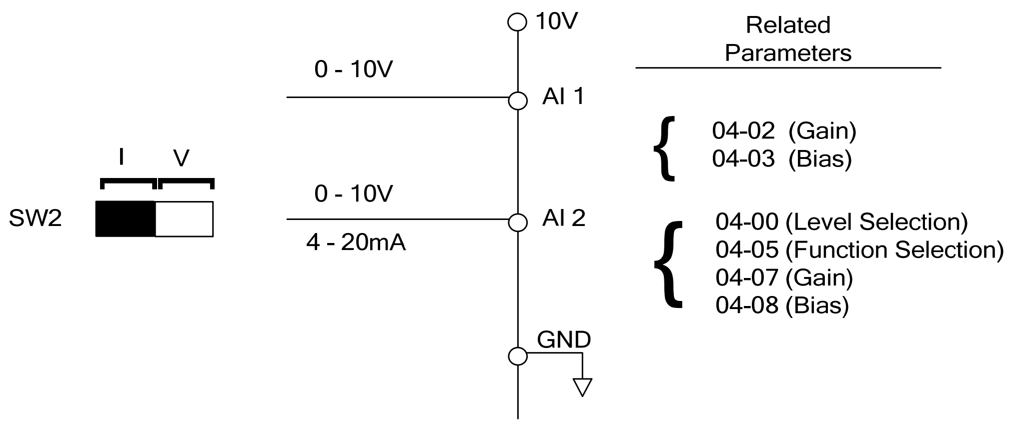


Figure 4.4.25 Analog inputs and related parameters (For Standard H & C type)

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.

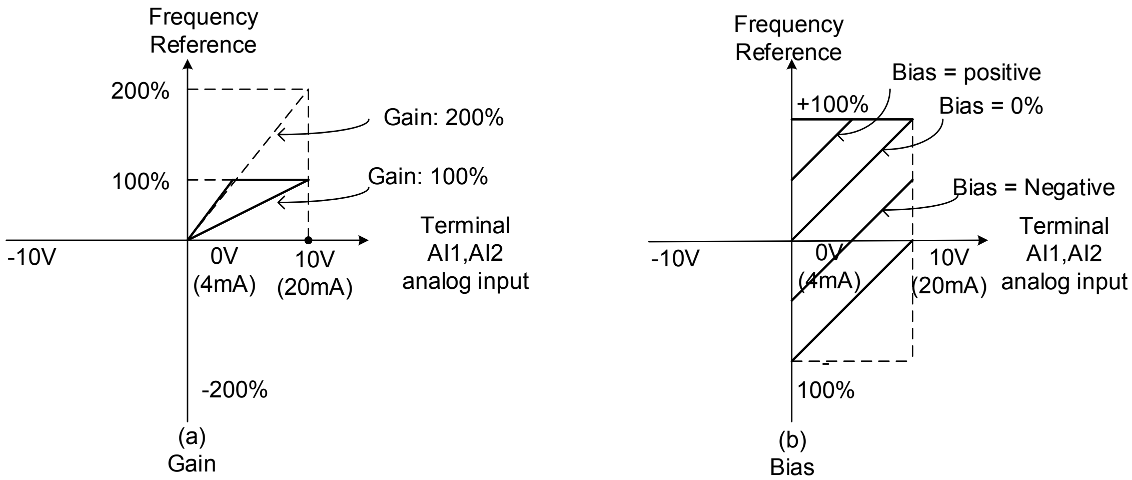
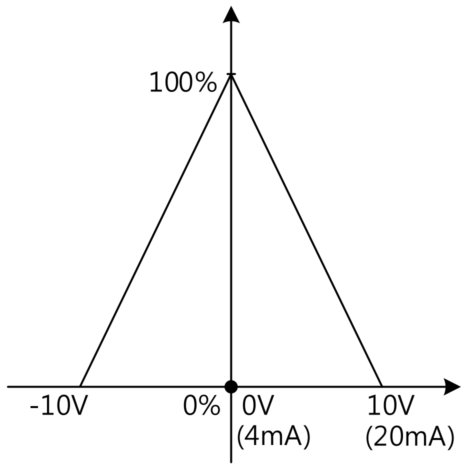


Figure 4.4.26 Gain and bias operations (for frequency reference signal)

04-04 (**AI negative characteristics**)

Through the following figure negative characteristics diagram find out the AI Input 10V, -10V, or 20mA input relative frequency reference to be used for the ratio of maximum output frequency (set the maximum output frequency 01-02 to 100%), the ratio will be presented in reverse.



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

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

(3) AI3 signal filtering time (04-21)

All analog inputs (AI1, AI2, AI3) 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.

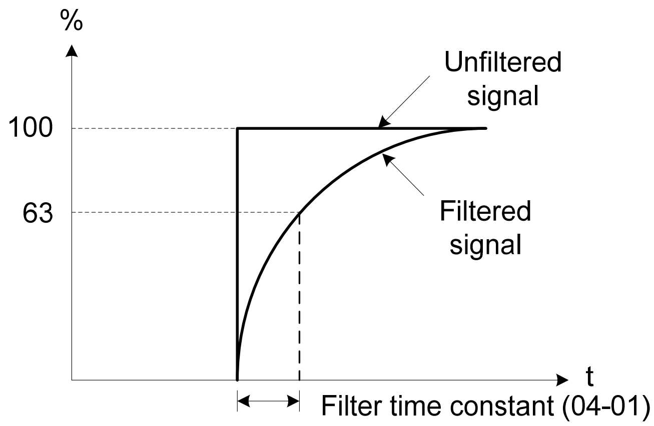


Figure 4.4.27 Filter time constant

(4) AI2 function setting (04-05/04-10)

AI2 is multi-function analog input terminal function selection. Refer to Table 4.4.8 for function overview

Table 4.4.8 Multi-function analog input list (04-05/04-10 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%	O	O	O
1	Frequency Reference Gain (FGAIN)	Freq Ref Gain	Aggregated gain＝ AI1 = 04-02 * FGAIN	O	O	O
2	Frequency Reference Bias (FBIAS)	Freq Ref Bias	Aggregated bias＝ AI1 = 04-03 * FBIAS	O	O	O
3	Output Voltage Bias (VBIAS)	Output Volt Bias	Aggregate output voltage =V/F curve voltage + VBIAS	O	X	O
4	Coefficient of Acceleration and Deceleration Reduction (K)	Tacc/Tdec Scaling	Actual acceleration and deceleration time = accel. and decal. time / K	O	O	O
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.	O	O	O

Value	Function		Description	Control mode		
	Name	LCD Display		V/F	SLV	PM SLV
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.	O	O	O
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%	O	X	O
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.	O	O	O
9	Jump Frequency 4	Jump Freq 4	Jump frequency 4. 100% = maximum output frequency	O	O	O
10	Added to AI1	Add to AI1	Added to AI1. 100% = maximum output frequency	O	O	O
11	Positive Torque Limit	Positive Tq Limit	100% = Motor's rated torque	X	O	O
12	Negative Torque Limit	Negative Tq Limit	100% = Motor's rated torque	X	O	O
13	Regenerative Torque Limit	Regen. Tq Limit	100% = Motor's rated torque	X	O	O
14	Positive / Negative Torque Limit	+/- Tq Limit	100% = Motor's rated torque	X	O	O
15	Torque Limit	Tq Limit	100% = Motor's rated torque	X	X	X
16	Torque Compensation	Tq Compensation	100% = Motor's rated torque	X	O	X
17	Reserved	No Function	Reserved	O	O	O

Note: When the setting of AI2 and AI3 are the same, use AI2 signal only.

04-05=0: Auxiliary frequency
When parameter 00-05 = 1 (main frequency from external control) the auxiliary speed reference frequency can be activated via the multi-speed input commands (see table 4.4.5). The auxiliary frequency command can be set via AI2/AI3. The maximum output frequency is set by 01-02, Fmax =100%.

04-05/04-10=1: Frequency Reference Gain (FGAIN)
Multi-function analog input AI2/AI3 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%.

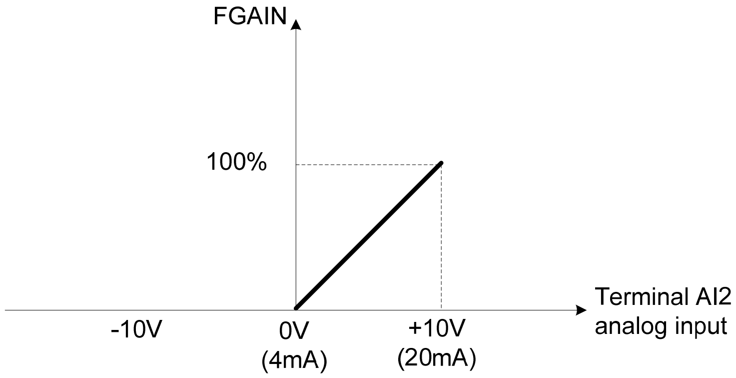


Figure 4.4.28 Frequency gain adjustment

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. 4.4.29.

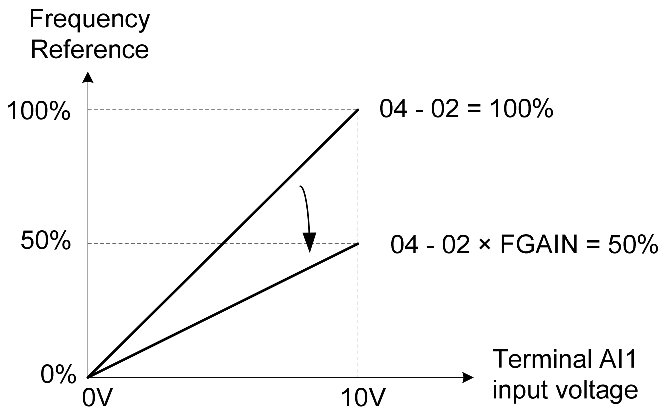


Figure 4.4.29 Frequency reference gain adjustment (example)

04-05/04-10=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%.

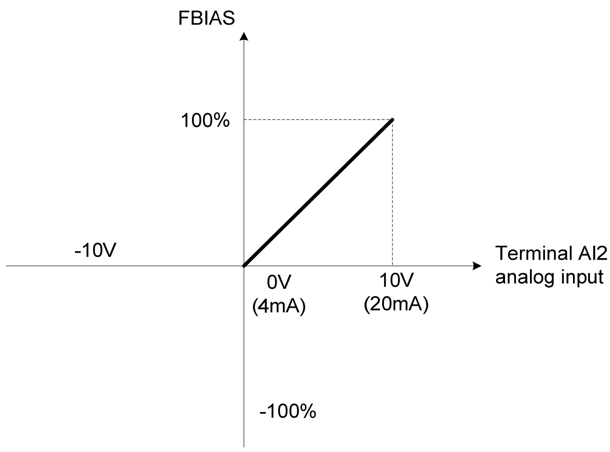


Figure 4.4.30 Bias adjustment

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.4.4.31.

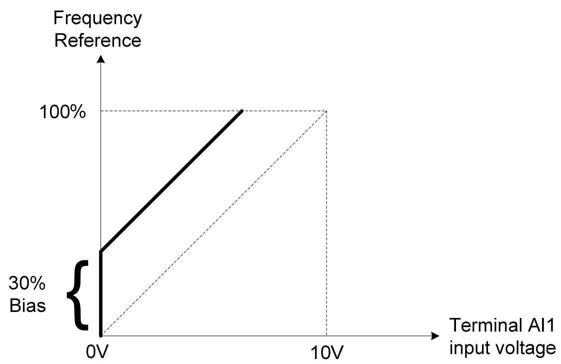


Figure 4.4.31 Frequency Reference bias adjustment (example)

04-05/04-10=3: Output Voltage Bias (VBIAS)
Multi-function analog input AI2/AI3 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, Vmax = 100%

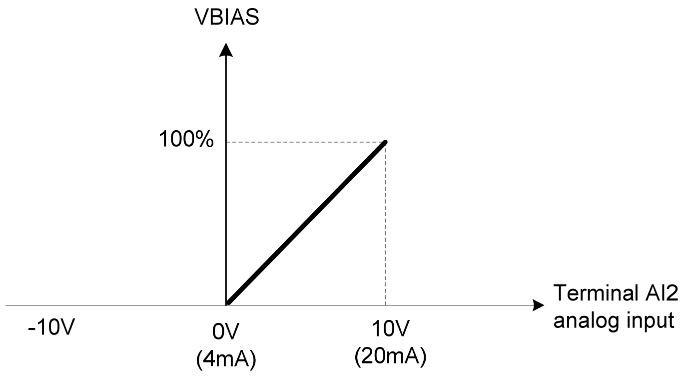


Figure 4.4.32 Bias adjustment

04-05/04-10=4: Acceleration and deceleration coefficient (K)
Multi-function analog input AI2/AI3 can be used to adjust the acceleration and deceleration time coefficient.
The actual acceleration and deceleration time is calculated as follows:

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

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

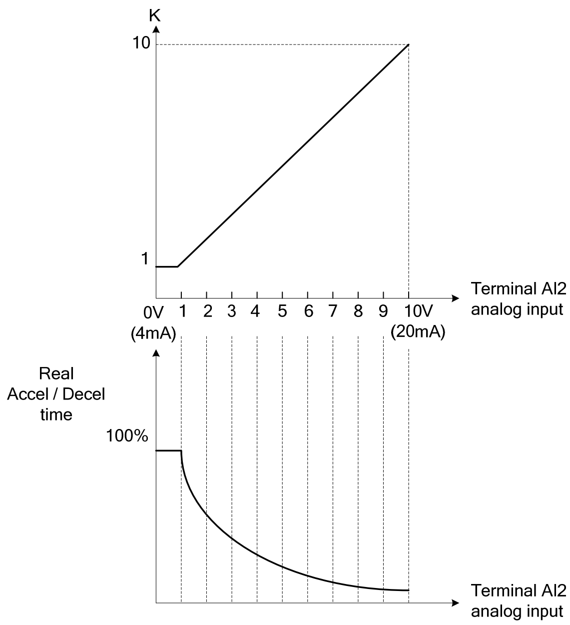


Figure 4.4.33 Acceleration / deceleration time reduction coefficient

04-05/04-10=5: DC braking current
Multi-function analog input AI2/AI3 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.

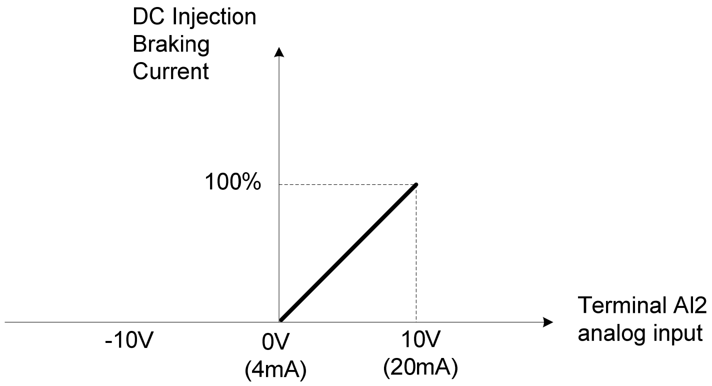


Figure 4.4.34 DC braking current adjustment

04-05/04-10=6: Over-torque detection level
Multi-function analog input AI2/AI3 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.

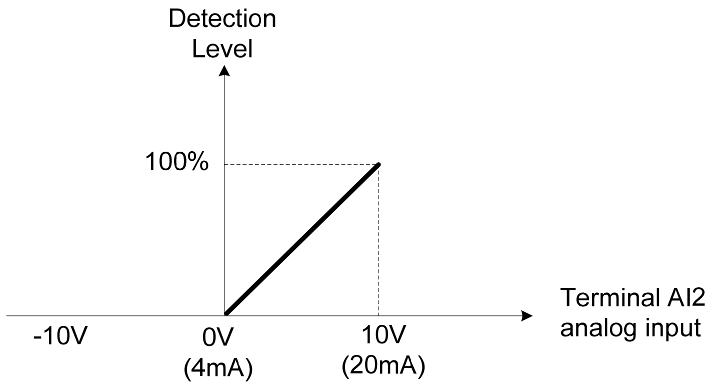


Figure 4.4.35 Over-torque/less torque detection level adjustment

4-05/04-10=7: Stall prevention level during running
Multi-function analog input AI2/AI3 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) or AI3 is set to control stall prevention level (04-10 = 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/AI3 can be used to reduce the stall prevention level during operation.

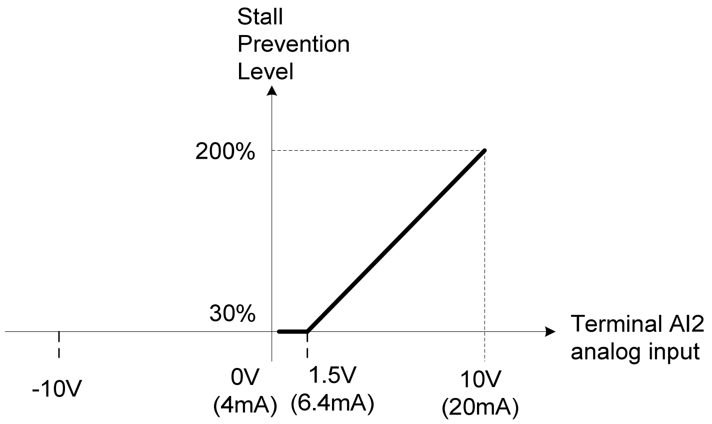


Figure 4.4.36 Stall prevention level adjustment during operation

04-05/04-10=8: Frequency lower limit

Multi-function analog input AI2/AI3 can be used to adjust the lower limit of frequency reference. Maximum output frequency (Fmax, 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/AI3.

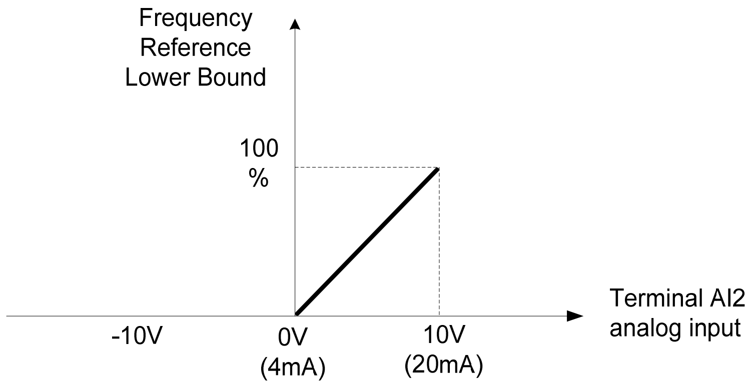
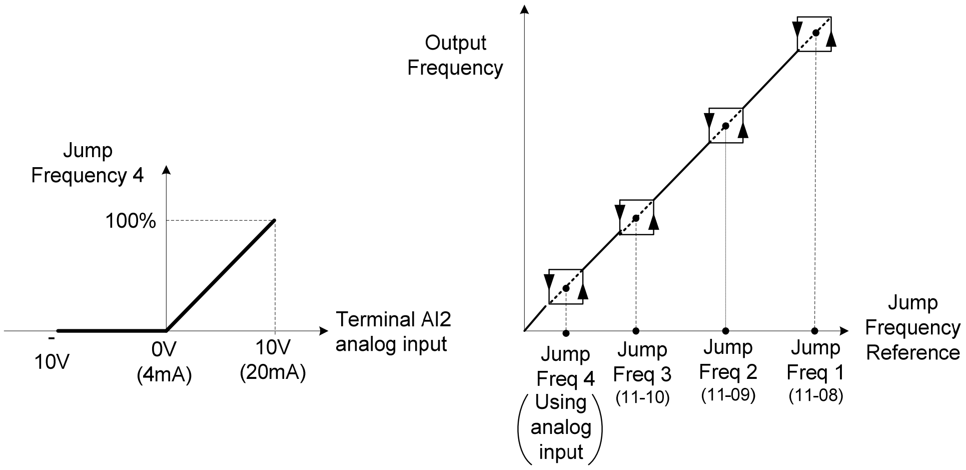


Figure 4.4.37 Adjustment of lower limit of frequency reference

04-05/04-10=9: Jump frequency 4

Multi-function analog input AI2/AI3 can be used to adjust Jump frequency 4.

Maximum output frequency (01-02, Fmax) = 100%. Setting 11-08 ~ 11-10 to 0.0Hz turns of the Jump frequency function.



(a) Jump Frequency 4 Adjustment

(b) Jump Frequency Hierarchy

Figure 4.4.38 Jump frequency 4 setting operation

04-05=10 or 04-10=10: Added to AI1

Multi-function analog input AI2/AI3 can be used as a bias level for analog input AI1.

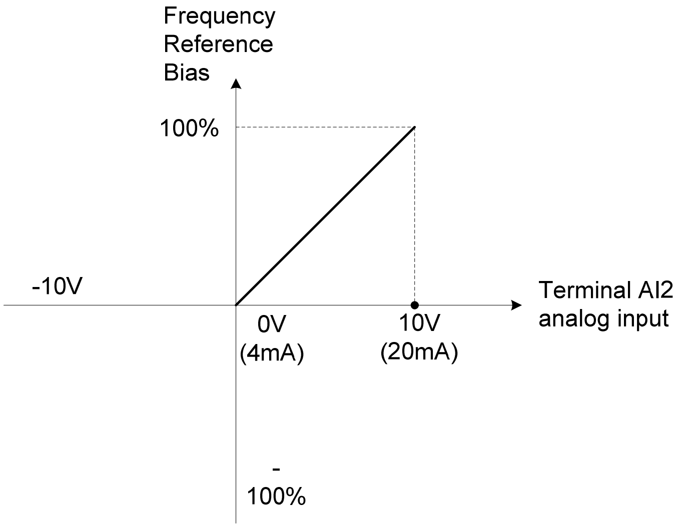


Figure 4.4.39 Added to AI1 as a bias operation

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**	**AO2 0~10V**
	【1】: AO1 0~10V	**AO2 4~20mA**
	【2】: AO1 4~20mA	**AO2 0~10V**
	【3】: AO1 4~20mA	**AO2 4~20mA**

For the analog output and related parameters, refer to Fig.4.4.40.

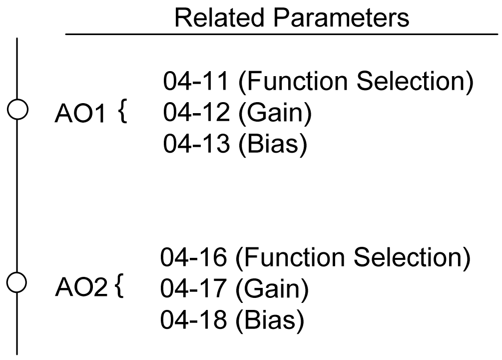


Figure 4.4.40 Analog outputs and related parameters

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).

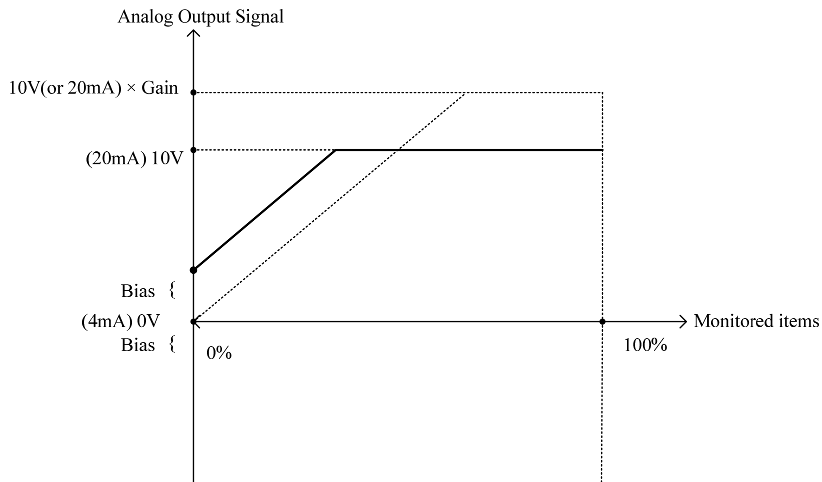


Figure 4.4.41 Analog output level adjustment

Table 4.4.9 **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 change of analog output signal.

Note: When this function is added, it will decrease the system reaction but increase interference protection.

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

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

Deceleration time calculation formula

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

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

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

Deceleration time calculation formula

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

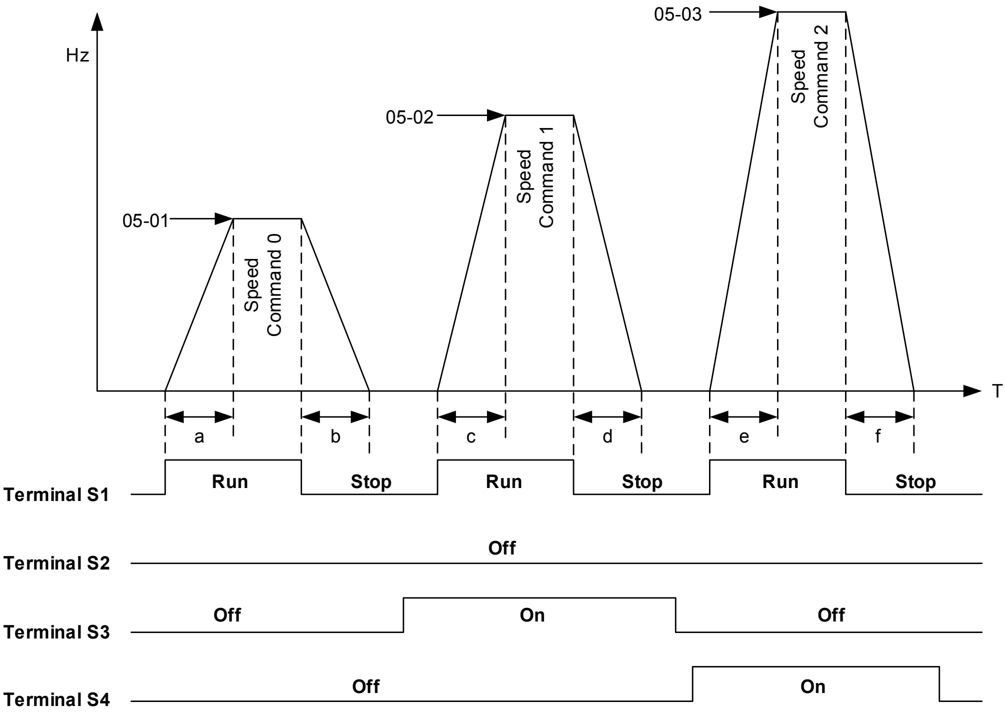
Example: Acceleration / deceleration timing when 05-00 is set to 1. In this example the following parameters are set:

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:

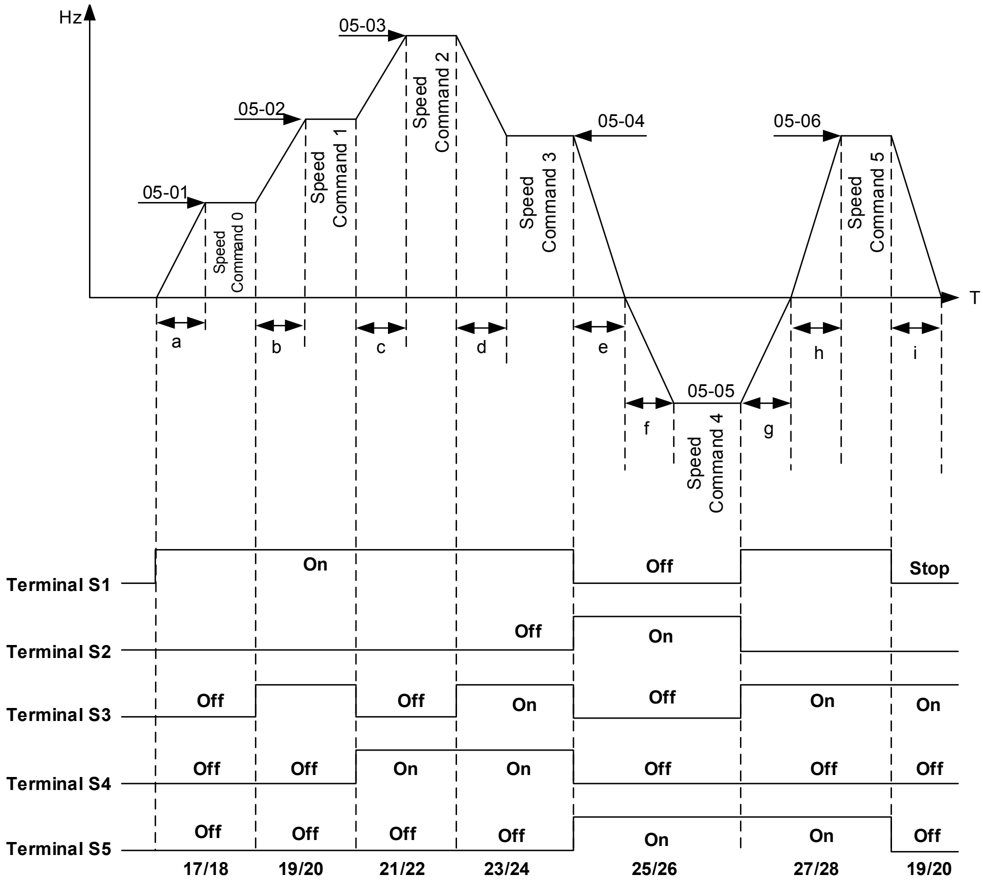


$$a = \frac{(05\text{-}17) \times (05\text{-}01)}{(01\text{-}02)} \qquad b = \frac{(05\text{-}18) \times (05\text{-}01)}{(01\text{-}02)} \qquad c = \frac{(05\text{-}19) \times (05\text{-}02)}{(01\text{-}02)} \quad \text{in sec.}$$

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

Acceleration / Deceleration Calculation Mode 2:

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



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

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

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

05- 01	*Frequency Setting of Speed-Stage 0
Range	【0.0~599.00】 Hz

05-02	*Frequency Setting of Speed- Stage 1 *1
Range	【0.0~599.00】 Hz

05-03	*Frequency Setting of Speed- Stage 2 *1
Range	【0.0~599.00】 Hz

05-04	*Frequency Setting of Speed- Stage 3 *1
Range	【0.0~599.00】 Hz

05-05	*Frequency Setting of Speed- Stage 4 *1
Range	【0.0~599.00】 Hz

05-06	*Frequency Setting of Speed- Stage 5 *1
Range	【0.0~599.00】 Hz

05-07	*Frequency Setting of Speed- Stage 6 *1
Range	【0.0~599.00】 Hz

05-08	*Frequency Setting of Speed- Stage 7 *1
Range	【0.0~599.00】 Hz

05-09	*Frequency Setting of Speed- Stage 8 *1
Range	【0.0~599.00】 Hz

05-10	*Frequency Setting of Speed- Stage 9 *1
Range	【0.0~599.00】 Hz

05-11	*Frequency Setting of Speed- Stage 10 *1
Range	【0.0~599.00】 Hz

05-12	*Frequency Setting of Speed- Stage 11 *1
Range	【0.0~599.00】 Hz

05-13	*Frequency Setting of Speed- Stage 12 *1
Range	【0.0~599.00】 Hz

05-14	*Frequency Setting of Speed- Stage 13 *1
Range	【0.0~599.00】 Hz

05-15	*Frequency Setting of Speed- Stage 14 *1
Range	【0.0~599.00】 Hz

05-16	*Frequency Setting of Speed- Stage 15 *1
Range	【0.0~599.00】 Hz

*: (When the motor's maximum output frequency is over than 300Hz, the frequency resolution is 0.1Hz.)

*1: It isnew added in inverter software V1.4. Parameters 05-02~05-16 is required to set the frequency in parameters 06-01~06-15 in inverter software V1.3.

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	【0】: Disable 【1, 4】: Execute a single cycle operation. Restart speed is based on the previous stopped speed. 【2, 5】: Execute continuous cycle operation. Restart speed is based on the previous cycle stop speed. 【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 **1 to 3:** After a stop the inverter will start with the incomplete step when the run command is re-applied. **4 to 6:** After a stop the inverter will start with the first step of the cycle when the run command is re-applied.

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	*1
06-02	*Frequency Setting of Operation -Stage 2	*1
06-03	*Frequency Setting of Operation -Stage 3	*1
06-04	*Frequency Setting of Operation -Stage 4	*1
06-05	*Frequency Setting of Operation -Stage 5	*1
06-06	*Frequency Setting of Operation -Stage 6	*1
06-07	*Frequency Setting of Operation -Stage 7	*1
06-08	*Frequency Setting of Operation -Stage 8	*1
06-09	*Frequency Setting of Operation -Stage 9	*1
06-10	*Frequency Setting of Operation -Stage 10	*1
06-11	*Frequency Setting of Operation -Stage 11	*1
06-12	*Frequency Setting of Operation -Stage 12	*1
06-13	*Frequency Setting of Operation -Stage 13	*1
06-14	*Frequency Setting of Operation -Stage 14	*1
06-15	*Frequency Setting of Operation -Stage 15	*1
Range	0.00~599.00 Hz	

***1: It is operation frequency in inverter software V1.4.**

*: **(When the motor's maximum output frequency is over than 300Hz, the frequency resolution is 0.1Hz.)**

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)

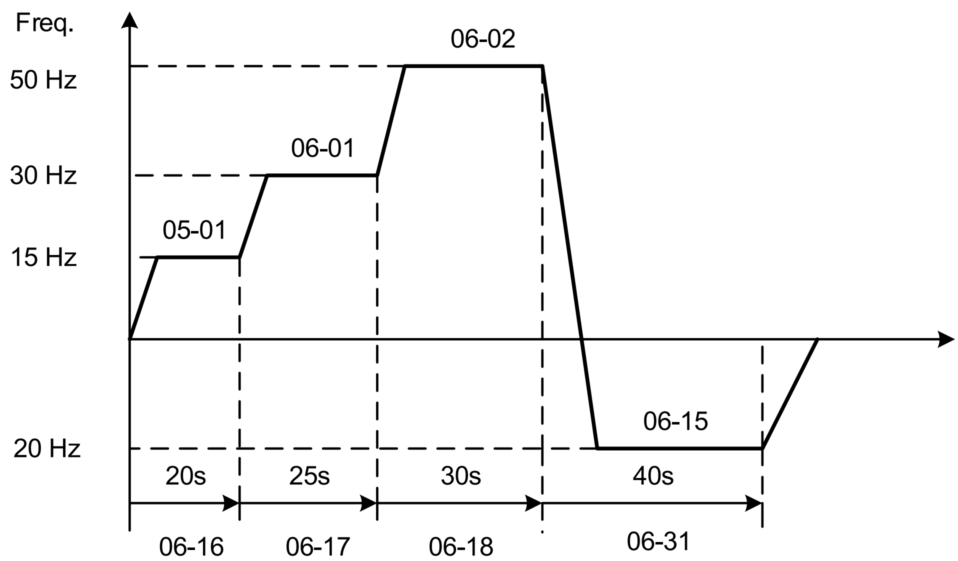


Figure 4.4.42 Single cycle automatic operation (stop)

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.

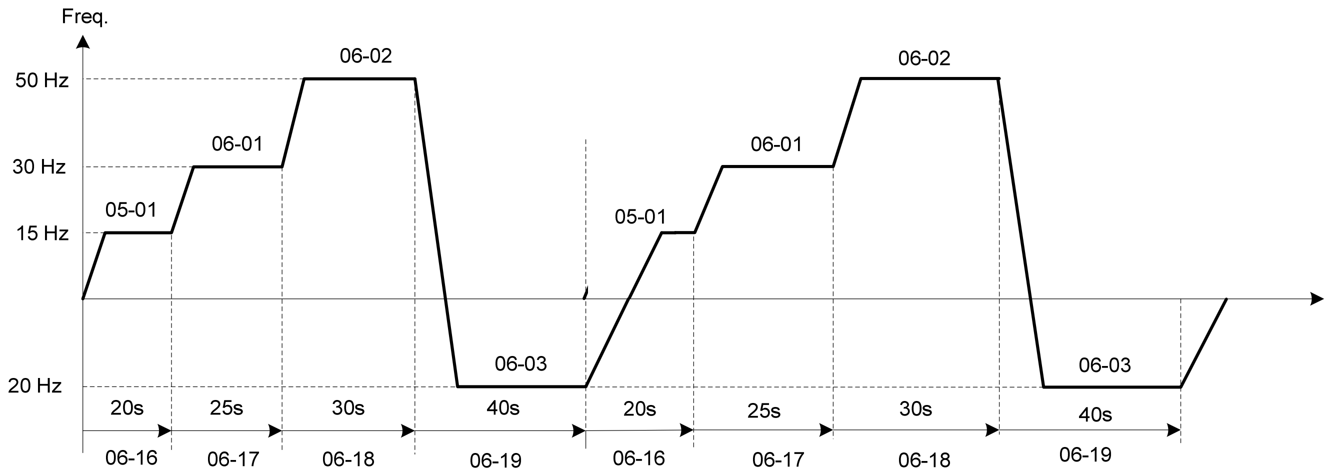


Figure 4.4.43 Periodic automatic operation

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.

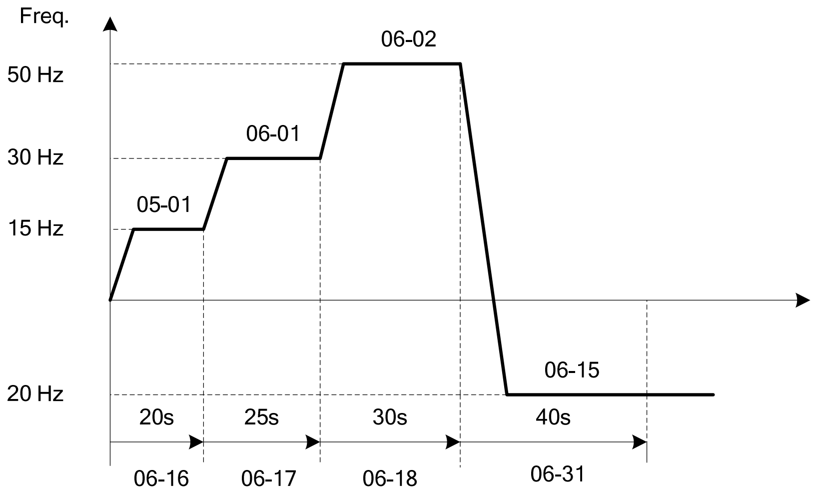
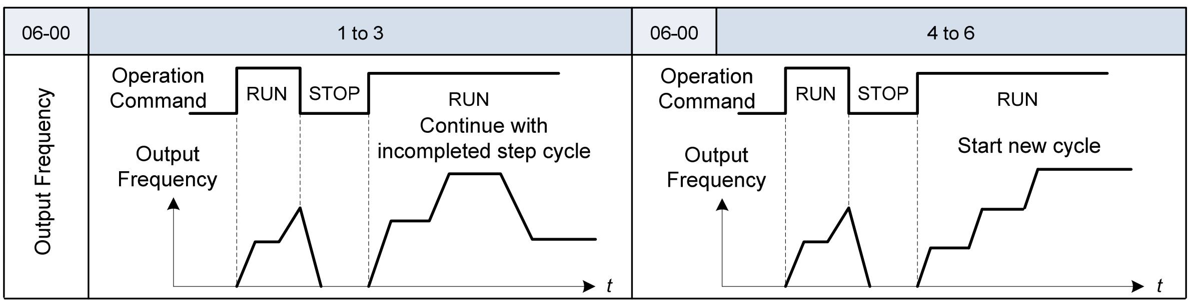


Figure 4.4.44 Single cycle automatic operation (continuous)

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.
- If the setting value of parameters 06-16~06-31 is 0, automatic operation mode is not active.

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 loss time is greater than 8ms.
07-00=1: Inverter restarts after restarting the power at the momentary power loss.

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 of 07-18 plus 07-01 and delay time of peed search (07-22).

Refer to Fig.4.4.45 for setting automatic restart interval.

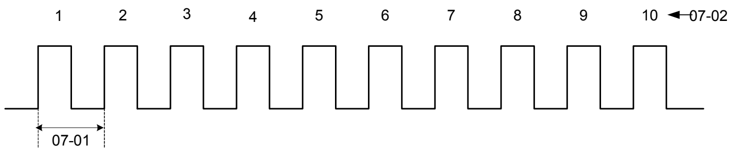


Figure 4.4.45 Automatic restart operation

07- 02	Number of Fault Auto-Restart Attempts
Range	【0~10】

When the automatic restart function is enabled the internal automatic restart attempt counter is reset based on the following actions:

a) No fault occurs in 10 minutes or longer after the automatic restart
b) Reset command to clear fault via input terminal or using the keypad (ex: press reset/ ◄ key)
c) 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:

a) Fault is detected. The inverter turn off the output, displays the fault on the keypad and waits for the minimum baseblock time parameter 07-18 to expire before accepting another run / automatic restart command.

b) After the minimum baseblock time (07-18) has 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.

c) When the total numbers of restart attempts exceed the number of automatic restart attempts set in parameter 07-02, the inverter will turn off the output and the fault contact is activated.

Please refer to Figure 4.4.46 for the automatic restart operation.

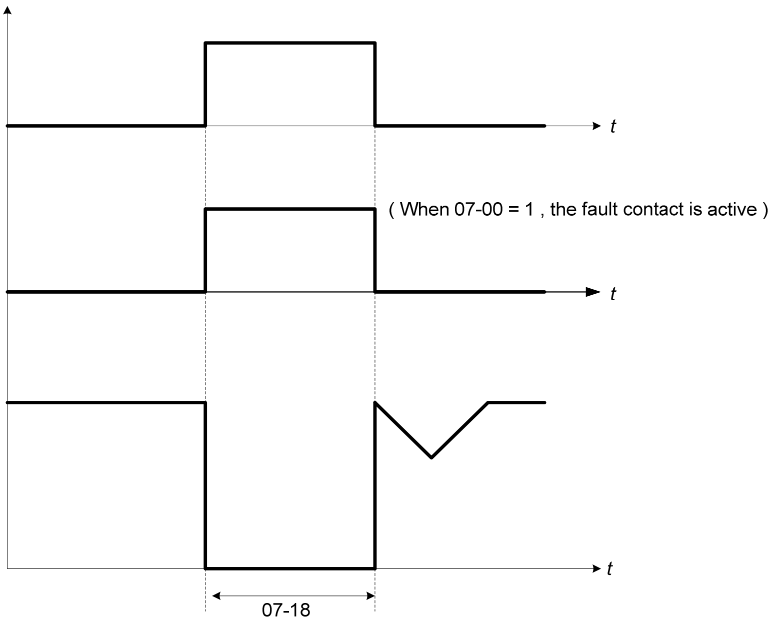


Figure 4.4.46 Auto-restart operation

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 **07-02**	**OC** (over current) **OCA** (over current in ACC.) **OCC** (over current in constant speed) **OCd** (over current in DEC) **OL1** (motor overload) **UT** (Under torque detection) **IPL** (input phase loss)	**GF** (ground failure) **OV** (overvoltage) **OL2** (Inverter overload) **OT** (Over-torque detection) **OPL** (Output phase loss) **CF07** (SLV motor control setting fault) **CF08** (PMSLV motor control setting fault)	**Depend on parameter 07-02**

Notes:

1. Fault restart function contains momentary power loss restart and auto reset restart.
2. Refer to chapter 10 for the details of troubleshooting and fault diagnostics.
3. Refer to speed search function (07-19~07-24) for the selection of speed search modes.

Note:
Automatic restart function is only active in the state of no harm to the safety or to the application devices.

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**

07- 04 = 0:
If the running switch is in conducting state when power supply is on, the inverter will start automatically.

07- 04 =1:
If the running switch is not in conducting state when power supply is on , the inverter will not start automatically and STP1 will flash. It is required to switch off the running switch and make it be in conducting state so as to start the inverter.

07- 05	Automatic start delay at power up
Range	【1.0~300.0】 Sec

When 07- 04 = 0, if power supply is on, the inverter automatically start at power up and it will count the delay time set by 07–05. The inverter starts running only when the delay time ends.

! **Warning:**

- When **07- 04 = 0** and run command source is set to external control **(00- 02/00- 03 = 1)**, if running switch is in conducting state and the inverter starts automatically when power supply is on, customers are suggested to switch off the power supply and running switch at power loss to prevent from the damage to the inverter and user when reconnecting.
- When **07- 04 = 1** and run command source is set to external control **(00- 02/00- 03 = 1)**, if running switch is not in conducting state when power supply is on, the inverter will not start automatically and STP1 will flash. It is required to switch off the running switch and then make it be in conducting state and start the inverter after the delay time of automatic start at power up ends.

07-06	DC injection braking starting frequency
Range	0.0~10.0 Hz

The braking opearion is controlled by the different control modes (00-00), please refer to the following descriptions:

1. Control mode: VF, SLV (00-00 = 0,2)
   When the inverter runs, DC injection braking is enabled by the time of parameter 07-16. Deceleration to stop is according to 07-06 and 07-08. When output frequency is lower than 07-06 in deceleration time, it starts DC injection braking by the time of 07-08.

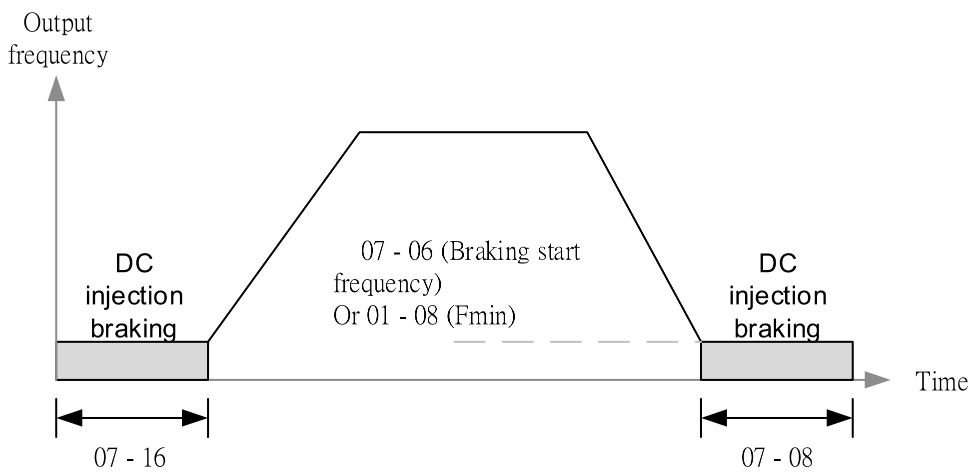


Figure 4.4.47a VF、VF+PG、SLV and SLV2 DC injection braking

Note: When 07-06<01-08, It start DC injection braking by the setting frequency (01-08)

2. Control mode: PMSLV (00-00=5)

- Set short-circuit breaking time at start by 07-34 and DC braking time by 07-16. Braking action at start runs by the setting time of 07-34 (short-circuit braking) and then by that of 07-16 (DC braking).
- Deceleration to stop is set by 07-35 (short-circuit braking) and 07-08 (DC braking). When output frequency is lower than 07-06 in deceleration, braking action runs by the setting time of 07-35 (short-circuit braking) and then by that of 07-08 (DC braking).

Note: If 07-06 < 01-08, braking function starts at the setting frequency of 01-08. Refer to the following figure 4.4.47b.

- Set DC braking current level by 07-07 on the base of the inverter rated current being 100%. If the setting value of 07-07 is higher than the motor rated current, DC braking current level is limited to the motor rated value.
- Set short-circuit braking current level by 07-36 on the base of the motor rated current being 100%.

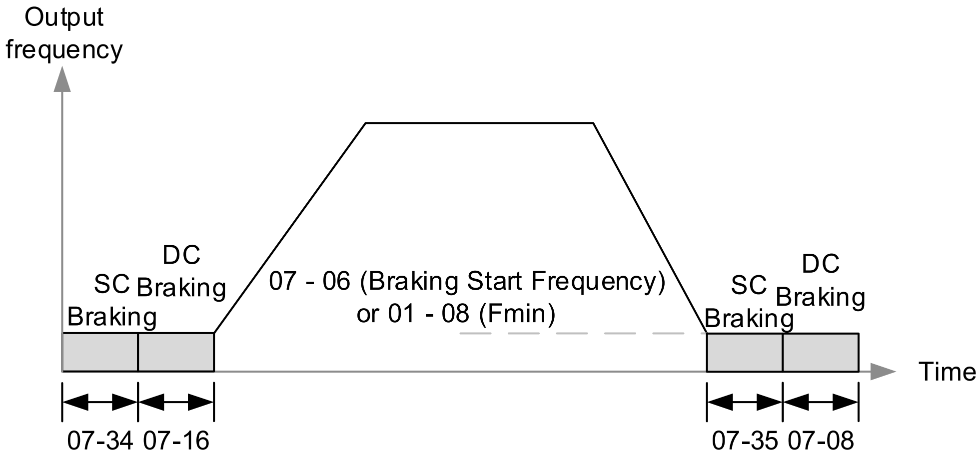


Figure 4.4.47b PMSLV braking action

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.

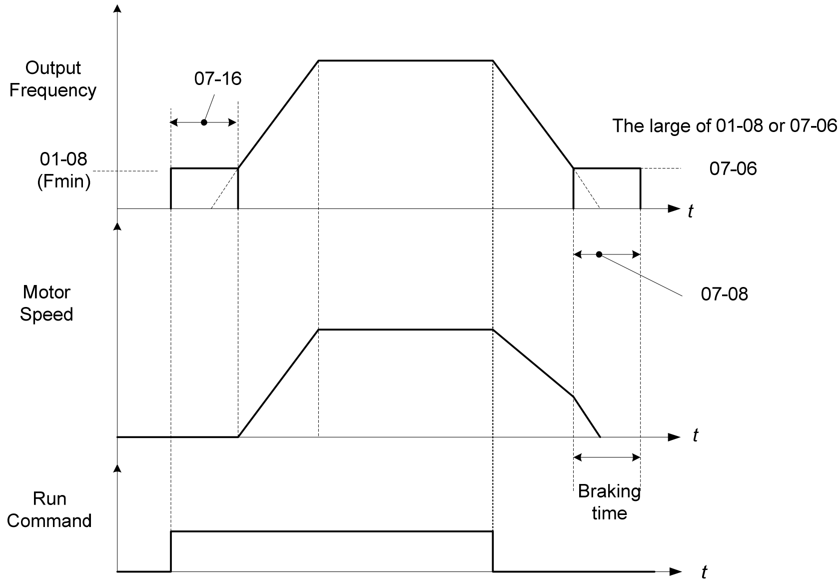


Figure 4.4.47c DC braking operation

DC braking operation can be controlled via any one of the multi-function input terminals (03-00 to 05) function 33. Refer to Fig. 4.4.47 for DC braking operation.

DC braking current can be controlled via the multi-function analog input (04-05 or 04-10) function 5. Refer to Fig. 4.4.34.

07- 34	Short-circuit braking time at Start
Range	【0.00~100.00】Sec
07- 35	Short-circuit braking time at Stop
Range	【0.00~100.00】Sec
07- 36	Short-circuit braking current limited level
Range	【0.0~200.0】%

PMSLV control mode is available for short-circuit braking. Short-circuit braking is the way to switch IGBT to produce braking torque. Setting value of 07-06, 07-34, 07-35 and 07-36 can adjust the braking action process.

If 07-35=0, Inverter starts from the minimum frequency.

The setting value of 07-36 depends on the motor rated current being 100%. (ex. motor rated current is 5A, 07-36=100% is 5A)

03-00~03-07=65, it can control Short-circuit braking action.

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) Fmin 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

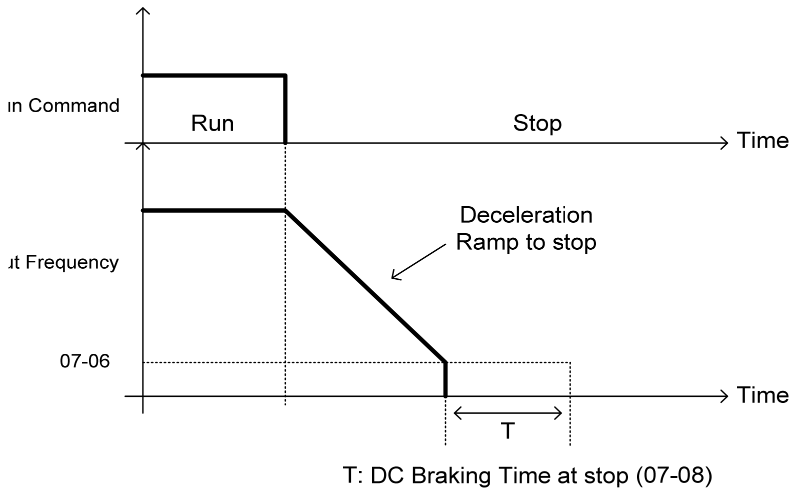


Figure 4.4.48 Deceleration to stop

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.

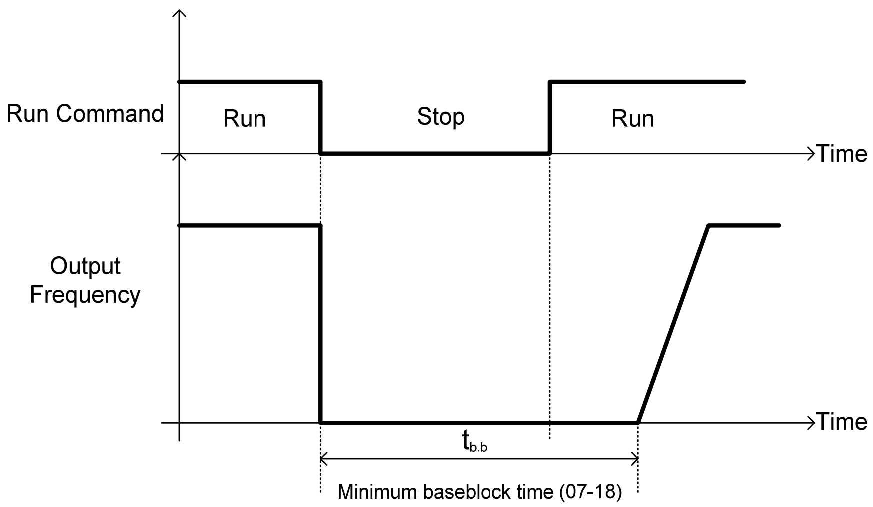


Figure 4.4.49 Coast to stop

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.4.4.50.

The DC braking time (t_{DCDB}) of Figure 4.4.50 is determined by the value of 07-08 (DC Braking start time) and the output frequency at the time the stop command was issued.

$$t_{DCDB} = \frac{(07\text{-}08) \times 10 \times \text{output frequency}}{\text{Fmax (01-02)}}$$

Note: Increase the minimum Baseblock time (07-18) in case an Overcurrent trip occurs during the DC braking.

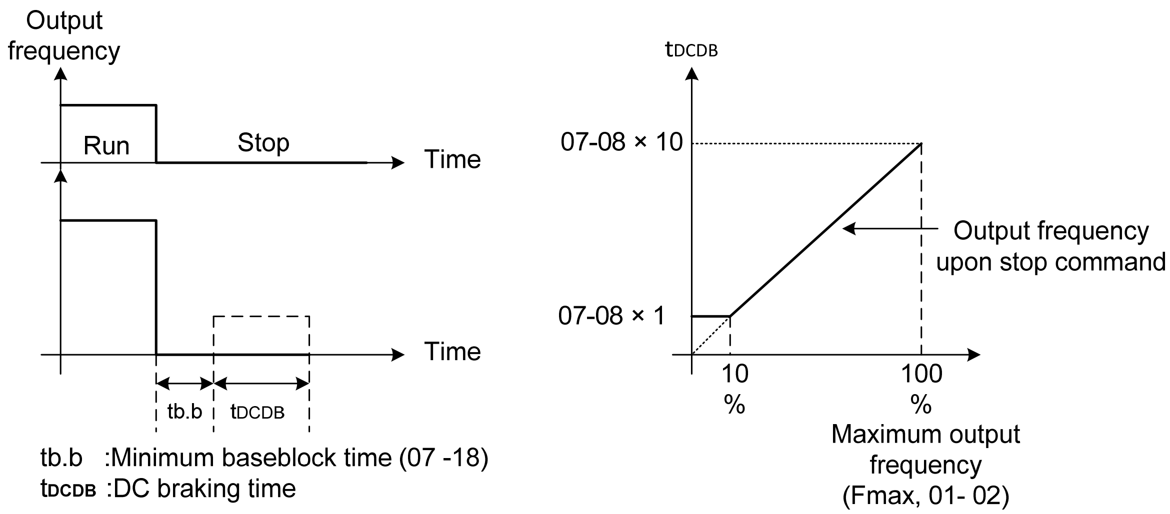


Figure 4.4.50 DC braking to stop

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.4.4.51

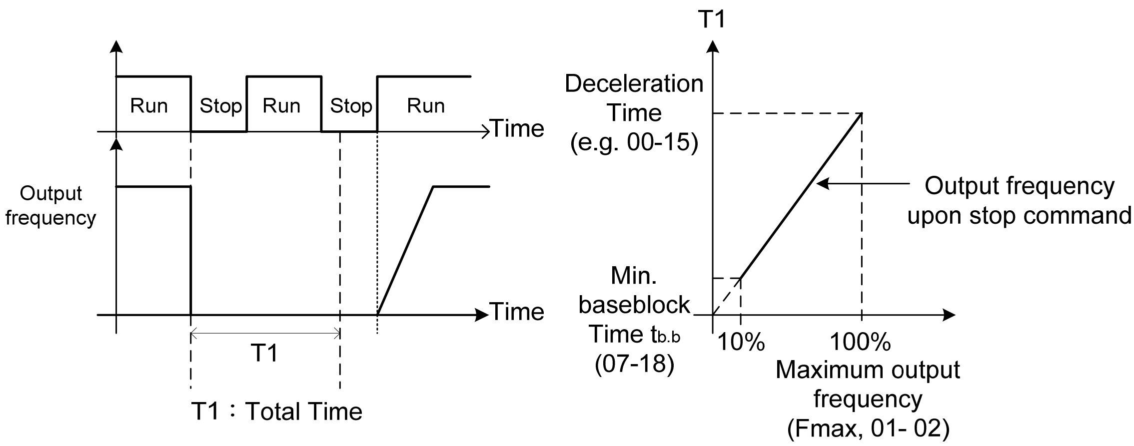


Figure 4.4.51 Coast to stop with timer

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 4.4.52).

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 shorted. 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.

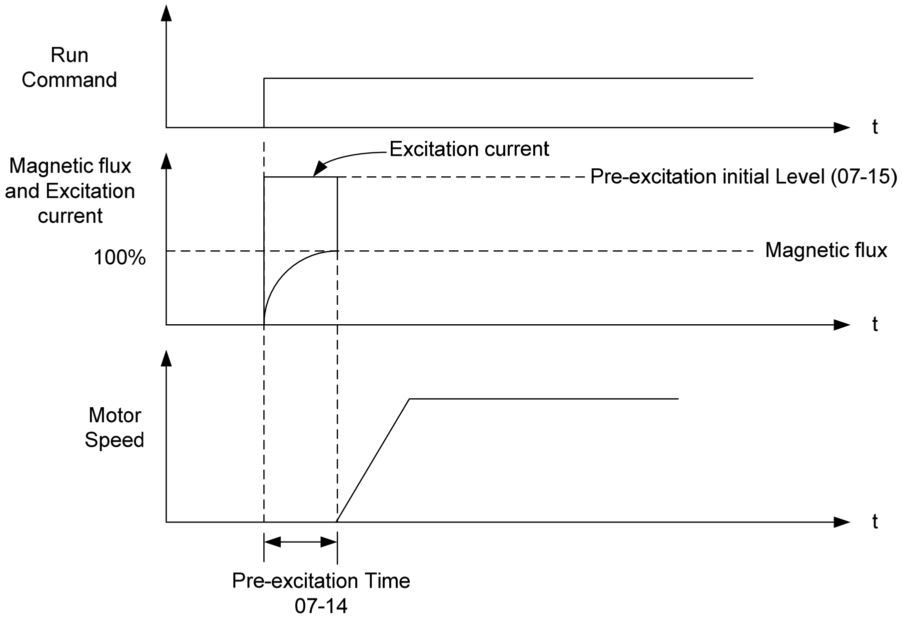


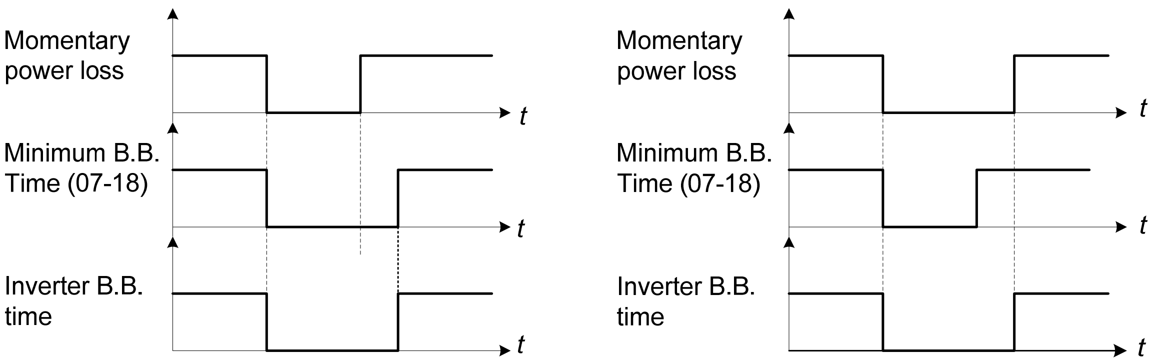
Figure 4.4.52 Pre-excitation operation

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 4.4.53.



(a) Minimum baseblock time (07-18) greater than momentary power loss time

(b) Minimum baseblock time (07-18) is shorter than momentary power loss time

Figure 4.4.53 Minimum B.B time and momentary power loss time

Minimum base block time (07-18) is also used to 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. 4.4.54.

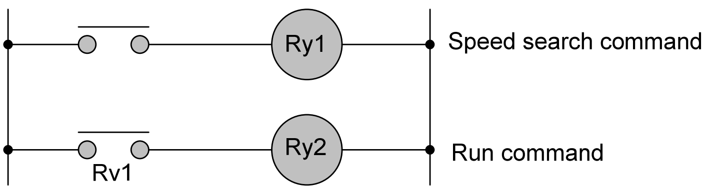


Figure 4.4.54 Speed search and operation commands

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.
- If speed search function is used and the control mode is in V / F mode, it is necessary to perform a static auto-tune.
- If speed search function is used and the control mode is 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: The inverter start to run from the lowest output frequency but it won't limit the other functions of trigger speed search.

1: Execute a Speed Search at Power On: The inverter executes a speed search at power on when entering first run command. It start the motor from found frequency.

2: The inverter will start speed search upon the motor run to find the exact frequency.

07-33: Start Frequency of Speed Search Selection

0: Maximum Output Frequency of Motor: The inverter start speed search from the maximum output frequency of motor.
1: Frequency Command: The inverter start speed search from setting 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.

- The inverter has no choices but can only normally start when using permanent magnetic motor.

■ **Speed search based on current detection**

(a) Speed search at starting

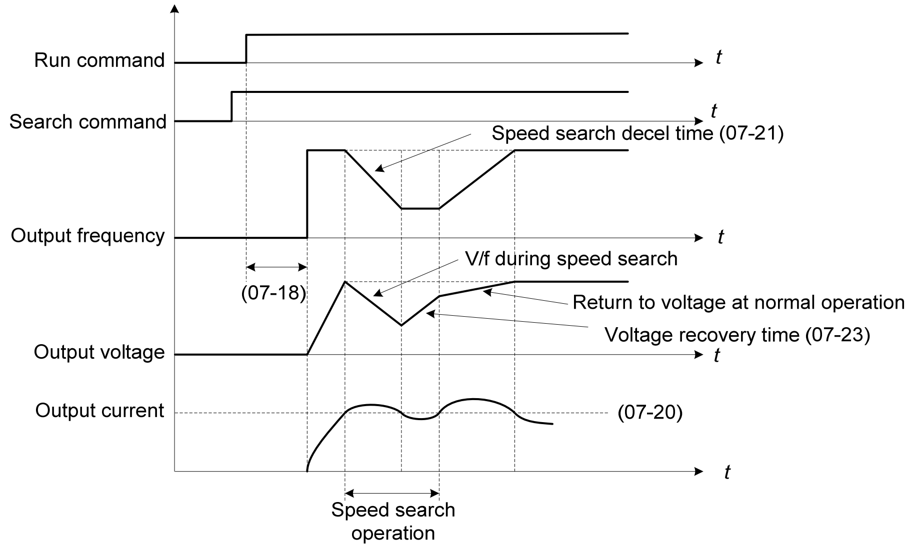


Figure 4.4.55 Speed search at starting

(b) Speed search in recovery period of momentary power failure

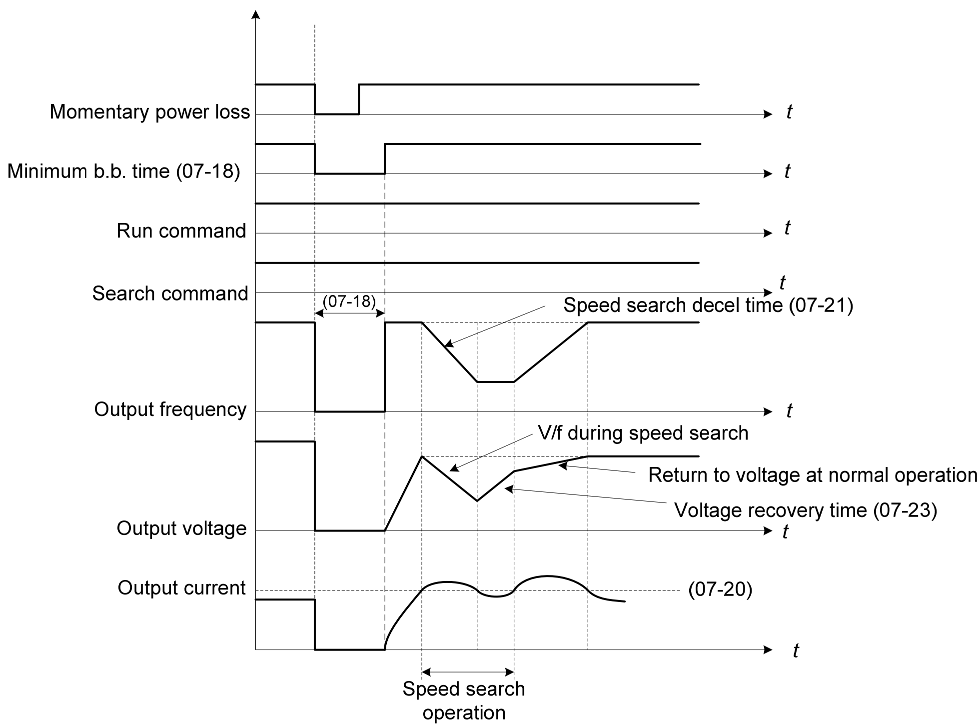


Figure 4.4.56 Speed search in recovery period of momentary power failure

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】%

When output voltage saturation happen, and the motor running is not normal, increase this parameter to limit the output voltage.
But when this parameter is too big, the output torque maybe not enough，please decrease this parameter.

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 in a rotating state due to inertia and the rotation speed is far below the minimum speed control range, parameters 07-43 and 07-44 are available to perform braking action to let the motor stop and then restart.

If the motor is in a rotating state due to inertia and the rotation speed is higher than the minimum speed control range, the motor starts in a certain searched frequency regardless of the setting value of parameter 07-43 or 07-44.

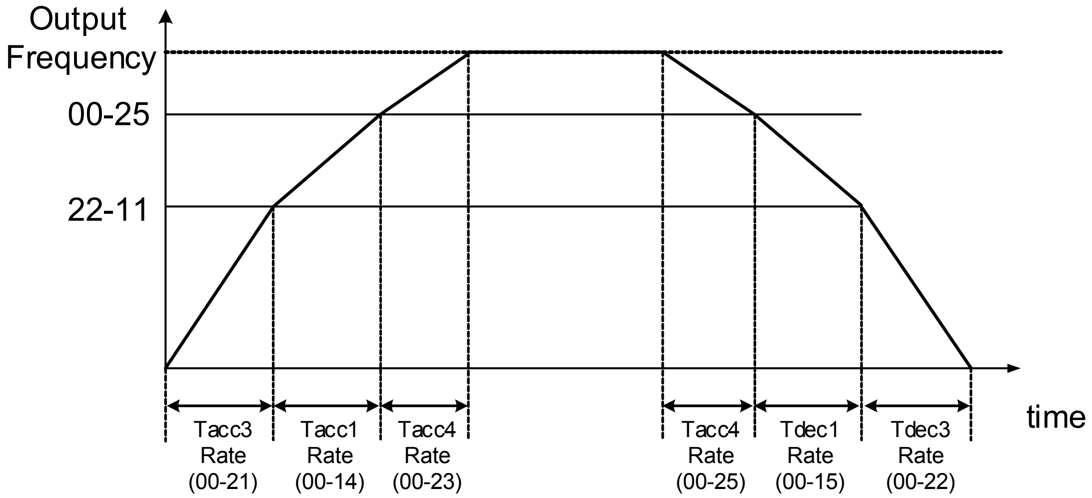
If parameters 07-43 and 07-44 are set to 0, the motor starts in a certain searched frequency after motor's speed search stops regardless of motor's rotarion speed.
.

07- 45	STP2 Function Selection
Range	【0】 : STP2 is enabled 【1】 : STP2 is disabled

- If STP2 is enabled, when 00-02=1 and external operation signal is tripped, keypad will display "Terminal STOP" error when stop command comes from keypad.
- If STP2 is disabled, when 00-02=1 and external operation signal is tripped, keypad will not display "Terminal STOP" error when stop command comes from keypad.

07- 47	PM Speed Switching Frequency Mode
Range	【0】: Disabled 【1】: Mode 1 【2】: Mode 2

If switch the three-speed speed switching according to the following figure, use the 00-25 (acceleration/deceleration switching frequency) ≠0 and 22-11 (I/f mode starting frequency switching point) parameters for frequency switching acceleration and deceleration:
Invalid: Please refer to the 00-25 parameter frequency for speed switching.
Mode 1: After the power is turned on, the speed can be switched, and the speed is switched according to the following figure.
Mode 2: The speed switching of the following figure can be realized only for the first operation, but the 22-11 switching will be invalid when decelerating.



Note: When 00-25≠0, the switching frequency can't be less than the 22-11 parameter frequency setting, and this parameter is enabled only in PMSLV mode.

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**

Note: Stall prevention function only can be set in V/F control mode.

Stall prevention during acceleration (08-00=xxx0b)

(1) Prevents the inverter from faulting (Overcurrent, Motor overload, Inverter overload) when accelerating with heavy loads.

(2) 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.

(3) Reduce stall prevention level during acceleration (08-01) in case the motor stalls (when the motor power is smaller than the inverter rating.

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.4.4.57 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%.

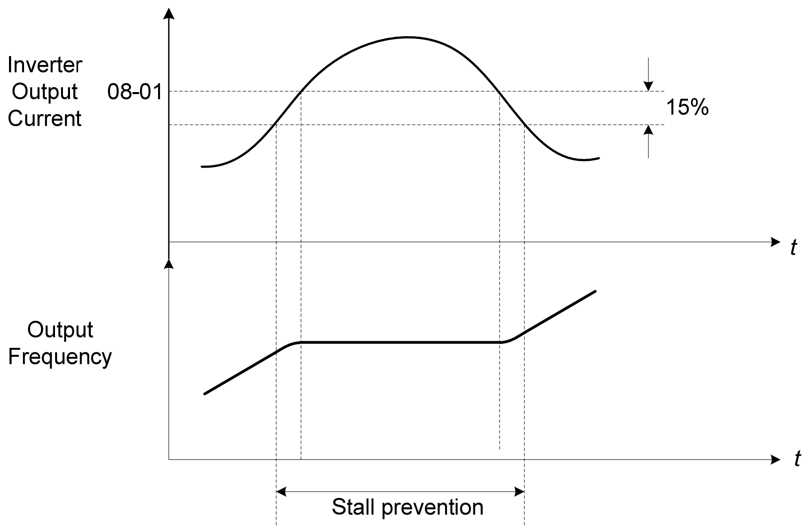


Figure 4.4.57 Stall prevention during acceleration

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)

$$\text{Stall Prev. Lev. Acceleration (CH)} = \frac{\text{Stall prevention level in acceleration (08-01) x Fbase (01-12)}}{\text{Output frequency}}$$

Parameter 08-21 is the stall prevention limit value in Constant Horsepower region. Refer to Fig.4.4.58.

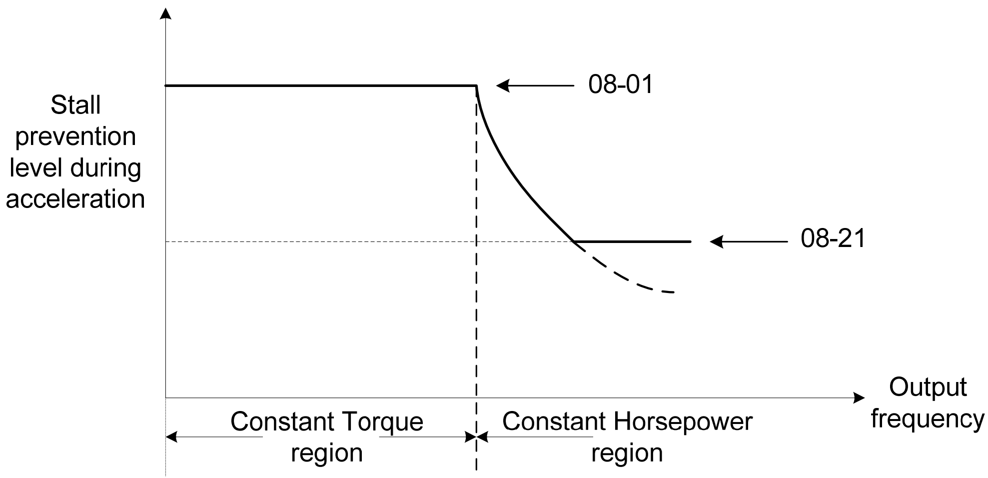


Figure 4.4.58 Stall prevention level and limit in acceleration

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.4.4.59 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 4.4.10.

Table 4.4.10 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).

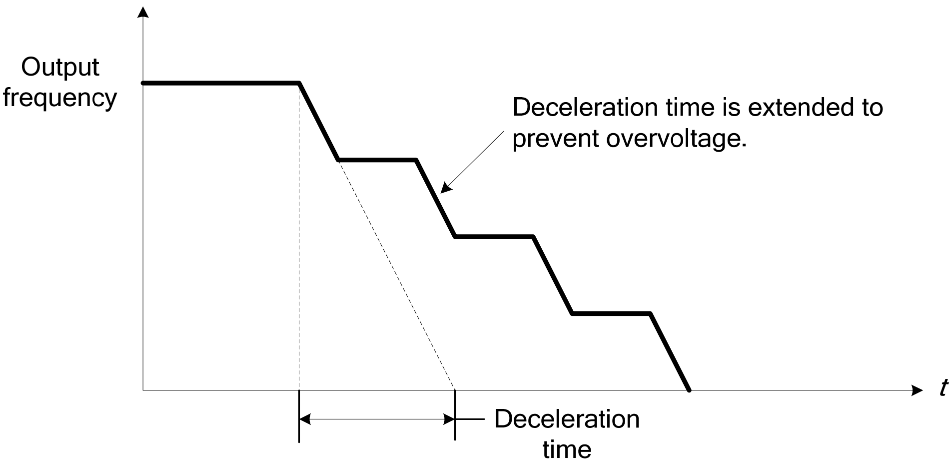


Figure 4.4.59 Stall prevention selection in deceleration

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.4.4.60.

Note: The stall prevention level during run can be set by using multi-function analog input AI2 (04-05=7) or AI3(04-10=7).

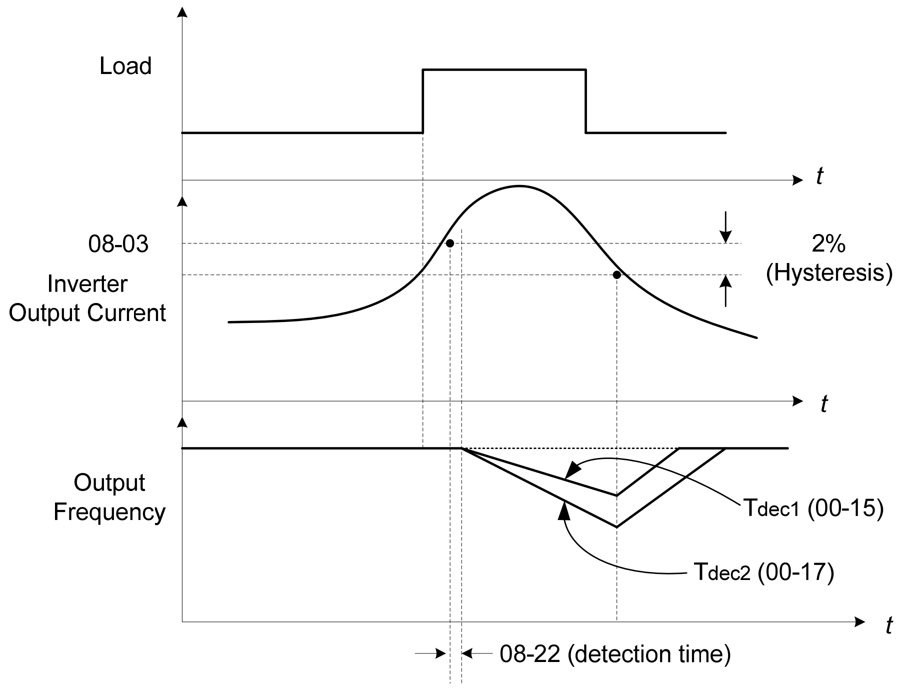


Figure 4.4.60 Stall prevention selection in operation

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.

On inverter 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.

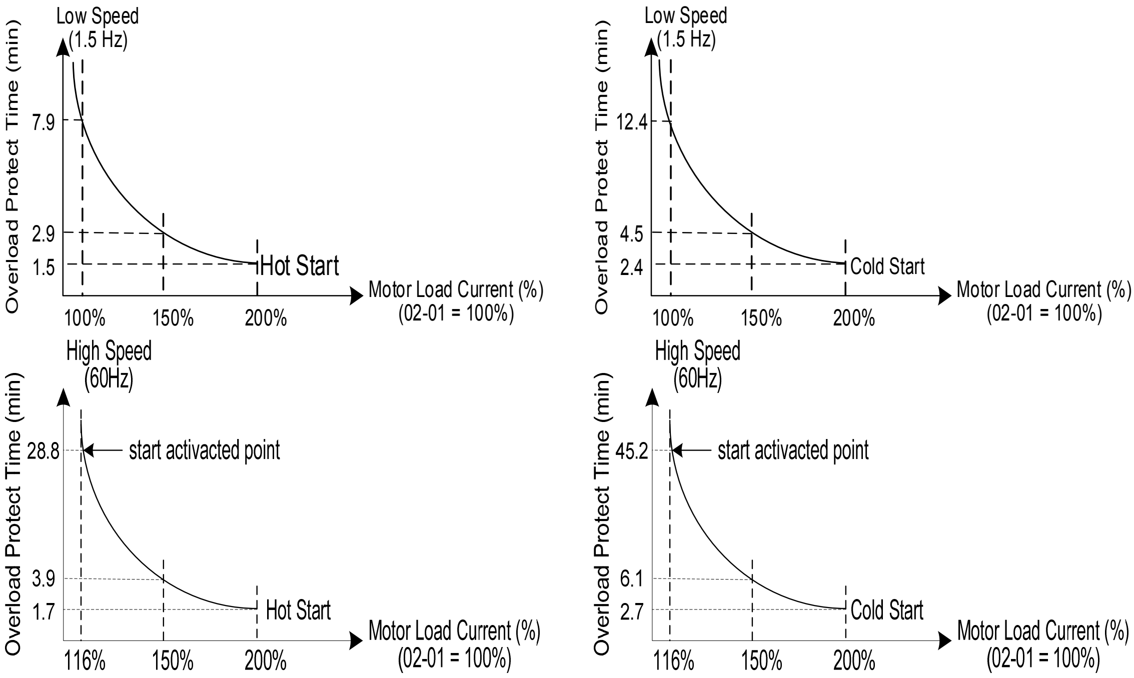
Turn off the motor overload protection when using two or more motors connected to the inverter (set 08-05 = xxx0b), and provide external overload protection for each motor (e.g. thermal overload switch).

With cold start enabled (08-05 = xx0xb), motor overload protection occurs in 5 and a half minutes when operating the motor at 150% of the motor rated current at an output frequency greater than 60Hz.

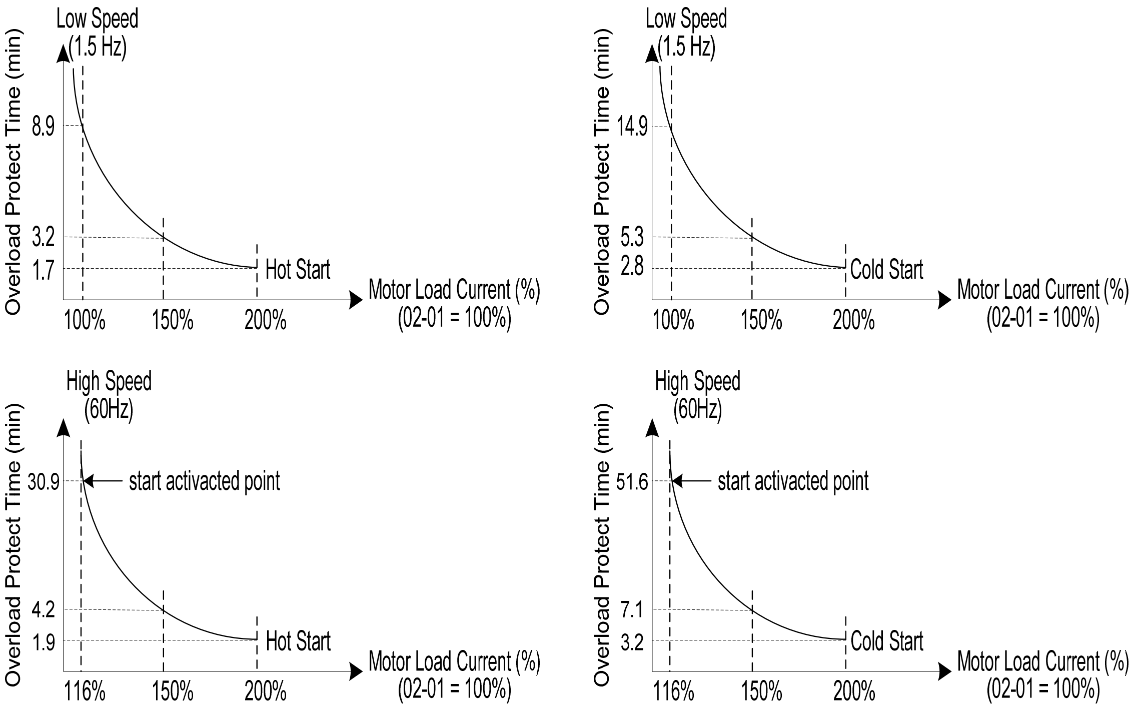
With hot start enabled (08-05 = xx1xb), motor overload protection occurs in 3 and a half minutes when operating the motor at 150% of the motor rated current at an output frequency greater than 60Hz.

Refer to the following Fig.4.4.61 for an example of motor overload protection standard curve.
And refer to the setting of 08-07 (Motor overload (OL1) protection level), the overload curve will be different.

