

INVERTER

F510



INSTRUCTION MANUAL

230V Class 3~

Open Chassis / NEMA 1 0.75 – 132 kW
1 – 175 HP

460V Class 3~

Open Chassis / NEMA 1 0.75 – 600 kW
1 – 800 HP

■ Read all operating instructions before installing, connecting (wiring), operating, servicing, or inspecting the inverter.

■ Ensure that this manual is made available to the end user of the inverter.

■ Store this manual in a safe, convenient location.

■ The manual is subject to change without prior notice.

*****STATEMENT*****

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

Table of Contents

Preface	0-1
Chapter 1 Safety Precautions	1-1
1.1 Before Supplying Power to the Inverter	1-1
1.2 Wiring.....	1-1
1.3 Before Operation.....	1-2
1.4 Parameters Setting	1-2
1.5 Operation	1-2
1.6 Maintenance, Inspection and Replacement	1-3
1.7 Disposal of the Inverter	1-3
Chapter 2 Model Description	2-1
2.1 Nameplate Data	2-1
2.2 Inverter Models-Motor Power Rating	2-2
Chapter 3 Environment and Installation	3-1
3.1 Environment.....	3-1
3.2 Installation.....	3-2
3.2.1 Installation Spaces	3-2
3.2.2 External View	3-3
3.2.2.1 External View (IP00/ IP20).....	3-3
3.2.3 Warning Labels.....	3-6
3.2.4 Removing the Front Cover and Keypad.....	3-7
3.2.4.1 Standard Type (IP00/IP20)	3-8
3.2.4.2 Built-in Filter Type (IP20/IP00).....	3-15
3.3 Inverter Wiring	3-17
3.3.1 Wire Gauges and Tightening Torque.....	3-17
3.3.2 Wiring Peripheral Power Devices	3-18
3.3.3 General Wiring Diagram	3-20
3.3.4 Wiring for Control Circuit Terminals	3-22
3.3.5 Wiring for Main Circuit Terminals	3-28
3.3.6 Wiring Precautions	3-41
3.3.8 Input Power and Cable Length	3-43
3.4 Inverter Specifications.....	3-44
3.5 Inverter De-rating Based on Carrier Frequency	3-48
3.6 Inverter De-rating Based on Temperature	3-52
3.7 Inverter Dimensions.....	3-53
3.7.1 Standard Type (IP00/IP20)	3-53
Chapter 4 Keypad and Programming Functions	4-1
4.1 LCD keypad	4-1
4.1.1 Keypad Display and Keys.....	4-1
4.1.2 Keypad Menu Structure	4-3
4.2 Parameters	4-7
4.3 Description of Common Parameters	4-60

Chapter 5 Check Motor Rotation and Direction	5-1
Chapter 6 Speed Reference Command Configuration	6-1
6.1 Reference from Keypad	6-1
6.2 Reference from External Analog Signal (0-10V / 4-20mA)	6-2
6.3 Reference from Serial Communication RS485 (00-05=3).....	6-4
6.4 Reference from two Analog Inputs	6-6
6.5 Change Frequency Unit from Hz to rpm	6-6
Chapter 7 Operation Method Configuration (Run / Stop).....	7-1
7.1 Run/Stop from the Keypad (00-02=0) – Default Setting	7-1
7.2 Run/Stop from External Switch / Contact or Pushbutton (00-02=1)	7-2
7.3 Run/Stop from Serial Communication RS485 (00-02=3)	7-3
Chapter 8 Motor and Application Specific Settings.....	8-1
8.1 Set Motor Nameplate Data (02-01, 02-05).....	8-1
8.2 Acceleration and Deceleration Time (00-14, 00-15).....	8-2
8.3 Torque Compensation Gain (01-10)	8-3
8.4 Automatic Energy Savings Function (11-19).....	8-4
8.5 Emergency Stop	8-6
8.6 Direct / Unattended Startup	8-7
8.7 Analog Output Setup.....	8-8
Chapter 9 Using PID Control for Constant Flow / Pressure Applications.....	9-1
9.1 What is PID Control?	9-1
9.2 Connect Transducer Feedback Signal (10-01)	9-3
9.3 Engineering Units	9-4
9.4 Sleep / Wakeup Function	9-5
Chapter 10 Troubleshooting and Fault Diagnostics.....	10-1
10.1 General	10-1
10.2 Fault Detection Function	10-1
10.3 Warning / Self-diagnosis Detection Function	10-7
10.4 Auto-tuning Error	10-15
10.5 PM Motor Auto-tuning Error	10-16
10.6 General troubleshooting.....	10-17
10.7 Troubleshooting of the Inverter	10-18
10.7.1 Quick troubleshooting of the Inverter	10-18
10.7.2 Troubleshooting for OC, OL error displays	10-20
10.7.3 Troubleshooting for OV, LV error.....	10-21
10.7.4 The motor can not run	10-22
10.7.5 Motor Overheating	10-23
10.7.6 Motor runs unbalanced	10-24
10.8 Routine and periodic inspection.....	10-25
10.9 Maintenance	10-26
Chapter 11 Inverter Peripheral devices and Options.....	11-1
11.1 Braking Resistors and Braking Units	11-1
11.2 AC Line Reactors.....	11-5

11.3 Input Noise Filters	11-5
11.4 Input Current and Fuse Specifications	11-6
11.5 Other options	11-8
11.6 Communication options	11-13
11.7 Protective Cover	11-13
11.8 NEMA1 Kit	11-14

Appendix-A Instructions for UL..... A-1

The complete F510 Instruction Manual can be found at www.tecowestinghouse.com

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 www.tecowestinghouse.com



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

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.

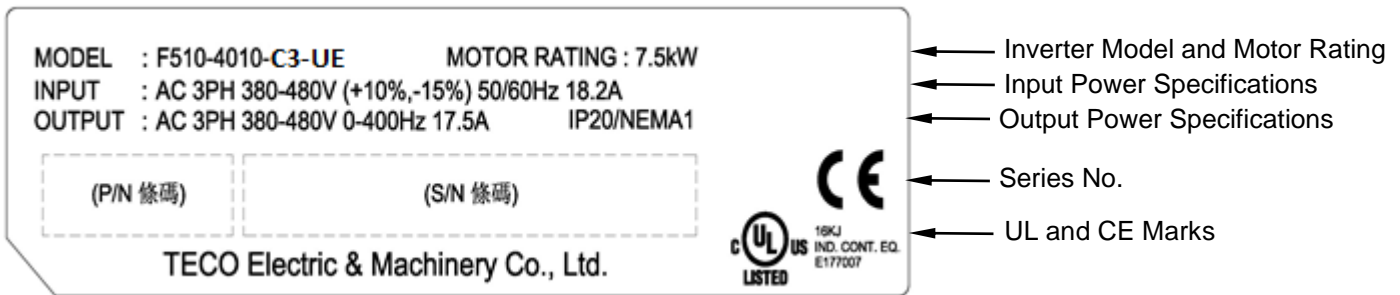
Chapter 2 Model Description

2.1 Nameplate Data

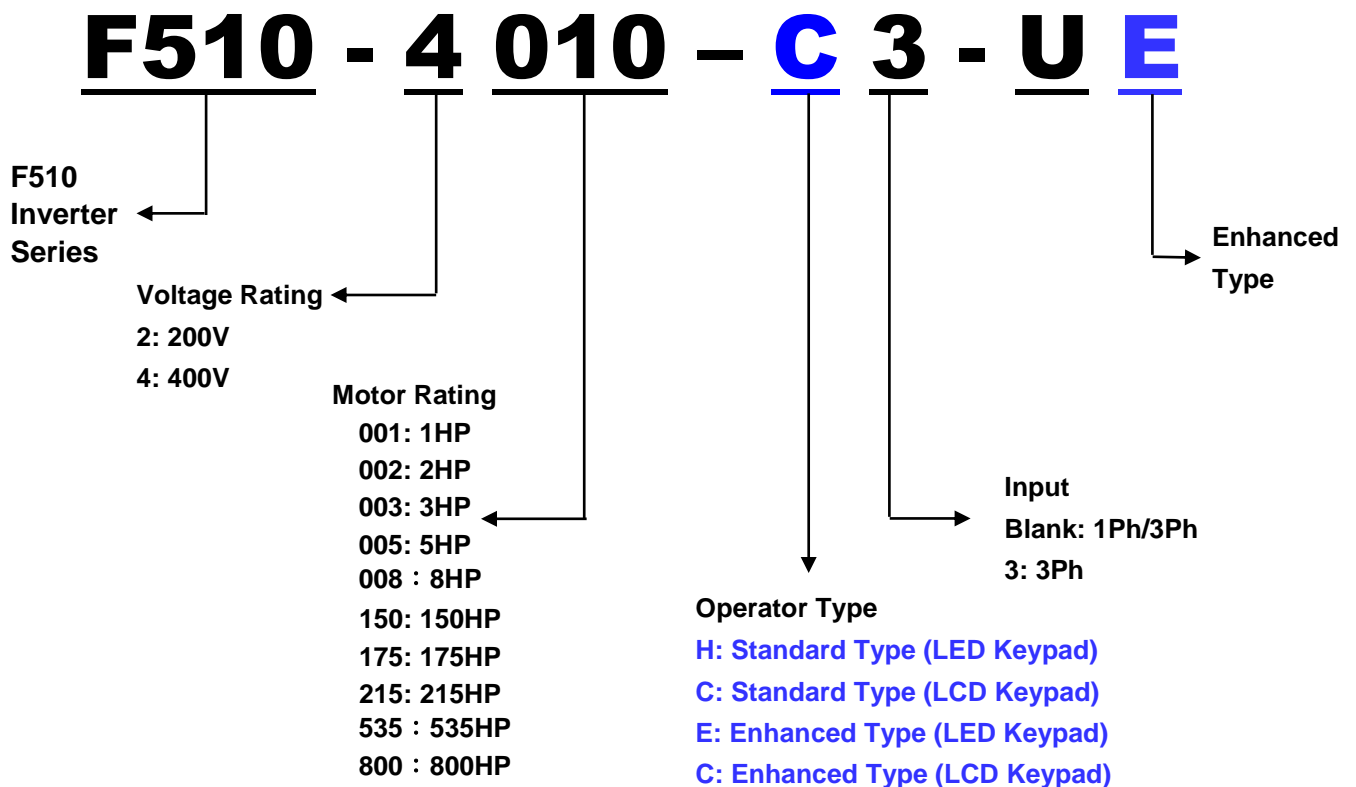
It is essential to verify the F510 inverter nameplate and make sure that the F510 inverter has the correct rating so it can be used in your application with the proper sized AC motor.

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 :

230V Class

Voltage	A510 Model	Applied Motor (HP)	Applied Motor (KW)	Filter	
				with	without
1ph/3ph, 200~240V +10%/-15% 50/60Hz	F510-2001-C-UE	1	0.75		⊙
	F510-2002-C-UE	2	1.5		⊙
	F510-2003-C-UE	3	2.2		⊙
3ph, 200~240V +10%/-15% 50/60Hz	F510-2005-C3-UE	5	3.7		⊙
	F510-2008-C3-UE	7.5	5.5		⊙
	F510-2010-C3-UE	10	7.5		⊙
	F510-2015-C3-UE	15	11		⊙
	F510-2020-C3-UE	20	15		⊙
	F510-2025-C3-UE	25	18.5		⊙
	F510-2030-C3-UE	30	22		⊙
	F510-2040-C3-UE	40	30		⊙
	F510-2050-C3-UE	50	37		⊙
	F510-2060-C3-UE	60	45		⊙
	F510-2075-C3-UE	75	55		⊙
	F510-2100-C3-UE	100	75		⊙
F510-2125-C3-UE	125	94		⊙	
F510-2150-C3-UE	150	112		⊙	

460V Class

Voltage (Vac) & Frequency (Hz)	F510 Model	Motor Power (Hp)	Applied Motor (kW)	Filter	
				with	without
3ph 380~480V +10%/-15% 50/60Hz	F510-4001-C3-UE	1	0.75		⊙
	F510-4002-C3-UE	2	1.5		⊙
	F510-4003-C3-UE	3	2.2		⊙
	F510-4005-C3-UE	5	3.7		⊙
	F510-4008-C3-UE	7.5	5.5		⊙
	F510-4010-C3-UE	10	7.5		⊙
	F510-4015-C3-UE	15	11		⊙
	F510-4020-C3-UE	20	15		⊙
	F510-4025-C3-UE	25	18.5		⊙
	F510-4030-C3-UE	30	22		⊙
	F510-4040-C3-UE	40	30		⊙
	F510-4050-C3-UE	50	37		⊙
	F510-4060-C3-UE	60	45		⊙
	F510-4075-C3-UE	75	55		⊙
	F510-4100-C3-UE	100	75		⊙
	F510-4125-C3-UE	125	94		⊙
	F510-4150-C3-UE	150	112		⊙
	F510-4175-C3-UE	175	130		⊙
	F510-4215-C3-UE	215	160		⊙
	F510-4250-C3-UE	250	185		⊙
	F510-4300-C3-UE	300	220		⊙
F510-4375-C3-UE	375	280		⊙	
F510-4425-C3-UE	425	317		⊙	
F510-4535-C3-UE	535	400		⊙	
F510-4670-C3-UE	670	500		⊙	
	F510-4800-C3-UE	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
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/s ²), from 49.84 to 150 Hz Displacement amplitude : 0.3mm (peak value), from 10 to 49.84 Hz (Follow IEC60068-2-6 standard)

*Not standard product in the America's market.

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

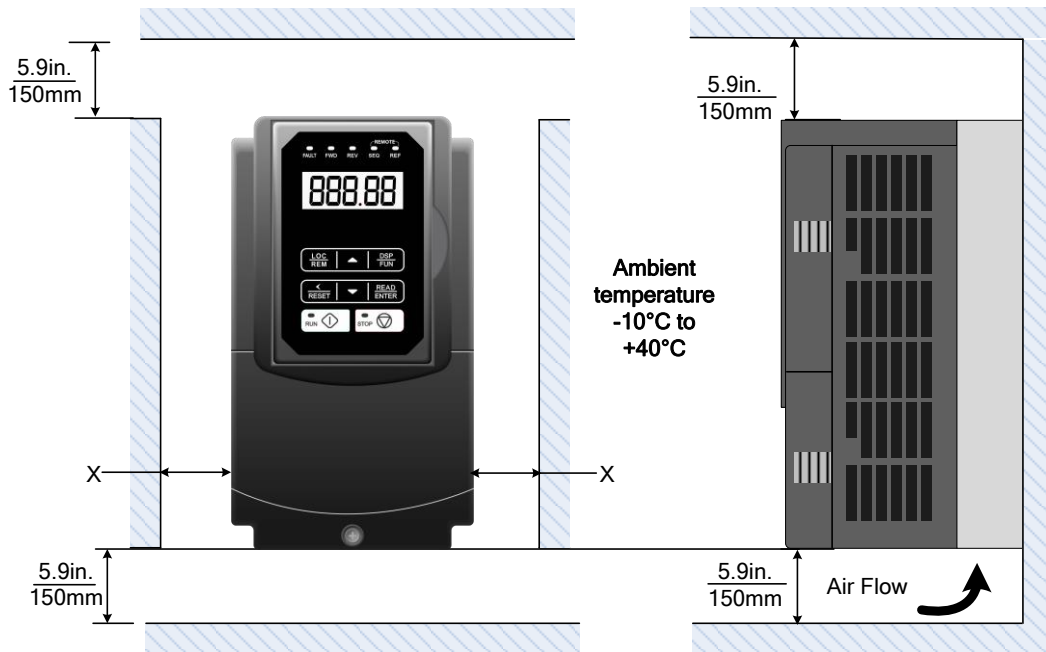


Fig 3.2.1: F510 Installation space

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

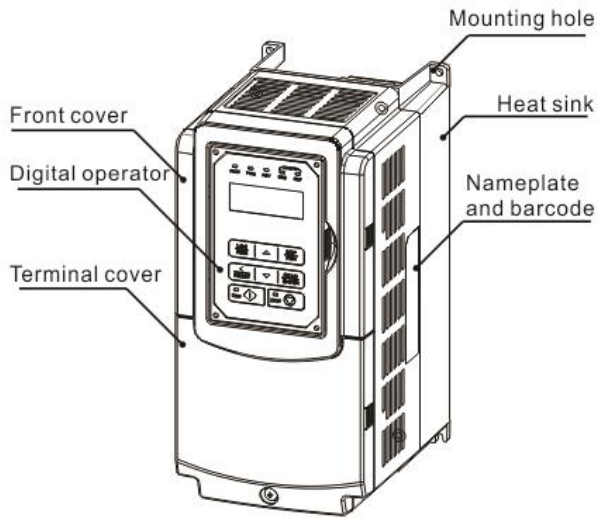
X = 1.96" (50mm) for inverter ratings 22kW or higher

- **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.

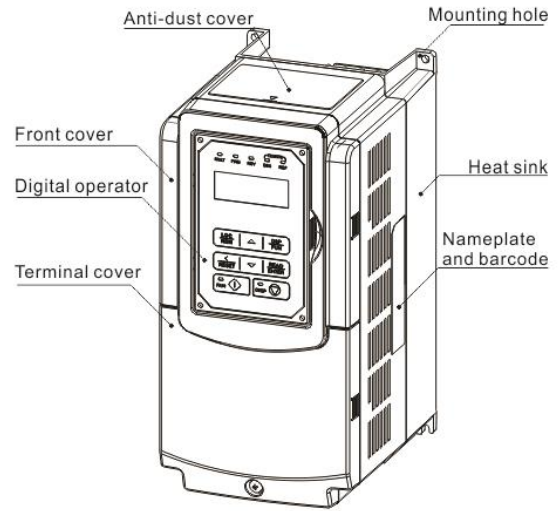
3.2.2 External View

3.2.2.1 External View (IP00/ IP20)

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

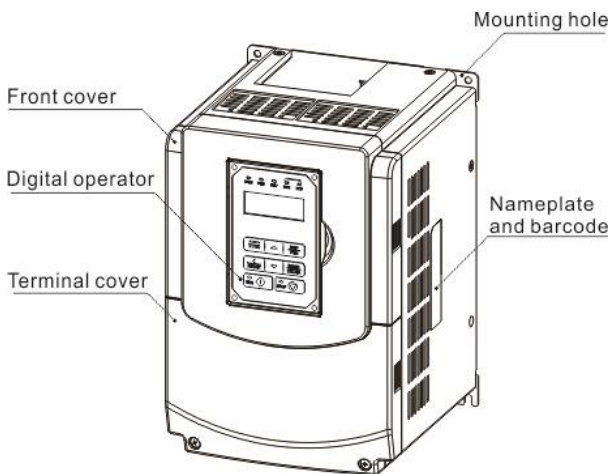


(Wall-mounted type, IEC IP00)

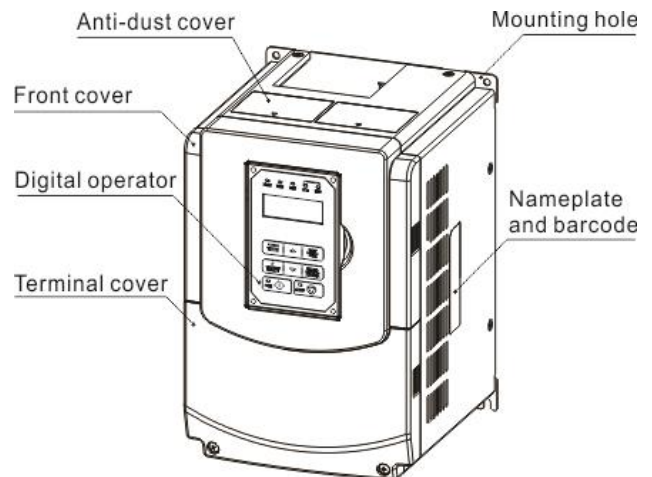


(Wall-mounted type, IEC IP20, NEMA1)

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

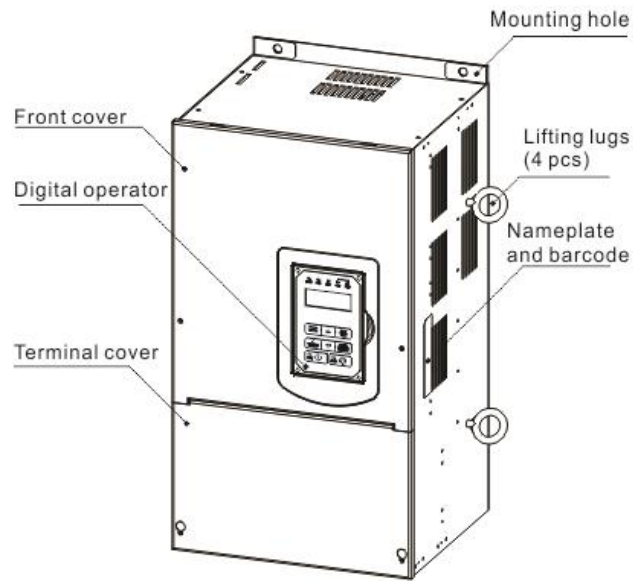


(Wall-mounted type, IEC IP00)



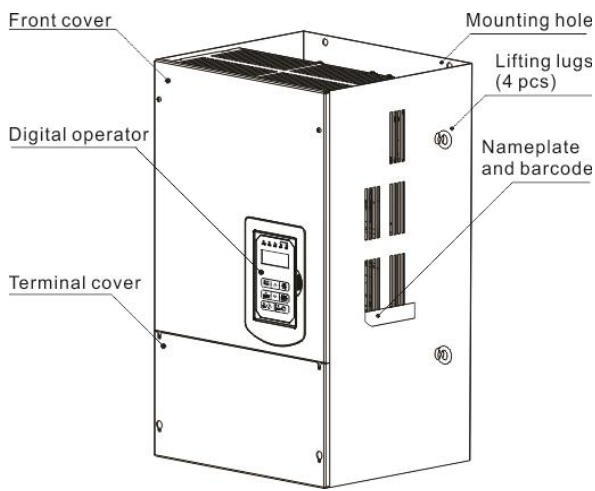
(Wall-mounted type, IEC IP20, NEMA1)

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

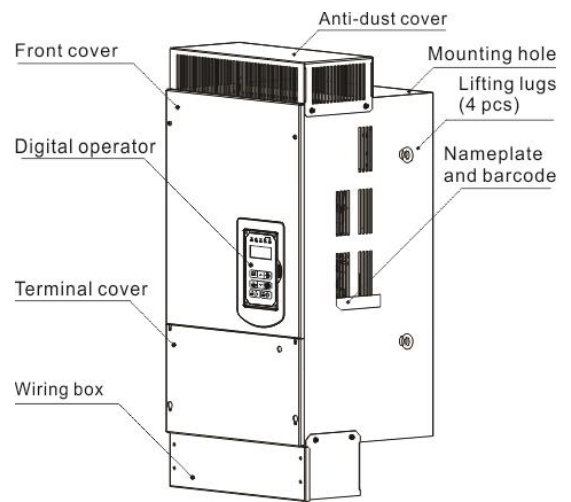


(Wall-mounted type, IEC IP20, NEMA1)

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

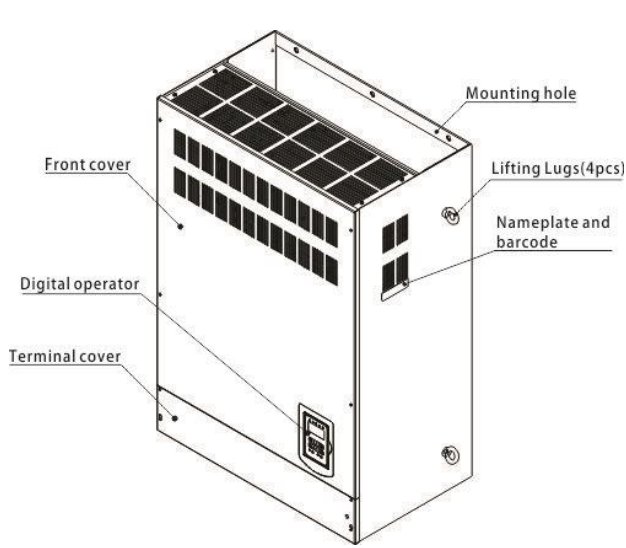


**(Wall-mounted type, IEC IP00)
NEMA1)**

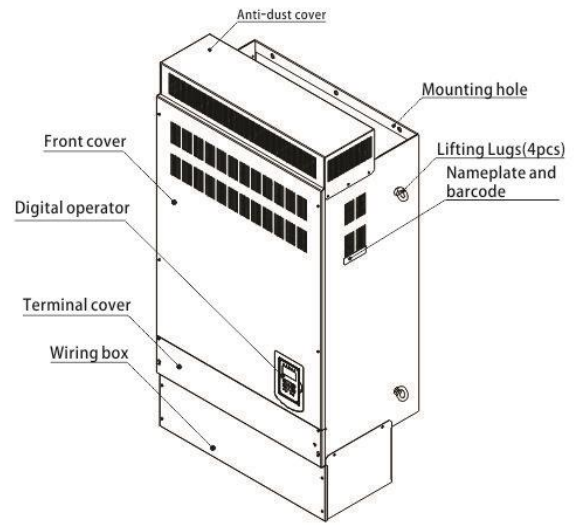


(Wall-mounted type, IEC IP20,

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

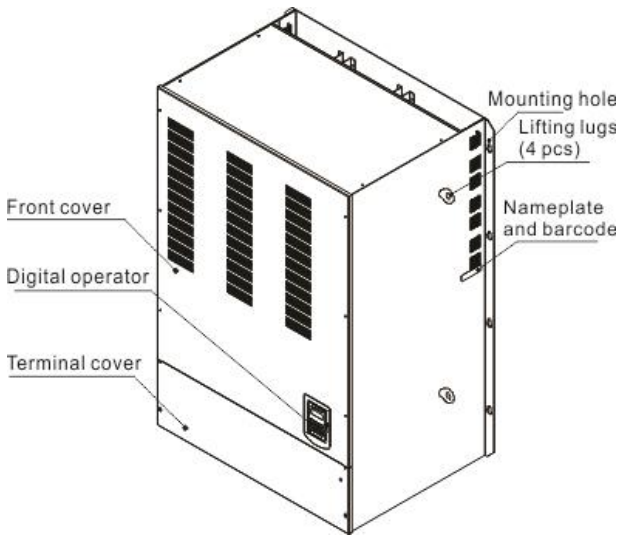


(Wall-mounted type, IEC IP00)

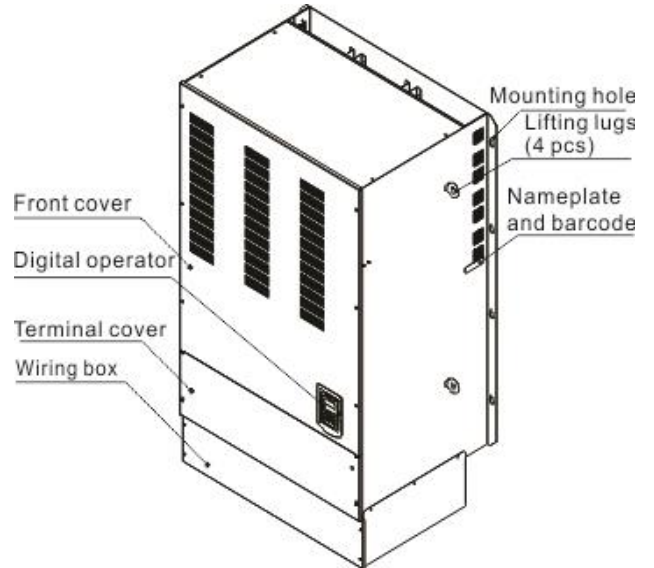


(Wall-mounted type, IEC IP20)

(f) 400V 535-800HP



(Wall-mounted type, IEC IP00)



(Wall-mounted type, IEC IP20)

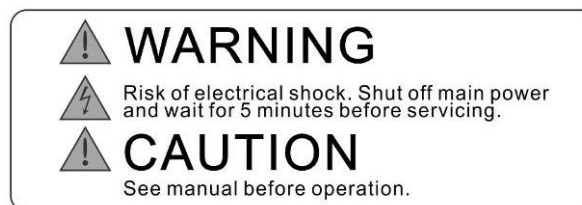
3.2.3 Warning Labels

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)

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

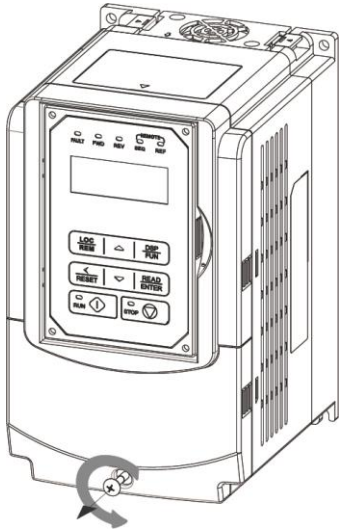


Caution

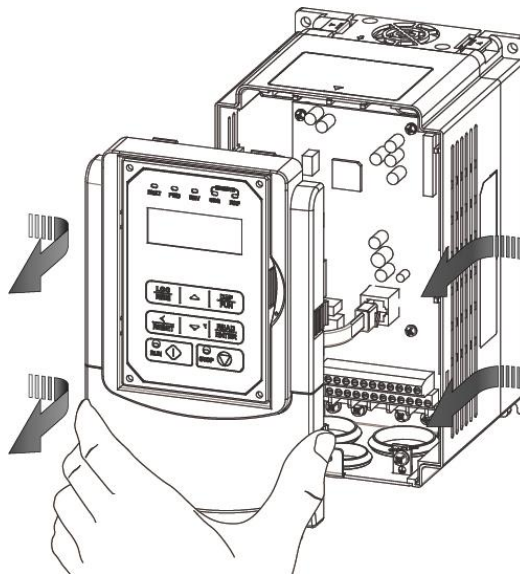
- It is not required to remove the digital operator before making any wiring connections.
- Models 200V, 1– 30 HP and 400V, 1 – 40 HP have a plastic cover. Loosen the screws and remove the cover to gain access to the terminals and make wiring connections. Place the plastic cover back and fasten screws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

3.2.4.1 IP00/ IP20 Type

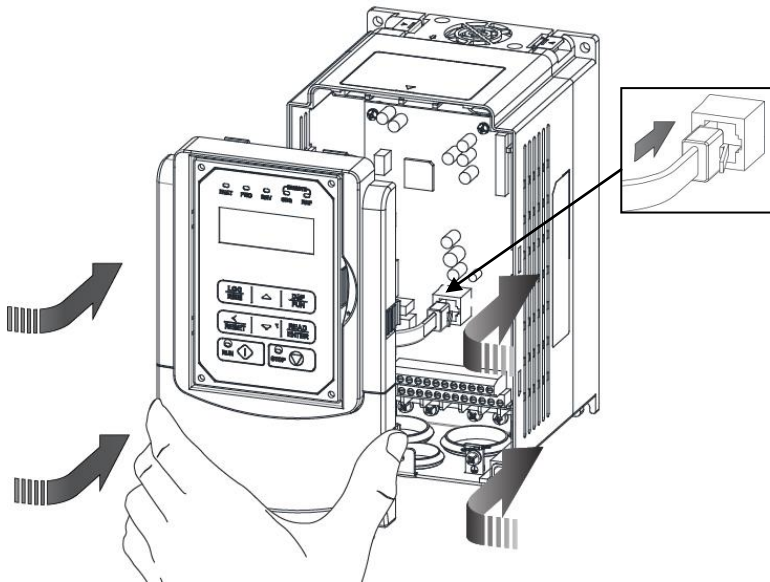
(a) 200V 1-3HP/ 400V 1-3HP



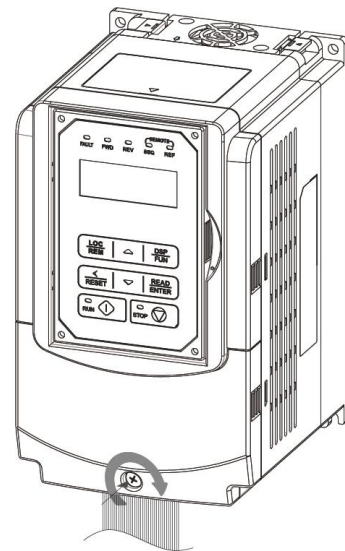
Step 1: Unscrew



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

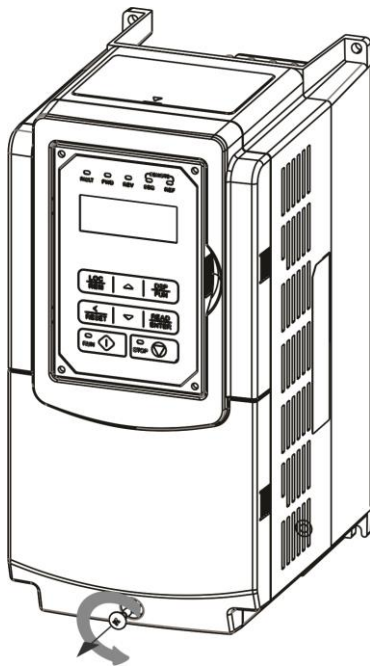


Step 3: Make wire connections, lock RJ45 connector and place top cover back

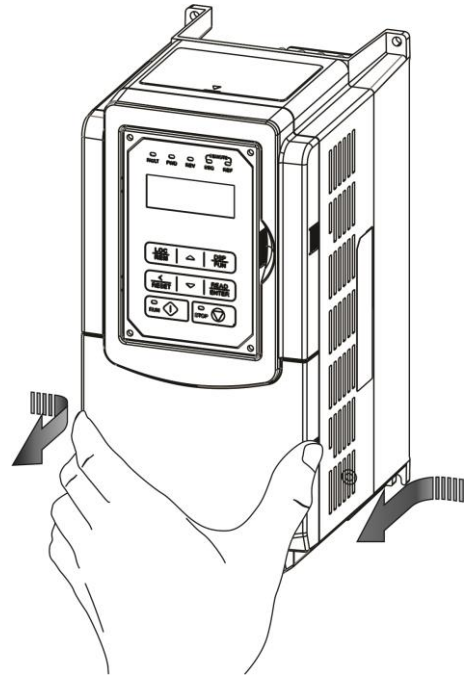


Step 4: Fasten screw

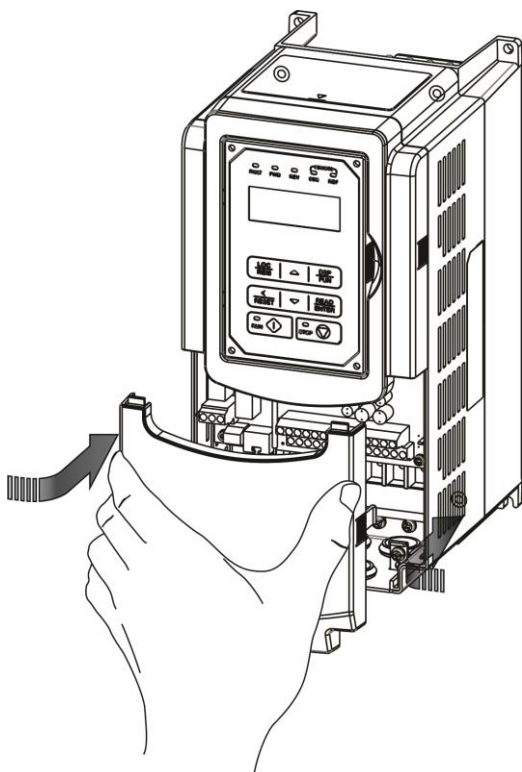
(b) 200V 5-7.5HP(U Type) 5~10HP (UE Type) /400V 5-10HP



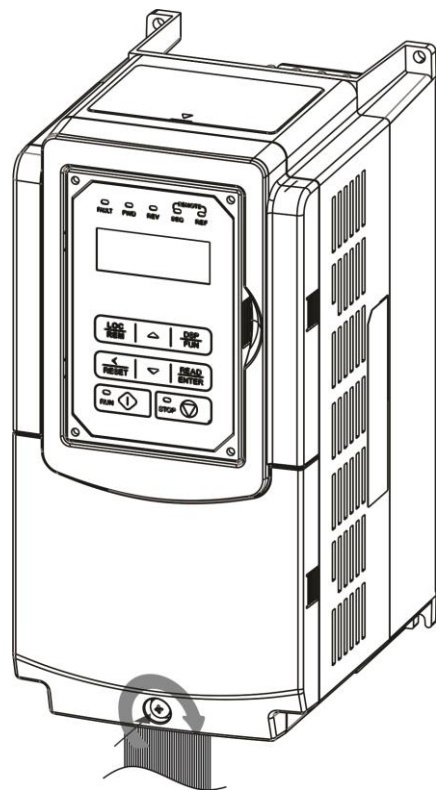
Step 1: Unscrew



Step 2: Remove cover

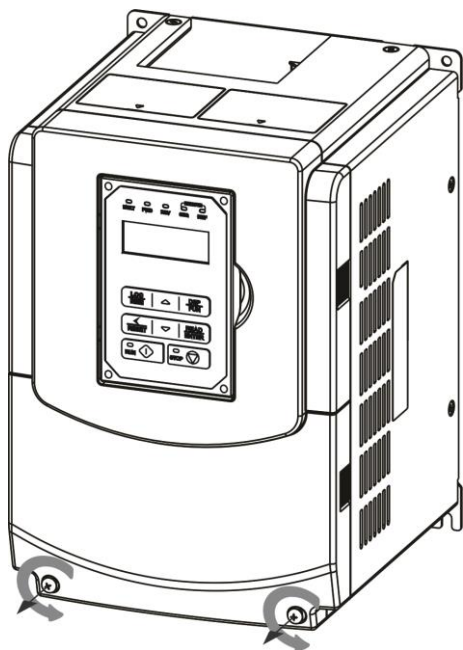


Step 3: Make wire connections and place cover back

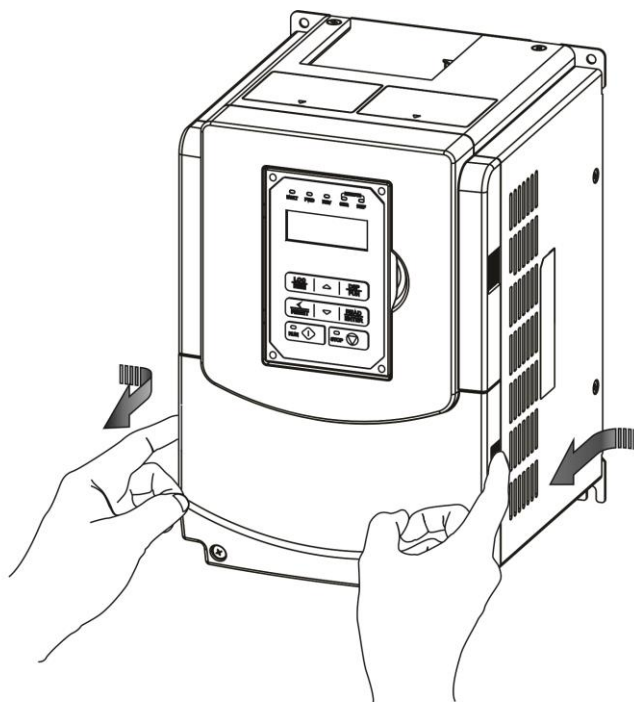


Step 4: Fasten screw

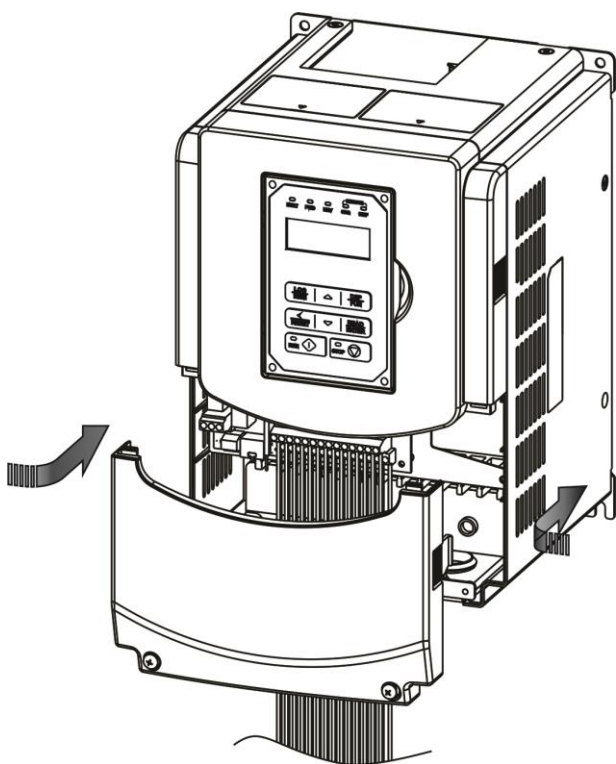
(c) 200V 10-30HP/ 400V 15-40HP



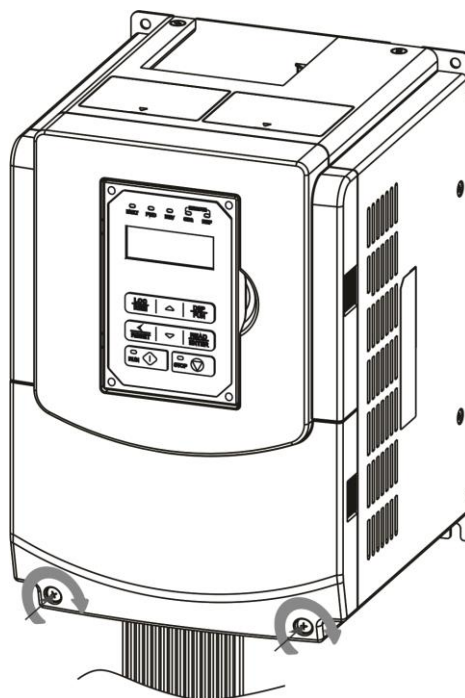
Step 1: Unscrew



Step 2: Remove cover

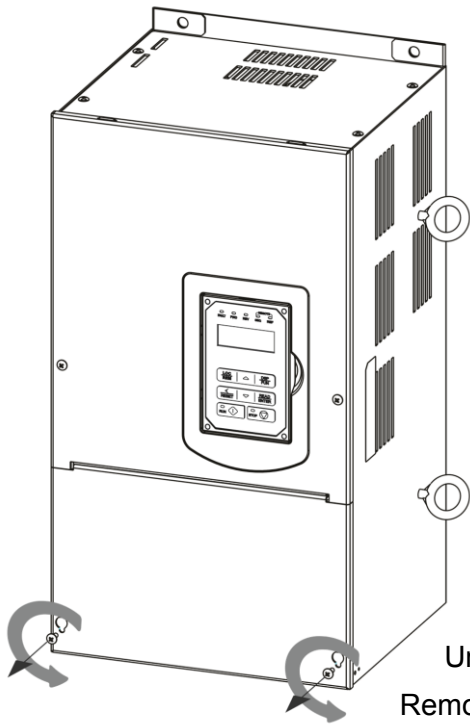


Step 3: Make wire connections and place cover back

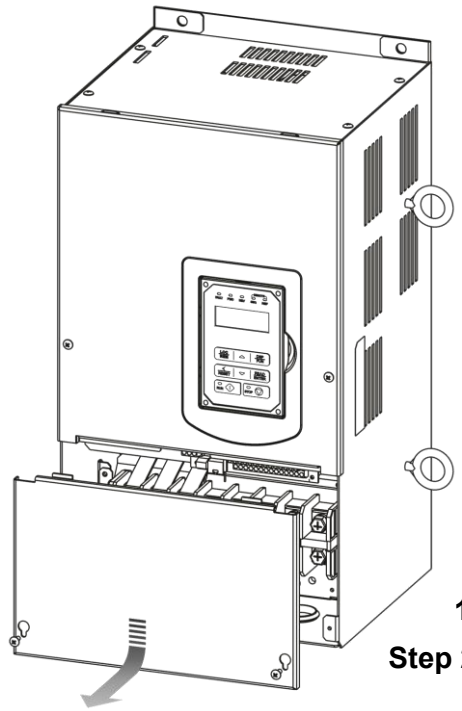


Step 4: Fasten screw

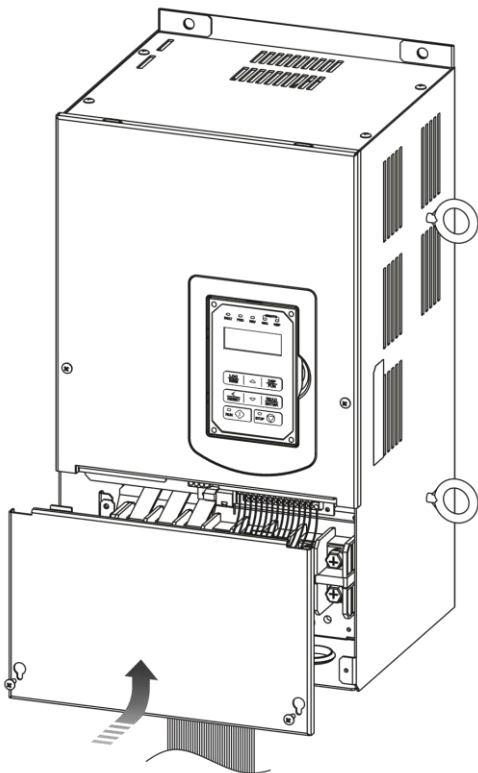
(d) 200V 40-50HP/ 400V 50-75HP (U Type) 50~100HP (UE Type)



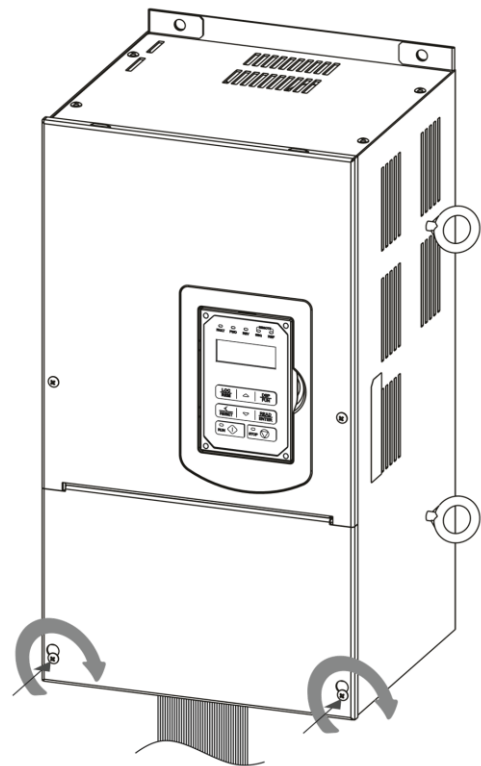
Step
Unscrew cover
Remove cover



1:
Step 2:

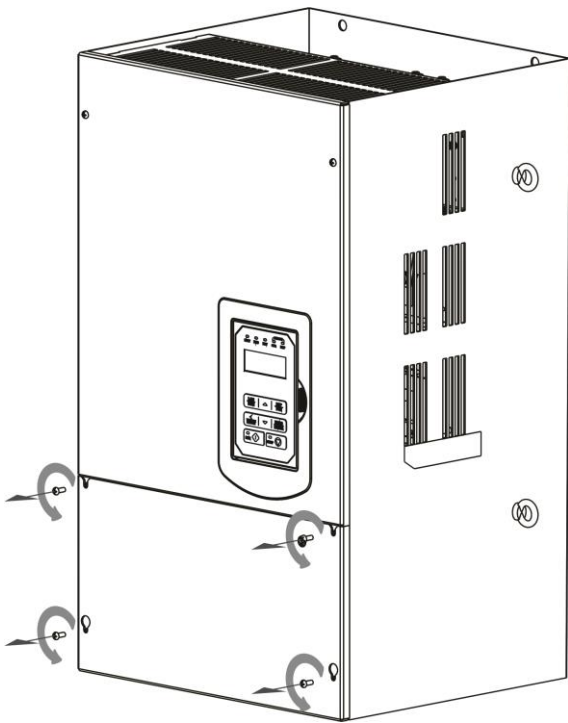


Step 3: Make wire connections and place cover back

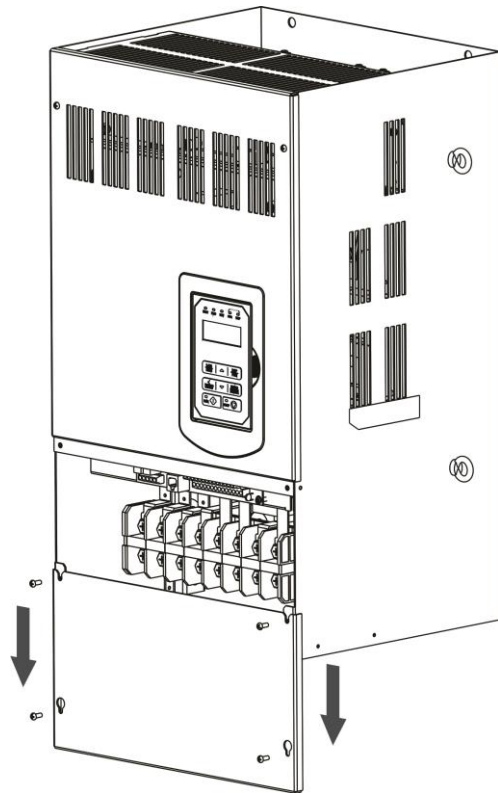


Step 4: Fasten screw

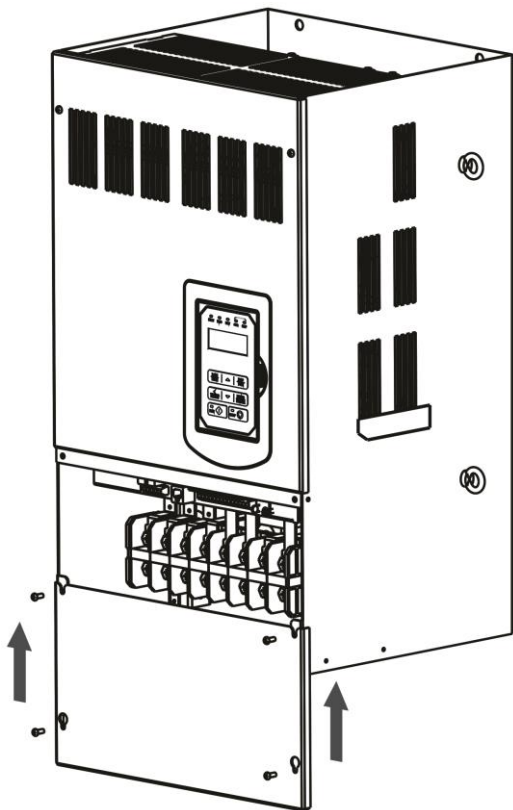
(e) 200V 60-125HP/ 400V 100-250HP



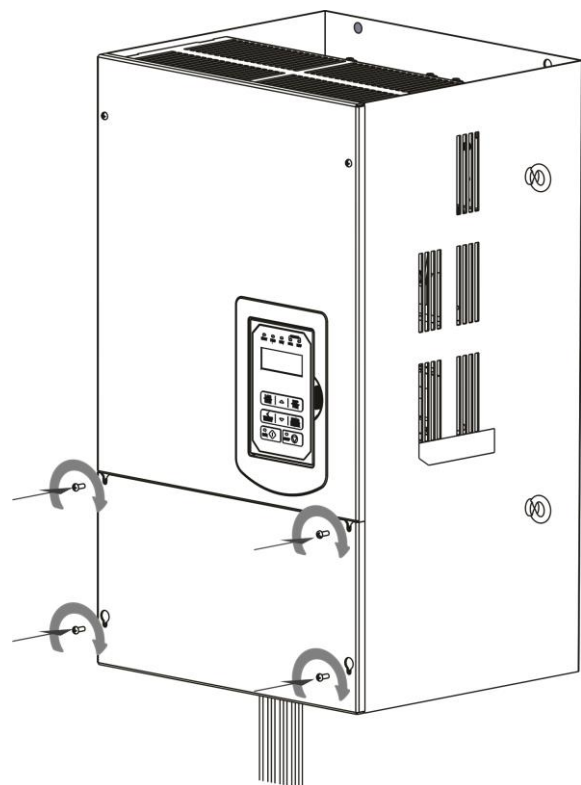
Step 1: Unscrew cover



Step 2: Remove cover

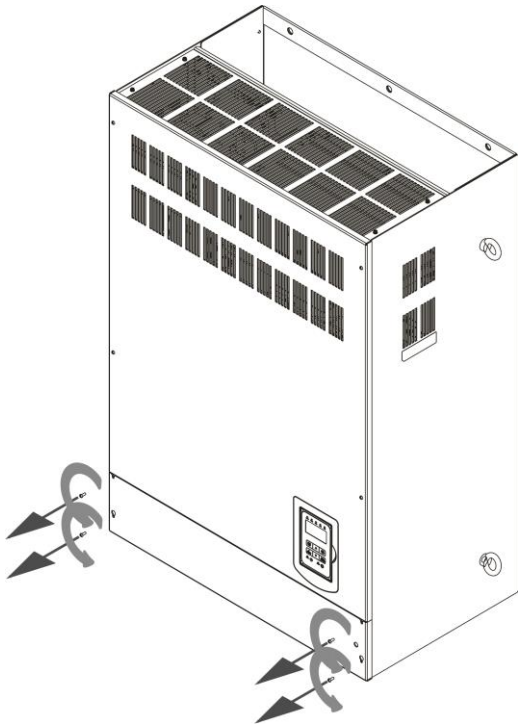


Step 3: Make wire connections and place cover back

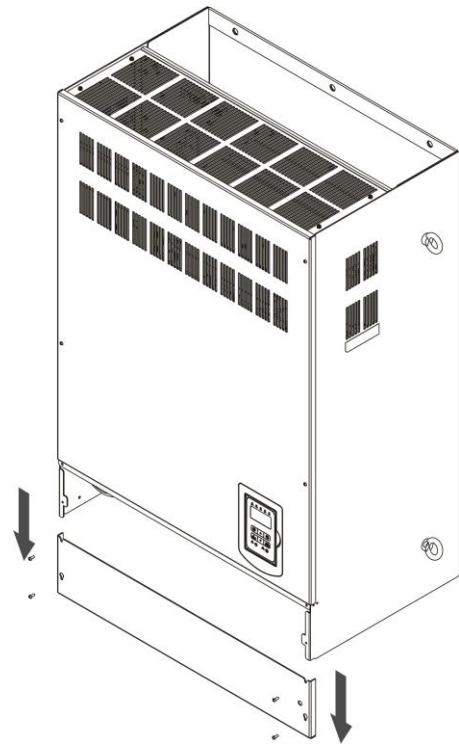


Step 4: Fasten screw

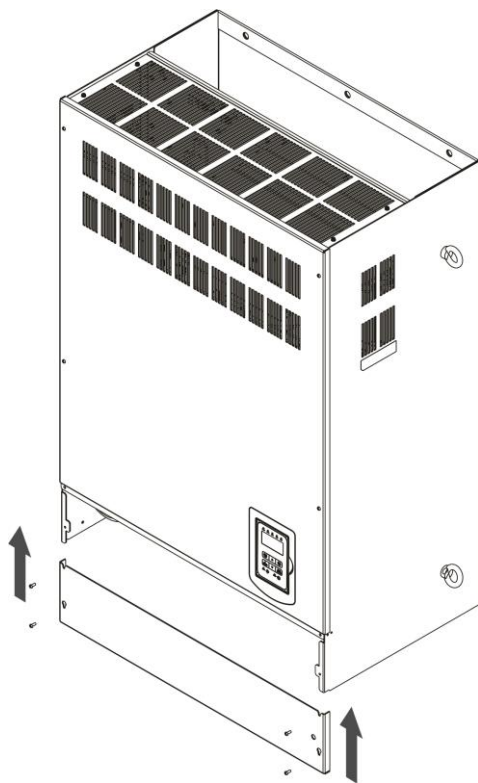
(f) 200V 150-175HP/ 400V 300-425HP



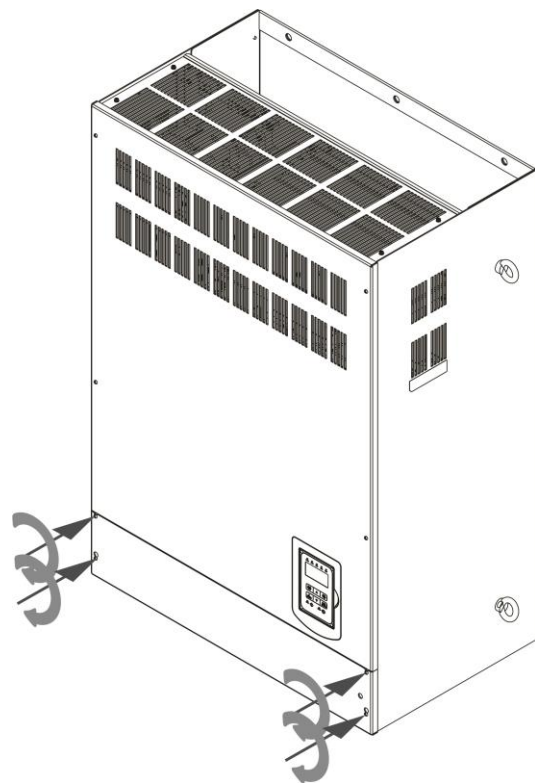
Step 1: Unscrew cover



Step 2: Remove cover

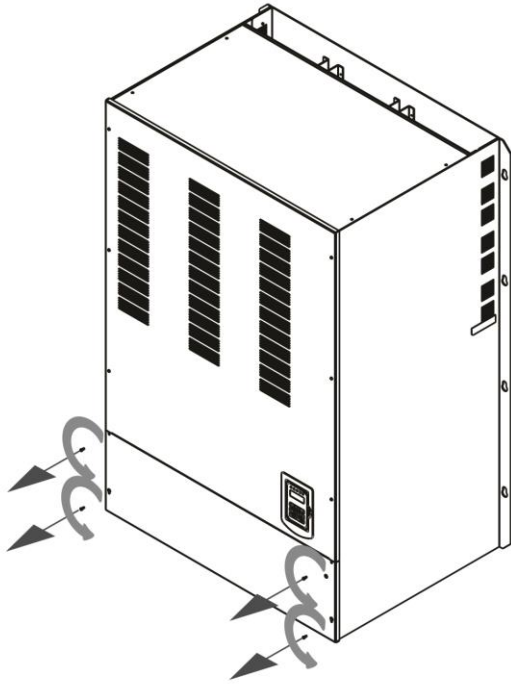


Step 3: Make wire connections and place cover back

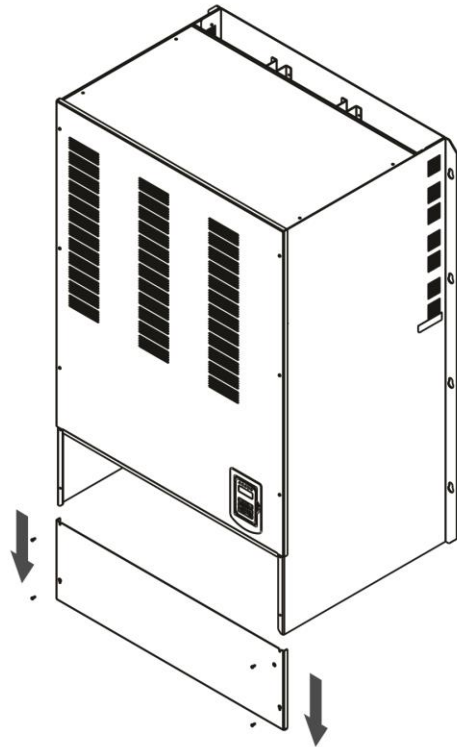


Step 4: Fasten screw

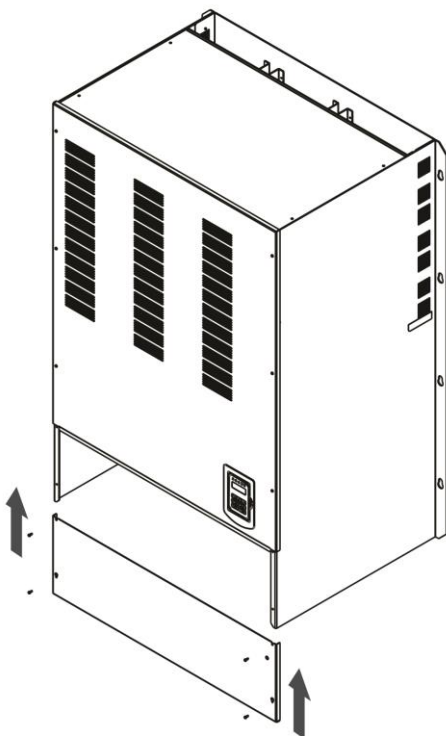
(g) 400V 535-800HP



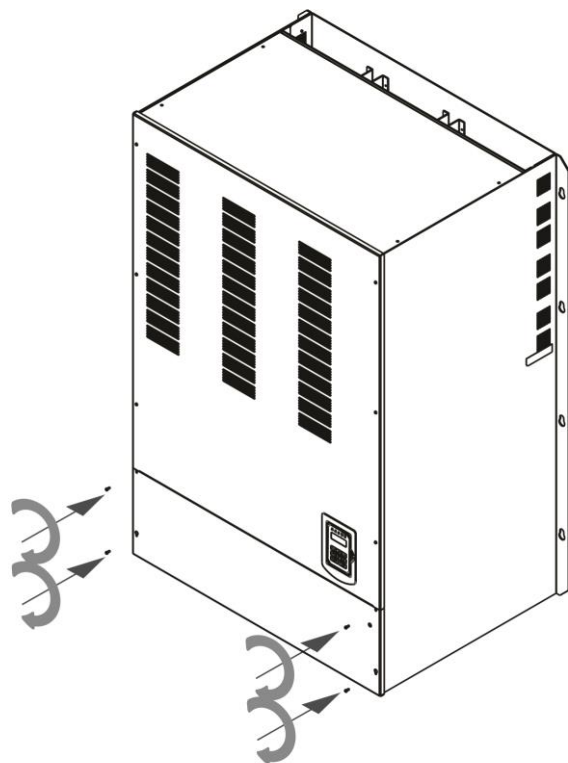
Step 1: Unscrew cover



Step 2: Remove cover



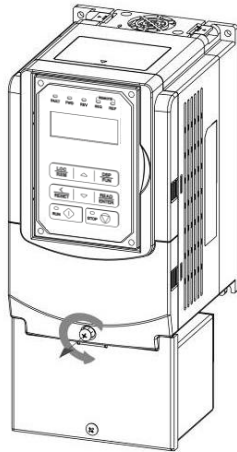
Step 3: Make wire connections and place cover back



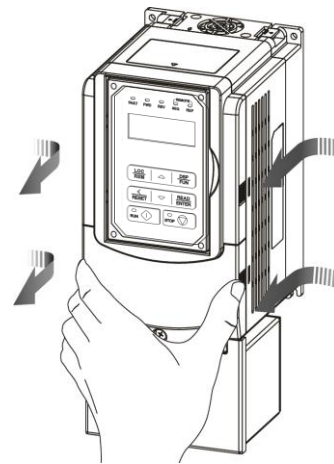
Step 4: Fasten screw

3.2.4.2 Built-in Filter Type (IP20/ IP00)

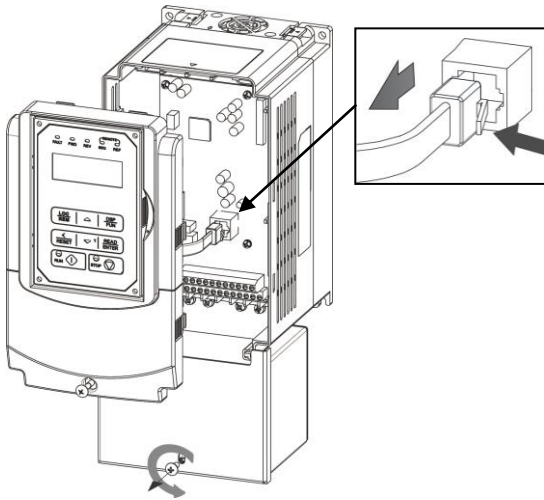
(a) 400V 1-3HP



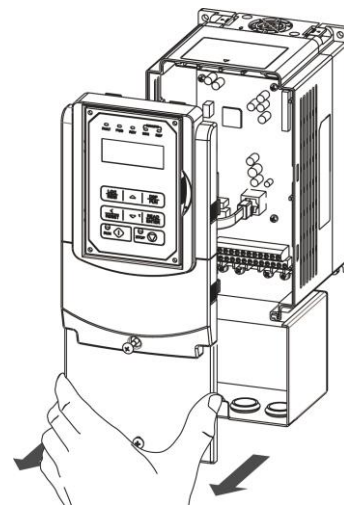
Step 1: Unscrew cover



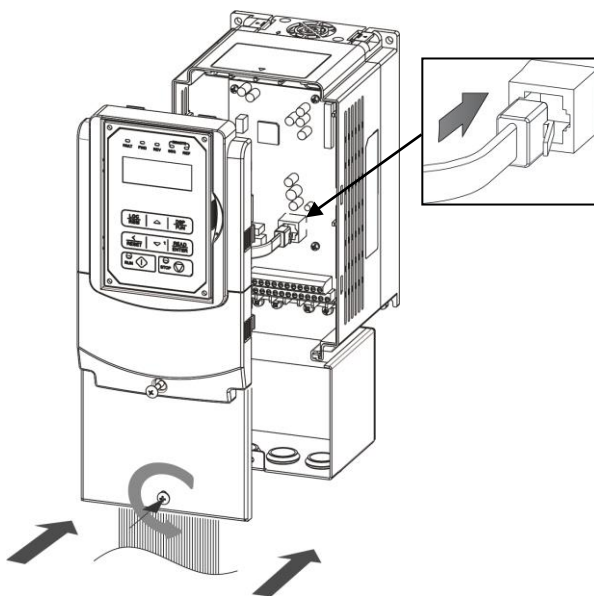
Step 2: Remove whole top cover



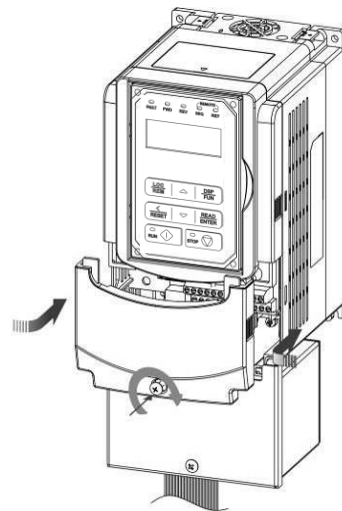
Step 3: Unlock RJ45 connector, Unscrew filter section



Step 4: Remove filter cover

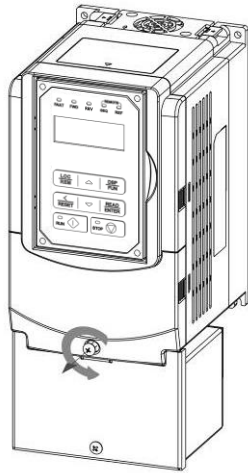


Step 5: Make wire connections, lock RJ45 cover back

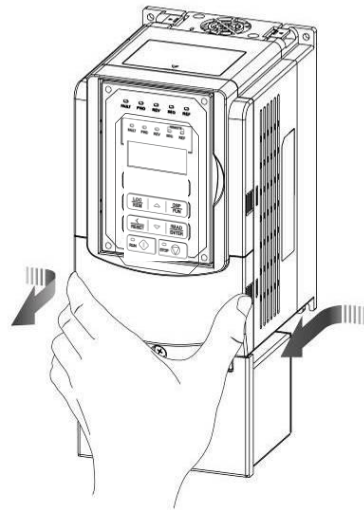


Step 6: Fasten screw connector and place top cover back

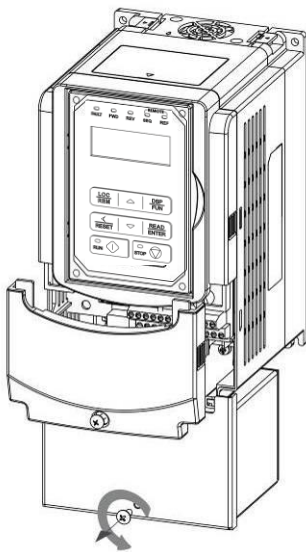
(b) 400V 5-75HP



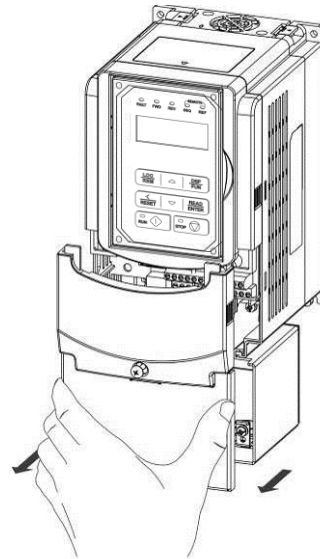
Step 1: Unscrew cover



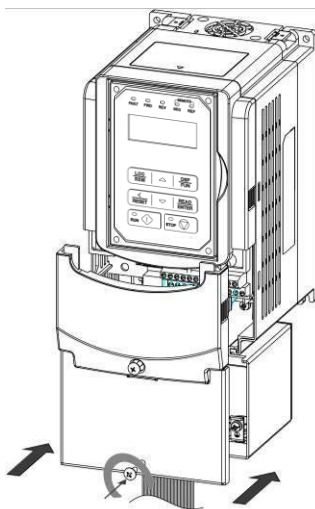
Step 2: Remove cover



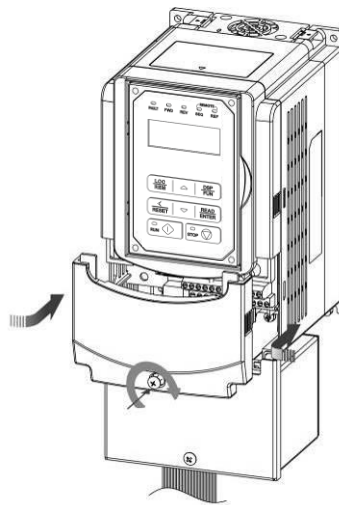
Step 3: Unscrew filter section



Step 4: Remove filter cover



Step 5: Make connections and place filter cover back



Step 6: Fasten screw

*****Filter Type Not Standard in US Market*****

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

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 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.



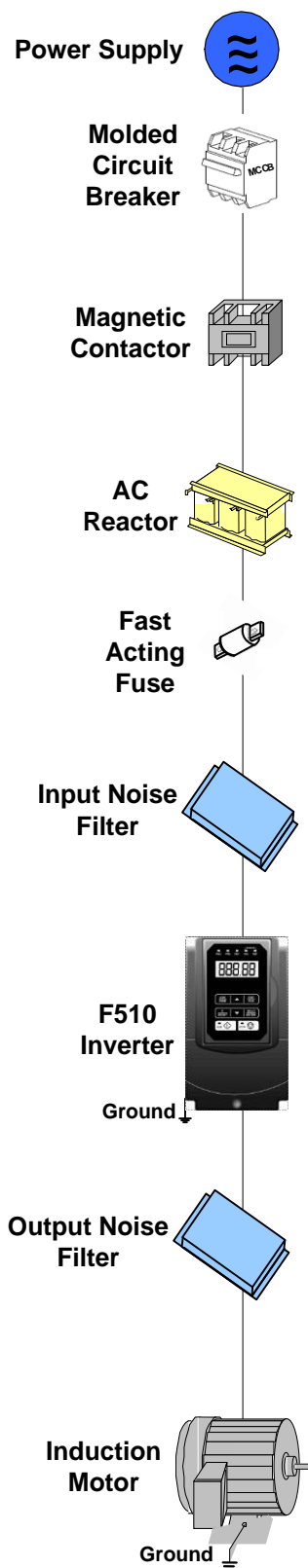
Caution

- 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%.


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

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

- Reduce the carrier frequency (parameter 11-01) If the cable from the inverter to the motor is greater than 25m (82ft). A high-frequency current can be generated by stray capacitance between the cables and result in an overcurrent trip of the inverter, an increase in leakage current, or an inaccurate current readout.
- To protect peripheral equipment, install fast acting fuses on the input side of the inverter. Refer to section 11.4 for additional information.




Power supply:


-  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 <math>< 100\Omega</math>; 400V series: Rg <math>< 10\Omega.</math>)

Output Noise filter:

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

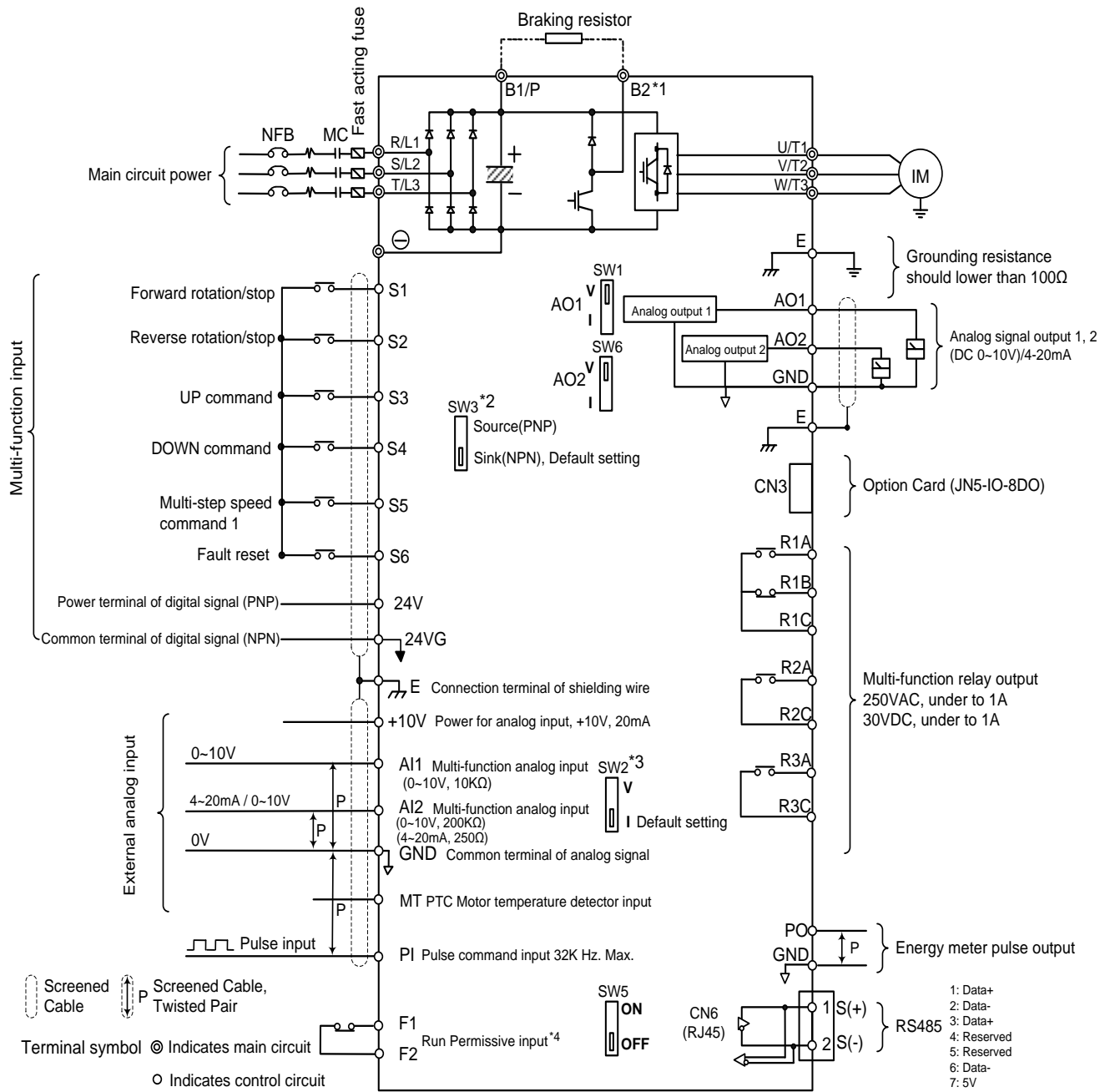
Motor:

- 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

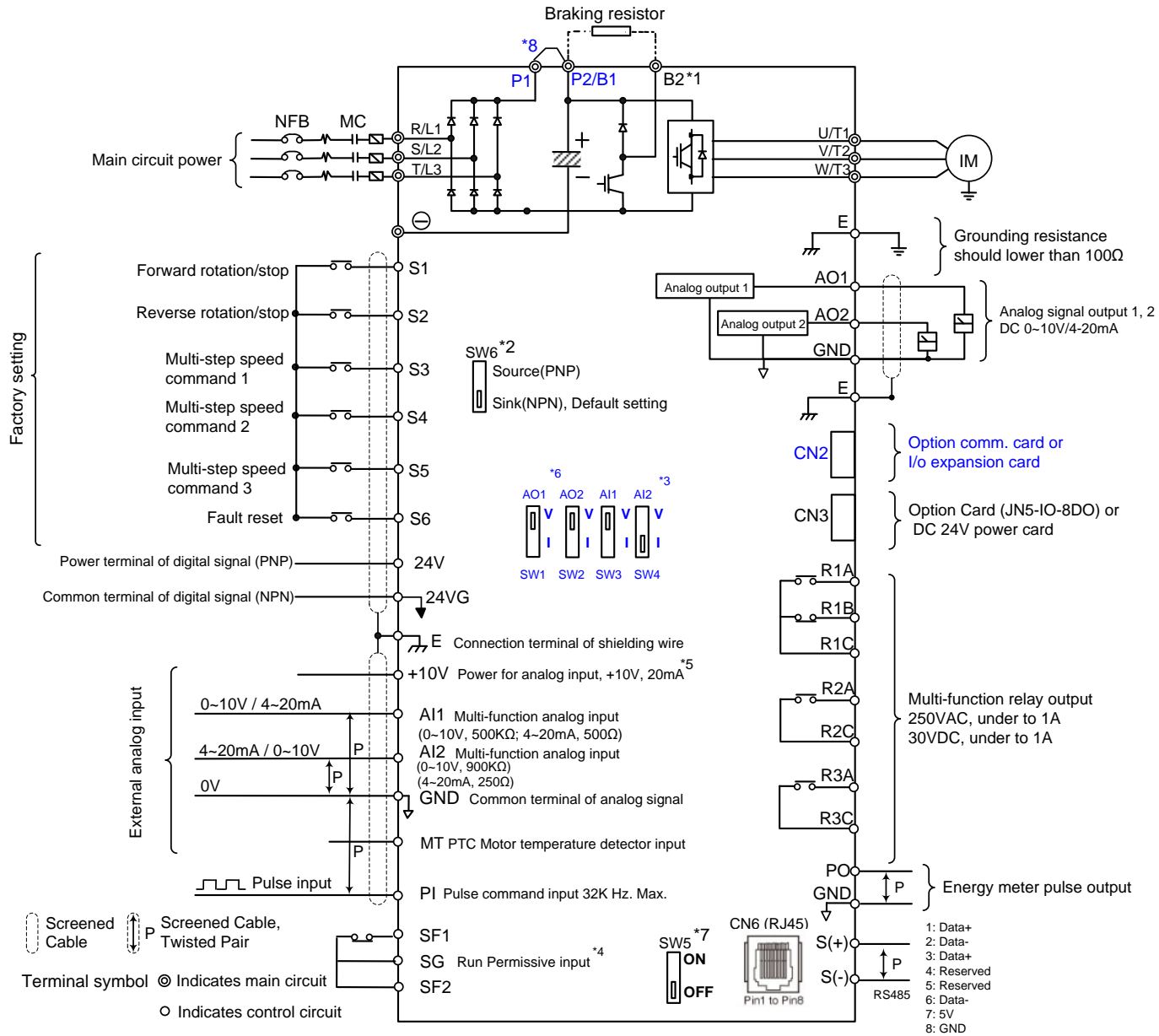
3.3.3.1 General Wiring Diagram (For U type)

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 3.3.4.1, 3.3.5.1 and 3.3.5.2



3.3.3.2 General Wiring Diagram (For UE 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 3.3.4.1, 3.3.5.1 and 3.3.5.2



3.3.4 Wiring for Control Circuit Terminals

3.3.4.1 Wiring for Control Circuit Terminals (For U 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
-----	-----	-----	-----	-----	-----	-----

Table 3.3.4.1 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 3.3.4.1 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 (+)	RS485/MODBUS	differential input and output
	S (-)		
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.

3.3.4.2 Wiring for Control Circuit Terminals (For UE type)

■ Control circuit terminals identification

IP00/IP20 type

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

R1A	R1B	R1C	R2A	R2C	R3A	R3C	S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
RJ45							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	S(+)	S(-)	S1	S3	S5	24V	+10V	MT	GND	GND	AI1	AI2
RJ45							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 3.3.4.2 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 3.3.4.2 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 (+)	RS485/MODBUS	differential input and output
	S (-)		
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 Wiring for Main Circuit Terminals

3.3.5.1 Wiring for Main Circuit Terminals (For U type)

Table 3.3.5.1.1 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/P	• B1/P – B2 : External braking resistor	-
B2		
⊖		• ⊕ - ⊖ : Connect braking module
⊕	-	
U/T1	Inverter output	
V/T2		
W/T3		
E	Ground terminal	

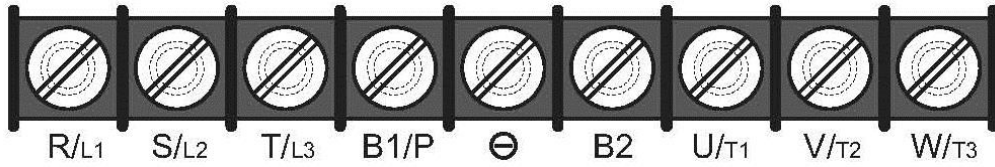
*1. The model of 400V 25HP (18.5KW) or below is built-in braking transistor.

*2. Before connecting DC reactor, please remove short circuit between terminal ⊕1 and ⊕2.

■ Main circuit terminals identification and screw size

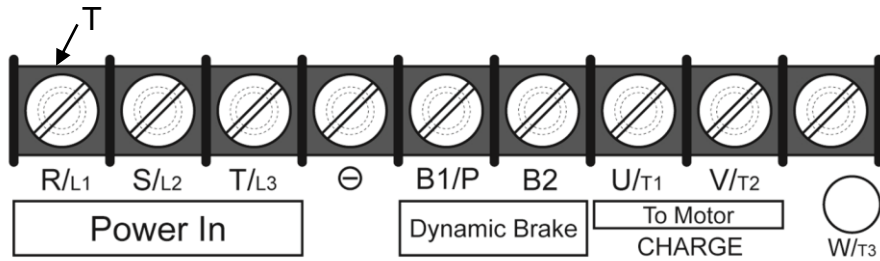
◆ IP20 Type

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



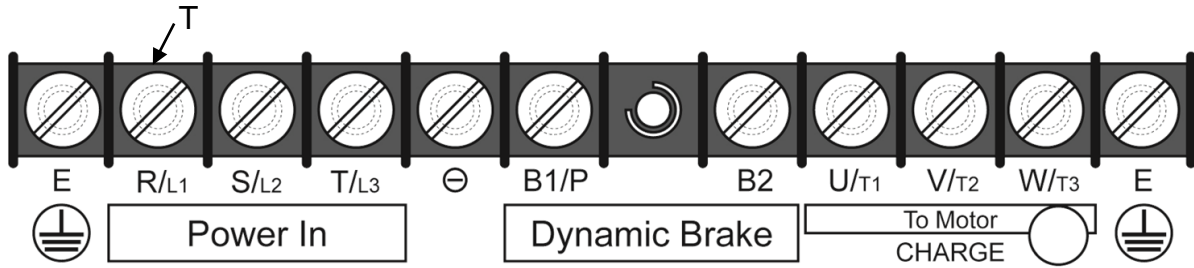
Terminal screw size	
T	
M4	M4

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



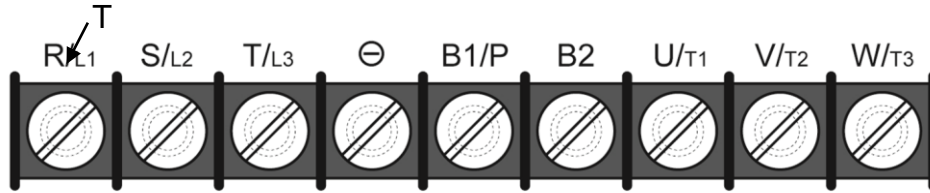
Terminal screw size	
T	
M4	M4

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



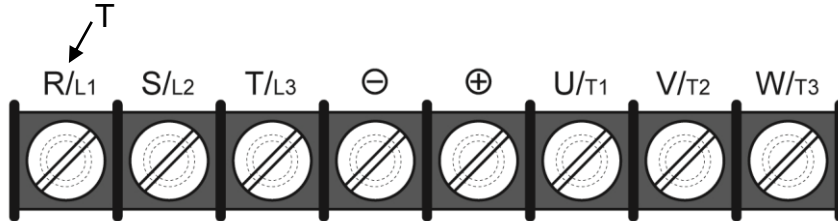
Terminal screw size	
T	
M4	M4

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



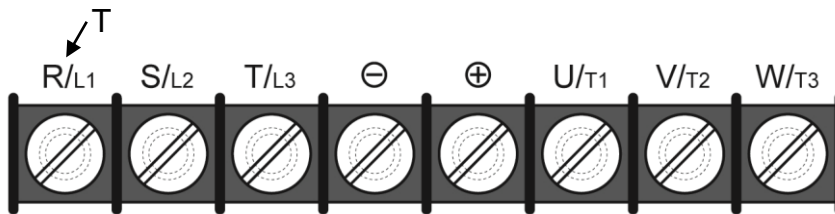
Terminal screw size	
T	⊖
M6	M6

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



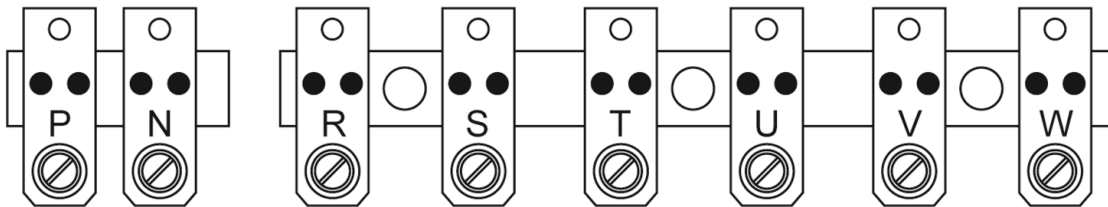
Terminal screw size	
T	⊖
M8	M8

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



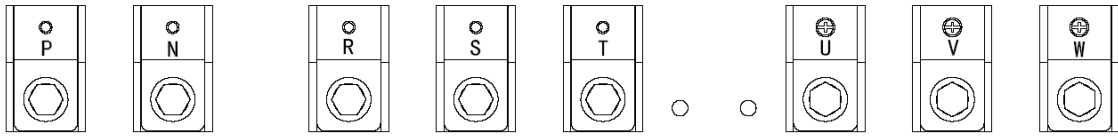
Terminal screw size		
Power supply	T	⊖
400V 100HP	M8	M10
200V 60-75HP/ 400V 125HP	M10	M10

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



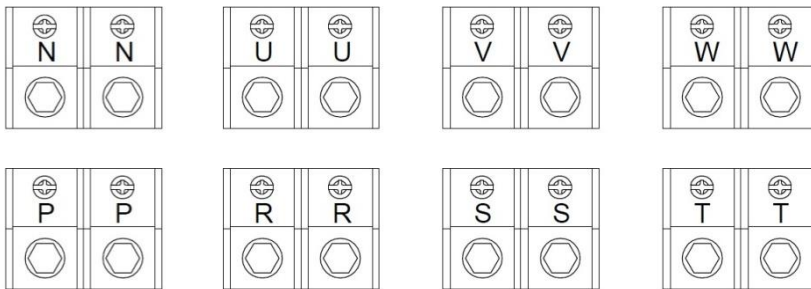
Terminal screw size	
T	⊖
M10	M10

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



Terminal screw size	
T	⏏
M12	M10

- 400V: 530-800HP



Terminal screw size	
T	⏏
M10	M10

3.3.5.2 Wiring for Main Circuit Terminals (For UE type)

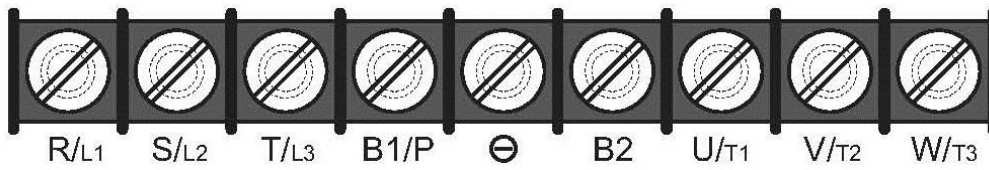
Table 3.3.5.2.1 Description of main circuit terminals (IP00/IP20 Type)

Terminal	200V : 1~30HP 400V : 1~40HP	200V : 40~175HP 400V : 50~800HP
R/L1	Input Power Supply	
S/L2		
T/L3		
B1/P2	<ul style="list-style-type: none"> • B1/P – B2 : External braking resistor 	-
B2		
⊖		<ul style="list-style-type: none"> • ⊕ - ⊖ : Connect braking module
⊕/P1	<ul style="list-style-type: none"> • ⊕/P1 – B1/P2 : External DCL 	
U/T1	Inverter output	
V/T2		
W/T3		
E	Ground terminal	

■ Main circuit terminals identification and screw size (For UE type)

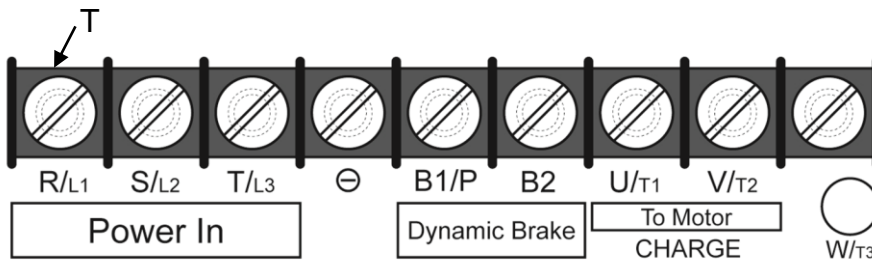
◆ IP20 Type

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



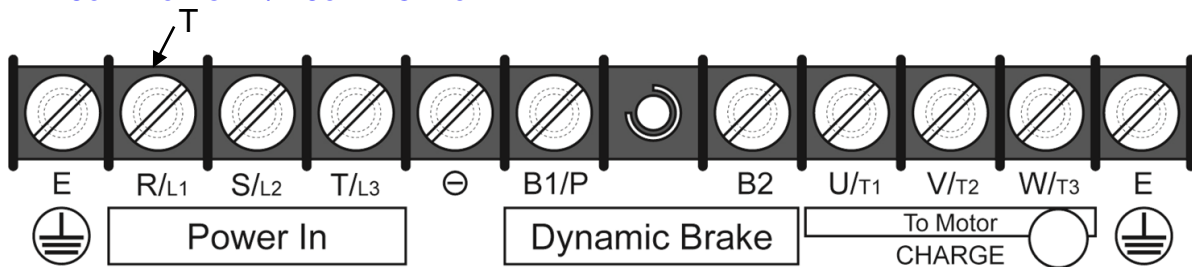
Terminal screw size	
T	
M4	M4

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



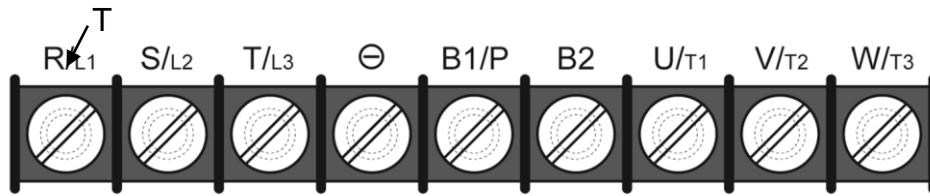
Terminal screw size	
T	
M4	M4

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



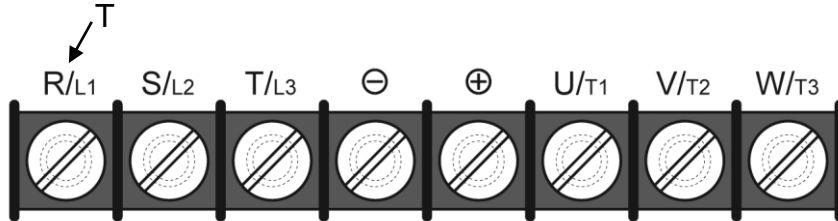
Terminal screw size	
T	
M4	M4

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



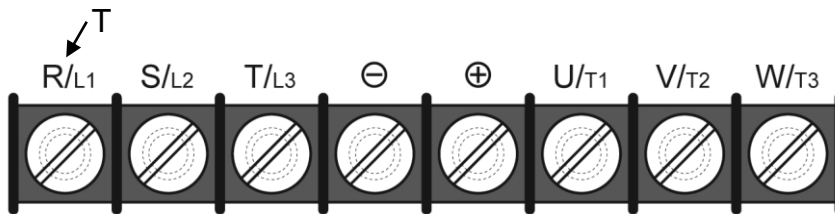
Terminal screw size	
T	⊖
M6	M6

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



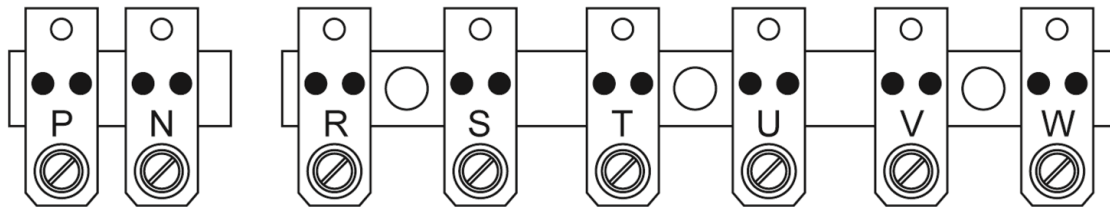
Terminal screw size	
T	⊖
M8	M8

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



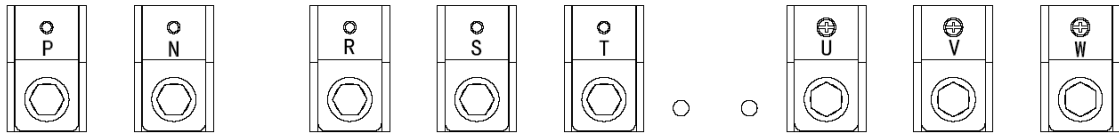
Terminal screw size		
Power supply	T	⊖
400V 100HP	M8	M10
200V 60-75HP/ 400V 125HP	M10	M10

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



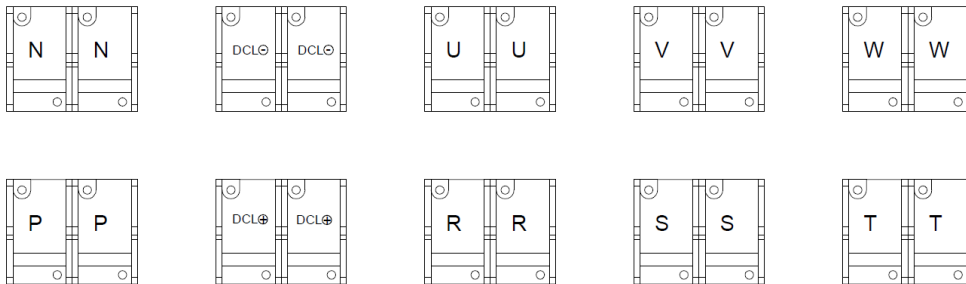
Terminal screw size	
T	⊖
M10	M10

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



Terminal screw size	
T	⊕
M12	M10

- 400V: 530-800HP

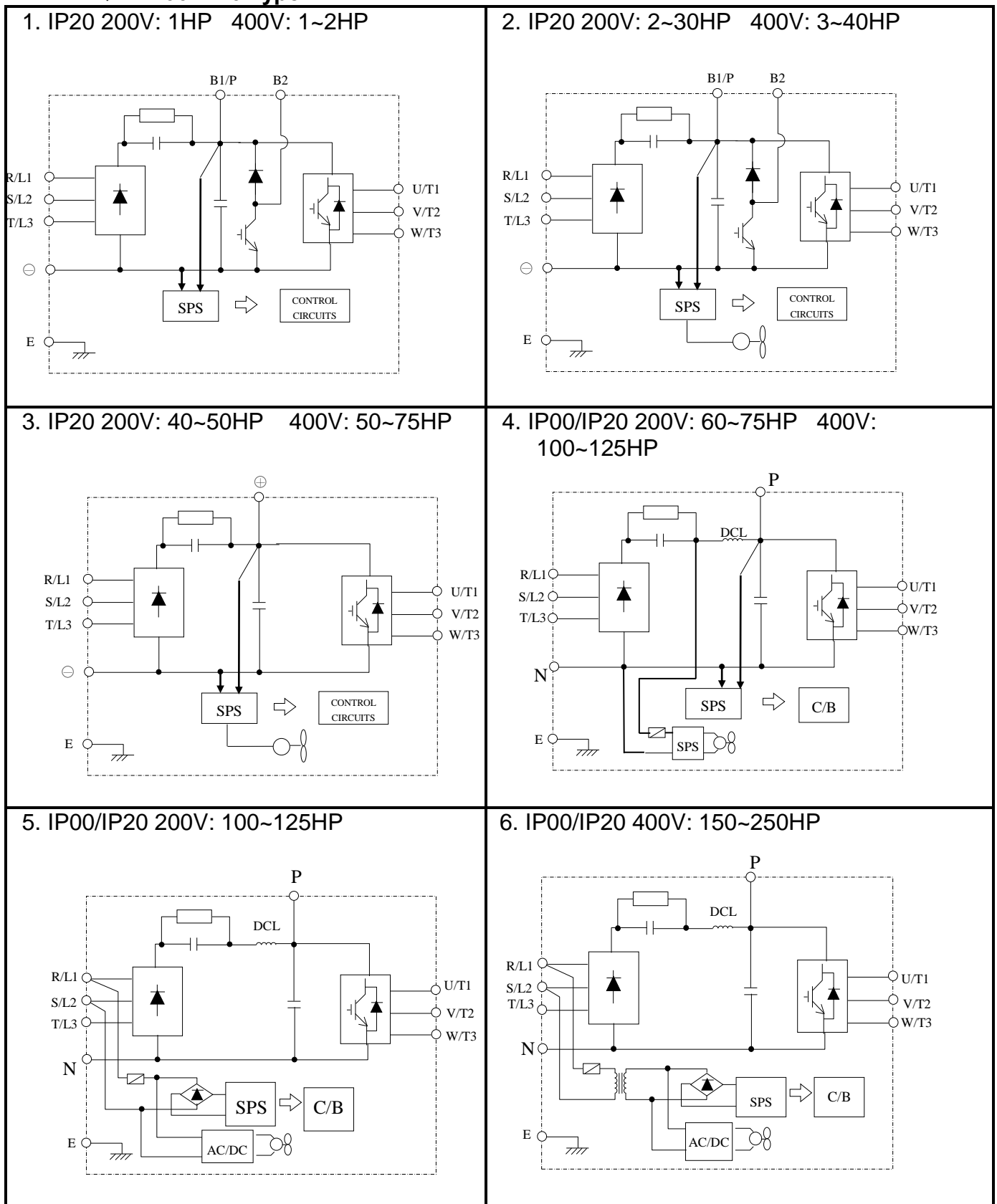


Terminal screw size	
T	⊕
M10	M10

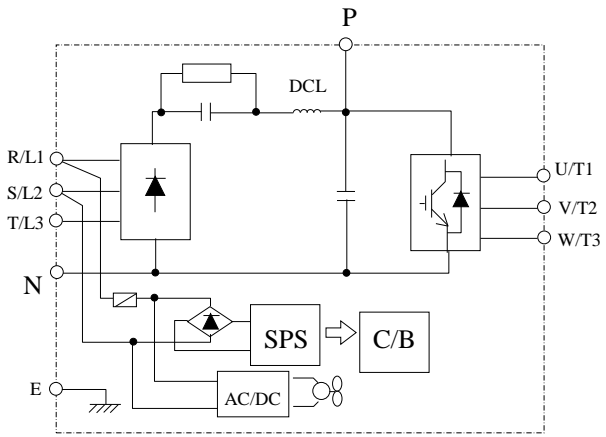
■ Input / Output Power Section Block Diagram

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.

