



INVERTER

F510



INSTRUCTION MANUAL

230V Class 3~

Open Chassis / NEMA 1

3.7 - 132 kW

5 - 175 HP

460V Class 3~

Open Chassis / NEMA 1

3.7 - 600 kW

5 - 800 HP

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

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

■ Store this manual in a safe, convenient location.

■ The manual is subject to change without prior notice.

****** STATEMENT ******

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

Table of Contents

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

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

11 Inverter Peripheral Devices and Option 11-1

11.1 Braking Resistors and Braking Units 11-1

11.2 AC Line Reactors 11-3

11.3 Output Filters 11-4

11.4 Input Current and Fuse Specifications11-5

11.5 Other options 11-6

11.6 Communication options 11-10

Appendix A: Single and Multi-Pump Wiring A1

Appendix B: UL Instructions B1

Preface

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

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



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

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

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

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

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

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

1. Safety Precautions

1.1 Before supplying Power to the Inverter



Warning

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



Caution

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



Warning

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

1.2 Wiring



Warning

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



Caution

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

1.3 Before Operation



Warning

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

1.4 Parameter Setting



Caution

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

1.5 Operation



Warning

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



Caution

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

1.6 Maintenance, Inspection and Replacement



Warning

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



Caution

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

1.7 Disposal of the Inverter



Caution

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

2. Model Description

2.1 Nameplate Data

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

Unpack the F510 inverter and check the following:

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

MODEL : F510-4010-C3

INPUT : AC 3PH 380-480V (+10%,-15%) 50/60Hz 18.2A

OUTPUT : AC 3PH 380-480V 0-400Hz 17.5A IP20/NEMA1

P/N BARCODE

S/N BARCODE

TECO Electric & Machinery Co., Ltd.

UL LISTED

CE

← Inverter Model

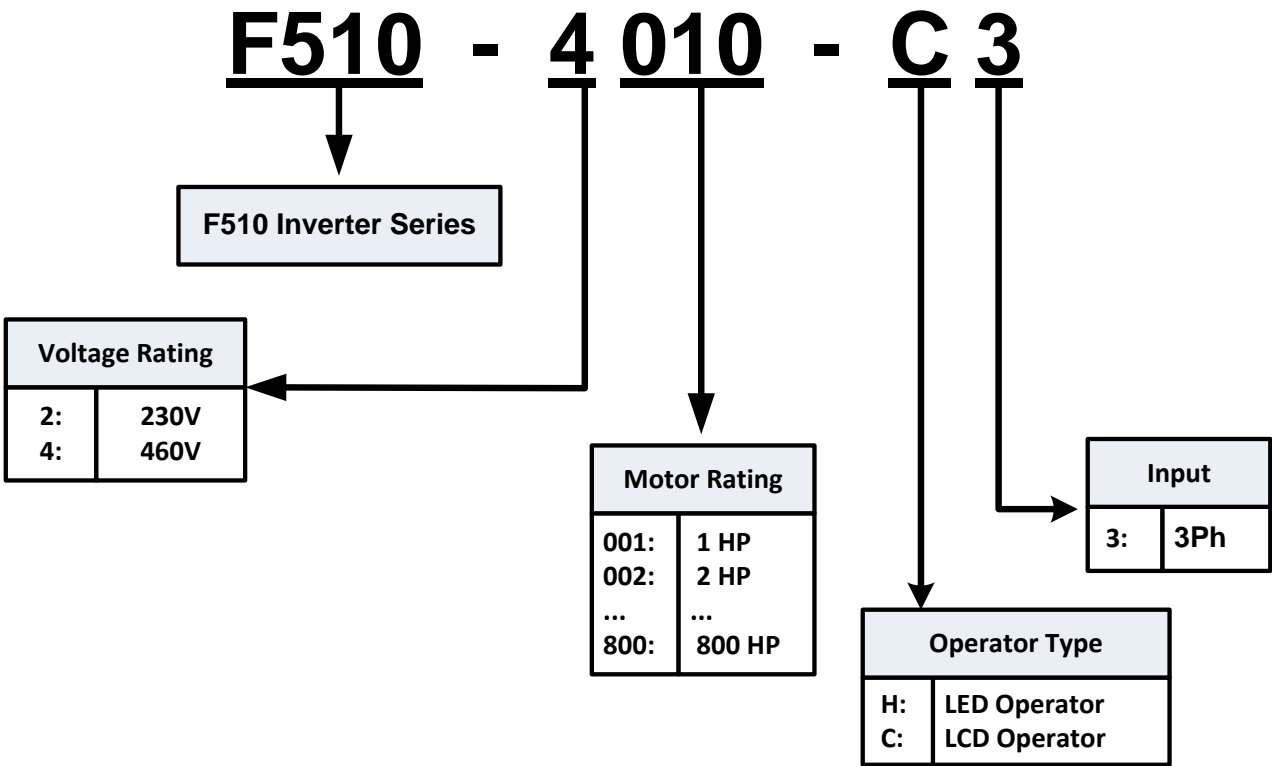
← Input Power Specifications

← Output Power Specifications

← Series No

← UL and CE Marks

Model Identification



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

230V Class

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

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

460V Class

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

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

460V Class (Continued)

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

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

3. Environment and Installation

3.1 Environment

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

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

3.2 Installation

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

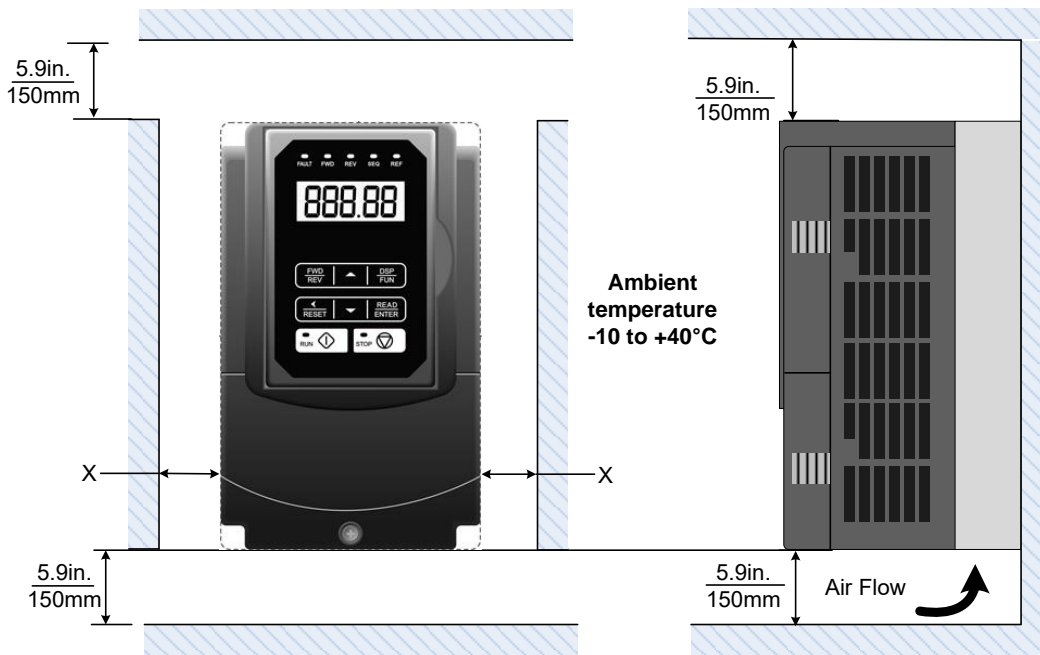


Fig 3.2.1: F510 Installation space

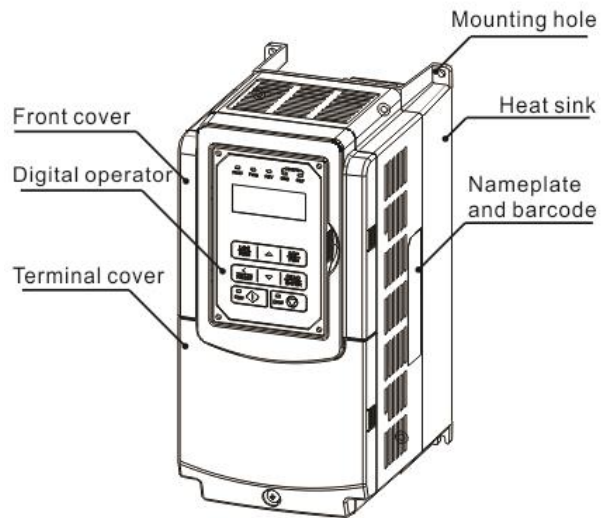
X = 1.18" (30mm) for inverter ratings up to 25HP

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

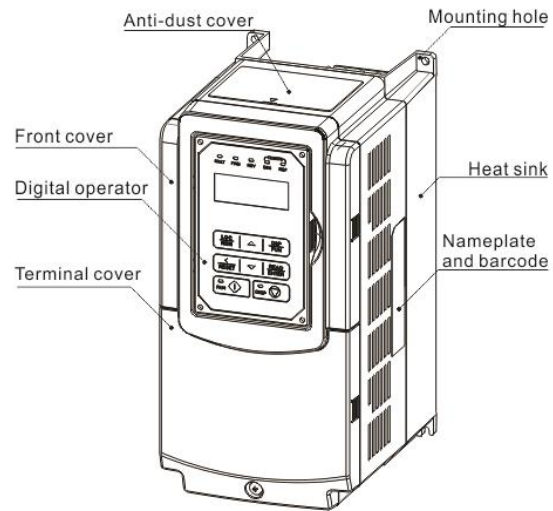
Important Note: The inverter heatsink temperature can reach up to 194°F / 90°C during operation; Use insulation material rated for this temperature.

3.3 External View

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

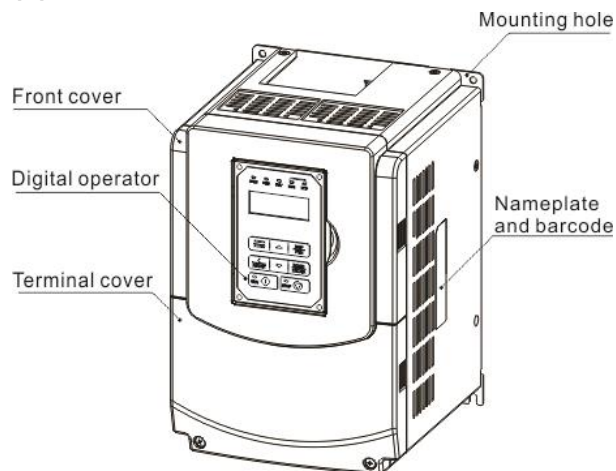


(Wall-mounted type, IEC IP00)

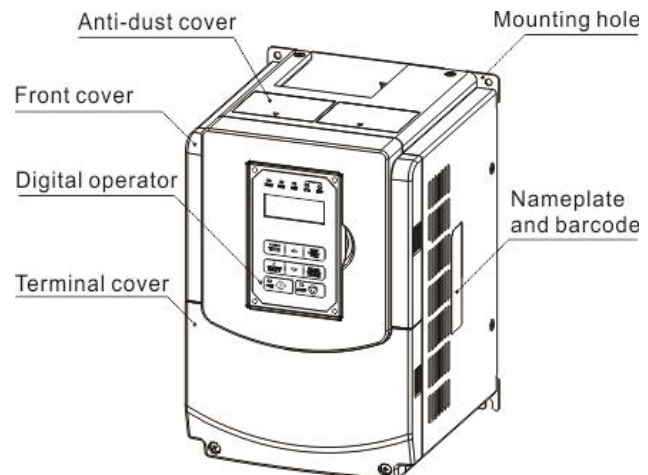


(Wall-mounted type, IEC IP20, NEMA1)

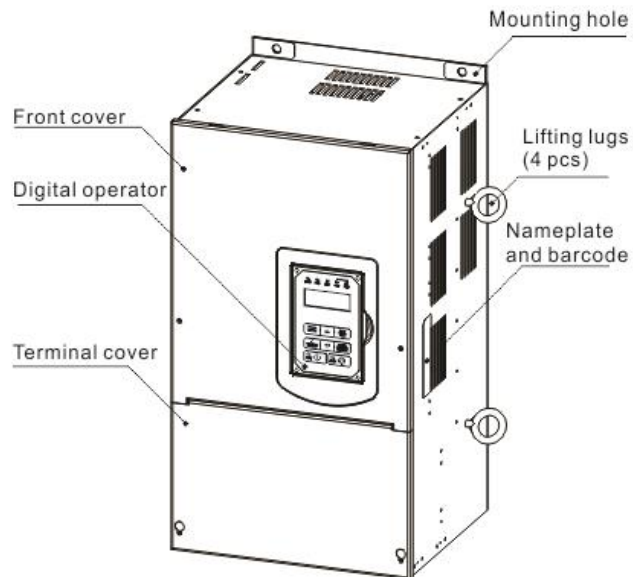
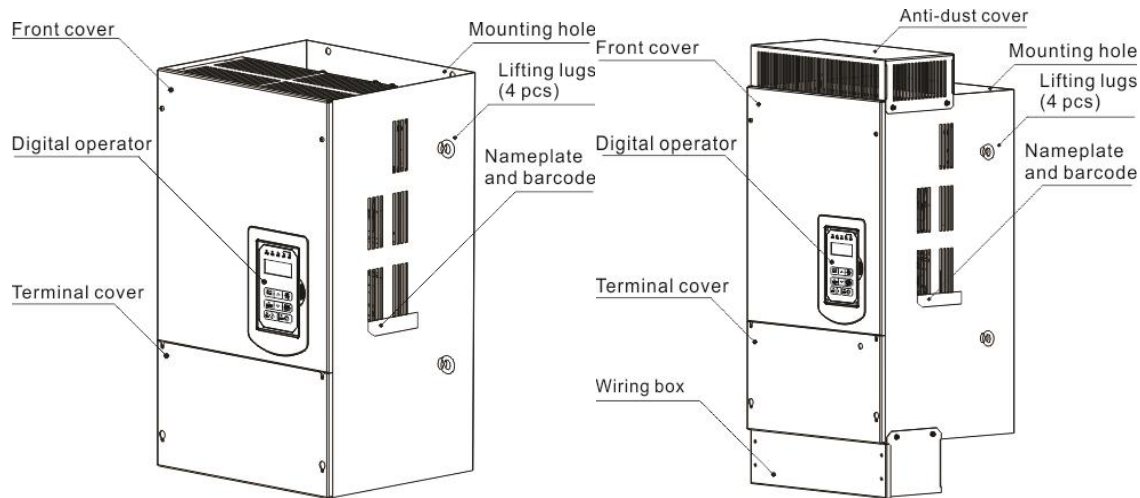
(b) 200V 10-30HP/ 400V 15-40HP

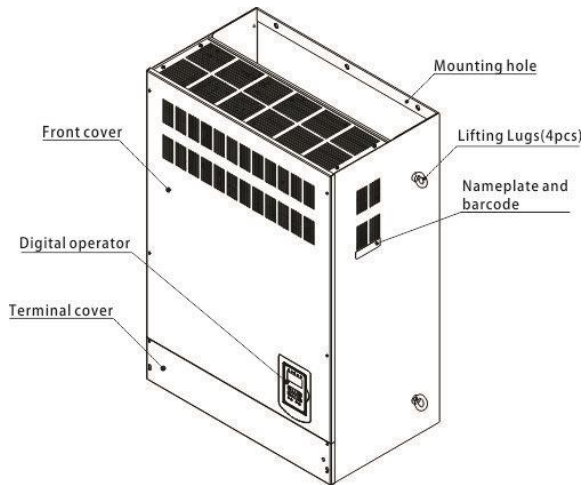
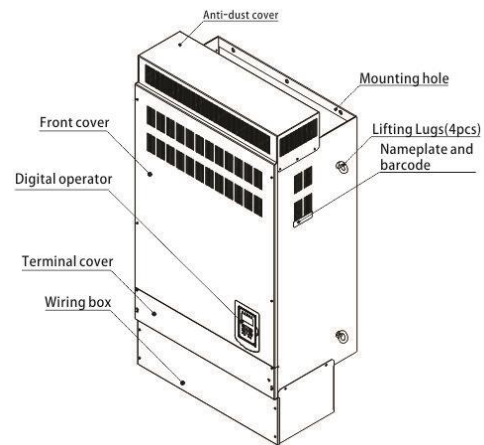
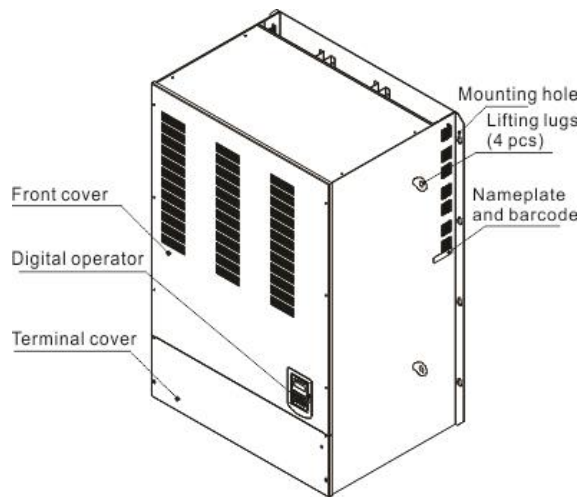
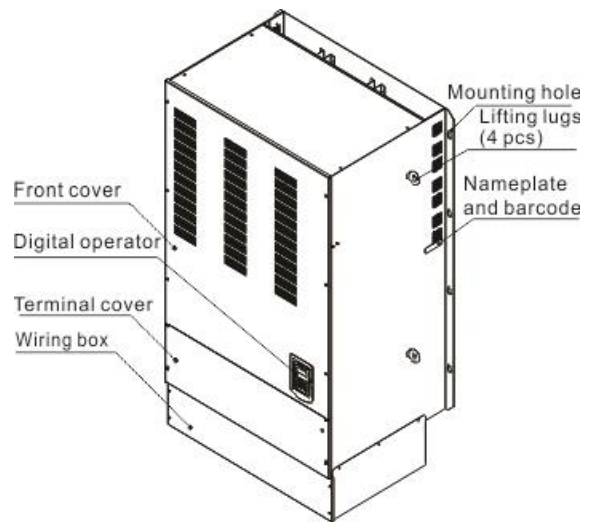


(Wall-mounted type, IEC IP00)



(Wall-mounted type, IEC IP20, NEMA1)

(c) 200V 40-50HP/ 400V 50-75HP**(Wall-mounted type, IEC IP20, NEMA1)****(d) 200V 60-125HP/ 400V 100-250HP****(Wall-mounted type, IEC IP00)****(Wall-mounted type, IEC IP20, NEMA1)**

(e) 200V 150-175HP/ 400V 300-425HP**(Wall-mounted type, IEC IP00)****(Wall-mounted type, IEC IP20)****(f) 400V 535-800HP****(Wall-mounted type, IEC IP00)****(Wall-mounted type, IEC IP20)**

3.4 Warning Labels

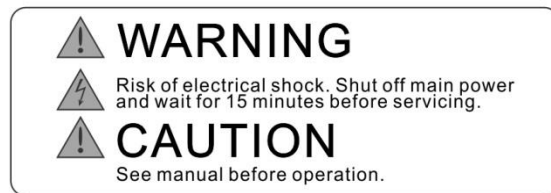
Important: Warning information located on the front cover must be read upon installation of the inverter.



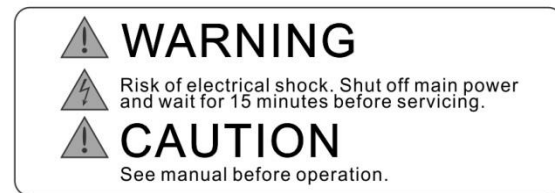
(a) 200V: 5 ~ 7.5HP / 400V: 5 ~ 10HP (IP20)



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



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



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

3.5 Removing the Front Cover and Keypad

IP00 / IP20

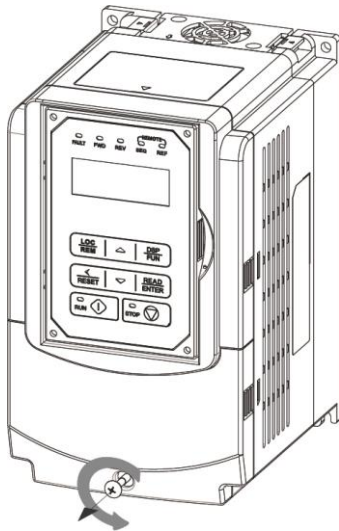


Caution

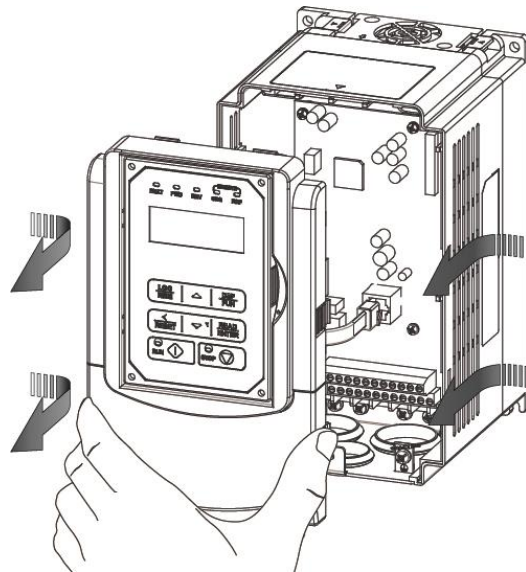
- Before making any wiring connections to the inverter the front cover needs to be removed.
- It is not required to remove the digital operator before making any wiring connections.
- Models 200V, 1 – 30 HP and 400V, 1 – 40 HP have a plastic cover. Loosen the screws and remove the cover to gain access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

3.5.1 Standard Type

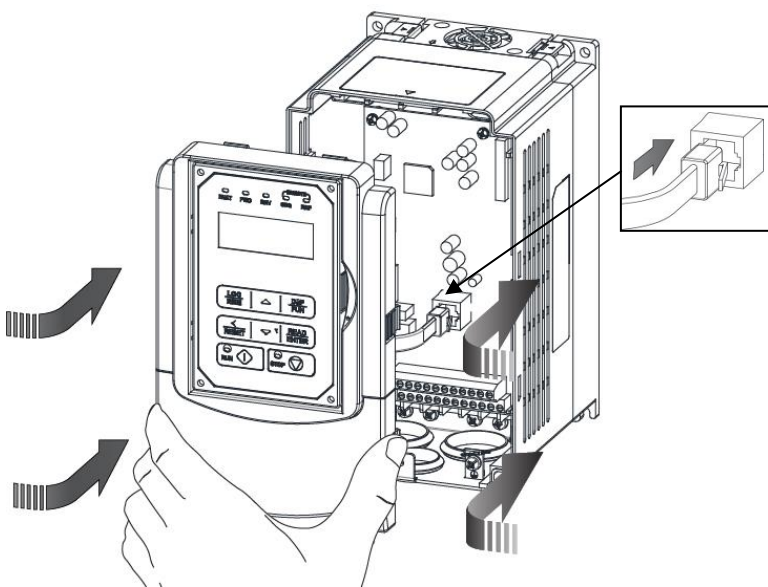
(a) 200V 1-3HP/ 400V 1-3HP



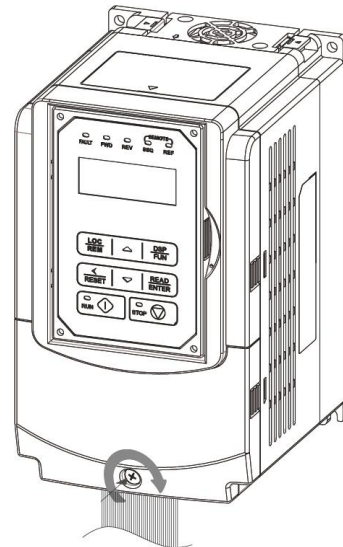
Step 1: Unscrew cover



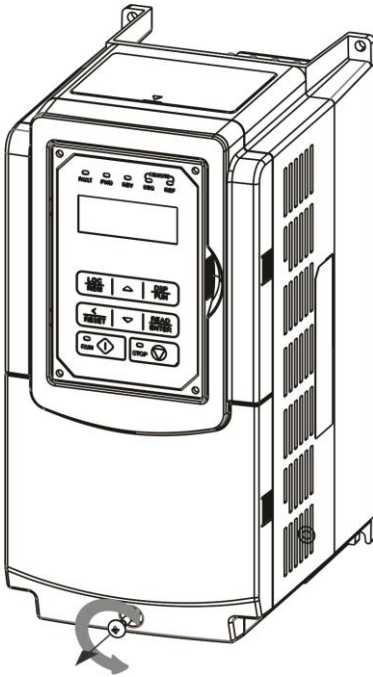
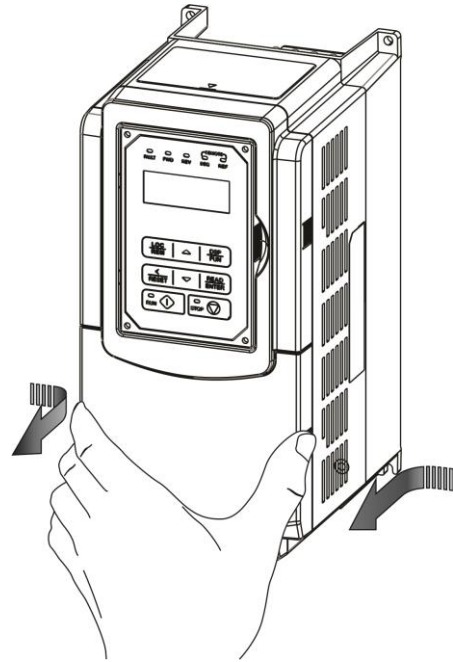
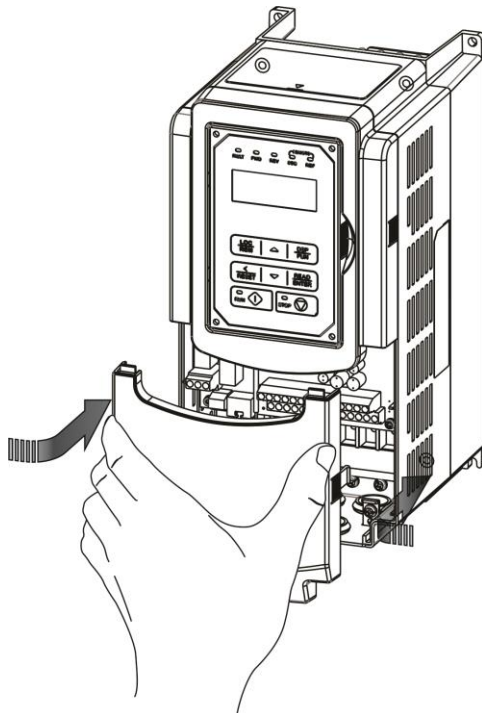
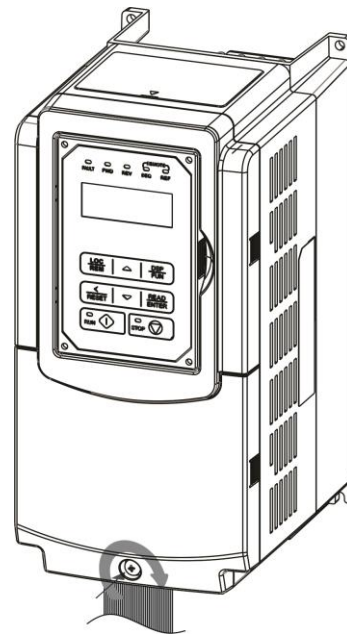
Step 2: Remove cover and unplug RJ45 connector

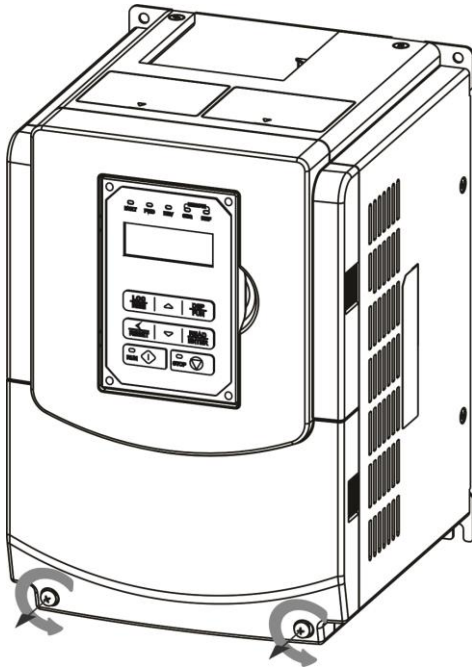
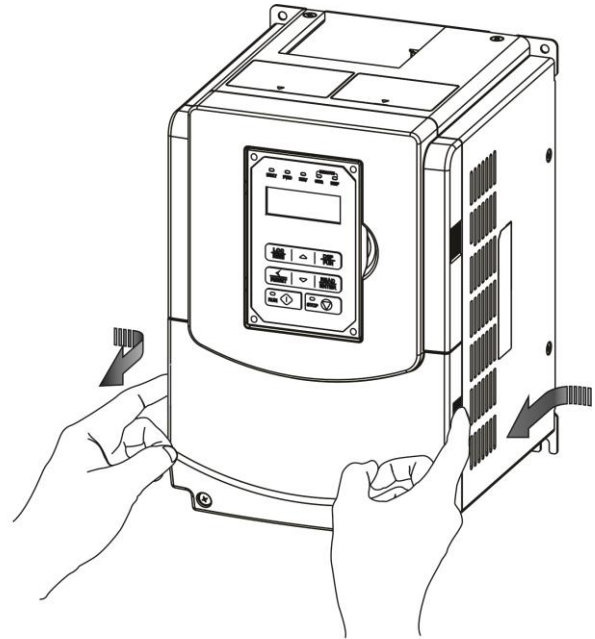
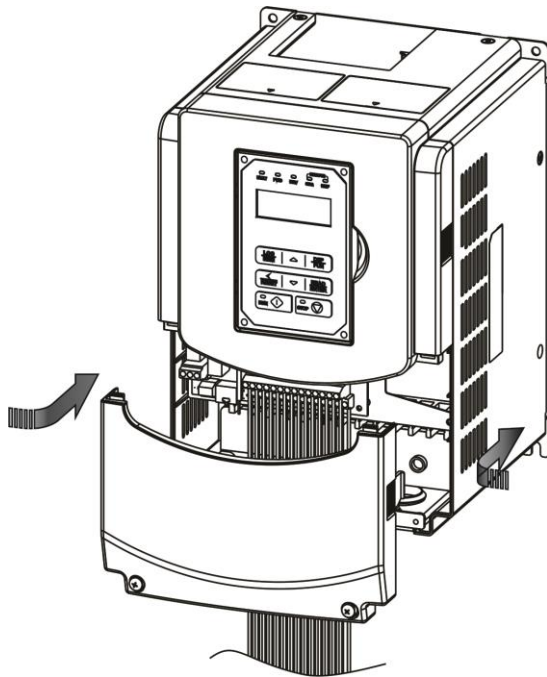
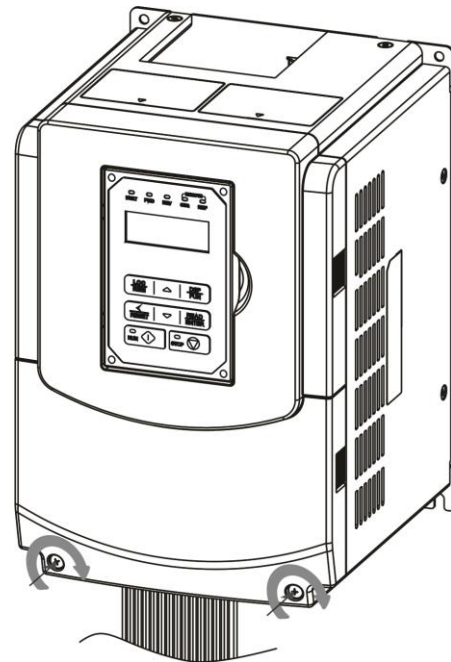