08-07=0:



08-07=1:



08-07=2:

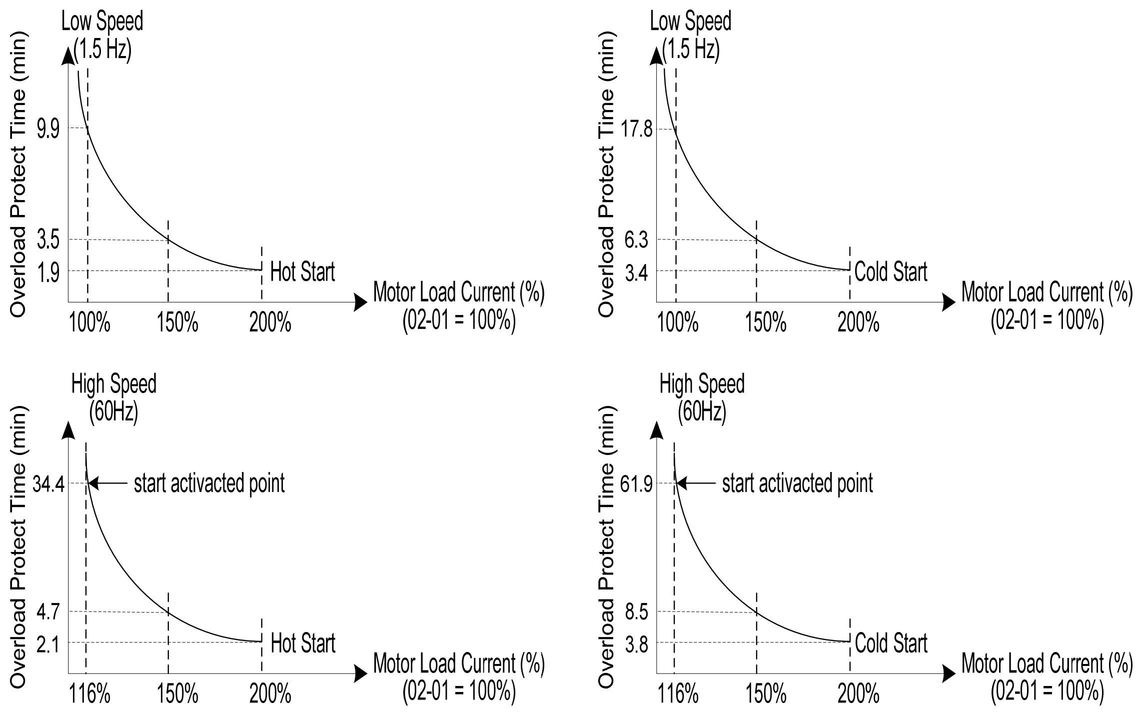


Figure 4.4.61 Motor overload protection curve (example: standard motor)

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.4.4.62 for motor overload rating at different output frequencies.

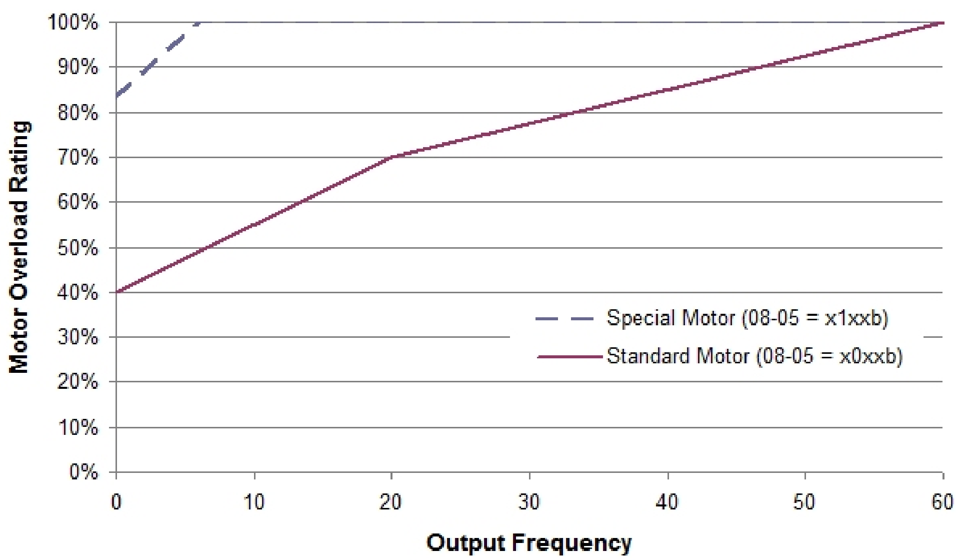


Figure 4.4.62 Motor overload rating at different output frequencies

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 display 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 input three-phase voltage fluctuates and the voltage 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 input three-phase voltage fluctuates, the output voltage won't fluctuate with the fluctuation of 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 the inverter output is turned off and the fault contact is activated.

Note: The 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: The 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 monitor the inverter output current or motor torque and can be used to detect increase 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 and 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 and over-torque detection fault and the motor coasts to a stop.

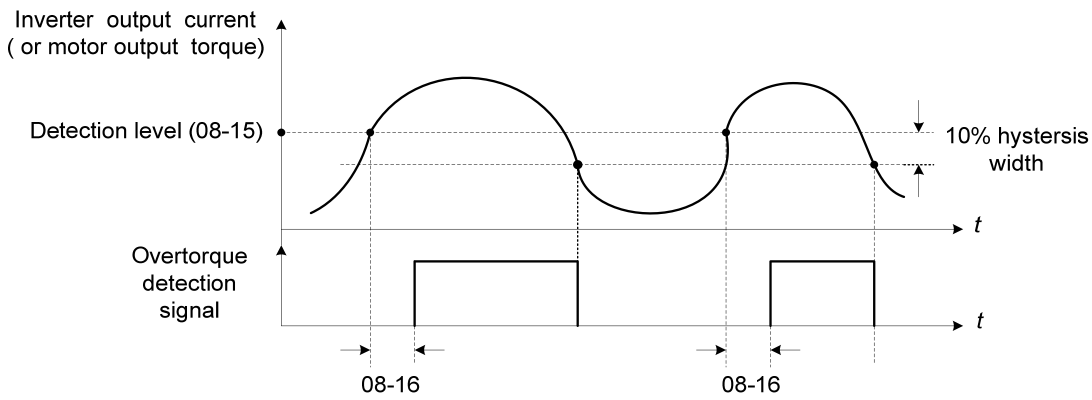


Figure 4.4.63 Over-torque detection operation

Low-torque detection

Parameter 08-18 selects low-torque detection function. An 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 and 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.

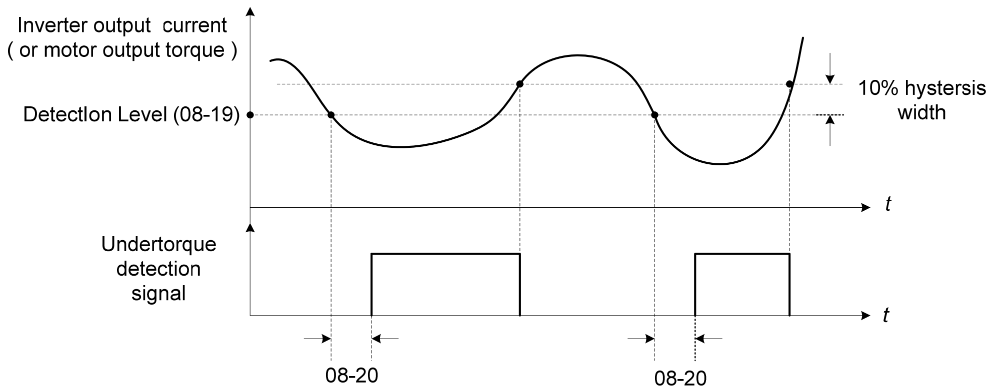


Figure 4.4.64 Low torque detection operation

Over and low torque detection condition can be output to the multi-function digital outputs (R1A-R1C, R2A-R2C, R3A-R3C) by setting parameters 03-11, 03-12 and 03-39 to 12 or 25. Refer to Fig. 4.4.65 for more information.

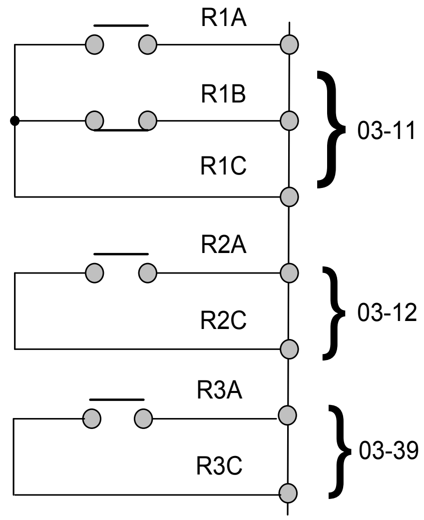


Figure 4.4.65 Over-torque / low torque detection multi-function digital output terminal

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

The reason for the detection of external faults is determined by parameter 08-25.

- When 08-25=0, faults are immediately detected at power up.
- When 08-25=1, faults are detected when the inverter is 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 via the set of 08-30 when this function is enabled.

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 while inverter is running.
If the inverter stops over the delay time of fan off (08-38), fan is off.

08-37=1: Permanent Start
When the inverter is at power on, fan will start permanently.
08-37=2: Start at High Temperature
When the temperature of heatsink is higher than that of internal setting, fan immediately starts.
If the temperature is lower than internal setting value or the delay time of fan off (08-38) is due, fan will be off.

Note: Function of fans on is disabled for the models of 60HP or the above (200V) and 100HP or the above (400V) in IP20 series and is enabled for all the models in IP55 series.

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

Protection of motor overheating is enabled via the sensor of motor fan with the temperature impedance chacteristics of positive temperature coefficient (PTC).

Thermistor of PTC connects with terminals MT and GND. If motor is overheating, the keypad displays the error code of OH4.

08-35=0: Fault selection of motor overheating is disabled.

08-35=1, 2: Motor stop running while fault of motor overheating occurs.

Protection of motor overheating is enabled when the motor temperature rises, and the MT voltage level is higher than 08-42 PTC trip level and the reach of delay time set by 08-39. The keypad will display an “OH4 Motor overheat” and fault output is active.

When the motor temperature falls, and the MT voltage level is lower than 08-43 PTC reset level, it can reset ''OH4 Motor overheat.''

Note: The stop mode of the inverter fault 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

Notes:

- If thermistor of PTC does not connect with MT and GND, the keypad will display an "OH4 Motor overheat."
- The value of the external thermistor of PTC is in compliance with British National Standard. When Tr is 150℃ in class F and 180℃ in class H,
  a. Tr－ 5℃ : $R_{PTC} \leqq 550\Omega$, use R_{PTC} value to formula (1), the V value can be set to 08-43 PTC reset level.
  b. Tr＋ 5℃ : $R_{PTC} \geqq 1330\Omega$, use R_{PTC} value to formula (1), the V value can be set to 08-42 PTC trip level

Notes:

1. If the specification of PTC is different, please follow formula 1 to calculate the value of 8-42 and 8-43.

$$V = \frac{1}{2} \times 10V \times \frac{R_{PTC} // 20K}{10K + \left(R_{PTC} // 20K\right)} \qquad \text{Formula (1)}$$

2. It can be calculated via formula (1) if it is in an empty connection or disconnection state when the voltage value is between 3.3~4V. if empty connection or disconnection occurs, the inverter trips to PTCLS warning or fault signal. Set fault signal by parameter 08-45. There will be ten seconds to detect once disconnection occurs. If it reconnects withinthe time, PTC signal will not be tripped and it will be recounting on redisconnection.

3. When measuring the voltage-across from MT and GND terminals, the measured voltage is not equal to the input level one. The level one is calculated by formula (1).

Refer to Fig. 4.4.66 for the connecting between the corresponding temperature of thermistor of PTC and terminals.

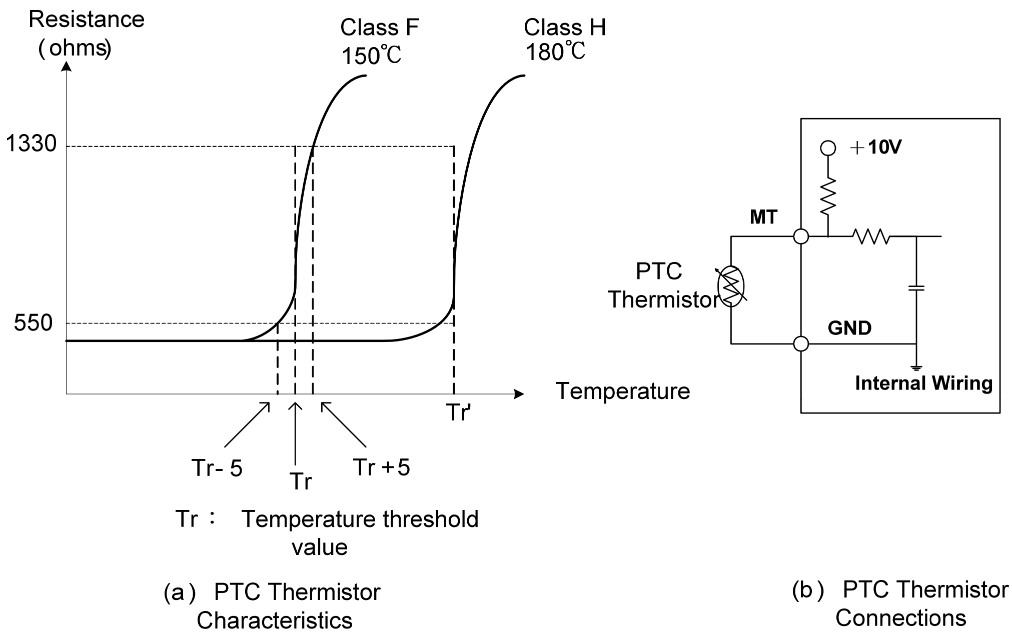


Figure 4.4.66 (a) PTC Themistor Characteristics (b) PTC Themistor Connections

08 - 46	Temperature agree level
Range	【0 ~ 254】°C
08 - 47	**Temperature reset level**
Range	【0 ~ 254】°C

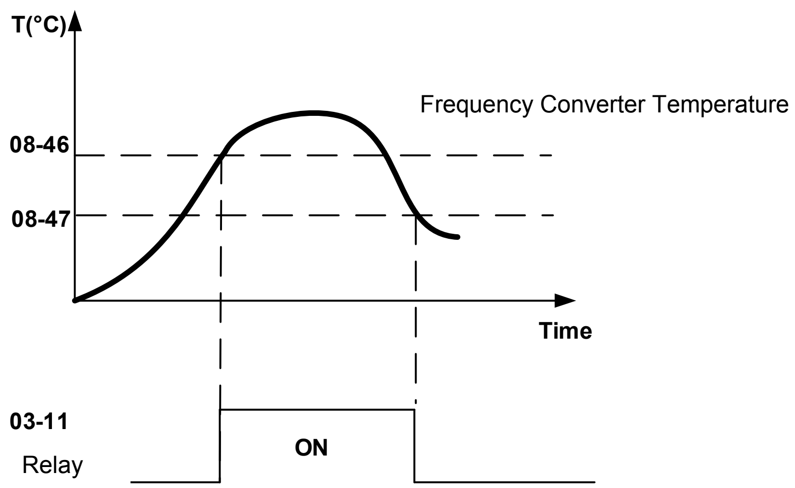
Note: 08-47 maximum value will be limited by **08-46** set value

The inverter temperature agree and reset level selection

03-11 set to【**59**】**:**

- **08-46: T**he inverter temperature is **> 08-46**, the relay operates.
- **08-47:** When the output current is ≤ 08-47, the relay signal from **ON** to **OFF**.

Down time frequency diagram:



Inverter temperature agree and reset detection

08 - 48	Selection of Fire Mode
Range	【0】: Disable 【1】: Enable
08 - 49	**Multi-Function Input Terminal Status of Fire Mode**
Range	【0】: Reset after Power Off 【1】: Reset after Terminal Removed
08 - 50	**Multi-Function Terminal Status of Fire Mode**
Range	【xxx0b】: S6 A Contact 【xxx1b】: S6 B Contact
08 - 51	**Motor Speed Setting Source of Fire Mode**
Range	【0】 : Fire Mode Speed (08-52) 【1】 : PID Control 【2】 : AI2
08 - 52	**Fire Mode Motor Speed**
Range	【0.00~100.00】%
08 - 59	**Fire Mode Motor Direction**
Range	【0】: Forward 【1】: Reverse
08 - 60	**Fire Mode Password**
Range	【00000 ~ 65534】

➢ When 08-48=0, Fire Mode is disabled.

When 08-48=1, Fire Mode is enabled.

- When fire mode is enabled, S6 will be defined to digital input of fire mode (03-0X=47).

When fire mode is enabled, inverter will become to fire mode. No matter inverter is running or stopping, run and frequency command source will be covered by the setting of fire mode, keypad display will show “ FIRE ”, some of protect functions will be ignored, please refer the table 4.3.35, inverter will not stop.

When fire mode (03-0X=47) and outour overload (03-0X=68) function is triggered, the other digital inputs will be ignored, the parameters just can be read by communication or keypad display.

- When 08-49=0, pelase disconnect the power first, remove external trigger signal and then connect the power.
- When 08-49=1, no need to disconnect the power, inverter will become to normal mode, run and frequency will reture to original setting.

Note: Only Version V1.53 and above will meet the above functions.

Table 4.3.35 These functions will be ignoed when fire mode is triggered

0x2521H	Fault Description
4	OH1 (Heat sink over heat)
5	OL1 (Motor overload)
6	OL2 (Inverter overload)
7	OT (Over torque)
25	FB (PID feedback signal error)
26	Keypad Removed
28	CE (Communication error)
46	OH4 (Motor over heat)
49	MtrSw (DI Motor Switch Fault)
58	PF(Protection error)

！Danger：

Fire mode:

The drive will run at full speed either in forward or reverse direction and ignore all software protections until any one of the hardware protection is triggered or drive is damaged to achieve the requirement of smoke extraction and reduce the hazard to humans.

- Each bit of 08-50 presents an input:

08-50= 0 0 0 0 0 : Normal open

s6 1 : Normal close

Notes:

Please set 08-48=0 (fire mode disabled) before setting normal open or normal close contact. Failure to comply may cause death or serious injury.

- When 08-51=0, motor speed setting will follow 08-52. If the value of 08-52 is 100%, inverter output frequency will follow the value of 01-02.
- When 08-51=1, motor speed setting will follow PID control; when fire mode is enabled, PID control will base on 10-47/10-48/10-49 (please refer the setting value of group 10)
- When 08-51=2, frequency reference will become to 4-20mA (default setting of 04-00)

08 – 59: Fire Mode Motor Direction

- When fire mode is enabled, motor direction will base on the setting of 08-59.

08 – 60: Fire Mode Password

- When fire mode is enabled, use can set password in parameter 08-60, please refer the process of parameter 13-07.
- In order to prevent the parameters of fire mode being modified, keypad display will just show the related parameters of fire mode when fire mode is enabled. (Parameter 08-48~08-60 will be read only).
- Parameter 08-60(password of fire mode) and 13-07(parameter password), only one parameter can be allowed to set at the same time.

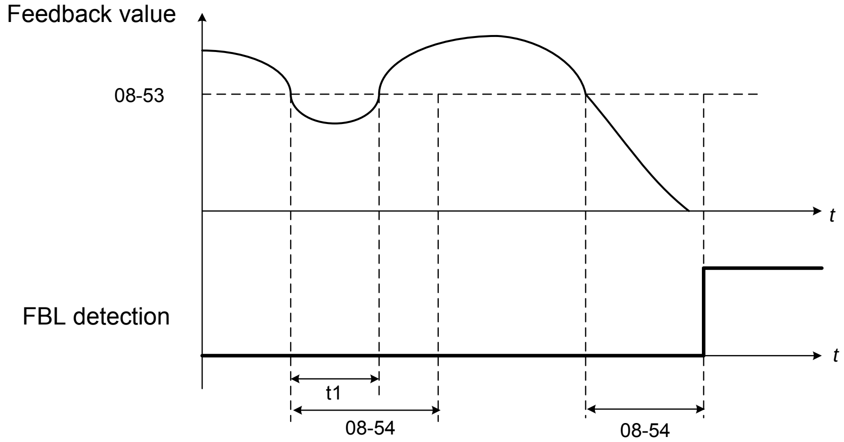
08 - 53	PID Detection Level of Fire Mode
Range	【0~100】%
08 - 54	Delay Time of Fire Mode PID Loss
Range	【0.0~10.0】Sec
08 - 55	PID Feedback Loss Detection Selection of Fire Mode
Range	【0】：Keep Running 【1】：Fire Mode Speed(08-52) 【2】：Max. Output Frequency of Motor 1 (01-02)

- When 08-51=1, PID feedback loss detection function will be opened automatically.
- When fire mode is enabled, if 08-51=1 and then PID feedback, inverter will be stopped after the setting value of 08-54.

08 - 55 PID Feedback Loss Detection Selection of Fire Mode

- When 08-55=0, output frequency will be fixed on current frequency.
- When 08-55=1, output frequency will be based on the setting value of parameter 08-52.
- When 08-55=2, output frequency will be based on the setting value of parameter 01-02.

When PID feedback value less than 08-53 and then longer than 08-54, inverter will keep running, but the frequency reference will be switched to 08-55, output frequency will not less than the setting value of 08-52.



PID feedback loss detection

Notes:

If there is no any feedback signal and then feedback loss level also be set to 0%, feedback loss detection function will not be triggered.

08 – 56	Detection Level of Fire Mode AI2 Signal
Range	【0~100】%
08 - 57	Delay Time of Fire Mode AI2 Signal Loss
Range	【0.0~10.0】Sec
08 - 58	Selection of Fire Mode AI2 Signal Loss
Range	【0】：Keep Running 【1】：Fire Mode Speed(08-52) 【2】：Max. Output Frequency of Motor 1 (01-02)

- When 08-51=2 (AI2), inverter will trigger AI2 feedback loss detection function automatically.

Selection of Fire Mode AI2 Signal Loss (08-58):

- When 08-58=0, output frequency will be fixed on current frequency.
- When 08-58=1, output frequency will be based on the setting value of parameter 08-52.
- When 08-58=2, output frequency will be based on the setting value of parameter 01-02.

If AI2 signal is less than the setting value of 08-56 in 360ms, and the time longer than setting value of 08-57, the frequency reference will be considered to loss.
Analog signal will compare with the previous value at 360ms, if inverter ensure the frequency reference already loss, frequency reference will base on the value of 08-58.

Following is the description of the Frequency Loss Function:
When the inverter is in operation and the selected analog command source AI2 disappears, the command will operate according to the setting ratio of 08-58.

The following figure is the operating diagram of analog frequency instruction AI2 when the frequency Instruction is lost.

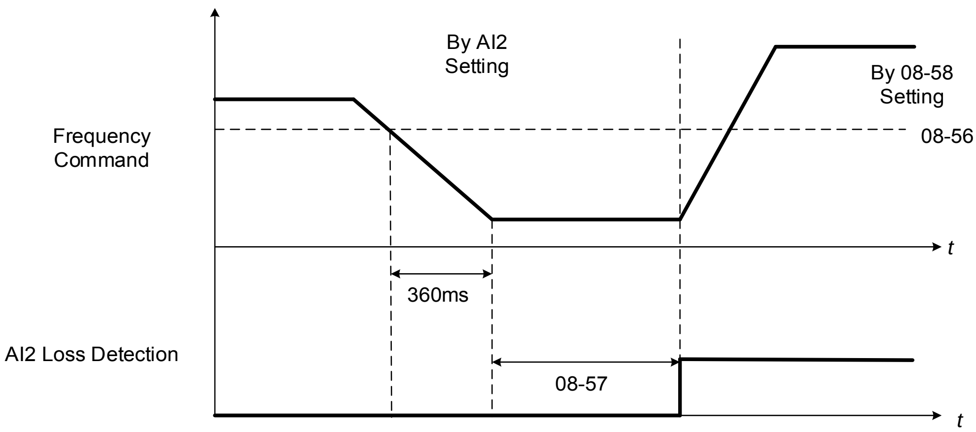


Fig 4.3.76 AI2 frequency reference loss

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**
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 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 protocol:

- 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)
- Pump in Parallel Connection (Refer to parameter group 23 for more details)

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 via the keypad.
(5) Press DSP/FUN key to go back to the main menu.
(6) If it is over the automatic return time (11-13) and DSP/FUN key is not pressed, reset the parameter and press DSP/FUN key to go back to the main menu. Or reconnect the inverter.
(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, a converter must be installed to convert 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 of RS-485 communication
= 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 00-15
= 1: Coast to stop
= 2: Deceleration to stop using the deceleration time of 00-26 (emergency stop time)
= 3: Continue to operate (only shows a warning message, press the stop button to stop operation)
= 4: Run the frequency command given by AI2 (After setting the Communication Error Detection Time (09-06), when RS-485 communication error, the warning message will display, and run the frequency given by AI2, when 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.

09-09: Wait time of inverter transmission
Sets the inverter response delay time. This is the time between the controller message and the start of the inverter response message. Refer to Fig. 4.4.67. Set the controller receive time-out to a greater value than the wait time parameter (09-09).

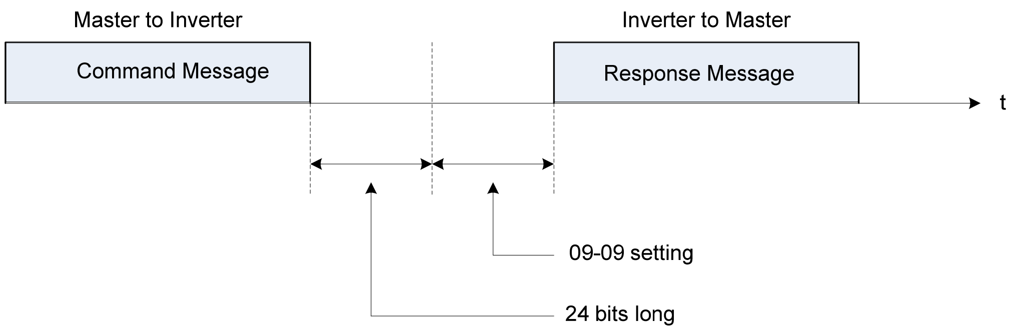


Figure 4.4.67 Communication Message Timing

Group 10: PID Parameters

10- 00	PID Target Value Source Setting
Range	【0】: Keypad Given (for PUMP or HVAC mode) 【1】: AI1 Given 【2】: AI2 Given 【3】: Reserved 【4】: 10-02 Given 【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 set as PID's target value only when 10-00=0 and 23-00=1 or 2.

When 10-00=1 or 2, signal source proportional is corresponding to PID target via analog input terminal. For example, 0~10V is corresponding to the target of 0~100% so given 2V is equivalent with the target value of 20%.

For normal use of PID, set 10-00 to 4 and set PID target value in parameter 10-02.

When 10-00=4, in addtition to the percentage setting of 10-02 (PID target value), it allows PID setting (12-38) in the main screen monitor. The maximum target value is set via parameter 10-33 (PID maximum feedback value), the decimals are set via parameter 10-34 (PID decimal width) and the unit is set via parameter 10-35 (PID unit). For example:

When 10-33 = 999, 10-34 = 1, 10-35 = 3 and 10-02 = 10%, then 12-38 = 9.9 PSI displayed in the main screen monitor. User can also modify the value of 12-38 in the main screen monitor but the maximum calue is 99.9 PSI (depending on the setting value of 10-33).

10-00=6 (from frequency command), it means the setpoint is the perecnetage of frequency reference corresponding to the rated frequency. (ie: setpoint = 50 %, if the frequency reference is 30Hz and the rated frequency is 60Hz). And this frequency source refers to the setting of 00-05.

When 10-00=7, DI multi-speed frequency command (refer to the setting description of parameter group 3) is proportionally corresponding to PID target via multi-speed stage frequenfy setting of 05-01~05-16.

Note: Speed-stage 1 cannot set PID target value by switching auxiliary frequency via 04-05=0 or 4-10=0.

10- 01	PID Feedback Value Source Setting
Range	【1】：AI1 Given 【2】：AI2 Given 【3】：Reserved 【4】：AI1 - AI2 Given

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 minus, it will be set to zero.

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 Cotrol 【0xxxb】：PID Output 【1xxxb】：PID Output + Frequency Command

PID target value source setting(10-00) / PID feedback value source setting(10-01)
Please confirm parameter 04-00 conform the need (0V~10 V or 4mA~20 mA) if AI2 as PID target or PID feedback. And check the dip switch from control board to the input type (V or I), please refer to wiring diagram for more detail.

When 10-03 is set to xxx0b, PID will is disabled; if it is set to xxx1b, PID is enabled.

Note:
- LCD keypad will be switched automatically (16-00).
- Main Screen Monitoring will be changed to PID Setting (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).

At this time, if the setting is disabled, it will be switched automatically back to frequency command as the main page. When switching to PID setting in the LED keypad, it displays the modes selection of parameter 23-05.

Note: when 23-05=0, set the value in the conditions of 10-33 < 1000 and 10-34=1, or the inverter will display the signal of PID setting error (SE05).

When 10-03 is set to xx0xb, PID output occurs forward;
When 10-03= xx1xb: PID output is reverse. PID output is chosen to reverse, If PID input is negative, the output frequency of PID will gain. On the contrary,

When 10-03 is set to x1xxb, PID control for feedback differential value is enabled; if it is set to x0xxb, basic PID control is enabled. Refer to Fig.4.4.69 and Fig.4.4.70.

When 10-03 is set to 0xxxb, PID output is enabled and it is corresponding to the frequency of 01-02 at 100%.

When 10-03 is set to 1xxxb, PID output and frequency command are enabled. The output percentage of frequency command (corresponding to the selected main frequency command of 00-05/ 00-06) will be cumulated 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

Gain control: The error signal (deviation) between the input command (set value) and the actual control value (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.

Integral control: The output of this control is the integral of the error signal (difference between set 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.

Differential control: 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 PID control (fan and pump) do not require differential control.
Refer to Fig. 4.4.68 for PID control operation

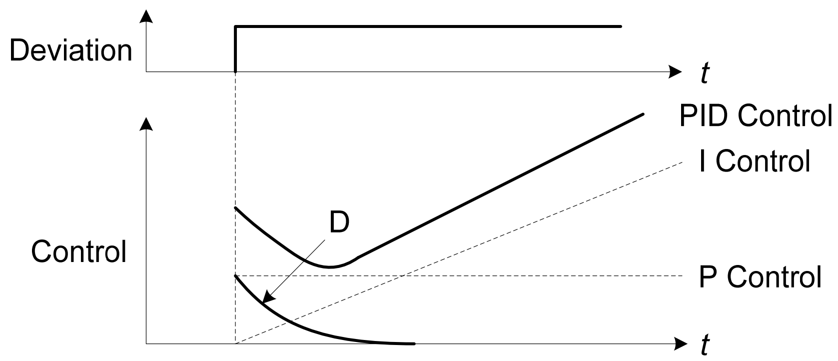


Figure 4.4.68 PID Control

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. 4.4.69 for PID control for feedback value differential.

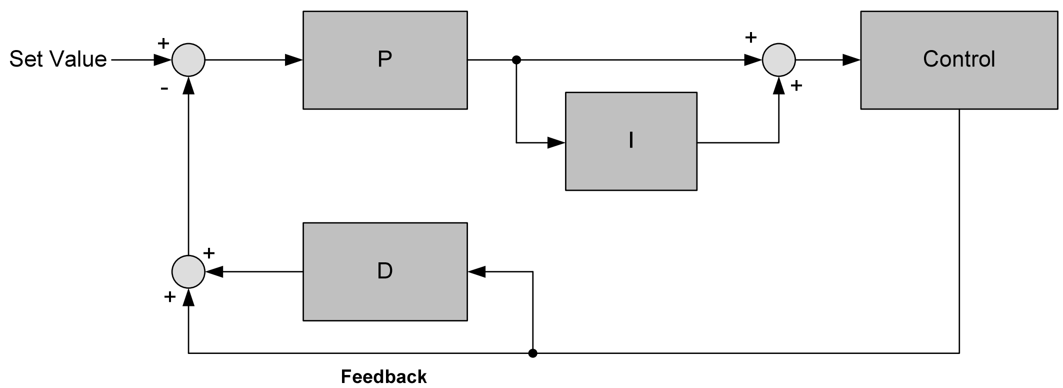


Figure 4.4.69 PID control for feedback differential value

(b) Basic PID control: (10-03 = x0xxb)

This is the basic type of PID control. Refer to the Fig. 4.4.70.

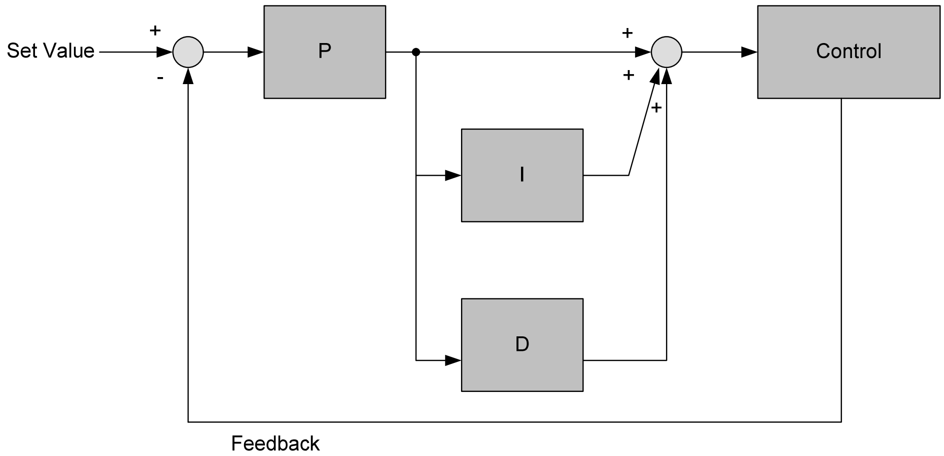


Figure 4.4.70 Basic PID control

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 value
= 0: keypad given
= 1: analog AI1 given (default)
= 2: analog AI2 given
= 3: Reserved
= 4:10-02

10-01: PID feedback value
= 1: Analog AI1 given
= 2: Analog AI2 given
= 3: Reserved

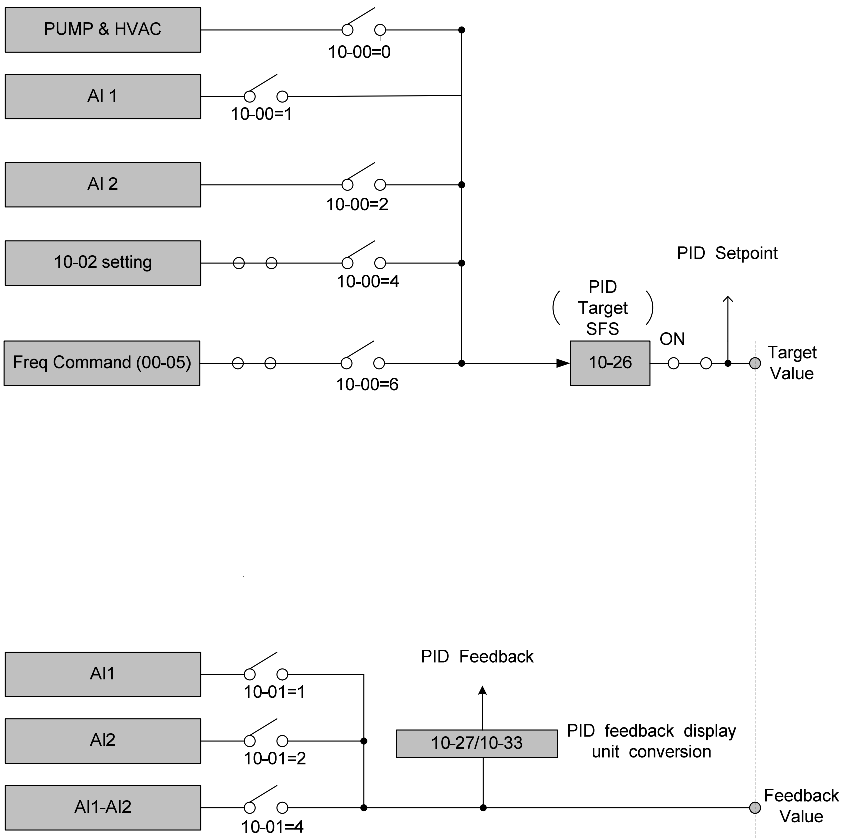


Figure 4.4.71 PID input selection

PID Control Setting

PID control block diagram.

The following figure shows the PID control block diagram.

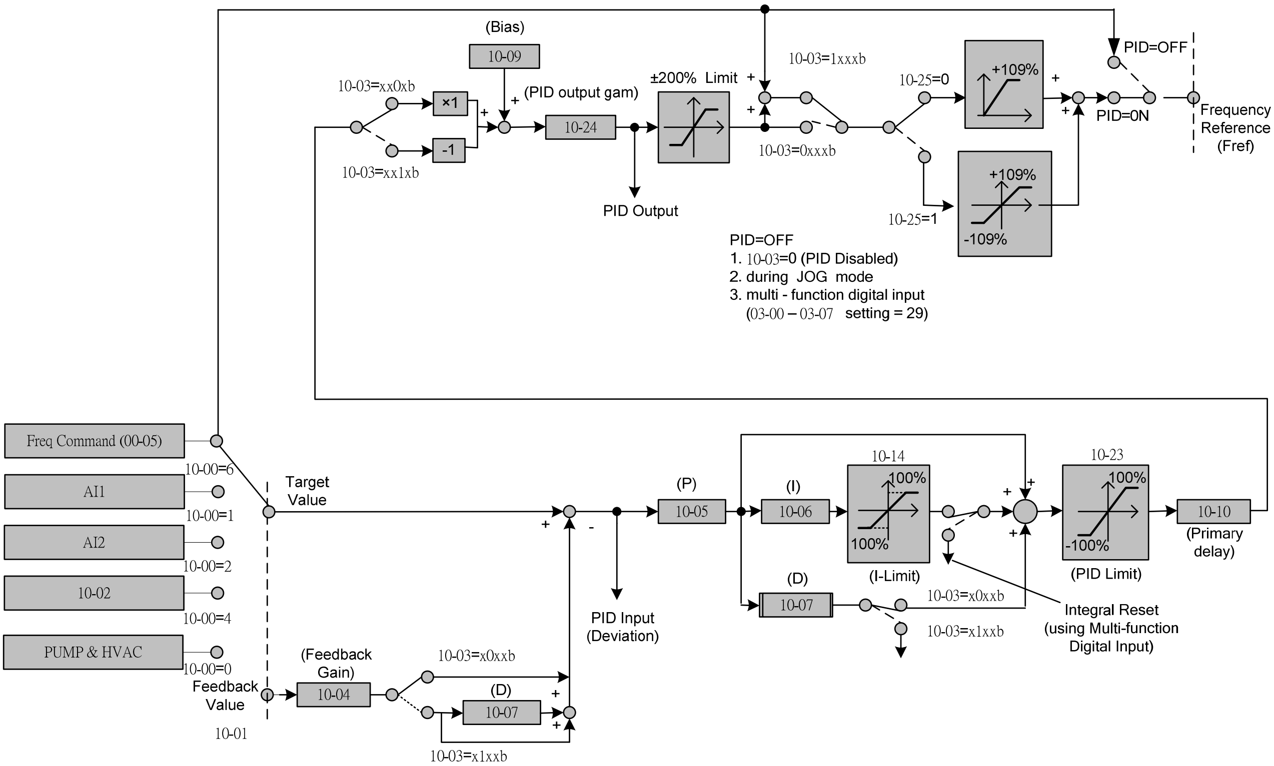


Figure 4.4.72 PID control block diagram

PID Tuning

Use the following procedures to start PID control,

(1) Enable PID control (set 10-03 to a value greater than "xxx0b").

(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 the PID output is set for reverse operation the output frequency decreased when the PID target value increases.

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 stall 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 situated 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 in case load resonance or system instability is encountered.

PID Fine Tuning

All PID control parameters are related to each other and require to be adjusted to the appropriate values. Therefore, the procedure achieving the minimum steady-state is shown as following:

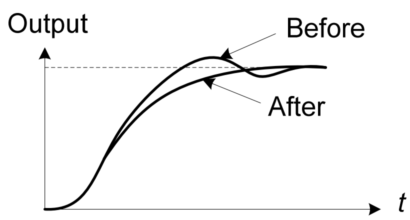
(1) Increase or decrease the proportion (P) gain until the system is stable using the smallest possible control change.

(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.

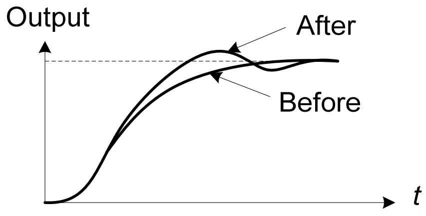
Fine-tuning PID control parameters:

(1) Reduce overshoot



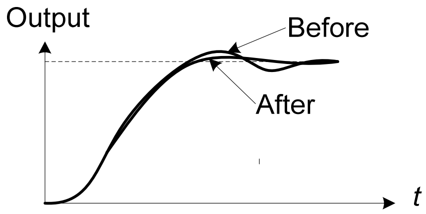
In case overshoot occurs, reduce the derivative time (D) and increase the integral time (I).

(2) Stabilize PID control



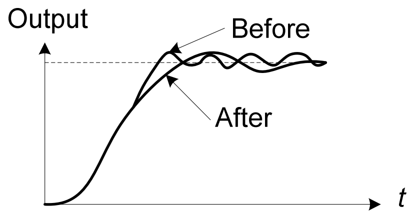
To quickly stabilize the PID control, reduce the integral time (I) and increase the differential time (D) in case overshoot occurs.

(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.

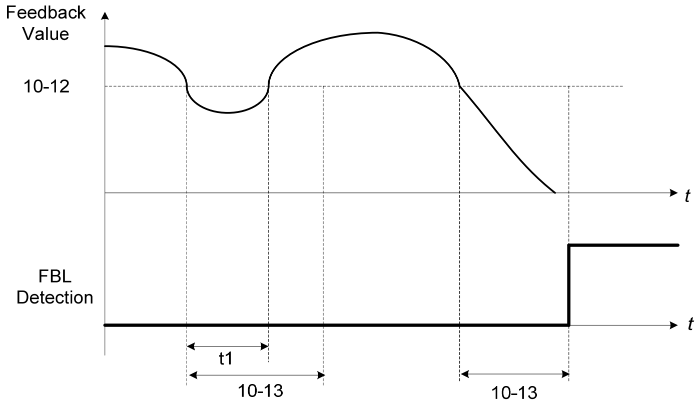


Figure 4.4.73 PID feedback loss detection

10-17	*Start Frequency of PID Sleep
Range	【0.00~599.00】Hz
10-18	Delay Time of PID Sleep
Range	【0.0~255.5】Sec
10-19	*Frequency of PID Waking up
Range	【0.00~599.00】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.4.4.74 (a), (b) and (c) for PID sleep / wakeup operation.

Note: Parameter 10-17 is the general start frequency of PID sleep, and it is not applied to the sleep frequency of constant pressure (parameter 23-10) by PUMP.

*: **(When the motor's maximum output frequency is over than 300Hz, the frequency resolution is 0.1Hz.)**

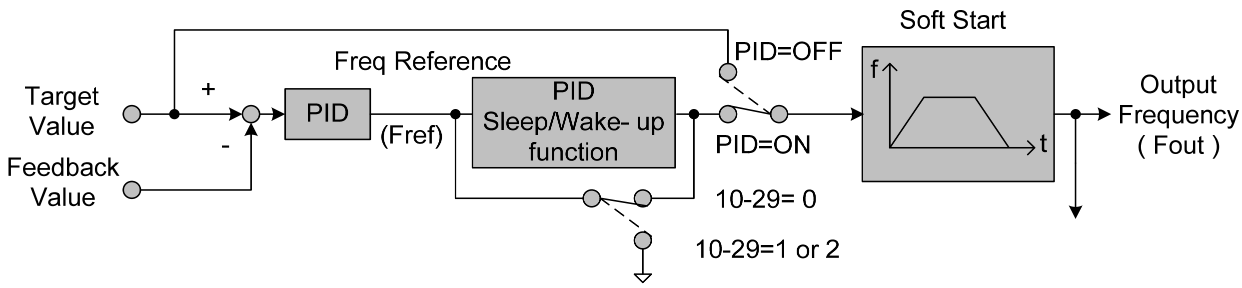


Figure 4.4.74: (a) PID control bock diagram

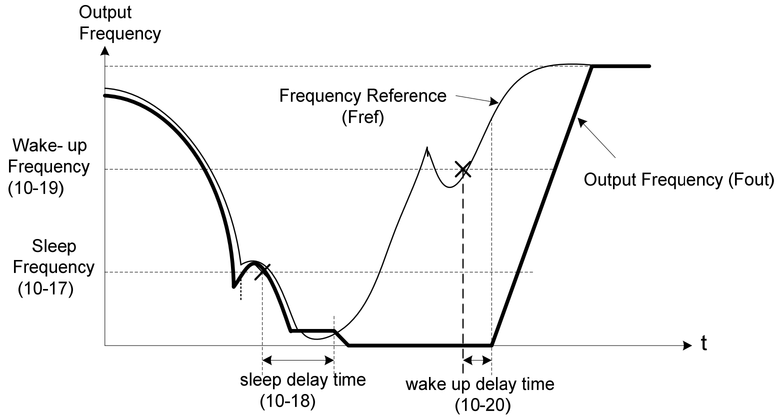


Figure 4.4.74: (b) Timing diagram PID sleep / wakeup

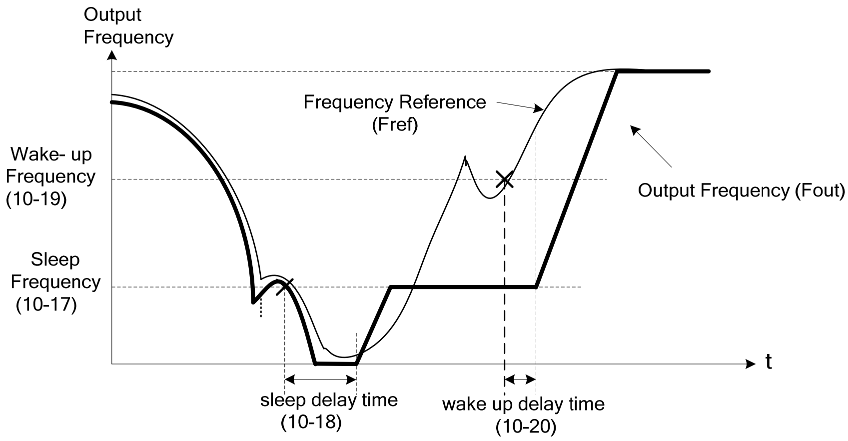


Figure 4.4.74: (c) Timing diagram of PID sleep compensation frequency/ wakeup

Notes:

- Refer to Fig. 4.4.74: (b) for parameter 10-40=0. The PID sleep timer is enabled when the output frequency (Fout) falls below the PID sleep frequency (10-17). When the sleep timer reaches the set PID sleep delay time (10-18) the inverter will decelerate to a stop and enter the sleep mode.
- Refer to Fig.4.4.74: (c) for parameter 10-40=1. The PID sleep timer is enabled when the output frequency (Fout) falls below the PID sleep frequency (10-17). The output frequency changes with the reference frequency (Fref) when the sleep timer reaches the set PID sleep delay time (10-18), the motor will run gradually to PID sleep frequency set by 10-17. (It is applicated in the occasion of fixed frequency.)
- While sleep mode is active and the motor has stopped, the internal PID control is still in 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.
  Ex:
  If wakeup frequency < sleep frequency, start upon sleep frequency and the inverter gets into sleep mode by wakeup frequency.
  If wakeup frequency > sleep frequency, start upon wakeup frequency and the inverter gets into

sleep mode by sleep frequency.
Ex1:
Sleep mode is only allowed in positive direction and if 10-25=1 (Allow Reversal Output), the sleep mode needs to be turned off.

- Parameter 10-00 and 10-01 can not be set in the same source. If they are set in the same value, “SE05” (PID selection error message) will be displayed in the keypad.
- When PID sleep selection is enabled or set by DI (10-29= 1 or 2) and PID reversal output selection (10-25)=1 (allow reversal output), “SE05” (PID selection error message) will be displayed in the keypad.
- When PID sleep selection is enabled ot set by DI (10-29= 1or 2) and PID control mode (10-03) = 1xxxb, “SE05” (PID selection error message) will be displayed in the keypad.

Note: When 23-00=1 (Pump), if PID sleep disable, most pump function will be affected.

10-22	**Start Level of PID Enable**
Range	**【0~599.00】**

Parameter 10-22 will be enabled when 23-00=1 (PUMP) and 10-03=xxx1b：PID enable.
When output frequency ≧ 10-22, PID Group 1 control the function, (P) Proportional Gain, (I) Integral Time, and (D) Differential Time are 10-05 / 10-06 and 10-07, to reduce the error between command and actual value.

When output frequency ＜10-22, PID Group 2 controls the function, (P) Proportional Gain, (I) Integral Time, and (D) Differential Time are 10-36 / 10-37 and 10-38, to reduce the error between command and actual value.

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 will be displayed as pressure, use 10-27 to set the pressure for 0V or 4mA feedback signal and use 10-33 to set the pressure for 10V or 20mA.

Refer to the Fig.4.4.75 for displaying the unit conversion.

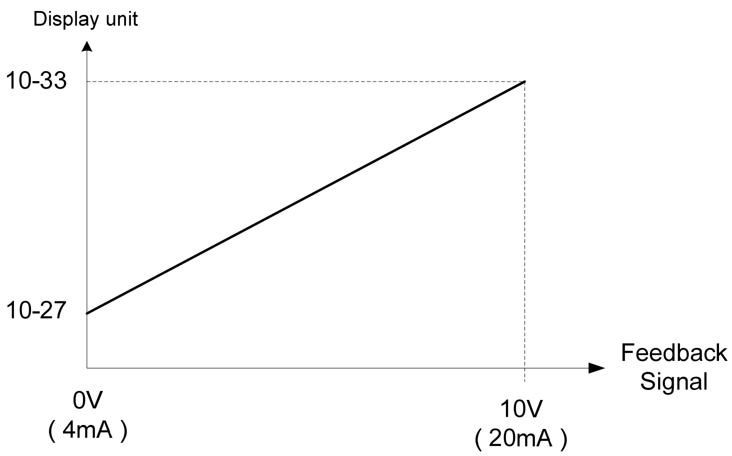


Figure 4.4.75 Feedback signal scaling

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】%

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 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 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 enabled (digital multi-function terminal is set to 54), PID1 will switch to PID2.

10-32=3: Set by RTC

When RTC timer is enabled, PID1 will switch to PID2.

10- 33	PID Maximum Feedback Value
Range	【1~10000】

Function of PID maximum feedback value is the 100% corresponding value of 10-02.

10- 34	PID Decimal Width
Range	【0~4】

Function of PID decimal width enables the user to set the decimal point.
For example, if it is set to 1, the keypad displays the first decimal place XXX.X. If it is set to 2, the keypad displays the second decimal place XX.XX.

10- 35	PID Unit (Only display in LCD Keypad)
Range	【0~24】

PID unit enables the user to select the unit for PID target vaule.
When 10-35=0, parameter of 12-38 will be used by the unit of %.

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 more details of PID2 description.

10- 39	*PID Output Frequency Setting during disconnection *1
Range	【0.00~599.00】Hz

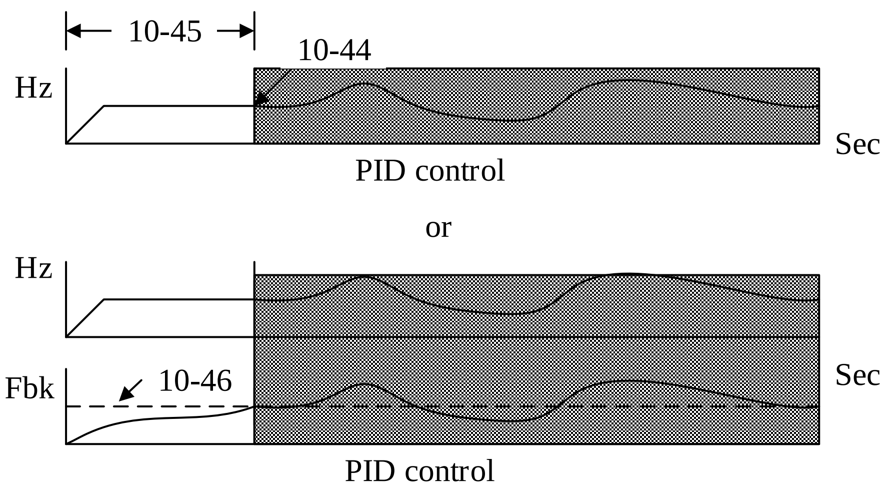
***1: It is new added in inverter software V1.4.**

*: **(When the motor's maximum output frequency is over than 300Hz, the frequency resolution is 0.1Hz.)**

When the warning of PID feedback disconnection occurs (10-11=1), frequency command output depends on the parameter 10-39. When the disconnection warning is removed, PID control restores.

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 precharge frequency and PID control mode is set to be 10-03=XXX1B (PID enable), the inverter runs by the precharge frequency and stops by the end of precharge time set by parameter 10-45. When the precharge time stops, the inverter runs by PID control. If PID feedback signal is equal or higher than the level of precharge target (parameter 10-46), it is not required to wait for the end of precharge time and the inverter can run by PID control. Refer to the following figure.



The setting description of parameter 10-00=4 can be referred by parameter 10-46. According to the the setting value of parameter 10-33, change the upper limit of setting value (parameter 10-46), determine the decimal places (parameter 10-34) and unit display (parameter 10-35).

10- 47	Proportioanl Gain (P) of Fire Mode
Range	【0.00~10.00】
10- 48	Integral Time (I) of Fire Mode
Range	【0.0~100.0】Sec
10- 49	Differential Time (D) of Fire Mode
Range	【0.00~10.00】Sec

➢ PID functions of ire mode, please refer to parameter group 08.

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 motor operation direction is set to 1 or 2, the motor can only operate in that specific direction. Run commands in the opposite direction are not accepted.

Forward or reverse commands can be issued via the control terminals or keypad.

Note: The reverse rotation selection 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, suggest to use 4KHz, and the motor cable used within 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 4.4.11.

Table 4.4.11 Carrier frequency settings

Carrier frequency	1KHz--6KH—10KHz—16KHz
Motor noise	High ---------------------- low
Output current waveform (similar to sinusoidal wave)	Bad ------ Good ------- Bad
Noise interference	Low ---------------------- high
Leakage current	Low ---------------------- high
Heat losses	Low ---------------------- high

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 might affect peripheral devices. Adjust the carrier frequency to avoid this as shown in Table 4.4.12.

Table 4.4.12 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) after parameter 11-01 is setted to be 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 control enabled. Soft-PWM 1 control can reduce the 'metal' noise produced by the motor, more comfortable for the human ear. At the same time, Soft-PWM also limits RFI noise to a minimum level. The default setting of Soft-PWM control is disabled. When Soft-PWM 1 is enabled, the maximum carrier frequency is limited to 8 kHz.

When 11-02=2 (Soft PWM 2 enables), users adjusts 2 Phase/ 3 Phase PWM Switch Frequency (parameter 11-66), detection range at Soft PWM function 2 (parameter 11-67), and detecting start frequency at Soft PWM function 2 (parameter 11-68) by the sensitivity to the sound.

11- 66	2 Phase/ 3 Phase PWM Switch Frequency
Range	【6.00~60.00】

When the inverter's output frequency is higher than the setting value of parameter 11-66, the modulation mode will be switched.

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】

When the inverter's output frequency is higher than the setting value of parameter 11-68, the inverter starts the function of noise detection and it adjusts electromagnetic noise coming from the motor run upon the setting value of parameter 11-67.

Note: When 11-02 = 2, the sum values of parameter 11-01 and parameter 11-67 can not be higher than the inverter's upper limit of carrier. For the inverter's proper run, there is affecting mechanism among these parameters (11-01, 11-02 and 11-67).

a) **If the error occurs in setting value of parameter 11-01, it is because parameter 11-02=2 and the setting value of parameter 11-01 + that of parameter 11-67 > upper limit of the inverter's carrier frequency. Thus, adjust the setting value of parameter 11-02 or that of parameter 11-67.**

b) **If the error occurs in setting value of parameter 11-67, it is because parameter 11-02=2 and the setting value of parameter 11-01 + that of parameter 11-67 > upper limit of the inverter's carrier frequency. Thus, adjust the setting value of parameter 11-02 or that of parameter 11-01.**

c) **When 11-02=2, the error occurs in setting value of parameter 11-01 or parameter 11-67. Please check the setting values of parameter 11-01 + that of parameter 11-67 > upper limit of the inverter's carrier frequency.**

d) **If the error occurs in setting parameter 11-02=2, it is because the setting value of parameter 11-01 + that of parameter 11-67 > upper limit of the inverter's carrier frequency. Thus, adjust the setting value of parameter 11-01 or that of parameter 11-67. Then set parameter 11-02 =2.**

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 overheats and returns to carrier frequency set in parameter 11-01 when the inverter temperature returns to normal. See section 3.5 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.4.4.76 for more information.

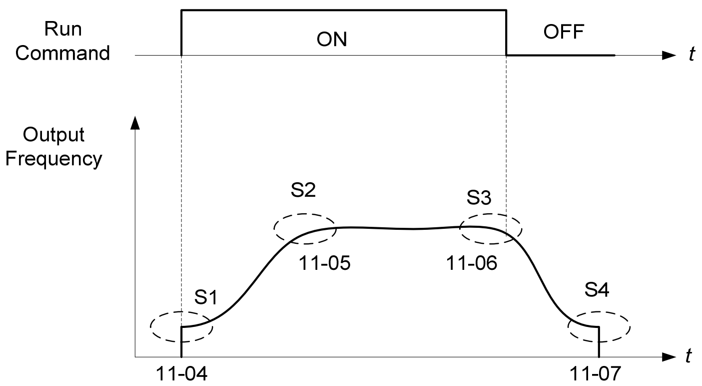


Figure 4.4.76 S curve characteristic

Total acceleration and deceleration time when the S curve is used:

$$\text{Accelerating time} = \text{Accelerating time 1 (or 2)} + \frac{(11\text{-}04) + (11\text{-}05)}{2}$$

$$\text{Deceleration time} = \text{Deceleration time 1 (or 2)} + \frac{(11\text{-}06) + (11\text{-}07)}{2}$$

11- 08	Jump Frequency 1
11- 09	Jump Frequency 2
11-10	Jump Frequency 3
Range	【0.0~599.0】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.4.4.77.

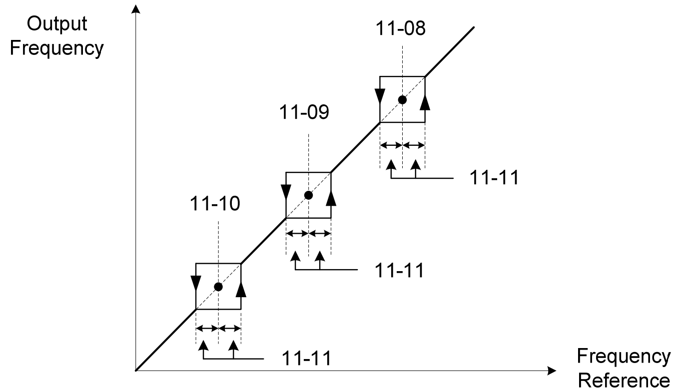


Figure 4.4.77 Jump frequency operation

Jump frequency via Analog Input.

Set parameter 04-05 (AI2 function selection) or 04-10 (AI2 function selection) to 9 (frequency jump setting 4) for controlling the jump frequency via analog input AI2. Refer to Fig. 4.4.38.

Note: When jump frequency overlap the sum of the overlapped jump frequencies will be used as the jump frequency range. Refer to Fig.4.4.78.

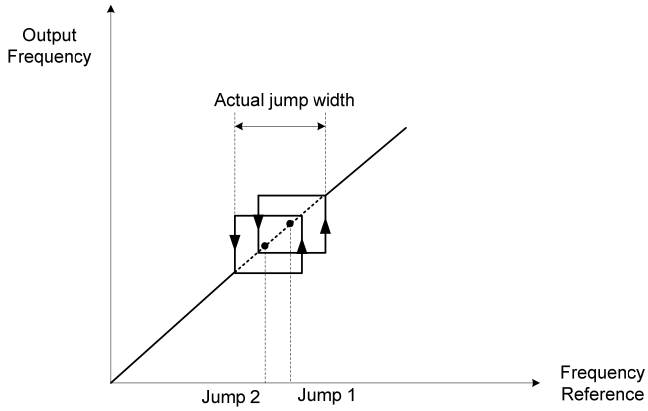


Figure 4.4.78 Jump frequency overlap

11- 13	Automatic Return Time
Range	【0~120】Sec

If the keypad is not 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	【0.00~599.00】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 4.4.88 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

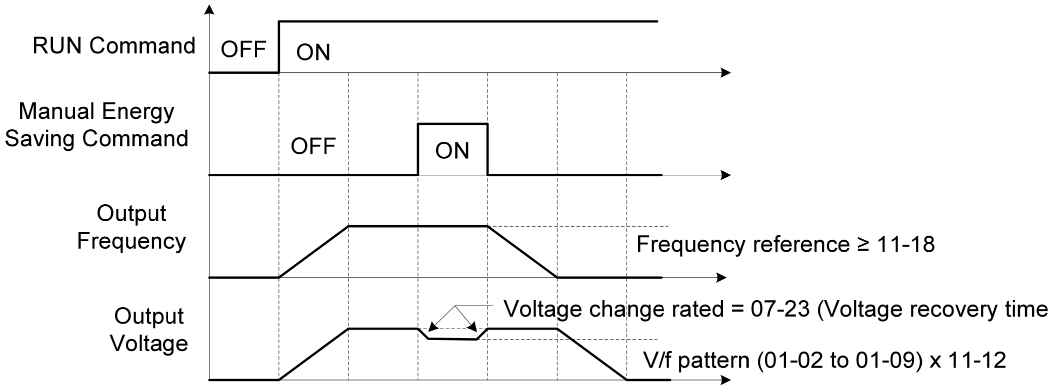


Figure 4.4.79 Manual energy saving operation

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 become greater when the load decreases.

AES function is suitable for the load is stable, just like fan or windmill. If the load is variable, please do not use this function to avoid the output torque is not enough.

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 the TECO standard, please refer to the following commands for adjusting parameters:

Enable Automatic Energy Savings Function

(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

Set the voltage upper limit during automatic energy saving. 100% corresponds to the settings of parameter 01-03 (Maximum Output Voltage) depending on the inverter class used. Refer to the Fig.4.4.80.

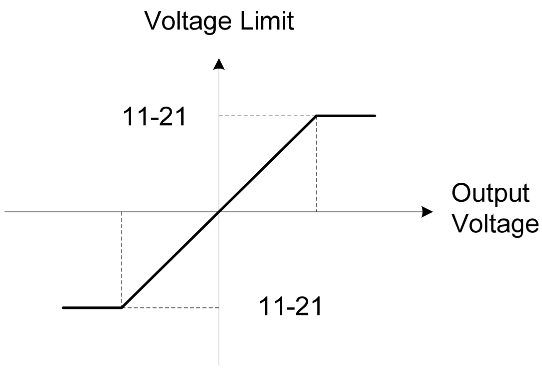


Figure 4.4.80 Voltage limit value of commissioning operation

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 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.

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 carried 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.

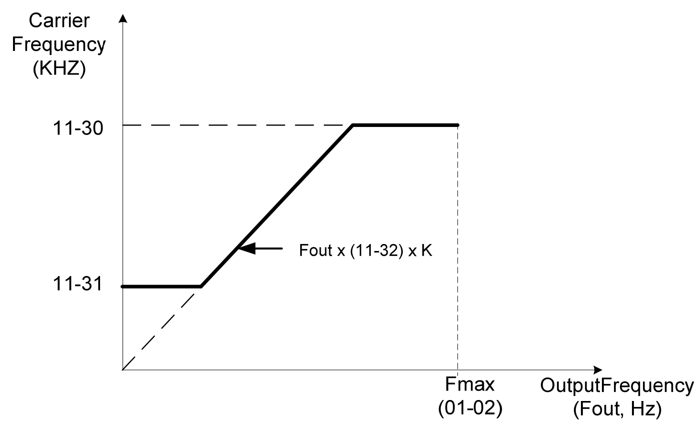
11-29=1: Auto de-rating selection is enabled.

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 depends 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	【0.00~599.00】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

* (When the output frequency is bigger than 300Hz, the resolution is 0.1Hz)

Overvoltage suppression is used for the application of likely causing to energy recharge.

Example: there are two situations causing excessive energy to recharge the inverter in stamping application

(1) When cam clutch is not engaged, the motor will accelerate and start flywheel. When motor decelerates, the rotation speed will higher than motor speed owing to the large flywheel's inertia and then recharge the inverter.
(2) When cam clutch is engaged, the motor will start flywheel and compress the spring. When the highest point of the cam moves beyond its center, the spring will release the power to the flywheel and excessive energy output recharge the inverter.

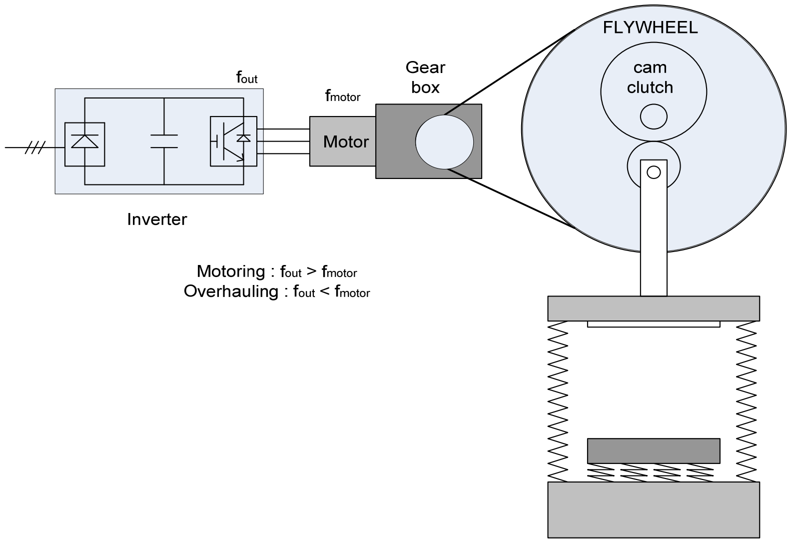


Figure 4.4.80.a Stamping Operation

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.

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 4.4.80.b.

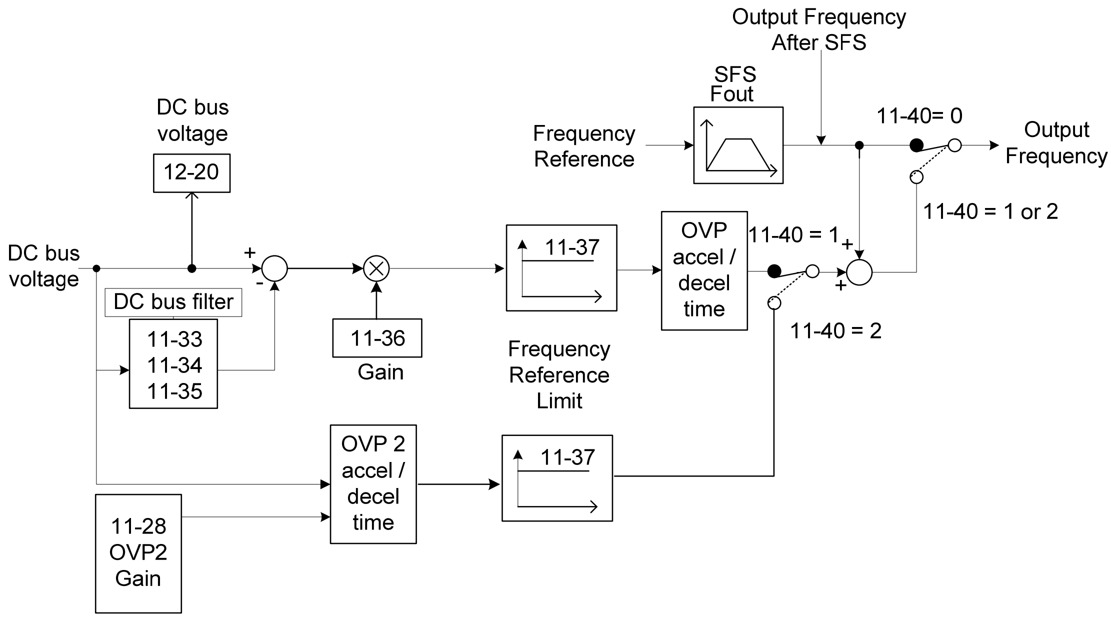


Figure 4.4.80.b operation

When 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 change 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 Deadband 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 Deadband 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 operation 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 4.4.80.c.

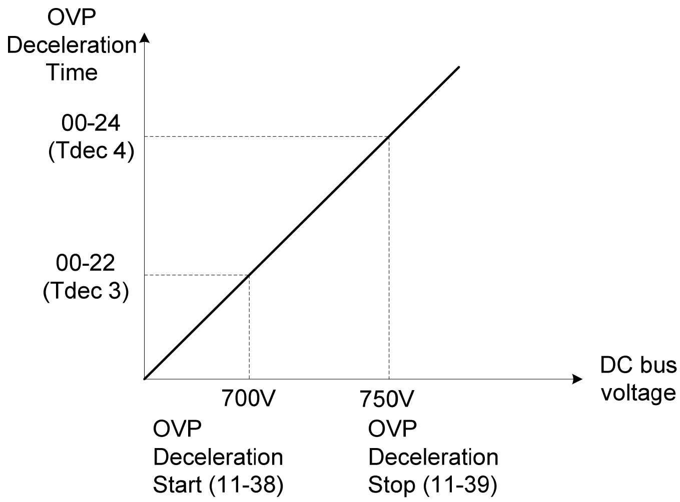


Figure 4.4.80.c OVP deceleration time

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 4.4.92.

- 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:

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).

When 11-40=2: OV prevention Mode 2

The process of OV prevention mode 2 is the same as that of OV prevention mode 1 but it strengthens more the part of DC BUS over the deceleration stop voltage of OV prevention (11-39) in Fig.4.4.80.c. It can accelerate frequency compensation to avoid OV protection by increasing frequency gain of OV prevention 2 (11-28).

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 output frequency to avoid OV occurring and it will be not higher than the maximum output frequency of motor 1. Thus, adjust parameter 01-02 (maximum output frequency of motor 1) depending on the application.

Adjustment modes

If OV still occurs in OV prevention mode 3, increase the setting value of parameter 11-64 in 0.1 units. When the setting value of parameter 11-64 is higher, the speed and the current increase more.

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, main frequency command continuously compares with the previous value occurring in 360 ms.

When the frequency loss occurs, inverter will operate depending on the following estimated frequency command.

Frequency command after frequency loss = the maximum output frequency of motor 1 (01-02) × the level set in parameter 11-42

Descriptions of frequency loss function:

1) When inverter is on operation and source of selected analog command disappears, the command acts depending on the setting of parameter 11-42.

2) When reference command restores to the level prior to frequency loss, inverter will restore to the previous state.

Notes:
1. Frequency command (11-42) is corresponding to the maximum output frequency of motor 1 (01-02) when reference frequency disappears.
2. The disappearance of reference frequency is only for the use of analog signal (1: AI1; 7:AI2) from the selection of main frequency source (00-05).

Refer to Fig.4.4.81 for the process diagram of multi-function digital output (03-11~03-12) when reference frequency loss occurs.

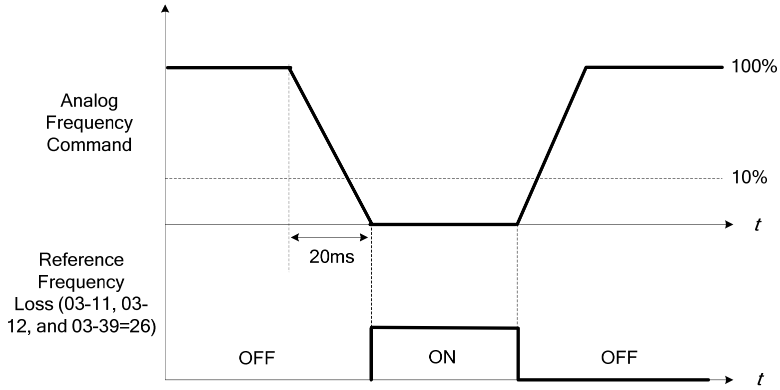


Figure 4.4.81 Operation for reference frequency loss

11- 43	**Hold Frequency at Start**
Range	**【0.0~599.0】Hz**
11- 44	**Frequency Hold Time at Start**
Range	**【0.0~10.0】Sec**
11- 45	**Hold Frequency at Stop**
Range	**【0.0~599.0】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 of deceleration time does not include the start and stop hold time. Refer to the Fig. 4.4.82.

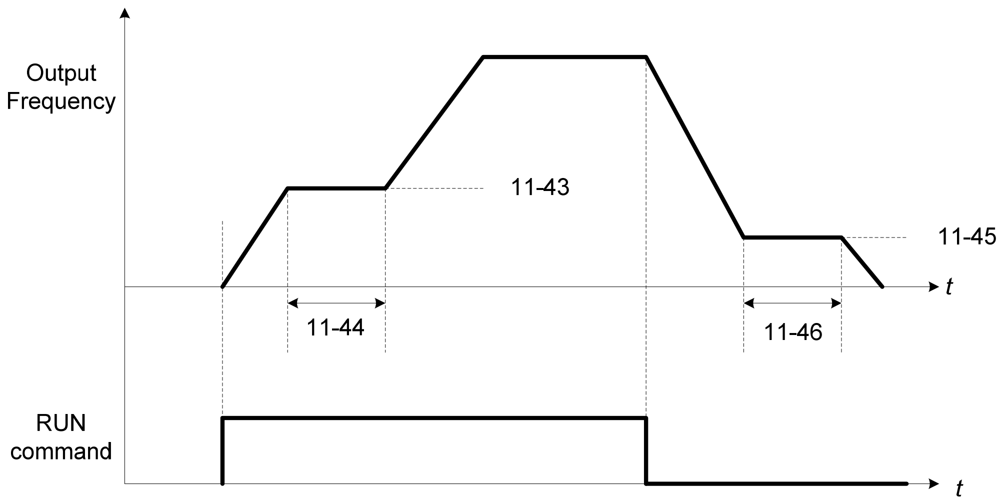


Figure 4.4.82 Reserved function

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.4.4.83.

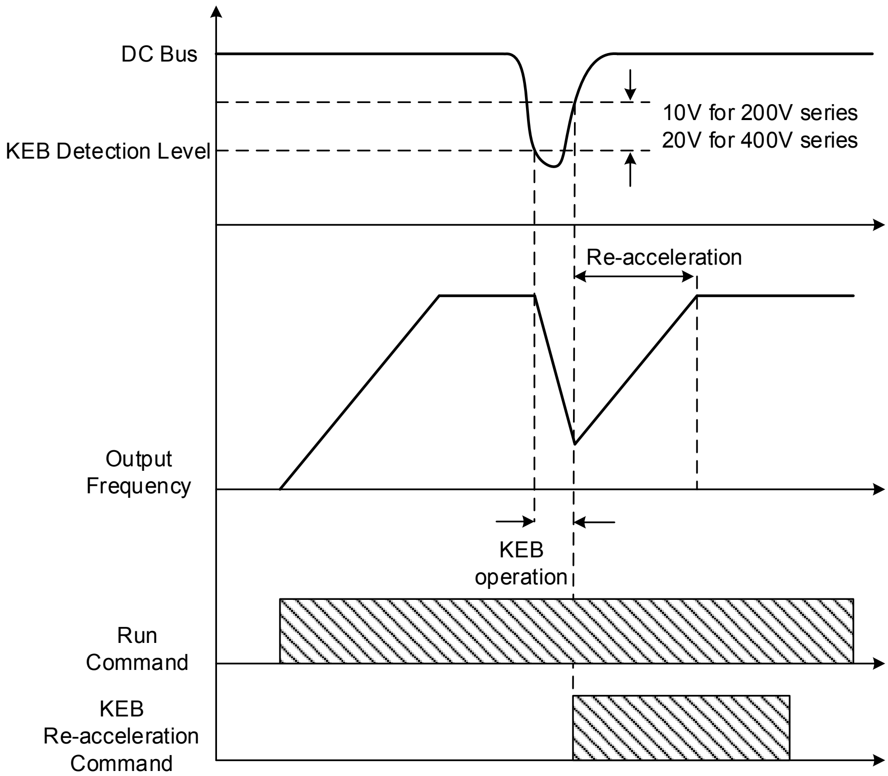


Figure 4.4.83 KEB operation

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.4.4.84 for more information on zero-speed DC braking operation.

Note: DC braking 07-07 is limited to 20% of the inverter rated current.

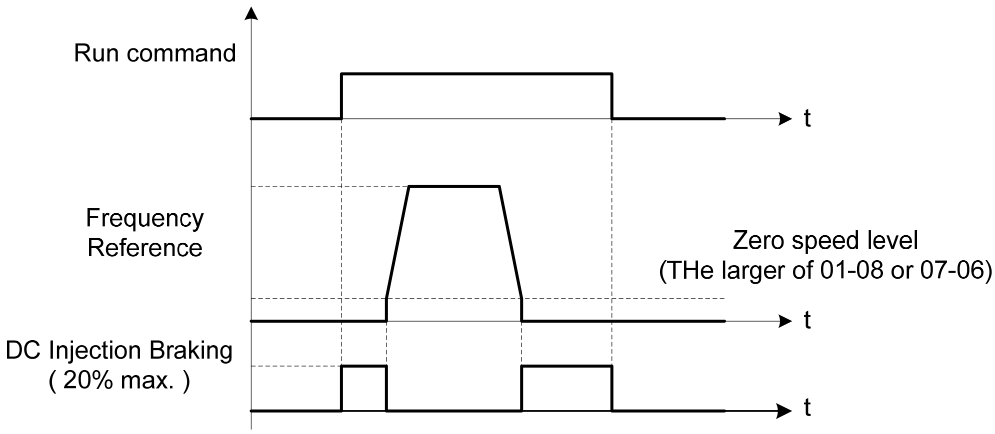


Figure 4.4.84 Zero-speed braking operation

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

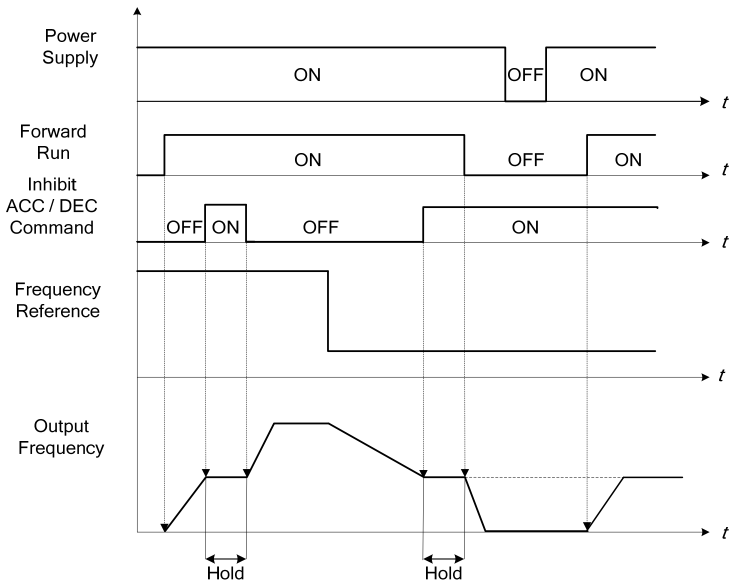
This function is enabled only when one of multi-function digital input terminals (03-00 to 03-07) is set to 11 (ACC / DEC Inhibition command).

11-58= 0: When ACC / DEC inhibition command is enabled, the motor will stop accelerating or decelerating and the frequency at the moment will be used as frequency command. If ACC / DEC inhibition command is disabled or stop command enabled, the frequency command will set to original frequency. Besides, when stop command enabled, or the power is cut off and reset. The frequency will be set to 0 Hz

Note: If ACC/DEC inhibition command is enabled before running, it will display STP0 after running, due to there is no reference frequency record.

11-58= 1: When ACC / DEC inhibition command is enabled, the output frequency will be recorded and to be used as frequency command. When it switches to stop or the power is cut off and reset, the ACC / DEC inhibition command is still enabled, the frequency command is still recorded and the frequency command is set to the frequency that was recorded.

Please refer to the following figure.



11- 59	Gain of Preventing Oscillation
Range	【0.00~2.50】

Gradually increase the setting value with the unit of 0.01 when the motor is driven leading to the occurrence of oscillation under the state of normal duty.

11- 60	Upper Limit of Preventing Oscillation
Range	【0~100】%

Function of prevention of oscillation upper limit is required to be within the setting value.

11- 61	Time Parameter of Preventing Oscillation
Range	【0~100】

Adjust the response of oscillation function. That is, adjust once delay time parameter of prevention oscillation function.

11- 62	Prevention of Oscillation Selection
Range	【0】: Mode 1 【1】: Mode 2 【2】: Mode 3

When 11-62 is set to 0 and 1, the response to prevention oscillation is slower.
When 11-62 is set to 2, the response to prevention oscillation is faster.

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 %

Adjust the response of Gain of Preventing Oscillation 3
If vibration with motor in ND mode occurs, please increase by 0.01 unit to set.

11- 70	Upper Limit of Preventing Oscillation 3
Range	0.01~100.00 %

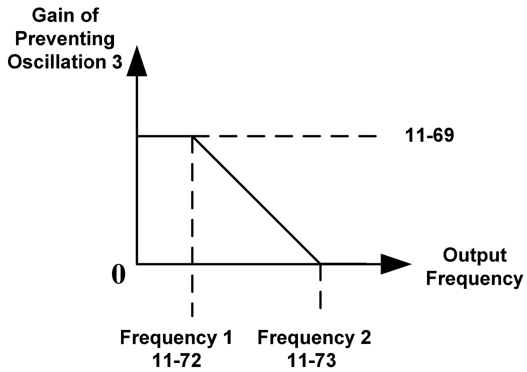
It is required to limit the preventing oscillation 3 upper limit within the setting value.

11- 71	Time Parameter of Preventing Oscillation 3
Range	0~30000 ms

Adjust the response of oscillation 3 function. (Time parameter of adjust preventing oscillation function delay.)

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

Refer to the following figure for the setting of parameters 11-72 and 11-73.



Group 12: Monitoring Parameters

12- 00	Display Screen Selection (LED)	
Range	Highest bit => 0 0 0 0 0 <= lowest bit The value range of each bit is 0~7 from the highest bit to the lowest bit,	
	【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

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 by Integer (xxx) 【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 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 is displayed in LED keypad. Parameter 12-01 will take the value of parameter 10-33 to convert to be five digits display 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;
if with the setting value of parameter 12-02, when 12-01=1 and 12-02=1, it displays 99.9Pb five digits; when 12-01=2 and 12-02=2, it displays 9.99FL and tenth digit 9 will be concealed.

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 at Integer.(xxxxx) 【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)

12-04=0

Inverter displays the line speed at stop, operation or the modification of frequency.

12-04≠0

12-03 is set to the maximum line speed and corresponds to the maximum output frequency.

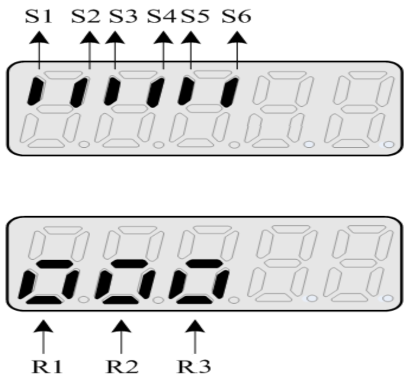
For example, if the line speed display of 12-03 is 1800, the keypad display is 900 when frequency output is 30Hz.