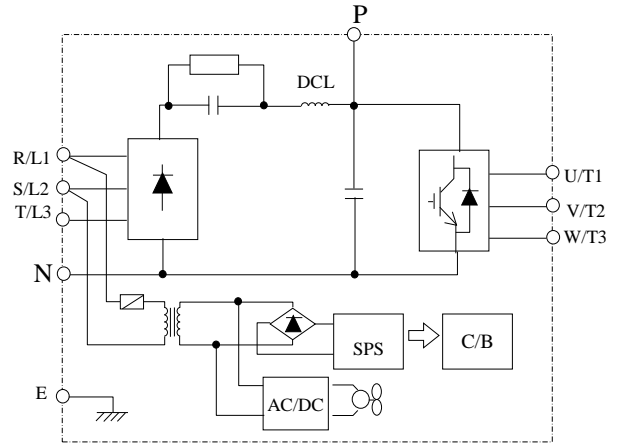
◆ IP00/IP20 Type



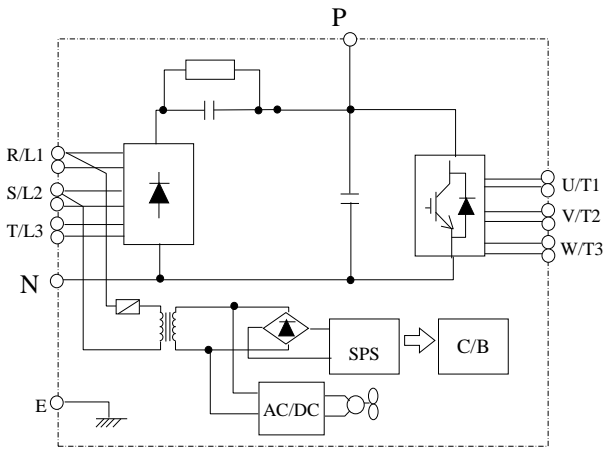
7. IP00/IP20 200V: 150~175HP



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



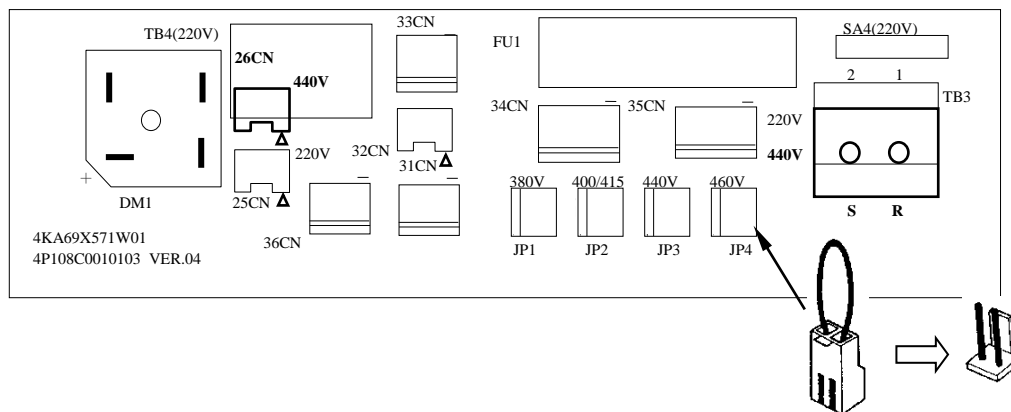
9. IP00/IP20 400V: 535~800HP



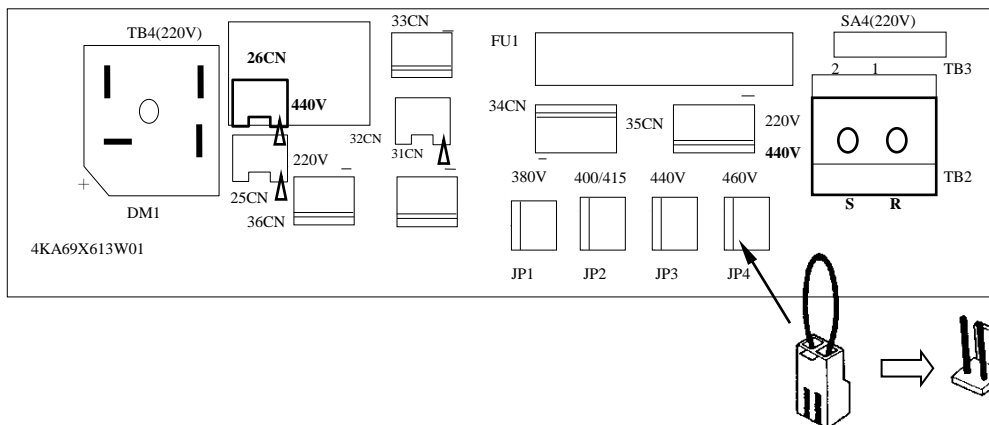
■ Cooling Fan Supply Voltage Selection (400V class)

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

Power supply	F510 Model			Wire size (mm ²)			NFB ^{*3}	MC ^{*3}
	Horse power (HP)	Rated KVA	Rated current (A)	Main circuit ^{*1}	Grounding E(G)	Control line ^{*2}		
200V 1 Ø / 3 Ø	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 3.3.5.4 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 ∅	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.

3.3.6 Wiring Precautions

! Danger	<ul style="list-style-type: none">• Do NOT remove any protective covers or attempt any wiring while input power is applied. Connect all wiring before applying input power. When making wiring changes after power up, remove input power and wait a minimum of five minutes after power has been turned off before starting. Also confirm that the charge lamp is off and that DC voltage between terminals B1/P or (+) and (-) does not exceed 25V, otherwise electric shock may result.• Only authorized personnel should work on the equipment. (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. 3.3.6.1 for control circuits to minimize noise problems. The maximum wiring distance should not exceed 50m (165 ft).

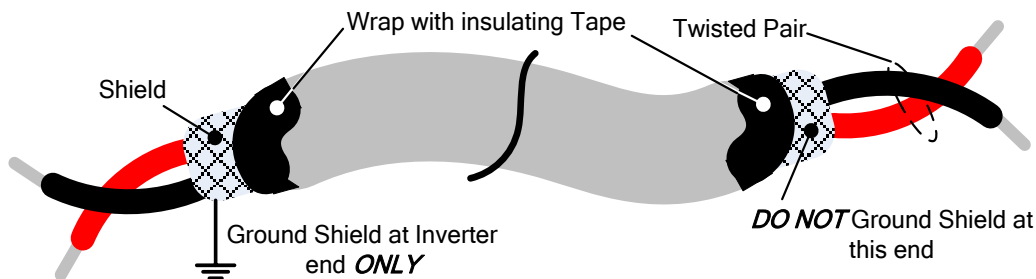


Figure 3.3.6.1 Shielded Twisted-Pair

(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. 3.3.6.2.

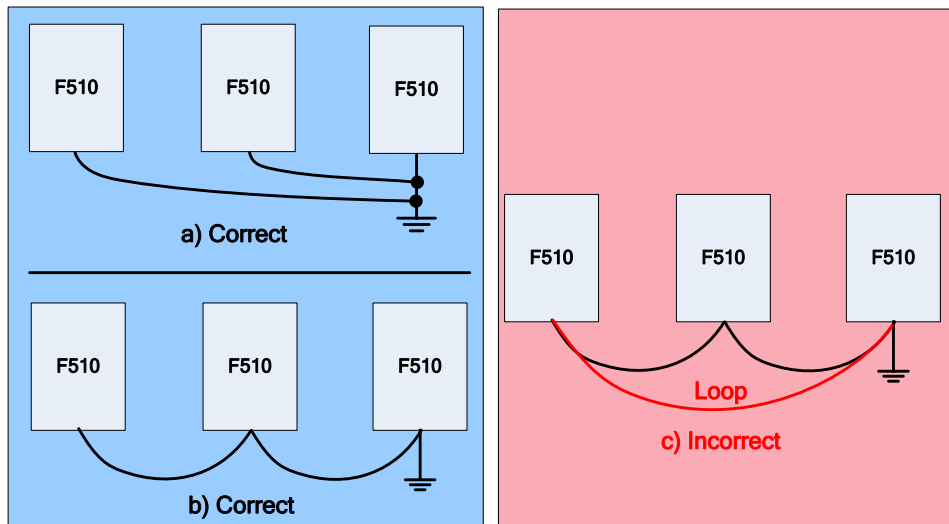


Figure 3.3.6.2 F510 Inverter Grounding

3.3.7 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 3.3.5.3 & 3.3.5.4 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 to phase voltage drop, apply the following formula:

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

(km=3280 x feet)

(m=3.28 x feet)

■ 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 3.3.7.1.

Table 3.3.7.1 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)	≥ 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: $\pm 0.01\%$ (-10 to +40°C), Analog references: $\pm 0.1\%$ (25°C $\pm 10^\circ\text{C}$)
	Speed Control Accuracy	$\pm 0.5\%$ (Sensorless Vector Control Mode) ^{*1}
	Frequency Setting Resolution	Digital references: 0.01Hz, Analog references: 0.06Hz/60Hz
	Output Frequency Resolution	0.01Hz
	Inverter Overload	120%/1 min
	Frequency Setting Signal	DC 0~+10V / 0~20mA or 4~20mA
	Acceleration/ Deceleration Time	0.0~6000.0 seconds (separately set acceleration and deceleration time)
	Voltage, Frequency Characteristics	Custom V/F curve based on parameters
	Braking Torque	About 20%
	Protection Function	Main Control Functions
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
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 $\square 50\text{V}$, the CHARGE LED turns on.
Environment Specifications		Input Phase Loss (OPL) Protection
	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.
	Installation Location	Indoor (protected from corrosive gases and dust)
	Ambient Temperature	-10~+40°C (14°F~104°F) (IP20/NEMA1 or IP55/NEMA12), -10~+50°C (14°F~122°F) (IP00 or top anti-dust cover removed) without de-rating; with de-rating, its maximum operation temperature is 60°C(140°F). (Enhanced type frame 5 is 50°C without de-rating)
	Storage Temperature	-20~+70°C (-4°F~+158°F)
Environment Specifications	Humidity	95%RH or less (no condensation)
	Altitude and Vibration	Altitude of 1000m (3181ft) or below, below 5.9m/s ² (0.6G)
	Pollution Degree	IP00/IP20/IP21 meet IEC 60721-3-3 Class 3C2, IP55 meet IEC 60721-3-3 Class 3C3

***1: Speed control accuracy will be different from the installation conditions and motor types.**

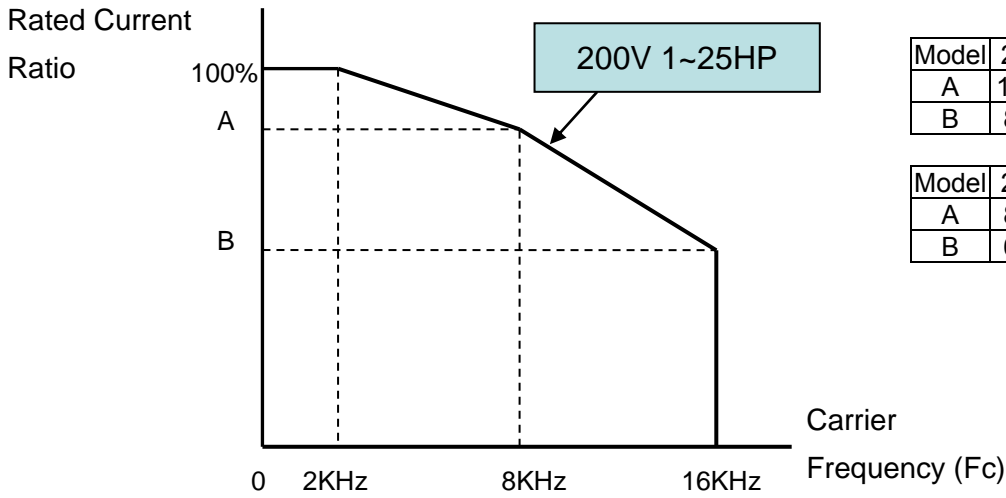
***2: The factory default carrier frequency is different from models.**

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	1 to 8 Pump card, HOA LCD keypad ; IP20 1-3HP don't support option card	

3.5 Inverter De-rating Based on Carrier Frequency

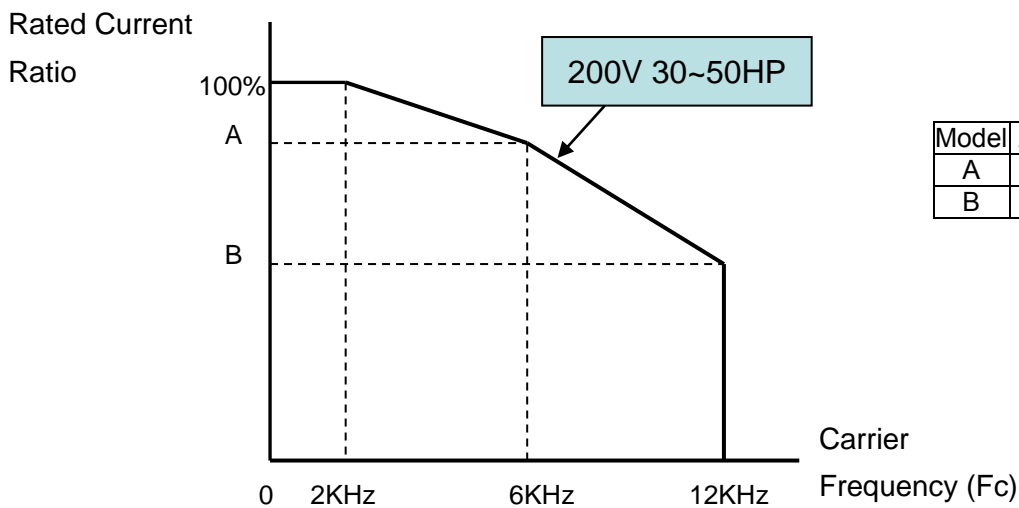
Note: De-rating curve current of carrier frequency means inverter rated current.

(a) 200V Models

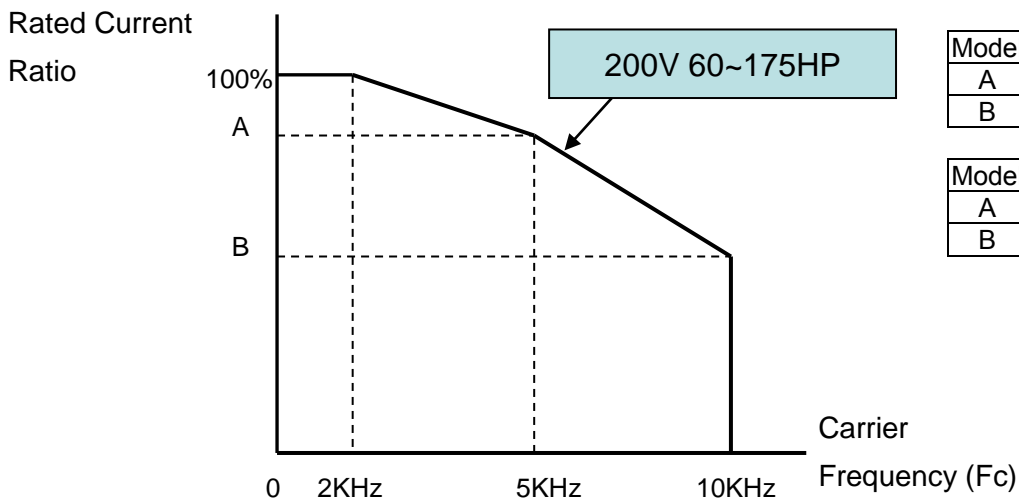


Model	2001	2002	2003	2005	2008
A	100%	67%	76%	76%	80%
B	80%	53%	60%	61%	68%

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



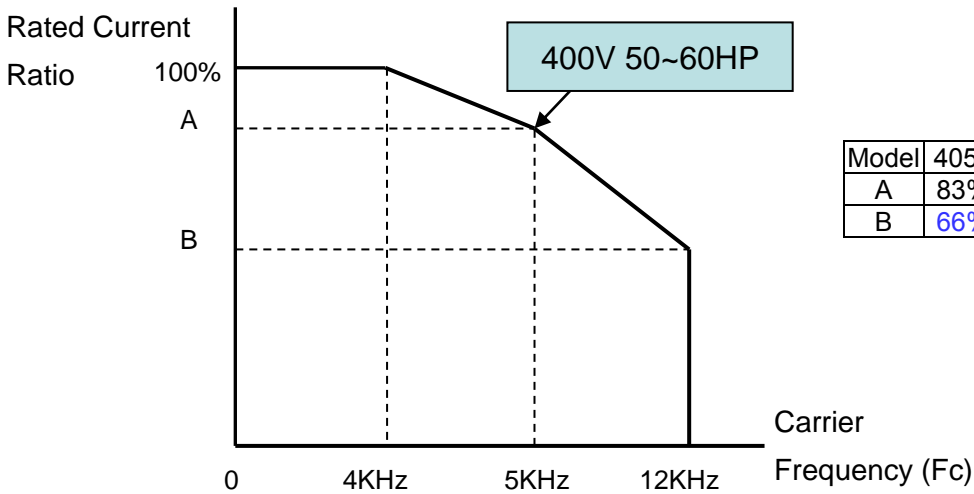
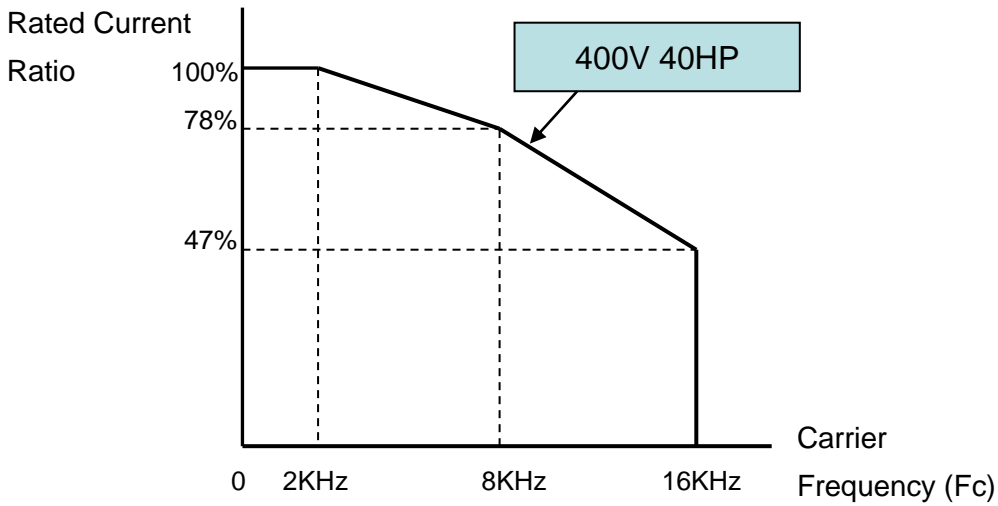
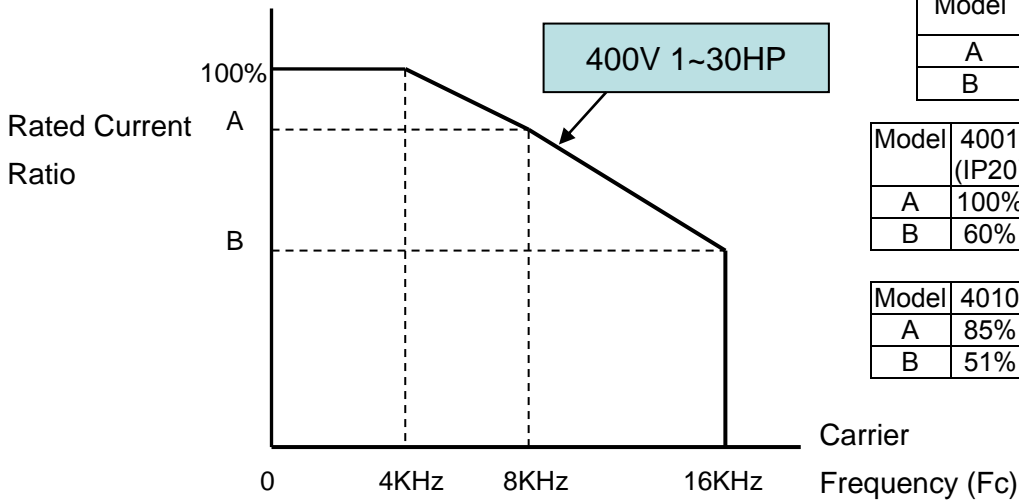
Model	2030	2040	2050
A	92%	77%	83%
B	74%	62%	67%

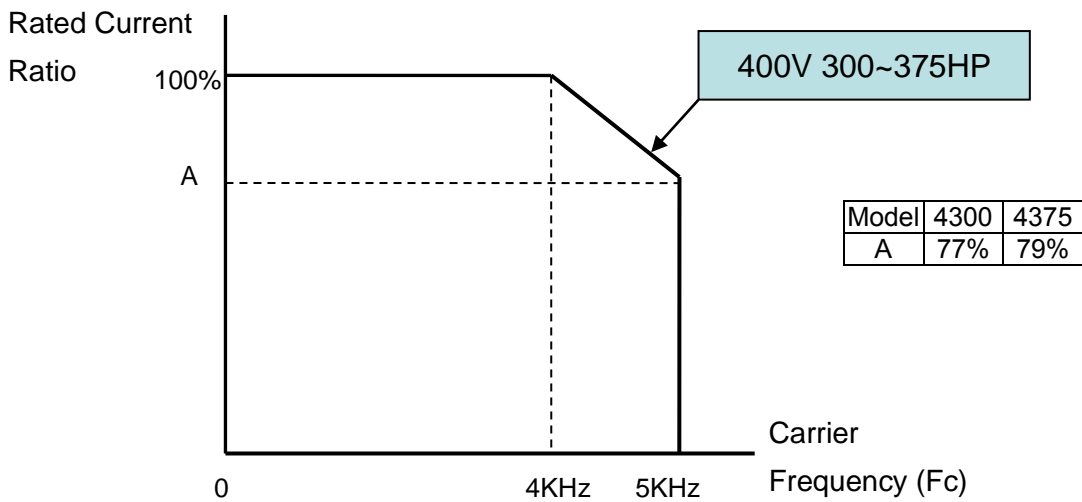
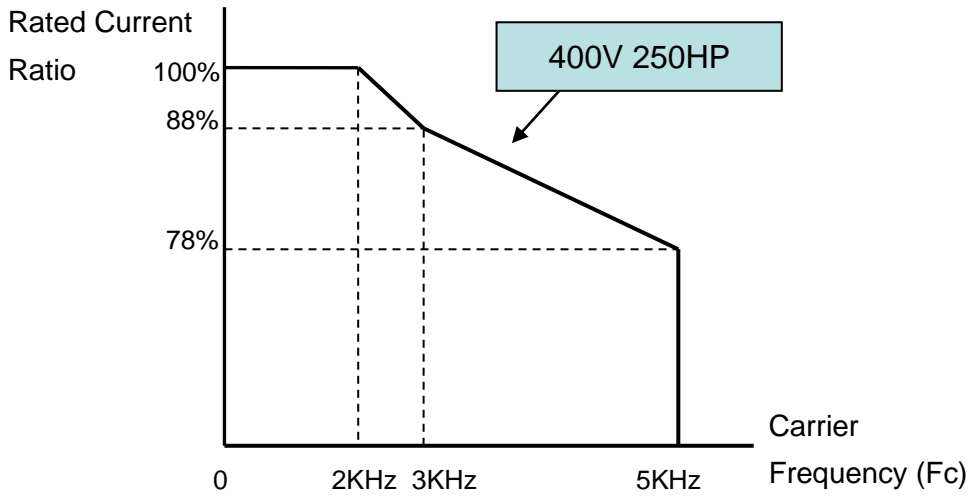
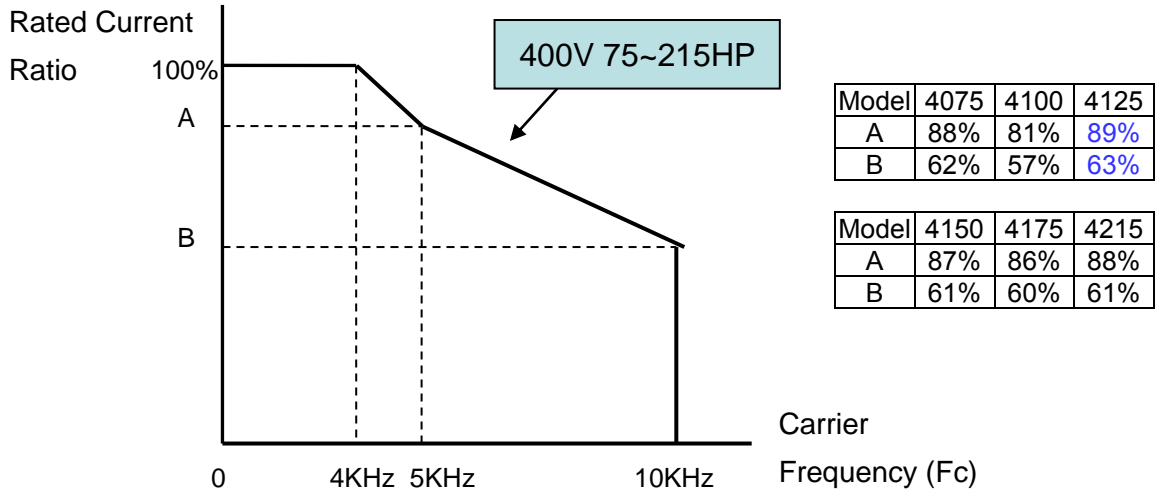


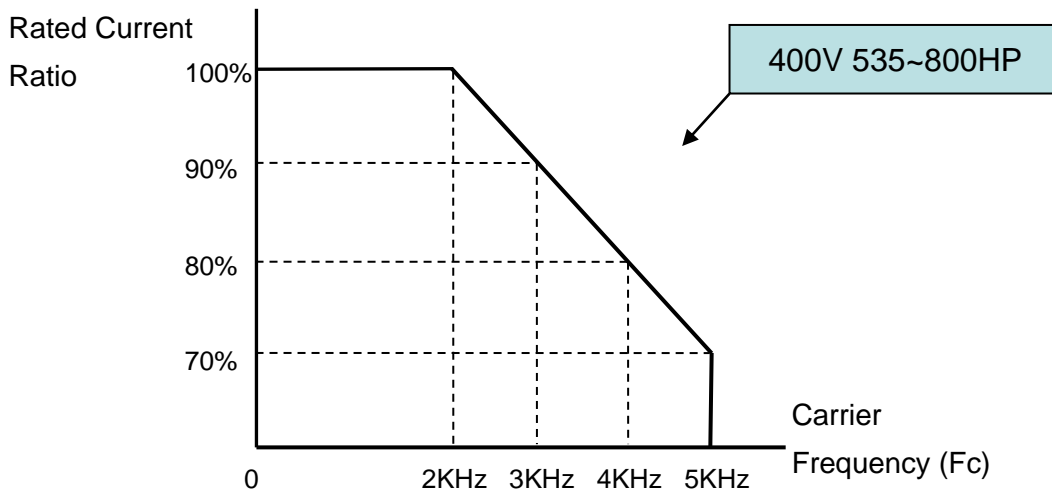
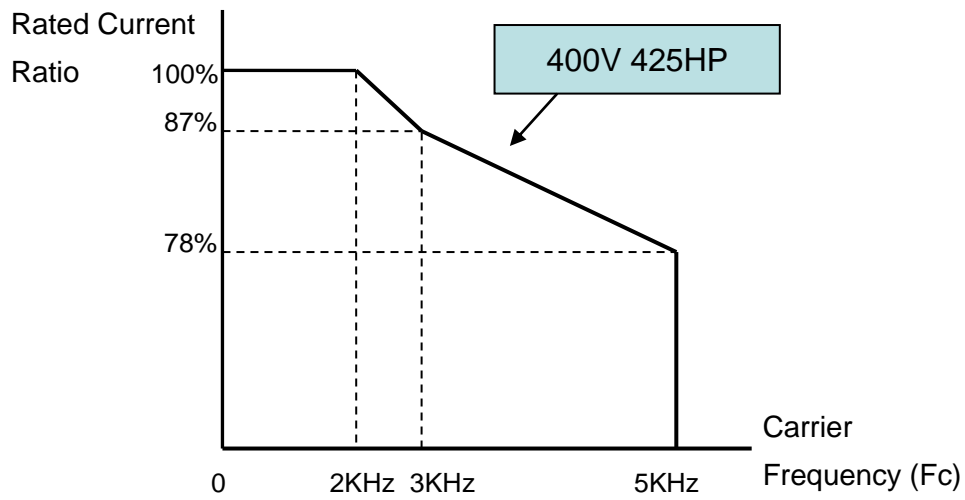
Model	2060	2075	2100
A	85%	90%	86%
B	68%	72%	69%

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

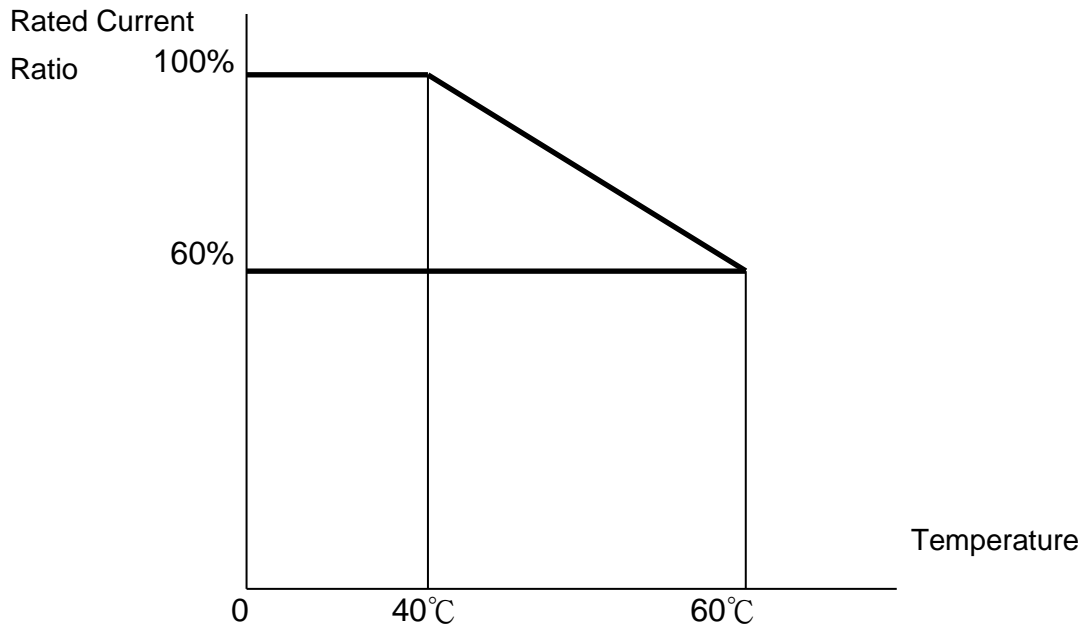
(b) 400V Models







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:

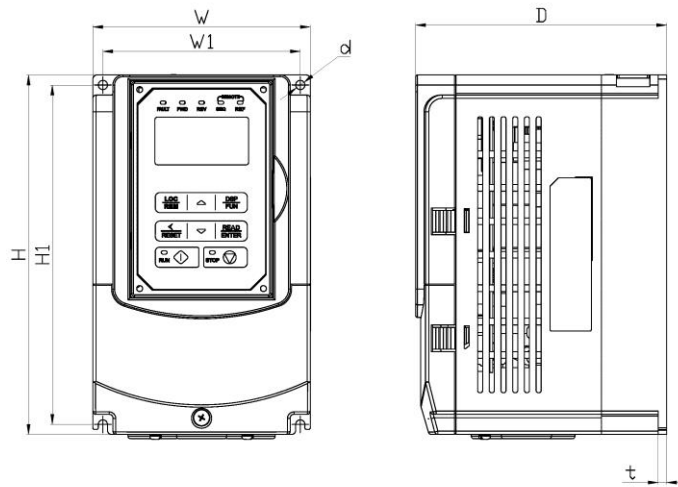
Storage time	Procedure to re-apply voltage
≤ 1 year	Apply rated voltage(*1) of inverter in the normal way
Between 1-2 years	Apply rated voltage of inverter to the product for one hour
≥ 2 years	Use a variable AC power supply to 1. Connecting 25% of inverter rated voltage for 30 minutes. 2. Connecting 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

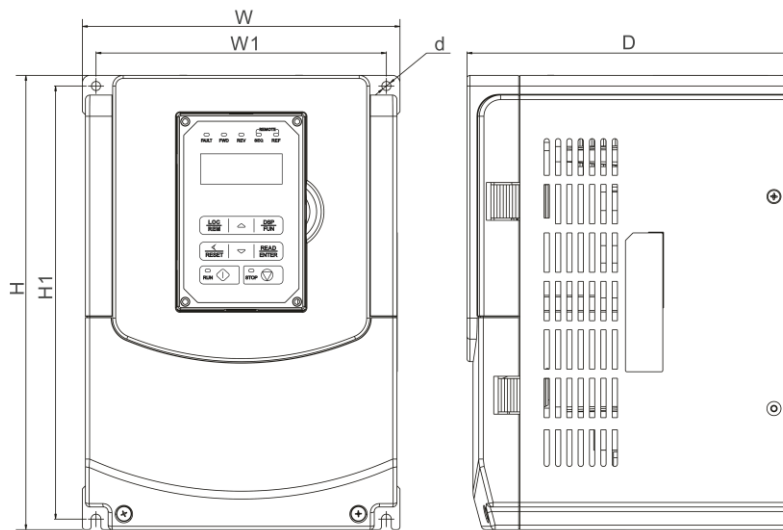
3.7.1 Standard Type (IP00/IP20)

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



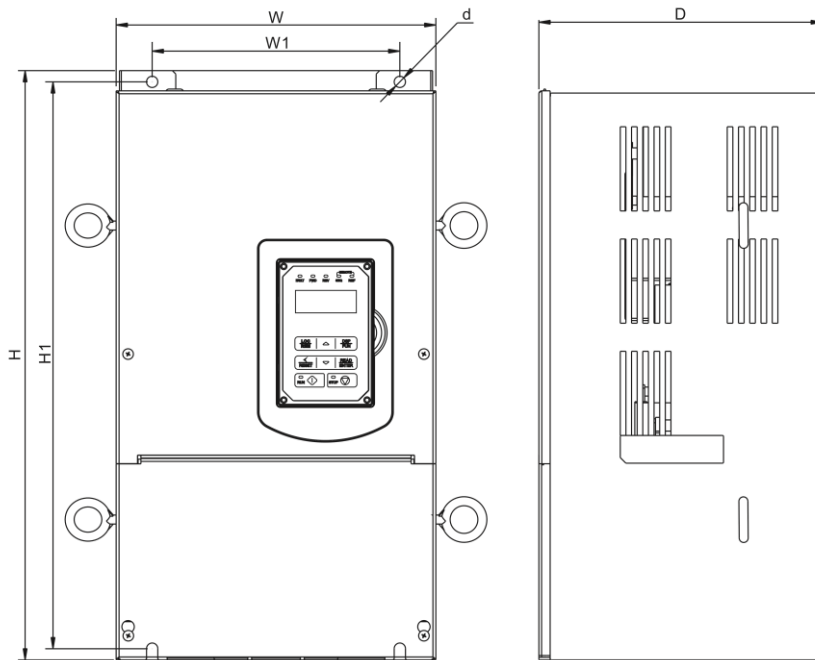
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2001-C-UE	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-2002-C-UE	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-2003-C-UE	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.2 (4.9)
F510-2005-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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(U type) 15~30HP (UE type) / 400V: 15-40HP



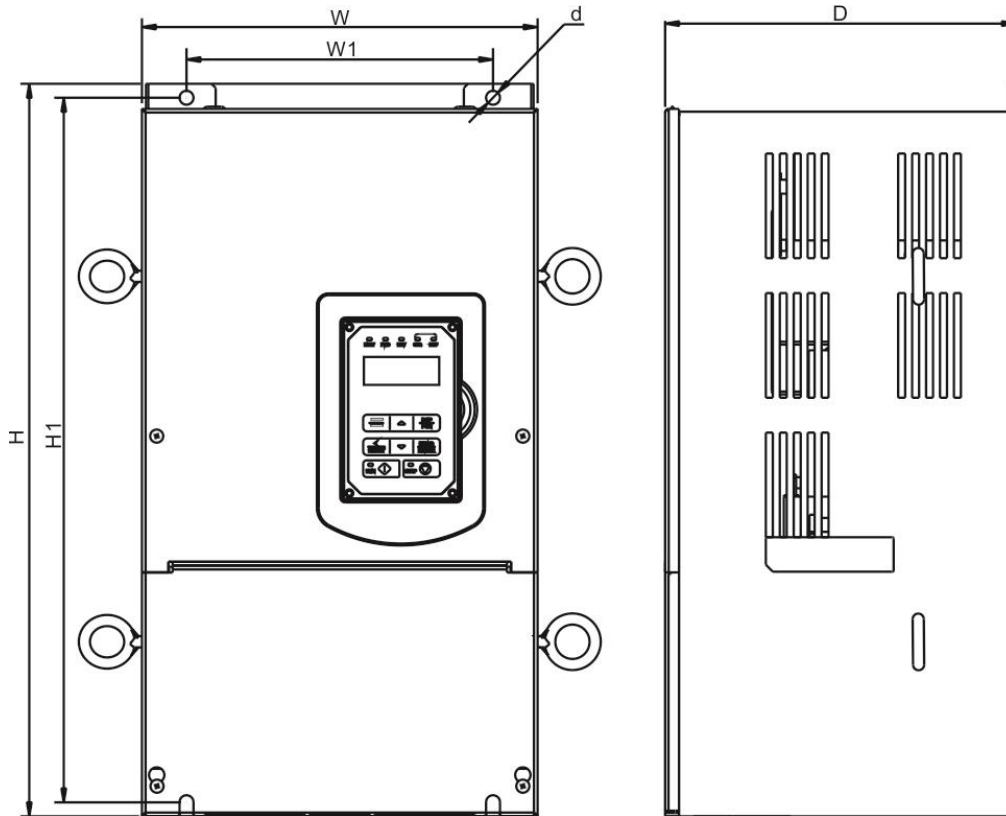
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2010-C3-U	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-2015-C3-UE	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-2020-C3-UE	265 (10.43)	360 (14.17)	225 (8.86)	245 (9.65)	340 (13.39)	1.6 (0.06)	M8	10 (22.05)
F510-2025-C3-UE	265 (10.43)	360 (14.17)	225 (8.86)	245 (9.65)	340 (13.39)	1.6 (0.06)	M8	10 (22.05)
F510-2030-C3-UE	265 (10.43)	360 (14.17)	225 (8.86)	245 (9.65)	340 (13.39)	1.6 (0.06)	M8	10 (22.05)
F510-4015-C3-UE	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-4020-C3-UE	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-4025-C3-UE	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-4025-C3-U	265 (10.43)	360 (14.17)	225 (8.86)	245 (9.65)	340 (13.39)	1.6 (0.06)	M8	10 (22.05)
F510-4030-C3-UE	265 (10.43)	360 (14.17)	225 (8.86)	245 (9.65)	340 (13.39)	1.6 (0.06)	M8	10 (22.05)
F510-4040-C3-UE	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 (U type) 50~100HP (UE type)



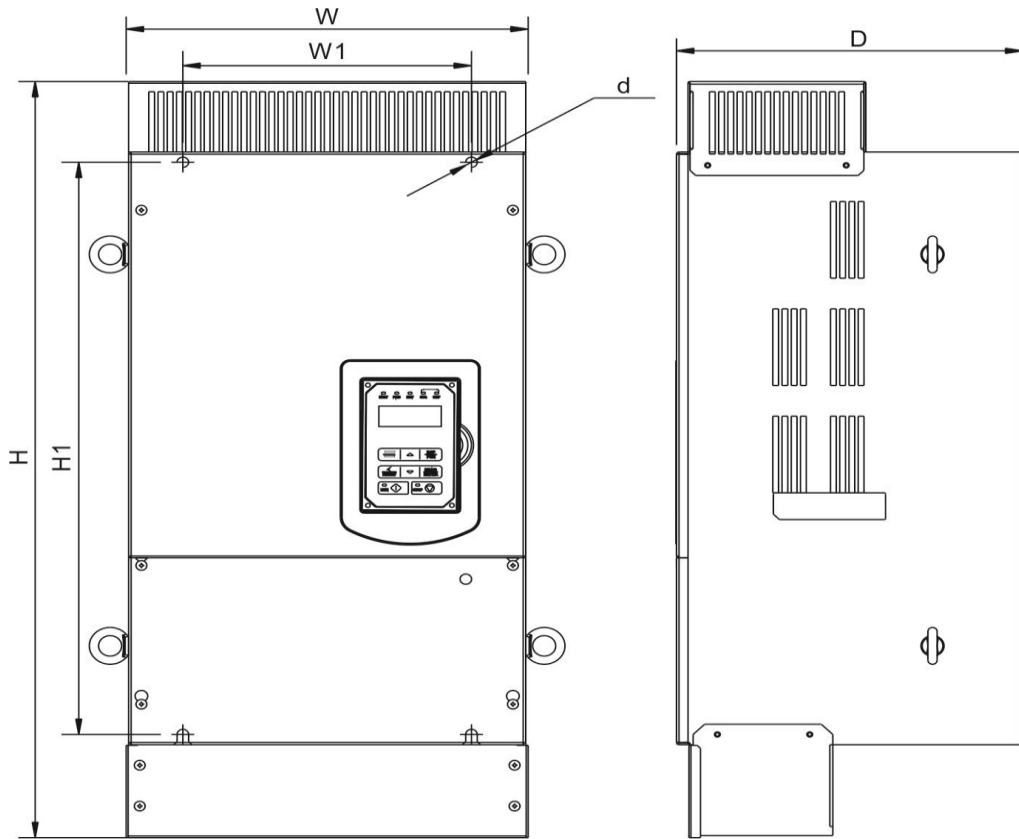
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2040-C3-U	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-2050-C3-U	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4050-C3-U	286.5 (11.28)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	3.3 (0.13)	M8	24 (52.91)
F510-4060-C3-U	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-C3-U	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	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 (U type) 125~250HP (UE type) (IP00)



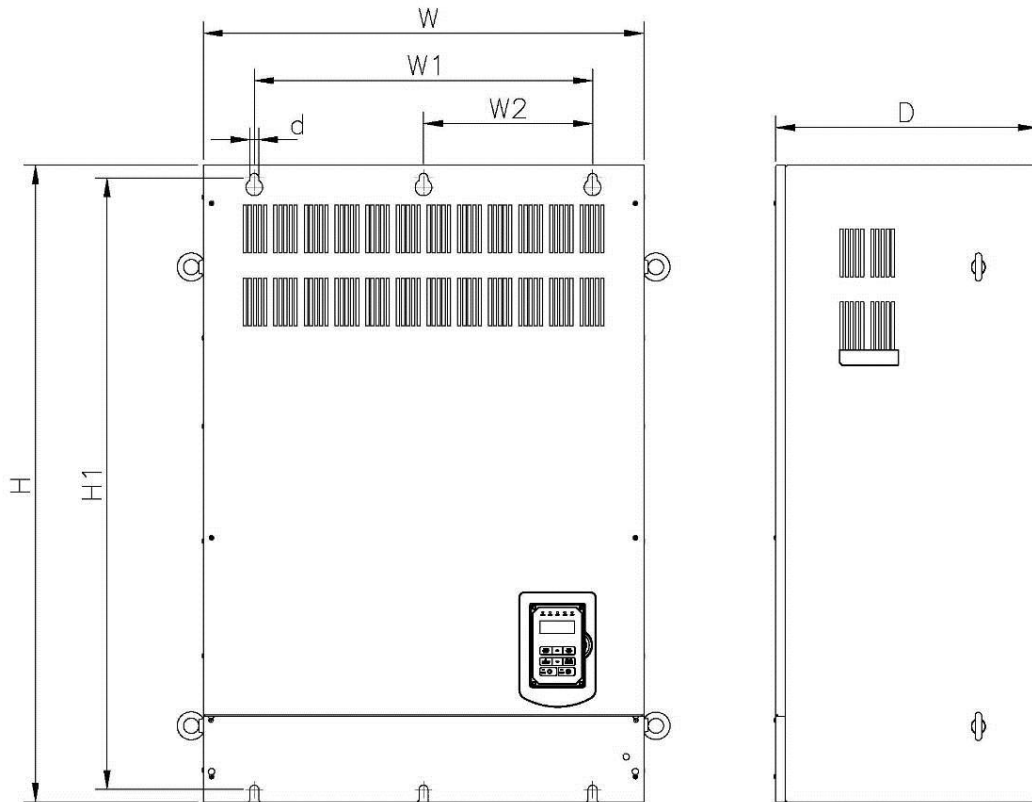
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2060-C3-UE	344 (13.54)	580 (22.83)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	40 (88.18)
F510-2075-C3-UE	344 (13.54)	580 (22.83)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	40 (88.18)
F510-2100-C3-UE	459 (18.07)	790 (31.10)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	74 (163.14)
F510-2125-C3-UE	459 (18.07)	790 (31.10)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	74 (163.14)
F510-4100-C3-U	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-C3-UE	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-C3-UE	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-C3-U	459 (18.07)	790 (31.10)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	74 (163.14)
F510-4175-C3-UE	459 (18.07)	790 (31.10)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	74 (163.14)
F510-4215-C3-UE	459 (18.07)	790 (31.10)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	74 (163.14)
F510-4250-C3-UE	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 (U type) 125~250HP (UE type) (IP20)



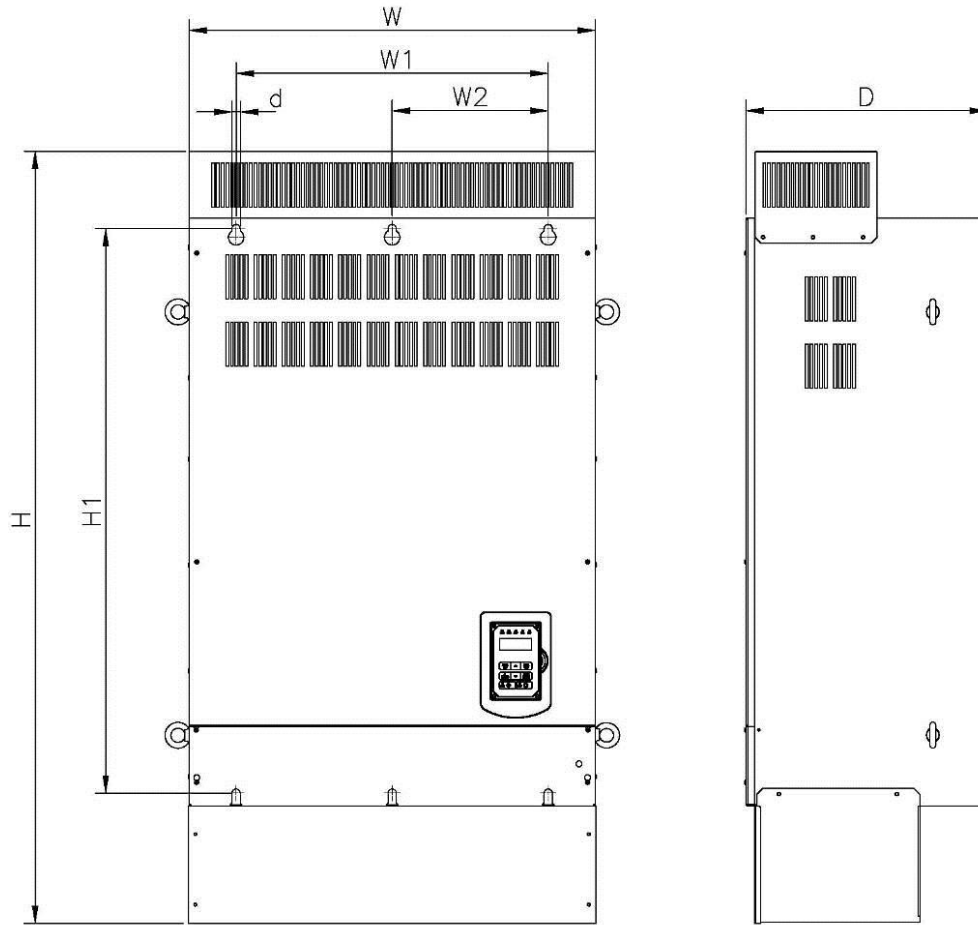
Inverter Model	Dimensions in mm (inch)							NW in kg(lbs)
	W	H	D	W1	H1	t	d	
F510-2060-C3-UE	348.5 (13.72)	740 (29.13)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	44 (97.00)
F510-2075-C3-UE	348.5 (13.72)	740 (29.13)	300 (11.81)	250 (9.84)	560 (22.05)	1.6 (0.06)	M8	44 (97.00)
F510-2100-C3-UE	463.5 (18.25)	1105 (43.50)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	81 (178.57)
F510-2125-C3-UE	463.5 (18.25)	1105 (43.50)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	81 (178.57)
F510-4100-C3-U	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-C3-UE	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-C3-UE	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-C3-U	463.5 (18.25)	1105 (43.50)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	81 (178.57)
F510-4175-C3-UE	463.5 (18.25)	1105 (43.50)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	81 (178.57)
F510-4215-C3-UE	463.5 (18.25)	1105 (43.50)	324.5 (12.78)	320 (12.60)	760 (29.92)	1.6 (0.06)	M10	81 (178.57)
F510-4250-C3-UE	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)



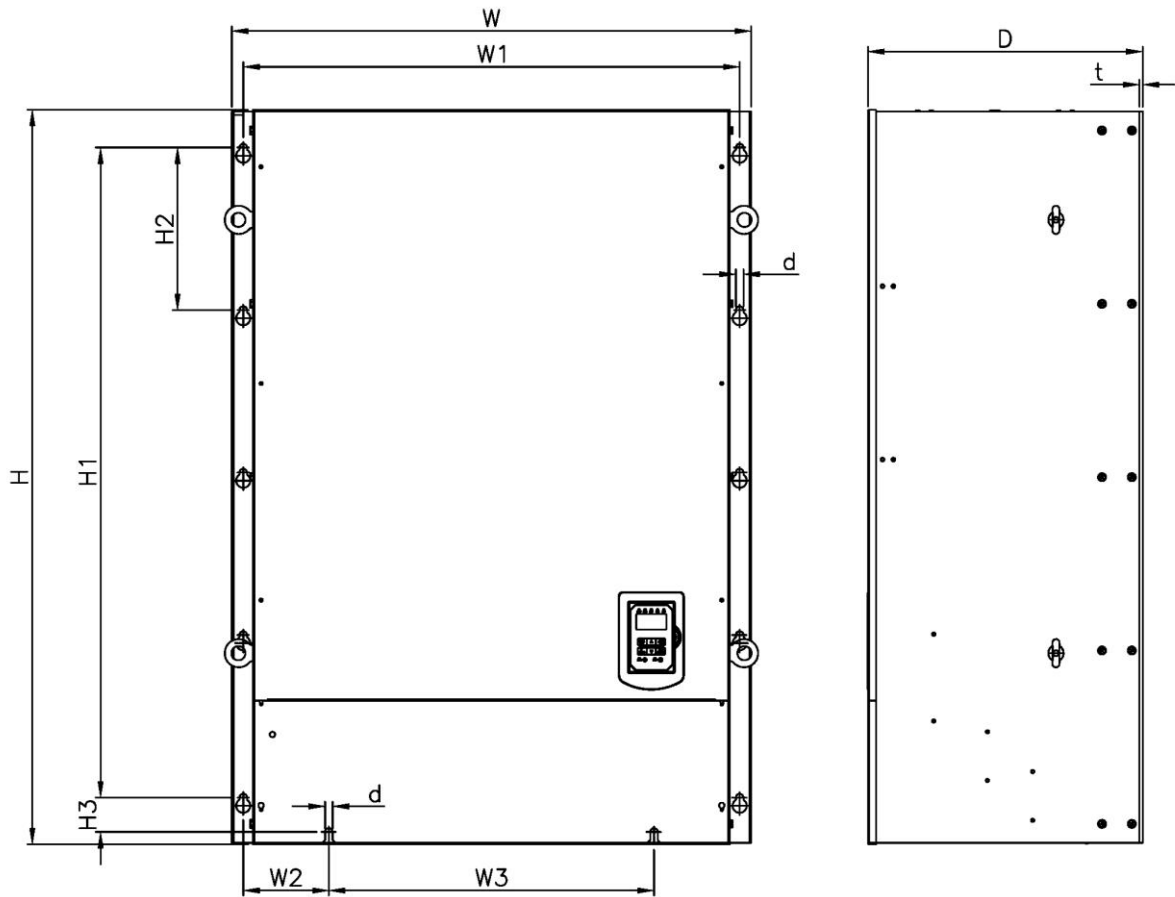
Inverter Model	Dimensions in mm (inch)								NW in kg(lbs)
	W	H	D	W1	W2	H1	t	d	
F510-2150-C3-UE	692 (27.24)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	184 (405.65)
F510-2175-C3-UE	690 (27.17)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	184 (405.65)
F510-4300-C3-UE	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-C3-UE	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-C3-UE	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)



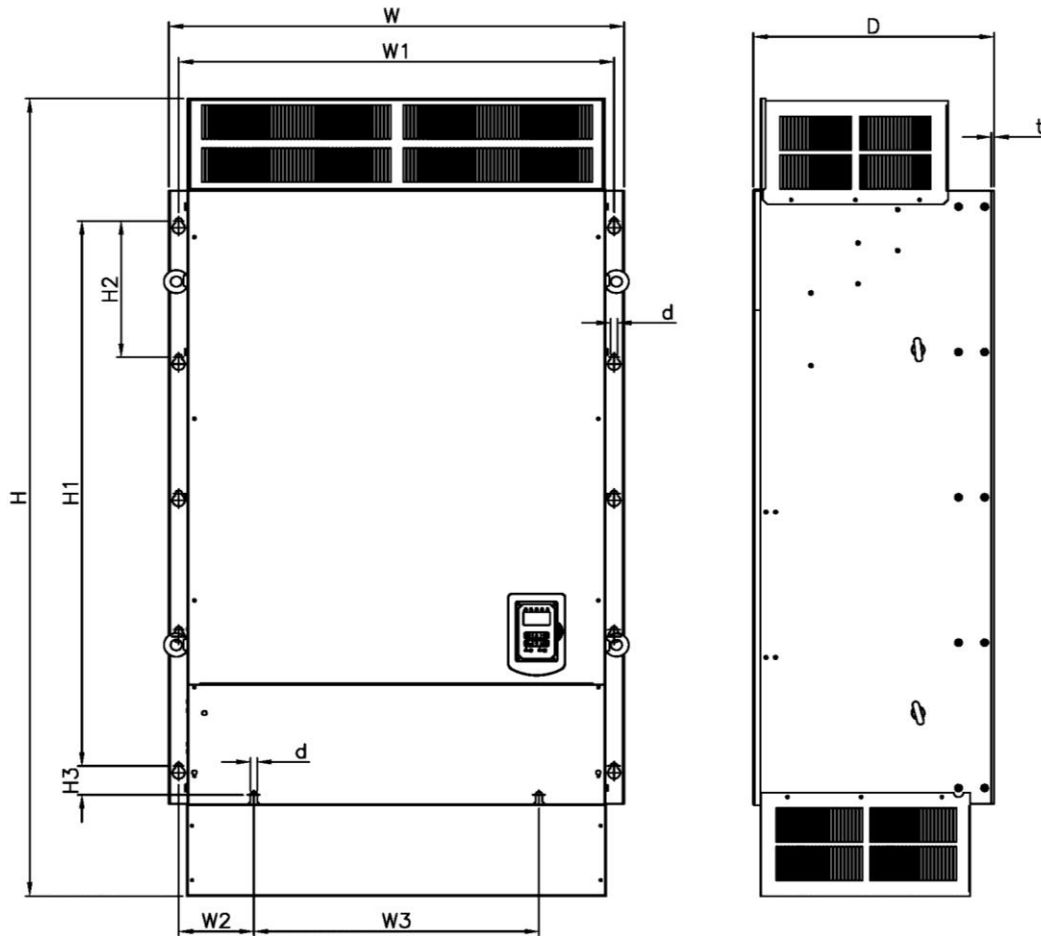
Inverter Model	Dimensions in mm (inch)								NW in kg(lbs)
	W	H	D	W1	W2	H1	t	d	
F510-2150-C3-UE	692 (27.24)	1313 (51.69)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	194 (427.70)
F510-2175-C3-UE	692 (27.24)	1313 (51.69)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12	194 (427.70)
F510-4300-C3-UE	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-C3-UE	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-C3-UE	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-C3-UE	958 (37.72)	1356 (53.38)	507 (19.96)	916 (36.06)	158 (6.22)	600 (23.62)	1200 (47.24)	300 (11.81)	63.5 (2.50)	6.2 (0.24)	M12	335 (739)
F510-4670-C3-UE	958 (37.72)	1356 (53.38)	507 (19.96)	916 (36.06)	158 (6.22)	600 (23.62)	1200 (47.24)	300 (11.81)	63.5 (2.50)	6.2 (0.24)	M12	335 (739)
F510-4800-C3-UE	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)

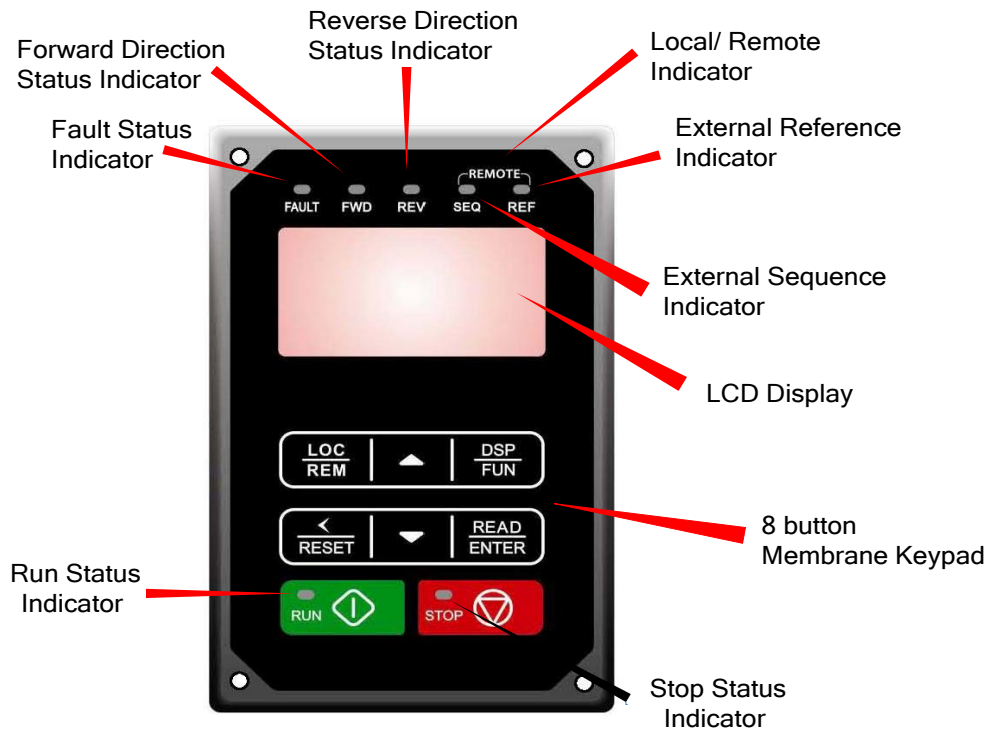


Inverter Model	Dimensions in mm (inch)											NW in kg(lbs)
	W	H	D	W1	W2	W3	H1	H2	H3	t	d	
F510-4535-C3-UE	958 (37.72)	1756 (69.13)	507 (19.96)	916 (36.06)	158 (6.22)	600 (23.62)	1200 (47.24)	300 (11.81)	63.5 (2.50)	6.2 (0.24)	M12	350 (772)
F510-4670-C3-UE	958 (37.72)	1756 (69.13)	507 (19.96)	916 (36.06)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

Chapter 4 Keypad and Programming Functions

4.1 LCD keypad

4.1.1 Keypad Display and Keys



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

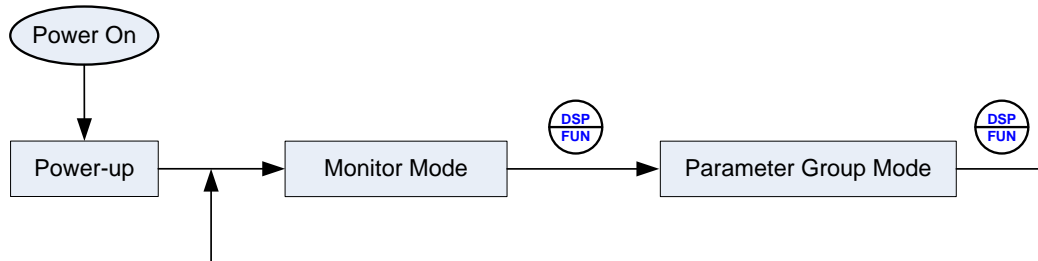
Holding the ▲UP or ▼DOWN key for a longer period of time will initiate the auto-repeat function resulting in the value of the selected digit to automatically increase or decrease.

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

4.1.2 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.

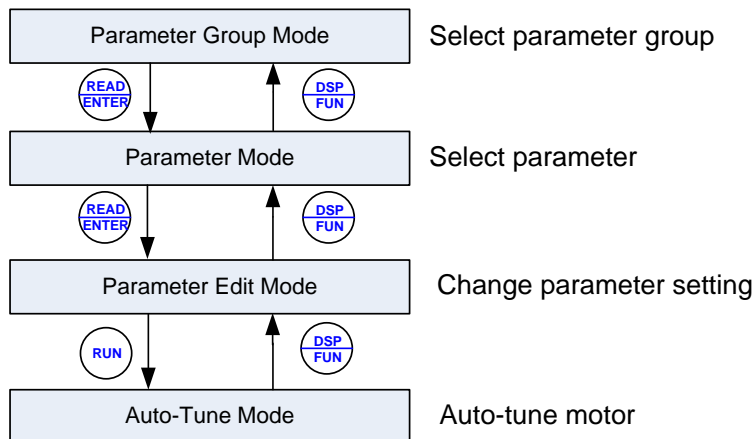


Fig. 4.1.2.1 Parameter Group Structure

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.

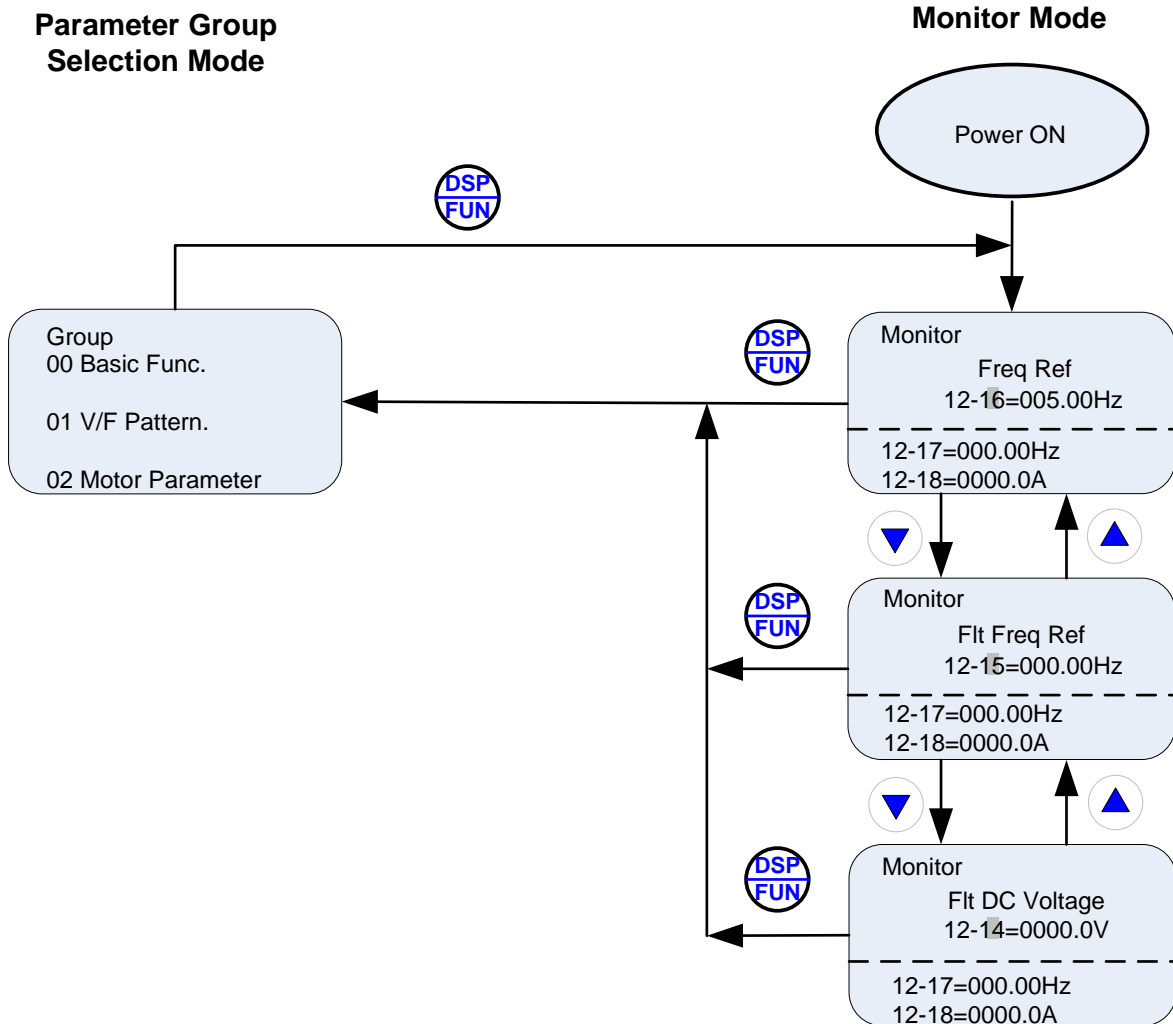


Fig 4.1.2.2 Monitor Mode

◆ Programming Mode

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

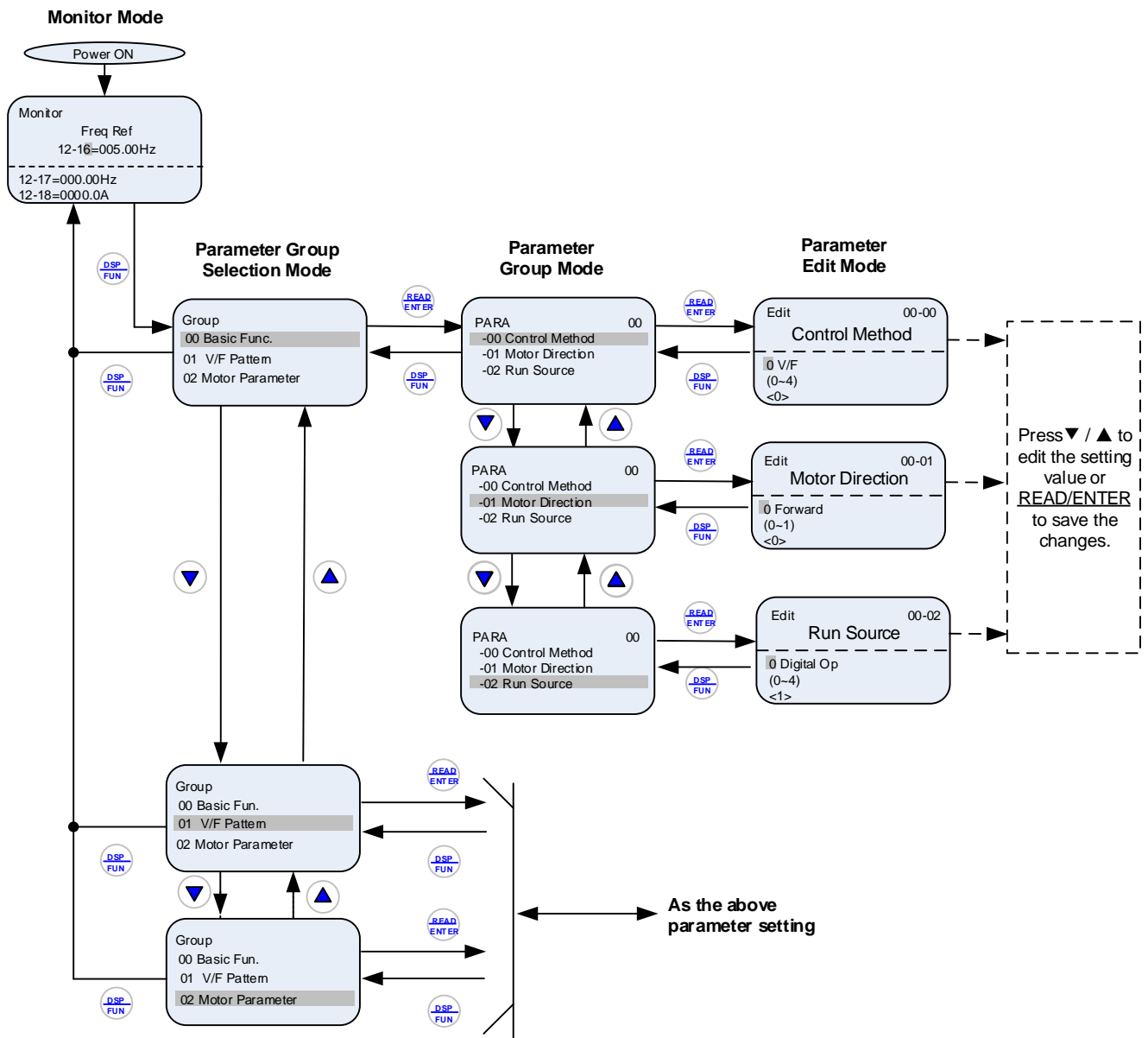


Fig 4.1.2.3 Programming Mode

Notes:

- The parameters values can be changed from the 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.

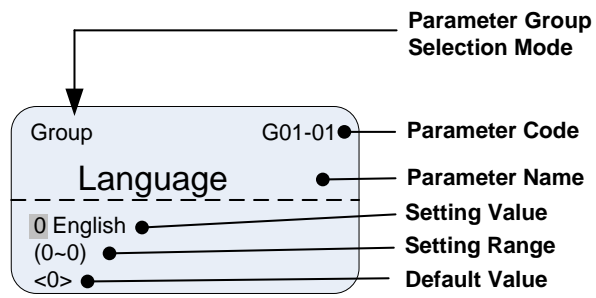


Fig 4.1.2.4 Parameter Group Selection Mode Screen

4.2 Parameters

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

Parameter Attribute		
*1	Parameters can be changed during run operation	Note1: New added or modified parameters in software V1.02
*2	Read-only parameters for communication	Note2: New added or modified parameters in software V1.10
*3	Parameter will not reset to default during a factory reset	Note3: New added or modified parameters in software V1.10
*4	Read-only parameter	Note4: New added or modified parameters in software V1.11
*5	Only displayed in using LED keypad	Note5: New added or modified parameters in software V1.11
*6 *7	Modified(*6) and New added (*7) parameters in software V1.02	Note6: New added or modified parameters in software V1.11
*8	The value will be modified depend on the setting of 13-08	Note7: Parameter edit available for software V1.11 above
*9	For enhanced UE type only	Note8: New added or modified parameters in software V1.12
*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	-	○	○	○	*3
		1: Reserved						
		2: SLV						
		3~4: Reserved						
		5: PM SLV						
00-01	Motor's Rotation Direction	0: Forward	0	-	○	○	○	*1
		1: Reverse						
00-02	Main Run Command Source Selection	0: Keypad	0	-	○	○	○	
		1: External Terminal (Control Circuit)						
		2: Communication Control (RS-485)						
		3: PLC						
		4: RTC						
00-03	Alternative Run Command Source Selection	0: Keypad	2	-	○	○	○	
		1: External Terminal (Control Circuit)						
		2: Communication Control (RS-485)						
		3: PLC						
		4: RTC						
00-04	Language Selection (for LCD only)	0: English	0	-	○	○	○	
		1: Simple Chinese						
		2: Traditional Chinese						
		3: Turkish						
00-05	Main Frequency Command Source Selection	0: Keypad	0	-	○	○	○	
		1: External Terminal (Analog AI1)						
		2: Terminal Command UP/ DOWN						
		3: Communication Control (RS-485)						
		4: Reserved						
		5: Reserved						
		6: RTC						
		7. AI2 Auxiliary Frequency *7						
00-06	Alternative Frequency Command Source Selection	0: Keypad	3	-	○	○	○	
		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	-	○	○	○	
		1: Main Frequency + Alternative Frequency						
00-08	Communication Frequency Command Range	0.00-599.00 (Note8)	0.00	Hz	○	○	○	
00-09	Communication Frequency Command Memory Selection	0: Do not save when power is off.	0	-	○	○	○	
		1: Save when power is off.						

Group 00 Basic Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
00-10	Minimum frequency detection	0: Show warning if lower than minimum frequency 1: Run as minimum frequency if lower than minimum frequency	0	-	○	○	○	Note2
00-11	Selection of PID Lower Limit Frequency	0: PID is bound to lower limit frequency when inverter sleeps.	0	-	○	○	○	Note1
		1: PID is bound to 0Hz when inverter sleeps.						
00-12	Upper Limit Frequency	0.1~109.0	100.0	%	○	○	○	
00-13	Lower Limit Frequency	0.0~109.0	0.0	%	○	○	○	
00-14	Acceleration Time 1	0.1~6000.0	-	s	○	○	○	*1
00-15	Deceleration Time 1	0.1~6000.0	-	s	○	○	○	*1
00-16	Acceleration Time 2	0.1~6000.0	-	s	○	○	○	*1
00-17	Deceleration Time 2	0.1~6000.0	-	s	○	○	○	*1
00-18	Jog Frequency	0.00~599.00 (Note8)	6.00	Hz	○	○	○	*1
00-19	Jog Acceleration Time	0.1~0600.0	-	s	○	○	○	*1
00-20	Jog Deceleration Time	0.1~0600.0	-	s	○	○	○	*1
00-21	Acceleration Time 3	0.1~6000.0	-	s	○	○	○	*1
00-22	Deceleration Time 3	0.1~6000.0	-	s	○	○	○	*1
00-23	Acceleration Time 4	0.1~6000.0	-	s	○	○	○	*1
00-24	Deceleration Time 4	0.1~6000.0	-	s	○	○	○	*1
00-25	Switch-Over Frequency of Acc/Dec Time 1 and Time 4	0.0~599.00 (Note8)	0.0	Hz	○	○	○	
00-26	Emergency Stop Time	0.1~6000.0	5.0	s	○	○	○	
00-27	Reserved							
00-28	Main Frequency Command Characteristic Selection	0: Positive Characteristic (0~10V/4~20mA is corresponding to 0~100%)	0	-	○	○	○	
		1: Negative Characteristic (0~10V/4~20mA is corresponding to 100~0%)						
00-29 ~ 00-31	Reserved							
00-32	Application Selection Presets	0: General	0	-	○	○	○	
		1: Water Supply Pump						
		2: Conveyor *7						
		3: Exhaust fan						
		4: HVAC						
		5: Compressor *7						
		6: Reserved						
7: Reserved								
00-33	Modified Parameters (only for LCD)	0: Disable	0	-	○	○	○	
		1: Enable						
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)	-		○	○	○	
00-42	User Parameter 1		-		○	○	○	
00-43	User Parameter 2		-		○	○	○	
00-44	User Parameter 3		-		○	○	○	
00-45	User Parameter 4		-		○	○	○	
00-46	User Parameter 5		-		○	○	○	
00-47	User Parameter 6		-		○	○	○	
00-48	User Parameter 7		-		○	○	○	
00-49	User Parameter 8		-		○	○	○	
00-50	User Parameter 9		-		○	○	○	
00-51	User Parameter 10		-		○	○	○	
00-52	User Parameter 11		-		○	○	○	
00-53	User Parameter 12		-		○	○	○	
00-54	User Parameter 13		-		○	○	○	
00-55	User Parameter 14		-		○	○	○	
00-56	User Parameter 15		-		○	○	○	

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	-	○	×	×	*3
01-01	Reserved							
01-02	Maximum Output Frequency	4.8~599.00 (Note8)	50.0/ 60.0	Hz	○	○	○	*6*8
01-03	Maximum Output Voltage	200V: 0.1~255.0 400V: 0.2~510.0	- -	V	○	×	×	*8
01-04	Middle Output Frequency 2	0.0~599.00 (Note8)	0.0	Hz	○	×	×	
01-05	Middle Output Voltage 2	200V: 0.0~255.0 400V: 0.0~510.0	0.0	V	○	×	×	*8
01-06	Middle Output Frequency 1	0.0~599.00 (Note8)	3.0	Hz	○	×	×	
01-07	Middle Output Voltage 1	200V: 0.0~255.0 400V: 0.0~510.0	15.5 77.0	V	○	×	×	*8
01-08	Minimum Output Frequency	0.0~599.00 (Note8)	1.5	Hz	○	○	○	
01-09	Minimum Output Voltage	200V: 0.0~255.0 400V: 0.0~510.0	6.6 13.2	V	○	×	×	*8
01-10	Torque Compensation Gain	0.0~2.0	0.5	-	○	×	×	*1
01-11	Selection of Torque Compensation Mode	0: Torque Compensation Mode 0 1: Torque Compensation Mode 1	0	-	○	×	×	Note1
01-12	Base Frequency	4.8~599.00 (Note8)	50.0/ 60.0	Hz	○	○	○	*8
01-13	Base Output Voltage	200V: 0.0~255.0 400V: 0.0~510.0	- -	V	○	×	×	*8
01-14	Input Voltage Setting	200V: 155.0~255.0 400V: 310.0~510.0	- -	V	○	○	○	*8
01-15	Torque Compensation Time	0~10000	200	ms	○	×	×	

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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)										
03-01	Multi-function Terminal Function Setting-S2	2: Multi-Speed Setting Command 1	1						O	O	O	
		3: Multi-Speed Setting Command 2										
		4: Multi-Speed Setting Command 3										
03-02	Multi-function Terminal Function Setting-S3	5: Multi-Speed Setting Command 4	2						O	O	O	*6
		6: Forward Jog Run Command										
03-03	Multi-function Terminal Function Setting-S4	7: Reverse Jog Run Command	3						O	O	O	*6
		8: UP Frequency Increasing Command										
03-04	Multi-function Terminal Function Setting-S5	9: DOWN Frequency Decreasing Command	4						O	O	O	*6
		10: Acceleration/ Deceleration Setting Command 1										
		11: Acceleration/ Deceleration Inhibition Command										
03-05	Multi-function Terminal	12: Main/Alternative Run command	17	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	
	Function Setting-S6	Switching	17	-				
		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)						
		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						
		34: Speed Search 2 (from Frequency Command)						
		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: Forced Frequency Run								
58: Run Permissive Function								
63: switch to Tolerance Range of Constant Pressure 2								
64: Reserved								
65: Short-circuit braking								

Group 03 External Digital Input and Output Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		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	0000b	-	O	O	O	
		xxx1b:S1 B Contact						
		xx0xb:S2 A Contact						
		xx1xb:S2 B Contact						
		x0xxb:S3 A Contact			O	O	O	
		x1xxb:S3 B Contact						
		0xxb:S4 A Contact						
		1xxb:S4 B Contact						
03-10	Multi-Function Terminal (S5-S6 Selection)	xxx0b:S5 A Contact	0000b	-	O	O	O	
		xxx1b:S5 B Contact						
		xx0xb:S6 A Contact						
		xx1xb:S6 B Contact						
		x0xxb: Reserved						
		x1xxb: Reserved						
		0xxb: Reserved						
		1xxb: Reserved						
03-11	Relay (R1A-R1C) Output	0: During Running	0	-	O	O	O	*6
		1: Fault Contact Output						
		2: Frequency Agree						
03-12	Relay (R2A-R2C) Output	3: Setting Frequency Agree (03-13 ± 03-14)	1	-	O	O	O	*6
		4: Frequency Detection 1 (≥03-13+03-14)						
		5: Frequency Detection 2 (<03-13+03-14)						
		6: Automatic Restart						
		7~8: Reserved						
		9: Baseblock						
		10~11: Reserved						
		12: Over-Torque Detection						
		13: Current Agree *7						
		14: Mechanical Brake Control (03-17~18) ^{Note1}						
		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								
					-	-	-	

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						
		33: RTC Timer 1						
		34: RTC Timer 2						
		35: RTC Timer 3			○	○	○	
		36: RTC Timer 4						
		37: Detection Output of PID Feedback Loss *7						
		38: Brake Release *7			X	○	X	
		42: Over-High Pressure ^{Note1}			○	X	X	
		43: Over-Low Pressure ^{Note1}			○	X	X	
		44: Loss of Pressure Detection ^{Note1}			○	X	X	
		45: PID Sleep ^{Note1}			○	○	○	
		46: Over-High Flow ^{Note1}			○	○	○	
		47: Over-Low Flow ^{Note1}			○	○	○	
		48: Shortage of Low Suction ^{Note1}			○	○	○	
		49: Communication Error ^{Note2}			○	○	○	
		50: Frequency Detection 3 ^{Note2}			○	○	○	
		51: Frequency Detection 4 ^{Note2}			○	○	○	
		52: Frequency Detection 5 ^{Note2}			○	○	○	
		53: Frequency Detection 6 ^{Note2}			○	○	○	
		54: Turn on short-circuit braking ^{Note2}			X	X	○	
		57: Low Current Detection ^{Note3}			○	○	○	
		58: Frequency Deceleration Detection ^{Note5}			○	○	○	
		59: Over Temperature Detection ^{Note6}			○	○	○	
03-13	Frequency Detection Level	0.0~599.00 (Note8)	0.0	Hz	○	○	○	
03-14	Frequency Detection Width	0.1~25.5	2.0	Hz	○	○	○	
03-15	Current Agree Level	0.1~999.9	0.1	A	○	○	○	*7
03-16	Delay Time of Current Agree Detection	0.1~10.0	0.1	s	X	○	X	*7
03-17	Setting of Mechanical Brake Release Level ^{Note1}	0.00~599.00 (Note8)	0.00	Hz	○	○	○	
03-18	Setting of Mechanical Brake Operation Level ^{Note1}	0.00~599.00 (Note8)	0.00	Hz	○	○	○	
03-19	Relay(R1A-R3C)Type	xxx0b: R1 A Contact	0000b	-	○	○	○	
		xxx1b: R1 B Contact						
		xx0xb: R2 A Contact						
		xx1xb: R2 B Contact						
		x0xxb: R3 A Contact						
x1xxb: R3 B Contact								
		0xxxb: R4 A Contact						*10
		1xxxb: R4 B Contact						
03-20	Relay (R4A-R4C) Output	Range and definition are the same as those of 03-11, 03-12	2	-	○	○	○	*10
03-21	Photo-coupler Output Selection (DO2-DOG)	Range and definition are the same as those of 03-11, 03-12	3	-	○	○	○	*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.	0	-	O	O	O	
		1: Clear UP/DOWN frequency when stopping.						
		2: Allow frequency UP/DOWN when stopping.						
		3: Refresh frequency at acceleration.						
03-28	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	0	-	O	O	O	*7
		1: PWM (Pulse Width Modulation)						
03-31	Pulse Input Scaling	50~32000	1000	Hz	O	O	O	*1
03-32	Pulse input gain	0.0~1000.0	100	%	O	O	O	*1
03-33	Pulse input bias	-100.0~100.0	0.0	%	O	O	O	*1
03-34	Pulse input filter time	0.00~2.00	0.1	Sec	O	O	O	*1
03-35 ~ 03-36	Reserved							
03-37	Timer ON Delay (DI/DO)	0.0~6000.0	0.0	s	O	O	O	
03-38	Timer OFF Delay (DI/DO)	0.0~6000.0	0.0	s	O	O	O	
03-39	Relay (R3A-R3C) Output	Setting range and definition are the same as those of 03-11 and 03-12.	20	-	O	O	O	
03-40	Up/down Frequency Width Setting	0.00~5.00	0.00	Hz	O	O	O	*7
03-41	Torque Detection Level	0~150	10	%	X	O	X	*7
03-42	Delay Time of Braking Action	0.00~65.00	0.00	s	X	O	X	*7
03-43	UP/DOWN Acceleration/ Deceleration Selection	0: Acceleration/ Deceleration Time 1	0	-	O	O	O	Note1
		1: Acceleration/ Deceleration Time 2						
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						
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	0	-	O	O	O	Note6
		1: Enable						
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	
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	0		O	O	O	
		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	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	0	-	○	○	○	
		1: Acceleration and Deceleration Time are set by 05-17 ~ 05-48						
05-01	Frequency Setting of Speed-Stage 0	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*1
05-02	Frequency Setting of Speed-Stage 1	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-03	Frequency Setting of Speed-Stage 2	0.00~599.00 (Note8)	10.00	Hz	○	○	○	*7
05-04	Frequency Setting of Speed-Stage 3	0.00~599.00 (Note8)	20.00	Hz	○	○	○	*7
05-05	Frequency Setting of Speed-Stage 4	0.00~599.00 (Note8)	30.00	Hz	○	○	○	*7
05-06	Frequency Setting of Speed-Stage 5	0.00~599.00 (Note8)	40.00	Hz	○	○	○	*7
05-07	Frequency Setting of Speed-Stage 6	0.00~599.00 (Note8)	50.00	Hz	○	○	○	*7
05-08	Frequency Setting of Speed-Stage 7	0.00~599.00 (Note8)	50.00	Hz	○	○	○	*7
05-09	Frequency Setting of Speed-Stage 8	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-10	Frequency Setting of Speed-Stage 9	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-11	Frequency Setting of Speed-Stage 10	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-12	Frequency Setting of Speed-Stage 11	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-13	Frequency Setting of Speed-Stage 12	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-14	Frequency Setting of Speed-Stage 13	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-15	Frequency Setting of Speed-Stage 14	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-16	Frequency Setting of Speed-Stage 15	0.00~599.00 (Note8)	5.00	Hz	○	○	○	*7
05-17	Acceleration Time Setting of Multi Speed 0	0.1~6000.0	10.0	s	○	○	○	
05-18	Deceleration Time Setting of Multi Speed 0	0.1~6000.0	10.0	s	○	○	○	
05-19	Acceleration Time Setting of Multi Speed 1	0.1~6000.0	10.0	s	○	○	○	
05-20	Deceleration Time Setting of Multi Speed 1	0.1~6000.0	10.0	s	○	○	○	
05-21	Acceleration Time Setting of Multi Speed 2	0.1~6000.0	10.0	s	○	○	○	

Group 05 Multi-Speed Function Group

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
05-22	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	0	-	O	O	X	
		1: Execute a single cycle operation mode. Restart speed is based on the previous stopped speed.						
		2: Execute continuous cycle operation mode. Restart speed is based on the previous stopped speed.						
		3: After the completion of a single cycle, the on-going operation speed is based on the speed of the last stage. Restart speed is based on the previous stopped speed.						
		4: Execute a single cycle operation mode. Restart speed will be based on the speed of stage 1.						
		5: Execute continuous cycle operation mode. Restart speed will be based on the speed of stage 1.						
6: After the completion of a single cycle, the on-going operation speed is based on the speed of the last stage. Restart speed is based on the previous stopped speed.								
06-01	Frequency Setting of Operation-Stage 1	0.00~599.00 (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	0	-	○	○	○	
		1: Enable						
07-01	Fault Auto-Restart Time	0~7200	0	s	○	○	○	
07-02	Number of Fault Auto-Restart Attempts	0~10	0	-	○	○	○	
07-03	Reserved							
07-04	Direct Start at Power on	0: When the external run command is enabled, direct start at power up	0	-	○	○	○	
		1: When the external run command is enabled, unable to direct start at power-up.						
07-05	Automatic start delay at power up	1.0~300.0	3.5	Sec	○	○	○	
07-06	DC Injection Braking Start Frequency	0.0~10.0	0.5	Hz	○	○	○	
07-07	DC Injection Braking Current	0~100	50	%	○	○	○	
07-08	DC Injection Braking Time at Stop	0.00~10.00	0.50	s	○	○	○	
07-09	Stop Mode Selection	0: Deceleration to Stop	0	-	○	○	○	
		1: Coast to Stop			○	○	○	
		2: DC Braking Stop			○	○	X	
		3: Coast to Stop with Timer			○	○	○	
07-10 ~ 07-12	Reserved							
07-13	Low Voltage Detection Level	200V: 150~300	190	V	○	○	○	
		400V: 300~600	380					
07-14	Pre-excitation Time	0.00~10.00	2.00	s	X	○	X	
07-15	Pre-excitation Level	50~200	100	%	X	○	X	*6
07-16	DC Injection Braking Time at Start	0.00~100.00	0.00	s	○	○	○	
07-17	Reserved							
07-18	Minimum Base block Time	0.1~5.0	-	Sec	○	○	○	
07-19	Direction-Detection Speed Search Operating Current	0~100	50	%	○	○	X	
07-20	Speed Search Operating Current	0~100	20	%	○	○	X	
07-21	Integral Time of Speed Searching	0.1~10.0	2.0	Sec	○	○	X	
07-22	Delay Time of Speed Searching	0.0~20.0	0.2	Sec	○	○	X	
07-23	Voltage Recovery Time	0.1~5.0	2.0	Sec	○	○	X	
07-24	Direction-Detection Speed Search Selection	0: Disable	1	-	○	○	X	
		1: Enable						
07-25	Low voltage Detection Time	0.00~1.00	0.02	Sec	○	○	○	
07-26	SLV Speed Search Function	0: Enable	0	-	X	○	X	

Group 07: Start /Stop Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		1: Disable						
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	Reserved							
07-31								
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

Group 08 Protection Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
08-00	Stall Prevention Function	xxx0b: Stall prevention is enabled in acceleration.	0000b	-	○	○	○	
		xxx1b: Stall prevention is disabled in acceleration.						
		xx0xb: Stall prevention is enabled in deceleration.						
		xx1xb: Stall prevention is disabled in deceleration.						
		x0xxb: Stall prevention is enabled in operation						
		x1xxb: Stall prevention is disabled in operation						
		0xxxb: Stall prevention in operation decelerates based on deceleration time 1						
		1xxxb: Stall prevention in operation decelerates based on deceleration time 2						
08-01	Stall Prevention Level in Acceleration	20~200	120	%	○	○	○	
08-02	Stall Prevention Level in Deceleration	200V: 330~410	385	V	○	○	○	
		400V: 660~820	770					
08-03	Stall Prevention Level in Operation	30~200	120	%	○	X	X	
08-04	Reserved							
08-05	Selection for Motor Overload Protection (OL1)	xxx0b: Motor Overload Protection is disabled	0101b	-	○	○	○	
		xxx1b: Motor Overload Protection is enabled						
		xx0xb: Cold Start of Motor Overload						
		xx1xb: Hot Start of Motor Overload						
		x0xxb: Standard Motor						
		x1xxb: Special motor						
		0xxxb: Reserved						
1xxxb: Reserved								
08-06	Start-up Mode of Overload Protection Operation (OL1)	0: Stop Output after Overload Protection	0	-	○	○	○	
		1: Continuous Operation after Overload Protection.						
08-07	Motor Overload (OL1) Protection Level	0: Motor overload (OL1) Protection 0	0	-	○	○	○	Note3
		1: Motor overload (OL1) Protection 1						
		2: Motor overload (OL1) Protection 2						
08-08	Automatic Voltage Regulation	0: Enable	0	-	○	○	○	

Group 08 Protection Parameters

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

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	0	-	○	○	○	
		1: Coast to Stop						
		2: Continuous Operation						
08-25	Detection selection of External Fault	0: Immediately Detect when the Power is Supplied.	0	-	○	○	○	
		1: Start to Detect during Operation						
08-26 ~ 08-29	Reserved							
08-30	Selection of Run Permissive Function	0: Deceleration to Stop	0	-	○	○	○	
		1: Coast to Stop						
08-31 ~ 08-34	Reserved							
08-35	Fault Selection of Motor Overheat	0: Disable	0	-	○	○	○	
		1: Deceleration to Stop						
		2: Coast to Stop						
08-36	Time Coefficient of PTC Input Filter	0.00 ~ 5.00	2.0	Sec	○	○	○	
08-37	Fan Control Function (*Note)	0: Start at Operation	0	-	○	○	○	
		1: Permanent Start						
		2: Start at High Temperature						
08-38	Delay Time of Fan Off	0~600	60	Sec	○	○	○	
08-39	Delay Time of Motor Overheat Protection	1~300	60	Sec	○	○	○	
08-42	PTC Trip Level	0.1~10.0	0.7	V	○	○	○	Note1
08-43	PTC Reset Level	0.1~10.0	0.3	V	○	○	○	Note1
08-45	PTC Disconnection Detection	0: Disable	0	-	○	○	○	Note3
		1: Warning						
		2: Fault						
08-46	Temperature Agree Level	0~254°C	0	°C	○	○	○	Note6
08-47	Temperature Reset Level	0~254°C	0	°C	○	○	○	Note6
08-48	Selection of Fire Mode	0: Disable	0	-	○	○	○	Note6
		1: Enable						
08-49	Multi-Function Input Terminal Status of Fire Mode	0 : Reset after Power Off 1 : Reset after Terminal Removed	0	-	○	○	○	Note6
08-50	Multi-Function Terminal Status of Fire Mode	XXX0b: S6 A contact XXX1b: S6 B contact	0000b	-	○	○	○	Note6
08-51	Motor Speed Setting Source of Fire Mode	0 : Fire Mode Speed(08-52) 1 : PID Control 2 : AI2	0	-	○	○	○	Note6
08-52	Motor Speed of Fire Mode	0.00~100.00	100.00	%	○	○	○	Note6
08-53	PID Detection Level of Fire Mode	0~100	0	%	○	○	○	Note6
08-54	Delay Time of Fire Mode PID Loss	0.0~10.0	1.0	s	○	○	○	Note6
08-55	PID Feedback Loss Detection	0 : Keep Running	1	-	○	○	○	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	%	○	○	○	Note6
08-57	Delay Time of Fire Mode AI2 Signal Loss	0.0~10.0	1.0	s	○	○	○	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	-	○	○	○	Note6
08-59	Fire Mode Motor Direction	0 : Forward 1 : Reverse	0	-	○	○	○	Note6
08-60	Fire Mode Password	00000~65534	0	-	○	○	○	Note6

- *Note:** 1. Standard U type, IP20 frame 6~9 do not have this function.
2. Enhanced UE type, IP20 frame 6~8 do not have "Start at High Temperature" function.
3. Enhanced UE type, IP20 frame 9 do not have this function.