Step 3: Make wire connections, insert RJ45 connector and reinstall cover

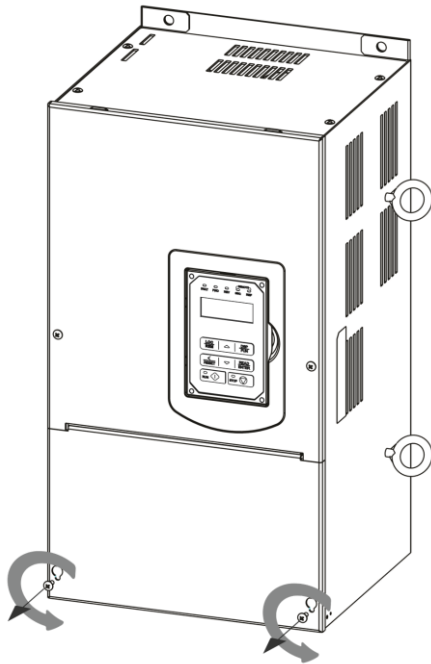


Step 4: Fasten screw

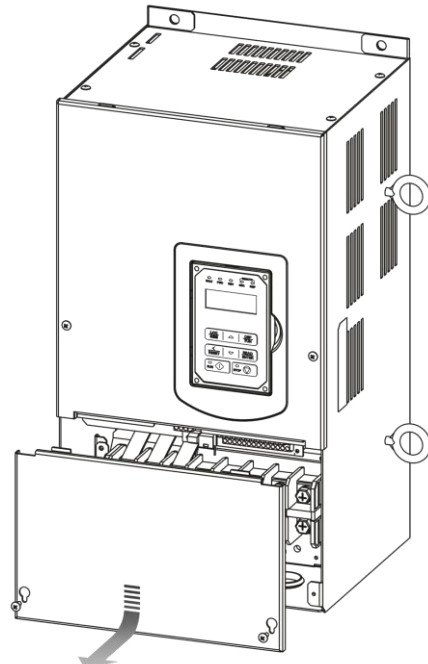
(b) 200V: 5 ~ 7.5 HP / 400V: 5 ~ 10 HP**Step 1:** Unscrew cover**Step 2:** Remove cover**Step 3:** Make wire connections and reinstall cover**Step 4:** Fasten screw

(c) 200V: 5 ~ 7.5 HP / 400V: 5 ~ 10 HP**Step 1:** Unscrew cover**Step 2:** Remove cover**Step 3:** Make wire connections and reinstall cover**Step 4:** Fasten screws

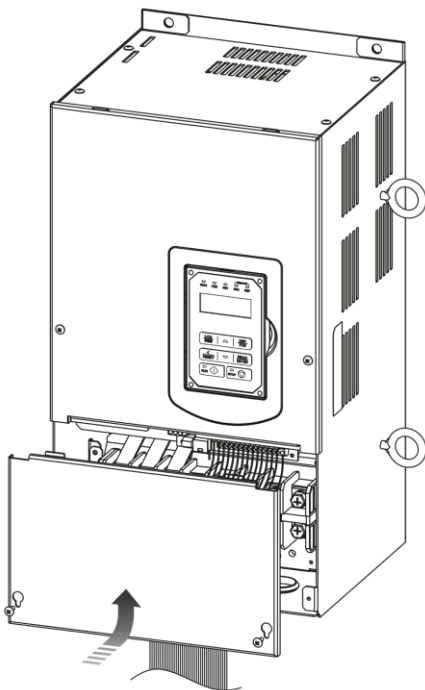
(d) 200V: 40 ~ 50 HP / 400V: 50 ~ 75 HP



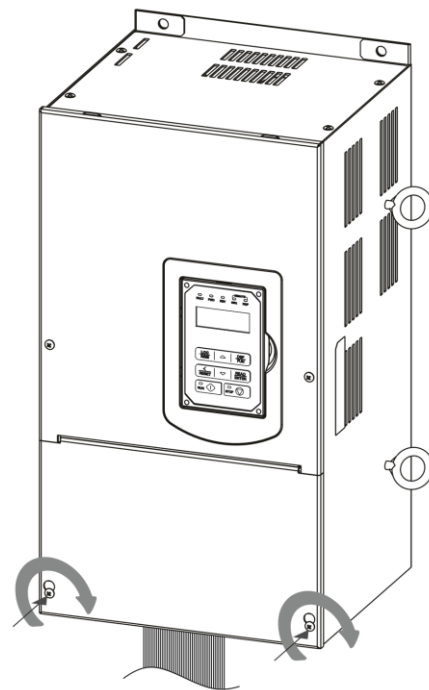
Step 1: Unfasten screw on cover



Step 2: Remove cover

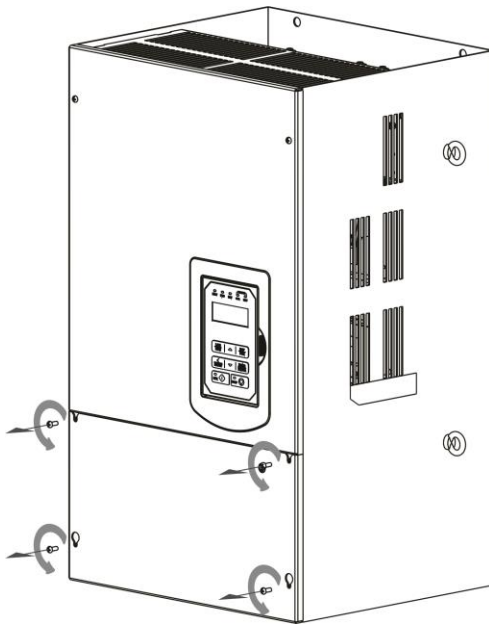


Step 3: Make wire connections and reinstall cover

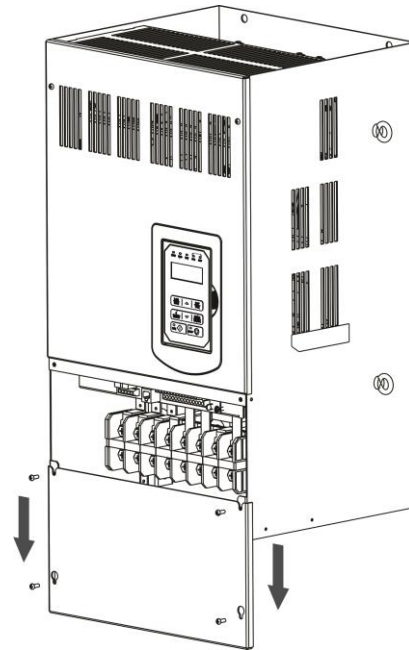


Step 4: Fasten screws

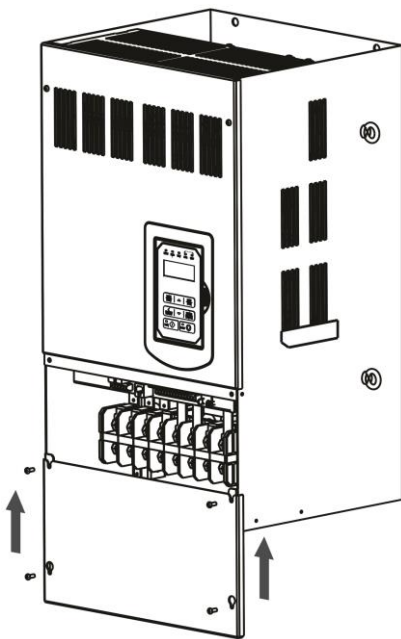
(e) 200V: 60 ~ 125 HP / 400V: 100 ~ 250 HP



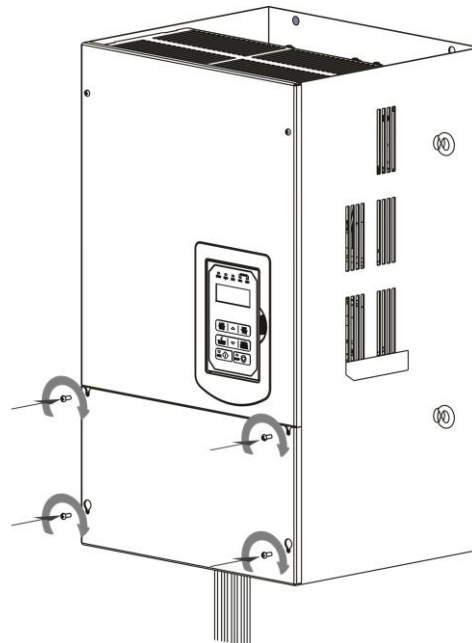
Step 1: Unfasten screw on cover



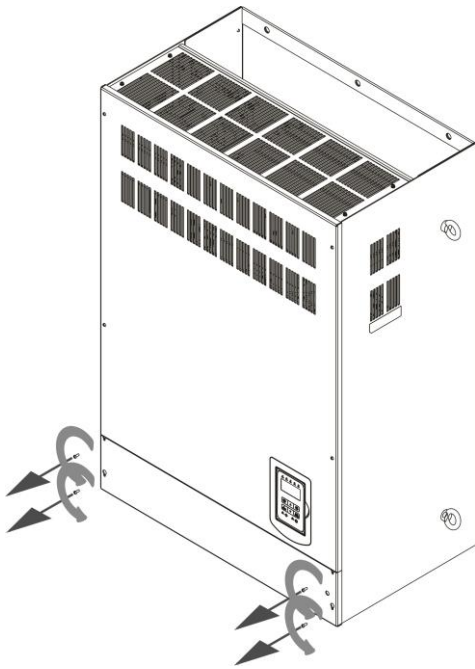
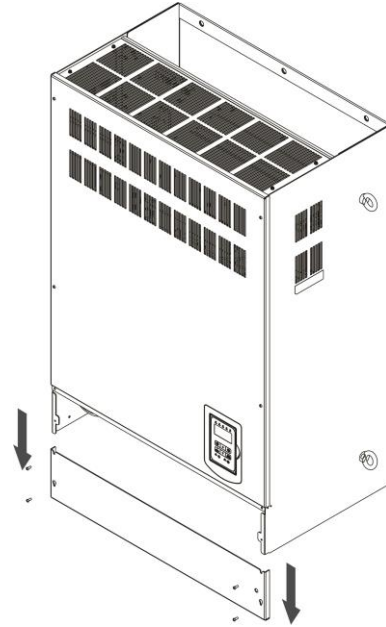
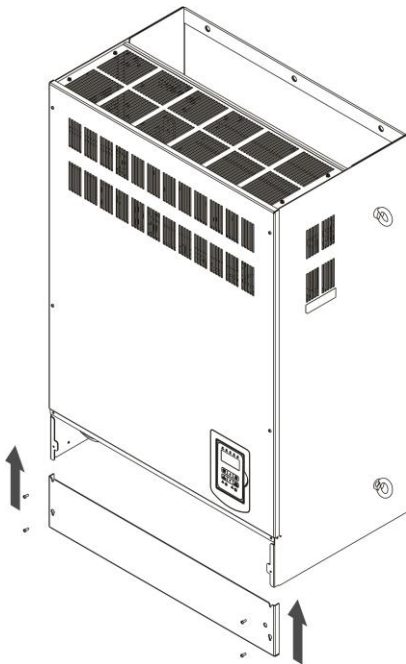
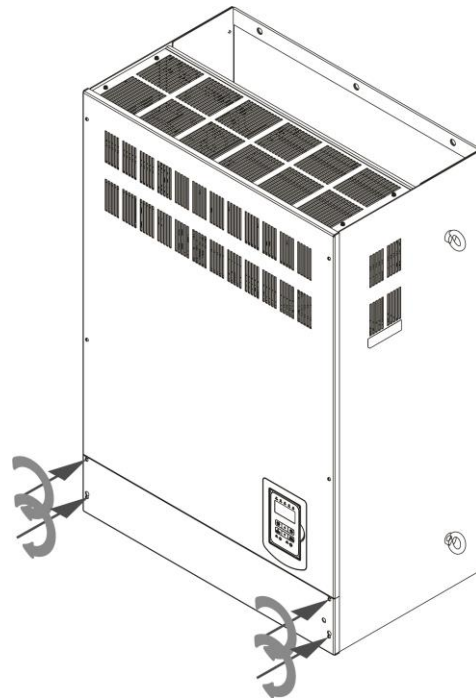
Step 2: Remove cover

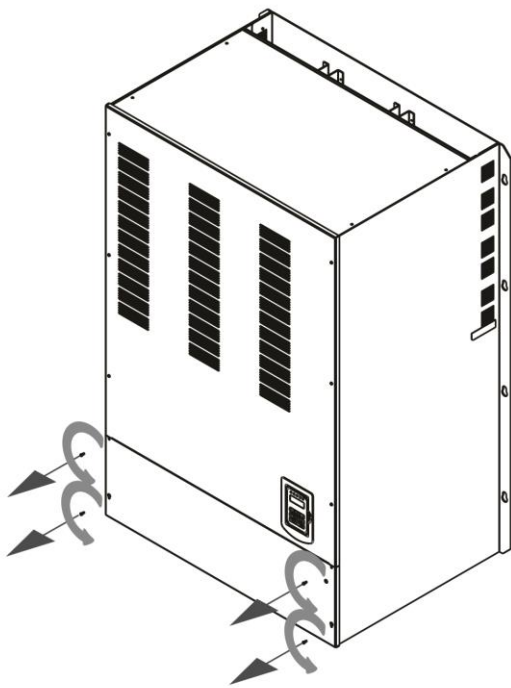
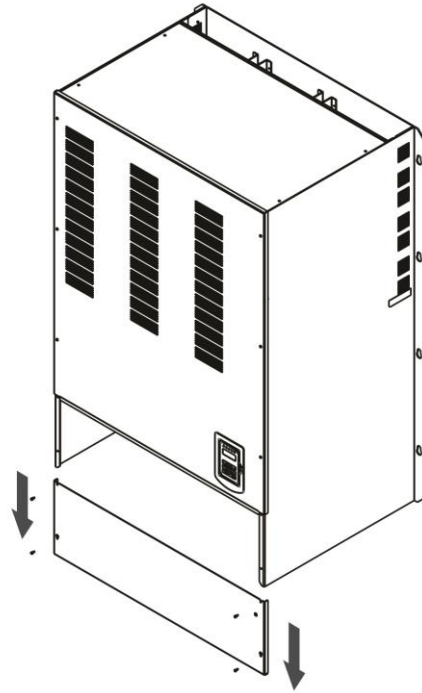
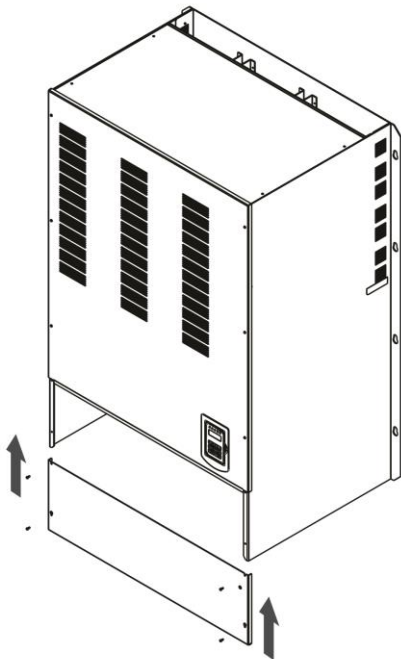
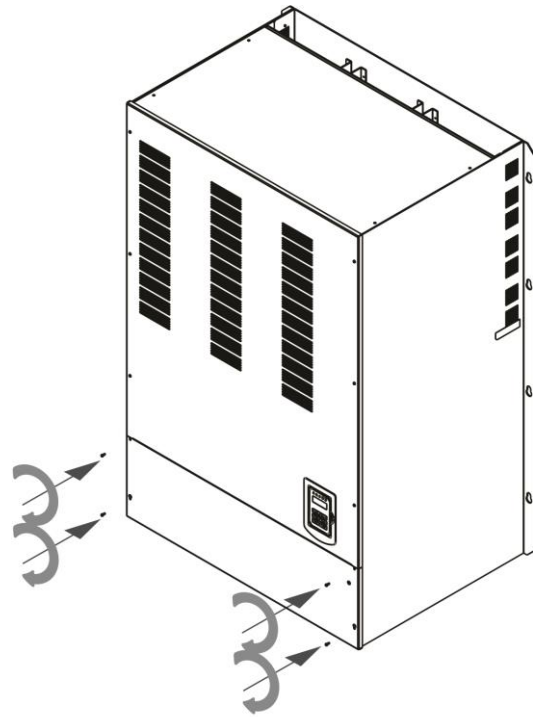


Step 3: Make wire connections and reinstall cover



Step 4: Fasten screws

(f) 200V 150-175HP/ 400V 300-425HP**Step 1: Unscrew cover****Step 2: Remove cover****Step 3: Make wire connections and place cover back****Step 4: Fasten screws**

(g) 400V 535-800HP**Step 1: Unscrew cover****Step 2: Remove cover****Step 3: Make wire connections and place cover back****Step 4: Fasten screws**

3.6 Wire Gauges and Tightening Torque

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

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

3.7 Wiring Peripheral Power Devices



Caution

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



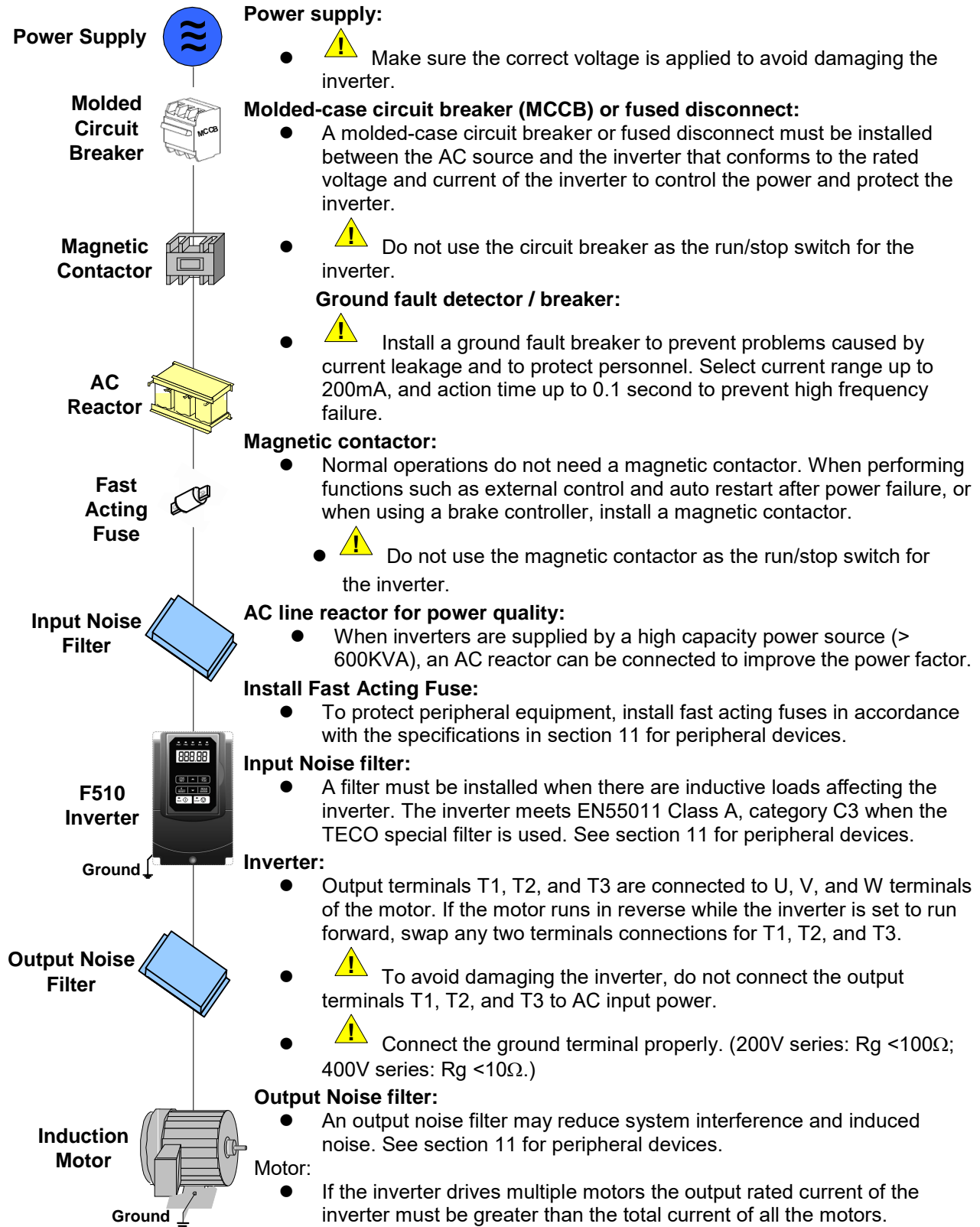
Caution

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

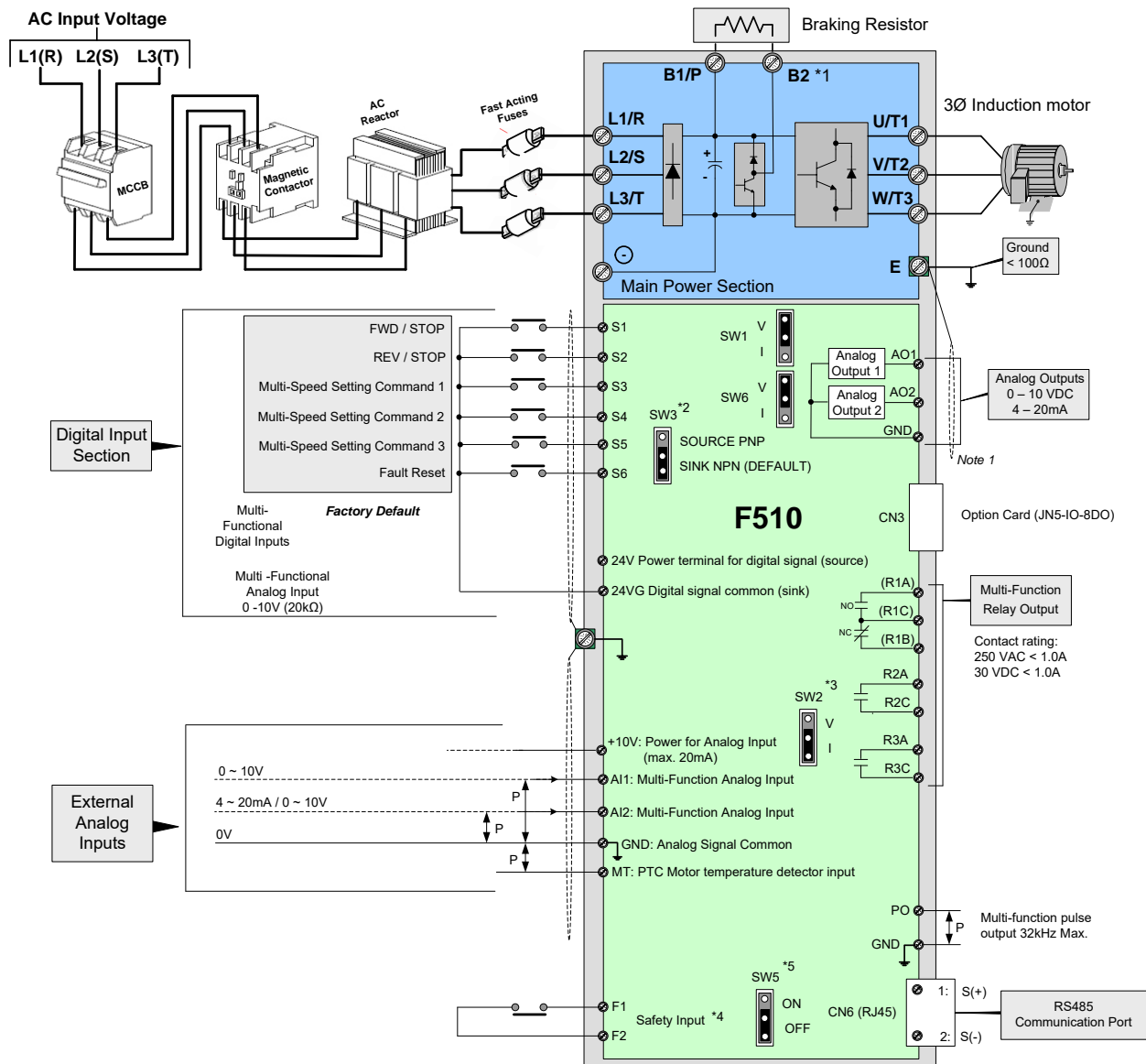
$$\text{Phase-to-phase voltage drop (V)} = \sqrt{3} \times \text{resistance of wire } (\Omega/\text{km}) \times \text{length of line (m)} \times \text{current} \times 10^{-3}.$$

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

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



3.8 General Wiring Diagram



Notes:

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

*2: Use SW3 to select between Sink (NPN, with 24VG common) or Source (PNP, with +24V common) for multi-function digital input terminals S1~S6.

*3: Use SW2 to switch between voltage and current input for Multi-function analog input 2 (AI2). See parameter 04-00.

*4: Safety input F1 and F2 is a normally closed input. This input should be closed to enable the inverter output. To activate this input remove the jumper wire between F1 and F2.

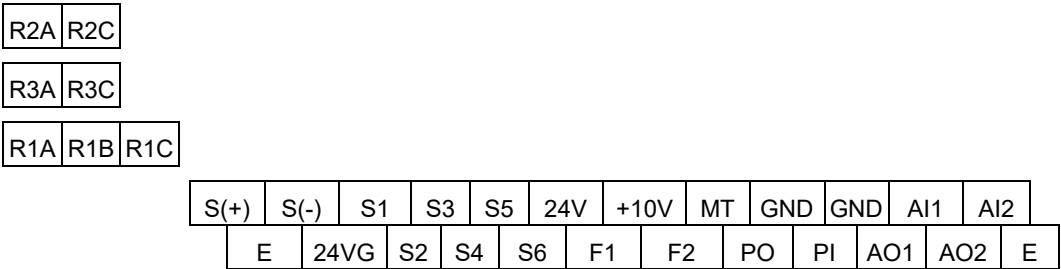
*5: Terminating resistor can be set to ON or bypass (Off). This is used when connecting multiple drives in an RS485 network.

*6: Models IP20 1 ~ 3HP do not support an option card.

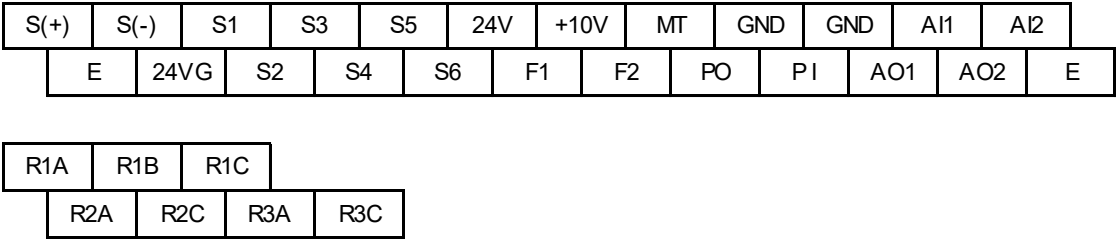
3.9 User Terminals (Control Circuit Terminals)

IP20 Type:

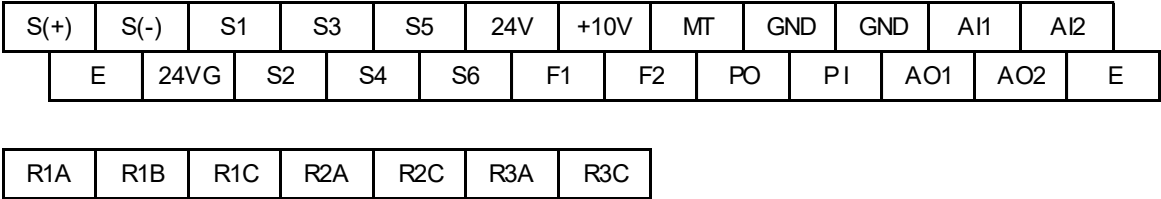
200V: 1 ~ 3 HP, 400V: 1~ 3HP



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



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



Description of User Terminals

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

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

Notes:

*1:Refer to:

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

*2:Refer to:

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

*3:Refer to:

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

**Caution**

- Maximum output current capacity for terminal 10V is 20mA.
- Multi-function analog output AO1 and AO2 are intended as analog output meter signals. Do not use them for feedback control.
- Control board's 24V and 10V are to be used for internal control only, Do not use the internal power-supply to power external devices.