12- 05	Status Display of Digital Input Terminal (LED/LCD)
Range	Read-only

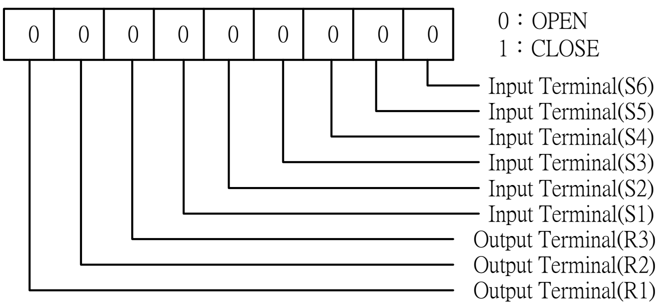
Terminals S1-S6 are represented using two segments of each digit. Segment turns on when input is active. The bottom segments of each of the first three digits are used to represent the digital outputs (R1, R2, R3). Segments turn on when output is active.

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



12- 81	Relay Card Display (LED/LCD)
Range	Readable only (only for keypad）

Please refer to parameter group 24.

10-03=xxx1b

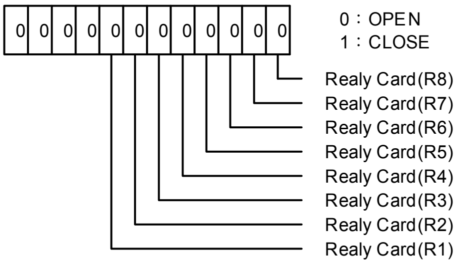
1 to 8 Relay card is installed.

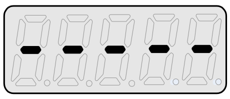
24-00=1
24-07=0: Relay is ON and RUN.

Display sequency:

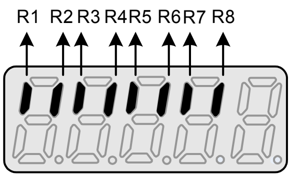
LED display (without output):

LCD display:





LED display (when input and output is active):



10-03=xxx1b

Control board Relay is installed.

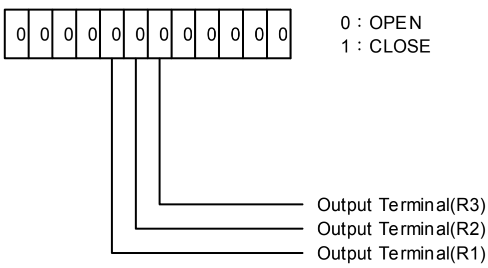
24-00=1

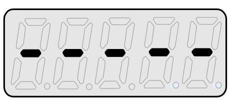
24-07=1: Relay is ON and RUN.

Display sequence:

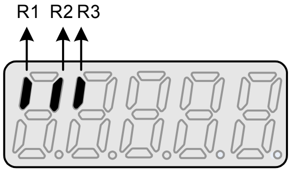
LED display (without output):

LCD display:





LED display (when input and output is active):



Note: Refer to section 4.3 for other monitor parameters 12-11~12-82.

Monitor parameters 12-67 (KWHr) and 12-68 (MWHr) is the display of accumulative energy.

Note: Parameter 11-54 can clear the monitor parameter.

Monitor parameter 12-76 (No-load voltage) is required to refer to the descriptons 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	00H~FFH

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 to Clear Cumulative Operation Hours 【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 set to 1, the value of 13-03/13-04 will be cleared.

13-05= 0: Inverter logs the time while the inverter is powered-up.

13-05= 1: Inverter logs the time when the inverter is running.

13- 06	Parameters Locked
Range	【0】: Only parameter 13-06 and frequency command parameters in main screen are writable 【1】: Only user parameter is enabled. 【2】: All parameters are writable.

When 13-06=0, only parameter 13-06 and frequency command parameter in main screen can be set but other parameters are read-only.

When 13-06=1, only user parameters (00-41~00-56) are enabled. Please refer to the instruction of parameters 00-41~00-56.

Note: it is only enabled in LCD keypad.

When 13-06=2, all parameters are writable except for the read-only parameters.

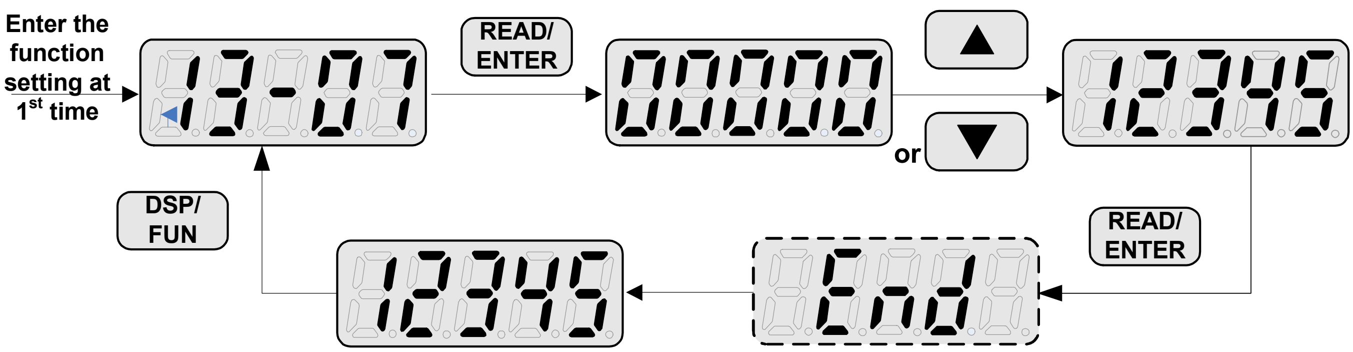
Note:
Main frequency setting is 12-16. The value is equal to frequency setting of speed-stage 0 (05-01) in LCD keypad.
LED Main Frequency can be set in the main frequency display

13- 07	Parameter Password Function
Range	【00000~65534】

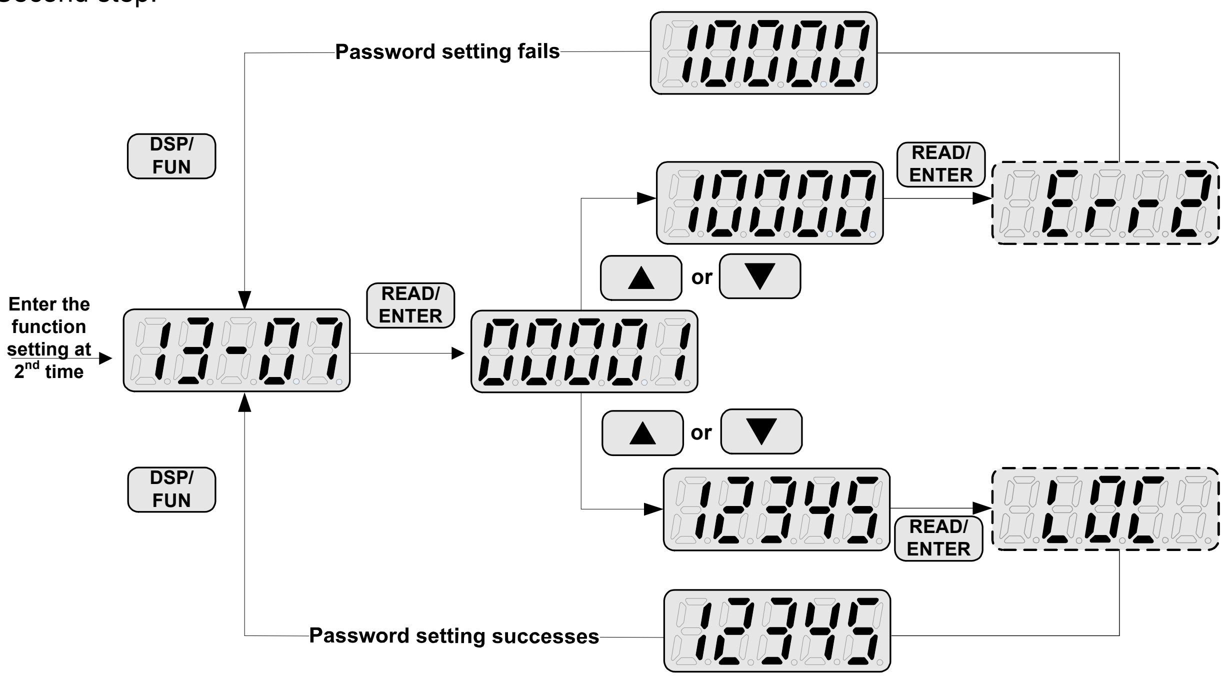
When the setting value of parameter 13-07 is enabled (13-07 > 0), all the parameters can not be adjusted except the frequency in main screen so user needs to input the password to adjust it.

Password setting:

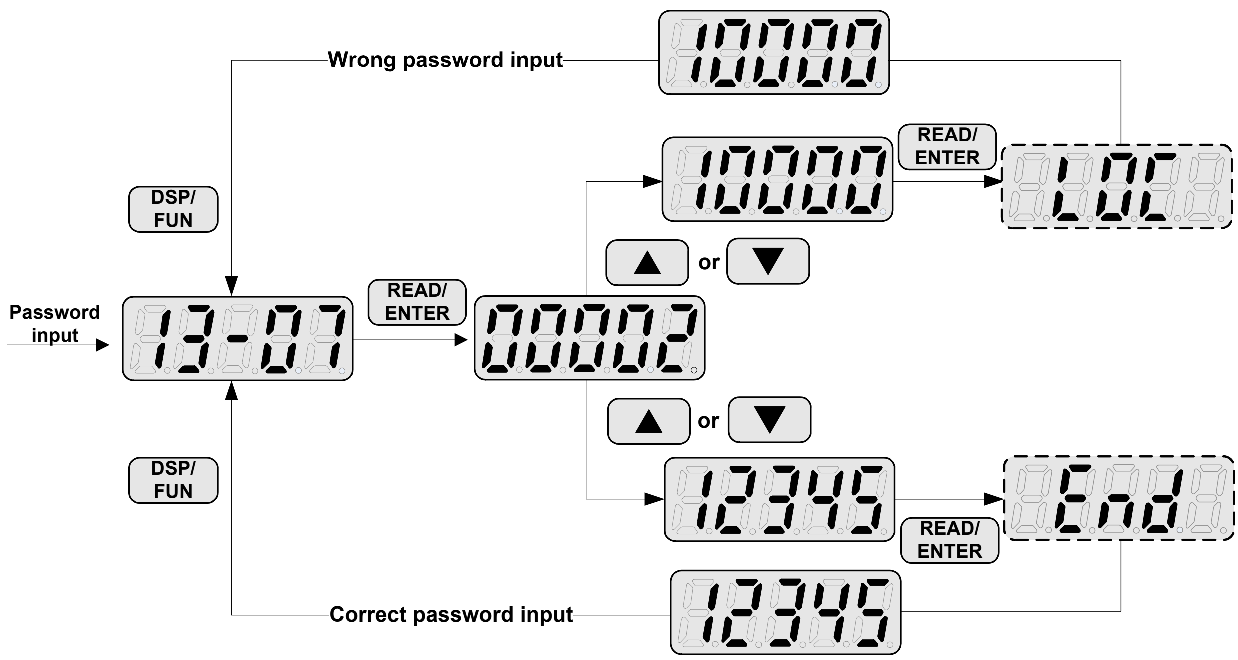
First step:



Second step:



Password Input：



13- 08	Restore Factory Setting
Range	【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

Note: Main frequency setting is 12-16. The value is equal to frequency setting of speed-stage 0 (05-01)

Use parameter 13-08 to initialize the inverter 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.4.4.1.

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 4.4.2 and Figure 4.4.3 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.4.4.1.

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.4.4.1.

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 4.4.1. 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 4.4.2 and Figure 4.4.3 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 4.4.1. 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 4.4.2 and Figure 4.4.3 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 4.4.1. 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 4.4.2 and Figure 4.4.3 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.4.4.1. 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 4.4.2 and Figure 4.4.3 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 modify the setting of 01-00 (V/F curve).

Parameter List: parameters that are not affected by default value

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	**Parameter Password Function 2**
Range	**0 ~ 9999**

13- 11	**C/B CPLD Ver.** ***1**
Range	**【0.00~9.99】**

This parameter displays CPLD version on the control board.

13- 12	Option Card Id *1
Range	【0~255】

This parameter displays option card Id on the control board and it is enabled only with the option card.

【0】: None
【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 on the control board and it is enabled only with option card.

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.

Note: Parameters 13-21~13-50 are 30 Fault History: When it detect fault, inverter will store to fault history. If the fault occurs again, parameter 13-21 will change to parameter 13-22.

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 more details of 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	【5~82】
16- 01	Sub-Screen Monitoring 1
Range	【5~82】
16- 02	Sub-Screen Monitoring 2
Range	【5~82】

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 ~ 12-82.

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	【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
16- 04	Selection of Engineering Unit
Range	【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 【19】: m 【20】: °C 【21】: RPM *1 【22】: Bar *1

	【23】: Pa *1 【24】: KPa

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

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.

<table>
<tr><th>16-03</th><th colspan="4">Set / displayed contents</th></tr>
<tr><td>0</td><td colspan="4">0.01 Hz</td></tr>
<tr><td>1</td><td colspan="4">0.01 % (maximum output frequency 01-02=100%)</td></tr>
<tr><td>2</td><td colspan="4">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.)</td></tr>
<tr><td>3-39</td><td colspan="4">Reserved</td></tr>
<tr><td rowspan="6">00040
-
39999</td><td colspan="4">Set the decimal point by using the fifth place.
i.e. □ □□□□
Sets full display scaling excluding decimals
Set the number of decimal places
⇨
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></td></tr>
<tr><td>16-03</td><td>Display</td><td>Display unit</td><td>Display example</td></tr>
<tr><td>00040
-
09999</td><td>□□□□</td><td rowspan="4">use
16-04 setting</td><td>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)</td></tr>
<tr><td>10001
–
19999</td><td>□□□. □</td><td>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</td></tr>
<tr><td>20001
–
29999</td><td>□□. □□</td><td>Example: 100 % speed is 65.00ºC
> set 16-03=26500 (05-01, 06-01 to 06-15, set range from 0000 to 9999)
> set 16-04=20 (ºC)
> 60% of speed is displayed as 39.00 ºC</td></tr>
<tr><td>30001
-
39999</td><td>□. □□□</td><td>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</td></tr>
</table>

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	Group 14 PLC Setting 15 PLC Monitor 16 LCD Keypad Func.	Select the copy function group (16) from the group menu.
2	PARA 16 -07：Copy Sel -08：READ Sel -09：Keypad Loss Sel	Press the Read / Enter key and select parameter (16-07) copy sel.
3	Edit 16-07 Copy Sel 0 Normal (0 – 3) < 0 >	Press the Read / Enter key to display the data setting / read screen (LCD display is inversed).
4	Edit 16-07 Copy Sel 1 READ (0 – 3) < 0 >	Change the set value to 1 (read) by using the up arrow key.
5	-ADV- READ INV → OP	• 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	-ADV- READ COMPLETE	"READ COMPLETE" will be displayed on the keypad when reading was successful.
	RDP Read Prohibited	• 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	Edit 16-07 Copy Sel 1 READ (0 – 3) < 0 >	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	Group 14 PLC Setting 15 PLC Monitor 16 LCD Keypad Func.	Select the copy function group (16) from the group menu.
2	PARA 16 -07：Copy Sel -08：READ Sel -09：Keypad Loss Sel	Press the Read / Enter key and select parameter (16-07) copy sel.
3	Edit 16-07 Copy Sel 0 Normal (0 – 3) < 0 >	Press the Read / Enter key to display the data setting / read screen (LCD display is inversed).
4	Edit 16-07 Copy Sel 2 WRITE (0 – 3) < 0 >	Change the set value to 2 (write) by using the up arrow key.

Steps	LCD Display (English)	Description
5	-ADV- WRITE INV → OP	• 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	-ADV- WRITE COMPLETE	"WRITE COMPLETE" will be displayed on the keypad when writing was successful. • Until the subsequent display of "SysInit", please power off and restart.
	WRE Write Error	• 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	Edit 16-07 Copy Sel 2 WRITE (0 – 3) < 0 >	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	Group 14 PLC Setting 15 PLC Monitor 16 LCD Keypad Func.	Select the copy function group (16) from the group menu.
2	PARA 16 -07：Copy Sel -08：READ Sel -09：Keypad Loss Sel	Press the Read / Enter key and select parameter (16-07) copy sel.
3	Edit 16-07 Copy Sel 0 Normal (0 – 3) < 0 >	Press the Read / Enter key to display the data setting / read screen (LCD display is inversed).
4	Edit 16-07 Copy Sel 3 VERIFY (0 – 3) < 0 >	Change the set value to 3 (verify) by using the up arrow key.
5	-ADV- VERIFY INV → OP	• 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	-ADV- VERIFY COMPLETE	"VERIFY COMPLETE" will be displayed on the keypad when writing was successful.
	VERY Verify Error	• 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	Edit 16-07 Copy Sel 3 VERIFY (0 – 3) < 0 >	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】

Set the internal clock before using the function of Real Time Clock (RTC).

RTC date setting is determined by parameter 16-11 and RTC time setting is determined by parameter 16-12.

RTC is displayed in the top of the keypad and refer to Fig.4.4.85 for the selection of RTC time display (16-10) is set to 1.

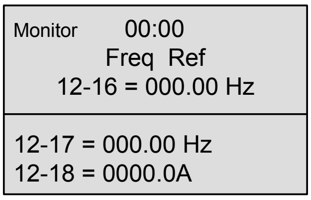


Figure 4.4.85 RTC Time Display (Example)

Notes:
- RTC is not enabled if keypad does not connect with the inverter.

- The counting time continues running regardless of the function being hide or display in the paramerer 16-10 (RTC Time Display Setting).

Users can apply the parameters 12-72 and 12-73 to monitor the specific RTC date and time.

RTC has the following characteristics:
- Four times a day
- Four weeks
- Timer offset function (preset time)
- Timrer enables via multi-function digital input
- Selection for contant time and speed
- Timer enables 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 4.4.13
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.

Timer is set by the following steps:

① **Start the timer:**
Timer starts via the setting of RTC timer function (16-13).

② **Set the time period:**
Set the start & stop time and date. If the setting of start time is equal to that of stop time, timing period is off.

③ **The timer is enabled:**
Arrange time period to the specific timer (16-32~16-35).

④ **Link to parameters:**
The timer can be linked to the relay output. One relay output can be only linked to one timer(ex. 03-11, 03-12 and 03-39, 16-36).

Note: If the stop time is set to 12:00, Motor start to stop from 12:01.

Refer to Fig.4.4.86 for RTC structure.

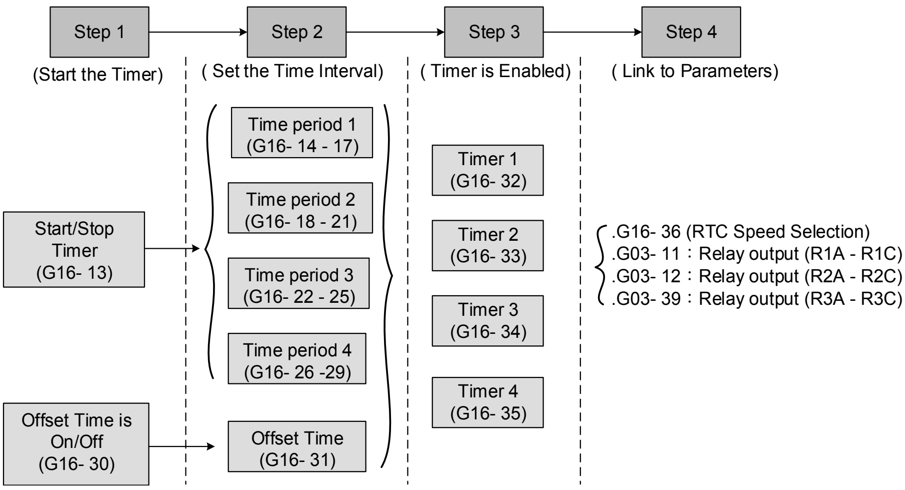


Figure 4.4.86 RTC structure

Refer to the following Table 4.4.13 for the selection of timer operation cycle.

Table 4.4.13 Arrange time period to the 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

16-32 ~ 16-35	O	P4	P3	P2	P1	Timer Function	Display
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 an 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=5: 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 selection of RTC speed setting (16-36) is affected by the action of time period 1 to 4 (P1~P4) which is corresponding to the selection of RTC rotation direction (16-37).
  For example:
  When the selection of RTC speed is set to 5 (by timer 1+2), source of run command (00-02) and source of frequecny command (00-05) are required to set to RTC. Thus, reference frequency is controlled by RTC timer 1 and 2 and the inverter continues running.

Refer to Table 4.4.14 for the control of reference frequency.

Note: Selection of RTC Rotation Direction (16-37) is limited by the Motor Direction Lock Selection(11-00).
Note: The offset 16-37 running direction will select by the direction of the timer 1.

Table 4.4.14 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)

RTC function can not run normally when:

- When multi-function terminal (03-00~03-05) is set to the fire mode.
- When KEB function is enabled
  - ■ Source of main frequency of RTC function is according to Table 4.4.14 and also can refer to 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 4.4.15 for the relationship between main run command and RTC timer status.

Table 4.4.15 Relationship between main run command and RTC timer status

Main run command 00-02	RTC timer x status	Inverter status
0~3	0	Inverter can not run (without run command)
0~3	1	Inverter can not run (without run command)
4	0	Inverter can not run (RTC timer is disabled)
4	1	Inverter runs and rotates depending on the function of 16-37.

Take an example for RTC timer connecting with different parameters:

The work time on Monday is 6:00 AM to 10:00 PM.
The work time on Tuesday to Friday is 8:00 AM to 8:00 PM.
The work time on Saturday is 8:00 AM to 6:00 PM.
The work time on Sunday is 8:00 AM to 12:00 PM.
Motor runs on weekdays (Mon. to Fri.) at speed 1 and on weekends at speed 2.

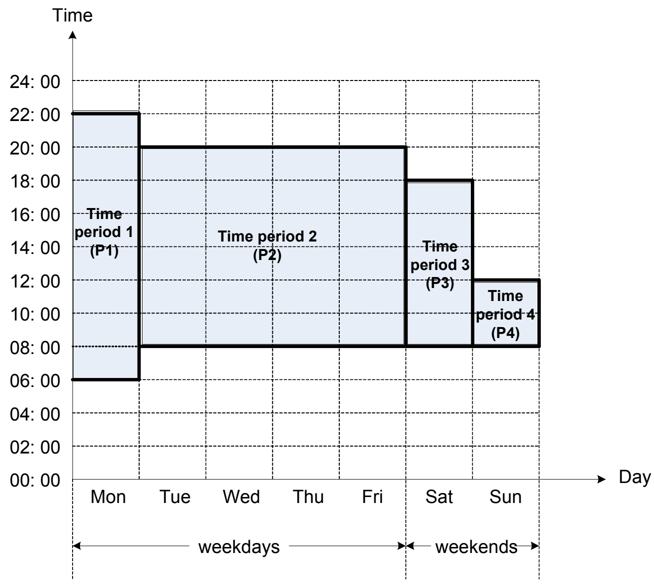


Figure 4.4.87 RTC timer (example)

① **Start up the timer in the parameter group 16** (Set the internal time first to enable this function).
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, 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 setting is speed-stage 0 (05-01).
Rotation direction (16-37) is set to 0000b.
Then, the rotation direction of time period 1~4 (P1~P4) is corresponding to the setting of 16-37.

⑧ **Choose two constant speeds (speed 1 & speed 2)**
16-36 = 5: Timer 1+2 is enabled.
When timer 1 is enabled, frequency setting is speed-stage 1; while timer 2 is enabled, frequency setting is speed-stage 2.
Rotation direction (16-37) is set to 0000b.
Then, when timer 1 and timer 2 are active, direction of motor rotation is forward rotation.

Note: Select RTC offset (16-30) and set RTC offset time (16-31) to enable the offset time. Inverter runs depending on the arranging time period to timer function. Refer to the following Fig.4.4.88.

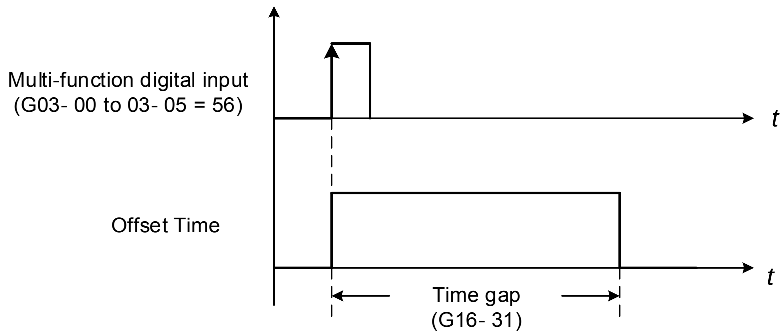


Figure 4.4.88 Operation of offset time

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 set by DI and the offset time is set via 16-31. Switch on DI and RTC will immediately start up.

If the source of timer is set to 15 (P1+P2+P3+P4), press “STOP” key at the time period 1 (P1). Normally, RTC will start automatically at the next time period (P2) but it can also start via the setting of 16-30 to 2 (set by DI). Inverter re-runs when switching on DI and RTC will immediately start up.

Notes:

If press “STOP” key at the time period and inverter can re-run at this time, user can:

- 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 be enabled.

Note:

RTC Accuracy:

Temperature	Deviation
+25℃(77℉)	+/-3 sec./ day
-20 / +50 ℃ (-4/ 122℉)	+/-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*1**
Range	200V:【50.0~240.0】V 400V:【100.0~480.0】V
17- 04	**Motor Rated Frequency*2**
Range	【4.8~599.0】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

*1. Values of motor rated voltage are for 200V class, double the values for 400V class.

*2. The setting range of motor rated frequency is 0.0 to 599.0 Hz.

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)

17-00=0: Perform rotational auto-tune (High performance auto-tune)
After executing Rotational auto-tuning (17-00), Excitation current (02-09), Core saturation coefficient 1 (02-10), Core saturation coefficient 2 and Core saturation coefficient 3 will renew the value.
17-00=1: Perform a static non-rotational auto-tune
Motor does not rotate during auto-tuning and this tuning causes lower power at low speed.
After executing Static auto-tuning (17-00=1), Proportion of motor leakage inductance (02-33) and Motor slip (02-34) will renew the value.
17-00=2: Perform stator resistance non-rotational auto-tune (V/F mode) when using long motor leads. This tuning causes lower power at low speed.
After executing Stator resistance measurement (17-00=2), Resistance between wires (02-15) will renew the value.

17-00=3: Reserved

17-00=4: Loop tuning makes optimization for current loop response to improve the bandwidth of urrent and torque.

17-00=5: Rotational auto-tuning combination is three-in-one auto-tuning, including loop tuning (17-00=4), stator resistance measurement (V / F) (17-00=2), and rotation auto-tuning (17-00=0).

17-00=6: Static auto-tuning combination () is three-in-one auto-tuning, including loop tuning (17-00=4), stator resistance measurement (V / F) (17-00=2) and static auto-tuning (17-00=1).

- Motor rated output power (17-01)
  Set by inverter capacity (13-00)

- Motor rated current (17-02)
  Set by inverter capacity (13-00)
  Set the range to 10 %~200 % of the inverter rated current.

- Motor rated voltage (17-03)

- Motor rated frequency (17-04)

- Motor rated speed (17-05)

When tuning a special motor (e.g. constant power motor, high-speed spindle motor), with a motor rated voltage or rated motor frequency that is lower than a standard AC motor, it is necessary to confirm the motor nameplate information or the motor test report.

Prevent the inverter output voltage from saturation when the motor rated voltage is higher than the inverter input voltage (see Example 1).

Example 1: Motor rated voltage (440V/60Hz) is higher than the inverter input voltage (380V/50 Hz).

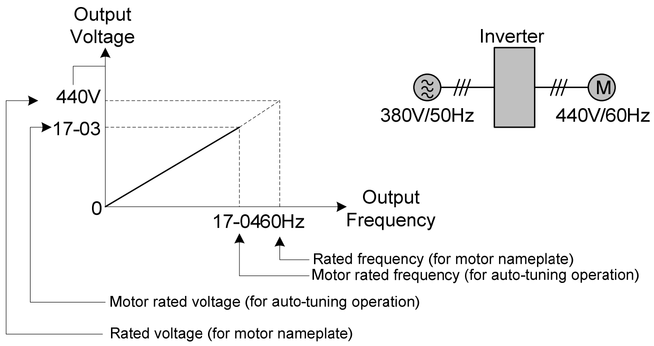


Figure 4.4.89 Rated voltage and frequency settings

Step 1: Set motor rated voltage, 17-03=440V.
Step 2: Set no-load voltage, 17-08=360V, lower the input voltage by 20V when operating in torque control.
Step 3: Set motor rated frequency:

$$17\text{-}04 = (\text{Rated frequency of motor nameplate}) \times \frac{(\text{Inverter input power voltage})}{(\text{Rated frequency of motor nameplate})} = 60\text{Hz} \times \frac{380\text{V}}{440\text{V}} = 51.8\text{Hz}$$

Step 4: Automatically tuning
Parameter 01-12 (Fbase) is automatically set during auto-tuning. Parameter 01-12 (Fbase) is set to the motor rated frequency.

Step 5: Set the 01-12 (Fbase) to the motor rated frequency on the motor nameplate. If the maximum output frequency (01-02, Fmax) and base frequency (01-12, Fbase) are different, set the maximum output frequency when the auto- tuning (01-02, Fmax) is completed.

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 rated frequency on the motor nameplate.

Example 2: The inverter input voltage and frequency (440V/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).

■ Number of poles (17-06)
Set the motor pole number with its range is 2, 4, 6, 8 and 16 poles. (It is only 2~8 poles in inverter software V1.3.

■ Motor no-load voltage (17-08)
a) Motor no-load voltage is mainly used in SLV mode, set to value 10~50V lower than the input voltage to ensure good torque performance at the motor rated frequency.
b) Set 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.
c) The motor no-load voltage can be set to a value greater than the actual input voltage. In this case, the motor can only operates under relatively low frequency. If the motor operates at the rated frequency an over voltage condition may occur.
d) The higher the motor power is, the higher the no-load voltage is.
e) A smaller no-load voltage will reduce the no-load current.
f) When load is applied the magnetic flux is weakened and the motor current increases.
g) A higher no-load voltage results in a higher the no-load current.
h) When 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)

a) Only the static-type or stator resistance measurement auto-tuning (17-00=1 or 17-00=2) can be set. This data can be obtained by manual tuning. Normally, it does not require adjusting.
b) Motor excitation current is used for non-rotational auto-tuning.
c) The setting range of motor excitation current is 15%~70% of the motor rated current.
d) If this parameter is not set, the inverter calculates the motor related parameters.

■ 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)

If auto-tuning fails the keypad will display the AtErr" message and the auto-tune cause is shown in parameter 17-11. Refer to section 5 for troubleshooting and possible automatic tuning error causes.

Note: The motor tuning error history (17-11) shows the tuning result of the last auto-tune. No error is displayed when auto-tune is aborted or when the last auto-tune was successful.

■ Motor Leakage Inductance Ratio (17-12)

a) Only stator resistance measurement auto-tuning (17-00=2) can be set and this data can be obtained by manual tuning. Normally, it does not require adjustment.
b) It is mainly for non-rotational auto-tuning. The default setting is 3.4%. It is required to tune to make the adjusted parameter value saved into the group 02-33.
c) If this parameter is not set, the inverter calculates the motor related parameters.

■ Motor Slip Frequency (17-13)

a) Only stator resistance measurement auto-tuning (17-00=2) can be set and this data can be obtained by manual tuning. Normally, it does not require adjustment.
b) It is mainly for non-rotational auto-tuning. The default setting is 1Hz. It is required to tune to make the adjusted parameter value saved into the group 02-34.
c) If this parameter is not set, the inverter calculates the motor related parameters.

Notes:

- Perform the “Stator resistance measurement” (17-00=2) auto-tune if the inverter/motor leads are longer than 167ft (50m).
- For the best performance in vector control perform the rotary-type automatic tune (17-00=0) first (using short motor leads between the inverter and motor) and a “Stator resistance measurement” (17-00=2) next.
- If a rotary auto-tune (17-00=0) cannot be performed, manually enter the mutual induction (02-18), excitation current (02-09), core saturation compensation factor 1-3 (02-11 - 02-13).
- Perform the “Stator resistance measurement” (17-00=2) in V/F control when inverter/motor leads are longer than 167ft (50m).

■ Rotational Tuning Mode Selection (17-14)

It is only enabled in rotation auto-tuning (17-00=0) and rotational auto-tuning combination (17-00=5).

17-14=0,
Under VF control mode, no-loading can drive general standard induction motors without oscillation. And it is the most widely used mode.

Note: If VF mode rotational tuning is failed, try Vector mode rotational tuning to run again.

17-14=1,
Under VF control mode, no-loading drives particular induction motor with oscillation. And such kinds of motors mostly are high-speed type.

Note: Because Vector mode measures no-load current of motor by internal current vector structure, so the particular induction motor can avoid the oscillated problem in the VF control 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) to1.0 (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.4.4.90., the slip compensation value is calculated as follows:

$$\text{Slip compensation value} = \text{Motor rated sync induction rotation difference} \times \frac{[\text{Output current (12-08)} - \text{motor no-load current (02-00)}]}{[\text{Motor output rated current (02-01)} - \text{motor no-load current (02-00)}]}$$

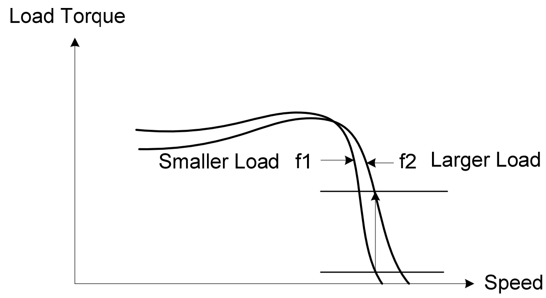


Figure 4.4.90 Slip compensation output frequency

18-02: Slip compensation limit
Sets slip compensation limit in constant torque and the constant power operation (Fig.4.4.91).
If 18-02 is 0%, the slip compensation limit is disabled.

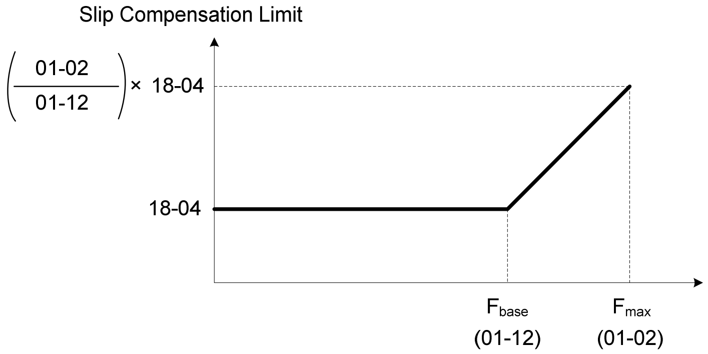


Figure 4.4.91 Slip compensation limit

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.

Note: Make sure that the slip compensation limit 18-02 does not exceed the maximum allowed system limit.

18-03: Slip compensation filter

Set slip compensation filter time in V/F mode

18-04: Regenerating slip compensation selection

The selections to enable or disable the slip compensation function during regeneration.

To enable slip compensation during regeneration caused by deceleration (SLV mode), set 18-04 to 1 in case speed accuracy is required. When the slip compensation function is used regenerative energy might increase temporarily (18-04= 1) therefore a braking module might be required.

SLV mode adjustment

18-00: Slip compensation gain

a) Slip compensation can be used to control the full rang speed accuracy under load condition.
b) If the speed is lower than 2 Hz and the motor speed decreases, increase the value of 18-00.
c) If the speed 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 whole speed range. As a result the slip compensation accuracy at low speed is high but slight inaccuracies might occur at high speeds.

Adjust parameter 18-02 together with the compensation value or continue to adjust 18-00 if the speed accuracy at higher speed is not acceptable. Please note adjusting these parameters might impact the accuracy at lower speeds.

The impact of 18-00 on the torque and the speed are shown in Fig.4.4.92.

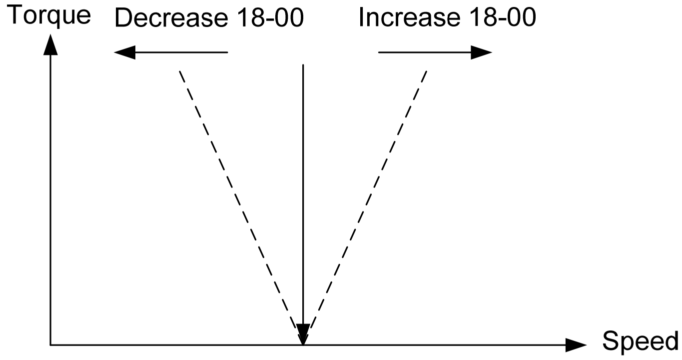


Figure 4.4.92 18-00 Effect on the torque and speed

18-01: Slip compensation gain at high speed

It is not required to adjust the Slip compensation gain at high speed if the motor is loaded. After adjusting parameter 18-00 it is recommended to increase the reference frequency and check the motor speed. In case of a speed error increase the value of 18-01 to adjust the compensation. Increase the motor rated frequency (01-12 base frequency) and increase the value of 18-01 to reduce the speed error. 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 for adjustment.

Compared to 18-00, 18-01 serves as a variable gain for the full speed range. Parameter 18-01 determines the slip compensation at the motor rated speed and is calculated follows:

$$\text{Slip compensation gain} = \text{Slip compensation gain at low speed} + \frac{[\text{Slip compensation gain at high speed x frequency reference}]}{[\text{Motor rated frequency}]}$$

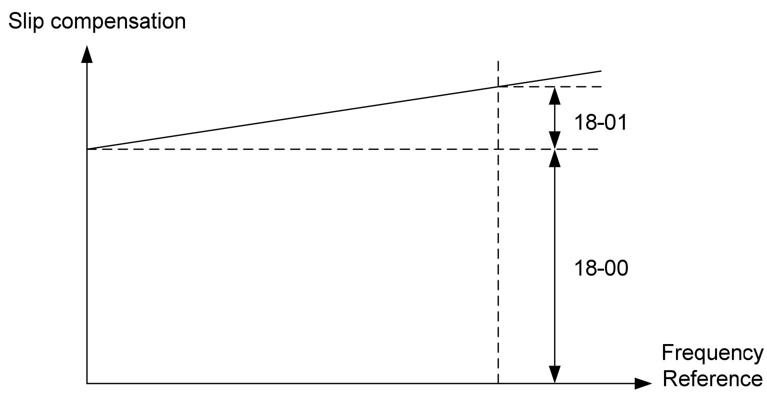


Figure 4.4.93 18-00/18-01 Slip compensation gain versus frequency reference

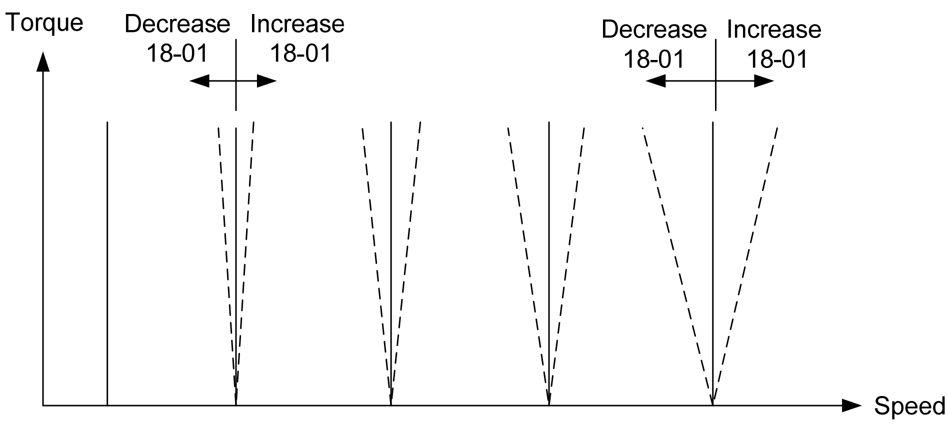


Figure 4.4.94 18-01 Effect on torque speed curve

18-05: FOC (Flux Orient Control) delay time

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 drops sharply, which may cause the inverter output to saturate and current jitter occur. The magnetic flux slip compensation will independently control the torque current and the excitation current to prevent 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

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	**【0】: PI speed control will be enabled only in constant speed. For accel/decel, only use P control.** **【1】: Speed control is enabled either in constant speed or accel/decal.**
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	**【0.0~599.0】Hz**
20- 16	**ASR Gain Change Frequency 2**
Range	**【0.0~599.0】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】%**

The following figure 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. The ASR output is passed through a low-pass filter.

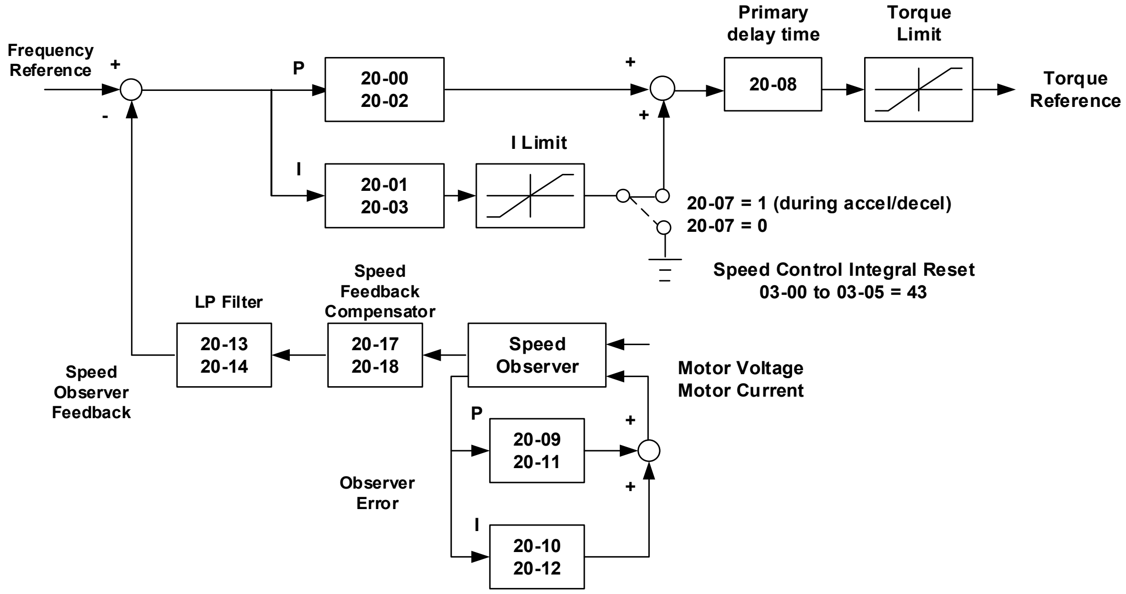


Figure 4.4.95 ASR block diagram (SLV mode)

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 is 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.

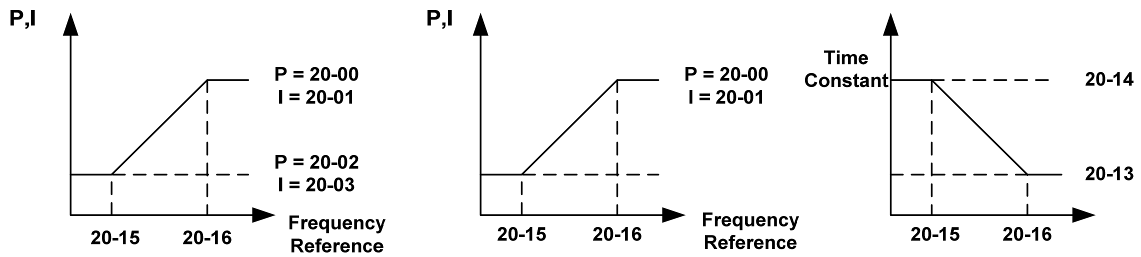


Figure 4.4.96 ASR gain setting (SLV mode)

Tune the speed control gain

Refer to the following steps:

a. Gain adjustment of minimum output frequency
- Motor running is at minimum output frequency (Fmin, 01-08).
- Maximum ASR proportional gain 2 (20-02) will not lead to instability.
- Minimum ASR integration time 2 (20-03) will not leas to instability.
- Ensure the output current is lower than 50% of inverter rated current. If the output current is over than 50% of inverter rated current, decrease the setting value of parameter 20-02 and increase that of 20-03.

b. Gain adjustment of maximum output frequency
- Motor running is at maximum output frequency (Fmax, 01-02).
- Maximum ASR proportional gain1 (20-00) will not lead to instability.
- Minimum ASR integration time 1 (20-02) will not leas to instability.

c. Gain adjustment of accel./ decel. integral control
- When 20-07=1, start integral control if PI speed control is enabled both at costant speed and accel./ decel..
- Integral control makes the motor speed as quickly as possible reach to the target speed but may cause overshooting or oscillation. Refer to Fig. 4.4.97 & Fig.4.4.98.

When 20-07=1, start ASR Proportion (P) and Integer (I) control during accel/ decel. and steady state

When 20-07=0, start ASR Proportion (P) and Integer (I) control only during steady state and use ASR P control during accel/ decel..

Parameter 20-33 (Constant Speed Detection Level) is active mainly for the setting value of 20-07 to be 0 and frequency command source to be analog input because there will be problems occur in analog input signal if the noise causes the system judgment in not reaching the constant speed. Thus, adjust the setting value of parameter 20-33 to avoid the occurrence of the problems.

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.4.4.96).

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), carefully monitor system stability.

Use parameter 20-00 and 20-02 to adjust the speed response for each cycle. Tuning the settings of 20-00, 20-02 can increase system response, but may cause system instability. See Fig.4.4.97.

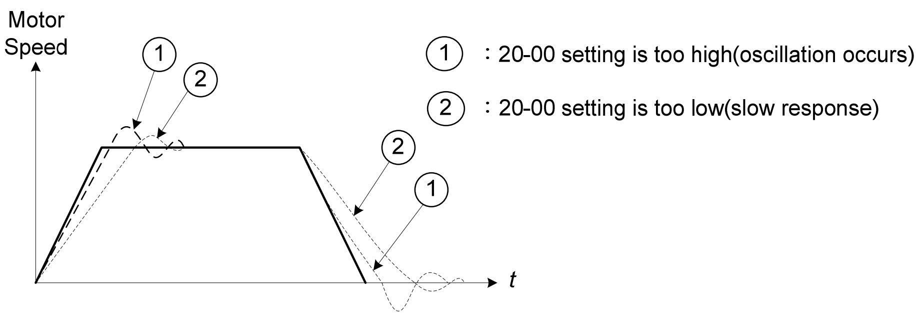


Figure 4.4.97 System response of ASR proportion gain

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 setting is too short, 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 can occur. A braking unit (braking resistor) can be used to avoid an over voltage condition.

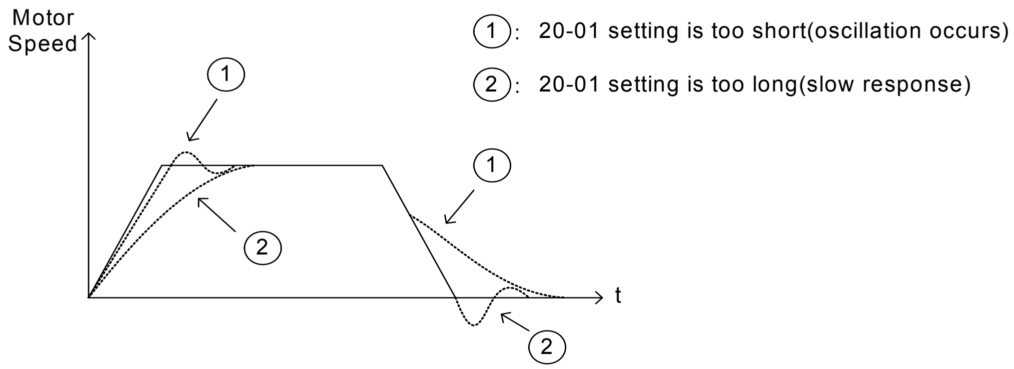


Figure 4.4.98 The response of ASR integral time

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.

- Tune low-speed low-pass filter time constant 20-14, make sure the reference frequency is below parameter 20-15 value.
- Tune high-speed low-pass filter time constant 20-13 at frequency reference, make sure the reference frequency is above parameter 20-16 value.
- 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 results 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.
- 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 is a quick system response is required for rapidly changing loads. The high bandwidth of the speed feedback allows for a relative high ASR gain.
- In case tuning 20-00 ~ 20-03 and the low-pass filter time constant 20-13 do not improve the system response time, tuning the PI gain 20-09 ~ 20-12 of the speed estimator may be required.
- 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.
- Setting a low gain for the speed estimator (small proportion (P) gain and high integral (I) time) decreases the bandwidth of the speed feedback, may improve speed feedback interference resulting in a more stable system.
- 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 gains requires a good understanding of the overall system.
- Parameter 20-15 sets the gain switch frequency at low-speed and parameter 20-16 sets the gain switch frequency at high-speed.
- Operating at a speed below 20-15 will result in a larger 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).
- 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.
- 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).
- Parameter 20-17 and 20-18 are for compensating speed feedback at low speed and high speed.
- Use parameter 20-17 to adjust the torque compensation gain for the low speed range. By tuning 20-17an 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:

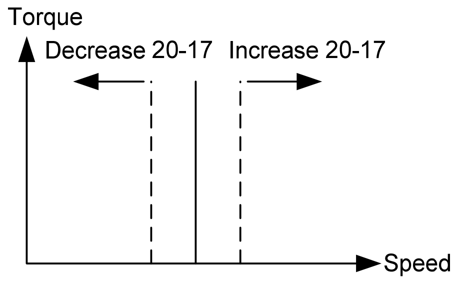


Figure 4.4.99 Effect on the torque-speed curve from 20-17

- 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 20-18an 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.4.4.100.

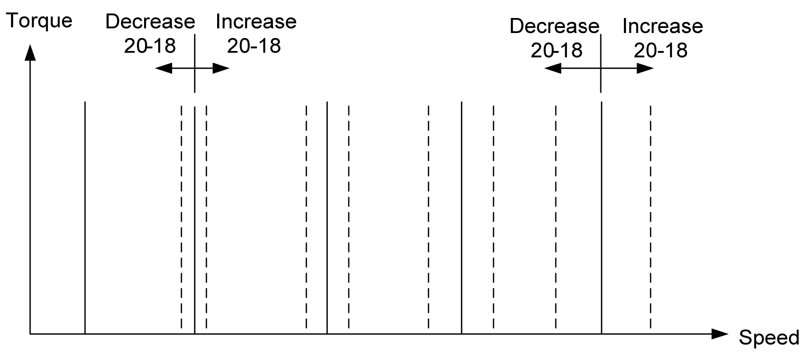


Figure 4.4.100 Effect on the torque-speed curve from 20-17

- 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.

- ASR Integral Time Limit (20-04)
  a) Setting a small value may prevent system response when the load suddenly changes.

Note:

- Response specificationsof 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 derating effect of ASR at shock load. Refer to Fig. 4.4.97 & Fig. 4.4.98.

20-34 Derating of Compensation Gain:

This gain effect is the same as the proportional gain of ASR (20-00, 20-02), but it is required to be with the derating compensation time (20-35) of larger speed tolerance to prevent the inverter from oscillation.

20-35 Derating of Compensation Time:

This time constant is used for the inhibition of oscillation caused from parameter 20-34, but excessive compensation time constant leading to slower output response is unfavorable to derating compensation.

The recommended setting value of 20-34 is 30~50 and that of 20-35 is 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 (21-08 negative torque limit)
(III) Negative torque limit in reverse direction (21-06 forward regenerating torque limit)
(IV) Negative torque limit in forward direction (21-07 reversal regenerating torque limit)

Refer to Fig.4.4.101.

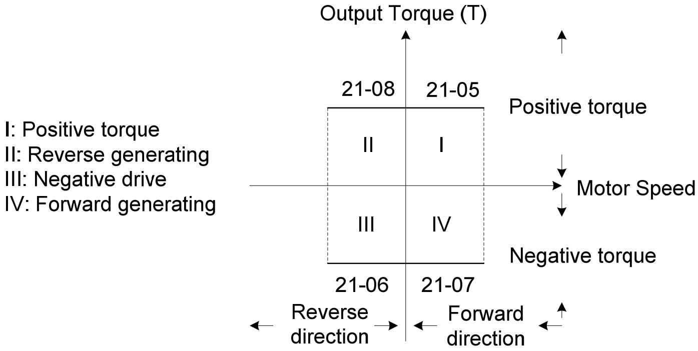


Figure 4.4.101 Torque limit setting

Torque limit setting by using multi-function analog input AI2 (04-05)

Table 4.4.16 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.4.4.102 shows the relationship between the output torque and the torque limit.

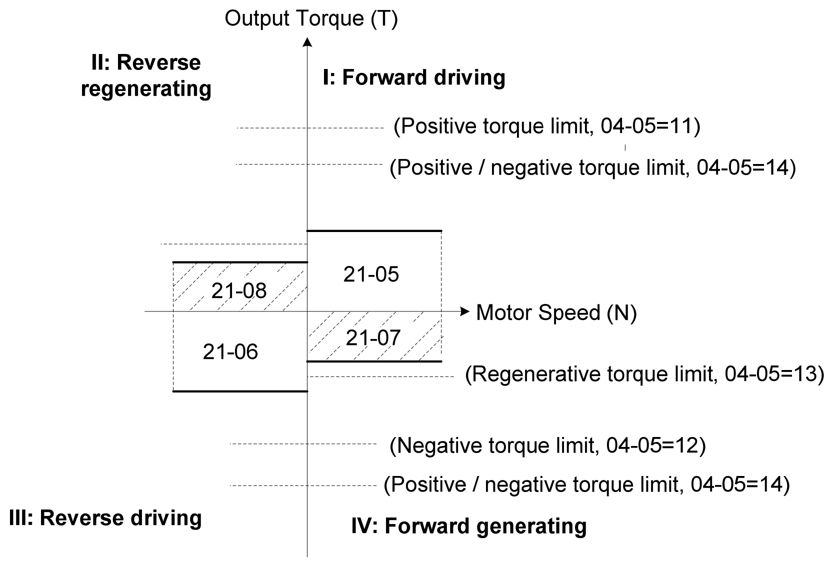


Figure 4.4.102 Analog input torque limit (AI2)

When the analog input is set to positive torque limit (value = 11) the torque limit is active in the third and fourth quadrant.in the 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- only available when PM Control Mode is selected

22- 00	Rated Power of PM Motor
Range	【0.00~600.00】Kw
22-01	PM motor rated voltage
Range	200V: 【50 ~ 240】V 400V: 【100 ~ 480】V
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	【4.8~599.0】Hz
22- 07	PM type selection
Range	【0】SPM 【1】IPM
22- 10	PM SLV Start Current
Range	【20 ~ 200】%
22- 11	I/F Mode Start Frequency Switching Point
Range	【10 ~ 100】%
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	PM No-Load Voltage
Range	200V: 【0 ~ 250】V 400V: 【0 ~ 500】V
22- 18	Flux-weakening Current Command Restriction
Range	【0 ~ 120】%

The PM parameter group can be restored to factory default be initializing the inverter (13-08).

1. PM motor rated power (22-00); PM motor rated voltage (22-01); PM motor rated current (22-02) Setting the motor nameplate value.
2. PM motor pole number (22-03); PM motor rated rotation speed (22-04); PM motor rated frequency (22-06). Setting the motor nameplate value. For the PM motor rated rotation speed (22-04) and the PM motor rated frequency (22-06), just set one of the two and the program will automatically calculate the other. When setting the PM motor rated rotation speed (22-04), the PM motor's maximum rotation speed (22-05) will synchronize and update to the same setting. When using the flux-weakening function, the PM motor's maximum rotation speed (22-05) setting value must be revised. The formula is as follows:

$$\text{(PM Motor rated rotation speed) N} = \frac{120 \ \text{x f} \ \text{(PM Motor rated frequency)}}{\text{P} \quad \text{(PM Motor pole number)}}$$

3. **PM motor's maximum rotation speed (22-05)**
   When using the flux-weakening function, the PM motor's maximum rotation speed (22-05) must be set higher than the PM motor's rated rotation speed (22-04).

4. **PM type selection (22-07)**
   When using the SPM motor, the recommended setting is 0. Related adjustable parameters are the speed estimated gain (22-30) and the speed estimated filter value (22-31).
   When using the IPM motor, the recommended setting is 1. Related adjustable parameters are the speed estimated gain (22-34) and the speed estimated filter value (22-35).

5. **PM SLV Start Current (22-10)**
   Set the torque current at start up and the unit is % of motor rated current.

6. **I/F Mode Start Frequency Switching Point (22-11)**
   This function is for the switching point from open-loop to close-loop in PMSLV mode. The unit is percentage for rated speed of motor .It recommends that over 5% for 400V and over 10% for 200V.

7. **PM Armature Resistance (22-14)**
   Set the moto rresistance per phase in unit of 0.001Ω. This parameter is automatically set under the motor auto-tuning (22-21).

   Note: The motor resistance is different from the line resistance.

8. **PM Motor D-axis Inductance (22-15)**
   Set motor D-axis inductance in unit of 0.01mH. This parameter is automatically set under the motor auto-tuning (22-21).

9. **PM Motor Q-axis Inductance (22-16)**
   Set motor Q-axis inductance in unit of 0.01mH. This parameter is automatically set under the motor auto-tuning (22-21).

10. **Flux-weakening Current Command Restriction (22-18)**
    (1) When the MTPA's selected (22-32) setting is 0, the setting parameter's (22-05) maximum motor rotation speed is higher than the parameter's (22-04) motor rated rotation speed. This will automatically activate the flux-weakening control. Set this parameter to restrict the maximum flux-weakening capability. The unit is the motor's rated current percentage.
    (2) When the MTPA's (22-32) selected setting is 2 or 3, and the output voltage is too high, the flux-weakening voltage command restriction setting value must be raised.

22- 21	**SLV PM Motor Tuning**
Range	**【0】: Disable** **【1】: Enable**
22- 22	**Fault History of SLV PM Motor Tuning**
Range	**【0】: No Error** **【5】: Circuit tuning time out** **【7】: Other motor tuning errors** **【9】: Current Abnormity Occurs while Loop Adjustment** **【11】: Stator Resistance Measurement is Timeout**
22- 25	**Detection Mode Selection of Default Magnetic Pole**
Range	**【0】: Upon the angle before stopping** **【1】: Mode 1** **【2】: Mode 2**
22-26	**Estimator Mode**
Range	**【0~1】 (in PMSLV mode)**
22- 27	**Voltage Command of Mode 2**
Range	**【5~120】%**
22- 28	**Divider Ratio of Mode 2**
Range	**【0~8】**
22- 29	**Flux-weakening Voltage Command Restriction**
Range	**【80~110】%**
22-30	**Speed Estimated Gain**
Range	**【1~150】%**
22-31	**Speed Estimated Filter Value**
Range	**【1~2000】Hz**
22-32	**MTPA Selection**
Range	**【0】: Disabled** **【1】: Mode 1**
22-33	**MTPA Gain**
Range	**【000~400】%**
22-34	**IPM Estimator Gain**
Range	**【1 ~300】**

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 supplied 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 brake this may result in incorrect motor data calculation. Disconnect the motor and the load and confirm that the motor can freely run.

1. Before selecting PM motor tuning, enter the motor data (22-00) - (22-06) according to the motor

nameplate.

2.

a) Use parameter 22-21 to select tuning mode.
b) Next press the enter key to go to the PM motor tuning screen. The keypad will display the message of "IPrdy" (Ready to Tune).
c) Press run to start the PM motor tuning. The keypad will display the “IPtun" message during auto-tune.
d) 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.

Detection Mode Selection of Default Magnetic Pole (22-25)

Select the motor activation’s rotor position detection method

Method 0: Do not detect rotor position, start by directly using the angle when the motor was previously stopped

Method 1: Use input pulse signal to detect rotor position.

Method 2: Use input continuous variable frequency signal to detect rotor position.

Selection of rotor position detection mode when the motor starts:

22-25=0: Angle before Stop

The rotor position is not detected and the motor starts by the angle before Stop

22-25=1: Mode 1

Pulse input signals detect the rotor position and there is jitter in the detection process.

22-25=2, Mode 2

Input continuously variable frequency signals to detect the rotor position.

Estimator Mode (22-26)

- It is suggested to set 22-26=0 when SPM motor is used. Inverter starts in I/f mode and the relevant adjustable parameters are 22-10 & 22-11.
- It is suggested to set 22-26=1 when IPM motor is used and speed control mode is performed by the speed control ratio 1:50. Inverter will input the continuously variable frequency signal to motor and the relevant adjustable parameters are 22-27 & 22-28.

Mode 2 Voltage Command (22-27)

When 22-25=2 (Mode 2), if the rotor jitters at start, it is required to tune up the set 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 error may be occurs.

Mode 2 Frequency Division Ratio (22-28)

When 22-25=2 (Mode 2), the input continuous signal frequency by mode 2 depends on the carrier frequency setting (parameter 11-01). It is recommended that the higher the carrier frequency is required to increase appropriately the frequency ratio to reduce the input continuous signal frequcncy so as to ensure the accuracy of the detection angle.

Field-Weakening Voltage Control (22-29)

It is set to prevent the output voltage's saturation. This setting value performs field-weakening control depending on the inverter's input power supply and voltage to be the limitation of output voltage command. If parameter 22-18 (Flux-Weakening Control) is set too low, the inverter's output voltage will exceed the voltage command control.

Speed Estimated Gain (22-30), Speed Estimated Filter Value (22-31)

When Estimator Mode 22-26 set to 0, adjust the speed response performance, the higher the setting value, the faster the motor reacts, however, if the setting value is too high, the control object will generate vibrations and become unstable, also, if the setting value is lower, the speed deviation will increase. Please adjust to the appropriate setting value according to the field equipment.

MTPA Selection (22-32)

0: MTPA invalid
1: Distribute D-Q-axis current command according to the torque command.

MTPA Gain (22-33)

When the default value is 200%, revising the PM motor's D-axis inductance (22-15) or Q-axis inductance (22-16) (such as completing the PM motor adjustment or directly changing the inductance value) will re-calculate the MTPA Gain (22-33).

IPM Estimator Gain (22:34)

When the estimator mode (22-26) setting is 1, the estimator gain is the multiple of the bandwidth. The larger the setting value, the faster the motor response. However, if the value is too high, the control item will exhibit vibration and become unstable. The smaller the setting value, the greater the speed deviation. Please adjust the appropriate setting value according to the site equipment.

Group 23 Pump & HVAC Function Parameters

23- 00	Function Selection
Range	【0】: Disable 【1】: Pump 【2】: HVAC 【3】: Compressor *1

***1: It is new added in firmware V1.4**

Select function of pump or HVAC via parameter 23-00. This function is enabled if PID control mode (10-03) is enabled. Function of pump or HVAC affects PID target value and if parameter group 23 are enabled.

When 23-00=1, LCD keypad switches automatically the main screen monitoring (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 automatically the main screen monitoring (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, selection of main frequency command source (00-05) can be set except PID mode and V/F curve is limited to F (01-00). Middle output voltage (01-07) is automatically set to the half of maximum output voltage and parameter 01-00 will be hidden.

Notes:

- Refer to the setting value of parameter 23-05 for the display of LED keypad.
- When the control mode 00-00≠0 ((V/F mode), the selection of 23-00=1 (Pump) or 3 (Compressor) is disabled. (It is new added in inverter software V1.4.)

Remarks 3: 23-00 and 24-00 are interlocked. If selecting function selection 23-00, then you cannot select Pump Control Function Selection 24-00. Vice versa. (V1.51 Newly Added)

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

Set the inverter as the Master or Slave 1~3 via parameter 23-01. Refer to Fig.4.4.111 for the functional process of dual pump start to enable multiple pumps in parallel. It is required to reconnect to write in the parameter after it is set.

23- 02	Operation Pressure Setting
Range	【0.10 ~ 650.00】PSI

Set the pressure value depending on the pressure transmitter of pump system after setting 10-00 to 0 (keypad given).

23- 03	Maximum Pressure of Pressure Transmitter
Range	【0.10 ~ 650.00】PSI

Set the maximum preesure value depending on the pressure transmitter of 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 is given the value set by 23-02 (Operation Pressure Setting) or AI. Refer to parameter 10-00 for the setting of 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 Transmitter)

23- 20	Switching of Pressure and Percentage
Range	【0】: Pressure 【1】: Percentage

When **23-20=1,**

Parameters 23-09, 23-24, 23-34, 23-38 and 23-39 are proceeding to switch percentage on the basis of parameter 23-02 and parameters 23-12 & 23-15 are on the basis of parameter 23-03.

When **23-20=0,**

Parameters 23-09, 23-24, 23-34, 23-38, 23-39, 23-12 and 23-15 is displayed and set via pressure mode.

For example, 23-02=4.00PSI, 23-03=10.00PSI, 23-09=0.5PSI, 23-12=5.00PSI

When **23-20=0→1**,

((23-09)/ (23-02))*100 => 23-09 = 13% (Rounded to integer)
((23-15)/ (23-03))*100 => 23-15 = 50% (Rounded to integer)

When **23-20=1→0**,

((23-09)/100)* 23-02 => 23-09 = 0.52PSI
((23-15)/100)* 23-03 => 23-15 = 5.00PSI

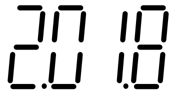
23- 36	PUMP Unit Display (only for LCD)
Range	【0】: PSI 【1】: inW 【2】: Bar 【3】: Pa

When 23-00=1 and 23-20=0, the LCD keypad dispays the unit upon the setting value by parameter 23-36 and unit diplay of parameters 12-74, 12-75, 23-02, 23-03, 23-09, 23-12, 23-15, 23-23, 23-24, 23-34, 23-38, 23-39 is switched at the same time.

23- 05	Display Mode Selection
Range	【0】: Display of Target and Preesure Feedback 【1】: Only Display Target Pressure 【2】: Only Display Pressure Feedback

This function can have the common display of target and feedback pressure or display separately.

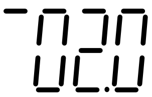
① when 23-05=0000：Led keypad displays pressure setting value and pressure feedback value.



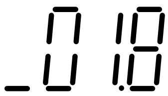
Two-digit in the left is the pressure value setting and two-digit in the right is the pressure feedback value in the seven-segment monitor.

Note: When 23-00=2 (HVAC), the unit will be multiplied by 1000 times. If the display value is 5.0, it means 5000GPM (It is only displayed in inverter software V1.4.)

② when 23-05=0001：Led keypad only displays the pressure setting value.



③ when 23-05=0002：Led keypad only displays the pressure feedback value.



Notes:

- Once the target value is bigger than 10, the target value is only shown as "an integer" instead of "a decimal." 10-33 is lower than 1000 and 10-34=1 in the PID modes.
- If Pump mode is used in inverter software V1.3, parameter 23-03 is required to set to <= 9.9 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

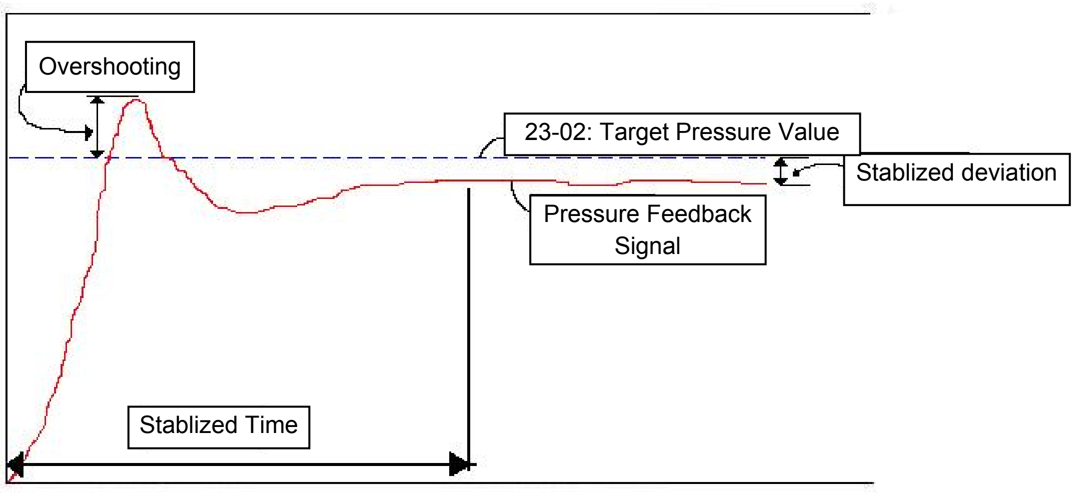


Figure 4.4.103 Diagram of pressure feedback value

Table 4.4.17 Guide for PID parameter adjustment

	Increase Setting Value	**Decrease Setting Value**	**Main Feature**
Proportional Gain (P)	(Pros) Increase response time	(Pros) Reduce jittering	Increase stabilized time
	(Cons) Might cause pump jittering	(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 jittering	(Cons) Overshooting easily	

Notes:

- PID parameters can be modified during the inverter is running.
- Cons: disadvantage, Pros: advantage.

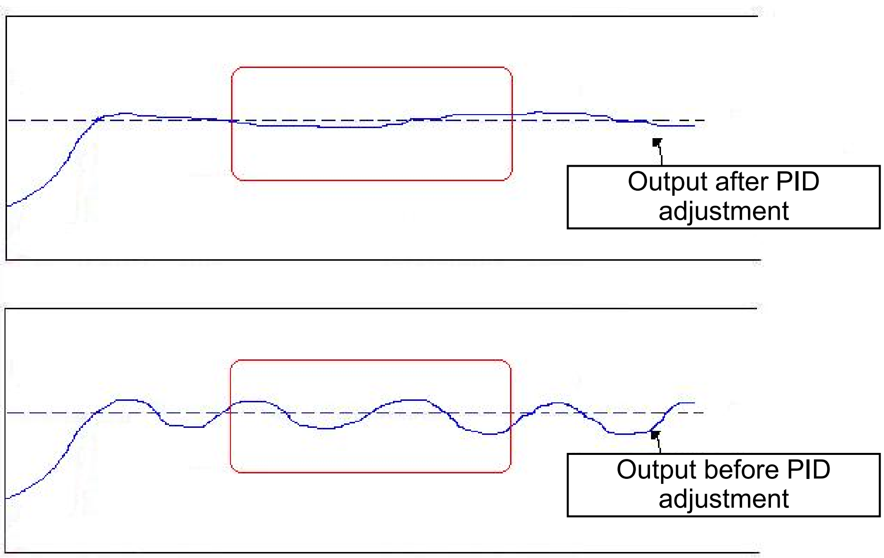


Figure 4.4.104 Diagram for PID parameter adjustment

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, presents the unit and range.
*2: 23-20=1, presents the unit and range.

When pressure feedback value is higher than 23-02 (operation pressure setting), inverter output frequency will decrease downward into sleep status. PID starts (output frequency will increase) when pressure feedback value is less than (23-02) – (23-09).

23- 10	*Sleep Frequency of Constant Pressure
Range	【0.00~599.00】Hz

***: (When the motor's maximum output frequency is over than 300Hz, the frequency resolution is 0.1Hz.)**

When inverter output frequency falls below 23-10 (sleep frequency of constant pressure), it starts to count the sleep time (23-11).

23- 11	Sleep Time of Constant Pressure
Range	【0.0~255.5】Sec

When the inverter finishes counting the sleep time (23-11), the output frequency falls downward at the deceleration time (00-15) and gets into sleep status.

Note: Parameter 23-10 (sleep frequency of constant pressure) is dedicated by the pump and it is not applied to parameter 10-17 (start frequency of PID sleep).

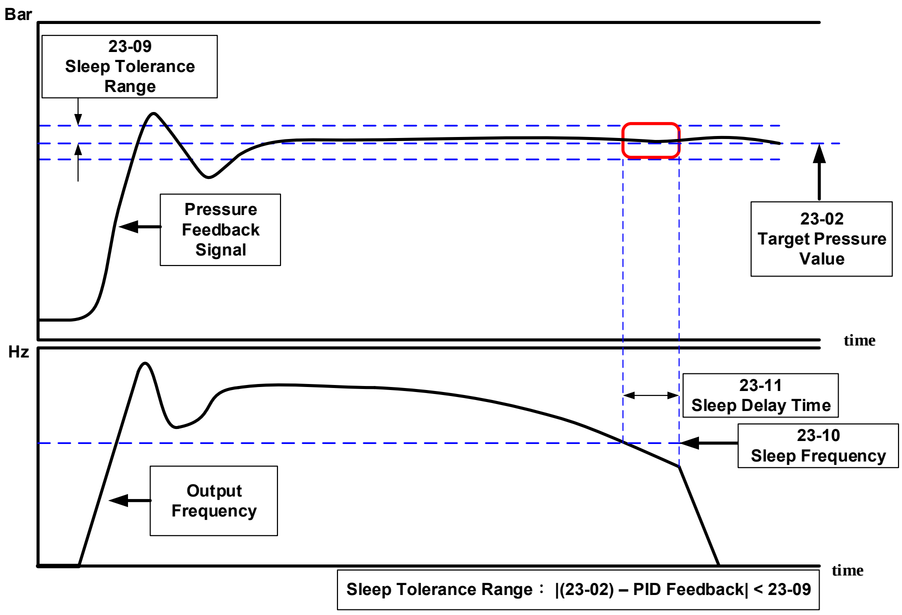


Figure 4.4.105 Diagram for stop time of constant pressure

Note: The purpose of stop time of constant pressure is energy saving.

23- 12	Maximum Pressure Limit
Range	【0.10 ~ 650.00】PSI *1 【0~100】% *2

*1: 23-20=0, presents the unit and range.
*2: 23-20=1, presents the unit and range.

It is convenient for user to limit maximum pressure. When pressure feedback value is higher than maximum pressure limit, the inverter displays warning signal and then stops.

23- 15	Minimum Pressure Limit
Range	【0.00 ~650.00】PSI *1 【0~100】% *2

*1: 23-20=0, presents the unit and range.
*2: 23-20=1, presents the unit and range.

It is convenient for user to limit minimum pressure. When pressure feedback value is lower than minimum pressure limit, the inverter displays warning signal and then stops.

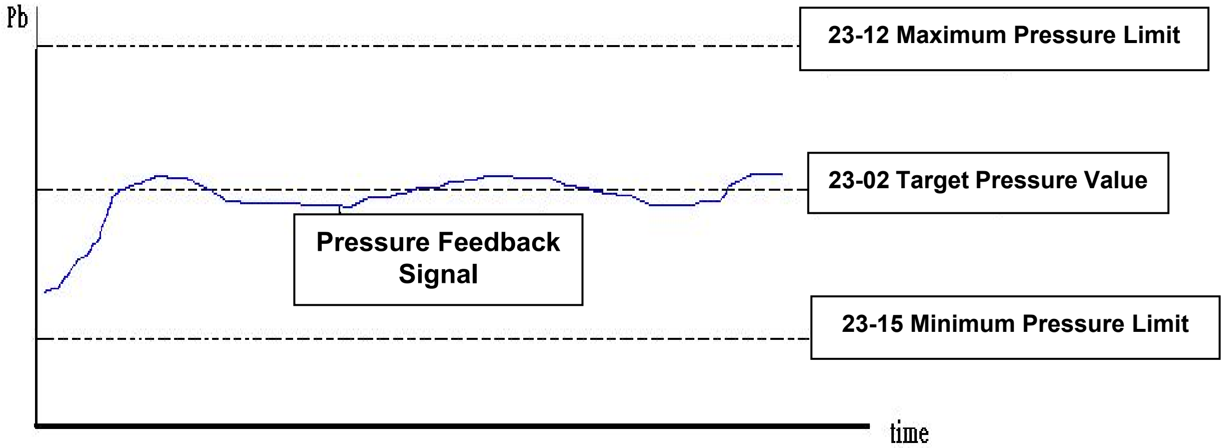


Figure 4.4.106 Diagram for pressure feedback limit

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 pressure feedback value is higher than maximum pressure limit, warning time of high pressure starts to count. If pressure feedback value is lower than maximum pressure limit during counting time, the warning time will recount and the inverter will display the warning signal of HIPb when the warning time ends.

23- 14	Stop Time of High Pressure
Range	【0.0 ~ 600.0】Sec

When the warning signal of high pressure occurs and pressure feedback value is higher than maximum pressure limit, stop time of high pressure starts to count. If pressure feedback value is lower than maximum pressure limit during counting time, the stop time will recount and the inverter will display stop error signal of OPbFt when the stop time ends.

Note: When user does not want the inverter to be restricted by the maximum pressure, set 23-74=0 (disable) to disable the function of high pressure limit.

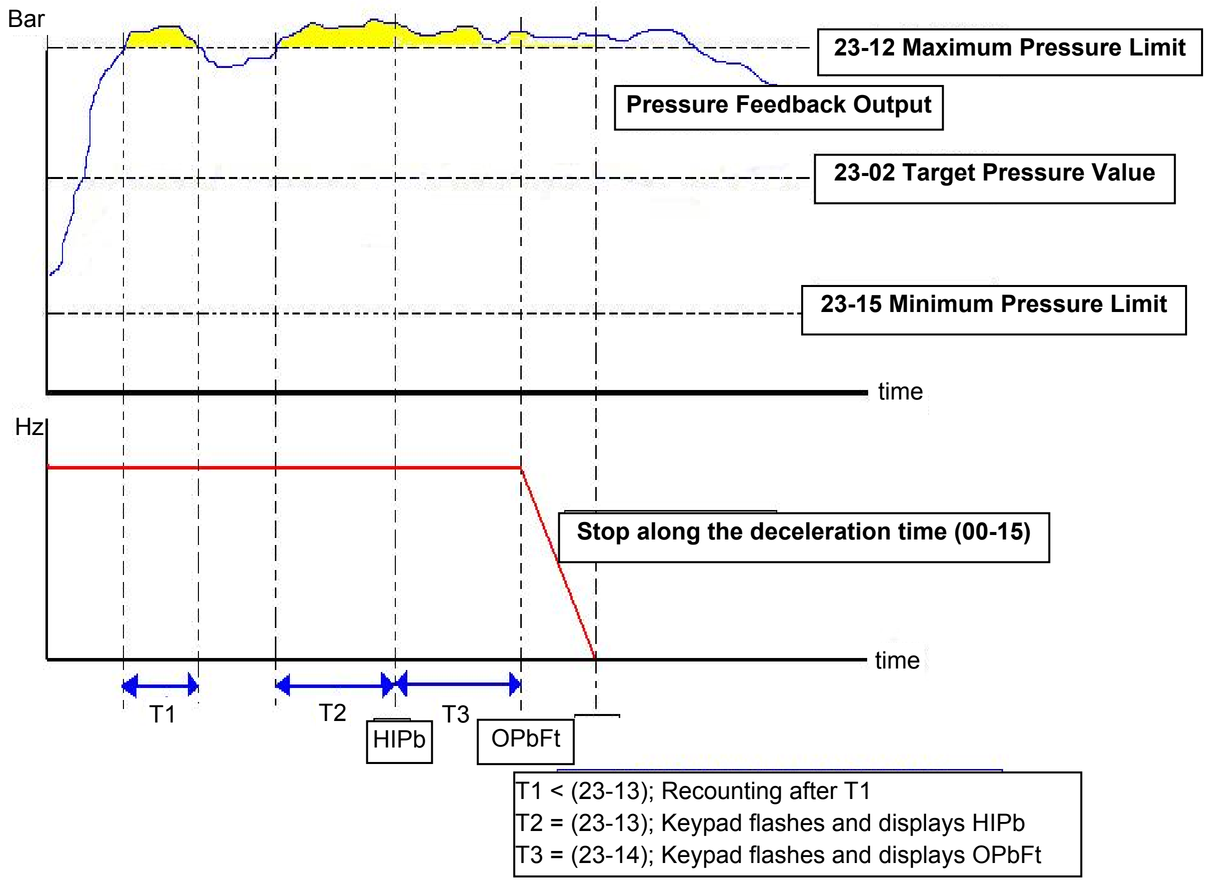


Figure 4.4.107 Diagram for warning to stop at high pressure limit

23- 74	High Pressure Setting
Range	【0】Disable 【1】High Pressure Warning 【2】High Pressure Warning or Error

When 23-74=0, High pressure warning or error is disabled.

When 23-74=1, High pressure warning is enabled. High pressure error is disabled.

When 23-74=2, High pressure warning or error is enabled. Refer to the instruction of Fig. 4.4.107.

23- 16	Warning Time of Low Pressure
Range	【0.0 ~ 600.0】Sec

When pressure feedback value is lower than minimum pressure limit, warning time of low pressure starts to count. If pressure feedback value is higher than minimum pressure limit during counting time, the warning time will recount and the inverter will display the warning signal of LoPb when the warning time ends.

23- 17	Fault Stop Time of Low Pressure
Range	【0.0 ~ 600.0】Sec

When the warning signal of low pressure occurs and pressure feedback value is lower than minimum pressure limit, stop time of low pressure starts to count. If pressure feedback value is higher than minimum pressure limit during counting time, the stop time will recount and the inverter will display stop error signal of LPbFt when the stop time ends.

Note: When user does not want the inverter to be restricted by the minimum pressure, set 23-75=0 (disable) to disable the function of low pressure limit.

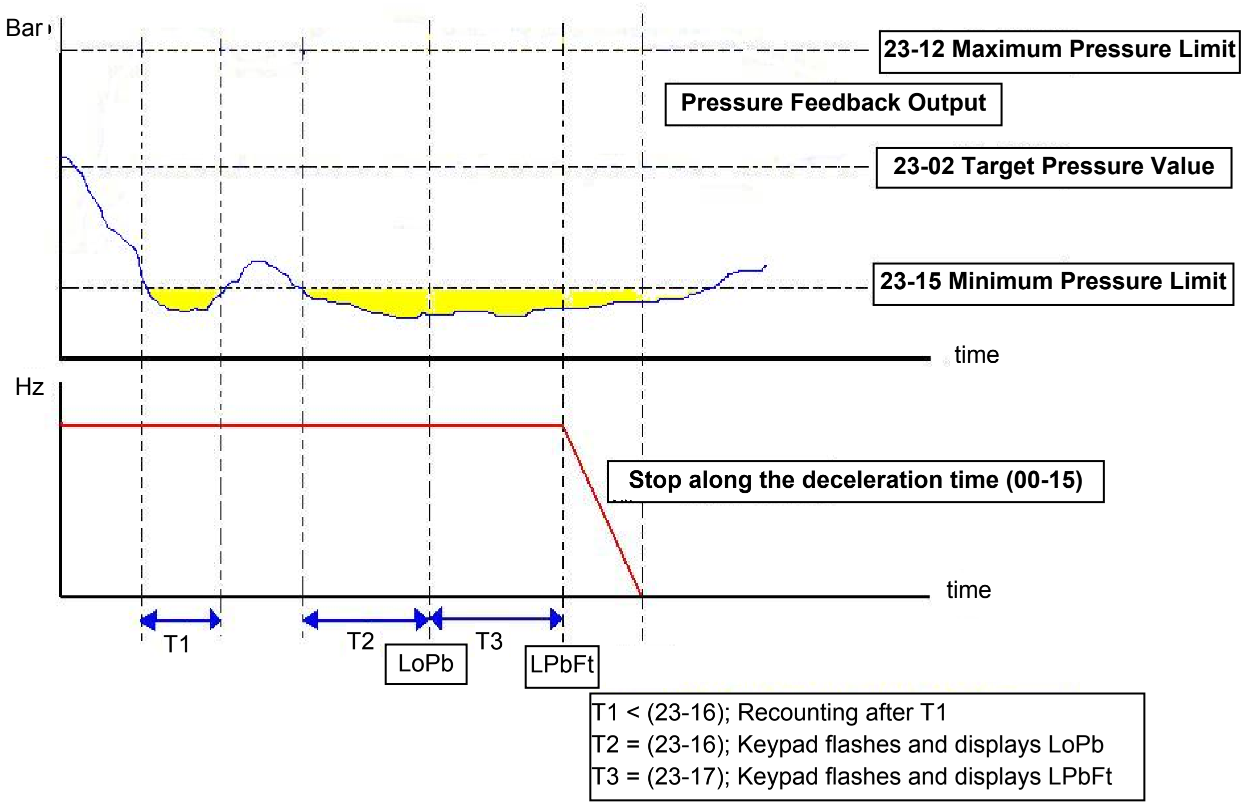


Figure 4.4.108 Diagram for warning to stop at low pressure limit

23- 75	Low Pressure Setting
Range	【0】Disable 【1】Low Pressure Warning 【2】Low Pressure Warning or Error

When 23-75=0, Low pressure warning or error is disabled.