Group 09: Communication Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
09-00	INV Communication Station Address	1~31	1	-	○	○	○	*2
09-01	Communication Mode Selection	0: MODBUS	0	-	○	○	○	
		1: BACNET						
		2: METASYS						
		3: PUMP in Parallel Connection						
09-02	Baud Rate Setting (bps)	0:1200	4	-	○	○	○	*2 *6
		1:2400						
		2:4800						
		3:9600						
		4:19200						
5:38400								
09-03	Stop Bit Selection	0:1 Stop Bit	0	-	○	○	○	*2
		1: 2 Stop Bit						
09-04	Parity Selection	0: No Parity	0	-	○	○	○	*2
		1: Even Bit						
		2: Odd Bit						
09-05	Communications Data Bits Selection	0: 8 bits data	0	-	○	○	○	Note1
		1: 7 bits data						
09-06	Communication Error Detection Time	0.0~25.5	0.0	S	○	○	○	
09-07	Fault Stop Selection	0: Deceleration to Stop Based on Deceleration Time 1 when Communication Fault Occurs.	3	-	○	○	○	

Group 09: Communication Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		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	-	○	○	○	
09-09	Waiting Time	5~65	5	ms	○	○	○	
09-10	Device Instance Number	1 ~ 254	1	-	○	○	○	

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)	4	-	○	○	○	
		1: AI1 Given						
		2: AI2 Given						
		3: Reserved						
		4: 10-02/12-38						
		5: Reserved ^{Note}						
		6: Frequency Command (00-05) ^{Note}						
7: Multi-speed Frequency Command ^{Note4}								
10-01	PID Feedback Value Source Setting	1: AI1 Given	2	-	○	○	○	
		2: AI2 Given						
		3: Reserved						
		4: AI1 - AI2 Given						
10-02	PID Target Value	0.0~100.0	0.0	%	○	○	○	
10-03	PID Control Mode	xxx0b: PID Disable	0000b	-	○	○	○	
		xxx1b: PID Enable						
		xx0xb: PID Positive Characteristic						
		xx1xb: PID Negative Characteristic						
		x0xxb: PID Error Value of D Control						
		x1xxb: PID Feedback Value of D Control						
		0xxxb: PID Output						
1xxxb: PID Output + Frequency Command								
10-04	Feedback Gain	0.01~10.00	1.00	-	○	○	○	*1

Group 10: PID Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
10-05	Proportional Gain (P)	0.00~10.00	3.00	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-06	Integral Time (I)	0.00~100.00	7.00	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-07	Differential Time (D)	0.00~10.00	0.00	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-08	Reserved							
10-09	PID Bias	-100.0~100.0	0	%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-10	PID Primary Delay Time	0.00~10.00	0.00	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-11	PID Feedback Loss Detection Selection	0: Disable	0	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		1: Warning						
		2: Fault						
10-12	PID Feedback Loss Detection Level	0~100	0	%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-13	PID Feedback Loss Detection Time	0.0~10.0	1.0	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-14	PID Integral Limit	0.0~100.0	100.0	%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-15 10-16	Reserved							
10-17	Start Frequency of PID Sleep	0.00~599.00 (Note8)	30.00	Hz	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-18	Delay Time of PID Sleep	0.0~255.5	0.0	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-19	Frequency of PID Waking up	0.00~599.00 (Note8)	0.00	Hz	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-20	Delay Time of PID Waking up	0.0~255.5	0.0	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-21	Reserved							
10-22	Start Level of PID Enable	0.00~599.00 (Note8)	0.00	Hz	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note2
10-23	PID Limit	0.00~100.0	100.0	%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-24	PID Output Gain	0.0~25.0	1.0	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-25	PID Reversal Output Selection	0: Do not Allow Reversal Output	0	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		1: Allow Reversal Output						
10-26	PID Target Acceleration/Deceleration Time	0.0~25.5	0.0	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-27	PID Feedback Display Bias	0~9999	0	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-28	Reserved							
10-29	PID Sleep Selection	0: Disable	1	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		1: Enable						
		2: Set by DI						
10-30	Upper Limit of PID Target	0.0 ~ 100.0	100.0	%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-31	Lower Limit of PID Target	0.0 ~ 100.0	0.0	%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-32	PID Switching Function	0: PID1	0		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
		1: PID2						
		2: Set by DI						
		3: Switch to PID2 when RTC Timer Enables						
10-33	PID Maximum Feedback Value	1~10000	999	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-34	PID Decimal Width	0~4	1	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
10-35	PID Unit	0: %	0	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*6
		1: FPM						
		2: CFM						

Group 10: PID Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		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	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-37	PID2 Integral Time (I)	0.0~100.0	0.50	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-38	PID2 Differential Time (D)	0.00~10.00	0.00	s	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*1
10-39	PID Output Frequency Setting during disconnection	00.00~599.00 (Note8)	30.00	Hz	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	*6
10-40	Compensation Frequency Selection of PID Sleep	0: Disable 1: Enable	0	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note1
10-41 ~ 10-43	Reserved							
10-44	Precharge Frequency	0.0~120.0	0	Hz	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note3
10-45	Precharge Time	0~250	0	Sec	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note3
10-46	Precharge Target Level	0~10000	0	-	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note3
10-47	Proportional Gain 3(P)	0.00~10.00	3.00		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note6
10-48	Integral Time 3(I)	0.00~100.00	7.00	Sec	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note6
10-49	Differential Time 3(D)	0.00~10.00	0.00	Sec	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Note6

Group 11: Auxiliary Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
11-00	Direction Lock Selection	0: Allow Forward and Reverse Rotation	0	-	○	○	○	
		1: Only Allow Forward Rotation						
		2: Only Allow Reverse Rotation						
11-01	Carrier Frequency	0: Carrier Output Frequency Tuning	KVA ^{*a}	-	○	○	○	
		1: 1~16: 1~16KHz						
11-02	Soft PWM Function Selection	0: Disable	1(V/f) 0(SLV& PMSLV)	-	○	○	○	
		1: Soft PWM Function 1						
		2: Soft PWM Function 2						
11-03	Automatic carrier lowering selection	0: Disable	0	-	○	X	X	
		1: Enable						
11-04	S-curve Time Setting at the Start of Acceleration	0.00~2.50	0.20	s	○	○	○	
11-05	S-curve Time Setting at the End of Acceleration	0.00~2.50	0.20	s	○	○	○	
11-06	S-curve Time Setting at the Start of Deceleration	0.00~2.50	0.20	s	○	○	○	
11-07	S-curve Time Setting at the End of Deceleration	0.00~2.50	0.20	s	○	○	○	
11-08	Jump Frequency 1	0.0~599.00 (Note8)	0.0	Hz	○	○	○	
11-09	Jump Frequency 2	0.0~599.00 (Note8)	0.0	Hz	○	○	○	
11-10	Jump Frequency 3	0.0~599.00 (Note8)	0.0	Hz	○	○	○	
11-11	Jump Frequency Width	0.0~25.5	1.0	Hz	○	○	○	
11-12	Manual Energy Saving Gain	0~100	80	%	○	X	X	
11-13	Automatic Return Time	0~120	60	Sec	○	○	○	*6
11-14 ~ 11-17	Reserved							
11-18	Manual Energy Saving Frequency	0.00~599.00 (Note8)	0.00	Hz	○	X	X	
11-19	Automatic Energy Saving Function	0: Disabled	0	-	○	X	X	
		1: Enabled						
11-20	Filter Time of Automatic Energy Saving	0~200	140	ms	○	X	X	
11-21	Voltage Upper Limit of Energy Saving Tuning	0~100	100	%	○	X	X	
11-22	Adjustment Time of Automatic Energy Saving	0~5000	20	ms	○	X	X	*1
11-23	Detection Level of Automatic Energy Saving	0~100	10	%	○	X	X	
11-24	Coefficient of Automatic Energy Saving	0.00~655.34	KVA ^{*a}	-	○	X	X	
11-25 ~ 11-27	Reserved							
11-28	Frequency Gain of Overvoltage Prevention 2	1~200	100	%	○	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	0	-	O	X	X	
		1: Enable						
11-30	Variable Carrier Frequency Max. Limit	2~16	KVA ^{*a}	KHz	O	X	X	
11-31	Variable Carrier Frequency Min. Limit	1~16	KVA ^{*a}	KHz	O	X	X	
11-32	Variable Carrier Frequency Proportional Gain	00~99	00	-	O	X	X	
11-33	Rise Amount of DC Voltage Filter	0.1~10.0	0.1	Vdc	O	X	X	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	0	-	O	O	O	
		1: Operation is Set by 11-42 when Reference Frequency Disappears						
11-42	Reference Frequency Loss Level	0.0~100.0	80.0	%	O	O	O	
11-43	Hold Frequency at Start	0.0~599.00 (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	200	V	O	X	X	
		400V: 380~420	400					

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	0.05		O	X	X	*7
11-60	Upper Limit of Preventing Oscillation	0~100	100	%	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	X	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	0.00~200.00	5.00	%	O	X	X	Note2

Group 11: Auxiliary Parameters

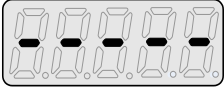
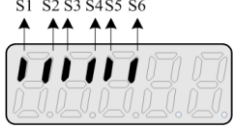
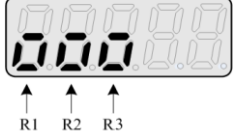
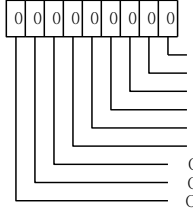
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
	3							
11-70	Upper Limit of Preventing Oscillation 3	0.01~100.00	5.00	%	O	X	X	Note2
11-71	Time Parameter of Preventing Oscillation 3	0~30000	100	ms	O	X	X	Note2
11-72	Switch Frequency 1 for Preventing Oscillation 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	-	○	○	○	*1 *5
12-01	PID Feedback Display Mode (LED)	0: Display the Feedback Value by Integer (xxx)	0		○	○	○	*5
		1: Display the Feedback Value by the Value with First Decimal Place (xx.x)						
		2: Display the Feedback Value by the Value with Second Decimal Place (x.xx)						
12-02	PID Feedback Display Unit Setting (LED)	0: xxxxx (no unit)	0		○	○	○	*5
		1: xxxPb (pressure)						
		2: xxxFL (flow)						
12-03	Line Speed Display (LED)	0~60000	1500/ 1800	RP M	○	○	○	*5
12-04	Line Speed Display Mode (LED)	0: Display Inverter Output Frequency	0		○	○	○	*1 *5
		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)						

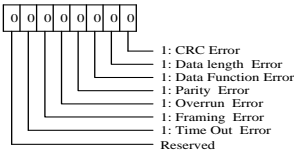
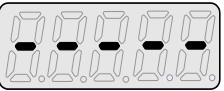
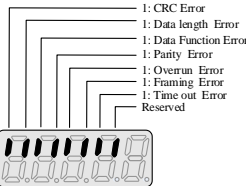
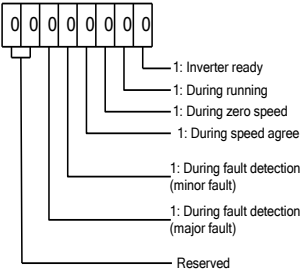
Group 12: Monitoring Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
12-05	Status display of digital input terminal (LED / LCD)	<p>LED display is shown as below no input</p>  <p>correspondences to input and output</p>   <p>LCD display is shown as below</p>  <p>0 : OPEN 1 : CLOSE</p>	-	-	○	○	○	
12-06 ~ 12-10	Reserved							
12-11	Output Current of Current Fault	Display the output current of current fault	-	A	○	○	○	
12-12	Output Voltage of Current Fault	Display the output voltage of current fault	-	V	○	○	○	
12-13	Output Frequency of Current Fault	Display the output frequency of current fault	-	Hz	○	○	○	
12-14	DC Voltage of Current Fault	Display the DC voltage of current fault	-	V	○	○	○	
12-15	Frequency Command of Current Fault	Display the frequency command of current fault	-	Hz	○	○	○	
12-16	Frequency Command	If LED enters this parameter, it only allows monitoring frequency command.	-	Hz	○	○	○	
12-17	Output Frequency	Display the current output frequency	-	Hz	○	○	○	
12-18	Output Current	Display the current output current	-	A	○	○	○	
12-19	Output Voltage	Display the current output voltage	-	V	○	○	○	
12-20	DC Voltage	Display the current DC voltage	-	V	○	○	○	
12-21	Output Power	Display the current output power	-	kW	○	○	○	

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	
12-39	PID Feedback	Display the feedback value of the	-	%	O	O	O	

Group 12: Monitoring Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute												
					V/F	SLV	PM SLV													
		PID controller (100% corresponds to the maximum frequency set by 01-02 or 01-16)																		
12-40	Reserved																			
12-41	Heatsink Temperature	Display the heatsink temperature of IGBT temperature.	-	°C	O	O	O													
12-42	RS-485 Error Code	<p>LCD Display:</p>  <p>LED Display: (without any error)</p>  <p>LED Display: (with certain error)</p> 	-	-	O	O	O	*7												
12-43	Inverter Status	<p>LCD Display:</p>  <p>LED Display:</p> <table border="0"> <tr><td>Inverter ready</td><td>1</td></tr> <tr><td>Running</td><td>2</td></tr> <tr><td>Zero Speed</td><td>4</td></tr> <tr><td>Frequency Agree</td><td>8</td></tr> <tr><td>Warning</td><td>16</td></tr> <tr><td>Error</td><td>32</td></tr> </table> <p>Inverter status display is the summed up value. Ex: Display of the value 6 means the inverter is running in zero speed.</p>	Inverter ready	1	Running	2	Zero Speed	4	Frequency Agree	8	Warning	16	Error	32	101B	-	O	O	O	
Inverter ready	1																			
Running	2																			
Zero Speed	4																			
Frequency Agree	8																			
Warning	16																			
Error	32																			
12-44	Reserved																			

Group 12: Monitoring Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
12-45	Recent Fault Message	Display current fault message	-	-	○	○	○	
12-46	Previous Fault Message	Display previous fault message	-	-	○	○	○	
12-47	Previous Two Fault Messages	Display previous two fault messages	-	-	○	○	○	
12-48	Previous Three Fault Messages	Display previous three fault messages	-	-	○	○	○	
12-49	Previous Four Fault Messages	Display previous four fault messages	-	-	○	○	○	
12-50	DIO Status of Current Fault	Display the DI/DO status of current fault Description is similar to 12-05	-	-	○	○	○	
12-51	Inverter Status of Current Fault	Display the inverter status of current fault Description is similar to 12-43	-	-	○	○	○	
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	○	○	○	
12-53	Trip Time 2 of Current Fault		-	day	○	○	○	
12-54	Frequency Command of Previous Fault	Display frequency command of previous fault	-	Hz	○	○	○	
12-55	Output Frequency of Previous Fault	Display output frequency of previous fault	-	Hz	○	○	○	
12-56	Output Current of Previous Fault	Display output current of previous fault	-	A	○	○	○	
12-57	Output Voltage of Previous Fault	Display output voltage of previous fault	-	V	○	○	○	
12-58	DC Voltage of Previous Fault	Display DC voltage of previous fault	-	V	○	○	○	
12-59	DIO Status of Previous Fault	Display DI/DO status of previous fault Description is similar to 12-05	-	-	○	○	○	
12-60	Inverter Status of Previous Fault	Display inverter status of previous fault Description is similar to 12-43	-	-	○	○	○	
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	○	○	○	
12-62	Trip time 2 of last fault		-	day	○	○	○	
12-63	Recent warning messages	Display the recent warning messages	-	-	○	○	○	
12-64	Previous warning message	Display the previous warning messages	-	-	○	○	○	
12-65 ~ 12-66	Reserved							
12-67	Accumulative Energy (kWHr)	0.0 ~ 999.9		kWHr	○	○	○	
12-68	Accumulative Energy (MWHr)	0 ~ 60000		MWHr	○	○	○	
12-69	Accumulative Electricity Price	0 ~ 9999		\$	○	○	○	

Group 12: Monitoring Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
	(\$)							
12-70	Accumulative Electricity Price (10000\$)	0 ~ 60000		\$	O	O	O	
12-71	Flow Meter Feedback	1 ~ 50000		GP M	O	O	O	
12-72	RTC Date	12.01.01 ~ 99.12.31	12.01.01		O	O	O	
12-73	RTC Time	00:00 ~ 23:59	00:00		O	O	O	
12-74	Operating Pressure Setting	0.01 ~ 25.50	2.00	PSI	O	X	X	
12-75	Pressure Feedback Value	0.01 ~ 25.50	-	PSI	O	X	X	
12-76	Non-Load Voltage	0.0 ~ 600.0	-	V	X	O	X	
12-77	Flow Meter Target Setting	1 ~ 50000	-	GP M	O	O	O	*7
12-78	Reserved							
12-79	Pulse Input Percentage	0.0~100.0	-	%	O	O	O	*7
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.

* 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		O	O	O	*1

Group 13 Maintenance Function Group

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		2: All parameters are writable.						
13-07	Parameter Password Function	00000~65534	00000	-	O	O	O	
13-08	Restore Factory Setting	0: No Initialization	0	-	O	O	O	
		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}								
13-09	Fault History Clearance Function	0: Do not Clear Fault History	0	-	O	O	O	*1
		1: Clear Fault History						
13-10	Parameter Situation 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		O	O	O	Note1
		1: Auto Restart Fault Messages are saved in fault history.						
13-15 ~ 13-20	Reserved							
13-21	Previous Fault Message	Display Previous Fault Message	-	-	O	O	O	Note2
13-22	Previous Two Fault Message	Display Previous Two Fault	-	-	O	O	O	Note2

Group 13 Maintenance Function Group

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		Message						
13-23	Previous Three Fault Message	Display Previous Three Fault Message	-	-	○	○	○	Note2
13-24	Previous Four Fault Message	Display Previous Four Fault Message	-	-	○	○	○	Note2
13-25	Previous Five Fault Message	Display Previous Five Fault Message	-	-	○	○	○	Note2
13-26	Previous Six Fault Message	Display Previous Six Fault Message	-	-	○	○	○	Note2
13-27	Previous Seven Fault Message	Display Previous Seven Fault Message	-	-	○	○	○	Note2
13-28	Previous Eight Fault Message	Display Previous Eight Fault Message	-	-	○	○	○	Note2
13-29	Previous Night Fault Message	Display Previous Night Fault Message	-	-	○	○	○	Note2
13-30	Previous Ten Fault Message	Display Previous Ten Fault Message	-	-	○	○	○	Note2
13-31	Previous Eleven Fault Message	Display Previous Eleven Fault Message	-	-	○	○	○	Note2
13-32	Previous Twelve Fault Message	Display Previous Twelve Fault Message	-	-	○	○	○	Note2
13-33	Previous Thirteen Fault Message	Display Previous Thirteen Fault Message	-	-	○	○	○	Note2
13-34	Previous Fourteen Fault Message	Display Previous Fourteen Fault Message	-	-	○	○	○	Note2
13-35	Previous Fifteen Fault Message	Display Previous Fifteen Fault Message	-	-	○	○	○	Note2
13-36	Previous Sixteen Fault Message	Display Previous Sixteen Fault Message	-	-	○	○	○	Note2
13-37	Previous Seventeen Fault Message	Display Previous Seventeen Fault Message	-	-	○	○	○	Note2
13-38	Previous Eighteen Fault Message	Display Previous Eighteen Fault Message	-	-	○	○	○	Note2
13-39	Previous Nineteen Fault Message	Display Previous Nineteen Fault Message	-	-	○	○	○	Note2
13-40	Previous Twenty Fault Message	Display Previous Twenty Fault Message	-	-	○	○	○	Note2
13-41	Previous Twenty One Fault Message	Display Previous Twenty One Fault Message	-	-	○	○	○	Note2
13-42	Previous Twenty Two Fault Message	Display Previous Twenty Two Fault Message	-	-	○	○	○	Note2
13-43	Previous Twenty Three Fault Message	Display Previous Twenty Three Fault Message	-	-	○	○	○	Note2
13-44	Previous Twenty Four Fault Message	Display Previous Twenty Four Fault Message	-	-	○	○	○	Note2
13-45	Previous Twenty Five Fault Message	Display Previous Twenty Five Fault Message	-	-	○	○	○	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	-	-	○	○	○	Note2
13-47	Previous Twenty Seven Fault Message	Display Previous Twenty Seven Fault Message	-	-	○	○	○	Note2
13-48	Previous Twenty Eight Fault Message	Display Previous Twenty Eight Fault Message	-	-	○	○	○	Note2
13-49	Previous Twenty Nine Fault Message	Display Previous Twenty Nine Fault Message	-	-	○	○	○	Note2
13-50	Previous Thirty Fault Message	Display Previous Thirty Fault Message	-	-	○	○	○	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	-	○	○	○	Note7
14-01	T1 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-02	T2 Set Value 1	0~9999	0	-	○	○	○	Note7
14-03	T2 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-04	T3 Set Value 1	0~9999	0	-	○	○	○	Note7
14-05	T3 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-06	T4 Set Value 1	0~9999	0	-	○	○	○	Note7
14-07	T4 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-08	T5 Set Value 1	0~9999	0	-	○	○	○	Note7
14-09	T5 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-10	T6 Set Value 1	0~9999	0	-	○	○	○	Note7
14-11	T6 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-12	T7 Set Value 1	0~9999	0	-	○	○	○	Note7
14-13	T7 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-14	T8 Set Value 1	0~9999	0	-	○	○	○	Note7
14-15	T8 Set Value 2 (Mode 7)	0~9999	0	-	○	○	○	Note7
14-16	C1 Set Value	0~65534	0	-	○	○	○	Note7
14-17	C2 Set Value	0~65534	0	-	○	○	○	Note7
14-18	C3 Set Value	0~65534	0	-	○	○	○	Note7
14-19	C4 Set Value	0~65534	0	-	○	○	○	Note7
14-20	C5 Set Value	0~65534	0	-	○	○	○	Note7
14-21	C6 Set Value	0~65534	0	-	○	○	○	Note7
14-22	C7 Set Value	0~65534	0	-	○	○	○	Note7
14-23	C8 Set Value	0~65534	0	-	○	○	○	Note7
14-24	AS1 Set Value 1	0~65534	0	-	○	○	○	Note7
14-25	AS1 Set Value 2	0~65534	0	-	○	○	○	Note7
14-26	AS1 Set Value 3	0~65534	0	-	○	○	○	Note7
14-27	AS2 Set Value 1	0~65534	0	-	○	○	○	Note7
14-28	AS2 Set Value 2	0~65534	0	-	○	○	○	Note7
14-29	AS2 Set Value 3	0~65534	0	-	○	○	○	Note7
14-30	AS3 Set Value 1	0~65534	0	-	○	○	○	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	-	○	○	○	Note7
14-32	AS3 Set Value 3	0~65534	0	-	○	○	○	Note7
14-33	AS4 Set Value 1	0~65534	0	-	○	○	○	Note7
14-34	AS4 Set Value 2	0~65534	0	-	○	○	○	Note7
14-35	AS4 Set Value 3	0~65534	0	-	○	○	○	Note7
14-36	MD1 Set Value 1	0~65534	1	-	○	○	○	Note7
14-37	MD1 Set Value 2	0~65534	1	-	○	○	○	Note7
14-38	MD1 Set Value 3	0~65534	1	-	○	○	○	Note7
14-39	MD2 Set Value 1	0~65534	1	-	○	○	○	Note7
14-40	MD2 Set Value 2	0~65534	1	-	○	○	○	Note7
14-41	MD2 Set Value 3	0~65534	1	-	○	○	○	Note7
14-42	MD3 Set Value 1	0~65534	1	-	○	○	○	Note7
14-43	MD3 Set Value 2	0~65534	1	-	○	○	○	Note7
14-44	MD3 Set Value 3	0~65534	1	-	○	○	○	Note7
14-45	MD4 Set Value 1	0~65534	1	-	○	○	○	Note7
14-46	MD4 Set Value 2	0~65534	1	-	○	○	○	Note7
14-47	MD4 Set Value 3	0~65534	1	-	○	○	○	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	-	○	○	○	
15-01	T1 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-02	T2 Current Value 1	0~9999	0	-	○	○	○	
15-03	T2 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-04	T3 Current Value 1	0~9999	0	-	○	○	○	
15-05	T3 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-06	T4 Current Value 1	0~9999	0	-	○	○	○	
15-07	T4 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-08	T5 Current Value 1	0~9999	0	-	○	○	○	
15-09	T5 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-10	T6 Current Value 1	0~9999	0	-	○	○	○	
15-11	T6 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-12	T7 Current Value 1	0~9999	0	-	○	○	○	
15-13	T7 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-14	T8 Current Value 1	0~9999	0	-	○	○	○	
15-15	T8 Current Value 2 (Mode 7)	0~9999	0	-	○	○	○	
15-16	C1 Current Value	0~65534	0	-	○	○	○	
15-17	C2 Current Value	0~65534	0	-	○	○	○	
15-18	C3 Current Value	0~65534	0	-	○	○	○	
15-19	C4 Current Value	0~65534	0	-	○	○	○	
15-20	C5 Current Value	0~65534	0	-	○	○	○	
15-21	C6 Current Value	0~65534	0	-	○	○	○	
15-22	C7 Current Value	0~65534	0	-	○	○	○	

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	-	○	○	○	
15-24	AS1 Results	0~65534	0	-	○	○	○	
15-25	AS2 Results	0~65534	0	-	○	○	○	
15-26	AS3 Results	0~65534	0	-	○	○	○	
15-27	AS4 Results	0~65534	0	-	○	○	○	
15-28	MD1 Results	0~65534	0	-	○	○	○	
15-29	MD2 Results	0~65534	0	-	○	○	○	
15-30	MD3 Results	0~65534	0	-	○	○	○	
15-31	MD4 Results	0~65534	0	-	○	○	○	
15-32	TD Current Value	0~65534	0	-	○	○	○	

Group 16: LCD Function Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
16-00	Main Screen Monitoring	5~82 (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	-	O	O	O	
		0: Frequency display unit is 0.01Hz						
		1: Frequency display unit 0.01%						
		2: Rpm display; motor rotation speed is set by the control modes to select IM (02-07)/ PM (22-03) motor poles to calculate.						
		3~39: Reserved						
		40~9999: Users specify the format, Input 0XXXX represents the display of XXXX at 100%.						
		10001~19999: Users specify the format; Input 1XXXX represents the display of XXX.X at 100%.						
		20001~29999: Users specify the format, Input 2XXXX represents the display of XX.XX at 100%.						
30001~39999: Users specify the format, Input 3XXXX represents the display of X.XXX at 100%.								
16-04	Selection of Engineering Unit	0: No Unit	0	-	O	O	O	*6
		1: FPM						
		2: CFM						
		3: PSI						
		4: GPH						
		5: GPM						
		6: IN						
		7: FT						
		8: /s						
		9: /m						
		10: /h						

Group 16: LCD Function Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		11: °F						
		12: inW						
		13: HP						
		14: m/s						
		15: MPM						
		16: CMM						
		17: W						
		18: KW						
		19: m						
		20: °C						
		21: RPM						
		22: Bar						
		23: Pa						
		24: KPa ^{Note4}						
16-05	LCD Backlight	0~7	5	-	0	0	0	*1
16-06	Reserved							
16-07	Copy Function Selection	0: Do not copy parameters	0	-	0	0	0	
		1: Read inverter parameters and save to the operator.						
		2: Write the operator parameters to inverter.						
		3: Compare parameters of inverter and operator.						
16-08	Selection of Allowing Reading	0: Do not allow to read inverter parameters and save it to the operator.	0	-	0	0	0	
		1: Allow to read inverter parameters and save it to the operator.						
16-09	Selection of Operator Removed (LCD)	0: Keep operating when LCD operator is removed.	0	-	0	0	0	*1
		1: Display fault to stop when LCD operator is removed						
16-10	RTC Time Display Setting	0: Hide	0		0	0	0	
		1: Display						
16-11	RTC Date Setting	12.01.01 ~ 99.12.31	12.01.01		0	0	0	
16-12	RTC Time Setting	00:00 ~ 23:59	00:00		0	0	0	
16-13	RTC Timer Function	0: Disable	0		0	0	0	
		1: Enable						
		2: Set by DI						
16-14	P1 Start Time	00:00 ~ 23:59	08:00		0	0	0	
16-15	P1 Stop Time	00:00 ~ 23:59	18:00		0	0	0	
16-16	P1 Start Date	1:Mon, 2:Tue, 3:Wed,	1		0	0	0	
16-17	P1 Stop Date	4:Thu,5:Fri,6:Sat, 7:Sun	5		0	0	0	

Group 16: LCD Function Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
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,	1		O	O	O	
16-21	P2 Stop Date	4:Thu,5:Fri,6:Sat,7:Sun	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,	1		O	O	O	
16-25	P3 Stop Date	4:Thu,5:Fri,6:Sat,7:Sun	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,	1		O	O	O	
16-29	P4 Stop Date	4:Thu, 5:Fri, 6:Sat, 7:Sun	5		O	O	O	
16-30	Selection of RTC Offset	0: Disable	0		O	O	O	
		1: Enable						
		2: Set by DI						
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,	1		O	O	O	
16-33	Source of Timer 2	2:P2, 3:P1+P2	2		O	O	O	
16-34	Source of Timer 3	4:P3, 5:P1+P3,	4		O	O	O	
16-35	Source of Timer 4	6:P2+P3, 7:P1+P2+P3, 8:P4, 9:P1+P4, 10:P2+P4, 11:P1+P2+P4 12:P3+P4 13:P1+P3+P4, 14:P2+P3+P4 15:P1+P2+P3+P4, 16:Off, 17:Off+P1 18:Off+P2, 19:Off+P1+P2 20:Off+P3, 21:Off+P1+P3 22:Off+P2+P3 23:Off+P1+P2+P3 24:Off+P4 25:Off+P1+P4 26:Off+P2+P4 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	8		O	O	O	

Group 16: LCD Function Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
16-36	Selection of RTC Speed	0: Off	0		O	O	O	
		1: By Timer 1						
		2: By Timer 2						
		3: By Timer 3						
		4: By Timer 4						
		5: By Timer 1+2						
16-37	Selection of RTC Rotation Direction	xxx0b: RTC Run1 Forward Rotation	0000b		O	O	O	
		xxx1b: RTC Run1 Reverse Rotation						
		xx0xb: RTC Run2 Forward Rotation						
		xx1xb: RTC Run2 Reverse Rotation						
		x0xxb: RTC Run3 Forward Rotation						
		x1xxb: RTC Run3 Reverse Rotation						
		0xxxb: RTC Run4 Forward Rotation						
		1xxxb: RTC Run4 Reverse Rotation						

Group 17: IM Motor Automatic Tuning Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
17-00	Mode Selection of Automatic Tuning	0: Rotational Auto-tuning	VF:2 SLV:6	-	O	O	X	
		1: Static Auto-tuning						
		2: Stator Resistance Measurement						
		3: Reserved						
		4: Loop Tuning						
		5: Rotational Auto-tuning Combination (Item: 4+2+0) ^{Note}						
		6: Static Auto-tuning Combination (Item: 4+2+1) ^{Note}						
17-01	Motor Rated Output Power	0.00~600.00	-	KW	O	O	X	
17-02	Motor Rated Current	0.1~1200.0	-	A	O	O	X	
17-03	Motor Rated Voltage	200V: 50.0~240.0	-	V	O	O	X	
		400V:100.0~480.0	-					
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							
17-08	Motor No-load Voltage	200V: 50~240	KVA ^a	V	O	O	X	

Group 17: IM Motor Automatic Tuning Parameters

Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		400V: 100~480						
17-09	Motor Excitation Current	0.01~600.00 (15%~70% motor rated current)	KVA ^{*a}	A	O	O	X	■1
17-10	Automatic Tuning Start	0: Disable 1: Enable	0	-	O	O	X	
17-11	Error History of Automatic Tuning	0: No Error	0	-	O	O	X	
		1: Motor Data Error						
		2. Stator Resistance Tuning Error						
		3. Leakage Induction Tuning Error						
		4. Rotor Resistance Tuning Error						
		5. Mutual Induction Tuning Error						
		6. Reserved						
		7. DT Error						
		8. Motor Acceleration Error						
9. Warning								
17-12	Leakage Inductance Ratio	0.1 ~ 15.0	3.4	%	X	O	X	
17-13	Slip Frequency	0.10 ~ 20.00	1.00	Hz	X	O	X	
17-14	Rotational Tuning Mode Selection	0: VF Mode 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			Attribute
					V/F	SLV	PM SLV	
18-00	Slip Compensation Gain at Low Speed	0.00~2.50	VF: 0.00	-	O	O	X	*1
			SLV: 1.00					
18-01	Slip Compensation Gain at High Speed	-1.00~1.00	0.0	-	O	O	X	*1
18-02	Slip Compensation Limit	0~250	200	%	O	X	X	
18-03	Slip Compensation Filter Time	0.0~10.0	1.0	Sec	O	X	X	
18-04	Regenerative Slip Compensation Selection	0: Disable	0	-	O	X	X	
		1: Enable						
18-05	FOC Delay Time	1~1000	100	ms	X	O	X	
18-06	FOC Gain	0.00~2.00	0.1	-	X	O	X	

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	-	X	O	X	
		1: Speed control is enabled either in constant speed or accel/ decel.						
20-08	ASR Delay Time	0.000~0.500	0.004	Sec	X	O	O	
20-09	Speed Observer Proportional (P) Gain 1	0.00~2.55	0.61	-	X	O	X	*1
20-10	Speed Observer Integral(I) Time 1	0.01~10.00	0.05	Sec	X	O	X	*1
20-11	Speed Observer Proportional (P) Gain 2	0.00~2.55	0.61	-	X	O	X	*1
20-12	Speed Observer Integral(I) Time 2	0.01~10.00	0.06	Sec	X	O	X	*1
20-13	Low-pass Filter Time Constant of Speed Feedback 1	1~1000	4	ms	X	O	X	
20-14	Low-pass Filter Time Constant of Speed Feedback 2	1~1000	30	ms	X	O	X	
20-15	ASR Gain Change Frequency 1	0.0~599.00 (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 are 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	100	%	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: 0~200 400V: 0~400"	150 300	V	X	X	O	Note8
22-18	Flux-Weakening Control	0~100	0	%	X	X	O	Note1
22-19 22-20	Reserved							
22-21	SLV PM Motor Tuning	0: Disable 1: Enable	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	
22-22	Fault History of SLV PM Motor Tuning	0: No Error	0	--	X	X	O	*4
		1~4: Reserved						
		5: Circuit tuning time out.						
		6: Reserved						
		7: Other motor tuning errors						
		8: Reserved						
		9: Current Abnormity Occurs while Loop Adjustment.						
		10: Reserved						
		11: Stator Resistance Measurement Timeout						
		12: Reserved						
22-25	Detection Mode Selection of Default Magnetic Pole	0: Angle before Stop	2 (Note8)	--	X	X	O	Note4
		1: Mode 1						
		2: Mode 2						
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=1 is enabled)	50	%	X	X	O	Note4
22-28	Mode 2 Frequency Division Ratio	0~8 (Note8) (22-25=2 or 22-26=1 is 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	1~100	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	0	-	X	X	O	Note8
		1: Mode 1						
22-33	MTPA Gain	0~400%	200	%	X	X	O	Note8
22-34	IPM Estimator Gain	0.1~500.0	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	0	-	O	O	O	
		1: Pump						
		2: HVAC						
		3: Compressor *7						
23-01	Setting of Single & Multiple Pumps and Master & Slave Machines	0: Single Pump	0		O	O	O	
		1: Master						
		2: Slave 1						
		3: Slave 2						
		4: Slave 3						
23-02	Operation Pressure Setting	0.10 ~ 650.00	4.00	PSI	O	O	O	*6
23-03	Maximum Pressure of Pressure Transmitter	0.10 ~ 650.00	10.00	PSI	O	O	O	*6

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 23-02/12-74	0		O	O	O	
		1: Set by AI						
23-05	Display Mode Selection	0: Display of Target and Pressure Feedback *	0	%	O	O	O	
		1: Only Display Target Pressure						
		2: Only Display Feedback Pressure						
23-06	Proportion Gain (P)	0.00~10.00	3.00	-	O	O	O	
23-07	Integral Time (I)	0.0~100.0	7.0	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 or Percentage	0:Pressure	1	-	O	O	O	Note4
		1:Percentage						
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	-	O	O	O	
		1: Downward Detection						
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	○	○	○	
23-31	Synchronous Selection of Multiple Pumps in Parallel	0: Disable	1		○	○	○	
		1: Pressure Setting and Run/Stop						
		2: Pressure Setting						
		3: Run/Stop						
23-32	Reserved							
23-33	Reserved							
23-34	Tolerance Range of Constant Pressure 2	23-20=0 : 0.01 ~ 650.00 23-20=1 : 1~100	5	%/ PSI	○	○	○	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		○	○	○	Note2
23-36	PUMP Unit Display	Reference 16-04 Engineering Units	0		○	○	○	Note4
23-37	Leakage Detection Time	0.0~100.0	0.0	Sec	○	○	○	*7
23-38	Pressure Variation of Leakage Detection Restart	23-20=0 : 0.01 ~ 65.00 23-20=1 : 1~10	1	%/ PSI	○	○	○	*7
23-39	Pressure Tolerance Range of Leakage Detection Restart	23-20=0 : 0.01 ~ 650.00 23-20=1 : 1~100	5	%/ PSI	○	○	○	*7
23-40	Reserved							
23-41	Local/ Remote Key	0: Disable	1		○	○	○	
		1: Enable						
23-42	Energy Recalculating	0: Disable (Energy Accumulating)	0		○	○	○	
		1: Enable						
23-43	Electricity Price per kWh	0.000 ~ 5.000	0.000	\$	○	○	○	
23-44	Selection of Accumulative Electricity Pulse Output Unit	0: Disable	0		○	○	○	
		1: Unit for 0.1kWh						
		2: Unit for 1kWh						
		3: Unit for 10kWh						
		4: Unit for 100kWh						
5: Unit for 1000kWh								
23-45	Given Modes of Flow Meters Feedback	0: Disable	1		○	○	○	
		1: Analog Input						
		2: Pulse Input						
23-46	Maximum Value of Flow Meters	1 ~ 50000	10000	GPM	○	○	○	
23-47	Target Value of Flow Meters	1 ~ 50000	5000	GPM	○	○	○	
23-48	Maximum Flow Value of Feedback	0.01 ~ 99.00	80.00	%	○	○	○	

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	0		O	O	O	
		1: PID Error Value						
		2: Current						
		3: Current and PID Error Value						
23-55	Detection Time of Low Suction	0 ~ 30.0	10.0	Sec	O	O	O	
23-56	PID Error Level of Low Suction	0 ~ 30	10	%	O	O	O	
23-57	Current Level of Low Suction(Motor Rated Current)	0 ~ 100	10	%	O	O	O	
23-58	Reaction of Low Suction	0: Disable	0		O	O	O	
		1: Warning						
		2: Fault						
		3: Fault & Restart						
23-59	Source of HVAC Pressure Command	0: Set by 23-47/12-77	0		O	O	O	
		1: Set by AI						
23-60	HVAC Unit Display	Reference 16-04 Engineering Units	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	0		O	O	O	Note4
		1: Minute						
23-73	Slave Wake-up Selection	0: Disable	0		O	O	O	Note4
		1: Enable						
23-74	High Pressure Setting	0: Disable	2		O	O	O	Note5
		1: High Pressure Warning						
		2: High Pressure Warning or Error						
23-75	Low Pressure Setting	0: Disable	0		O	O	O	Note5
		1: Low Pressure Warning						
		2: Low Pressure Warning or Error						
23-76	High Flow Setting	0: Disable	2		O	O	O	Note5
		1: High Flow Warning						

Group 23 Pump & HVAC Function Parameters

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

Group 24 Pump Control Function Parameters

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

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	0000b		O	O	O	
		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						
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	0		O	O	O	
		1: Built-in 1 to 3 control mode						
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	50.0	-	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	0	-	O	O	O	Note6
		1: PID Control is enabled during increasing/ decreasing pumps						

4.3 Description of Parameters

Group 00-Basic Parameters

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

The inverter offers the following control modes:

00-00=0: V/F Mode

Select the required V/F curve (01-00) based on your motor and application. Perform a stationary auto-tune (17-00=2). If the motor cable length is longer than 50m (165ft), see parameter 17-00 for details.

00-00=2: Sensorless Vector Control

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

00-00=5: PM Sensorless Vector Control

Verify the inverter rating matches the motor rating. Set PM motor data in parameters 22-00 to 22-06. Refer to parameter 22-21 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.

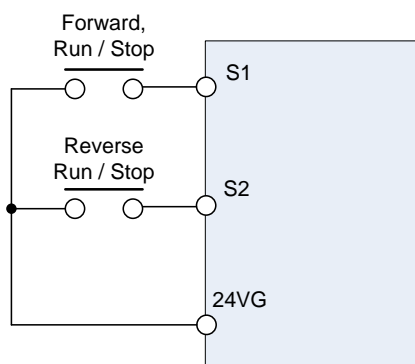


Figure 4.3.1 Wiring example of 2-wire

■ 3-wire operation

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

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

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

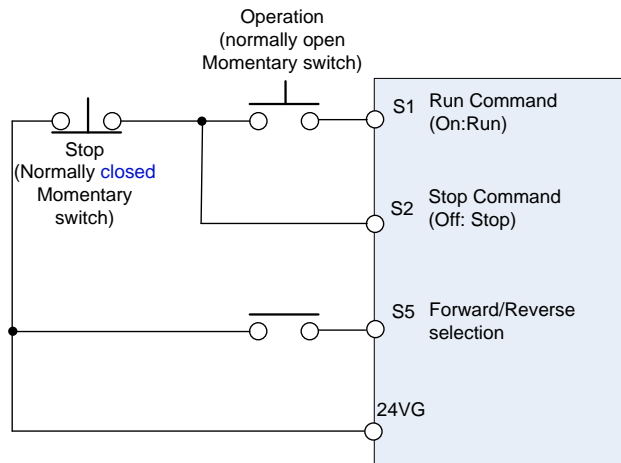


Figure 4.3.2 Wiring example of 3-wire

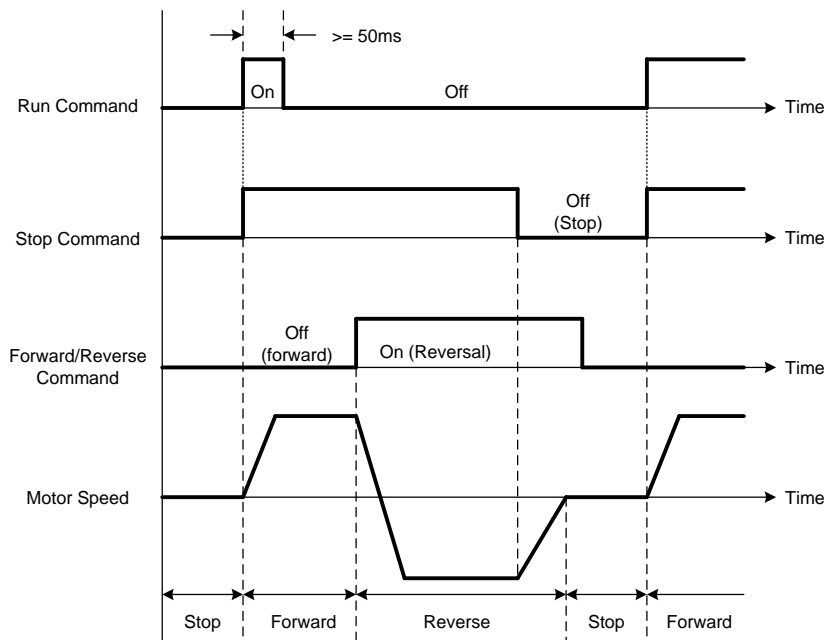
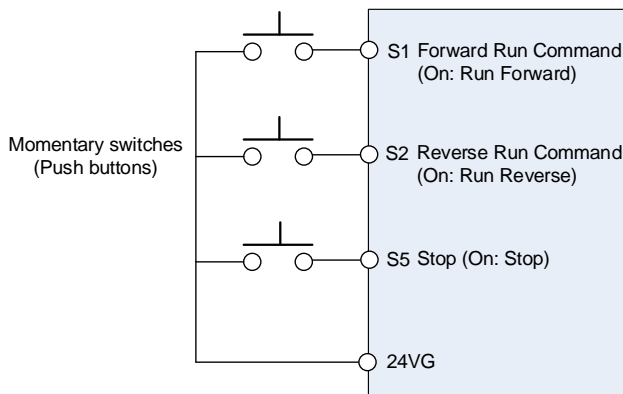


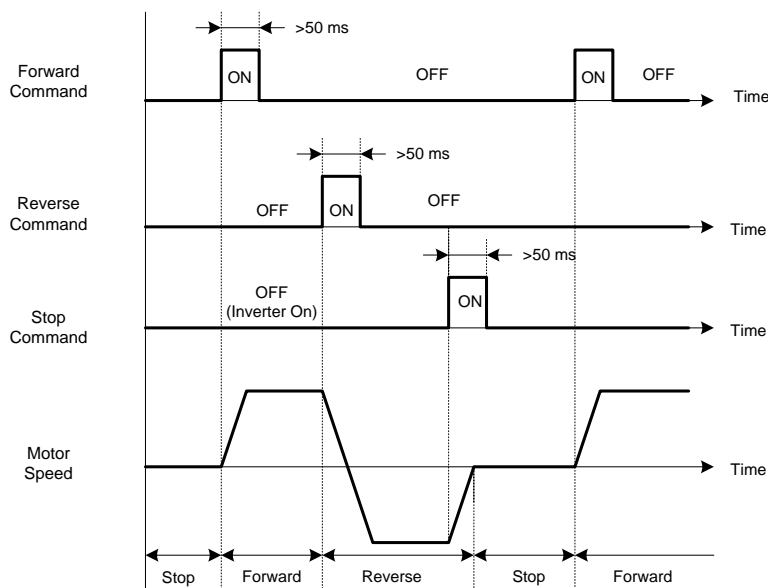
Figure 4.3.3 Timing chart of 3-wire operation

■ 2-wire self holding (latching) operation

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



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



00-02=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 4.3.

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 4.3.4). Refer to parameter 04-00 to select the signal type.

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

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

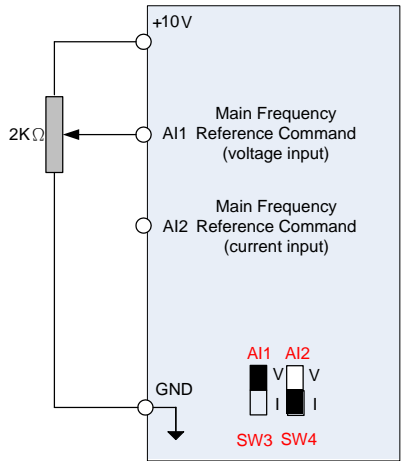


Figure 4.3.4 Analog input as main frequency reference command (For UE type)

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 parameters 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 SE1 error when 00-07 = 1 and parameter 00-05 and 00-06 are set to the same selection.

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

00- 08	Communication Frequency Command – READ ONLY
Range	【0.00~599.00】 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】 %
--------------	----------------------

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

Motor 1: Maximum frequency parameter 01-02.

Motor 2: Maximum frequency parameter 01-16.

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

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

Notes:

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

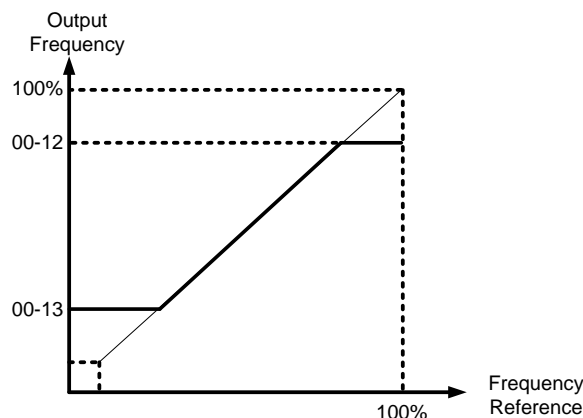


Figure 4.3.5 Frequency reference upper and lower limits

Note: The maximum 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 400Hz 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 4.3.1 Acceleration / deceleration time selection

Accel/dec2 time 2 (Set 03-00 ~ 03-05 = 30)	Accel/dec1 time 1 (Set 03-00 to 03-05 = 10)	Acceleration time	Deceleration time
0	0	Tacc1 (00-14)	Tdec1 (00-15)
0	1	Tacc2 (00-16)	Tdec2 (00-17)
1	0	Tacc3 (00-21)	Tdec3 (00-22)
1	1	Tacc4 (00-23)	Tdec4 (00-24)

0: OFF, 1: ON

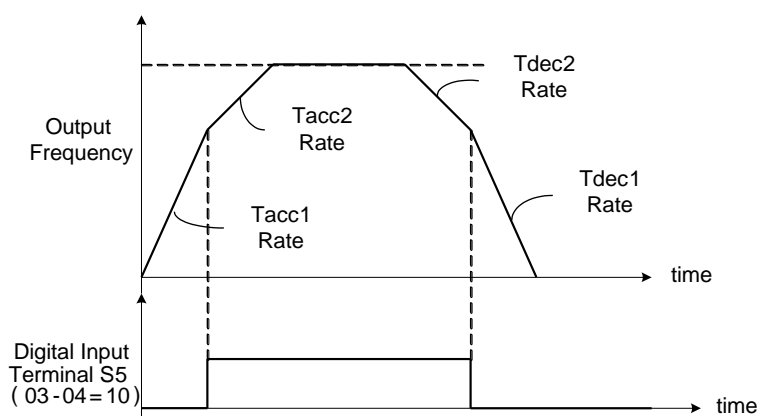


Figure 4.3.6: Terminal S5 switch between Tacc1/Tacc2 and Tdec1/Tdec2

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

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

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

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

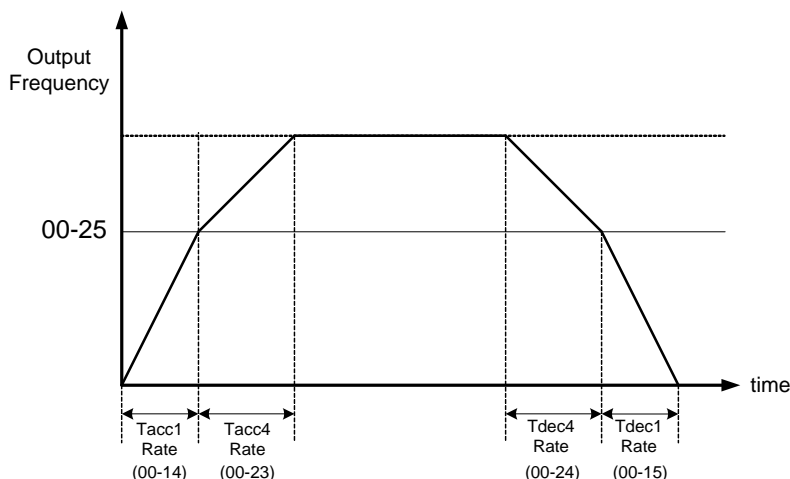


Figure 4.3.7 Automatic acceleration / deceleration time switch-over based on output frequency

00-18	Jog Frequency
Range	【0.00~599.00】 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 4.3.8. The emergency stop function can be used to stop inverter in case of an external event.

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

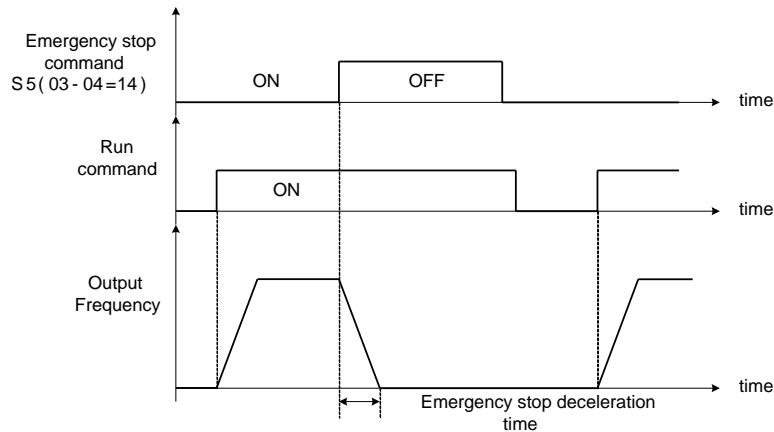


Figure 4.3.8 Emergency stop example

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

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

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

Note: Selection applies to analog input AI1 and AI2.

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

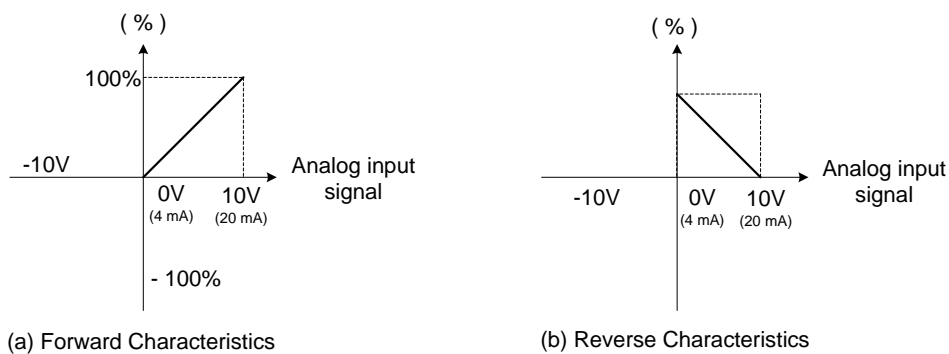


Figure 4.3.9 Positive/negative analog input as main frequency reference command.

00- 32	Application
Range	【0】 : General 【1】 : Water supply pump 【2】 : Conveyor 【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. 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.

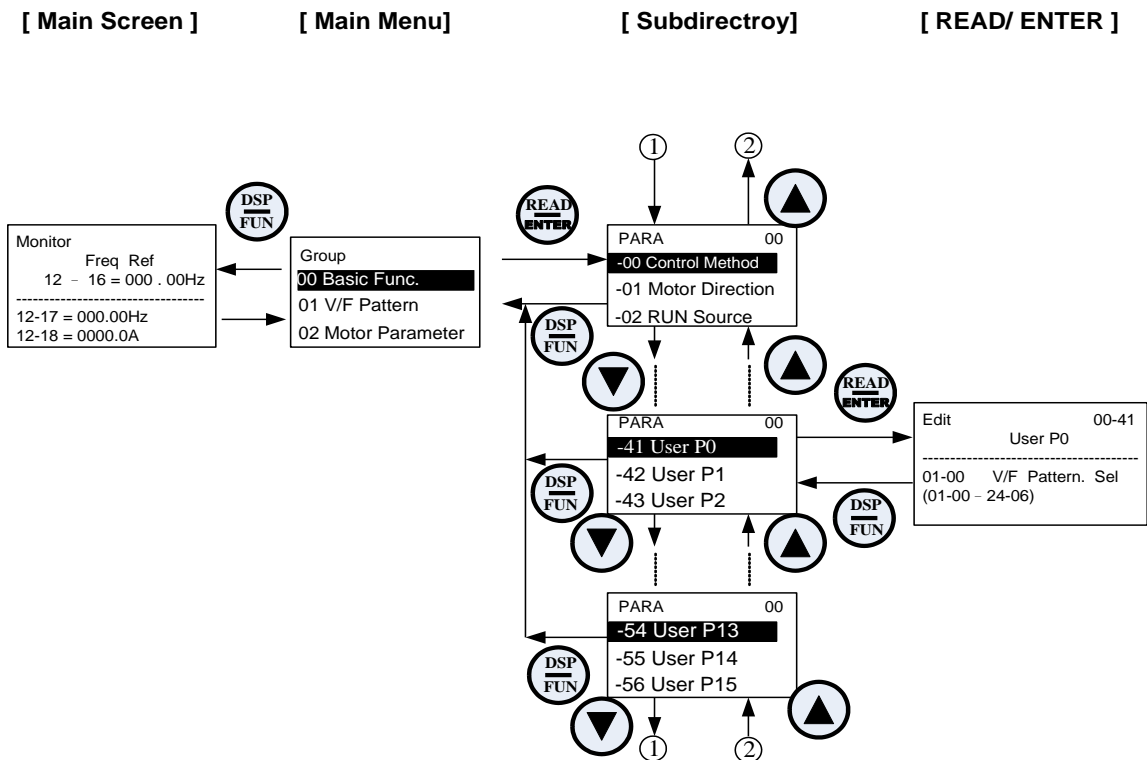
Example 2: After one or more parameters in 00-41 ~ 00-56 are set, user parameters settings are as follows.

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 V1.12.
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 <hr/> 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.
	Monitor Freq Ref 12-16=000.00Hz <hr/> 12-17=000.00Hz <hr/> 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.



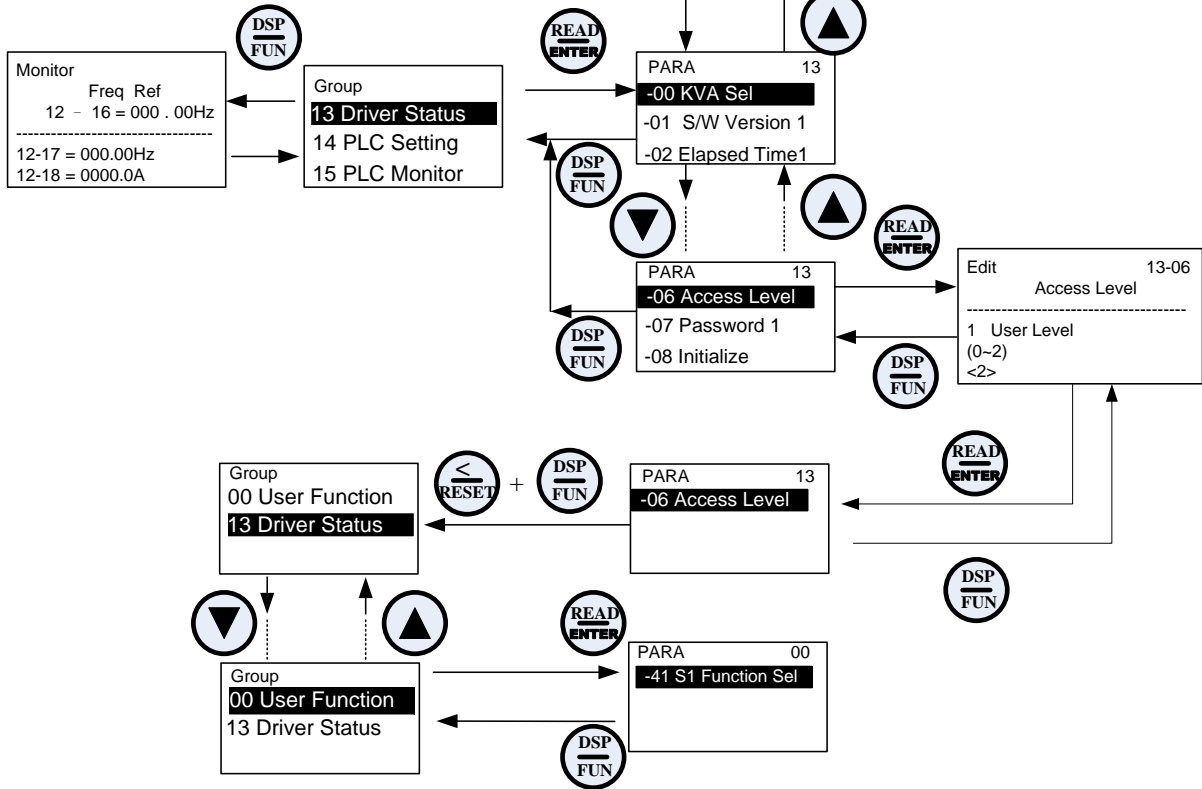
Note: User level (13-06=1) can be set by one or more parameters in the user parameters of 00-41 ~ 00-56.

[Main Screen]

[Main Menu]

[Subdirectory]

[READ / ENTER]



Group 01-V/F Control Parameters

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

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

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

There are three ways to set V/F curve:

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

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

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

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

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

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

Table 4.3.2 1 - 30HP V/F curve selection

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

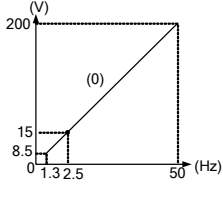
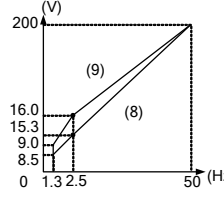
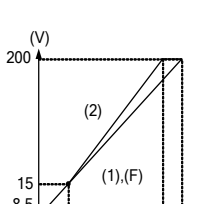
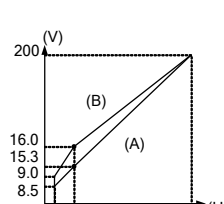
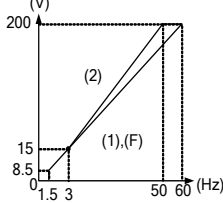
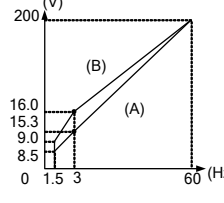
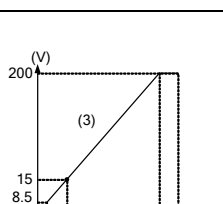
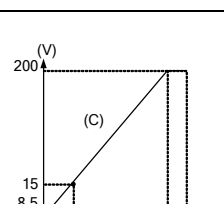
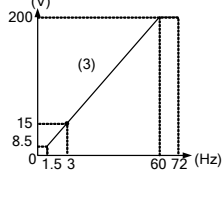
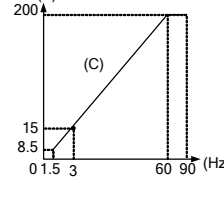
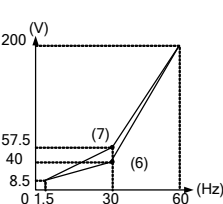
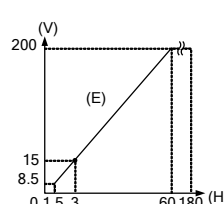
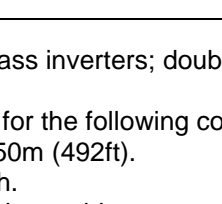
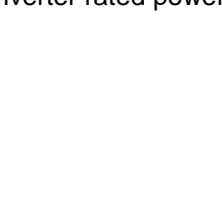

Type	Specification	01-00	V/F curve ^{*1}
Rated Horsepower Torque (Reducer)	180Hz	F	

*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 4.3.3 40HP and above V/F curve selection

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

*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.

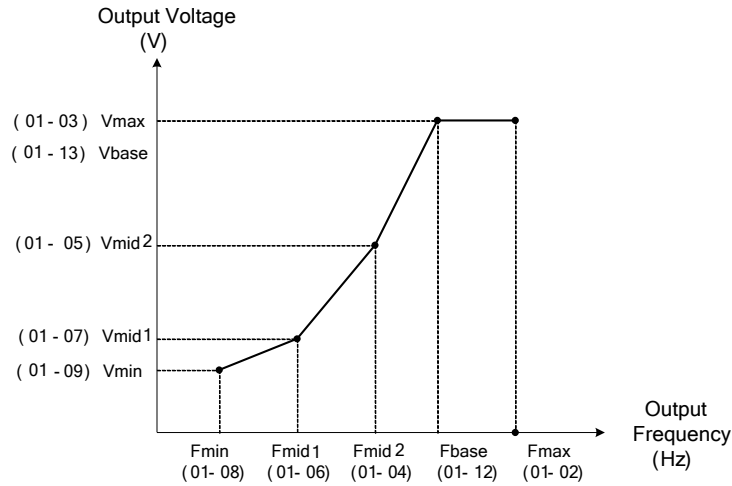


Figure 4.3.10 Custom V/F curve

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

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

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

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

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

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

SLV (Sensorless vector control)

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

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

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

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

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

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

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

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

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

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

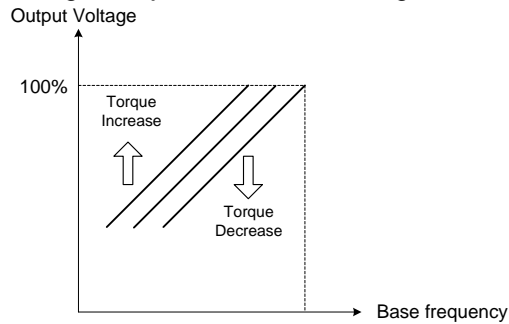


Figure 4.3.11 Torque compensation gain to increase/decrease output torque

Increase value when:

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

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

Reduce value when:

- When experiencing motor vibration

Important:

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

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

01-11=0: General torque compensation mode.

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

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

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

The minimum input voltage of inverter is 0.1V.

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

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

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

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

Set the torque compensation delay time in milliseconds.

Only adjust in the following situations:

Increase value when:

- When experiencing motor vibration

Decrease value when:

- When motor torque response is too slow

Group 02-IM Motor Parameter

02- 00	No-load Current
Range	【0.01~600.00】 A
02- 01	Rated Current
Range	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)

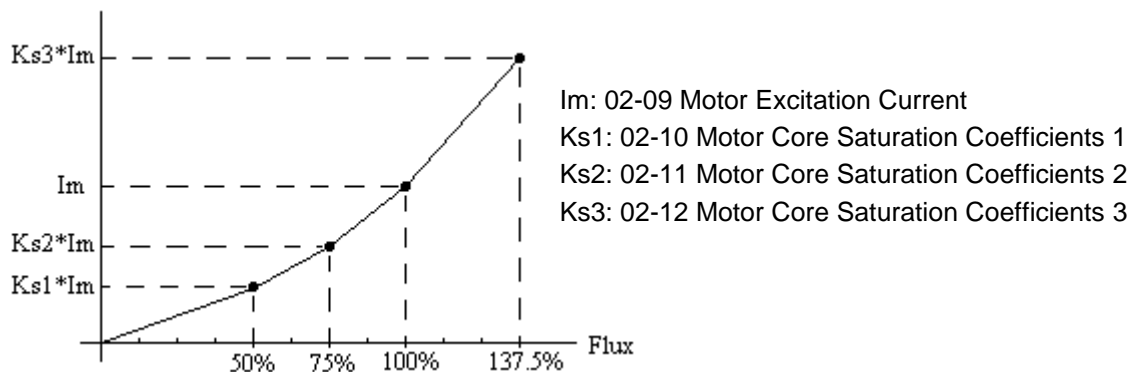
Parameter determines the rated flux during motor's rated rotation in SLV control mode. Set the value of this parameter to the same value as parameter 17-08 (02-19 for motor 2). A value of 10~50V below the input voltage level ensures that the motor is capable of providing adequate torque performance when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



(10) Motor core loss (02-13)

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

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

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

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

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

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

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

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

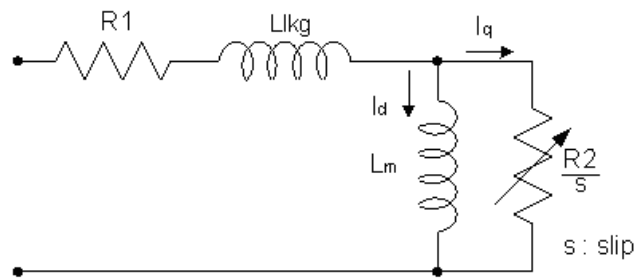


Figure 4.3.12 Y-equivalent model of an induction motor

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

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

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

	【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
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*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. 4.3.13

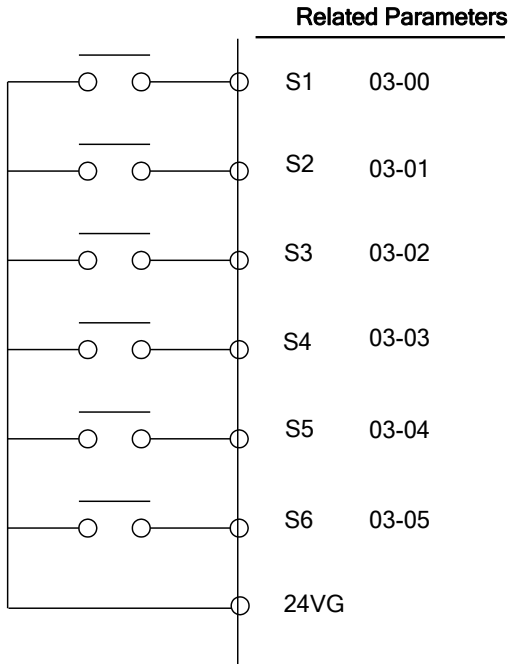


Figure 4.3.13 Multi-function digital input and related parameters

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

Value	Function		Description	Control mode		
	Name	LCD Display		V/F	SLV	PM SLV
0	2-wire type (Forward operation)	2-Wire (FWD-RUN)	2- wire (ON : Forward operation command).	O	O	O
1	2-wire type (Reverse operation)	2-Wire (REV-RUN)	2- wire (ON : Reverse operation command).	O	O	O
2	Multi-Speed Setting Command 1	Muti-Spd Ref 1	Multi-Speed Reference 1	O	O	O
3	Multi-Speed Setting Command 2	Muti-Spd Ref 2	Multi-Speed Reference 2	O	O	O
4	Multi-Speed Setting Command 3	Muti-Spd Ref 3	Multi-speed Reference 3	O	O	O
5	Multi-Speed Setting Command 4	Muti-Spd Ref 4	Multi-speed Reference 4	O	O	O
6	Forward Jog Run Command	FJOG	ON: Forward operation in jog mode (00-18)	O	O	O
7	Reverse Jog Run Command	RJOG	ON: Reverse operation in jog mode (00-18)	O	O	O
8	UP Frequency Increasing Command	UP command	ON: Command of output frequency increasing (only used by support of DOWN command).	O	O	O
9	DOWN Frequency Decreasing Command	DOWN command	ON: Command of output frequency decreasing (only used by support of UP command).	O	O	O
10	Acceleration/ Deceleration Setting Command 1	Acc/Decel Time Selection 1	Acceleration/deceleration time selection command1	O	O	O
11	Acceleration/ Deceleration Inhibition Command	ACC/DEC Inhibit	ON: Acceleration/deceleration prohibition	O	O	O
12	Main/Alternative Run command Switching	Run Change Sel	Run command source is set by alternative run command (00-03).	O	O	O
13	Main/Alternative Frequency Command Switching	Freq Change Sel	Frequency command source is set by alternative frequency command (00- 06).	O	O	O
14	Emergency Stop (Decelerate to Zero and Stop)	E-Stop	ON: Emergency stop input	O	O	O
15	External Baseblock Command (Rotation freely to Stop)	Ext. 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.	○	×	×
21	PID Integral Reset	PID I-Reset	ON: PID integral value reset	○	○	○
22~23	Reserved	Reserved	Reserved	-	-	-
24	PLC input	PLC Input	ON: Digital PLC input	○	○	○
25	External fault	Ext. Fault	ON: External fault alarm	○	○	○
26	3-Wire Sequence (Forward/ Reverse Command)	3-Wire (FWD/REV)	3-wire control (forward/reverse command). ON: Reverse; OFF: Forward. When the parameter is set to 26 , terminal S1 and terminal will become operation command and stop command respectively, and their original functions will be closed.	○	○	○
27	Local/ Remote Selection	Local/Remote	ON: Local mode (via the digital operator) OFF: Frequency command and operation command will be determined according to the setting of parameter (00-02 and 00-05)	○	○	○
28	Remote Mode Selection	Remote Mode Sel	ON: RS-485 communication OFF: Control circuit terminal	○	○	○
29	Jog Frequency Selection	JOG Freq Ref	ON: Selection jog frequency command	○	○	○
30	Acceleration/ Deceleration Setting Command 2	Acc/Decel Time Selection 2	Acceleration/deceleration time selection command2	○	○	○
31	Inverter Overheating Warning (OH2)	Overheat Alarm	ON: Inverter overheat alarm (OH2) input(will display OH2)	○	○	○
32	Reserved	Reserved	Reserved	-	-	-
33	DC Braking	DC Brake Command	ON: Perform DC braking	○	×	×
34	Speed Search 2 (from Frequency Command)	Speed Search 2	ON: Search speed from set frequency	○	×	○
35	Timing Function Input	Timer Input	.Set the time function at 03-37, 03-38 .Set the time function output at 03-11, 03-12	○	○	○
36	PID Soft Start Disable	PID SFS Disable	ON: PID slow-start off	○	○	○
37~40	Reserved	Reserved	Reserved	-	-	-
41	PID Sleep	PID Sleep	ON: PID Sleep	○	○	○
42~46	Reserved	Reserved	Reserved	-	-	-
47	Fire Mode (Forced to Run Mode)	Fire Mode	ON: Inverter runs in the max. frequency of motor 1 (parameter 01-02). Note: If fault message of OC, SC, CUV, FUL, STO occur, function of fire mode will stop.	○	○	○
48	KEB Acceleration	KEB Accel.	ON: KEB acceleration start	○	×	×
49	Parameters Write-in Allowed	Write Enabled	ON: All parameters are writable. OFF: Except reference frequency (00-05) all parameters are write-protected.	○	○	○

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.	○	○	○
51~52	Reserved	Reserved	Reserved	-	-	-
53	2-Wire Self Holding Mode (Stop Command)	2-Wire (STOP)	2-Wire Self Holding Mode (ON: Stop Command).	○	○	○
54	Switch PID1 and PID2	PID 2 Enable	ON: PID1 enabled OFF: PID2 enabled	○	○	○
55	RTC Time Enable	RTC Timer Switch	ON:RTC Time Function Enabled	○	○	○
56	RTC Offset Enable	Offset Time Switch	ON:RTC Offset Enabled	○	○	○
57	Forcing Frequency Run	Force Freq Cmd	ON: Run on Forcing Frequency (23-28) OFF: Determine frequency reference and run command depending on the setting of parameter (00-02 and 00-05)	○	○	○
58	Run Permissive Function	Safety Function	ON: Stop on the setting of 08-30	○	○	○
63	Switch to Tolerance Range of Constant Pressure 2	Switch Const.P. Range 2	ON: Use tolerance range of constant pressure 2 (23-34) for PUMP mode OFF: Use tolerance range of constant pressure 1 (23-09) for PUMP mode	○	○	○
64	Reserved	Reserved	Reserved	-	-	-
65	Short-circuit braking	SC Brk	ON: Excute short-circuit braking	X	X	○
66	Reserved	Reserved	Reserved	-	-	-
67	Reserved	Reserved	Reserved	-	-	-
68	External Fault 2	Ext. Fault 2	ON: the alarm of external Fault	○	○	○
69	External Overload	Ext. Overload	ON: the input of external overload	○	○	○

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

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

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

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

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

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

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

Select frequency reference using the multi-function digital input.

Table 4.3.5 Multi-speed operation selection

Speed	Multi-function digital input (S1 ~ S6)					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. 4.3.14 and 4.3.15 show an example of a 9-speed operation selection.

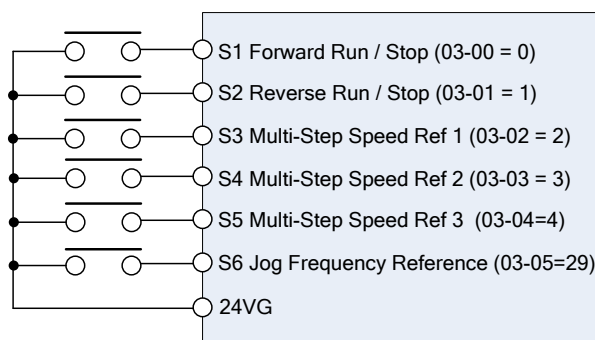


Figure 4.3.14 Control Terminal Wiring Example

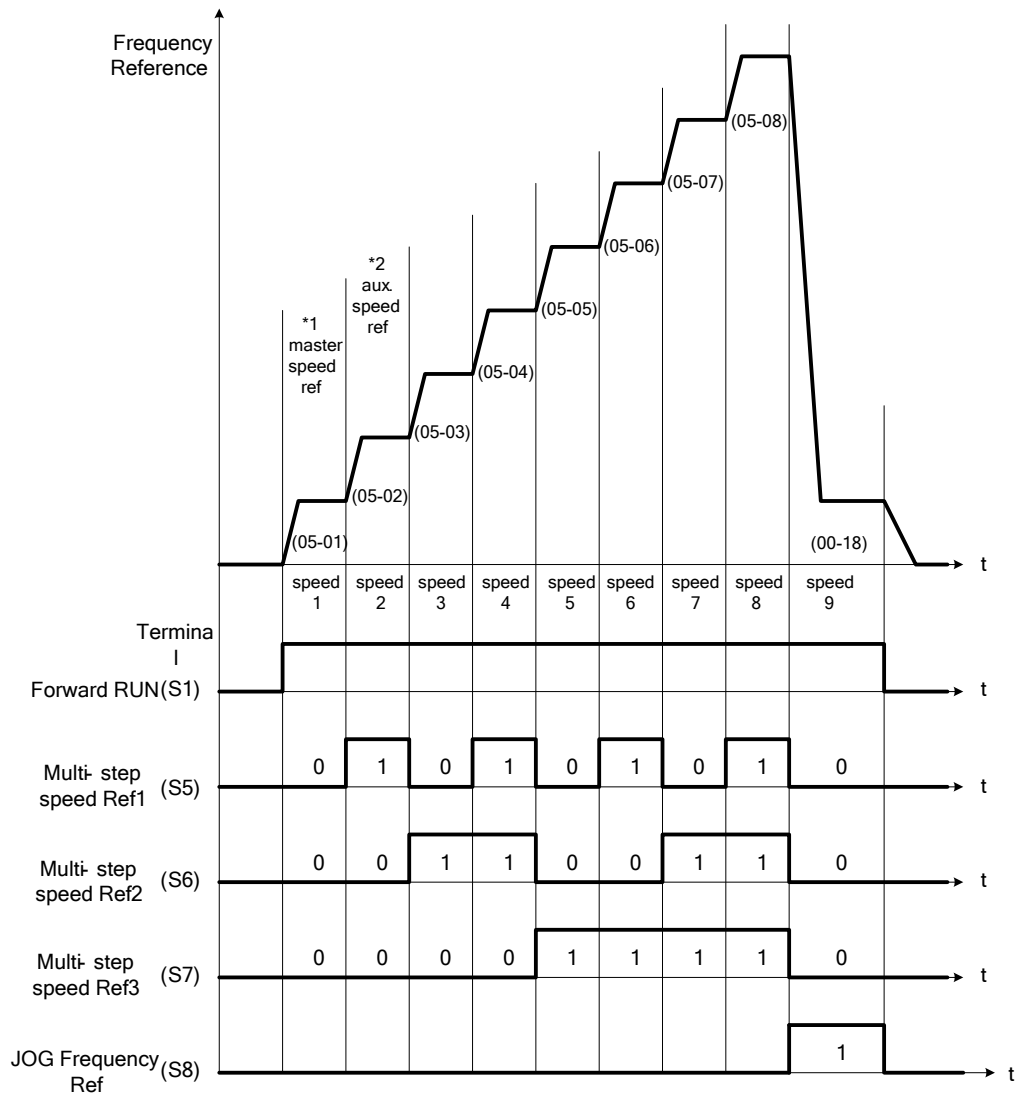


Figure 4.3.15 9-speed timing diagram

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

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

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

Notes:

- To execute 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 S1 to 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 4.3.16 and 4.3.17.

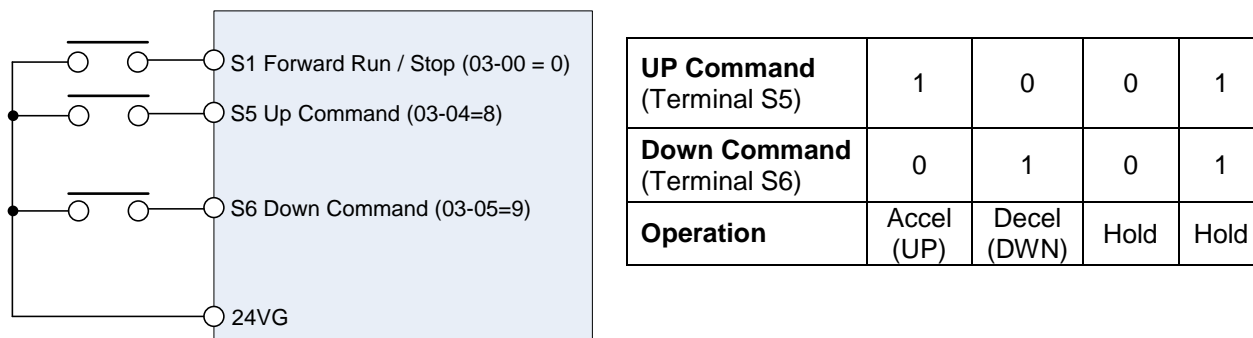


Figure 4.3.16 UP/DOWN wiring and operation example

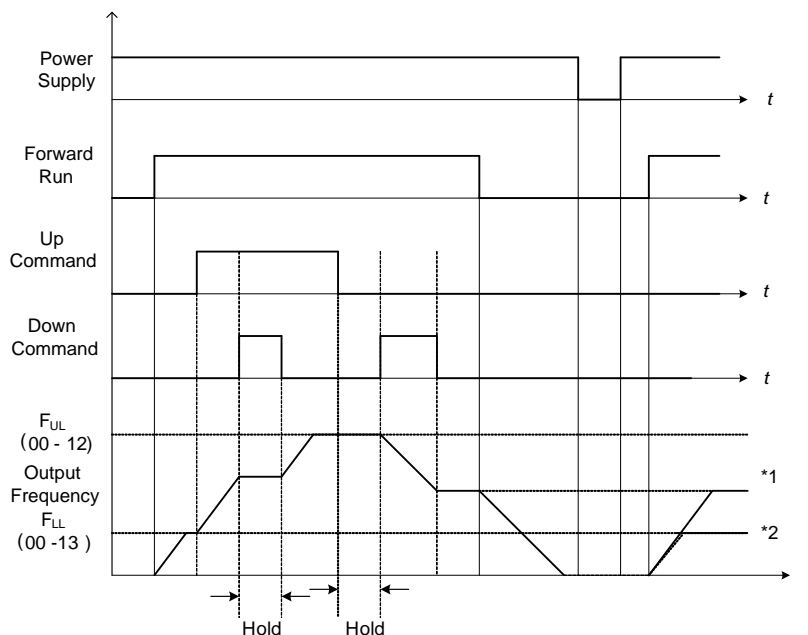


Figure 4.3.17 Up / Down command timing diagram

UP / DOWN Command Operation

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

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

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

Refer to 03-40 UP/ DOWN frequency width setting for using other functions of UP/ DOWN. (It is enabled in inverter software V1.12)

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

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

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

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

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

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

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

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

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

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

Refer to Fig.4.3.18. for an example.