3.10 Power Terminals

IP00 / IP20 Type

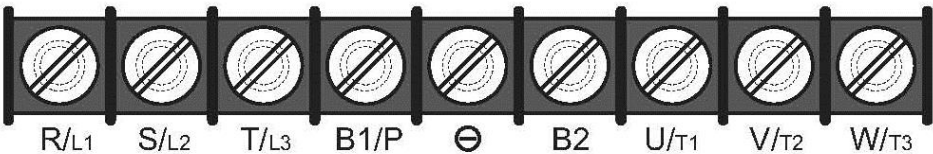
Terminal	200V: 1 ~ 30HP 400V: 1 ~ 40HP	200V: 40 ~ 175HP 400V: 50 ~ 800HP
R/L1	Input Power Supply (For single phase use terminals R/L1 and S/L3)	
S/L2		
T/L3		
B1 / P	<ul style="list-style-type: none"> • B1 / P—\ominus: DC power supply • B1 / P—B2: external braking resistor 	-
B2		<ul style="list-style-type: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

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

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

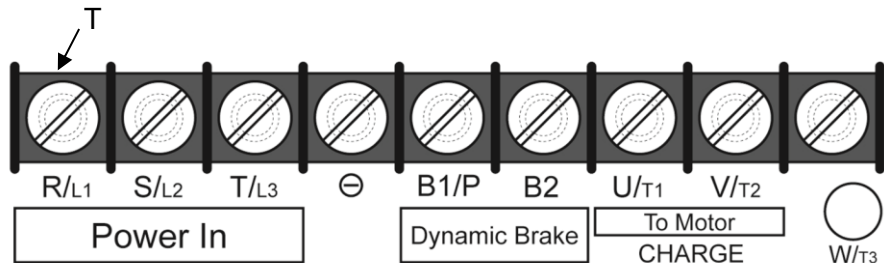
IP20 Type

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



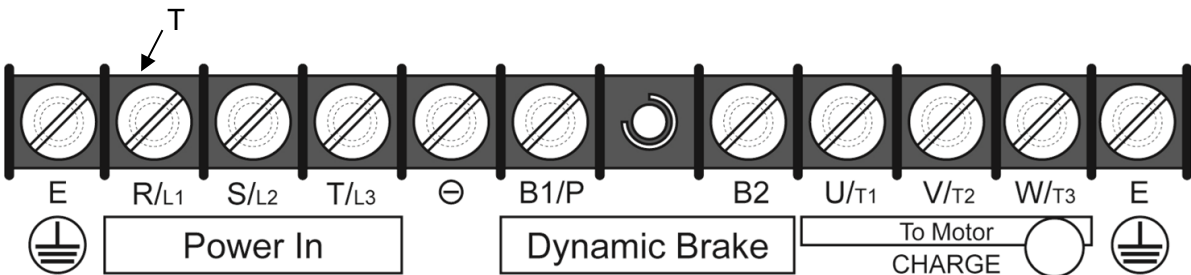
Terminal screw size	
T	
M4	M4

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



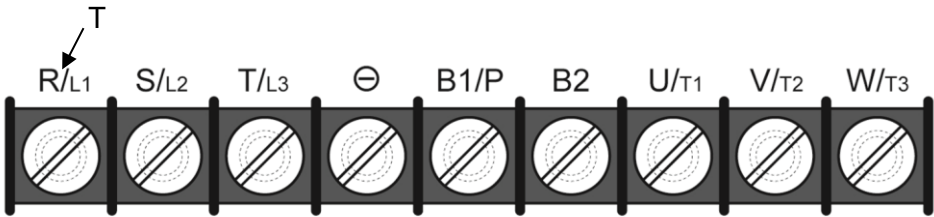
Terminal screw size	
T	
M4	M4

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



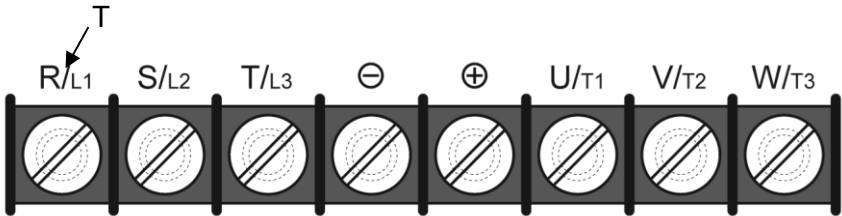
Terminal screw size	
T	
M4	M4

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



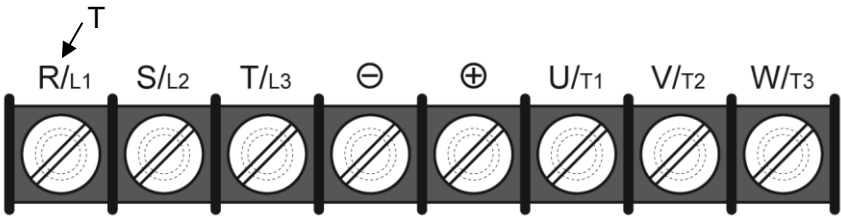
Terminal screw size	
T	
M6	M6

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



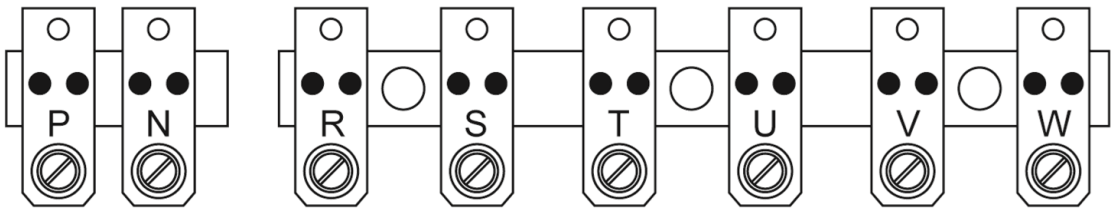
Terminal screw size	
T	
M8	M8

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



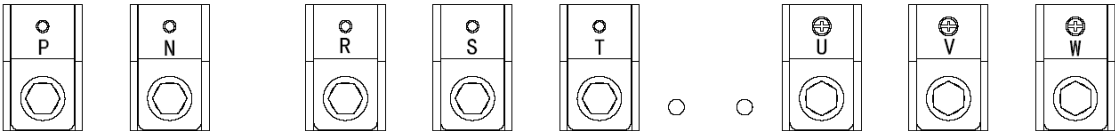
Terminal screw size		
Power supply	T	
400V 100HP	M8	M10
200V 60-75HP/ 400V 125HP	M10	M10

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



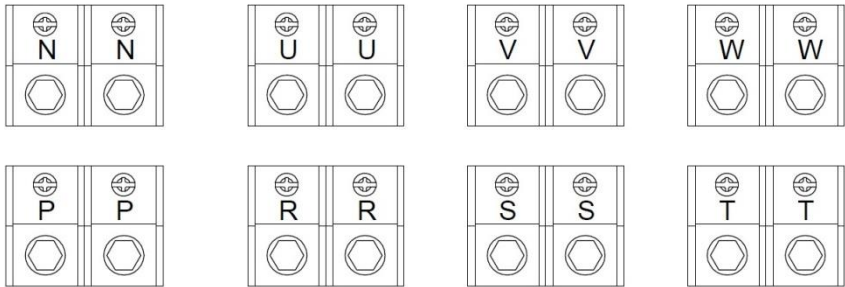
Terminal screw size	
T	
M10	M10

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



Terminal screw size	
T	
M12	M10

400V: 530-800HP



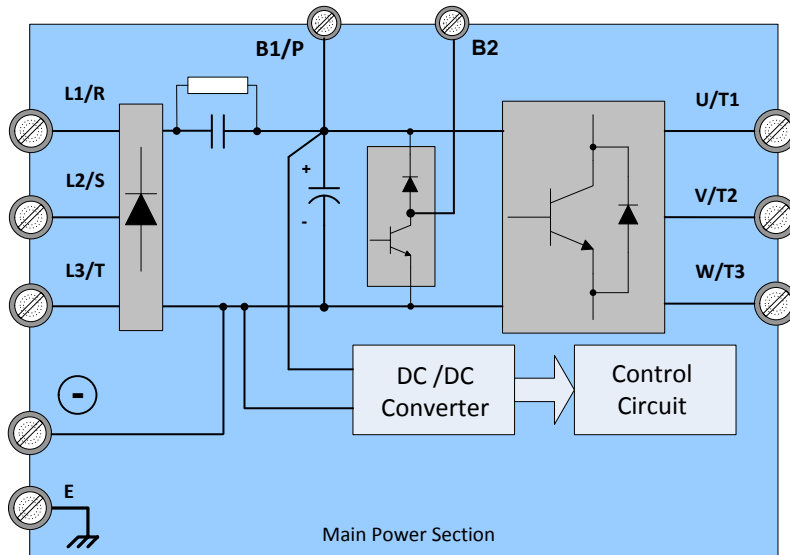
Terminal screw size	
T	
M10	M10

3.11 Input / Output Power Section Block Diagram

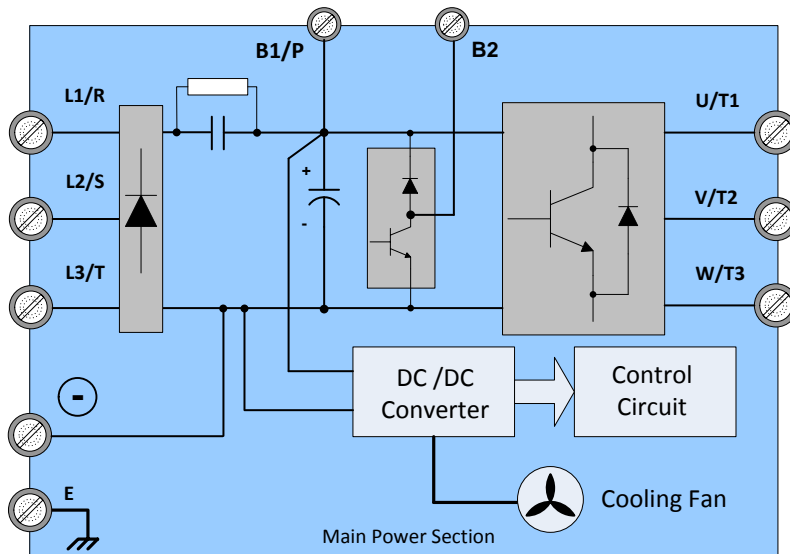
The following diagrams show the basic configuration for IP00/IP20 power sections for the range of horsepower and input voltages. This is shown for reference only and is not a detailed depiction.

IP00/IP20 Type

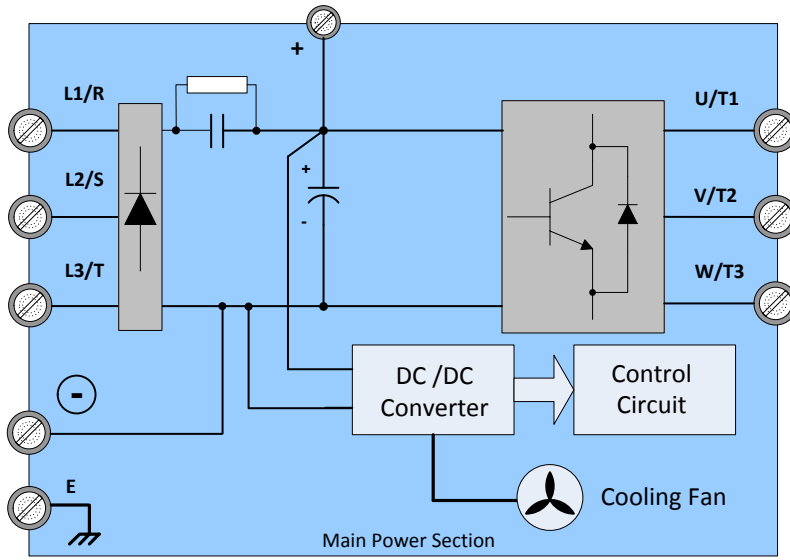
1: 200V: 1 HP / 400V: 1 ~ 2 HP



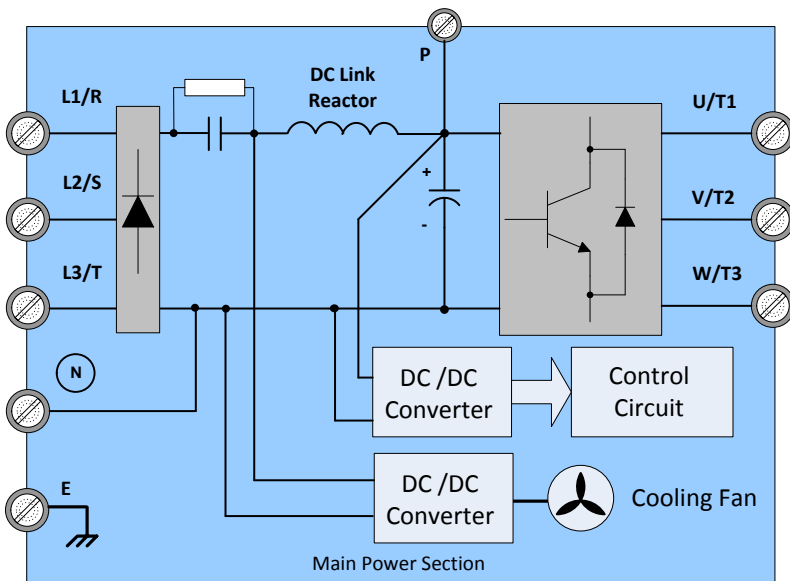
2: 200V: 2 ~ 30 HP / 400V: 3 ~ 40 HP



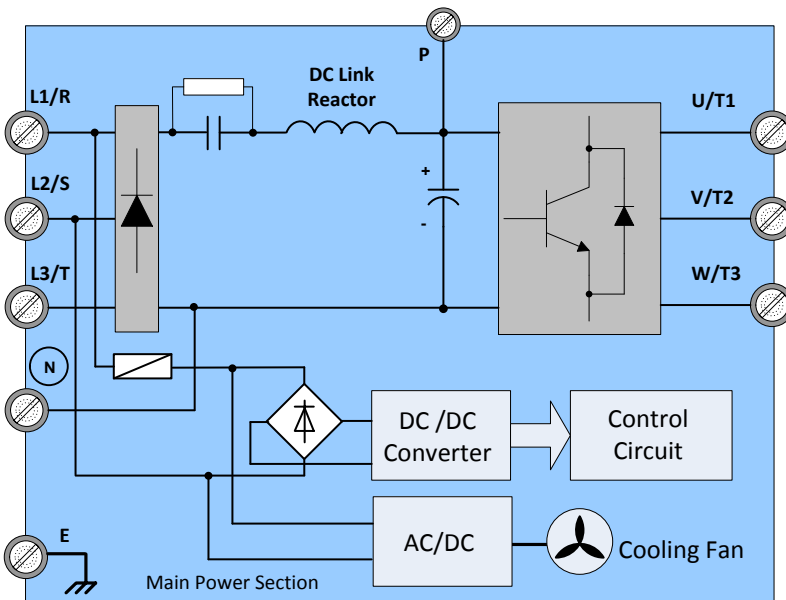
3: 200V: 40 ~ 50 HP / 400V: 50 ~ 75 HP



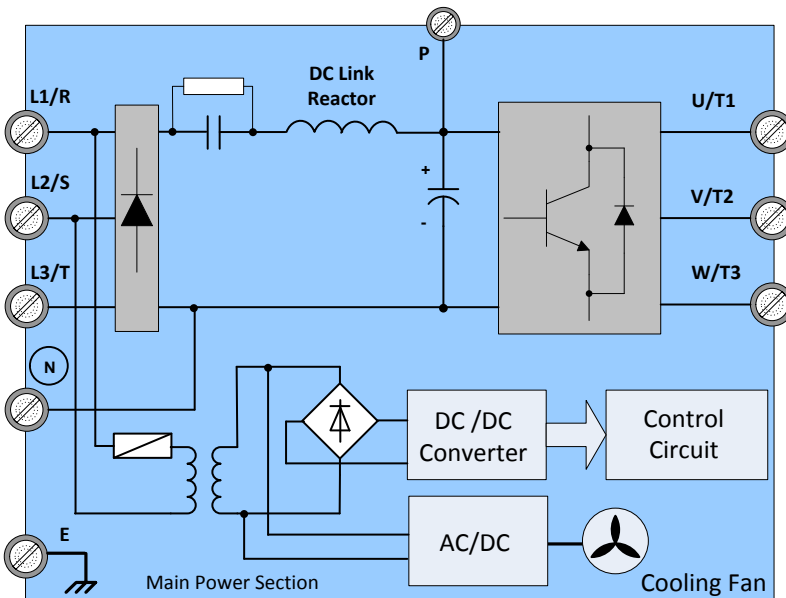
4: 200V: 60 ~ 75 HP / 400V: 100 ~ 125 HP



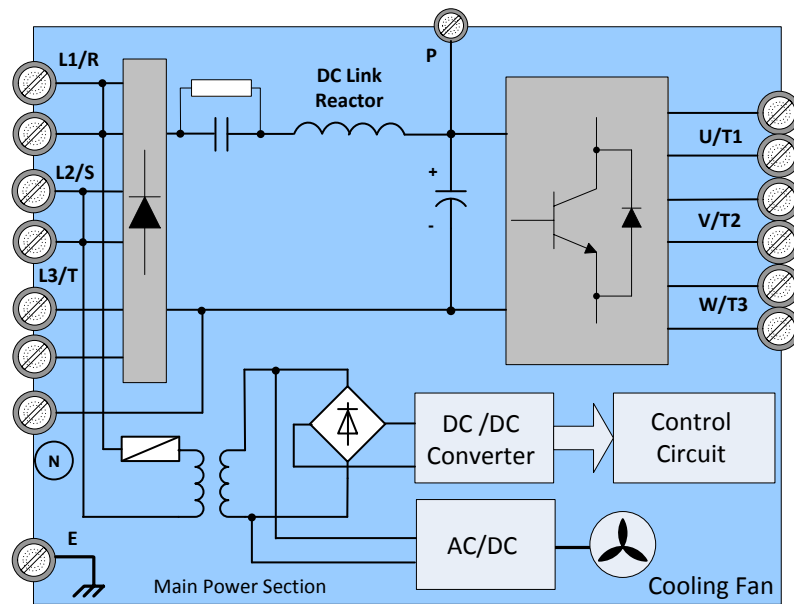
5: 200V: 100 ~ 175 HP



6: 400V: 150 ~ 425 HP



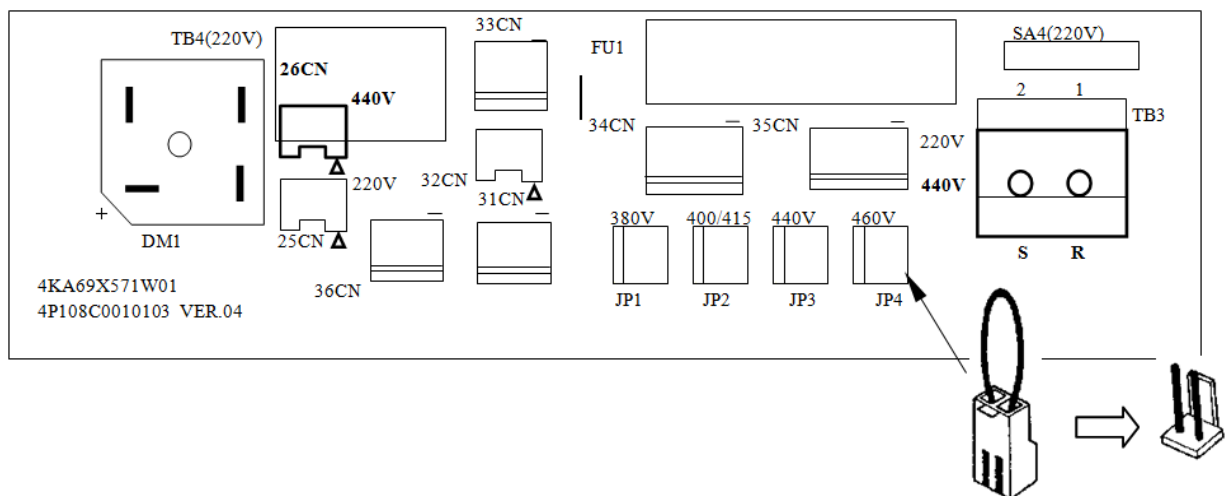
7: 400V: 535 ~ 800 HP



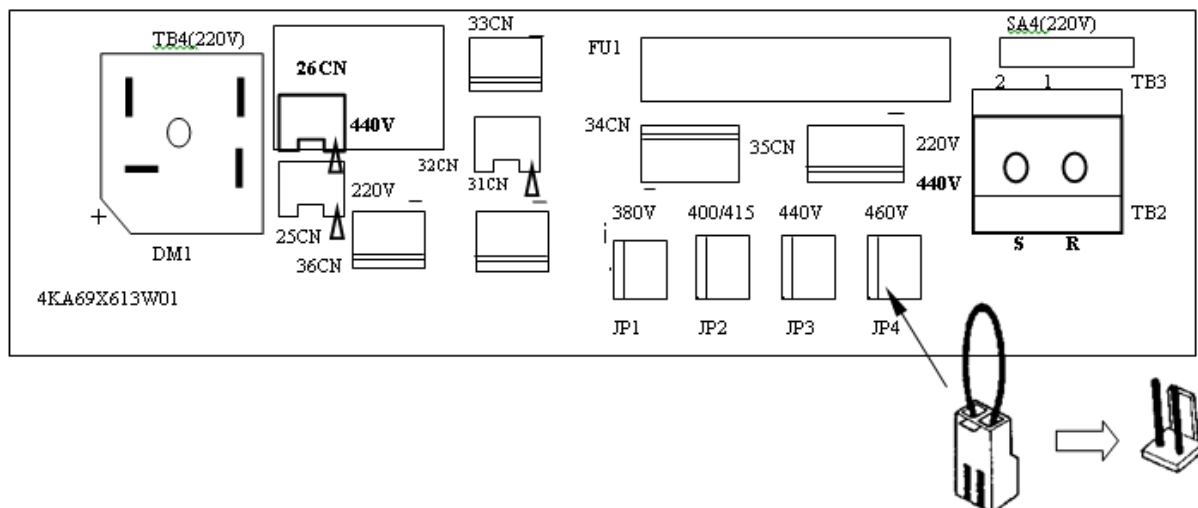
3.11.1 Cooling Fan Supply Voltage Selection (400V class)

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

400V: 150 – 250 HP



400V: 300 – 800 HP



3.12 Inverter Wiring

Wiring Precautions

! Danger

- Do **NOT** remove any protective covers or attempt any wiring while input power is applied. Connect all wiring before applying input power. When making wiring changes after power up, remove input power and wait a minimum of five minutes after power has been turned off before starting. Also confirm that the charge lamp is off and that DC voltage between terminals B1/P or (+) and (-) does not exceed 25V, otherwise **electric shock may result**.
- Only authorized personnel should work on the equipment. (Remove any metal jewelry such as watches and rings and use insulated tools.), otherwise **electric shock or injury may result**.

(A) Power input terminals

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

(B) Grounding

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

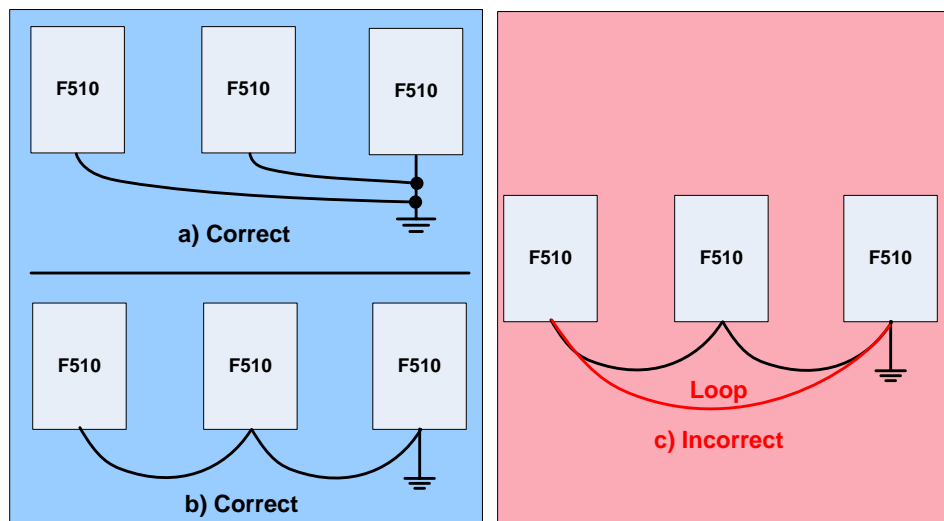


Fig. 3.12.1 Inverter Grounding

3.13 Input Power and Motor Cable Length

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

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

(km=3280 x feet)

(m=3.28 x feet)

3.14 Cable Length vs. Carrier Frequency

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

Table 3.14.1 Cable Length vs. Carrier Frequency

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

3.15 Installing an AC Line Reactor

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

3.16 Power Input Wire Size, NFB and MCB Part Numbers

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

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

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

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

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

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

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

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

3.17 Control Circuit Wiring

- (1) Separate the wiring for control circuit terminals from main circuit wiring for terminals (R/L1, S/L2, T/L3, U/T1, V/T2, W/T3).
- (2) Separate the wiring for control circuit terminals R1A-R1B-R1C (or R2A, R2C) (Relay outputs) from wiring for terminals ① - ⑧, A01, A02, GND, DO1, DO2, DOG, +12V, (-12V), AI1, AI2 and GND wiring.
- (3) Use shielded twisted-pair cables (#24 - #14 AWG / 0.5 -2 mm²) shown in Fig. 3.17.1 for control circuits to minimize noise problems. The maximum wiring distance should not exceed 50m (165 ft).

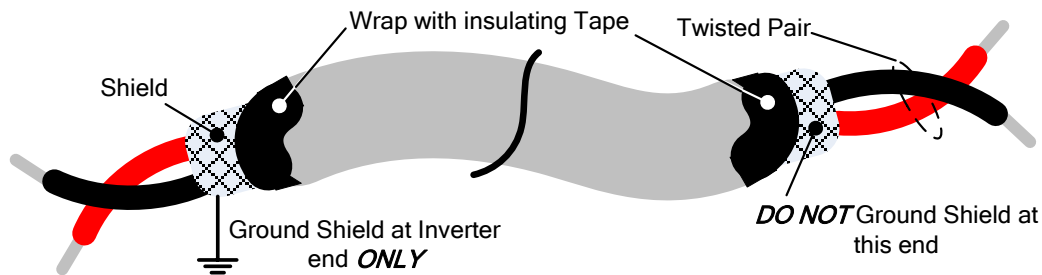


Fig. 3.17.1 Shielded Twisted-Pair

- (4) In Section 3.8 the control boards referenced have a jumper SW3 that can select the digital input to terminals ① - ⑧ to be set for SINK or SOURCE. The following Fig. 3.17.2 (a.) – (d.) shows examples for the various SINK / Source interfaces.

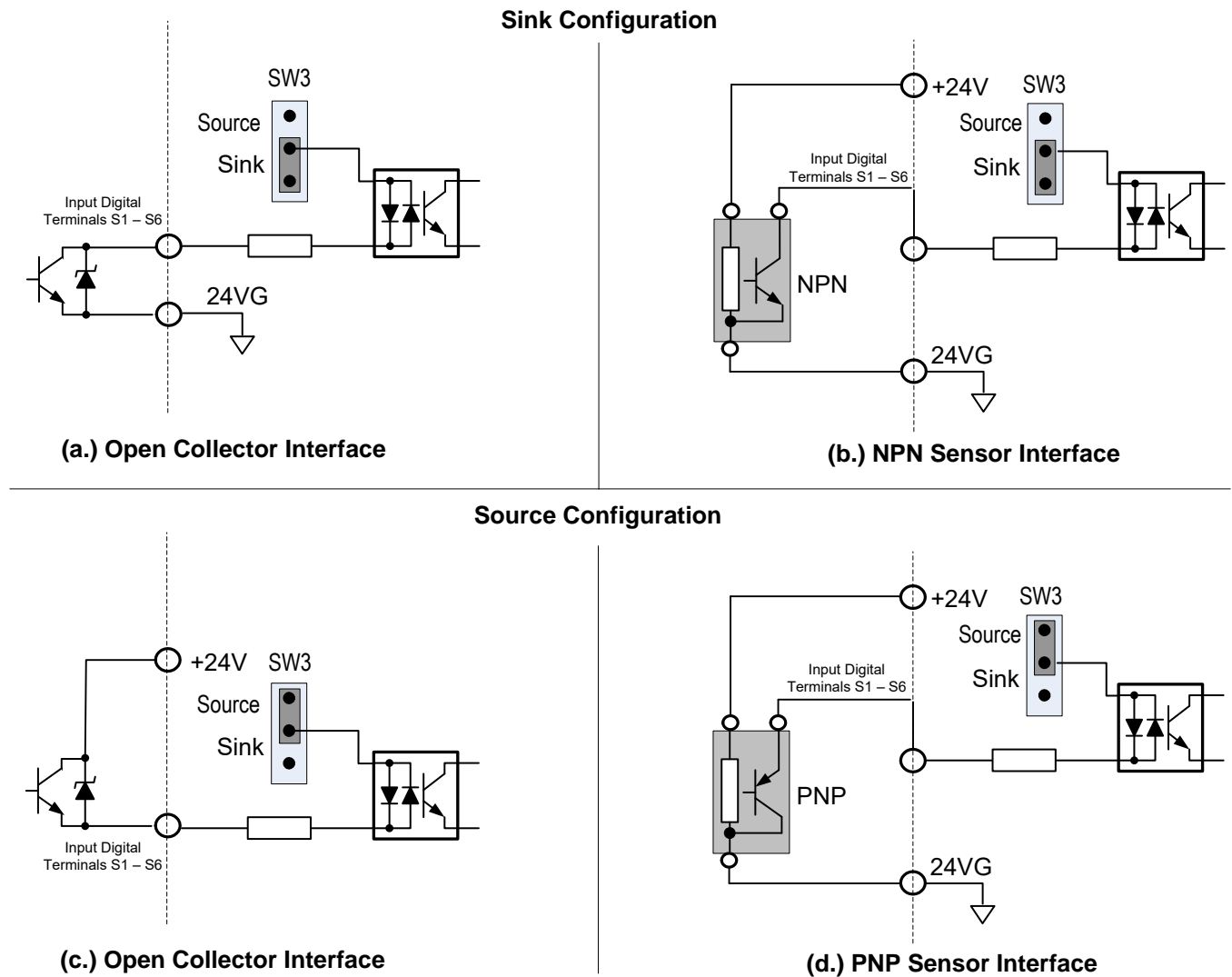


Fig. 3.17.2 Sink / Source Configurations

3.18 Inverter Specification

Basic Specifications 200V class

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

Basic Specifications 400V class

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

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

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

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

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

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

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

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

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

3.19 General Specifications

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

Environment Specifications	Installation Location	Indoor (protected from corrosive gases and dust)
	Ambient Temperature	-10~+40°C(14°F~104°F) (IP20/NEMA1 or NEMA12), -10~+50°C(14°F~122°F) (IP00) without de-rating; with de-rating, its maximum operation temperature is 60°C(140°F).
	Storage Temperature	-20~+70°C(-4°F~+158°F)
	Humidity	95%RH or less (no condensation)
	Altitude and Vibration	Altitude of 1000m (3181ft) or below, below 5.9m/s ² (0.6G)
Communication Function		Built-in RS-485 as standard (Modbus protocol with RJ45/ BACnet/ Metasys N2)
PLC Function		Built-in
EMI Protection		The built-in noise filter complies with EN61800-3 available for inverters 400V 75HP or below (IP20) / 400V 60HP or below
EMS Protection		in compliance with EN61800-3
Safety Certification	CE Declaration	in compliance with EN61800-3 (CE & RE) and EN61800-5-1 (LVD, Low-Voltage Directive)
	UL Certification	UL508C
Accessories		1 to 8 Pump card, HOA keypad, Profibus card

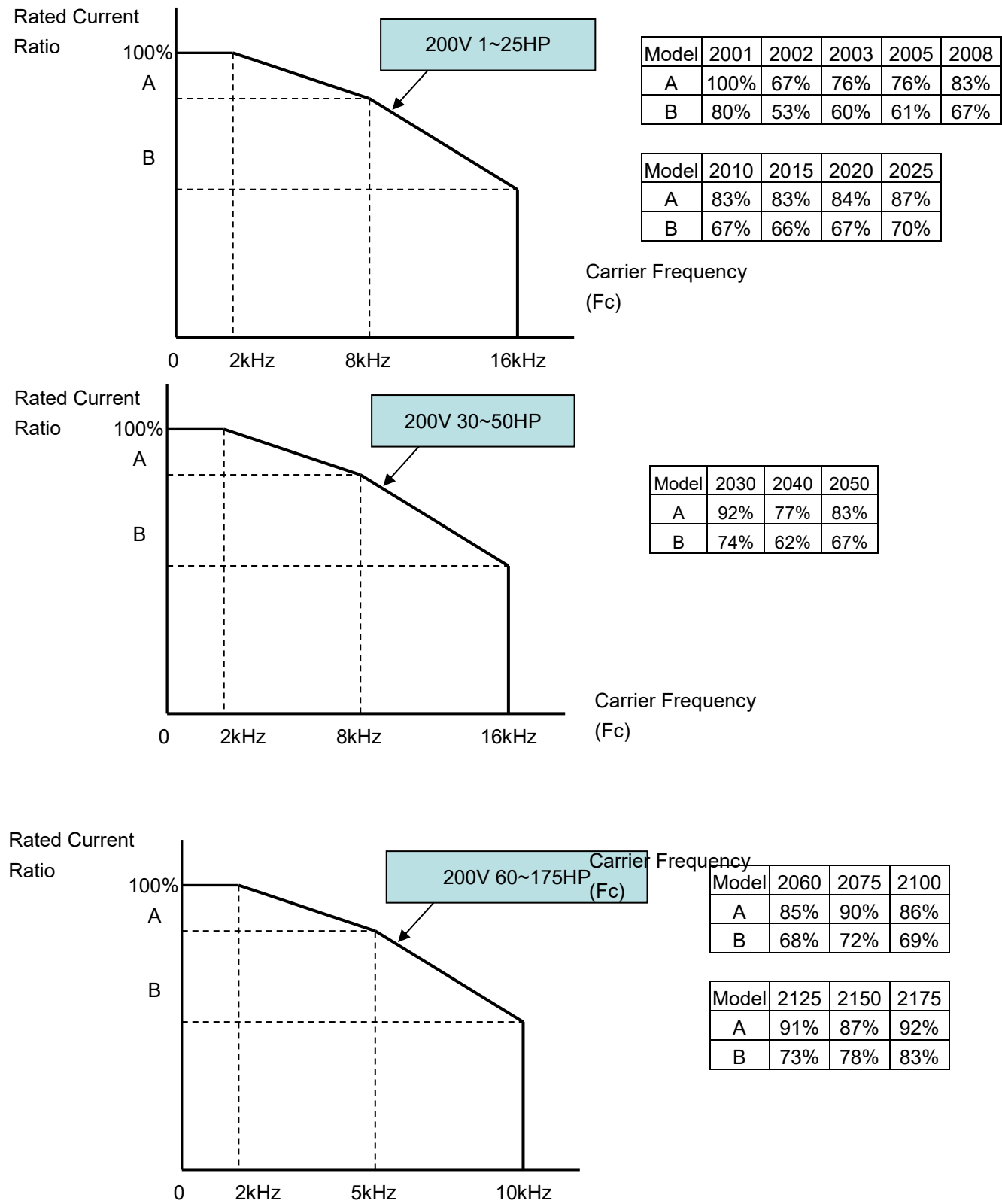
*1: Speed control accuracy is different for each system and motor type.