When 23-75=1, Low pressure warning is enabled. Low pressure error is disabled.

When 23-75=2, Low pressure warning or error is enabled. Refer to the instruction of Fig. 4.4.108.

23- 18	Time of Loss Pressure Detection
Range	【0.0 ~ 600.0】Sec
23- 19	Proportion of Loss Pressure Detection
Range	【0 ~ 100.0】%
23- 78	Selection of Loss Pressure Detection
Range	【0】Disable 【1】Loss Pressure Warning 【2】Low Pressure Error

When 23-19 = 0 or 23-78 = 0, function of loss pressure detection is disabled.

When 23-19 > 0, If the feedback pressure value is lower than the value of 【(23-02) x (23-19)】and the detection time of loss pressure (23-18) passes, the inverter jumps to fault signal (FBLSS).

When 23-78=1, the inverter will display warning signal when detecting the loss pressure.

When 23-78=2, the inverter will display error signal when detecting the loss pressure.

23-23	Direction of Water Pressure Detection
Range	【0】: Upward Detection 【1】: Downward Detection
23- 24	Range of Water Preesure Detection
Range	【0.0 ~ 65.00】PSI *1 【0~10】% *2
23- 25	Period of Water Preesure 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, presents the unit and range.
*2: 23-20=1, presents the unit and range.

Acceleration time of water pressure detection (23-26) and deceleration time of water pressure detection (23-27) are corresponding to the acceleration time 2 (00-16) and the deceleration time 2 (00-17), so the setting of 23-26 changed with the setting of 00-16. Thus, avoid using multi-speed application function while using PUMP function.

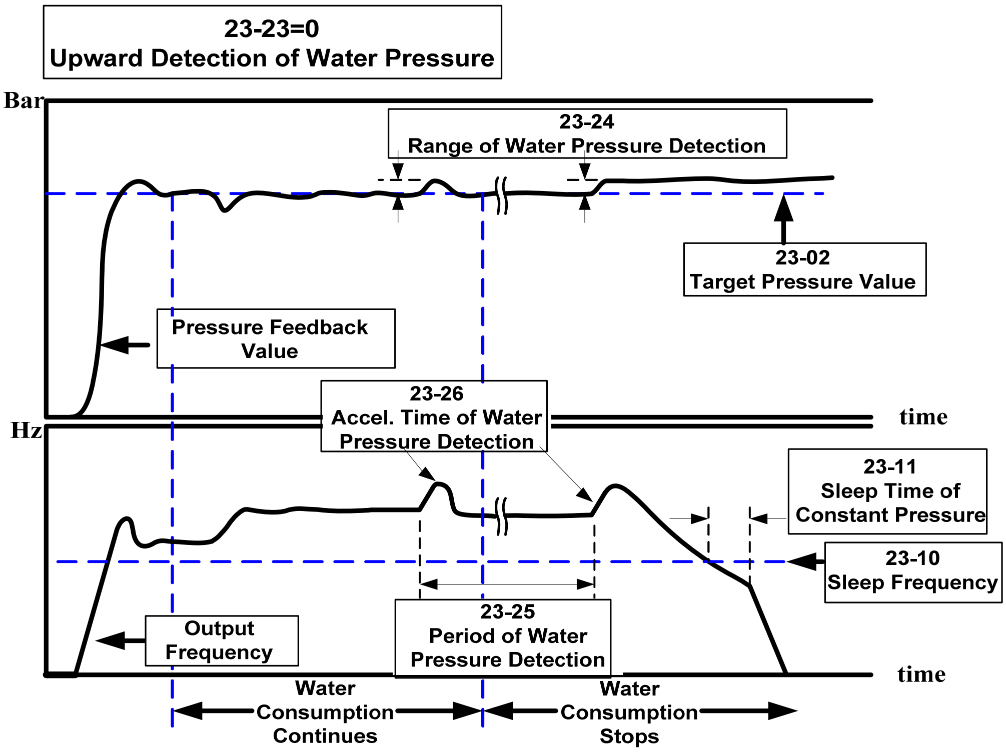


Figure 4.4.109 Diagram for upward detection of water pressure

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 jumping into sleep without water consumption or with mild water consumption.

If water consumption frequenctly continues, it is recommended to extend the cycle of water pressure detection (23-25) so as the detection times can be reduced and the occurance of fluttering or instability during water pressure detection in constant pressure can be avoided.

When upward detection of water pressure starts, water pressure will slightly increase. At this time, it may cause shortly pressure fluttering or instability if water consumption continues. It is recommended to reduce the range of water pressure detection (23-24) but it will extend the time of inverter jumping into sleep without water consumption or with mild water consumption.

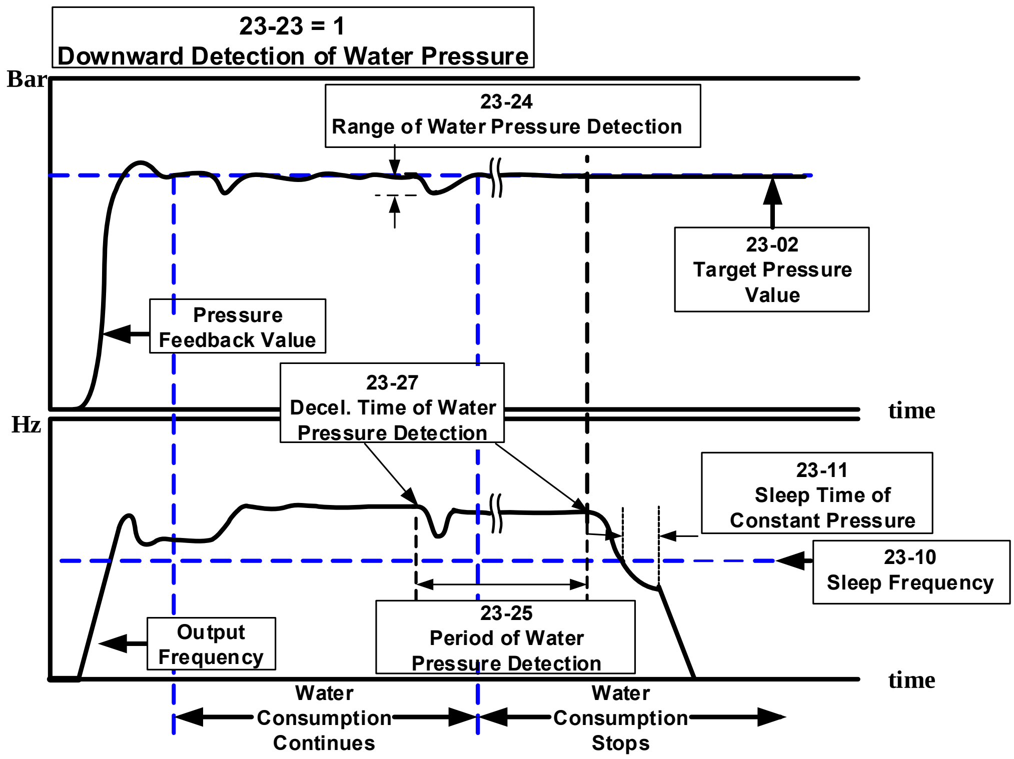


Figure 4.4.110 Diagram for downward detection of water pressure

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.

If water consumption frequenctly continues, it is recommended to extend the cycle of water pressure detection (23-25) so as the detection times can be reduced and the occurance of fluttering or instability during water pressure detection in constant pressure can be avoided.

When downward detection of water pressure starts, the output frequency will decelerate with the deceleration time of water pressure detection (23-27). Water pressure reduces with the deceleration when water consumption continues and pressure feedback value rises if the value is lower than that of target pressure value (23-02) - range of water pressure detection (23-24).

Note: It may cause shortly fluttering or instability during water detection process. User can appropriately adjust the range of water pressure detection (23-24) to avoid the occurrence of severe flutter.

Mild water consumption result in pressure reducing during deceleration and the inverter's output frequency may decrease to sleep frequency. But if pressure feedback value is lower than that of target pressure value (23-02) - range of water pressure detection (23-24), the output frequency will accelerate again.

Table 4.4.18 Guide for comparison of water pressure detection direction

	Pros	Cons
Upward detection of water pressure	● Keep the pressure above the target pressure during this process. ● For strict and precise applications	● If "Pump lift" is too high, operation frequency is higher without water consumption or with mild water consumption. So this detection effect is too restricted to jump into sleep. ● Energy-saving of water flow is not obvious and Slave is not easy to sleep under the multiple pumps in parallel.
Downward detection of water pressure	● Jump into sleep status without water consumption or with mild water consumption. ● For energy-saving purpose, under the multiple pumps in parallel regulate the pumps to the optimum operation state during this process. ● Startup sequency is by Master, Slave 1, Slave 2, and Slave 3. Sleep sequency is by Slave 1, Slave 2, and Slave 3 and Master. After the switching time is allowable, alternate Master and Slave reach the average of life expectancy.	● Pressure fluctuations may occur during this process if user inappropriately regulates the range of water pressure detection (23-24) and the deceleration time of water pressure detection (23-27).

23- 28	*Forced Run Command
Range	【0.00 ~ 599.00】Hz

*: (When the motor's maximum output frequency is over than 300Hz, the frequency resolution is 0.1Hz.)

This function is enabled when PID mode (10-03) is selected.

Pump will not depend on the feedback to make any PID output adjustment and runs the frequency of 00-05 (Frequency command) when multi-function digital input (S1~S6) is set to 16 (PID control disable).

And when the other digital input is set to 57(forced frequency run), inverter sets the frequency to run depending on the parameter 23-28 (forced run command). If PID function disable is removed, the inverter is controlled by 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 function of multiple pumps in parallel is enabled, the switching way is Master→Slave1→ Slave2→Slave3 → Master → … and the switching time is set via parameter 23-29.

Parameter 23-72 Switching Time of Alternation in Parallel

23-72=0, parameter 23-29 (Switching Time of Multiple Pumps in Parallel) will be in the unit of hour.

23-72=1, parameter 23-29 (Switching Time of Multiple Pumps in Parallel) will be in the unit of minute.

Note: It will recount the time if parameter 23-29 change time and the inverter re-power up.

Selection of Multiple Pumps Shift Operation (23-35)

23-35=1: Timer Alternative Selection
The Master and Slave of multiple pumps in parallel will be exchange, after the switching time of multiple pumps in parallel.

23-35=2: Sleep Stop Alternative Selection
When the Master and Slave of multiple pumps in parallel are both in sleep mode, and after the detecting time (23-30), the Master and Slave of multiple pumps in parallel will be exchange. Every time the multiple pumps start, the exchange will be processed. Please refer to the diagram of sleep stop alternative selection action.

23-35=3: Timer and Sleep Stop Alternative Selection
Timer alternately selected and sleep stop alternately selected will be enabled at the same time.

23-35=4: Multiple Pumps Test Mode
When master stop running and the slave need to run, please set 23-35=4, and no exchange between Master and Slave.

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, detection time of multiple pumps in parallel running start is enabled. If water pressure can not reach the error range of constant pressure and water flow time is over the detection time (23-30), Master will inform Slave of running start.

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 modified by Master and Slave follows Master's command. Run/Stop command from Slave can be regarded as the emergency stop command with the highest priority.

23-31=2: Pressure Setting

Set 23-01 to 2, Pressure setting is modified by Master and Slave follows Master's command to update synchronously.

23-31=3: Run/Stop

Set 23-01 to 3, Run/ Stop command is set by Master and Slave follows Master's command. Run/Stop command from Slave can be regarded as the emergency stop command with the highest priority.

Notes:

1. When Master modifies the pressure setting, it requires pressing ENTER key to modify the pressure setting of Slave.
2. When the switching time of multiple pumps in parallel (23-29) changes and reconnection, it will recount the time.

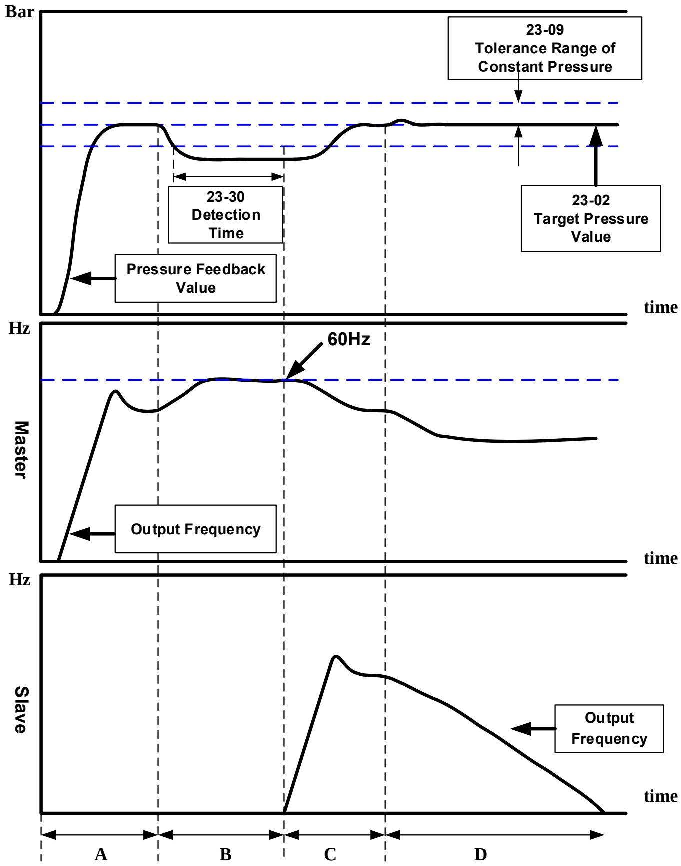


Figure 4.4.111 Dual pumps start up process

A：Dual pumps are enabled during this time. Master starts up first and Slave is in standby to enter constant-pressure operation.

B：Large water consumption results in the higher operation frequency of Master. If water pressure is not lower than the tolerance range of constant-pressure and the operation time is not over the detection time (23-30), Slave is still in standby.

C：If it is over the detection time (23-30), and Master runs at 60Hz, Master informs Slave of auxiliary kicking water. After Slave operates, the operation frequency of Master and Slave reduces to the operation of constant-pressure if water consumption is stable.

D：If water consumption is mild, the operation frequency of Master and Slave reduces. Because the water consumption is less than that of the operation of dual pumps, Slave stops to sleep (please refer to parameter 23-22 for dual pump slave sleep requirements) and only Master runs to reach constant-pressure operation.

Notes:

- When 23-35=3, If the operation time is over the switching time (23-29) or sleep to stop under the operation of dual pumps, the dominance between Master and Slave will exchange to operate.
- When 23-01≠0, the parameter 23-01 of these two inverters can not be simultaneously set to 1 or 2. That is, the parameter 23-01 of one inverter is set to 1 and that of the other inverter should be set to 2 and vice versa.

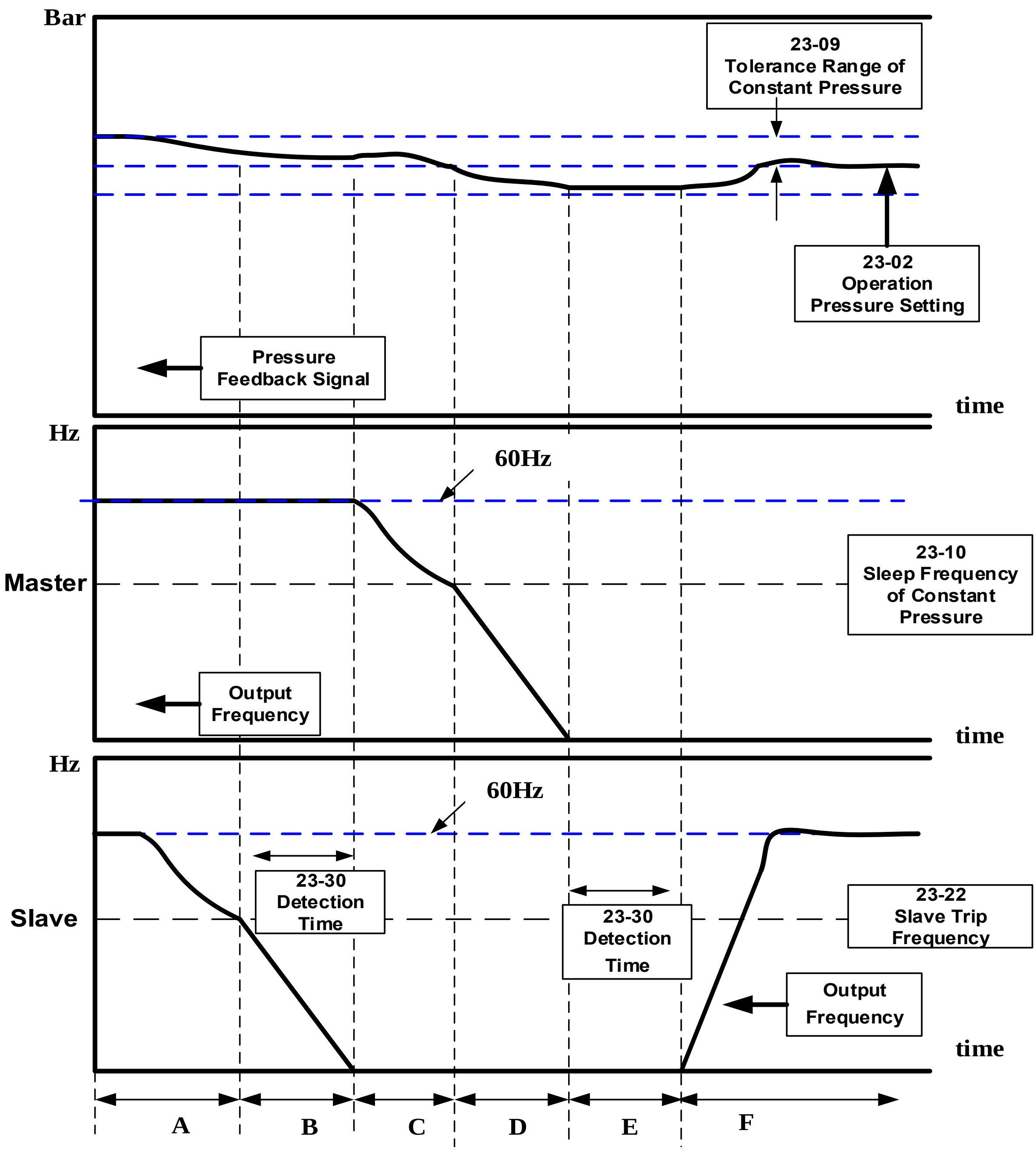


Diagram of sleep stop alternative selection action

Note:

A：Dual pumps are enabled during this time. Higher operation pressure occurs, Master keeps operation and Slave output frequency decreases.

B：Master operation frequency maintains 60Hz. If water pressure doesn't decrease to the target constant pressure and Slave continuously decreases to the set trip frequency (23-22), Slave detection time (23-30) starts and Slave decelerates to stop.

C：If milder water consumption and higher water pressure occur and Slave operation command is in sleep status, Master output frequency decreases to let the water pressure be in constant status when the detection time (23-30) is over.

D：When Master operation frequency decreases to the sleep frequency of constant pressure (23-10), Master will decrease to stop, water consumption is continuously mild and water pressure will reduce slowly.

E：When water consumption stops, Master jumps into sleep and the pressure remains the same. And Slave's detection time (23-30) starts.

F：When the detection time (23-30) is over, shift operation stops and virtual Master starts to become Slave. The inverter operates in constant pressure under the target pressure value.

23-73	Slave Wake-up Selection
Range	【0】Disable 【1】Enable

When multiple pumps are in parallel and the requirements of slave wake-up can not be achieved in tolerance range, user can set parameter 23-73=1 and refer to the following conditions to wake up Slave.

1. Master is in full speed operation (01-02 maximum output frequency) but pressure feedback value can not achieve the target pressure value.
2. Slave is forced to start after 30 seconds + time of (23-30) (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) and keeps operations to achieve the target pressure value.
3. It is required to follow the formula (the set method 1) and refer to the following diagram to set the wake-up requirements.

$$\frac{23-30}{00-14} \geq \frac{23-22}{01-02}$$ ----------------------- set method 1

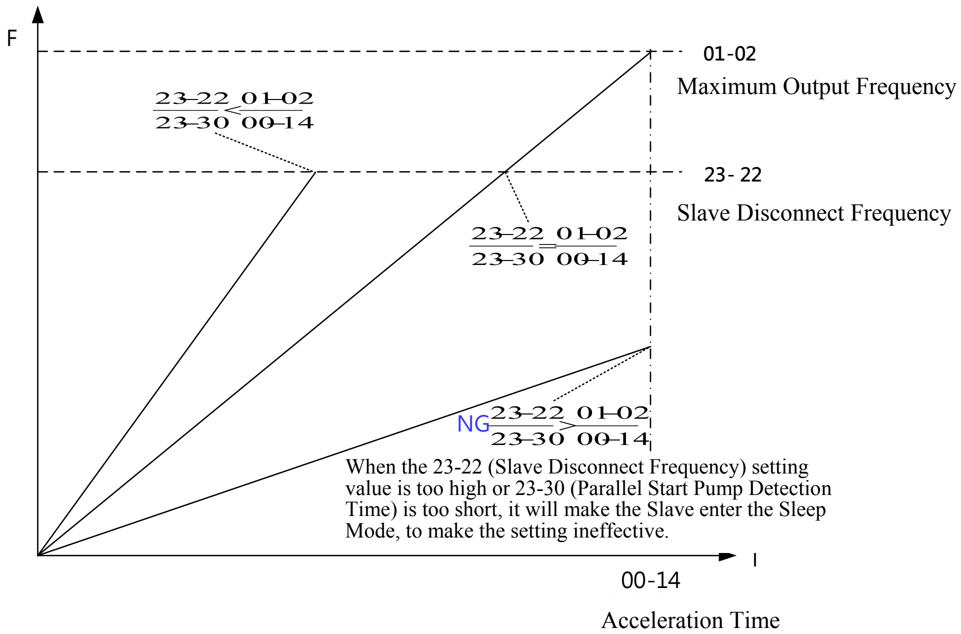


Diagram of requirements for waking up Slave

23- 22	Slave Trip Frequency
Range	【0.00~599.00】Hz

If Master and Slave start to run at the same time, Slave will stop depend on the condition listed as below.
When 23-22=0 Hz, if output frequency of Slave is lower than 23-10 (Sleep Frequency of Constant Pressure) and after the time of 23-11 (Sleep Time of Constant Pressure), the Slave will be stop automatically.
When 23-22 = 1 ~ 400 Hz (The maximum frequency follow 01-02), if the output frequency of Slave is lower

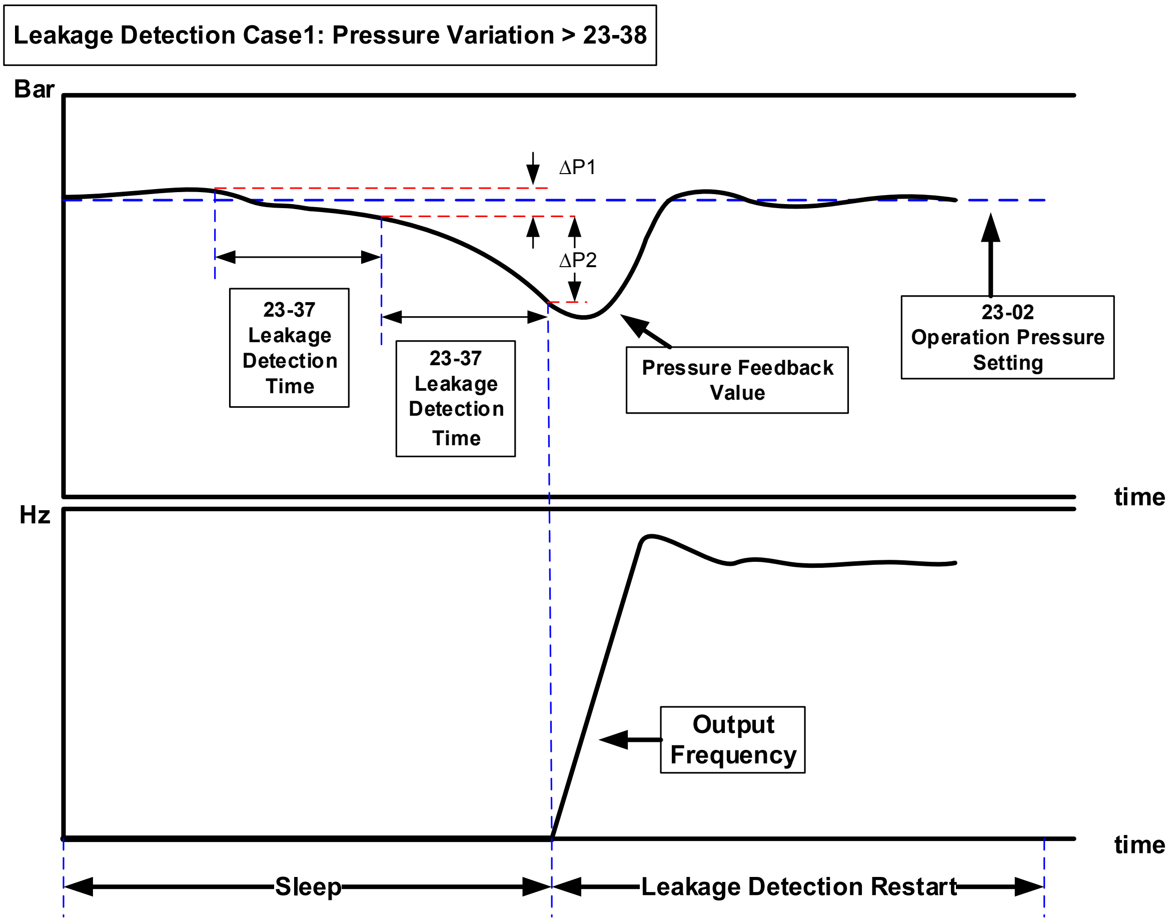
than 23-22, Master will inform Slave to stop and enter sleep mode, or output frequency of Slave is lower than 23-10 (Sleep Frequency of Constant Pressure) and after the time of 23-11 (Sleep Time of Constant Pressure), the Slave will be stop automatically.

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, presents the unit and range.

*2: 23-20=1, presents the unit and range.

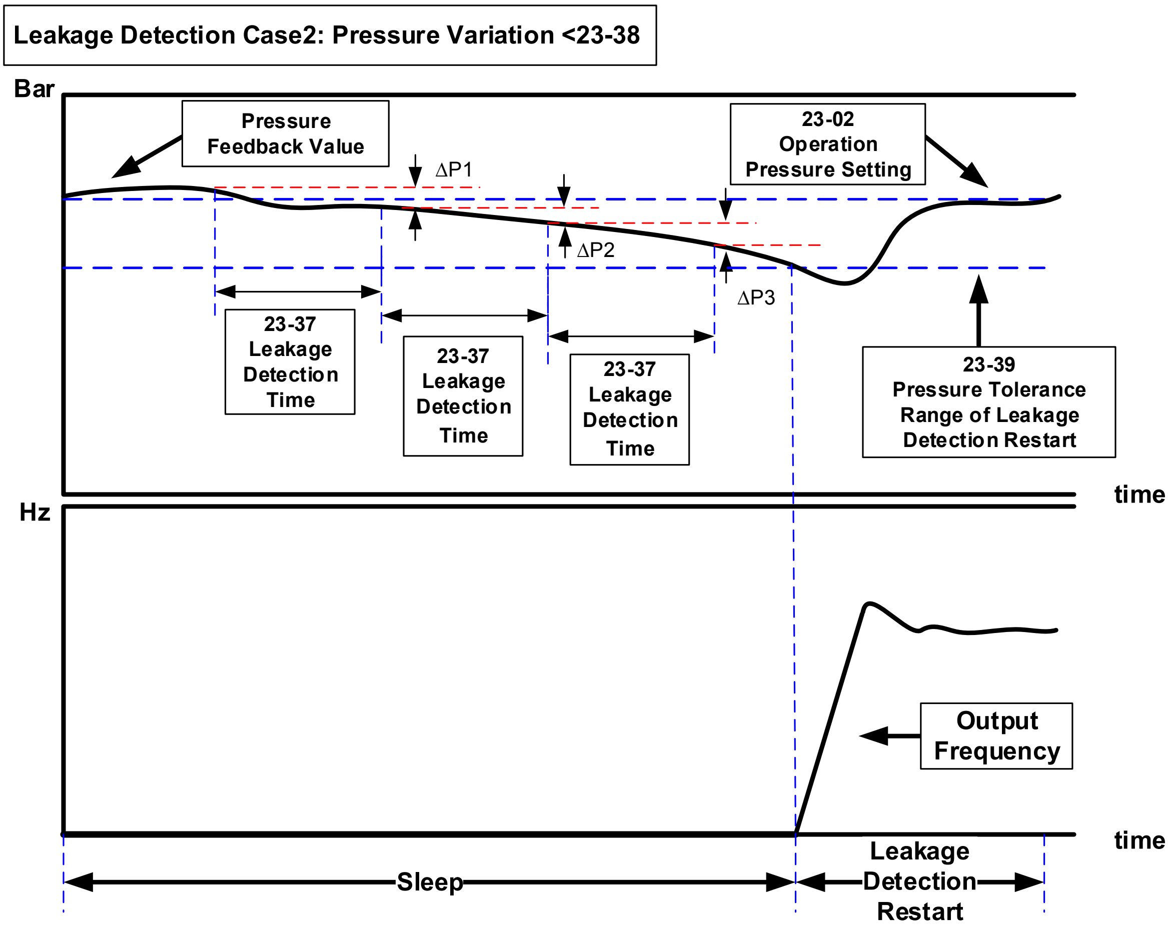
***3: It is new added in inverter software V1.4.**



Pressure Variation of Leakage Detection Restart
ΔP1 < 23-38
ΔP2 > 23-38

Notes:

- To limit single inverter to use leakage detection.
- When 23-37 = 0.0 (sec), switch off this function.
- When pump is at shutdown state, pressure will drop over time if pipeline leaks. Pump will restart if pressure variation is larger than the value of parameter 23-38 in every detection time (23-37).



Pressure Variation of Leakage Detection Restart
ΔP1 < 23-38
ΔP2 < 23-38
ΔP3 < 23-38

Notes:

- When 23-37 = 0.0 (sec), switch off this function.
- When pump is at shutdown state, pressure will drop over time if pipeline leaks. Inverter will keep sleep state if pressure variation is lower than the value of parameter 23-38 in every detection time (23-37) and pump will restart if pressure variation is larger than that of 23-38 or pressure tolerance range is over the value of parameter 23-39 in the detection time.
- Properly adjust the relevant leakage detection parameters 23-37, 23-38 and 23-39 to improve the condition of frequenct pump start and stop caused from the dropping pressure of water system due to leakage.
- Function of leakage detection is enabled only in the setting of single pump.

23-41	Local/ Remote Key
Range	【0】: Disable 【1】: Enable

User can switch reference frequency of the inverter and give the run command in the local or remote mode.

Input source selection is determined by the source of frequency command (00-05) and the operation modes (00-02).

23-41=0: Disable

Frequency command is controlled by terminal AI1 and AI2 when SEQ and REFsignal light up and run command is controlled by terminal S1, S2 or RS485.

23-41=1: Enable

User can control FWD/REV key for the switch of Local / Remote key.

Frequency command is controlled by the keypad when SEQ and REF signal light off.

Note: Local mode is controlled by the keypad and remote mode is controlled by control circuit terminals or RS485 connection.

23-42	**Energy Recaculating**
Range	**【0】: Disable (Energy Accumulating)** **【1】: Enable**
23-43	**Electricity Price per kWh**
Range	**【0.000~5.000】**

When the inverter starts up, user can learn the motor accumulative output energy from parameter 12-67 (unit: kWHr) and 12-68 (unit: MWHr). User recalculates energy via the setting of parameter 23-42 to 1.

User caculates electricity price via the setting of electricity price per kWh (23-43) and learn the accumulative electricity price from parameter 12-69 and 12-70.

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**

Unit of accumulative electricity pulse output signal (23-44) is for kWh. When accumulating the electricity to the setting unit of parameter 23-44, the pulse output signal of the electric meter or PLC is on lasting 200 msec.

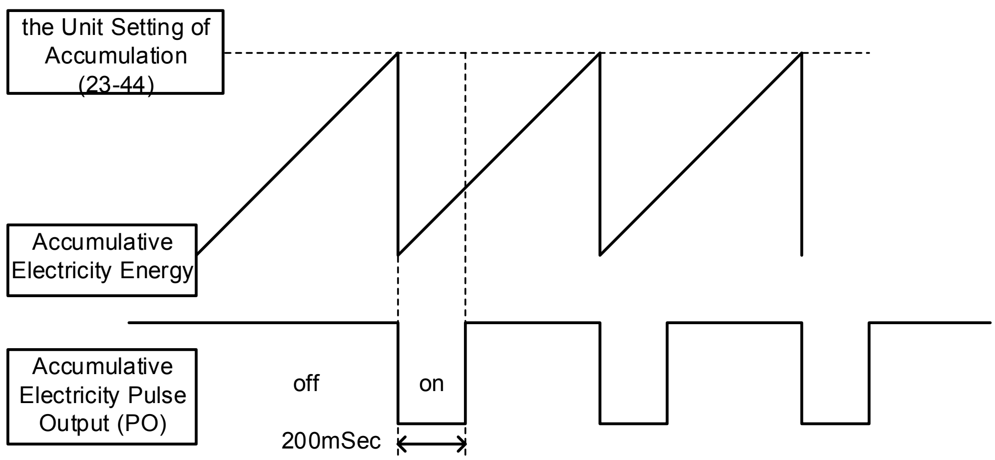


Figure 4.4.112 Diagram for accumulative electricity pulse output

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**

23-00=2: HVAC

HVAC is enabled when the source of main frequency command (00-05) is set to 5 (PID given) and PID mode is enabled (10-03).

23-45: Given Modes of Flow Meters Feedback

Modes of flow meters feedback is given by analog input (AI) or pulse input (PI) and flow meter (12-71) displays feedback value. Refer to the instruction of parameter 23-05 for PID display.

23-46: Maximum Value of Flow Meters

Maximum value of flow meters is the maximum value set by the target value of flow meters for HVAC system.

23-47: Target Value of Flow Meters

This function sets the target value of flow meters for HVAC system depending on the setting of 10-00 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 dispays the unit upon the setting value by parameter 23-60 and unit display of parameters 12-71,12-77,23-46,23-47 is switched at the same time.

23-48	**Maximum Flow Value of Feedback**
Range	**【0.01~99.00】%**

It is convenient for user to limit the maximum flow value depending on the different situations. When flow feedback value is higher than the maximum flow value, the inverter will display warning signal and then stops.

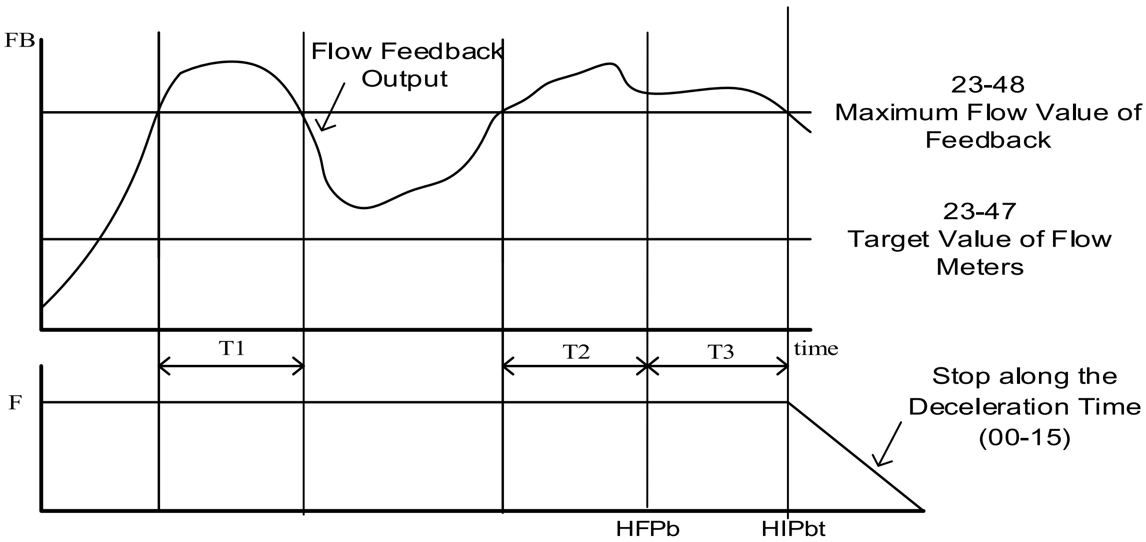
23- 49	**Maximum Flow Warning Time of Feedback**
Range	**【0~255】Sec**

When flow feedback is higher than the maximum flow limit, warning time of high flow starts to count. If the flow feedback is lower than the maximum flow limit during counting time, the warning time will recount and the inverter will display the warning signal of HFPb when the warning time ends.

23- 50	**Maximum Flow Stop Time of Feedback**
Range	**【0~255】Sec**

When the warning signal of high flow occurs and flow feedback is higher than maximum flow limit, stop time of high flow starts to count. If flow feedback is lower than maximum flow limit during counting time, the stop time will recount and the inverter will display stop error signal of HIbFt when the stop time ends.

Note: When user does not want the inverter to be restricted by the maximum flow, set 23-76=0 (disable) to disable the function of high flow limit.



T1 < (23-49): Recounting after T1.
T2 = (23-49): Keypad flashes and displays HFPb
T3 = (23-50): Keypad flashes and displays HIPbt

Figure 4.4.113 Diagram for warning to stop at high flow limit

23- 76	High Flow Setting
Range	【0】Disable 【1】High Flow Warning 【2】High Flow Warning or Error

When 23-76=0, High flow warning or error is disabled.

When 23-76=1, High flow warning is enabled. High flow error is disabled.

When 23-76=2, High flow warning or error is enabled. Refer to the instruction of Fig. 4.4.113.

23-51	Minimum Flow Value of Feedback
Range	【0.01~99.00】%

It is convenient for user to limit the minimum flow value depending on the different situations. When flow feedback value is lower than the minimum flow value, the inverter will display warning signal and then stops.

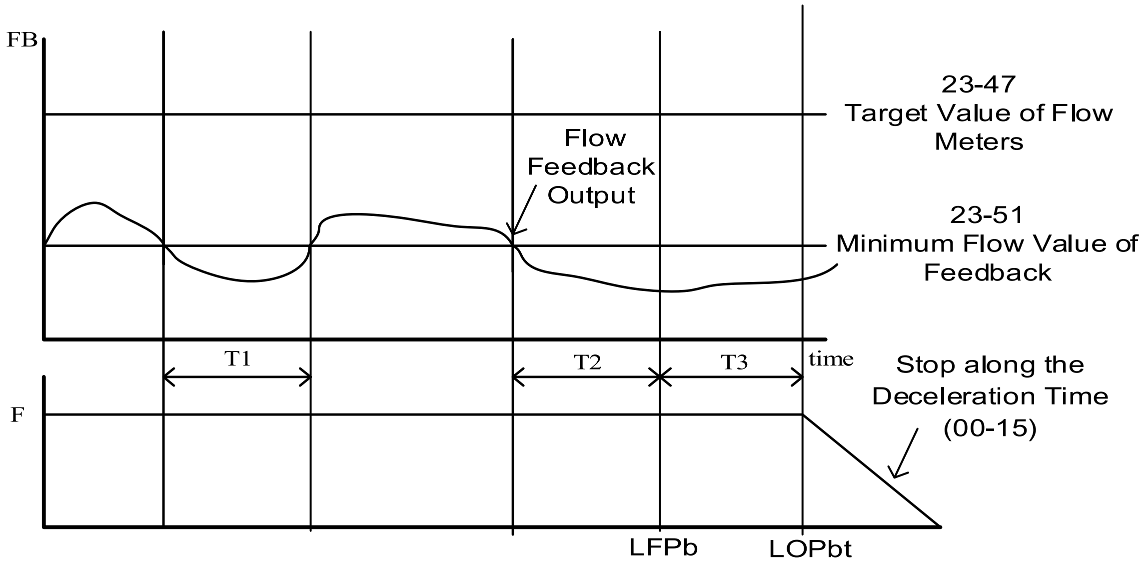
23- 52	Minimum Flow Warning Time of Feedback
Range	【0~255】Sec

When flow feedback is lower than the minimum flow limit, warning time of low flow starts to count. If the flow feedback is higher than the minimum flow limit during counting time, the warning time will recount and the inverter will display the warning signal of LFPb when the warning time ends.

23- 53	Minimum Flow Stop Time of Feedback
Range	【0~255】Sec

When the warning signal of low flow occurs and flow feedback is lower than minimum flow limit, stop time of low flow starts to count. If flow feedback is higher than minimum flow limit during counting time, the stop time will recount and the inverter will display stop error signal of LObFt when the stop time ends.

Note: When user does not want the inverter to be restricted by the minimum flow, set 23-77=0 (disable) to disable the function of low flow limit.



T1 < (23-52): Recounting after T1.
T2 = (23-52): Keypad flashes and displays LFPb
T3 = (23-53): Keypad flashes and displays LOPbt

Figure 4.4.114 Diagram for low flow limited warning of stop

23- 77	Low Flow Setting
Range	【0】Disable 【1】Low Flow Warning 【2】Low Flow Warning or Error

When 23-77=0, Low flow warning or error is disabled.

When 23-77=1, Low flow warning is enabled. Low flow error is disabled.

When 23-77=2, Low flow warning or error is enabled. Refer to the instruction of Fig. 4.4.114.

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

The hydraulic application can detect insufficient water in the tank resulting in low suction via HVAC function. User can select the reaction of low suction (23-58) to run command. Low suction is detected by parameter 23-54. Refer to Fig.4.4.115 for the process of low suction.

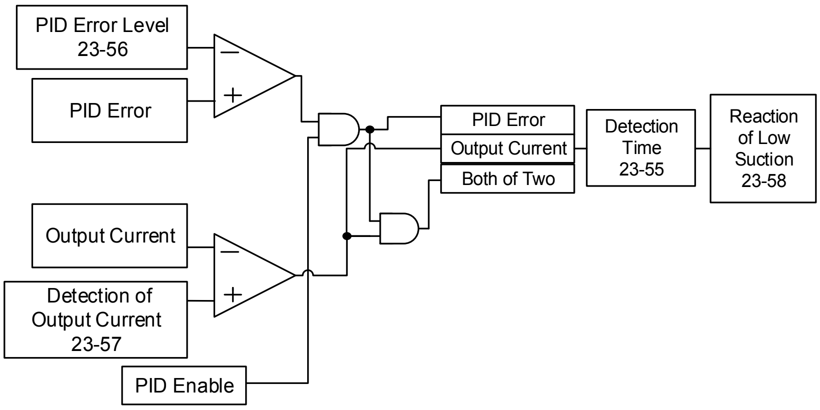


Figure 4.4.115 Diagram for the process of low suction

When 23-54=0, detection function of low suction is disabled.
And refer to Table 4.4.19 for the detection logic of parameter 23-54 to select PID error of output current as the detection signal.

Table 4.4.19 the detection logic of low suction

23-54	Detection Signal	
	PID Error	Output Current
1	1	0
2	0	1
3	1	1

The detection level is required to be set by PID error level of low suction (23-56) and output current signal (23-57) after selecting the detection signal.

The state of low suction experiences the detection time of low suction (23-55); when it is over the detection time, low suction is active.

The reaction of low suction (23-58) is set by user to act. Refer to Table 4.4.20 for the detection signal of water used.

When 23-58=3, refer to the instruction of parameter 07-01~07-02. Set fault auto-restart time by parameter 07-01 and the maximum number of fault auto-restart attempts is 10 by parameter 07-02.

Table 4.4.20 Detection signal of water used

23-58	Inverter Status	Keypad Signal	Error Signal
0	Continous Running	None	None
1	Continous 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

Note: Low suction state is detected by if the signal is higher than PID error level or lower than output current.

23- 59	Source of HVAC Pressure Command *3
Range	**【0】: Set by 23-47** **【1】: Set by AI**

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

23-59=0: Target value depends on parameter 23-47.

23-59=1: Convert the proportional target value of flow meters via AI1 input voltage value. Refer to parameter 10-00 for the setting of AI terminal.

23- 66	**Derating of Current Level (for Compressor Current) *3**
Range	**【10 ~ 200】%**
23- 67	**Derating of Delay Time *3**
Range	**【1.0 ~ 20.0】Sec**
23- 68	**Derating of Frequency Gain *3**
Range	**【1~100】%**
23- 69	**OL4 Current Level *3**
Range	**【10~200】%**
23-70	**OL4 Delay Time *3**
Range	**【0.0 ~ 20.0】Sec**

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

The application of water-cooled chiller is when the rated current of compressor operates for 1 to 2 minutes easily to cause damage to compressor so the inverter is required to be set two- stage protection to protect the compressor.

Protection of first stage:
When the inverter is at constant speed and the current is higher than the derating of current level (23-66) (this is the percentage for the rated current of compressor), it will start to count the derating of delay time (23-67). After the counting time is over the delay one, frequency command can reach the derating of output frequency and reduce the current load via being multiplied by the derating of frequency gain (23-68). When the current is lower than the derating of current level, output frequency will be restored to the frequency command. The action of derating to restore is counted one time. When it repeats more than three times, the output frequency will stop at the last derating frequency until the current is lower than the derating of current level (23-66).

For example: Set 23-66=80%, 23-67=10sec, 23-68=90%, the frequency command=60Hz and the rated current of compressor=30A, then,
when the output current=27A, higher than 24A (30A*80%), 10 sec (the derating of delay time) passes, and the output frequency=54Hz (frequency command 60Hz*90%), the output current decreases to 25A, also higher than 24A; then another 10 sec passes, 60Hz*81%=48.6Hz, the output current decreases to 23A, lower than 24A, so the output frequency is restored to 60Hz and the current rises to 27A. When it repeats more than three times, the output frequency will stop at 48.6Hz and the output current decreases to 23A.

Protection of second stage:
After the current reaches OL4 current level (23-69), the inverter will count the time at the setting value of OL4 delay time (23-70). When the counting time ends, it will decelerate to stop automatically and display the warning signal (fault signal, OL4 Compressor Overload).

If fault occurs, PLC can read if the inverter is running from the digital output terminals. If the inverter stops, terminate the RUN command. If 00-02=0, user can press Reset key; if 00-02=1, terminate the RUN command of digital input terminal to reach the effect of Reset. Then PLC can be restored to give RUN command.

Note: It is recommended that the rated current of compressor is required to be lower than that of inverter.

Group 24 Pump Control Function Parameters

24- 00	Selection of Pump Control Function
Range	【0】: Function of 1 to 8 Pump Card and 1 to 3 Relay are Disabled. 【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】: 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling. 【8】: Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling. 【9】: 1 to 3 Relay of Cycle Modes of Inverter Pump: Only Stop Inverter Pump. And First Boot Relay in Cycling.

The inverter with built-in PID controller and simple programmable logic controller (PLC) is widely applied to water supply industry. 1 to 8 pump card, mainly applied to the situation of water supply of constant pressure, dispenses the inverter from the need of an external controller.

The inverter provides the power supply of variable frequency for pump to implement the continuously variable transmission (CRT) and makes the water pressure being satbly controlled via the built-in PID controller.

There are two basic operation modes in 1 to 8 pump card:

① **Fixed modes of inverter pump:**

Pump drived by the inverter is fixed to 1 set and maximum to 8 sets.

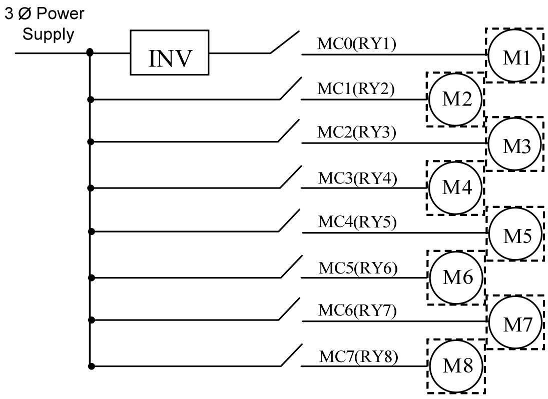


Figure 4.4.116 Fixed modes of inverter pump

② **Cycle modes of inverter pump:**

Pump drived by the inverter is not fixed to 1 set and maximum to 4 sets.

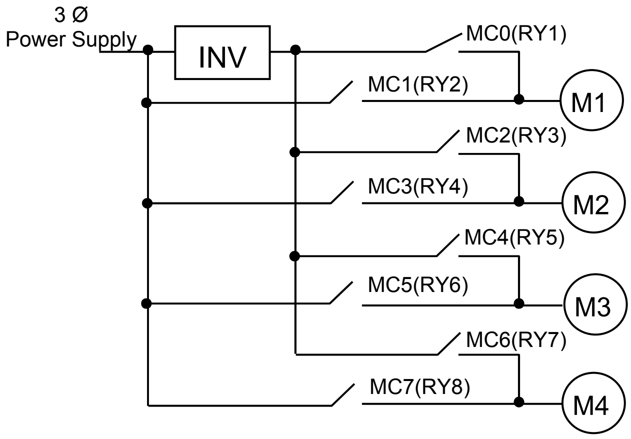


Figure 4.4.117 Cycle modes of inverter pump

In addition to the two basic operation modes provided from 1 to 8 pump card, it can only use the Relay in the control board to enable the cycle modes of inverter pump.

*** Cycle modes of inverter pump in the control board:** Run via a Relay with a pump to start the cycle modes of inverter pump.

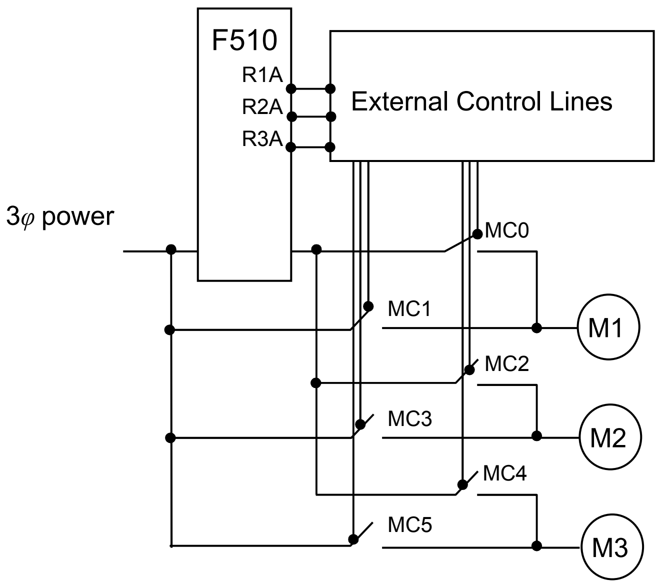


Figure 4.4.118 Cycle modes of inverter pump in the control board

24-00=0: Function of 1 to 8 pump card and 1 to 3 Relay are disabled.

24-00 = 1: in the fixed modes of inverter pump, first on and last off; then stop all.

Pump (motor) drived by the inverter is fixed. Switching off the pump (motor) is by the sequence of the last on and this mode is applicable to different pump (motor) ratings.

24-00=2: only inverter pump stops in the fixed modes of inverter pump.

When the inverter sends the stop command, only the pump (motor) stops but the Relay keeps on.

24-00=3: in the fixed modes of inverter pump, first on and first off; then stop all.

Switching off the pump (motor) is by the sequence of the first on (longer operation time) to make the pump (motor) be used for the eq ual frequency and this mode is applicable to the same pump (motor) ratings.

24-00=4: in the cycle modes of inverter pump, first on and first off; then stop all.

All the motors besides the pump are drived by the inverter and switching off the pump (motor) is by the sequence of the first on.

24-00=5: only inverter pump stops in the cycle modes of inverter pump.

When the inverter sends the stop command, only the pump (motor) stops but the Relay keeps on.

24-00=6 : 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First off; then Stop All.

This mode runs via a Relay with a pump in the cycle modes of inverter pumps. If 24-07=1, only Relay in the control board is enabled in 1 to 3 Relay of cycle modes and can switch the drive sequence of every pump.

24-00=7: Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling.

The first inverter drives the motor depending on the Relay switching time (24-08) to change the inverter's position.

24-00=8: Cycle Modes of Inverter Pump 1 to 3 Relay: First on and First Off; then Stop All. And First Boot Relay in Cycling.

The inverter drives the motor at the first time depending on the Relay switching time (24-08) to change the inverter's position. That is, at this mode, the inverter runs in a Relay with a pump. Users can switch the orders of each pump driving at this cycle mode of 1 to 3 Relay with the setting of parameter 24-07.

24-00=9：Cycle Modes of Inverter Pump 1 to 3 Relay: Only Stop Inverter Pump. And First Boot Relay in Cycling.

As the fixed modes, first on and first off, but only stop the inverter pump. The inverter drives the motor at the first time depending on the Relay switching time (24-08) to change the inverter's position. (The Relay switching is enabled only in one motor.)

Notes:

- When 1 to 8 pump card is not installed, it is forced to be disabled (24-00=0).
- When parameter 24-00 (pump control selection) is enabled, the selection of DI function to 16 (PID function disable) and 57 (forced frequency run) are disabled.
- Set 24-07=1 to enable the Relay in the control board to provide the function selection of 1 to 8 pump cards, or it is still forced to be disabled.
- 1 to 8 pump cards enabled or disabled and the selection modes of water supply are determined by parameter 24-00.
- PID Setting:
  PID function is enabled via the setting of PID control mode (10-03) to xxx1b (PID enable). Set PID target value source (10-00) to 4 (10-02 given) and the target value is determined by 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), it requires to set the dip switch to V in 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 modes of inverter pump, RY1 is permanently used and RY2~RY8 is arbitrarily selected to be used.

Inverter decelerates/ accelerates to lower/ upper limit frequency when user increases/ decreases pumps and function of PID is temporarily disabled. When the inverter reaches lower/ upper limit frequency, function of PID restores and the inverter output is determined by the feedback.

Cycle modes of inverter pump:

In the cycle modes of inverter pump, RY2 and RY1 are always used. The rest (RY3~RY8) is a group of two, RY3/RY4, RY5/RY6, and RY7/RY8. If any one of the group is set to be disabled, this group is disabled.

The inverter output disconnects when user increases pumps. When a motor originally drived by the inverter is switched by commercial AC power supply, it requires the switching time of magnetic contactor (24-05) to allow the AC power supply input. Then the inverter output drives the next motor, which is determined by the feedback.

Switch off the motor of the first on when user decreases pumps to make the pump (motor) be the equal using frequency.

Cycle modes of inverter pump in the control board:

In the cycle modes of inverter pump, RY1 is permanently used and RY2~RY3 is arbitrarily selected to be used. 24-01 can only set 0xxx (Relay 4 can not be set.) and 24-02 can only set 0000 (Relay 5-8 can not be set.) so this parameter will be hidden.

24- 03	Duration of Upper Limit Frequency
Range	【1.0 ~ 600.0】Sec

Set the inverter output frequency controlled by PID reaches the upper limit frequency (the proportion setting by parameter 00-12) via parameter 24-03. 1 to 8 pump card controls the time required for increasing pumps.

The setting value of duration of upper limit frequency (24-03) is determined by the changing time speed of system pressure. The setting value of 24-03 is the fewer the better in the range without producing oscillation of system pressure.

24- 04	Duration of Lower Limit Frequency
Range	【1.0 ~ 600.0】Sec

Set the inverter output frequency controlled by PID reaches the lower limit frequency (the proportion setting by parameter 00-13) via parameter 24-04. 1 to 8 pump card controls the time required for decreasing pumps.

The setting value of duration of lower limit frequency (24-04) is determined by the changing time speed of system pressure. The setting value of 24-04 is the fewer the better in the range without producing oscillation of system pressure.

24- 05	Switching Time of Magnetic Contactor
Range	【0.1 ~ 20.0】Sec

When a motor originally drived by the inverter is switched by the commercial AC power supply or originally drived by the commercial AC power supply is switched by the inverter, function of parameter 24-05 is used to avoid the delay of external magnetic contactor resulting in a short circuit of the inverter output and AC power supply.

The setting value of 24-05 requires being larger than the time from the switch of the inverter Relay signal to the action of external magnetic contactor. Generally, the off to on time of magnetic contactor is longer than the on to off time. Set parameter 24-05 depending on the longer time.

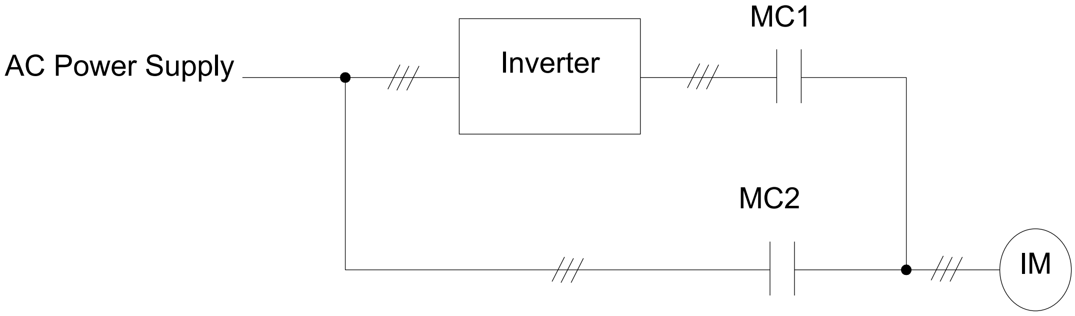


Figure 4.4.119 Diagram for the single cycle modes of inverter pump

24- 06	Allowable Bias of Pump Switch
Range	【0.0~20.0】%

When increasing or decreasing pumps with PID control to operate in coordination with Relay card, user has to determine if it is required to increase or decrease allowable value of pump in the situation of inverter output frequency being closed to upper limit frequency (00-12) or lower limit frequency (00-13).

The setting unit is 0.1% and if the setting is 0.0%, inverter output frequency needs to reach the upper limit or lower limit value to increase or decrease pump (motor).

For example, 00-12 = 80%, and 00-13 = 20%, then:

- If 24-06 = 0%, when the output frequency needs to reach 80% of the maximum frequency and the period of time reach the Duration of Upper Limit Frequency (24-03), the pump (motor) increase; when the output frequency needs to reach 20% of the minimum frequency and the period of time reach the Duration of Lower Limit Frequency (24-04), the pump (motor) decrease.
- If 24-06 = 5%, when the output frequency needs to reach 75% of the maximum frequency and the period of time reach the Duration of Upper Limit Frequency (24-03), the pump (motor) increase; when the output frequency needs to reach 25% of the minimum frequency and the period of time reach the Duration of Lower Limit Frequency (24-04), the pump (motor) decrease.

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

It is Relay in the 1 to 8 pump card used for function of inverter pump.

24-07 = 1: Built-in 1 to 3 Control Mode

It is Relay in the control board used for function of inverter pump.
Only R1A~R3A in the control board can be used and Relay in 1 to 8 pump card cannot be used.

It is required for the following conditions to enable this control mode.
① 24-00 is only set to 1~3 and 6.
② 24-01 is only set to 0xxx (Relay 4 is disabled).
③ 24-02 is only set to 0000 (Relay 5~8 are disabled).

Note: If user does not follow the above requirements (24-00, 24-01, 24-02, and 24-07), errors will coour when user give commands to the inverter.

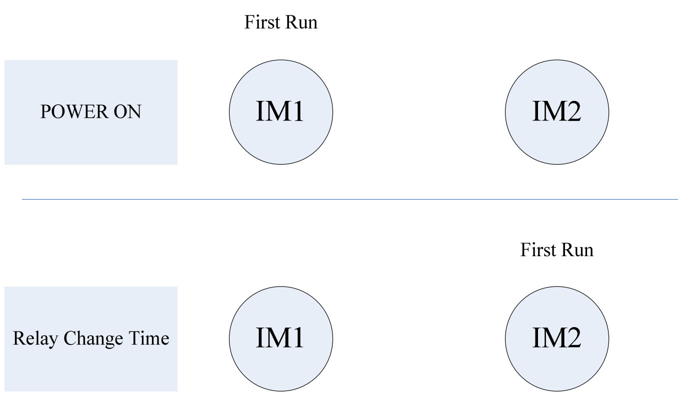
Refer to the following table for controlling the maximum value of pump under the different setting values of 24-00 and 24-07.

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 is fixed to support Relay 1 controlled by pump and function of parameter 03-11 is disabled.
- If 24-07=1 and 24-01= xx1x, R2A supports Relay 2 controlled by pump and function of parameter 03-12 is disabled.
- If 24-07 = 1，24-01 = x1xx, R3A supports Relay 3 controlled by pump and function of parameter 03-39 is disabled.

24- 08	Relay Switching Time
Range	【0 ~ 240】hour

Relay switching time is required to be with modes 7 or 8 of parameter 24-00. When the power is on, the first run motor is the motor 1. If the switching time reaches and all motor are at sleep mode, the motor 2 will start up and the inverter drives the motor 2. Refer to the following figure for motors change when the Relay switching time reaches.



Note: It will recount time when parameter 24-00 is enabled or parameter 24-08 changes the Relay switching time or the power reconnects.

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, action of reducing pump starts from the output frequency after PID control agreeing the level of lower limit frequency and the delay time of lower limit frequency.

When 24-09=1, action of reducing pump starts when PID feedback (12-39)>PID setting (12-38).

When 24-10=1, all relays disconnect at stop and first relay starts to run at operation.

Note: 24-10 is enabled only when 24-00=6, 7, 9.

24- 17	Increase and Decrease Pump Interval PID Control
Range	【0】Increasing / Decreasing Pump Section without PID Control 【1】Increasing / Decreasing Pump Section with PID Control

24-17=0: When increasing / decreasing the pump, in order to balance the current water usage, the Inverter will decelerate to the Frequency Lower Limit when increasing the pump, conversely, the Inverter will increase to Frequency Upper Limit when decreasing the pump, then the Inverter will switch back to the speed required by the PID Control.
24-17=1: When using water at the extreme switch when increasing / decreasing the pump, and in order to balance the water usage, the Inverter Increasing / Decreasing Pump All Sections can be selected to use PID to control the Inverter Speed.

24- 11	High Pressure Limit Level
Range	【0~10000】
24- 14	**Low Pressure Limit Level**
Range	【0~10000】

24-11 High Pressure Limit Level:
When pressure feedback value is higher than the set value of highp pressure limit level, the alarm signal occurs and then inverter stops the operation.

24-14 Low Pressure Limit Level:
When pressure feedback value is lower than the set value of low pressure limit level, the alarm signal occurs and then inverter stops the operation.

User can refer to the setting of 10-00=4 to set the value of parameters 24-11& 24-14. Revise the upper limit value by the setting of parameter 10-33, determine the decimal position by adjusting the setting of parameter 10-34, and the unit display by parameter 10-35.

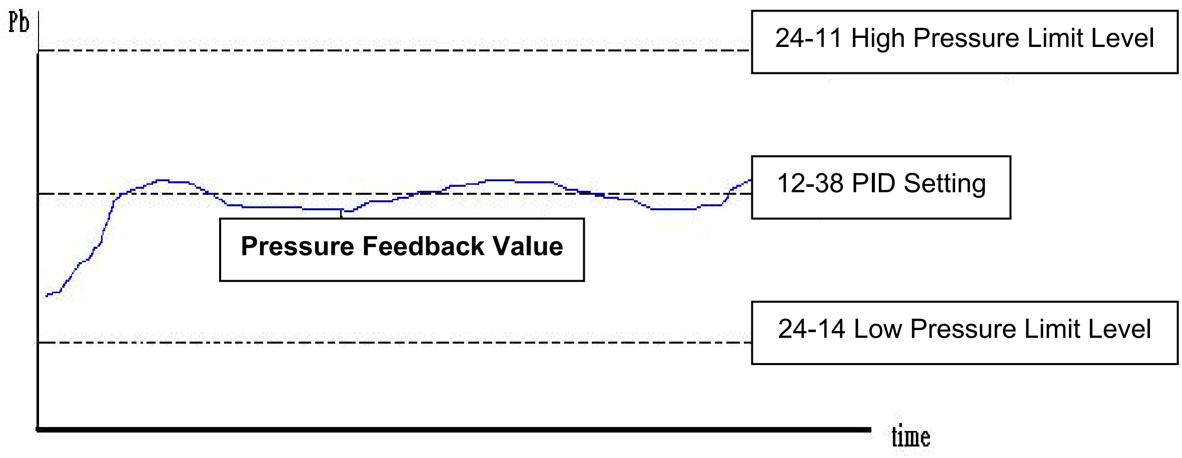


Diagram of pressure feedback value limit

Note: Pressure feedback value will be between the high pressure limit level (24-11) and the low pressure limit level.

24- 12	Delay Time of High Pressure Warning
Range	【0.0 ~600.0】Sec
24- 13	Delay Time of High Pressure Error
Range	【0.0 ~ 600.0】Sec

24-12 Delay Time of High pressure Warning

When pressure feedback value is higher than the high pressure limit level, high pressure warning time will start to count. If the value is lower than the high pressure limit level during the counting time, the warning time will recount. It will jump to the warning signal "HIPb" when the counting time is over.

24-13 Delay Time of High Pressure Error

When the warning signal of high pressure occurs and pressure feedback value is higher than the high pressure limit level, high pressure shutdown time will start to count. If the value is lower than the high pressure limit level during the counting time, the shutdown time will recount. It will jump to the error signal "OPbFt" when the counting time is over.

Note: If user wouldn't like to limit to the high pressure level, the high pressure warning time can be set to zero, and then the high pressure limit function is disabled.

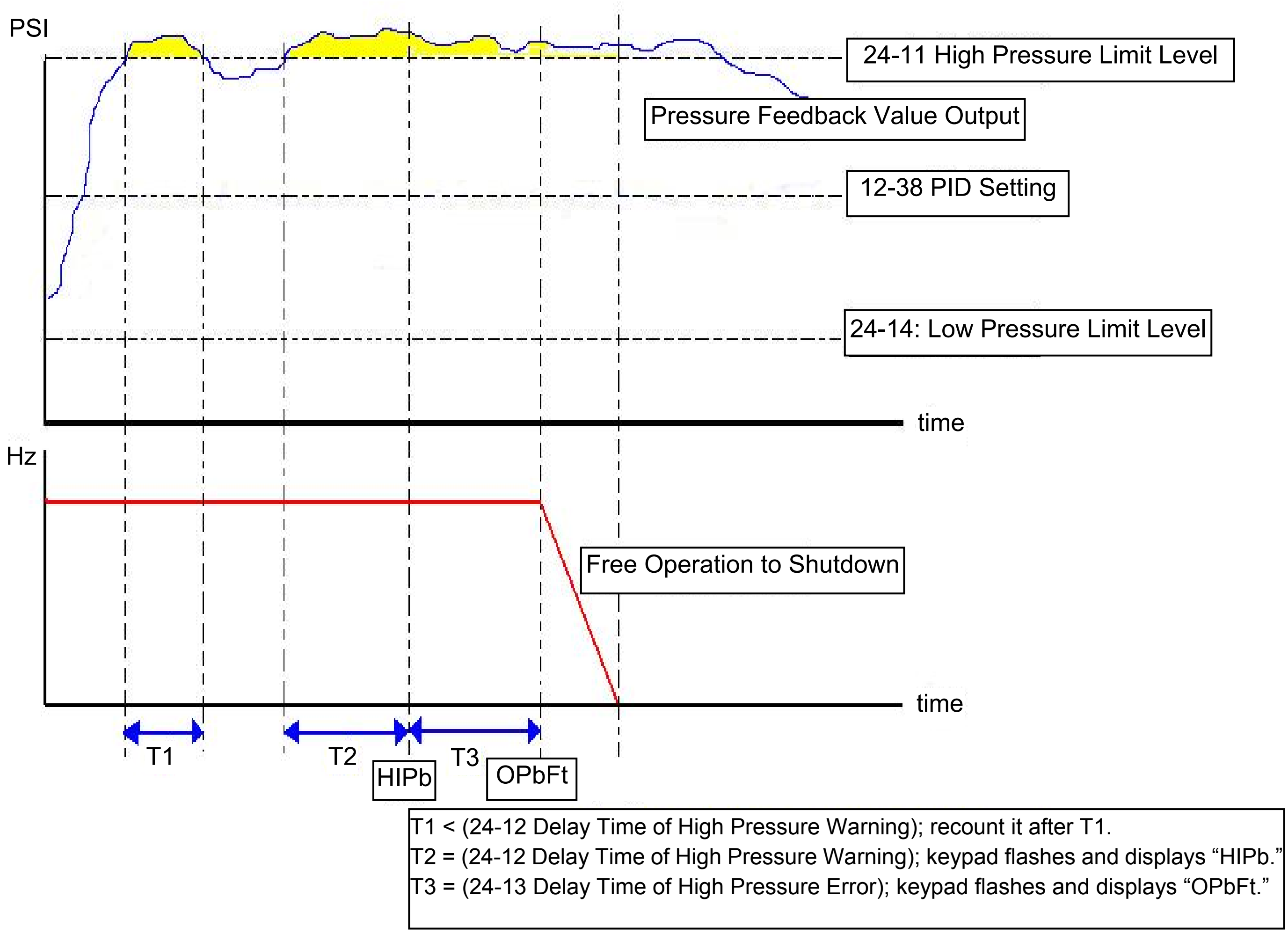


Diagram of high pressure limit warning to shutdown

24- 15	Delay Time of Low Pressure Warning
Range	【0.0 ~ 600.0】Sec
24- 16	**Delay Time of Low Pressure Error**
Range	【0.0 ~ 600.0】Sec

24-15 Delay Time of Low Pressure Warning

When pressure feedback value is lower than the low pressure limit level, low pressure warning time will start to count. If the value is higher than the low pressure limit level during the counting time, the warning time will recount. It will jump to the warning signal “LoPb” when the counting time is over.

24-16 Delay Time of Low Pressure Error

When the warning signal of low pressure occurs and pressure feedback value is lower than the low pressure limit level, low pressure shutdown time will start to count. If the value is higher than the low pressure limit level during the counting time, the shutdown time will recount. It will jump to the error signal “LPbFt” when the counting time is over.

Note: If user wouldn’t like to limit to the low pressure level, the low pressure warning time can be set to zero, and then the low pressure limit function is disabled.

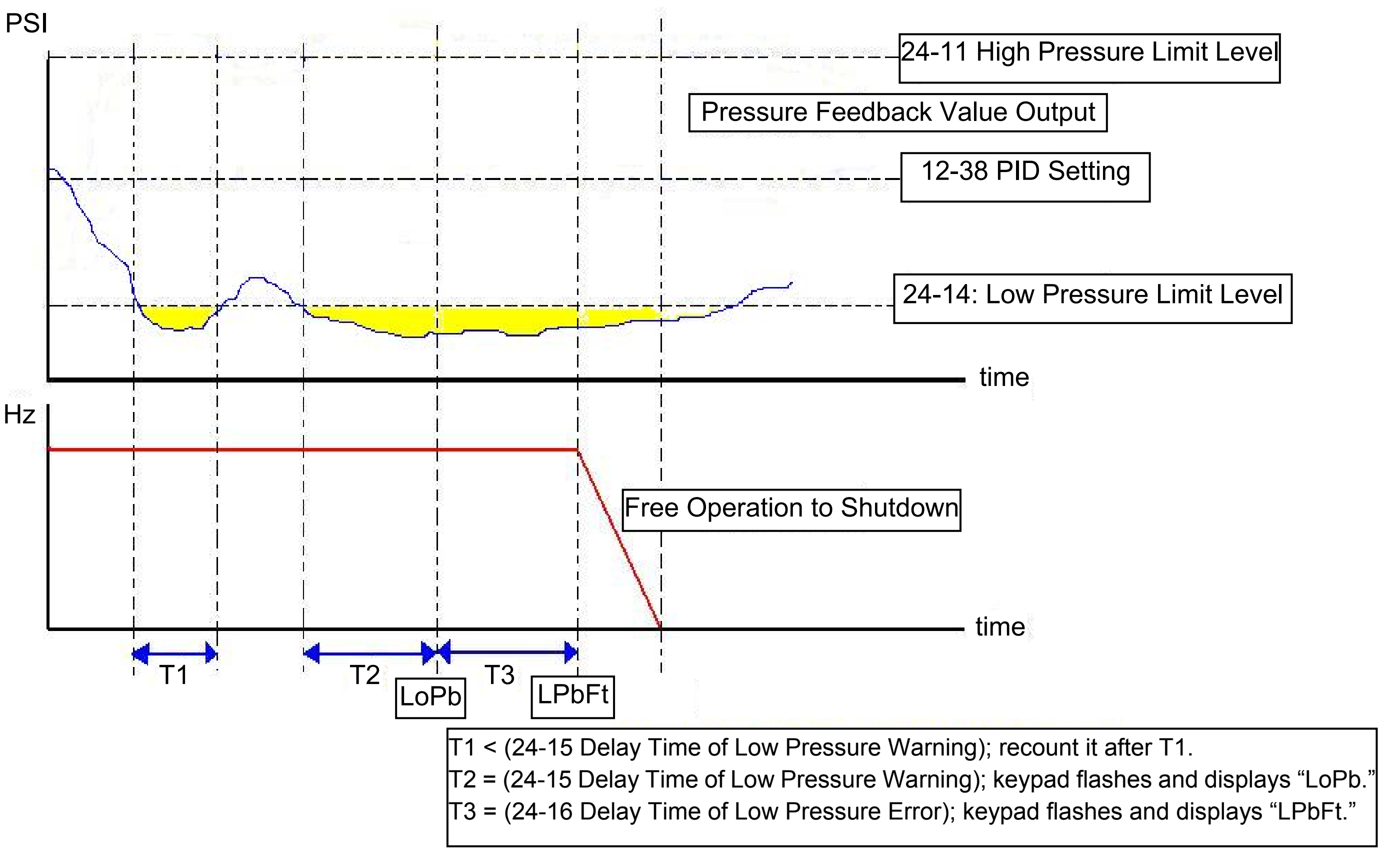


Diagram of low pressure limit warning to shutdown

The following examples are for the actions of increasing / decreasing pumps in the fixed modes of inverter pump. Relay 1~Relay 4 in 1 to 8 pump card is set to be enabled. Motor 1 is connected to inverter and motor 2~4 are connected to AC power supply. MC of AC power supply is mainly controlled by the external circuit control. Refer to Fig. 4.4.126.

When 24-00=1, 24-06=0 and depending on the above PID setting, the following status occurs.

✧ Output frequency (Fout) reaches the upper limit frequency (00-12) and Fout time is over than the duration of upper limit frequency (24-03). Then Relay 2 is power on and the connected motor starts to accelerate.

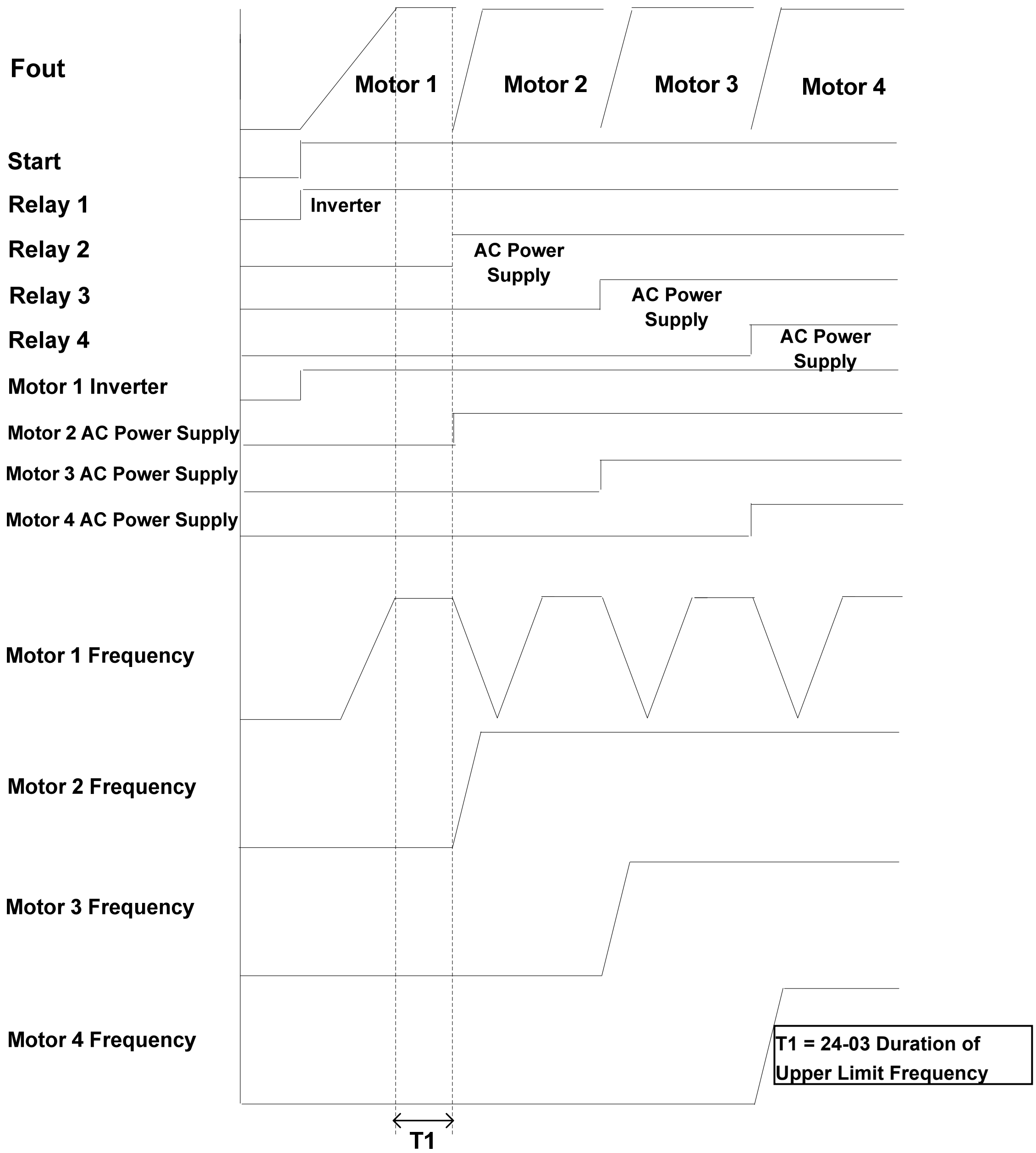


Figure 4.4.120 Diagram of increasing pump in the fixed modes of inverter pump

- ✧ Output frequency (Fout) decreases to the lower limit frequency (00-13) and the Fout time is over than the duration of lower limit frequency (24-04). Then Relay 4 is power off and the inverter accelerates to the upper limit frequency (00-12).
- ✧ When Fout reaches to the upper limit frequency (00-12), the inverter starts to decelerate.

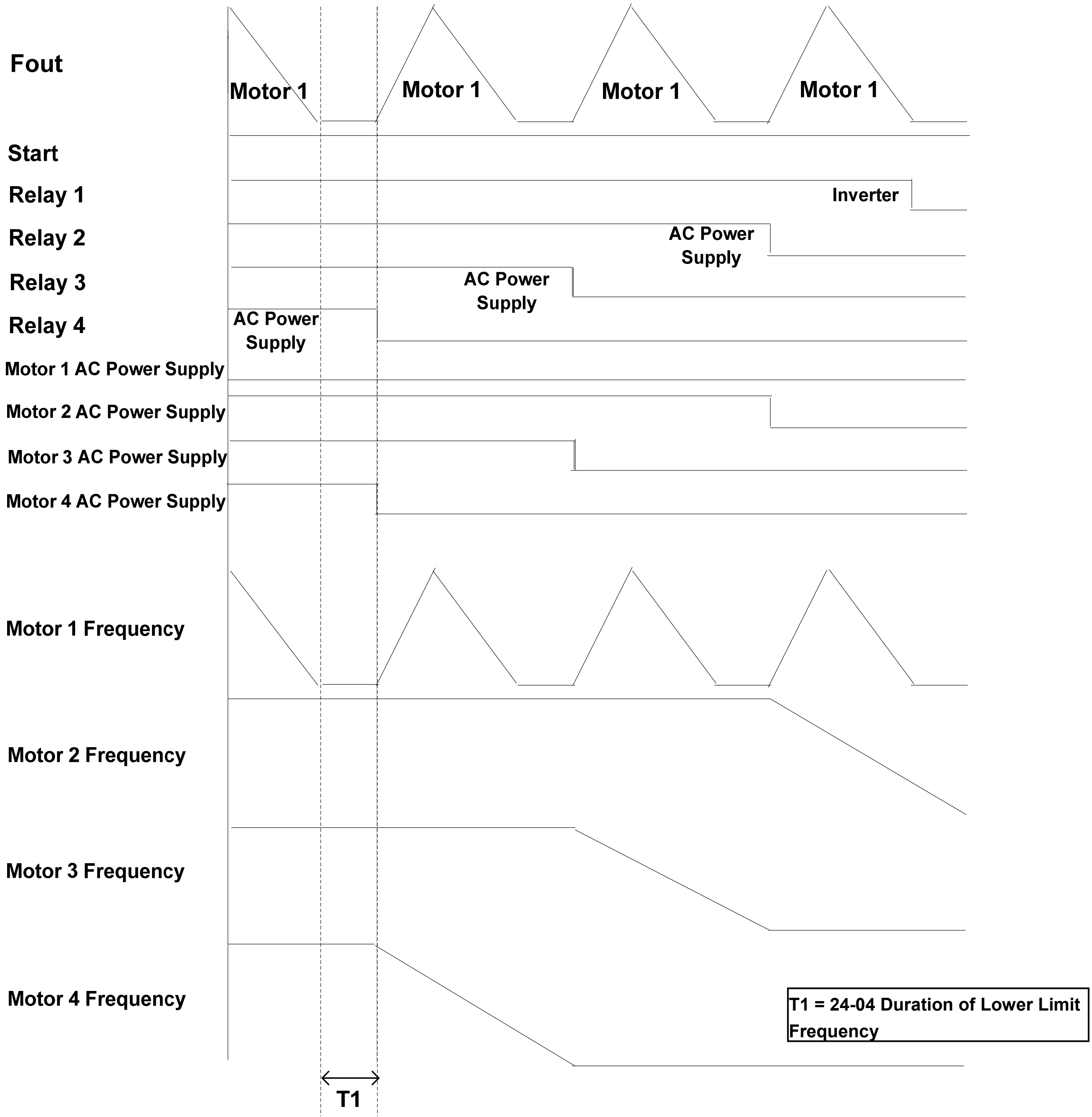


Figure 4.4.121 Diagram of decreasing pump in the fixed modes of inverter pump

The following examples are for the actions of increasing / decreasing pumps in the cycle modes of inverter pump. Relay 1~Relay 4 in 1 to 8 pump card is set to be enabled. Refer to Fig.4.4.119 for switching of the motor connected to the inverter or AC power supply. MC of AC power supply is mainly controlled by the external circuit control. Refer to Fig.4.4.127.

When 24-00=1, 24-06=0 and depending on the above PID setting, the following status occurs.