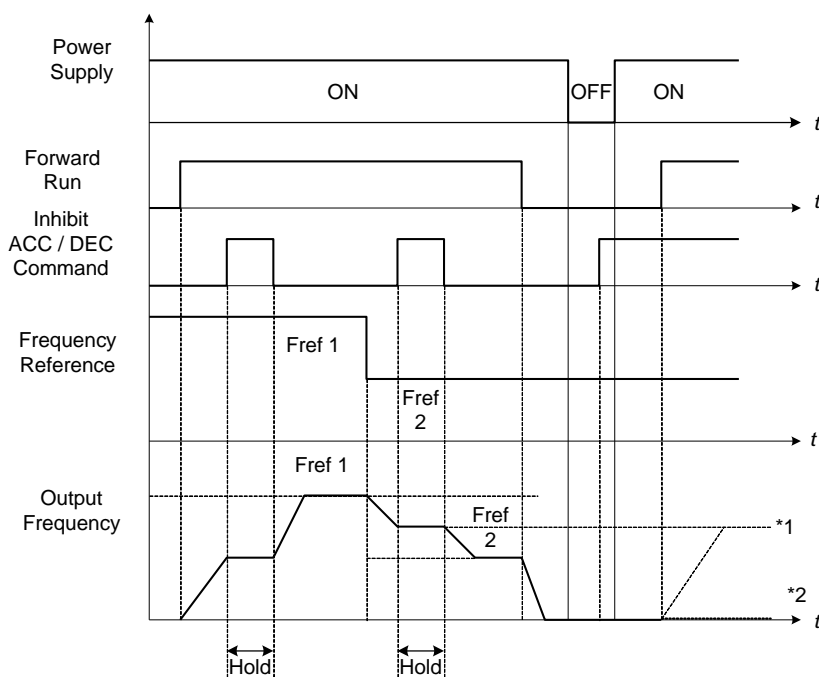


Figure 4.3.18 Acceleration / deceleration inhibition command operation

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

*2. When 11-58 = 0, and a run command is given and the acceleration / deceleration inhibit command is

active, the frequency reference and output frequency will remain at zero.

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

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

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

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

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

Refer to the "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 search from frequency reference is active the inverter output frequency starts from the frequency reference and searches for the coasting motor speed and continue to operate. If speed search is not active the output frequency starts at 0Hz.

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

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

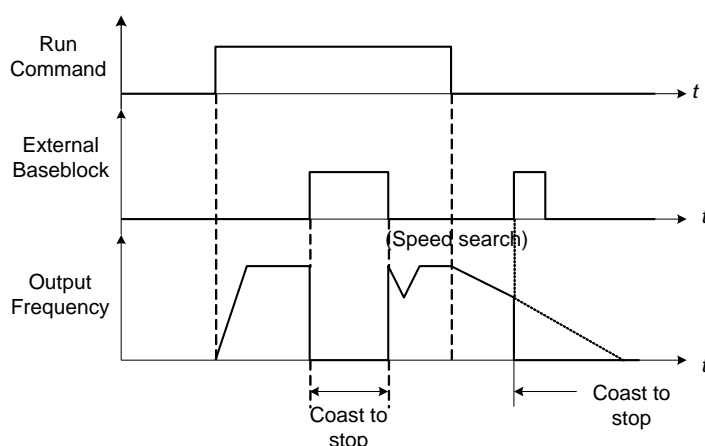


Figure 4.3.19 External base block operation

03-0X =16: PID control disable.

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

03-0X =17: Fault reset

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

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

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

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

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

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

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

03-0X =20: Energy saving enabled

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

For the manual energy saving operation refer to Figure 4.3.78.

03-0X =21: PID integral reset

03-0X =25: External fault

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

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

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

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

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

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

03-0X =28: Remote mode selection

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

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

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

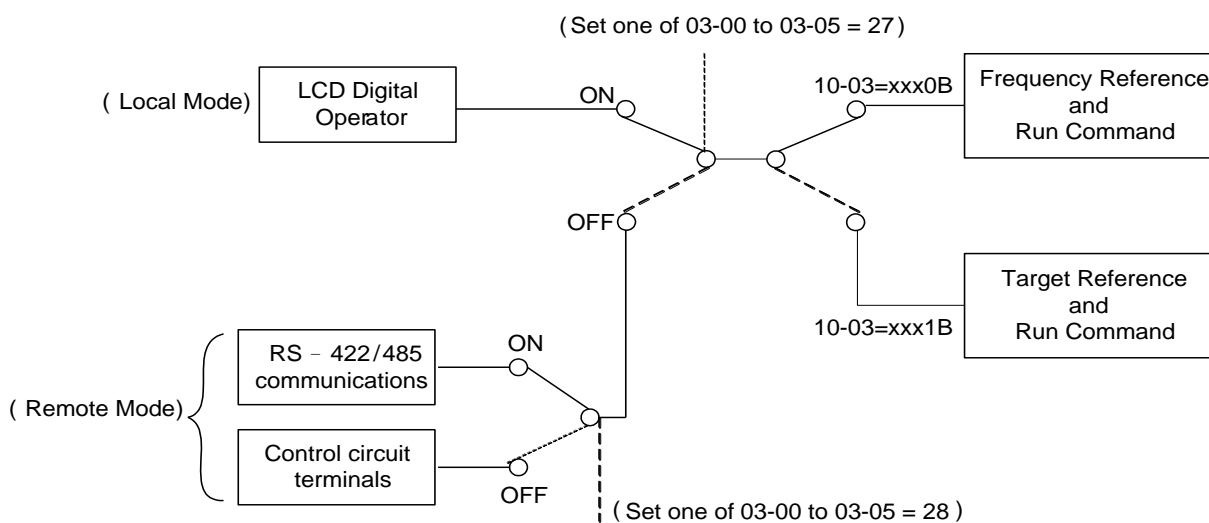


Figure 4.3.20 Remote mode operation selection

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

1. 00-05=1 (use control terminal AI1 or AI2 as reference frequency source)
2. 00-02=1 (use control terminal S1 or S2 for operation command)
3. Set one of the digital input terminals (03-02 to 03-05) to 28 (Operation selection of remote mode)

03-0X =24: PLC Input

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

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

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

03-0X =29: Jog Frequency Selection

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

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

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

03-0X =31: Inverter overheat warning

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

03-0X =33: DC braking

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

Note: 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.4.3.21.

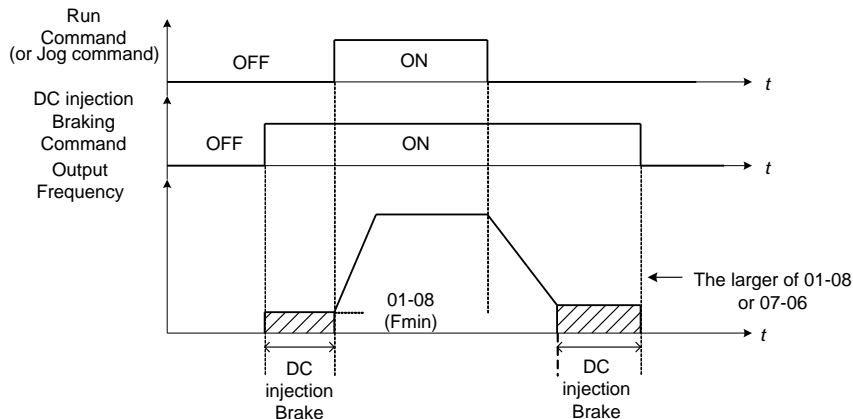


Figure 4.3.21 DC braking timing diagram

03-0X =35: Timing function

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

03-0X =36: PID Soft start disable

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

03-0X =47: Fire mode (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.4.3.21a for more details.

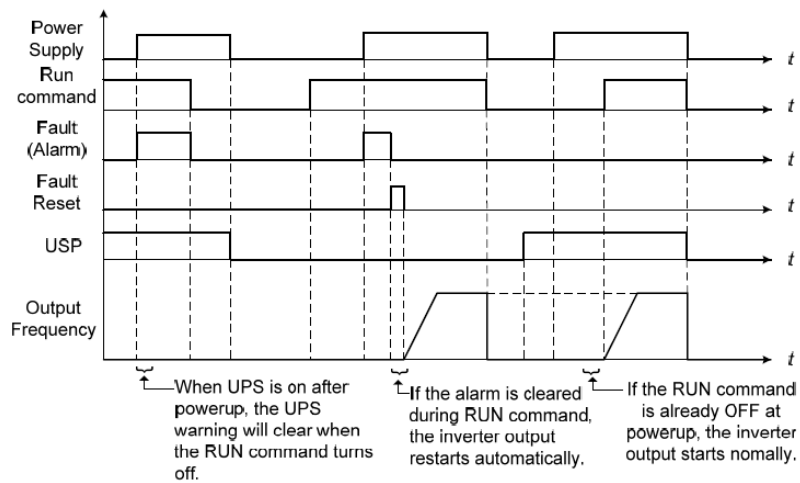


Figure 4.3.21a Unattended Start Protection

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 of 10-03 needs to be active).

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

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

03-0X =58: Run Permissive Function

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

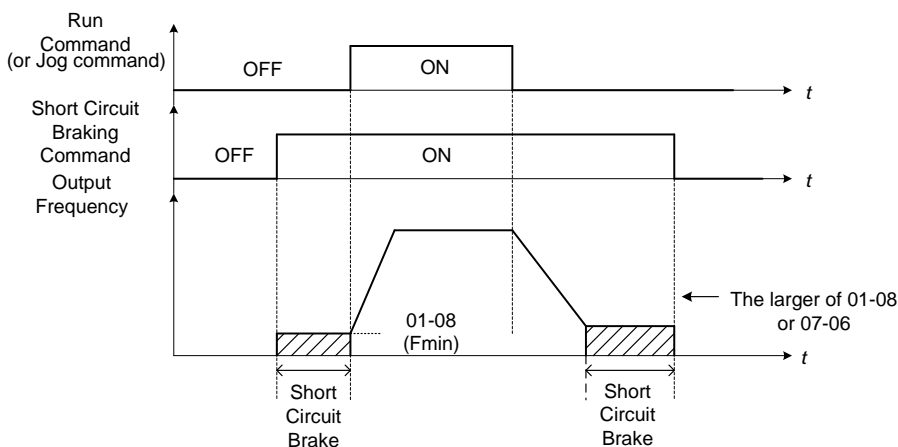
03-0X =63: Switch to Tolerance Range of Constant Pressure 2

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 (\geq 03-13 + 03-14) 【5】 : Frequency Detection 2 ($<$ 03-13) 【6】 : Automatic Restart 【7】 ~ 【8】 : Reserved 【9】 : Baseblock 【10】 ~ 【11】 : Reserved 【12】 : Over-Torque Detection 【13】 : Current Agree 【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	

<p> 【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 (\geq 03-44+03-45) 【51】 : Frequency Detection 4 ($<$ 03-44) 【52】 : Frequency Detection 5 (\geq 03-46+03-47) 【53】 : Frequency Detection 6 ($<$ 03-46) 【54】 : Turn on short-circuit braking 【57】 : Low Current Detection 【58】 : Frequency Deceleration Detection 【59】 : Overheat Detection </p>
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*1: The parameters are available when the I/O expansion card installed.

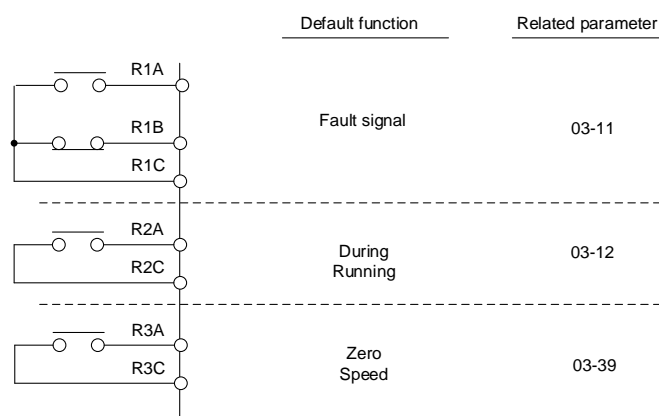


Figure 4.3.22 Multi-function digital output and related parameters

Table 4.3.6 Description of multi-function digital output

Value	Function		Description	Control Mode		
	Name	LCD Display		V/F	SLV	PM SLV
0	During Running	Running	ON: During running (Run Command is ON)	○	○	○
1	Fault Contact Output	Fault	ON: Fault contact output (except CF00 and CF01)	○	○	○
2	Frequency Agree	Freq. Agree	ON: Frequency agree (frequency agree width detection is set by 03-14)	○	○	○
3	Setting Frequency Agree	Setting Freq Agree	ON: Output frequency = allowed frequency detection level (03-13) \pm frequency bandwidth (03-14)	○	○	○
4	Frequency Detection 1	Freq. Detect 1	ON: Output frequency \geq 03-13 + 03-14	○	○	○
5	Frequency Detection 2	Freq. Detect 2	OFF: Output frequency \geq 03-13 + 03-14	○	○	○

Value	Function		Description	Control Mode		
	Name	LCD Display		V/F	SLV	PM SLV
6	Automatic Restart	Auto Restart	ON: the period of automatic restart	○	○	○
7~8	Reserved	Reserved	Reserved	-	-	-
9	Baseblock	Baseblock	ON: During baseblock	○	○	○
10~11	Reserved	Reserved	Reserved	-	-	-
12	Over-Torque Detection	Over Torque	ON: Over torque detection is ON	○	○	○
13	Current Agree	Current Agree	ON: Output current > 03-15	○	○	○
14	Mechanical Brake Control (03-17~03-18)	Mechanical Brake Control	ON: Mechanical brake release frequency OFF: Mechanical brake operation frequency	○	○	○
15~17	Reserved	Reserved	Reserved	-	-	-
18	PLC Status	PLC statement	ON: when 00-02 is set to 3 (PLC operation command source)	○	○	○
19	PLC Control	Control From PLC	ON: Control from PLC	○	○	○
20	Zero Speed	Zero Speed	ON: Output frequency < Minimum output frequency (Fmin)	○	○	○
21	Inverter Ready	Ready	ON: Inverter ready (after power on, no faults)	○	○	○
22	Undervoltage Detection	Low Volt Detected	ON: DC bus voltage = < Low-voltage warning detection level (07-13)	○	○	○
23	Source of Operation Command	Run Cmd Status	ON: Operation command from LED digital operator (local mode)	○	○	○
24	Source of Frequency Command	Freq Ref Status	ON: Reference frequency from LED digital operator (local mode)	○	○	○
25	Low Torque Detection	Under Torque	ON: Low-torque detection is ON	○	○	○
26	Frequency Reference Missing	Ref. Loss.	ON: Reference frequency loss	○	○	○
27	Timing Function Output	Timer Output	Set time function parameter to 03-37 and 03-38 , and the time function input is set by parameter from 03-00 and 03-05	○	○	○
28~31	Reserved	Reserved	Reserved	-	-	-
32	Communication Control Contacts	Control From Comm	ON: DO is set by communication control.	○	○	○
33	RTC Timer 1	RTC Timer 1	ON: 16-36 (RTC Speed Selection) selects Timer 1 and 16-32 (Source of Timer 1) is active in the set time.	○	○	○
34	RTC Timer 2	RTC Timer 2	ON: 16-36 (RTC Speed Selection) selects Timer 2 and 16-33 (Source of Timer 2) is active in the set time.	○	○	○
35	RTC Timer 3	RTC Timer 3	ON: 16-36 (RTC Speed Selection) selects Timer 3 and 16-34 (Source of Timer 3) is active in the set time.	○	○	○
36	RTC Timer 4	RTC Timer 4	ON: 16-36 (RTC Speed Selection) selects Timer 4 and 16-35 (Source of Timer 4) is active in the set time.	○	○	○
37	Detection Output of PID Feedback Loss	PID Fbk Loss	ON: PID Feedback Loss	○	○	○

Value	Function		Description	Control Mode		
	Name	LCD Display		V/F	SLV	PM SLV
38	Brake Release	Brake Release	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 \leq 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 (03-14) and deactivates when the output frequency falls below frequency detection level (03-13).

03-1X=5: Frequency detected 2

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

Refer to parameter group 03 for frequency detection function.

03-1X=6: Automatic restart.

Output is active during an auto-restart operation.

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

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

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

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

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

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

03-1X=13: Current Agree

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

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

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

03-1X=19: PLC control contact

Output is controlled by the PLC logic

03-1X=20: Zero-speed

Output is active during zero-speed

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

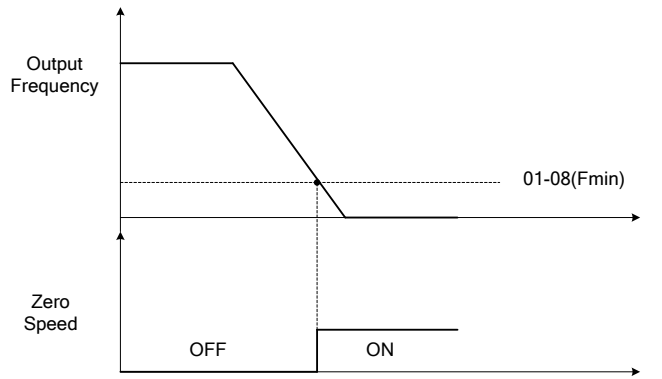


Figure 4.3.23 Zero-speed operation

03-1X=21: Inverter Ready

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

03-1X=22: Undervoltage Detection

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

03-1X=23: Source of operation command

Output is active in local operation command.

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

03-1X=24: Source of frequency command

Output is active in local frequency command.

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

03-1X=26: Frequency reference missing

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

03-1X=27: Time function output

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

03-1X=32: Communication control contacts

Output is active when communication control is active.

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

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

03-1X=38: Brake Release

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

03-1X=42: Over-High Pressure

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

03-1X=43: Over-Low Pressure

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

03-1X=44: Loss of Pressure Detection

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

03-1X=45: PID Sleep

PID sleep will be informed.

03-1X=46: Over-High Flow

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

03-1X=47: Over-Low Flow

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

03-1X=48: Shortage of Low Suction

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

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

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

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

Output terminal is closed when Turning on short-circuit braking

03-1X=57: Low Current Detection

When output current \leq 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 4.3.7.

Table 4.3.7 Frequency Detection Operation

Function	Detection operation of frequency confirmation	Description
Frequency agree		<ul style="list-style-type: none"> Output is active when the output frequency falls within the frequency reference minus the frequency detection width (03-14). Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 2 (Frequency agree).
Set frequency agree		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> 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		<ul style="list-style-type: none"> Output frequency detection 1 signal is ON in acceleration when the output frequency rises above the frequency detection level (03-13) + frequency detection width (03-14). Output frequency detection 1 signal is OFF in deceleration when the output frequency declines to the frequency detection level 4 (03-50). Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 4 (Output frequency detection 1).
Output frequency detection 2		<ul style="list-style-type: none"> Output frequency detection 2 signal is OFF in acceleration when the output frequency rises above the frequency detection level (03-13) + frequency detection width (03-14). Output frequency detection 2 signal is ON in deceleration when the output frequency declines to the frequency detection level 4 (03-50). Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 5 (Output frequency detection 2).
Output frequency detection 3		<ul style="list-style-type: none"> Output frequency detection 3 signal is ON in acceleration when the output frequency rises above the frequency detection level 2 (03-44) + frequency detection width 2 (03-45). Output frequency detection 3 signal is OFF in deceleration when the output frequency declines to the frequency detection level 5 (03-51). Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 50 (Output frequency detection 3).
Output frequency detection 4		<ul style="list-style-type: none"> Output frequency detection 4 signal is OFF in acceleration when the output frequency rises above the frequency detection level 2 (03-44) + frequency detection width 2 (03-45). Output frequency detection 4 signal is ON in deceleration when the output frequency declines to the frequency detection level 5 (03-51). Any of the digital outputs function (03-11, 03-12 or 03-39) can be set to 51 (Output frequency detection 4).

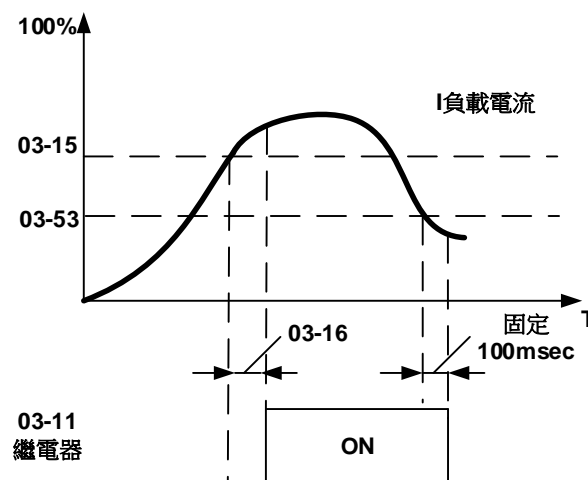
Function	Detection operation of frequency confirmation	Description
<p style="text-align: center;">Output frequency detection 5</p>		<ul style="list-style-type: none"> • Output frequency detection 5 signal is ON in acceleration when the output frequency rises above the frequency detection level 3 (03-46)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

03-15	Current Agree Level
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 \leq 03-53, the delay time of relay signal from ON to OFF is 100ms (constant).

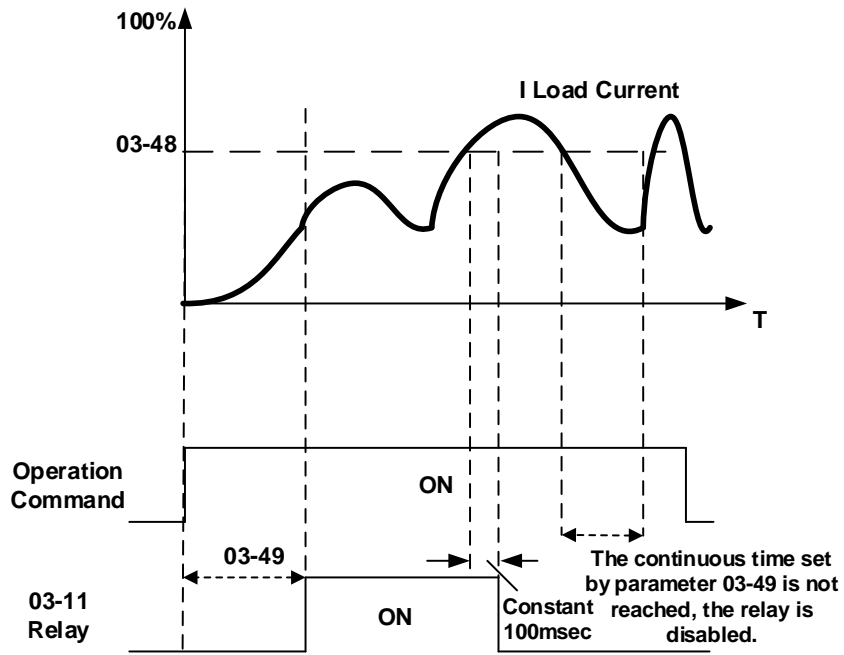
Timing Diagram:



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:



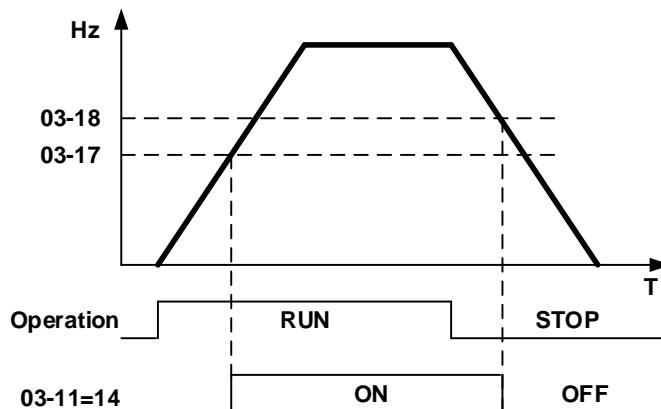
03-17	Setting of Mechanical Brake Release Level
Range	0.00~599.00 Hz
03-18	Setting of Mechanical Brake Operation Level
Range	0.00~599.00 Hz

When 03-11=14,

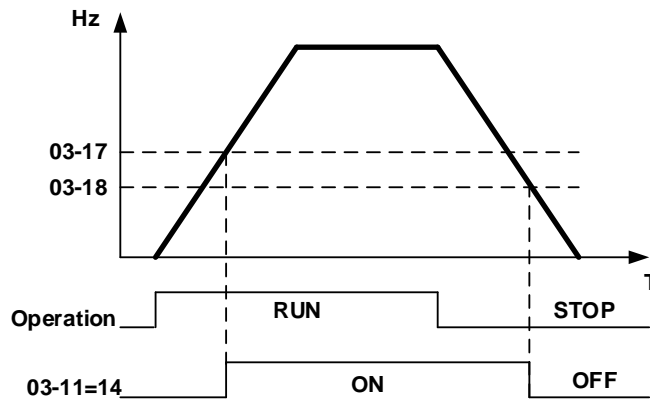
Relay output starts at acceleration if the output frequency reaches the mechanical brake release level (03-17).

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

When $03-17 \leq 03-18$, timing diagram is as follows:



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



03- 19	Relay (R1A-R3C) Type	
Range	【xx0b】 : R1A normally open 【xx0xb】 : R2A normally open 【x0xxb】 : R3A normally open 【x0xxb】 : R4A normally open	【xx1b】 : R1A normally close 【xx1xb】 : R2A normally close 【x1xxb】 : R3A normally close 【x1xxb】 : R4A normally close
03- 29	Photo-coupler Output Selection (DO2-DOG)	
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 V1.12.**

There are two modes in pulse input selection:

03-30=0: Common Pulse Input

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

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

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

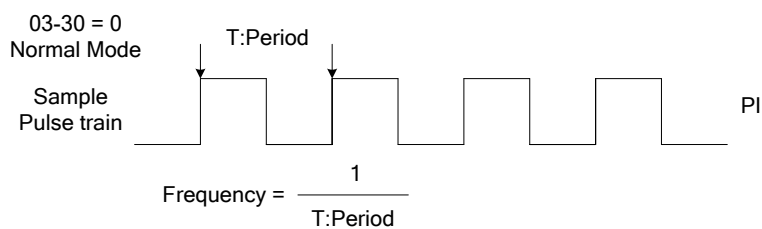
It is required to input the correct frequency.

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

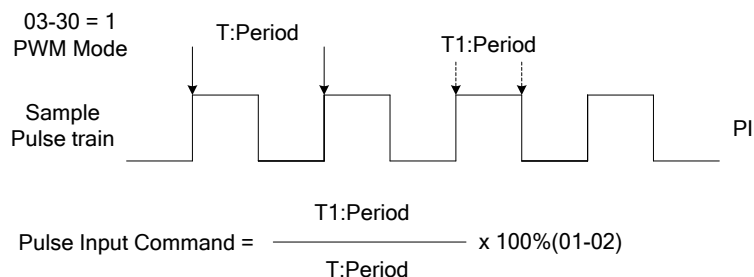
Note: Monitor parameter 12-79 (pulse input percentage) displays the proportional relationship between the positive edge of input signal and time period.

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

Diagram of pulse input selection:



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



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.4.3.24 for the pulse input specification.

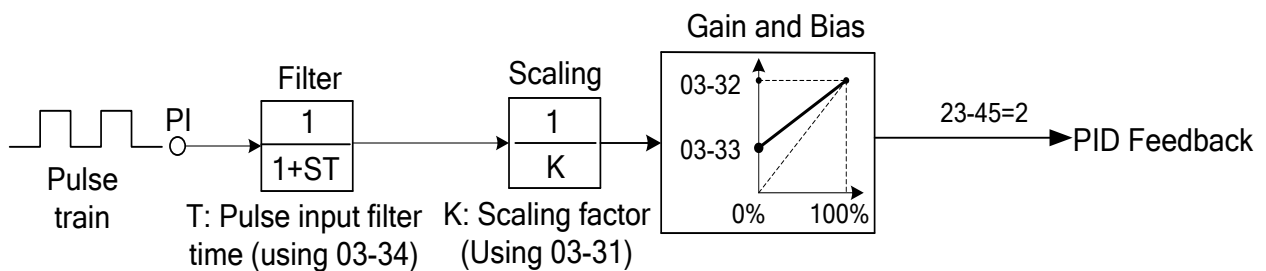


Figure 4.3.24 Pulse input adjustment

Set Pulse Input Setup as Flow Meters Input

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

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

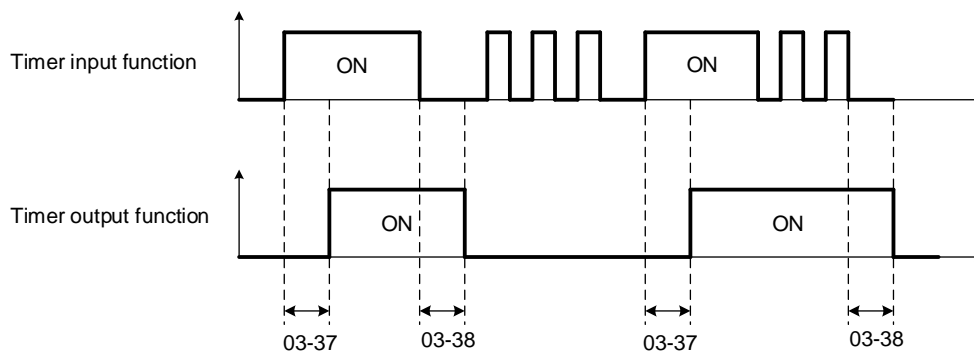
Enable the timer function by setting one of multi-function input parameters 03-00~03-05 (S1 to S6) to 35 (timer function input) and one of multi-function output parameters 03-11, 03-12, 03-39 (R1A-R1C to R3A-R3C) to 27 (timer function output).

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

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

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

Timing example:



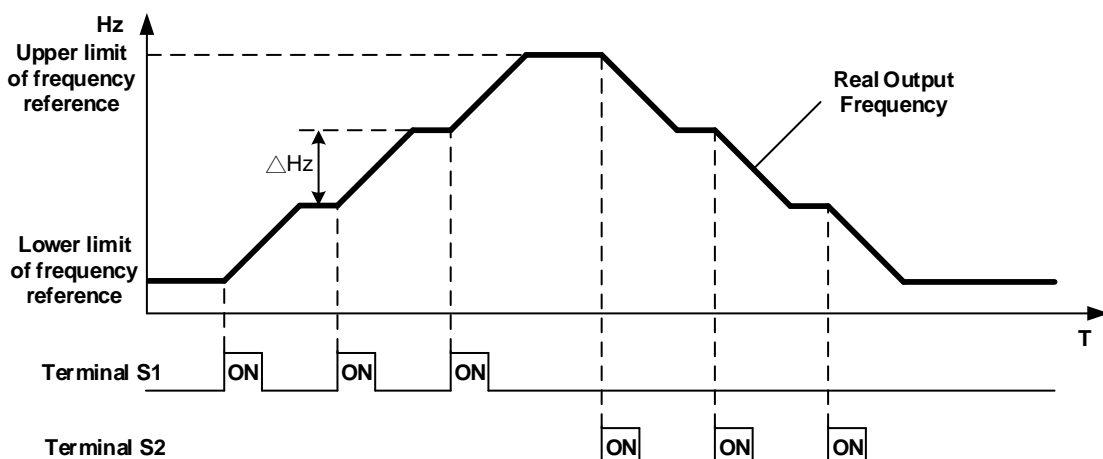
03- 40	Up/down Frequency Width Setting	*1
Range	【0.00~5.00】 Hz	

*1: It is new added in inverter software V1.12.

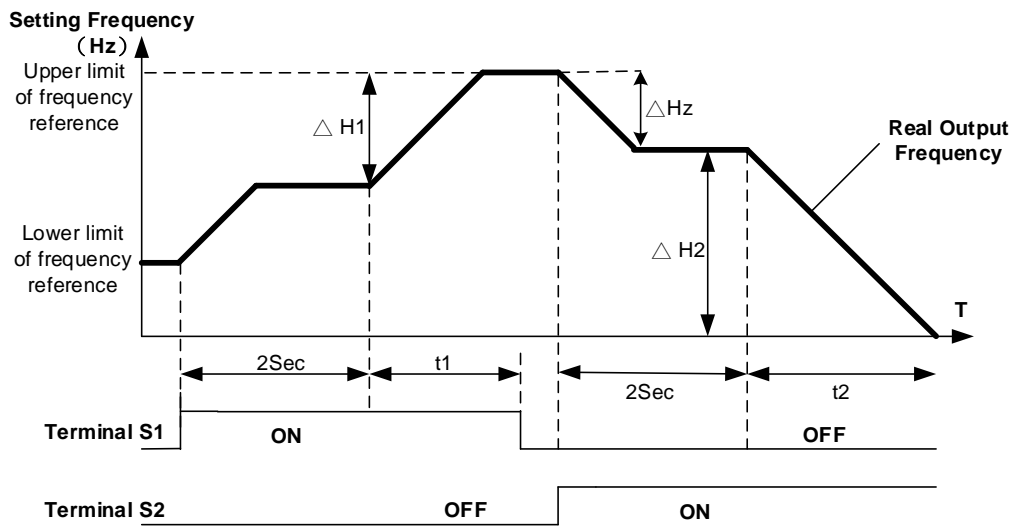
For example: Set terminal S1: 03- 00=**【8】**(Up Frequency Increasing Command), S2: 03- 01=**【9】**(DOWN Frequency Decreasing Command) and 03- 40= **【△】** Hz.

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

Mode2: When 03-40 is not set to 0Hz and terminal conduction time is lower than 2 sec, conducting one time leading to frequency variation Δ 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:

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

$$\Delta H1 = \frac{\text{UpperLimitFrequency}}{\text{Acceleration Time 2}} \times \text{TerminalConductionTime (t1)}$$

$$\Delta H2 = \frac{\text{UpperLimitFrequency}}{\text{Deceleration Time 2}} \times \text{TerminalConductionTime (t2)}$$

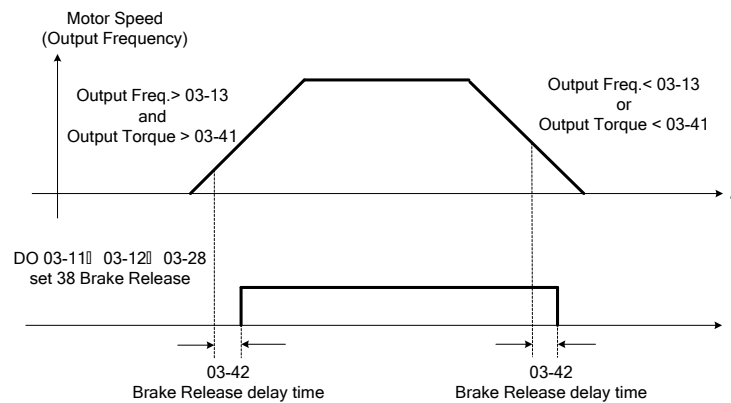
03- 41	Torque Detection Level	*1
Range	【0~150】 %	
03-42	Delay Time of Braking Action	*1
Range	【0.00~65.00】 Sec	

*1: It is new added in inverter software V1.2

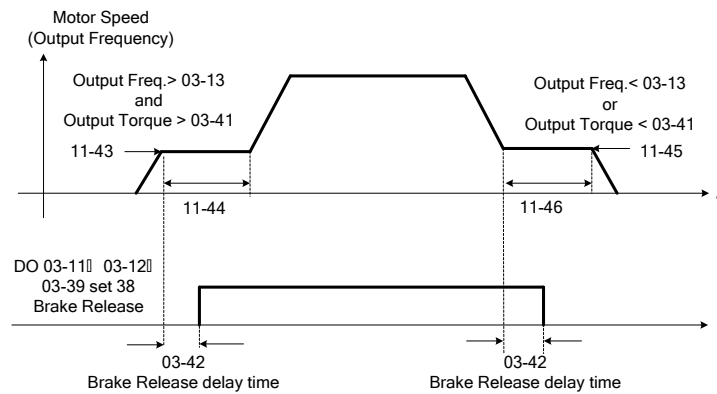
Function of Brake Release:

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:

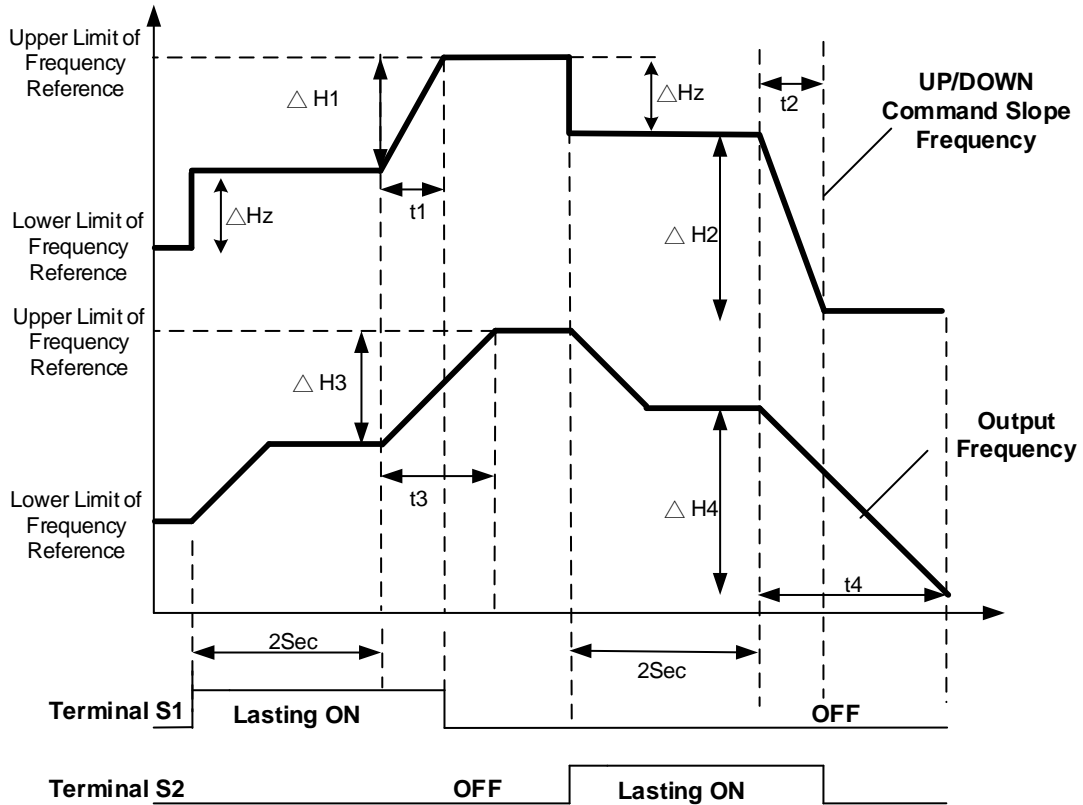


03-43	UP/DOWN Acceleration/ Deceleration Selection
Range	【0】 : Acceleration/Deceleration Time 1 【1】 : Acceleration/Deceleration Time 2

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

Ex 1 :

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



Notes:

- $\Delta H1$: Frequency augmentation setting in acceleration, $t1$: Terminal conduction time in acceleration
- $\Delta H2$: Frequency augmentation setting in deceleration, $t2$: Terminal conduction time in deceleration
- $t3$: Acceleration time in output
- $\Delta H3$: Output frequency augmentation in acceleration, $t4$: Deceleration time in output
- $\Delta H4$: Output frequency augmentation in deceleration

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

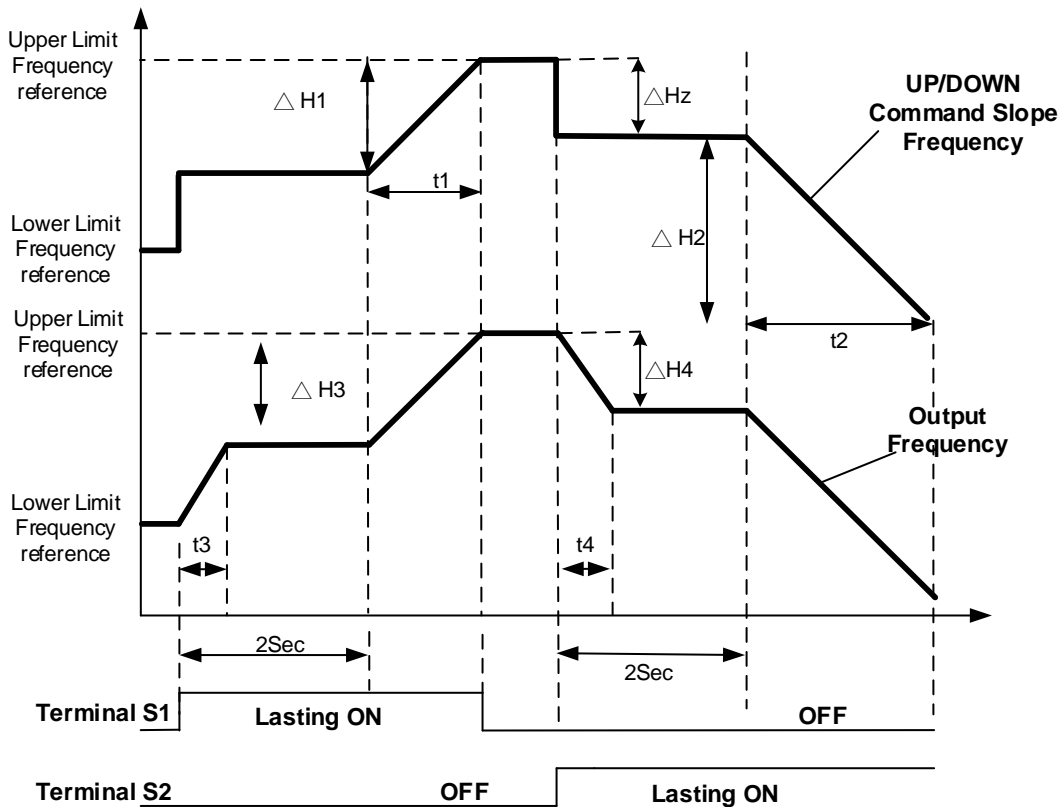
$$\Delta H3 = \frac{\text{UpperLimit Frequency}}{\text{Acceleration Time 1}} \times t3$$

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

$$\Delta H4 = \frac{\text{UpperLimit Frequency}}{\text{Deceleration Time 1}} \times t4$$

Ex2 :

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



Notes:

- $\Delta H1$: Frequency augmentation setting in acceleration $t1$: Terminal conduction time in acceleration
- $\Delta H2$: Frequency augmentation setting in deceleration $t2$: Terminal conduction time in deceleration
- $t3$: Acceleration time in output
- $\Delta H3$: Output frequency augmentation in acceleration, $t4$: Deceleration time in output
- $\Delta H4$: Output frequency augmentation in deceleration

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

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

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

$$\Delta H4 = \frac{\text{UpperLimit Frequency}}{\text{Deceleration T i m e 1}} \times t4$$

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 U 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 to 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 UE 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 AI1 and AI2 has a separate gain and bias parameter associated with it.

Analog input signal AI1 can be adjusted with parameter 04-02 and 04-03; Analog input signal AI2 can be adjusted with parameter 04-07 and 04-08, **Analog input signal AI3 can be adjusted with parameter 04-22 and 04-23.** Refer to Fig.4.3.25.

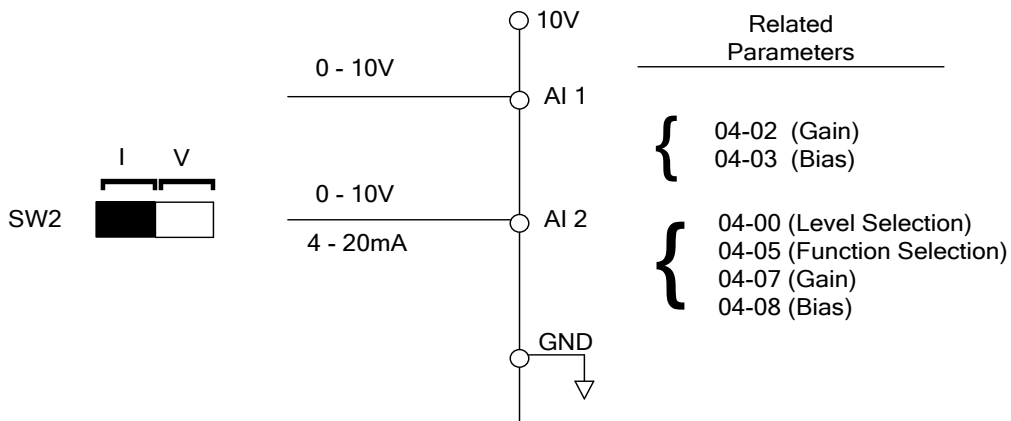


Figure 4.3.25 Analog inputs and related parameters (For U type)

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.

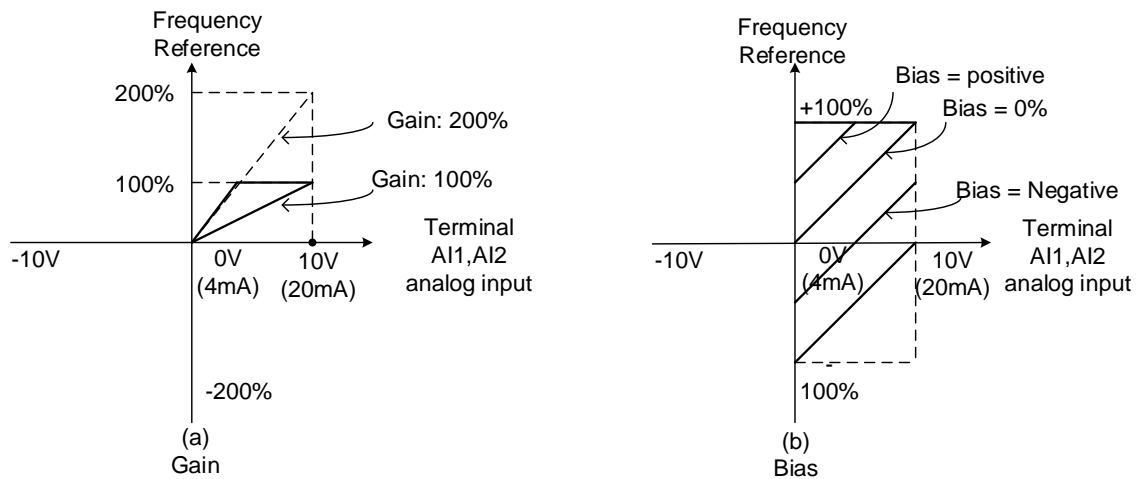
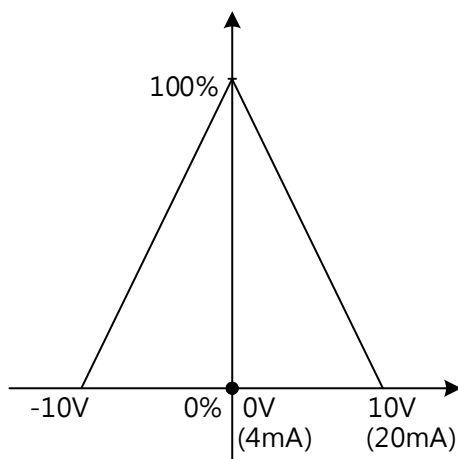


Figure 4.3.26 Gain and bias operations (for frequency reference signal)

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.

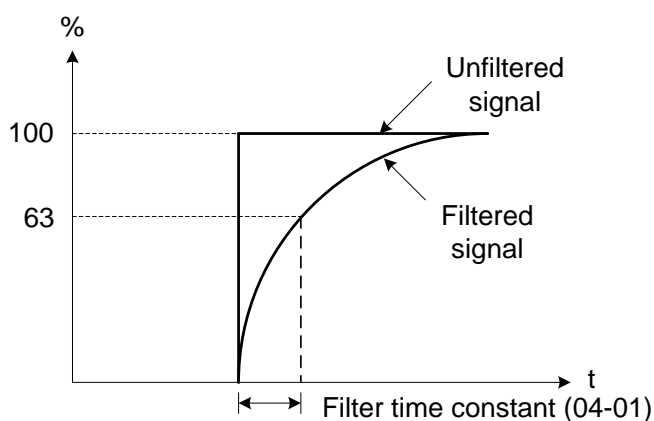


Figure 4.3.27 Filter time constant

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

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

Table 4.3.8 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%	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
1	Frequency Reference Gain (FGAIN)	Freq Ref Gain	Aggregated gain = AI1 = 04-02 * FGAIN	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2	Frequency Reference Bias (FBIAS)	Freq Ref Bias	Aggregated bias = AI1 = 04-03 * FBIAS	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3	Output Voltage Bias (VBIAS)	Output Volt Bias	Aggregate output voltage =V/F curve voltage + VBIAS	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
4	Coefficient of Acceleration and Deceleration Reduction (K)	Tacc/Tdec Scaling	Actual acceleration and deceleration time = accel. and decal. time / K	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Value	Function		Description	Control mode		
	Name	LCD Display		V/F	SLV	PM SLV
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%	○	×	○
8	Frequency Lower Limit	Ref. Low Bound	Adjust the lower limit (0 ~ 100%) of frequency command based on analog input, the maximum output = 100%. The lower limit of frequency command is the greater one of the actual frequency command's lower limit 00-13 or the multi-function analog input.	○	○	○
9	Jump Frequency 4	Jump Freq 4	Jump frequency 4. 100% = maximum output frequency	○	○	○
10	Added to AI1	Add to AI1	Added to AI1. 100% = maximum output frequency	○	○	○
11	Positive Torque Limit	Positive Tq Limit	100% = Motor's rated torque	×	○	○
12	Negative Torque Limit	Negative Tq Limit	100% = Motor's rated torque	×	○	○
13	Regenerative Torque Limit	Regen. Tq Limit	100% = Motor's rated torque	×	○	○
14	Positive / Negative Torque Limit	+/- Tq Limit	100% = Motor's rated torque	×	○	○
15	Torque Limit	Tq Limit	100% = Motor's rated torque	×	×	×
16	Torque Compensation	Tq Compensation	100% = Motor's rated torque	×	○	×
17	Reserved	No Function	Reserved	○	○	○

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 4.3.5). The auxiliary frequency command can be set via AI2/AI3. The maximum output frequency is set by 01-02, $F_{max} = 100\%$.

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%.

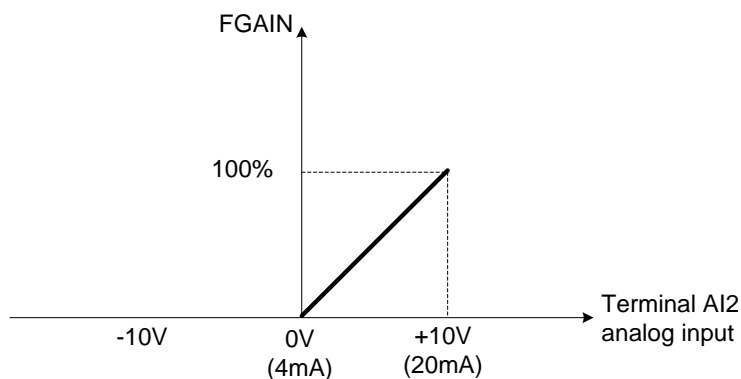


Figure 4.3.28 Frequency gain adjustment

Example:

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

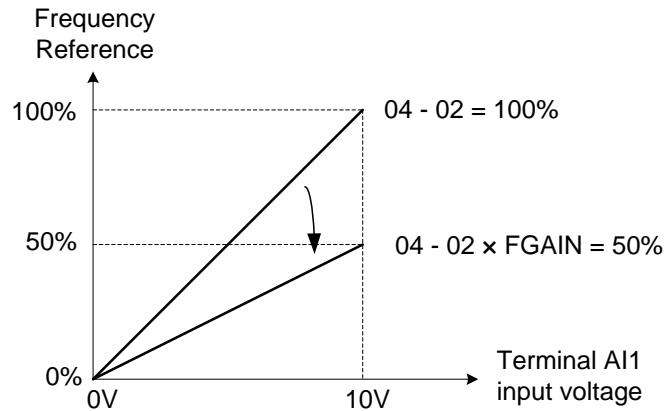


Figure 4.3.29 Frequency reference gain adjustment (example)

04-05/04-10=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%.

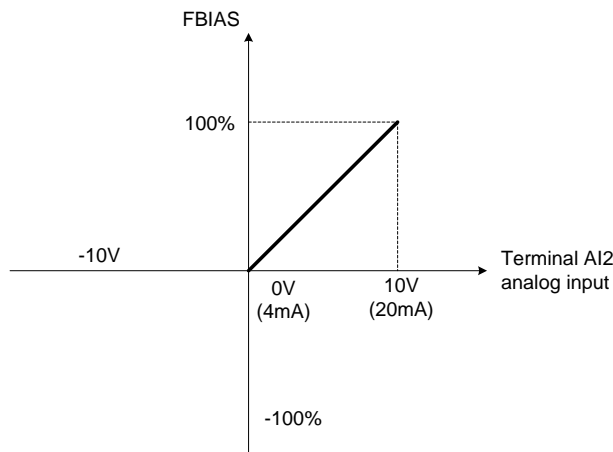


Figure 4.3.30 Bias adjustment

Example:

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

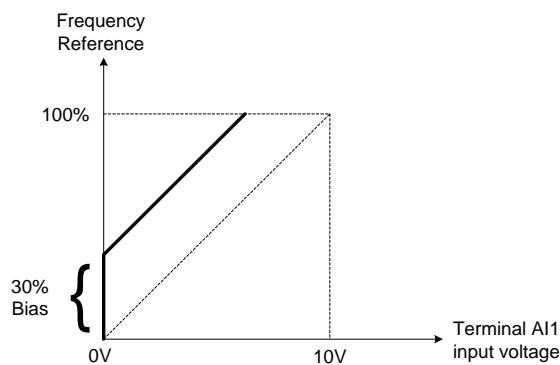


Figure 4.3.31 Frequency Reference bias adjustment (example)

04-05/04-10=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, $V_{max} = 100\%$

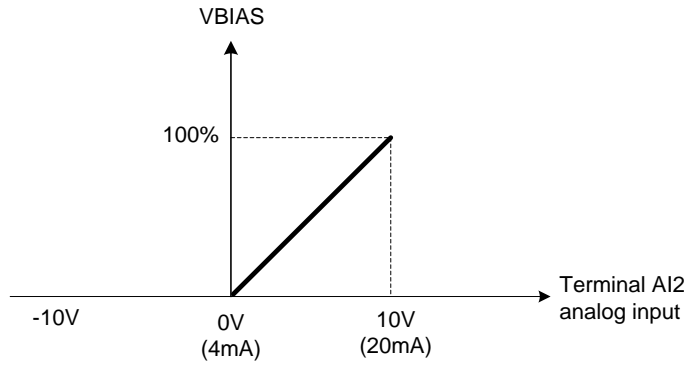


Figure 4.3.32 Bias adjustment

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:

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

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

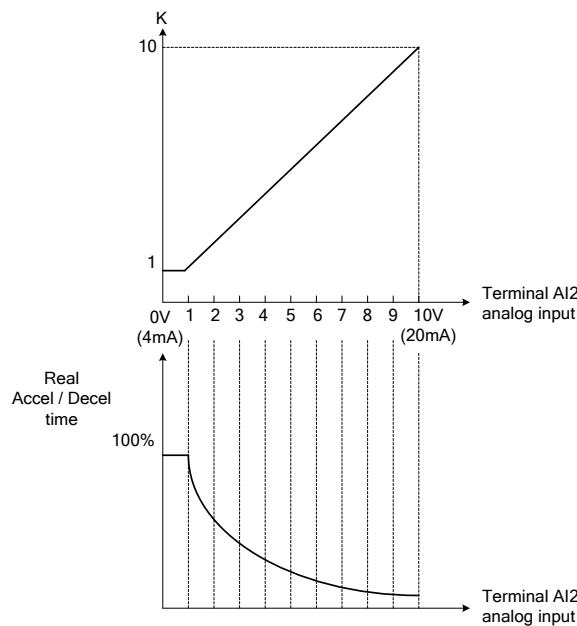


Figure 4.3.33 Acceleration / deceleration time reduction coefficient

04-05/04-10=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.

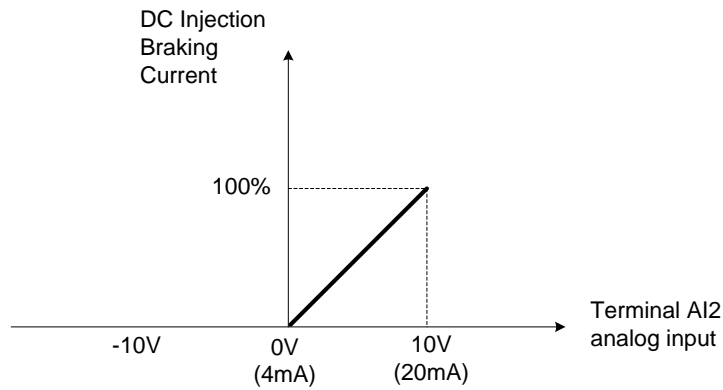


Figure 4.3.34 DC braking current adjustment

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.

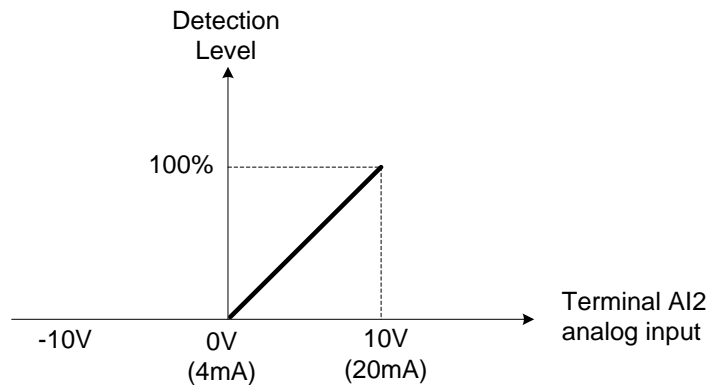


Figure 4.3.35 Over-torque/less torque detection level adjustment

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.

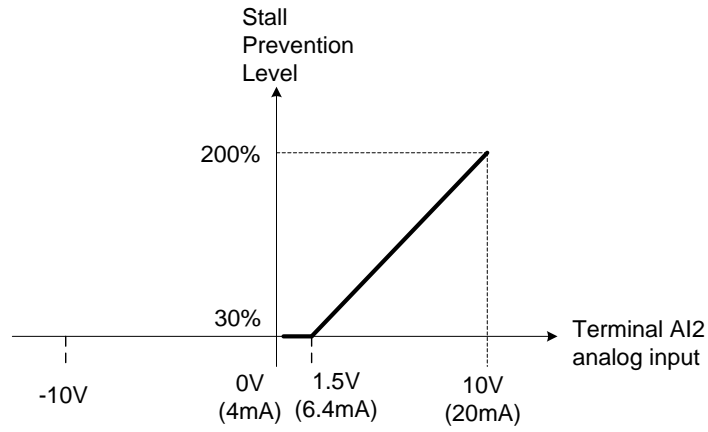


Figure 4.3.36 Stall prevention level adjustment during operation

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.

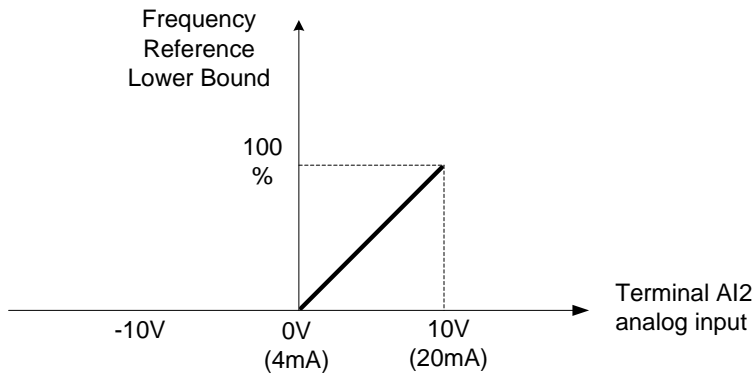


Figure 4.3.37 Adjustment of lower limit of frequency reference

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.

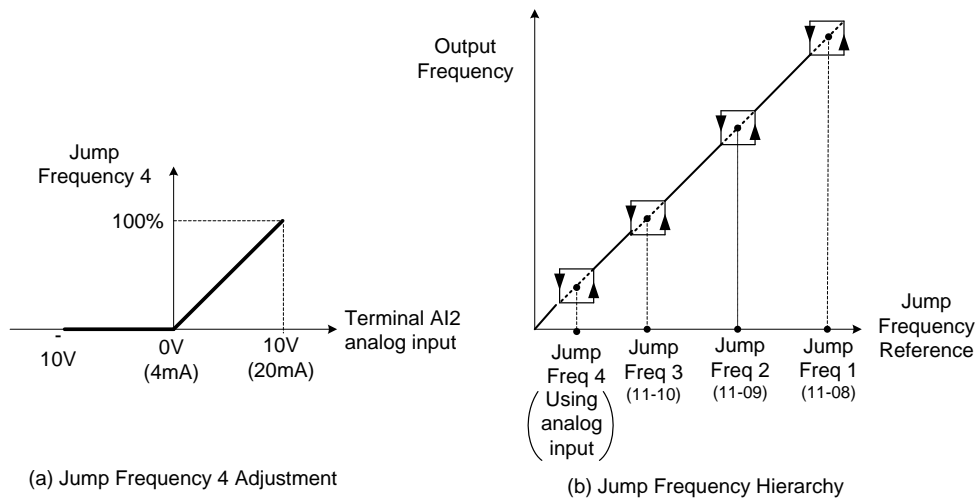


Figure 4.3.38 Jump frequency 4 setting operation

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.

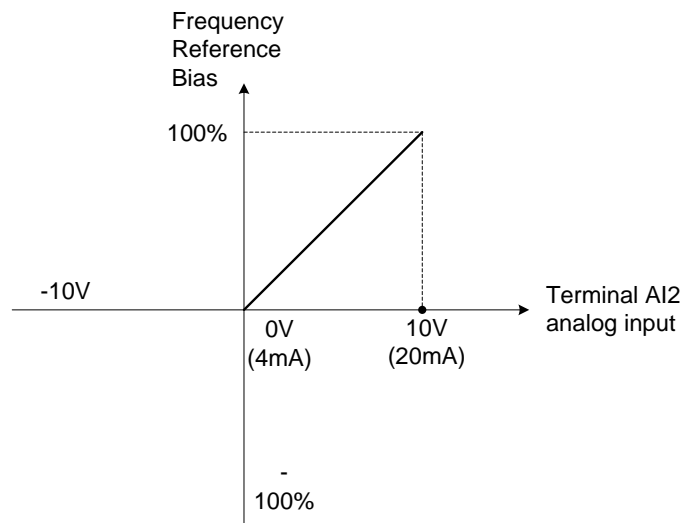


Figure 4.3.39 Added to AI1 as a bias operation

Example:

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

04-05=11: Positive torque limit

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

04-05=12: Negative torque limit

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

04-05=13: Regenerative torque limit

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

04-05=14: Positive / negative torque limits

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

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

04-05=15: Reserved**04-05=16:** Torque compensation of speed control

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

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

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

Range	[0] : AO1 0~10V	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.4.3.40.

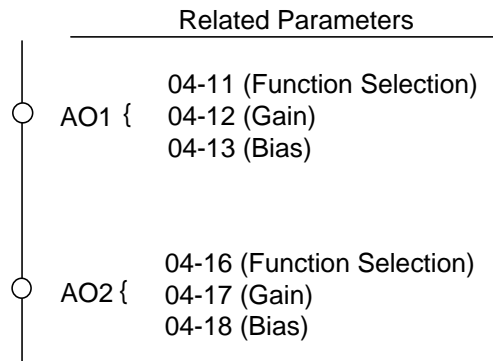


Figure 4.3.40 Analog outputs and related parameters

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

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

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

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

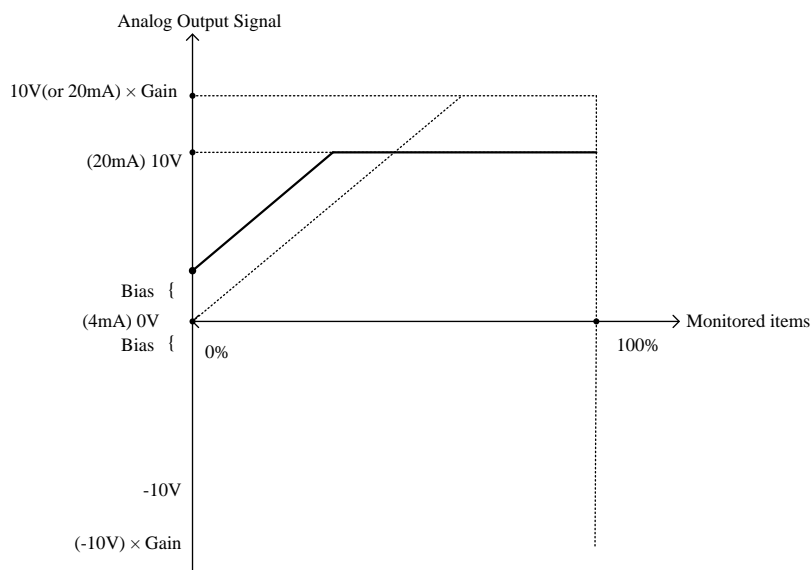


Figure 4.3.41 Analog output level adjustment

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

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

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

***1: It is new added in inverter software V1.12.**

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

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

Deceleration time calculation formula

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

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

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

Acceleration time calculation formula

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

Deceleration time calculation formula

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

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

00-02=1 (External Terminal Operation)

03-00=0 (Terminal S1: Forward /Stop)

03-01=1 (Terminal S2: Reversal /Stop)

03-02=2 (Terminal S3: Speed 1)

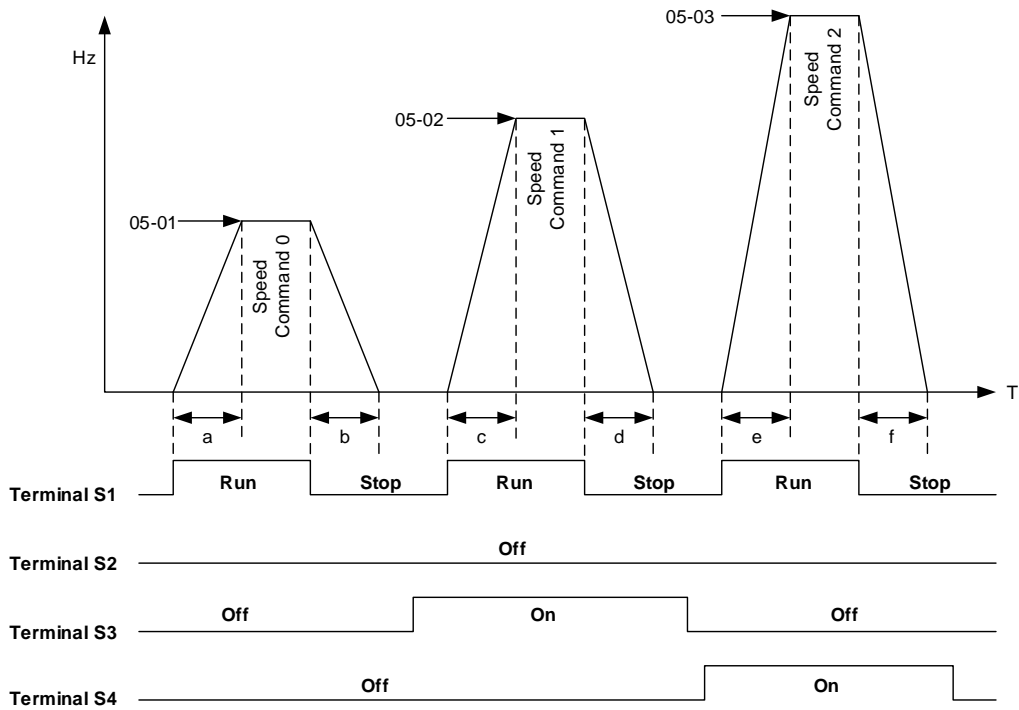
03-03=3 (Terminal S4: Speed 2)

03-03=4 (Terminal S5: Speed 3)

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

Acceleration / Deceleration Calculation Mode 1:

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

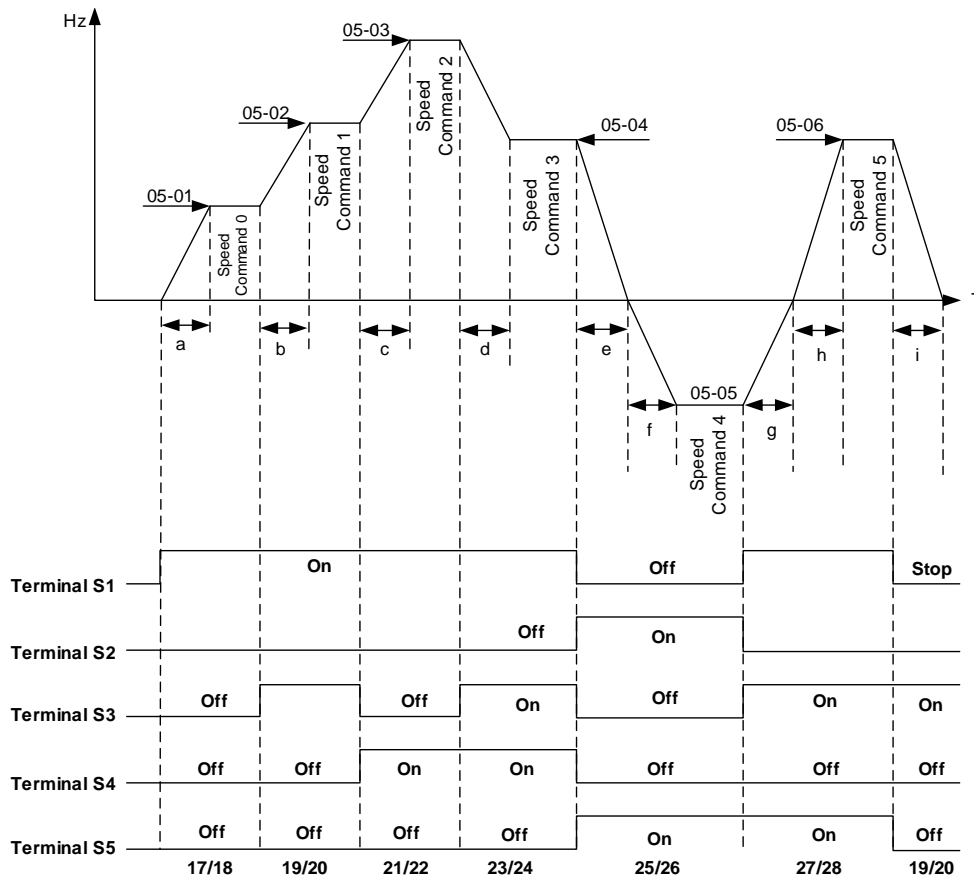


$$a = \frac{(05-17) \times (05-01)}{(01-02)} \quad b = \frac{(05-18) \times (05-01)}{(01-02)} \quad c = \frac{(05-19) \times (05-02)}{(01-02)} \quad \text{in sec.}$$

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

Acceleration / Deceleration Calculation Mode 2:

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



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

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

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

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

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

05-03	*Frequency Setting of Speed- Stage 2	*1
Range	【0.0~400.00】 Hz	

05-04	*Frequency Setting of Speed- Stage 3	*1
Range	【0.0~400.00】 Hz	

05-05	*Frequency Setting of Speed- Stage 4	*1
Range	【0.0~400.00】 Hz	

05-06	*Frequency Setting of Speed- Stage 5	*1
Range	【0.0~400.00】 Hz	

05-07	*Frequency Setting of Speed- Stage 6	*1
Range	【0.0~400.00】 Hz	

05-08	*Frequency Setting of Speed- Stage 7	*1
Range	【0.0~400.00】 Hz	

05-09	*Frequency Setting of Speed- Stage 8	*1
Range	【0.0~400.00】 Hz	

05-10	*Frequency Setting of Speed- Stage 9	*1
Range	【0.0~400.00】 Hz	

05-11	*Frequency Setting of Speed- Stage 10	*1
Range	【0.0~400.00】 Hz	

05-12	*Frequency Setting of Speed- Stage 11	*1
Range	【0.0~400.00】 Hz	

05-13	*Frequency Setting of Speed- Stage 12	*1
Range	【0.0~400.00】 Hz	

05-14	*Frequency Setting of Speed- Stage 13	*1
Range	【0.0~400.00】 Hz	

05-15	*Frequency Setting of Speed- Stage 14	*1
Range	【0.0~400.00】 Hz	

05-16	*Frequency Setting of Speed- Stage 15	*1
Range	【0.0~400.00】 Hz	
	【0.1~6000.0】 Sec	

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

*1: It is new added in inverter software V1.12. Parameters 05-02~05-16 is required to set the frequency in parameters 06-01~06-15 in inverter software V1.12.

05-17	Acceleration time setting for multi speed 0	
Range	【0.1~6000.0】 Sec	

05-18	Deceleration time setting for multi speed 0	
Range	【0.1~6000.0】 Sec	

05-19	Acceleration time setting for multi speed 1
Range	【0.1~6000.0】 Sec
05-20	Deceleration time setting for multi speed 1
Range	【0.1~6000.0】 Sec
05-21	Acceleration time setting for multi speed 2
Range	【0.1~6000.0】 Sec
05-22	Deceleration time setting for multi speed 2
Range	【0.1~6000.0】 Sec
05-23	Acceleration time setting for multi speed 3
Range	【0.1~6000.0】 Sec
05-24	Deceleration time setting for multi speed 3
Range	【0.1~6000.0】 Sec
05-25	Acceleration time setting for multi speed 4
Range	【0.1~6000.0】 Sec
05-26	Deceleration time setting for multi speed 4
Range	【0.1~6000.0】 Sec
05-27	Acceleration time setting for multi speed 5
Range	【0.1~6000.0】 Sec
05-28	Deceleration time setting for multi speed 5
Range	【0.1~6000.0】 Sec
05-29	Acceleration time setting for multi speed 6
Range	【0.1~6000.0】 Sec
05-30	Deceleration time setting for multi speed 6
Range	【0.1~6000.0】 Sec
05-31	Acceleration time setting for multi speed 7
Range	【0.1~6000.0】 Sec
05-32	Deceleration time setting for multi speed 7
Range	【0.1~6000.0】 Sec
05-33	Acceleration time setting for multi speed 8
Range	【0.1~6000.0】 Sec
05-34	Deceleration time setting for multi speed 8
Range	【0.1~6000.0】 Sec

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

Group 06 Automatic Program Operation Parameters

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

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

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

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

Notes:

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

Automatic operation frequency reference settings		
06-01	*Frequency Setting of Operation -Stage 1	*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 V1.12.

*: (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)

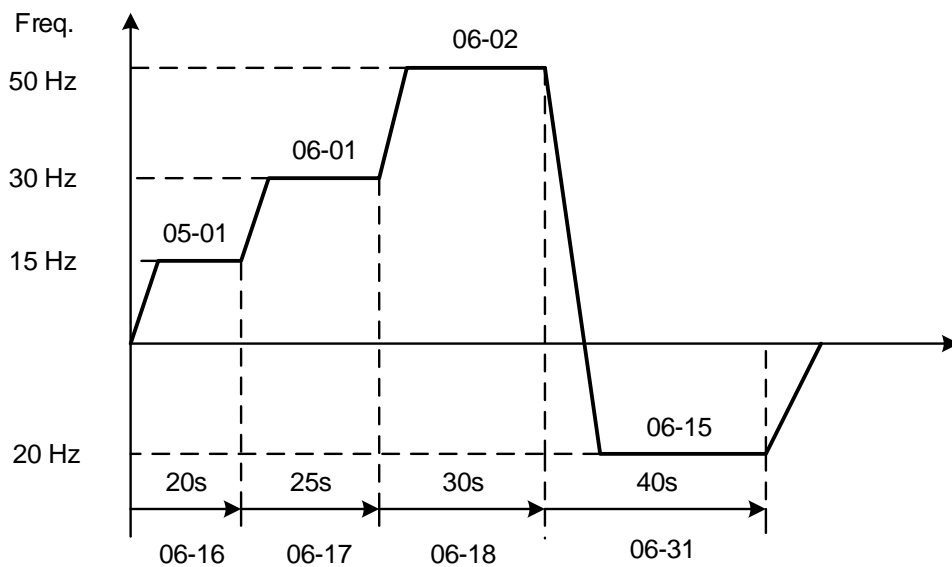


Figure 4.3.42 Single cycle automatic operation (stop)

Example 2: Automatic operation mode – Continuous cycle

In this example the inverter repeats the same cycle.

Parameter Settings:

- 06-00 = 2 or 5 (Continuous cycle operation)
- 06-01~06-47=Enter same setting as that of Example 1.

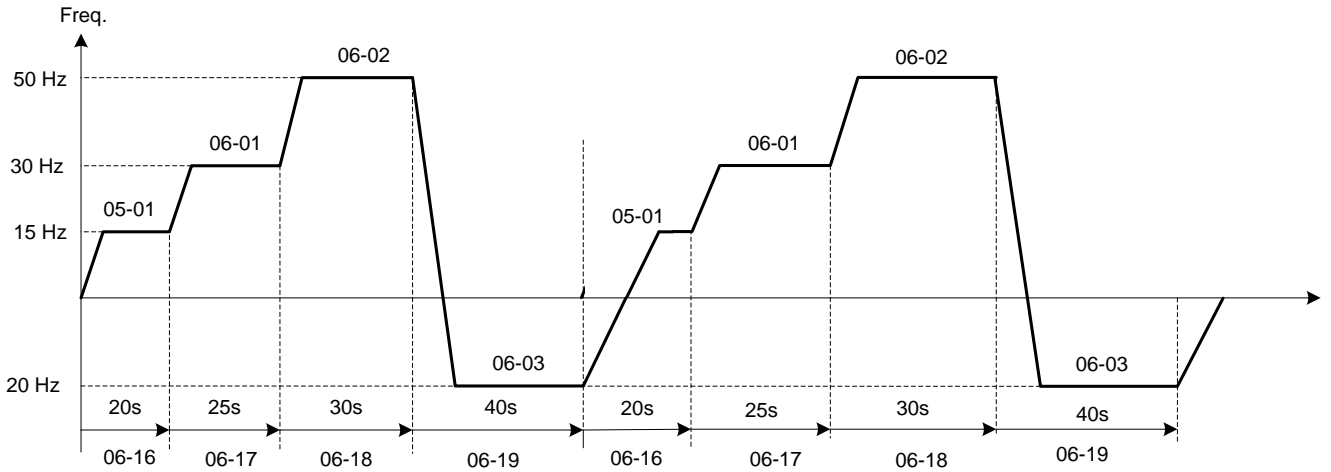


Figure 4.3.43 Periodic automatic operation

Example 3: Automatic operation mode – Single cycle and continue running at last speed of the cycle

In this example the inverter executes a single cycle and continue running at last speed of the cycle.

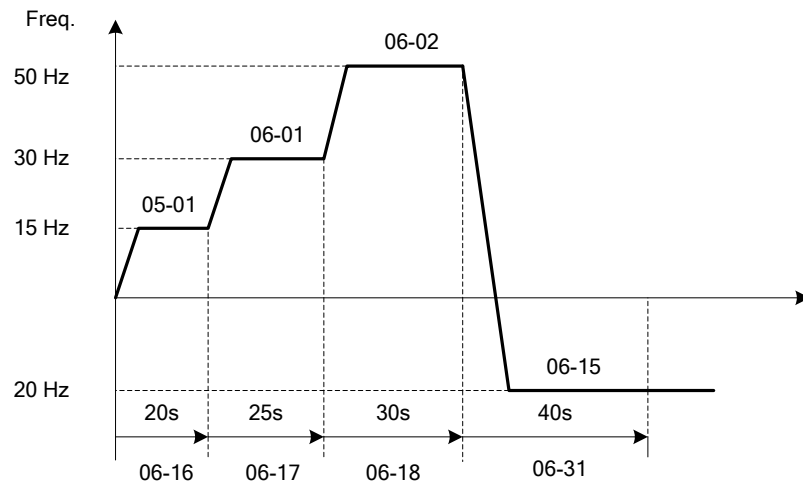


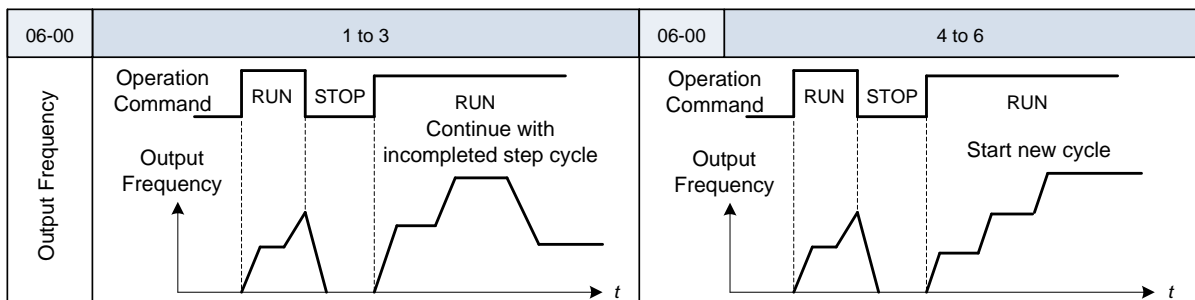
Figure 4.3.44 Single cycle automatic operation (continuous)

06-00= 1 to 3:

After a stop the inverter will start with the incomplete step when the run command is re-applied.

06-00= 4 to 6:

After a stop the inverter will start with the first step of the cycle when the run command is re-applied.



Notes:

- Acceleration/ deceleration time is set with parameters 00-14 and 00-15 in automatic operation mode.
- 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.4.3.45 for setting automatic restart interval.

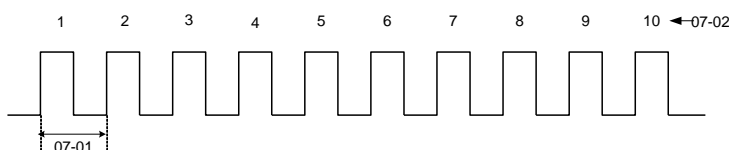


Figure 4.3.45 Automatic restart operation

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

When the 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 4.3.46 for the automatic restart operation.

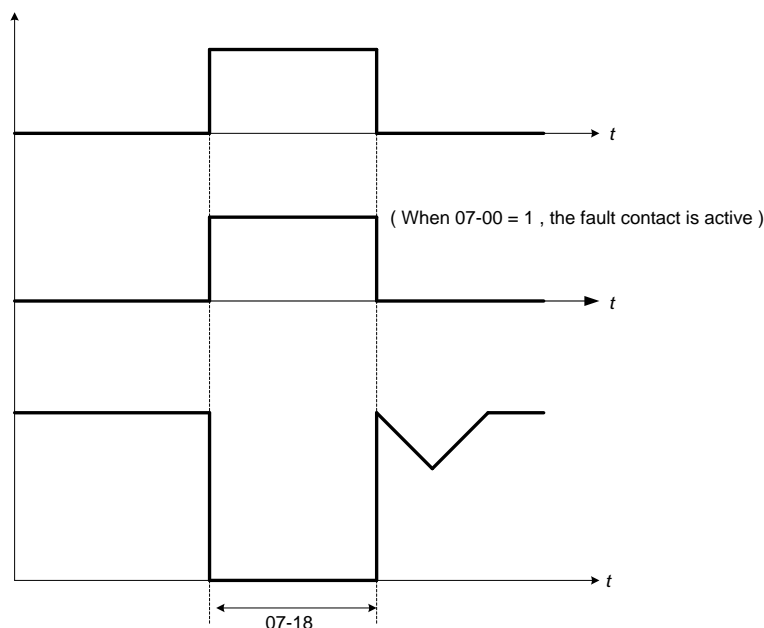


Figure 4.3.46 Auto-restart operation

The automatic restart function is active for the following faults. Please note that when the fault is not listed in the table the inverter will not attempt an automatic restart.

Parameter Name	Faults		Numbers of Restart
07-00	UV (under voltage)		Unlimited
07-01	OC (over current) OCA (over current in ACC.) OCC (over current in constant speed) OCd (over current in DEC)	GF (ground failure) OV (overvoltage) OL2 (Inverter overload) OT (Over-torque detection) OPL (Output phase loss)	Depend on parameter 07-02
07-02	OL1 (motor overload) UT (Under torque detection) IPL (input phase loss)	CF07 (SLV motor control setting fault) CF08 (PMSLV motor control setting fault)	

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 operation 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.

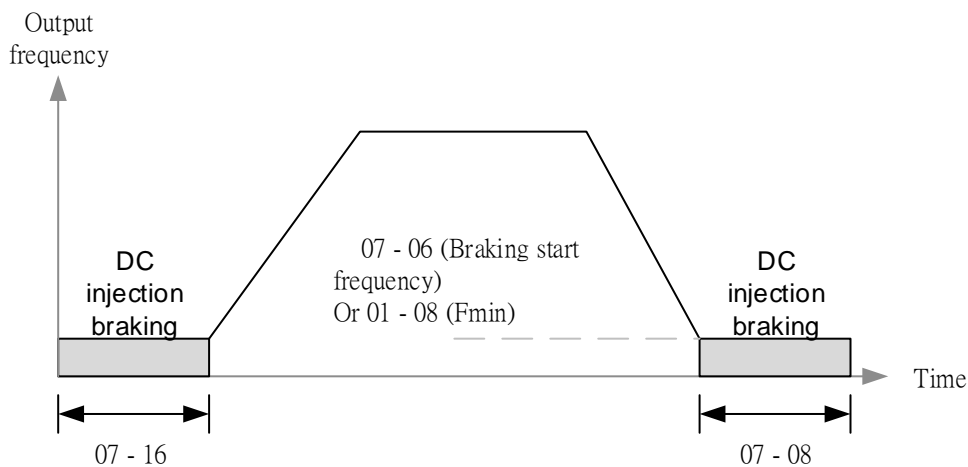


Figure 4.3.47a VF、VF+PG、SLV and SLV2 DC injection braking

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 4.3.47b.

- 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%.

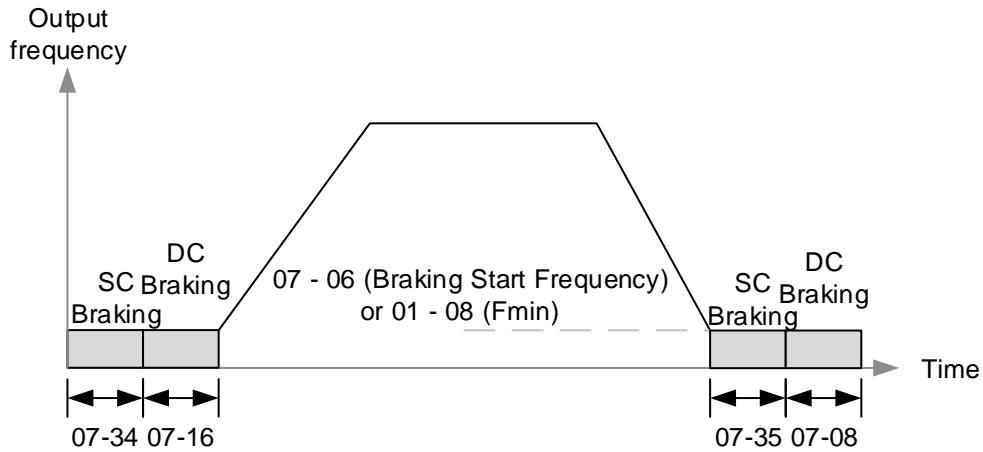


Figure 4.3.47b PMSLV braking action

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.

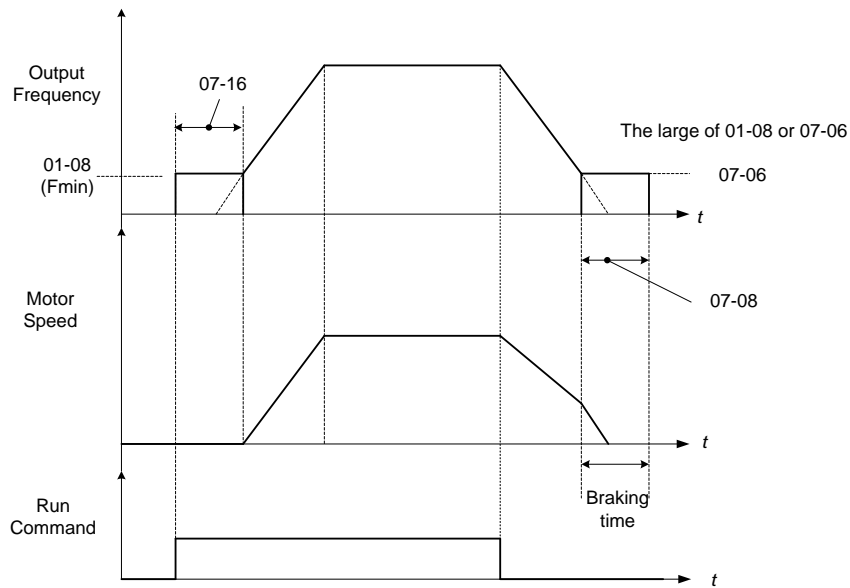


Figure 4.3.47c DC braking operation

DC braking operation can be controlled via any one of the multi-function input terminals (03-00 to 05) function 33. Refer to Fig. 4.3.47 for DC braking operation.

DC braking current can be controlled via the multi-function analog input (04-05 or 04-10) function 5. Refer to Fig. 4.3.34.

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

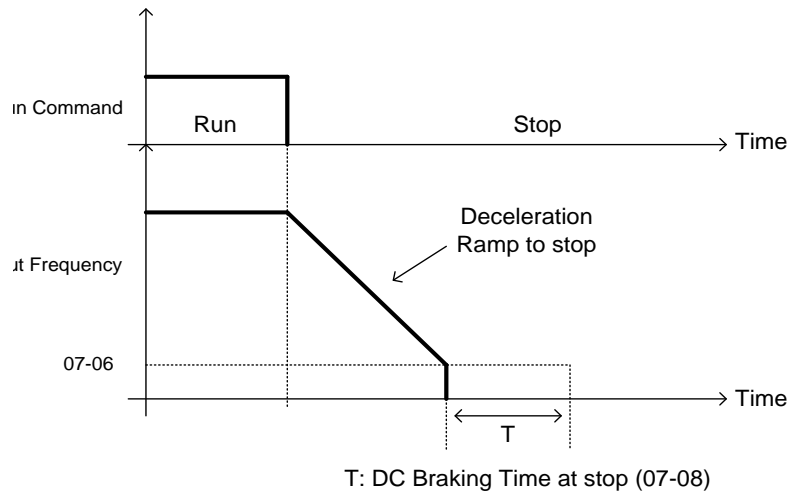


Figure 4.3.48 Deceleration to stop

07-09=1: Coast to stop

When a stop command is issued, the motor will coast to a stop. Stop time depends on motor load and friction of the system.

The inverter waits for the time set in the minimum baseblock time (07-18) before accepting the next run command.

In SLV mode (00-00=2) the speed search function is automatically enabled upon the next run command.

Note: When using a mechanical brake set parameter 07-26 to 1.

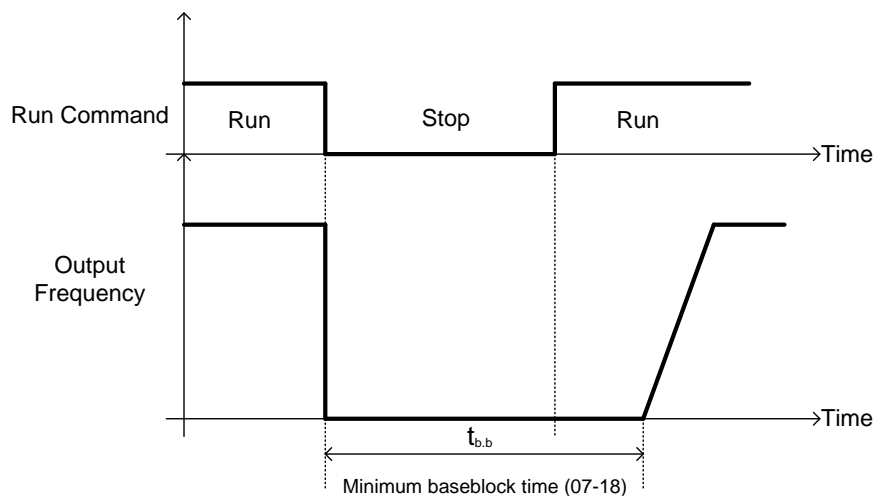


Figure 4.3.49 Coast to stop

07-09=2: DC braking to stop

When a stop command is issued, the inverter will turn off the output (Baseblock) and after the minimum Baseblock time (07-18) has expired activate DC braking (07-07). Refer to Fig.4.3.50.

The DC braking time (t_{DCDB}) of Figure 4.3.50 is determined by the value of 07-08 (DC Braking start time) and the output frequency at the time the stop command was issued.