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

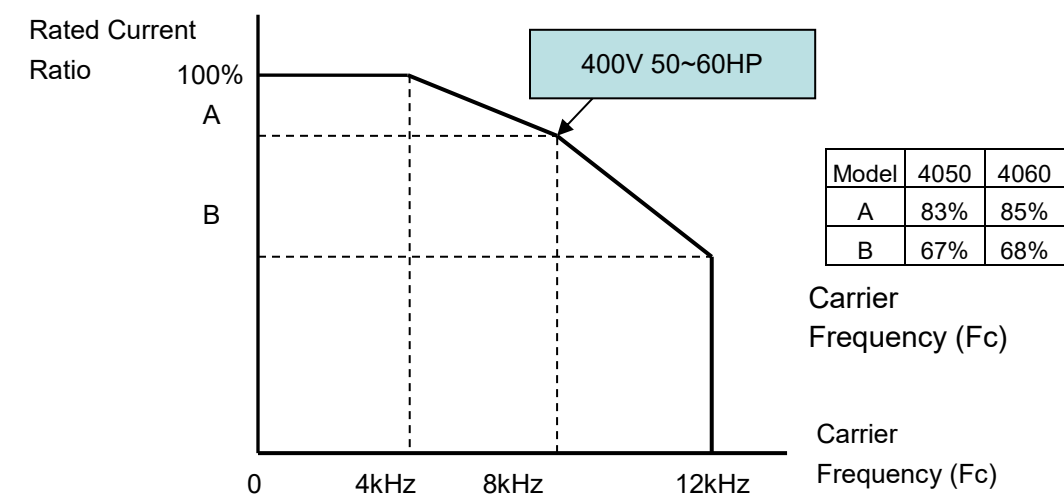
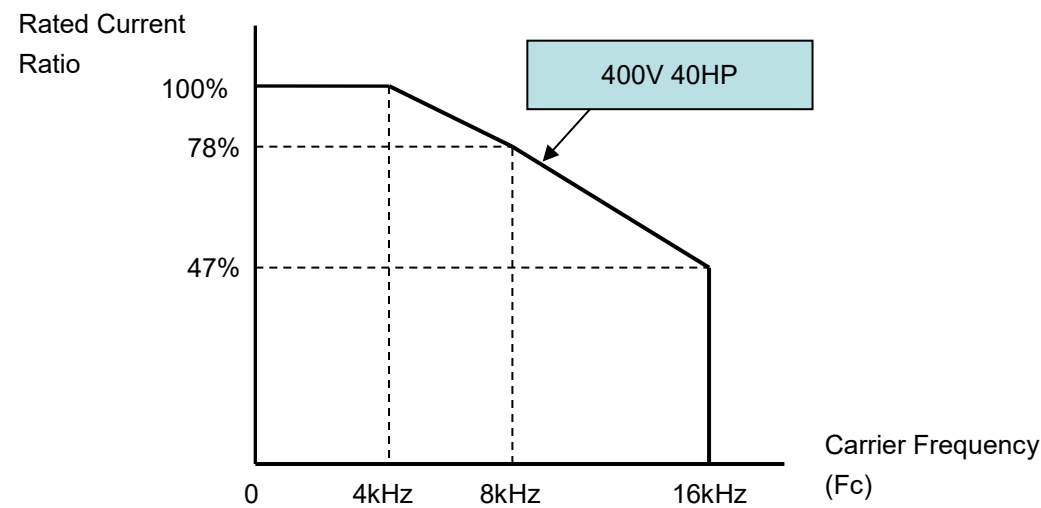
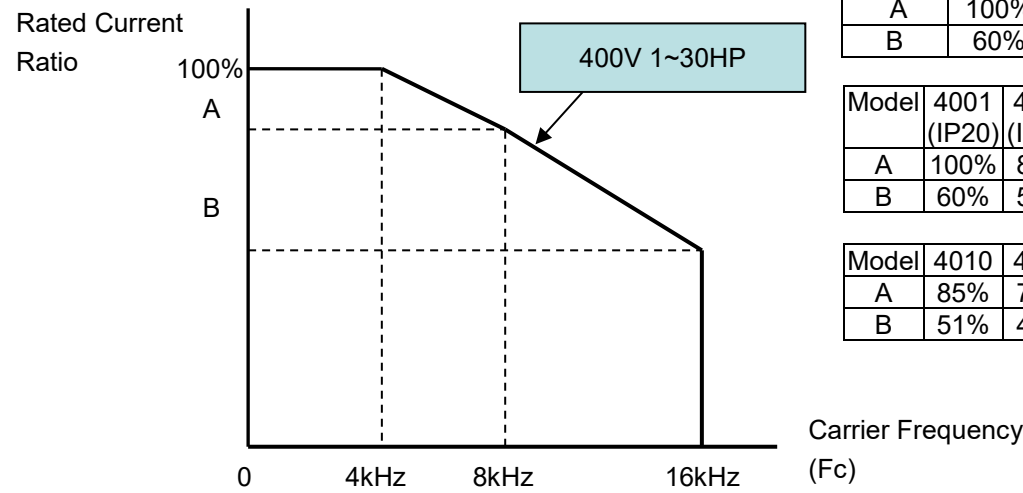
3.20 Inverter Derating Based on Carrier Frequency

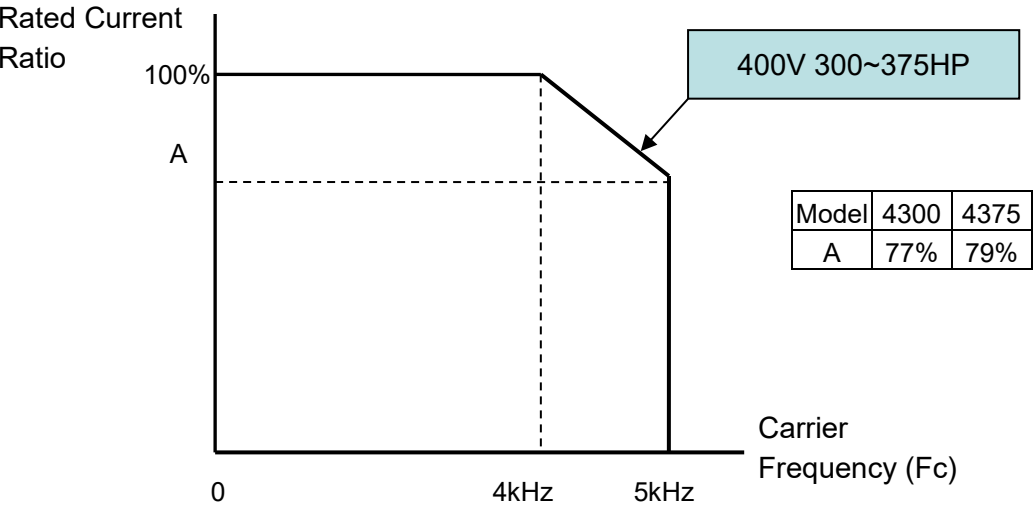
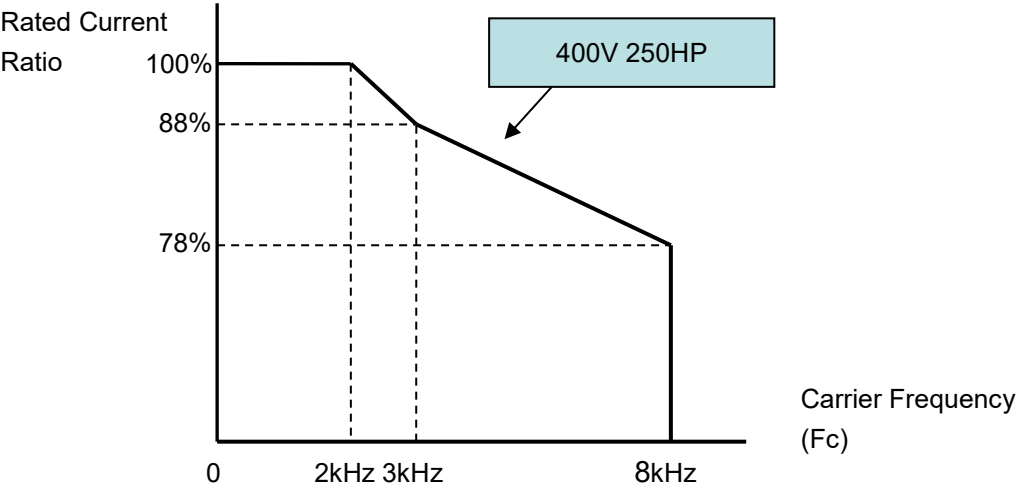
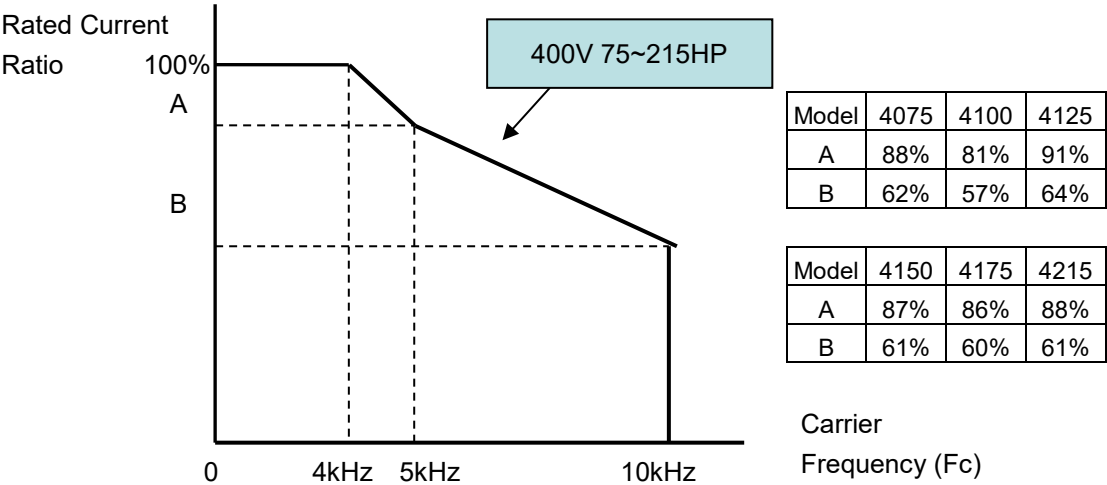
200V Models

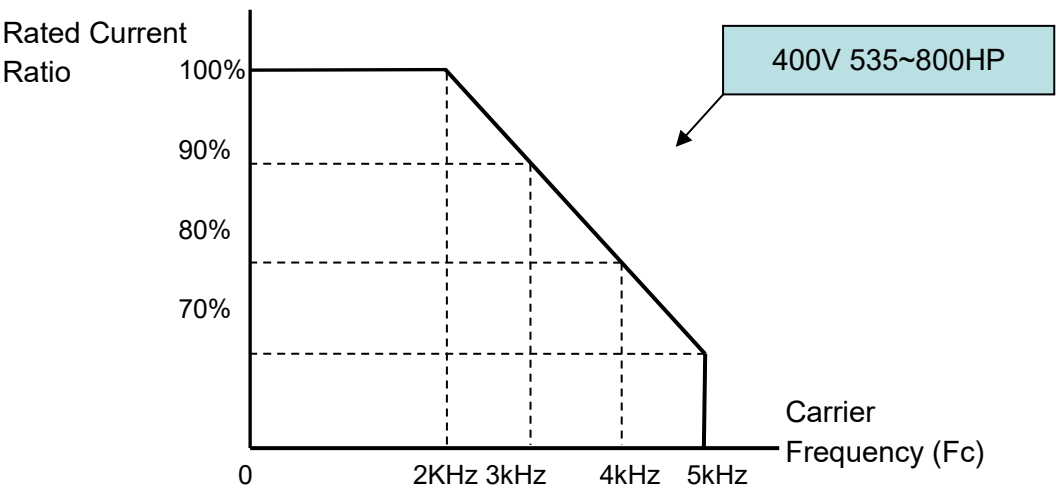
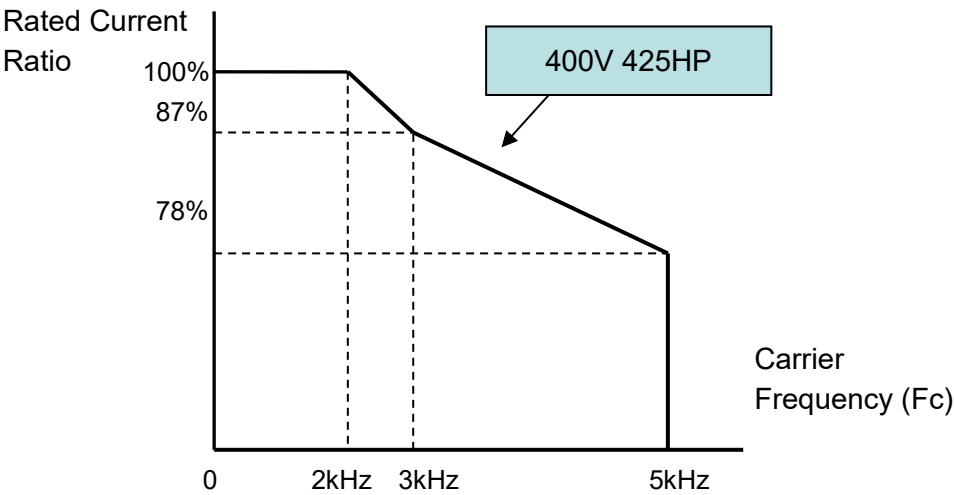
Note: Derating curve current of carrier frequency means inverter rated current.



400V Models

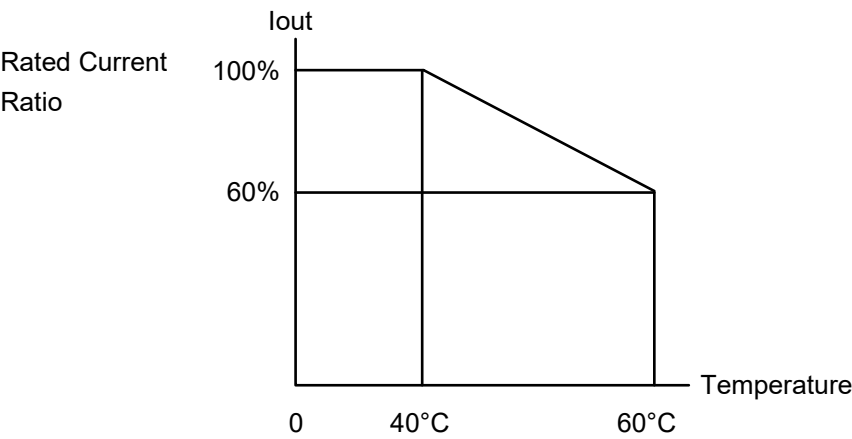






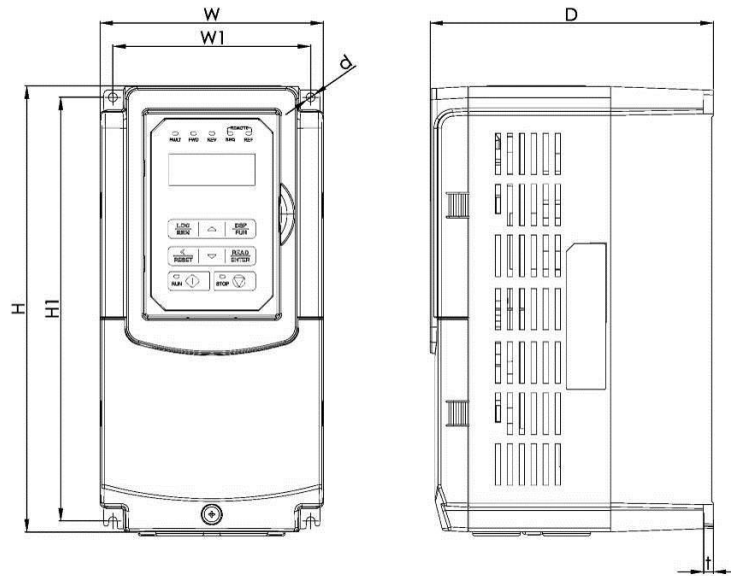
3.21 Inverter Derating Based on Temperature

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

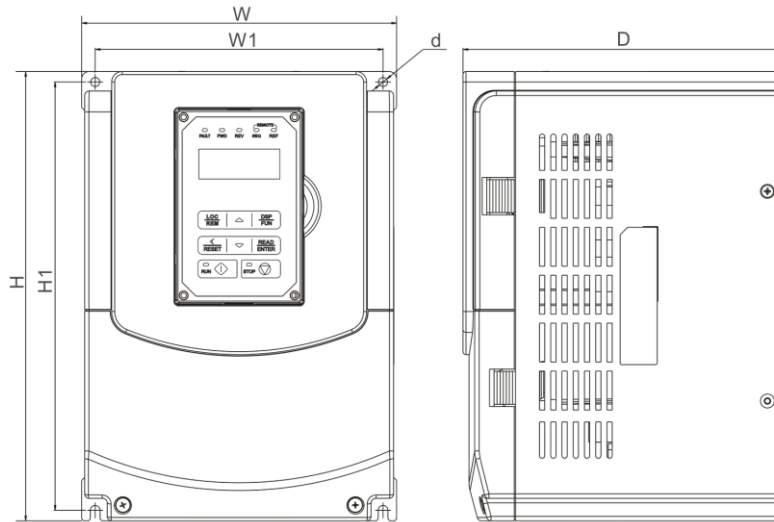


3.22 Inverter Dimensions (IP00 / IP20)

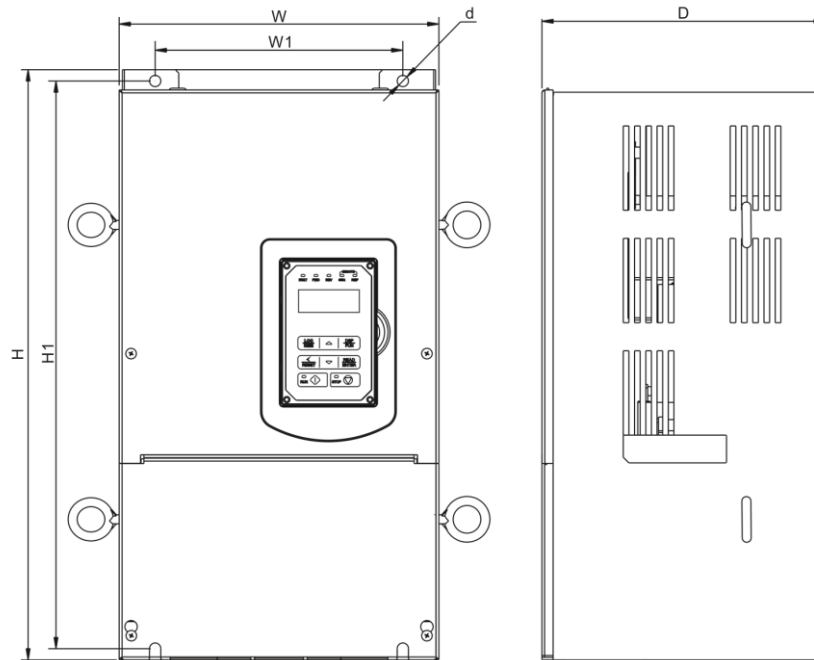
(a) 200V: 1-7.5HP/ 400V: 1-10HP



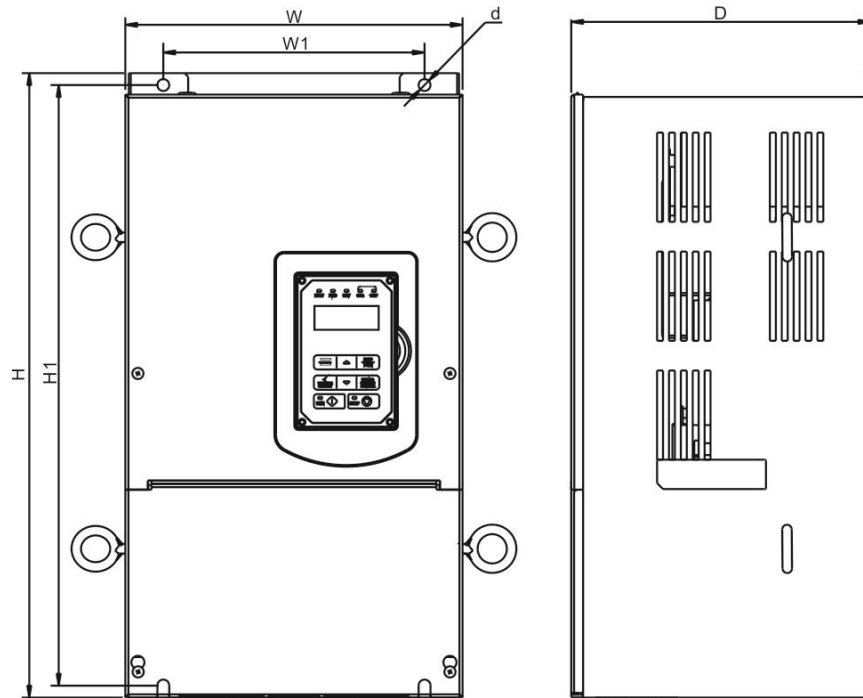
Inverter Model	Dimensions in inch (mm)							
	W	H	D	W1	H1	t	d	NW in kg(lbs)
F510-2001-C	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.5 (5.5)
F510-2002-C	130 (5.12)	215 (8.46)	150 (5.91)	118 (4.65)	203 (7.99)	5 (0.20)	M5	2.5 (5.5)
F510-2003-C	130 (5.12)	215 (8.46)	150 (5.91)	118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

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

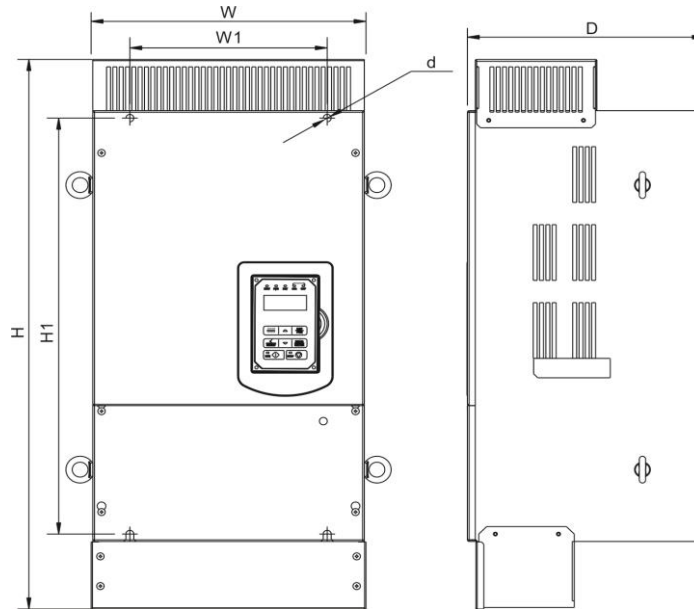
Inverter Model	Dimensions in inch (mm)							
	W	H	D	W1	H1	t		
F510-2010-C3	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-2015-C3	210 (8.27)	300 (11.81)	215 (8.46)	192 (7.56)	286 (11.26)	1.6 (0.06)	M6	6.2 (13.67)
F510-2020-C3	265 (10.43)	360 (14.17)	225 (8.86)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

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

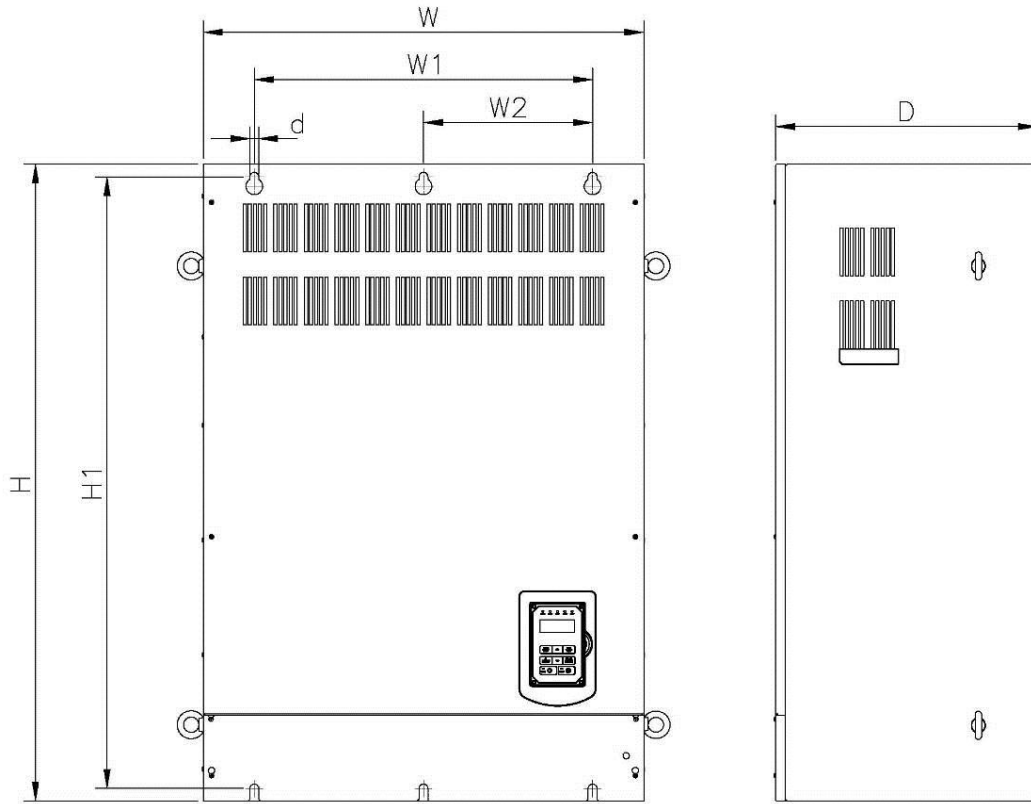
Inverter Model	Dimensions in inch (mm)						d	NW in kg(lbs))
	W	H	D	W1	H1	t		
F510-2040-C3	284 (11.18)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	1.6 (0.06)	M8	30 (66.14)
F510-2050-C3	284 (11.18)	525 (20.67)	252 (9.92)	220 (8.66)	505 (19.88)	1.6 (0.06)	M8	30 (66.14)
F510-4050-C3	284 (11.18)	525 (20.67)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

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

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

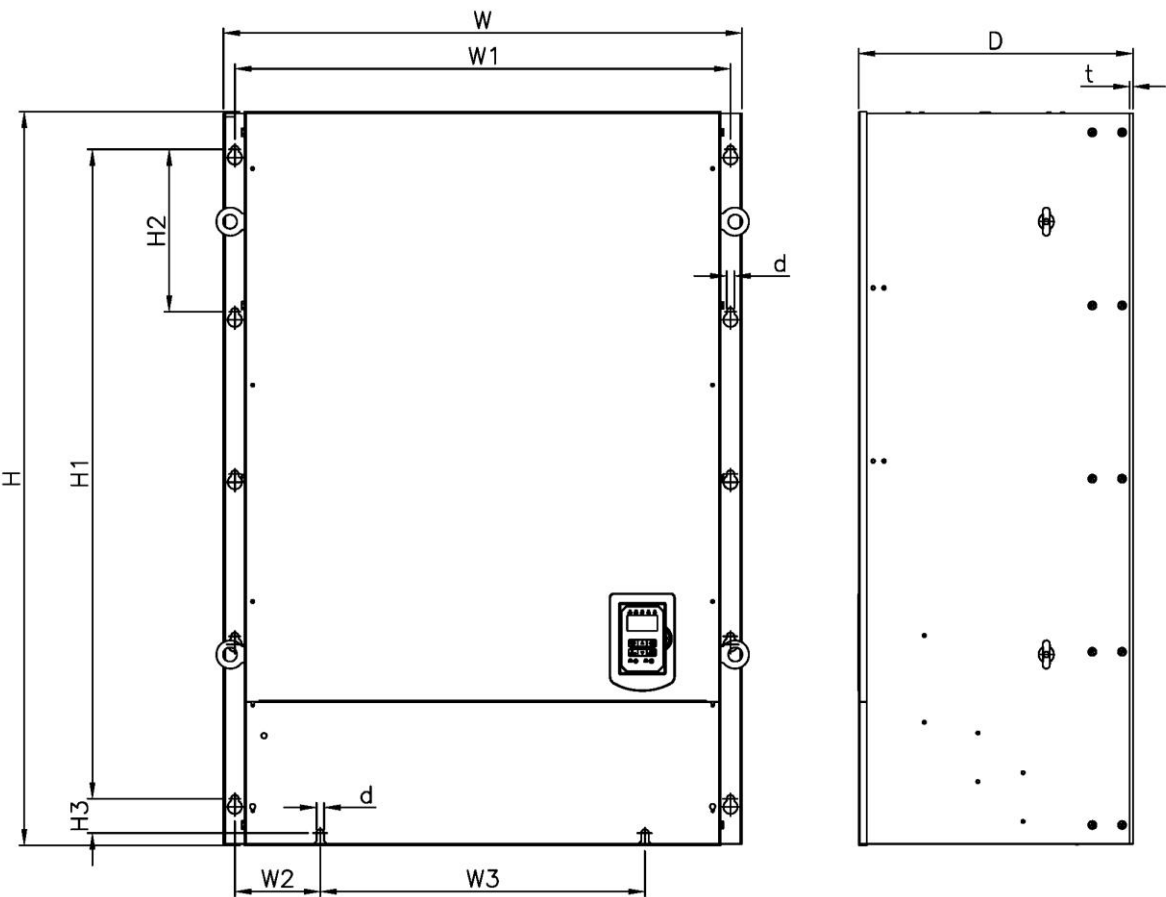
(e) 200V: 60-125HP/ 400V: 100-250HP (IP20)

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

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

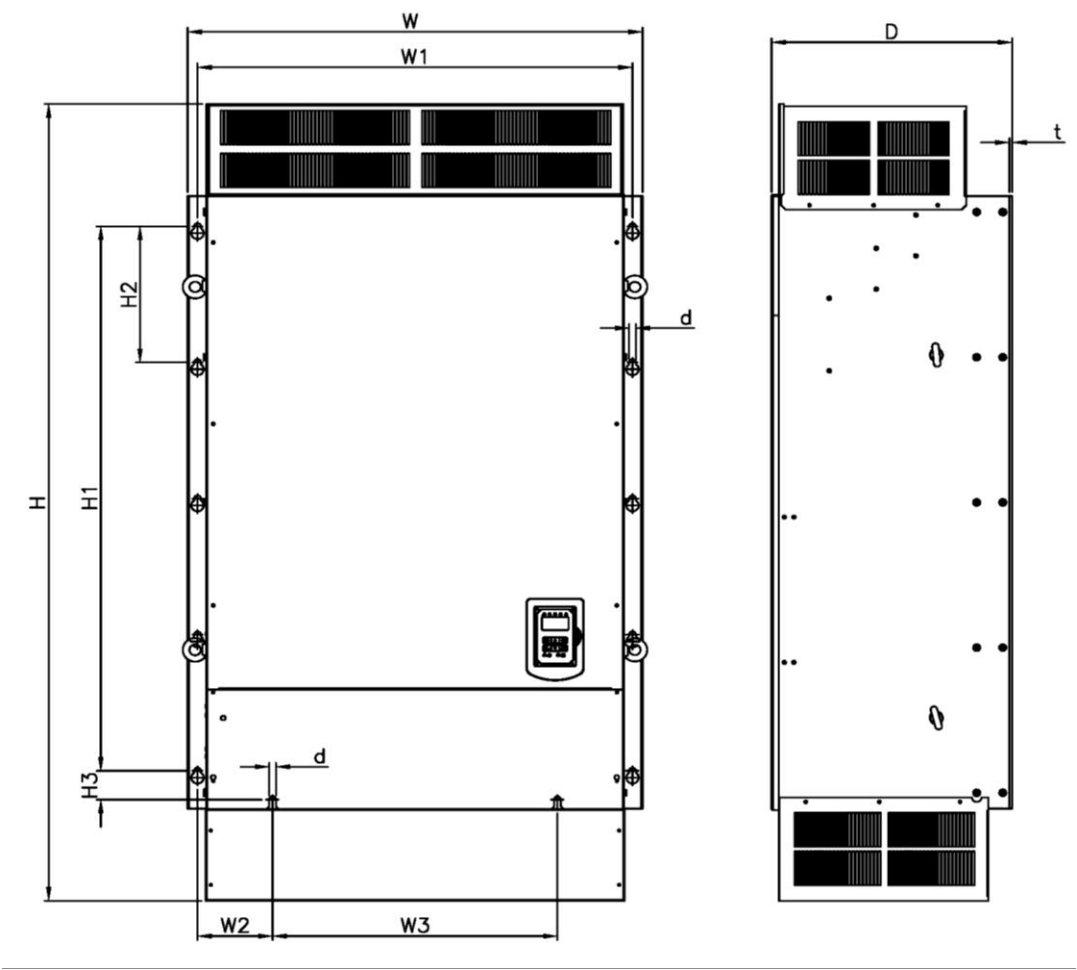
Inverter Model	Dimensions in inch (mm)							
	W	H	D	W1	H1	t	d	NW in kg(lbs)
F510-2150-C3	690 (27.17)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12
F510-2175-C3	690 (27.17)	1000 (39.37)	410 (16.14)	530 (20.87)	265 (10.43)	960 (37.80)	1.6 (0.06)	M12
F510-4300-C3	690 (27.17)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

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



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

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



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

4. Keypad and Programming Functions

4.1 LCD Keypad

4.1.1 Keypad Display and Keys



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

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

Auto-Repeat Keys

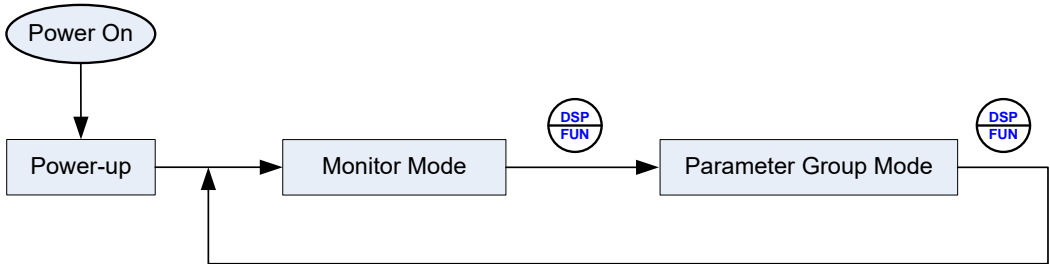
Holding the ▲UP or ▼DOWN key for a longer period of time will initiate the auto-repeat function resulting in the value of the selected digit to automatically increase or decrease.