- ✧ Output frequency (Fout) reaches the upper limit frequency (00-12) and Fout time is over than the duration of upper limit frequency (24-03). Then Relay 1 is power off and output frequency of the inverter does not occur.
- ✧ Relay 1 and Relay 2 is power on and the inverter starts to accelerate after the switching time of MC (24-05) ends.

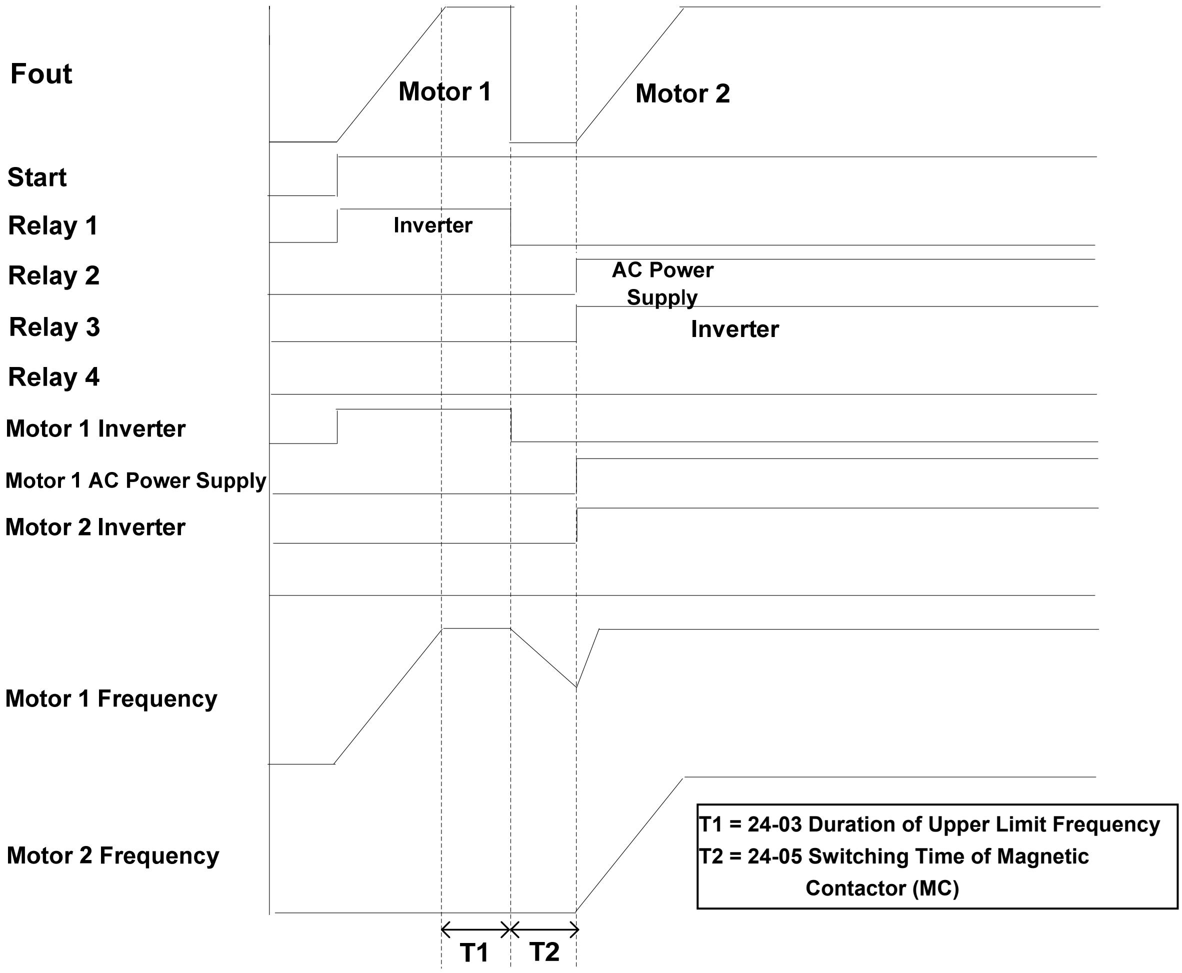


Figure 4.4.122 Diagram of increasing pump in the cycle modes of inverter pump

- ✧ Output frequency (Fout) reaches the lower limit frequency (00-13) and Fout time is over than the duration of lower limit frequency (24-04). Then Relay 1 and Relay 2 is power off
- ✧ Relay 1 is power on and the inverter starts to decelerate after the switching time of MC (24-05) ends.

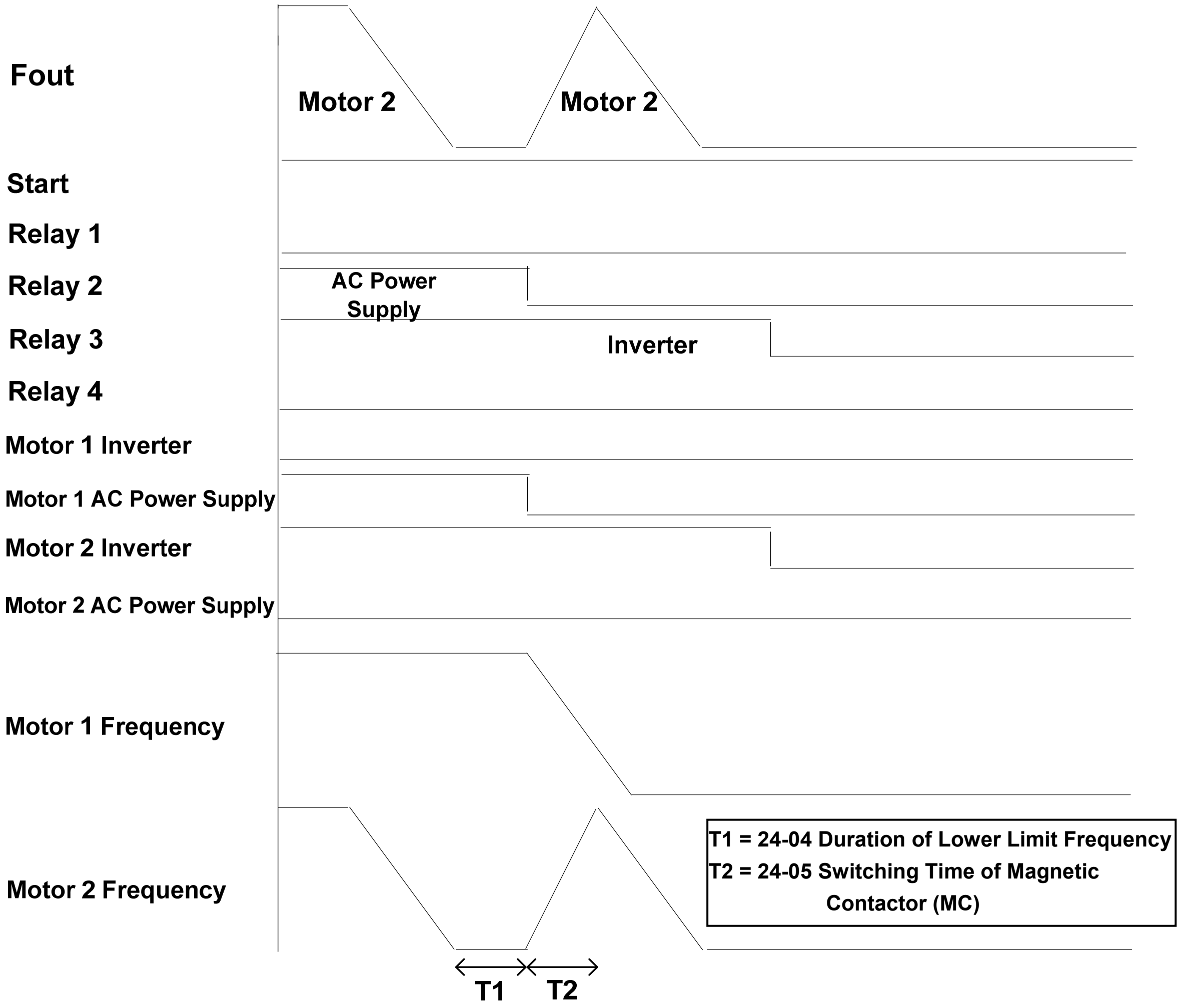


Figure 4.4.123 Diagram of decreasing pump in the fixed modes of inverter pump

The following examples are for the actions of increasing / decreasing pumps in 1 to 3 Relay modes. Relay 1~Relay 3 is corresponding to R1A-R3A. Refer to Fig.4.4.118 for switching of the motor connected to the inverter or AC power supply. MC of AC power supply is mainly controlled by the external circuit control. Refer to Fig.4.4.128.

When 24-00=1, 24-06=0 and depending on the above PID setting, the following status occurs.

- ✧ Output frequency (Fout) reaches the upper limit frequency (00-12) and Fout time is over than the duration of upper limit frequency (24-03). Then Relay 1 is power off and output frequency of the inverter does not occur.
- ✧ Relay 2 is power on and output frequency of the inverter does not still occur after the switching time of MC (24-05) ends.
- ✧ Relay 1 is power on and the inverter starts to accelerate after the switching time of MC (24-05) ends.

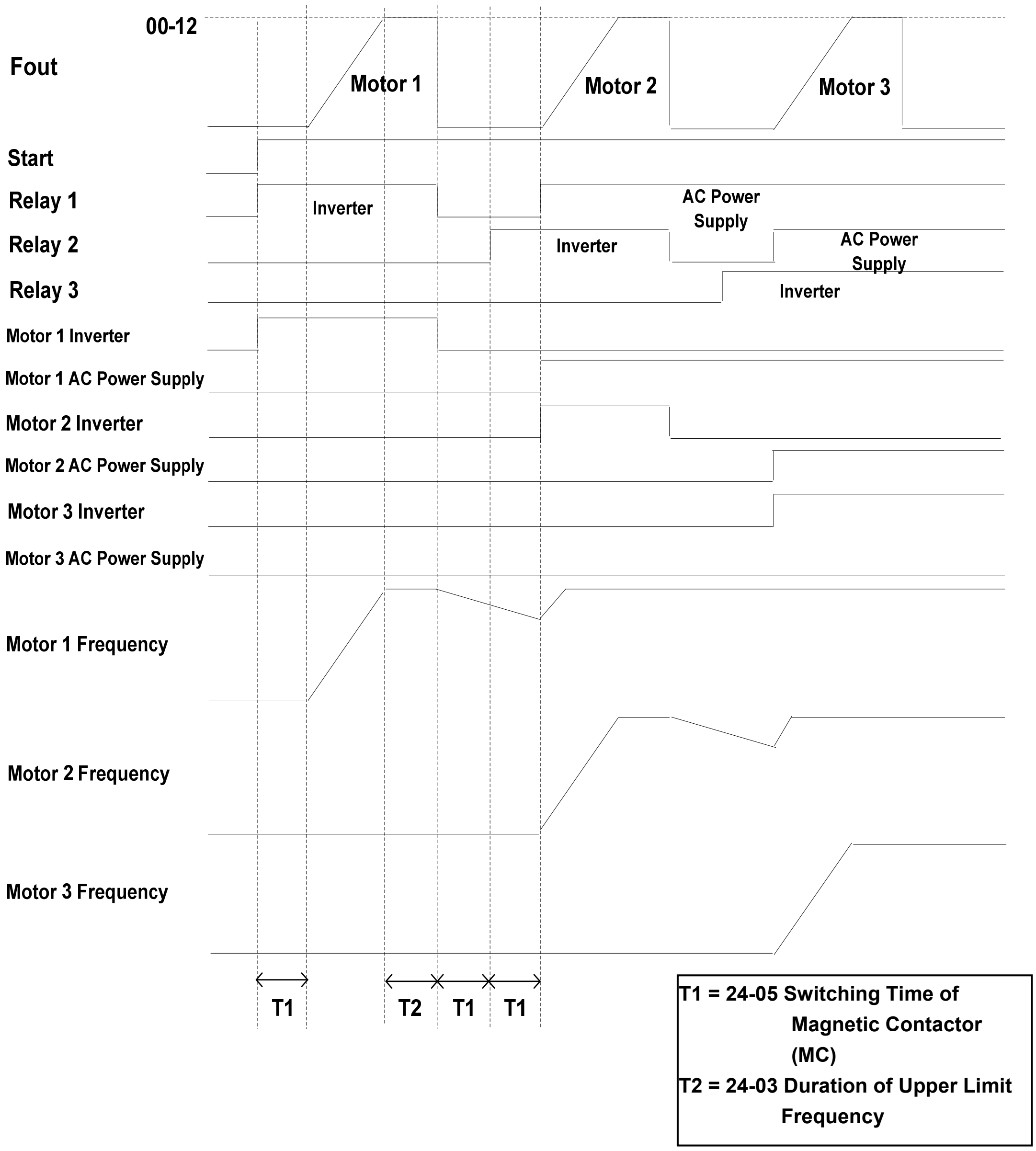


Figure 4.4.124 Diagram of increasing pump in 1 to 3 Relay modes

✧ When pressure feedback value is larger than the target value, output frequency (Fout) decreases. Relay 1 is power off when the output frequency reaches to the lower limit frequency (00-13) and Fout time is over than the duration of lower limit frequency (24-04).

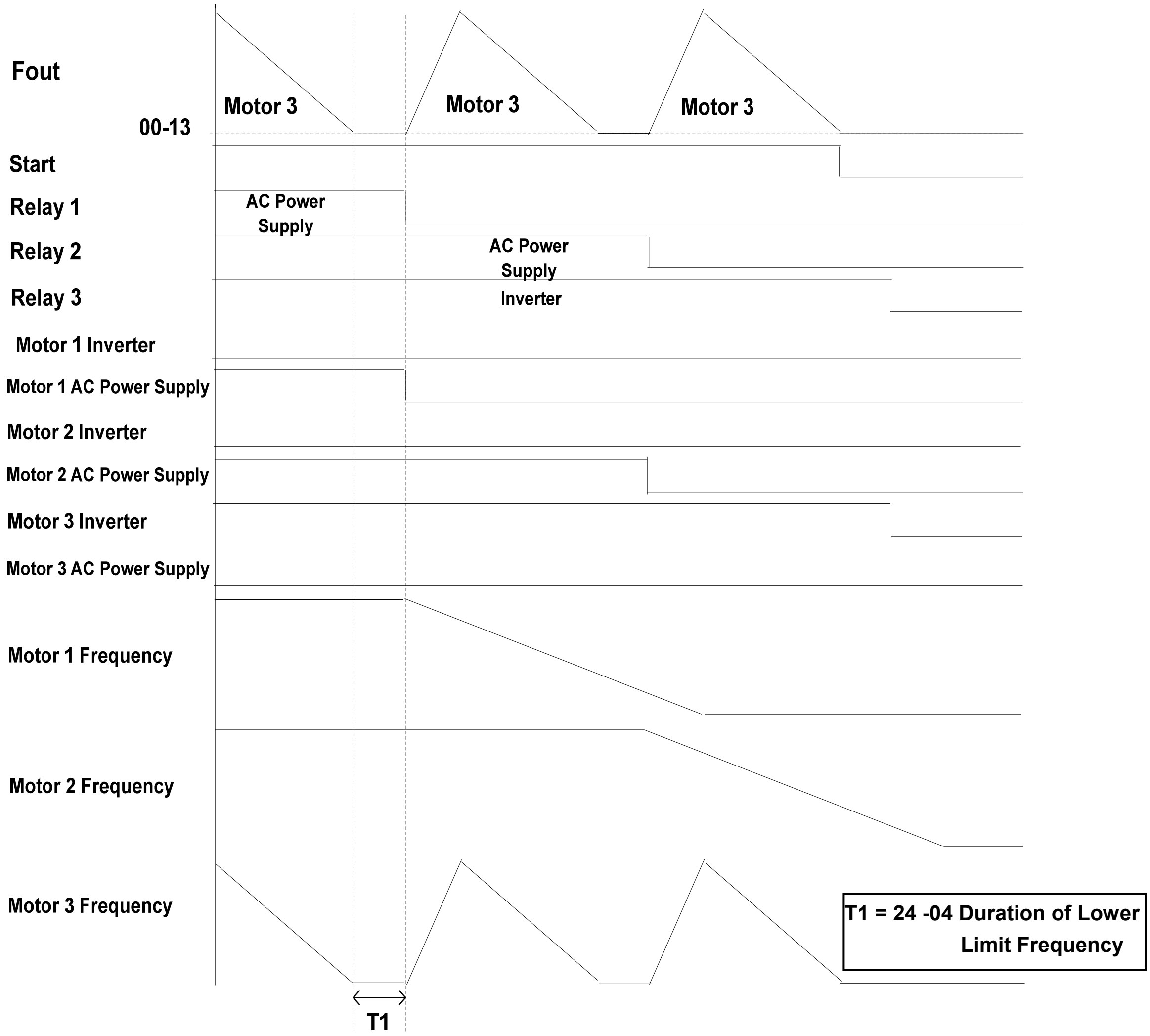


Figure 4.4.125 Diagram of decreasing pump in 1 to 3 Relay modes

■ Wiring for 1 to 8 Pump Card and 1 to 3 Relay Modes

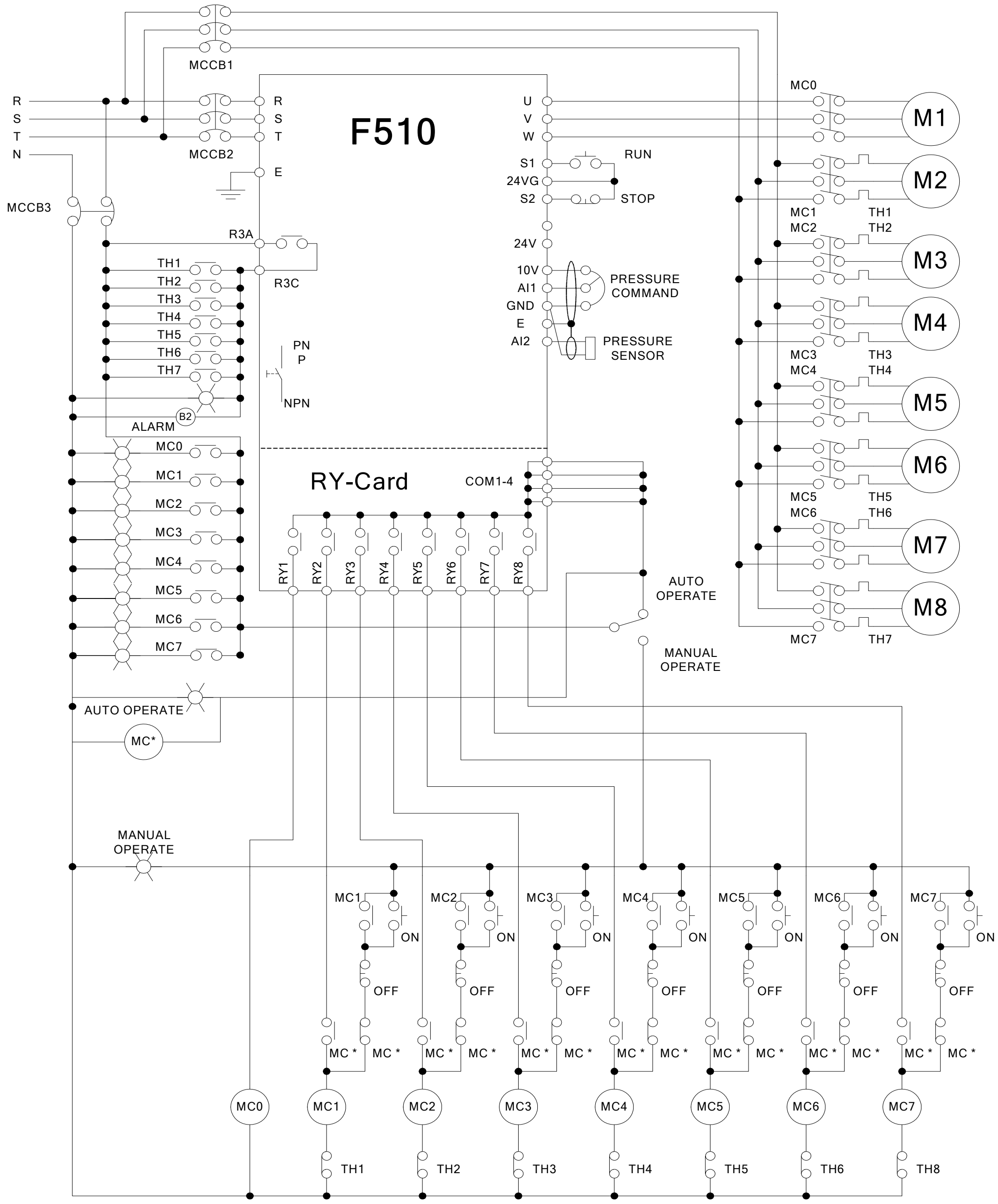


Figure 4.4.126 Wiring for the fixed modes of inveter pump

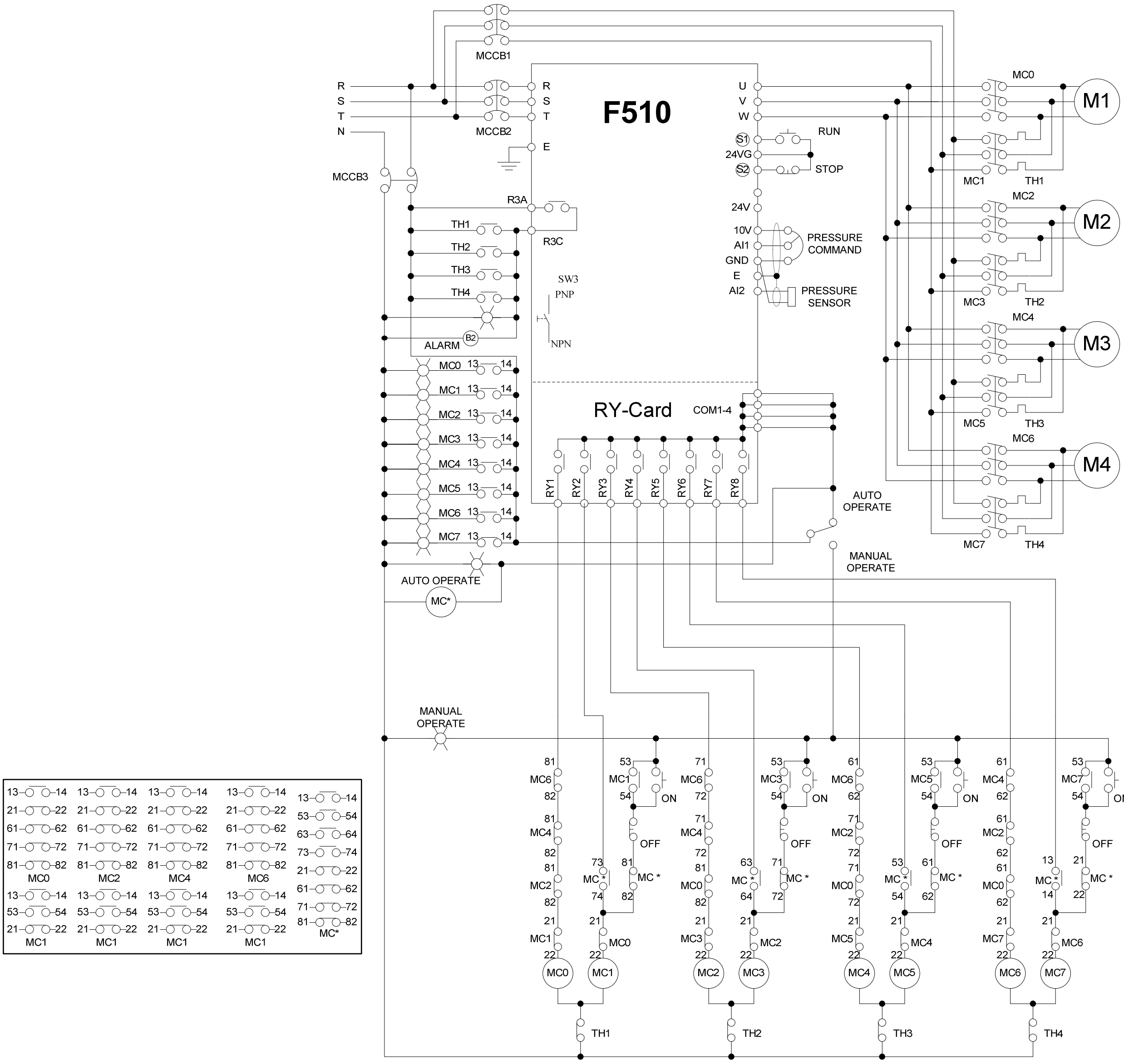


Figure 4.4.127 Wiring for the cycle modes of inverter pump

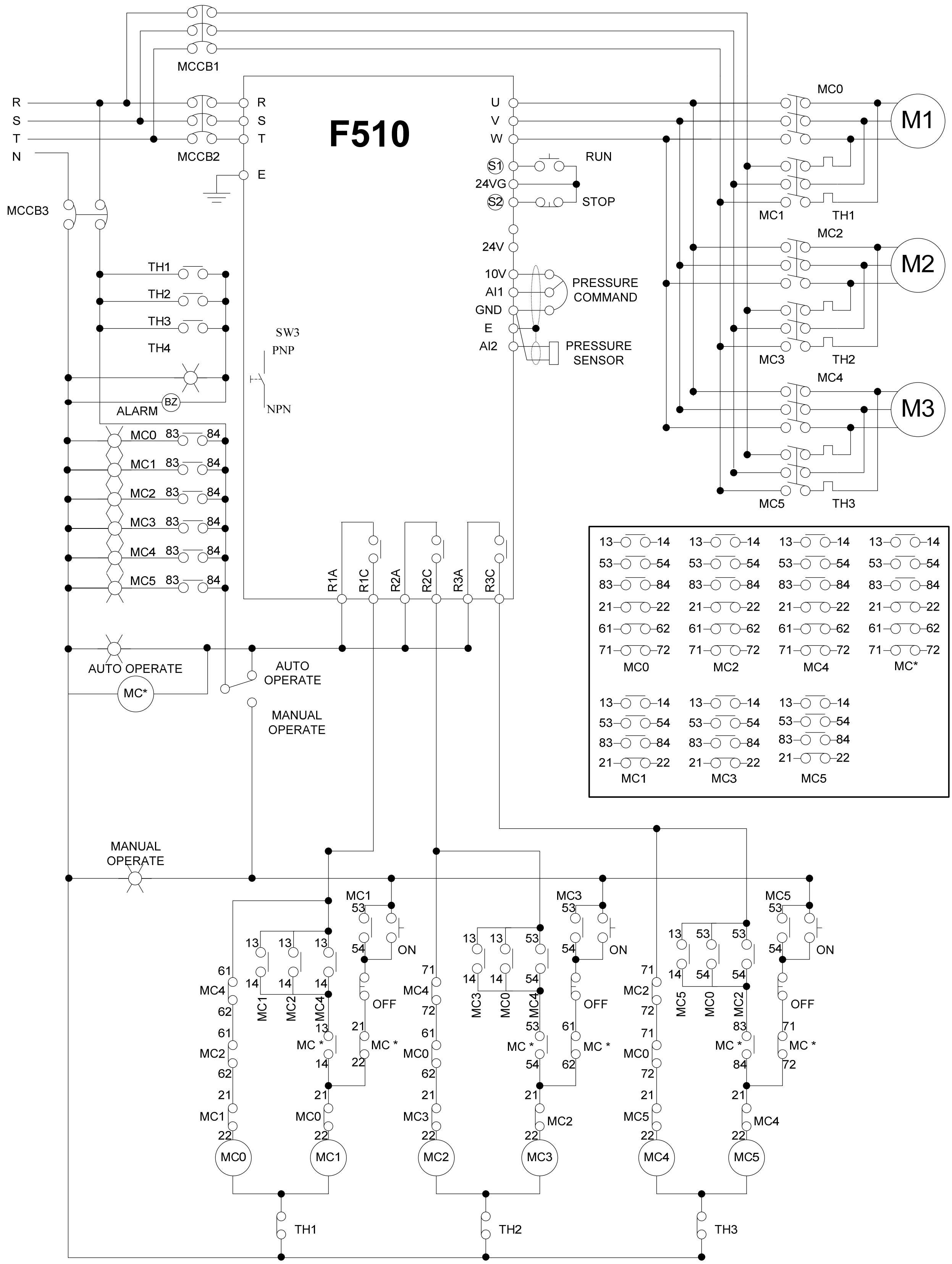


Figure 4.4.128 Wiring for the cycle modes of inverter pump in the control board

4.5 Built-in PLC Function

The PLC ladder logic can be created and downloaded using the TECO drive link software.

4.5.1 Basic Command

	[	↑	↓	P	─┤├─	─┤/├─	NO / NC
Inputs					I	i	I1~I6 / i1~i6
Outputs	Q	Q	Q	Q	Q	q	Q1~Q2 / q1~q2
Auxiliary command	M	M	M	M	M	m	M1~MF / m1~mF
Special registers							V1~V8
Counter function	C				C	c	C1~C8 / c1~c8
Timer function	T				T	t	T1~T8 / t1~t8
Analog comparison function	G				G	g	G1~G8 / g1~g8
Operation control function	F				F	f	F1~F8 / f1~f8
summation and subtraction function	AS						AS1~4
Multiplication and division function	MD						MD1~4

Description of registers

V1：Set frequency	**Range：0.1~400.0Hz**
V2：Operation frequency	**Range：0.1~400.0Hz**
V3：AI1 input value	**Range：0~1000**
V4：AI2 input value	**Range：0~1000**
V5：Keypad input value	**Range：0~1000**
V6：Operation current	**Range：0.1~999.9A**
V7：Torque value	**Range：0.1~200.0%**
V8：PID Target Value	**Range：0.1~400.0Hz**

Command	Upper Differential	Lower Differential	Other command symbol
Differential command	D	d	
SET command			↑
RESET command			↓
P command			P

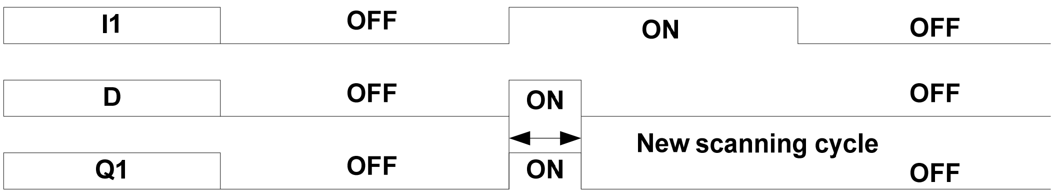
Open circuit	“ “	
Short circuit	“--”	

Connection symbol	Definition
─	Connect components on the left and right side
┴	Connects components on the left , right and top side
┼	Connects components on the left , right , top and bottom side
┬	Connects components on the left , right and bottom side

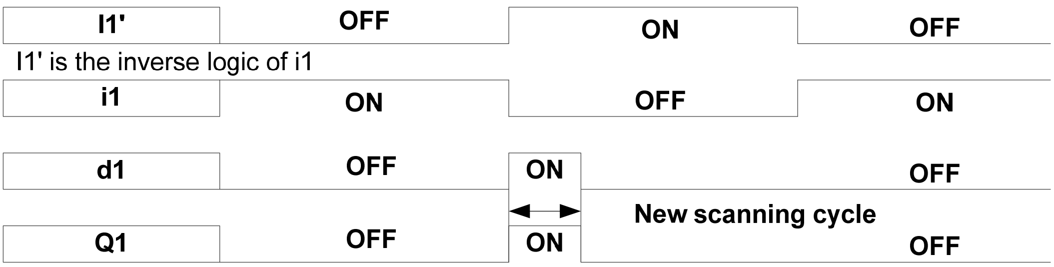
4.5.2 Basic Command Function

◎ D（d）command function

Example 1： I1─D ──[Q1

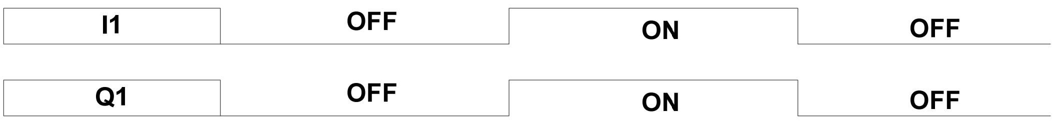


Example 2： i1─d ──[Q1



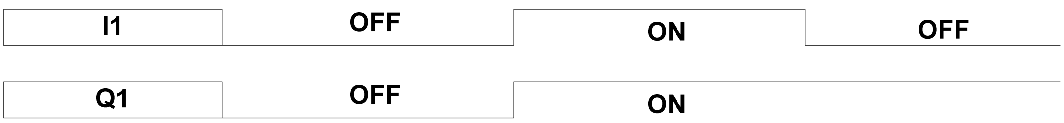
◎ NORMAL(-[ ) output

I1──[Q1



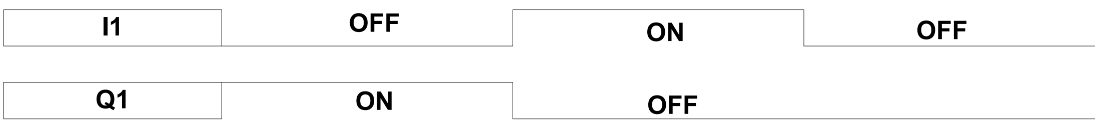
◎ SET（ ）output

I1── Q1



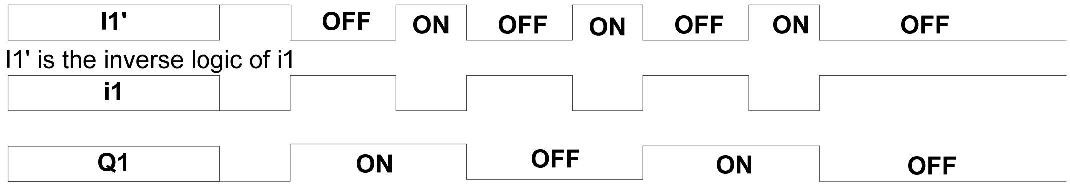
◎ RESET（ ）output

I1── Q1



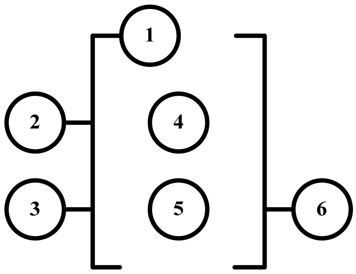
◎ P output

i1──PQ1



4.5.3 Application Functions

1: Counter Function



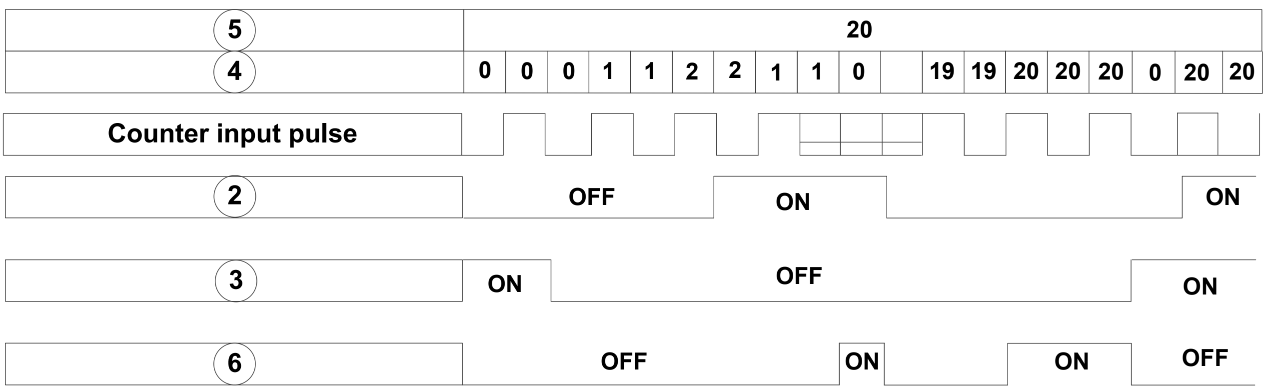
Symbol	Description
①	Counter mode (1 ~ 4)
②	UP/Down counting modes can be set by (I1 ~ f8).
	OFF: Count up (0, 1, 2, 3…)
	ON: Count down (…3,2,1,0)
③	Use (I1~f8) to reset counting value
	ON: Internal count value is reset and counter output ⑥ is OFF
	OFF: Internal counter value retained
④	Internal counter value
⑤	Counter compare value (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8,constant)
⑥	Counter output (C1 to C8, there are a total of 8 counters)

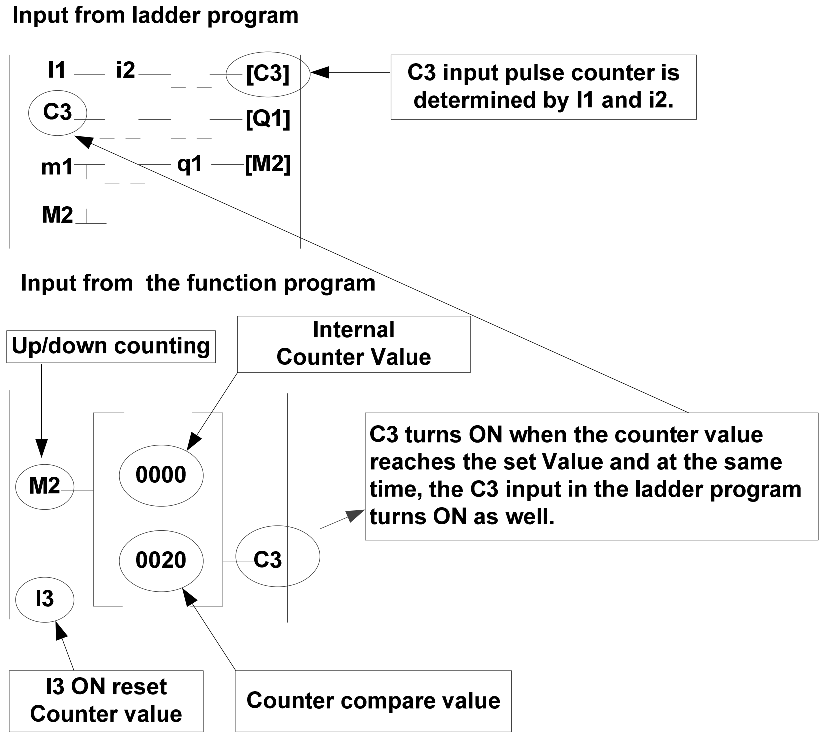
Counter modes:

Mode 1: Counter value is locked to the set value. The value will not be retained when the power is cut off.
Mode 2: Counter value is not locked. The value will not be retained when the power is cut off.
Mode 3: Counter value is locked. The value will be retained when the power is cut off.
Mode 4: Counter value is not locked. The value will be retained when the power is cut off.

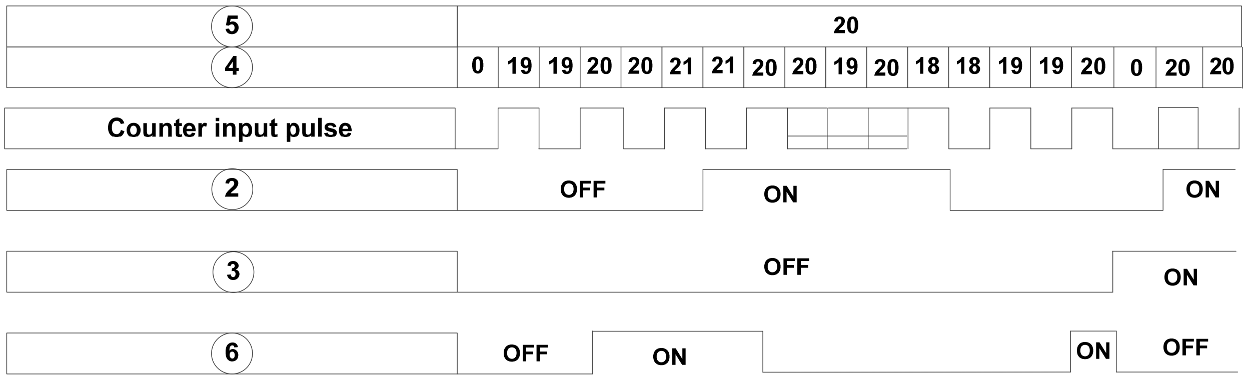
Counter mode 1

Example:





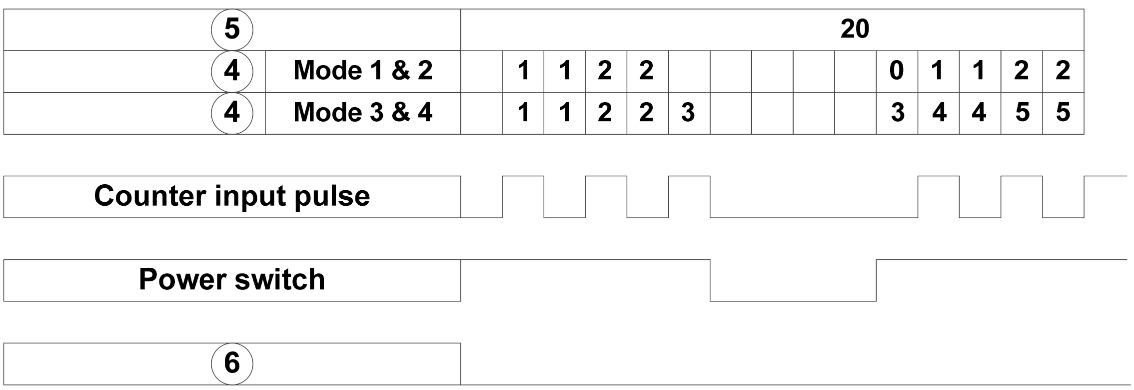
Counter mode 2



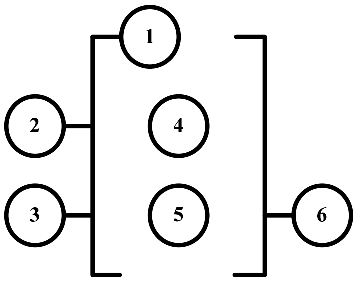
Note: In this mode the internal counter may increase past the counter compare value, unlike mode 1 where the internal counter value is limited to the counter compare value.

(1) Counter mode 3 is similar to the counter mode 1, with the exception that the counter value is saved when the drive is powered down and reloaded at power up.

(2) Counter mode 4 is similar to the counter mode 2, with the exception that the counter value is saved when the drive is powered down and reloaded at power up.



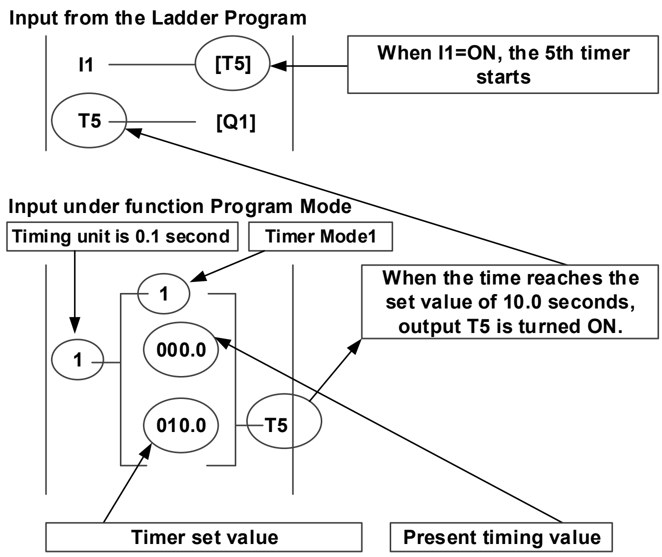
2: Timer Function



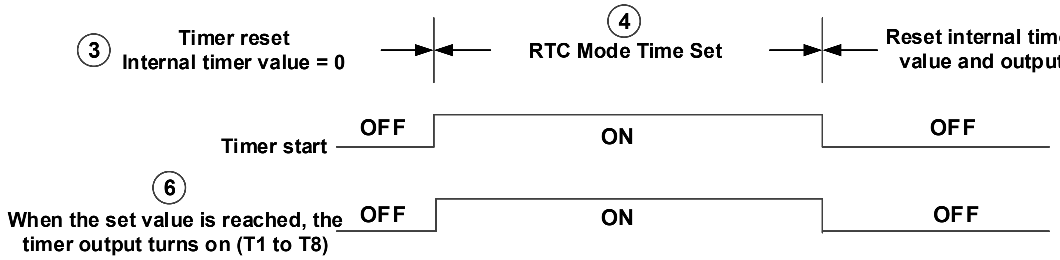
Symbol	Description
①	Timer mode (0-7)
②	Timing unit: 1:0.0~999.9 second
	2:0~9999 second
	3:0~9999 minute
③	Use (I1~f8) to reset timing value
	ON: Internal timing value is reset and timer output ⑥ is OFF
	OFF: Internal timer stays running
④	Internal timer value
⑤	Timer set value (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8,constant)
⑥	Timer output (T1 to T8, there are a total of 8 timers)

Timer mode description：

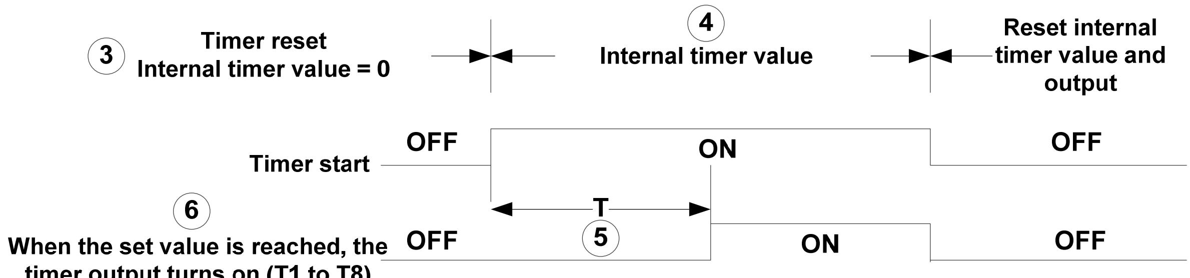
Example:



(1) Timer mode description 0 (ON-RTC Mode)

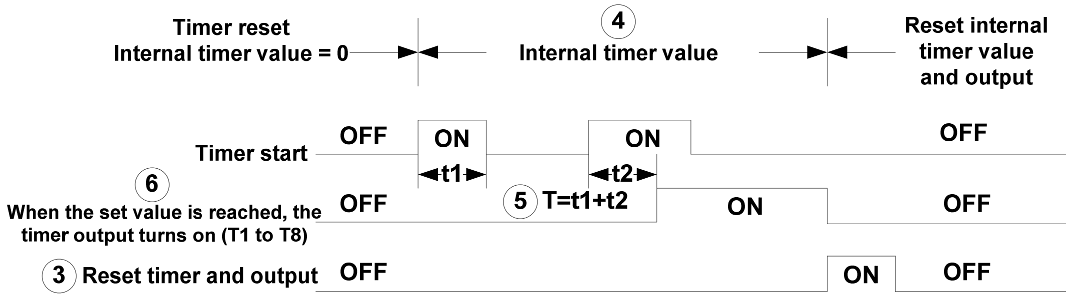


(2) Timer mode 1 (ON-delay Timer mode 1)



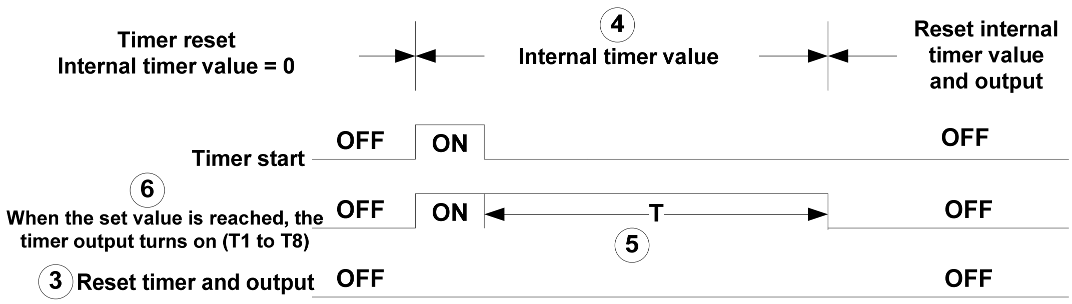
T= timer set value

(3) Timer mode 2 (ON-delay Timer mode 2)

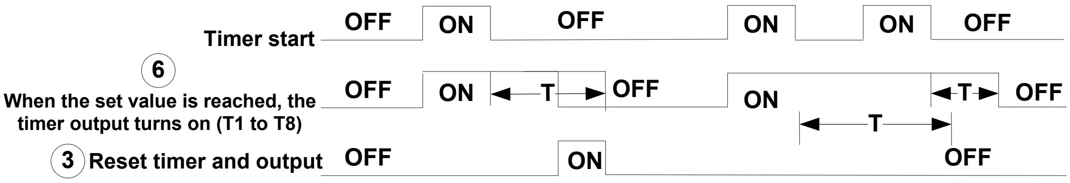


T= timer set value

(4) Timer mode 3 (OFF-delay Timer mode 1)

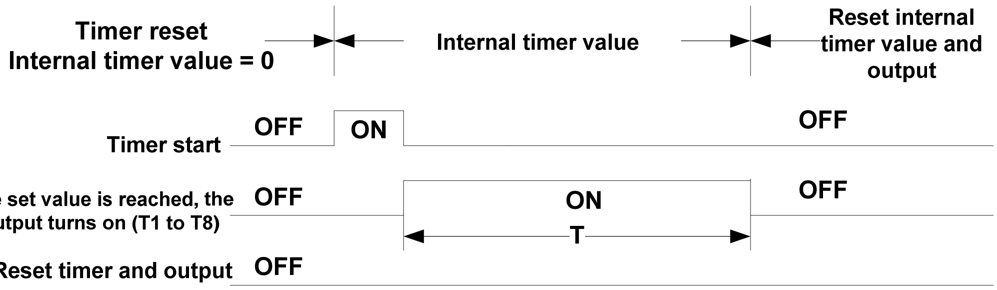


T= timer set value



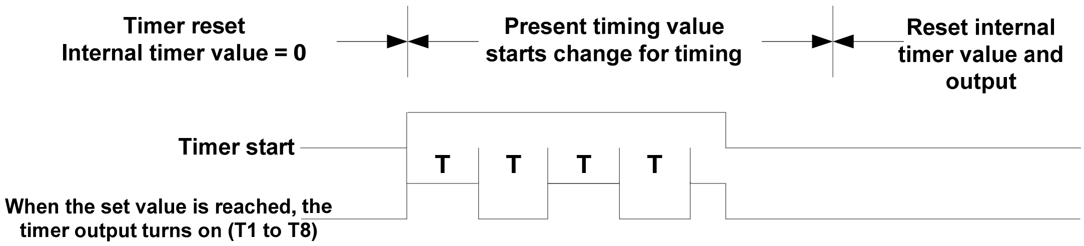
T= timer set value

(5) Timer mode 4 (OFF-delay Timer mode 2)



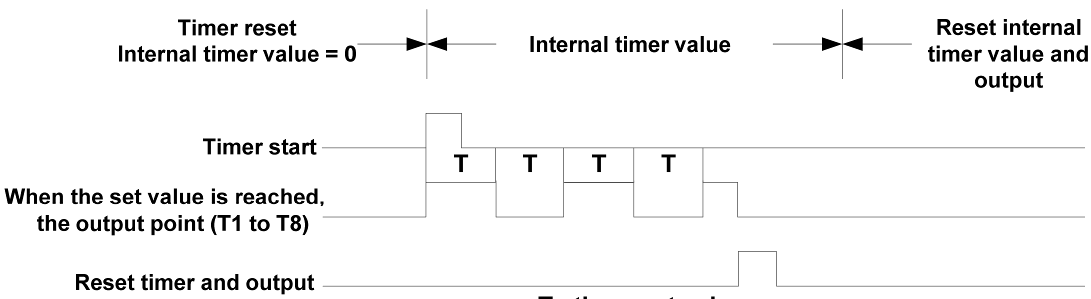
T= timer set value

(6) Timer mode 5 (FLASH Timer mode 1)



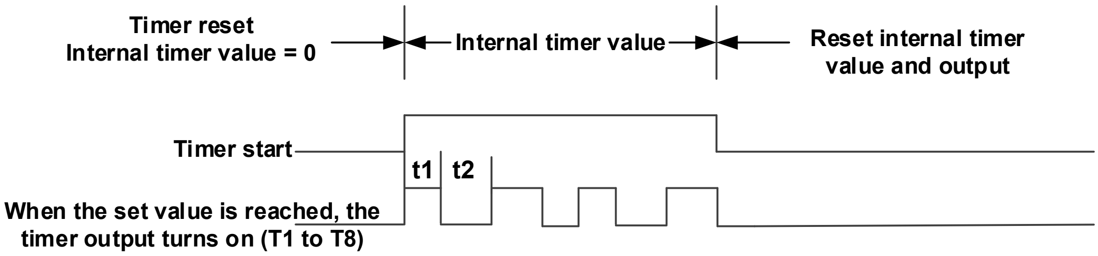
T= timer set value

(7) Timer mode 6 (FLASH Timer mode 2)



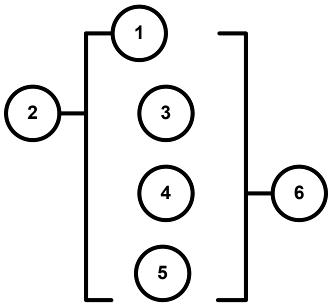
T= timer set value

(8) Timer mode 7 (FLASH Timer mode 3)



t1= 1st timer set value
t2= 2nd timer set value

3: Analog comparator function



Symbol	Description
①	Analog comparator mode (1~3)
②	Input comparison value selection (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8)
③	Current analog input value
④	Set the reference comparison value (Upper limit) (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
⑤	Set the reference comparison value (lower limit) (AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
⑥	Comparator output (G1 to G8, there are a total of 8 comparators)

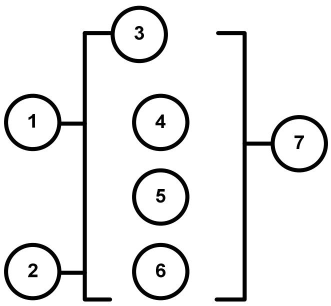
The description of analog comparison mode:

(1) Analog comparison mode 1 (③ ≤ ⑤, ⑥ ON)
(2) Analog comparison mode 2 (③ ≥ ④, ⑥ ON)
(3) Analog comparison mode 3 (⑤ ≤ ③ ≤ ④, ⑥ ON)

Input comparison value selection (V1~V7)

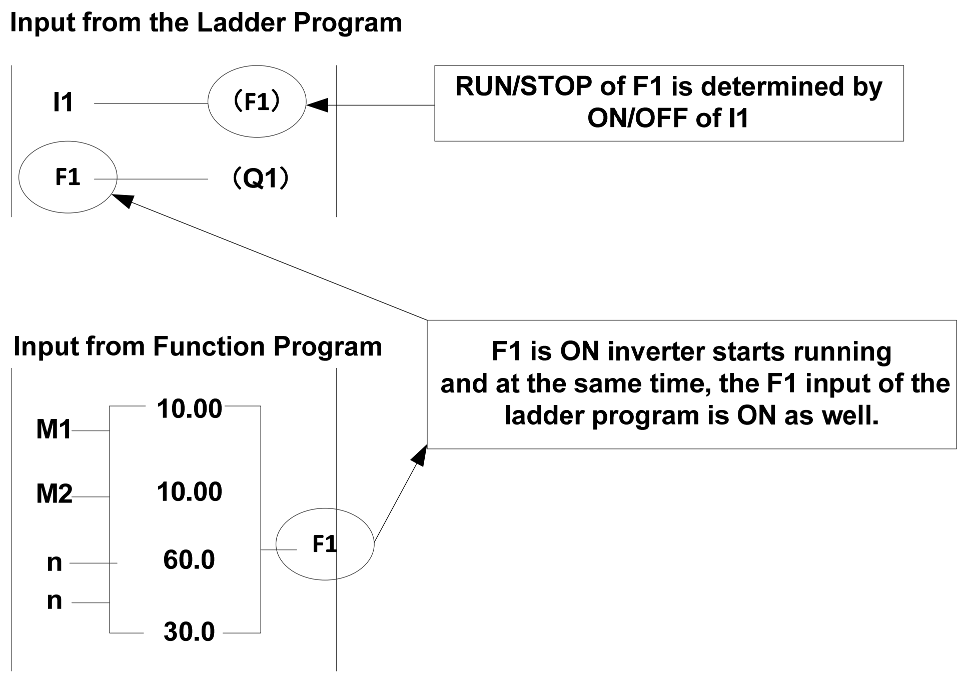
(1) Input comparison value selection = V1: Set frequency
(2) Input comparison value selection = V2: Operation frequency
(3) Input comparison value selection = V3: AI1 input value
(4) Input comparison value selection = V4: AI2 input value
(5) Input comparison value selection = V5: Keypad input value
(6) Input comparison value selection = V6: Operation current
(7) Input comparison value selection = V7: Torque value
(8) Input comparison value selection = V8: PID Target Value

4: Operation control function

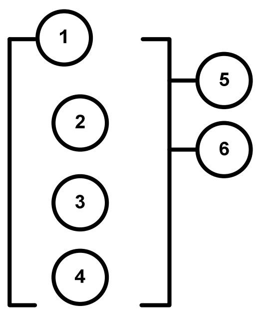


Symbol	Description
①	Forward /Reversal control can be set by (I1~f8) OFF: Forward(FWD) ON: Reversal(REV)
②	Speed terminal control can be set by (I1~f8)
	OFF: Operation based on ③ set frequency
	ON: Operation based on frequency of speed ④
③	Set frequency (can be constant or V3, V4, V5, V8)
④	Speed frequency (can be constant or V3, V4, V5, V8)
⑤	Acceleration time (ACC Time)
⑥	Deceleration time (DEC Time)
⑦	Operation command output (F1 to F8, there are a total of 8 operation control functions)

Example:



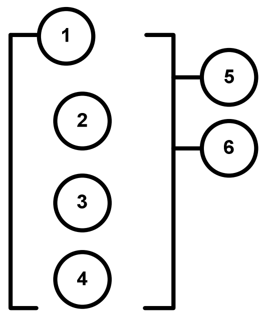
5: Summation and subtraction functions



RESULT (calculation result) = V1+ V2- V3

Symbol	Description
①	Calculation result : RESULT
②	Addend V1(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
③	Addend V2(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
④	Subtrahend V3(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
⑤	Coil output of error signal (M1~MF)
⑥	Addition and subtraction modes number (AS1~AS4)

6：Multiplication and division modes



RESULT（calculation result）=V1*V2/V3

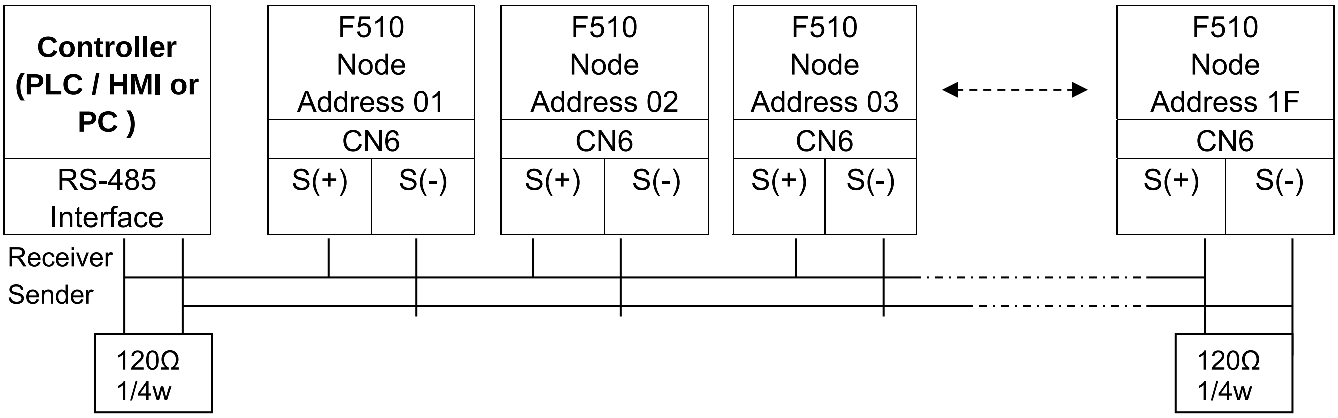
Symbol	Description
①	Calculation result : RESULT
②	Multiplier V1(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
③	Multiplier V2(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
④	Divisor V3(AS1~AS4,MD1~MD4,T1~T8,C1~C8,V1~V8, constant)
⑤	Coil output of error signal（M1~MF）
⑥	Multiplication and division modes number (MD1~ MD4)

4.6 Modbus Protocol Descriptions

4.6.1 Communication Connection and Data Frame

The inverter can communicate with a PC or PLC via RS485 or RS232 using the Modbus RTU or Modbus ACSII protocol. The maximum frame length is 80 bytes.

- **Network Connection**

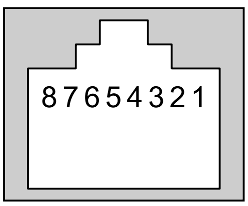


**When several inverters are connected togerher by Modbus, please turn on the terminal resistor switch on the end inverter.
**The distance of communication line with above 200m should have terminal resistors, which ought to be placed at both ends, so as to eliminate reflection phenomenon.

Inverter Model	Terminal resistor switch
220V 1HP~50HP	SW5
440V 1HP~75HP	
220V 60HP~175HP	SW4 (Standard H & C) SW5 (Enhanced E & G)
440V 100HP~800HP	

■ Use S (+) and S (-) terminals (only for RS-485) or CN6 connector to connect.

◆ CN6 Connector:



Pin	Signal	Pin	Signal
1	RS-485 S+ signal	5	Tx signal
2	RS-485 S- signal	6	RS-485 S- signal
3	RS-485 S+ signal	7	VCC of isolated 5V power supply
4	Rx signal	8	GND of isolated 5V power supply

◆ For RS-485 communication, use pin 1 or pin 3 for S (+) and pin 2 or pin 6 for S (-).

• Data Format Frame

■ Data Frame for ASCII Mode

STX(3AH)	Start Bit = 3AH
Address Hi	Communication Address (Station):
Address Lo	2-digit ASCII Code
Function Hi	Function Code (command):
Function Lo	2-digit ASCII Code
Command Start Address	Command Start Byte: 4-digit ASCII Code
Command Start Address	
Command Start Address	
Command Start Address	
Data length	The length of the command: 4-digit ASCII Code
Data length	
Data length	
Data length	
LRC Check Hi	LRC Check Code:
LRC Check Lo	2-digit ASCII Code
END Hi	End Bit:
END Lo	END Hi = CR(0DH) , END Li = LF(0AH)

■ Data Frame for RTU Mode

Master (PLC etc.) sends request to follower (inverter), and the follower sends a response to the master (PC, PLC). The data received is illustrated here.
The data length varies depending on the command (Function).

Node Address
Function Code
DATA
CRC CHECK
Signal Interval

** The inverter response time is 10ms.

• Node Address

00H: Broadcast to all the drivers
01H: to the No. 01 inverter
0FH: to the No.15 inverter
10H: to the No.16 inverter and so on...., max to No. 254 (FEH)

• Function Code

03H: Read the register contents
06H: Write a WORD to register
08H: Loop test
10H: Write several data to register (complex number register write)

• Checksum Calculation

■ LRC

```
 ex. NODE ADDRESS          01H
     FUNCTION              03H
     COMMAND               01H
                           00H
+    DATA LENGTH           0AH
----------------------------------------
                           0FH------------2's complement
   Checksum     =          F1H
     CS(H)      =          46H (ASCII)
     CS(L)      =          31H (ASCII)
```

■ CRC

CRC Check: CRC code covers the content from Slave address to DATA. Please calculate it according to the following methods.

(1) Load a 16-bit register with FFFF hex (all1's). Call this CRC register.
(2) Exclusive OR the first 8-bit byte of the message, the low-order byte of the 16-bit CRC register, putting the result in the CRC register.
(3) Shift the CRC register one bit to the right (toward the LSB), Zero-filling the MSB, Extract and examines the LSB.
(4) (If the LSB was 0): Repeat Steps (3) (another shift)
(If the LSB was 1): Exclusive OR the CRC register with the polynomial value A001 hex (1010 0000 0000 0001), putting the result in CRC register.
(5) Repeat Steps (3) and (4) until 8 shifts been performed. When this is done, a complete 8-bit byte will be processed.
(6) Repeat Steps (2) through (5) for next 8-bit byte of the message, Continue doing this until all bytes have been processed. The final content in the CRC register is the CRC value. When sending the CRC value, the Low-order byte should be sent firstly, then the High-order byte. For example, CRC value: 1241 Hex, the high-order byte should be set to 41hex and low-order byte 12hex.

• CRC Calculate Program (C language)

```c
UWORD ch_sum (UBYTE long , UBYTE *rxdbuff ) {
        BYTE i = 0;
        UWORD wkg = 0xFFFF;
        while ( long-- ) {
        wkg ^= rxdbuff++;
           for ( i = 0 ; i < 8; i++ ) {
              if ( wkg & 0x0001 ) {
                 wkg = ( wkg >> 1 ) ^ 0xa001;
              }
              else {
                 wkg = wkg >> 1;
              }
          }
      }
    return( wkg );
}
```

- **Exception Code**

ASCII Mode	
STX	‘:’
Address	‘0’
	‘1’
Function	‘8’
	‘6’
Exception code	‘5’
	‘1’
LRC Check	‘2’
	‘8’
END	‘CR’
	‘LF’

RTU Mode		
SLAVE Address		02H
Function		83H
Exception code		52H
CRC-16	High	C0H
	Low	CDH

During a communication error, the inverter will respond with an Exception Code and send a message back to the main system consisting of a Function Code that is “ANDED (and 80h)” with 80 Hex.

Exception Code	Content
01	Function code error
02	Register number error
03	Number error
04	DATA setting error

4.6.2 Register and Data Format

- **Command Data (Read / Write)**

Register No.		Bit	Content		
2500H	Reserved				
2501H	Operation Signal	0	Operation Command	1 : Run	0 : Stop
		1	Reverse Command	1 : Reverse	0 : Forward
		2	External Fault	1 : Fault	
		3	Fault Reset	1 : Reset	
		4	Reserved		
		5	Reserved		
		6	Multi-function Comm S1	1 :“ON”	
		7	Multi-function Comm S2	1 :“ON”	
		8	Multi-function Comm S3	1 :“ON”	
		9	Multi-function Comm S4	1 :“ON”	
		A	Multi-function Comm S5	1 :“ON”	
		B	Multi-function Comm S6	1 :“ON”	
		C	Reserved		
		D	Reserved		
		E	Controller Mode	1 : “ON”	
		F	Reserved		
2502H			Frequency Command (Unit: 0.01Hz)		
2503H			Reserved		
2504H			Speed Limit (+/- 120 correspond to +/-120%)		
2505H			AO1 (0 ~ 1000): Voltage (0.00V ~ 10.00V); Current (4mA~20mA)		
2506H			AO2 (0 ~ 1000): Voltage (0.00~10.00V); Current (4mA~20mA)		
2507H			DO		
2508H			Reserved		
2509H			Reserved		
250AH			Reserved		
250BH			Reserved		
250CH			Reserved		
250DH			Reserved		
250EH			Reserved		
250FH			Reserved		
2510H			G12-00 H-WORD		
2511H			G12-00 L-WORD		

Note: Write a zero into the register for not used bit; do not write data to a reserved register.

• **Monitor Data (Read only)**

Register No.		Bit	Content		
2520H	State Signal	0	Operation	1 : Run	0 : Stop
		1	Direction	1 : Reverse	0 : Forward
		2	Inverter ready	1 : Ready	0 : Unready
		3	Fault	1 : Abnormal	
		4	Warning	1 :“ON”	
		5	Zero Speed	1 :“ON”	
		6	Ls 440	1 :“ON”	
		7	Frequency Agree	1 :“ON”	
		8	Set Frequency Agree	1 :“ON”	
		9	Frequency Detection 1	1 :“ON”	
		A	Frequency Detection 2	1 :“ON”	
		B	Under Voltage	1 :“ON”	
		C	Baseblock	1 :“ON”	
		D	Freq Ref. not from Comm.	1 :“ON”	
		E	Seq. not from Comm.	1 :“ON”	
		F	Over Torque	1 :“ON”	

Register No.		Bit	Content	Bit	Content
2521H	Error Description	0	Reserved	31	Reserved
		1	UV	32	Reserved
		2	OC	33	Reserved
		3	OV	34	Reserved
		4	OH1	35	Reserved
		5	OL1	36	Low Suction Fault
		6	OL2	37	Low Suction Fault (with retry)
		7	OT	38	CF07
		8	UT	39	LOPBT(Low Flow Fault)
		9	SC	40	HIPBT(High Flow Fault)
		10	GF(Ground Fault)	41	Reserved
		11	FU(Fuse Broken)	42	LPBFT(Low Pressure Fault)
		12	IPL(Input Phase Loss)	43	OPBFT(High Pressure Fault)
		13	OPL(Output Phase Loss)	44	FBLSS(PID Feedback Loss)
		14	Reserved	45	Reserved
		15	Reserved	46	Motor Overheat (OH4)
		16	Reserved	47	SS1
		17	EF1(External terminal S1 Fault)	48	CF20
		18	EF2(External terminal S2 Fault)	49	Reserved
		19	EF3(External terminal S3 Fault)	50	OCA(Overcurrent in acceleration)
		20	EF4(External terminal S4 Fault)	51	OCD(Overcurrent in deceleration)
		21	EF5(External terminal S5 Fault)	52	OCC(Overcurrent in constant speed)
		22	EF6(External terminal S6 Fault)	53	Reserved
		23	Reserved	54	PTCLS (PTC signal loss)
		24	Reserved	55	PF (Protection Fault)
		25	FB(PID Feedback Fault)	56	TOL (External Overload)
		26	Keypad Removed	57	STO2
		27	Reserved	58	Reserved

<table>
<tr><th>Register No.</th><th></th><th></th><th>Bit</th><th colspan="7">Content</th></tr>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td>28</td><td colspan="3">CE</td><td>59</td><td colspan="3">Reserved</td></tr>
<tr><td>29</td><td colspan="3">STO</td><td>60</td><td colspan="3">Reserved</td></tr>
<tr><td>30</td><td colspan="3">Reserved</td><td>61</td><td colspan="3">Reserved</td></tr>
<tr><td rowspan="16">2522H</td><td rowspan="16"></td><td rowspan="16">DI State</td><td>0</td><td colspan="7">Multi-function Comm S1</td></tr>
<tr><td>1</td><td colspan="7">Multi-function Comm S2</td></tr>
<tr><td>2</td><td colspan="7">Multi-function Comm S3</td></tr>
<tr><td>3</td><td colspan="7">Multi-function Comm S4</td></tr>
<tr><td>4</td><td colspan="7">Multi-function Comm S5</td></tr>
<tr><td>5</td><td colspan="7">Multi-function Comm S6</td></tr>
<tr><td>6</td><td colspan="7">Reserved</td></tr>
<tr><td>7</td><td colspan="7">Reserved</td></tr>
<tr><td>8</td><td colspan="7">Reserved</td></tr>
<tr><td>9</td><td colspan="7">Reserved</td></tr>
<tr><td>A</td><td colspan="7">Reserved</td></tr>
<tr><td>B</td><td colspan="7">Reserved</td></tr>
<tr><td>C</td><td colspan="7">Reserved</td></tr>
<tr><td>D</td><td colspan="7">Reserved</td></tr>
<tr><td>E</td><td colspan="7">Reserved</td></tr>
<tr><td>F</td><td colspan="7">Reserved</td></tr>
<tr><td>2523H</td><td></td><td></td><td colspan="8">Frequency Command (0.01Hz)</td></tr>
<tr><td>2524H</td><td></td><td></td><td colspan="8">Output Frequency (0.01Hz)</td></tr>
<tr><td>2525H</td><td></td><td></td><td colspan="8">Reserved</td></tr>
<tr><td>2526H</td><td></td><td></td><td colspan="8">DC Voltage Command (0.1V)</td></tr>
<tr><td>2527H</td><td></td><td></td><td colspan="8">Output Current (0.1A)</td></tr>
<tr><td rowspan="20">2528H</td><td rowspan="20"></td><td rowspan="20">Warning Description</td><td>0</td><td>No alarm</td><td>20</td><td>EF4</td><td>40</td><td>EF</td><td>60</td><td>LOPb</td></tr>
<tr><td>1</td><td>OV</td><td>21</td><td>EF5</td><td>41</td><td>Reserved</td><td>61</td><td>RETRY</td></tr>
<tr><td>2</td><td>UV</td><td>22</td><td>EF6</td><td>42</td><td>Reserved</td><td>62</td><td>Reserved</td></tr>
<tr><td>3</td><td>OL2</td><td>23</td><td>Reserved</td><td>43</td><td>RDP</td><td>63</td><td>Reserved</td></tr>
<tr><td>4</td><td>OH2</td><td>24</td><td>Reserved</td><td>44</td><td>Reserved</td><td>64</td><td>HIPb</td></tr>
<tr><td>5</td><td>Reserved</td><td>25</td><td>Reserved</td><td>45</td><td>OL1</td><td>65</td><td>OH1</td></tr>
<tr><td>6</td><td>OT</td><td>26</td><td>CLB</td><td>46</td><td>HP_ER</td><td>66</td><td>FIRE</td></tr>
<tr><td>7</td><td>Reserved</td><td>27</td><td>Reserved</td><td>47</td><td>SE10</td><td>67</td><td>ES</td></tr>
<tr><td>8</td><td>Reserved</td><td>28</td><td>CT</td><td>48</td><td>COPUP</td><td>68</td><td>STP1</td></tr>
<tr><td>9</td><td>UT</td><td>29</td><td>USP</td><td>49</td><td>BB1</td><td>69</td><td>BDERR</td></tr>
<tr><td>10</td><td>Reserved</td><td>30</td><td>RDE</td><td>50</td><td>BB2</td><td>70</td><td>EPERR</td></tr>
<tr><td>11</td><td>Reserved</td><td>31</td><td>WRE</td><td>51</td><td>BB3</td><td>71</td><td>ADCER</td></tr>
<tr><td>12</td><td>Reserved</td><td>32</td><td>FB</td><td>52</td><td>BB4</td><td>72</td><td>OL4</td></tr>
<tr><td>13</td><td>CE</td><td>33</td><td>VRYE</td><td>53</td><td>BB5</td><td>73</td><td>STP0</td></tr>
<tr><td>14</td><td>CALL</td><td>34</td><td>SE01</td><td>54</td><td>BB6</td><td>74</td><td>Reserved</td></tr>
<tr><td>15</td><td>Reserved</td><td>35</td><td>SE02</td><td>55</td><td>Reserved</td><td>75</td><td>STP2</td></tr>
<tr><td>16</td><td>EF0</td><td>36</td><td>SE03</td><td>56</td><td>Reserved</td><td>76</td><td>RUNER</td></tr>
<tr><td>17</td><td>EF1</td><td>37</td><td>Reserved</td><td>57</td><td>LOPb</td><td>77</td><td>LOC</td></tr>
<tr><td>18</td><td>EF2</td><td>38</td><td>SE05</td><td>58</td><td>HIPb</td><td>78</td><td>PTCLS</td></tr>
<tr><td>19</td><td>EF3</td><td>39</td><td>HPERR</td><td>59</td><td>LSCFT</td><td>79</td><td>FBLSS</td></tr>
<tr><td>2529H</td><td></td><td></td><td colspan="8">DO State</td></tr>
<tr><td>252AH</td><td></td><td></td><td colspan="8">AO1 (0 ~ 1000): Voltage (0.00V ~ 10.00V); Current (4mA~20mA)</td></tr>
<tr><td>252BH</td><td></td><td></td><td colspan="8">AO2 (0 ~ 1000): Voltage (0.00~10.00V); Current (4mA~20mA)</td></tr>
<tr><td>252CH</td><td></td><td></td><td colspan="8">Analog Input 1 (0.1%)</td></tr>
<tr><td>252DH</td><td></td><td></td><td colspan="8">Analog Input 2 (0.1%)</td></tr>
<tr><td>252EH</td><td></td><td></td><td colspan="8">Reserved</td></tr>
</table>

Register No.	Bit	Content
252FH		F510/A510/L510/E510 Check
2532H		Relay card status display

Note: Do not write data to a reserved register.

• Read Holding Register [03H]

Read consecutive holding registers. The address of the first holding register is specified in the protocol.

Example: Read frequency command from the inverter with node address 1.

■ ASCII Mode

Command message

3AH	STX
30H	Node Address
31H	
30H	Function Code
33H	
30H	Starting Register
43H	
31H	
30H	
30H	Number of Registers
30H	
30H	
31H	
44H	LRC CHECK
46H	
0DH	END
0AH	

Response Message (Normal)

3AH	STX
30H	Node Address
31H	
30H	Function Code
33H	
30H	DATA Length
32H	
31H	Data
37H	
37H	
30H	
37H	LRC CHECK
33H	
0DH	END
0AH	

Response Message (Error)

3AH	STX
30H	Node Address
31H	
38H	Function Code
33H	
30H	Exception Code
34H	
34H	LRC CHECK
30H	
0DH	END
0AH	

+

■ RTU Mode

Command Message

Node Address		01 H
Function Code		03H
Starting Register	High	0CH
	Low	10H
Number of Registers	High	00H
	Low	01H
CRC-16	High	86H
	Low	9FH

Response Message (Normal)

Node Address		01H
Function Code		03H
DATA Length		02H
Data	High	17H
	Low	70H
CRC-16	High	B6H
	Low	50H

Response Message (Error)

Node Address		01H
Function Code		83H
Exception Code		04H
CRC-16	High	40H
	Low	F3H

• Loop Back Test [08H]

Check the communication between the master and the follower (inverter). The data used can be arbitrary.

■ ASCII Mode

Command Message

3AH	STX
30H	Node Address
31H	
30H	Function Code
38H	
30H	Test Code
30H	
30H	
30H	
41H	DATA
35H	
33H	
37H	
31H	LRC CHECK
42H	
0DH	END
0AH	

Response Message (Normal)

3AH	STX
30H	Node Address
31H	
30H	Function Code
38H	
30H	Test Code
30H	
30H	
30H	
41H	DATA
35H	
33H	
37H	
31H	LRC CHECK
42H	
0DH	END
0AH	

Response Message (Error)

3AH	STX
30H	Node Address
31H	
38H	Function Code
38H	
30H	Exception Code
33H	
30H	LRC CHECK
36H	
0DH	END
0AH	

■ RTU Mode

Command Message

Node Address		01 H
Function Code		08H
Test Code	High	00H
	Low	00H
DATA	High	A5H
	Low	37H
CRC-16	High	DAH
	Low	8DH

Response Message (Normal)

Node Address		01H
Function Code		08H
Test Code	High	00H
	Low	00H
DATA	High	A5H
	Low	37H
CRC-16	High	DAH
	Low	8DH

Response Message (Error)

Node Address		01H
Function Code		88H
Exception Code		03H
CRC-16	High	06H
	Low	01H

• Write Single Holding Register [06H]

Write single holding register. The register address of the holding register is specified in the message.
Example: Write a 60.00Hz frequency command to node address 1.

■ ASCII Mode

Command Message

3AH	STX
30H	Node Address
31H	
30H	Function Code
36H	
32H	Starting Register
35H	
30H	
32H	
31H	DATA
37H	
37H	
30H	
34H	LRC CHECK
42H	
0DH	END
0AH	

Response Message (Normal)

3AH	STX
30H	Node Address
31H	
30H	Function Code
36H	
32H	Starting Register
35H	
30H	
32H	
31H	DATA
37H	
37H	
30H	
34H	LRC CHECK
42H	
0DH	END
0AH	

Response Message (Error)

3AH	STX
30H	Node Address
31H	
38H	Function Code
36H	
30H	Exception Code
33H	
30H	LRC CHECK
32H	
0DH	END
0AH	

■ RTU Mode

Command Message

Node Address		01 H
Function Code		06H
Starting Register	High	25H
	Low	02H
DATA	High	17H
	Low	70H
CRC-16	High	2DH
	Low	12H

Response Message (Normal)

Node Address		01H
Function Code		06H
Starting Register	High	25H
	Low	02H
DATA	High	17H
	Low	70H
CRC-16	High	2DH
	Low	12H

Response Message (Error)

Node Address		01H
Function Code		86H
Exception Code		03H
CRC-16	High	02H
	Low	61H

• **Write Multiple Holding Register [10H]**

Write multiple holding registers. The address of the first holding register is specified in the message.
Example: Write a 60.00Hz frequency command to node address 1 and enable FWD run command.

■ **ASCII Mode**

Command Message

3AH	STX
30H	Node Address
31H	
31H	Function Code
30H	
32H	Starting Register
35H	
30H	
31H	
30H	Number of Registers
30H	
30H	
32H	
30H	Number of Bytes *
34H	
30H	DATA 1
30H	
30H	
31H	
31H	DATA 2
37H	
37H	
30H	
33H	LRC CHECK
42H	
0DH	END
0AH	

* Number of bytes is register amount x 2.

Response Message (Normal)

3AH	STX
30H	Node Address
31H	
31H	Function Code
30H	
32H	Starting Register
35H	
30H	
31H	
30H	Number of Registers
30H	
30H	
32H	
43H	LRC CHECK
37H	
0DH	END
0AH	

Response Message (Error)

3AH	STX
30H	Node Address
31H	
39H	Function Code
30H	
30H	Exception Code
33H	
30H	LRC CHECK
43H	
0DH	END
0AH	

■ RTU Mode

Command Message

Node Address		01H
Function Code		10H
Starting Register	High	25H
	Low	01H
Number of Registers	High	00H
	Low	02H
Number of Bytes *		04H
DATA 1	High	00H
	Low	01H
DATA 2	High	17H
	Low	70H
CRC-16	High	60H
	Low	27H

* Number of bytes is register amount x 2.