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

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

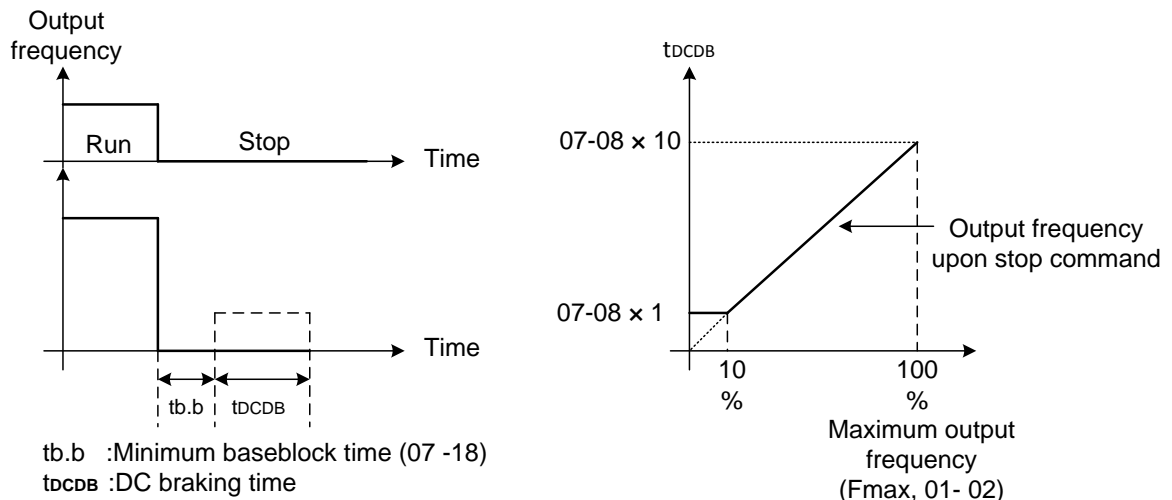


Figure 4.3.50 DC braking to stop

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.4.3.51

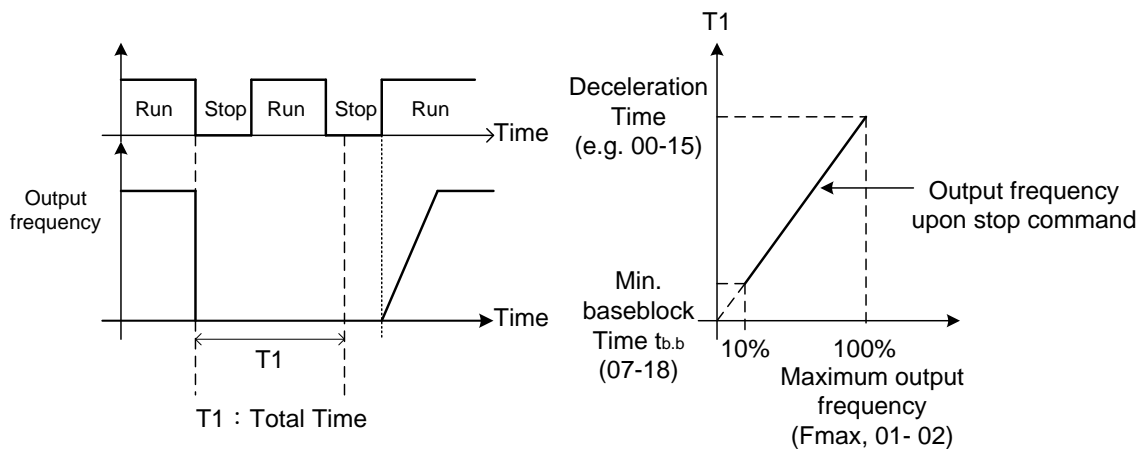


Figure 4.3.51 Coast to stop with timer

07- 13	Low Voltage Detection Level
Range	【200V】 : 150~300V 【400V】 : 300~600V
07- 25	Low voltage Detection Time
Range	【0.00~1.00】 Sec

Adjust the 07-13 voltage level from 150 to 300 Vdc (200V class) or from 300 to 600 Vdc (400V class).

When the AC input voltage is lower than the 07-13 value (07-13/ 1.414 = AC voltage detection level) for the time specified in 07-25 the low-voltage error "UV" will displayed. If 07-25 = 0.00 sec., the UV error will be displayed immediately.

Set preventive measures:

- The inverter input voltage will limit the output voltage. If the input voltage drops excessively, or if the load is too big, the motor may stall.
- If the input voltage drops below the value set in 07-13 then the output is turned off momentarily. The inverter will not automatically start when power is restored.

07- 14	Pre-excitation Time
Range	【0.00~10.00】 Sec
07- 15	Pre-excitation Level
Range	【50~200】 %

If a high starting torque is required for the application, especially for a large horsepower motors, the pre-excitation operation can be used to pre-flux (magnetize) the motor.

07-14: Pre-excitation time

When an operation command (forward or reverse) is activated, the inverter will automatically start pre-excitation based on the time set in parameter 07-14.

The time for the flux to reach 100% is a function value of motor's electrical time constant (See figure 4.3.52).

Electrical time constant (quadratic by-pass circuit time constant) is suggested to set 2.00~4.00 Sec.

07-15: Pre-excitation initial level

Use the pre-excitation initial level (07-15) to provide a higher excitation current during the pre-excitation time (07-14), which will increase the speed and stability for motors.

In order to quickly magnetize the motor, reduce the pre-excitation time (07-14) and set the pre-excitation level (07-15) to a high level.

If 07-15 is set greater than 100%, providing a high excitation current during the pre-excitation time (07-14), motor's magnetization time is 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.

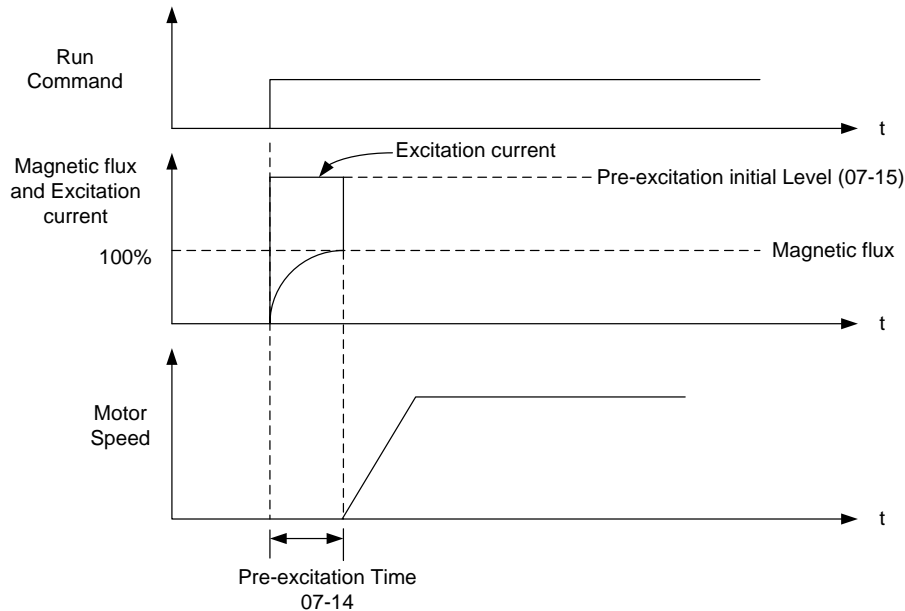


Figure 4.3.52 Pre-excitation operation

07- 18	Minimum Base block Time
Range	【0.1~5.0】 Sec

In case of a momentary power failure, the inverter continues to operate after the power has been restored when parameter 07-00 is set to 1. Once the momentary power failure is detected; the inverter will automatically shut down the output and maintain B.B for a set time (07-18).

It is expected that after the minimum base block time has expired the residual voltage to be almost zero.

When the momentary power failure time exceeds the minimum base block time (07-18), the inverter will automatically perform a speed search upon return of power. Refer to the following figure 4.3.53.

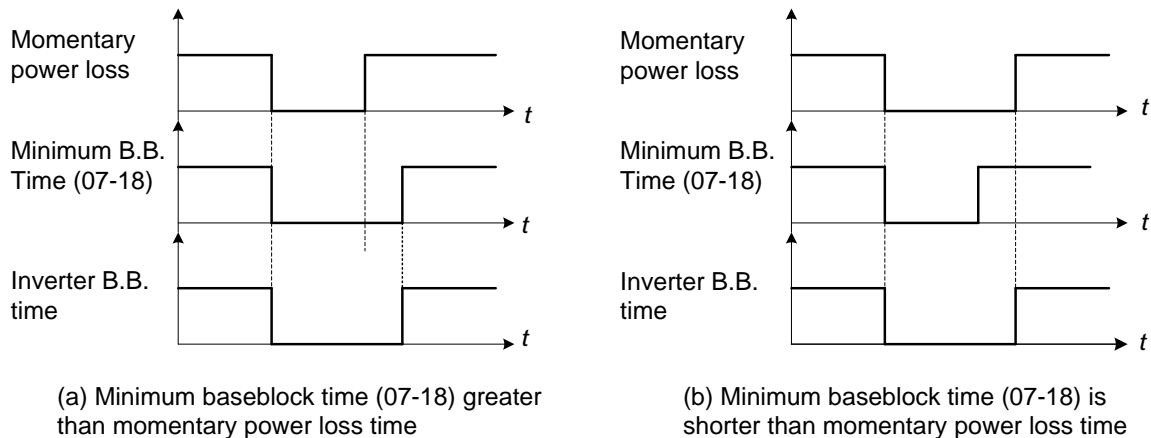


Figure 4.3.53 Minimum B.B time and momentary power loss time

Minimum base block time (07-18) is also used 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. 4.3.54.

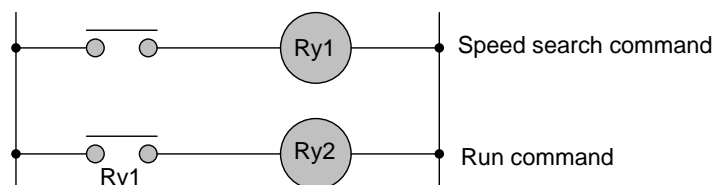


Figure 4.3.54 Speed search and operation commands

Notes: Speed Search Operation

- The speed search cannot be used when the motor rated power is greater than the inverter rated power.
- The speed search cannot be used when the motor rated power is two inverter sizes smaller than the inverter currently used.
- The speed search cannot be used in combination with a high-speed motor.
- 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

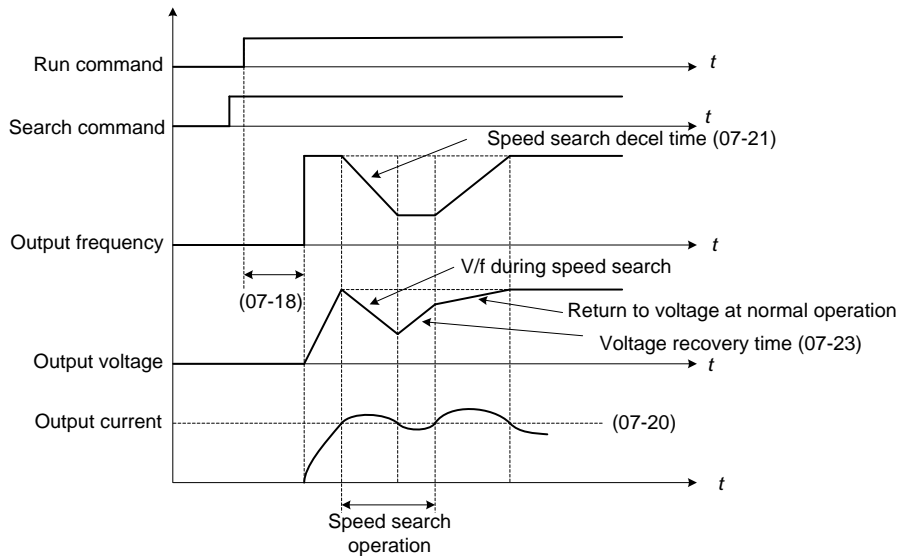


Figure 4.3.55 Speed search at starting

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

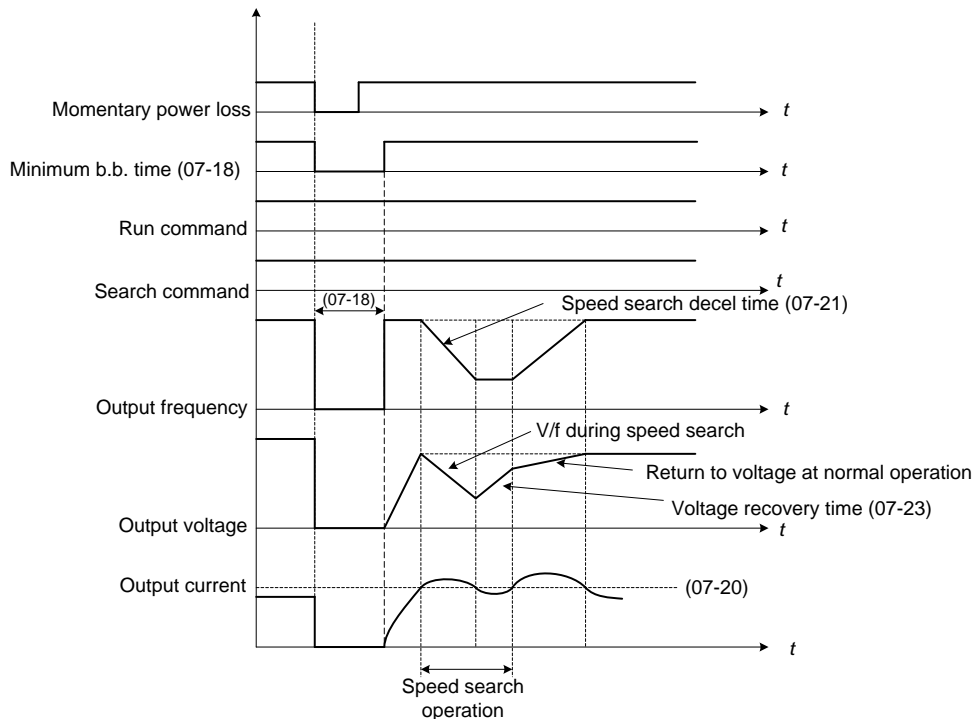


Figure 4.3.56 Speed search in recovery period of momentary power failure

Notes:

- If the minimum base block time (07-18) is longer than the momentary power failure time, the speed search starts operation after the minimum base block time (07-18).
- If the minimum base block time (07-18) is too short, the speed search operation begins immediately after power has been restored.

07- 29	Run Command Available during DC Braking
Range	【0】 : Disable (Run command isn't available until the DC braking is completely done) 【1】 : Enable

After DC braking action starts, if run command selection is set to 0, it will not run until DC braking action ends.

If run command selection is set to 1, it is not required to wait for the ending of DC braking action. It can run during DC braking action process.

07- 42	Voltage Limit Gain
Range	【0.0~ 50.0】 %

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 rotation 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.

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 deceleration (08-00=xxx1b)

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

When the inverter output current reaches the level set in parameter 08-01 minus 15% the deceleration rate starts to decrease. When the inverter output current reaches the level set in parameter 08-01 the motor stops decelerating. Refer to Fig.4.3.57 for more information.

Notes:

- Reduce stall prevention level during deceleration (08-01) in case the motor stalls (when the motor power is smaller than the inverter rating).
- The inverter rated output current should be set to 100%.

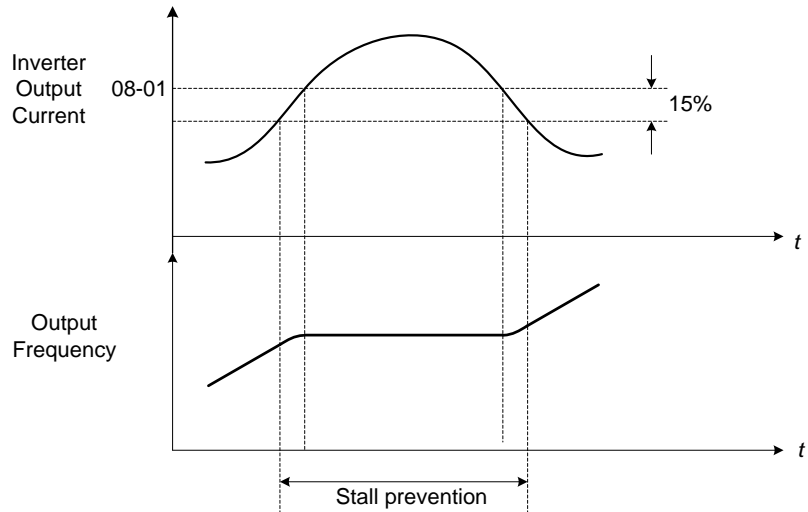


Figure 4.3.57 Stall prevention during acceleration

If the motor is used in the constant power (CH) region, the stall prevention level (08-01) is automatically reduced to prevent the stall.

Stall prevention level during acceleration (Constant horsepower)

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

Parameter 08-21 is the stall prevention limit value in Constant Horsepower region. Refer to Fig.4.3.58.

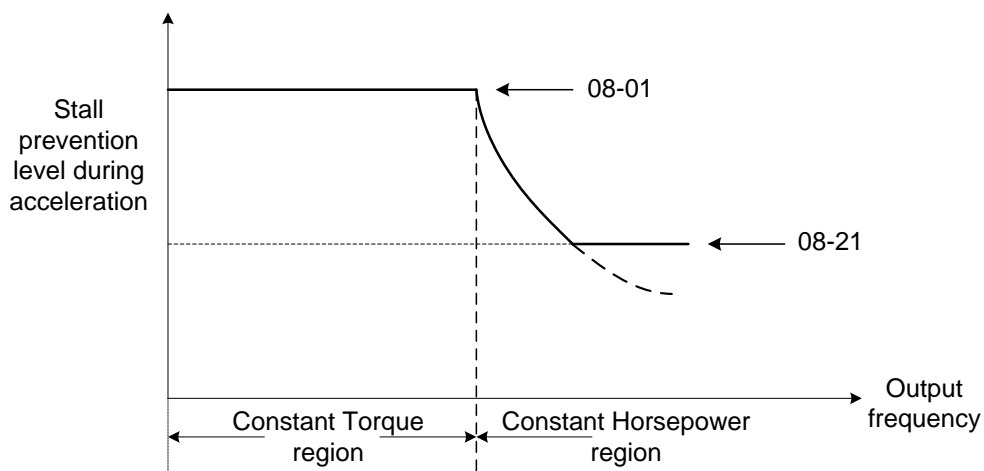


Figure 4.3.58 Stall prevention level and limit in acceleration

Stall prevention selection during deceleration (08-00=xx0xb)

Stall prevention during deceleration automatically increases the deceleration time according based on the DC-bus voltage to prevent over-voltage during deceleration. Refer to Fig.4.3.59 for stall prevention during deceleration

When the DC-bus voltage exceeds the stall prevention level deceleration will stop and the inverter will wait for the DC-bus voltage to fall below the stall prevention level before continuing deceleration. Stall prevention level can be set by 08-02, see Table 4.3.10.

Table 4.3.10 Stall prevention level

Inverter model	08-02 default value
200V class	385VDC
400V class	770VDC

Note: When using external braking (braking resistor or braking module) disable stall prevention during deceleration (08-00 to xx1xb).

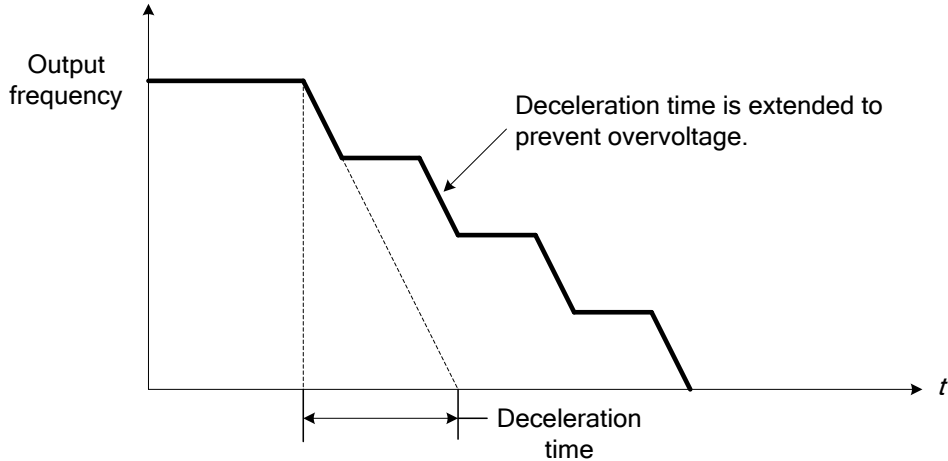


Figure 4.3.59 Stall prevention selection in deceleration

Stall prevention selection during run (08-00=x0xxb)

Stall prevention during run can only be used in V/F control mode for induction motor.

This function prevents the motor from stalling by automatically reducing the output frequency during run.

If the inverter output current rises above the level set in parameter 08-03 for the time specified in parameter 08-22, the inverter output frequency is automatically decreased following deceleration time 1 (00-15) or deceleration time 2 (00-17).

When the inverter output current falls below the level set in parameter (08-03) minus 2%, normal operation continues and the output frequency increases to the frequency reference using the acceleration time 1 or acceleration time 2. Refer to the following Fig.4.3.60.

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

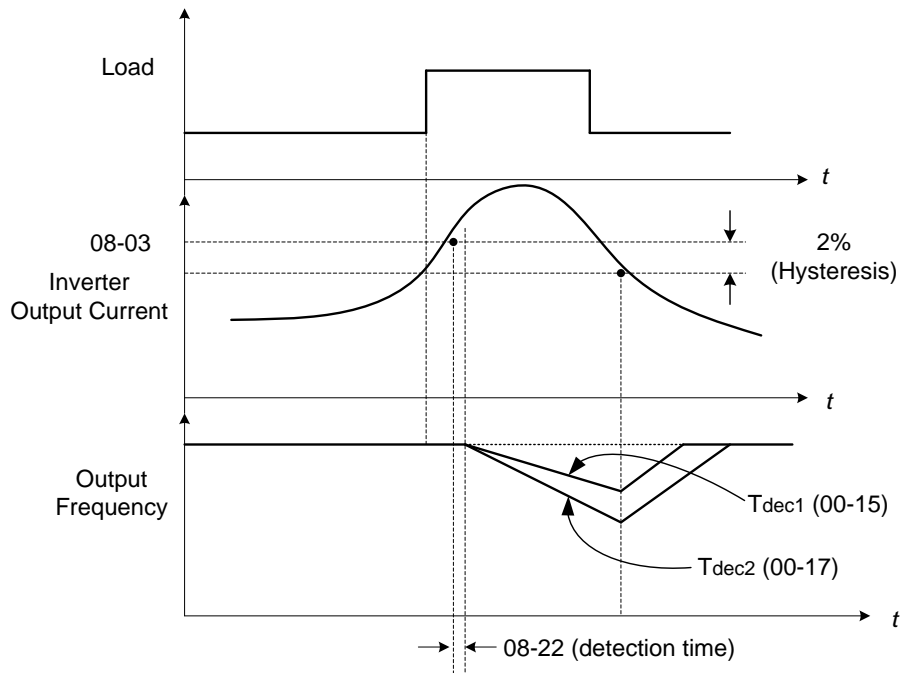


Figure 4.3.60 Stall prevention selection in operation

08-05	Selection for Motor Overload Protection (OL1)
Range	<p>【xxx0b】 : Motor Overload Protection is disabled.</p> <p>【xxx1b】 : Motor Overload Protection is enabled.</p> <p>【xx0xb】 : Cold Start of Motor Overload</p> <p>【xx1xb】 : Hot Start of Motor Overload</p> <p>【x0xxb】 : Standard Motor</p> <p>【x1xxb】 : Special motor</p> <p>【0xxxb】 : Reserved</p> <p>【1xxxb】 : Reserved</p>
08-07	Motor Overload (OL1) Protection Level
Range	<p>【0】 : Motor Overload (OL1) Protection 0</p> <p>【1】 : Motor Overload (OL1) Protection 1</p> <p>【2】 : Motor Overload (OL1) Protection 2</p>

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).

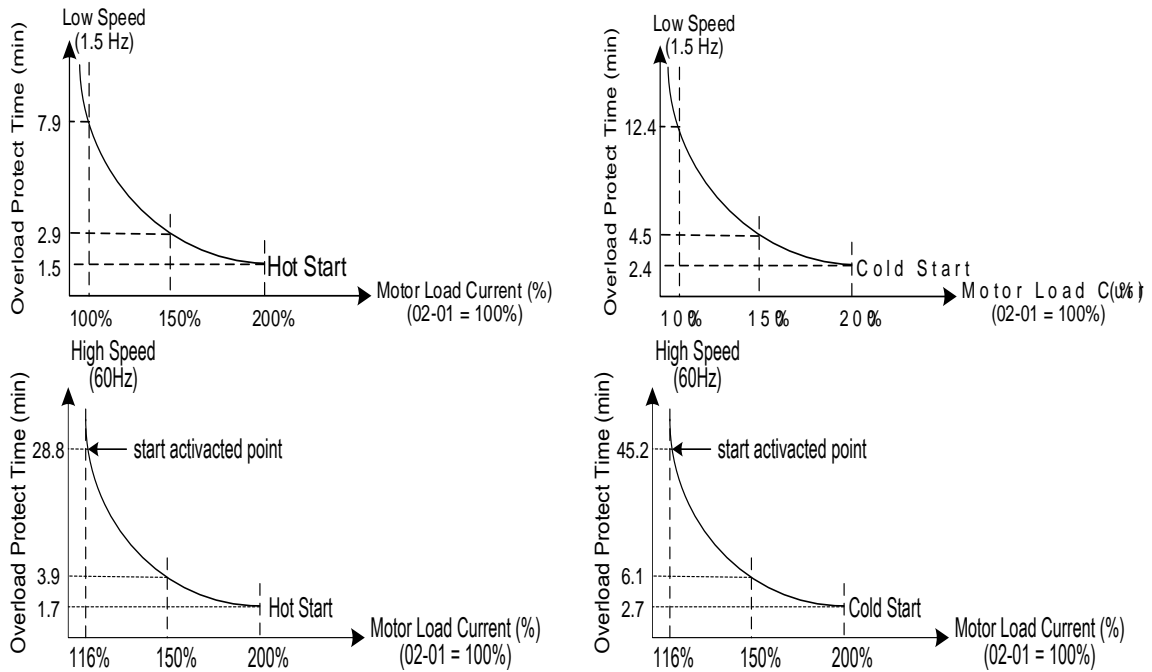
With cold start enabled (08-05 = xx0xb), motor overload protection occurs in 5 and a half minutes when operating the motor at 150% of the motor rated current at an output frequency greater than 60Hz.

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.

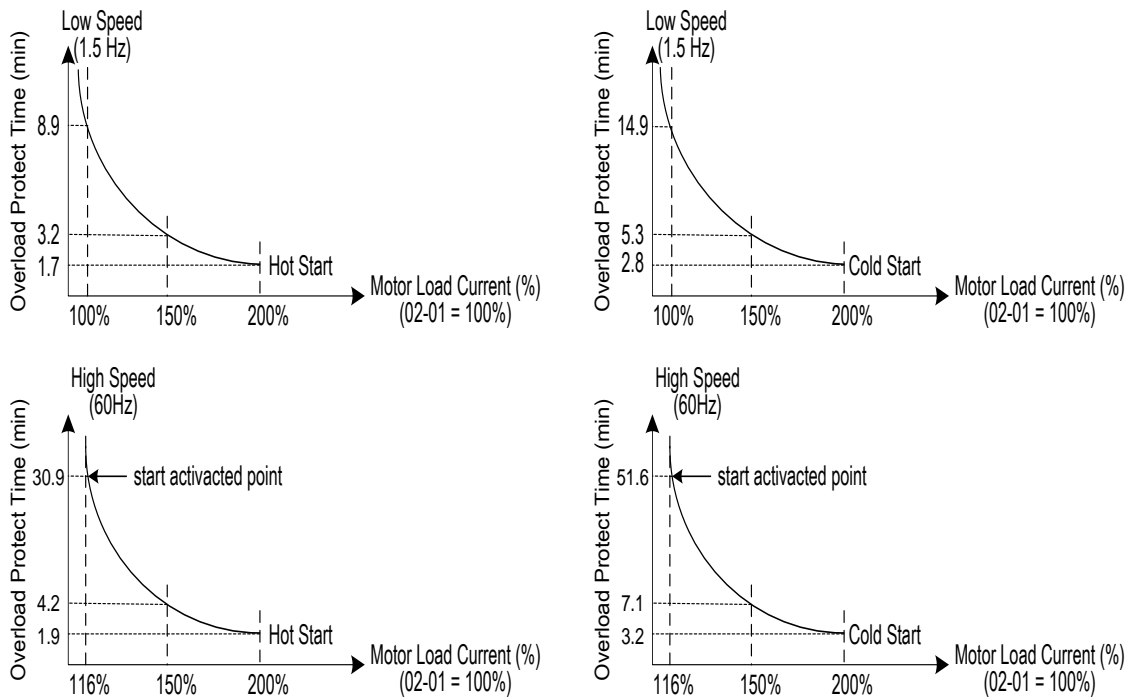
Refer to the following Fig.4.3.61 for an example of motor overload protection standard curve.

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:

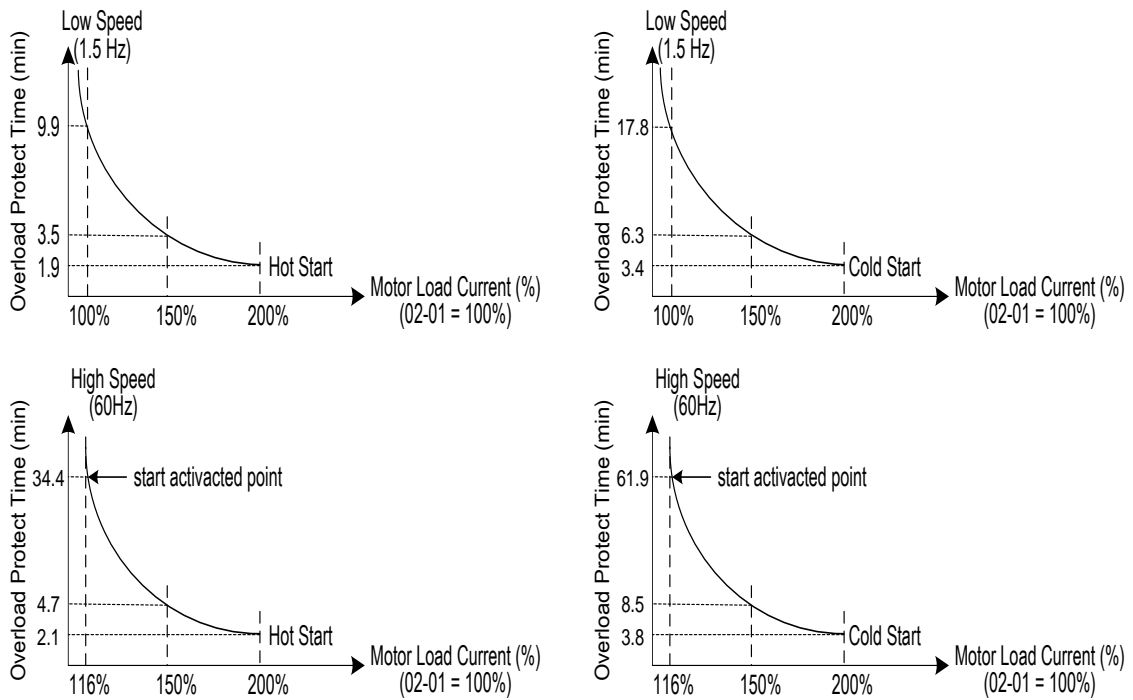


Figure 4.3.61 Motor overload protection curve (example: standard motor)

When using force cooled motors (Special inverter motor), thermal characteristics are independent of the motor speed, set 08-05 = x1xxb.

When 08-05 = x1xxb, overload protection function is based on motor rated current for output frequencies between 6 and 60Hz. If the output frequency is lower than 1Hz, the overload protection function uses 83% of the motor rated current to determine an overload condition.

When 08-05 = x0xxb, overload protection function is based on 70% of the motor rated current for an output frequency of 20Hz. If the output frequency is lower than 1Hz, the overload protection function uses 40% of the motor rated current to determine an overload condition.

Refer to Fig.4.3.62 for motor overload rating at different output frequencies.

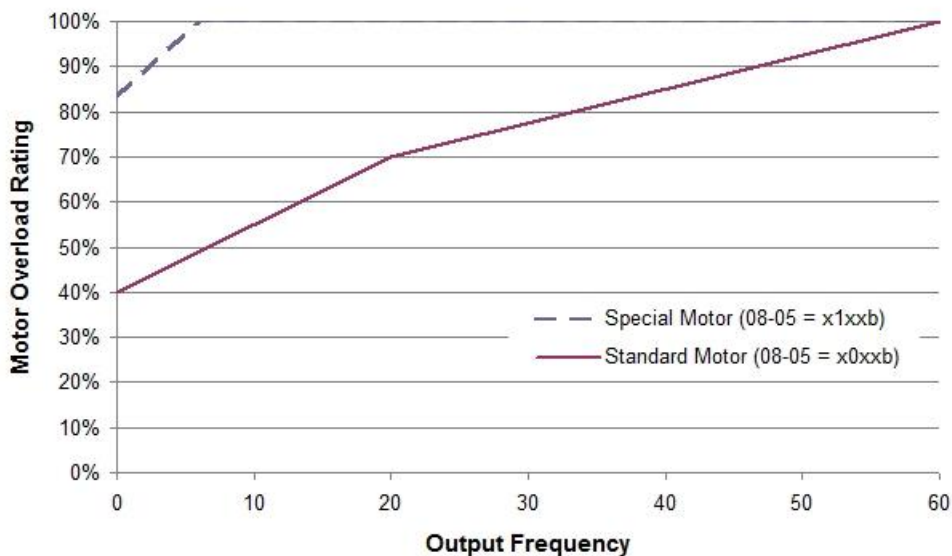


Figure 4.3.62 Motor overload rating at different output frequencies

08- 06	Start-up mode of overload protection operation (OL1)
Range	【0】 : Stop Output after Overload Protection 【1】 : Continuous Operation after Overload Protection.

08-06=0: When the inverter detects a motor overload the inverter output is turned off and the OL1 fault message will 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.

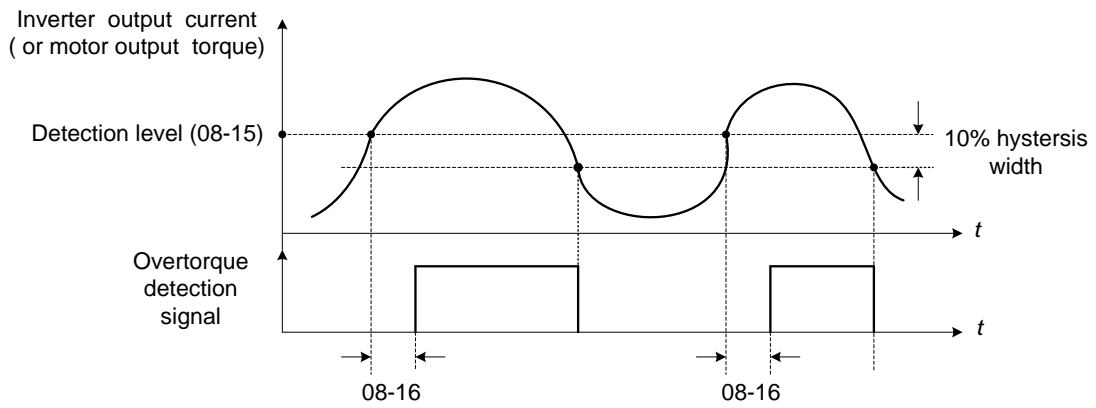


Figure 4.3.63 Over-torque detection operation

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 a low-torque detection fault and the motor decelerates to a stop.

08-18=1: When a low-torque condition is detected the inverter displays a low-torque detection alarm and continues to run.

08-18=2: When a low-torque condition is detected the inverter displays a low-torque detection fault and the motor coasts to a stop.

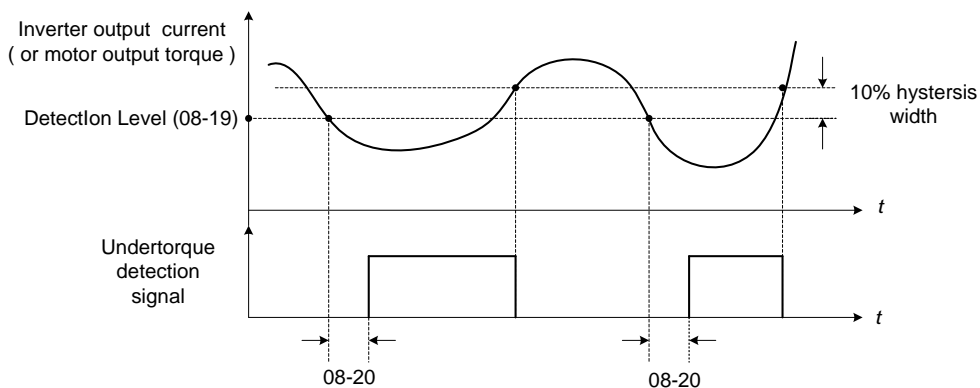


Figure 4.3.64 Low torque detection operation

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. 4.3.65 for more information.

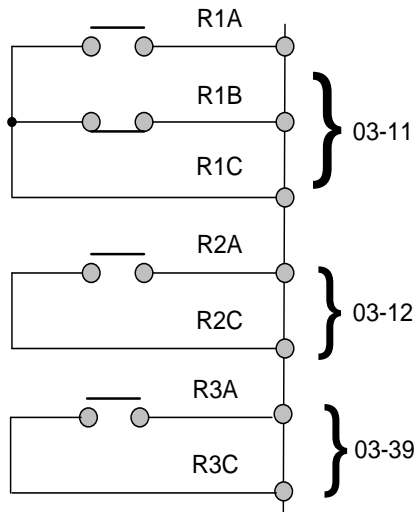


Figure 4.3.65 Over-torque / low torque detection multi-function digital output terminal

08- 23	Ground Fault (GF) Selection
Range	【0】 : Disable 【1】 : Enable

If the inverter leakage current is greater than 50% of inverter rated current and the ground fault function is enabled (08-23), the keypad will display a "GF Ground Fault" (GF), motor will coast to a stop and fault contact is activated.

08- 24	Operation Selection of External Fault
Range	【0】 : Deceleration to Stop 【1】 : Coast to Stop 【2】 : Continuous Operation

When multi-function digital input terminal is set to 25 (the external fault) and this terminal signal is triggered off, parameter 08-24 (Operation Selection of External Fault) can be selected to stop it. The selection of stop modes is the same as 07-09.

08- 25	Detection selection of External Fault
Range	【0】 : Immediately Detect when the Power is Supplied 【1】 : Start to Detect during Operation

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.

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 characteristics 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 T_r is 150°C in class F and 180°C in class H,
 - a. $T_r - 5^\circ\text{C}$: $R_{PTC} \leq 550\Omega$, use R_{PTC} value to formula (1), the V value can be set to 08-43 PTC reset level.
 - b. $T_r + 5^\circ\text{C}$: $R_{PTC} \geq 1330\Omega$, 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.

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

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 within the 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. 4.3.66 for the connecting between the corresponding temperature of thermistor of PTC and terminals.

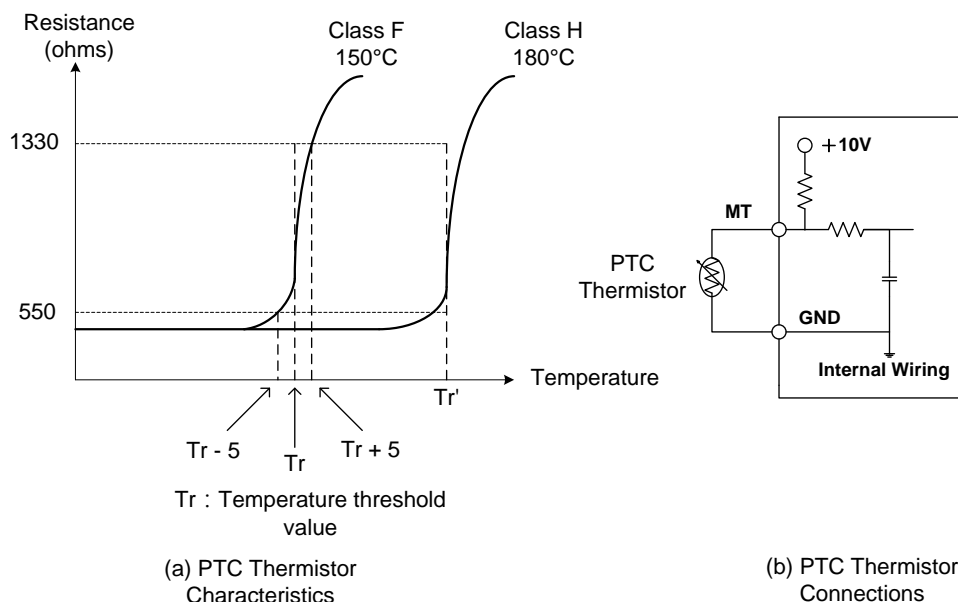


Figure 4.3.66 (a) PTC Themistor Characteristics (b) PTC Themistor Connections

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

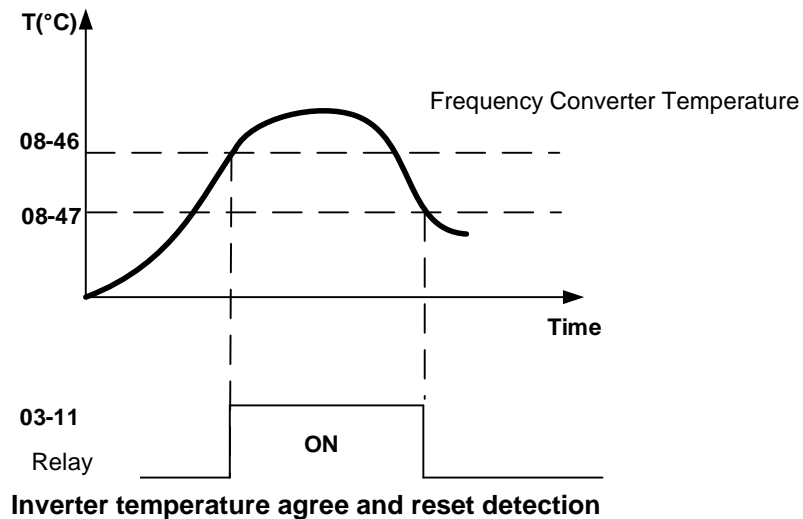
08 - 47	Temperature reset level
Range	【0 ~ 254】 °C

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**: The inverter temperature is $> 08-46$, the relay operates.
- **08-47**: When the output current is $\leq 08-47$, the relay signal from **ON** to **OFF**.

Down time frequency diagram:



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.

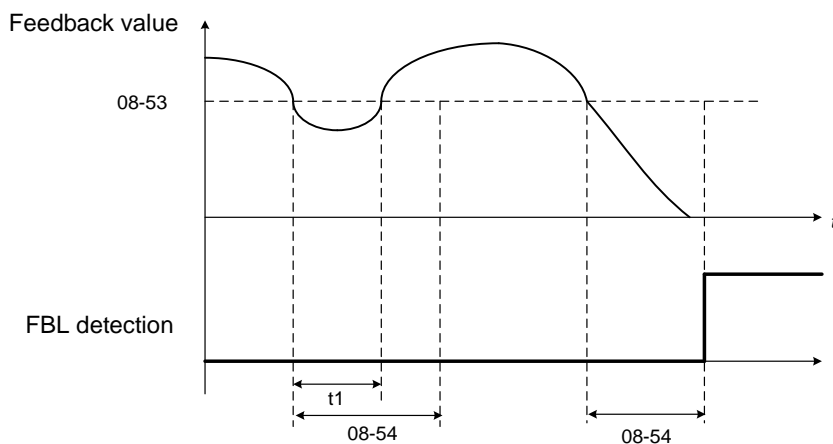
08 - 53	PID Detection Level of Fire Mode
Range	【0~100】 %
08 - 54	Delay Time of Fire Mode PID Loss
Range	【0.0~10.0】 Sec
08 - 55	PID Feedback Loss Detection Selection of Fire Mode
Range	【0】 : Keep Running 【1】 : Fire Mode Speed(08-52) 【2】 : Max. Output Frequency of Motor 1 (01-02)

- 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.

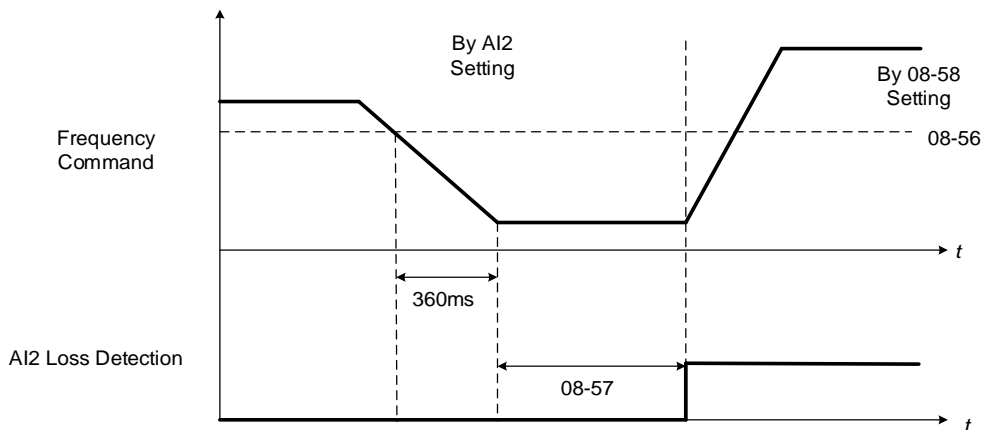


Fig 4.3.76 AI2 frequency reference loss

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 protocols:

- Modbus communication protocol
- BacNet communication protocol
- MetaSys communication protocol
- Pump in Parallel Connection

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. 4.3.67. Set the controller receive time-out to a greater value than the wait time parameter (09-09).

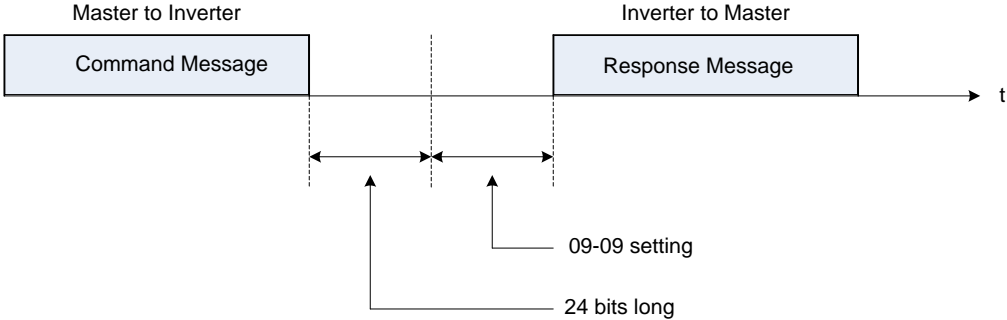


Figure 4.3.67 Communication Message Timing

Group 10: PID Parameters

10- 00	PID Target Value Source Setting
Range	【0】 : Keypad 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 addition 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 value is 99.9 PSI (depending on the setting value of 10-33).

10-00=6 (from frequency command), it means the setpoint is the percentage 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 frequency 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 Control 【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.4.3.69 and Fig.4.3.70.

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. 4.3.68 for PID control operation

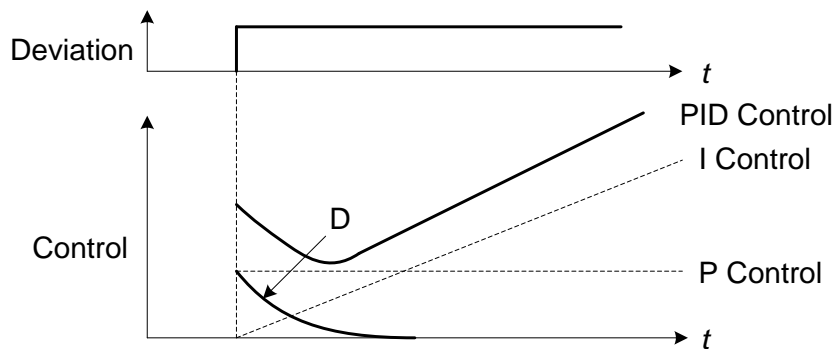


Figure 4.3.68 PID Control

PID Control Type

The inverter offers two types of PID control:

(a) **PID control with differential feedback:** (10-03 = x1xxb)

Make sure to adjust the PID parameters without causing system instability. Refer to Fig. 4.3.69 for PID control for feedback value differential.

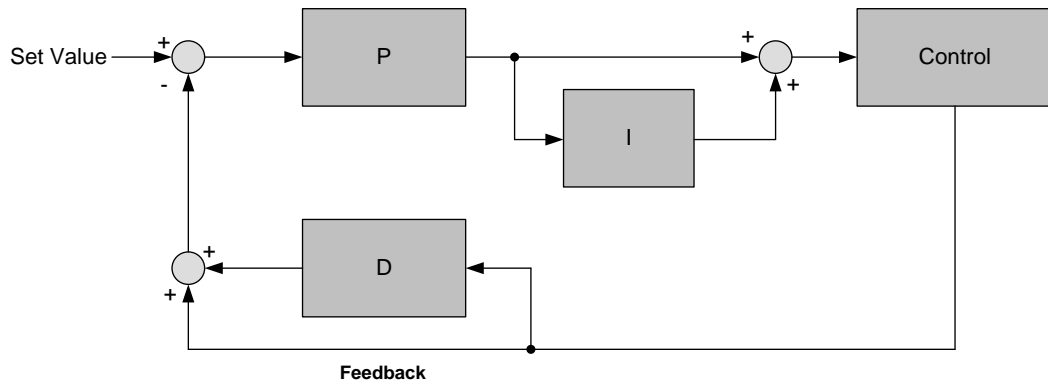


Figure 4.3.69 PID control for feedback differential value

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

This is the basic type of PID control. Refer to the Fig. 4.3.70.

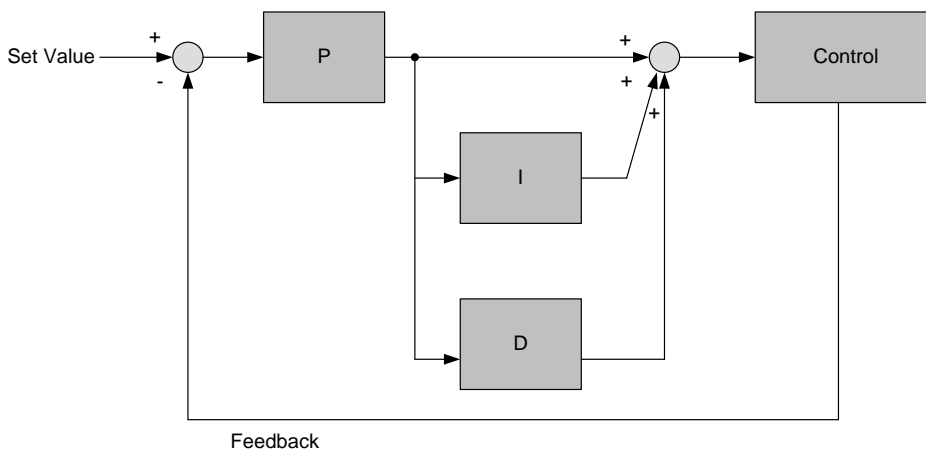


Figure 4.3.70 Basic PID control

PID Setup

Enable PID control by setting parameter 10-03, PID target value (10-00) and PID feedback value (10-01).

10-00: PID target 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

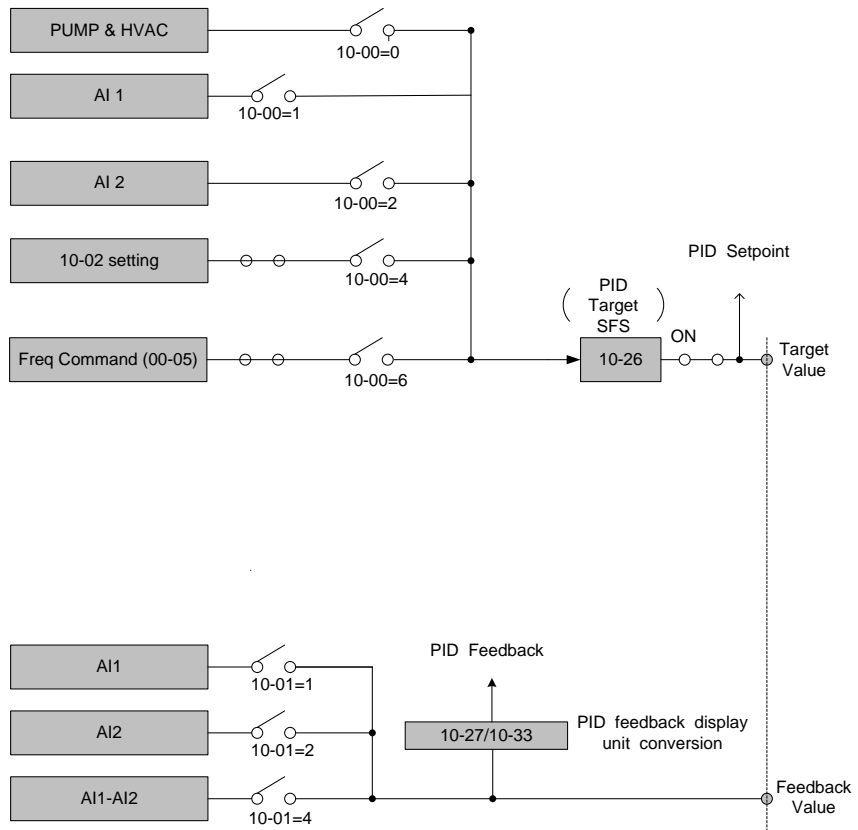
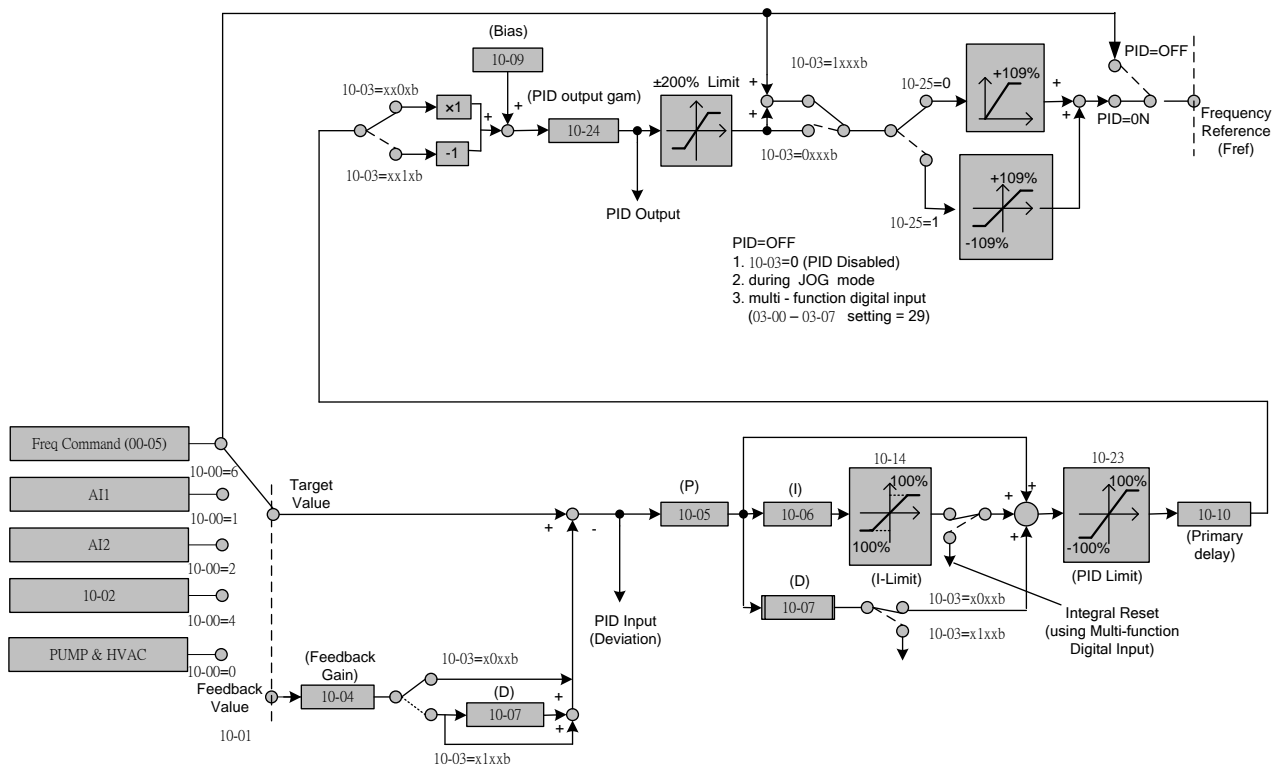


Figure 4.3.71 PID input selection

PID Control Setting

PID control block diagram.

The following figure shows the PID control block diagram.



PID Tuning

Use the following procedures to start PID control,

- (1) Enable PID control (set 10-03 to a value greater than "xx0b").
- (2) Increase the proportional gain (10-05) to the highest value possible without causing the system to become unstable.
- (3) Decrease the integral time (10-06) to the lowest value possible without causing the system to become unstable.
- (4) Increase the differential time (10-07) to the highest value possible without causing the system to become unstable.

The PID control serves to maintain a given process within certain limits whether it is pressure, flow etc. To do this the feedback signal is compared to the set value and the difference becomes the error signal for the PID control.

The PID control then responds by trying to minimize this error. The error is multiplied times the value of the proportional gain set by parameter 10-05. An increased gain value results in a larger error. However, in any system as the gain is increased there is a point that the system will become unstable (oscillate).

To correct this instability, the response time of the system may be slowed down by increasing the Integral time set by parameter 10-06. However slowing the system down too much may be unsatisfactory for the process.

The end result is that these two parameters in conjunction with the acceleration time (01-14) and deceleration (01-15) times require to be adjusted to achieve optimum performance for a particular application.

PID output polarity can be selected with parameter 10-03 (setting = xx0b: 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.

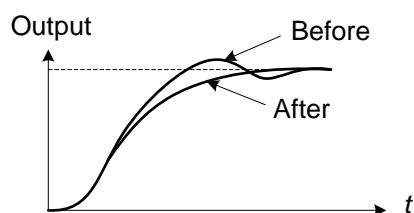
PID Fine Tuning

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.

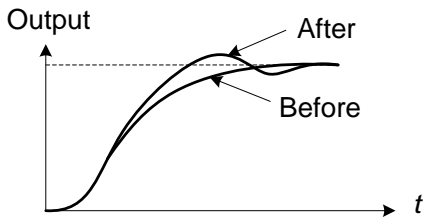
Fine-tuning PID control parameters:

- (1) Reduce overshoot



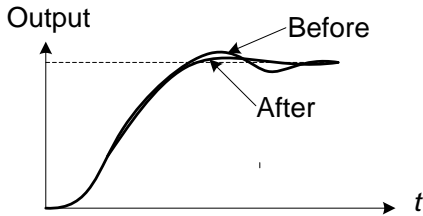
In case overshoot occurs, reduce the derivative time (D) and increase the integral time (I).

- (2) Stabilize PID control



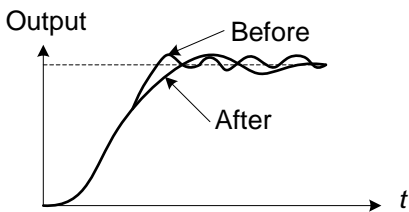
To quickly stabilize the PID control, reduce the integral time (I) and increase the differential time (D) in case overshoot occurs.

(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.

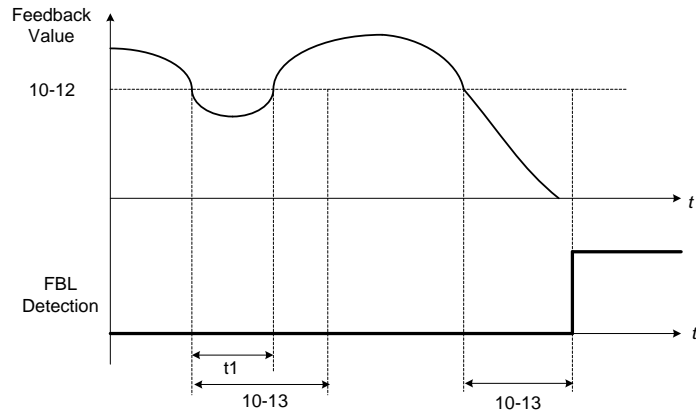


Figure 4.3.73 PID feedback loss detection

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.4.3.74 (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.)**

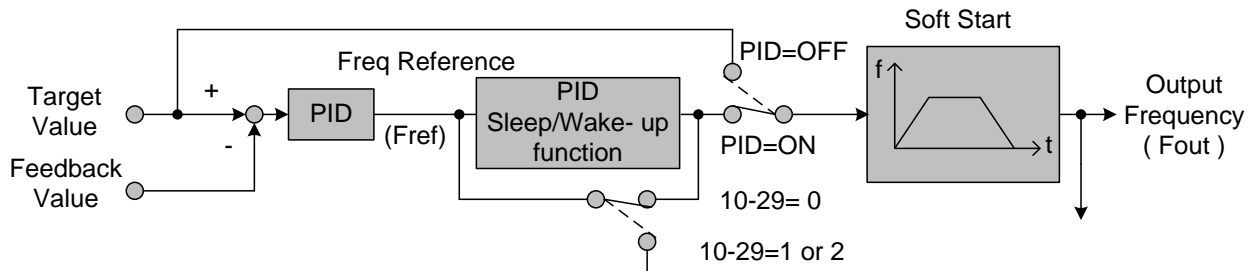


Figure 4.3.74: (a) PID control block diagram

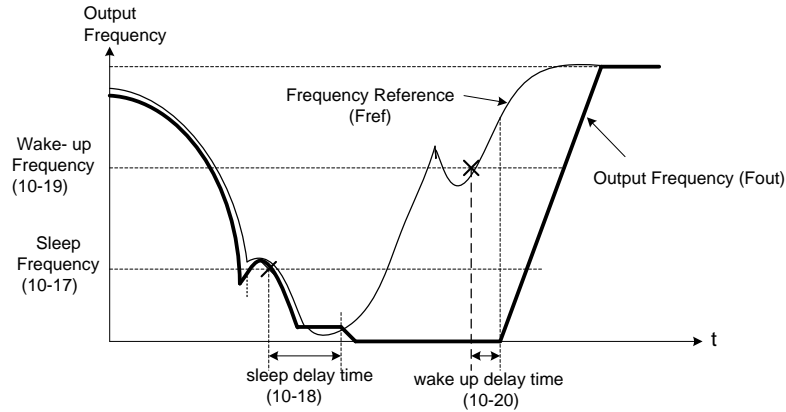


Figure 4.3.74: (b) Timing diagram PID sleep / wakeup

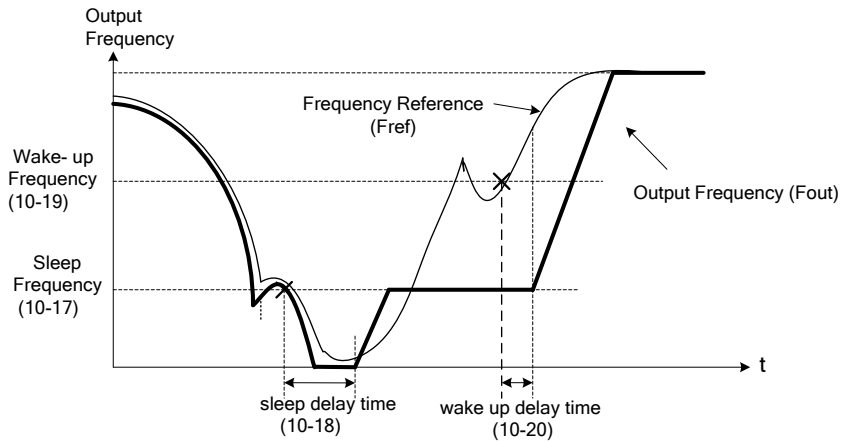


Figure 4.3.74: (c) Timing diagram of PID sleep compensation frequency/ wakeup

Notes:

- Refer to Fig. 4.3.74: (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.4.3.74: (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 applied 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 or set by DI (10-29= 1 or 2) and PID control mode (10-03) = 1xxx, "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 \geq 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.4.3.75 for displaying the unit conversion.

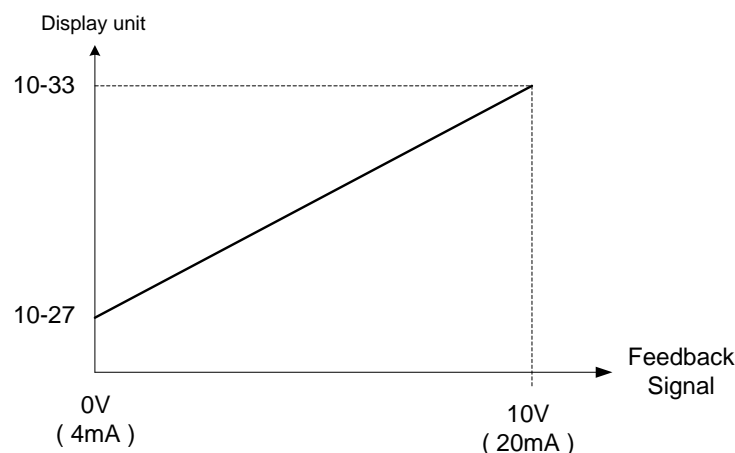


Figure 4.3.75 Feedback signal scaling

Example: Feedback signal: 0V = 0% = 1.0 PSI
 10V = 100% = 20.0 PSI
 Parameter setting: 10-27 = 10 (0% feedback)
 10-33 = 200 (100% feedback)

10-30	Upper Limit of PID Target
Range	【0 ~ 100】 %
10-31	Lower Limit of PID Target
Range	【0 ~ 100】 %

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	

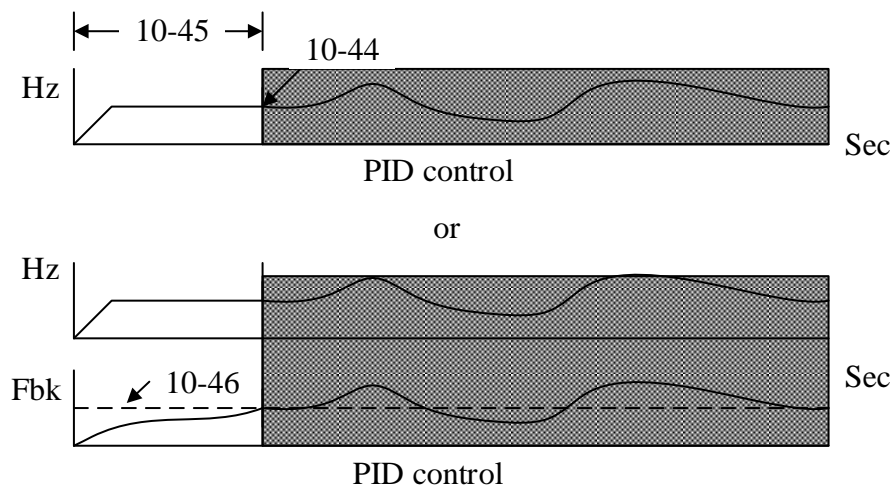
*1: It is new added in inverter software V1.12.

*: (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 fire 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 4.3.11.

Table 4.3.11 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 4.3.12.

Table 4.3.12 Wire length and carrier frequency

Wire length	< 30 Meter (98ft)	up to 50 Meter (164 ft)	up to 100 Meter (328ft)	> 100 Meter > 328ft
Carrier frequency (11-01 value)	Max. value 16KHz (11-01=16KHz)	Max. value 10KHz (11-01=10KHz)	Maxi. value 5KHz (11-01=5KHz)	Max. value 2KHz (11-01=2KHz)

Notes:

- Reduce the carrier frequency if the torque does not match the speed.
- In V/F control mode, the carrier frequency is determined by parameters 11-30 (Carrier frequency max. limit), 11-31 (Carrier frequency lower limit) and 11-32 (Carrier frequency proportional gain) 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.4.3.76 for more information.

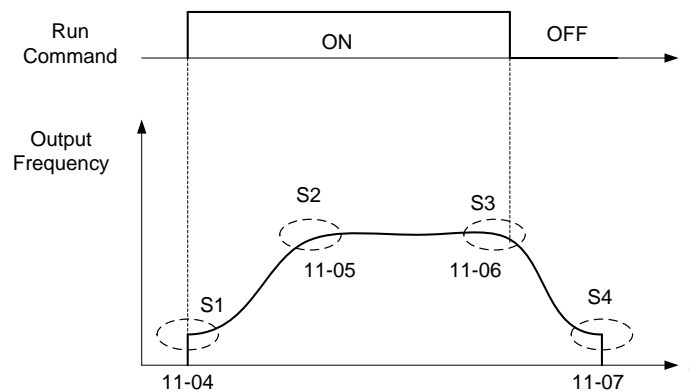


Figure 4.3.76 S curve characteristic

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

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

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

11-08	Jump Frequency 1
11-09	Jump Frequency 2
11-10	Jump Frequency 3
Range	【0.0~599.0】 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.4.3.77.

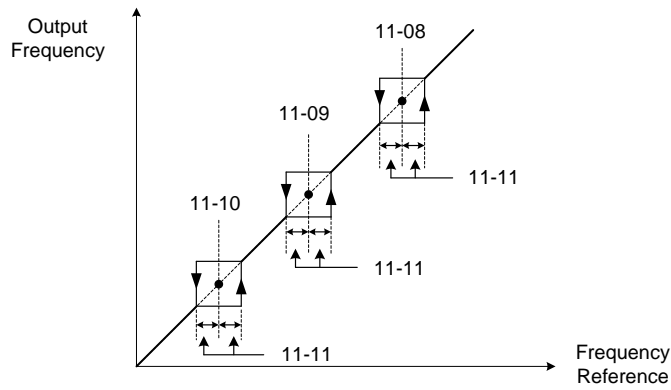


Figure 4.3.77 Jump frequency operation

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. 4.3.38.

Note: When jump frequency overlap the sum of the overlapped jump frequencies will be used as the jump frequency range. Refer to Fig.4.3.78.

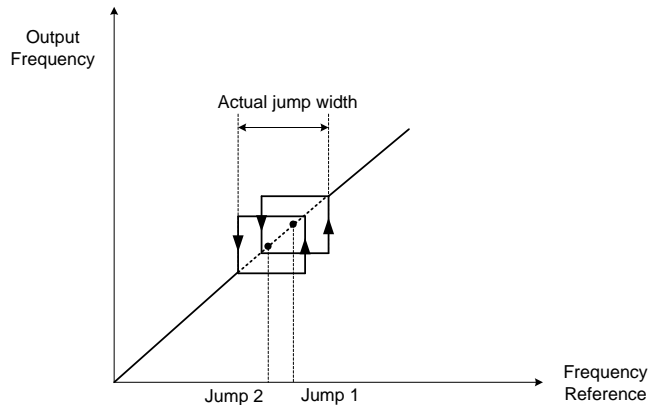


Figure 4.3.78 Jump frequency overlap

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

If 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 4.3.88 for more information.

Note: Only use manual energy savings functions in combination with light loads.

Manual energy saving gain (11-12) determines the output voltage of the inverter when manual energy savings is enabled. Output voltage is percentage gain times the V/F voltage.

Manual energy saving control uses the voltage recovery time (07-23) to change the output voltage

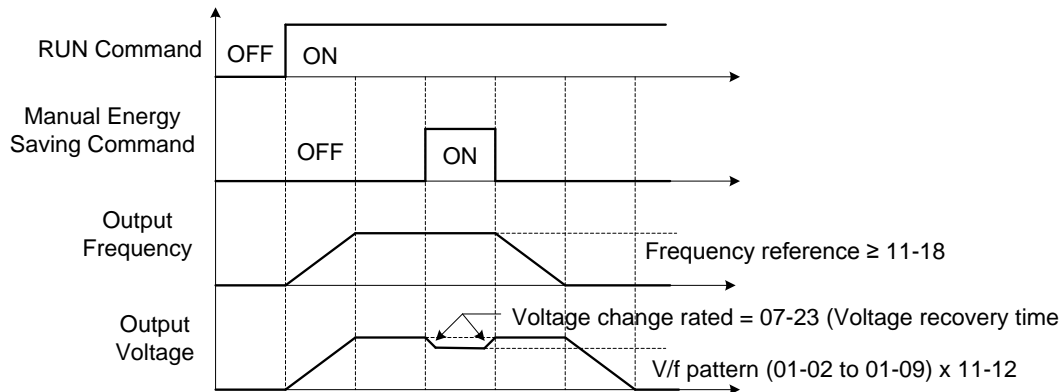


Figure 4.3.79 Manual energy saving operation

11- 19	Automatic Energy Saving Function
Range	【0】 : Automatic Energy Saving is Disabled. 【1】 : Automatic Energy Saving is Enabled.
11- 20	Filter Time of Automatic Energy Saving
Range	【0~200】 msec
11- 21	Voltage Upper Limit of Energy Saving Tuning
Range	【0~100】 %
11- 22	Adjustment Time of Automatic Energy Saving
Range	【0~5000】 msec
11- 23	Detection Level of Automatic Energy Saving
Range	【0~100】 %
11- 24	Coefficient of Automatic Energy Saving
Range	【0.00~655.34】

In the V/F control mode the automatic energy saving (AES) function automatically adjusts the output voltage and reduces the output current of the inverter to optimize energy savings based on the load. The output power changes proportional to the motor load. Energy savings is minimal when the load exceeds 70% of the output power and savings 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.4.3.80.

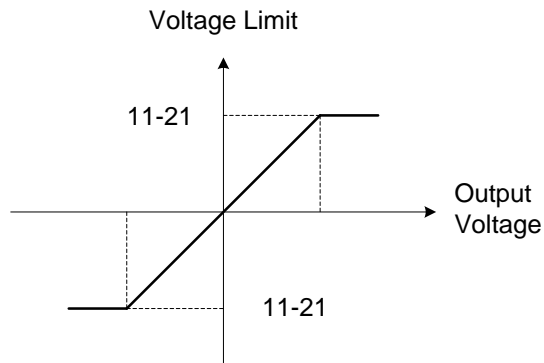


Figure 4.3.80 Voltage limit value of commissioning operation

11-22: Adjustment time of automatic energy saving

Set sample time constant for measuring output power.

Reduce the value of 11-22 to increase response when the load changes.

Note: If the value of 11-22 is too low and the load is reduced the motor may become unstable.

11-23: Detection level of automatic energy saving

Set the automatic energy saving output power detection level.

11-24: Coefficient of automatic energy saving

The coefficient is used to tune the automatic energy saving. Adjust the coefficient while running the inverter on light load while monitoring the output power. A lower setting 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 carrier frequency reduction selection (11-03).

If automatic carrier frequency reduction is disabled (11-03=0), the output frequency is reduced by 30% of the nominal motor speed when an overheat condition is detected.

If automatic carrier frequency reduction is enabled (11-03=1), the output frequency is reduced by 30% of the nominal motor speed when the carrier frequency is at its minimum setting.

11-29=0: Auto de-rating selection disabled, carrier frequency is based on 11-01 or 11-03.

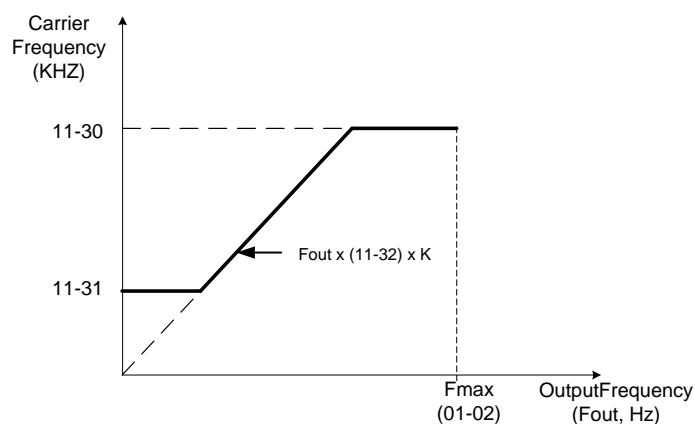
11-29=1: Auto de-rating selection is enabled.

11- 30	Variable Carrier Frequency Max. Limit
Range	【2~16】 KHz
11- 31	Variable Carrier Frequency Min. Limit
Range	【1~16】 KHz
11- 32	Variable Carrier Frequency Proportional Gain
Range	【00~99】

Carrier frequency method 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.

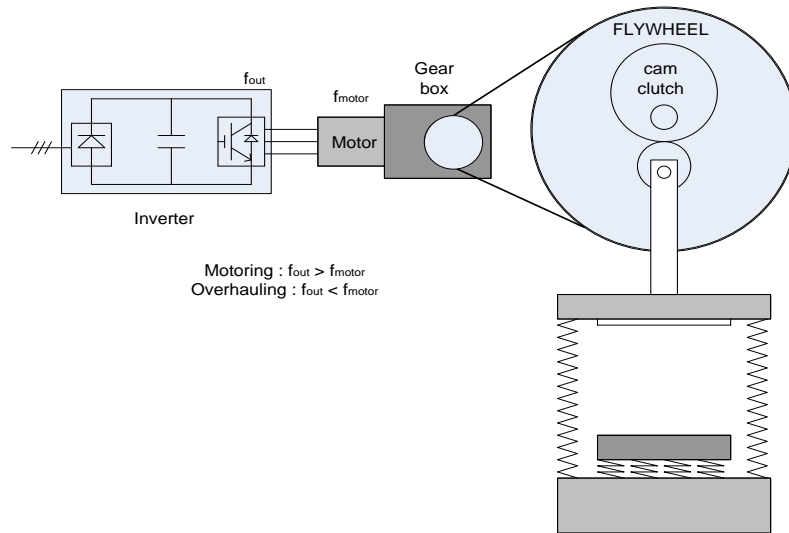


Figure 4.3.80.a Stamping Operation

Over-voltage prevention (OVP) function monitors the DC-bus voltage and adjusts the speed reference, acceleration and deceleration rate, to prevent the inverter from tripping on an overvoltage.

When the speed reference is reduced, the motor will start to decelerate. When the inverter is operating at a fixed output frequency and excessive regenerative energy back to the inverter is detected the inverter will accelerate the motor in order to reduce the DC-bus voltage. Refer to figure 4.3.80.b.

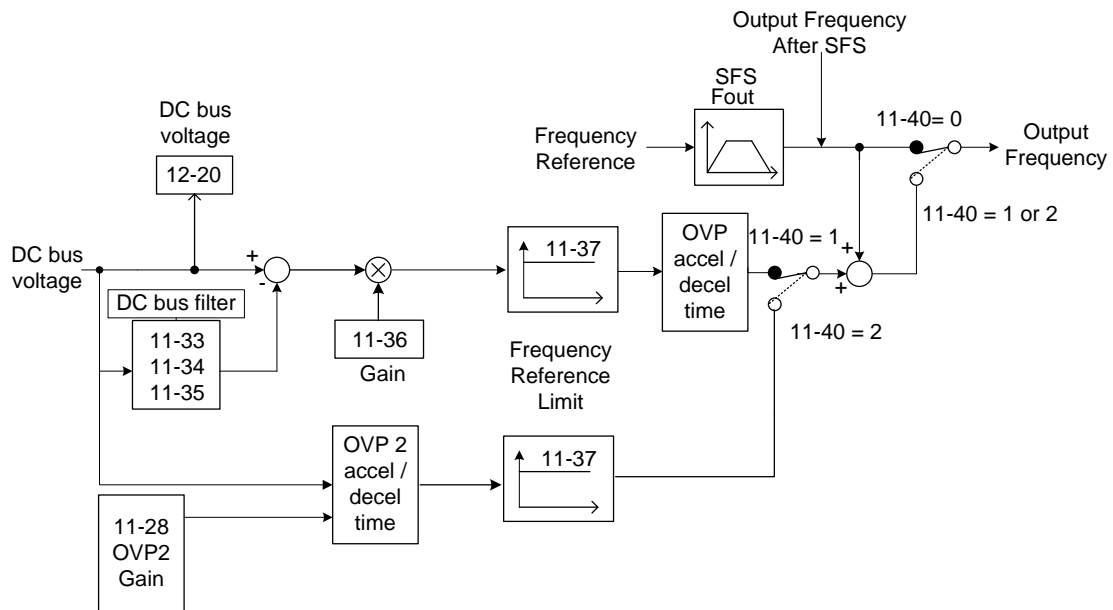


Figure 4.3.80.b operation

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 4.3.80.c.

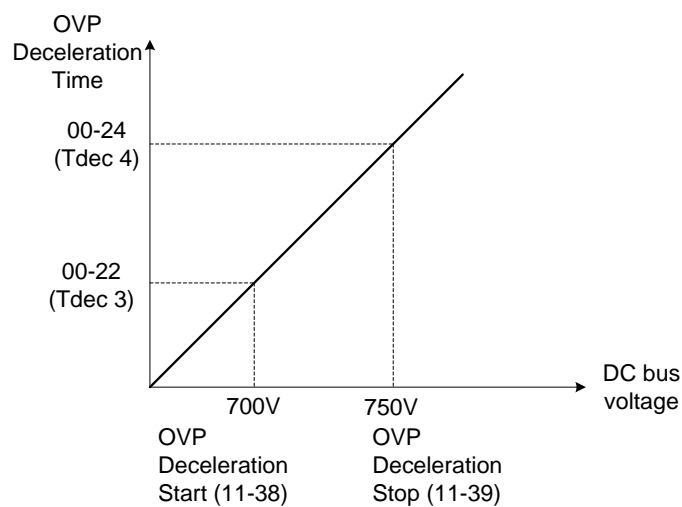


Figure 4.3.80.c OVP deceleration time

3) When the inverter is stopped, the deceleration rate can be set with parameter 00-15 (Tdec1). In case the DC voltage is too high, the inverter will decelerate based on the OVP deceleration time as shown in Figure 4.3.92.

- 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.4.3.80.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.4.3.81 for the process diagram of multi-function digital output (03-11~03-12) when reference frequency loss occurs.

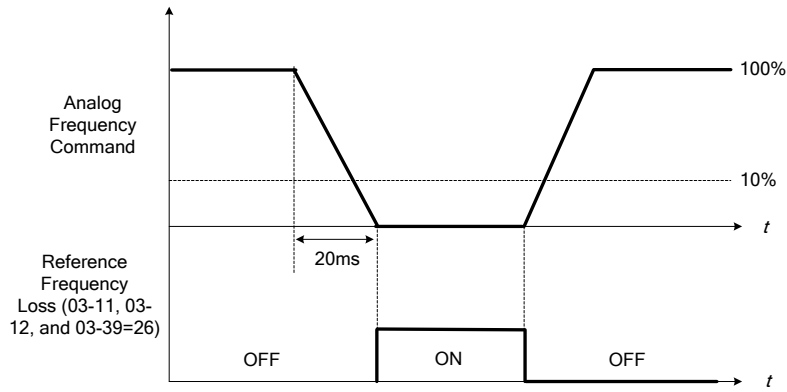


Figure 4.3.81 Operation for reference frequency loss

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 or deceleration time does not include the start and stop hold time. Refer to the Fig. 4.3.82.

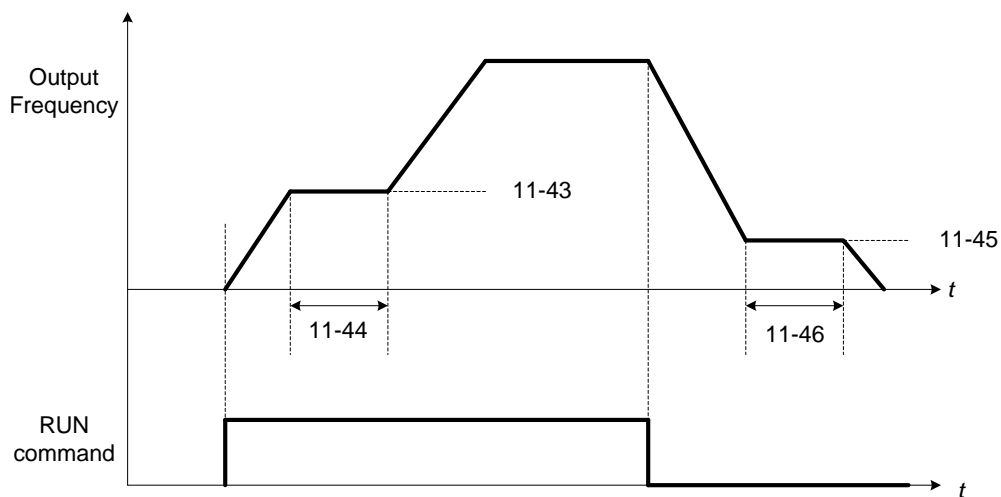


Figure 4.3.82 Reserved function

When the inverter is in stop mode, this function can also be used to prevent wind milling. In addition, it can be used for the purpose of braking using the motor to consume the braking energy resulting in a better controlled stop. Refer to the DC brake parameter 07-16 for DC braking during start.

Notes:

- The hold function at start is inactive when the hold frequency at start (11-43) is set to a value less than Fmin (01-08).

- The hold function at stop is inactive when the hold frequency at stop (11-45) is set to a value less than Fmin (01-08).

11- 47	KEB Deceleration Time
Range	【0.0~25.5】 Sec
11- 48	KEB Detection Level
Range	200V : 【190~210】 V 400V : 【380~420】 V

KEB function can be used to keep the inverter from tripping on a under voltage condition due to a momentary power-loss. To enable the KEB function set parameter 11-47 to a value greater than 0.0 sec.

Upon detection of a power-loss the inverter uses the KEB deceleration time (11-47) to decelerate the motor and using the regenerative energy from the motor to maintain the DC-bus at a nominal level.

11-48: KEB detection level

If the DC-bus voltage falls below the value set in 11-48, the KEB is activated and the inverter starts decelerating according to the value set in 11-47.

To accelerate back to the original output frequency one of the digital inputs (03-00 to 03-05) set for 48 (KEB acceleration) has to be activated and the DC voltage has to rise above 11-48 + delta V (Delta V = +10V for 200V series, Delta V = +20 V for 400V series).

Refer to the example in Fig.4.3.83.

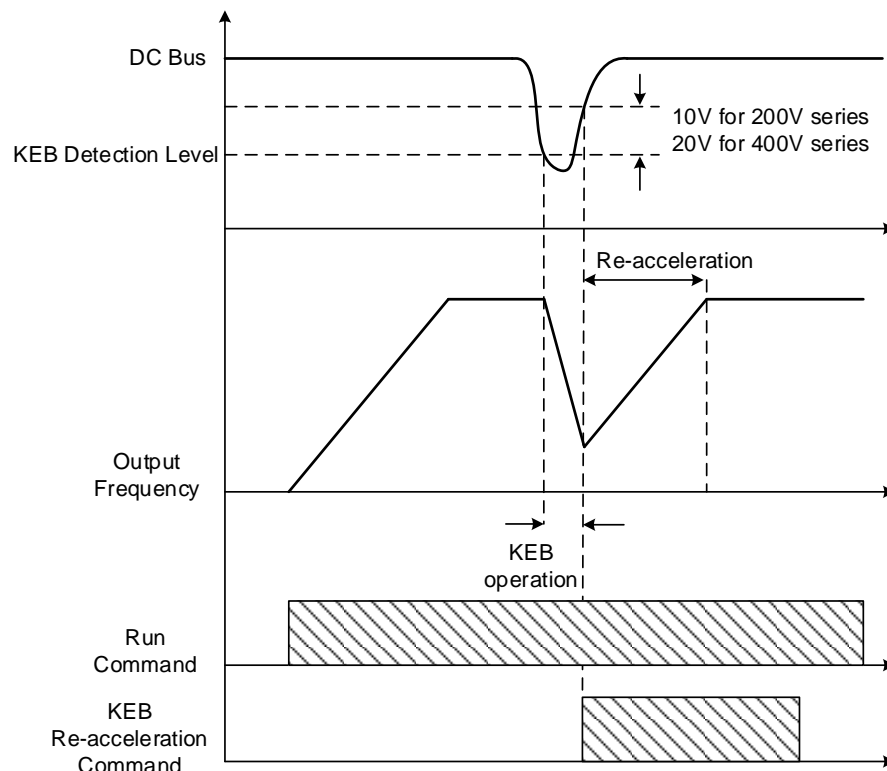


Figure 4.3.83 KEB operation

11- 51	Braking Selection of Zero Speed
Range	【0】 : Disable 【1】 : Enable

11-51: Operation selection of zero-speed braking

In V/F control mode, the DC braking operation can be used to the motor shaft.
Set 11-51 to select zero-speed braking operation to 1 to enable this function.

To use DC braking operation set parameter 00-02 (operation command selection) to 1 and parameter 00-05 (frequency reference selection) to 1, the operation command and frequency reference are now set for external control. When the frequency reference is 0V (or less than 4mA), and the operation command is turned on, the zero-speed 'DC' braking operation is activated and holding torque is generated using DC braking.

Refer to Fig.4.3.84 for more information on zero-speed DC braking operation.

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

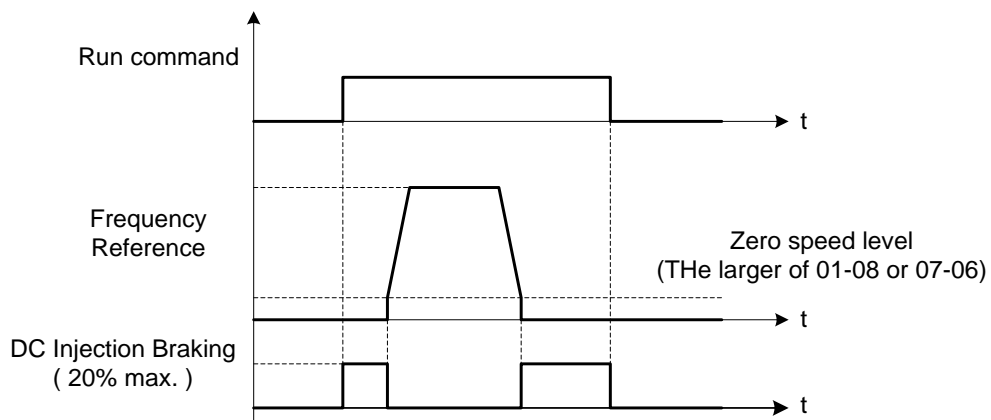


Figure 4.3.84 Zero-speed braking operation

11- 54	Initialization of Cumulative Energy
Range	【0】 : Do not Clear Cumulative Energy 【1】 : Clear Cumulative Energy

Reset the cumulative energy (KWHr) (12-67) and the cumulative energy (MWHr) (12-68) via parameter 11-54.

11- 55	STOP Key Selection
Range	【0】 : Stop Key is Disabled when the Operation Command is not Provided by Keypad. 【1】 : Stop Key is Enabled when the Operation Command is not Provided by Keypad.

11-55= 0: Stop button disabled when operation command is set for terminals (00-02=1) or communication (00-02=3).

11-55= 1: Stop button enabled.

11- 56	UP/DOWN Selection
Range	<p>【0】 : When UP/DOWN in Keypad is Disabled, it will be Enabled if Pressing ENTER after Frequency Modification.</p> <p>【1】 : When UP/DOWN in Keypad is Enabled, it will be Enabled upon Frequency Modification.</p>

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	<p>【0】 : Disable</p> <p>【1】 : Enable</p>

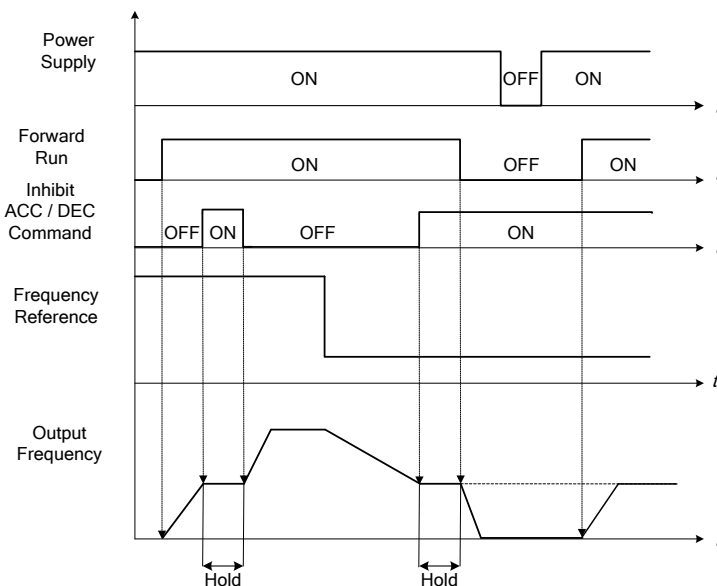
This function is enabled only when one of multi-function digital input terminals (03-00 to 03-07) is set to 11 (ACC / DEC Inhibition command).

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 %

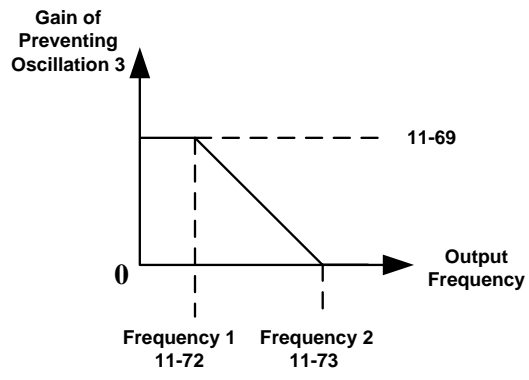
It is required to limit the preventing oscillation 3 upper limit within the setting value.