Note: HOA LCD keypad is available as an option.

4.1.2 Keypad Menu Structure

Main Menu

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



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

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

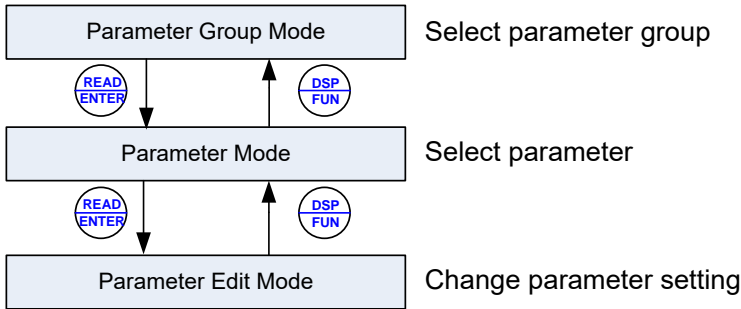


Fig. 4.1.2.1 Parameter Group Structure

Notes:

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

Monitor Mode

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

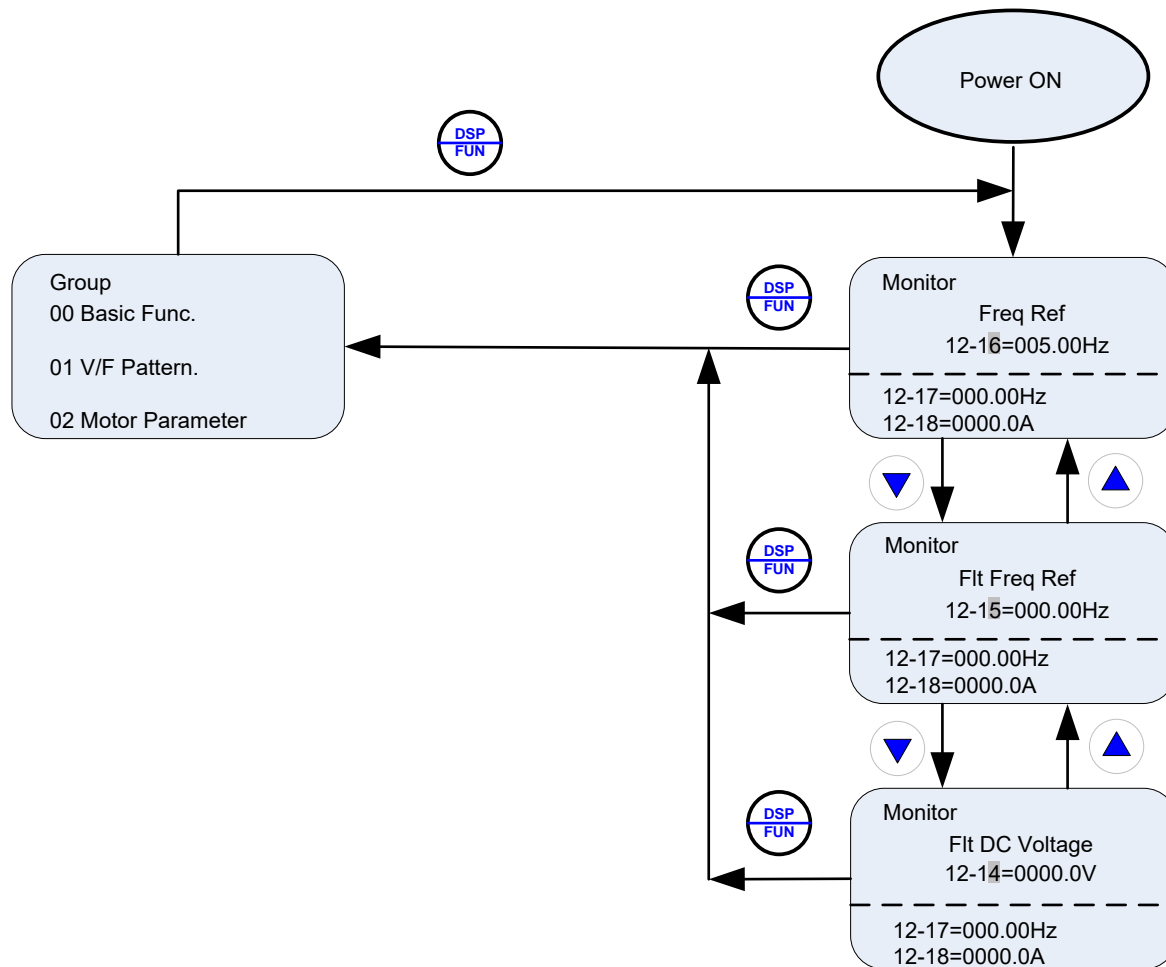


Fig 4.1.2.2 Monitor Mode

Notes:

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

Programming Mode

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

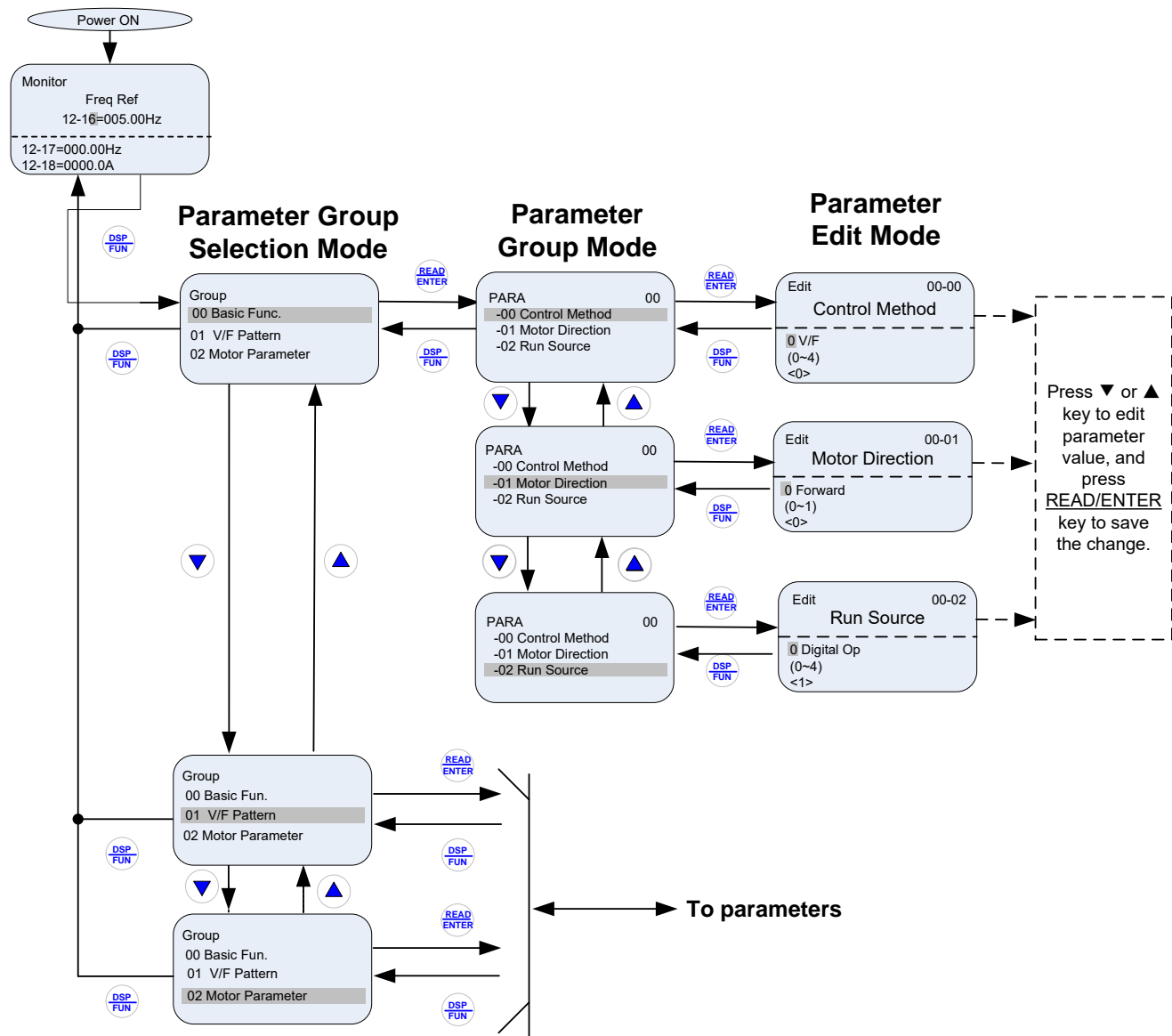
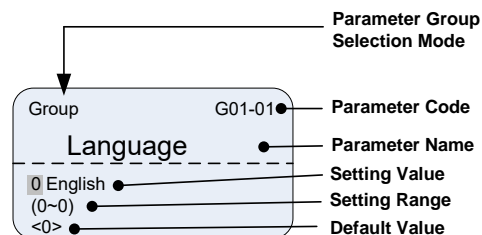


Fig 4.1.2.3 Programming Mode



Notes:

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

Auto-tuning Mode (Sensorless Vector Only)

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

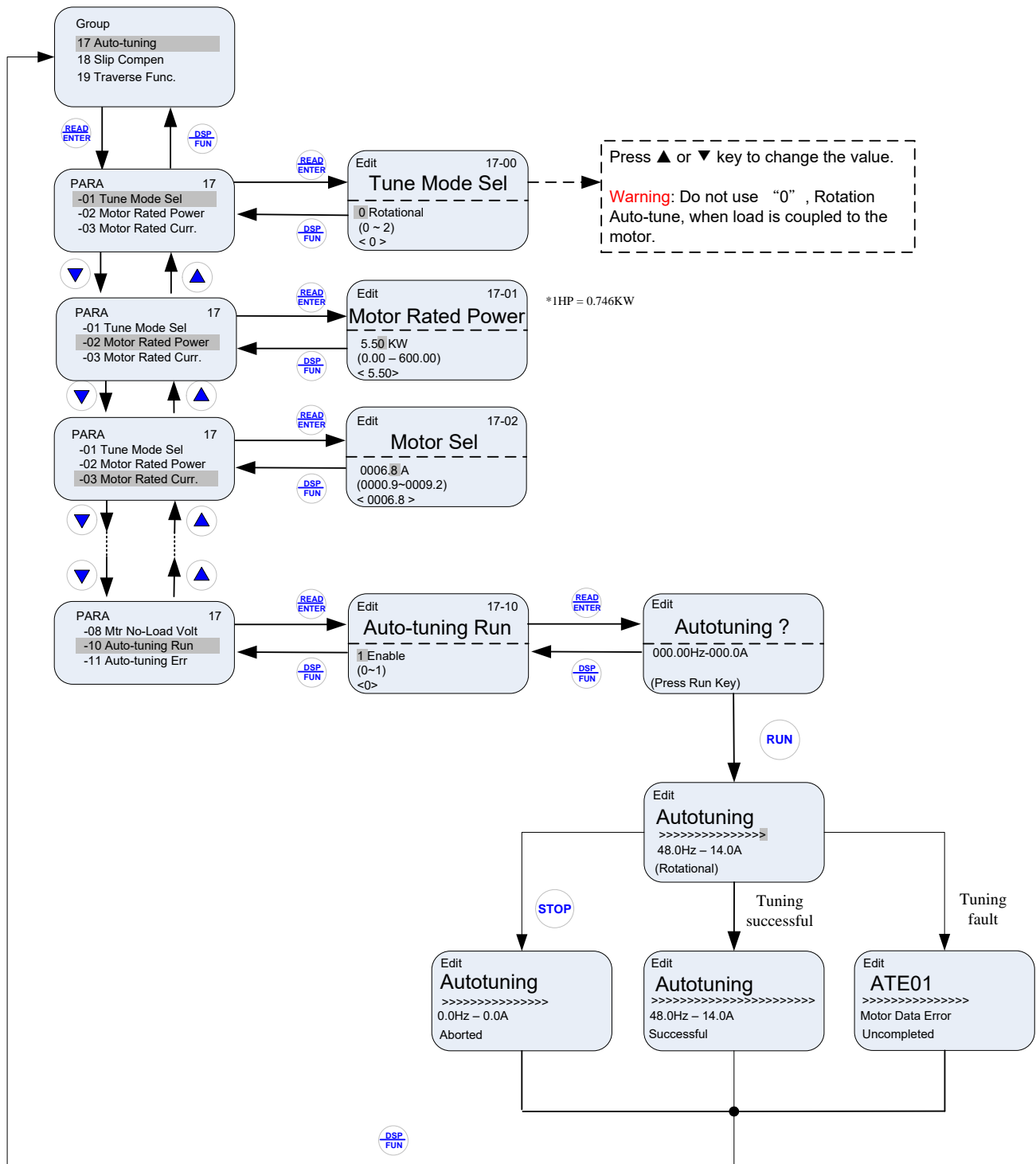


Fig 4.1.2.4 Auto-tuning Mode

Notes:

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

Notes:

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

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

4.2 Parameters

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

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

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

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

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

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

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

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

Group 03 External Digital Input and Output Parameters									
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute	
					V/F	SLV	PM SLV		
		37~40: Reserved		-	-	-	-		
		41: PID Sleep		-	O	O	O		
		42~46: Reserved		-	-	-	-		
		47: Fire Mode (Forced to Run Mode)		-	O	O	O		
		48: KEB Acceleration		-	O	X	X		
		49: Parameters Writing Allowable		-	O	O	O		
		50: Unattended Start Protection (USP)		-	O	O	O		
		51~52: Reserved		-	-	-	-		
		53: 2-Wire Self Holding Mode (Stop Command)		-	O	O	O		
		54: Switch PID1 and PID2							
		55: RTC Time Enable							
		56: RTC Offset Enable							
		57: Forced Frequency Run							
		58: Run Permissive Function							
		63: switch to Tolerance Range of Constant Pressure 2							
		64: Reserved			-	-	-		
		65: Short-circuit braking			X	X	O		
03-06 ~ 03-07	Reserved								
03-08	(S1~S6) DI Scan Time	0: Scan Time 4ms 1: Scan Time 8ms	1	-	O	O	O		
03-09	Multi-Function Terminal (S1-S4 Selection)	xxx0b:S1 A Contact xxx1b:S1 B Contact	0000b	-	O	O	O		
		xx0xb:S2 A Contact xx1xb:S2 B Contact							
		x0xxb:S3 A Contact x1xxb:S3 B Contact							
		0xxxb:S4 A Contact 1xxxb:S4 B Contact							
03-10	Multi-Function Terminal (S5-S6 Selection)	xxx0b:S5 A Contact xxx1b:S5 B Contact	0000b	-	O	O	O		
		xx0xb:S6 A Contact xx1xb:S6 B Contact							
		x0xxb: Reserved x1xxb: Reserved							
		0xxxb: Reserved 1xxxb: Reserved							
03-11	Relay (R1A-R1C) Output	0: During Running 1: Fault Contact Output 2: Frequency Agree	1	-	O	O	O	*6	
03-12	Relay (R2A-R2C) Output	3: Setting Frequency Agree (03-13 ± 03-14) 4: Frequency Detection 1 (≧03-13+03-14) 5: Frequency Detection 2 (<03-13+03-14)	0	-	O	O	O	*6	
		O			O	O			
		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				
		6: Automatic Restart			O	O	O				
		7~8: Reserved			-	-	-				
		9: Baseblock			O	O	O				
		10~11: Reserved			-	-	-				
		12: Over-Torque Detection			O	O	O				
		13: Current Agree *7			O	O	O				
		14: Mechanical Brake Control (03-17~18) ^{Note1}			O	O	O				
		15~17: Reserved			-	-	-				
		18: PLC Status									
		19: PLC Control									
		20: Zero Speed									
		21: Inverter Ready									
		22: Undervoltage Detection			O	O	O				
		23: Source of Operation Command									
		24: Source of Frequency Command									
		25: Low Torque Detection									
		26: Frequency Reference Missing									
		27: Timing Function Output									
		28~31: Reserved							-	-	-
		32: Communication Control Contacts							O	O	O
		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	O	X
		42: Over-High Pressure ^{Note1}							O	X	X
		43: Over-Low Pressure ^{Note1}			O	X	X				
		44: Loss of Pressure Detection ^{Note1}			O	X	X				
		45: PID Sleep ^{Note1}			O	O	O				
		46: Over-High Flow ^{Note1}			O	O	O				
		47: Over-Low Flow ^{Note1}			O	O	O				
		48: Shortage of Low Suction ^{Note1}			O	O	O				
		49: Communication Error ^{Note2}			O	O	O				
		50: Frequency Detection 3 ^{Note2}			O	O	O				
51: Frequency Detection 4 ^{Note2}	O	O	O								
52: Frequency Detection 5 ^{Note2}	O	O	O								
53: Frequency Detection 6 ^{Note2}	O	O	O								
54: Turn on short-circuit braking ^{Note2}	X	X	O								
57: Low Current Detection ^{Note3}	O	O	O								
03-13	Frequency Detection Level	0.0~400.0	0.0	Hz	O	O	O				
03-14	Frequency Detection Width	0.1~25.5	2.0	Hz	O	O	O				
03-15	Current Agree Level	0.1~999.9	0.1	A	O	O	O	*7			
03-16	Delay Time of Current Agree	0.1~10.0	0.1	s	X	O	X	*7			

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

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

Group 04 External Analog Input and Output Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
04-00	AI Input Signal Type	0: AI2: 0~10V/0~20mA 1: AI2: 4~20mA/ 2~10V	1	-	O	O	O	
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	Reserved							
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 ~ 04-10	Reserved							
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	

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

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	-	O	O	O	
		1: Acceleration and Deceleration Time are set by 05-17 ~ 05-48						
05-01	Frequency Setting of Speed-Stage 0	0.00~400.00	5.00	Hz	O	O	O	*1
05-02	Frequency Setting of Speed-Stage 1	0.00~400.00	5.00	Hz	O	O	O	*7
05-03	Frequency Setting of Speed-Stage 2	0.00~400.00	10.00	Hz	O	O	O	*7
05-04	Frequency Setting of Speed-Stage 3	0.00~400.00	20.00	Hz	O	O	O	*7
05-05	Frequency Setting of Speed-Stage 4	0.00~400.00	30.00	Hz	O	O	O	*7
05-06	Frequency Setting of Speed-Stage 5	0.00~400.00	40.00	Hz	O	O	O	*7
05-07	Frequency Setting of Speed-Stage 6	0.00~400.00	50.00	Hz	O	O	O	*7
05-08	Frequency Setting of Speed-Stage 7	0.00~400.00	50.00	Hz	O	O	O	*7
05-09	Frequency Setting of Speed-Stage 8	0.00~400.00	5.00	Hz	O	O	O	*7
05-10	Frequency Setting of Speed-Stage 9	0.00~400.00	5.00	Hz	O	O	O	*7
05-11	Frequency Setting of Speed-Stage 10	0.00~400.00	5.00	Hz	O	O	O	*7
05-12	Frequency Setting of Speed-Stage 11	0.00~400.00	5.00	Hz	O	O	O	*7
05-13	Frequency Setting of Speed-Stage 12	0.00~400.00	5.00	Hz	O	O	O	*7
05-14	Frequency Setting of Speed-Stage 13	0.00~400.00	5.00	Hz	O	O	O	*7
05-15	Frequency Setting of Speed-Stage 14	0.00~400.00	5.00	Hz	O	O	O	*7
05-16	Frequency Setting of Speed-Stage 15	0.00~400.00	5.00	Hz	O	O	O	*7
05-17	Acceleration Time Setting of Multi Speed 0	0.1~6000.0	10.0	s	O	O	O	
05-18	Deceleration Time Setting of Multi Speed 0	0.1~6000.0	10.0	s	O	O	O	
05-19	Acceleration Time Setting of Multi Speed 1	0.1~6000.0	10.0	s	O	O	O	
05-20	Deceleration Time Setting of Multi Speed 1	0.1~6000.0	10.0	s	O	O	O	

Group 05 Multi-Speed Function Group								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
05-21	Acceleration Time Setting of Multi Speed 2	0.1~6000.0	10.0	s	O	O	O	
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	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	
	Multi Speed 12							
05-43	Acceleration Time Setting of Multi Speed 13	0.1~6000.0	10.0	s	O	O	O	
05-44	Deceleration Time Setting of Multi Speed 13	0.1~6000.0	10.0	s	O	O	O	
05-45	Acceleration Time Setting of Multi Speed 14	0.1~6000.0	10.0	s	O	O	O	
05-46	Deceleration Time Setting of Multi Speed 14	0.1~6000.0	10.0	s	O	O	O	
05-47	Acceleration Time Setting of Multi Speed 15	0.1~6000.0	10.0	s	O	O	O	
05-48	Deceleration Time Setting of Multi Speed 15	0.1~6000.0	10.0	s	O	O	O	

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

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

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

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

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

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

Group 08 Protection Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		2: Motor overload (OL1) Protection 2						
08-08	Automatic Voltage Regulation (AVR)	0: Enable	0	-	O	O	O	
		1: Disable						
08-09	Selection of Input Phase Loss Protection	0: Disable	0	-	O	O	O	
		1: Enable						
08-10	Selection of Output Phase Loss Protection	0: Disable	0	-	O	O	O	
		1: Enable						
08-11 ~ 08-12	Reserved							
08-13	Selection of Over-Torque Detection	0: Over-Torque Detection is Disabled.	0	-	O	O	O	
		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	-	O	O	O	
		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	%	O	O	O	
08-16	Time of Over-Torque Detection	0.0~10.0	0.1	Sec	O	O	O	
08-17	Selection of Low-Torque Detection	0: Low-Torque Detection is Disabled.	0	-	O	O	O	
		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	-	O	O	O	
		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	%	O	O	O	
08-20	Time of Low-Torque Detection	0.0~10.0	0.1	Sec	O	O	O	
08-21	Limit of Stall Prevention in Acc	1~100	50	%	O	O	O	

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

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

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

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

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

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

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

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

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

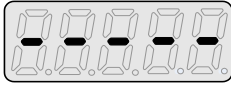
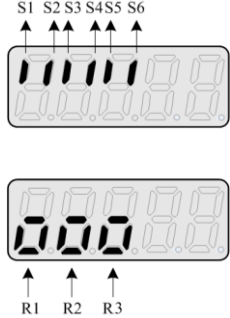
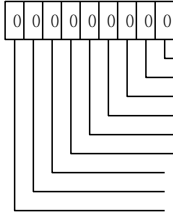
Group 11: Auxiliary Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
11-35	Dead band Level of DC Voltage Filter	0.0~99.0	10.0	Vdc	O	X	X	*1
11-36	Frequency Gain of OV Prevention	0.000~1.000	0.050	-	O	X	X	*1
11-37	Frequency Limit of OV Prevention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

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

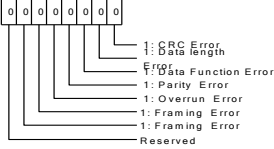
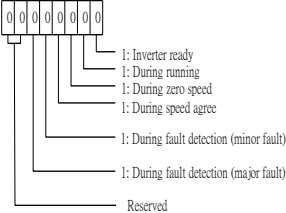
***a: KVA means the default value of this parameter is changed based on the inverter rating.**

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

Group 12: Monitoring Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
12-00	Display Screen Selection (LED)	00000~77777 From the leftmost bit, it displays the screen when press DSP key in order. 0: No display 1: Output Current 2: Output Voltage 3: DC Bus Voltage 4: Heatsink Temperature 5: PID Feedback 6: AI1 Value 7: AI2 Value	00321	-	O	O	O	*1 *5
12-01	PID Feedback Display Mode (LED)	0: Display the Feedback Value by Integer (xxx)	0		O	O	O	*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		O	O	O	*5
		1: xxxPb (pressure)						
		2: xxxFL (flow)						
12-03	Line Speed Display (LED)	0~60000	1500/ 1800	RPM	O	O	O	*5
12-04	Line Speed Display Mode (LED)	0: Display Inverter Output Frequency	0		O	O	O	*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> <p>Input Terminal(S6) Input Terminal(S5) Input Terminal(S4) Input Terminal(S3) Input Terminal(S2) Input Terminal(S1) Output Terminal(R3) Output Terminal(R2) Output Terminal(R1)</p>	-	-	O	O	O	
12-06 ~ 12-10	Reserved							
12-11	Output Current of Current Fault	Display the output current of current fault	-	A	O	O	O	
12-12	Output Voltage of Current Fault	Display the output voltage of current fault	-	V	O	O	O	
12-13	Output Frequency of Current Fault	Display the output frequency of current fault	-	Hz	O	O	O	
12-14	DC Voltage of Current Fault	Display the DC voltage of current fault	-	V	O	O	O	
12-15	Frequency Command of Current Fault	Display the frequency command of current fault	-	Hz	O	O	O	
12-16	Frequency Command	If LED enters this parameter, it only allows monitoring frequency command.	-	Hz	O	O	O	
12-17	Output Frequency	Display the current output frequency	-	Hz	O	O	O	
12-18	Output Current	Display the current output current	-	A	O	O	O	
12-19	Output Voltage	Display the current output voltage	-	V	O	O	O	
12-20	DC Voltage	Display the current DC voltage	-	V	O	O	O	
12-21	Output Power	Display the current output power	-	kW	O	O	O	

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

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

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

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

Group 13 Maintenance Function Group								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
13-00	Inverter Rating Selection	00H~FFH	-	-	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: Parameters out of 13-06 and main frequency 05-01 are read-only. 1: Only user parameter is enabled. 2: All parameters are writable.	2		O	O	O	*1
13-07	Parameter Password Function	00000~65534	00000	-	O	O	O	
13-08	Restore Factory Setting	0: No Initialization 2: 2 wire Initialization (220/440V, 60Hz) 3: 3 wire Initialization (220/440V, 60Hz) 4: 2 wire Initialization (230/415V, 50Hz) 5: 3 wire Initialization (230/415V, 50Hz) 6: 2 wire Initialization (200/380V, 50Hz) 7: 3 wire Initialization (200/380V, 50Hz) 8: PLC Initialization 9: 2 Wire Initialization (230V/460V, 60Hz) 10: 3 Wire Initialization (230V/460V, 60Hz) 11: 2 wire Initialization, 230V/400V, 60Hz 12: 3 wire Initialization, 230V/400V, 60Hz 13: 2 wire Initialization, 230V/400V, 50Hz 14: 3 wire Initialization, 230V/400V, 50Hz 15: 2 wire Initialization, (220/380V, 50Hz) ^{Note4} 16: 3 wire Initialization	0	-	O	O	O	

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

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

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

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

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

Group 16: LCD Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
16-00	Main Screen Monitoring	5~79 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	5~79 (Parameter 12-05~12-79) 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	5~76 (Parameter 12-05~12-79) 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						

Group 16: LCD Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		8: /s						
		9: /m						
		10: /h						
		11: °F						
		12: inW						
		13: HP						
		14: m/s						
		15: MPM						
		16: CMM						
		17: W						
		18: KW						
		19: m						
		20: °C						
		21: RPM						
		22: Bar						
		23: Pa						
		24: KPa ^{Note4}						
16-05	LCD Backlight	0~7	5	-	O	O	O	*1
16-06	Reserved							
16-07	Copy Function Selection	0: Do not copy parameters	0	-	O	O	O	
		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	-	O	O	O	
		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	-	O	O	O	*1
		1: Display fault to stop when LCD operator is removed						
16-10	RTC Time Display Setting	0: Hide	0		O	O	O	
		1: Display						
16-11	RTC Date Setting	12.01.01 ~ 99.12.31	12.01.01		O	O	O	
16-12	RTC Time Setting	00:00 ~ 23:59	00:00		O	O	O	
16-13	RTC Timer Function	0: Disable	0		O	O	O	
		1: Enable						
		2: Set by DI						

Group 16: LCD Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
16-14	P1 Start Time	00:00 ~ 23:59	08:00		O	O	O	
16-15	P1 Stop Time	00:00 ~ 23:59	18:00		O	O	O	
16-16	P1 Start Date	1:Mon, 2:Tue, 3:Wed, 4:Thu, 5:Fri, 6:Sat, 7:Sun	1		O	O	O	
16-17	P1 Stop Date		5		O	O	O	
16-18	P2 Start Time	00:00 ~ 23:59	08:00		O	O	O	
16-19	P2 Stop Time	00:00 ~ 23:59	18:00		O	O	O	
16-20	P2 Start Date	1:Mon, 2:Tue, 3:Wed, 4:Thu, 5:Fri, 6:Sat, 7:Sun	1		O	O	O	
16-21	P2 Stop Date		5		O	O	O	
16-22	P3 Start Time	00:00 ~ 23:59	08:00		O	O	O	
16-23	P3 Stop Time	00:00 ~ 23:59	18:00		O	O	O	
16-24	P3 Start Date	1:Mon, 2:Tue, 3:Wed, 4:Thu, 5:Fri, 6:Sat, 7:Sun	1		O	O	O	
16-25	P3 Stop Date		5		O	O	O	
16-26	P4 Start Time	00:00 ~ 23:59	08:00		O	O	O	
16-27	P4 Stop Time	00:00 ~ 23:59	18:00		O	O	O	
16-28	P4 Start Date	1:Mon, 2:Tue, 3:Wed, 4:Thu, 5:Fri, 6:Sat, 7:Sun	1		O	O	O	
16-29	P4 Stop Date		5		O	O	O	
16-30	Selection of RTC Offset	0: Disable	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, 2:P2, 3:P1+P2 4:P3, 5:P1+P3, 6:P2+P3, 7:P1+P2+P3, 8:P4, 9:P1+P4, 10:P2+P4, 11:P1+P2+P4 12:P3+P4 13:P1+P3+P4, 14:P2+P3+P4 15:P1+P2+P3+P4, 16:Off, 17:Off+P1 18:Off+P2, 19:Off+P1+P2 20:Off+P3, 21:Off+P1+P3 22:Off+P2+P3 23:Off+P1+P2+P3 24:Off+P4 25:Off+P1+P4 26:Off+P2+P4	1		O	O	O	
16-33	Source of Timer 2		2		O	O	O	
16-34	Source of Timer 3		4		O	O	O	
16-35	Source of Timer 4		8		O	O	O	

Group 16: LCD Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
		27:Off+P1+P2+P4 28:Off+P3+P4 29:Off+P1+P3+P4 30:Off+P2+P3+P4 31:Off+P1+P2+P3+P4						
16-36	Selection of RTC Speed	0: Off	0		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						
		x0xb: RTC Run3 Forward Rotation						
		x1xb: RTC Run3 Reverse Rotation						
		0xxb: RTC Run4 Forward Rotation						
		1xxb: RTC Run4 Reverse Rotation						

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

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

Note: New added parameters in software V1.41

■1: Enabled when 17-00=1, 2, 6.