Response Message (Normal)

Node Address		01H
Function Code		10H
Starting Register	High	25H
	Low	01H
Number of Registers	High	00H
	Low	02H
CRC-16	High	1BH
	Low	04H

Response Message (Error)

Node Address		01H
Function Code		90H
Exception Code		03H
CRC-16	High	0CH
	Low	01H

- **Parameter Data and Corresponding Register No.**

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 0		Group 0		Group 1	
0 – 00	0000H	0 – 45	002DH	1 – 00	0100H
0 – 01	0001H	0 – 46	002EH	1 – 01	0101H
0 – 02	0002H	0 – 47	002FH	1 – 02	0102H
0 – 03	0003H	0 – 48	0030H	1 – 03	0103H
0 – 04	0004H	0 – 49	0031H	1 – 04	0104H
0 – 05	0005H	0 – 50	0032H	1 – 05	0105H
0 – 06	0006H	0 – 51	0033H	1 – 06	0106H
0 – 07	0007H	0 – 52	0034H	1 – 07	0107H
0 – 08	0008H	0 – 53	0035H	1 – 08	0108H
0 – 09	0009H	0 – 54	0036H	1 – 09	0109H
0 – 10	000AH	0 – 55	0037H	1 – 10	010AH
0 – 11	000BH	0 – 56	0038H	1 – 11	010BH
0 – 12	000CH			1 – 12	010CH
0 – 13	000DH			1 – 13	010DH
0 – 14	000EH			1 – 14	010EH
0 – 15	000FH			1 – 15	010FH
0 – 16	0010H				
0 – 17	0011H				
0 – 18	0012H				
0 – 19	0013H				
0 – 20	0014H				
0 – 21	0015H				
0 – 22	0016H				
0 – 23	0017H				
0 – 24	0018H				
0 – 25	0019H				
0 – 26	001AH				
0 – 27	001BH				
0 – 28	001CH				
0 – 29	001DH				
0 – 30	001EH				
0 – 31	001FH				
0 – 32	0020H				
0 – 33	0021H				
0 – 34	0022H				
0 – 35	0023H				
0 – 36	0024H				
0 – 37	0025H				
0 – 38	0026H				
0 – 39	0027H				
0 – 40	0028H				
0 – 41	0029H				
0 – 42	002AH				
0 – 43	002BH				
0 – 44	002CH				

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 2		Group 3		Group 3	
2 – 00	0200H	3 – 00	0300H	3 – 33	0321H
2 – 01	0201H	3 – 01	0301H	3 – 34	0322H
2 – 02	0202H	3 – 02	0302H	3 – 35	0323H
2 – 03	0203H	3 – 03	0303H	3 – 36	0324H
2 – 04	0204H	3 – 04	0304H	3 – 37	0325H
2 – 05	0205H	3 – 05	0305H	3 – 38	0326H
2 – 06	0206H	3 – 06	0306H	3 – 39	0327H
2 – 07	0207H	3 – 07	0307H	3 – 40	0328H
2 – 08	0208H	3 – 08	0308H	3 – 41	0329H
2 – 09	0209H	3 – 09	0309H	3 – 42	032AH
2 – 10	020AH	3 – 10	030AH	3 – 43	032BH
2 – 11	020BH	3 – 11	030BH	3 – 44	032CH
2 – 12	020CH	3 – 12	030CH	3 – 45	032DH
2 – 13	020DH	3 – 13	030DH	3 – 46	032EH
2 – 14	020EH	3 – 14	030EH	3 – 47	032FH
2 – 15	020FH	3 – 15	030FH	3 – 48	0330H
2 – 16	0210H	3 – 16	0310H	3 – 49	0331H
2 – 17	0211H	3 – 17	0311H	3 – 50	0332H
2 – 18	0212H	3 – 18	0312H	3 – 51	0333H
2 – 19	0213H	3 – 19	0313H	3 – 52	0334H
2 – 33	0221H	3 – 20	0314H	3 – 53	0335H
2 – 34	0222H	3 – 21	0315H		
		3 – 22	0316H		
		3 – 23	0317H		
		3 – 24	0318H		
		3 – 25	0319H		
		3 – 26	031AH		
		3 – 27	031BH		
		3 – 28	031CH		
		3 – 29	031DH		
		3 – 30	031EH		
		3 – 31	031FH		
		3 – 32	0320H		

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 4		Group 5		Group 5	
4 – 00	0400H	5 – 00	0500H	5 – 33	0521H
4 – 01	0401H	5 – 01	0501H	5 – 34	0522H
4 – 02	0402H	5 – 02	0502H	5 – 35	0523H
4 – 03	0403H	5 – 03	0503H	5 – 36	0524H
4 – 04	0404H	5 – 04	0504H	5 – 37	0525H
4 – 05	0405H	5 – 05	0505H	5 – 38	0526H
4 – 06	0406H	5 – 06	0506H	5 – 39	0527H
4 – 07	0407H	5 – 07	0507H	5 – 40	0528H
4 – 08	0408H	5 – 08	0508H	5 – 41	0529H
4 – 09	0409H	5 – 09	0509H	5 – 42	052AH
4 – 10	040AH	5 – 10	050AH	5 – 43	052BH
4 – 11	040BH	5 – 11	050BH	5 – 44	052CH
4 – 12	040CH	5 – 12	050CH	5 – 45	052DH
4 – 13	040DH	5 – 13	050DH	5 – 46	052EH
4 – 14	040EH	5 – 14	050EH	5 – 47	052FH
4 – 15	040FH	5 – 15	050FH	5 – 48	0530H
4 – 16	0410H	5 – 16	0510H		
4 – 17	0411H	5 – 17	0511H		
4 – 18	0412H	5 – 18	0512H		
4 – 19	0413H	5 – 19	0513H		
4 – 20	0414H	5 – 20	0514H		
		5 – 21	0515H		
		5 – 22	0516H		
		5 – 23	0517H		
		5 – 24	0518H		
		5 – 25	0519H		
		5 – 26	051AH		
		5 – 27	051BH		
		5 – 28	051CH		
		5 – 29	051DH		
		5 – 30	051EH		
		5 – 31	051FH		
		5 – 32	0520H		

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 6		Group 6		Group 7	
6 – 00	0600H	6 – 33	0621H	7 – 00	0700H
6 – 01	0601H	6 – 34	0622H	7 – 01	0701H
6 – 02	0602H	6 – 35	0623H	7 – 02	0702H
6 – 03	0603H	6 – 36	0624H	7 – 03	0703H
6 – 04	0604H	6 – 37	0625H	7 – 04	0704H
6 – 05	0605H	6 – 38	0626H	7 – 05	0705H
6 – 06	0606H	6 – 39	0627H	7 – 06	0706H
6 – 07	0607H	6 – 40	0628H	7 – 07	0707H
6 – 08	0608H	6 – 41	0629H	7 – 08	0708H
6 – 09	0609H	6 – 42	062AH	7 – 09	0709H
6 – 10	060AH	6 – 43	062BH	7 – 10	070AH
6 – 11	060BH	6 – 44	062CH	7 – 11	070BH
6 – 12	060CH	6 – 45	062DH	7 – 12	070CH
6 – 13	060DH	6 – 46	062EH	7 – 13	070DH
6 – 14	060EH	6 – 47	062FH	7 – 14	070EH
6 – 15	060FH			7 – 15	070FH
6 – 16	0610H			7 – 16	0710H
6 – 17	0611H			7 – 17	0711H
6 – 18	0612H			7 – 18	0712H
6 – 19	0613H			7 – 19	0713H
6 – 20	0614H			7 – 20	0714H
6 – 21	0615H			7 – 21	0715H
6 – 22	0616H			7 – 22	0716H
6 – 23	0617H			7 – 23	0717H
6 – 24	0618H			7 – 24	0718H
6 – 25	0619H			7 – 25	0719H
6 – 26	061AH			7 – 26	071AH
6 – 27	061BH			7 – 27	071BH
6 – 28	061CH			7 – 28	071CH
6 – 29	061DH			7 – 29	071DH
6 – 30	061EH			7 – 30	071EH
6 – 31	061FH			7 – 31	071FH
6 – 32	0620H			7 – 32	0720H
				7 – 33	0721H
				7 – 34	0722H
				7 – 35	0723H
				7 – 36	0724H
				7 – 37	0725H
				7 – 38	0726H
				7 – 39	0727H
				7 – 40	0728H
				7 – 41	0729H
				7 – 42	072AH
				7 – 43	072BH
				7 – 44	072CH
				7 – 45	072DH

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 8		Group 8		Group 9		Group 10	
8 – 00	0800H	8 – 44	082CH	9 – 00	0900H	10 – 00	0A00H
8 – 01	0801H	8 – 45	082DH	9 – 01	0901H	10 – 01	0A01H
8 – 02	0802H	8 – 46	082EH	9 – 02	0902H	10 – 02	0A02H
8 – 03	0803H	8 – 47	082FH	9 – 03	0903H	10 – 03	0A03H
8 – 04	0804H	8 – 48	0830H	9 – 04	0904H	10 – 04	0A04H
8 – 05	0805H	8 – 49	0831H	9 – 05	0905H	10 – 05	0A05H
8 – 06	0806H	8 – 50	0832H	9 – 06	0906H	10 – 06	0A06H
8 – 07	0807H	8 – 51	0833H	9 – 07	0907H	10 – 07	0A07H
8 – 08	0808H	8 – 52	0834H	9 – 08	0908H	10 – 08	0A08H
8 – 09	0809H	8 – 53	0835H	9 – 09	0909H	10 – 09	0A09H
8 – 10	080AH	8 – 54	0836H	9 – 10	090AH	10 – 10	0A0AH
8 – 11	080BH	8 – 55	0837H			10 – 11	0A0BH
8 – 12	080CH	8 – 56	0838H			10 – 12	0A0CH
8 – 13	080DH	8 – 57	0839H			10 – 13	0A0DH
8 – 14	080EH	8 – 58	083AH			10 – 14	0A0EH
8 – 15	080FH	8 – 59	083BH			10 – 15	0A0FH
8 – 16	0810H	8 – 60	083CH			10 – 16	0A10H
8 – 17	0811H					10 – 17	0A11H
8 – 18	0812H					10 – 18	0A12H
8 – 19	0813H					10 – 19	0A13H
8 – 20	0814H					10 – 20	0A14H
8 – 21	0815H					10 – 21	0A15H
8 – 22	0816H					10 – 22	0A16H
8 – 23	0817H					10 – 23	0A17H
8 – 24	0818H					10 – 24	0A18H
8 – 25	0819H					10 – 25	0A19H
8 – 26	081AH					10 – 26	0A1AH
8 – 27	081BH					10 – 27	0A1BH
8 – 28	081CH					10 – 28	0A1CH
8 – 29	081DH					10 – 29	0A1DH
8 – 30	081EH					10 – 30	0A1EH
8 – 31	081FH					10 – 31	0A1FH
8 – 32	0820H					10 – 32	0A20H
8 – 33	0821H					10 – 33	0A21H
8 – 34	0822H					10 – 34	0A22H
8 – 35	0823H					10 – 35	0A23H
8 – 36	0824H					10 – 36	0A24H
8 – 37	0825H					10 – 37	0A25H
8 – 38	0826H					10 – 38	0A26H
8 – 39	0827H					10 – 39	0A27H
8 – 40	0828H					10 – 40	0A28H
8 – 41	0829H					10 – 41	0A29H
8 – 42	082AH					10 – 42	0A2AH
8 – 43	082BH					10 – 43	0A2BH

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 10		Group 11		Group 11	
10 – 44	0A2CH	11 – 00	0B00H	11 – 44	0B2CH
10 – 45	0A2DH	11 – 01	0B01H	11 – 45	0B2DH
10 – 46	0A2EH	11 – 02	0B02H	11 – 46	0B2EH
10 – 47	0A2FH	11 – 03	0B03H	11 – 47	0B2FH
10 – 48	0A30H	11 – 04	0B04H	11 – 48	0B30H
10 – 49	0A31H	11 – 05	0B05H	11 – 49	0B31H
		11 – 06	0B06H	11 – 50	0B32H
		11 – 07	0B07H	11 – 51	0B33H
		11 – 08	0B08H	11 – 52	0B34H
		11 – 09	0B09H	11 – 53	0B35H
		11 – 10	0B0AH	11 – 54	0B36H
		11 – 11	0B0BH	11 – 55	0B37H
		11 – 12	0B0CH	11 – 56	0B38H
		11 – 13	0B0DH	11 – 57	0B39H
		11 – 14	0B0EH	11 – 58	0B3AH
		11 – 15	0B0FH	11 – 59	0B3BH
		11 – 16	0B10H	11 – 60	0B3CH
		11 – 17	0B11H	11 – 61	0B3DH
		11 – 18	0B12H	11 – 62	0B3EH
		11 – 19	0B13H	11 – 63	0B3FH
		11 – 20	0B14H	11 – 64	0B40H
		11 – 21	0B15H	11 – 65	0B41H
		11 – 22	0B16H	11 – 66	0B42H
		11 – 23	0B17H	11 – 67	0B43H
		11 – 24	0B18H	11 – 68	0B44H
		11 – 25	0B19H	11 – 69	0B45H
		11 – 26	0B1AH	11 – 70	0B46H
		11 – 27	0B1BH	11 – 71	0B47H
		11 – 28	0B1CH	11 – 72	0B48H
		11 – 29	0B1DH	11 – 73	0B49H
		11 – 30	0B1EH		
		11 – 31	0B1FH		
		11 – 32	0B20H		
		11 – 33	0B21H		
		11 – 34	0B22H		
		11 – 35	0B23H		
		11 – 36	0B24H		
		11 – 37	0B25H		
		11 – 38	0B26H		
		11 – 39	0B27H		
		11 – 40	0B28H		
		11 – 41	0B29H		
		11 – 42	0B2AH		
		11 – 43	0B2BH		

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 12		Group 12		Group 12	
12 – 00	0C00H	12 – 41	0C29H	12 – 81	0C51H
12 – 01	0C01H	12 – 42	0C2AH	12 – 82	0C52H
12 – 02	0C02H	12 – 43	0C2BH		
12 – 03	0C03H	12 – 44	0C2CH		
12 – 04	0C04H	12 – 45	0C2DH		
12 – 05	0C05H	12 – 46	0C2EH		
12 – 06	0C06H	12 – 47	0C2FH		
12 – 07	0C07H	12 – 48	0C30H		
12 – 08	0C08H	12 – 49	0C31H		
12 – 09	0C09H	12 – 50	0C32H		
12 – 10	0C0AH	12 – 51	0C33H		
12 – 11	0C0BH	12 – 52	0C34H		
12 – 12	0C0CH	12 – 53	0C35H		
12 – 13	0C0DH	12 – 54	0C36H		
12 – 14	0C0EH	12 – 55	0C37H		
12 – 15	0C0FH	12 – 56	0C38H		
12 – 16	0C10H	12 – 57	0C39H		
12 – 17	0C11H	12 – 58	0C3AH		
12 – 18	0C12H	12 – 59	0C3BH		
12 – 19	0C13H	12 – 60	0C3CH		
12 – 20	0C14H	12 – 61	0C3DH		
12 – 21	0C15H	12 – 62	0C3EH		
12 – 22	0C16H	12 – 63	0C3FH		
12 – 23	0C17H	12 – 64	0C40H		
12 – 24	0C18H	12 – 65	0C41H		
12 – 25	0C19H	12 – 66	0C42H		
12 – 26	0C1AH	12 – 67	0C43H		
12 – 27	0C1BH	12 – 68	0C44H		
12 – 28	0C1CH	12 – 69	0C45H		
12 – 29	0C1DH	12 – 70	0C46H		
12 – 30	0C1EH	12 – 71	0C47H		
12 – 31	0C1FH	12 – 72	0C48H		
12 – 32	0C20H	12 – 73	0C49H		
12 – 33	0C21H	12 – 70	0C46H		
12 – 34	0C22H	12 – 71	0C47H		
12 – 35	0C23H	12 – 72	0C48H		
12– 36	0C24H	12 – 73	0C49H		
12 – 37	0C25H	12 – 74	0C4AH		
12 – 38	0C26H	12 – 75	0C4BH		
12 – 39	0C27H	12 – 76	0C4CH		
12 – 40	0C28H	12 – 77	0C4DH		
		12 – 78	0C4EH		
		12 – 79	0C4FH		
		12 – 80	0C50H		

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 13		Group 13			
13 – 00	0D00H	13 – 48	0D2FH		
13 – 01	0D01H	13 – 49	0D30H		
13 – 02	0D02H	13 – 50	0D31H		
13 – 03	0D03H				
13 – 04	0D04H				
13 – 05	0D05H				
13 – 06	0D06H				
13 – 07	0D07H				
13 – 08	0D08H				
13 – 09	0D09H				
13 – 10	0D0AH				
13 – 11	0D0BH				
13 – 12	0D0CH				
13 – 13	0D0DH				
13 – 14	0D0DH				
13 – 15	0D0EH				
13 – 16	0D0FH				
13 – 17	0D10H				
13 – 18	0D11H				
13 – 19	0D12H				
13 – 20	0D13H				
13 – 21	0D14H				
13 – 22	0D15H				
13 – 23	0D16H				
13 – 24	0D17H				
13 – 25	0D18H				
13 – 26	0D19H				
13 – 27	0D1AH				
13 – 28	0D1BH				
13 – 29	0D1CH				
13 – 30	0D1DH				
13 – 31	0D1EH				
13 – 32	0D1FH				
13 – 33	0D20H				
13 – 34	0D21H				
13 – 35	0D22H				
13 – 36	0D23H				
13 – 37	0D24H				
13 – 38	0D25H				
13 – 39	0D26H				
13 – 40	0D27H				
13 – 41	0D28H				
13 – 42	0D29H				
13 – 43	0D2AH				
13 – 44	0D2BH				
13 – 45	0D2CH				
13 – 46	0D2DH				
13 – 47	0D2EH				

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 14		Group 15		Group 16	
14 – 00	0E00H	15 – 00	0F00H	16 – 00	1000H
14 – 01	0E01H	15 – 01	0F01H	16 – 01	1001H
14 – 02	0E02H	15 – 02	0F02H	16 – 02	1002H
14 – 03	0E03H	15 – 03	0F03H	16 – 03	1003H
14 – 04	0E04H	15 – 04	0F04H	16 – 04	1004H
14 – 05	0E05H	15 – 05	0F05H	16 – 05	1005H
14 – 06	0E06H	15 – 06	0F06H	16 – 06	1006H
14 – 07	0E07H	15 – 07	0F07H	16 – 07	1007H
14 – 08	0E08H	15 – 08	0F08H	16 – 08	1008H
14 – 09	0E09H	15 – 09	0F09H	16 – 09	1009H
14 – 10	0E0AH	15 – 10	0F0AH	16 – 10	100AH
14 – 11	0E0BH	15 – 11	0F0BH	16 – 11	100BH
14 – 12	0E0CH	15 – 12	0F0CH	16 – 12	100CH
14 – 13	0E0DH	15 – 13	0F0DH	16 – 13	100DH
14 – 14	0E0EH	15 – 14	0F0EH	16 – 14	100EH
14 – 15	0E0FH	15 – 15	0F0FH	16 – 15	100FH
14 – 16	0E10H	15 – 16	0F10H	16 – 16	1010H
14 – 17	0E11H	15 – 17	0F11H	16 – 17	1011H
14 – 18	0E12H	15 – 18	0F12H	16 – 18	1012H
14 – 19	0E13H	15 – 19	0F13H	16 – 19	1013H
14 – 20	0E14H	15 – 20	0F14H	16 – 20	1014H
14 – 21	0E15H	15 – 21	0F15H	16 – 21	1015H
14 – 22	0E16H	15 – 22	0F16H	16 – 22	1016H
14 – 23	0E17H	15 – 23	0F17H	16 – 23	1017H
14 – 24	0E18H	15 – 24	0F18H	16 – 24	1018H
14 – 25	0E19H	15 – 25	0F19H	16 – 25	1019H
14 – 26	0E1AH	15 – 26	0F1AH	16 – 26	101AH
14 – 27	0E1BH	15 – 27	0F1BH	16 – 27	101BH
14 – 28	0E1CH	15 – 28	0F1CH	16 – 28	101CH
14 – 29	0E1DH	15 – 29	0F1DH	16 – 29	101DH
14 – 30	0E1EH	15 – 30	0F1EH	16 – 30	101EH
14 – 31	0E1FH	15 – 31	0F1FH	16 – 31	101FH
14 – 32	0E20H	15 – 32	0F20H	16 – 32	1020H
14 – 33	0E21H			16 – 33	1021H
14 – 34	0E22H			16 – 34	1022H
14 – 35	0E23H			16 – 35	1023H
14 – 36	0E24H			16 – 36	1024H
14 – 37	0E25H			16 – 37	1025H
14 – 38	0E26H				
14 – 39	0E27H				
14 – 40	0E28H				
14 – 41	0E29H				
14 – 42	0E2AH				
14 – 43	0E2BH				
14 – 44	0E2CH				
14 – 45	0E2DH				
14 – 46	0E2EH				
14 – 47	0E2FH				

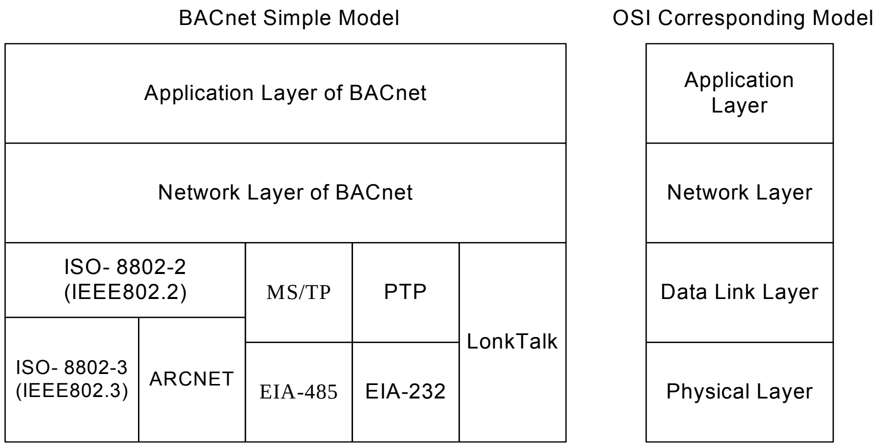
Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 17		Group 18			
17 – 00	1100H	18 – 00	1200H		
17 – 01	1101H	18 – 01	1201H		
17 – 02	1102H	18 – 02	1202H		
17 – 03	1103H	18 – 03	1203H		
17 – 04	1104H	18 – 04	1204H		
17 – 05	1105H	18 – 05	1205H		
17 – 06	1106H	18 – 06	1206H		
17 – 07	1107H				
17 – 08	1108H				
17 – 09	1109H				
17 – 10	110AH				
17 – 11	110BH				
17 – 12	110CH				
17 – 13	110DH				
17 – 14	110EH				

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 20		Group 21		Group 22	
20 – 00	1400H	21 – 00	1500H	22 – 00	1600H
20 – 01	1401H	21 – 01	1501H	22 – 01	1601H
20 – 02	1402H	21 – 02	1502H	22 – 02	1602H
20 – 03	1403H	21 – 03	1503H	22 – 03	1603H
20 – 04	1404H	21 – 04	1504H	22 – 04	1604H
20 – 05	1405H	21 – 05	1505H	22 – 05	1605H
20 – 06	1406H	21 – 06	1506H	22 – 06	1606H
20 – 07	1407H	21 – 07	1507H	22 – 07	1607H
20 – 08	1408H	21 – 08	1508H	22 – 08	1608H
20 – 09	1409H			22 – 09	1609H
20 – 10	140AH			22 – 10	160AH
20 – 11	140BH			22 – 11	160BH
20 – 12	140CH			22 – 12	160CH
20 – 13	140DH			22 – 13	160DH
20 – 14	140EH			22 – 14	160EH
20 – 15	140FH			22 – 15	160FH
20 – 16	1410H			22 – 16	1610H
20 – 17	1411H			22 – 17	1611H
20 – 18	1412H			22 – 18	1612H
20 – 33	1421H			22 – 19	1613H
20 – 34	1422H			22 – 20	1614H
20 – 35	1423H			22 – 21	1615H
				22 – 22	1616H
				22 – 23	1617H
				22 – 24	1618H
				22 – 25	1619H
				22 – 26	161AH
				22 – 27	161BH
				22 – 28	161CH
				22 – 29	161DH
				22 – 30	161EH
				22 – 31	161FH
				22 – 32	1620H
				22 – 33	1621H
				22 – 34	1622H
				22 – 35	1623H

Function Code	Register No.	Function Code	Register No.	Function Code	Register No.
Group 23		Group 23		Group 24	
23 – 00	1700H	23 – 47	172FH	24 – 00	1800H
23 – 01	1701H	23 – 48	1730H	24 – 01	1801H
23 – 02	1702H	23 – 49	1731H	24 – 02	1802H
23 – 03	1703H	23 – 50	1732H	24 – 03	1803H
23 – 04	1704H	23 – 51	1733H	24 – 04	1804H
23 – 05	1705H	23 – 52	1734H	24 – 05	1805H
23 – 06	1706H	23 – 53	1735H	24 – 06	1806H
23 – 07	1707H	23 – 54	1736H	24 – 07	1807H
23 – 08	1708H	23 – 55	1737H	24 – 08	1808H
23 – 09	1709H	23 – 56	1738H	24 – 09	1809H
23 – 10	170AH	23 – 57	1739H	24 – 10	180AH
23 – 11	170BH	23 – 58	173AH	24 – 11	180BH
23 – 12	170CH	23 – 59	173BH	24 – 12	180CH
23 – 13	170DH	23 – 60	173CH	24 – 13	180DH
23 – 14	170EH	23 – 61	173DH	24 – 14	180EH
23 – 15	170FH	23 – 62	173EH	24 – 15	180FH
23 – 16	1710H	23 – 63	173FH	24 – 16	1810H
23 – 17	1711H	23 – 64	1740H	24 – 17	1811H
23 – 18	1712H	23 – 65	1741H		
23 – 19	1713H	23 – 66	1742H		
23 – 20	1714H	23 – 67	1743H		
23 – 21	1715H	23 – 68	1744H		
23 – 22	1716H	23 – 69	1745H		
23 – 23	1717H	23 – 70	1746H		
23 – 24	1718H	23 – 71	1747H		
23 – 25	1719H	23 – 72	1748H		
23 – 26	171AH	23 – 73	1749H		
23 – 27	171BH	23 – 74	174AH		
23 – 28	171CH	23 – 75	174BH		
23 – 29	171DH	23 – 76	174CH		
23 – 30	171EH	23 – 77	174DH		
23 – 31	171FH	23 – 78	174EH		
23 – 32	1720H				
23 – 33	1721H				
23 – 34	1722H				
23 – 35	1723H				
23 – 36	1724H				
23 – 37	1725H				
23 – 38	1726H				
23 – 39	1727H				
23 – 40	1728H				
23 – 41	1729H				
23 – 42	172AH				
23 – 43	172BH				
23 – 44	172CH				
23 – 45	172DH				
23 – 46	172EH				

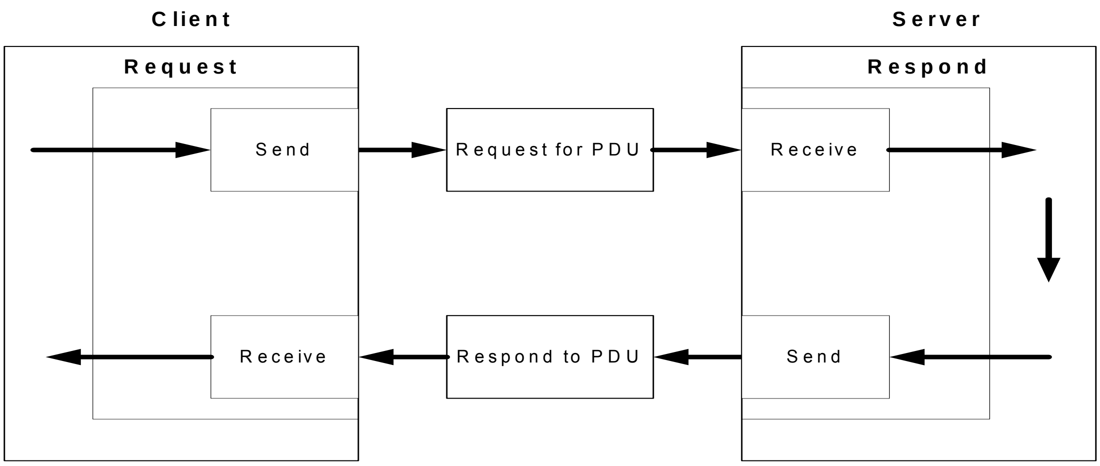
4.7 BACnet Protocol Descriptions

BACnet is in compliance with four-layer of seven-layer structure models in OSI (Open Systems Interconnection) of International Standard Organization (ISO). These four-layer structure models are application layer, network layer, data link layer and physical layer. Besides, BACnet is defined by the view of standard "object" and "property." All BACnet devices are controlled via the property of objects. Every controller with BACnet devices is considered an object collector so that every controller device can execute different kinds of functions of objects to achieve the communication control and monitor control.

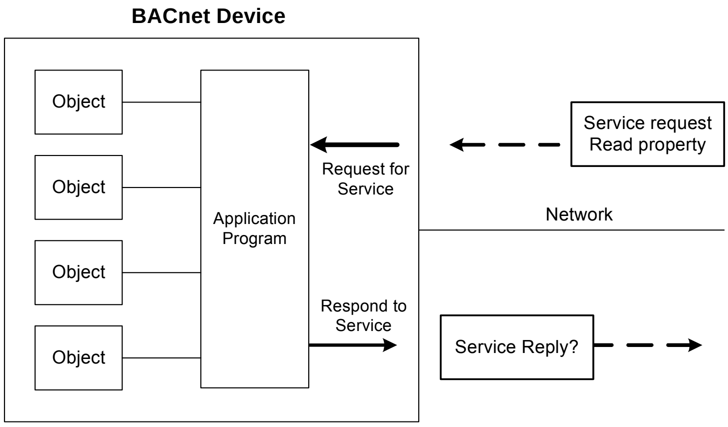


4.7.1 BACnet Services

Services provide some commands to save or control information and some functions to achieve the purpose of monitoring and control. Namely, one BACnet device reveive certain information or command to complete specific work from other BACnet device so the two devices need to support the same service to complete communication. To complete the exchange of these service messages, these communication requirements are specified in the communication protocol of application layer by BACnet. Thus, services are parts of the communication protocol data unit (PDU) in the application layer and build the communication modes via the relationship of Server – Client. Client will send the message of sevice requirements to Server and Server needs to respond to Client to execute this service. Refer to the following fugure.

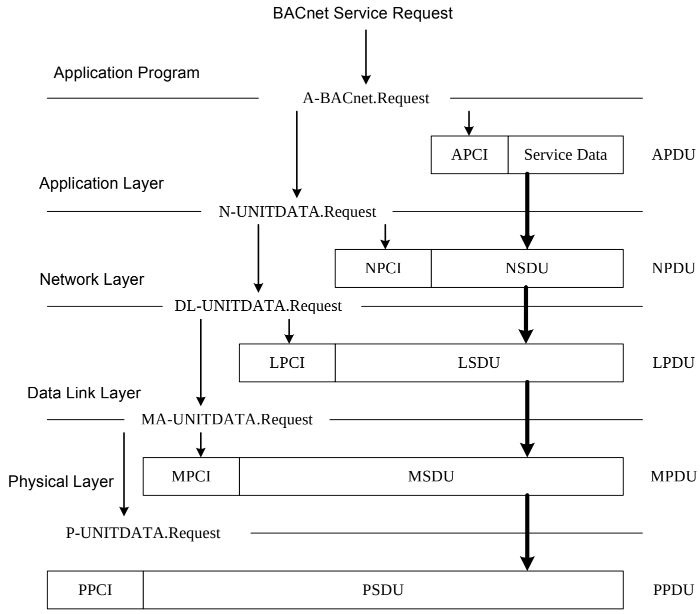


All BACnet devices have the application programs to manage the requirements of device motion and executing services. Take work station for example, the application program needs to keep the display value of every input so it requires sending the service request to the object of other device to update the display value of input. The application program of the device needs to respond to the service requiremtents. Refer to the following fugure.



4.7.2 BACnet Protocol Structure

BACnet is the communication protocol by way of protocol stack so the pocket is composed of stacked layer types. Refer to the following figure.



When application program sends the BACnet service request for the pocket, it requires requesting for executing BACnet request program in the application layer via application program interface. The requirements of the program are sent to the application layer and application protocol data unit (APDU) consists of Application Protocol Control Information (APCI) and Servie Data of application program. Then APDU passes its messages downward to BACnet request program in the network layer. APDU becomes Network Layer Protocol Data Unit (NPDU) composed of Network Service Data Unit (NSDU) and Network Protocol Control Information (NPCI). And so forth for the data link layer and physical layer to complete the full service for the packet.

4.7.3 BACnet Specifications

Inverter F510 model is built-in standard BACnet MS/TP communication protocol structure to meet the demand of automatic communication equipment. Control or monitor F510 via BACnet to be allowable to read and modify specific parameter. F510 includes the following supports of standard objects:

- **Inverter Objects**
- **Analog Input**
- **Analog Output**
- **Analog Value**
- **Digital Input**
- **Digital Output**
- **Digital Value**

Refer to Table 4.7.3.1 for F510 supporting the property information of object classification. User can collect related properties of objects required via the dedicated communication software of BACnet to give control or monitor command for each object.

Table 4.7.3.1 Object and property supporting list

Proerty	Inverter (DEV)	Analog Input (AI)	Analog Output (AO)	Analog Value (AV)	Digital Input (BI)	Digital Output (BO)	Digital Value (BV)
Object_Identifier	V	V	V	V	V	V	V
Object_Name	V	V	V	V	V	V	V
Object_Type	V	V	V	V	V	V	V
System_Status	V						
Vendor_Name	V						
Vendor_ Identifier	V						
Model_Name	V						
Firmware_Revision	V						
Applocation_Software_Supported	V						
Protocol_Version	V						
Protocol_Revision	V						
Protocol_Services_Supported	V						
Protocol_Object_Type_Supported	V						
Object_List	V						
Max_APDU_Length_Accepted	V						
Segmentation_Supported	V						
APDU_Timeout	V						
Number_Of_APDU_Retries	V						
Max_Masters	V						
Max_Info_Frames	V						
Device_Address_Binding	V						
Location							
Presnent_Value		V	V	V	V	V	V
Status_Flags		V	V	V	V	V	V
Event_State		V	V	V	V	V	V
Relibility							
Out_Of_Service		V	V	V		V	
Units		V	V	V			
Priority_Array			V			V	
Relinquish_Default			V			V	
Polarity					V	V	V
Inactive_Text							
Active_Text							

4.7.4 BACnet Object Properties

This section provides the predetermined configuration of the inverter. User can achieve the optimizazed situation at any necessary modification.

Refer to Table 4.7.4.1 for the property information of inverter objects and user can learn the inverter messages from the inverter objects.

Refer to Table 4.7.4.2 ~ Table 4.7.4.7 for the related object information that inverter supports. User can control/ read each object with the application requirements.

Table 4.7.4.1 – Inverter property list

Property	Inverter
Object_Identifier	DEV
Object_Name	VFD
Object_Type	8
System_Status	0
Vendor_Name	VFD
Vendor_ Identifier	461
Model_Name	VFD
Firmware_Revision	0.14
Applocation_Software_Supported	0.14
Protocol_Version	1
Protocol_Revision	5
Protocol_Services_Supported	{ readProperty , writeProperty , who is }
Protocol_Object_Type_Supported	{ Analog_Input , Analog_Output, Analog_Value Binary_ Input, Binary_Output, Binary_Value, Device}
Max_Masters	127
Max_Info_Frames	1

Table 4.7.4.2 Analog input property list (READ)

No.	Object Name	Description	Unit	Classification	Range
AI0	TM2 AIN	AI1 inpur	Volt	R	0 - 10
AI1	TM2 AIN2	AI2 input	Volt	R	0 - 10
AI2	Error code	Recent fault message	No Units	R	0 – 45
AI3	Freq cmd	Frequency command	HZ	R	0 - 60
AI4	Frequency	Output frequency	HZ	R	0 - 60
AI5	Current	Output current	Amps	R	
AI6	Control Mode	Control mode	No Units	R	0 - 2
AI7	Motor R-Volt	Motor rated voltage	Volt	R	
AI8	Motor R-HP	Motor rated power	horsepower	R	
AI9	Motor R-RPM	Motor rated rotation speed	No Units	R	
AI10	Motor R-Hz	Motor rated frequency	HZ	R	
AI11	CarrierFreq	Carrier frequency	KiloHertz	R	4 - 16
AI12	Comm Station	INV communication station	No Units	R	1 - 254
AI13	BaudRate	Baudrate setting	No Units	R	0 - 3
AI14	BacnetSel	Communication mode selection	No Units	R	0 - 1
AI15	DevInstance	Inverter number	No Units	R	1 - 254

Table 4.7.4.3 – Analog output property list (READ/ WRITE)

No.	Object Name	Description	Unit	Classification	Range
AO0	Set frequency	Frequency command	HZ	R/W	0 - 60
AO1	TB2 AO1	Analog output voltage 1	Volt	R	0 - 10
AO2	TB2 AO2	Analog output voltage 2	Volt	R	0 - 10
AO3	Motor R-Amp	Motor rated current	Amps	R/W	0-65535
AO4	PwrL Sel	Momentary Power Loss/ Fault Restart Selection	No Units	R	0 - 1
AO5	RestartSel	Number of Fault Auto-Restart Attempts	No Units	R	0 – 10
AO6	RestartDelay	Fault Auto-Restart Time	seconds	R	0 - 7200
AO7	FreqCommand1	Speed frequency setting-stage 0	HZ	R/W	0 - 400
AO8	FreqCommand2	Speed frequency setting-stage 1	HZ	R/W	0 - 400
AO9	FreqCommand3	Speed frequency setting-stage 2	HZ	R/W	0 - 400
AO10	FreqCommand4	Speed frequency setting-stage 3	HZ	R/W	0 - 400
AO11	FreqCommand5	Speed frequency setting-stage 4	HZ	R/W	0 - 400
AO12	FreqCommand6	Speed frequency setting-stage 5	HZ	R/W	0 - 400
AO13	FreqCommand7	Speed frequency setting-stage 6	HZ	R/W	0 - 400
AO14	FreqCommand8	Speed frequency setting-stage 7	HZ	R/W	0 - 400
AO15	FreqCommand9	Speed frequency setting-stage 8	HZ	R/W	0 - 400
AO16	FreqCommand10	Speed frequency setting-stage 9	HZ	R/W	0 - 400
AO17	FreqCommand11	Speed frequency setting-stage 10	HZ	R/W	0 - 400
AO18	FreqCommand12	Speed frequency setting-stage 11	HZ	R/W	0 - 400
AO19	FreqCommand13	Speed frequency setting-stage 12	HZ	R/W	0 - 400
AO20	FreqCommand14	Speed frequency setting-stage 13	HZ	R/W	0 - 400
AO21	FreqCommand15	Speed frequency setting-stage 14	HZ	R/W	0 - 400
AO22	FreqCommand16	Speed frequency setting-stage 15	No Units	R/W	0 - 2
AO23	RunMode	Main run command source selection	No Units	R/W	0 - 2
AO24	ReverseOper	Direction locked command	No Units	R/W	0 - 1

No.	Object Name	Description	Unit	Classification	Range
AO25	StoppingSel	Stop modes selection	No Units	R/W	0 - 1
AO26	FrequenceComm	Main frequency command source selection	No Units	R/W	0 - 5
AO27	FreqUpperLim	Upper limit frequency	HZ	R/W	0 - 400
AO28	FreqLowerLim	Lower limit frequency	HZ	R/W	0 - 400
AO29	Acc Time1	Acceleration time 1	seconds	R/W	0 - 3600
AO30	Dec Time1	Deceleration time 1	seconds	R/W	0 - 3600

Table 4.7.4.4 Analog value property list (READ/ WRITE)

No.	Object Name	Description	Unit	Classification	Range
AV0	PID – P Gain	Proportional gain (P)	No Units	R/W	0 - 10
AV1	PID – I Time	Integral time (I)	No Units	R/W	0 - 100
AV2	PID – D Time	Differential time (D)	No Units	R/W	0 – 10

Table 4.7.4.5 Digital input property list (READ)

No.	Object Name	Description	Unit	Classification	Range
BI0	Run/Stop	Operation status	Stop / Run	R	0 - 1
BI1	Direction	Operation direction	FWD/REV	R	0 - 1
BI2	ststus	Inverter status	OK/Fault	R	0 - 1
BI3	Abnormal	Error occurs	Close/ Open	R	0 - 1
BI4	DI_1 status	S1 status	Close/ Open	R	0 - 1
BI5	DI_2 status	S2 status	Close/ Open	R	0 - 1
BI6	DI_3 status	S3 status	Close/ Open	R	0 - 1
BI7	DI_4 status	S4 status	Close/ Open	R	0 - 1
BI8	DI_5 status	S5 status	Close/ Open	R	0 - 1
BI9	DI_6 status	S6 status	Close/ Open	R	0 - 1

Table 4.7.4.6 Digital output property list (READ/ WRITE)

No.	Object Name	Description	Unit	Classification	Range
BO0	RY1 status	Relay output 1 status	Close/Open	R	0 - 1
BO1	RY2 status	Relay output 2 status	Close/Open	R	0 - 1
BO2	RY3 status	Relay output 3 status	Close/Open	R	0 - 1

Table 4.7.4.7 Digital value property list (READ/ WRITE)

No.	Object Name	Description	Unit	Classification	Range
BV0	RUN/STOP	RUN/STOP	Stop / Run	R/W	0 - 1
BV1	FWD/REV	FWD/REV	FWD/REV	R/W	0 - 1

4.8 MetaSys N2 Communication Protocol

4.8.1 Introduction and Setting

This section mainly describes the communication modes of MetaSys N2 communication protocol. Connect terminal S+ and S- of hardware line RS485 and check if Baudrate setting of parameter 09-02 is 9600bps. If not, inverter requires reconnecting after the communication mode selection of parameter 09-01 is set to 2 (MetaSys).

4.8.2 MetaSys N2 Specification

Serial Communication Interface	RS-485
Maximum Numbers of Connection	255 MetaSys N2 slave standard
Communication Speed	9600 (BPS)
Data Format	● Data byte: 8 byte ● Stop byte: 1 byte ● No parity
Access to Data	● 15 Analog input ● 10 Digital input ● 34 Analog Output ● 5 Digital output
Supporting Command	Support the following command 0/0 : Time Setting Command 0/4, 0/5 : Poll Command 0/8 : Warm Reset Command 1 : Read Command 2 : Write Command F : Identify Device Command
	● The following Override command is enabled but it will not clear automatically after 10 minutes. 7/2/3 : AO Override command 7/2/4 : BO Override command ● The following command will respond but not execute this action. 7/3 : Remove Override command 7/2/1 : AI Override command 7/2/2 : BI Override command

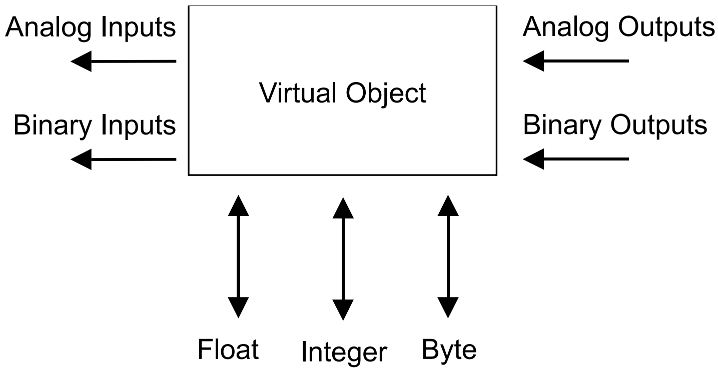
4.8.3 Definition of MetaSys N2 Communication Protocol

MetaSys N2 is the communication protocol developed by Johnson Control Company. MetaSys N2 communication protocol uses the configuration of Master/ Slave. Every N2 Slave device can set N2 address and the range is 1-255.

The data of N2 Slave is displayed by the object and Network Point Type (NPT) is classified to seven kinds of objects:

No.	NPT Name	NPT (abbreviation)	Description
1	Analog input	AI	32-bit, IEEE- Standard floating-point
2	Binary input	BI	1-bit
3	Analog output	AO	32-bit, IEEE- Standard floating-point
4	Binary output	BO	1-bit
5	Internal floating-point	ADF	32-bit, IEEE- Standard floating-point
6	Internal integer	ADI	16-bit
7	Internal Bytes	DB	8-bit

The input and output are mainly for N2 network. The input is the data from N2 Slave to N2 network and the output is the data from N2 network to N2 Slave.



The object of N2 Slave has grouping and every group data can set the address of 0-255, abbreviated for NPA (Network Point Address).

Every object has its property which includes data contens (AI and AO object), object status (BI and BI object data), planning approach (if COS can respond or not) and so on. The property can read or write command but the data value of analog output and digital output requires the Override command to write in.

The object of N2 support function of COS (output in the change of status) and if COS starts, object of AO, BI, and BO will automatically record under the data change and respond under the poll.

N2 Slave device waits for the indentify command after the inverter starts and starts for the communication with network after receiving the indentify command.

4.8.4. MetaSys N2 Communication Protocol in F510 Model

F510 models support four NPT, AI, AO, BI and BO but DO NOT support the following functions:

- Do not support only for the property or field that JCI used.
- Do not support functions of Analog Alarm and Analog Warning in AI. The related fields can read or write but do not have corresponding action.
- Do not support functions of OverRide in AI and BI. The inverter does not have error message for giving the OverRide command in AI and BI but do not have corresponding action.
- Support functions of OverRide in AO and BO but values of AO and BO do not restore to defult value when removing OverRide function.

The followings are the supporting properties list in AI, AO, BI and BO for F510 models:

(1) AI Property List

No.	Data Type	Description	Notes
1	Byte	Object Configuration	READ/ WRITE
2	Byte	Object Status	Only READ
3	Float	Analog Input Value	Only READ

(2) BI Property List

No.	Data Type	Description	Notes
1	Byte	Object Configuration	READ/ WRITE
2	Byte	Object Status	Only READ

(3) AO Property List

No.	Data Type	Description	Notes
1	Byte	Object Configuration	READ/ WRITE
2	Byte	Object Status	Only READ
3	Float	Current Value	READ/ OverRide

(4) BO Property List

No.	Data Type	Description	Notes
1	Byte	Object Configuration	READ/ WRITE
2	Byte	Object Status	READ/ OverRide
3	Integer	Minimum On-time	READ/ WRITE
4	Integer	Minimum On-time	READ/ WRITE
5	Integer	Maximum Cycles/Hour	READ/ WRITE

The followings are parameters F510 models can read and write via MetaSys communication.

Analog input property list (READ)

No.	Object Name	F510 Parameters	Unit	Classification	Range
AI1	Motor R-RPM	02-03 Motor Rated Rotation Speed	No Units	R	0 ~ 60000
AI2	Motor R-Volt	02-04 Motor Rated Voltage	Volt	R	0~240.0/0~480.0
AI3	Motor R-HP	02-05 Motor Rated Power	horsepower	R	0~600.00
AI4	Motor R-Hz	02-06 Motor Rated Frequency	HZ	R	0.00 ~ 599.00
AI5	Comm Station	09-00 INV Communication Station Address	No Units	R	1 - 254
AI6	CommSel	09-01 Communication Mode Selection	No Units	R	0 ~ 3
AI7	BaudRate	09-02 Baud Rate Setting	No Units	R	0 ~ 5
AI8	CarrierFreq	11-01 Carrier Frequency	KiloHertz	R	0 ~ 16
AI9	Freq cmd	12-16 Frequency Command	HZ	R	0.00 ~ 599.00
AI10	Frequency	12-17 Output Frequency	HZ	R	0.00 ~ 599.00
AI11	Current	12-18 Output Current	Amps	R	0.0~6553.5
AI12	Control Mode	12-24 Control Mode	No Units	R	0 ~ 5
AI13	TM2 AIN	12-25 AI1 Input	Volt	R	0 ~ 100.0
AI14	TM2 AIN2	12-26 AI2 Input	Volt	R	0 ~ 100.0
AI15	Error code	12-45 Recent Fault Message	No Units	R	0 ~ 45

Analog output property list (READ/ Write)

No.	Object Name	F510 Parameters	Unit	Classification	Range
AO1	Set frequency	Register 2502H	HZ	R/W	0.00 ~ 599.00
AO2	AO1	Register 2505H	Volt/ Amps	R	0.00 ~ 100.00
AO3	AO2	Register 2506H	Volt/ Amps	R	0 .00 ~ 100.00
AO4	RunSource	00-02 Main Run Command Source Selection	No Units	R/W	0 ~ 4
AO5	FrequenceComm	00-05 Main Frequency Command Source Selection	No Units	R/W	0 ~ 6
AO6	FreqUpperLim	00-12 Upper Limit Frequency	HZ	R/W	0 – 109
AO7	FreqLowerLim	00-13 Lower Limit Frequency	HZ	R/W	0 - 109
AO8	Acc Time1	00-14 Acceleration Time 1	seconds	R/W	0 ~ 6000.0
AO9	Dec Time1	00-15 Deceleration Time 1	seconds	R/W	0 ~ 6000.0
AO10	Motor R-Amp	02-01 Motor Rated Current	Amps	R/W	1 ~ 999.9
AO11	FreqCommand1	05-01 Frequency Setting of Speed-Stage 0	HZ	R/W	0.00 ~ 599.00
AO12	FreqCommand2	06-01 Frequency Setting of Speed-Stage 1	HZ	R/W	0.00 ~ 599.00
AO13	FreqCommand3	06-02 Frequency Setting of Speed-Stage 2	HZ	R/W	0.00 ~ 599.00

No.	Object Name	F510 Parameters	Unit	Classification	Range
AO14	FreqCommand4	06-03 Frequency Setting of Speed-Stage 3	HZ	R/W	0.00 ~ 599.00
AO15	FreqCommand5	06-04 Frequency Setting of Speed-Stage 4	HZ	R/W	0.00 ~ 599.00
AO16	FreqCommand6	06-05 Frequency Setting of Speed-Stage 5	HZ	R/W	0.00 ~ 599.00
AO17	FreqCommand7	06-06 Frequency Setting of Speed-Stage 6	HZ	R/W	0.00 ~ 599.00
AO18	FreqCommand8	06-07 Frequency Setting of Speed-Stage 7	HZ	R/W	0.00 ~ 599.00
AO19	FreqCommand9	06-08 Frequency Setting of Speed-Stage 8	HZ	R/W	0.00 ~ 599.00
AO20	FreqCommand10	06-09 Frequency Setting of Speed-Stage 9	HZ	R/W	0.00 ~ 599.00
AO21	FreqCommand11	06-10 Frequency Setting of Speed-Stage 10	HZ	R/W	0.00 ~ 599.00
AO22	FreqCommand12	06-11 Frequency Setting of Speed-Stage 11	HZ	R/W	0.00 ~ 599.00
AO23	FreqCommand13	06-12 Frequency Setting of Speed-Stage 12	HZ	R/W	0.00 ~ 599.00
AO24	FreqCommand14	06-13 Frequency Setting of Speed-Stage 13	HZ	R/W	0.00 ~ 599.00
AO25	FreqCommand15	06-14 Frequency Setting of Speed-Stage 14	HZ	R/W	0.00 ~ 599.00
AO26	FreqCommand16	06-15 Frequency Setting of Speed-Stage 15	HZ	R/W	0.00 ~ 599.00
AO27	PwrL Sel	07-00 Momentary Power Loss/Fault Restart Selection	No Units	R	0 ~ 1
AO28	RestartDelay	07-01 Fault Auto-Restart Time	seconds	R	0 ~ 7200
AO29	RestartSel	07-02 Number of Fault Auto-Restart Attempts	No Units	R	0 ~ 10
AO30	StoppingSel	07-09 Stop Mode Selection	No Units	R/W	0 - 1
AO31	PID – P Gain	10-05 Proportional Gain (P)	No Units	R/W	0 ~ 10.00
AO32	PID – I Time	10-06 Integral Time (I)	No Units	R/W	0 ~ 100.00
AO33	PID – D Time	10-07 Differential Time (D)	No Units	R/W	0 – 10.00
AO34	ReverseOper	11-00 Direction Lock Selection	No Units	R/W	0 ~ 2

Binary input property list (READ)

No.	Object Name	No Action / Action	Classification	Range
BI1	Run/ Stop	Stop/ Run	R	0 - 1
BI2	Direction	Forward/ Reverse	R	0 - 1
BI3	Status	OK/ Fault	R	0 - 1
BI4	Abnormal	Off/ On	R	0 - 1
BI5	DI_1 Status	Off/ On	R	0 - 1
BI6	DI_2 Status	Off/ On	R	0 - 1
BI7	DI_3 Status	Off/ On	R	0 - 1
BI8	DI_4 Status	Off/ On	R	0 - 1
BI9	DI_5 Status	Off/ On	R	0 - 1
BI10	DI_6 Status	Off/ On	R	0 - 1

Binary output property list (READ/ WRITE)

No.	Object Name	No Action / Action	Classification	Range
BO1	Run/ Stop	Stop/ Run	R/W	0 - 1
BO2	Forward/ Reverse	Forward/ Reverse	R/W	0 - 1
BO3	RY1 Status	Off/ On	R	0 - 1
BO4	RY2 Status	Off/ On	R	0 - 1
BO5	RY3 Status	Off/ On	R	0 - 1

MetaSys N2 Error Code List

Error Code	Cause
00	Without receving Identify command at power up
01	Receive the non-support command
02	Check Code occurs error
03	Receive the data of more than 256 bits
05	Incorrect command length
10	Data is out of the range
11	Save the undefined fields or the fields that JCI dedicated
12	The parameter position is only for read command.

Chapter 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.

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.

◆ LED Keypad Display

At this point, **DO NOT RUN THE MOTOR**, the LED keypad should display as shown below in Fig. 5.1 and all LEDs are flashing. Next press the **RUN** key, all LEDs light on. See Fig 5.2. The motor should now be operating at low speed running in forward (clockwise) direction. The value shown in the screen will change from 000.00Hz to 005.00Hz. Next press **STOP** key to stop the motor.

Fig 5.1: LED Keypad (Stopped)

Fig 5.2: LED Keypad (Running)

◆ LCD Keypad Display

At this point, **DO NOT RUN THE MOTOR**, the LCD keypad should display as shown below in Fig. 5.3 and the speed reference 12-16=00**5.00Hz** should be blinking at the parameter code "12-16". Next press the **RUN** key, see Fig 5.4. 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.

Fig 5.3: Keypad (Stopped)

Fig 5.4: Keypad (Running)

Notes:

- **If the motor rotation is incorrect, power down the inverter.**
- **After the power has been turned OFF, wait <u>at</u> <u>least</u> <u>ten minutes</u> until the charge indicator extinguishes <u>completely</u> 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.**

Chapter 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 5

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.

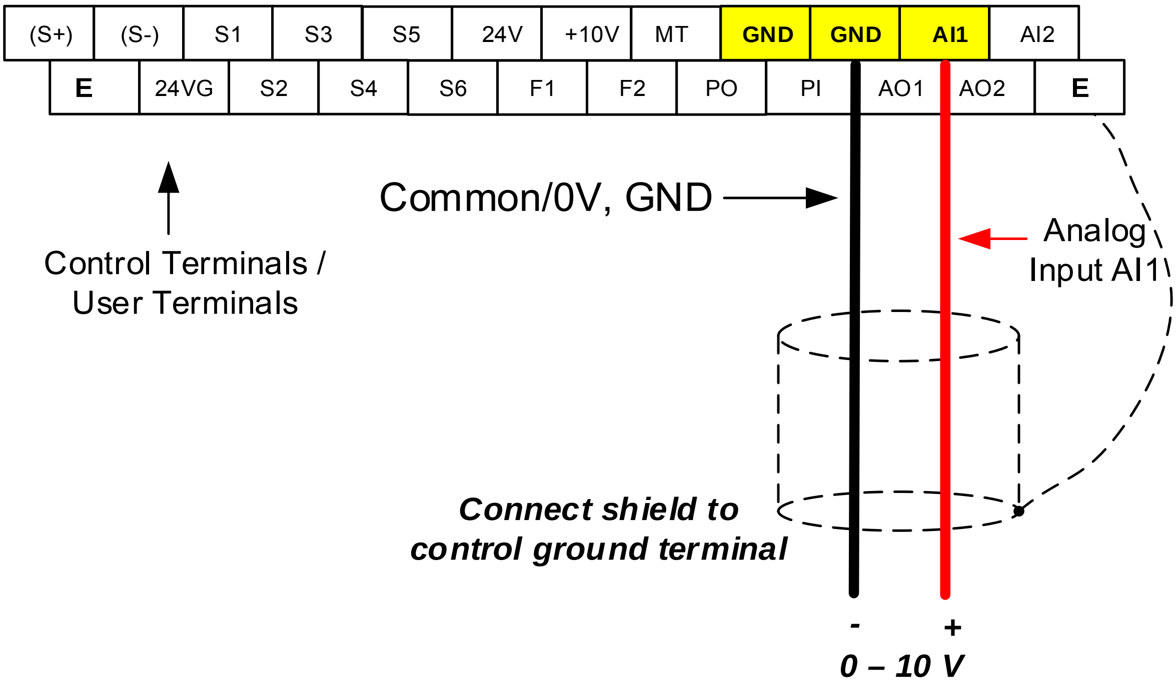
00-05	Main Frequency Command Source Selection
Range	**0:** Keypad **1:** External Terminal (Analog AI1) **2:** Terminal Command UP / DOWN **3:** Communication control (RS-485) **4:** Reserved **5:** Reserved **6:** RTC **7:** AI2 Auxiliary Frequency

6.1 Reference from Keypad

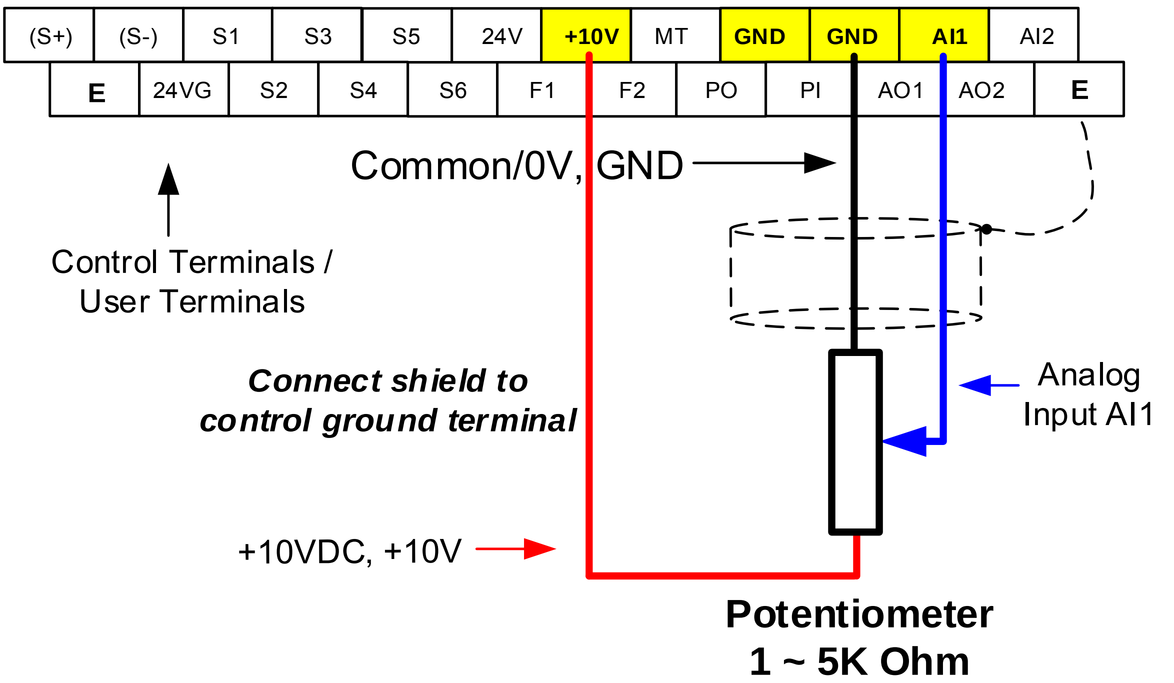
Speed reference from the keypad is the default setting. Press the **READ/ ENTER** key first and use the </RESET, ▲ and ▼ keys to change the speed reference.

6.2 Reference from External Analog Signal (0-10V / 4-20mA)

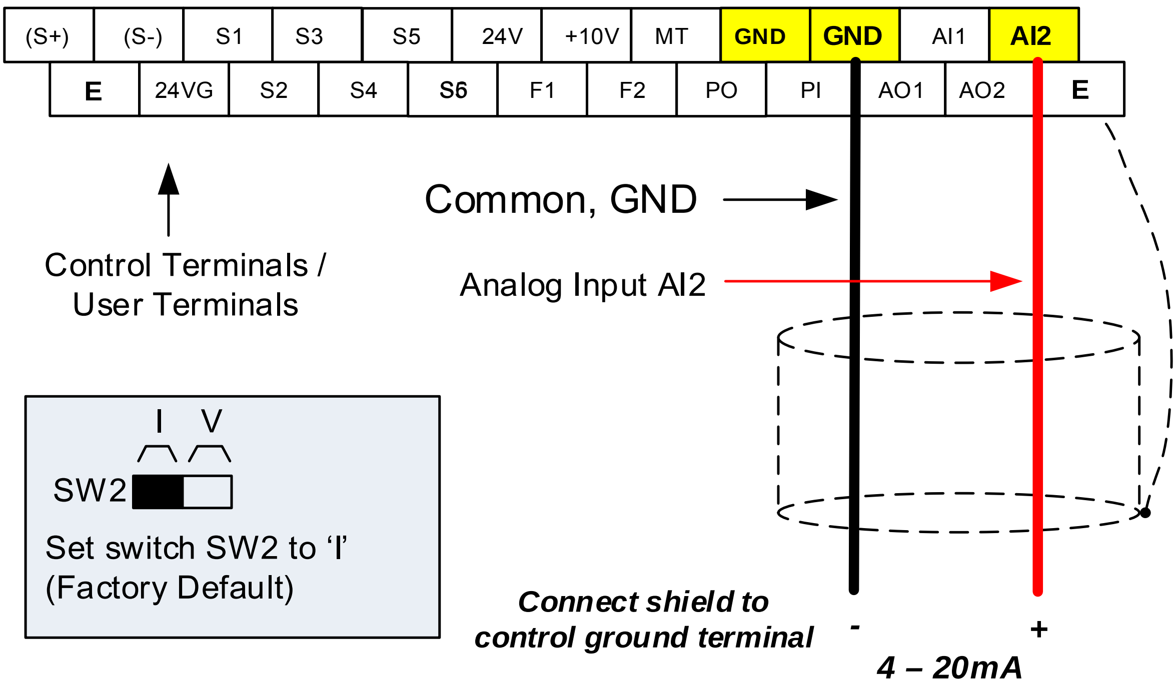
Analog Reference: 0 – 10 V (Setting 00-05 = 1)



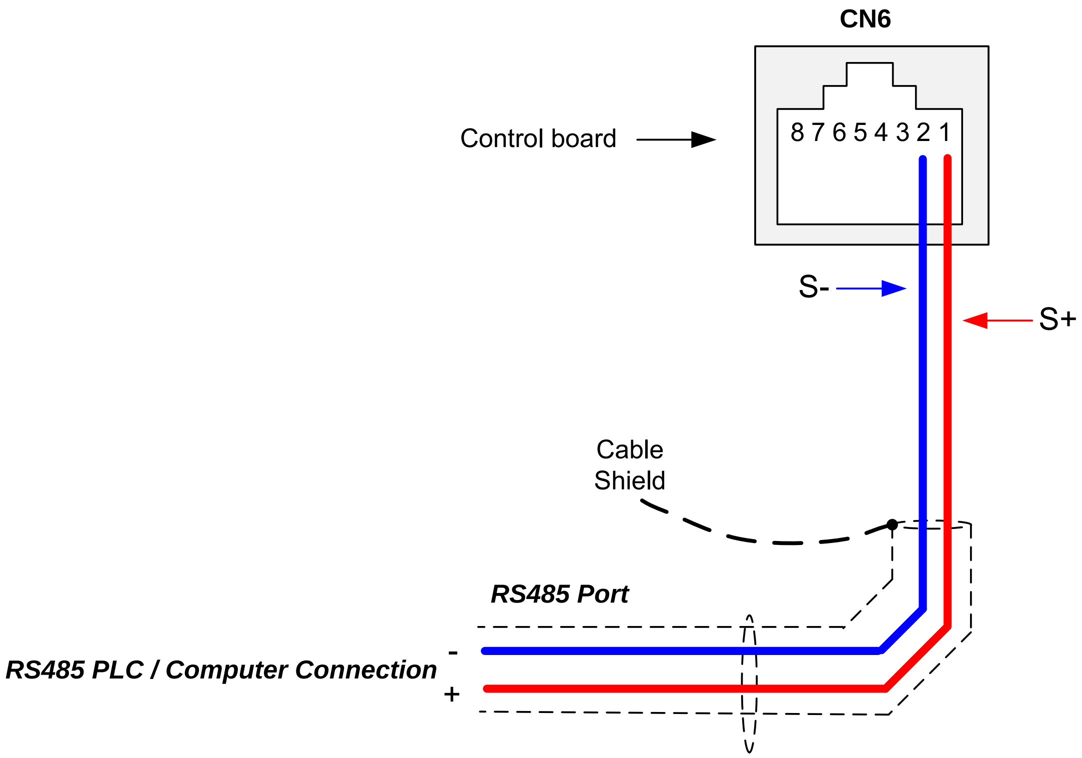
Analog Reference: Potentiometer / Speed Pot (Setting 00-05 = 1)



Analog Reference: 4 – 20mA (Setting 00-05 = 7)



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 ~ 599.00 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

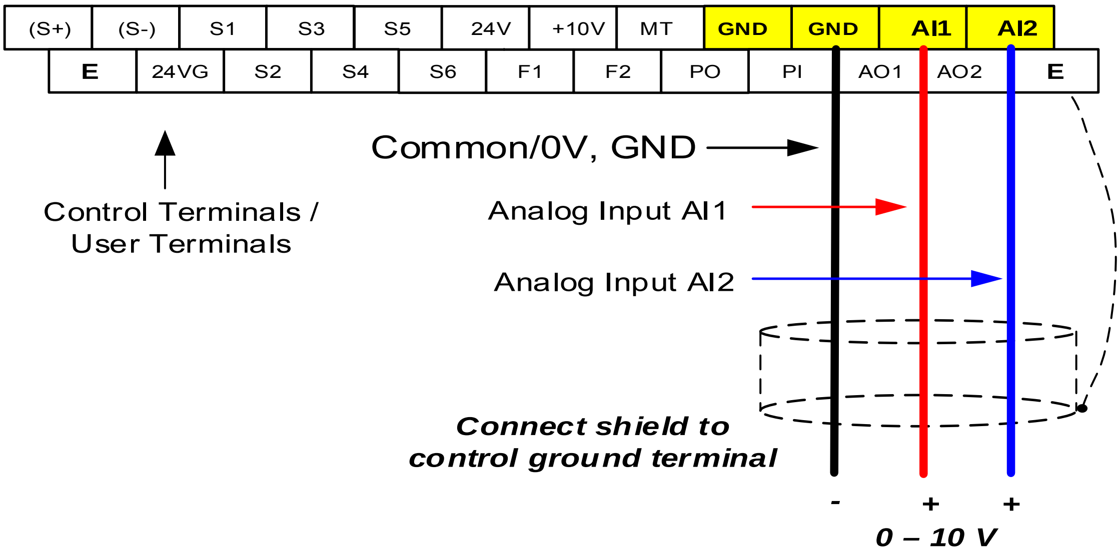
Note: The last 2 bytes of the command strings consist of a CRC16 checksum, please refer to section 4.5 of the instruction manual for additional information.

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 = 1, 04-05 = 1)

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:** 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

Example: Motor poles 4, 02-07 or 22-03 = 4.

Chapter 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 3

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

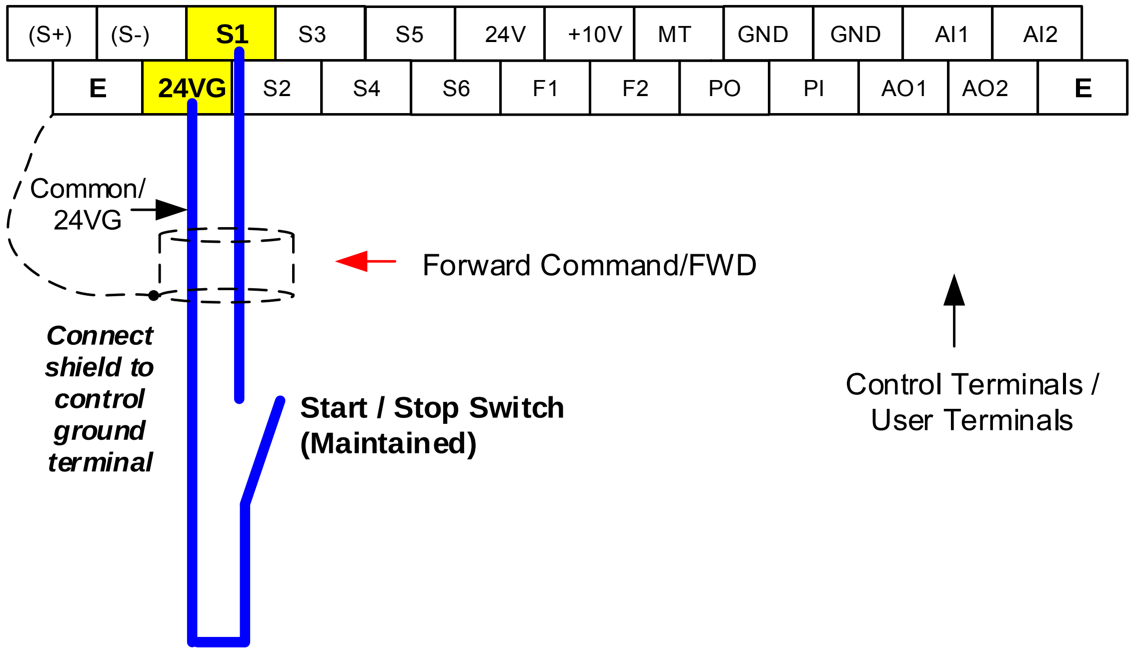
Use the **RUN** key to run the drive in forward direction and the **FWD/REV** key to change the motor direction. (Note: to disable reverse direction set parameter 11-01 to 1)

Press **STOP** key to stop the inverter. (Note: Stop method can be set with parameter 07-09, default is **deceleration to stop)**.

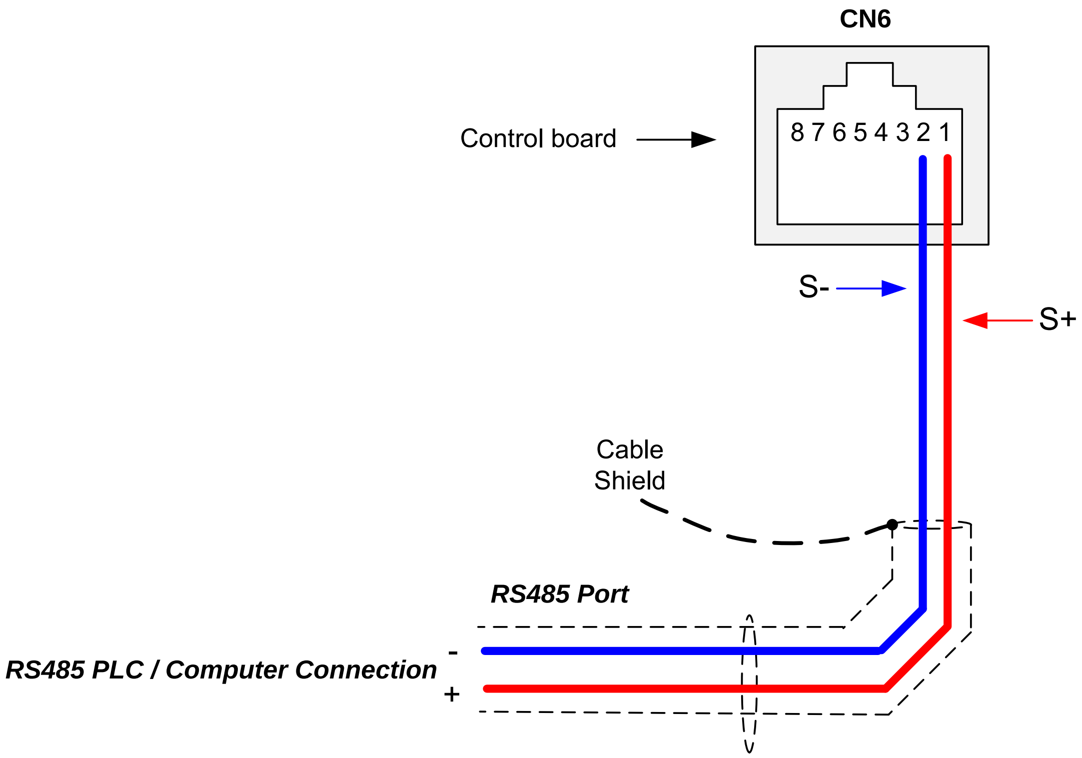
7.2 Run/Stop from External Switch / Contact or Pushbutton (00-02=1)

Use an external contact or switch to Run and Stop the inverter.

Permanent Switch / Contact



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, please refer to section 4.5 of the instruction manual for additional information.

Chapter 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

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.

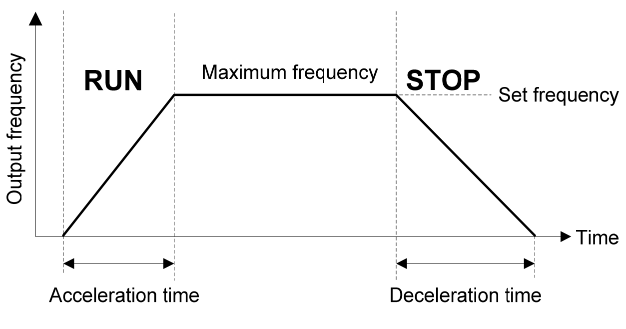
The default values suggested normally result in good system performance for the majority of general purpose applications. If the values need to be adjusted, caution should be exercised, and the changes should be in small increments to avoid system instability.

00-14 Acceleration time 1
00-15 Deceleration time 1

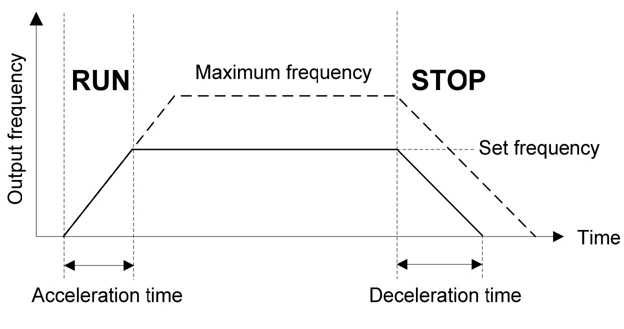
These parameters set the acceleration and deceleration times of the output frequency from 0 to maximum frequency and from maximum frequency to 0.

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:



Set Frequency = Maximum Frequency



Set Frequency < Maximum Frequency

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 Torque Compensation Gain (01-10)

This parameter sets the relationship between output frequency and output voltage. Constant torque applications have the same torque requirements at low speed as well as at high speed.

Initial Setup

For Variable Torque / Normal Duty applications set parameter 01-10 to an initial value of 0.5.

For Constant Torque / Heavy Duty applications set parameter 01-10 to an initial value of 1.0.

01-10 Torque compensation gain

This parameter sets the torque boost for motor.

Setting range: 0.0 to 2.0

To set parameter 01-10:
- After power-up press the **DSP/FUN** key
- Select **01 V/F Pattern**
- Press **READ/ ENTER** key
- Select parameter -10 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

Increase value when:
- The wiring between the inverter and the motor very 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:
- Experiencing motor vibration
- Over Current Fault
- Overload Fault

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

Warning: A larger than required torque compensation gain value creates over-excitation at low speeds, continued operation may cause the motor to overheat. Check the characteristics of the motor for additional information.

8.4 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.

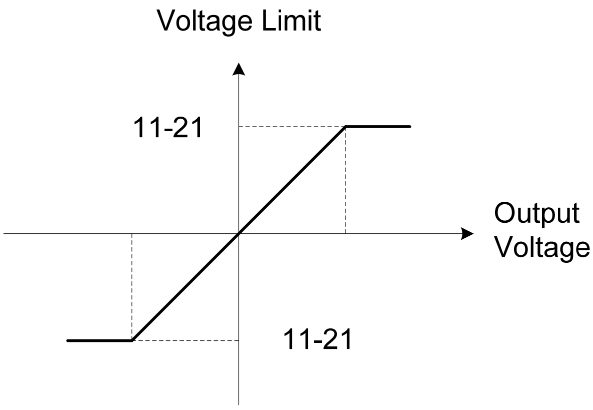
(1) To enable automatic energy saving function set 11-19 to 1.
(2) Filter time of automatic energy saving (11-20)
(3) Commissioning parameter of energy saving (11-21 to 11-22)

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:

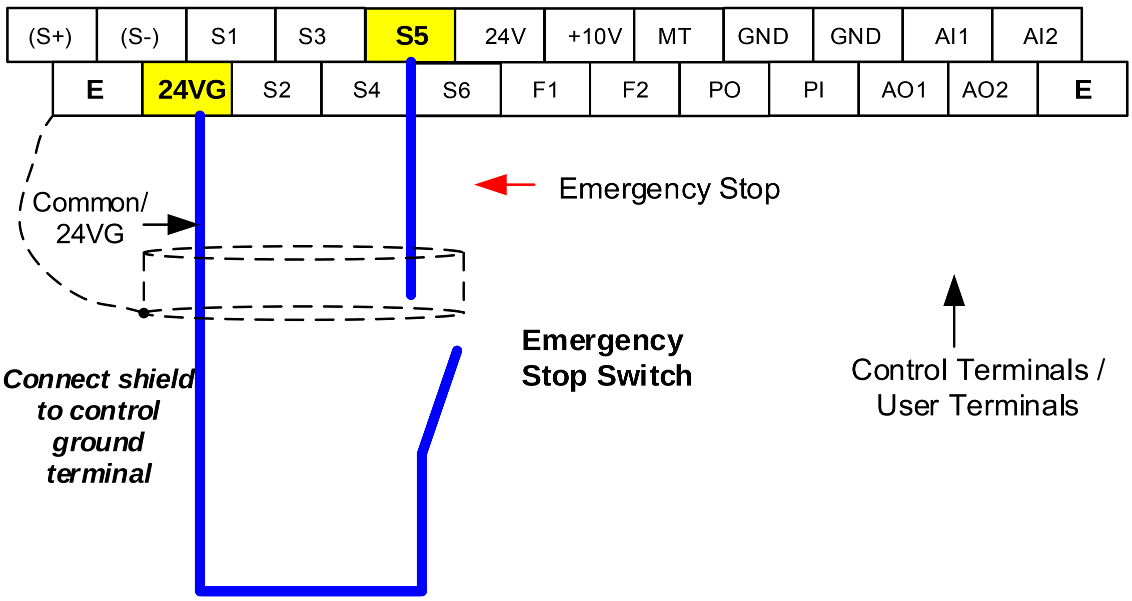
- If the coefficient is set to low the motor may stall.
- Coefficient default value is based on the inverter rating. Set parameter 13-00. If the motor power does not match the inverter rating.

8.5 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.

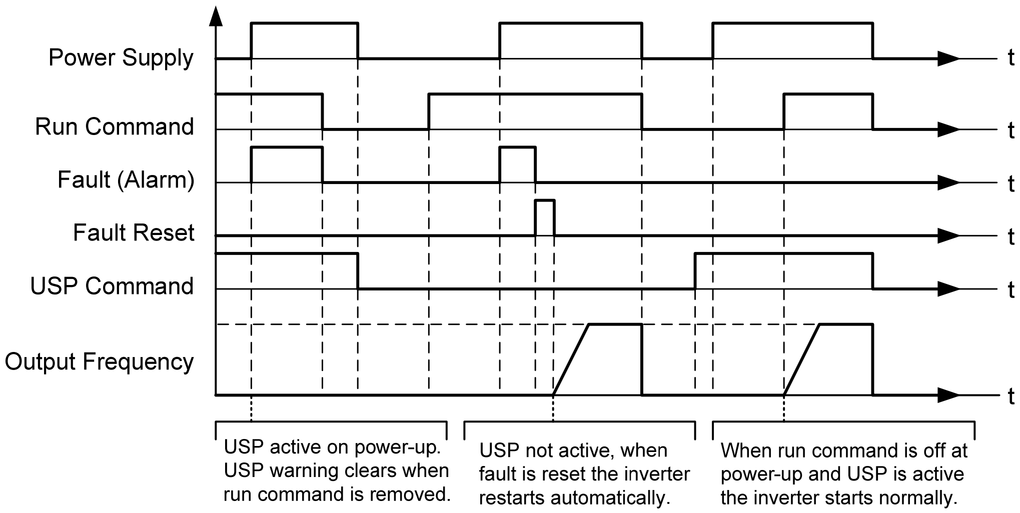
Example: Emergency Stop Switch set for input terminal S5 (03-04 = 14).



00-26	Emergency stop time
Range	0.1~6000.0 Sec

8.6 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

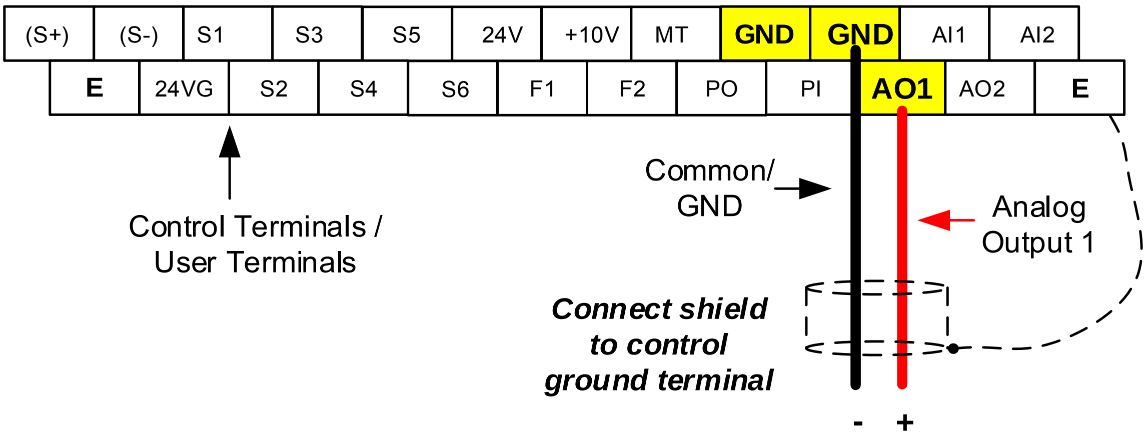
8.7 Analog Output Setup

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 **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 **26~27:** Reserved **28:** Communication control

04-12	AO1 gain value
Range	0.0~1000.0%

04-13	AO1 bias-voltage value
Range	-100.0~100.0%

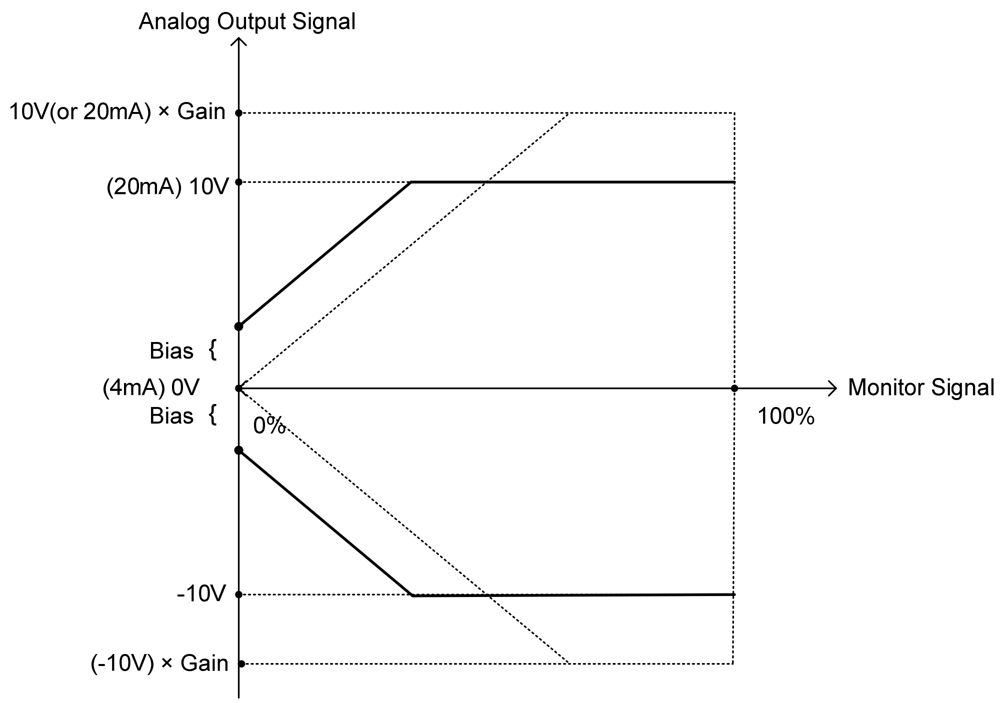
04-16	AO2 function Setting
Range	See parameter 04-11

04-17	AO2 gain value
Range	0.0~1000.0%

04-18	AO2 bias-voltage value
Range	-100.0~100.0%

04-19	AO2 Output Signal Type
Range	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

04-20	Filter Time of AO Signal Scan
Range	0.00~0.50s



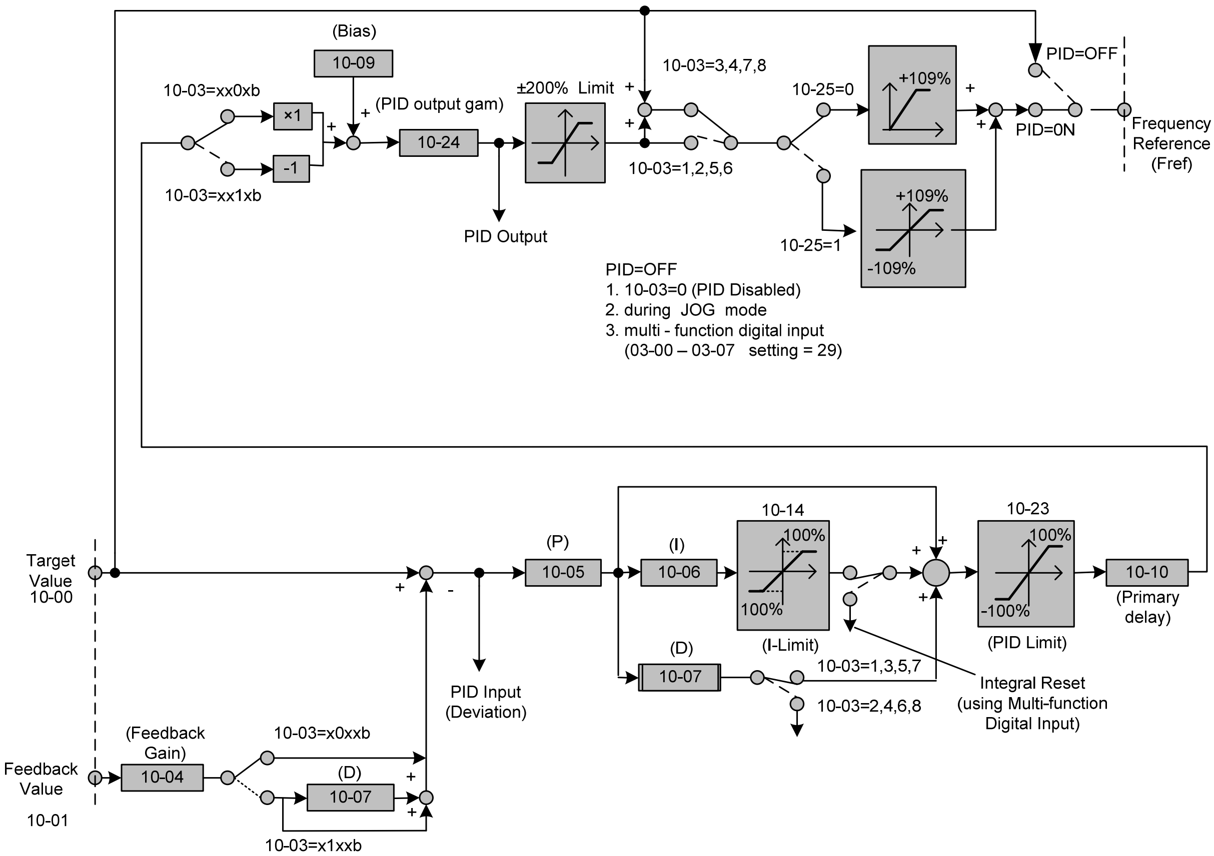
Analog output level adjustment

Chapter 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.