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 => <u>0</u> <u>0</u> <u>0</u> <u>0</u> <u>0</u> <= lowest bit The value range of each bit is 0~7 from the highest bit to the lowest bit,	
	【0】 : No display 【2】 : Output Voltage 【4】 : heatsink Temperature 【6】 : AI1 Value	【1】 : Output Current 【3】 : DC Bus Voltage 【5】 : PID Feedback 【7】 : AI2 Value

Note: The highest bit is used for power-up monitor. The 4 least significant bits can be used to customize the display sequence see section 4.1.3.

12- 01	PID Feedback Display Mode (LED)	
Range	【0】 : Display the Feedback Value 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.

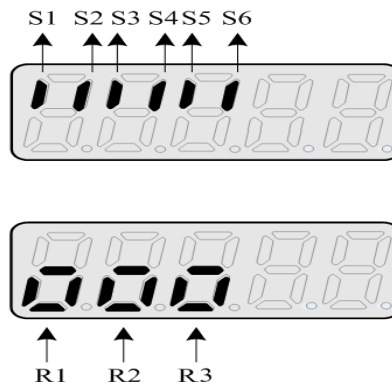
For example, if the line speed display of 12-03 is 1800, the keypad display is 900 when frequency output is 30Hz.

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

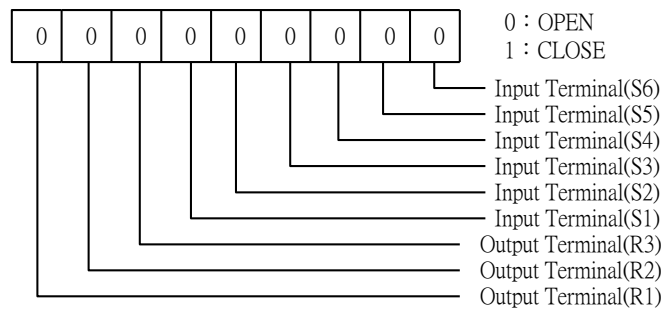
Terminals S1-S6 are represented using two segments of each digit. Segment turns on when input is active. The bottom segments of each of the first three digits are used to represent the digital outputs (R1, R2, R3). Segments turn on when output is active.

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

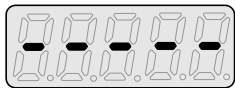
1 to 8 Relay card is installed.

24-00=1

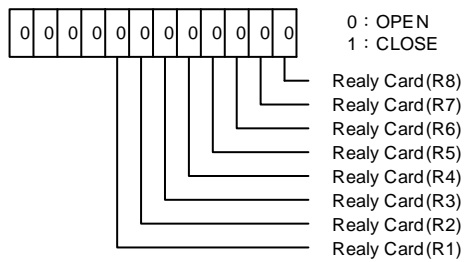
24-07=0: Relay is ON and RUN.

Display sequency:

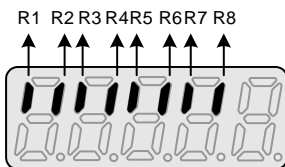
LED display (without output):



LCD display:



LED display (when input and output is active):



10-03=xxx1b

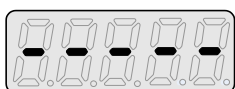
Control board Relay is installed.

24-00=1

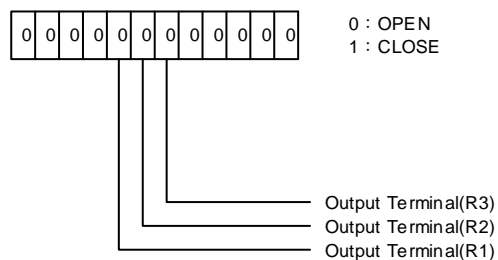
24-07=1: Relay is ON and RUN.

Display sequence:

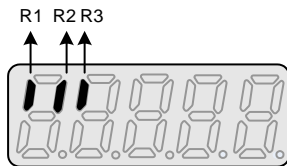
LED display (without output):



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	<p>【0】 : Only parameter 13-06 and frequency command parameters in main screen are writable</p> <p>【1】 : Only user parameter is enabled.</p> <p>【2】 : All parameters are writable.</p>

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.

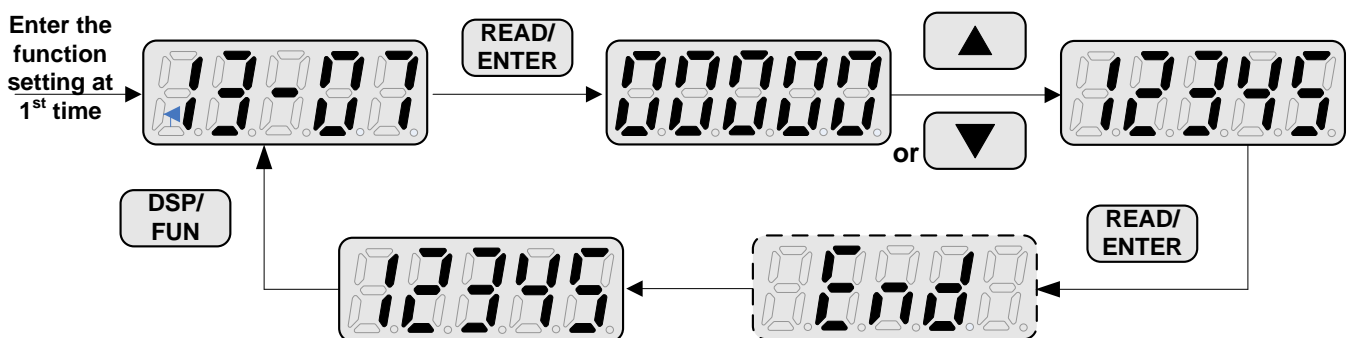
LED Main Frequency can be set in the main frequency display

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

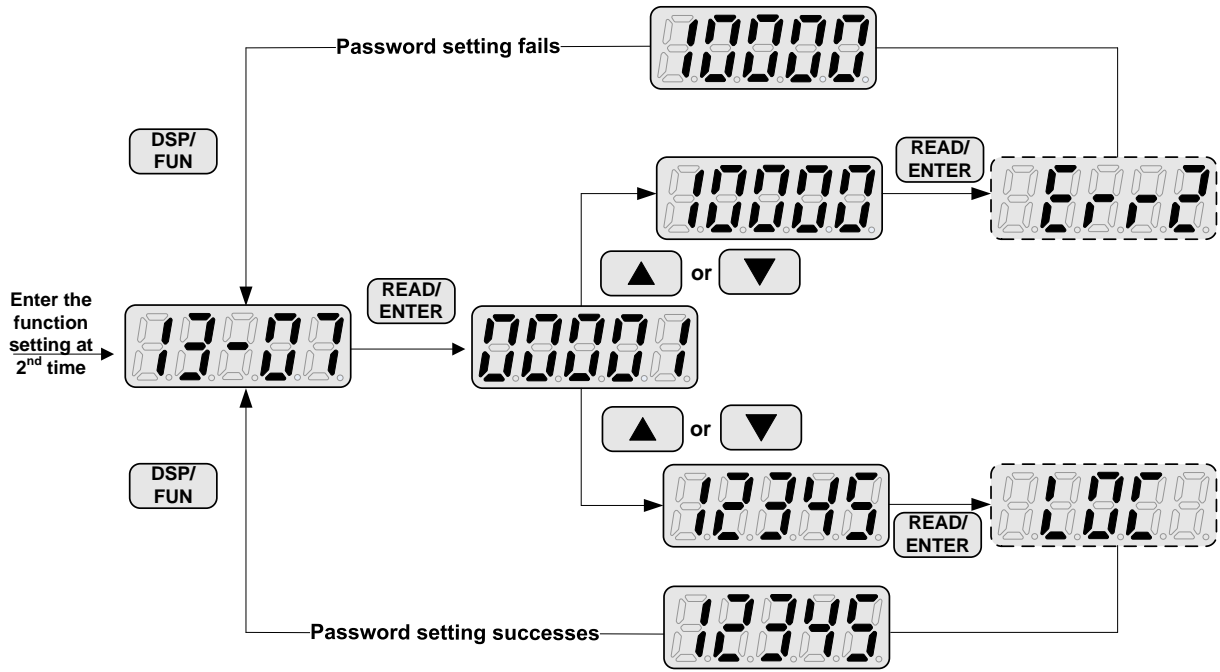
When the setting value of parameter 13-07 is enabled (13-07 > 0), all the parameters can not be adjusted except the frequency in main screen so user needs to input the password to adjust it.

Password setting:

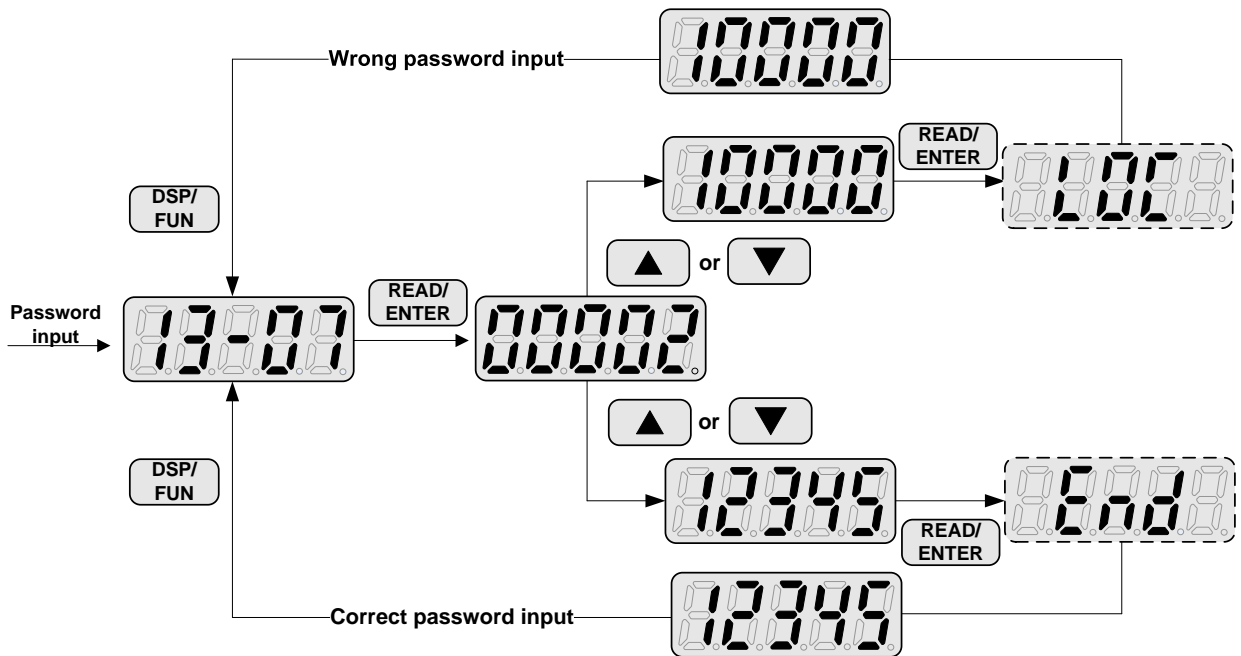
First step:



Second step:



Password Input :



13- 08	Restore Factory Setting
Range	<p> 【0】 : No Initialization 【1】 : Reserved 【2】 : 2 Wire Initialization (220/440V, 60Hz) 【3】 : 3 Wire Initialization (220/440V, 60Hz) 【4】 : 2 Wire Initialization (230/415V, 50Hz) 【5】 : 3 Wire Initialization (230/415V, 50Hz) 【6】 : 2 Wire Initialization (200/380V, 50Hz) 【7】 : 3 Wire Initialization (200/380V, 50Hz) 【8】 : PLC Initialization 【9】 : 2 Wire Initialization (230V/460V, 60Hz) 【10】 : 3 Wire Initialization (230V/460V, 60Hz) 【11】 : 2 wire Initialization (230V/400V, 60Hz) 【12】 : 3 wire Initialization (230V/400V, 60Hz) 【13】 : 2 wire Initialization (230V/400V, 50Hz) 【14】 : 3 wire Initialization (230V/400V, 50Hz) 【15】 : 2 wire Initialization (220V/380V, 50Hz) 【16】 : 3 wire Initialization (220V/380V, 50Hz) 【Others】 : Reserved </p>

Note: Main frequency setting 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.4.3.1.

Inverter input voltage (01-14) is automatically set to 220V (200V class) or 440V (400V class).

When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 60Hz.

13-08=3: 3-wire initialization (220V/440V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode.

Inverter input voltage (01-14) is automatically set to 220V (200V class) or 440V (400V class).

When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 60Hz.

13-08=4: 2-wire initialization (230V/415V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 230V (200V class) or 415V (400V class).

When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=5: 3-wire initialization (230V/415V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are

set for 3-wire start operation and stop command.

Inverter input voltage (01-14) is automatically set to 230V (200V class) or 415V (400V class).

When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=6: 2-wire initialization (200V/380V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 200V (200V class) or 380V (400V class).

When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=7: 3-wire initialization (200V/380V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command.

Inverter input voltage (01-14) is automatically set to 200V (200V class) or 380V (400V class).

When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=8: PLC initialization

Clear built-in PLC ladder logic and related values.

13-08=9: 2 wire initialization (230V/460V, 60Hz) – FACTORY DEFAULT

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 460V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=10: 3 wire initialization (230V/460V, 60Hz) – FACTORY DEFAULT

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 460V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=11: 2 wire initialization (230V/400V, 60Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=12: 3 wire initialization (230V/460V, 60Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=13: 2 wire initialization (230V/400V, 50Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=14: 3 wire initialization (230V/460V, 50Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=15: 2 wire initialization (220V/380V, 50Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1. The input voltage (01-14) will be set to 220V (200V class) or 380V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=16: 3 wire initialization (220V/380V, 50Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 220V (200V class) or 380V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

Note: Restore factory setting (13-08) will not 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 Situation 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 V1.12.**

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	<p>【0】 : Display unit is Hz (Resolution is 0.01Hz) 【1】 : Display unit is % (Resolution is 0.01%) 【2】 : Rpm display; motor rotation speed is set by the control modes to select IM (02-07)/ PM (22-03) motor poles to calculate. 【3~39】 : Reserved 【40~9999】 : 100% is XXXX with no decimals (integer only) 【10001~19999】 : 100% is XXX.X with 1 decimal 【20001~29999】 : 100% is XX.XX with 2 decimals 【30001~39999】 : 100% is X.XXX with 3 decimals</p>
16- 04	Selection of Engineering Unit
Range	<p>【0】 : No Unit 【1】 : FPM 【2】 : CFM 【3】 : PSI 【4】 : GPH 【5】 : GPM 【6】 : IN 【7】 : FT 【8】 : /s 【9】 : /m 【10】 : /h 【11】 : °F 【12】 : inW 【13】 : HP 【14】 : m/s 【15】 : MPM 【16】 : CMM 【17】 : W 【18】 : KW 【19】 : m 【20】 : °C 【21】 : RPM *1 【22】 : Bar *1</p>

	【23】 : Pa 【24】 : KPa	*1
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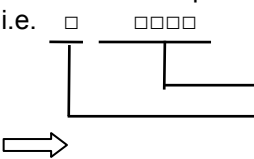
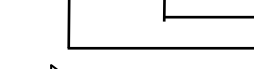
*1: It is new added in inverter software V1.4.

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.

16-03	Set / displayed contents			
0	0.01 Hz			
1	0.01 % (maximum output frequency 01-02=100%)			
2	RPM (RPM = 120 x reference frequency / numbers of motor pole. The numbers of motor pole is set by 02-07 in the control modes of V/F or SLV and is set by 22-03 in PMSLV.)			
3-39	Reserved			
00040 - 39999	Set the decimal point by using the fifth place. i.e. 			
	 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>			
	16-03	Display	Display unit	Display example
00040 - 39999	□□□□	use 16-04 setting	Example: 100 % speed is 0200 > set 16-03=00200 (from 05-01, 06-01 to 06-15, set range from 0040 to 9999). > set 16-04=0 (no unit)	
10001 - 19999	□□□. □		Example: 100 % speed is 200.0 CFM > set 16-03=12000 (05-01, 06-01 to 06-15, set range from 0000 to 9999). > set 16-04=2 (CFM) > 60% speed will be displayed as 120.0 CFM	
20001 - 29999	□□. □□		Example: 100 % speed is 65.00°C > set 16-03=26500 (05-01, 06-01 to 06-15, set range from 0000 to 9999) > set 16-04=20 (°C) > 60% of speed is displayed as 39.00 °C	
30001 - 39999	□. □□□		Example: 100 % speed is 2.555 m/s > set 16-03=32555 > set 16-04=14 (m/s) > 60% speed is displayed as 1.533 m/s	

16- 05	LCD Backlight
Range	【0~7】

Adjust the screen contrast of the digital operator. If it is set to 0, the screen backlight is turned off.

16- 07	Copy Function Selection
Range	【0】 : Do not copy parameters 【1】 : Read inverter parameters and save to the operator. 【2】 : Write the operator parameters to inverter. 【3】 : Compare parameters of inverter and operator.
16- 08	Selection of Allowing Reading
Range	【0】 : Do not allow to read inverter parameters and save to the operator. 【1】 : Allow to read inverter parameters and save to the operator.

LCD digital operator with built-in memory (EEPROM) can be used to store and retrieve parameters:

- (1) Read: Save inverter parameters to the digital operator (INV → OP).
- (2) Write: Write the parameters from the digital operator to the inverter and save (OP → INV).
- (3) Verify: Compare the inverter parameters against the parameters in the digital operator.

16-07=0: No action

16-07=1: Read (all parameters are copied from the inverter to the keypad).

16-07=2: Write (all parameter are copied from the keypad to the inverter).

16-07=3: Verify (Compare the set value of the inverter to the parameter of the digital operator).

Set 16-08 = 0, to prevent the saved parameter data stored in the digital operator from accidentally being overwritten.

When parameter 16-08=0 and the read operation is executed (16-07=1) a warning message of "RDP Read Prohibited" will be displayed on the keypad and the read operation is cancelled.

Refer to the following steps for copy function operation.

For the write-in operation requires the following items to match.

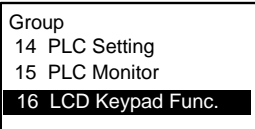
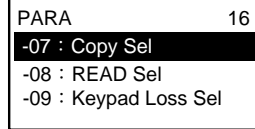
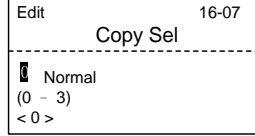
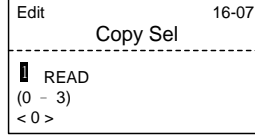
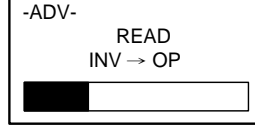
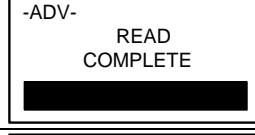
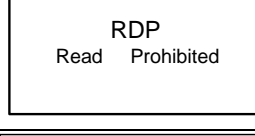
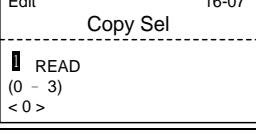
- (1) Software version
- (2) Control method
- (3) Inverter type
- (4) Inverter rated capacity and voltage

Set one of the parameters 03-00 to 03-05 (multi-function digital input selection) to 49 (Enable the parameter write-in function) to enable or disable the parameter write-in function.

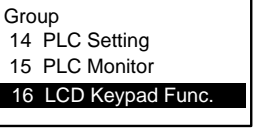
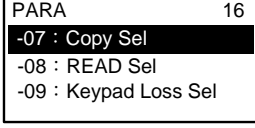
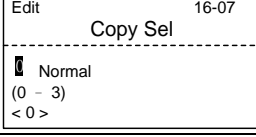
When terminal is active, parameters can be copied from the digital operator to the inverter. When the terminal is not active inverter parameters are prohibited from write-in, excluding the reference frequency (00-05).

Note: Parameter 16-11 (RTC date setting) and 16-12 (RTC time setting) require resetting, after parameter setting in the keypad is written and saved in the inverter (OP→INV).

■ **READ : Copy inverter parameters to the keypad**

Steps	LCD Display (English)	Description
1		Select the copy function group (16) from the group menu.
2		Press the Read / Enter key and select parameter (16-07) copy sel.
3		Press the Read / Enter key to display the data setting / read screen (LCD display is inverted).
4		Change the set value to 1 (read) by using the up arrow key.
5		<ul style="list-style-type: none"> • Use Read / Enter key to enable the read operation, the display is shown as the left. • The bottom of LCD display will show a bar to indicate the read progress s.
6		"READ COMPLETE" will be displayed on the keypad when reading was successful.
		<ul style="list-style-type: none"> • The error message of "RDP Read Prohibited" may occur on the keypad when reading parameters from the inverter is prohibited. • If the error is displayed, press any key to remove the error message and go back to parameter 16-07.
7		When DSP/FUN key is pressed, the display returns to parameter 16-07.

■ **WRITE: Copy Keypad parameters to the Inverter**

Steps	LCD Display (English)	Description
1		Select the copy function group (16) from the group menu.
2		Press the Read / Enter key and select parameter (16-07) copy sel.
3		Press the Read / Enter key to display the data setting / read screen (LCD display is inverted).

Steps	LCD Display (English)	Description
4		Change the set value to 2 (write) by using the up arrow key.
5		<ul style="list-style-type: none"> • Use Read / Enter key to enable the read operation, the display is shown as the left. • The bottom of LCD display will show a bar to indicate the read progress.
6		<p>“WRITE COMPLETE” will be displayed on the keypad when writing was successful.</p> <ul style="list-style-type: none"> • Until the subsequent display of "Syslnit", please power off and restart.
		<ul style="list-style-type: none"> • The error message of “WRE Write Error ” may occur on the keypad when writing parameters to the inverter is prohibited. • If the error is displayed, press any key to remove the error message and go back to parameter 16-07.
7		When DSP/FUN key is pressed, the display returns to parameter 16-07.

■ **Verify: Compare Inverter Parameters against Keypad Parameters.**

Steps	LCD Display (English)	Description
1		Select the copy function group (16) from the group menu.
2		Press the Read / Enter key and select parameter (16-07) copy sel.
3		Press the Read / Enter key to display the data setting / read screen (LCD display is inversed).
4		Change the set value to 3 (verify) by using the up arrow key.
5		<ul style="list-style-type: none"> • Use Read / Enter key to enable the read operation, the display is shown as the left. • The bottom of LCD display will show a bar to indicate the read progress.
6		<p>“VERIFY COMPLETE” will be displayed on the keypad when writing was successful.</p>
		<ul style="list-style-type: none"> • The error message of “VRYE Verify Error ” may occur on the keypad when writing parameters to the inverter is prohibited. • If the error is displayed, press any key to remove the error message and go back to parameter 16-07.

Steps	LCD Display (English)	Description
7	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> <div style="display: flex; justify-content: space-between;"> Edit 16-07 </div> <div style="text-align: center; margin-top: 5px;">Copy Sel</div> <hr style="border-top: 1px dashed black;"/> <div style="display: flex; align-items: center;"> ▣ VERIFY </div> <div style="margin-top: 2px;">(0 - 3)</div> <div style="margin-top: 2px;">< 0 ></div> </div>	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.

Monitor	00:00
	Freq Ref
	12-16 = 000.00 Hz
	12-17 = 000.00 Hz
	12-18 = 0000.0A

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 parameter 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)
- Timer enables via multi-function digital input
- Selection for constant 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.

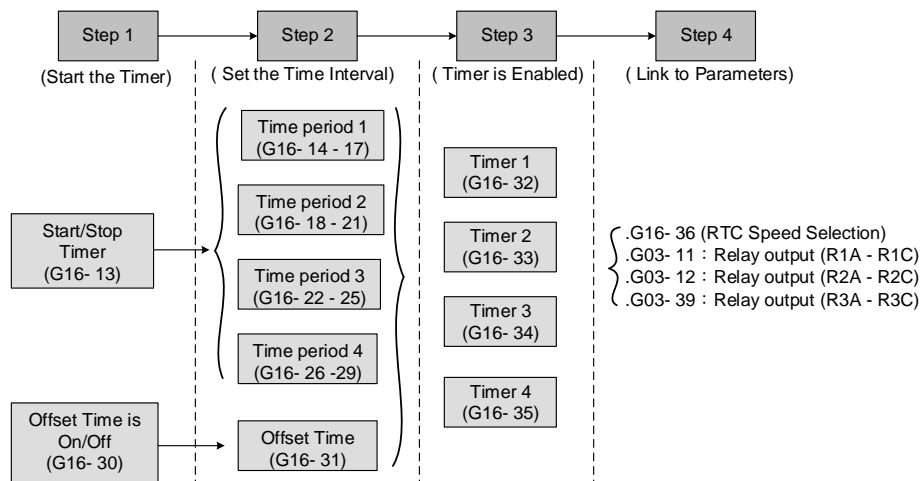


Figure 4.4.86 RTC structure

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=4: Timer 1 and 2 are enabled.

Reference frequency is enabled by the simultaneous operation of timer 1 and 2.

Notes:

- The inverter runs via the start of the specific timer without the influence of other timers.
- The 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 frequency 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).

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.

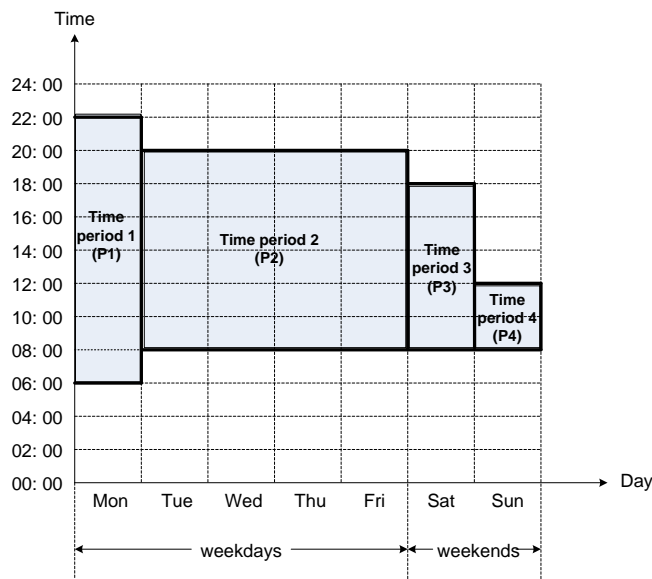


Figure 4.4.87 RTC timer (example)

- 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.

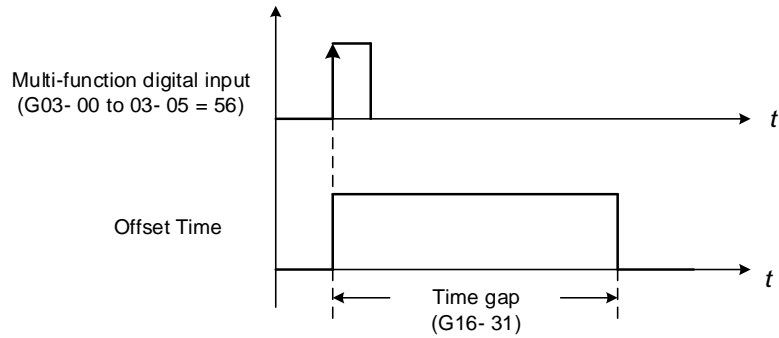


Figure 4.4.88 Operation of offset time

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 + P1), 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°C(77°F)	+/-3 sec./ day
-20 / +50 °C (-4/ 122°F)	+/-6 sec./ day

Group 17: IM Motor Automatic Tuning Parameters

17- 00	Mode Selection of Automatic Tuning
Range	【0】 : Rotation Auto-tune 【1】 : Static Auto-tune 【2】 : Stator Resistance Measurement 【4】 : Loop Tuning 【5】 : Rotational Auto-tuning Combination (Item: 4+2+0) 【6】 : Static Auto-tuning Combination (Item: 4+2+1)
17- 01	Motor Rated Output Power
Range	【0.00~600.00】 KW
17- 02	Motor Rated Current
Range	10%~200% of the inverter rated current in V/F control mode 25%~200% of the inverter rated current in SLV control mode
17- 03	Motor Rated Voltage^{*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 current 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).

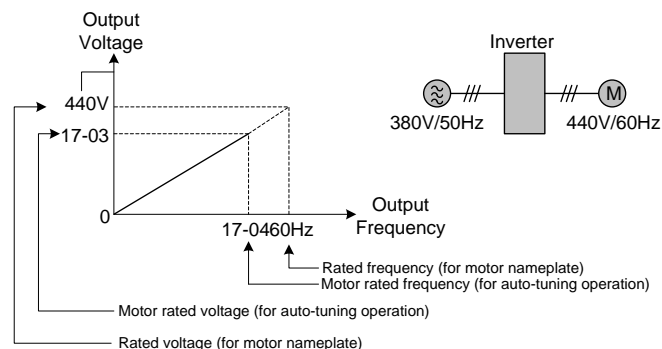


Figure 4.4.89 Rated voltage and frequency settings

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:

$$17-04 = (\text{Rated frequency of motor nameplate}) \times \frac{(\text{Inverter input power voltage})}{(\text{Rated frequency of motor nameplate})} = 60\text{Hz} \times \frac{380\text{V}}{440\text{V}} = 51.8\text{Hz}$$

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 operate 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) to 1.0 (factory default setting is 0.0 in V / F control mode)
3. For the operation with a load attached, measure the speed and adjust the slip gain (18-00) accordingly (increase in steps of 0.1).
 - If the motor speed is lower than frequency reference, increase the value of 18-00.
 - If the motor speed is higher than frequency reference, decrease the value of 18-00.

When the output current is greater than the no-load current (02-00), the slip compensation is enabled and the output frequency increases from f1 to f2. Refer to Fig.4.4.90., the slip compensation value is calculated as follows:

$$\text{Slip compensation value} = \text{Motor rated sync induction rotation difference} \times \frac{[\text{Output current (12-08)} - \text{motor no-load current (02-00)}]}{[\text{Motor output rated current (02-01)} - \text{motor no-load current (02-00)}]}$$

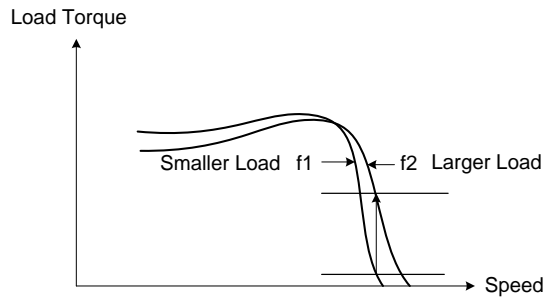


Figure 4.4.90 Slip compensation output frequency

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.

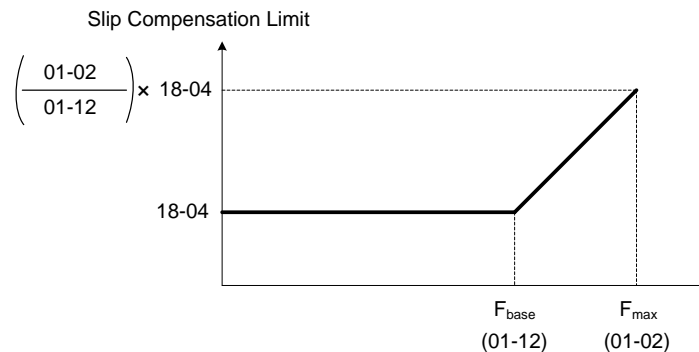


Figure 4.4.91 Slip compensation limit

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.

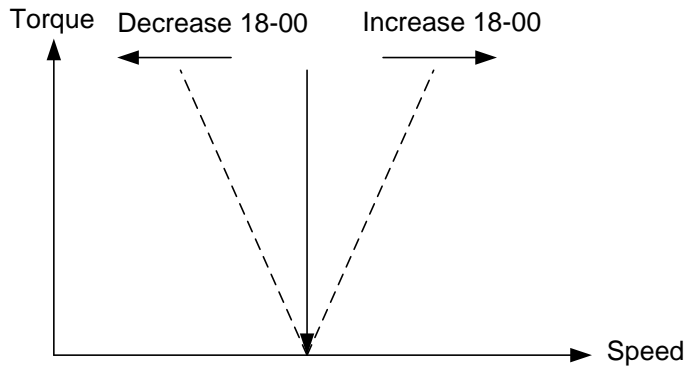


Figure 4.4.92 18-00 Effect on the torque and speed

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:

$$\text{Slip compensation gain} = \text{Slip compensation gain at low speed} + \frac{[\text{Slip compensation gain at high speed} \times \text{frequency reference}]}{[\text{Motor rated frequency}]}$$

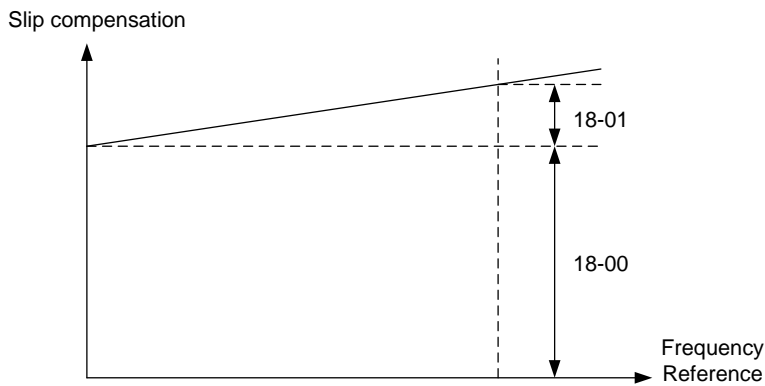


Figure 4.4.93 18-00/18-01 Slip compensation gain versus frequency reference

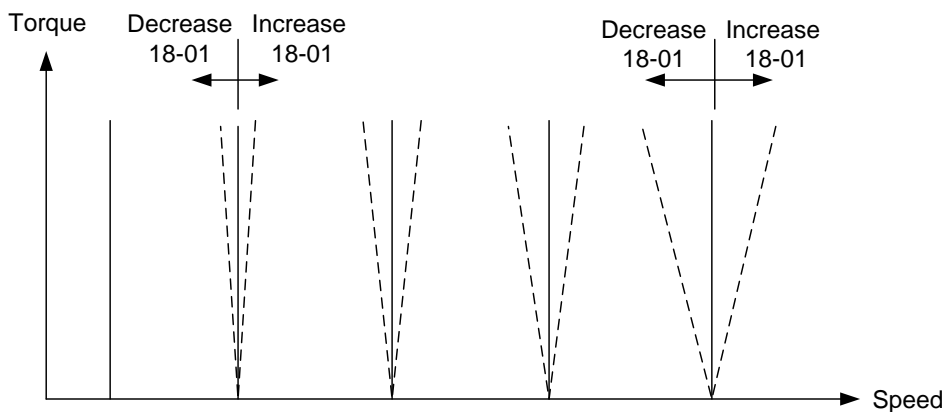


Figure 4.4.94 18-01 Effect on torque speed curve

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	<p>【0】 : PI speed control will be enabled only in constant speed. For accel/decel, only use P control.</p> <p>【1】 : Speed control is enabled either in constant speed or accel/decel.</p>
20- 08	ASR Delay Time
Range	【0.000~0.500】 Sec
20- 09	Speed Observer Proportional (P) Gain 1
Range	【0.00~2.55】
20- 10	Speed Observer Integral(I) Time 1
Range	【0.01~10.00】 Sec
20- 11	Speed Observer Proportional (P) Gain 2
Range	【0.00~2.55】
20- 12	Speed Observer Integral(I) Time 2
Range	【0.01~10.00】 Sec
20- 13	Low-pass Filter Time Constant of Speed Feedback 1
Range	【1~1000】 mSec
20- 14	Low-pass Filter Time Constant of Speed Feedback 2
Range	【1~1000】 mSec
20- 15	ASR Gain Change Frequency 1
Range	【0.0~599.0】 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.

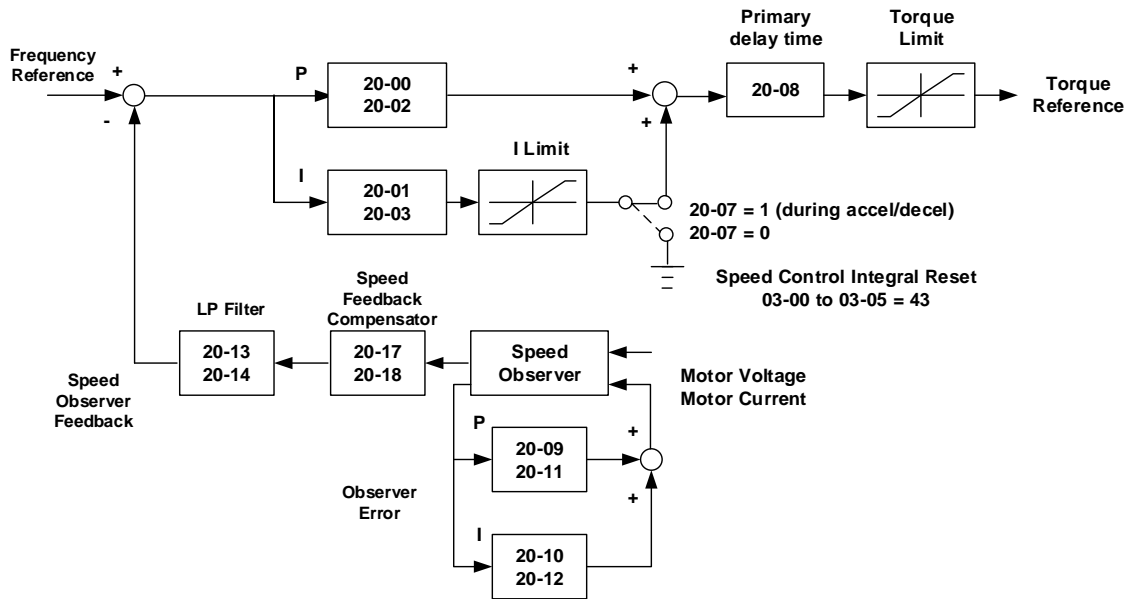


Figure 4.4.95 ASR block diagram (SLV mode)

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.

- 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.
- 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.
- 20-17 sets the low-speed compensation gain of the speed feedback.
- 20-18 sets the high-speed compensation gain of the speed feedback.
- 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.
- 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.
- Gain time constant is adjusted linearly when the speed command falls within the range of 20-15 to 20-16, for a smooth operation.

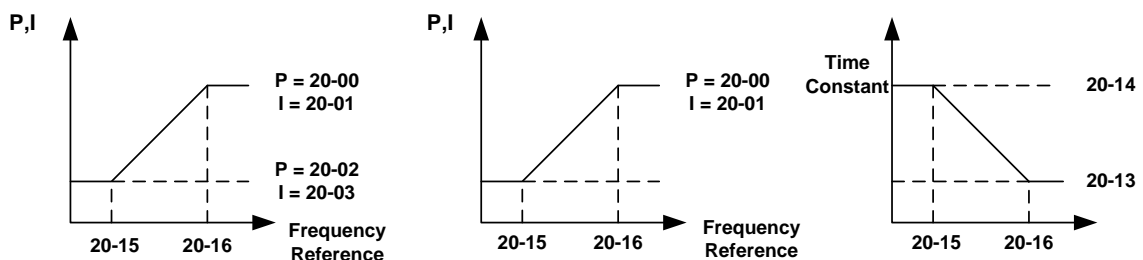


Figure 4.4.96 ASR gain setting (SLV mode)

Tune the speed control gain

Refer to the following steps:

- a. Gain adjustment of minimum output frequency
 - Motor running is at minimum output frequency (F_{min} , 01-08).
 - Maximum ASR proportional gain 2 (20-02) will not lead to instability.
 - Minimum ASR integration time 2 (20-03) will not lead 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 (F_{max} , 01-02).
 - Maximum ASR proportional gain 1 (20-00) will not lead to instability.
 - Minimum ASR integration time 1 (20-02) will not lead 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 constant 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.

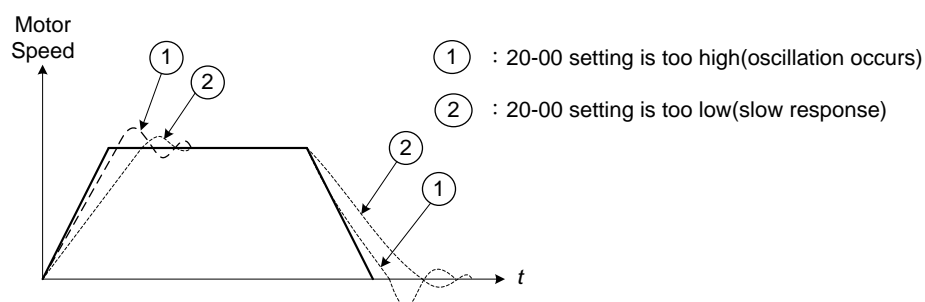


Figure 4.4.97 System response of ASR proportion gain

- 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.

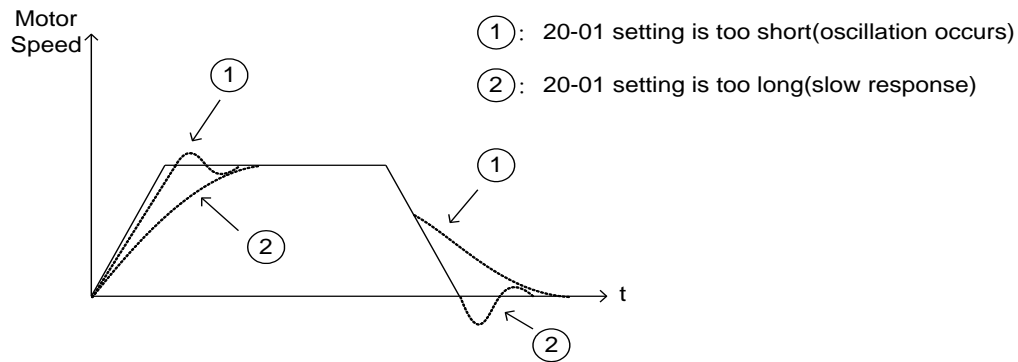


Figure 4.4.98 The response of ASR integral time

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 20-17 an offset is added to the torque-speed curve. Increase 20-17 when the no-load speed is lower than the frequency reference. Decrease 20-17 when the no-load speed is higher than the frequency reference. The effect on the torque-speed curve from 20-17 is shown as the following figure:

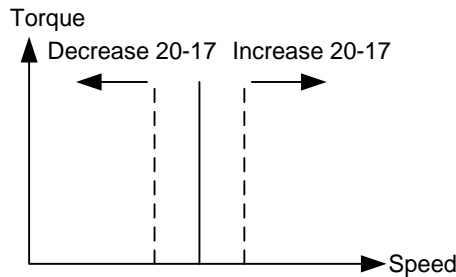


Figure 4.4.99 Effect on the torque-speed curve from 20-17

- 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 20-18 an offset is added to the torque-speed curve. Increase 20-18 when the no-load speed is lower than the frequency reference. Decrease 20-18 when the no-load speed is higher than the frequency reference. The effect on the torque-speed curve from 20-18 is shown as the following Fig.4.4.100.

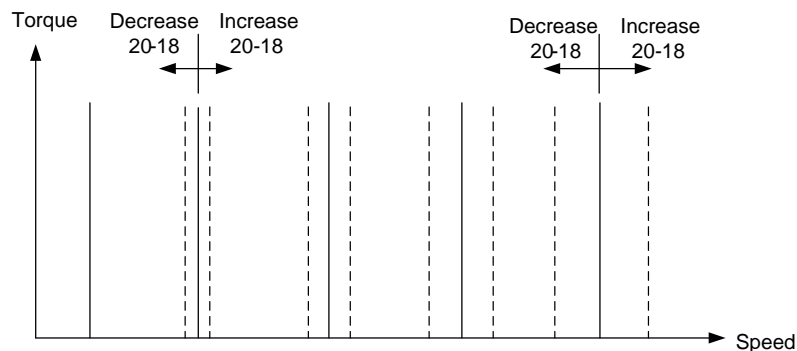


Figure 4.4.100 Effect on the torque-speed curve from 20-17

- 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 specifications of no-load speed circuit bandwidth at vector control:
 1. 50 Hz is at the control modes of SV / PMSV.
 2. 10 Hz is at the control modes of SLV / PMSLV.
- Speed response will be affected by kp adjustment, inertia, load and motor temperature, etc. so that the bandwidth decrease slightly in application.

20- 34	Derating of Compensation Gain
Range	【0.00~25600】
20- 35	Derating of Compensation Time
Range	【0~30000】 mSec

Derating of torque compensation function can reduce 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.

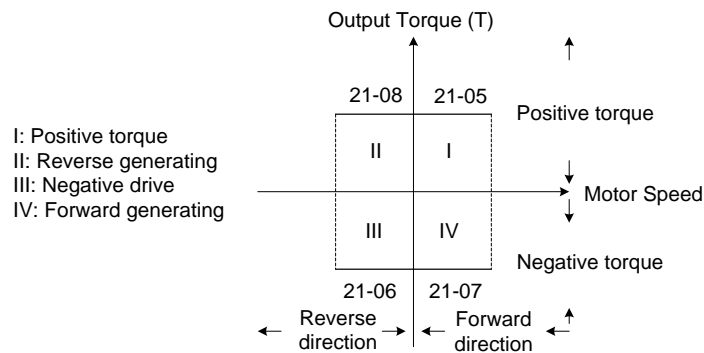


Figure 4.4.101 Torque limit setting

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.

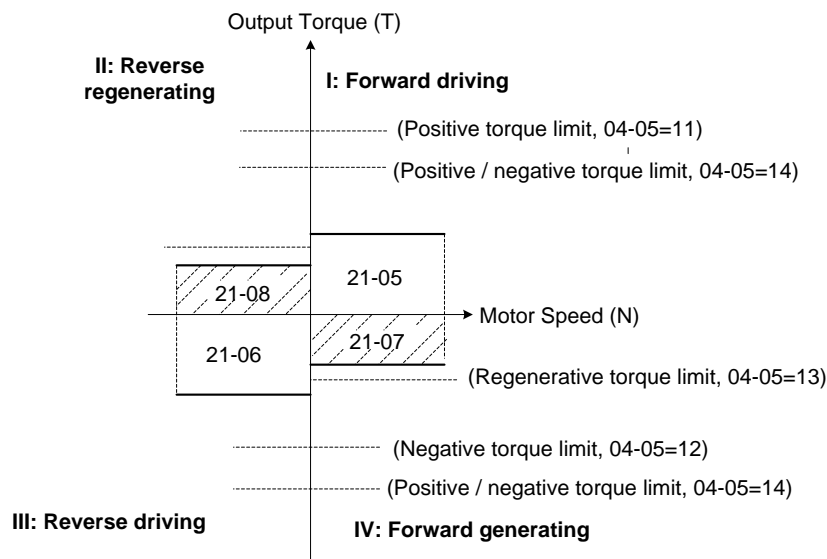


Figure 4.4.102 Analog input torque limit (AI2)

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 ~ 200】 V 400V: 【0 ~ 400】 V
22- 18	Flux-weakening Current Command Restriction
Range	【0 ~ 100】 %

*2: It is reserved in inverter software V1.4.

The PM parameter group can be restored to factory default by 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:

$$(\text{PM Motor rated rotation speed}) N = \frac{120 \times f \text{ (PM Motor rated frequency)}}{P \text{ (PM Motor pole number)}}$$

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 motor resistance 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	【1~100】 %
22-31	Speed Estimated Filter Value
Range	【1~2000】 Hz
22-32	MTPA Selection
Range	【0】 : Disabled 【1】 : Mode 1 【2】 : Mode 2 【3】 : Mode 3
22-33	MTPA Gain
Range	【000~400】 %
22-34	IPM Estimator Gain
Range	【0.1 ~ 500.0】
22-35	IPM Estimator Compensation
Range	【0 ~ 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 frequency 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.
- 2: Distribute D-Q-axis current command according to the torque command and restrict output voltage (12-19) to below the motor's rated voltage (22-01).
- 3: Distribute D-Q-axis current command according to the torque command and control the output voltage (12-19) to around the motor's rated voltage (22-01).

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.

IPM Estimator Compensation (22-35)

When the estimator mode (22-26) setting is 1, adjust the estimator compensation will change the output voltage. Adjustments can be made according to the following situation:

When the output voltage (12-19) is too low (Note 1), the compensation setting value must be set higher.

When the MPTA function (22-32) is at 1, and the output voltage is still too high (Note 2), adjust to a lower compensation setting value.

When the MPTA function (22-32) is at 2, and the output voltage is still too high, then increase the flux-weakening restrict (22-18) parameter setting value.

Note 1: When the permanent magnet motor is operating at no load frequency conditions, the output voltage should be greater than or equal to the motor back EMF coefficient stated on the nameplate.

Note 2: When the permanent magnet motor is operating at full load frequency conditions, the output voltage should be lesser than or equal to the motor's rated voltage stated on the nameplate.

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 inverter software.

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 pressure 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**,

$$((23-09) / (23-02)) * 100 \Rightarrow 23-09 = 13\% \text{ (Rounded to integer)}$$

$$((23-15) / (23-03)) * 100 \Rightarrow 23-15 = 50\% \text{ (Rounded to integer)}$$

When **23-20=1→0**,

$$((23-09) / 100) * 23-02 \Rightarrow 23-09 = 0.52\text{PSI}$$

$$((23-15) / 100) * 23-03 \Rightarrow 23-15 = 5.00\text{PSI}$$

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 displays the unit upon the setting value by parameter 23-36 and unit display of parameters 12-74,12-75,23-02,23-03,23-09,23-12,23-15,23-23-24,23-34,23-38,23-39 is switched at the same time.

23- 05	Display Mode Selection
Range	【0】 : Display of Target and Pressure 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.

The image shows a seven-segment display with two digits on the left and two digits on the right. The left digits are '20' and the right digits are '10'. There is a small horizontal line above the '2' and a small vertical line to the left of the '0' on the right side.

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.

The image shows a seven-segment display with three digits. The digits are '020'. There is a small horizontal line above the '0' and a small vertical line to the left of the '0' on the right side.

③ when 23-05=0002 : Led keypad only displays the pressure feedback value.

The image shows a seven-segment display with two digits on the left and two digits on the right. The left digit is '0' and the right digits are '10'. There is a small horizontal line above the '0' and a small vertical line to the left of the '0' on the right side.

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

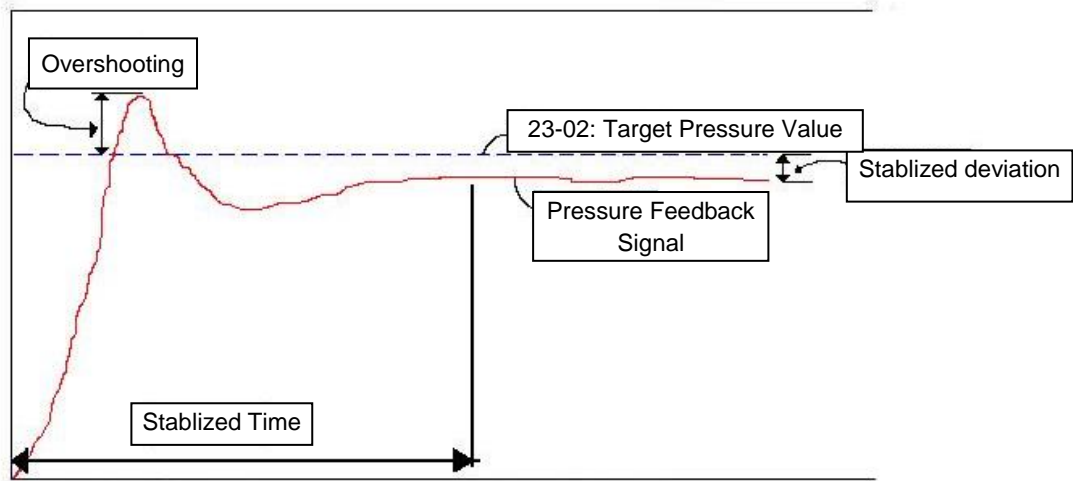


Figure 4.4.103 Diagram of pressure feedback value

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.

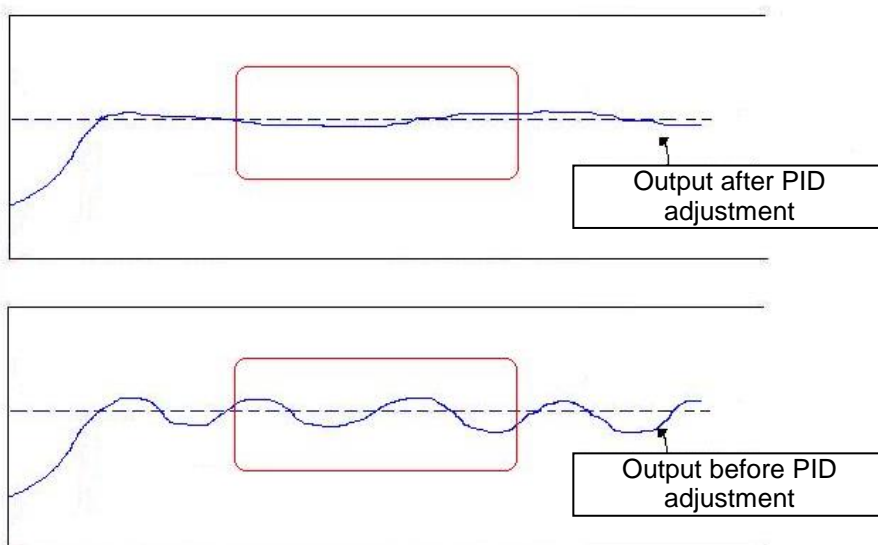


Figure 4.4.104 Diagram for PID parameter adjustment

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).

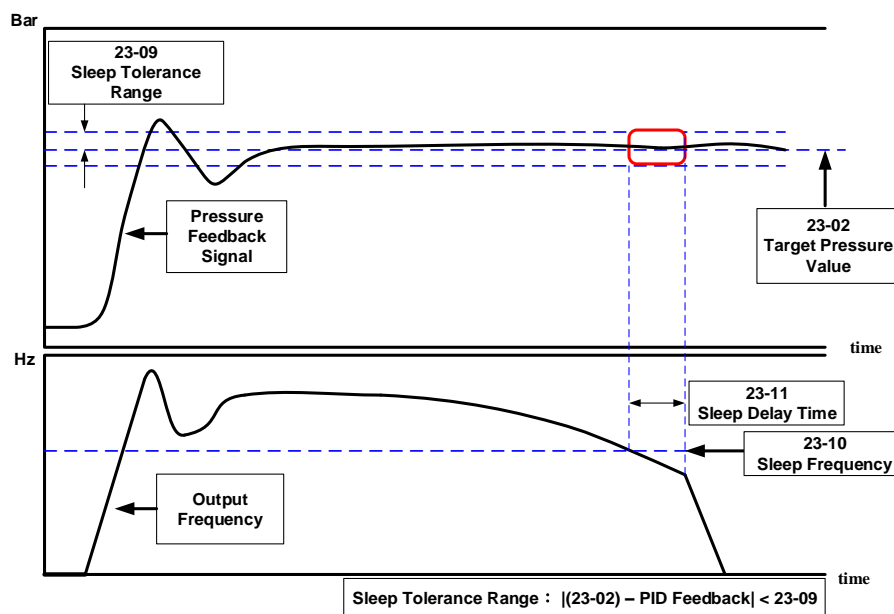


Figure 4.4.105 Diagram for stop time of constant pressure

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.

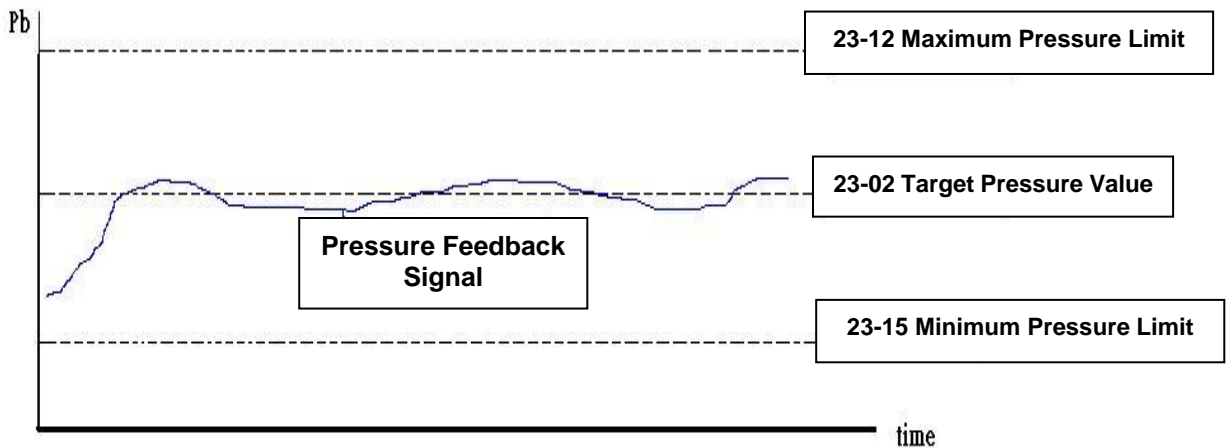


Figure 4.4.106 Diagram for pressure feedback limit

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.

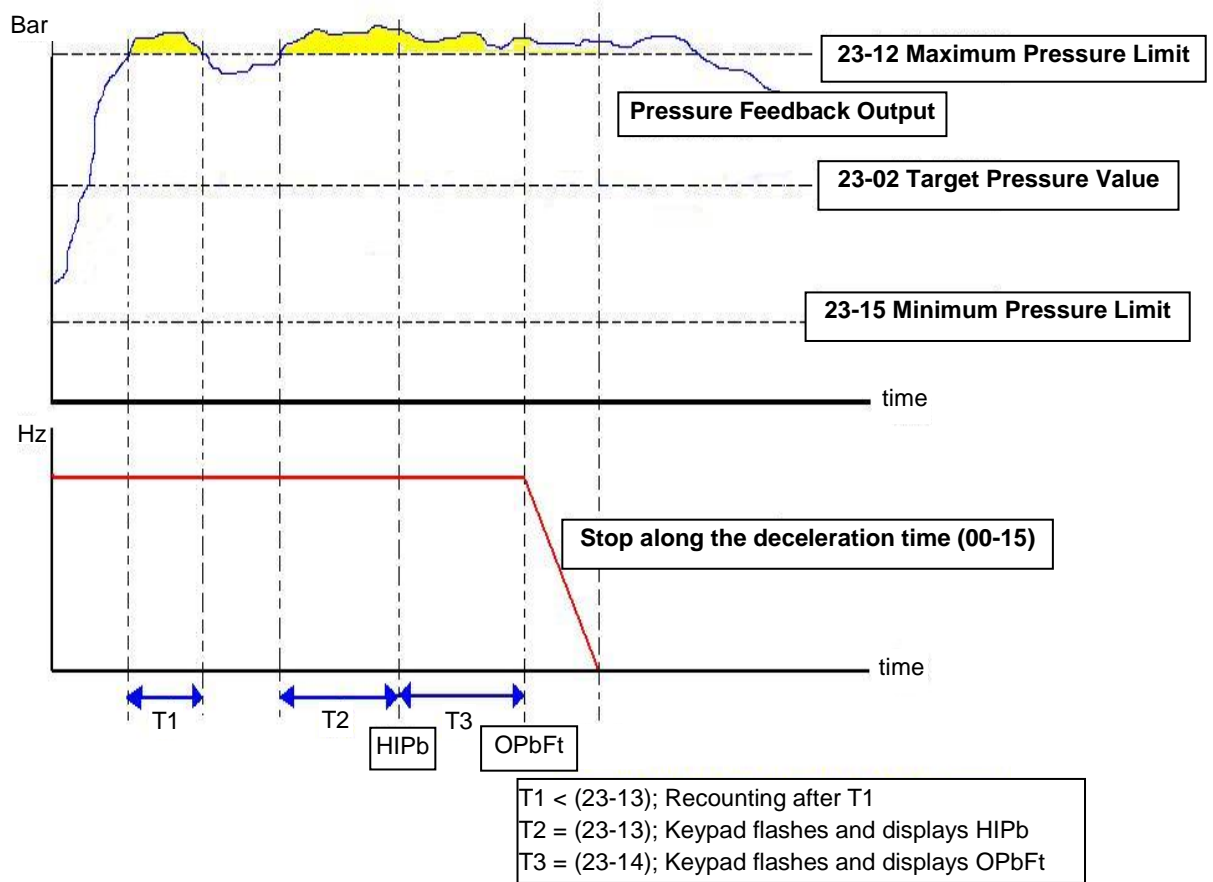


Figure 4.4.107 Diagram for warning to stop at high pressure limit

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.

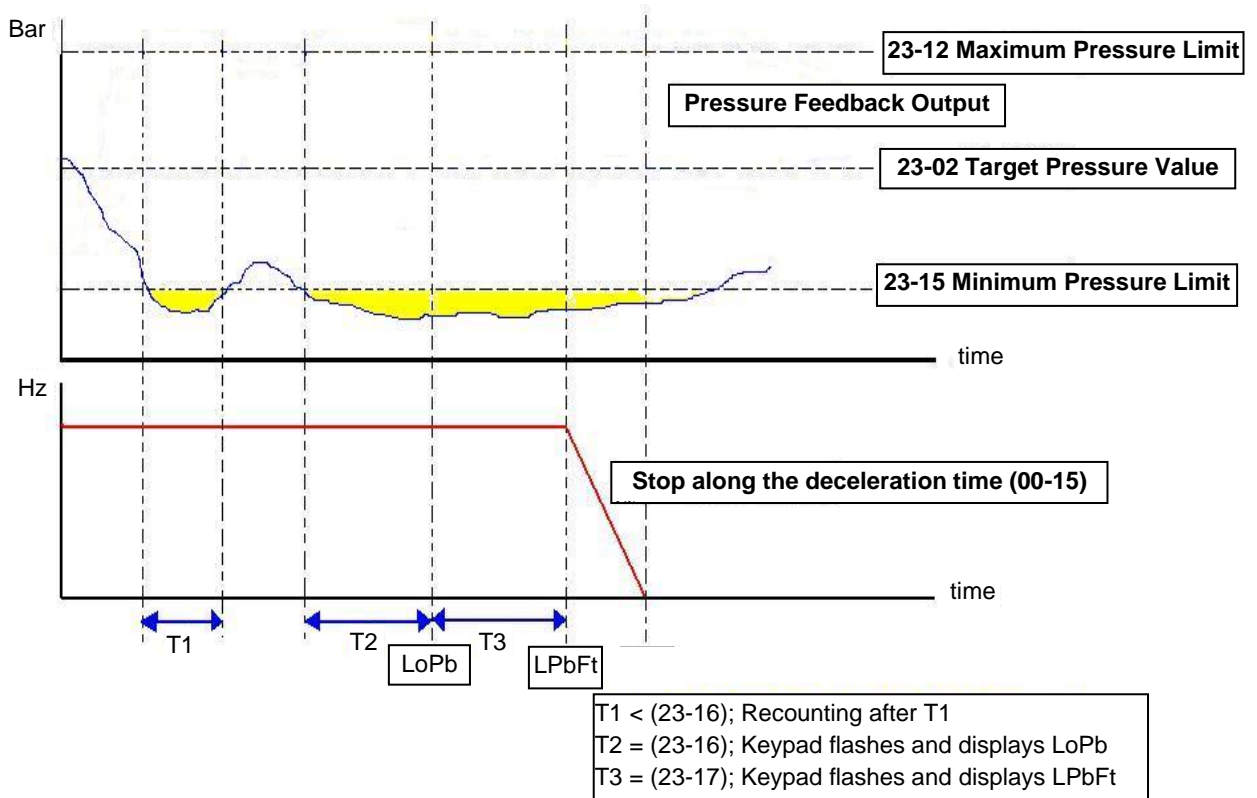


Figure 4.4.108 Diagram for warning to stop at low pressure limit

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 Pressure Detection
Range	【0.0 ~ 65.00】 PSI *1 【0~10】 % *2
23- 25	Period of Water Pressure Detection
Range	【0.0 ~ 200.0】 Sec
23- 26	Acceleration Time of Water Pressure Detection
Range	【0.1 ~ 600.0】 Sec
23- 27	Deceleration Time of Water Pressure Detection
Range	【0.1 ~ 600.0】 Sec

*1: 23-20=0, 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.

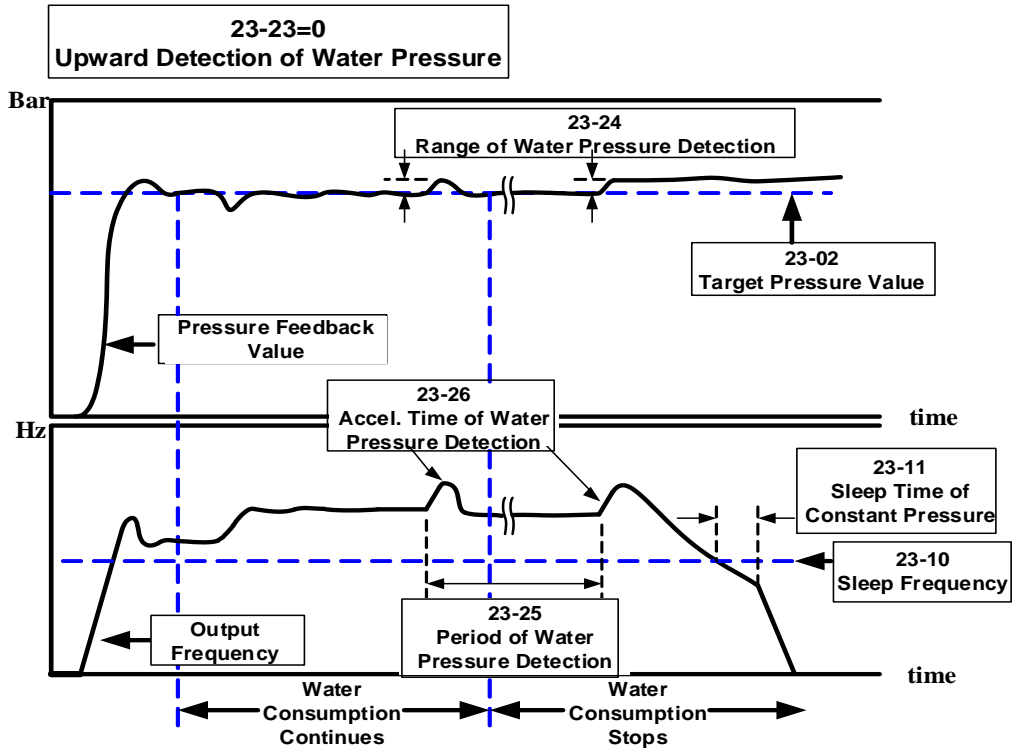


Figure 4.4.109 Diagram for upward detection of water pressure

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 frequently continues, it is recommended to extend the cycle of water pressure detection (23-25) so as the detection times can be reduced and the occurrence 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.

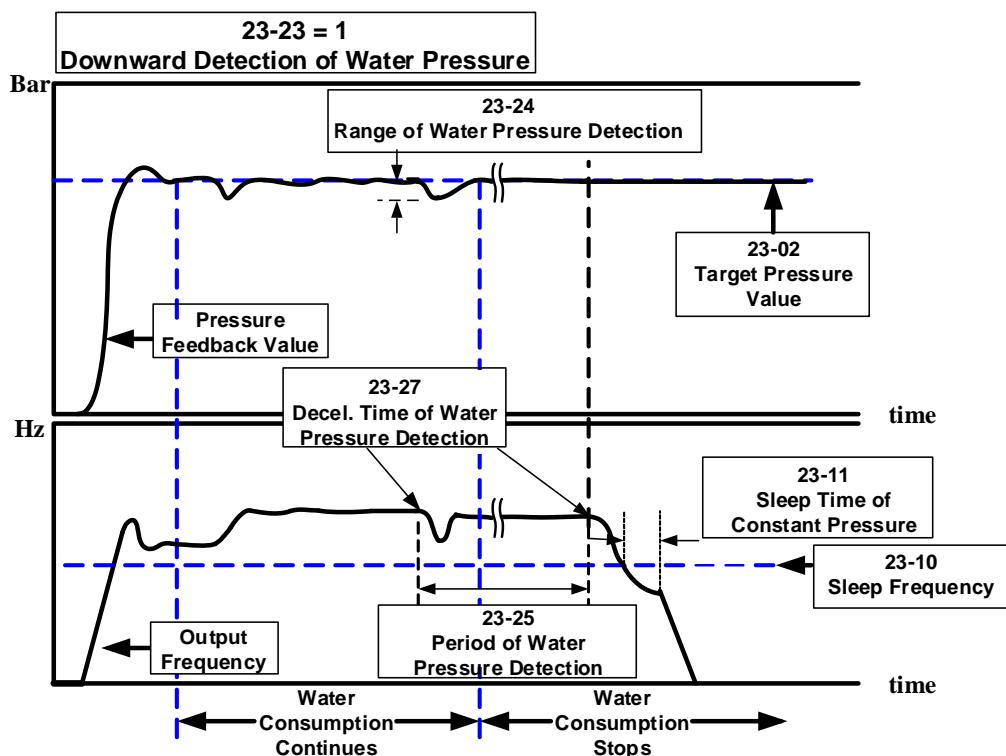


Figure 4.4.110 Diagram for downward detection of water pressure

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 frequently continues, it is recommended to extend the cycle of water pressure detection (23-25) so as the detection times can be reduced and the occurrence 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	<ul style="list-style-type: none"> Keep the pressure above the target pressure during this process. For strict and precise applications 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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	*Foreced 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.

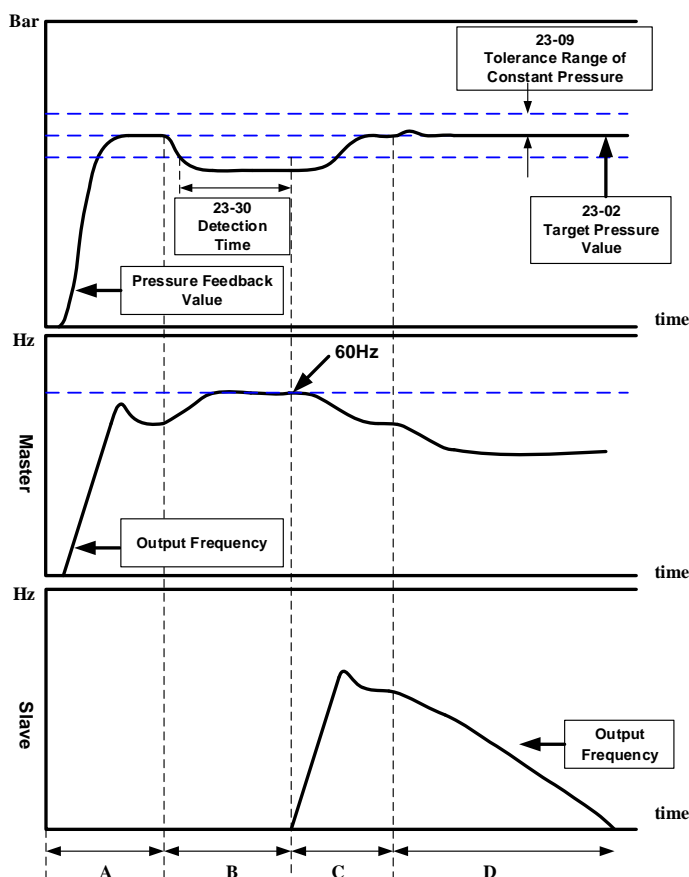


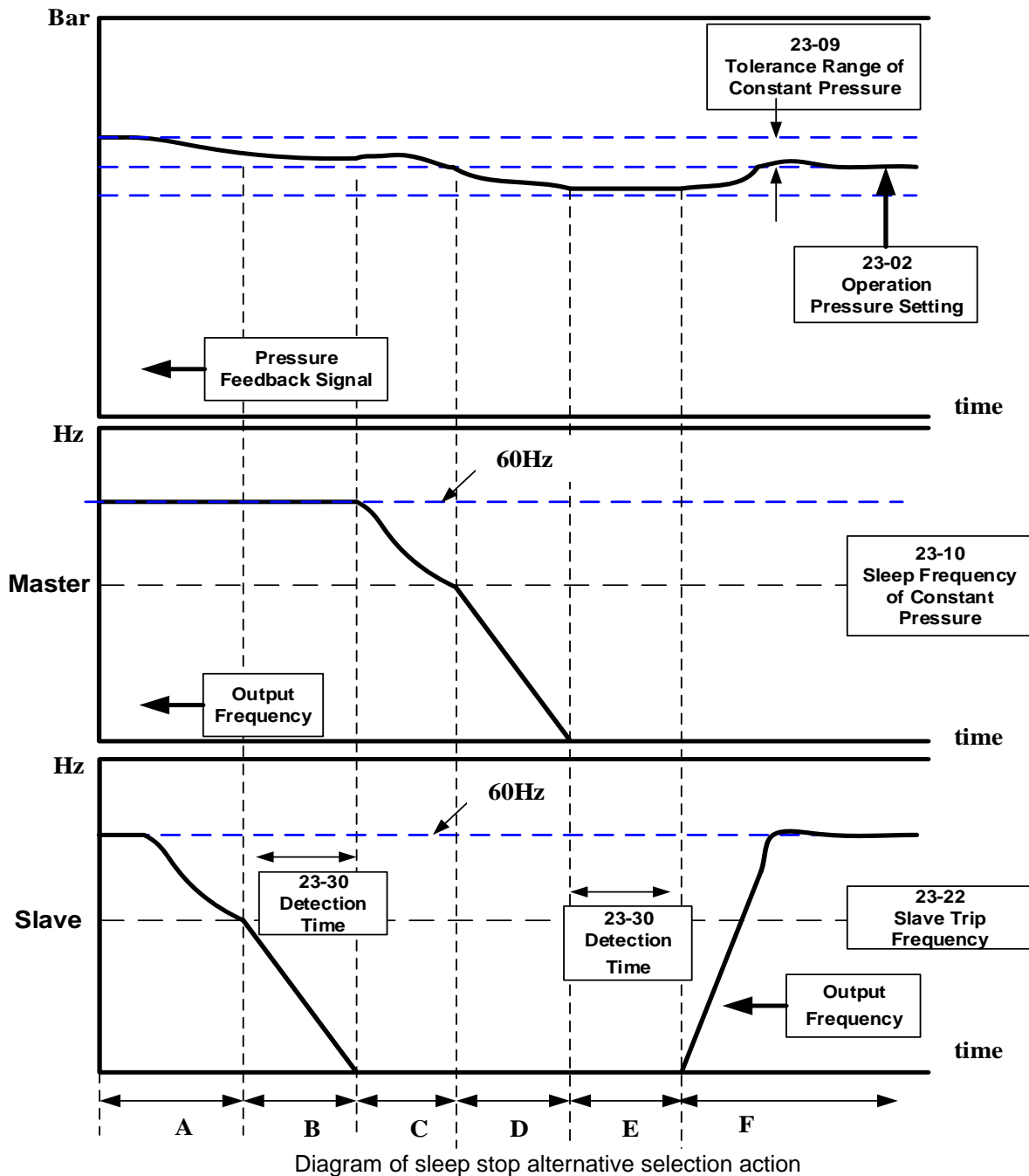
Figure 4.4.111 Dual pumps start up process

- 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.



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.

$$\frac{23-30}{00-14} \geq \frac{23-22}{01-02} \text{ ----- set method 1}$$

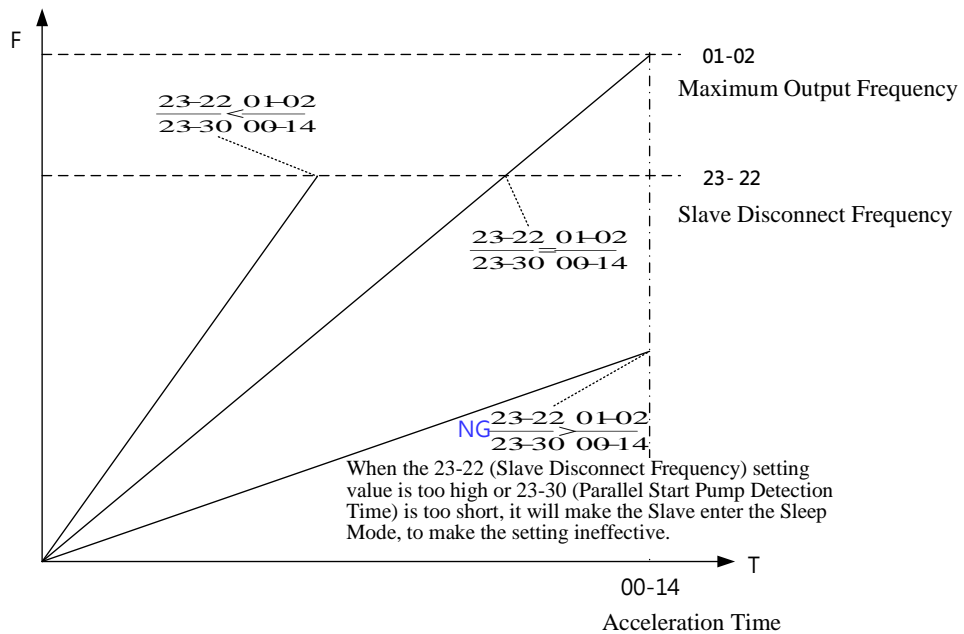


Diagram of requirements for waking up Slave

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.

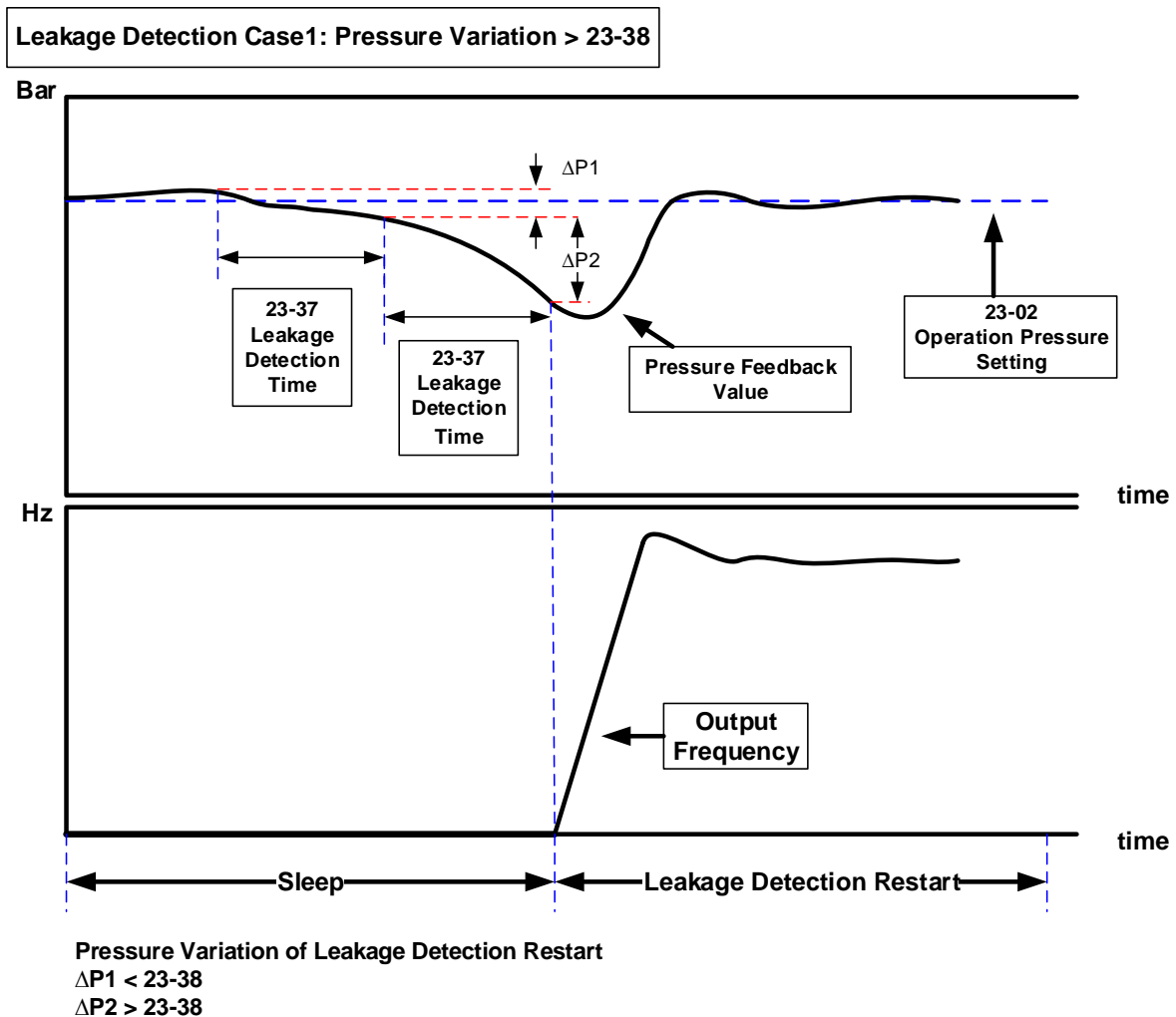
When 23-22 = 1 ~ 400 Hz (The maximum frequency follow 01-02), if the output frequency of Slave is lower than 23-22, Master will inform Slave to stop and enter sleep mode, or output frequency of Slave is lower than 23-10 (Sleep Frequency of Constant Pressure) and after the time of 23-11 (Sleep Time of 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.

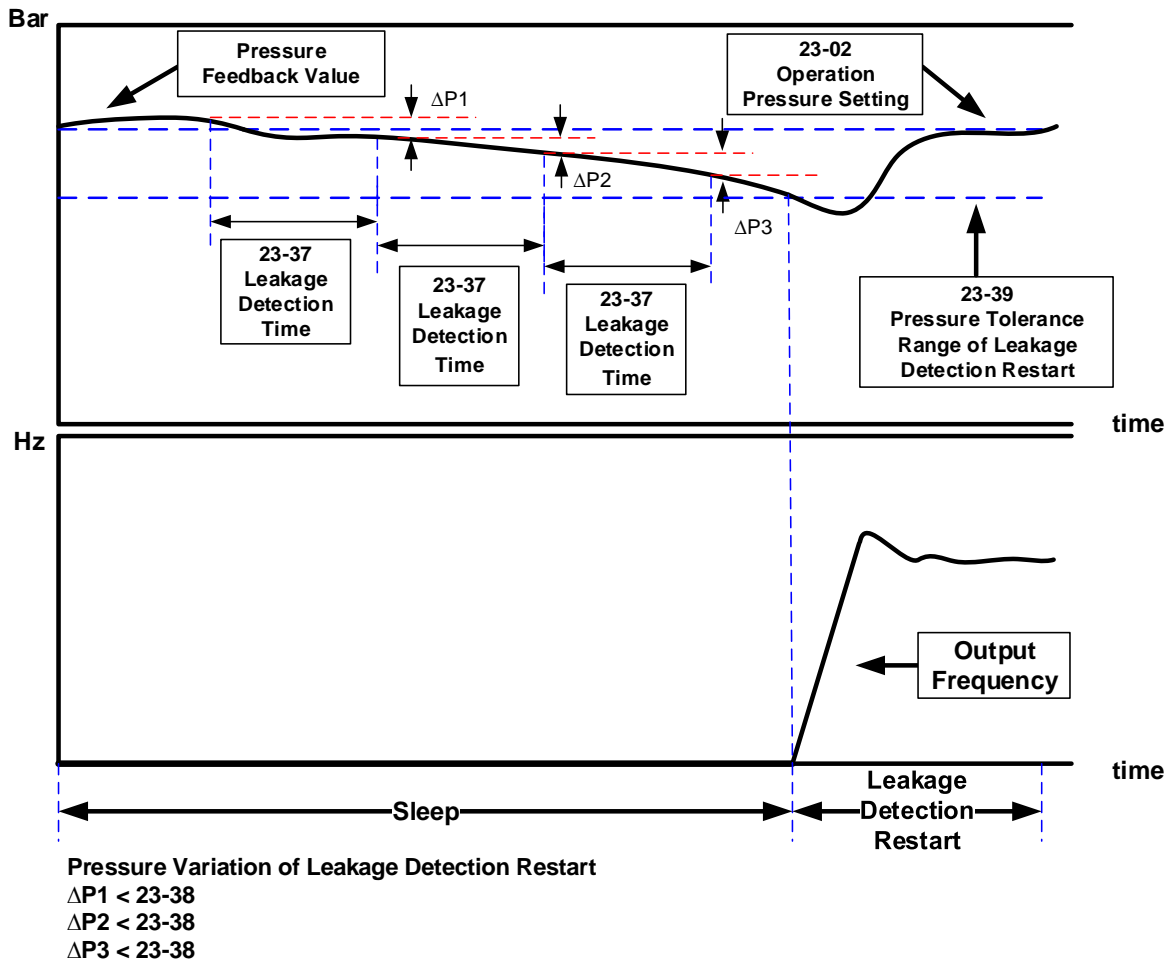
*3: It is new added in inverter software V1.4.



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).

Leakage Detection Case2: Pressure Variation <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 frequent 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.

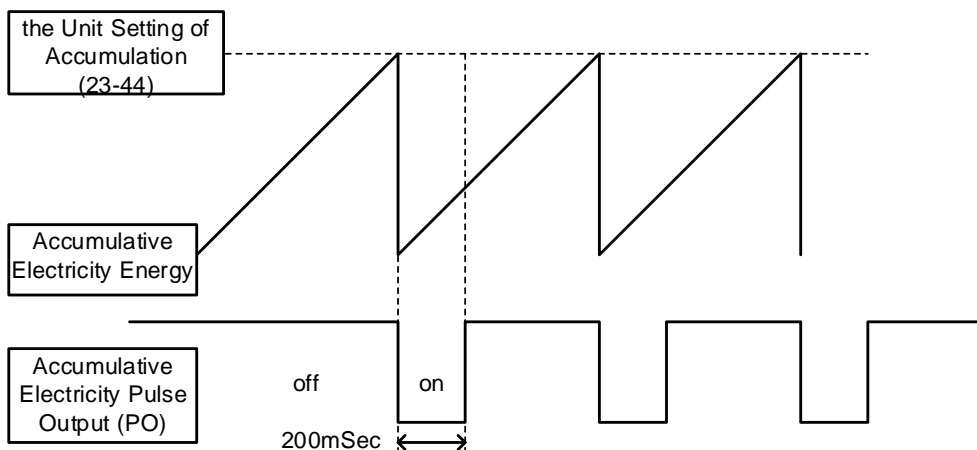


Figure 4.4.112 Diagram for accumulative electricity pulse output

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 displays 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 HlbfT 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.

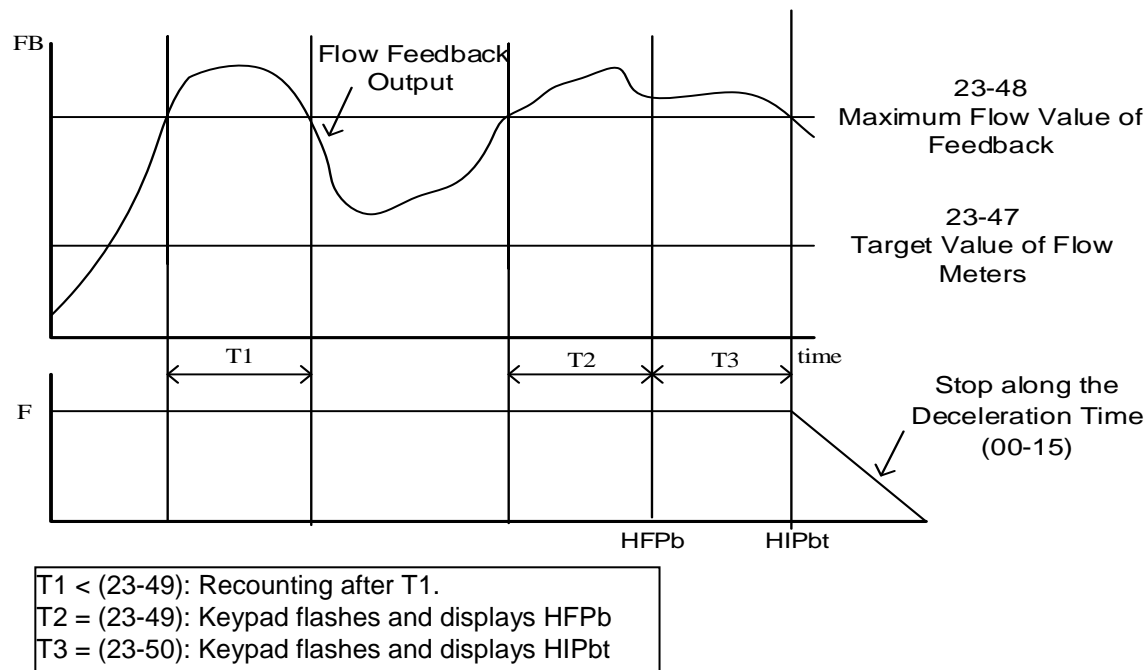


Figure 4.4.113 Diagram for warning to stop at high flow limit

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.

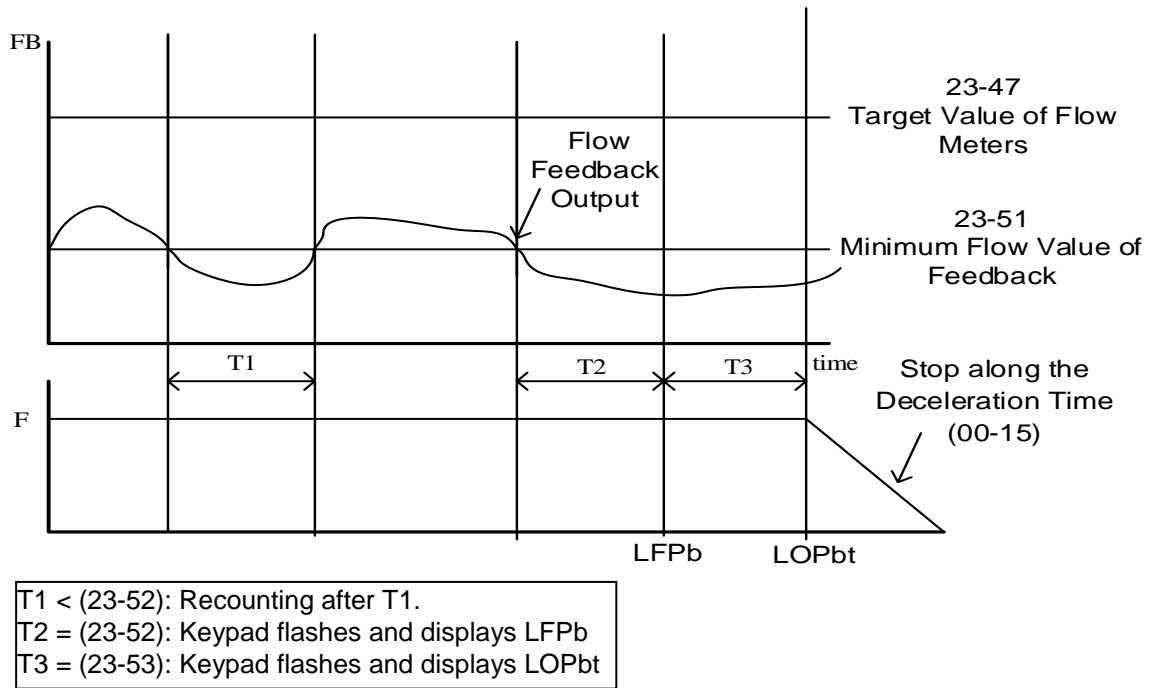


Figure 4.4.114 Diagram for low flow limited warning of stop

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.

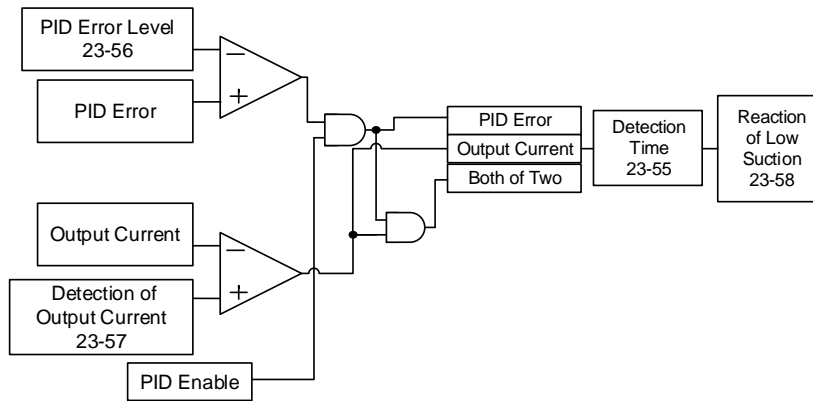


Figure 4.4.115 Diagram for the process of low suction

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	<p>【0】 : Function of 1 to 8 Pump Card and 1 to 3 Relay are Disabled.</p> <p>【1】 : Fixed Modes of Inverter Pump: First on and Last off; then Stop All.</p> <p>【2】 : Fixed Modes of Inverter Pump: Only Stop Inverter Pump.</p> <p>【3】 : Fixed Modes of Inverter Pump: First on and First Off; then Stop All.</p> <p>【4】 : Cycle Modes of Inverter Pump: First on and First Off; then Stop All.</p> <p>【5】 : Cycle Modes of Inverter Pump: Only Stop Inverter Pump.</p> <p>【6】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First off; then Stop All.</p> <p>【7】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling.</p> <p>【8】 : Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling.</p> <p>【9】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: Only Stop Inverter Pump. And First Boot Relay in Cycling.</p>

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 driven by the inverter is fixed to 1 set and maximum to 8 sets.