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

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

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

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

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

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

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

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

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

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

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

Group 24 Pump Control Function Parameters								
Code	Parameter Name	Setting Range	Default	Unit	Control Mode			Attribute
					V/F	SLV	PM SLV	
24-00	Selection of Pump Control Function	0: Function of 1 to 8 Pump Card is Disabled	0	-	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						
		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						

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

4.3 Description of Parameters

Group 00: Basic Parameters

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

The inverter offers the following control modes:

00-00=0: V/F Mode

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

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

00-00=2: Sensorless Vector Control

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

00-00=5: PM Sensorless Vector Control

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

Note: Parameter 00-00 is excluded from initialization.

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

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

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

00-02=0: Keypad Control

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

00-02=1: External Terminal Control

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

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

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

00-03=0: Keypad Control

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

00-03=1: External Terminal Control

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

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

■ 2-wire operation

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

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

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

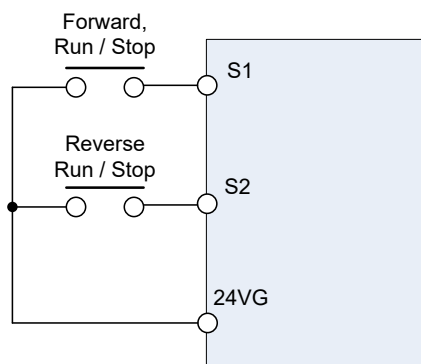


Figure 4.3.1 Wiring example of 2-wire

■ 3-wire operation

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

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

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

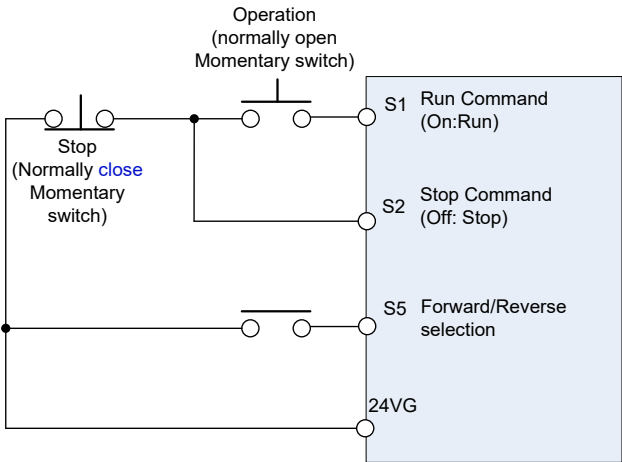


Figure 4.3.2 Wiring example of 3-wire

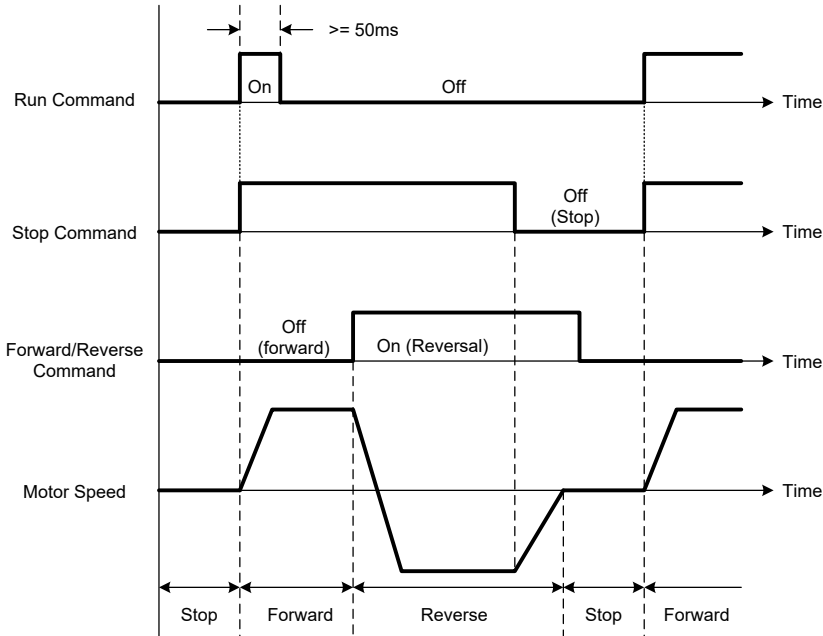
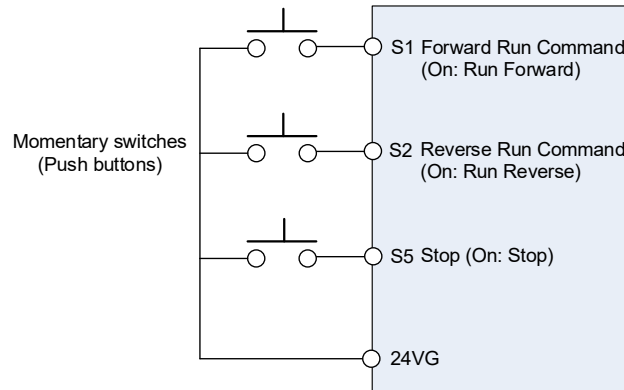


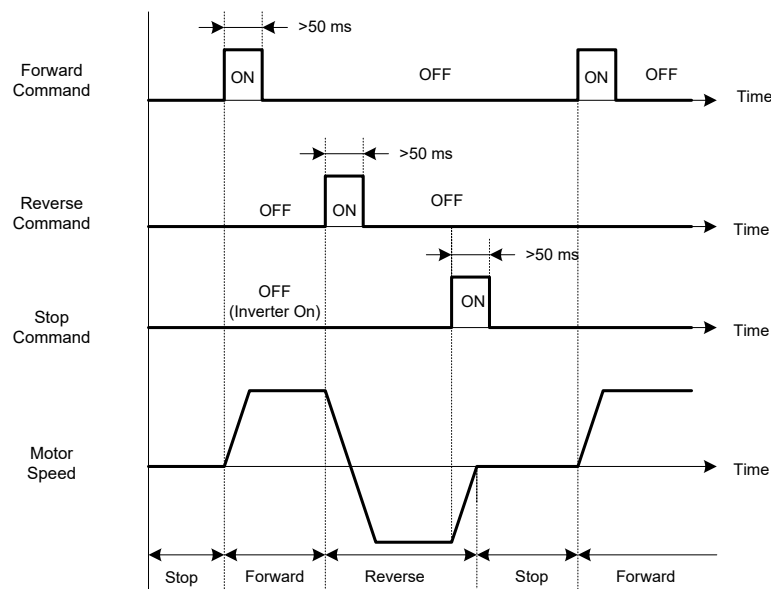
Figure 4.3.3 Timing chart of 3-wire operation

■ 2-wire self holding (latching) operation

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



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



00-03=2: Communication control

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

00-03=3: PLC control

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

00-03=4: RTC control

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

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

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

00-04 = 0: English Display

00-04 = 1: Simple Chinese Display

00-04 = 2: Traditional Chinese Display

00-04 = 3: Turkish Display

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

*1

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

00-05/00-06= 0: Keypad

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

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

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

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

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

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

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

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

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

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

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

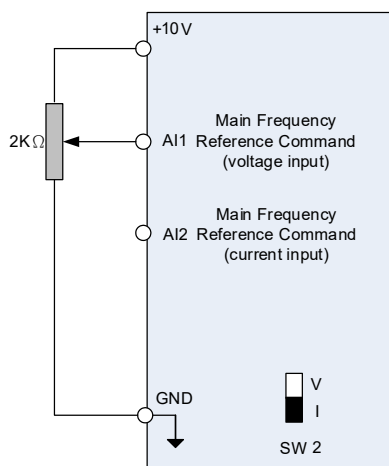


Figure 4.3.4 Analog input as main frequency reference command

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

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

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

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

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

Refer to parameter group 9 for additional information.

00-05/00-06= 6: RTC

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

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

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

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

When set to 0 the reference frequency is set by the main reference frequency selection of parameter 00-05.

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

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

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

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

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

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

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

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

00-10=0:

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

00-10=1:

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

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

When inverter gets to sleep,

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

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

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

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

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

Motor 1: Maximum frequency parameter 01-02.

Motor 2: Maximum frequency parameter 01-16.

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

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

Notes:

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

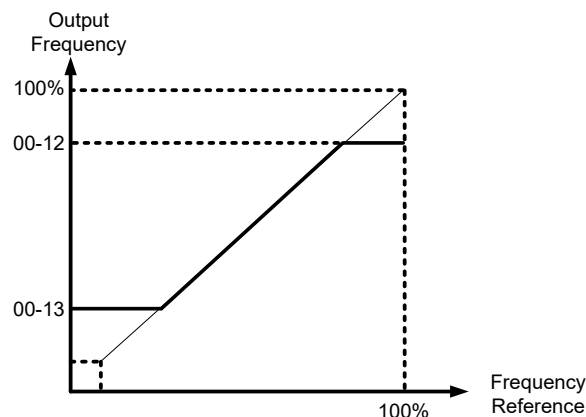


Figure 4.3.5 Frequency reference upper and lower limits

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

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

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

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

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

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

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

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

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

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

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

Table 4.3.1 Acceleration / deceleration time selection

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

0: OFF, 1: ON

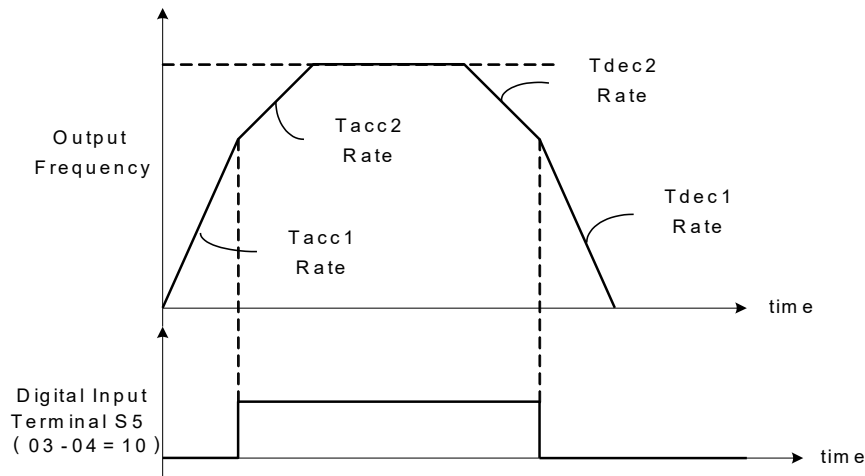


Figure 4.3.6: Terminal S5 switch between Tacc1/Tacc2 and Tdec1/Tdec2

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

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

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

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

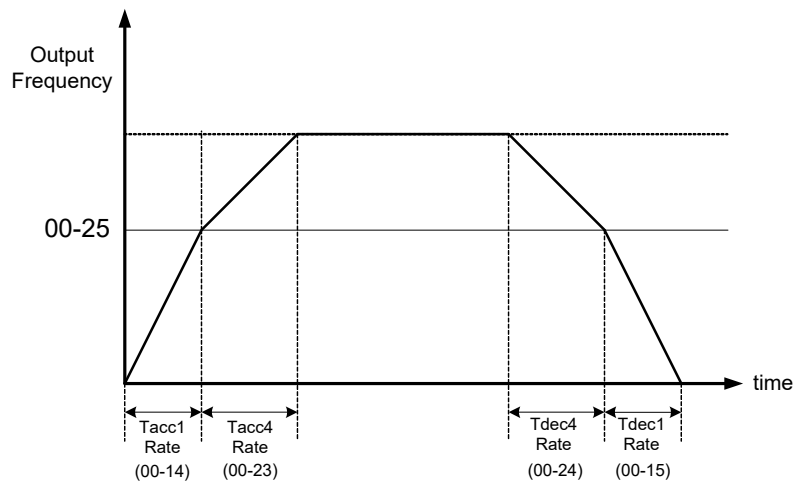


Figure 4.3.7 Automatic acceleration / deceleration time switch-over based on output frequency

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

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

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

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

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

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

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

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

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

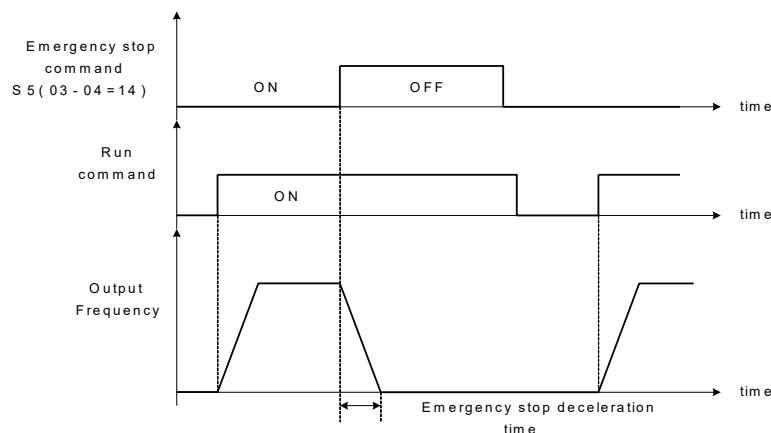


Figure 4.3.8 Emergency stop example

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

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

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

Note: Selection applies to analog input AI1 and AI2.

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

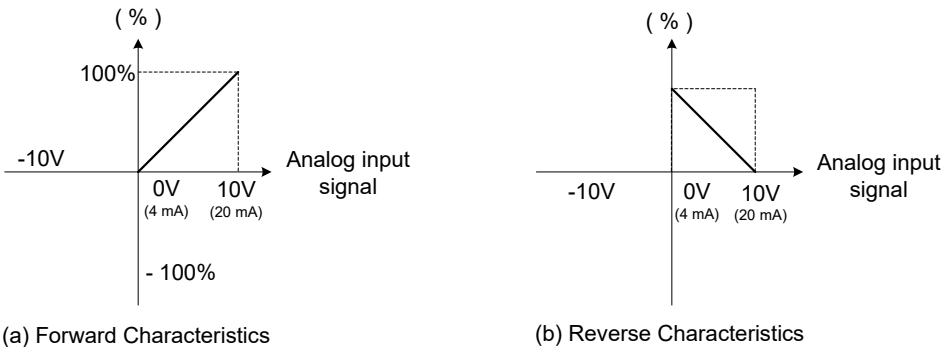


Figure 4.3.9 Positive/negative analog input as main frequency reference command.

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

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

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

(1) Water supply pump

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

(2) Conveyor

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

(3) Exhaust fan

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

(4) HVAC

Parameter	Name	Value
00-00	Control mode selection	0 : V/F
11-00	Direction lock selection	1 : Forward direction only
11-01	Carrier frequency	8.0kHz
07-00	Momentary power loss/ fault restart selection	1 : Enable
07-32	Speed Search Mode Selection	0 : Disable
10-03	PID Control Mode	xx1b: PID Enable
11-03	Automatic carrier frequency reduction	1 : Enable
01-00	V/F curve selection	F
23-00	Function Selection	2: HVAC

(5) Compressor

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

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

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

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

Note: only for LCD.

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

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

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

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

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

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

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

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

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

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

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

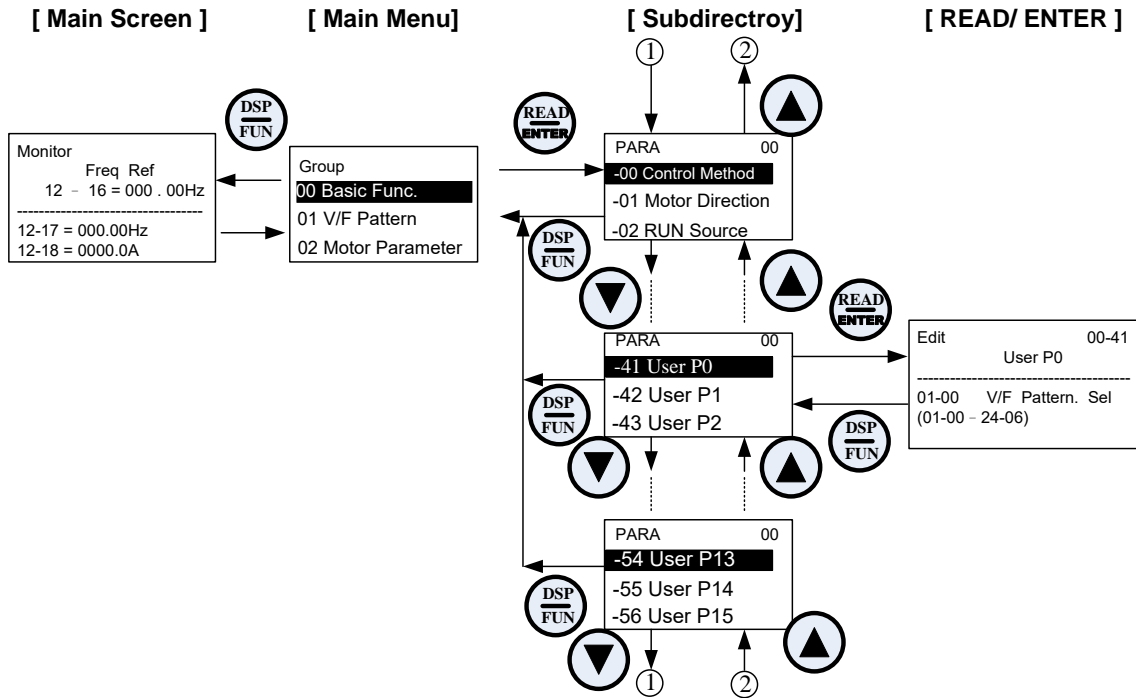
Step	LCD Display	Descriptions
1	Group 13 Driver Status 14 PLC Setting 15 PLC Monitor	Select the start parameter group (03) in the advanced modes.
2	PARA 13 -06. Access Level -07. Password 1 -08. Initialize	Press (READ/ ENTER) and ▲ (Up) / ▼ (Down) key to enter the access level of parameter (13-06).
3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

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

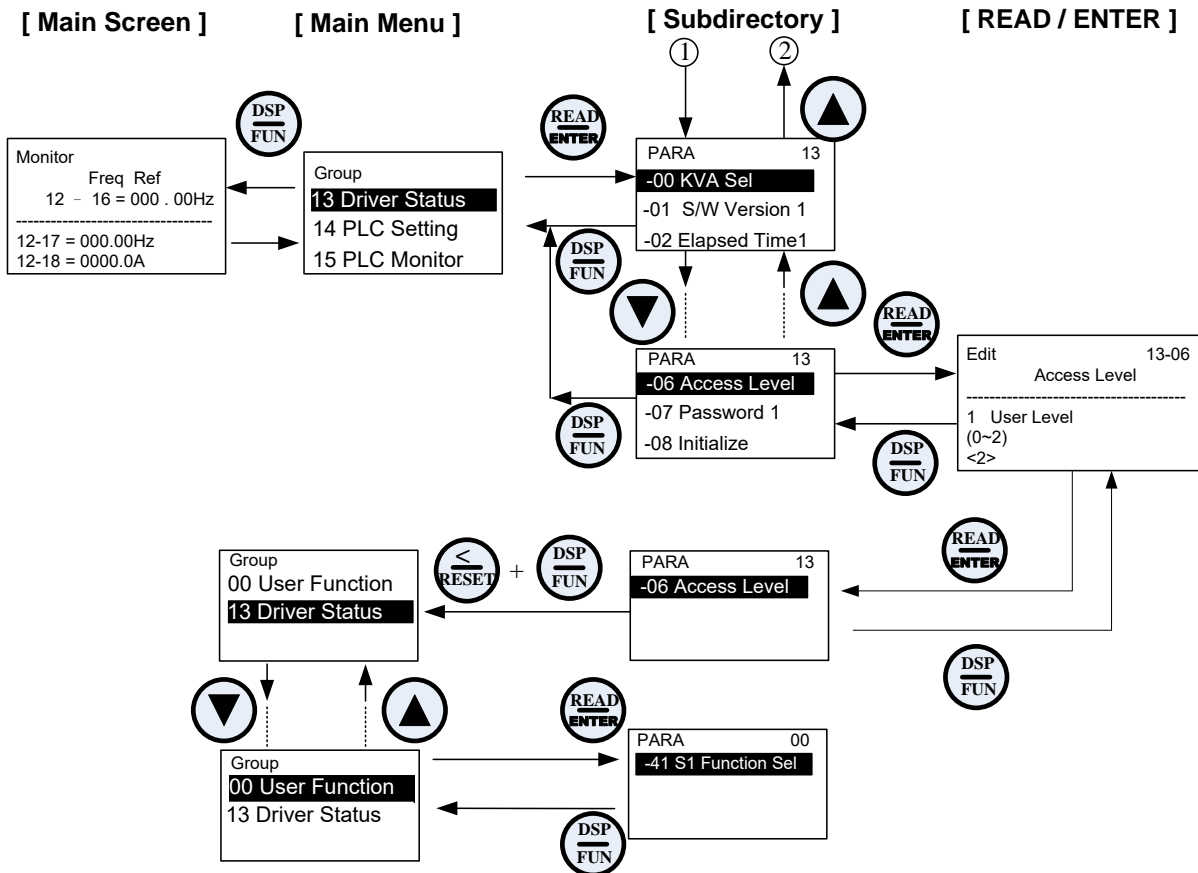
Step	LCD Display	Descriptions
11	Edit 00-41 S1 Function Sel 06 FJOG (00~57) < 00 > < 03-00 >	Press ▲ (Up) / ▼ (Down) key to change the setting value to 2. Use (READ/ ENTER) key to save the setting value. When the selected setting value does not flash again, the setting value will be saved to 00-41 and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

User Parameter Run Mode Structures

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



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



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.

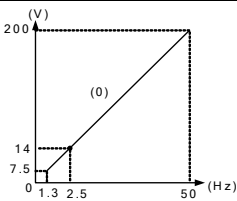
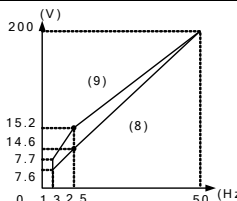
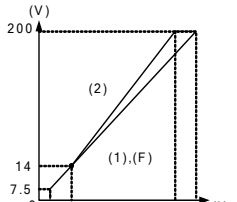
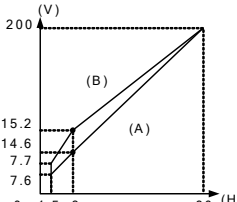
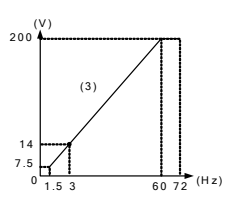
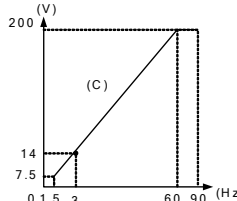
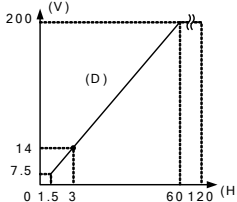
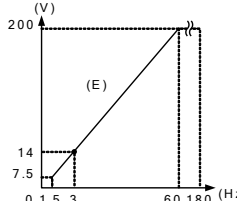
Parameters 01-02 ~ 01-13 are automatically set when any of the predefined V/F curves are selected.

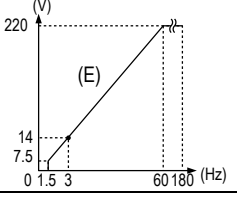
This parameter will be affected to reset by the initialization parameter (13-08).

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

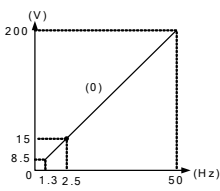
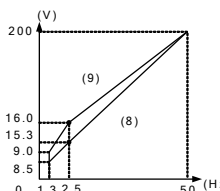
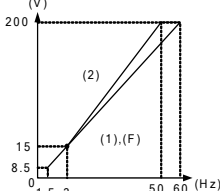
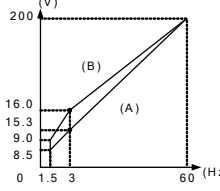
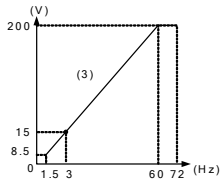
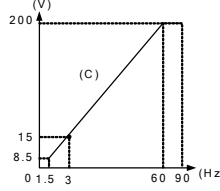
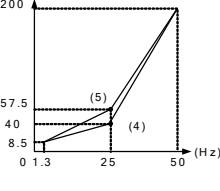
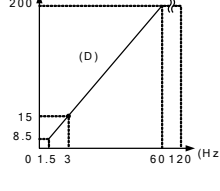
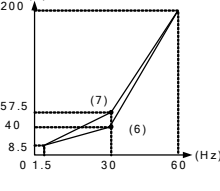
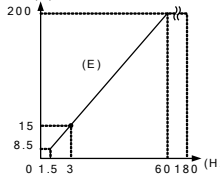
Type	Specification	01-00	V/F curve ^{*1}
Rated Horsepower Torque (Reducer)	180Hz	F	

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

‡ Select high starting torque only for the following conditions.

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

Table 4.3.3 40HP and above V/F curve selection

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

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

‡ Select high starting torque only for the following conditions.

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

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

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

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

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

Important:

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

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

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

Custom V/F Curve Setting:

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

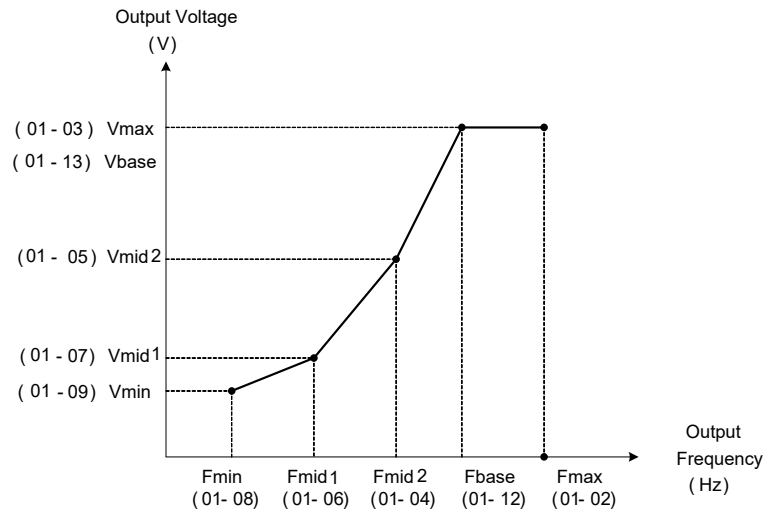


Figure 4.3.10 Custom V/F curve

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

$$\begin{matrix} F_{\max} & > & F_{\text{base}} & > & F_{\text{mid2}} & > & F_{\text{mid1}} & > & F_{\min} \\ (01-02) & & (01-12) & & (01-04) & & (01-06) & & (01-08) \end{matrix}$$

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

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

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

SLV (Sensorless vector control)

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

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

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

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

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

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

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

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

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

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

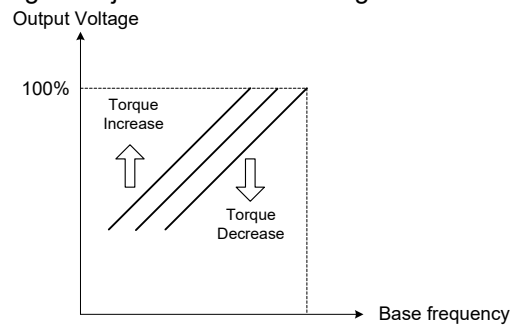


Figure 4.3.11 Torque compensation gain to increase/decrease output torque

Increase value when:

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

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

Reduce value when:

- When experiencing motor vibration

Important:

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

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

01-11=0: General torque compensation mode.

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

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

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

The minimum input voltage of inverter is 0.1V.

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

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

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

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

Set the torque compensation delay time in milliseconds.

Only adjust in the following situations:

Increase value when:

- When experiencing motor vibration

Decrease value when:

- When motor torque response is too slow

Group 02-IM Motor Parameter

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

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

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

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

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

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

(2) Motor rated power (02-05)

Set the motor power according to the motor nameplate.

(3) Motor rated current (02-01)

Set the motor rated current according to the motor nameplate.

(4) Motor rated voltage (02-04)

Set the motor rated voltage according to the motor nameplate.

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

Set the motor rated frequency according to the motor nameplate.

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

Set the motor rpm according to the motor nameplate.

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

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

(8) Motor excitation current (02-09)

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

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

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

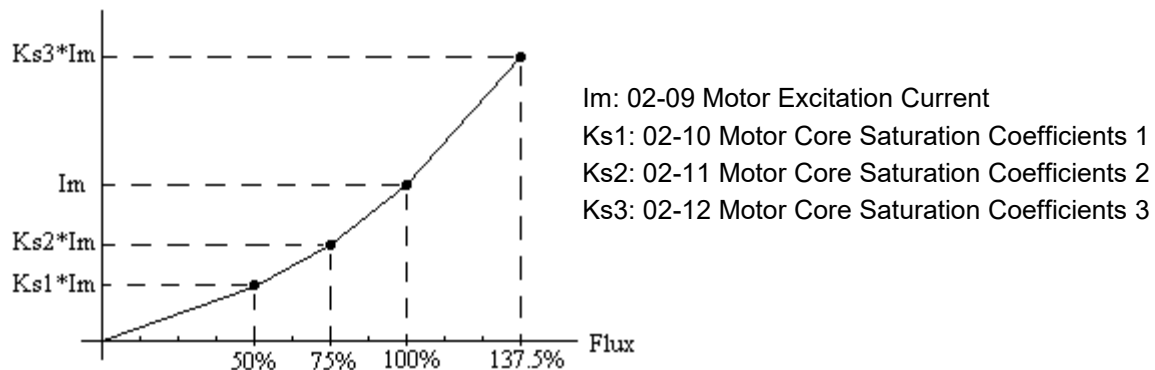


Figure 4.3.12-a Y-equivalent model of an induction motor

(10) Motor core loss (02-13)

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

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

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

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

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

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

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

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

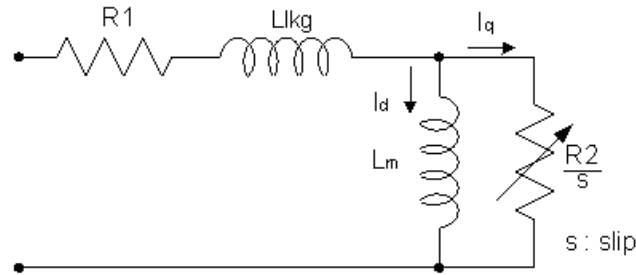


Figure 4.3.12-b Y-equivalent model of an induction motor

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

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

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

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

(14) Motor Slip Frequency (02-34)

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

Synchronous speed is $N = \frac{120 \times \text{Frequency}}{\text{Pole}} = \frac{120 \times 60}{4} = 1800 \text{ rpm}$ 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 marked with <1> will have updated values. Please refer Group 17: Automatic Tuning Parameters for more detail.