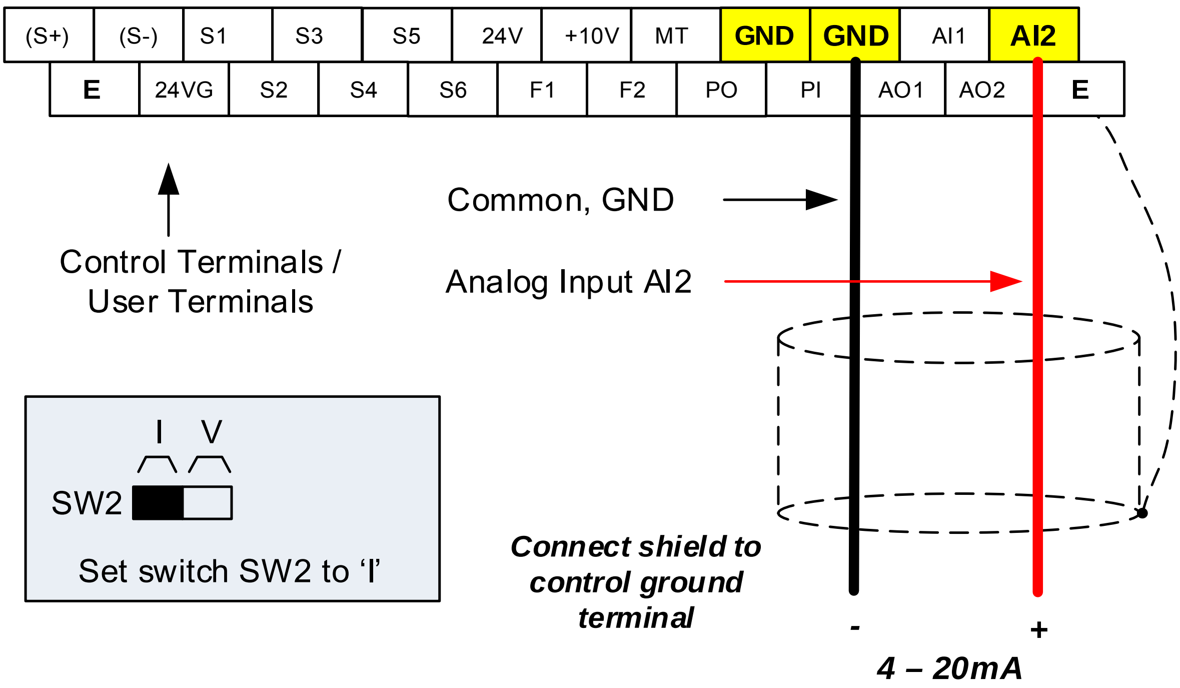
Important: To use the PID function parameter 00-05 (Main Frequency Command Source Selection) has to be set to 5 for PID reference.

9.2 Connect Transducer Feedback Signal (10-01)

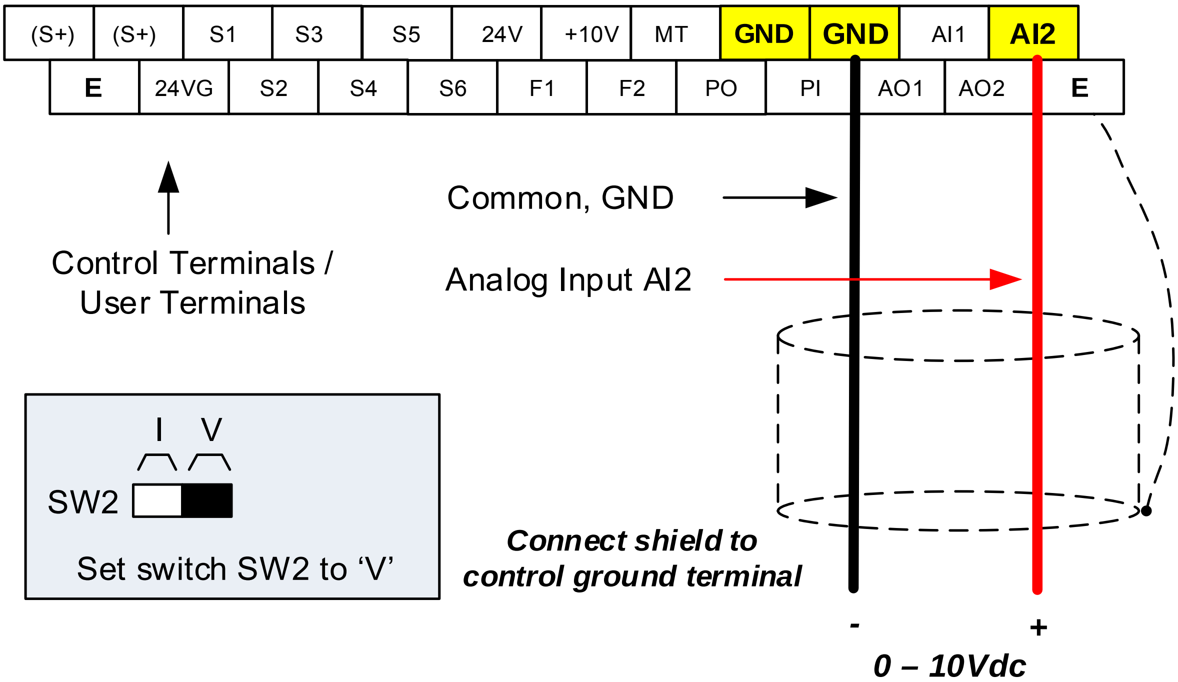
The PID function in the inverter

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 (only for LCD)

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).

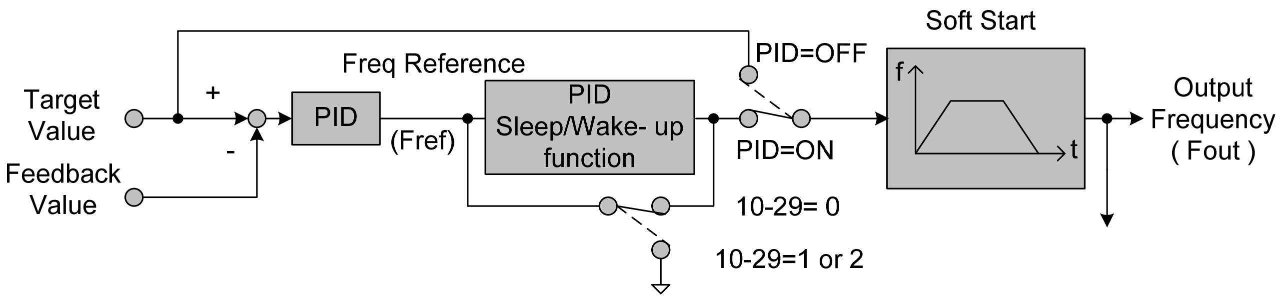
The inverter wakes up from a sleep condition when the PID output (Reference frequency) rises above the PID wake-up frequency (10-19) for the time specified in the PID wake-up delay time (10-20).

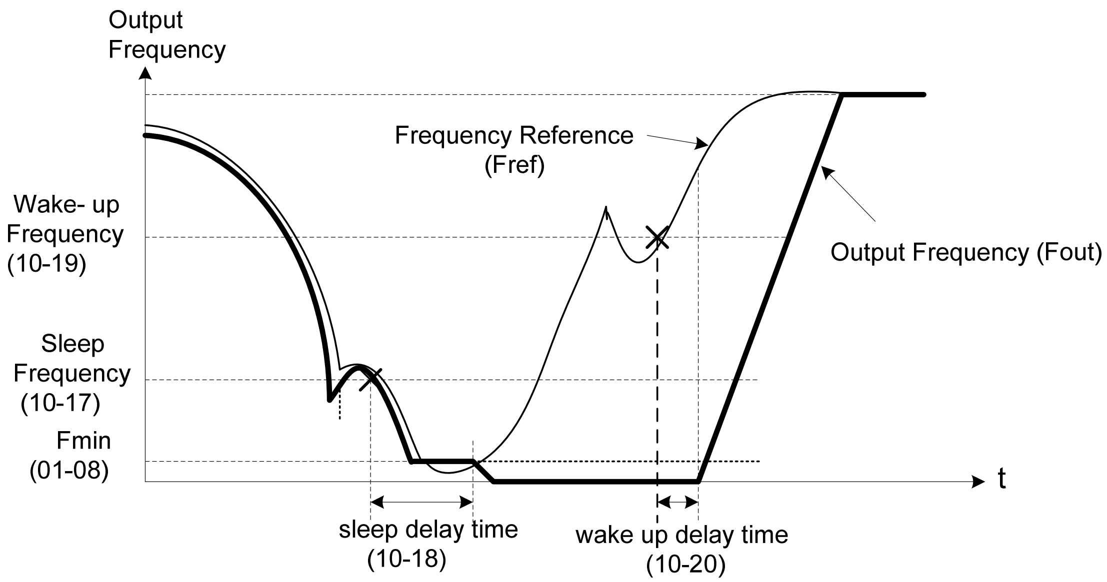
10-29 =0: PID Sleep function is disabled.

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 4.4.74 (a) and (b) for PID sleep / wakeup operation.





PID Sleep Function

Chapter 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, 03-05) to 17 (Fault reset); activate input
2. Press the reset button on the keypad and clear fault message.
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 (around 200% of the inverter rated current).	• Acceleration 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.	• Extend acceleration time. • Check the motor wiring. • Disconnect motor and try running inverter.
OCA over current	The inverter output current exceeds the overcurrent level in acceleration time	• Acceleration time is too short • Capacity of motor is bigger than inverter • Short circuit between winding and shell of motor • Short circuit between wire and ground of motor • IGBT broken module	• Set the longer acceleration time • Change to bigger capacity of inverter • Examine motor • Check the wire • Replace IGBT module
OCC over current	The inverter output current exceeds the overcurrent level in constant speed	• Instantaneous change of load • Instantaneous change of current	• Change to bigger capacity of inverter • Add reactor to power source
OCD over current	The inverter output current exceeds the overcurrent level in deceleration time	• Deceleration time is too short	• Set the longer acceleration time
GF Ground fault	The current to ground exceeds 50% of the inverter rated output current (08-23 = 1, GF function is enabled).	• Motor damaged (insulation). • Wire damage or deterioration. • Inverter DCCT sensors defect.	• 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 OV	DC bus voltage exceeds the OV detection level: 410Vdc: 200V class 820Vdc: 400V class (For 400V class, if input voltage 01-14 is set lower than 400V, the OV detection value will is decreased to 730Vdc).	• 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.	• 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 Under voltage uV	DC bus voltage is lower than the UV detection level or the pre-charge contactor is not active while the inverter is running. 190Vdc: 200V class; 380Vdc: 400V class (The detection value can be adjusted by 07-13).	• The input voltage is too low. • Input phase loss. • Input voltage fluctuation. • Pre-charge contactor damaged. • DC bus voltage feedback signal value not incorrect.	• Check the input voltage. • Check input wiring. • Check power source • Replace pre-charge contactor • Replace control board or complete inverter.
IPL input phase loss IPL	Phase loss at the input side of the inverter or input voltage imbalance, active when 08-09 = 1 (enabled).	• IPL occurs. • Terminal screws of R/L1, S/L2 or T/L3 are loose or lost. • Input voltage fluctuation is too big. • Input Voltage is imbalance per phase • Aging of the capacity on main circuit inside inverter	• Check if the main wiring connection is correct. • Check if the terminal screw gets loose. • Make sure having stable input voltage or turn off IPL detection function. • Replace the circuit board or inverter
OPL output phase loss OPL	Phase loss at the output side of the inverter, active when 08-10 = 1 (enabled).	• Wiring loose in inverter output terminal. • Motor rated current is less than 10% of the inverter rated current.	• Check output wiring / faster screws. • Check motor & inverter rating.
OH1 Heatsink overheat OH1	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.	• Ambient temperature too high. • cooling fan failed • Carrier frequency set too high. • Load too heavy.	• Install fan or AC to cool surroundings. • Replace cooling fan. • Reduce carrier frequency. • Reduce load / Measure output current
OH4 Motor overheating OH4	Motor overheating : The input of PTC (Positive Temperature Coefficient) exceeds the overheat protection level	• The surrounding temperature of motor is too high. • The input of PTC (Positive Temperature Coefficient) exceeds the overheat protection level.	• Check the surrounding temperature of motor. • Check MT and GND terminal wiring be correct.
OL1 Motor overload OL1	Internal motor overload protection tripped, active when protection curve 08-05 = xxx1.	• Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Motor rated current (02-01) set incorrectly. • Load too heavy.	• Check V/f curve. • Check motor rated current • Check and reduce motor load, check and operation duty cycle.

LED display	Description	Cause	Possible solutions
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.	• Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Inverter rating too small. • Load too heavy.	• Check V/f curve. • Replace inverter with larger rating. • Check and reduce motor load, check and operation duty cycle.
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 or 2 to activate.	• Load too heavy.	• Check over torque detection parameters (08-15 / 08-16). • Check and reduce motor load, check and operation duty cycle.
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 or 2 to activate.	• Sudden drop in load. • Belt break.	• Check under torque detection parameters (08-19 / 08-20). • Check load / application.
CE communication error	No Modbus communication received in for the time specified in 09-06 (communication error detection time). Active when 09-07(= 0 to 2).	• Connection lost or wire broken. • Host stopped communicating.	• Check connection • Check host computer / software.
FB PID feedback loss	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 = 2).	• Feedback signal wire broken • Feedback sensor broken.	• Check feedback wiring • Replace feedback sensor.
STO Safety switch STO2 Safety switch	Inverter safety switches open.	• Terminal board Input F1 and F2 are not connected (For standard H & C type) • Terminal board Input SF1 / SF2 and SG are not connected (For enhanced E & G type) • 08-30 set to 1,free run to stop, and digital terminal is open, when 03-00~03-07=58	• Check F1 and F2 connection. (For standard H & C type) • Check SF1 / SF2 and SG connection (For enhanced E & G type) • Check if 08-30 =0 and 03-00~03-07=58
SS1 Safety switch	Inverter safety switches open.	• When 08-30 is set to 0: Deceleration to stop, and digital terminal switch(58) is turned on.	• Check digital terminal(58) is turned on.
EF0 External fault 0	External fault (Modbus)	Modbus communication 0x2501 bit 2= "1"	• Reset Modbus communication 0x2501 bit 2= "1"

LED display	Description	Cause	Possible solutions
EF1 External fault (S1) EF1	External fault (Terminal S1) Active when 03-00= 25 or 68, and Inverter external fault selection 08-24=0 or 1.	• Multifunction digital input external fault active.	• Multi-function input function set incorrectly. • Check wiring
EF2 External fault (S2) EF2	External fault (Terminal S2) Active when 03-01= 25 or 68, and Inverter external fault selection 08-24=0 or 1.		
EF3 External fault (S3) EF3	External fault (Terminal S3) Active when 03-02= 25 or 68, and Inverter external fault selection 08-24=0 or 1.		
EF4 External fault (S4) EF4	External fault (Terminal S4) Active when 03-03= 25 or 68, and Inverter external fault selection 08-24=0 or 1.		
EF5 External fault (S5) EF5	External fault (Terminal S5) Active when 03-04= 25 or 68, and Inverter external fault selection 08-24=0 or 1.		
EF6 External fault (S6) EF6	External fault (Terminal S6) Active when 03-05= 25 or 68, and Inverter external fault selection 08-24=0 or 1.		
CF07 Motor control fault CF07	Motor control fault	• SLV mode is unable to run motor.	• Perform rotational or stationary auto-tune • Increase minimum output frequency (01-08)
CF08 Motor control fault CF08	Motor control fault	• Start or Run fault in PMSLV mode.	• Increase the value of 22-10 properly. • Re auto-tune (22-21) • Check if the load is too heavy to raise torque output limit.
FU fuse open Fu	DC bus fuse blown DC fuse (Models 230V 50HP and above, 460V 75HP and above) open circuit.	• IGBT damaged. • Short circuit output terminals.	• Check IGBTs • Check for short circuit at inverter output. • Replace inverter.
LOPBT Low flow fault LOPbt	Low flow fault	• The feedback signal is not connected. • Due to HVAC feedback value is lower than the limit of minimum flow.	• Check feedback signal is correct and with right connection. • Ensure that the feedback value is higher than the limit of minimum flow (23-51).
HIPBT High flow fault HI Pbt	High flow fault	• Since HVAC feedback value is higher than the limit of maximum flow.	• Check feedback signal is correct. • Ensure that the feedback value is lower than the limit of maximum flow (23-48).
LPBFT Low pressure fault LPbFt	Low pressure fault	• The feedback signal is not connected. • Since feedback value of pump pressure is lower than limit of minimum flow.	• Check feedback signal is correct and with connection. • Check if feedback value of pressure is lower than limit of minimum pressure (23-15).

LED display	Description	Cause	Possible solutions
OPBFT High pressure fault	High pressure fault	• Since feedback value of pump pressure is lower than limit of maximum flow.	• Check feedback signal is correct. • Check if feedback value of pressure is lower than limit of maximum pressure (23-12).
LSCFT Low suction fault	Low suction fault	• Insufficient water supply of effluent channel leads to insufficient suction • PID difference is higher than its level or current is lower than output current level	• Check if water of effluent channel is enough, and water supply is regular. • Check PID difference is higher than its level or current is lower than output current level
CF00 Operator Communication Error	Errors of data transmission occur in keypad	• Keypad and inverter cannot transmit data after power on 5 seconds	• Disconnect the operator and then reconnect. • Replace the control board
CF01 Operator Communication Error 2	Errors of data transmission occur in keypad	• Keypad and inverter can transmit data but transmission error occurs for more than 2 seconds	• Disconnect the operator and then reconnect. • Replace the control board
CT Fault	Fault occurs in voltage level of three-phase input	• Abnormal input voltage, too much noise or malfunctioning control board	• Check input voltage signal and the voltage on the control board.
Double Communication Error	Redundant Profibus and Modbus protocol	• User may use two communication mechanisms simultaneously	• Check only one communication mechanism is used.
PTC Signal Loss	PTC Signal Loss detecting triggers error message	• PTC connection trips and has lasted for more than 10 seconds	• Check if MT terminal and GND terminal are connected.
OPR Disconnection	Run command is set to keypad mode (00-02=0). But when the inverter runs, the operator is disconnected. Selection of operator removed (16-09) determines if the inverter stops or displays fault signal.	• The inverter runs at keypad mode (00-02=0), but warning of operator being disconnected/ removed occurs.	• Check if the operator is disconnected or removed.
FBLSS PID Feedback Signal Loss	When 23-19 > 0, the inverter will display fault signal on the basis of the value of feedback pressure < operation pressure setting (23-02) x detection proportion of loss pressure (23-19) and detection time of loss pressure (23-18) passed, and 23-78=2 in the meanwhile.	• Since proportion of loss pressure (23-19) is enabled and over high, the inverter trips to fault. Thus, feedback sensor cannot operate properly or is not installed correctly.	• Check if the proportion of loss pressure (23-19) is set correctly. • Make sure the feedback sensor is installed correctly and PID feedback signal operates normally.
SC Short Circuit	The inverter output or load is at short circuit.	• Short circuit or grounding fault (08-23=1) occurs from the damage to motor, insulation deterioration or cable breakage.	• Check if the load is at correct wiring.

LED display	Description	Cause	Possible solutions
PF Protection Fault PF	OH1 error occurs for 3 times in 5 minutes when run command in multi-function digital input terminals is not removed.	• Run command in multi-function digital input terminals is not removed.	• Remove run command in multi-function digital input terminals.
TOL External Overload tOL	External overload (enabled only when firemode activated	• External overload in multi-function digital input terminals. (Ex. Fan overheat)	• Check external overload. • Reset external overload of digital input.

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 of 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.

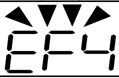
Refer to Table 10.3.1 for and overview, cause and corrective action for inverter warnings and self-diagnostic errors.

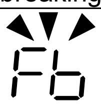
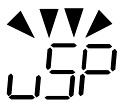
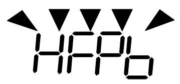
Table 10.3.1 Warning / self-diagnosis and corrective actions

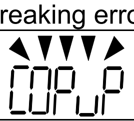
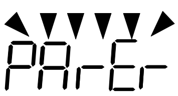
LED display	Description	Cause	Possible solutions
OV (flash) Over voltage 	DC bus voltage exceeds the OV detection level: 410Vdc: 200V class 820Vdc: 400V class (for 440V class, if input voltage 01-14 is set lower than 400V, the OV detection value will is decreased to 700Vdc)	• Deceleration time set too 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.	• 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 	DC bus voltage is lower than the UV detection level or the pre-charge contactor is not active while the inverter is running. 190Vdc: 200V class; 380Vdc: 400V class (the detection value can be adjusted by 07-13)	• The input voltage is too low. • Input phase loss. • Input voltage fluctuation. • Magnetic contactor damaged. • DC bus voltage feedback signal value not incorrect.	• Check the input voltage. • Check input wiring. • Check power source • Replace magnetic contactor • Replace control board or complete inverter.
OH1 Heat sink overheating 	Heat sink is overheating : The temperature of the heat sink is too high. If heat sink overheating fault has occurred with three times in five minutes, it is required to wait for 10 minutes before resetting the fault.	• Ambient temperature is too high. • The cooling fan has stopped. • Carrier frequency setting is too high.	• Check the ambient temperature of the inverter. • Check the fan or dust and dirt in the heat sink. • Check the carrier frequency setting.

LED display	Description	Cause	Possible solutions
OH2 (flash) Inverter over heating warning	Inverter overheat warning: Multi-function digital input set to 32. (Terminal S1 ~ S6) Active when 03-00 ~ 03-05 =31).	• Multifunction digital input overheat warning active.	• Multi-function input function set incorrectly. • Check wiring
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.	• Load too heavy.	• 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.	• Sudden drop in load. • Belt break.	• Check under torque detection parameters (08-19 / 08-20). • Check load / application.
bb1 (flash) External baseblock	External base block (Terminal S1)	• Multifunction digital input external baseblock active.	• 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)		
bb5 (flash) External baseblock	External base block (Terminal S5)		

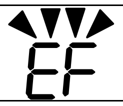
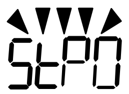
LED display	Description	Cause	Possible solutions
bb6 (flash) External baseblock	External base block (Terminal S6)	• Multifunction digital input external baseblock active.	• Multi-function input function set incorrectly. • Check wiring
OL1 Motor overload	Internal motor overload protection tripped, active when protection curve 08-05 = xxx1.	• Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Motor rated current (02-01) set incorrectly. • Load too heavy.	• 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	• Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Inverter rating too small. • Load too heavy.	• 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.	• Connection lost or wire broken. • Host stopped communicating.	• Check connection • Check host computer / software.
CLB over current protection level B	Inverter current reaches the current protection level B.	• Inverter current too high. • Load too heavy.	• Check load and duty cycle operation.
Retry (flash) retry	Automatic reset has activated, and it displays before the period of 07-01 automatic reset terminates.	• The period of 07-01 automatic reset≠0. • The times of 07-02 automatic reset≠0.	• It will disappear after the period of automatic reset.
EF1 (flash) External fault (S1)	External fault (Terminal S1) Active when 03-00= 25 or 68, and Inverter external fault selection 08-24=2.	• Multifunction digital input external fault active and parameter 08-24 = 2 for operation to continue.	• 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 or 68, and Inverter external fault selection 08-24=2.		
EF3 (flash) External fault (S3)	External fault (Terminal S3) Active when 03-02= 25 or 68, and Inverter external fault selection 08-24=2.		

LED display	Description	Cause	Possible solutions
EF4 (flash) External fault (S4) 	External fault (Terminal S4) Active when 03-03= 25 or 68, and Inverter external fault selection 08-24=2.	• Multifunction digital input external fault active and parameter 08-24 = 2 for operation to continue.	• Multi-function input function set incorrectly. • Check wiring • Multi-function input function set incorrectly. • Check wiring
EF5 (flash) External fault (S5) 	External fault (Terminal S5) Active when 03-04= 25 or 68, and Inverter external fault selection 08-24=2.		
EF6 (flash) External fault (S6) 	External fault (Terminal S6) Active when 03-05= 25 or 68, and Inverter external fault selection 08-24=2.		
EF9 (flash) error of forward/reversal rotation 	Forward run and reverse run are active within 0.5 sec of each other. Stop method set by parameter 07-09.	• Forward run and reverse run active (see 2-wire control).	• Check run command wiring
SE01 Rang setting error 	Parameter setting falls outside the allowed range.	• Some parameter ranges are determined by other inverter parameters which could cause an out of range warning when the dependency parameter is adjusted. For example: 02-00>02-01, 00-12<00-13 or when 00-07 = 1, 00-05 is the same with 00-06 or 20-16 <= 20-15.	• Check parameter setting.
SE02 Digital input terminal error 	Multi-function input setting error.	• 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). • UP/DOWN commands (08 and 09) and ACC/DEC commands (11) are set at the same time. • Speed search 1(19，maximum frequency) and Speed search 2 (34，from the set frequency）are set at the same time. • 2-wire sequence and 3-wire sequence set at the same time in 03-00~03-07	• Check multi-function input setting.

LED display	Description	Cause	Possible solutions
SE03 V/f curve error 	V/f curve setting error.	• V/F curve setting error. 01-02 > 01-12 > 01-06 (Fmax) (Fbase) (Fmid1) >01-08; (Fmin)	• Check V/F parameters
SE05 PID selection error 	PID selection error.	• 10-00 and 10-01are set to 1 (AI1) or 2 (AI2) simultaneously. • When 23-05=0 and 10-33>= 1000 or 10-34≠1.	• Check the setting value of parameters 10-00 and 10-01. • Check the setting value of 10-33, 10-34 and 23-05.
HPErr Model selection error 	Inverter capacity setting error: Inverter capacity setting 13-00 does not match the rated voltage.	• Inverter capacity setting does not match voltage class (13-00).	• Check inverter capacity setting 13-00.
SE09 PI setting error 	Inverter PI setting error	• Inverter pulse input selection (03-30) selection conflicts with PID source (10-00 and 10-01).	• Check pulse input selection (03-30) and PID source (10-00 and 10-01).
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).	• Feedback signal wire broken • Feedback sensor broken.	• Check feedback wiring • Replace feedback sensor.
USP (flash) Unattended Start Protection 	Unattended Start Protection (USP) is enabled (enabled at power-up.)	• USP at power-up (activated by multi-function digital input) is enabled. The inverter will not accept a run command. • While the warning is active the inverter does not accept a run command. (See parameter 03-00 - 03-05 = 50).	• Remove run command or reset inverter via multi-function digital input (03-00 to 03-07 = 17) or use the RESET key on the keypad to reset inverter. • Activate USP input and re-apply the power.
LFPB Low flow error 	Low flow error	• The feedback signal is not connected. • Due to HVAC feedback value is lower than limit of minimum flow.	• Check feedback signal is correct and with right connection. • Check if feedback value is lower than limit of minimum flow.
HFPB High flow error 	High flow error	• Due to HVAC feedback value is lower than limit of maximum flow.	• Check feedback signal is correct. • Check if feedback value is lower than limit of maximum flow.

LED display	Description	Cause	Possible solutions
L0PB Low pressure error 	Low pressure error	• The feedback signal is not connected. • Due to feedback value of pump pressure is lower than limit of minimum flow.	• Check feedback signal is correct and with connection. • Check if feedback value of pressure is lower than limit of minimum pressure.
HIPB High pressure error 	High pressure error	• Due to feedback value of pump pressure is lower than limit of maximum flow.	• 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	• Insufficient water of supply tank leads to insufficient suction. • PID difference is higher than its level or current is lower than output current level.	• 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	• Fire override mode is active	• None • (Fire override mode is not a kind of warning).
SE10 PUMP/HVAC Setting error 	PUMP/HVAC settings of inverter error	• PUMP selection of inverter (23-02)> (23-03). • HVAC selection of inverter (23-46)< (23-47).	• Check pump selection of inverter (23-02) and (23-03) settings. • Check HVAC selection of inverter (23-46) and (23-47) settings.
COPUP PUMP communication breaking error 	Breaking error of multiple pumps communication	• Communication breaking or disconnection of pump cascade control.	• Check if it has setting issue or is not properly connected.
Parameter Setting Error 	Parameter setting error	• Error of Parameter setting occurs.	• 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 can not start directly but displays the warning signal.	• Set the digital input terminal (S1~S6) to run and simultaneously set 07-04=1.	• Check the digital input terminal and disconnect it. Then reconnect the DI terminal after the setting delay time (07-05) ends.

LED display	Description	Cause	Possible solutions
External Terminal Stop Error StP2	External Terminal is main run command source selection (00-02=1) and run command executes but executes stop command from keypad.	• Run command executes from external terminal but executes stop command from keypad.	• Remove the run command from external terminal
ADC Voltage Error AdCEr	Abnormal voltage level on the control board	• Abnormal input voltage, too much noise or malfunctioning control board.	• Check the input voltage signal and the voltage on the control board.
EEPROM Archiving Error EPErr	EEPROM Poor archiving	• EEPROM poor peripheral circuit • It occurs in parameters check at inverter boot.	• Reconnect and if the warning signal appears again, replace the circuit board. • Contact TECO for more information.
Control Board Error bdErr	The control board is not correspondent with the program.	• The control board is not correspondent with the program.	• Replace the control board.
Wrong running direction Error rUnEr	Only for run in one direction, another direction command is not allowed.	• Run command for another direction on the terminal of control board is active.	• Cancel the run command for another direction on the terminal of control board.
PTC Signal Loss PtCLS	PTC Signal Loss detecting triggers error message	• PTC connection trips and has lasted for more than 10 seconds.	• Check if MT terminal and GND terminal are connected.
Parameters Locked LOC	Parameter password have been locked	• Parameter password function (13-07) starts.	• Correct password input at parameter 13-07
Password Setting Error Err2	Password input at the second time is different from that at the first time when the password lock function enables.	• Password input at the second time is different from that at the first time when the password lock function enables.	• Password input at the second time is the same as that at the first time when the password lock function enables.
Operator Reading Error **RDE***	Operator cannot read the inverter's information.	• Since signals from the inverter's control board are transmitted error, the inverter cannot normally transmit the data to operator.	• Check if the inverter is normally connected to the operator.

LED display	Description	Cause	Possible solutions
Operator Writing Error **WRE***	Operator cannot write the information into the inverter.	• Data control mode in operator is not consistent with that in the inverter. • Data models in operator are not consistent with that in the inverter. • Data firmware version in operator is not consistent with that in the inverter.	• Check the inverter's firmware version/ control mode/ models
Operator Verifying Error **VRYE***	After operator reads or writes data in the inverter, user can verify it. If the data are not consistent, the inverter displays the signal of verifying error.	• The data in the operator and the inverter is not consistent.	• Check if the inverter is normally connected to the operator.
Repeat Run Command 	The inverter is only allowed unidirectional operation and cannot operate in reverse direction simultaneously.	• Check if the external terminal is given a run command in reverse direction.	• Cancel the run command in reverse direction from the external terminal.
Operator Read Prohibit **RDP***	Selection of allowing reading (16-08) is set to 0 (Do not allow to read inverter parameters and save it to the operator).	• Set parameter 16-08 to 0.	• Set parameter 16-08 to 1 (Allow to read inverter parameters and save it to the operator).
External Emergency Stop 	Function of external emergency stop starts.	• Parameter 03-00~03-08 is set to 14 (Function of emergency stop is enabled.)	• Remove & shutdown the run command of external emergency stop and reset it to multi-function digital input.
Zero Speed Stop Warning 	The operation signal is enabled but frequency command is lower than the minimum output frequency (01-08) and DC brake is disabled.	• The frequency command is not set up.	• Set up the frequency command.
Overload of Air Compressor 	If the inverter's output current reaches OL4 current level (23-69), OL4 Delay Time (23-70) passed. When the count is reached, the inverter will automatically decelerate to stop and displays a warning signal.	• Since the current level (23-69) is set to be over low, the inverter's output current is higher than the standard one or compressor's current is used to be over high.	• Check if the compressor load used is higher than the standard one.
PID feedback signal loss 	When 23-19 > 0, the inverter will according to feedback pressure is less than (pressure transmitter maximum pressure (23-03) x proportion of loss pressure detection (23-19)) value, if the pressure loss detection time (23-18) passed and 23-78 = 1 (loss of pressure detection function) will jump warning signal	• 23-19 proportion of loss pressure detection is too big • Feedback sensor install failure or not work normal。	• Check 23-19 setting. • Make sure correct installation and PID feedback signal.

*** RDE、WRE、VRYE、RDP warning signals are only displayed in LCD keypad.**

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.	• Motor Input data error during auto-tuning. • Inverter output current does not match motor rated current.	• Check the motor tuning data (17-00 to 17-09). • Check inverter capacity
02	Motor lead to lead resistance R1 tuning error.	• Auto-tuning is not completed within the specified time • Auto-tuning results fall outside parameter setting range. • Motor rated current exceeded. • Motor was disconnected.	• 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		
08	Motor acceleration error (Rotational type auto-tuning only).	• Motor fails to accelerate in the specified time (00-14= 20sec).	• Increase acceleration time (00-14). • Disconnect motor load.
09	Other auto-tuning errors	• No load current is higher than 70% of the motor rated current. • Torque reference exceeds 100%. • Errors other than ATE01~ATE08.	• 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 22-22.

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.

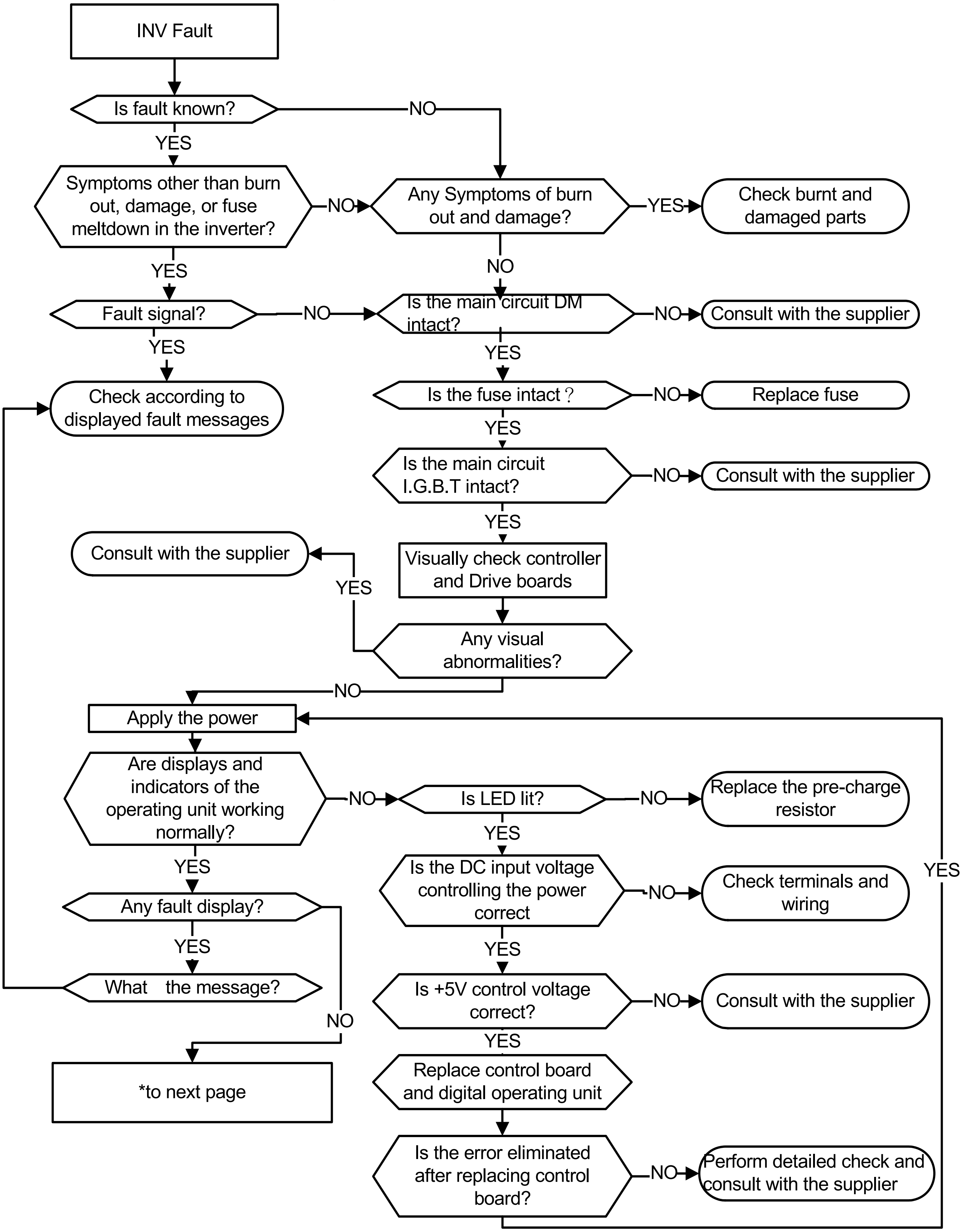
Table 10.5.1 Auto-tuning fault and corrective actions for PM motor

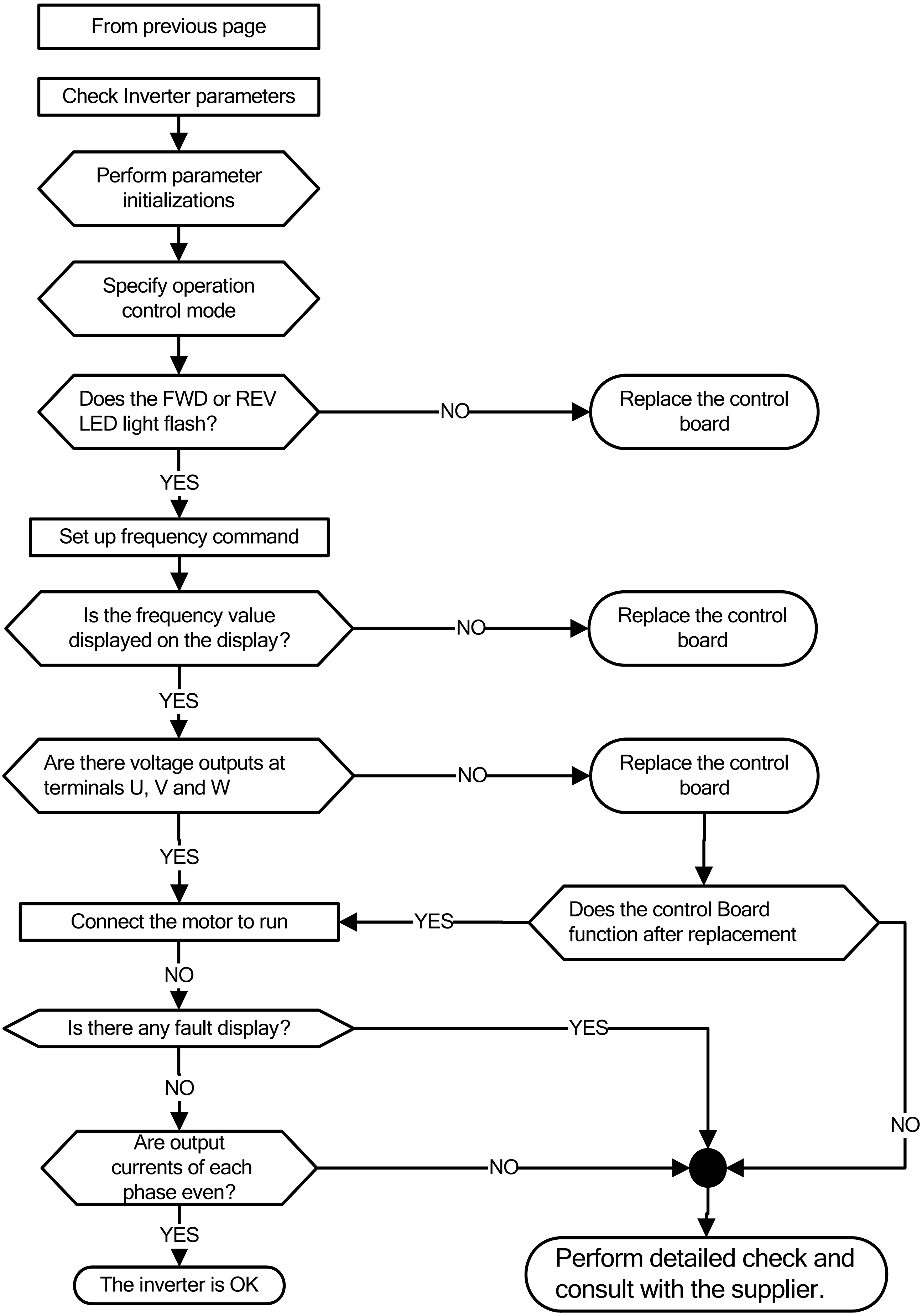
Error	Description	Cause	Corrective action
01	Magnetic pole alignment tuning failure (static).	• Inverter output current does not match motor current.	• Check the motor tuning data (22-02). • Check inverter capacity
02~04	Reserved		
05	Circuit tuning time out.	• System abnormality during circuit tuning.	• Check for active protection functions preventing auto-tuning.
06	Reserved		
07	Other motor tuning errors.	• Other tuning errors.	• Check the motor tuning data (22-02). • Check motor connection.
08	Reserved		
09	Current out of range during circuit tuning.	• Inverter output current does not match motor current.	• Check the motor tuning data (22-02). • Check inverter capacity
10	Reserved		
11	Parameter tuning and detecting time out.	• Error relationship between voltage and current.	• Check if the setting value of parameter 22-11 is too low, but its value cannot exceed 100% of the inverter. • Check motor connection.

10.6 General troubleshooting

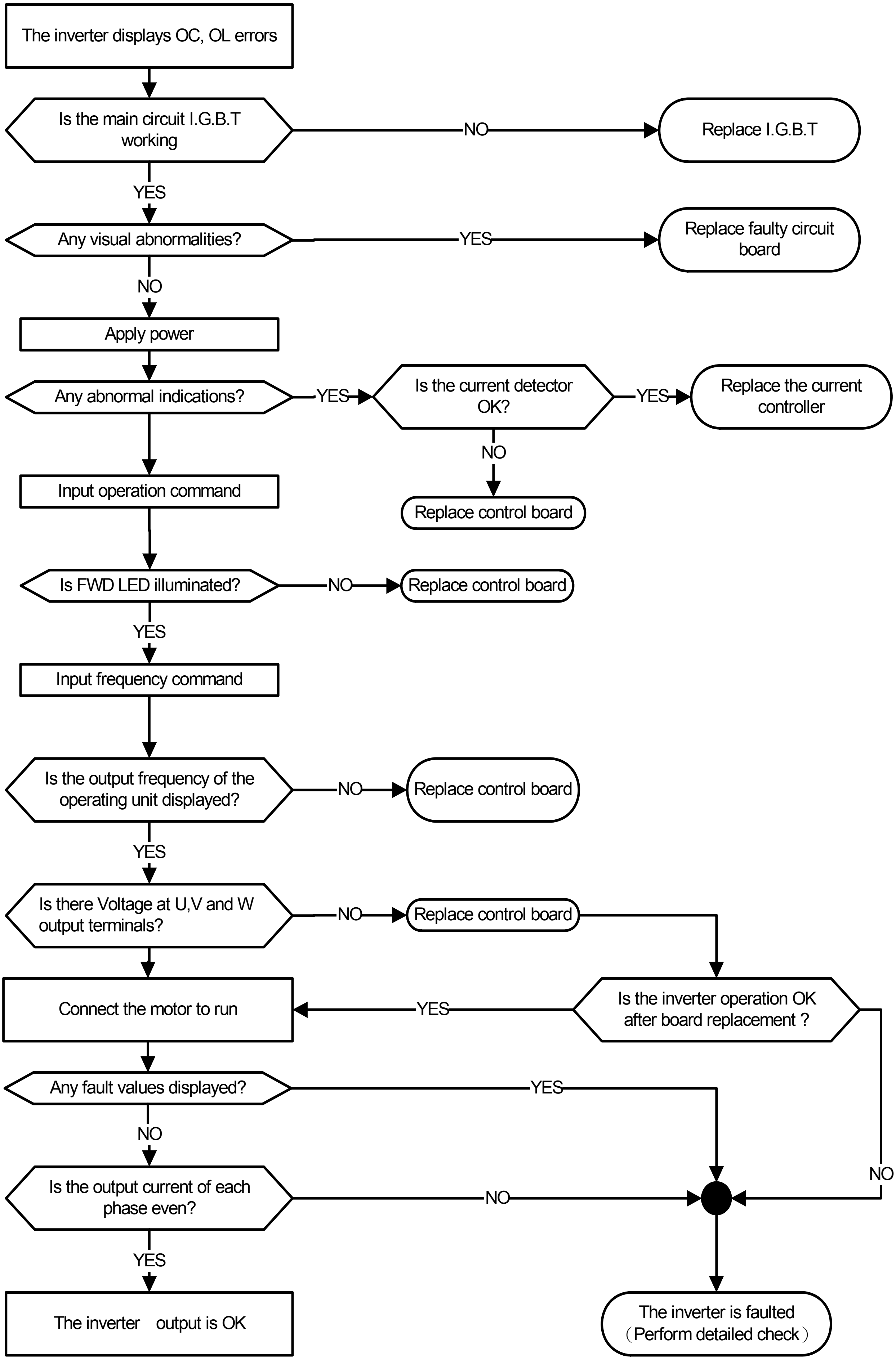
Status	Checking point	Remedy
Motor runs in wrong direction	Is the wiring for the output terminals correct?	Wiring must match U, V, and W terminals of the motor.
	Is the wiring for forward and reverse signals correct?	Check for correct wiring.
The motor speed can not be regulated.	Is the wiring for the analog frequency inputs correct?	Check for correct wiring.
	Is the setting of operation mode correct?	Check the Frequency Source set in parameters 00-05/00-06.
	Is the load too excessive?	Reduce the load.
Motor running speed too high or too low	Check the motor specifications (poles, voltage…) correct?	Confirm the motor specifications.
	Is the gear ratio correct?	Confirm the gear ratio.
	Is the setting of the highest output frequency correct?	Confirm the highest output frequency
Motor speed varies unusually	Is the load too excessive?	Reduce the load.
	Does the load vary excessively?	1.Minimize the variation of the load. 2.Consider increasing the capacities of the inverter and the motor.
	Is the input power unstable or is there a phase loss ?	1.Consider adding an AC reactor at the power input side if using single-phase power. 2.Check wiring if using three-phase power
Motor can not run	Is the power connected to the correct L1, L2, and L3 terminals? is the charging indicator lit ?	1.Is the power applied? 2.Turn the power OFF and then ON again. 3.Make sure the power voltage is correct. 4.Make sure screws are secured firmly.
	Is there voltage across the output terminals T1, T2, and T3?	Turn the power OFF and then ON again.
	Is overload causing the motor to stall?	Reduce the load so the motor will run.
	Are there any abnormalities in the inverter?	See error descriptions to check wiring and correct if necessary.
	Is there a forward or reverse run command ?	
	Has the analog frequency signal been input?	1.Is analog frequency input signal wiring correct? 2.Is voltage of frequency input correct?
	Is the operation mode setting correct?	Operate through the digital keypad

10.7 Troubleshooting of the Inverter
10.7.1 Quick troubleshooting of the Inverter

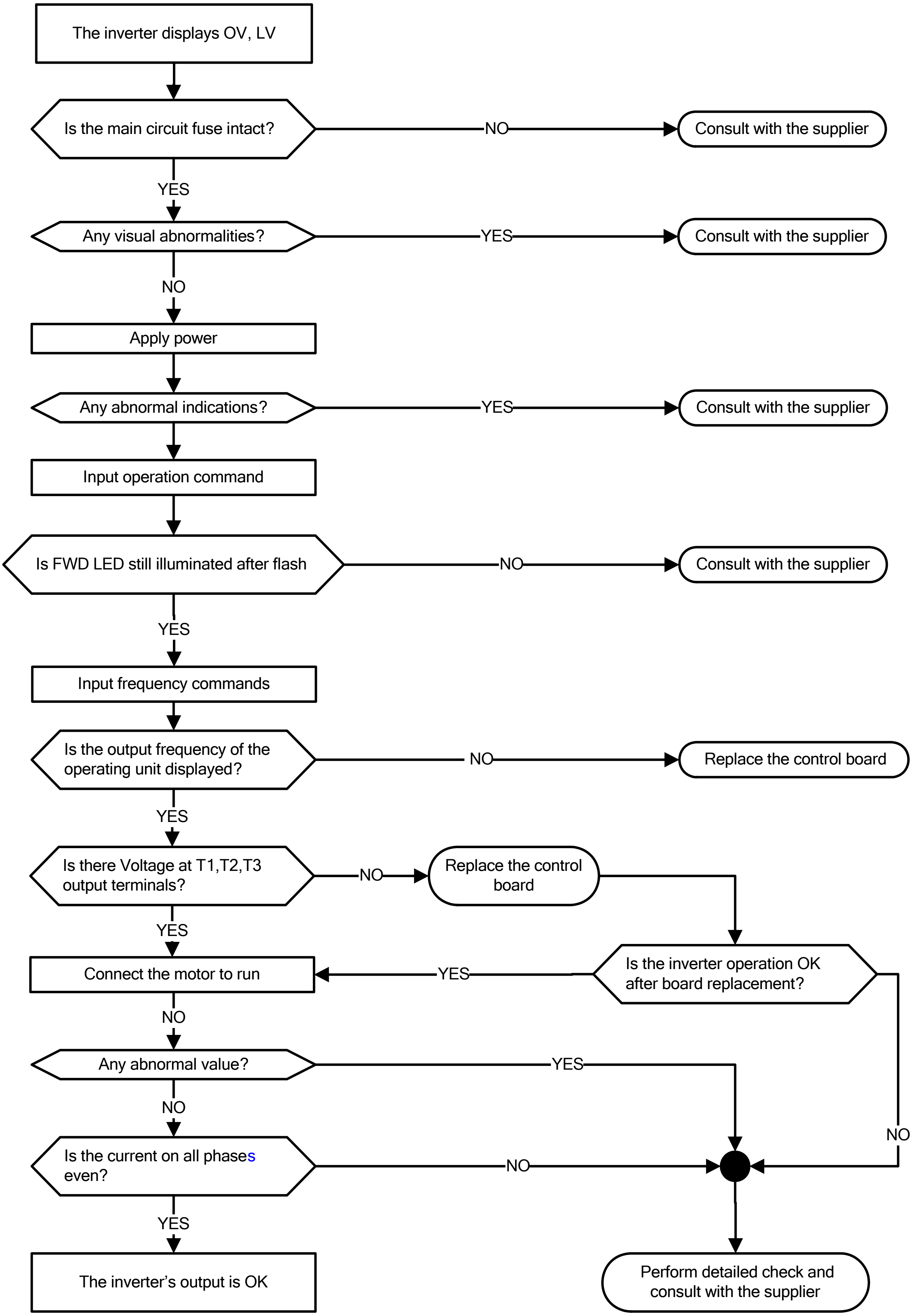



From previous page
Check Inverter parameters
Perform parameter initializations
Specify operation control mode
Does the FWD or REV LED light flash?
NO
Replace the control board
YES
Set up frequency command
Is the frequency value displayed on the display?
NO
Replace the control board
YES
Are there voltage outputs at terminals U, V and W
NO
Replace the control board
YES
Connect the motor to run
YES
Does the control Board function after replacement
NO
Is there any fault display?
YES
NO
Are output currents of each phase even?
NO
NO
YES
The inverter is OK
Perform detailed check and consult with the supplier.

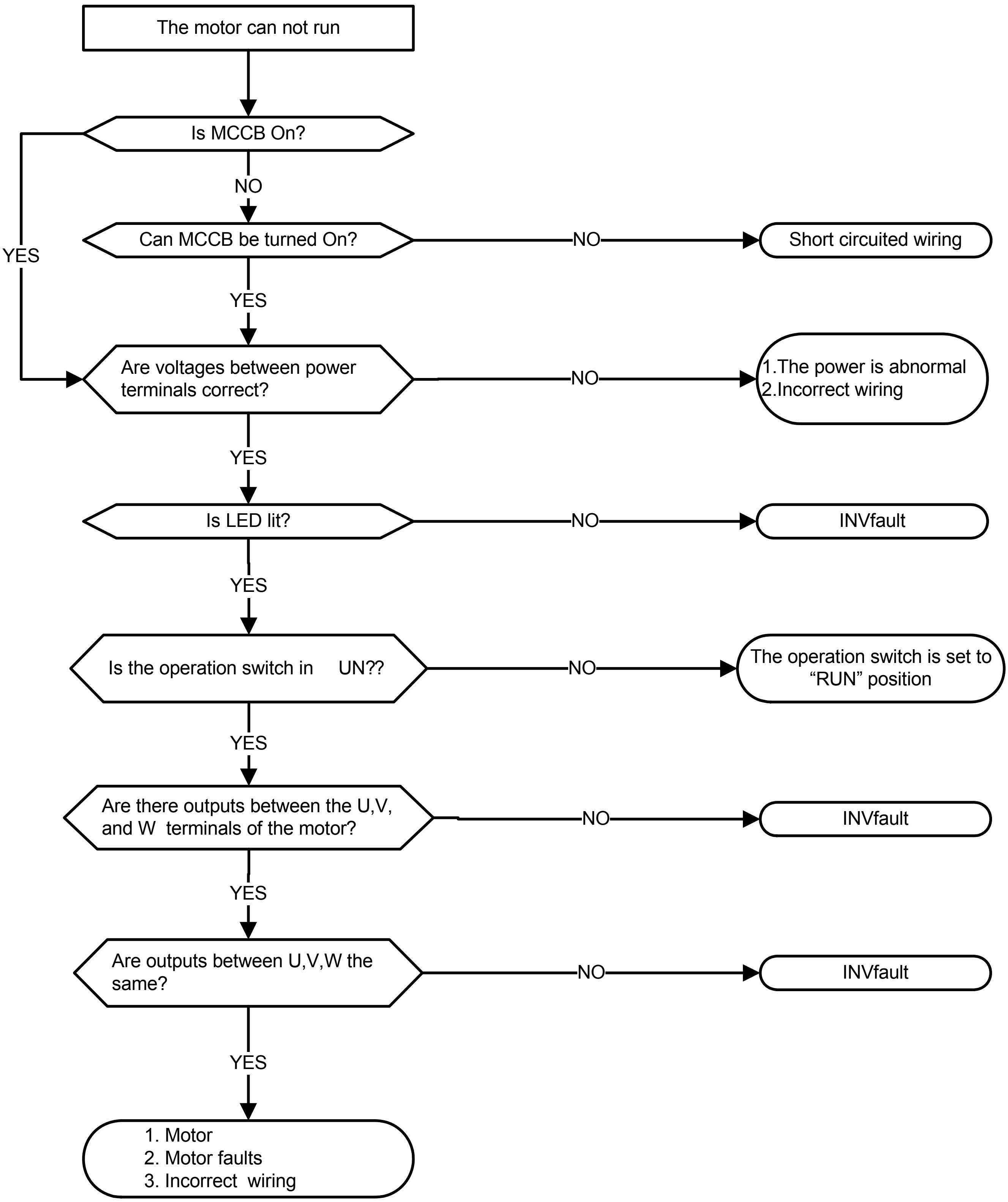
10.7.2 Troubleshooting for OC, OL error displays



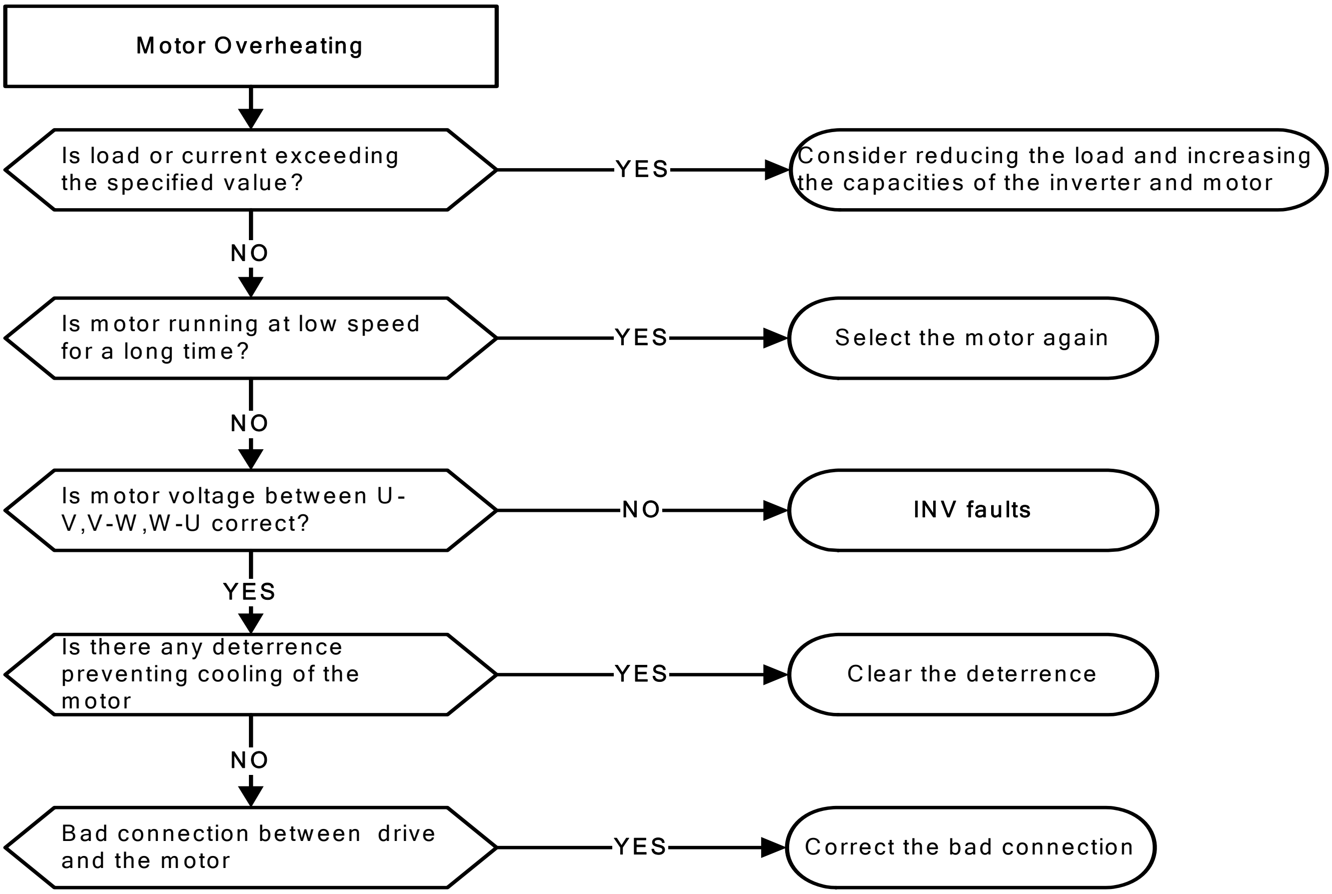
10.7.3 Troubleshooting for OV, LV error



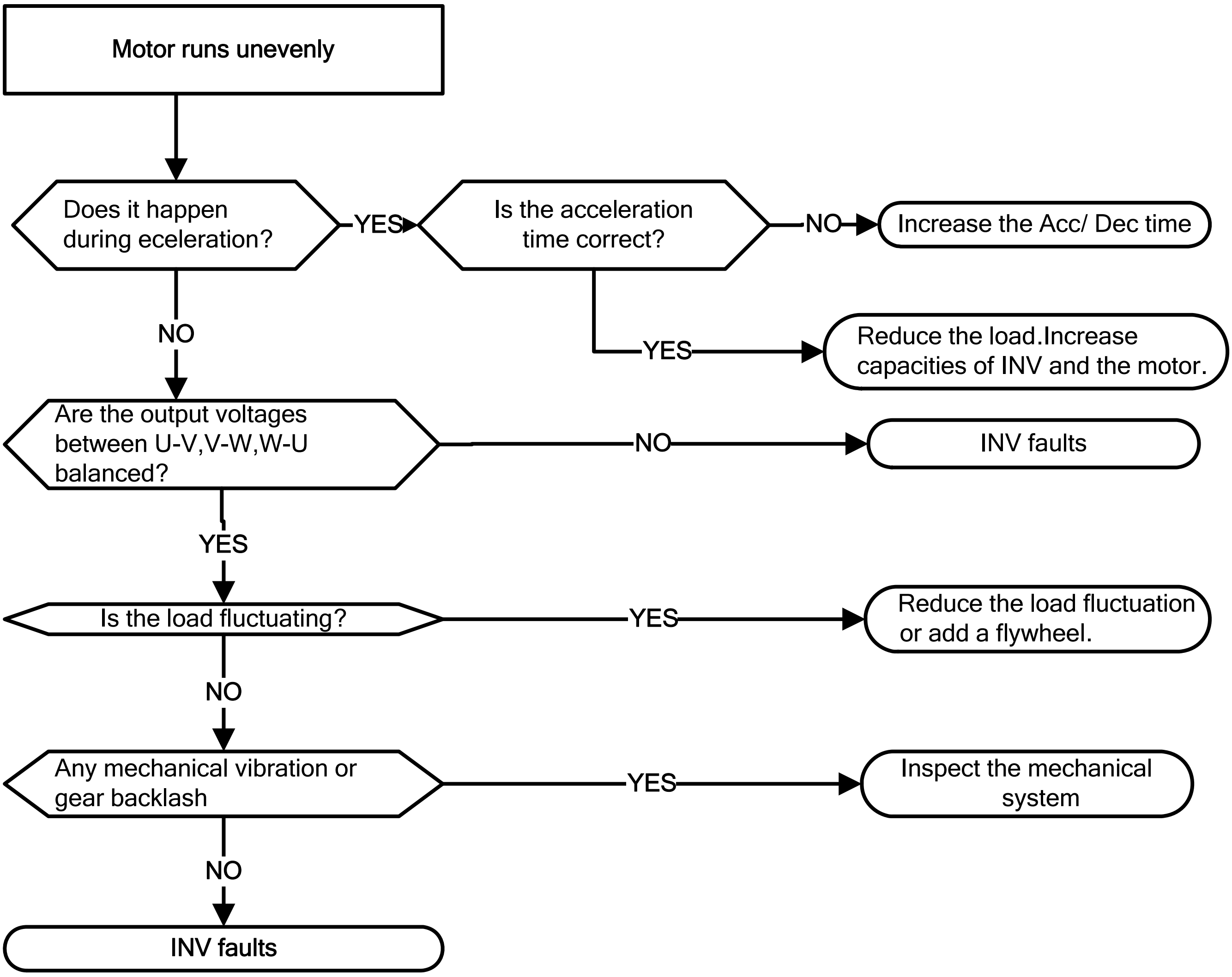
10.7.4 The motor can not run



10.7.5 Motor Overheating



10.7.6 Motor runs unbalanced



10.8 Routine and periodic inspection

To ensure stable and safe operations, check and maintain the inverter at regular intervals.
Use the checklist below to carry out inspection.
Disconnect power after approximately 5 minutes to make sure no voltage is present on the output terminals before any inspection or maintenance.

Items	Details	Checking period: Daily	Checking period: 1Year	Methods	Criteria	Remedies
Environment & Ground connection						
Ambient conditions at the installation	Confirm the temperature and humidity at the machine	◎		Measure with thermometer and hygrometer	Temperature: -10 ~40°C/50°C (14~104°F)/(122°F) Humidity: Below 95%RH	Improve the ambient or relocate the drive to a better area.
Installation Grounding	Is the grounding resistance correct?		◎	Measure the resistance with a multi-tester	200Vclass: below 100Ω	Improve the grounding if needed.
Terminals & Wiring						
Connection terminals	Any loose parts or terminals?		◎	Visual check Check with a screwdriver	Correct installation requirement	Secure terminals and remove rust
	Any damage to the base ?		◎			
	Any corroded Terminals?		◎			
Wiring	Any broken wires?		◎	Visual check	Correct wiring requirement	Rectify as necessary
	Any damage to the wire insulation?		◎			
voltage						
Input power voltage	Is the voltage of the main circuit correct?	◎		Measure the voltage with a multi-tester	Voltage must conform with the spec.	Improve input voltage if necessary.
Circuit boards and components						
Printed circuit board	Any contamination or damage to printed circuit board?		◎	Visual check	Correct component condition	Clean or replace the circuit board
Power component	Any dust or debris		◎			Clean component s
	Check resistance between terminals		◎	Measure with a multi-tester	No short circuit or broken circuit in three phase output	Consult with the supplier
Cooling System						
Cooling fan	Unusual vibration and noise?		◎	Visual and sound check	Correct cooling	Consult with the supplier
	Excessive dust or debris	◎		Visual check		Clean the fan
Heat sink	Excessive dust or debris	◎				Clean up debris or dust
Ventilation Path	Is the ventilation path blocked?	◎				Clear the path

10.9 Maintenance

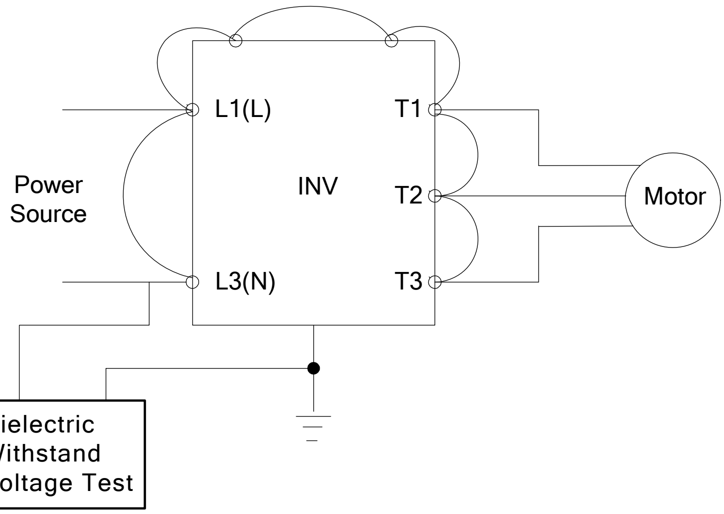
To ensure long-term reliability, follow the instructions below to perform regular inspection. Turn the power off and wait for a minimum of 5 minutes before inspection to avoid potential shock hazard from the charge stored in high-capacity capacitors.

1. Maintenance Check List.

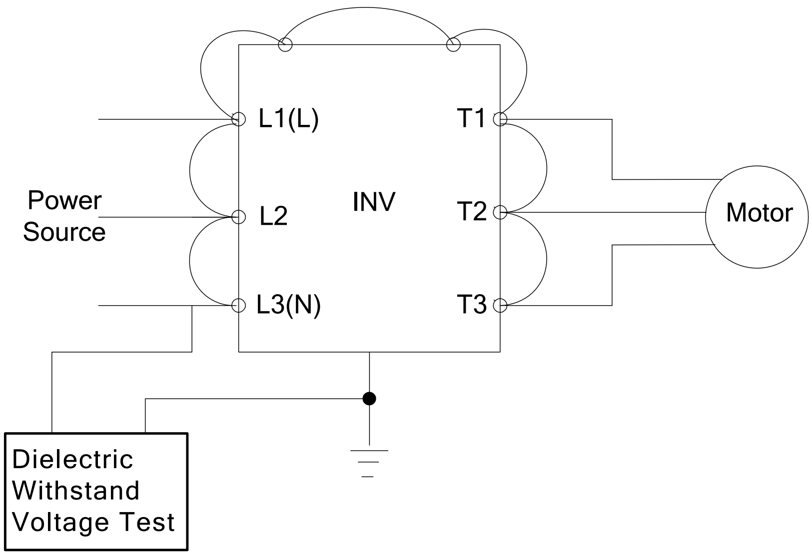
➢ Ensure that temperature and humidity around the inverters is as required in the instruction manual, installed away from any sources of heat and the correct ventilation is provided..
➢ For replacement of a failed or damaged inverter consult with the local supplier.
➢ Ensure that the installation area is free from dust and any other contamination.
➢ Check and ensure that the ground connections are secure and correct.
➢ Terminal screws must be tight, especially on the power input and output of the inverter.
➢ Do not perform any insulation test on the control circuit.

2. Insulation test Method .

Single Phase



Three Phase



Chapter 11 Inverter Peripheral devices and Options

11.1 Braking Resistors and Braking Units

Inverters ratings 200V 1~30HP/400V 1~40HP (IP20) and 400V 1~25HP (IP55) have a built-in braking transistor. For applications requiring a greater braking torque an external braking resistor can be connected to terminals B1 / P and B2 in protection level of IP20 and to terminals B1 and B2 in protection level of IP55; for inverter ratings above 200V 40HP/400V 50HP (IP20) or 400V 30HP (IP55), external braking units (connected to ⊕ - ⊖ of the inverter) and braking resistors (connected to two ends of the detection module B-P0) are required.

Table 11.1.1 List of braking resistors and braking units (IP20)

Inverter			Braking unit		Braking resistor					Braking torque (Peak / Continues) 10%ED	Minimum Resistance[*1]	
Input Voltage	HP	KW	Model	Qty Req.	Part Number	Resistor specification	Qty Req. (set)	Resistor Spec.(W/Ω) & Dimensions (L*W*H)mm	Qty Req. (pcs)		(Ω)	(W)
1 Ø /3 Ø 200V	1	0.75	-	-	JNBR-100W200	100W/200Ω	1	100W/200Ω (196*28*60)	1	119%	17Ω	1000W
	2	1.5	-	-	JNBR-200W100	200W/100Ω	1	200W/100Ω (274*35*76)	1	119%	17Ω	1000W
	3	2.2	-	-	JNBR-260W70	260W/70Ω	1	260W/70Ω (274*40*78)	1	115%	17Ω	1000W
3 Ø 200V	5	3.7	-	-	JNBR-450W40	450W/40Ω	1	450W/40Ω (320*40*78)	1	119%	23Ω	780W
	7.5	5.5	-	-	JNBR-600W28	600W/28Ω	1	600W/28Ω (395*40*78)	1	115%	17Ω	1000W
	10	7.5	-	-	JNBR-900W20	900W/20Ω	1	900W/20Ω (470*50*100)	1	119%	17Ω	1000W
	15	11	-	-	JNBR-1R5KW13R6	1500W/13.6Ω	1	1500W/13.6Ω (615*60*110)	1	117%	10.0Ω	1800W
	20	15	-	-	JNBR-2KW10	2000W/10Ω	1	2000W/10Ω (722*65*115)	1	119%	10.0Ω	1800W
	25	18.5	-	-	JNBR-2R4KW8	2400W/8Ω	1	1200W/16Ω (535*60*110)	2 in parallel	119%	6.8Ω	2600W
	30	22			JNBR-3KW6R8	3000W/6.8Ω	1	1500W/13.6Ω (615*60*110)	2 in parallel	117%	6.8Ω	2600W
	40	30	JNTBU-230	2	JNBR-2KW10	2000W/10Ω	2	2000W/10Ω (722*65*115)	1	122%	5.5Ω	3300W
	50	37	JNTBU-230	2	JNBR-2KW10	2000W/10Ω	2	2000W/10Ω (722*65*115)	1	102%	5.5Ω	3300W
	60	45	JNTBU-230	2	JNBR-3KW6R8	3000W/6.8Ω	2	1500W/13.6Ω (615*60*110)	2 in parallel	120%	5.5Ω	3300W
			JNTBU-260	1	JNBR-7R5KW4	7500W/4Ω	1	1500W/20Ω	5 in parallel	106%	3.8Ω	4500W
	75	55	JNTBU-230	2	JNBR-3KW6R8	3000W/6.8Ω	2	1500W/13.6Ω (615*60*110)	2 in parallel	100%	5.5Ω	3300W
			JNTBU-260	2	JNBR-4R5KW6R6	4500W/6.6Ω	2	1500W/20Ω (615*60*110)	3 in parallel	106%	3.8Ω	4500W
	100	75	JNTBU-230	3	JNBR-3KW6R8	3000W/6.8Ω	3	1500W/13.6Ω (615*60*110)	2 in parallel	110%	5.5Ω	3300W

Inverter			Braking unit		Braking resistor					Braking torque (Peak / Continues) 10%ED	Minimum Resistance*1	
Input Voltage	HP	KW	Model	Qty Req.	Part Number	Resistor specification	Qty Req. (set)	Resistor Spec.(W/Ω) & Dimensions (L*W*H)mm	Qty Req. (pcs)		(Ω)	(W)
			JNTBU-260	2	JNBR-6KW5	6000W/5Ω	2	1500W/20Ω (615*60*110)	4 in parallel	107%	3.8Ω	4500W
	125	90	JNTBU-230	4	JNBR-3KW6R8	3000W/6.8Ω	4	1500W/13.6Ω (615*60*110)	2 in parallel	116%	5.5Ω	3300W
			JNTBU-260	2	JNBR-7R5KW4	7500W/4Ω	2	1500W/20Ω (615*60*110)	5 in parallel	110%	3.8Ω	4500W
	150	110	JNTBU-230	4	JNBR-3KW6R8	3000W/6.8Ω	4	1500W/13.6Ω (615*60*110)	2 in parallel	100%	5.5Ω	3300W
			JNTBU-260	2	JNBR-7R5KW4	7500W/4Ω	2	1500W/20Ω (615*60*110)	5 in parallel	92%	3.8Ω	4500W
	175	130	JNTBU-230	5	JNBR-3KW6R8	3000W/6.8Ω	5	1500W/13.6Ω (615*60*110)	2 in parallel	106%	5.5Ω	3300W
			JNTBU-260	3	JNBR-6KW5	6000W/5Ω	3	1500W/20Ω (615*60*110)	4 in parallel	94%	3.8Ω	4500W
3 Ø 400V	1	0.75	-	-	JNBR-100W750	100W/750Ω	1	100W/750Ω (196*28*60)	1	126%	100Ω	700W
	2	1.5	-	-	JNBR-200W400	200W/400Ω	1	200W/400Ω (274*35*76)	1	120%	100Ω	700W
	3	2.2	-	-	JNBR-300W250	300W/250Ω	1	300W/250Ω (320*40*78)	1	126%	68Ω	1000W
	5	3.7	-	-	JNBR-500W150	500W/150Ω	1	500W/150Ω (400*50*100)	1	126%	60Ω	1200W
	7.5	5.5	-	-	JNBR-700W110	700W/110Ω	1	700W/110Ω (530*50*100)	1	117%	60Ω	1200W
	10	7.5	-	-	JNBR-900W80	900W/80Ω	1	900W/80Ω (470*50*100)	1	120%	43Ω	1600W
	15	11	-	-	JNBR-1R6KW50	1600W/50Ω	1	1600W/50Ω (615*60*110)	1	126%	43Ω	1600W
	20	15	-	-	JNBR-2KW40	2000W/40Ω	1	2000W/40Ω (722*65*115)	1	120%	39Ω	1800W
	25	18.5	-	-	JNBR-2R4KW32	2400W/32Ω	1	1200W/64Ω (535*60*110)	2 in parallel	120%	20.5Ω	3500W
	30	22	-	-	JNBR-3KW27R2	3000W/27.2Ω	1	1500W/13.6Ω (615*60*110)	2 in series	118%	13.5Ω	5200W
	40	30	-	-	JNBR-4KW20	4000W/20Ω	1	2000W/40Ω (722*65*115)	2 in parallel	120%	13.5Ω	5200W
	50	37	JNTBU-430	2	JNBR-2R4KW32	2400W/32Ω	2	1200W/64Ω (535*60*110)	2 in parallel	122%	19.2Ω	3800W
	60	45	JNTBU-430	2	JNBR-3KW27R2	3000W/27.2Ω	2	1500W/13.6Ω (615*60*110)	2 in series	120%	19.2Ω	3800W
	75	55	JNTBU-430	2	JNBR-4KW20	4000W/20Ω	2	2000W/40Ω (722*65*115)	2 in parallel	129%	19.2Ω	3800W
	100	75	JNTBU-430	3	JNBR-3KW27R2	3000W/27.2Ω	3	1500W/13.6Ω (615*60*110)	2 in series	110%	19.2Ω	3800W
	125	90	JNTBU-430	3	JNBR-4KW20	4000W/20Ω	3	2000W/10Ω (722*65*115)	2 in series	118%	19.2Ω	3800W

Inverter			Braking unit		Braking resistor					Braking torque (Peak / Continues) 10%ED	Minimum Resistance[*1]	
Input Voltage	HP	KW	Model	Qty Req.	Part Number	Resistor specification	Qty Req. (set)	Resistor Spec.(W/Ω) & Dimensions (L*W*H)mm	Qty Req. (pcs)		(Ω)	(W)
			JNTBU-4120	1	JNBR-11R2KW7R2	11200W/7.2Ω	1	1600W/50Ω (615*60*110)	7 in parallel	107%	7.6Ω	9000W
	150	110	JNTBU-430	4	JNBR-4KW20	4000W/20Ω	4	2000W/10Ω (722*65*115)	2 in series	129%	19.2Ω	3800W
			JNTBU-4120	2	JNBR-6R4KW12R5	6400W/12.5Ω	2	1600W/50Ω (615*60*110)	4 in parallel	102%	7.6Ω	9000W
	175	132	JNTBU-430	4	JNBR-4KW20	4000W/20Ω	4	2000W/10Ω (722*65*115)	2 in series	113%	19.2Ω	3800W
			JNTBU-4120	2	JNBR-8KW10	8000W/10Ω	2	1600W/50Ω (615*60*110)	5 in parallel	108%	7.6Ω	9000W
	215	160	JNTBU-430	5	JNBR-4KW20	4000W/20Ω	5	2000W/10Ω (722*65*115)	2 in series	115%	19.2Ω	3800W
			JNTBU-4120	2	JNBR-9R6KW8R3	9600W/8.3Ω	2	1600W/50Ω (615*60*110)	6 in parallel	106%	7.6Ω	9000W
	250	185	JNTBU-430	6	JNBR-4KW20	4000W/20Ω	6	2000W/10Ω (722*65*115)	2 in series	118%	19.2Ω	3800W
			TBU-4120	2	JNBR-11R2KW7R2	11200W/7.2Ω	2	1600W/50Ω (615*60*110)	7 in parallel	106％	7.6Ω	9000W
	300	220	JNTBU-430	6	JNBR-4KW20	4000W/20Ω	6	2000W/10Ω (722*65*115)	2 in series	102%	19.2Ω	3800W
			JNTBU-4120	3	JNBR-9R6KW8R3	9600W/8.3Ω	3	1600W/50Ω (615*60*110)	6 in parallel	112%	7.6Ω	9000W
	375	280	JNTBU-430	8	JNBR-4KW20	4000W/20Ω	8	2000W/10Ω (722*65*115)	2 in series	107%	19.2Ω	3800W
			JNTBU-4120	3	JNBR-9R6KW8R3	9600W/8.3Ω	3	1600W/50Ω (615*60*110)	6 in parallel	105%	7.6Ω	9000W
	425	315	JNTBU-430	9	JNBR-4KW20	4000W/20Ω	9	2000W/10Ω (722*65*115)	2 in series	107%	19.2Ω	3800W
			JNTBU-4120	4	JNBR-8KW10	8000W/10Ω	4	1600W/50Ω (615*60*110)	5 in parallel	104%	7.6Ω	9000W
	535	400	JNTBU-430	10	JNBR-4KW20	4000W/20Ω	10	2000W/10Ω (722*65*115)	2 in series	96%	19.2Ω	3800W
			TBU-4120	5	JNBR-8KW10	8000W/10Ω	5	1600W/50Ω (615*60*110)	5 in parallel	113％	7.6Ω	9000W
	670	500	JNTBU-430	12	JNBR-4KW20	4000W/20Ω	12	2000W/10Ω (722*65*115)	2 in series	94%	19.2Ω	3800W
			TBU-4120	7	JNBR-8KW10	8000W/10Ω	7	1600W/50Ω (615*60*110)	5 in parallel	112％	7.6Ω	9000W
	800	600	JNTBU-430	14	JNBR-4KW20	4000W/20Ω	14	2000W/10Ω (722*65*115)	2 in series	92%	19.2Ω	3800W
			TBU-4120	8	JNBR-8KW10	8000W/10Ω	8	1600W/50Ω (615*60*110)	5 in parallel	108％	7.6Ω	9000W

IP55 煞車電阻及煞車檢出模組一覽表

Inverter			Braking Unit		Braking resistor					Braking torque (Peak / Continues) 10%ED	Minimum resistance	
V	HP	KW	Model	Qty Req	V	HP	KW	Model	Qty Req		(Ω)	(W)
3 Ø 400V	1	0.75	-	-	JNBR-100W750	100W/750Ω	1	100W/750Ω (196*28*60)	1	126%	100Ω	700W
	2	1.5	-	-	JNBR-200W400	200W/400Ω	1	200W/400Ω (274*35*76)	1	120%	100Ω	700W
	3	2.2	-	-	JNBR-300W250	300W/250Ω	1	300W/250Ω (320*40*78)	1	126%	100Ω	700W
	5	3.7	-	-	JNBR-500W150	500W/150Ω	1	500W/150Ω (400*50*100)	1	126%	68Ω	1000W
	7.5	5.5	-	-	JNBR-700W110	700W/110Ω	1	700W/110Ω (530*50*100)	1	117%	68Ω	1000W
	10	7.5	-	-	JNBR-900W80	900W/80Ω	1	900W/80Ω (470*50*100)	1	120%	41Ω	1800W
	15	11	-	-	JNBR-1R5KW50	1500W/50Ω	1	1500W/50Ω (615*60*110)	1	126%	41Ω	1800W
	20	15	-	-	JNBR-2KW40	2000W/40Ω	1	2000W/40Ω (722*65*115)	1	120%	20.5Ω	3500W
	25	18.5	-	-	JNBR-2R4KW32	2400W/32Ω	1	1200W/64Ω (535*60*110)	2 in parallel	120%	20.5Ω	3500W
	30	22	JNTBU-430	1	JNBR-3KW27R2	3000W/27.2Ω	1	1500W/13.6Ω (615*60*110)	2 in series	118%	19.2Ω	3800W
	40	30	JNTBU-430	1	JNBR-4KW20	4000W/20Ω	1	2000W/40Ω (722*65*115)	2 in parallel	120%	19.2Ω	3800W
	50	37	JNTBU-430	2	JNBR-2R4KW32	2400W/32Ω	2	1200W/64Ω (535*60*110)	2 in parallel	122%	19.2Ω	3800W
	60	45	JNTBU-430	2	JNBR-3KW27R2	3000W/27.2Ω	2	1500W/13.6Ω (615*60*110)	2 in series	120%	19.2Ω	3800W
	75	55	JNTBU-430	2	JNBR-4KW20	4000W/20Ω	2	2000W/40Ω (722*65*115)	2 in parallel	129%	19.2Ω	3800W
	100	75	JNTBU-430	3	JNBR-3KW27R2	3000W/27.2Ω	3	1500W/13.6Ω (615*60*110)	2 in series	110%	19.2Ω	3800W

Note 1: 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

Model		AC reactor	
Voltage	**HP**	**Inductance Value (mH)**	**Rated Current (A)**
1ϕ/3ϕ 200V	**1**	1.7	15
	2	1.1	20
	3	0.85	25
3ϕ 200V	**5**	0.7	17
	7.5	0.46	25
	10	0.34	40
	15	0.24	50
	20	0.18	70
	25	0.15	85
	30	0.13	95
	40	0.09	140
	50	0.07	170
	60	0.06	210
	75	0.05	250
	100	0.04	310
	125	0.03	390
	150	0.03	490
	175	0.02	550
3ϕ 400V	**1/2**	4.9	5
	3	3.7	6.5
	5/7.5	1.7	15
	10	1.2	25
	15	0.88	30
	20	0.65	40
	25	0.53	50
	30	0.46	55
	40	0.35	70
	50	0.28	90
	60	0.23	110
	75	0.2	130
	100	0.14	180
	125	0.12	210
	150	0.1	260
	175/215	0.07	360
	250	0.06	400
	300	0.05	550
	375/425	0.04	720

Model		AC reactor	
Voltage	HP	Inductance Value (mH)	Rated Current (A)
	535	0.02	862
	670	0.02	1050
	800	0.02	1200

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. 200V class 60~175HP (IP20), 400V class 100HP~425HP (IP20 standard H & C type), 400V class 125HP~425HP (IP20 enhanced E & G type) and 5HP~100HP (IP55) have built-in DC reactors. If required by the application an AC reactor may be added.