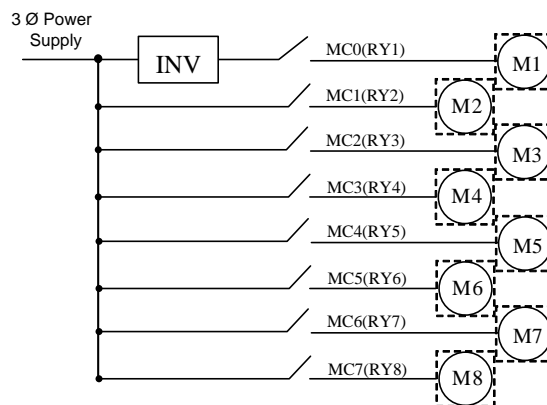


Figure 4.4.116 Fixed modes of inverter pump

② Cycle modes of inverter pump:

Pump driven by the inverter is not fixed to 1 set and maximum to 4 sets.

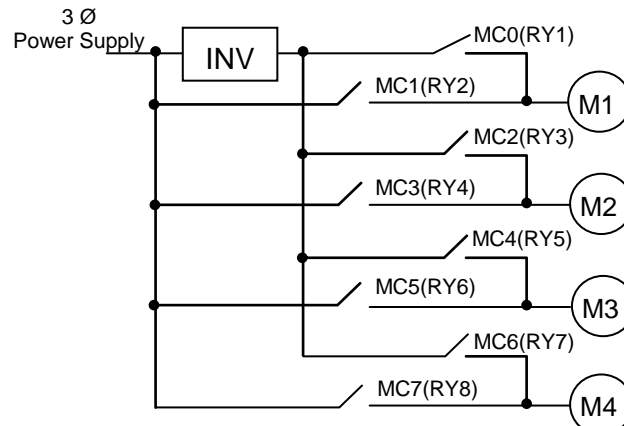


Figure 4.4.117 Cycle modes of inverter pump

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.

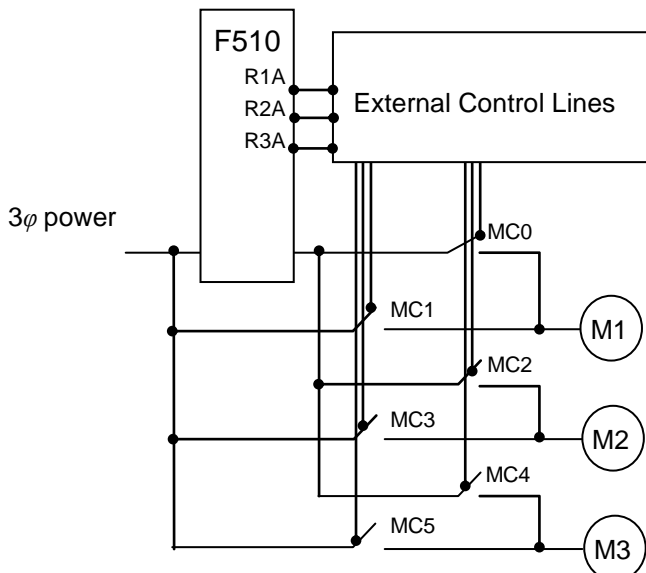


Figure 4.4.118 Cycle modes of inverter pump in the control board

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) driven 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 equal 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 driven 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 driven 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 driven by the inverter is switched by the commercial AC power supply or originally driven 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.

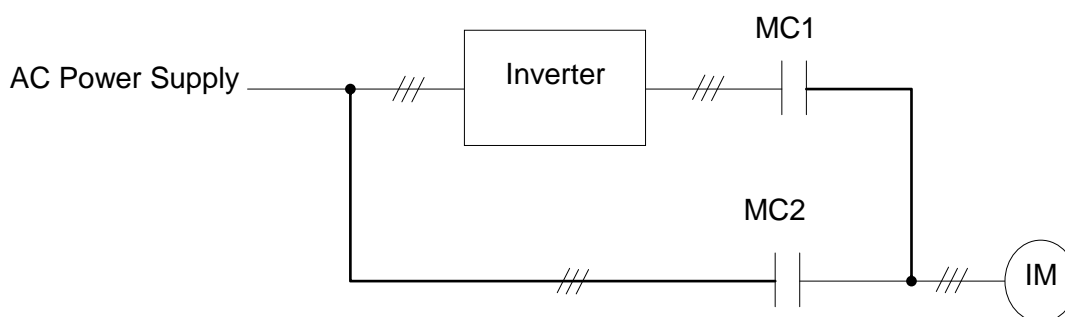


Figure 4.4.119 Diagram for the single cycle modes of inverter pump

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 occur when user give commands to the inverter.

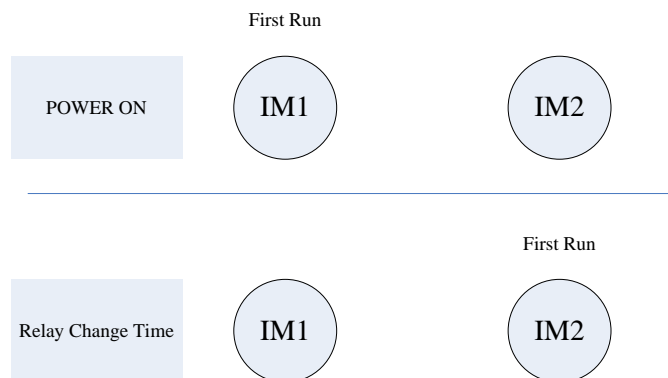
Refer to the following table for controlling the maximum value of pump under the different setting values of 24-00 and 24-07.

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.

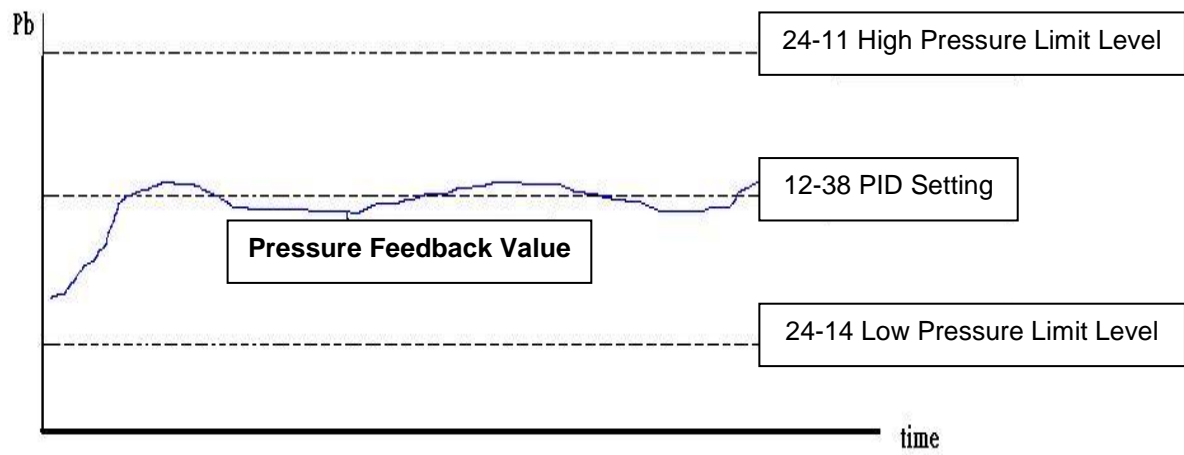


Diagram of pressure feedback value limit

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.

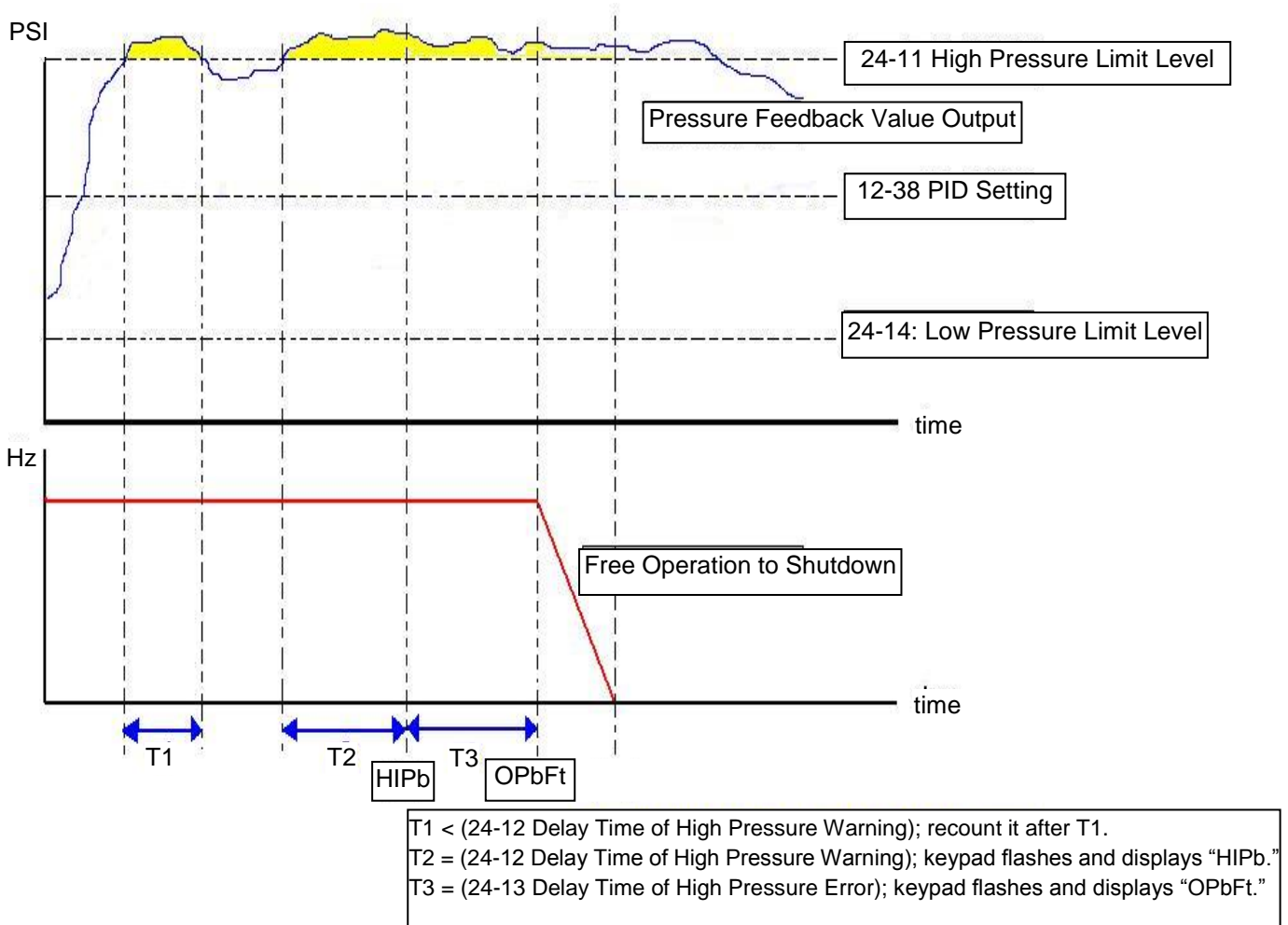


Diagram of high pressure limit warning to shutdown

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.

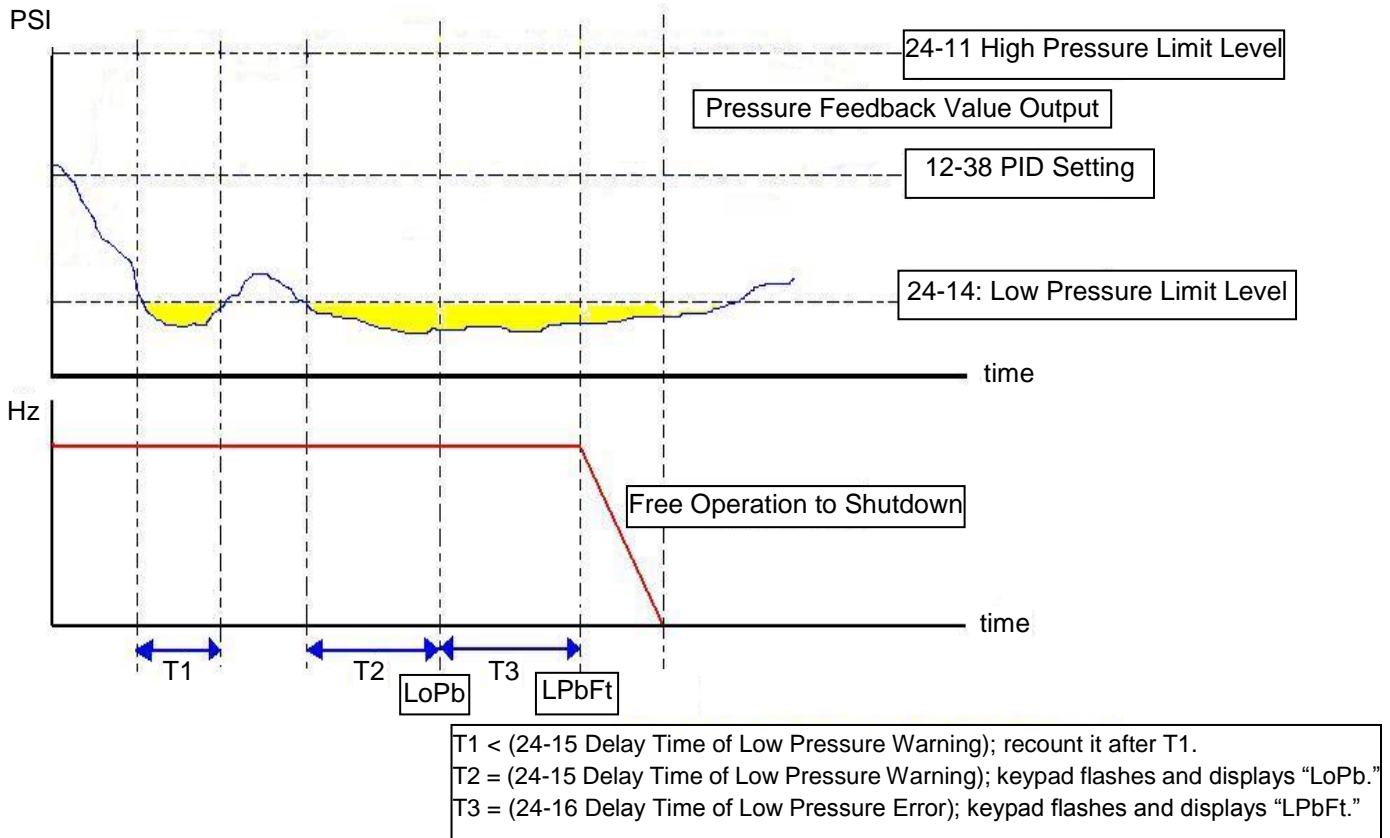


Diagram of low pressure limit warning to shutdown

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.

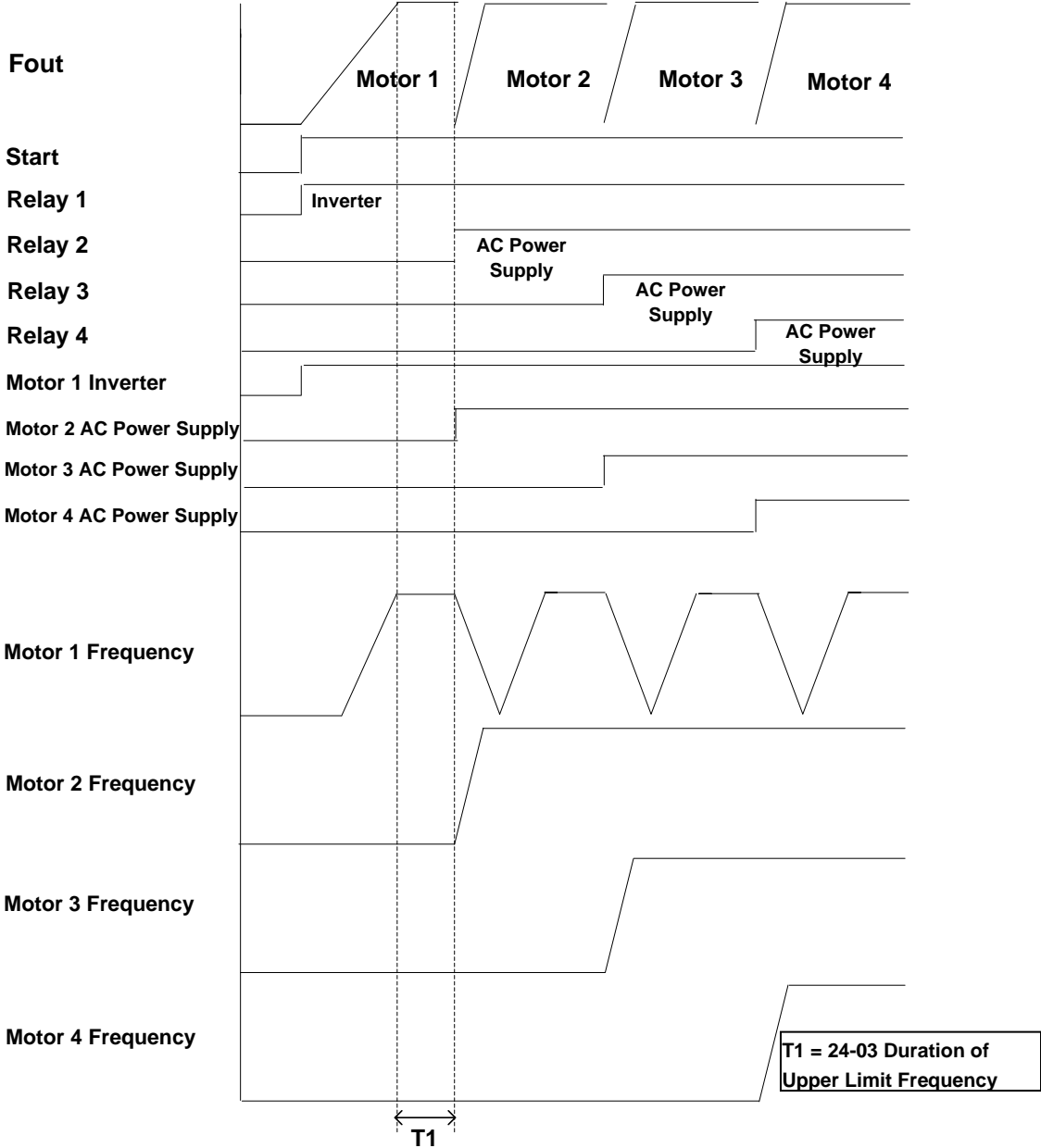


Figure 4.4.120 Diagram of increasing pump in the fixed modes of inverter pump

- Output frequency (F_{out}) decreases to the lower limit frequency (00-13) and the F_{out} 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 F_{out} reaches to the upper limit frequency (00-12), the inverter starts to decelerate.

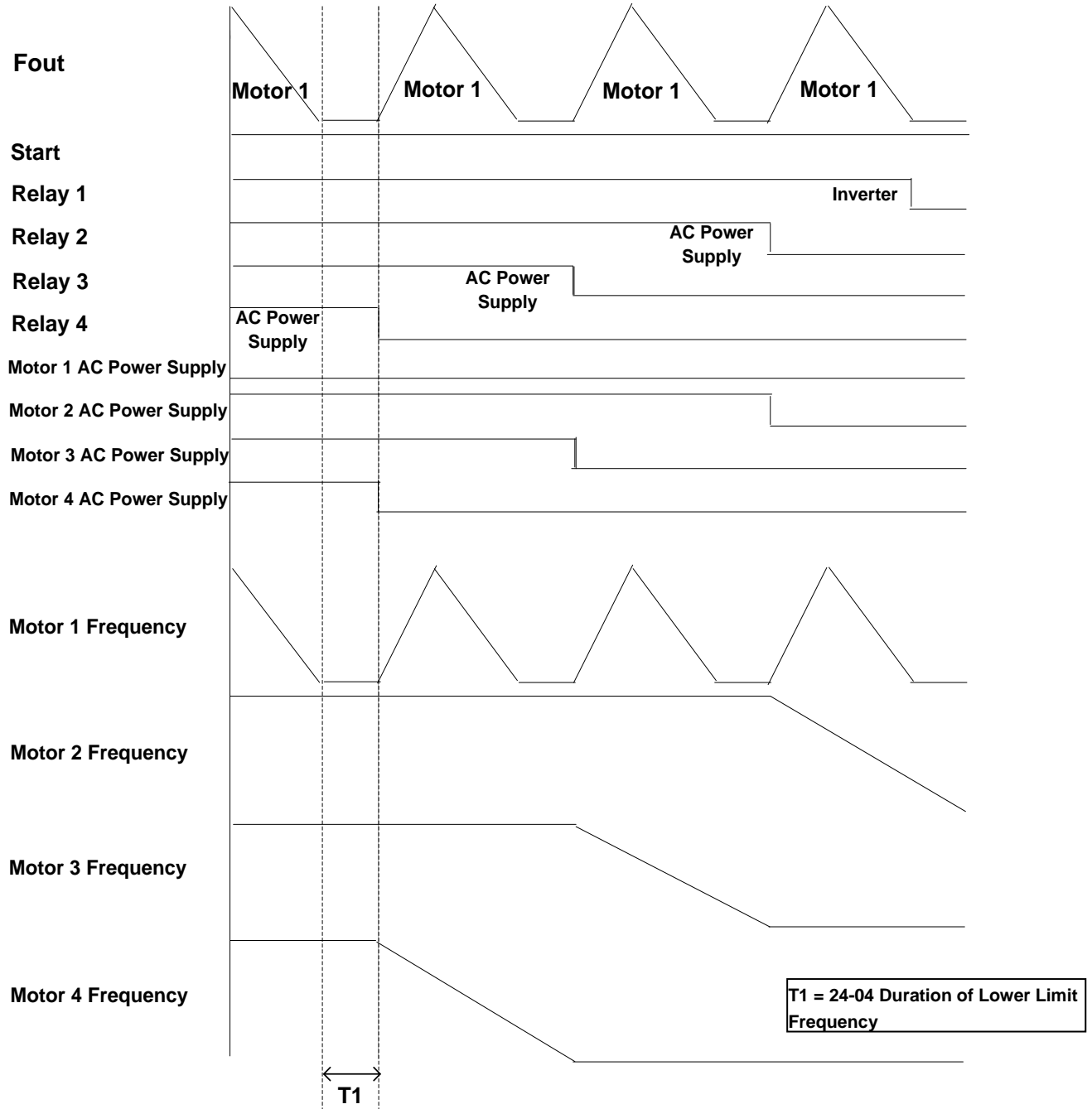


Figure 4.4.121 Diagram of decreasing pump in the fixed modes of inverter pump

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.

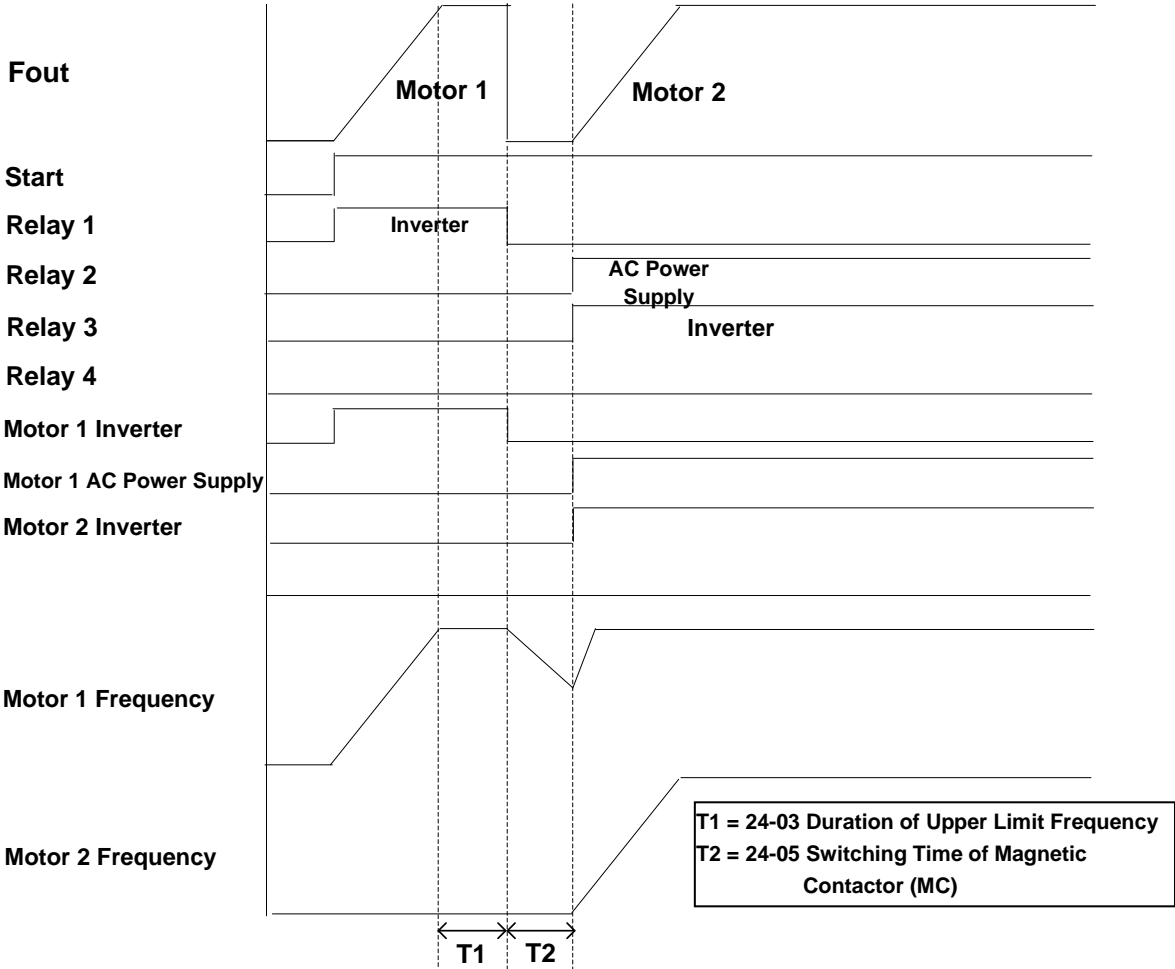


Figure 4.4.122 Diagram of increasing pump in the cycle modes of inverter pump

- ✧ 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.

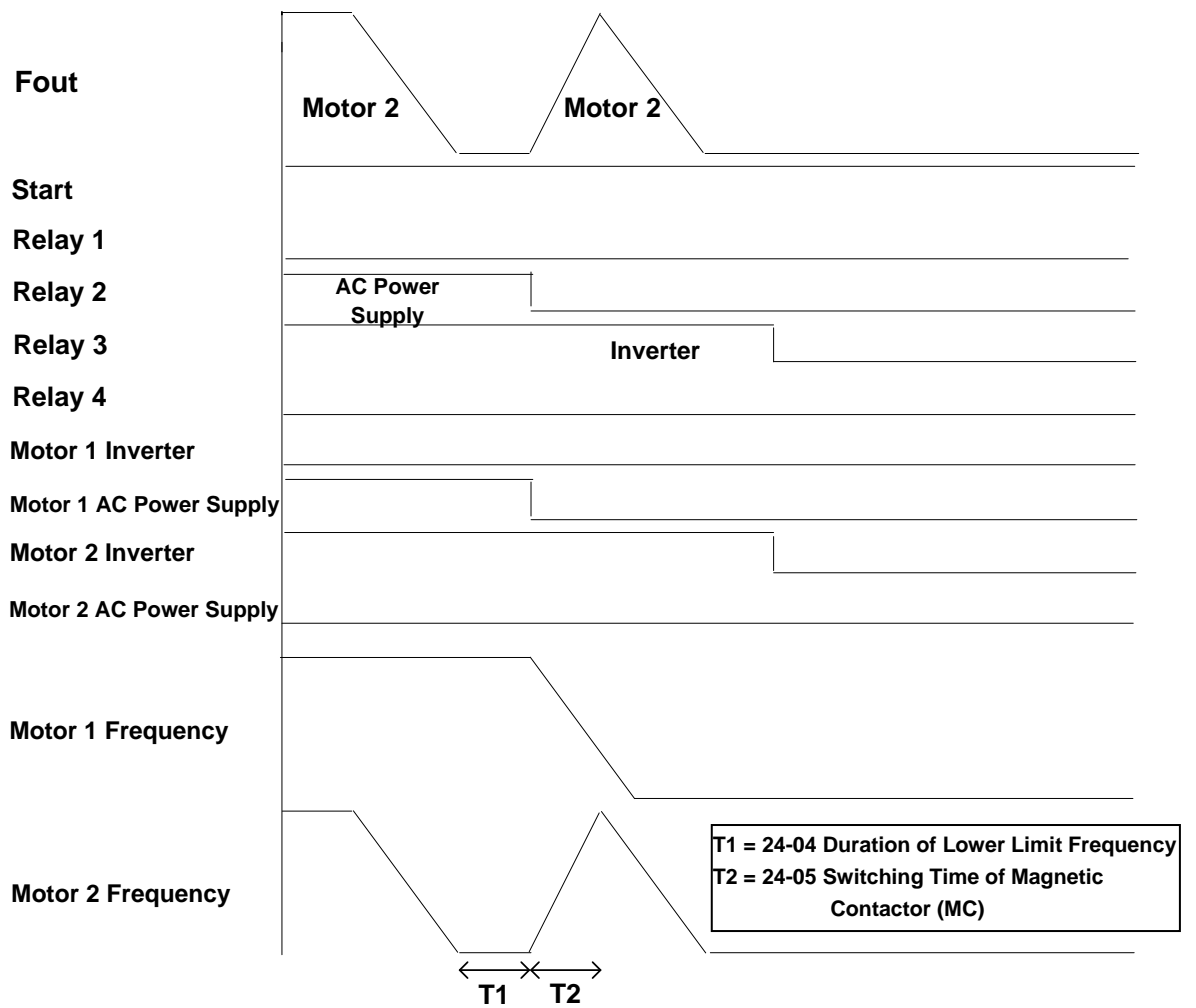


Figure 4.4.123 Diagram of decreasing pump in the fixed modes of inverter pump

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.

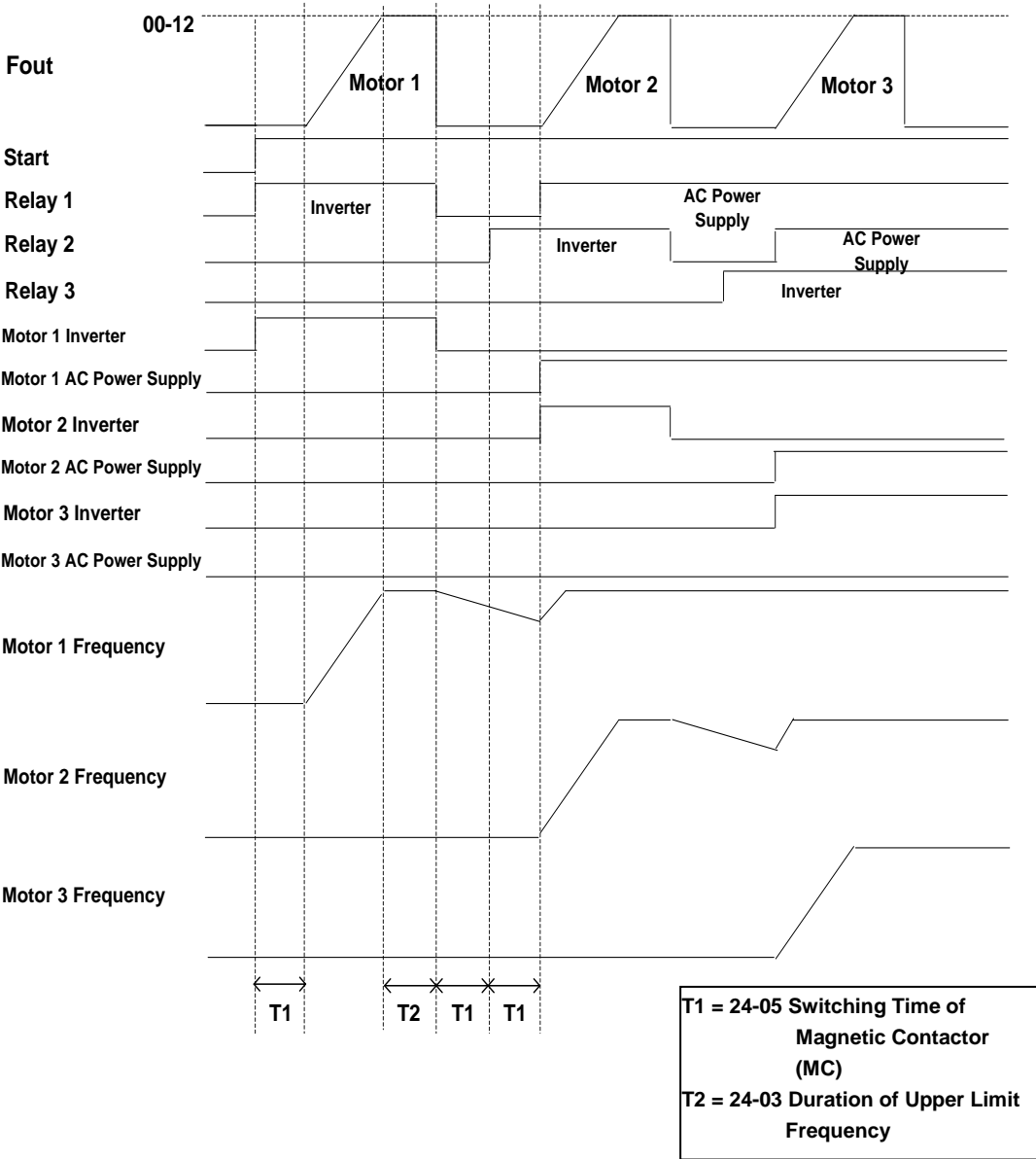


Figure 4.4.124 Diagram of increasing pump in 1 to 3 Relay modes

- ✧ When pressure feedback value is larger than the target value, output frequency (F_{out}) decreases. Relay 1 is power off when the output frequency reaches to the lower limit frequency (00-13) and F_{out} time is over than the duration of lower limit frequency (24-04).

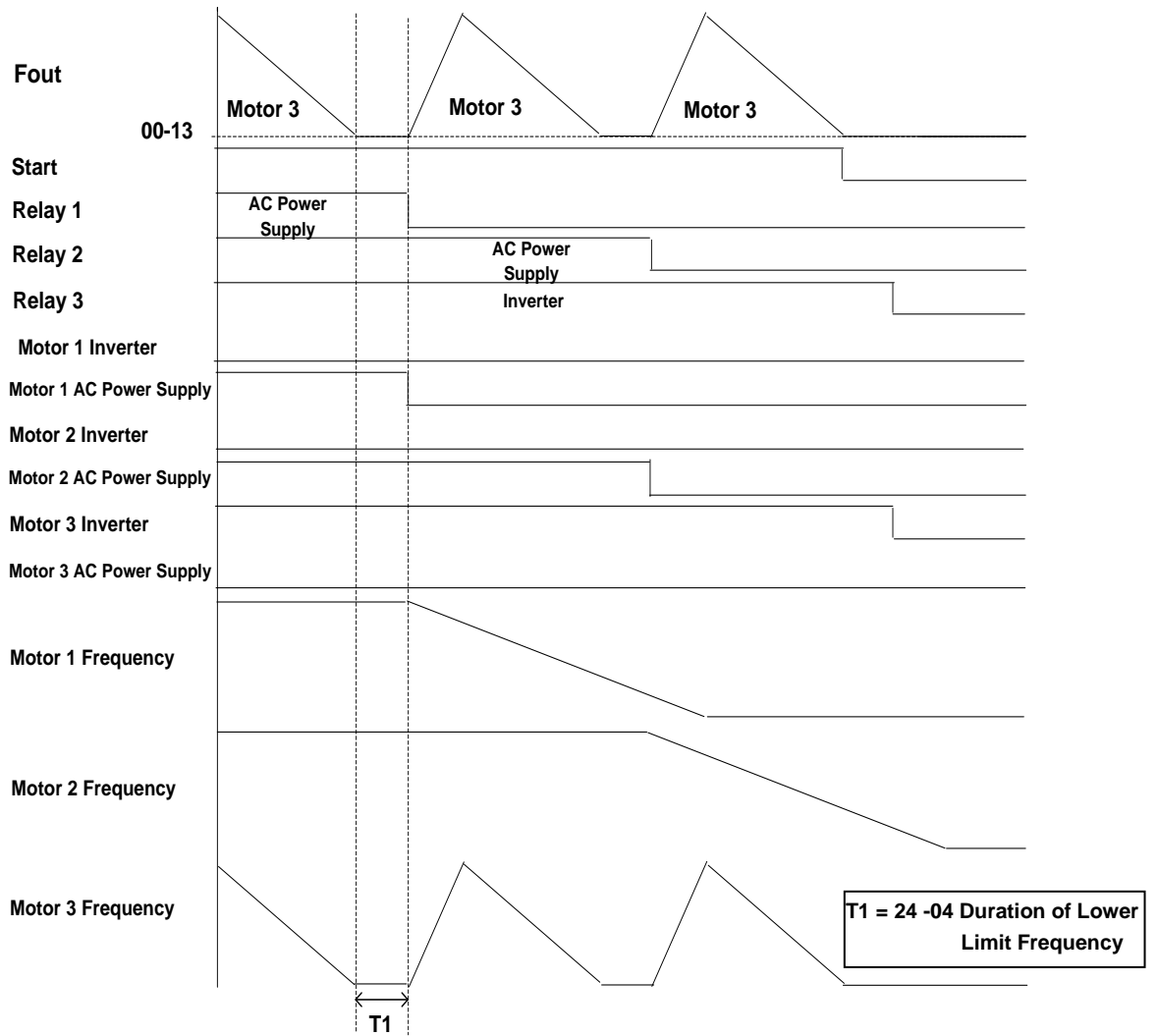


Figure 4.4.125 Diagram of decreasing pump in 1 to 3 Relay modes

■ Wiring for 1 to 8 Pump Card and 1 to 3 Relay Modes

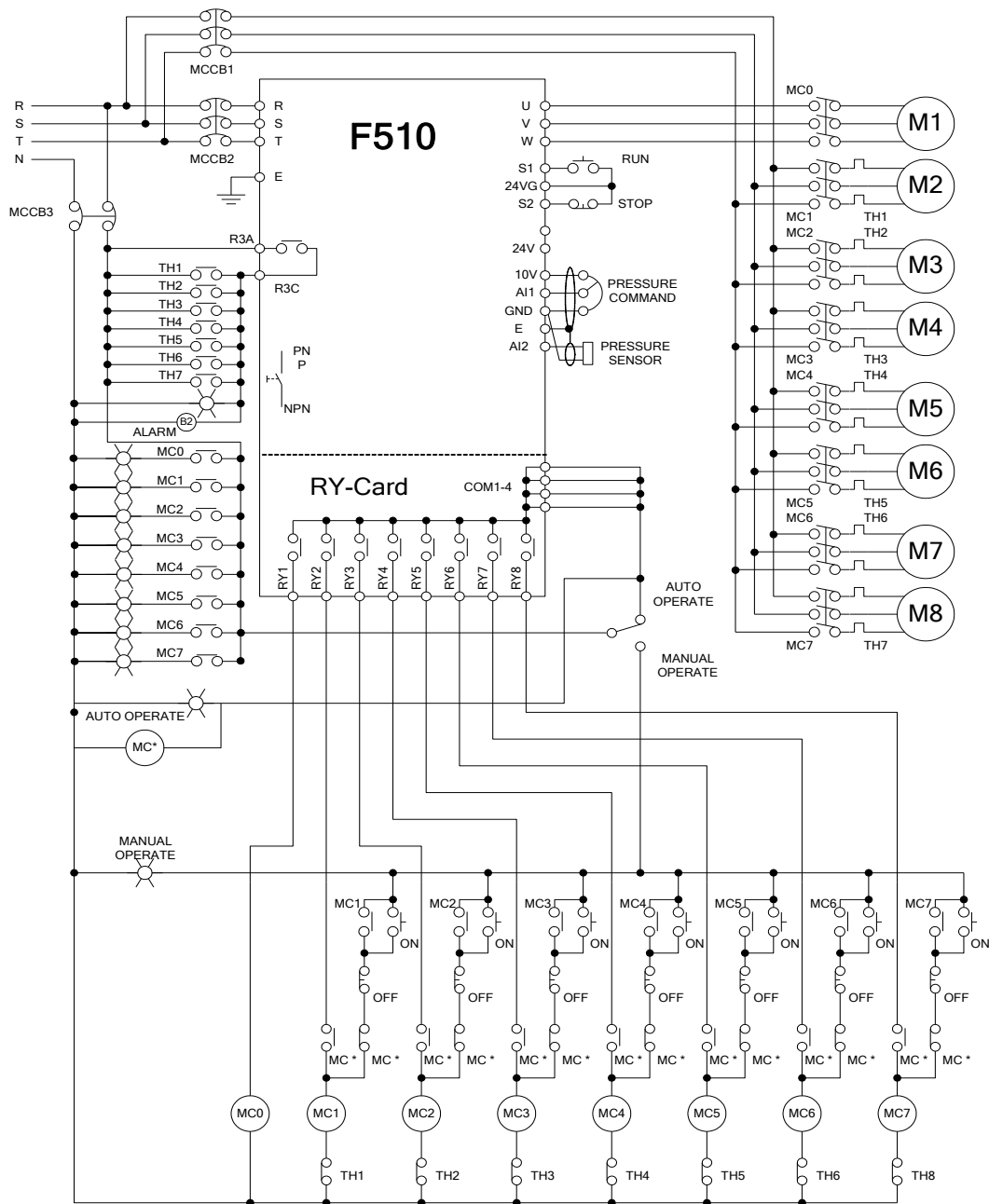


Figure 4.4.126 Wiring for the fixed modes of inveter pump

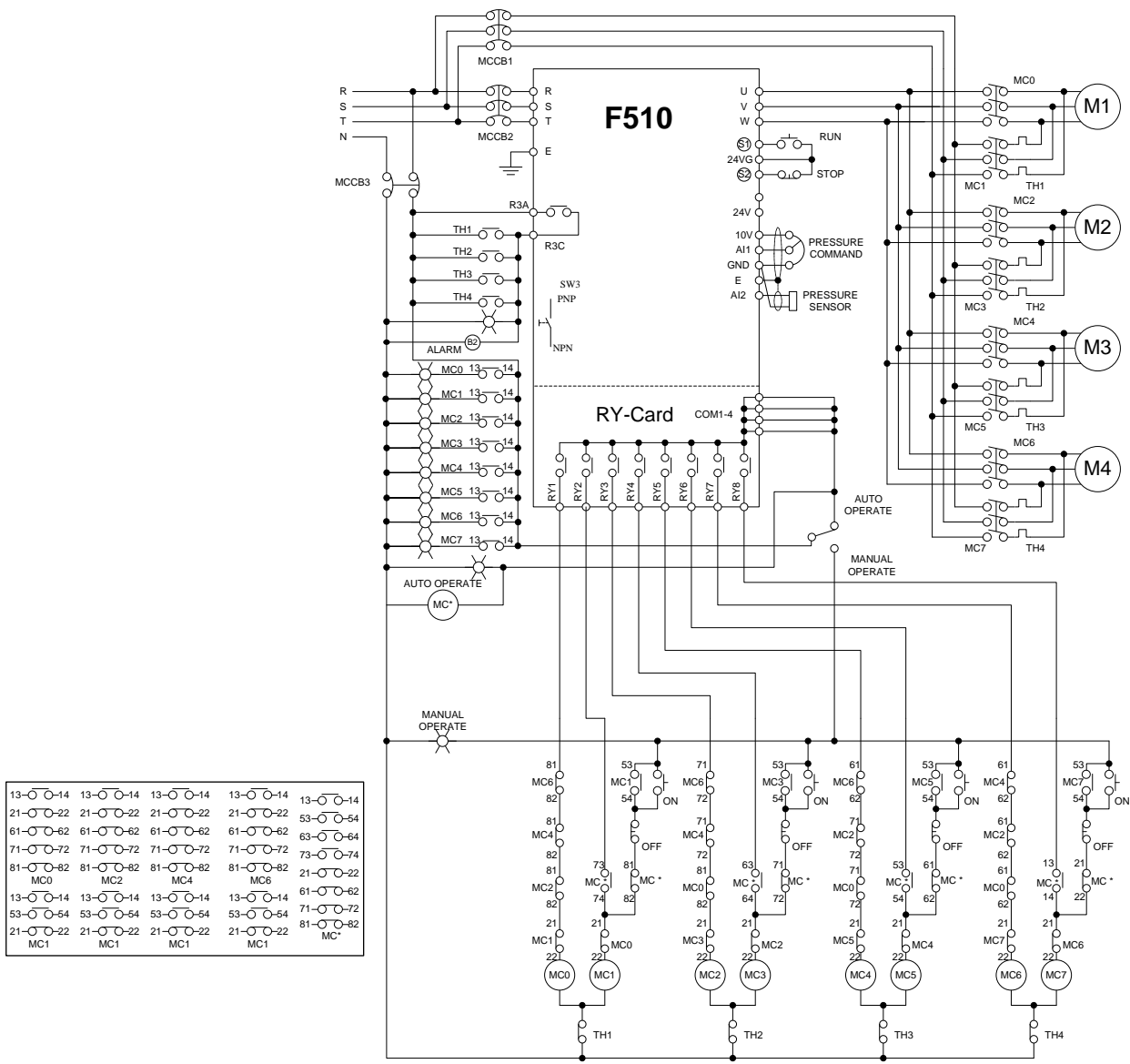


Figure 4.4.127 Wiring for the cycle modes of inverter pump

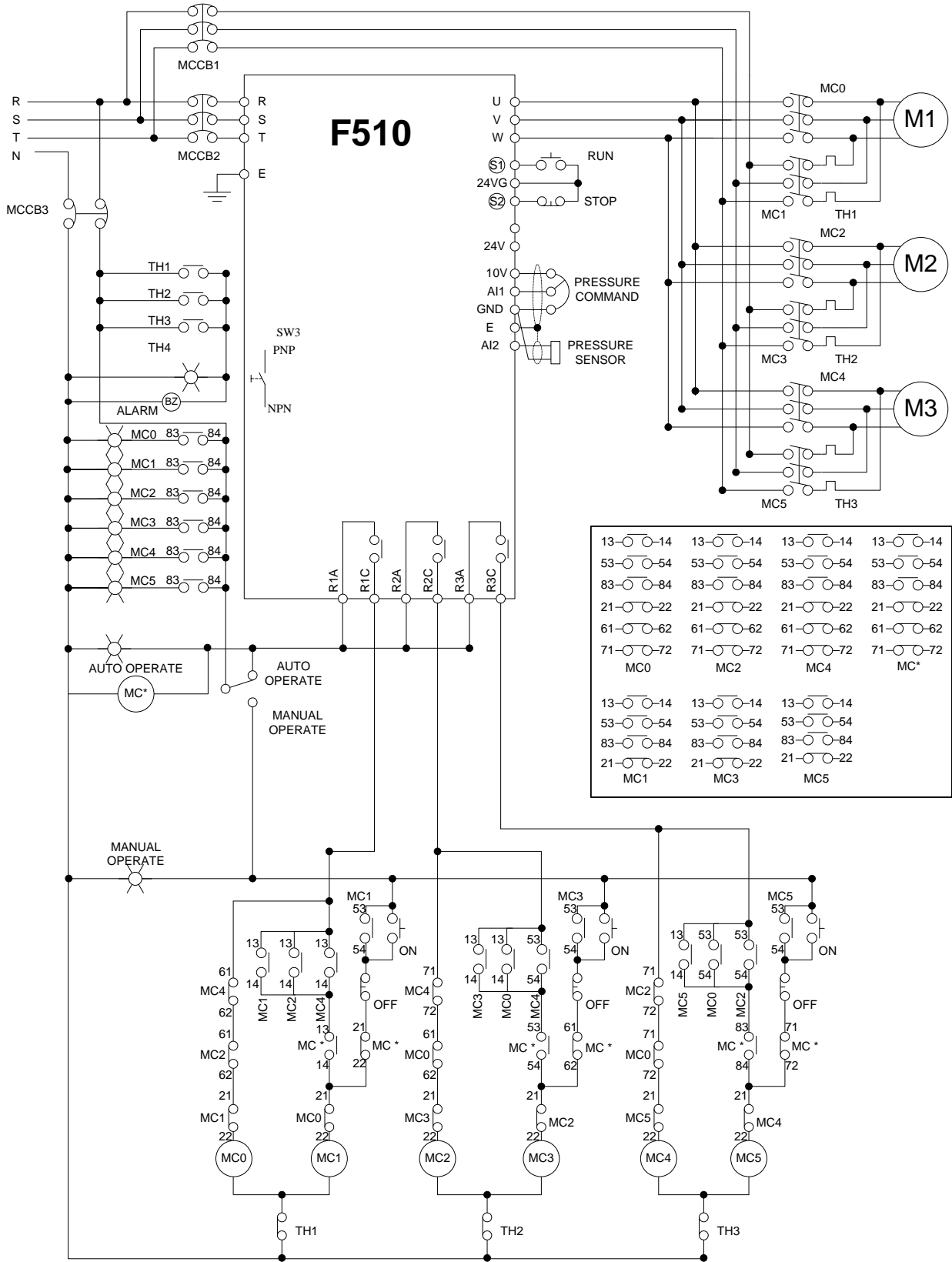


Figure 4.4.128 Wiring for the cycle modes of inverter pump in the control board

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=005.00Hz 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 at least ten minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.
- Using Safety precaution, and referring to section 3.8 exchange any two of the three output leads to the motor (U/T1, V/T2 and W/T3). After the wiring change, repeat this step and recheck motor direction.

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.

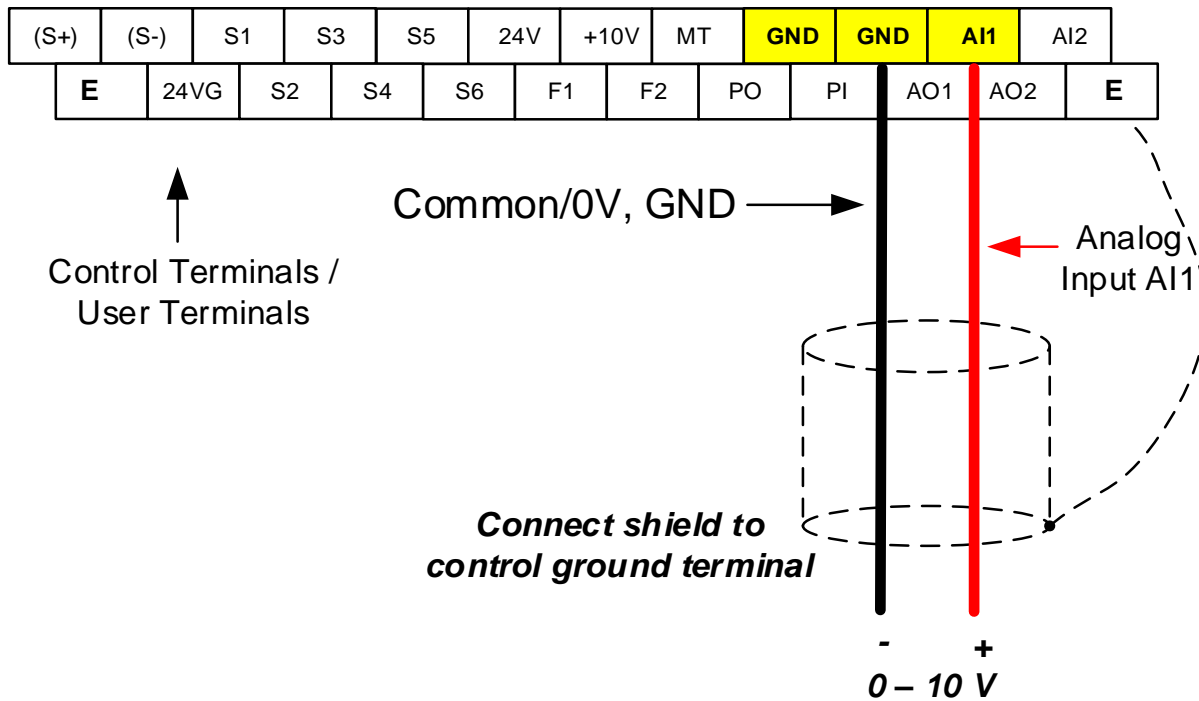
00-05	Main Frequency Command Source Selection
Range	0: Keypad 1: External Terminal (Analog AI1) 2: Terminal Command UP / DOWN 3: Communication control (RS-485) 4: Reserved 5: Reserved 6: RTC 7: AI2 Auxiliary Frequency

6.1 Reference from Keypad

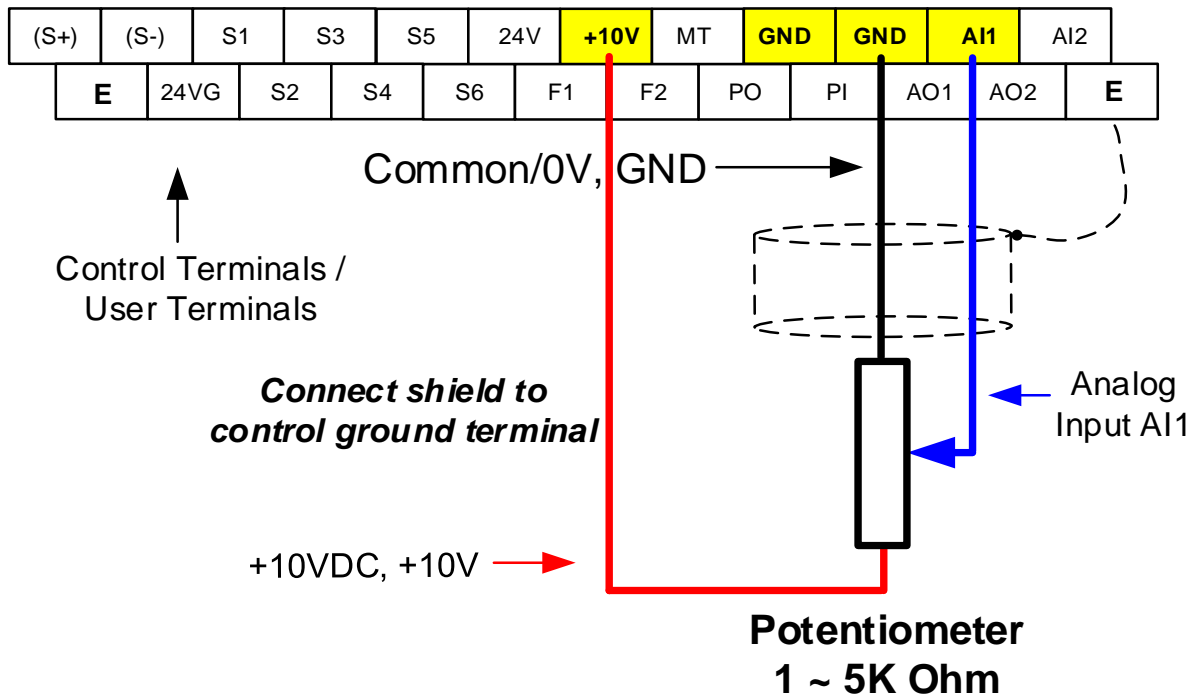
Speed reference from the keypad is the default setting. Press the **READ/ ENTER** key first and use the **</RESET, ▲** and **▼** keys to change the speed reference.

6.2 Reference from External Analog Signal (0-10V / 4-20mA)

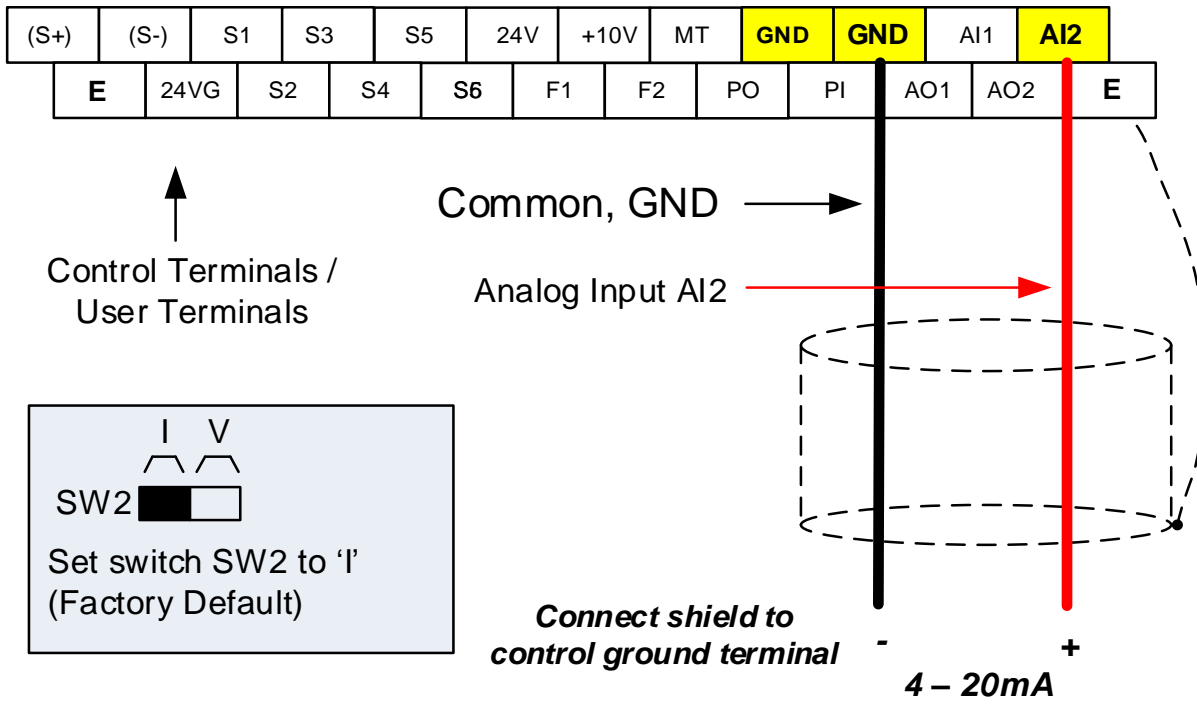
Analog Reference: 0 – 10 V (Setting 00-05 = 1)



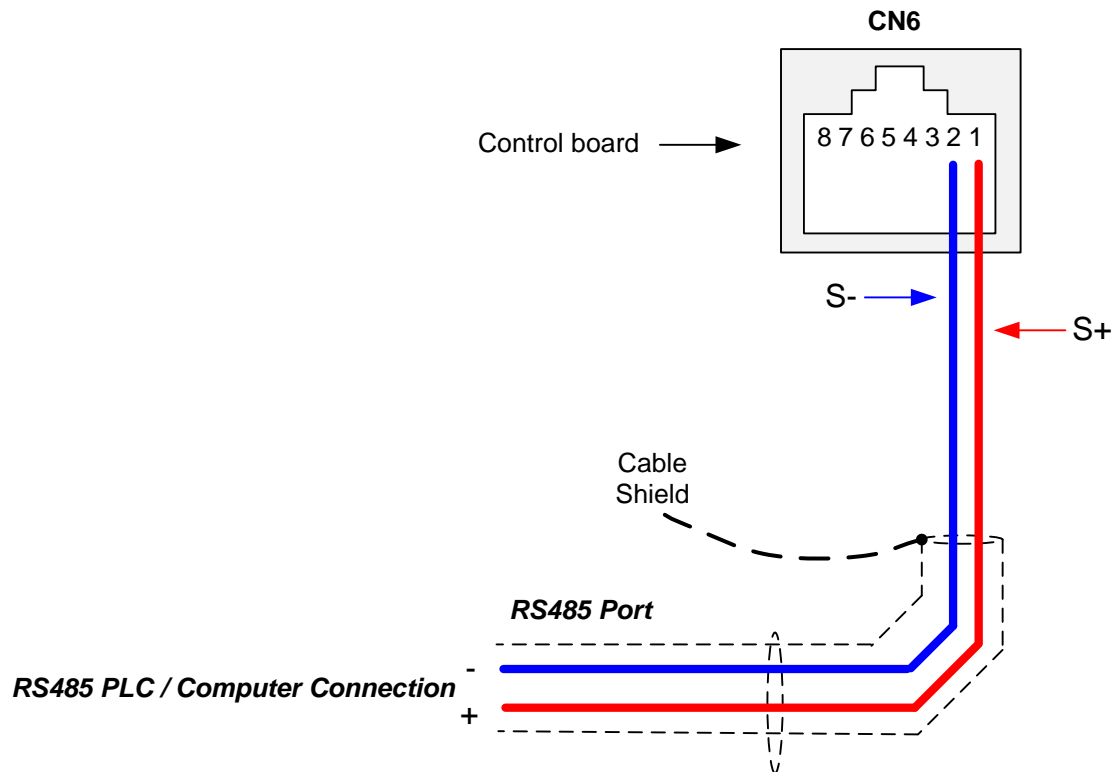
Analog Reference: Potentiometer / Speed Pot (Setting 00-05 = 1)



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 ~ 400.00 Hz

Examples:

Frequency Reference Command: 10.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 03 E8 23 B8

To set the frequency reference to 10.00, a value of '1000' (03E8h) has to be send to the inverter.

Frequency Reference Command: 30.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 0B B8 24 44

To set the frequency reference to 30.00, a value of '3000' (0BB8h) has to be send to the inverter.

Frequency Reference Command: 60.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 17 70 2D 12

To set the frequency reference to 60.00, a value of '6000' (1770h) has to be send to the inverter

Note: The last 2 bytes of the command strings consist of a CRC16 checksum, please refer to section 4.5 of the instruction manual for additional information.

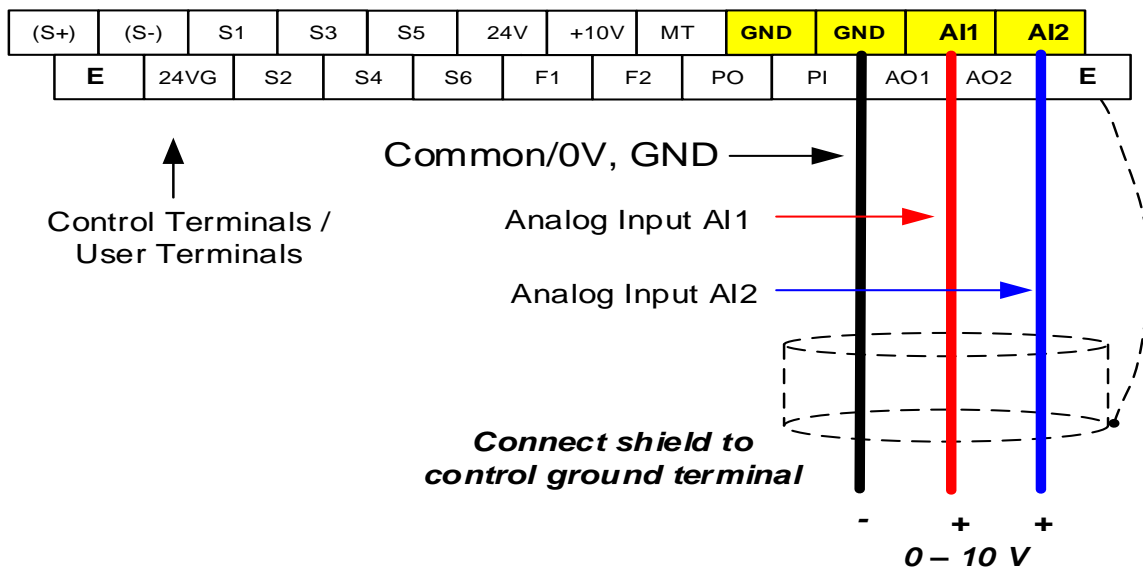
6.4 Reference from two Analog Inputs

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	<p>0: Display unit is Hz (Resolution is 0.01Hz)</p> <p>1: Display unit is % (Resolution is 0.01%)</p> <p>2: Rpm display; motor rotation speed is set by the control modes to select IM (02-07)/ PM (22-03) motor poles to calculate</p> <p>3~39: Reserved</p> <p>40~9999: 100% is XXXX with no decimals (integer only)</p> <p>10001~19999: 100% is XXX.X with 1 decimal</p> <p>20001~29999: 100% is XX.XX with 2 decimals</p> <p>30001~39999: 100% is X.XXX with 3 decimals</p>

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)

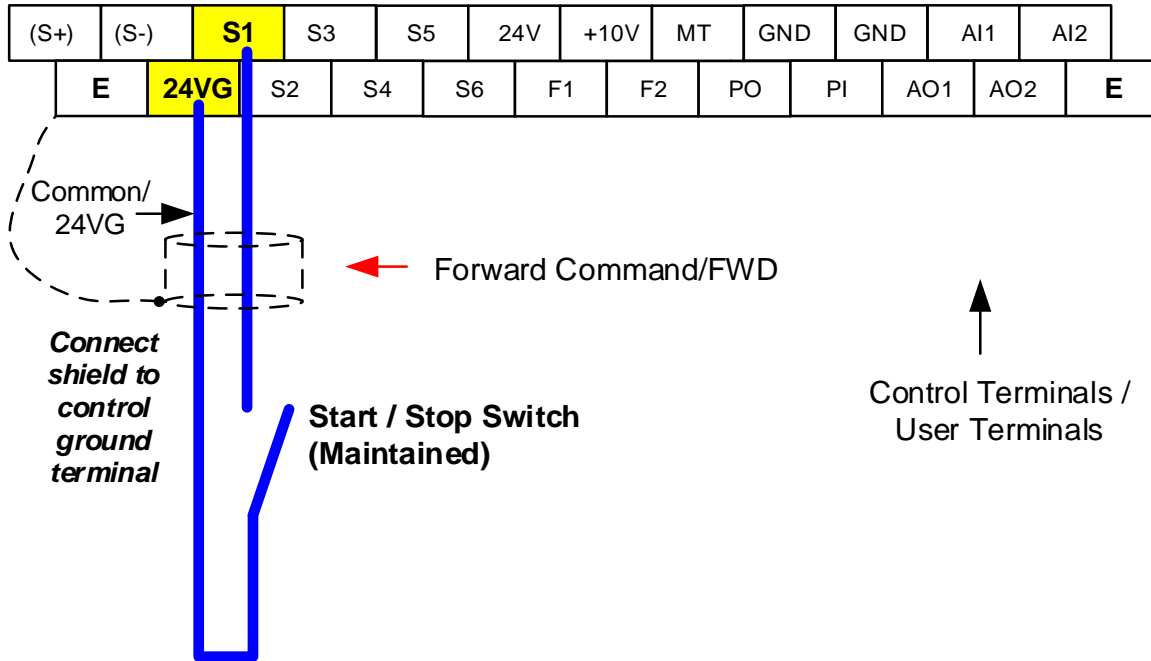
Press **STOP** key to stop the inverter. (Note: Stop method can be set with parameter 07-09, default is **deceleration to stop**).



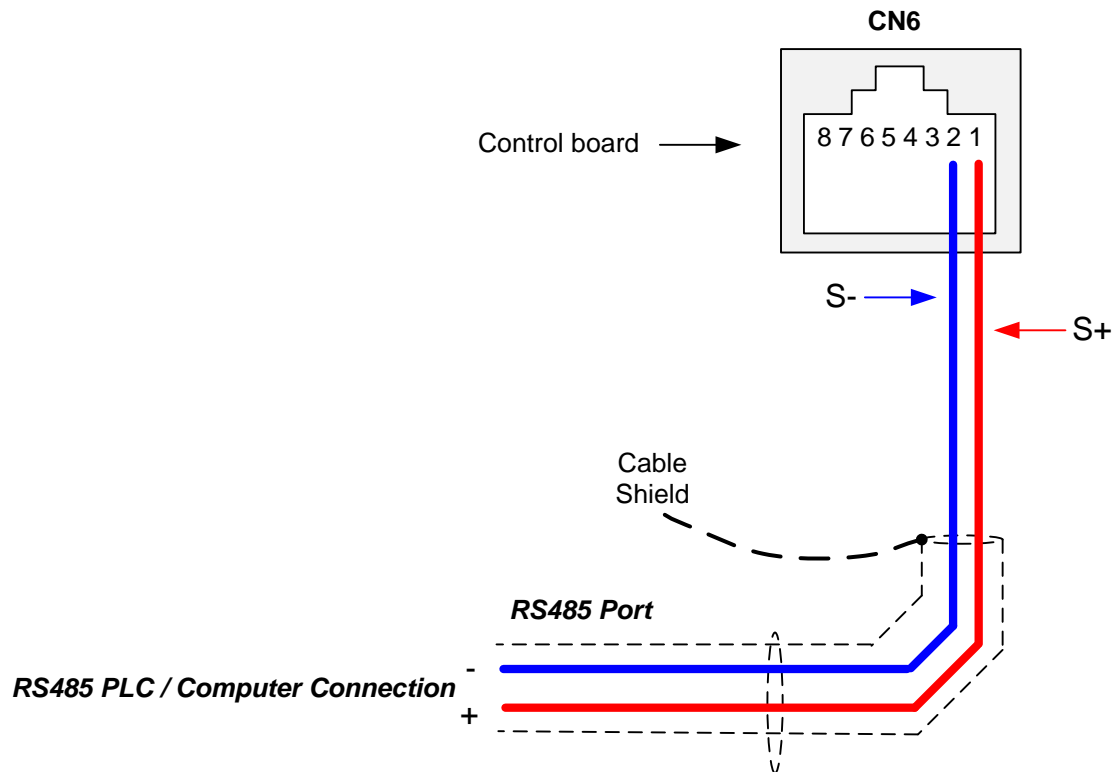
7.2 Run/Stop from External Switch / Contact or Pushbutton (00-02=1)

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

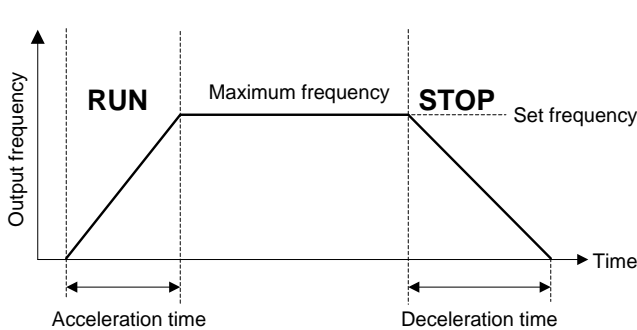
00-15 Deceleration time 1

These parameters set the acceleration and deceleration times of the output frequency from 0 to maximum frequency and from maximum frequency to 0.

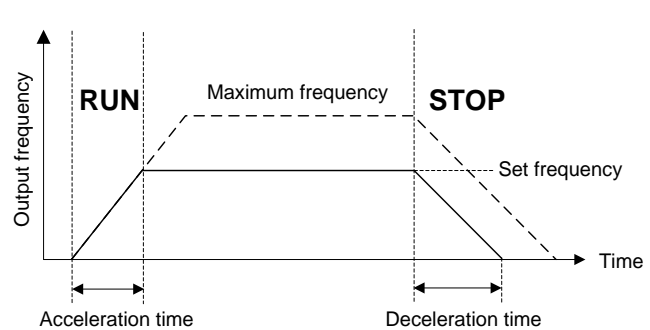
To set parameter 00-14 or 00-15:

- 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.

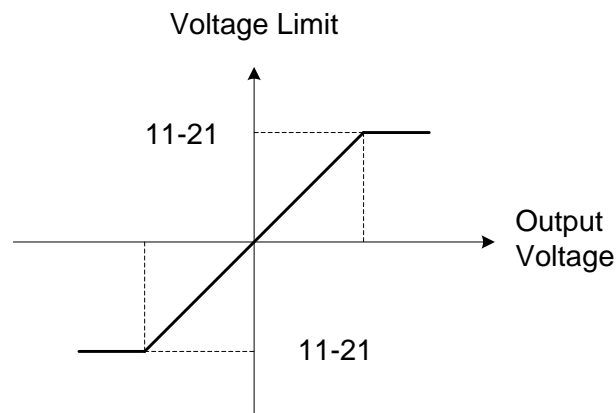
- (1) To enable automatic energy saving function set 11-19 to 1.
- (2) Filter time of automatic energy saving (11-20)
- (3) Commissioning parameter of energy saving (11-21 to 11-22)

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:

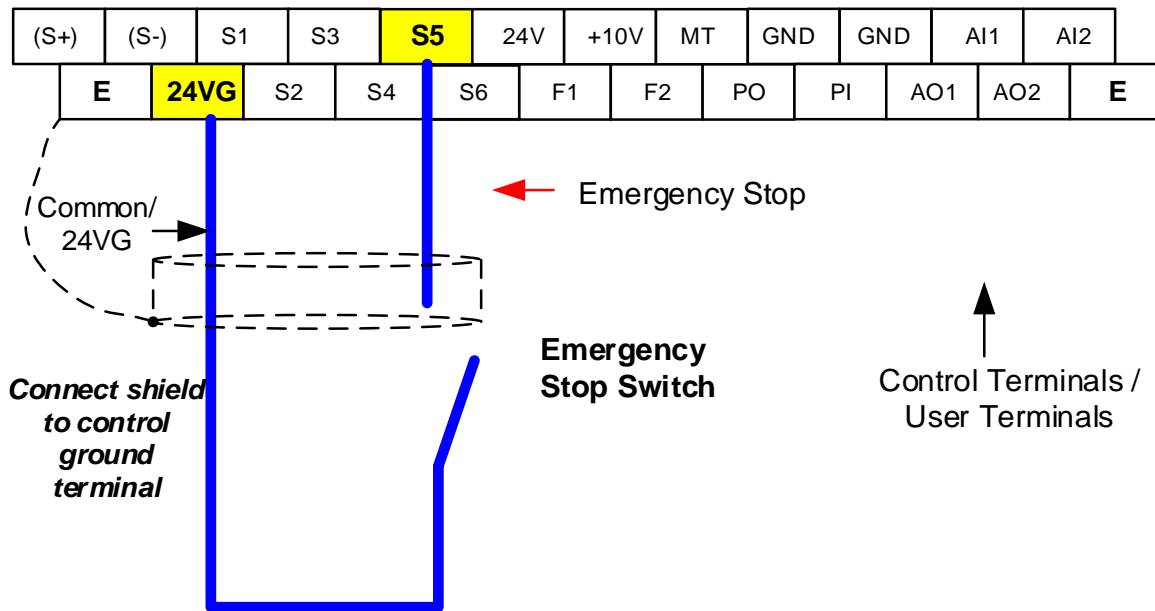
- If the coefficient is set to low the motor may stall.
- Coefficient default value is based on the inverter rating. Set parameter 13-00. If the motor power does not match the inverter rating.

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.

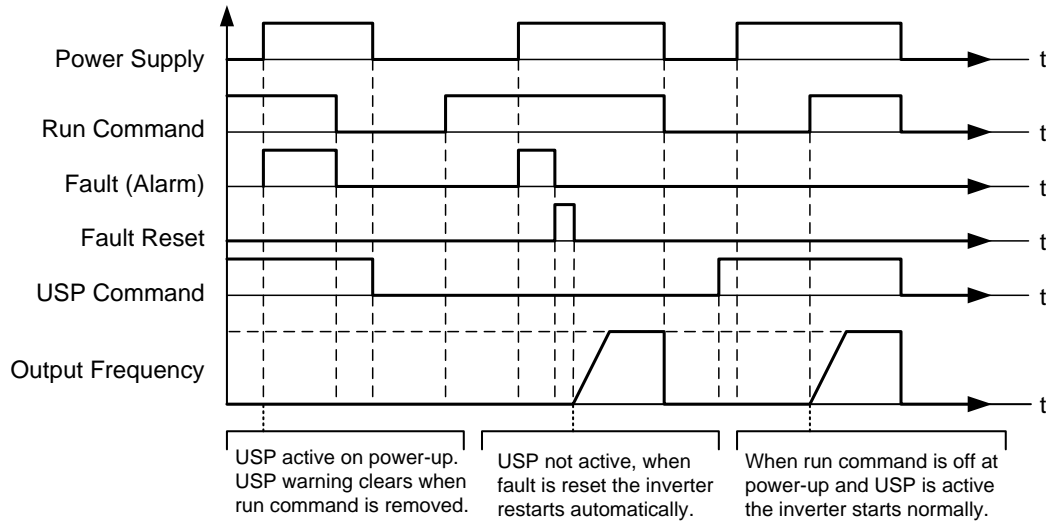
Example: Emergency Stop Switch set for input terminal S5 (03-04 = 14).



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

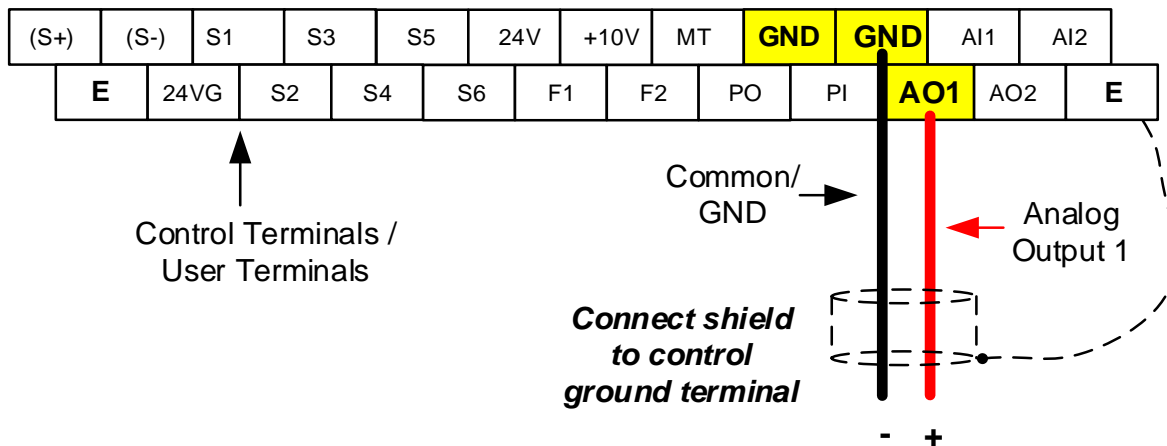
8.7 Analog Output Setup

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).

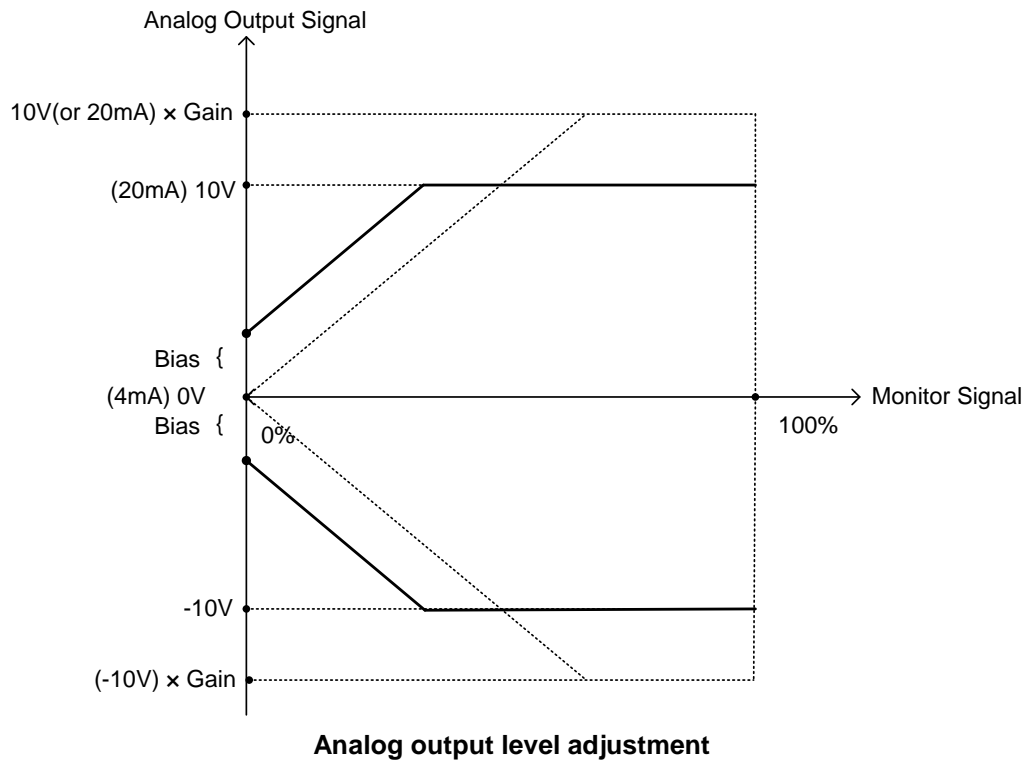
Bias: Use parameter 04-13 to adjust the bias for AO1 and parameter 04-18 to adjust the bias for AO2. Adjust the bias so that the analog output (0V/4mA) matches 0% of the selected analog output signal (04-11 for AO1 and 04-16 for AO2).

Example: Analog Output 1 Wiring



04-11	AO1 function Setting			
Range	0:	Output frequency	14:	Reserved
	1:	Frequency command	15:	ASR output
	2:	Output voltage	16:	Reserved
	3:	DC voltage	17:	q-axis voltage
	4:	Output current	18:	d-axis voltage
	5:	Output power	19~20:	Reserved
	6:	Motor speed	21:	PID input
	7:	Output power factor	22:	PID output
	8:	AI1 input	23:	PID target value
	9:	AI2 input	24:	PID feedback value
	10:	Torque command	25:	Output frequency of the soft starter
	11:	q -axis current	26~27:	Reserved
	12:	d-axis current	28:	Communication control
	13:	Speed deviation		

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



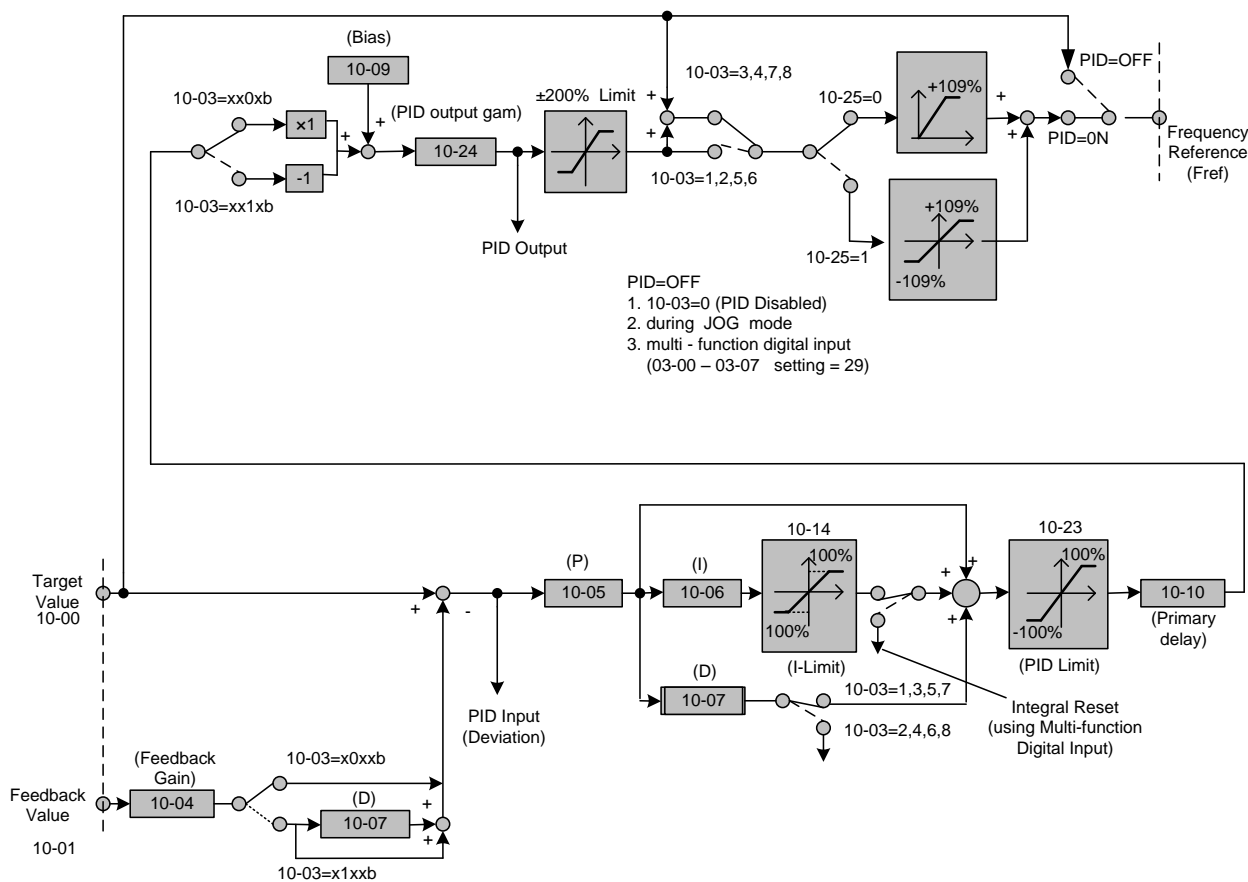
Chapter 9 Using PID Control for Constant Flow / Pressure Applications

****PID QUICKSTART GUIDE AVAILABLE AT www.tecowetstinghouse.com****

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.

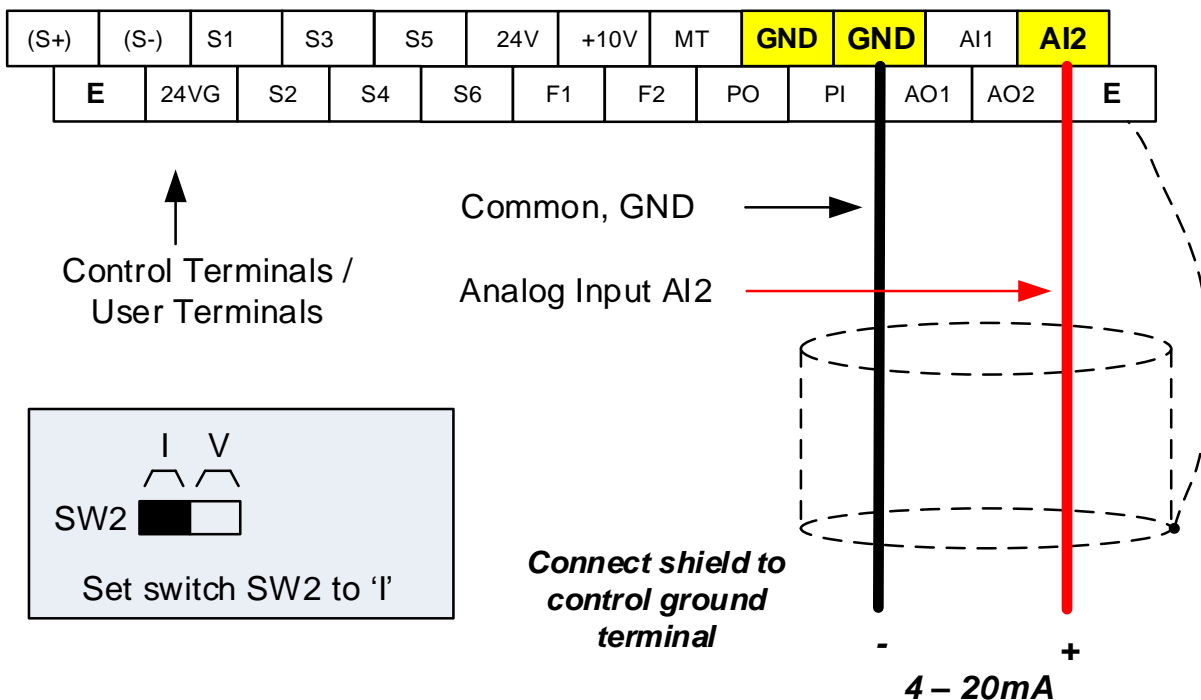
Important: To use the PID function parameter 00-05 (Main Frequency Command Source Selection) has to be set to 5 for PID reference.

9.2 Connect Transducer Feedback Signal (10-01)

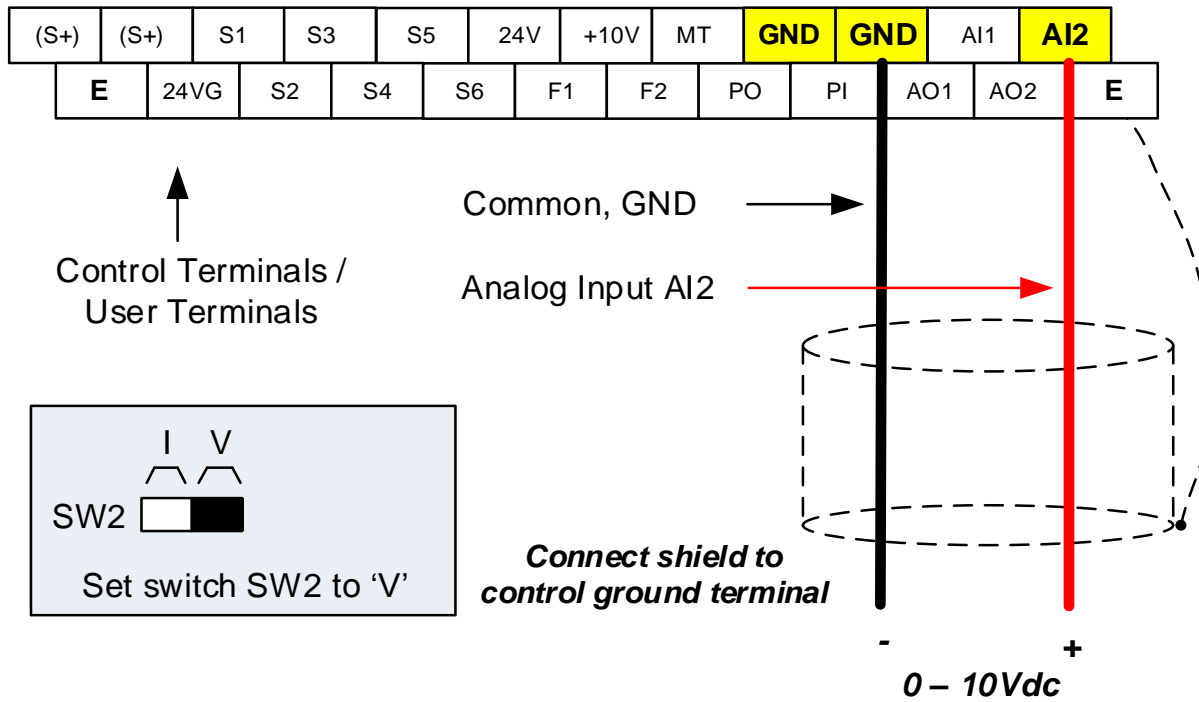
The PID function in the inverter

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).