Group 03- External Digital Input and Output Parameters

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

	<div><div>【49】 : Parameters Writing Allowable</div><div>【50】 : Unattended Start Protection (USP)</div><div>【51】 ~ 【52】 : Reserved</div><div>【53】 : 2-Wire Self Holding Mode (Stop Command)</div><div>【54】 : Switch PID1 and PID2</div><div>【55】 : RTC Time Enable</div><div>【56】 : RTC Offset Enable</div><div>【57】 : Forcing Frequency Run</div><div>【58】 : Run Permissive Function</div><div>【63】 : Switch to Tolerance Range of Constant Pressure 2</div><div>【64】 : Reserved</div><div>【65】 : Short-circuit braking</div></div>
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*1: Selection 15, 19, 33, and 34 cannot be used when using a permanent magnetic (PM) motor.

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

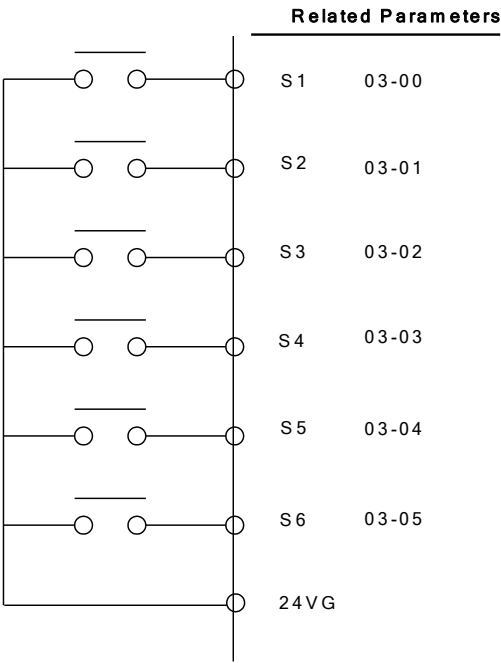


Figure 4.3.13 Multi-function digital input and related parameters

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

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

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

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

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

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

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

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

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

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

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

Select frequency reference using the multi-function digital input.

Table 4.3.5 Multi-speed operation selection

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

0: OFF, 1: ON, —: Ignore

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

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

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

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

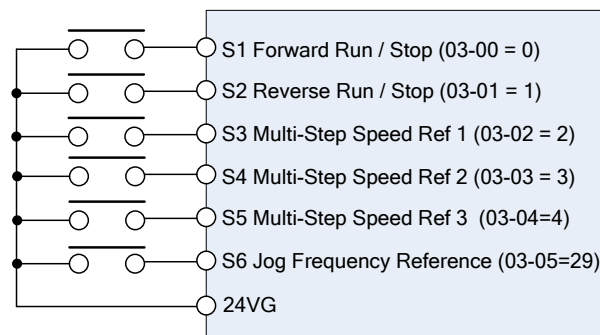


Figure 4.3.14 Control Terminal Wiring Example

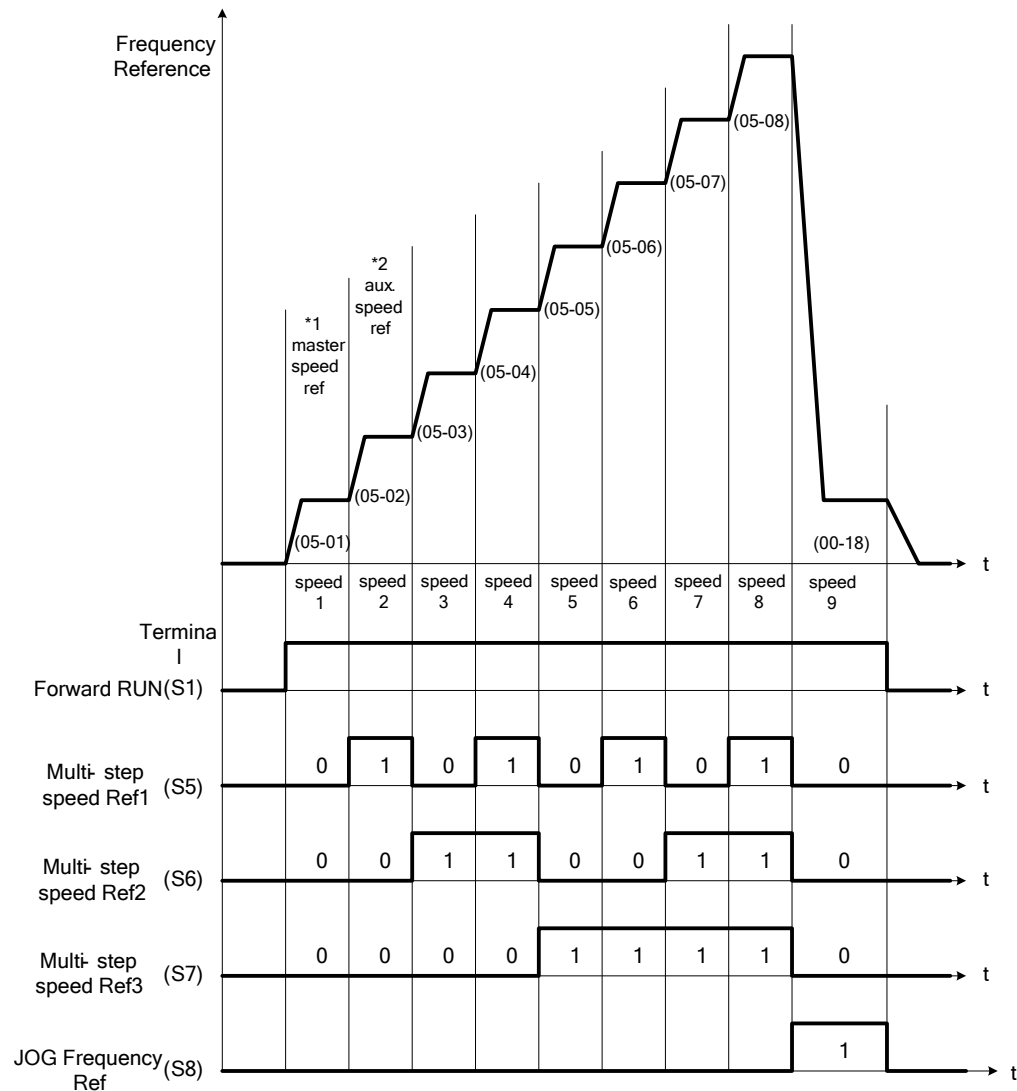


Figure 4.3.15 9-speed timing diagram

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

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

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

Notes:

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

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

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

Note:

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

Note: SE02 DI terminal Error is displayed when:

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

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

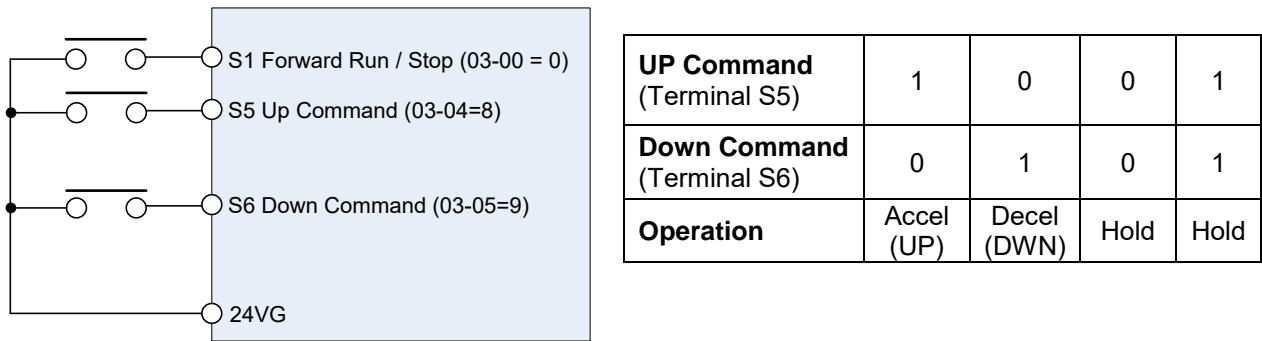


Figure 4.3.16 UP/DOWN wiring and operation example

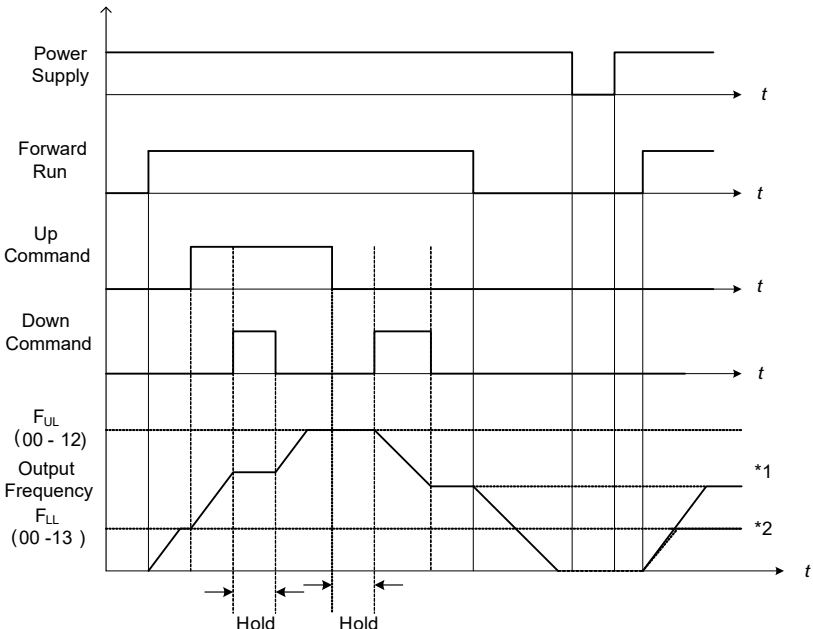


Figure 4.3.17 Up / Down command timing diagram

UP / DOWN Command Operation

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

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

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

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

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

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

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

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

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

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

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

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

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

If 11-58 = 1, the frequency reference value is saved when the acceleration/deceleration inhibition command is active and even when powering down the inverter.

Refer to Fig.4.3.18.

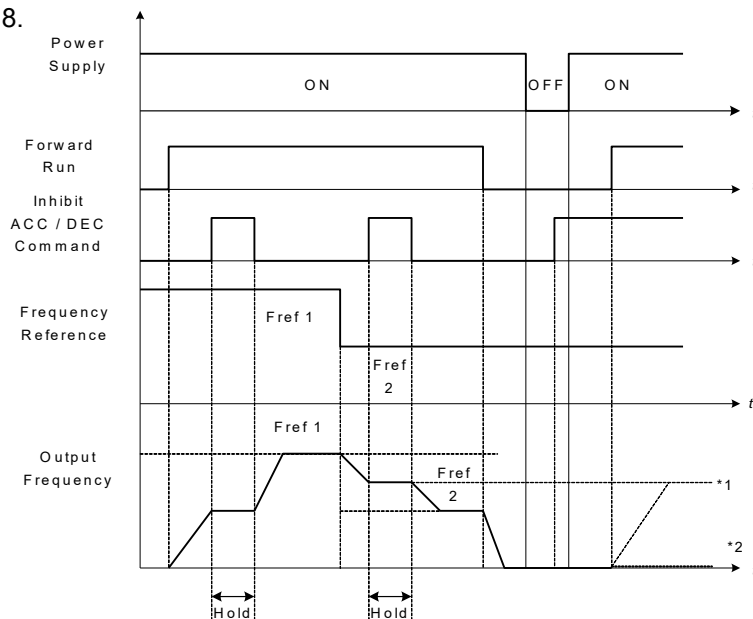


Figure 4.3.18 Acceleration / deceleration inhibition command operation

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

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

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

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

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

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

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

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

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

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

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

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

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

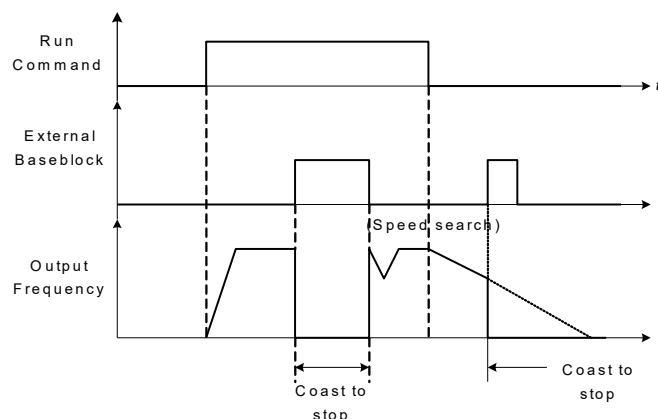


Figure 4.3.19 External base block operation

03-0X =16: PID control disable.

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

03-0X =17: Fault reset

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

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

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

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

03-0X =19: Speed Search 1 (from the maximum frequency).**03-0X =34:** Speed Search 2 (from the frequency command).

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

03-0X =20: Energy saving enabled

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

For the manual energy saving operation refer to Figure 4.3.78.

03-0X =21: PID integral reset**03-0X =25:** External fault

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

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

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

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

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

Input	Mode	Frequency Reference / Run/Stop Command Source
ON	Local	<ul style="list-style-type: none"> - 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	<ul style="list-style-type: none"> - Frequency reference source selected by parameter 00-05 and Run-Stop source selected by parameter 00-02. - LEDs SEQ and REF are on. - When PID is enabled, REF indicator ON presents PID target value is set by the control terminal AI1.

03-0X =28: Remote mode selection

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

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

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

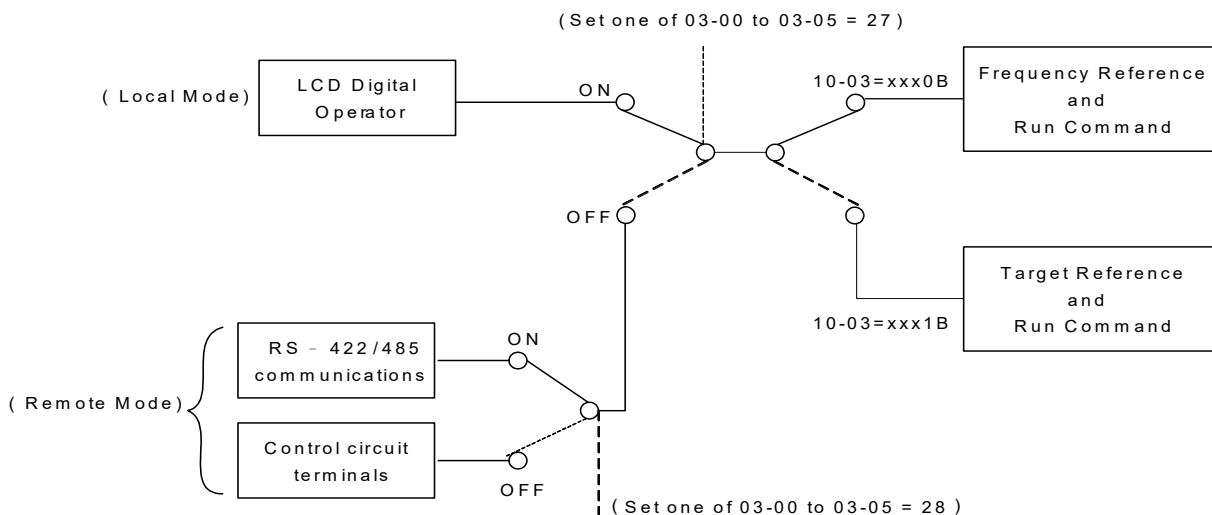


Figure 4.3.20 Remote mode operation selection

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

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

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

03-0X =24: PLC Input

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

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

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

03-0X =29: Jog Frequency Selection

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

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

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

03-0X =31: Inverter overheat warning

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

03-0X =33: DC braking

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

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

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

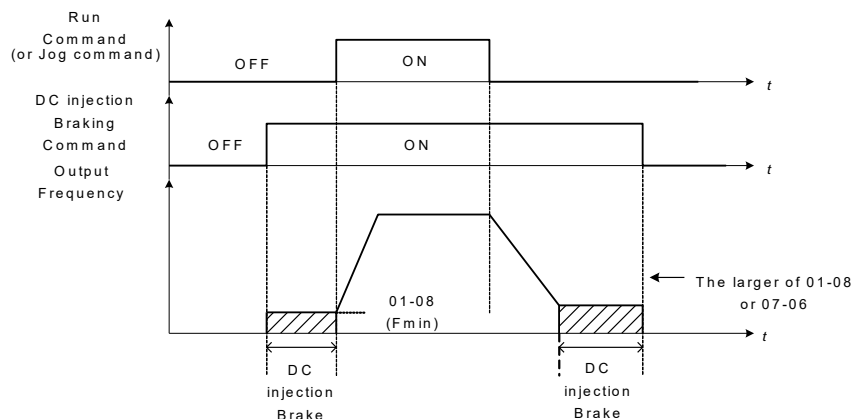


Figure 4.3.21 DC braking timing diagram

03-0X =35: Timing function

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

03-0X =36: PID Soft start disable

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

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

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

03-0X =48: KEB acceleration

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

03-0X =49: Parameters write-in allowed

When input is active allows parameter to be changed.

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

Input	Parameter Save
ON	Parameters Write Enabled
OFF	Parameters Write Protected

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

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

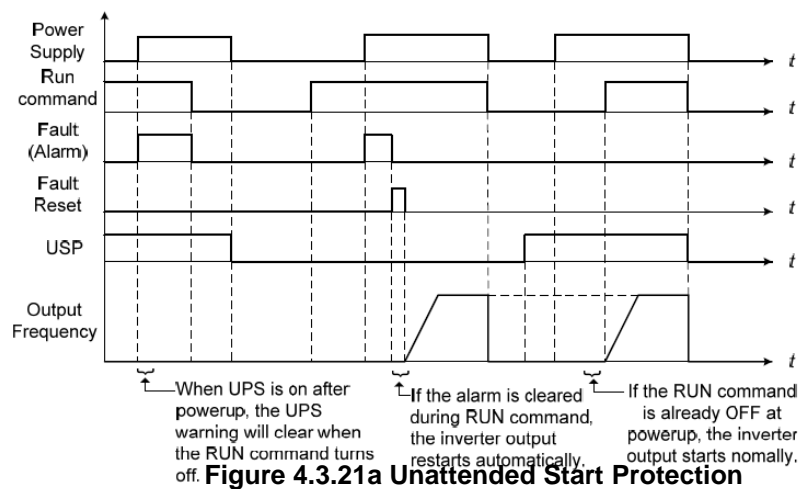


Figure 4.3.21a Unattended Start Protection

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

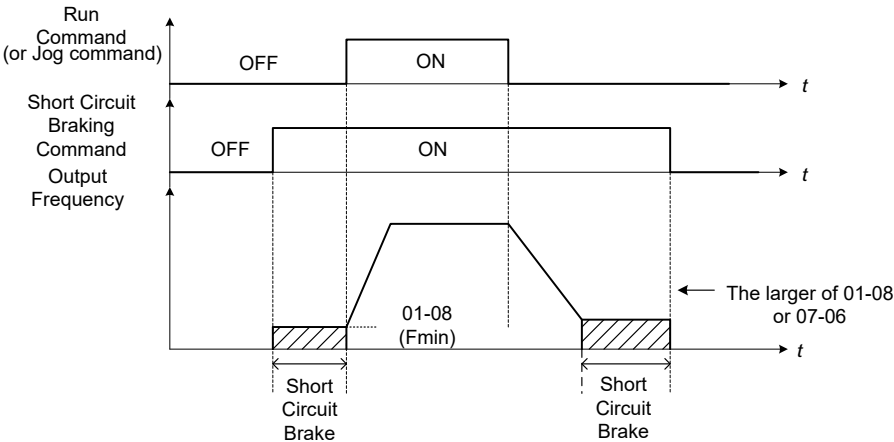
03-0X =63: Switch to Tolerance Range of Constant Pressure 2

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

03-0X =65: Short-circuit braking

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

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



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

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

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

03- 09	Multi-function Terminal S1-S4 Type Selection	
Range	【xxx0b】 : S1 A contact	【xxx1b】 : S1 B contact
	【xx0xb】 : S2 A contact	【xx1xb】 : S2 B contact
	【x0xb】 : S3 A contact	【x1xb】 : S3 B contact
	【0xxb】 : S4 A contact	【1xxb】 : S4 B contact

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

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

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

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

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

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



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

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

*1

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

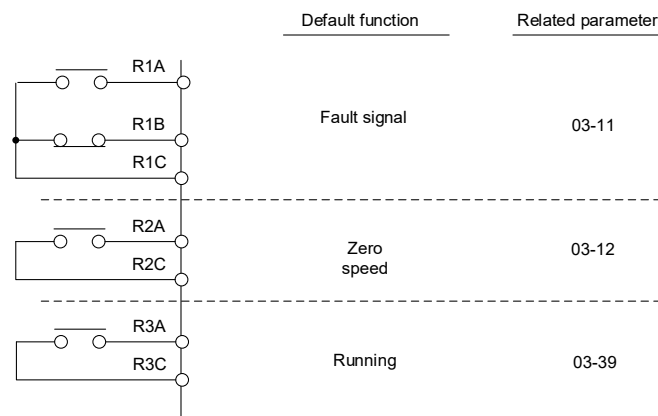


Figure 4.3.22 Multi-function digital output and related parameters

Table 4.3.6 Description of multi-function digital output

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

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

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

03-1X=0: During Running

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

03-1X=1: Fault contact output

Output is active during fault condition.

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

03-1X=2: Frequency Agree

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

03-1X=3: Setting Frequency Agree

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

03-1X=4: Frequency detected 1

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

03-1X=5: Frequency detected 2

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

Refer to parameter group 03 for frequency detection function.

03-1X=6: Automatic restart.

Output is active during an auto-restart operation.

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

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

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

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

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

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

03-1X=13: Current Agree

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

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

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

03-1X=19: PLC control contact

Output is controlled by the PLC logic

03-1X=20: Zero-speed

Output is active during zero-speed

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

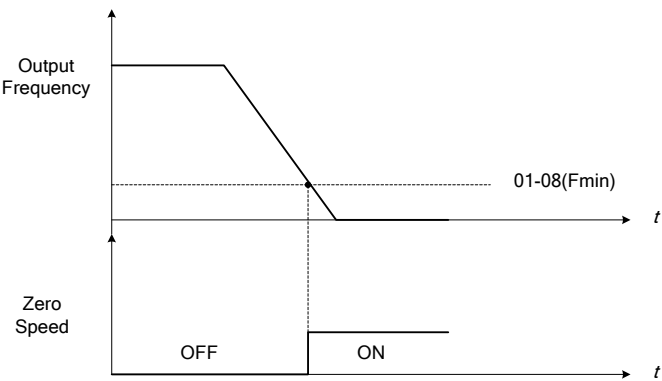


Figure 4.3.23 Zero-speed operation

03-1X=21: Inverter Ready

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

03-1X=22: Undervoltage Detection

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

03-1X=23: Source of operation command

Output is active in local operation command.

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

03-1X=24: Source of frequency command

Output is active in local frequency command.

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

03-1X=26: Frequency reference missing

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

03-1X=27: Time function output

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

03-1X=32: Communication control contacts

Output is active when communication control is active.

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

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

03-1X=38: Brake Release

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

03-1X=42: Over-High Pressure

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

03-1X=43: Over-Low Pressure

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

03-1X=44: Loss of Pressure Detection

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

03-1X=45: PID Sleep

PID sleep will be informed.

03-1X=46: Over-High Flow

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

03-1X=47: Over-Low Flow

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

03-1X=48: Shortage of Low Suction

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

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

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

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

Output terminal is closed when Turning on short-circuit braking

03-1X=57: Low Current Detection

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

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

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

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

Table 4.3.7 Frequency Detection Operation

Function	Detection operation of frequency confirmation	Description
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 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)
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).

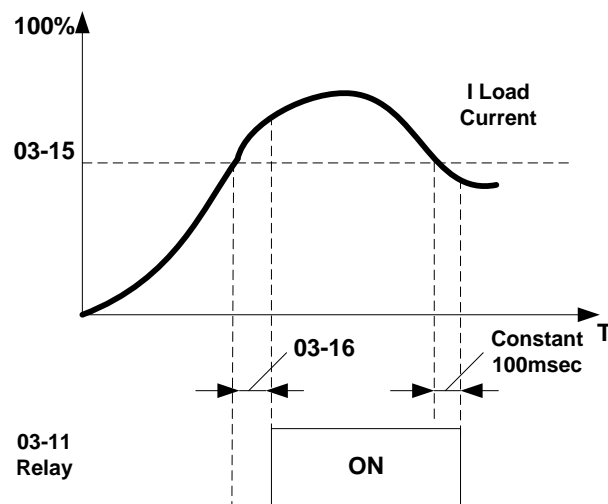
Function	Detection operation of frequency confirmation	Description
Output frequency detection 3		<ul style="list-style-type: none"> Output frequency detection 3 signal is ON in acceleration when the output frequency rises above the frequency detection level 2 (03-44) + frequency detection width 2 (03-45).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

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

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

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

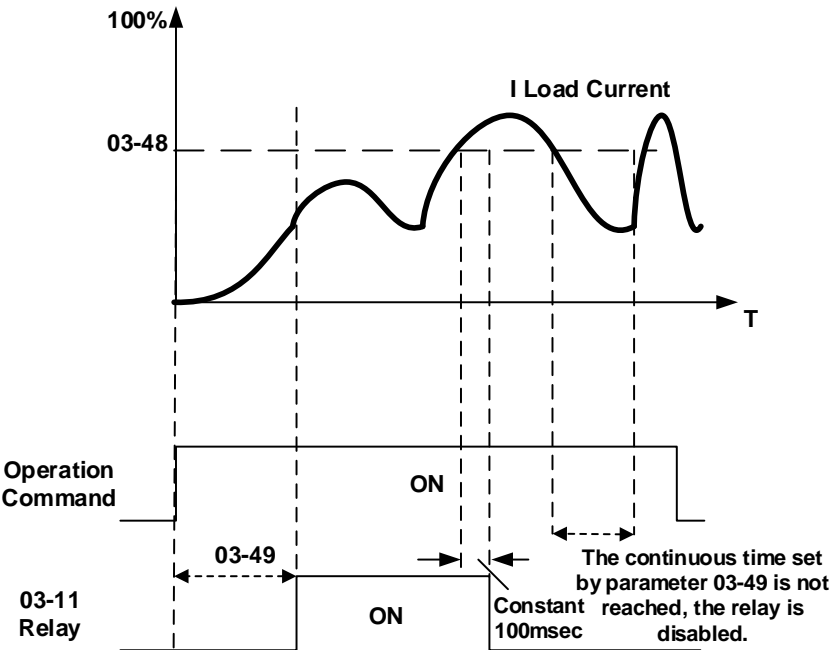
Timing Diagram:



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

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

Timing Diagram:

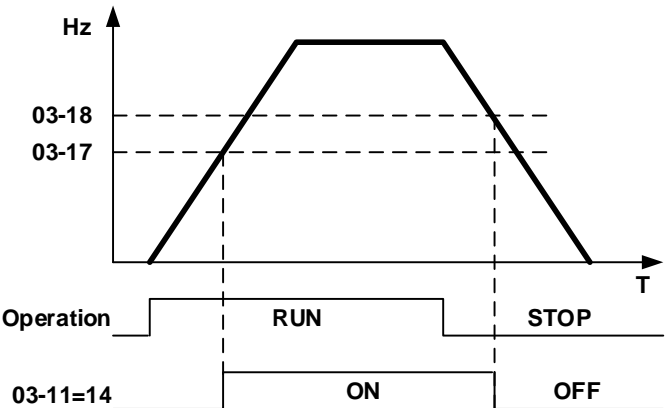


03-17	Setting of Mechanical Brake Release Level
Range	0.00~400.00 Hz
03-18	Setting of Mechanical Brake Operation Level
Range	0.00~400.00 Hz

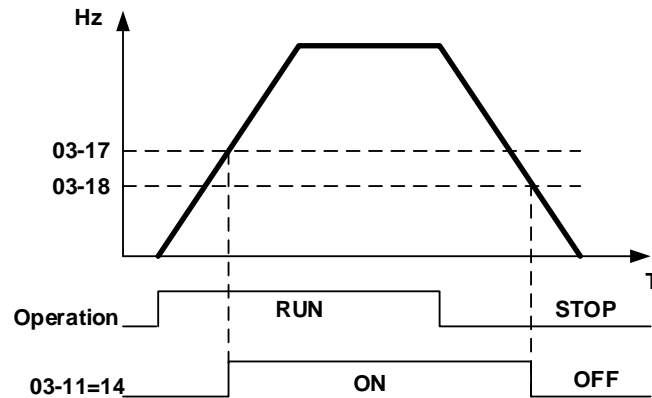
When 03-11=14,

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

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



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



03- 19	Relay (R1A-R3C) Type	
Range	【xxx0b】 : R1A normally open	【xxx1b】 : R1A normally close
	【xx0xb】 : R2A normally open	【xx1xb】 : R2A normally close
	【x0xxb】 : R3A normally open	【x1xxb】 : R3A normally close

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

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

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

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

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

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

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

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

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

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

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

There are two modes in pulse input selection:

03-30=0: Common Pulse Input

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

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

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

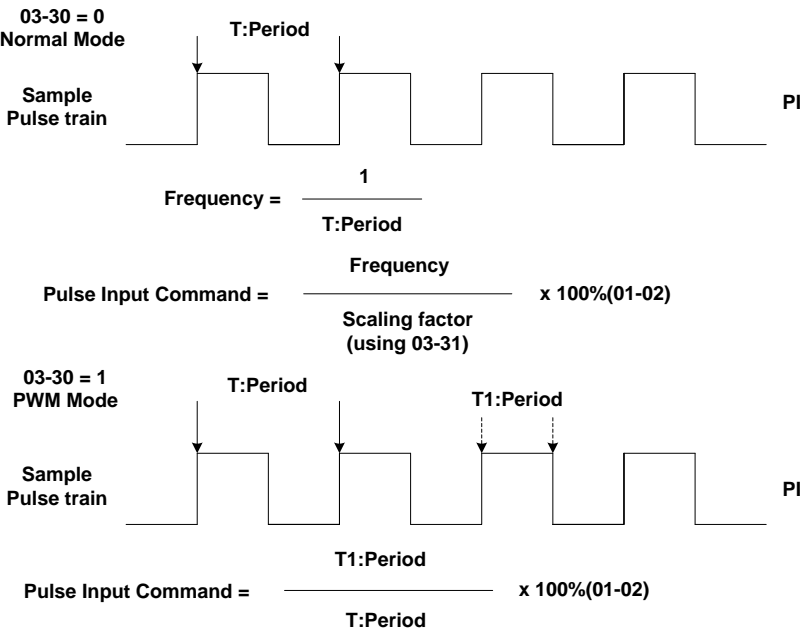
It is required to input the correct frequency.