11.3 Input Noise Filters

A. Input Noise Filter on Specifications & Ratings

Install a noise filter on power supply side to eliminate noise transmitted between the power line and the inverter. The inverter noise filter shown in Table 11.3.1 and Table 11.3.2 below meets the EN61800-3 class A specification. 400V inverter class models can be ordered with integrated noise filter.

Table 11.3.1 Input Noise Filter Specifications and Ratings (IP20)

Inverter size		Noise filter	
Input voltage	**HP**	**Model**	**Dimension**
1ϕ 200V	1HP/2HP/3HP	FN3258-30-47	240*50*85
3ϕ 200V	1HP/2HP/3HP	FN3258-16-45	264*45*70
	5HP/7.5HP	FS32124-23-99	290*50*85
	10HP/15HP	FS32123-40-99	330*85*90
	20HP	FS32125-56-99	318*80*135
	25HP/30HP	FS32125-79-99	360*95*90
	40HP/50HP	FS32125-138-99	320*226.5*86
	60HP/75HP	FS32125-211-99	320*226.5*86
	100HP/125HP	FS32125-312-99	320*226.5*86
	150HP/175HP	FN3270H-1000-99	610*230*132
3ϕ 400V	1HP/2HP/3HP	JN5-FLT-8A-02	102*130*92
	5HP/7.5HP/10HP	JN5-FLT-19A	123*141*92
	15HP/20HP	JN5-FLT-33A	132*206*124
	25HP/30HP/40HP	JN5-FLT-63A	127*260*131
	50HP/60HP/75HP	JN5-FLT-112A	186*284*128
	100HP/125HP	FS32126-165-99	320*226.5*86
	150HP/175HP/215HP/250HP	FS32126-361-99	320*226.5*86
	300HP/375HP/425HP	FN3270H-1000-99	610*230*132
	535HP/670HP/800HP	FN3270H-1000-99	610*230*132

B. Input or Output Noise Filter (EMI Suppression Zero Phase Core)

- Part Number: 4H000D0250001
- Select a matched ferrite core to suppress EMI noise according to the required power rating and wire size.
- The ferrite core can attenuate high frequencies in the range of 100 kHz to 50 MHz, as shown in figure 11.4.1 below, and therefore should minimize the RFI generated by the inverter.
- The zero-sequence noise ferrite core can be installed either on the input side or on the output side. The wire around the core for each phase should be wound by following the same convention and in one direction. The more turns without resulting in saturation the better the attenuation. If the wire size is too large to be wound, all the wiring can be grouped and put through several cores together in one direction.

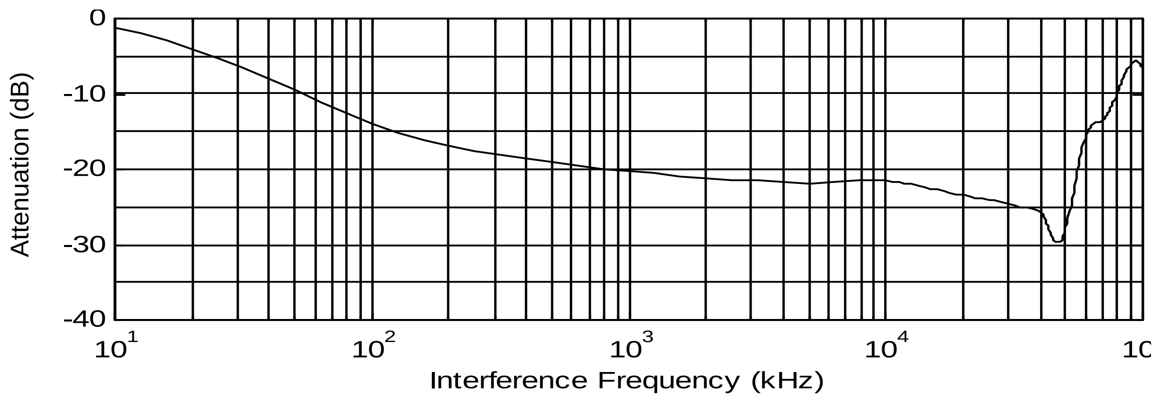


Figure 11.3.1 Frequency attenuation characteristics (10 windings case)

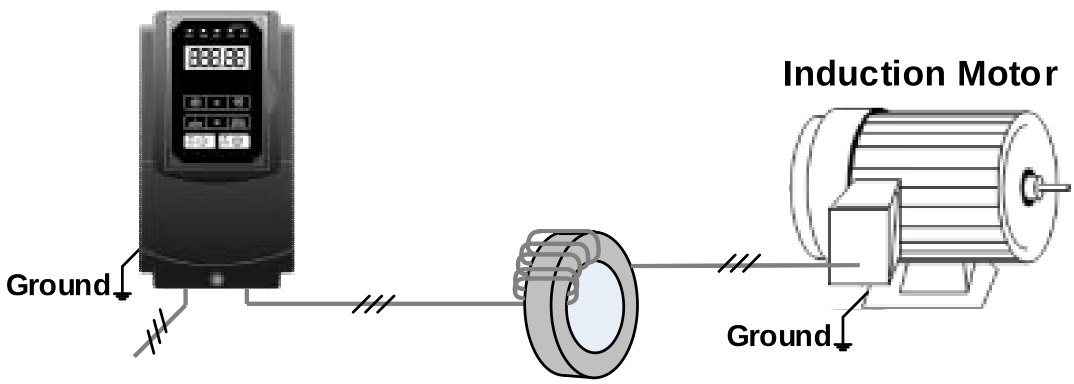


Figure 11.3.2 Example of EMI Suppression Zero Phase Core Application

Note: All the wiring of phases U/T1, V/T2, W/T3 must pass through the same zero-phase core without crossing over.

11.4 Input Current and Fuse Specifications

IP20 200V class

Model	Horse power	KVA	100% of rated output current	Rated input current (3ϕ)	Fuse rating (3ϕ)	Rated input current (1ϕ)
F510-2001-□	1	1.9	5.0	5.4	20	9.4
F510-2002-□	2	2.9	7.5	8.1	30	14.1
F510-2003-□	3	4.0	10.6	11.4	50	19.6
F510-2005-□3	5	5.5	14.5	16	50	X
F510-2008-□3	7.5	8.0	22	22.3	50	X
F510-2010-□3	10	11.4	30	31.6	63	X
F510-2015-□3	15	15	42	41.7	100	X
F510-2020-□3	20	21	56	60.9	120	X
F510-2025-□3	25	26	69	75	150	X
F510-2030-□3	30	30	80	85.9	200	X
F510-2040-□3	40	42	110	119.6	250	X
F510-2050-□3	50	53	138	150	300	X
F510-2060-□3	60	64	169	186	400	X
F510-2075-□3	75	76	200	232	500	X
F510-2100-□3	100	95	250	275	600	X
F510-2125-□3	125	119	312	343	700	X
F510-2150-□3	150	152	400	440	800	X
F510-2175-□3	175	172	450	495	800	X

IP20 400V class

Model	Horse power	KVA	100% of rated output current	Rated input current	Fuse rating
F510-4001-□3	1	2.6	3.4	3.7	10
F510-4002-□3	2	3.1	4.1	4.5	16
F510-4003-□3	3	4.1	5.4	5.9	16
F510-4005-□3(F)	5	7.0	9.2	9.6	16
F510-4008-□3(F)	7.5	8.5	12.1	11.6	25
F510-4010-□3(F)	10	13.3	17.5	18.2	40
F510-4015-□3(F)	15	18	23	24	50
F510-4020-□3(F)	20	24	31	32.3	63
F510-4025-□3(F)	25	29	38	41.3	80
F510-4030-□3(F)	30	34	44	47.8	100
F510-4040-□3(F)	40	41	58	63	120
F510-4050-□3(F)	50	55	73	78.3	150
F510-4060-□3(F)	60	67	88	95.7	200
F510-4075-□3(F)	75	79	103	112	250
F510-4100-□3	100	111	145	159	300
F510-4125-□3	125	126	168	181	400
F510-4150-□3	150	159	208	229	500
F510-4175-□3	175	191	250	275	600
F510-4215-□3	215	226	296	325	700
F510-4250-□3	250	250	328	361	700
F510-4300-□3	300	332	435	478	800
F510-4375-□3	375	393	515	566	800

Model	Horse power	KVA	100% of rated output current	Rated input current	Fuse rating
F510-4425-□3	425	446	585	643	1000
F510-4535-□3	535	526	700	750	1400
F510-4670-□3	670	640	875	913	1800
F510-4800-□3	800	732	960	1044	2200

IP55 400V class

Model	Horse power	KVA	100% of rated output current	Rated input current	Fuse rating
F510-4001-C3(F)N4	1	2.6	3.4	3.7	10
F510-4002-C3(F)N4	2	3.1	4.1	4.5	16
F510-4003-C3(F)N4	3	4.1	5.4	5.9	16
F510-4005-C3(F)N4	5	7.0	9.2	9.6	20
F510-4008-C3(F)N4	7.5	8.5	12.1	11.6	20
F510-4010-C3(F)N4	10	13.3	17.5	18.2	30
F510-4015-C3(F)N4	15	18	23	24	40
F510-4020-C3(F)N4	20	24	31	34	50
F510-4025-C3(F)N4	25	29	38	41	70
F510-4030-C3(F)N4	30	34	44	48	80
F510-4040-C3(F)N4	40	41	54	59	100
F510-4050-C3(F)N4	50	55	72	68	125
F510-4060-C3(F)N4	60	67	88	96	150
F510-4075-C3N4	75	79	103	112	200
F510-4100-C3N4	100	111	145	140	250

Fuse type: Choose semiconductor fuse to comply with UL.
Voltage Range:
For 200V class inverter, use 300V class fuse.
For 400V class inverter, use 500V class fuse.

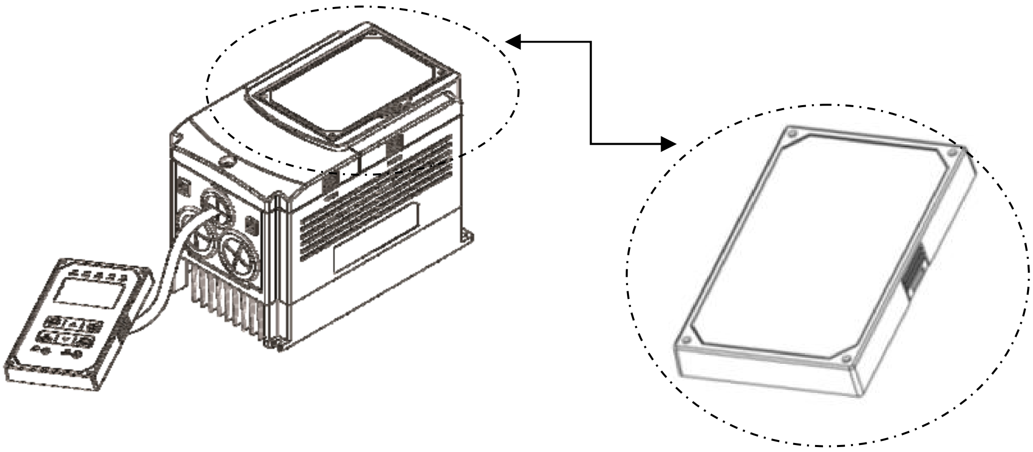
11.5 Other options

A. JN5-OP-F02 (LCD keypad)

LED keypad is standard for F510 IP20 model and it is optional for LCD keypad. Refer to the following figure.

B. Blank operation box and digital operator wire

- Digital operator can detach inverter itself and users apply digital operator wire for remote operation. Wires have four specifications, inclusive of 1m, 2m, 3m, and 5m.
- For digital operation remote control, separately blank operation box installed in the original position of the operator to prevent the entry of foreign matter.



Remote control installation diagram blank operation box

Name	Model	specification
blank operation box	JN5-OP-A03	Black Panel

Name	Model	specification
LED digital operator wire	JN5-CB-01M	**1m**
	JN5-CB-02M	**2m**
	JN5-CB-03M	**3m**
	JN5-CB-05M	**5m**

Name	Model	specification
LED digital operator wire with blank operation box	JN5-CB-01MK	**1m**
	JN5-CB-02MK	**2m**
	JN5-CB-03MK	**3m**
	JN5-CB-05MK	**5m**

Dimensions of LED/LCD keypad (IP20):

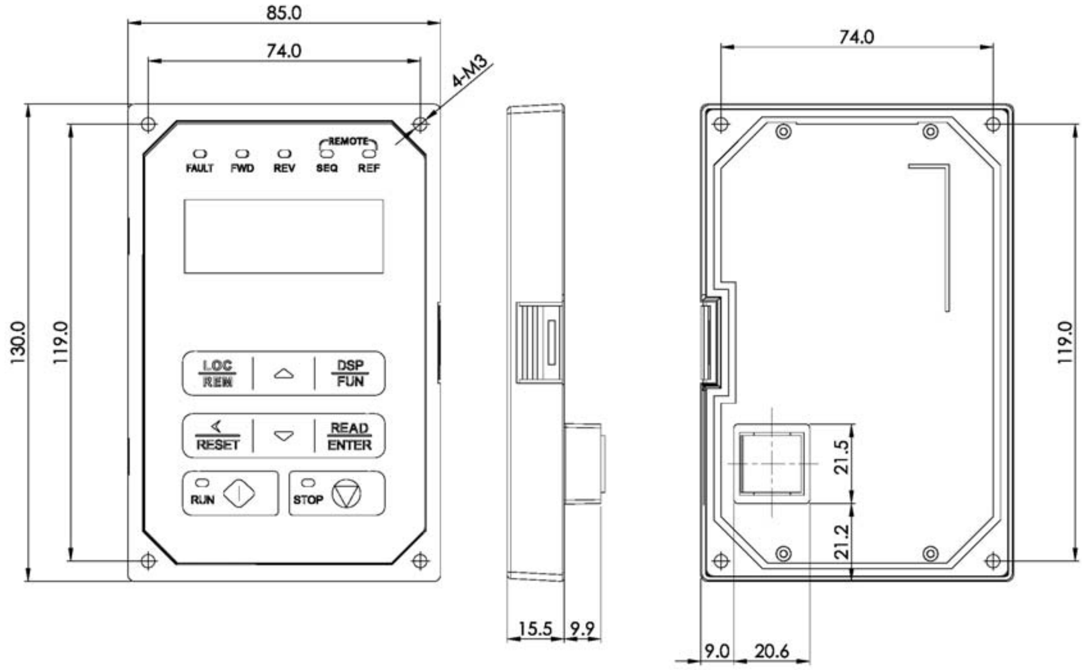


Figure 11.5.2 Dimensions of LED keypad

Dimensions of LCD keypad (IP55):

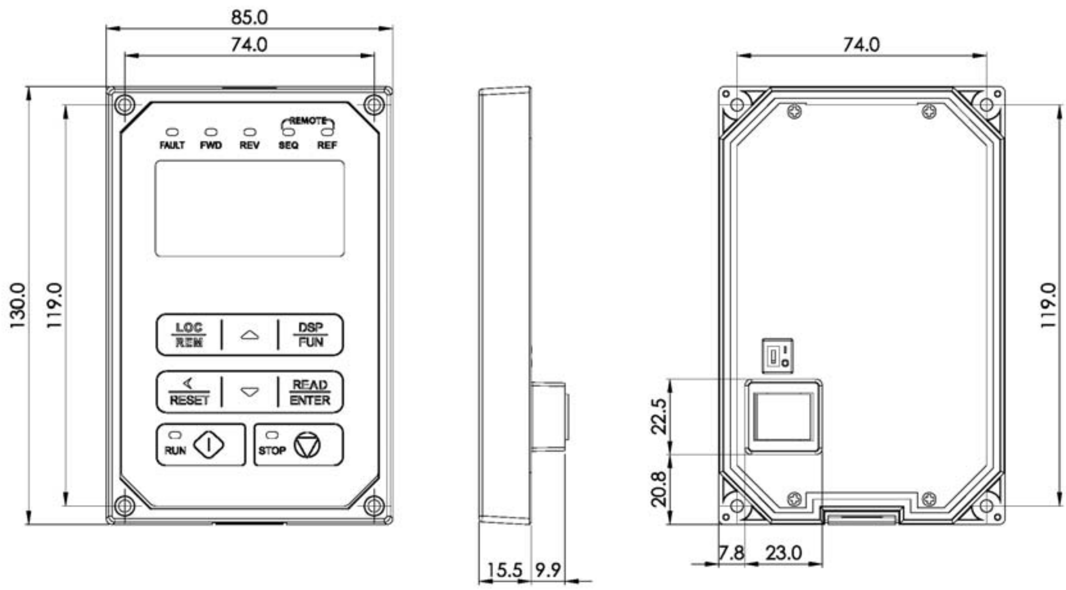


Figure 11.5.3 Dimensions of LCD keypad (IP55)

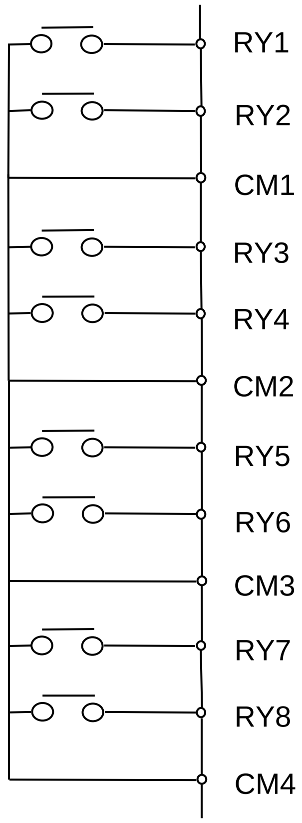
C. 1 to 8 Pump Card

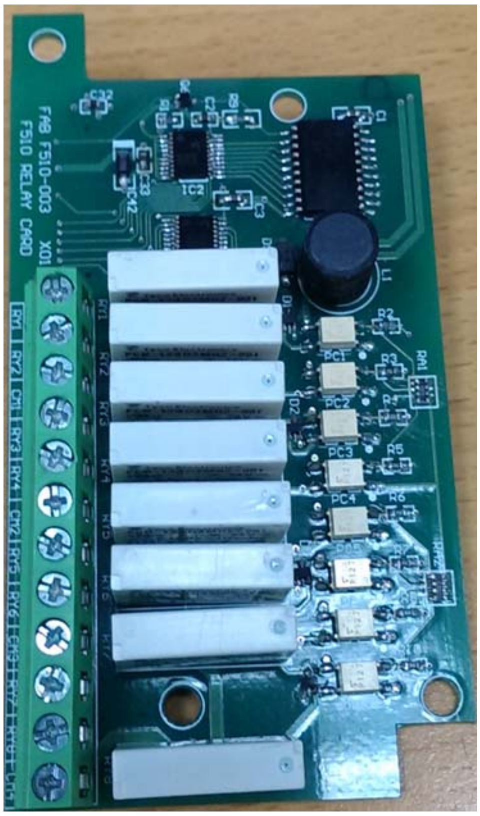
Refer to instruction manual of the option card to install.
JN5-IO-8DO Card: 8 Relay Output Card.

Terminals of JN5-IO-8DO:

Terminal	Description
RY1~RY8	Relay1~Relay8　A terminal output
CM1~CM4	Common terminal output

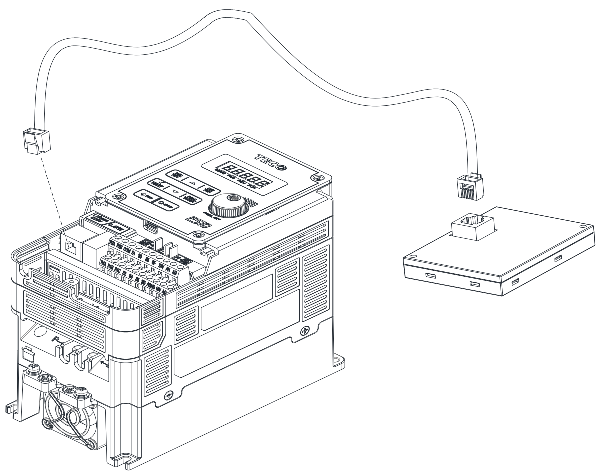
Wiring of JN5-IO-8DO (Example):





D. Copy Unit (JN5-CU)

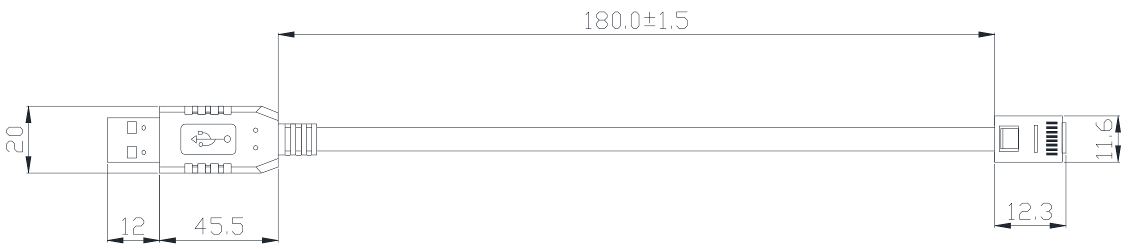
The copy unit is used to copy an inverter parameter setup to another inverter.



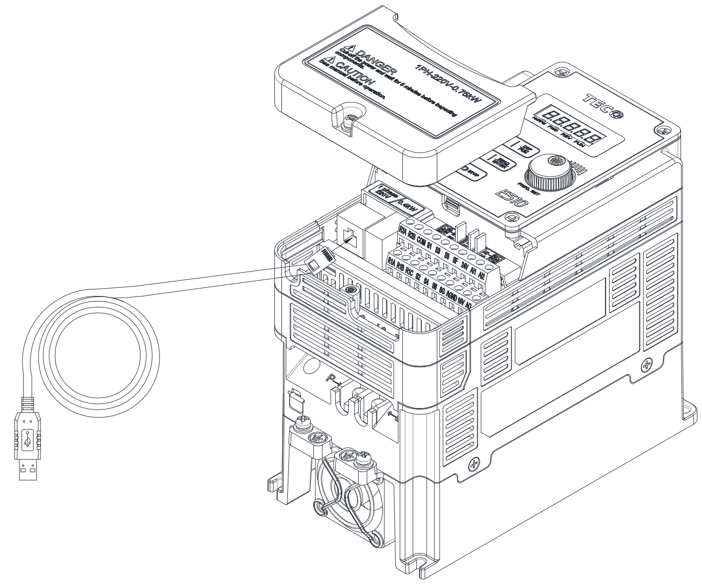
E. RJ45 to USB connecting Cable (1.8m)

JN5-CM-USB has the function of converting USB communication format to RS485 to achieve the inverter communication control being similar with PC or other control equipment with USB port.

- Exterior:



- Connecting:



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-CAN communication option manual.

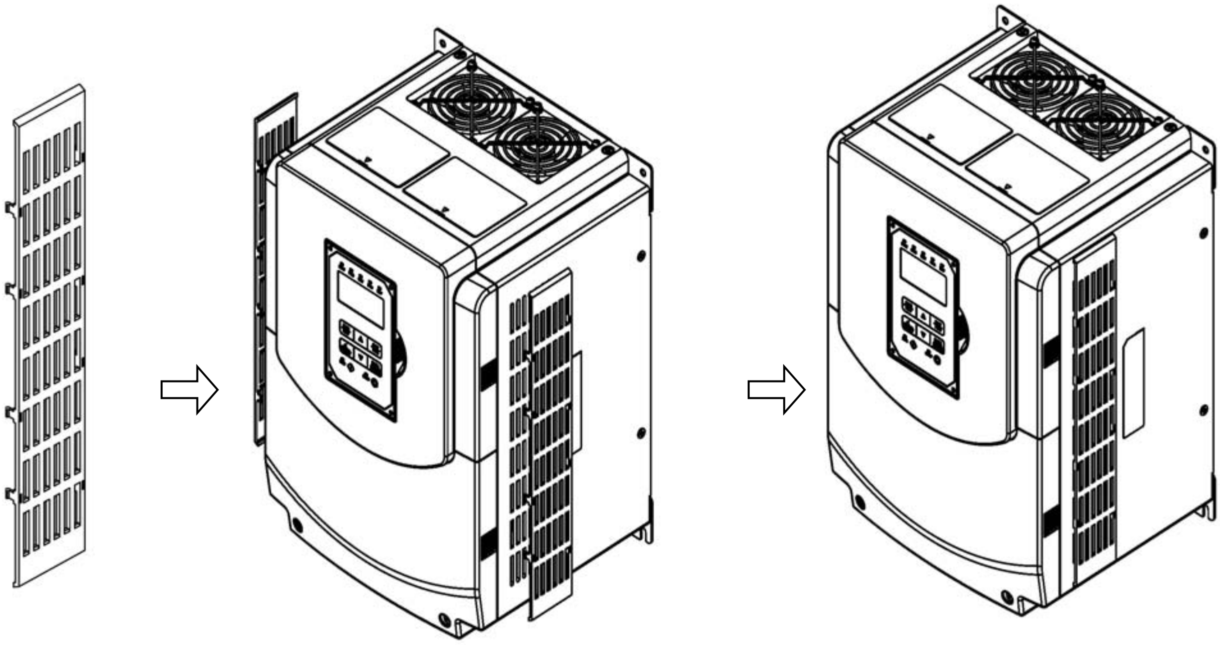
(d) TCP-IP communication interface module (JN5-CM-TCPIP)
For wiring example and communication setup refer to JN5-CM-TCPIP communication option manual.

11.7 Others Options

A. Protective Cover

If inverter is around the environment of dust or metal shavings, it is recommended to purchase the protective covers positioned on both sides of the inverter to prevent unknown objects from invading.

Frame	Model
1	JN5-CR-A01
2	JN5-CR-A02
4	JN5-CR-A04



Protective Cover **Installation of Protective Cover** **Inverter with Protective Cover**

B. High-speed communication expansion card & I/O expansion card & Middle layer case

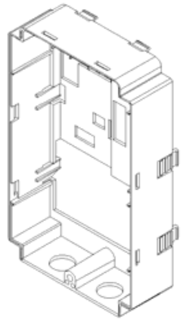
If frame 1~4 of the inverter need to install high-speed communication expansion card or I/O expansion card, middle layer case is necessary, which is option, to install between the top cover and the bottom case, for adding extra space to install the expansion card.

Table 1. Expansion card model number

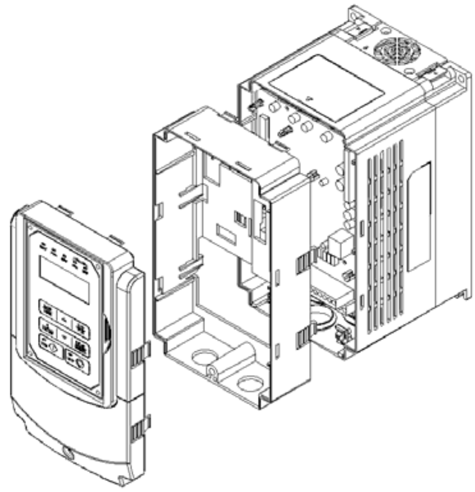
Expansion card type	Model number	Reference chapter
PROFIBUS high-speed comm.	JN5-CMHI-PDP	6.9
CANopen high-speed comm.	JN5-CMHI-CAN	6.10
EtherCAT high-speed comm.	JN5-CMHI-ECAT	6.11
I/O expansion	JN5-IO-2DO1AI	6.12

Table 2. Middle layer case model number

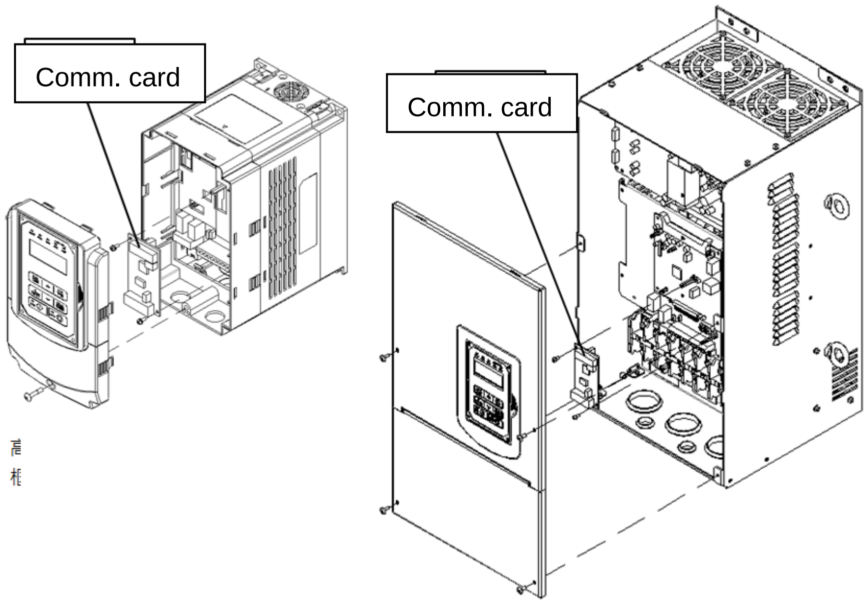
Frame	Middle layer case model number
1	JN5-MD-A01
2	JN5-MD-A02
3	JN5-MD-A03
4	JN5-MD-A04



Middle layer case outline



Middle layer case installation diagram



Communication card installation diagram

11.8 NEMA1 Kit

If NEMA1 or IP20 protective level is necessary to upgrade, it is recommended to purchase the NEMA1 kit positioned on top and bottom sides of the inverter. The drawings installed in the inverter, please refer to chapter 3.7.

Frame	Model
6	JN5-NK-A06
7	JN5-NK-A07
8	JN5-NK-A08
9	JN5-NK-A09

11.9 PROFIBUS high speed communication expansion card

11.9.1 Communication hardware and data structure

This product is the PROFIBUS high-speed communication expansion module; it can perform remote setting and communication functions through the PROFIBUS bus. It is used on the TECO A510s/F510 AC motor driver (hereinafter referred to as the “driver”), and allows the driver to operate on the PROFIBUS network.

11.9.2 Product specifications

PROFIBUS ports

Item	Specifications
Connector	DB-9
Transmission rate	9.6Kbit/s to 12Mbit/s (automatic detection of transmission rate)
Network protocols	PROFIBUS communication protocol

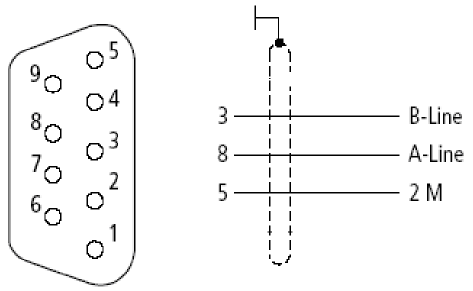
AC motor driver port

Item	Specifications
Connector	Control board CN2 connector
Transmission method	SPI high speed communication
Terminal functions	1. The communication module communicates with the AC motor driver through this interface. 2. The AC motor driver provides power to the communication module through this interface.
Communication protocols	TECO communication protocol

11.9.3 Installation instructions

PROFIBUS network connection

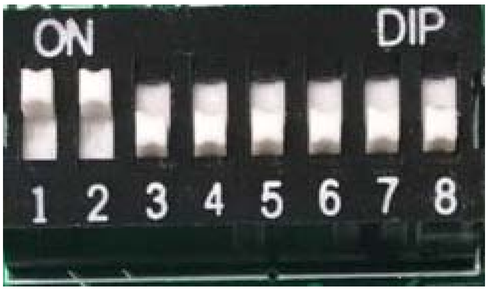
Definitions of PROFIBUS DP communication port pins are as shown in the figure below.



Pin	Definition	Description
1~2	Not assigned	-
3	RXD/TXD-P (B-Line)	Receive/Send data -P
4	Not assigned	-
5	DGND (2M)	Data reference potential
6~7	Not assigned	-
8	RXD/TXD-N (A-Line)	Receive/Send data -N
9	Not assigned	-

PROFIBUS network connection

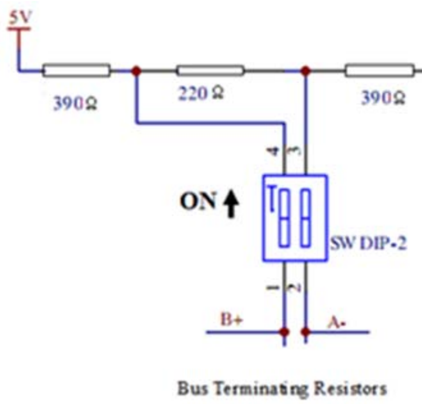
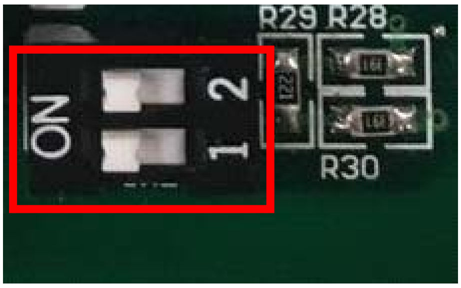
As shown in the figure below, ID addresses (1~125) correspond to SW1 b1~b7.



Function	DIP switch position	DIP switch status	Description
Network address setting	b1~b7	1000000	Network address is 1
		0100000	Network address is 2
		1100000	Network address is 3
		....	…….
		1011111	Network address is 125
No function	b8	-	-

Network address switch setting range: 1~125 (0, 128~255 cannot be used).

PROFIBUS bus terminal resistor

<table>
<tr><td>
</td><td>
</td></tr>
<tr><td colspan="2">The first and last station of the PROFIBUS bus must be connected to the bus, and the bus terminal resistor must be turned on.</td></tr>
</table>

11.9.4 LED indicator descriptions

The module has two dual-color LED indicators built-in used to quickly diagnose and monitor the communication statuses between the module itself and the bus.

Module status LED (RUN LED & ERR LED)

Used to monitor whether the equipment is operating normally.

Indicator statuses	Description
Does not light up	Power not supplied
Orange light lights up	Communication with the frequency converter not established
Red light flashes (1 Hz)	Communication error with the frequency converter
Red light flashes (4 Hz)	Flip-switch ID address error
Green light flashes (4 Hz)	Power supply normal but DP communication not established
Green light lights up	DP communication normal

Network status LED (COMM LED)

Used to monitor the operability of the communication module PROFIBUS network.

Indicator statuses	Description
Does not light up	DP communication not established
Green light lights up	DP communication established and normal

11.9.5 Driver parameter setting descriptions

Used to monitor the operability of the communication module PROFIBUS network.

Users must first confirm related parameter settings on the driver in order to ensure that the communication module can connect normally.

Parameters	Parameter name	Settings	Settings descriptions
00-02	Operation command source	2	Communication control
00-05	Frequency command source	3	Communication control

11.9.6 Connection instructions

PPO communication

<table>
<tr><td colspan="4">PKW</td><td colspan="10">PZD</td></tr>
<tr><td>PKE</td><td>IND</td><td colspan="2">PWE</td><td>PZD1
STW
ZSW</td><td>PZD2
HSW
HIW</td><td>PZD3</td><td>PZD4</td><td>PZD5</td><td>PZD6</td><td>PZD7</td><td>PZD8</td><td>PZD9</td><td>PZD10</td></tr>
<tr><td>1st word</td><td>2nd word</td><td>3rd word</td><td>4th word</td><td>1st word</td><td>2nd word</td><td>3rd word</td><td>4th word</td><td>5th word</td><td>6th word</td><td>7th word</td><td>8th word</td><td>9th word</td><td>10th word</td></tr>
<tr><td colspan="6">PPO1</td><td colspan="8"></td></tr>
<tr><td colspan="10">PPO2</td><td colspan="4"></td></tr>
<tr><td colspan="4"></td><td colspan="2">PPO3</td><td colspan="8"></td></tr>
<tr><td colspan="4"></td><td colspan="6">PPO4</td><td colspan="4"></td></tr>
<tr><td colspan="14">PPO5</td></tr>
</table>

PKW: Parameter address/value	**STW**: Control word
PZD: Process data	**ZSW**: Status word
PKE: Parameter address	**HSW**: Main settings
IND: Subindex	**HIW**: Main actual value
PWE: Parameter value	

PZD Structure default

User parameters of the communication module configured through the GSD file. Default values of the PZD structure are as follows:

STW1 Control word; mapped to the MODBUS address 0x2501 of the driver.

HSW Main setting value; mapped to the MODBUS address 0x2502 of the driver.

ZSW1 Status word; mapped to the MODBUS address 0x2520 of the driver.

HIW Main actual value; mapped to the MODBUS address 0x2524 of the driver.

PLC Master station→ driver slave station

PZD3/ PZD4: Not used.

Driver slave station→ PLC master station

Driver output status; mapped to the MODBUS addresses 0x2520~0x252F of the driver.

The default values of PZD3/PZD4/PZD5/PZD6 are set as follows:

PZD3: Default multi-function terminal block on/off status; mapped to the MODBUS address 0x2522 of the driver.

PZD4: Default output current; mapped to the MODBUS address 0x2527 of the driver.

PZD5: Default output current; mapped to the MODBUS address 0x2521 of the driver.

PZD6: Default output current; mapped to the MODBUS address 0x2528 of the driver.

11.9.7 Meanings of each character

Control character

Bit	Description	1	0
0	Operation command	Operate	Stop
1	Reverse command	Reverse	Forward
2	External error	Error	-
3	Error reset	Reset	-
4~5	Reserved	-	-
6	Multi-function terminal S1	ON	OFF
7	Multi-function terminal S2	ON	OFF
8	Multi-function terminal S3	ON	OFF
9	Multi-function terminal S4	ON	OFF
A	Multi-function terminal S5	ON	OFF
B	Multi-function terminal S6	ON	OFF
C	Multi-function terminal S7	ON	OFF
D	Multi-function terminal S8	ON	OFF
E	Controller mode	ON	OFF
F	Communication setting torque command	ON	

Status character

Bit	Meaning	1	0
0	Operation status	Operate	Stop
1	Direction status	Reverse	Forward
2	Frequency converter operation preparation status	Preparation complete	Not yet prepared
3	Error	Abnormal	Normal
4	Warning	ON	OFF
5	Zero speed	ON	OFF
6	Model 440	ON	OFF
7	Frequency reached	ON	OFF
8	Any frequency reached	ON	OFF
9	Frequency detection 1	ON	OFF
A	Frequency detection 2	ON	OFF
B	Low voltage	ON	OFF
C	Frequency converter no output	ON	OFF
D	Frequency not according to communication	ON	OFF
E	SeqNotFromComm	ON	OFF
F	Over-torque	ON	OFF

11.9.8 PKW regional access parameters

The driver can provide request and response information. Due to the request and response mechanism, the master station must send requests until a communication response is received. The 4 characters of the PKW region are as follows:

Word 1	Parameter ID(PKE)	
bit	15 12 AK	11 0 Parameter number(PNU)
Word 2	IND Reserved	
Word 3	PWE1	
bit	15 8 Reserved	7 0 Fault number
Word 4	PWE2 Read/Write parameters	

PKE

Bit 0~11 (PNU): Parameter address/MODBUS address that includes related parameters.
Parameter address/MODBUS address: Please refer to the MODBUS communication protocol description chapter in the driver manual for the register numbers, registers and data format that corresponds to the operation parameters.
Bit 12~15 (AK): Includes the identification characters of requests or responses.

Request character AK

PLC master station→ driver slave station

Request Identifier	Description
0	No request
1	Read parameter value
2	Modify parameter value

Response character AK

Driver slave station→ PLC master station

Request Identifier	Description
0	No response
1	Request parameter value processed
7	Request parameter value cannot process

Error character

If the request parameter value was not processed, then the error codes that will be kept in the low-bit PWE1 set are as follows:

Error code	Description
0	Parameter does not exist
1	The current status parameter cannot be read/written
2	Parameter value not within range
101	Other SP communication error occurred, such as: response timeout

PWE

Driver parameters are sent through PWE2 (4th word). In the following example, PWEI (3rd word) must be set as 0 in the PROFIBUS master station.

Example of the PKW mechanism:

For example: Read parameters 00-05 (frequency command source).

Read the values of 00-05; first set the request identification character as 1, and then refer to the MODBUS communication protocol description chapter in the driver manual to find out that the address of 00-05 is 0x0005, then the data sequences are as follows:

PLC master station→ driver slave station: 1000 0005 0000 0000

Driver slave station→ PLC master station: 1000 0005 0000 0004

Request	
1st word (PKE)	1000
2nd word (IND)	0005
3rd word (PWE1)	0000
4th word (PWE2)	0000

Response	
1st word (PKE)	1000
2nd word (IND)	0005
3rd word (PWE1)	0000
4th word (PWE2)	0004

11.9.9 Troubleshooting

There are two indicators on top of the PROFIBUS communication module; when malfunction occurs, the cause of the malfunction can be confirmed based on the indicator statuses, and troubleshoot the error by following the descriptions below.

Indicator troubleshooting

Module status LED

Indicator statuses	Status name	Troubleshooting method
Does not light up	Power not supplied to the communication module	1. Confirm whether the driver power is normal. 2. Confirm whether the power terminal of the communication module is connected to the driver.
Red and green light flashes alternately	Self-check	1. The host is under self-check; if it flashes continuously, disconnect the power and then reconnect it. 2. Confirm whether the driver communication connection parameters are properly set (19200, 8, N, 1)
Green light flashes	the communication module Standby	1. Not yet connected with the driver.

Network status LED

Indicator statuses	Status name	Description
Does not light up	Power not supplied	1. Confirm whether the driver power is normal. 2. Confirm whether the power terminal of the communication module is connected to the driver.
	Standby	1. Not yet connected with the PROFIBUS host terminal.

11.9.10 GSD File

When using the Profibus communication module, if the GSD description file (JN5-CMHI-PDP_V (latest version).GSD) is needed, please download it from the TECO official website or request for it from your purchasing sales channel.

11.10 CANopen high speed communication expansion card

11.10.1 Communication hardware and data structure

This product is the CANopen high-speed communication expansion module; it can perform remote setting and communication functions through the CANopen bus. It can only be used with the TECO A510s/F510 AC motor driver (hereinafter referred to as the “driver”), and allow the driver to operate on the CANopen network.

11.10.2 Product specifications

CANopen ports

Item	Specifications
Connector	5-pin open pluggable connector; pin spacing 5.08mm
Transmission rate	10kbps, 20kbps, 50kbps, 125kbps, 250kbps, 500kbps, 800kbps, 1Mbps
Network protocols	CANopen communication protocol

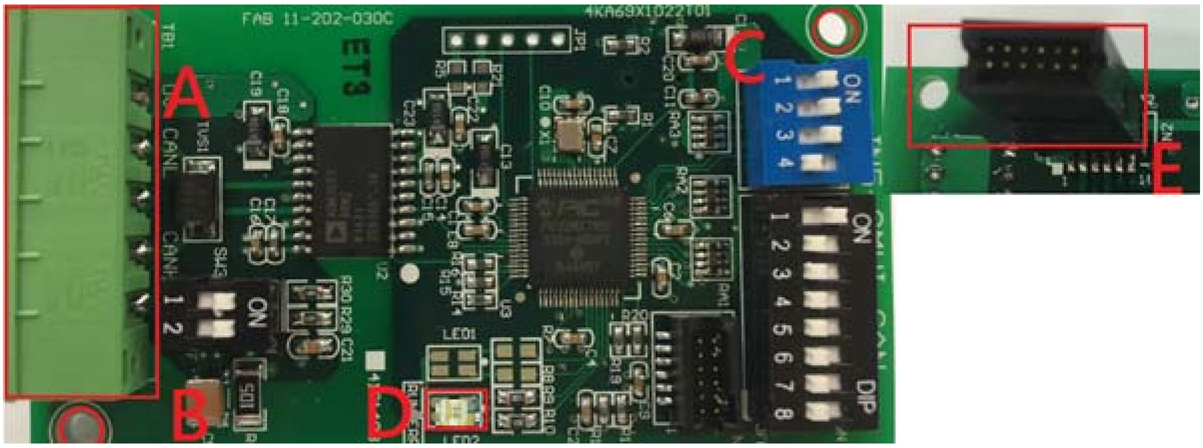
AC motor driver port

Item	Specifications
Connector	Control board CN2 connector
Transmission method	SPI high speed communication
Terminal functions	1. The communication module communicates with the AC motor driver through this interface. 2. The AC motor driver provides power to the communication module through this interface.
Communication protocols	TECO communication protocol

11.10.3 Installation instructions

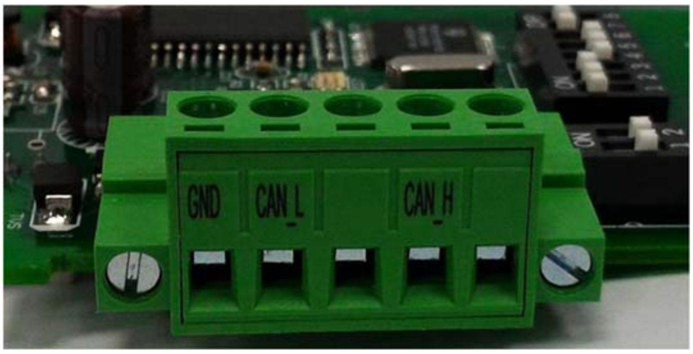
Communication module contact description

As shown in the figure below, A – Terminal block (TB1)
B, C – Mounting holes
D - RUN LED
E - ERR LED
F – Control board connector (CN2)



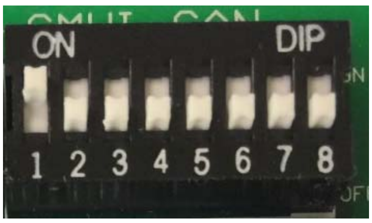
Terminal block definition

As shown in the figure below, the contact definitions in the order from left to right are GND, CAN_L, NC, CAN_H and NC.

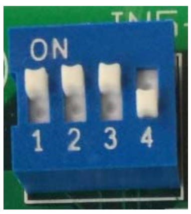


ID address setting description

As shown in the figure below, ID addresses (1~127) correspond to SW1 b1~b7.



Transmission rate corresponds to SW2 b1~b3.



Function	DIP switch position	DIP switch status 7654321	Description
Network address Setting	SW1 b7—b1	0000000	Cannot be used
		0000001	Network address is 1
		0000010	Network address is 2
		0000011	Network address is 3
		…………	…………
		1111110	Network address is 126
		1111111	Network address is 127
CANopen Transmission rate setting	SW2 b3—b1	000	10K
		001	20K
		010	50K
		011	125K
		100	250K
		101	500K
		110	800K
		111	1M

Network address switch setting range: 1~127 (0, 128~255 cannot be used).

Transmission rate switch setting range: 0~7 (8~15 cannot be used).

11.10.4 LED indicator descriptions

The module has RUN (green) and ERR (red) indicators built-in used to quickly diagnose and monitor the communication statuses between the module itself and the bus.

Module status LED (RUN LED)

Used to monitor whether the equipment is operating normally.

Indicator statuses	Status name	Description
Does not light up	Initial status	Power not supplied
Continuous flashing	Pre-operation	Preparation status
Single flash	Stop	Stopping
Green light lights up	Operation	Operating

Error status LED (ERR LED)

Used to monitor the operability of the communication module CANopen network.

Indicator statuses	Status name	Description
Does not light up	No error	Operating
Single flash	Warning	Packet error
Double flash	Error	Guard/Heartbeat error
Red light lights up	Disconnected	Bus closed

11.10.5 Driver parameter setting descriptions

Used to monitor the operability of the communication module CANopen network.

Users must first confirm related parameter settings on the driver in order to ensure that the communication module can connect normally.

Parameters	Parameter name	Settings	Settings descriptions
00-02	Operation command source	2	Communication control
00-05	Frequency command source	3	Communication control

11.10.6 Connection instructions

Service data object (SDO)

This module supports 1 SDO server, which means it can provide SDO service, and the SDO uses the sending and receiving COB-ID of the predefined connection, 0x580 + NodeID (sending) and 0x600 + NodeID (receiving).

Each SDO message includes a set of COB-ID (request SDO and response SDO); it allows performing of access actions within two nodes. SDO can transmit any size of data, but segment transmission must be used once it exceeds 4 bytes.

The COB IDs of SDO communication are as follows:

Read: Master to slave (request code 0x40) / Master to slave: 600H + Node ID

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
(600H) + Node ID	Request code	Object index		Object subindex	Request data			
		LSB	MSB		Reserved			

Read: Slave response / slave to master: 580H + Node ID

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
(580H) + Node ID	Request code	Object index		Object subindex	Request data			
		LSB	MSB		bit0~ bit7	Bit8~ bit15	Bit16~ bit23	Bit24~ bit31

Response code:

43H: Read 4-byte data / 4BH: read 2-byte data / 4FH: read 1-byte data

Write: Master to slave (4-byte data maximum)

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
(600H) + Node ID	Request code	Object index		Object subindex	Request data			
		LSB	MSB		bit0~ bit7	Bit8~ bit15	Bit16~ bit23	Bit24~ bit31

Request code:

23H: Write a 4-byte data entry

2BH: Write a 2-byte data entry

2FH: Write a 1-byte data entry

Write: Slave to master (response code 0x60H)

COB-ID	Byte0	Byte1	Byte2	Byte3	Byte4	Byte5	Byte6	Byte7
(580H) + Node ID	Request code	Object index		Object subindex	Request data			
		LSB	MSB		Reserved			

When we use SDO to perform control to the group 25H of the driver control group, corresponding rules are as follows:

Index
25xxH (register address)

For example, when we want to perform write/read to 2501H of the control group, the corresponding SDO object index is the control group register address 2501H.
Perform operation with index 2501H directly and the module will automatically convert to the A510s 2501H control group register address to perform operation.

11.10.7 Object index list

Basic index

Index	Sub	Name	Default value	R/W	Size	Remarks
1000H	0	Device type	00010192H	R	U32	
1001H	0	Error register	0	R	U8	
1005H	0	COB-ID SYNC message	80H	R	U32	
1006H	0	Communication cycle period	0	RW	U32	
1008H	0	Manufacturer device name	A510	R	U32	
1009H	0	Manufacturer hardware version	1.0	R	U32	
100AH	0	Manufacturer software version	1.00	R	U32	
1014H	0	COB-ID emergency	00000080H+Node-ID	R	U32	
1015H	0	Inhibit time EMCY	0	RW	U16	
1016H	0	number of entries	1	R	U8	
	1	Consumer heartbeat time	0	RW	U32	Not supported
1017H	0	Producer heartbeat time	0	RW	U16	
1018H	0	number of entries	3	R	U8	
	1	Vender ID	00000373H	R	U32	
	2	Product code	00000100H	R	U32	
	3	Revision	00010000H	R	U32	
1200H	0	Server SDO Parameter	2	R	U8	
	1	COB-ID Client Server	0000600H+Node-ID	R	U32	
	2	COB-ID Client Server	0000580H+Node-ID	R	U32	
1400H	0	Number of entries	2	R	U8	
	1	COB-ID used by PDO	00000200H+Node-ID	RW	U32	
	2	Transmission Type	0xFF	RW	U8	
1401H	0	Number of entries	2	R	U8	
	1	COB-ID used by PDO	00000300H+Node-ID	RW	U32	
	2	Transmission Type	0xFF	RW	U8	
1600H	0	Number of entries	2	RW	U8	
	1	1.Mapped Object	60400010H	RW	U32	
	2	2.Mapped Object	60420010H	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	

Index	Sub	Name	Default value	R/W	Size	Remarks
1601H	0	Number of entries	2	RW	U8	
	1	1.Mapped Object	604F0010H	RW	U32	
	2	2.Mapped Object	60500010H	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1800H	0	Number of entries	5	R	U8	Number of entries
	1	COB-ID used by PDO	180H+Node-ID	RW	U32	
	2	Transmission Type	0xFF	RW	U8	Transmission type
	3	Inhibit time	0x64	RW	U16	Inhibit time
	4	CMS-Priority Group	0	RW	U8	
	5	Event timer	0x64	RW	U16	Event timer
1801H	0	Number of entries	5	R	U8	Number of entries
	1	COB-ID used by PDO	00000280H+Node-ID	RW	U32	
	2	Transmission Type	0xFF	RW	U8	
	3	Inhibit time	0x64	RW	U16	Inhibit time
	4	CMS-Priority Group	0	RW	U8	
	5	Event timer	0x64	RW	U16	Event time
	4	CMS-Priority Group	0	RW	U8	
	5	Event timer	0x64	RW	U16	Event time
	2	Transmission Type	0xFF	RW	U8	
	3	Inhibit time	0x64	RW	U16	Inhibit time
	4	CMS-Priority Group	0	RW	U8	
	5	Event timer	0x64	RW	U16	Event time
1A00H	0	Number of entries	2	RW	U8	
	1	1.Mapped Object	60400010	RW	U32	
	2	2.Mapped Object	60420010	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1A01H	0	Number of entries	2	RW	U8	
	1	1.Mapped Object	604F0010	RW	U32	
	2	2.Mapped Object	60500010	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	

DS402 part

Index	Sub-Index	Name	Default value	R/W	Size	Unit	PDO MAP
603F	0	Error code	0	RO	U16		Yes
6040	0	Control word	0	RW	U16		Yes
6041	0	Status word	0	RO	U16		Yes
6042	0	vl target velocity	0	RW	S16	Hz	Yes
6043	0	vl velocity demand	0	RO	S16	Hz	Yes
604F	0	vl ramp function time Acceleration time	100	RW	U16	0.1S	Yes
6050	0	vl slow down time Deceleration time	100	RW	U16	0.1S	Yes

Driver control group command index

Command DATA (allows reading and writing)

Register address		Bit	Content
2500H	Reserved		
2501H	Operation signal	0	Operation command 1: Operate 0: Stop
		1	Reverse command 1: Reverse 0: Forward
		2	External error 1: Error
		3	Error reset 1: Reset
		4	Reserved
		5	Reserved
		6	Multi-function terminal S1 1: “ON”
		7	Multi-function terminal S2 1: “ON”
		8	Multi-function terminal S3 1: “ON”
		9	Multi-function terminal S4 1: “ON”
		A	Multi-function terminal S5 1: “ON”
		B	Multi-function terminal S6 1: “ON”
		C	Multi-function terminal S7 1: “ON”
		D	Multi-function terminal S8 1: “ON”
		E	Controller mode 1: “ON”
		F	Communication setting torque command 1: “ON”
2502H		*Frequency command (Unit: 0.01Hz)	
2505H		AO1 (0.00V ~ 10.00V)	
2510H		G12-00 H-WORD	
2511H		G12-00 L-WORD	

Monitor DATA (read only)

Register address		Bit	Content		
2520H	Status signal	0	Operation status 1: Operate 0: Stop		
		1	Direction status 1: Reverse 0: Forward		
		2	Frequency converter operation preparation status 1: Preparation complete 0: Preparation not yet complete		
		3	Error 1: Abnormal		
		4	Warning 1: “ON”		
		5	Zero speed 1: “ON”		
		6	Model 440 1: “ON”		
		7	Frequency reached 1: “ON”		
		8	Any frequency reached 1: “ON”		
		9	Frequency detection one 1: “ON”		
		A	Frequency detection two 1: “ON”		
		B	Low voltage 1: “ON”		
		C	Frequency converter no output 1: “ON”		
		D	Frequency not according to communication 1: “ON”		
		E	Operation not according to communication 1: “ON”		
		F	Over-torque 1: “ON”		
2521H	Error description	0	Reserved	31	Reserved
		1	UV (Under-voltage)	32	Reserved
		2	OC (Over-current)	33	Reserved
		3	OV (Over-voltage)	34	Reserved
		4	OH1 (Heat sink overheat)	35	Reserved
		5	OL1 (Motor overload)	36	Reserved
		6	OL2 (Frequency converter overload)	37	Reserved
		7	OT (Over-torque)	38	CF07 (Motor control fault)
		8	UT (Under-torque)	39	Reserved
		9	SC (Short circuit)	40	Reserved
		10	GF (Ground fault)	41	Reserved
		11	FO	42	Reserved
		12	IPL (Input phase loss)	43	Reserved
		13	OPL (Output phase loss)	44	Reserved
		14	OS	45	Reserved
		15	PGO	46	OH4 (Motor overheat)

Register address		Bit	Content				
		16	DEV	47	Reserved		
		17	EF1	48	Reserved		
		18	EF2	49	MtrSw (DI Motor Switch Fault)		
		19	EF3	50	OCA (Acceleration over-current)		
		20	EF4	51	OCD (Deceleration over-current)		
		21	EF5	52	OCC (Operation over-current)		
		22	EF6	53	CF08		
		23	EF7	54	PTCLS		
		24	EF8	55	PF (Protection fault)		
		25	FB (PID feedback signal error)	56	TOL		
		26	OPR(Keypad Removed)	57	STO2 (Safety switch 2)		
		27	Reserved	58	Reserved		
		28	CE	59	Reserved		
		29	STO (Safety switch 1)	60	Reserved		
		30	Reserved	61	Reserved		
2522H	DI status	0	Multi-function terminal S1	4	Multi-function terminal S5	8~F	Reserved
		1	Multi-function terminal S2	5	Multi-function terminal S6		
		2	Multi-function terminal S3	6	Multi-function terminal S7		
		3	Multi-function terminal S4	7	Multi-function terminal S8		
2523H		Frequency command (0.01Hz)					
2524H		Output frequency (0.01Hz)					
2526H		DC voltage command (0.1V)					
2527H		Output current (0.1A)					
2528H	Warning description	0	No alarm	30	RDE	60	Reserved
		1	OV	31	WRE	61	RETRY
		2	UV	32	FB	62	SE07
		3	OL2	33	VRYE	63	Reserved
		4	OH2	34	SE01	64	Reserved
		5	Reserved	35	SE02	65	OH1
		6	OT	36	SE03	66	FIRE
		7	Reserved	37	Reserved	67	ES

Register address		Bit	Content				
		8	Reserved	38	SE05	68	STP1
		9	UT	39	HPERR	69	BDERR
		10	OS	40	EF	70	EPERR
		11	PGO	41	Reserved	71	Reserved
		12	DEV	42	Reserved	72	Reserved
		13	CE	43	RDP	73	STP0
		14	CALL	44	Reserved	74	Reserved
		15	Reserved	45	OL1	75	STP2
		16	EF0	46	Reserved	76	RUNER
		17	EF1	47	Reserved	77	LOC
		18	EF2	48	Reserved	78	PTCLS
		19	EF3	49	BB1	79	Sys Init
		20	EF4	50	BB2	80	FBLSS
		21	EF5	51	BB3		
		22	EF6	52	BB4		
		23	EF7	53	BB5		
		24	EF8	54	BB6		
		25	Reserved	55	BB7		
		26	Reserved	56	BB8		
		27	Reserved	57	Reserved		
		28	Reserved	58	Reserved		
		29	Reserved	59	Reserved		
2529H		DO status					
252AH		AO1					
252BH		AO2					
252CH		AI 1 input (0.1%)					
252DH		AI 2 input (0.1%)					
252FH		L510(s)/ E510(s)/ A510(s)/ F510 Check					

11.10.8 Troubleshooting

There are two indicators on top of the CANopen communication module; when malfunction occurs, the cause of the malfunction can be confirmed based on the indicator statuses, and troubleshoot the error by following the descriptions below.

Indicator troubleshooting

Module status LED (RUN LED)

Indicator statuses	Status name	Troubleshooting method
Does not light up	Power not supplied to the communication module	1. Confirm whether the driver power is normal. 2. Confirm whether the power terminal of the communication module is connected to the driver.

Error status LED (ERR LED)

Indicator statuses	Status name	Description
Single flash	CANopen packet error	Poor connection quality with the CANopen host terminal or host not connected when powered on. Continue transmission or power off inspection can be selected. Two results can be expected with continue transmission 1) Packet transmission returns to normal and the red light no longer flashes 2) Packet continues to have errors causing disconnection. When the power is off, check whether the TB1 terminal and cable are firmly connected, and whether the transmission rate, maximum transmission distance and cable length comply with ODVA specifications.
Double flash	Guard/Heartbeat error	User sends periodic heartbeat messages. If a message is not received after a specific time, please disconnect the power and check the connection status of that node.
Red light lights up	Disconnected	Cannot connect with the CANopen host terminal; disconnect the power and check whether the TB1 terminal and cable is firmly connected, and whether the transmission rate, maximum transmission distance and cable length comply with ODVA specifications.

11.10.9 EDS file

When using the CANopen communication module, if the EDS description file (JN5-CMHI-CAN_V (latest version).eds) is needed, please download it from the TECO official website or request for it from your purchasing sales channel.

11.11 Introduction to the EtherCAT high speed communication expansion module

11.11.1 Communication hardware and data structure

This product is the EtherCAT high-speed communication expansion module (hereinafter referred to as communication module); it can perform remote setting and communication functions through the EtherCAT network environment. It can only be used with the TECO A510s/F510 AC motor driver (hereinafter referred to as a driver), and allow the driver to operate on the EtherCAT network.

11.11.2 Product specifications

EtherCAT ports

Item	Specifications
Connector	Dual-port network socket
Network protocols	EtherCAT communication protocol

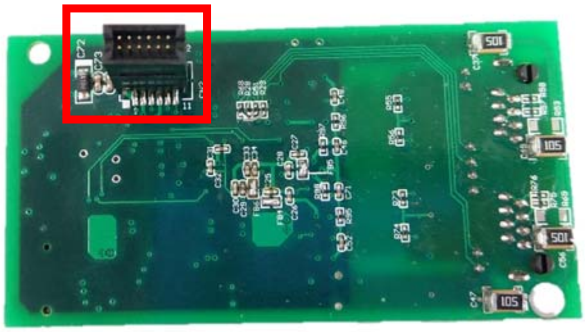
AC motor driver port

Item	Specifications
Connector	Control board CN2 connector
Terminal functions	1. The communication module communicates with the AC motor driver through this interface. 2. The AC motor driver provides power to the communication module through this interface.

11.11.3 Installation instructions

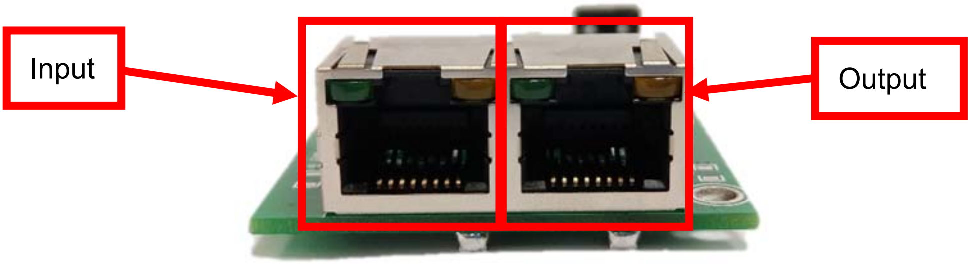
Communication module contact description

As shown in the figure below, the framed part is the CN2 connector that connects to the driver.



Communication module network socket

As shown in the figure below, the left socket is input and the right socket is output.



Driver parameter setting description

Users must first confirm related parameter settings on the driver in order to ensure that the communication module can connect normally.

Parameters	Parameter name	Settings	Settings descriptions
00-02	Operation command source	2	Communication control
00-05	Frequency command source	3	Communication control

11.11.4 LED indicator descriptions

The module has two dual-color LED indicators built-in used to quickly diagnose and monitor the communication statuses between the module itself and the EtherCAT network.

Module status LED2

Used to monitor whether the communication module is operating normally.

Indicator statuses	Status name	Description
Does not light up	Power not supplied	Power not supplied
Red light flashes	Data transmitting	Driver and communication expansion module data transmitting
Red/green light lights up	Driver data transmission error	Data transmission error between the driver and communication expansion module

Network status LED1

Used to monitor the operability of the communication module EtherCAT network.

Indicator statuses	Status name	Description
Does not light up	Not connected / INIT	EtherCAT network not connected (INIT)
Green light flashes	Standby	Preparation status (Pre-OP)
Green light lights up	Operation status	Operation status (OP)
Red light lights up	Driver data transmission error	Data transmission error between the driver and communication expansion module

11.11.5 Object index list

Basic index

Index	Sub-Index	Name	Default value	R/W	Size	Remarks
1000H	0	Device type	00000192H	R	U32	
1001H	0	Error register	0	R	U8	
1008H	0	Manufacturer device name	JN5-CM-CAN	R	U32	
1009H	0	Manufacturer hardware version	Version	R	U32	
100AH	0	Manufacturer software version	Version	R	U32	
1018H	0	number of entries	4	R	U8	
	1	Vender ID	0000081BH	R	U32	
	2	Product code	00000001H	R	U32	
	3	Revision	00000001H	R	U32	
1600H	0	Number of entries	2	RW	U8	
	1	1.Mapped Object	60400010H	RW	U32	
	2	2.Mapped Object	60420010H	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1601H	0	Number of entries	2	RW	U8	
	1	1.Mapped Object	604F0010H	RW	U32	
	2	2.Mapped Object	60500010H	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1A00H	0	Number of entries	3	RW	U8	
	1	1.Mapped Object	60400010	RW	U32	
	2	2.Mapped Object	60420010	RW	U32	
	3	3.Mapped Object	604F0020	RW	U32	
	4	4.Mapped Object	0	RW	U32	
1A01H	0	Number of entries	3	RW	U8	
	1	1.Mapped Object	604F0020	RW	U32	
	2	2.Mapped Object	60500020	RW	U32	
	3	3.Mapped Object	0	RW	U32	
	4	4.Mapped Object	0	RW	U32	

Object part

Index	Sub-Index	Name	Default value	R/W	Size	Unit	PDO MAP
603F	0	Error code	0	RO	U16		Yes
6040	0	Control word	0	RW	U16		Yes
6041	0	Status word	0	RO	U16		Yes
6042	0	vl target velocity	0	RW	S16	Hz	Yes
6043	0	vl velocity demand	0	RO	S16	Hz	Yes
604F	0	vl ramp function time Acceleration time	Driver default value	RW	U32	0.1S	Yes
6050	0	vl slow down time Deceleration time	Driver default value	RW	U32	0.1S	Yes

11.11.6 Troubleshooting

There are two indicators on top of the EtherCAT communication module. When a malfunction occurs, the cause of the malfunction can be confirmed based on the indicator statuses, and troubleshoot the error by following the descriptions below.

Indicator troubleshooting

Module status LED2

Indicator statuses	Status name	Troubleshooting method
Does not light up	Power not supplied	1. Confirm whether the driver power is normal. 2. Confirm whether the power terminal of the communication module is connected to the driver.
Red/green light lights up	Driver data transmission error	1. Confirm whether the communication module has proper contact. 2. Reconnect the power of the driver and confirm whether the error has been eliminated.

Network status LED1

Indicator statuses	Status name	Description
Does not light up	Not connected / INIT	1. Confirm whether the driver power is normal. 2. If connected to EtherCAT, confirm whether it is in INIT mode.
Red light lights up	Driver data transmission error	1. Confirm whether the communication module has proper contact. 2. Reconnect the power of the driver and confirm whether the error has been eliminated.

11.11.7 xml file

When using the EtherCAT communication module, if the xml description file (JN5-CMHI-ECAT_V (latest version).xml) is needed, please download it from the TECO official website or request for it from your purchasing sales channel.

11.12 I/O expansion card

11.12.1 Hardware and data structure

This product is an I/O expansion module; it allows performing of I/O expansion functions through the SPI bus. Used with the TECO A510s/F510 AC motor driver (hereinafter referred to as a driver).

11.12.2 Product specifications

I/O ports

Item	Specifications
Connector	TB1　7 external contacts

AC motor driver port

Item	Specifications
Connector	Control board CN2 connector/CN5 connector
Transmission method	SPI high speed communication
Terminal functions	TB1　7 external contacts

11.12.3 Installation instructions

Contact description

Type	Terminal	Terminal functions	Signal level
Analog input signal	AI3	Main speed command input; SW7 can be used to switch between voltage or current input (-10~10V)/(4-20mA)	-10V to +10V, (Input resistance 500KΩ) 4 to 20 mA (Input resistance: 500Ω) (12bit resolution)
	GND	Analog signal shared terminal	----

Type	Terminal	Terminal functions	Signal level
Relay Output	R4A- R4B- R4C	Relay A contact (multi-function output terminal) Relay B contact (multi-function output terminal) Relay shared terminal; please refer to the manual for its functions.	Terminal capacity: At 250Vac, 10 mA~1A At 30Vdc, 10 mA~1A
Digital Output	DO2	Multi-function (open collector transistor) output: Operating, zero speed, frequency consistent, any frequency consistent, output frequency, preparation complete, low-voltage detection, output occlusion, operation and frequency commands, over-torque detection, abnormal, low-voltage, overheat, motor over-load, frequency converter over-load output, retrying, signal abnormal, chronograph output…	48Vdc, 2 mA~50mA Optical coupling output
	DOG	Open collector transistor shared terminal	

11.12.4 Driver parameter setting descriptions

Please refer to group 3, 4 parameter descriptions in the manual

11.13 DC reactor

Installing a DC reactor at the DC terminal of the frequency converter provides the following advantages:

- Improves the input current waveform distortion caused by the rectifier in the frequency converter while maintaining continuous rectified current.
- Suppresses instantaneous current surges and prevents related overheating phenomenon caused by the rectifier and voltage regulator components due to instantaneous current surges.
- Reduces harmonic interference problems generated by the frequency converter.
- Improves and increase power factor and reduces AC component pulses at the DC terminal.
- Compared to AC reactors, the size of DC reactors are smaller and the costs are also lower.

Table 6.13 DC reactor list

Model			DC reactor	
V	**HP**	**Rated current (A)**	**Inductance value (mH)**	**Rated current (A)**
200V 1 Ø /3 Ø	1	5	2.9	10
	2	7.5	2	15
	3	10.6	1.2	20
200V 3 Ø	5	14.5	0.78	35
	7.5	22	0.78	35
	10	30	0.57	45
	15	42	0.39	65
	20	56	0.29	85
	25	69	0.23	105
	30	80	0.2	120
	40	110	0.14	165
	50 (built-in)	138	0.12	210
	60 (built-in)	169	0.1	200
	75 (built-in)	200	0.08	260
	100 (built-in)	250	0.08	390
	125 (built-in)	312	0.08	390
	150 (built-in)	400	0.065	520
	175 (built-in)	450	0.05	800
400V 3 Ø	1	3.4	10.2	6.5
	2	4.1	7	8.5
	3	5.4	4.2	11
	5	9.2	2.8	20

Model			DC reactor	
V	HP	Rated current (A)	Inductance value (mH)	Rated current (A)
	7.5	12.1	2.8	20
	10	17.5	2.1	30
	15	23	1.4	35
	20	31	1.0	50
	25	38	0.83	60
	30	44	0.7	70
	40	58	0.51	90
	50	73	0.41	115
	60	88	0.34	140
	75	103	0.28	160
	100 (built-in)	145	0.2	230
	125 (built-in)	168	0.18	240
	150 (built-in)	208	0.15	240
	175 (built-in)	250	0.22	290
	215 (built-in)	296	0.15	370
	270 (built-in)	328	0.15	370
	300 (built-in)	435	0.12	520
	375 (built-in)	515	0.08	800
	425 (built-in)	585	0.08	800
	535	700	0.05	1000
	670	875	0.04	1200
	800	960	0.03	1400

Note: When using DC reactors, please first remove the short-circuit copper sheet between the P1 and P2 terminals, and then fix the current reactor on these two terminals.

11.14 Sinusoidal output reactor

The parasitic inductance and capacitance that exist in the frequency converter and motor wiring are determined by the component switching speed and wiring of the frequency converter. The voltage of the motor terminal will reach as high as twice the DC voltage of the frequency converter. LC resonance may cause surge voltages at the motor terminal and cause danger. Installing an AC reactor at the frequency converter output can suppress voltages (dv/dt). If the wiring length is too long, suppression of surge voltages will become more difficult. Installing a sinusoidal output filter at the output terminal of the frequency converter can prevent the motor terminal voltage from generating surges.

Table 6.14 Sinusoidal output reactor list

Model			**Output reactor**	
V	**HP**	**Rated current (A) HD/ND**	**Inductance value (mH)**	**Rated current (A)**
200V 1 Ø /3 Ø	1	5	0.61	6
	2	7.5	0.38	9.6
	3	10.6	0.31	12
200V 3 Ø	5	14.5	0.17	22
	7.5	22	0.17	22
	10	30	0.12	30
	15	42	0.09	42
	20	56	0.07	56
	25	69	0.05	69
	30	80	0.05	79
	40	110	0.03	110
	50	138	0.03	138
	60	169	0.02	169
	75	200	0.017	200
	100	250	0.013	250
	125	312	0.013	312
	150	400	0.008	400
	175	450	0.008	450
400V 3 Ø	1	3.4	1.7	4.1
	2	4.1	1.29	5.4
	3	5.4	1.01	6.9
	5.4	9.2	0.58	12.1
	7.5	12.1	0.58	12.1
	10	17.5	0.4	17.5
	15	23	0.3	23

Model			Output reactor	
V	HP	Rated current (A) HD/ND	Inductance value (mH)	Rated current (A)
	20	31	0.23	31
	25	38	0.18	38
	30	44	0.16	44
	40	58	0.12	58
	50	73	0.1	73
	60	88	0.08	88
	75	103	0.07	103
	100	145	0.05	145
	125	168	0.04	168
	150	208	0.032	208
	175	250	0.027	250
	215	296	0.023	296
	270	328	0.021	328
	300	435	0.015	435
	375	515	0.012	515
	425	585	0.012	585
	535	700	0.01	700
	670	875	0.08	875
	800	960	0.07	960

Note: 1. The frequency converter has improved IGBT equipment and soft-switching driver circuit; compared to previous models, it can improve dv/dt by approximately 50% terminal voltage.

2. The purposes of installing sinusoidal output filters are as follows:

- Prolong motor life.
- Reduce motor interference.
- Reduce frequency converter pulse load.
- Improve system stability and efficiency.

11.15 DC24V power expansion card

This product allows parts of the communication or driver functions to operate normally before connecting power to the frequency converter.

11.15.1 JN5-PS-DC24V product specifications

Connection terminal

Item	Specifications
Input terminal	24V: 24V±5%, 0.6A 0V: 24V reference ground
Notes	The terminals above cannot be connected to the power and terminals on the frequency converter itself in order to achieve the goal of safety isolation.

Appendix-A Instructions for UL

◆ Safety Precautions

DANGER

Electrical Shock Hazard

Do not connect or disconnect wiring while the power is on.

Failure to comply will result in death or serious injury.

WARNING

Electrical 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 drives without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the drives and run the drives 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 drive before touching any components.

Do not allow unqualified personnel to perform work on the drive.

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 AC drives.

Do not perform work on the drive 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 drive.

Do not remove covers or touch circuit boards while the power is on.

Failure to comply could result in death or serious injury.

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 drive 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 drive to metal or other noncombustible material.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the drive and circuit boards.

Failure to comply may result in ESD damage to the drive circuitry.

Never connect or disconnect the motor from the drive while the drive is outputting voltage.

Improper equipment sequencing could result in damage to the drive.

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 drive.

NOTICE

Do not modify the drive circuitry.

Failure to comply could result in damage to the drive 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 drive and connecting any other devices.

Failure to comply could result in damage to the drive.

◆ 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/cUL Mark

◆ UL Standards Compliance

This drive is tested in accordance with UL standard UL508C and complies with UL requirements. To ensure continued compliance when using this drive in combination with other equipment, meet the following conditions:

■ Installation Area

Do not install the drive to an area greater than pollution severity 2 (UL standard).

■ Main Circuit Terminal Wiring

UL approval requires crimp terminals when wiring the drive'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 drives 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) R/L1 S/L2 T/L3 U/T1 V/T2 W/T3	Terminal Screws	Crimp Terminal Model No.	Tool Machine No.	Insulation Cap Model No.
2001/2002/ 2003	2 (14)	M4	R2-4	Nichifu NH 1 / 9	TIC 2
	3.5 (12)		R5.5-4		TIC 3.5
	5.5 (10)				TIC 5.5
2005/2008	5.5 (10)	M4	R5.5-4	Nichifu NH 1 / 9	TIC 5.5
2010/2015	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
2175	152 (300)*2	M12	R150-12*2	Nichifu NOP 150H	TIC 150
4001/4002/ 4003	2 (14)	M4	R2-4	Nichifu NH 1 / 9	TIC 2
	3.5 (12)		R5.5-4		TIC 3.5
	5.5 (10)				TIC 5.5
4005/4008/ 4010	5.5 (10)	M4	R5.5-4	Nichifu NH 1 / 9	TIC 5.5
4015/4020	8 (8)	M6	R8-6	Nichifu NOP 60	TIC 8
4025/4030/ 4040	22 (6)	M6	R22-6	Nichifu NOP 60 / 150H	TIC 14
4050/4060/ 4075	60 (2)	M8	R60-8	Nichifu NOP 60 / 150H	TIC 38
4100/4125	150 (3/0)	M8	R150-8	Nichifu NOP 150H	TIC 80
4150/4175/ 4215/4250	300 (4/0)*2	M10	R150-10	Nichifu NOP 150H	TIC 100
4300	203 (400)*2	M12	R200-12S*2	Nichifu NOH 300K	TIC 200
4375/4425	253 (500)*2	M12	R325-12S*2	Nichifu NOH 300K	TIC 325
4535/4670	152 (300)*4	M10	R150-10*4	Nichifu NOP 150H	TIC 150
4800	203 (400)*4	M10	R200-10S *4	Nichifu NOH 300K	TIC 200

◆Type 1

During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used.
PS : About 2175 and 4300~4425, please see additional data page.

Recommended Input Fuse Selection

Drive Model F510	Fuse Type	
	Manufacturer: Bussmann / FERRAZ SHAWMUT	
	Model	Fuse Ampere Rating (A)
200 V Class Three-Phase Drives		
2001	Bussmann 20CT	690V 20A
2002	Bussmann 20CT	690V 20A
2003	Bussmann 30FE	690V 30A
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
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		
4001	Bussmann 10CT	690V 10A
4002	Bussmann 10CT	690V 10A
4003	Bussmann 16CT	690V 16A
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	690V 80A
4030	Bussmann 100FE / FERRAZ A50QS100-4	690V 100A / 500V 100A
4040	Bussmann 120FEE	690V 120A
4050	FERRAZ SHAWMUT A50QS150-4	500V 150A
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
4300	Bussmann 170M5464	690V 800A
4375	Bussmann 170M5464	690V 800A
4425	Bussmann 170M5466	690V 1000A
4535	Bussmann 170M6217	690V 1400A
4670	Bussmann 170M6217	690V 1400A
4800	Bussmann 170M6217	690V 1400A

◆ 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.

■ Drive Short-Circuit Rating

This drive 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 (Hp) Hp 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

◆ Drive 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 drive 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.

Overload Protection Settings

Setting	Description
---0B	Motor Overload Protection is disabled
---1B	Motor Overload Protection is enabled
--0-B	Cold Start of Motor Overload
--1-B	Hot Start of Motor Overload
-0--B	Standard Motor
-1--B	Special motor

Sets the motor overload protection function in 08-05 according to the applicable motor.

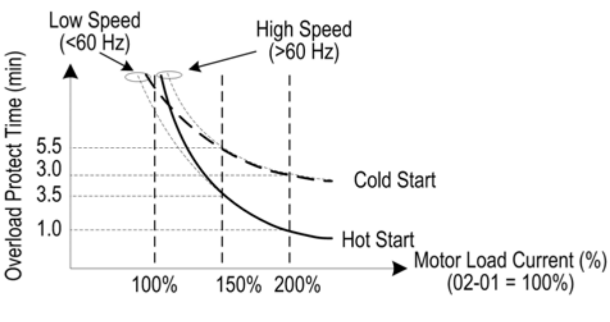
Setting 08-05 = ---0B. Disables the motor overload protection function when two or more motors are connected to a single inverter. Use an alternative method to provide separate overload protection for each motor such as connecting a thermal overload relay to the power line of each motor.

Setting 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.

Setting 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.

Setting 08-05 = -1--B. For motors with a forced cooling fan (inverter duty or V/F 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.



Motor Overload Protection Time

■ **08-06 Start-up mode of overload protection operation**

Setting	Description
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.

Motor over temperature protection shall be provided in the end use application.

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4KA72X662T41 Ver:09 2020.01