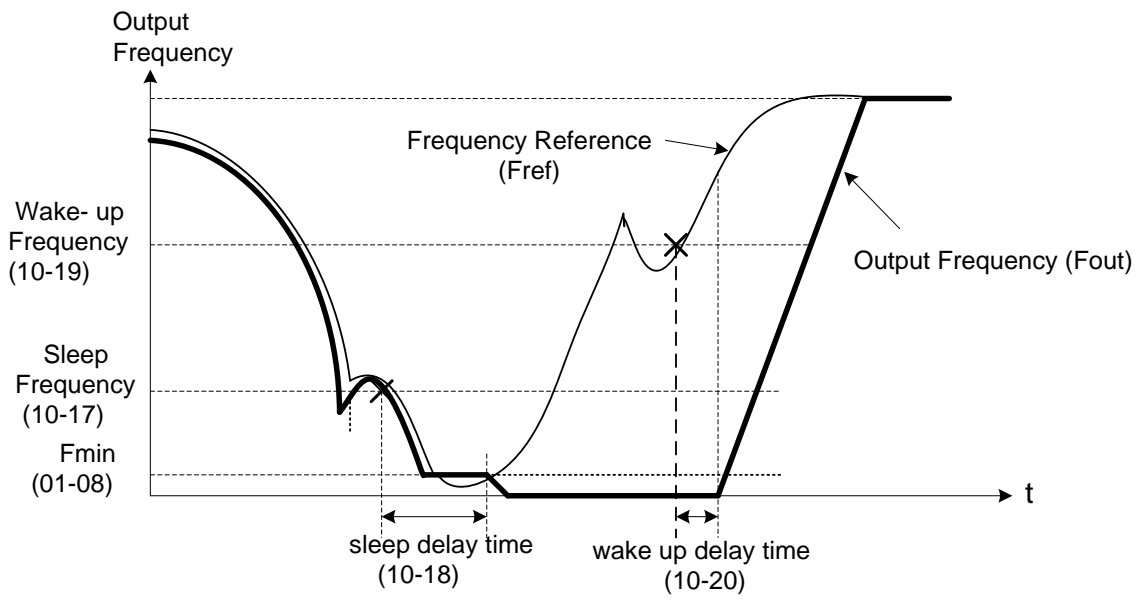
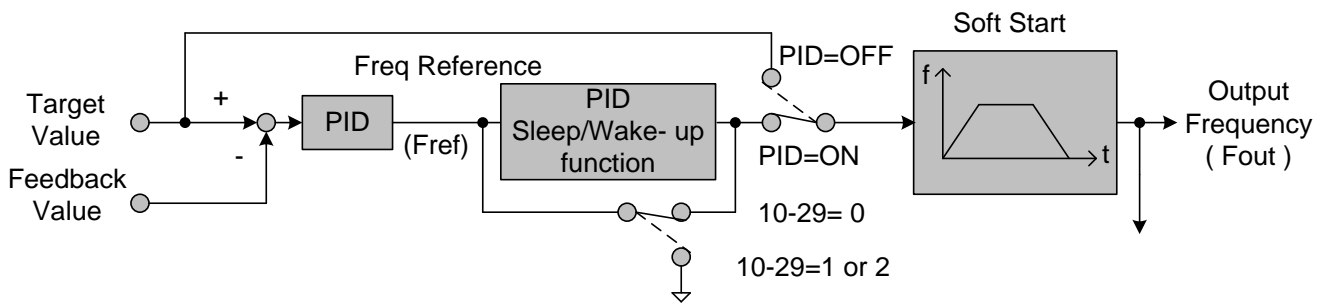
The inverter wakes up from a sleep condition when the PID output (Reference frequency) rises above the PID wake-up frequency (10-19) for the time specified in the PID wake-up delay time (10-20).

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.

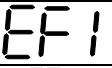
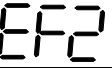
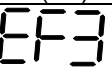
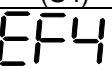
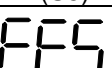
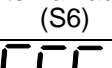





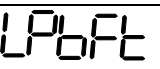
When a fault occurs, the fault message is stored in the fault history (see group 12 parameters).





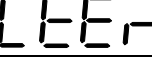
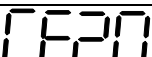




Table 10.2.1 Fault information and possible solutions

LED display	Description	Cause	Possible solutions
OC over current	The inverter output current exceeds the overcurrent level (around 200% of the inverter rated current).	<ul style="list-style-type: none"> • 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. 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Instantaneous change of load • Instantaneous change of current 	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Deceleration time is too short 	<ul style="list-style-type: none"> • 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).	<ul style="list-style-type: none"> • Motor damaged (insulation). • Wire damage or deterioration. • Inverter DCCT sensors defect. 	<ul style="list-style-type: none"> • Replace motor. • Check the motor wiring. • Disconnect motor and try running inverter. • Check resistance between cables and ground. • Reduce carrier frequency.
			

LED display	Description	Cause	Possible solutions
OV Over voltage	DC bus voltage exceeds the OV detection level: 410Vdc: 200V class 820Vdc: 400V class (For 400V class, if input voltage 01-14 is set lower than 400V, the OV detection value will be decreased to 730Vdc).	<ul style="list-style-type: none"> Deceleration time set too short, resulting in regenerative energy flowing back from motor to the inverter. The inverter input voltage is too high. Use of power factor correction capacitors. Excessive braking load. Braking transistor or resistor defective. Speed search parameters set incorrectly. 	<ul style="list-style-type: none"> Increase deceleration time Reduce input voltage to comply with the input voltage requirements or install an AC line reactor to lower the input voltage. Remove the power factor correction capacitor. Use dynamic braking unit. Replace braking transistor or resistor. Adjust speed search parameters.
OU			
UV Under voltage	DC bus voltage is lower than the UV detection level or the pre-charge contactor is not active while the inverter is running. 190Vdc: 200V class; 380Vdc: 400V class (The detection value can be adjusted by 07-13).	<ul style="list-style-type: none"> The input voltage is too low. Input phase loss. Input voltage fluctuation. Pre-charge contactor damaged. DC bus voltage feedback signal value not incorrect. 	<ul style="list-style-type: none"> Check the input voltage. Check input wiring. Check power source Replace pre-charge contactor Replace control board or complete inverter.
UU			
IPL input phase loss	Phase loss at the input side of the inverter or input voltage imbalance, active when 08-09 = 1 (enabled).	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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
IPL			
OPL output phase loss	Phase loss at the output side of the inverter, active when 08-10 = 1 (enabled).	<ul style="list-style-type: none"> Wiring loose in inverter output terminal. Motor rated current is less than 10% of the inverter rated current. 	<ul style="list-style-type: none"> Check output wiring / faster screws. Check motor & inverter rating.
OPL			
OH1 Heatsink overheat	The temperature of the heat sink is too high. Note: when OH1 fault occurs three times within five minutes, it is required to wait 10 minutes before resetting the fault.	<ul style="list-style-type: none"> Ambient temperature too high. cooling fan failed Carrier frequency set too high. Load too heavy. 	<ul style="list-style-type: none"> Install fan or AC to cool surroundings. Replace cooling fan. Reduce carrier frequency. Reduce load / Measure output current
OH1			
OH4 Motor overheating	Motor overheating : The input of PTC (Positive Temperature Coefficient) exceeds the overheat protection level	<ul style="list-style-type: none"> The surrounding temperature of motor is too high. The input of PTC (Positive Temperature Coefficient) exceeds the overheat protection level. 	<ul style="list-style-type: none"> Check the surrounding temperature of motor. Check MT and GND terminal wiring be correct.
OH4			
OL1 Motor overload	Internal motor overload protection tripped, active when protection curve 08-05 = xxx1.	<ul style="list-style-type: none"> Voltage setting V/F mode too high, resulting in over-excitation of the motor. Motor rated current (02-01) set incorrectly. Load too heavy. 	<ul style="list-style-type: none"> Check V/f curve. Check motor rated current Check and reduce motor load, check and operation duty cycle.
OL1			

LED display	Description	Cause	Possible solutions
OL2 Inverter overload	Inverter thermal overload protection tripped. If an inverter overload occurs 4 times in five minutes, it is required to wait 4 minutes before resetting the fault.	<ul style="list-style-type: none"> Voltage setting V/F mode too high, resulting in over-excitation of the motor. Inverter rating too small. Load too heavy. 	<ul style="list-style-type: none"> Check V/f curve. Replace inverter with larger rating. Check and reduce motor load, check and operation duty cycle.
OL2			
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.	<ul style="list-style-type: none"> Load too heavy. 	<ul style="list-style-type: none"> Check over torque detection parameters (08-15 / 08-16). Check and reduce motor load, check and operation duty cycle.
OT			
UT Under torque detection	Inverter output torque is lower than 08-19 (under torque detection level) for the time specified in 08-20. Parameter 08-18 = 0 or 2 to activate.	<ul style="list-style-type: none"> Sudden drop in load. Belt break. 	<ul style="list-style-type: none"> Check under torque detection parameters (08-19 / 08-20). Check load / application.
UT			
CE 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).	<ul style="list-style-type: none"> Connection lost or wire broken. Host stopped communicating. 	<ul style="list-style-type: none"> Check connection Check host computer / software.
CE			
FB PID feedback loss	PID feedback signal falls below level specified in 10-12 (PID feedback loss detection level) for the time specified in 10-13 (Feedback loss detection time). Active when parameter (10-11 = 2).	<ul style="list-style-type: none"> Feedback signal wire broken Feedback sensor broken. 	<ul style="list-style-type: none"> Check feedback wiring Replace feedback sensor.
Fb			
STO Safety switch	Inverter safety switches open.	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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
STO			
STO2 Safety switch			
SS1 Safety switch	Inverter safety switches open.	<ul style="list-style-type: none"> When 08-30 is set to 0: Deceleration to stop, and digital terminal switch(58) is turned on. 	<ul style="list-style-type: none"> Check digital terminal(58) is turned on.
SS1			
EF0 External fault 0	External fault (Modbus)	Modbus communication 0x2501 bit 2="1"	<ul style="list-style-type: none"> Reset Modbus communication 0x2501 bit 2="1"
EF0			

LED display	Description	Cause	Possible solutions
EF1 External fault (S1) 	External fault (Terminal S1) Active when 03-00= 25 or 68, and Inverter external fault selection 08-24=0 or 1.	<ul style="list-style-type: none"> Multifunction digital input external fault active. 	<ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring
EF2 External fault (S2) 	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) 	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) 	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) 	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) 	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 	Motor control fault	<ul style="list-style-type: none"> SLV mode is unable to run motor. 	<ul style="list-style-type: none"> Perform rotational or stationary auto-tune Increase minimum output frequency (01-08)
CF08 Motor control fault 	Motor control fault	<ul style="list-style-type: none"> Start or Run fault in PMSLV mode. 	<ul style="list-style-type: none"> 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 	DC bus fuse blown DC fuse (Models 230V 50HP and above, 460V 75HP and above) open circuit.	<ul style="list-style-type: none"> IGBT damaged. Short circuit output terminals. 	<ul style="list-style-type: none"> Check IGBTs Check for short circuit at inverter output. Replace inverter.
LOPBT Low flow fault 	Low flow fault	<ul style="list-style-type: none"> The feedback signal is not connected. Due to HVAC feedback value is lower than the limit of minimum flow. 	<ul style="list-style-type: none"> 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 	High flow fault	<ul style="list-style-type: none"> Since HVAC feedback value is higher than the limit of maximum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct. Ensure that the feedback value is lower than the limit of maximum flow (23-48).
LPBFT Low pressure fault 	Low pressure fault	<ul style="list-style-type: none"> The feedback signal is not connected. Since feedback value of pump pressure is lower than limit of minimum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct and with connection. Check if feedback value of pressure is lower than limit of minimum pressure (23-15).

LED display	Description	Cause	Possible solutions
OPBFT High pressure fault 	High pressure fault	<ul style="list-style-type: none"> Since feedback value of pump pressure is lower than limit of maximum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct. Check if feedback value of pressure is lower than limit of maximum pressure (23-12).
LSCFT Low suction fault 	Low suction fault	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Keypad and inverter cannot transmit data after power on 5 seconds 	<ul style="list-style-type: none"> Disconnect the operator and then reconnect. Replace the control board
CF01 Operator Communication Error 2 	Errors of data transmission occur in keypad	<ul style="list-style-type: none"> Keypad and inverter can transmit data but transmission error occurs for more than 2 seconds 	<ul style="list-style-type: none"> Disconnect the operator and then reconnect. Replace the control board
CT Fault 	Fault occurs in voltage level of three-phase input	<ul style="list-style-type: none"> Abnormal input voltage, too much noise or malfunctioning control board 	<ul style="list-style-type: none"> Check input voltage signal and the voltage on the control board.
Double Communication Error 	Redundant Profibus and Modbus protocol	<ul style="list-style-type: none"> User may use two communication mechanisms simultaneously 	<ul style="list-style-type: none"> Check only one communication mechanism is used.
PTC Signal Loss 	PTC Signal Loss detecting triggers error message	<ul style="list-style-type: none"> PTC connection trips and has lasted for more than 10 seconds 	<ul style="list-style-type: none"> Check if MT terminal and GND terminal are connected.
OPR Disconnection 	Run command is set to keypad 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.	<ul style="list-style-type: none"> The inverter runs at keypad mode (00-02=0), but warning of operator being disconnected/ removed occurs. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Short circuit or grounding fault (08-23=1) occurs from the damage to motor, insulation deterioration or cable breakage. 	<ul style="list-style-type: none"> Check if the load is at correct wiring.
PF Protection	OH1 error occurs for 3 times in 5 minutes when	<ul style="list-style-type: none"> Run command in multi-function digital input terminals is not 	<ul style="list-style-type: none"> Remove run command in multi-function digital input

LED display	Description	Cause	Possible solutions
Fault	run command in multi-function digital input terminals is not removed.	removed.	terminals.
PF			
TOL	External overload (enabled only when firemode activated)	<ul style="list-style-type: none"> External overload in multi-function digital input terminals. (Ex. Fan overheat) 	<ul style="list-style-type: none"> Check external overload. Reset external overload of digital input.
External Overload			
EOL			

10.3 Warning / Self-diagnosis Detection Function

When the inverter detects a warning, the keypad displays a warning code (flash).

Note: The fault contact output does not energize on a warning and the inverter continues operation. When the warning is no longer active the keypad will return to its original state.



When the inverter detected a programming error (for example two parameters contradict each other or are set to an invalid setting), the keypad displays a self-diagnostics code.

Note: The fault contact output does not energize on a self-diagnostics error. While a self-diagnostics code is active the inverter does not accept a run command until the programming error is corrected.









Note: When a warning or self- diagnostic error is active the warning or error code will flash on the keypad.










Refer to Table 10.3.1 for an overview, cause and corrective action for inverter warnings and self-diagnostics 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 be decreased to 700Vdc)	<ul style="list-style-type: none"> Deceleration time set too short, resulting in regenerative energy flowing back from motor to the inverter. The inverter input voltage is too high. Use of power factor correction capacitors. Excessive braking load. Braking transistor or resistor defective. Speed search parameters set incorrectly. 	<ul style="list-style-type: none"> Increase deceleration time Reduce input voltage to comply with the input voltage requirements or install an AC line reactor to lower the input voltage. Remove the power factor correction capacitor. Use dynamic braking unit. Replace braking transistor or resistor. Adjust speed search parameters.
UV (flash) under voltage			
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.	<ul style="list-style-type: none"> Ambient temperature is too high. The cooling fan has stopped. Carrier frequency setting is too high. 	<ul style="list-style-type: none"> 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
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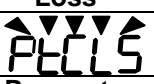


LED display	Description	Cause	Possible solutions
OH2 (flash) Inverter over heating warning	Inverter overheat warning: Multi-function digital input set to 32. (Terminal S1 ~ S6) Active when 03-00 ~ 03-05 =31).	<ul style="list-style-type: none"> • Multifunction digital input overheat warning active. 	<ul style="list-style-type: none"> • Multi-function input function set incorrectly. • Check wiring
			
OT (flash) over torque detection	Inverter output torque is higher than 08-15 (over torque detection level) for the time specified in 08-16. Parameter 08-14 = 0 to activate.	<ul style="list-style-type: none"> • Load too heavy. 	<ul style="list-style-type: none"> • Check over torque detection parameters (08-15 / 08-16). • Check and reduce motor load, check and operation duty cycle.
			
UT (flash) under torque detection	Inverter output torque is lower than 08-19 (under torque detection level) for the time specified in 08-20. Parameter 08-18 = 0 to activate.	<ul style="list-style-type: none"> • Sudden drop in load. • Belt break. 	<ul style="list-style-type: none"> • Check under torque detection parameters (08-19 / 08-20). • Check load / application.
			
bb1 (flash) External baseblock	External base block (Terminal S1)	<ul style="list-style-type: none"> • Multifunction digital input external baseblock active. 	<ul style="list-style-type: none"> • Multi-function input function set incorrectly. • Check wiring
			
bb2 (flash) External baseblock	External base block (Terminal S2)		
			
bb3 (flash) External baseblock	External base block (Terminal S3)		
			
bb4 (flash) External baseblock	External base block (Terminal S4)		
			
bb5 (flash) External baseblock	External base block (Terminal S5)		
			






LED display	Description	Cause	Possible solutions
bb6 (flash) External baseblock 	External base block (Terminal S6)	<ul style="list-style-type: none"> Multifunction digital input external baseblock active. 	<ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring
OL1 Motor overload 			
OL2 Inverter overload 	Inverter thermal overload protection tripped. If an inverter overload occurs 4 times in five minutes, it is required to wait 4 minutes before resetting the fault	<ul style="list-style-type: none"> Voltage setting V/F mode too high, resulting in over-excitation of the motor. Motor rated current (02-01) set incorrectly. Load too heavy. Voltage setting V/F mode too high, resulting in over-excitation of the motor. Inverter rating too small. Load too heavy. 	<ul style="list-style-type: none"> Check V/f curve. Check motor rated current Check and reduce motor load, check and operation duty cycle. Check V/f curve. Replace inverter with larger rating. Check and reduce motor load, check and operation duty cycle
CE (flash) communication error 			
CLB over current protection level B 	Inverter current reaches the current protection level B.	<ul style="list-style-type: none"> Inverter current too high. Load too heavy. 	<ul style="list-style-type: none"> Check load and duty cycle operation.
Retry (flash) retry 			
EF1 (flash) External fault (S1) 	External fault (Terminal S1) Active when 03-00= 25 or 68, and Inverter external fault selection 08-24=2.	<ul style="list-style-type: none"> The period of 07-01 automatic reset≠0. The times of 07-02 automatic reset≠0. 	<ul style="list-style-type: none"> It will disappear after the period of automatic reset.
EF2 (flash) External fault (S2) 			
EF3 (flash) External fault (S3) 	External fault (Terminal S3) Active when 03-02= 25 or 68, and Inverter external fault selection 08-24=2.	<ul style="list-style-type: none"> Multifunction digital input external fault active and parameter 08-24 = 2 for operation to continue. 	<ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring Multi-function input function set incorrectly. Check wiring

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.		<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • Multifunction digital input external fault active and parameter 08-24 = 2 for operation to continue. 		
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.	<ul style="list-style-type: none"> • Forward run and reverse run active (see 2-wire control). 		<ul style="list-style-type: none"> • Check run command wiring
SE01 Rang setting error 	Parameter setting falls outside the allowed range.	<ul style="list-style-type: none"> • Some parameter ranges are determined by other inverter parameters which could cause an out of range warning when the dependency parameter is adjusted. 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. 		<ul style="list-style-type: none"> • Check parameter setting.
SE02 Digital input terminal error 	Multi-function input setting error.	<ul style="list-style-type: none"> • Multi-function digital input terminals (03-00 to 03-07) are set to the same function (not including ext. fault and not used.) or ①UP/DOWN commands are not set at the same time(they must be used together). • 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 		<ul style="list-style-type: none"> • Check multi-function input setting.

LED display	Description	Cause	Possible solutions
SE03 V/f curve error	V/f curve setting error.	<ul style="list-style-type: none"> V/F curve setting error. 01-02 > 01-12 > 01-06 (Fmax) (Fbase) (Fmid1) >01-08; (Fmin) 	<ul style="list-style-type: none"> Check V/F parameters
			
SE05 PID selection error	PID selection error.	<ul style="list-style-type: none"> 10-00 and 10-01 are set to 1 (AI1) or 2 (AI2) simultaneously. When 23-05=0 and 10-33>=1000 or 10-34≠1. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Inverter capacity setting does not match voltage class (13-00). 	<ul style="list-style-type: none"> Check inverter capacity setting 13-00.
			
SE09 PI setting error	Inverter PI setting error	<ul style="list-style-type: none"> Inverter pulse input selection (03-30) selection conflicts with PID source (10-00 and 10-01). 	<ul style="list-style-type: none"> 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).	<ul style="list-style-type: none"> Feedback signal wire broken Feedback sensor broken. 	<ul style="list-style-type: none"> Check feedback wiring Replace feedback sensor.
			
USP (flash) Unattended Start Protection	Unattended Start Protection (USP) is enabled (enabled at power-up.)	<ul style="list-style-type: none"> 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). 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> The feedback signal is not connected. Due to HVAC feedback value is lower than limit of minimum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct and with right connection. Check if feedback value is lower than limit of minimum flow.
			
HFPB High flow error	High flow error	<ul style="list-style-type: none"> Due to HVAC feedback value is lower than limit of maximum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct. Check if feedback value is lower than limit of maximum flow.
			

LED display	Description	Cause	Possible solutions
LOPB Low pressure error	Low pressure error	<ul style="list-style-type: none"> The feedback signal is not connected. Due to feedback value of pump pressure is lower than limit of minimum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct and with connection. Check if feedback value of pressure is lower than limit of minimum pressure.
			
HIPB High pressure error	High pressure error	<ul style="list-style-type: none"> Due to feedback value of pump pressure is lower than limit of maximum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct. Check if feedback value of pressure is lower than limit of maximum pressure.
			
LSCFT Low suction error	Inadequate suction error	<ul style="list-style-type: none"> Insufficient water of supply tank leads to insufficient suction. PID difference is higher than its level or current is lower than output current level. 	<ul style="list-style-type: none"> Check if water of supply tank is enough, and water supply is regular. Check PID difference is higher than its level or current is lower than output current level
			
FIRE Fire override mode	Fire override mode	<ul style="list-style-type: none"> Fire override mode is active 	<ul style="list-style-type: none"> None (Fire override mode is not a kind of warning).
			
SE10 PUMP/HVAC Setting error	PUMP/HVAC settings of inverter error	<ul style="list-style-type: none"> PUMP selection of inverter (23-02)> (23-03). HVAC selection of inverter (23-46)< (23-47). 	<ul style="list-style-type: none"> Check pump selection of inverter (23-02) and (23-03) settings. Check HVAC selection of inverter (23-46) and (23-47) settings.
			
COPUP PUMP communication breaking error	Breaking error of multiple pumps communication	<ul style="list-style-type: none"> Communication breaking or disconnection of pump cascade control. 	<ul style="list-style-type: none"> Check if it has setting issue or is not properly connected.
			
Parameter Setting Error	Parameter setting error	<ul style="list-style-type: none"> Error of Parameter setting occurs. 	<ul style="list-style-type: none"> Refer to the instruction manual or this parameter is selected to be disabled.
			
Warning of Direct Start	When 07-04 is set to 1, the inverter can not start directly but displays the warning signal.	<ul style="list-style-type: none"> Set the digital input terminal (S1~S6) to run and simultaneously set 07-04=1. 	<ul style="list-style-type: none"> Check the digital input terminal and disconnect it. Then reconnect the DI terminal after the setting delay time (07-05) ends.
			

LED display	Description	Cause	Possible solutions
External Terminal Stop Error 	External Terminal is main run command source selection (00-02=1) and run command executes but executes stop command from keypad.	<ul style="list-style-type: none"> Run command executes from external terminal but executes stop command from keypad. 	<ul style="list-style-type: none"> Remove the run command from external terminal
ADC Voltage Error 	Abnormal voltage level on the control board	<ul style="list-style-type: none"> Abnormal input voltage, too much noise or malfunctioning control board. 	<ul style="list-style-type: none"> Check the input voltage signal and the voltage on the control board.
EEPROM Archiving Error 	EEPROM Poor archiving	<ul style="list-style-type: none"> EEPROM poor peripheral circuit It occurs in parameters check at inverter boot. 	<ul style="list-style-type: none"> Reconnect and if the warning signal appears again, replace the circuit board. Contact TECO for more information.
Control Board Error 	The control board is not correspondent with the program.	<ul style="list-style-type: none"> The control board is not correspondent with the program. 	<ul style="list-style-type: none"> Replace the control board.
Wrong running direction Error 	Only for run in one direction, another direction command is not allowed.	<ul style="list-style-type: none"> Run command for another direction on the terminal of control board is active. 	<ul style="list-style-type: none"> Cancel the run command for another direction on the terminal of control board.
PTC Signal Loss 	PTC Signal Loss detecting triggers error message	<ul style="list-style-type: none"> PTC connection trips and has lasted for more than 10 seconds. 	<ul style="list-style-type: none"> Check if MT terminal and GND terminal are connected.
Parameters Locked 	Parameter password have been locked	<ul style="list-style-type: none"> Parameter password function (13-07) starts. 	<ul style="list-style-type: none"> Correct password input at parameter 13-07
Password Setting Error 	Password input at the second time is different from that at the first time when the password lock function enables.	<ul style="list-style-type: none"> Password input at the second time is different from that at the first time when the password lock function enables. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Since signals from the inverter's control board are transmitted error, the inverter cannot normally transmit the data to operator. 	<ul style="list-style-type: none"> Check if the inverter is normally connected to the operator.

LED display	Description	Cause	Possible solutions
Operator Writing Error	Operator cannot write the information into the inverter.	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Check the inverter's firmware version/ control mode/ models
WRE*			
Operator Verifying Error	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.	<ul style="list-style-type: none"> The data in the operator and the inverter is not consistent. 	<ul style="list-style-type: none"> Check if the inverter is normally connected to the operator.
VRYE*			
Repeat Run Command	The inverter is only allowed unidirectional operation and cannot operate in reverse direction simultaneously.	<ul style="list-style-type: none"> Check if the external terminal is given a run command in reverse direction. 	<ul style="list-style-type: none"> Cancel the run command in reverse direction from the external terminal.
			
Operator Read Prohibit	Selection of allowing reading (16-08) is set to 0 (Do not allow to read inverter parameters and save it to the operator).	<ul style="list-style-type: none"> Set parameter 16-08 to 0. 	<ul style="list-style-type: none"> Set parameter 16-08 to 1 (Allow to read inverter parameters and save it to the operator).
RDP*			
External Emergency Stop	Function of external emergency stop starts.	<ul style="list-style-type: none"> Parameter 03-00~03-08 is set to 14 (Function of emergency stop is enabled.) 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> The frequency command is not set up. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 23-19 proportion of loss pressure detection is too big Feedback sensor install failure or not work normal. 	<ul style="list-style-type: none"> 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.	<ul style="list-style-type: none"> Motor Input data error during auto-tuning. Inverter output current does not match motor rated current. 	<ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check inverter capacity
02	Motor lead to lead resistance R1 tuning error.	<ul style="list-style-type: none"> Auto-tuning is not completed within the specified time Auto-tuning results fall outside parameter setting range. Motor rated current exceeded. Motor was disconnected. 	<ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check motor connection. Disconnect motor load. Check inverter current detection circuit and DCCTs. Check motor installation.
03	Motor leakage inductance tuning error.		
04	Motor rotor resistance R2 tuning error.		
05	Motor mutual inductance Lm tuning error.		
07	Deadtime compensation detection error		
08	Motor acceleration error (Rotational type auto-tuning only).	<ul style="list-style-type: none"> Motor fails to accelerate in the specified time (00-14=20sec). 	<ul style="list-style-type: none"> Increase acceleration time (00-14). Disconnect motor load.
09	Other auto-tuning errors	<ul style="list-style-type: none"> No load current is higher than 70% of the motor rated current. Torque reference exceeds 100%. Errors other than ATE01~ATE08. 	<ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check motor connection.

10.5 PM Motor Auto-tuning Error

When a fault occurs during auto-tuning of a PM motor, the display will show the “IPErr” fault and the motor stops. The fault information is displayed in parameter 22-22.

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

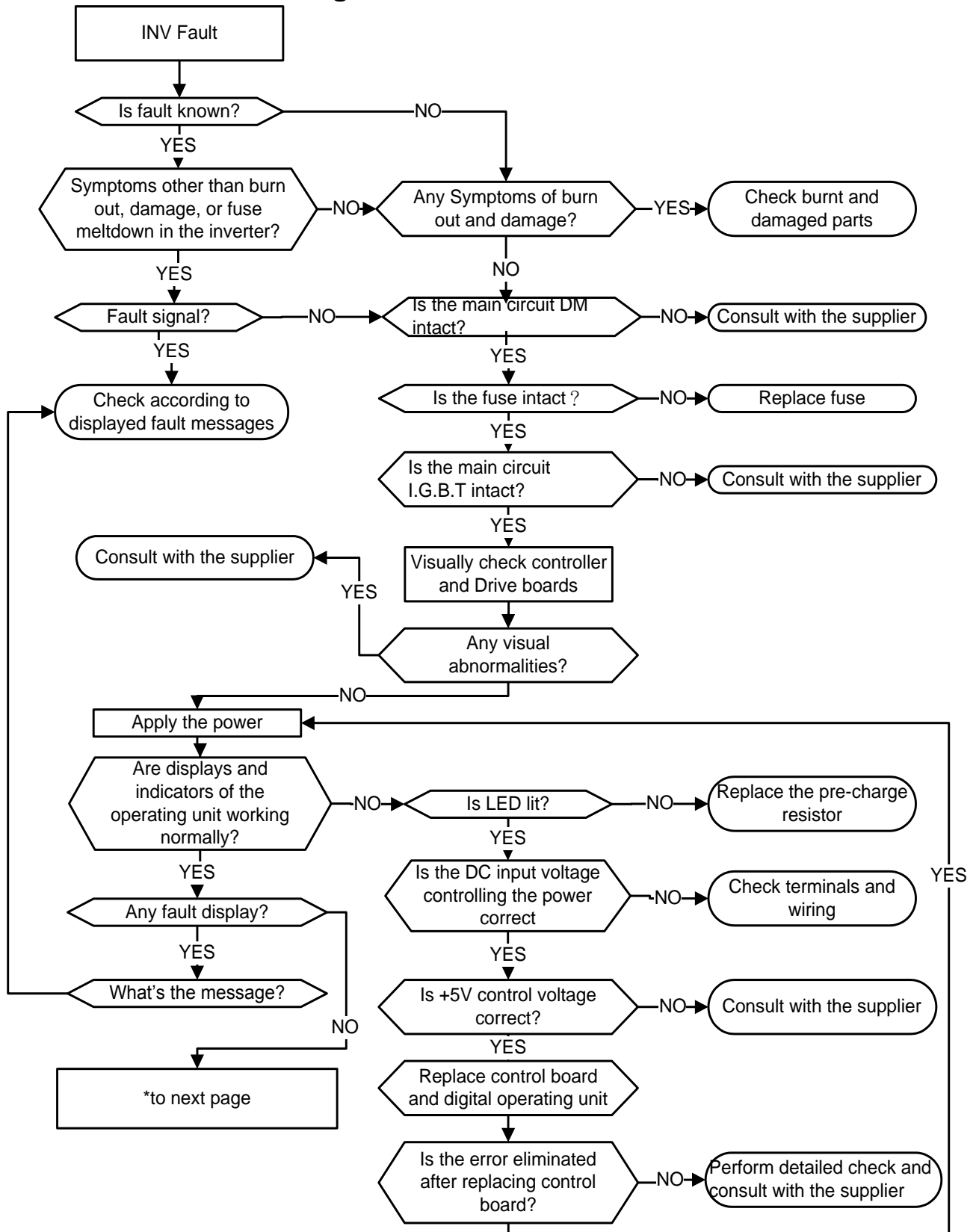
Error	Description	Cause	Corrective action
01	Magnetic pole alignment tuning failure (static).	<ul style="list-style-type: none"> Inverter output current does not match motor current. 	<ul style="list-style-type: none"> Check the motor tuning data (22-02). Check inverter capacity
02~04	Reserved		
05	Circuit tuning time out.	<ul style="list-style-type: none"> System abnormality during circuit tuning. 	<ul style="list-style-type: none"> Check for active protection functions preventing auto-tuning.
06	Reserved		
07	Other motor tuning errors.	<ul style="list-style-type: none"> Other tuning errors. 	<ul style="list-style-type: none"> Check the motor tuning data (22-02). Check motor connection.
08	Reserved		
09	Current out of range during circuit tuning.	<ul style="list-style-type: none"> Inverter output current does not match motor current. 	<ul style="list-style-type: none"> Check the motor tuning data (22-02). Check inverter capacity
10	Reserved		
11	Parameter tuning and detecting time out.	<ul style="list-style-type: none"> Error relationship between voltage and current. 	<ul style="list-style-type: none"> Check if the setting value of parameter 22-11 is too low, but its value cannot exceed 100% of the inverter. Check motor connection.

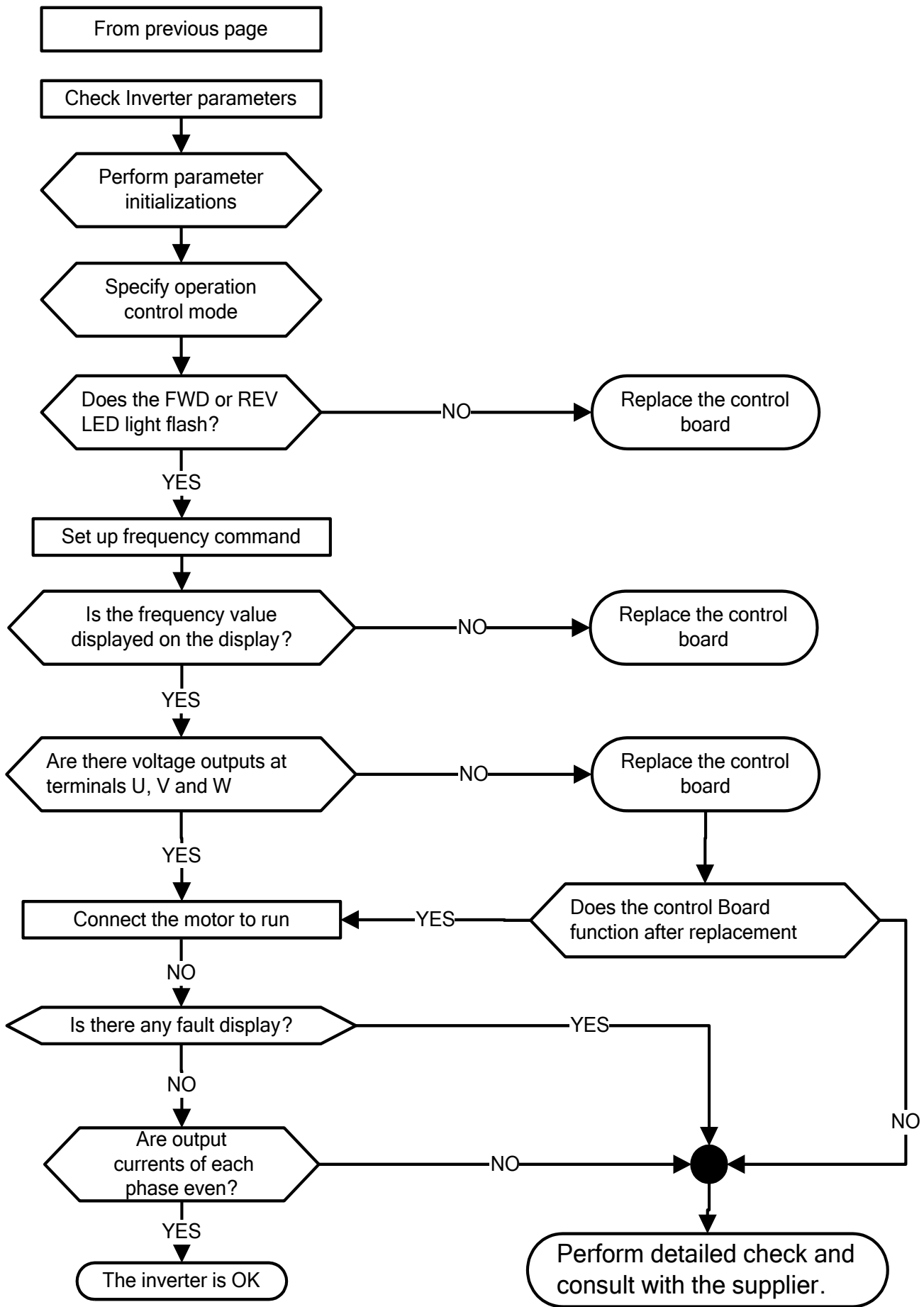
10.6 General troubleshooting

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

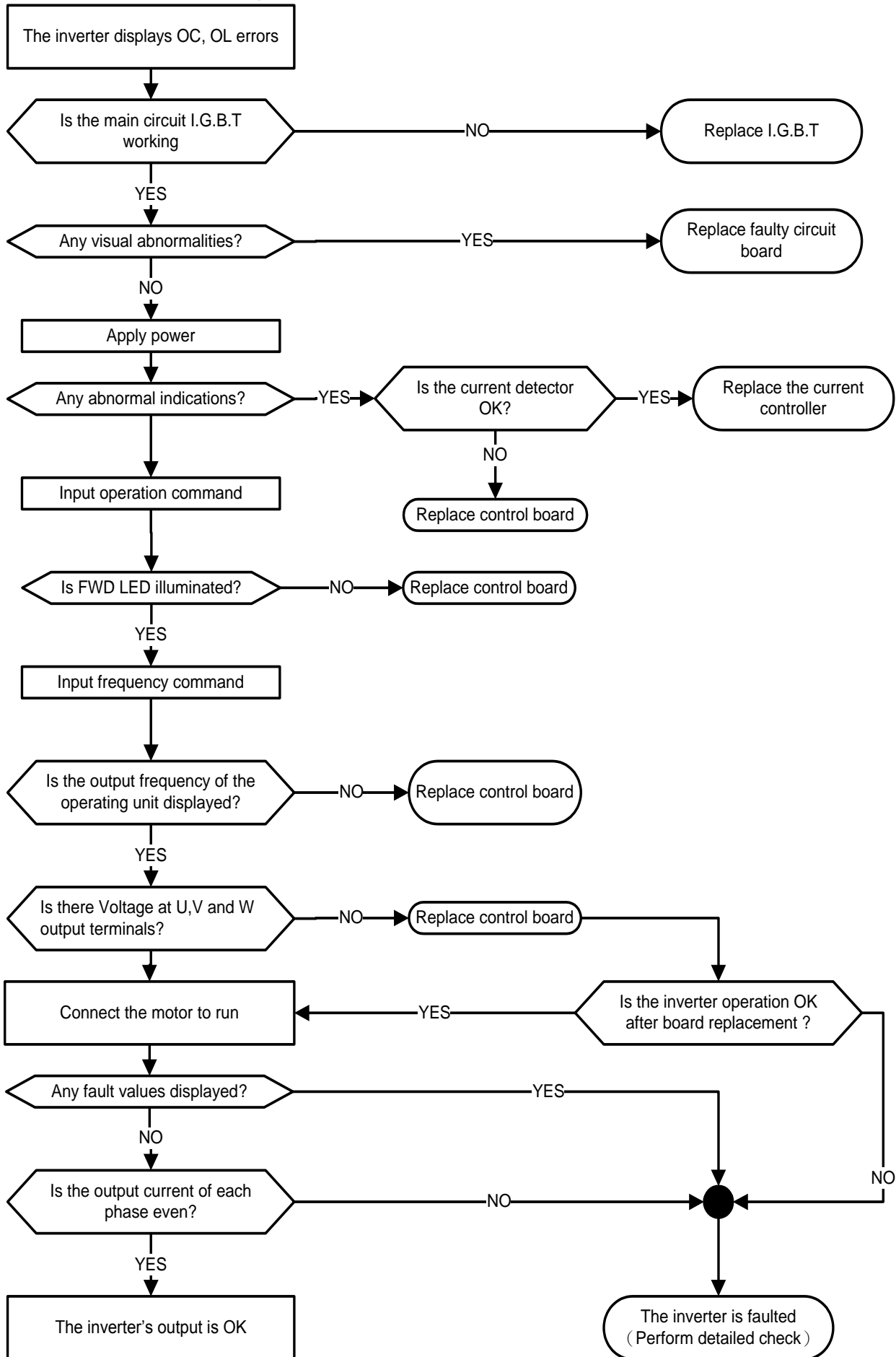
10.7 Troubleshooting of the Inverter

10.7.1 Quick troubleshooting of the Inverter

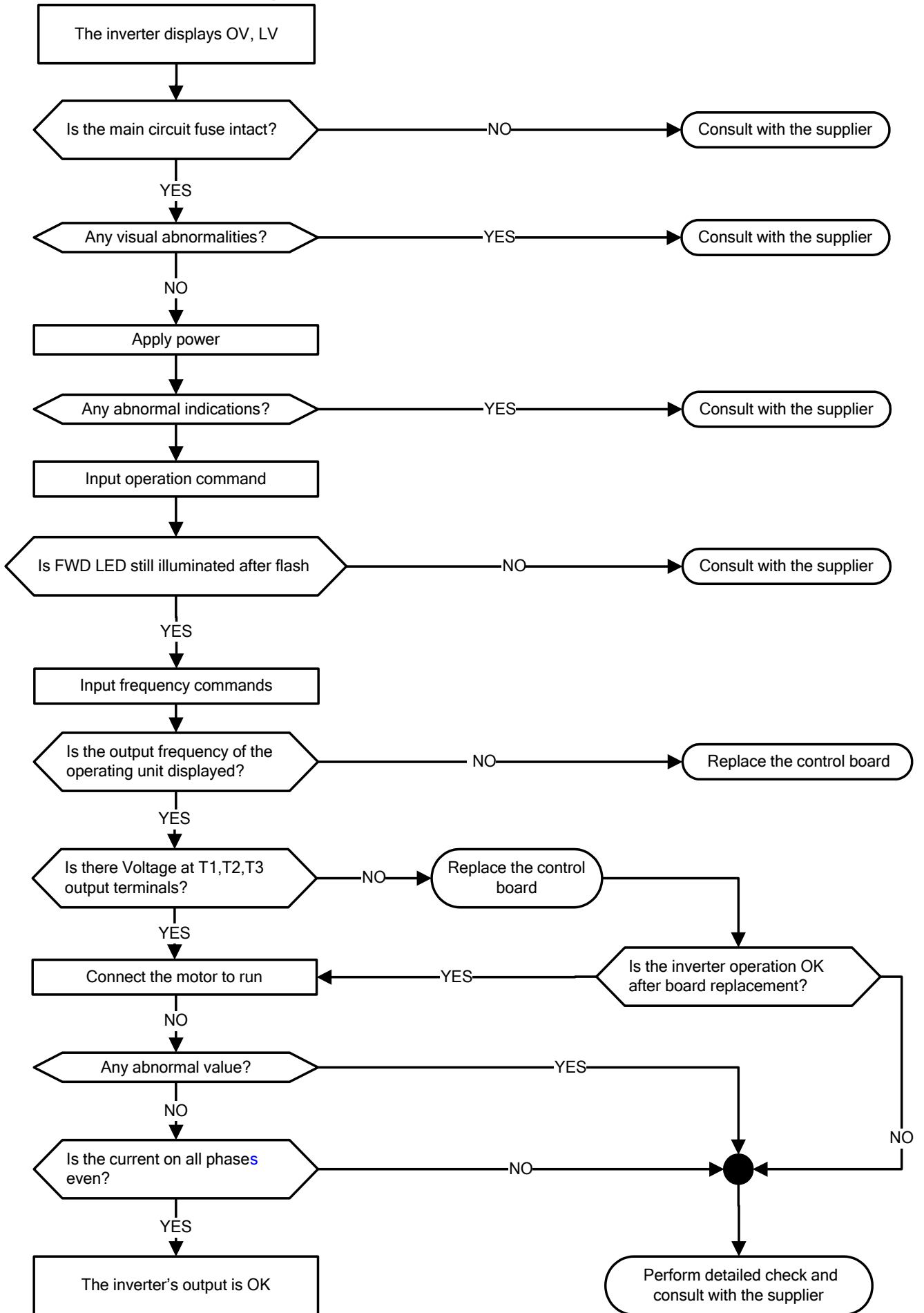




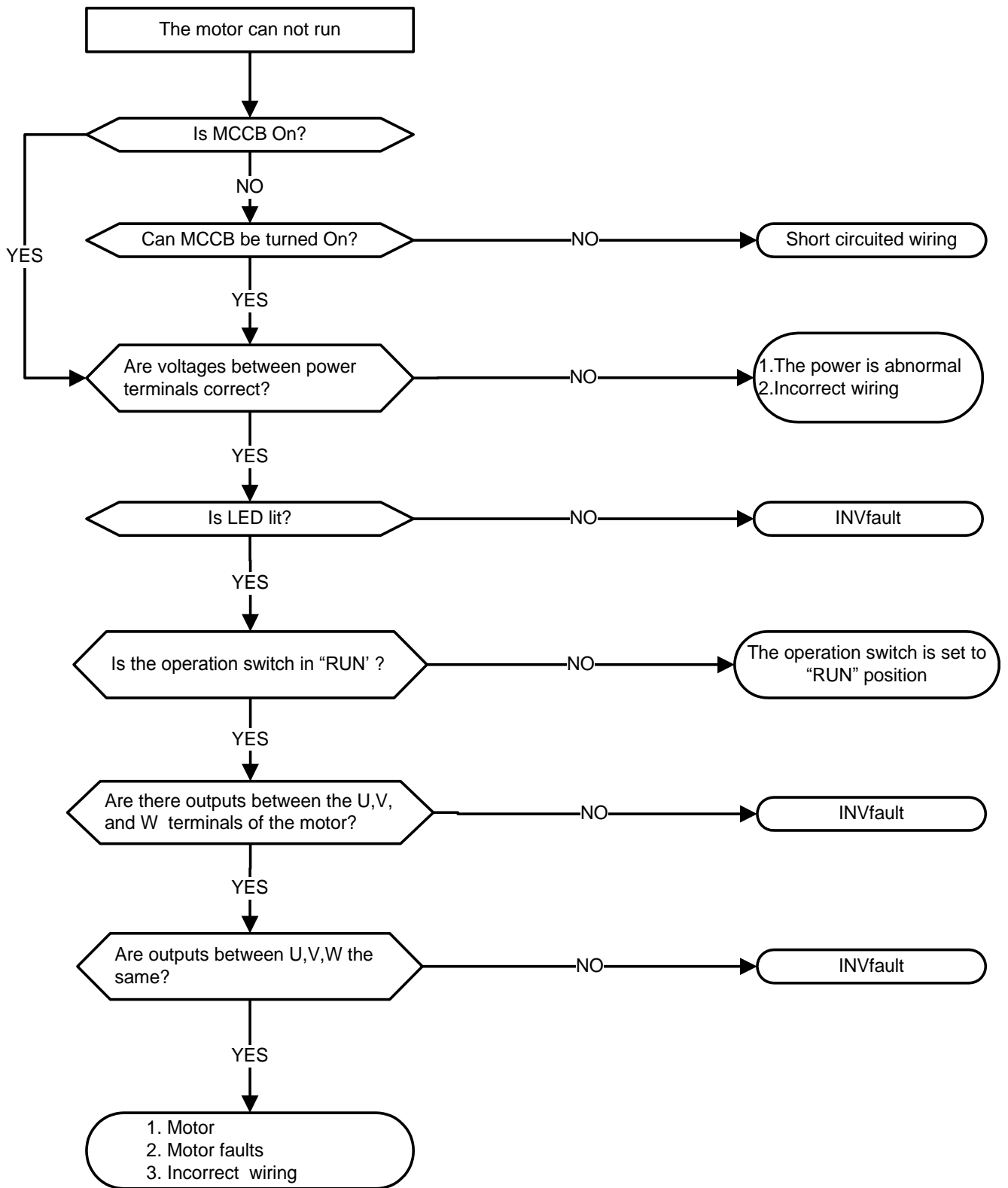
10.7.2 Troubleshooting for OC, OL error displays



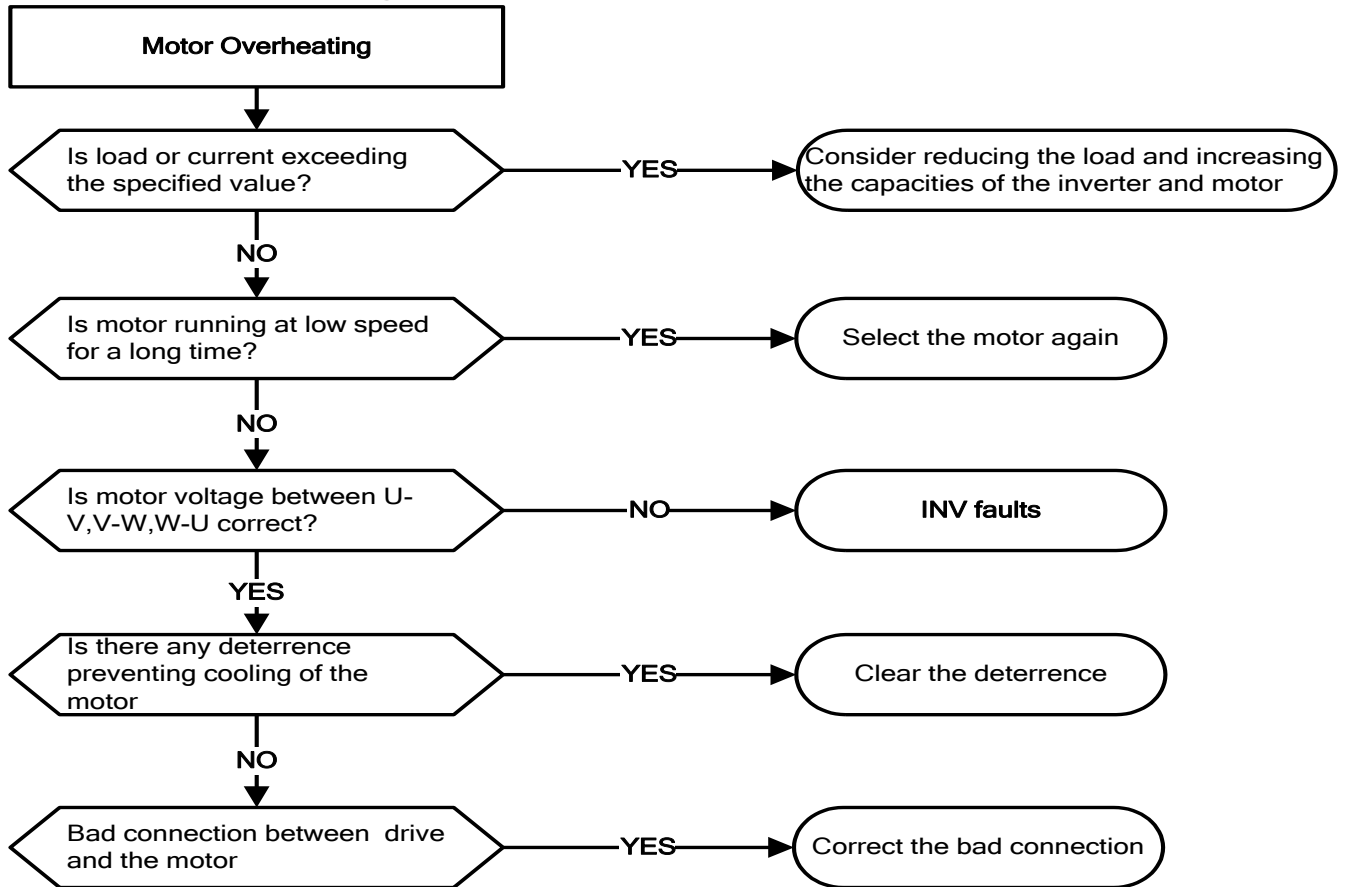
10.7.3 Troubleshooting for OV, LV error



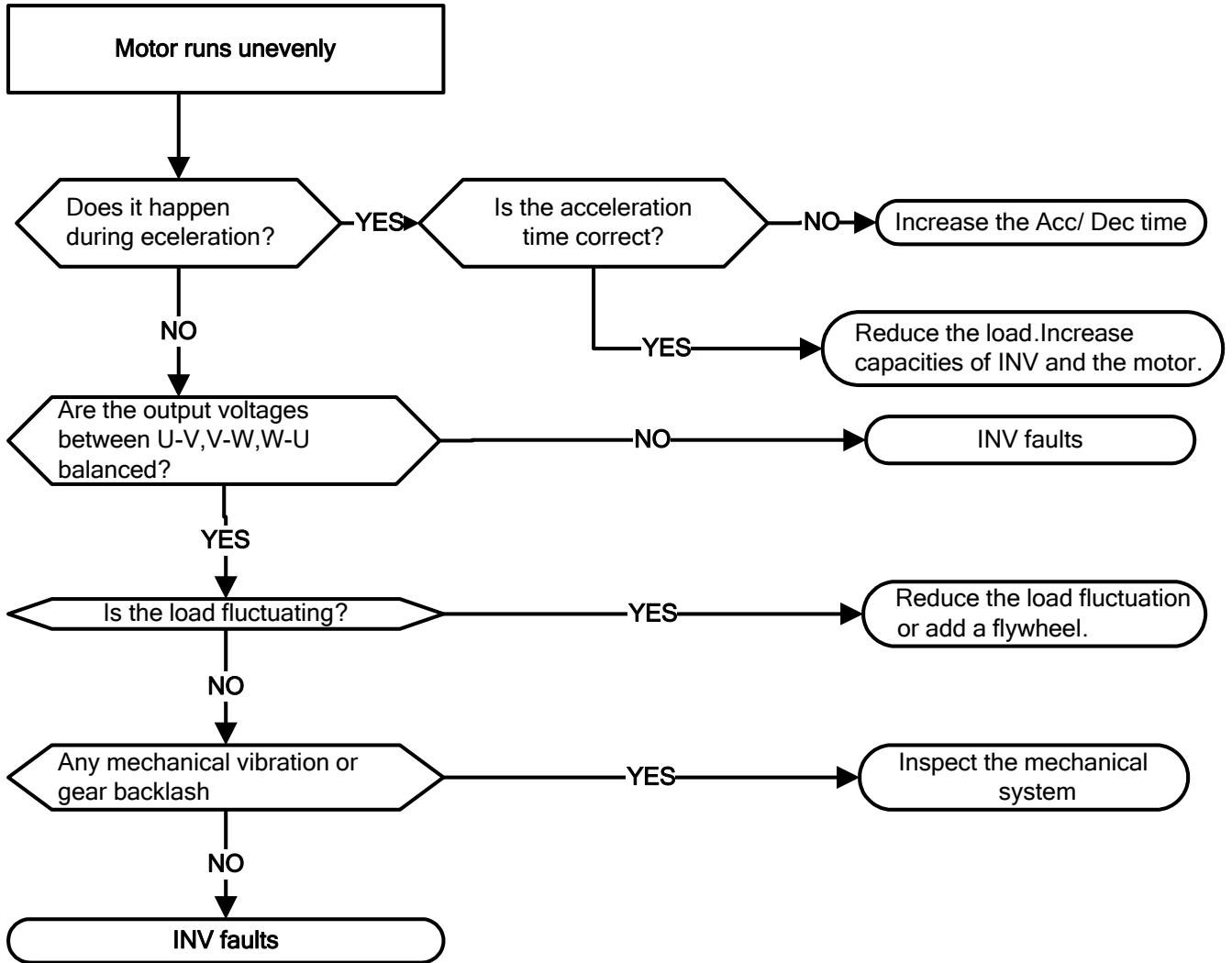
10.7.4 The motor can not run



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		Methods	Criteria	Remedies
		Daily	1Year			
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 components
		Check resistance between terminals		☉	Measure with a multi-tester	No short circuit or broken circuit in three phase output
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			

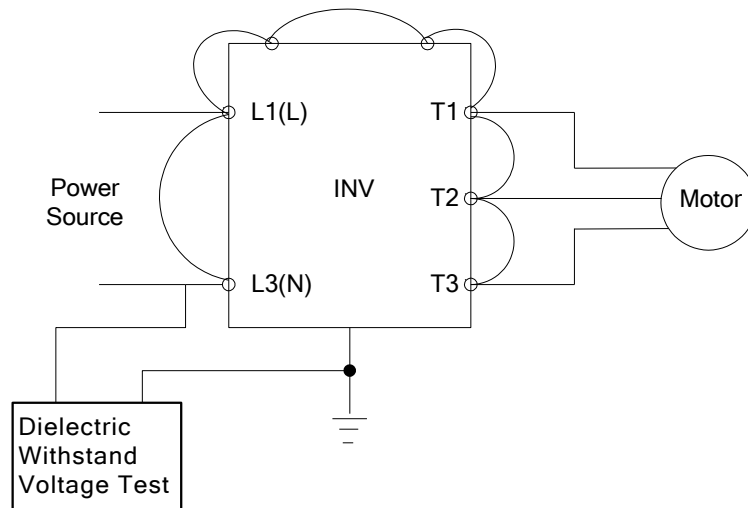
10.9 Maintenance

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.

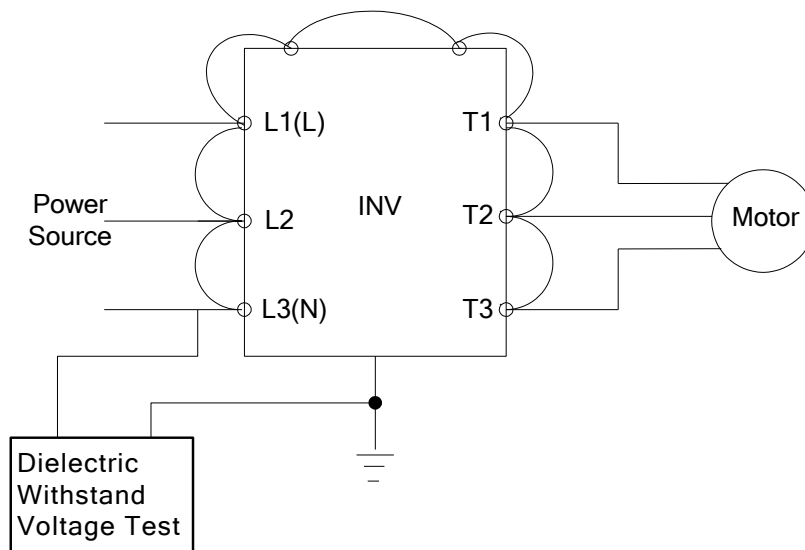
1. Maintenance Check List.

➤ 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; for inverter ratings above 200V 40HP/400V 50HP (IP20) 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	
V	HP	KW	Model	Qty Req	Part Number	Resistor specification	Qty Req.	Resistor Spec.(W/Ω) & Dimensions (L*W*H)mm	Qty Req.		(Ω)	(W)
1 φ/3 φ 200V	1	0.75	-	-	JNBR-150W200	150W/200Ω	1	150W/200Ω (251*28*60)	1	119%	17Ω	1000W
	2	1.5	-	-	JNBR-150W100	150W/100Ω	1	150W/100Ω (251*28*60)	1	119%	17Ω	1000W
	3	2.2	-	-	JNBR-260W70	260W/70Ω	1	260W/70Ω (274*40*78)	1	115%	17Ω	1000W
3 φ 200V	5	3.7	-	-	JNBR-390W40	390W/40Ω	1	390W/40Ω (395*40*78)	1	119%	25Ω	680W
	7.5	5.5	-	-	JNBR-520W30	520W/30Ω	1	520W/30Ω (400*50*100)	1	108%	21Ω	800W
	10	7.5	-	-	JNBR-780W20	780W/20Ω	1	780W/20Ω (400*50*100)	1	119%	18Ω	900W
	15	11	-	-	JNBR-2R4KW13R6	2400W/13.6Ω	1	1200W/27.2Ω (535*60*110)	2	117%	11Ω	1500W
	20	15	-	-	JNBR-3KW10	3000W/10Ω	1	1500W/20Ω (615*60*110)	2	119%	11Ω	1500W
	25	18.5	-	-	JNBR-4R8KW8	4800W/8Ω	1	1200W/32Ω (535*60*110)	4	119%	7Ω	2400W
	30	22	-	-	JNBR-4R8KW6R8	4800W/6.8Ω	1	1200W/27.2Ω (535*60*110)	4	117%	7Ω	2400W
	40	30	JNTBU-230	2	JNBR-3KW10	3000W/10Ω	2	1500W/20Ω (615*60*110)	4	119%	5.5Ω	3000W
	50	37	JNTBU-230	2	JNBR-3KW10	3000W/10Ω	2	1500W/20Ω (615*60*110)	4	99%	5.5Ω	3000W
			JNTBU-260	1	JNBR-4R8KW8	4800W/8Ω	2 In para	1200W/32Ω (535*60*110)	8	113%	3.8Ω	4500W
	60	45	JNTBU-230	2	JNBR-4R8KW6R8	4800W/6.8Ω	2	1200W/27.2Ω (535*60*110)	8	117%	5.5Ω	3000W
			JNTBU-260	1	JNBR-4R8KW8	4800W/8Ω	2 In para	1200W/32Ω (535*60*110)	8	98%	3.8Ω	4500W
	75	55	JNTBU-230	2	JNBR-4R8KW6R8	4800W/6.8Ω	2	1200W/27.2Ω (535*60*110)	8	98%	5.5Ω	3000W
JNTBU-260			1	JNBR-4R8KW8	4800W/8Ω	2 In para	1200W/32Ω (535*60*110)	8	82.5%	3.8Ω	4500W	

Inverter			Braking Unit		Braking resistor					Braking torque (Peak / Continues) 10%ED	Minimum resistance		
V	HP	KW	Model	Qty Req	Part Number	Resistor specification	Qty Req.	Resistor Spec.(W/Ω) & Dimensions (L*W*H)mm	Qty Req.		(Ω)	(W)	
	100	75	JNTBU-230	3	JNBR-4R8KW6R8	4800W/6.8Ω	3	1200W/27.2Ω (535*60*110)	12	108%	5.5Ω	3000W	
			JNTBU-260	2	JNBR-4R8KW8	4800W/8Ω	2 In para X2	1200W/32Ω (535*60*110)	16	113%	3.8Ω	4500W	
	125	90	JNTBU-230	4	JNBR-4R8KW6R8	4800W/6.8Ω	4	1200W/27.2Ω (535*60*110)	16	113%	5.5Ω	3000W	
			JNTBU-260	2	JNBR-4R8KW8	4800W/8Ω	2 In para X2	1200W/32Ω (535*60*110)	16	95%	3.8Ω	4500W	
	150	110	JNTBU-230	4	JNBR-4R8KW6R8	4800W/6.8Ω	4	1200W/27.2Ω (535*60*110)	16	98%	5.5Ω	3000W	
			JNTBU-260	2	JNBR-4R8KW8	4800W/8Ω	2 In para X2	1200W/32Ω (535*60*110)	16	82.5%	3.8Ω	4500W	
	175	130	JNTBU-230	5	JNBR-4R8KW6R8	4800W/6.8Ω	5	1200W/27.2Ω (535*60*110)	20	106%	5.5Ω	3000W	
			JNTBU-260	3	JNBR-4R8KW8	4800W/8Ω	2 In para X3	1200W/32Ω (535*60*110)	24	100.4%	3.8Ω	4500W	
	3φ 400V	1	0.75	-	-	JNBR-150W750	150W/750Ω	1	150W/750Ω (251*28*60)	1	126%	120Ω	600W
		2	1.5	-	-	JNBR-150W400	150W/400Ω	1	150W/400Ω (251*28*60)	1	119%	120Ω	600W
		3	2.2	-	-	JNBR-260W250	260W/250Ω	1	260W/250Ω (274*40*78)	1	126%	100Ω	680W
		5	3.7	-	-	JNBR-400W150	400W/150Ω	1	400W/150Ω (395*40*78)	1	126%	60Ω	1200W
7.5		5.5	-	-	JNBR-600W130	600W/130Ω	1	600W/130Ω (470*50*100)	1	102%	60Ω	1200W	
10		7.5	-	-	JNBR-800W100	800W/100Ω	1	800W/100Ω (535*60*110)	1	99%	43Ω	1600W	
15		11	-	-	JNBR-1R6KW50	1600W/50Ω	1	1600W/50Ω (615*60*110)	1	126%	43Ω	1600W	
20		15	-	-	JNBR-1R5KW40	1500W/40Ω	1	1500W/40Ω (615*60*110)	1	119%	39Ω	1600W	
25		18.5	-	-	JNBR-4R8KW32	4800W/32Ω	1	1200W/32Ω (535*60*110)	4	119%	22Ω	3000W	
30		22	-	-	JNBR-4R8KW27R2	4800W/27.2Ω	1	1200W/27.2Ω (535*60*110)	4	117%	14Ω	4800W	
40		30	-	-	JNBR-6KW20	6000W/20Ω	1	1500W/20Ω (615*60*110)	4	119%	14Ω	4800W	
50		37	JNTBU-430	2	JNBR-4R8KW32	4800W/32Ω	2	1200W/32Ω (535*60*110)	8	119%	19.2Ω	3600W	
60		45	JNTBU-430	2	JNBR-4R8KW27R2	4800W/27.2Ω	2	1200W/27.2Ω (535*60*110)	8	117%	19.2Ω	3600W	
75		55	JNTBU-430	2	JNBR-6KW20	6000W/20Ω	2	1500W/20Ω (615*60*110)	8	126%	19.2Ω	3600W	
100	75	JNTBU-430	3	JNBR-6KW20	6000W/20Ω	3	1500W/20Ω (615*60*110)	12	139%	19.2Ω	3600W		

Inverter			Braking Unit		Braking resistor					Braking torque (Peak / Continues) 10%ED	Minimum resistance	
V	HP	KW	Model	Qty Req	Part Number	Resistor specification	Qty Req.	Resistor Spec.(W/Ω) & Dimensions (L*W*H)mm	Qty Req.		(Ω)	(W)
			JNTBU-4120	1	JNBR-6KW20	6000W/20Ω	2 In para	1500W/20Ω (615*60*110)	8	99%	7.6Ω	9000W
	125	90	JNTBU-430	3	JNBR-6KW20	6000W/20Ω	3	1500W/20Ω (615*60*110)	12	115%	19.2Ω	3600W
			JNTBU-4120	2	JNBR-6KW20	6000W/20Ω	2 In para X2	1500W/20Ω (615*60*110)	16	146%	7.6Ω	9000W
	150	110	JNTBU-430	4	JNBR-6KW20	6000W/20Ω	4	1500W/20Ω (615*60*110)	16	125%	19.2Ω	3600W
			JNTBU-4120	2	JNBR-6KW20	6000W/20Ω	2 In para X2	1500W/20Ω (615*60*110)	16	125%	7.6Ω	9000W
	175	132	JNTBU-430	4	JNBR-6KW20	6000W/20Ω	4	1500W/20Ω (615*60*110)	16	111%	19.2Ω	3600W
			JNTBU-4120	2	JNBR-6KW20	6000W/20Ω	2 In para X2	1500W/20Ω (615*60*110)	16	110%	7.6Ω	9000W
	215	160	JNTBU-430	5	JNBR-6KW20	6000W/20Ω	5	1500W/20Ω (615*60*110)	20	112%	19.2Ω	3600W
			JNTBU-4120	3	JNBR-6KW20	6000W/20Ω	2 In para X3	1500W/20Ω (615*60*110)	24	130%	7.6Ω	9000W
	250	185	JNTBU-430	5	JNBR-6KW20	6000W/20Ω	5	1500W/20Ω (615*60*110)	20	99%	19.2Ω	3600W
			TBU-4120	3	JNBR-6KW20	6000W/20Ω	2 in para. X 3	1500W/20Ω (615*60*110)	24	114%	7.6Ω	9000W
	300	220	JNTBU-430	6	JNBR-6KW20	6000W/20Ω	6	1500W/20Ω (615*60*110)	24	99%	19.2Ω	3600W
			JNTBU-4120	3	JNBR-6KW20	6000W/20Ω	2 In para X3	1500W/20Ω (615*60*110)	24	99%	7.6Ω	9000W
	375	280	JNTBU-430	8	JNBR-6KW20	6000W/20Ω	8	6000W/20Ω (615*60*110)	32	105%	19.2Ω	3600W
			JNTBU-4120	4	JNBR-6KW20	6000W/20Ω	2 In para X4	1500W/20Ω (615*60*110)	32	104%	7.6Ω	9000W
	425	315	JNTBU-430	9	JNBR-6KW20	6000W/20Ω	9	6000W/20Ω (615*60*110)	36	104%	19.2Ω	3600W
			JNTBU-4120	5	JNBR-6KW20	6000W/20Ω	2 In para X5	1500W/20Ω (615*60*110)	40	113%	7.6Ω	9000W
	535	400	JNTBU-430	10	JNBR-6KW20	6000W/20Ω	10	1500W/20Ω (615*60*110)	40	96%	19.2Ω	3600W
			TBU-4120	6	JNBR-6KW20	6000W/20Ω	2 in para. X 6	1500W/20Ω (615*60*110)	48	108%	7.6Ω	9000W
	670	500	JNTBU-430	11	JNBR-6KW20	6000W/20Ω	11	1500W/20Ω (615*60*110)	44	87%	19.2Ω	3600W
			TBU-4120	7	JNBR-6KW20	6000W/20Ω	2 in para. X 7	1500W/20Ω (615*60*110)	56	102%	7.6Ω	9000W
	800	600	JNTBU-430	13	JNBR-6KW20	6000W/20Ω	13	1500W/20Ω (615*60*110)	52	86%	19.2Ω	3600W
			TBU-4120	8	JNBR-6KW20	6000W/20Ω	2 in para. X 8	1500W/20Ω (615*60*110)	64	99%	7.6Ω	9000W

Note: "2 in parallel" means that need to use 2 set of braking resistor and to be connected in parallel, then connected to braking unit.

For example, 400V class 100HP, it need TBU-4120 for 1 and 6000W/20Ω for 2, the braking resistor need to be connected in parallel, after the connection, the braking resistor is 12000W/10Ω.

Table 11.1.2 List of braking resistors and braking units (IP55)

Inverter			Braking unit		Braking resistor						Braking torque (Peak / Continues)		Minimum resistance	
V	HP	KW	Model	Qty Req	Part Number	Resistor specification	Qty Req.	Resistor Spec. (W/Ω) & Dimensions (L*W*H)mm	Qty Req		(Ω)	(W)		
3φ 400V	1	0.75	-	-	JNBR-150W750	150W/750Ω	1	150W/750Ω (251*28*60)	1	126%	120Ω	600W		
	2	1.5	-	-	JNBR-150W400	150W/400Ω	1	150W/400Ω (251*28*60)	1	119%	120Ω	600W		
	3	2.2	-	-	JNBR-260W250	260W/250Ω	1	260W/250Ω (274*40*78)	1	126%	100Ω	680W		
	5	3.7	-	-	JNBR-400W150	400W/150Ω	1	400W/150Ω (395*40*78)	1	126%, 10%ED	65Ω	1000W		
	7.5	5.5	-	-	JNBR-600W130	600W/130Ω	1	600W/130Ω (470*50*100)	1	102%, 10%ED	65Ω	1000W		
	10	7.5	-	-	JNBR-800W100	800W/100Ω	1	800W/100Ω (535*60*110)	1	99%, 10%ED	39Ω	1600W		
	15	11	-	-	JNBR-1R6KW50	1600W/50Ω	1	1600W/50Ω (615*60*110)	1	126%, 10%ED	39Ω	1600W		
	20	15	-	-	JNBR-1R5KW40	1500W/40Ω	1	1500W/40Ω (615*60*110)	1	119%, 10%ED	20Ω	3000W		
	25	18.5	-	-	JNBR-4R8KW32	4800W/32Ω	1	1200W/32Ω (535*60*110)	4	119%, 10%ED	20Ω	3000W		
	30	22	JNTBU-430	1	JNBR-4R8KW27R2	4800W/27.2Ω	1	1200W/27.2Ω (535*60*110)	4	117%, 10%ED	19.2Ω	3600W		
	40	30	JNTBU-430	1	JNBR-6KW20	6000W/20Ω	1	1500W/20Ω (615*60*110)	4	119%, 10%ED	19.2Ω	3600W		
	50	37	JNTBU-430	2	JNBR-4R8KW32	4800W/32Ω	2	1200W/32Ω (535*60*110)	8	119%, 10%ED	19.2Ω	3600W		
	60	45	JNTBU-430	2	JNBR-4R8KW27R2	4800W/27.2Ω	2	1200W/27.2Ω (535*60*110)	8	117%, 10%ED	19.2Ω	3600W		
	75	55	JNTBU-430	2	JNBR-6KW20	6000W/20Ω	2	1500W/20Ω (615*60*110)	8	126%, 10%ED	19.2Ω	3600W		
100	75	JNTBU-430	3	JNBR-6RKW20	6000W/20Ω	3	1500W/20Ω (615*60*110)	12	139%, 10%ED	19.2Ω	3600W			

※Note 1: Keep sufficient space between inverter, braking unit and braking resistor and ensure proper cooling is provided for.

11.2 AC Line Reactors

Contact TECO Westinghouse Motor Company for AC Line Reactor Information

11.3 Input Noise Filters

Contact TECO Westinghouse Motor Company for Input and Output Filter Information.

11.4 Input Current and Fuse Specifications

IP20 200V class

Model	Horse power	KVA	100% of rated output current	Rated input current (3 ϕ)	Fuse rating (3 ϕ)	Rated input current (1 ϕ)
F510-2001-C-UE	1	1.9	5.0	5.4	20	9.4
F510-2002-C-UE	2	2.9	7.5	8.1	30	14.1
F510-2003-C-UE	3	4.0	10.6	11.4	50	19.6
F510-2005-C3-UE	5	5.5	14.5	16	50	X
F510-2008-C3-UE	7.5	8.0	22	22.3	50	X
F510-2010-C3-UE	10	11.4	30	31.6	63	X
F510-2015-C3-UE	15	15	42	41.7	100	X
F510-2020-C3-UE	20	21	56	60.9	120	X
F510-2025-C3-UE	25	26	69	75	150	X
F510-2030-C3-UE	30	30	80	85.9	200	X
F510-2040-C3-UE	40	42	110	119.6	250	X
F510-2050-C3-UE	50	53	138	150	300	X
F510-2060-C3-UE	60	64	169	186	400	X
F510-2075-C3-UE	75	76	200	232	500	X
F510-2100-C3-UE	100	95	250	275	600	X
F510-2125-C3-UE	125	119	312	343	700	X
F510-2150-C3-UE	150	152	400	440	800	X
F510-2175-C3-UE	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-C3-UE	1	2.6	3.4	3.7	10
F510-4002-C3-UE	2	3.1	4.1	4.5	16
F510-4003-C3-UE	3	4.1	5.4	5.9	16
F510-4005-C3-UE	5	7.0	9.2	9.6	16
F510-4008-C3-UE	7.5	8.5	12.1	11.6	25
F510-4010-C3-UE	10	13.3	17.5	18.2	40
F510-4015-C3-UE	15	18	23	24	50
F510-4020-C3-UE	20	24	31	32.3	63
F510-4025-C3-UE	25	29	38	41.3	80
F510-4030-C3-UE	30	34	44	47.8	100
F510-4040-C3-UE	40	41	58	63	120
F510-4050-C3-UE	50	55	73	78.3	150
F510-4060-C3-UE	60	67	88	95.7	200
F510-4075-C3-UE	75	79	103	112	250
F510-4100-C3-UE	100	111	145	159	300
F510-4125-C3-UE	125	126	168	181	400
F510-4150-C3-UE	150	159	208	229	500
F510-4175-C3-UE	175	191	250	275	600
F510-4215-C3-UE	215	226	296	325	700
F510-4250-C3-UE	250	250	328	361	700
F510-4300-C3-UE	300	332	435	478	800
F510-4375-C3-UE	375	393	515	566	800

Model	Horse power	KVA	100% of rated output current	Rated input current	Fuse rating
F510-4425-C3-UE	425	446	585	643	1000
F510-4535-C3-UE	535	526	700	750	1400
F510-4670-C3-UE	670	640	875	913	1800
F510-4800-C3-UE	800	732	960	1044	2200

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

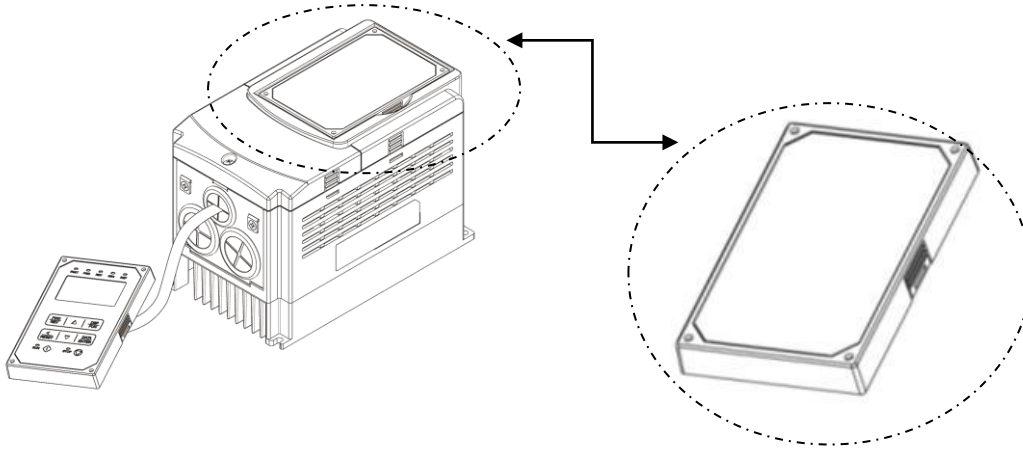
A. 4KA41S1139T01 (LCD keypad)

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 with blank operation box	JN5-CB-01MK	1m
	JN5-CB-02MK	2m
	JN5-CB-03MK	3m
	JN5-CB-05MK	5m

Name	Model	specification
LED digital operator wire	JN5-CB-01M	1m
	JN5-CB-02M	2m
	JN5-CB-03M	3m
	JN5-CB-05M	5m

Dimensions of LED/LCD keypad (IP20):

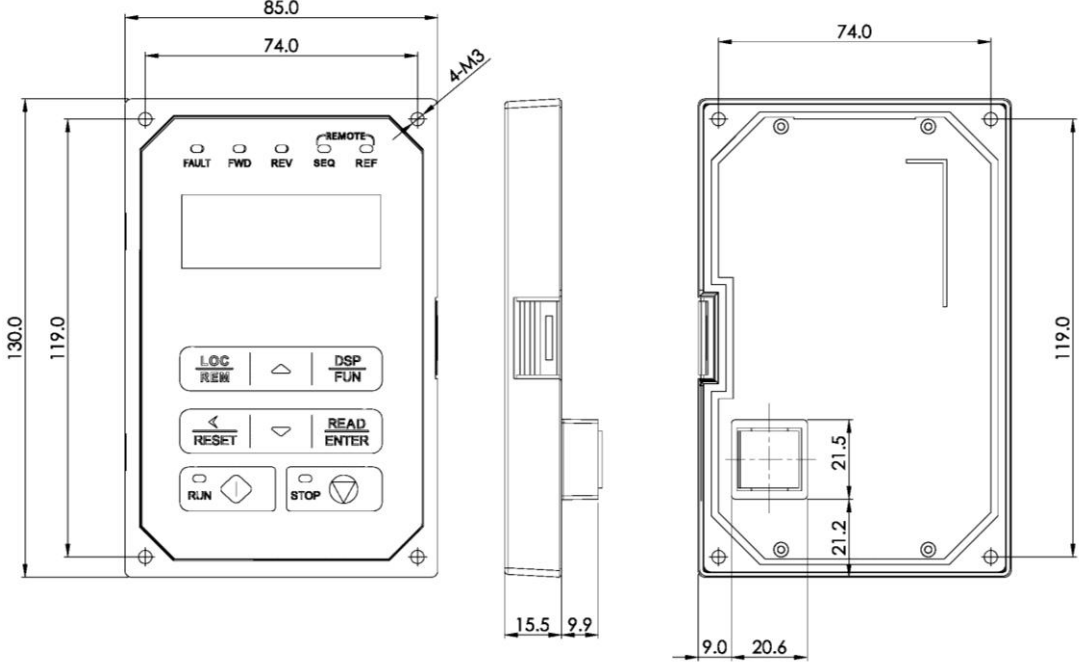


Figure 11.5.2 Dimensions of LED keypad

1 to 8 Pump Card

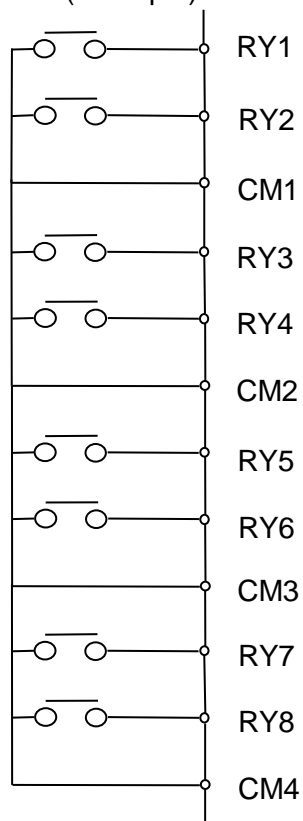
Refer to instruction manual of the option card to install.

JN5-IO-8DO Card: 8 Relay Output Card.

Terminals of JN5-IO-8DO:

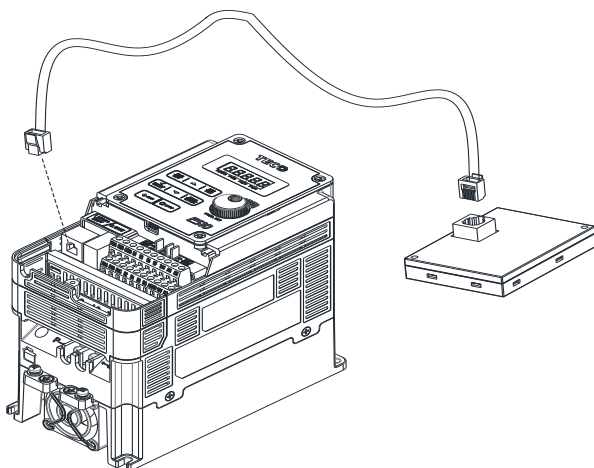
Terminal	Description
RY1~RY8	Relay1~Relay8 A terminal output
CM1~CM4	Common terminal output

Wiring of JN5-IO-8DO (Example):



Copy Unit (JN5-CU) *NOTE STANDARD LCD KEYPAD IS ALSO A COPY UNIT*

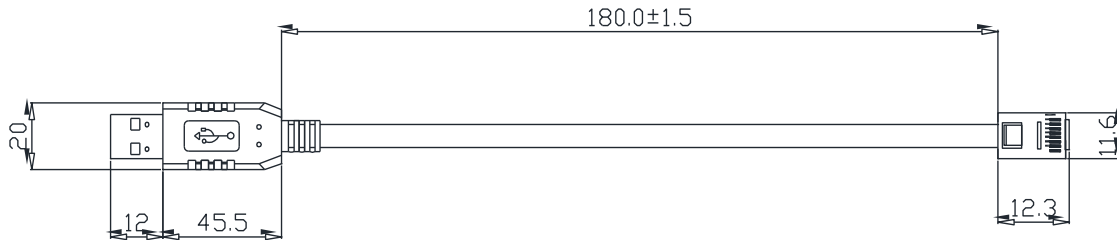
The copy unit is used to copy an inverter parameter setup to another inverter.



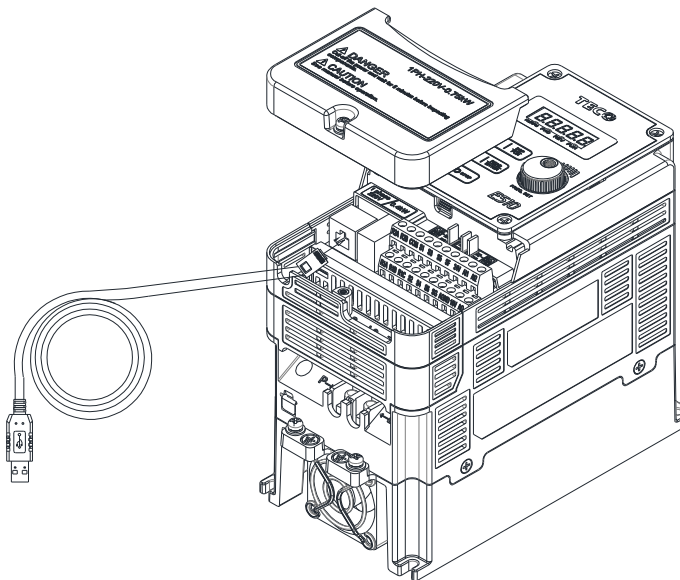
C. RJ45 to USB connecting Cable (1.8m)

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:

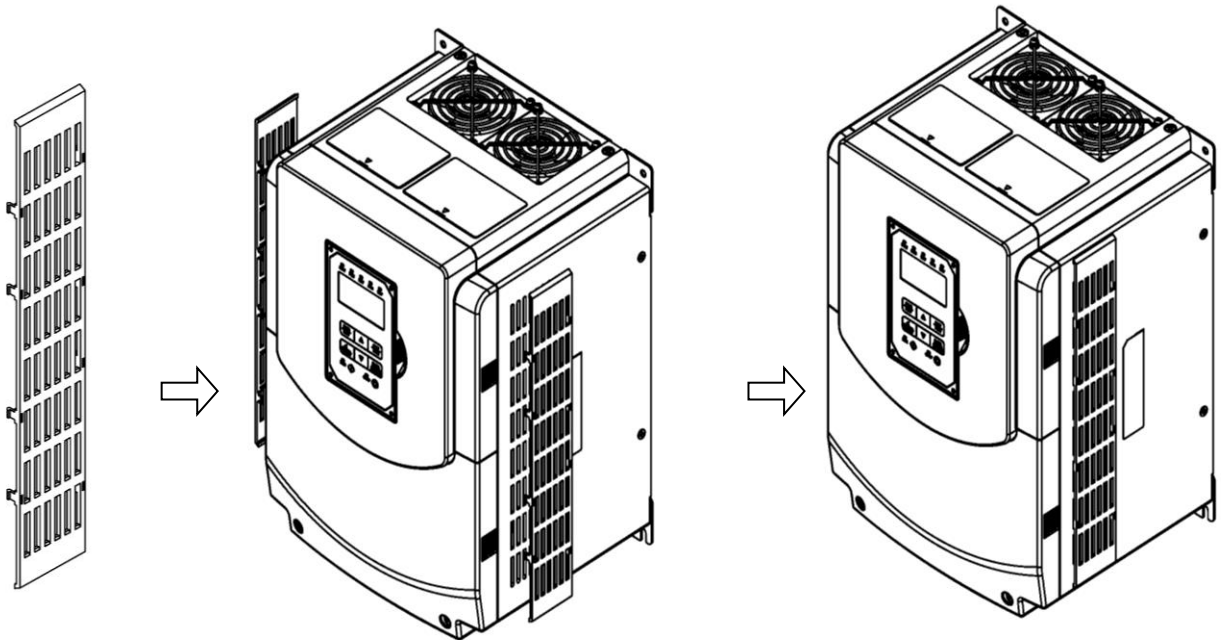


11.6 Others Options

A. Protective Cover *Not Standard for US Market*

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

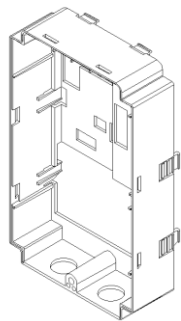
If frame 1~4 of the inverter need to install high-speed communication expansion card or I/O expansion card, middle layer case is necessary, which is option, to install between the top cover and the bottom case, for adding extra space to install the expansion card.

Table 1. Expansion card model number

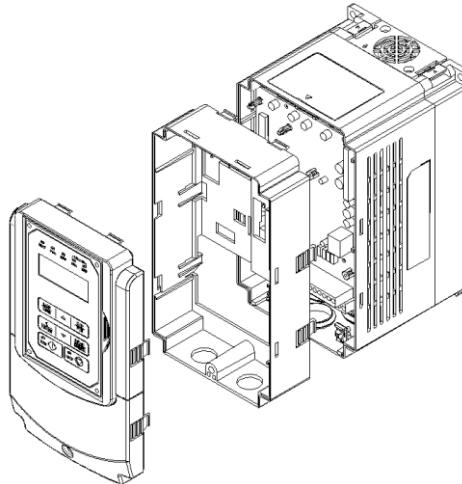
Expansion card type	Model number	Reference chapter
PROFIBUS high-speed comm.	JN5-CMHI-PDP	6.9
CANopen high-speed comm.	JN5-CMHI-CAN	6.10
EtherCAT high-speed comm.	JN5-CMHI-ECAT	6.11
I/O expansion	JN5-IO-2DO1AI	6.12

Table 2. Middle layer case model number

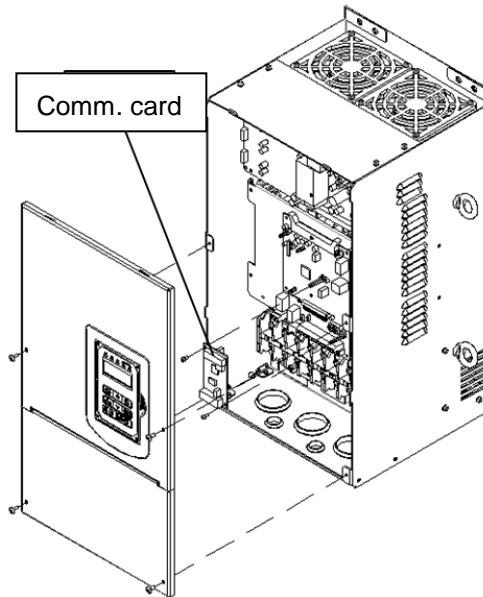
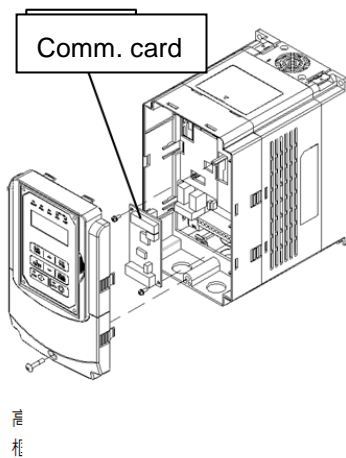
Frame	Middle layer case model number
1	JN5-MD-A01
2	JN5-MD-A02
3	JN5-MD-A03
4	JN5-MD-A04



Middle layer case outline



Middle layer case installation diagram



Communication card installation diagram

11.7 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

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 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	Wire Gauge mm ² , (AWG)		Terminal	Crimp Terminal	Tool	Insulation Cap
	R/L1 □ S/L2 □ T/L3	U/T1 □ V/T2 □ W/T3				
F510						
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
2008	5.5 (10)		M4	R5.5-4	Nichifu NH 1 / 9	TIC 5.5
2015	14 (6)		M4	R14-6	Nichifu NOP 60	TIC 8
2030	38 (2)		M6	R38-6	Nichifu NOP 60 / 150H	TIC 22
2050	80 (3/0)		M8	R80-8	Nichifu NOP 60 / 150H	TIC 60
2075	150 (4/0)		M8	R150-8	Nichifu NOP 150H	TIC 80
2125	300 (4/0)*2		M10	R150-10	Nichifu NOP 150H	TIC 100
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
4010	5.5 (10)		M4	R5.5-4	Nichifu NH 1 / 9	TIC 5.5
4020	8 (8)		M6	R8-6	Nichifu NOP 60	TIC 8
4040	22 (6)		M6	R22-6	Nichifu NOP 60 / 150H	TIC 14
4075	60 (2)		M8	R60-8	Nichifu NOP 60 / 150H	TIC 38
4125	150 (3/0)		M8	R150-8	Nichifu NOP 150H	TIC 80
4250	300 (4/0)*2		M10	R150-10	Nichifu NOP 150H	TIC 100

◆ Type 1

During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used.

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

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

◆ Motor Overtemperature Protection

Motor overtemperature 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.

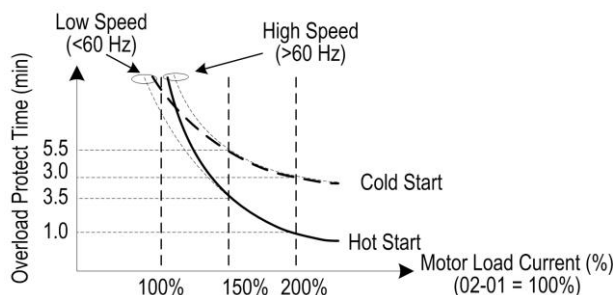
Setting 08-05 = ---0B. Disables the motor overload protection function when two or more motors are connected to a single inverter. Use an alternative method to provide separate overload protection for each motor such as connecting a thermal overload relay to the power line of each motor.

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

Appendix-A Instructions for UL- Additional Data

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 overtemperature protection shall be provided in the end use application.

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.
2175	152 (300)*2			M12	R150-12*2	Nichifu NOP 150H	TIC 150
4300	203 (400)*2			M12	R200-12S*2	Nichifu NOH 300K	TIC 200
4375	253 (500)*2			M12	R325-12S*2	Nichifu NOH 300K	TIC 325
4425	253 (500)*2			M12	R325-12S*2	Nichifu NOH 300K	TIC 325

◆Type 1

During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used.

Recommended Input Fuse Selection

Drive Model F510	Fuse Type	
	Manufacturer: Bussmann / FERRAZ SHAWMUT	
	Model	Fuse Ampere Rating (A)
200 V Class Three-Phase Drives		
2150	Bussmann 170M5464	690V 800A
2175	Bussmann 170M5464	690V 800A

Drive Model A510	Fuse Type	
	Manufacturer: Bussmann / FERRAZ SHAWMUT	
	Model	Fuse Ampere Rating (A)
400 V Class Three-Phase Drives		
4300	Bussmann 170M5464	690V 800A
4375	Bussmann 170M5464	690V 800A
4425	Bussmann 170M5466	690V 1000A

TECO   **Westinghouse**

INVERTER

F510

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Ver 02: 2019:09