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

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

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

Diagram of pulse input selection:



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

Pulse input scaling, 100% = Maximum pulse frequency.

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

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

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

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

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

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

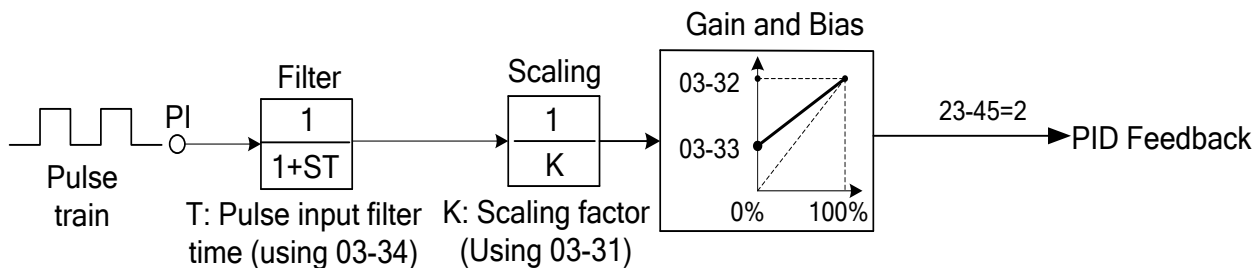


Figure 4.3.24 Pulse input adjustment

Set Pulse Input Setup as Flow Meters Input

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

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

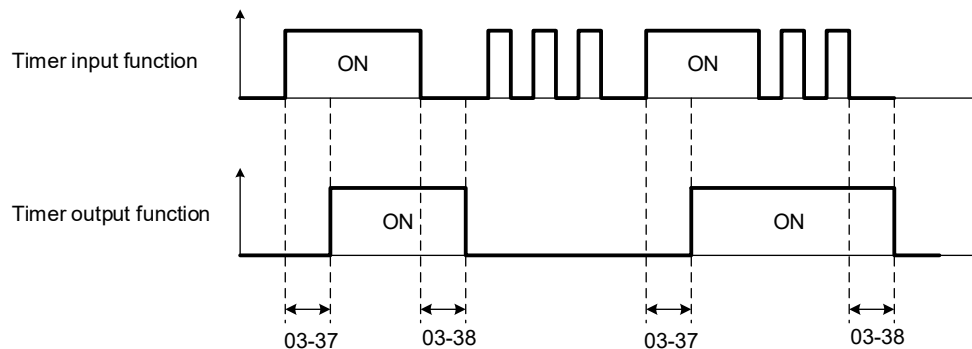
Enable the timer function by setting one of multi-function input parameters 03-00~03-05 (S1 to S6) to 35 (timer function input) and one of multi-function output parameters 03-11, 03-12, 03-39 (R1A-R1C to R3A- R3C) to 27 (timer function output).

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

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

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

Timing example:



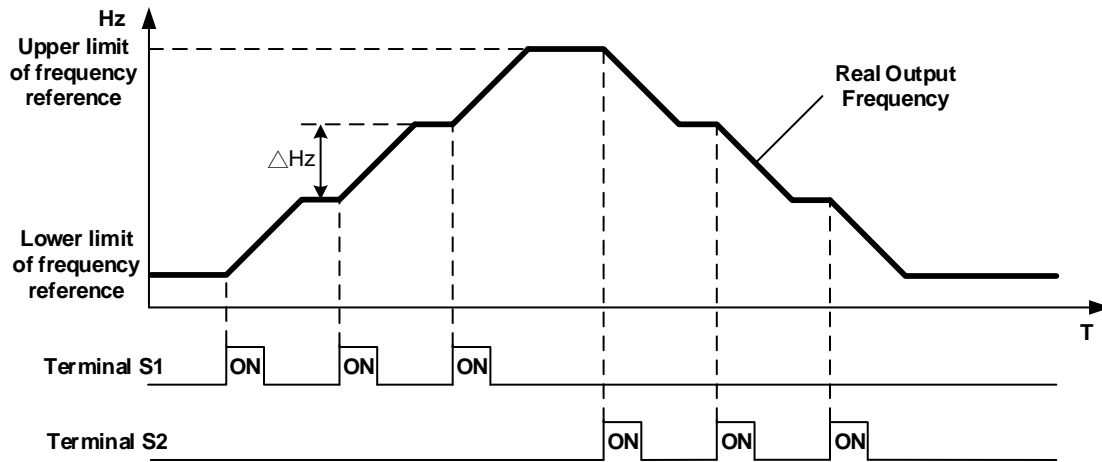
03- 40	Up/down Frequency Width Setting	*1
Range	【0.00~5.00】 Hz	

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

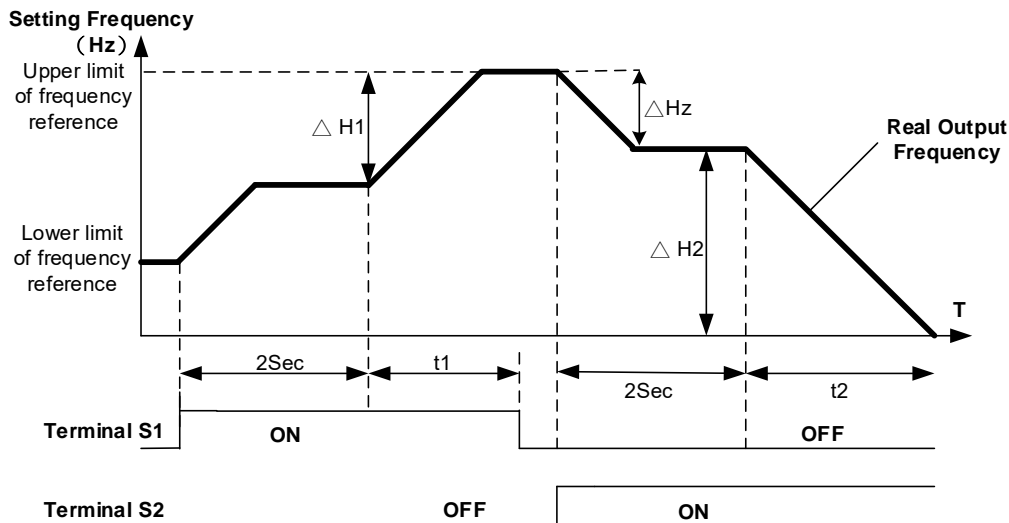
For example: Set terminal **S1: 03- 00= 【8】 (Up Frequency Increasing Command)**, **S2: 03- 01= 【9】 (DOWN Frequency Decreasing Command)** and **03- 40= 【Δ】 Hz**.

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

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



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



Notes:

$\Delta H1$: setting frequency increment in acceleration, $t1$: terminal conduction time in acceleration,

$\Delta H2$: setting frequency increment in deceleration, $t2$: terminal conduction time in deceleration.

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

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

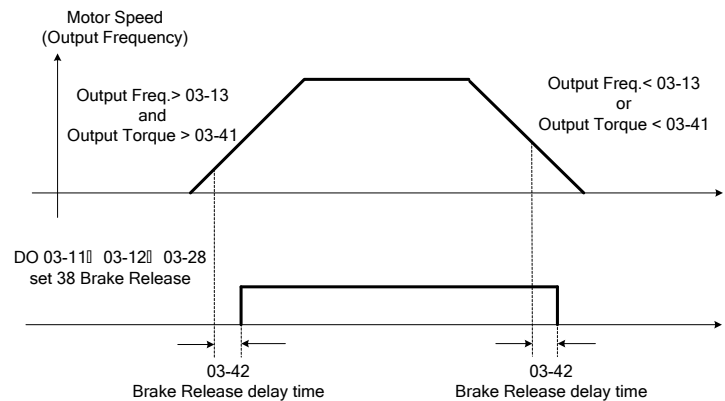
03- 41	Torque Detection Level	*1
Range	【0~150】 %	
03-42	Delay Time of Braking Action	*1
Range	【0.00~65.00】 Sec	

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

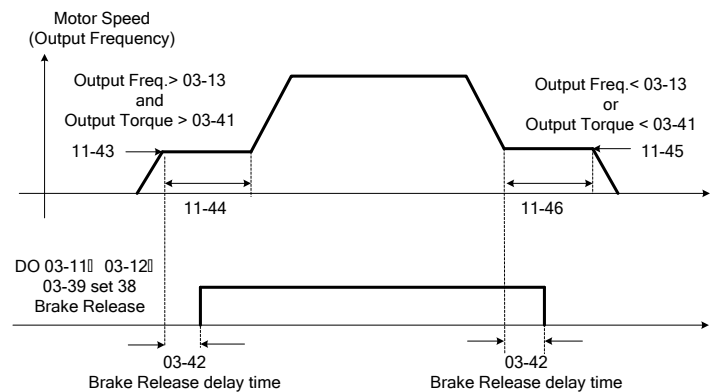
Function of Brake Release:

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

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



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



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

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

Group 04 External Analog Input and Output Parameters

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

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

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

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

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

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

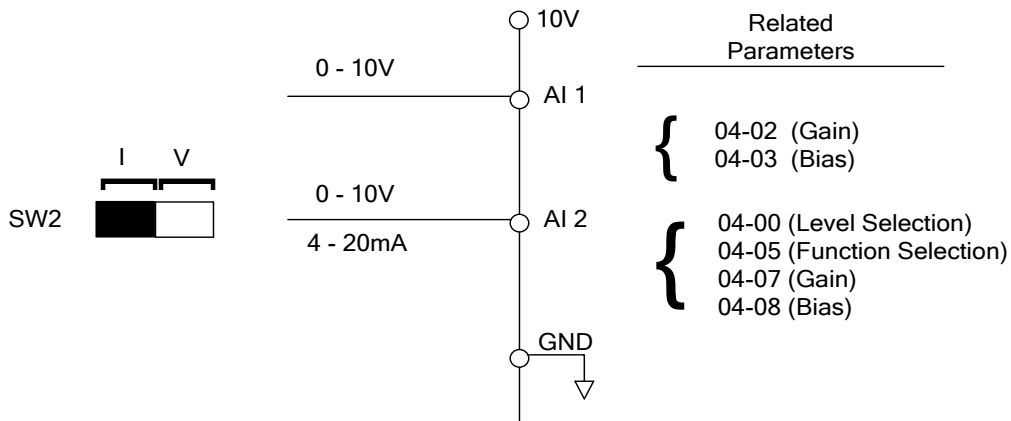


Figure 4.3.25 Analog inputs and related parameters

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

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

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

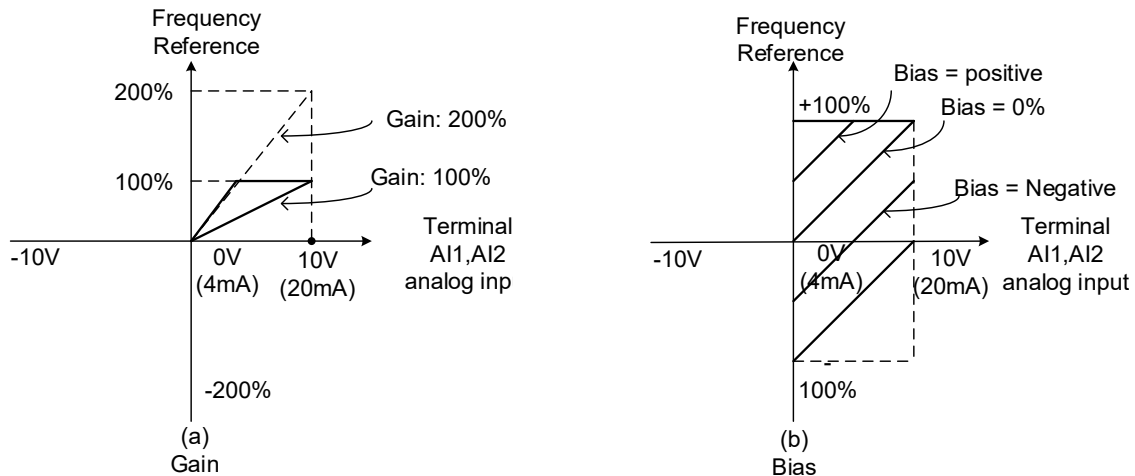


Figure 4.3.26 Gain and bias operations (for frequency reference signal)

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

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

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

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

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

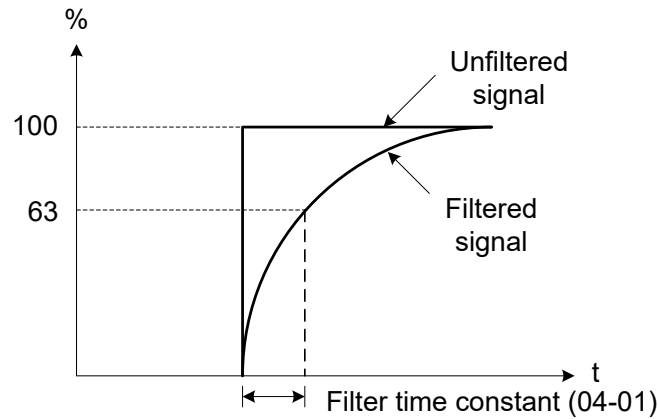


Figure 4.3.27 Filter time constant

(4) AI2 function setting (04-05)

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

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

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

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

04-05=0: Auxiliary frequency

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

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

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

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

The maximum frequency reference for AI1 is 100%.

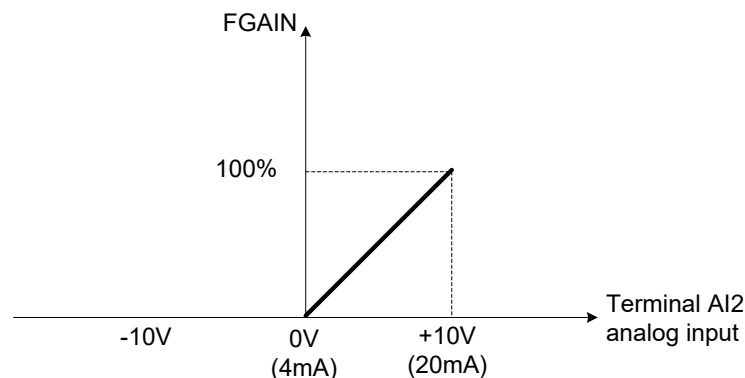


Figure 4.3.28 Frequency gain adjustment

Example:

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

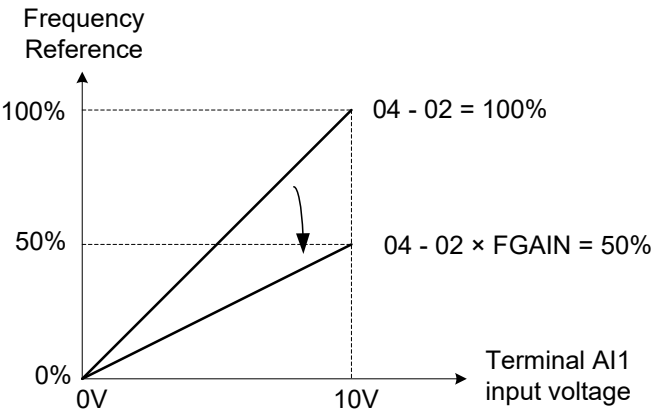


Figure 4.3.29 Frequency reference gain adjustment (example)

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

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

The total frequency reference bias of terminal AI1 is the sum of internal bias set by parameter 04-03 and FBIAS.

The maximum frequency reference for AI1 is 100%.

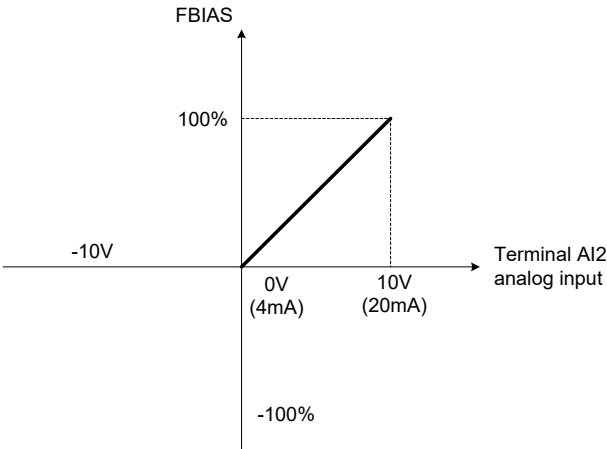


Figure 4.3.30 Bias adjustment

Example:

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

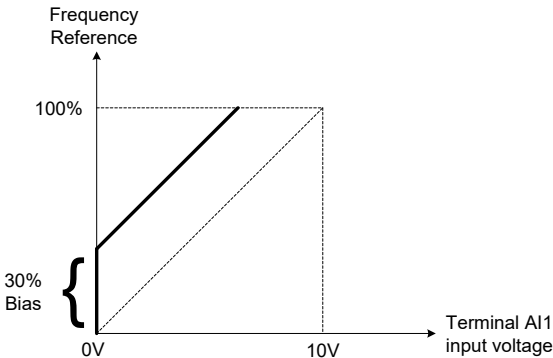


Figure 4.3.31 Frequency Reference bias adjustment (example)

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

Multi-function analog input AI2 can be used to adjust the output voltage. The total output voltage of inverter is the sum of output voltage based on the selected V/F curve (01-00=F) and VBIAS.
The maximum output voltage will be limited by 01-03, $V_{max} = 100\%$

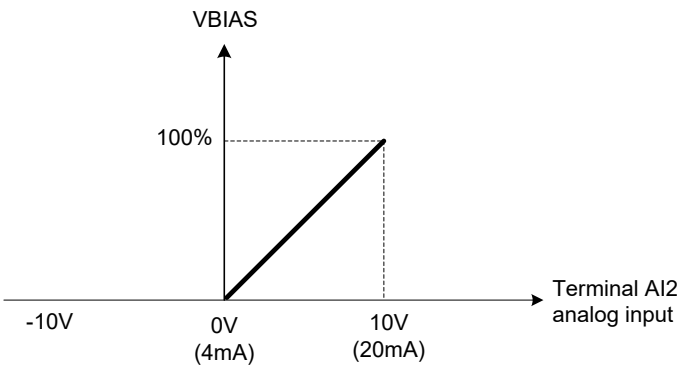


Figure 4.3.32 Bias adjustment

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

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

Acceleration / Deceleration time (00-14 ~ 00-17, 00-21~ 00-24)

Actual accel /decel time = $\frac{\hspace{10em}}{K}$

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

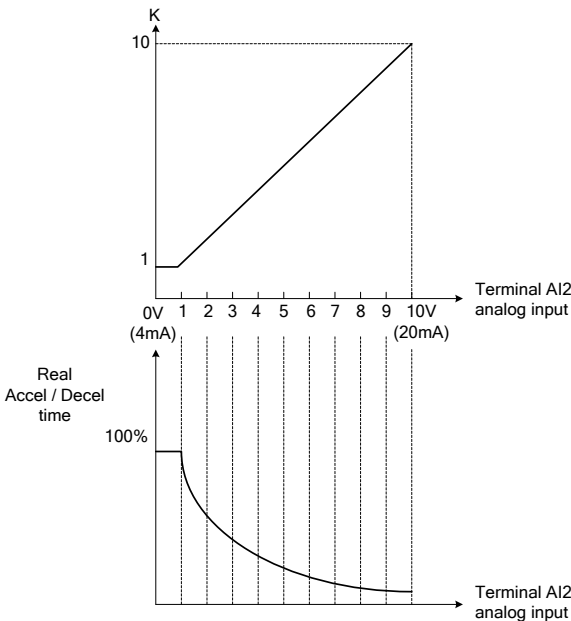


Figure 4.3.33 Acceleration / deceleration time reduction coefficient

04-05=5: DC braking current

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

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

The inverter rated current = 100%

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

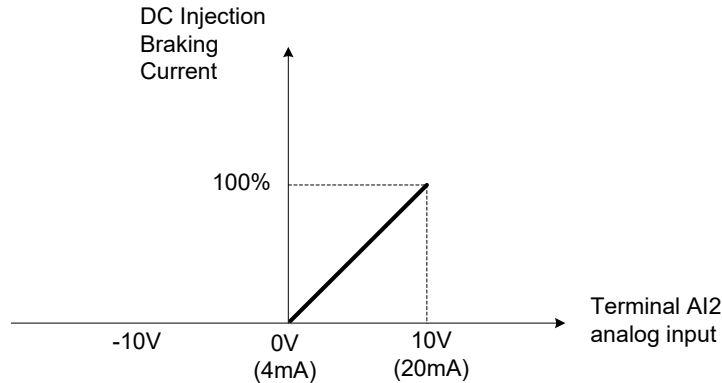


Figure 4.3.34 DC braking current adjustment

04-05=6: Over-torque detection level

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

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

100% motor rated torque (SLV control mode)

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

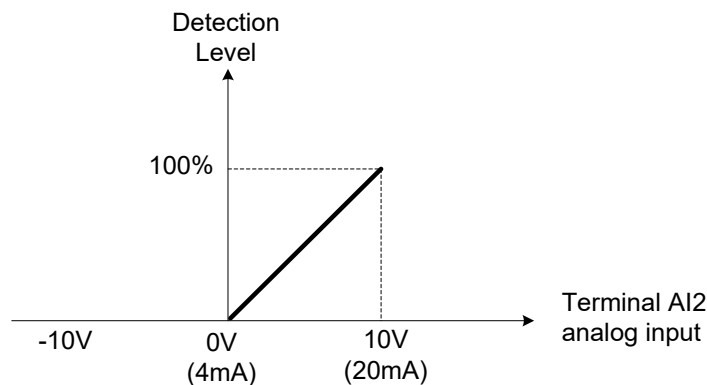


Figure 4.3.35 Over-torque/less torque detection level adjustment

4-05=7: Stall prevention level during running

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

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

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

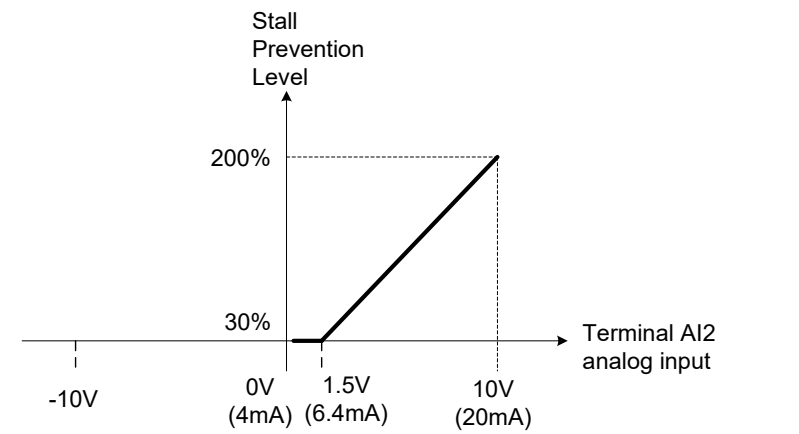


Figure 4.3.36 Stall prevention level adjustment during operation

04-05=8: Frequency lower limit

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

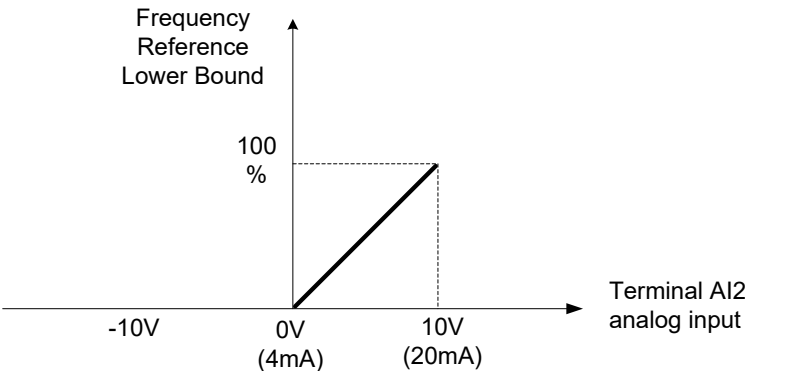


Figure 4.3.37 Adjustment of lower limit of frequency reference

04-05=9: Jump frequency 4

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

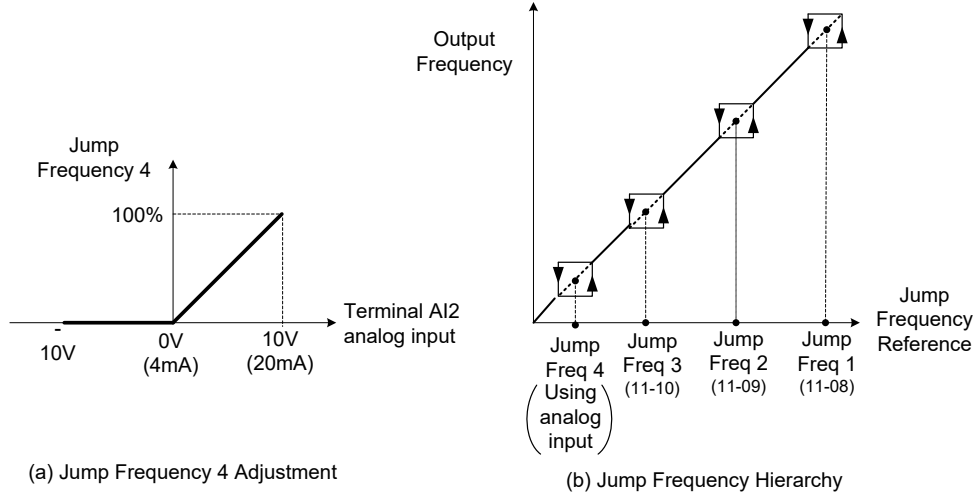


Figure 4.3.38 Jump frequency 4 setting operation

04-05=10: Added to AI1

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

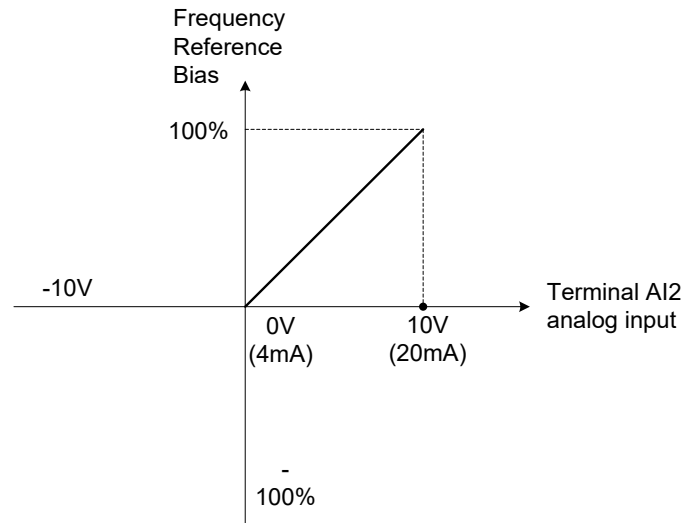


Figure 4.3.39 Added to AI1 as a bias operation

Example:

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

04-05=11: Positive torque limit

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

04-05=12: Negative torque limit

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

04-05=13: Regenerative torque limit

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

04-05=14: Positive / negative torque limits

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

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

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

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

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

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

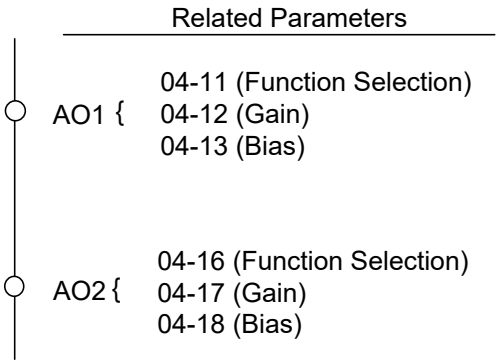


Figure 4.3.40 Analog outputs and related parameters

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).

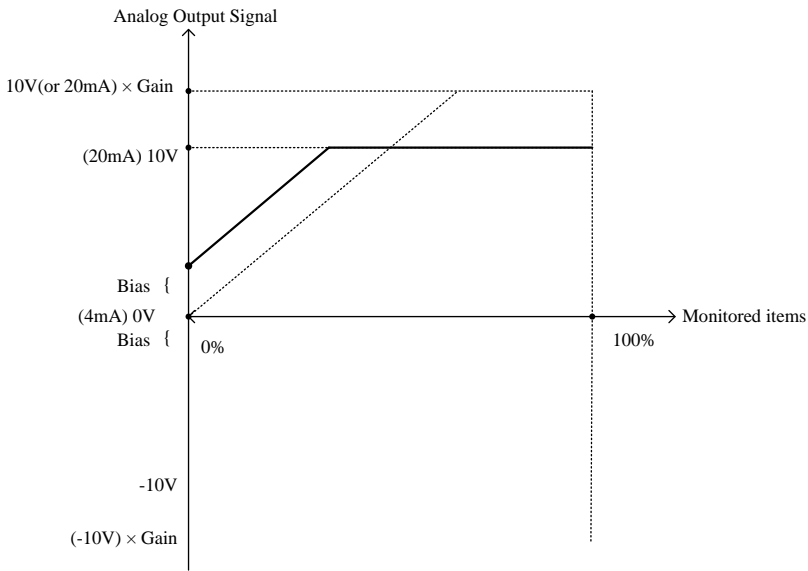


Figure 4.3.41 Analog output level adjustment

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 V1.4.

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

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

Group 05 Multi-Speed Parameters
--

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

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

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

Acceleration time calculation formula

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

Deceleration time calculation formula

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

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

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

Acceleration time calculation formula

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

Deceleration time calculation formula

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

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

00-02=1 (External Terminal Operation)

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

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

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

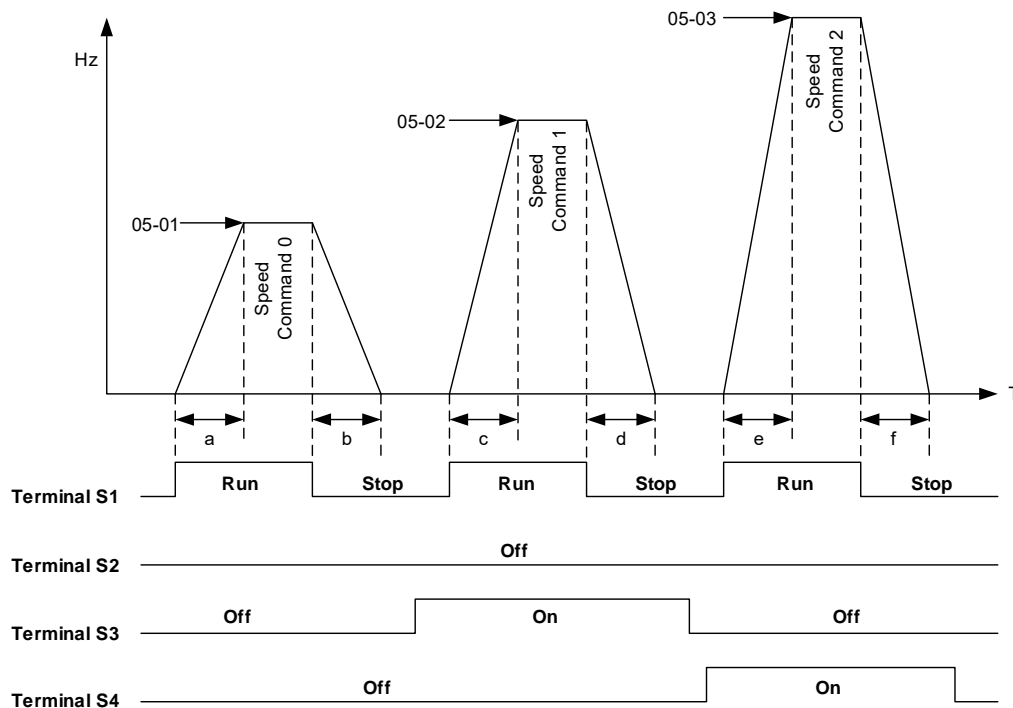
03-03=3 (Terminal S4: Speed 2)

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

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

Acceleration / Deceleration Calculation Mode 1:

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

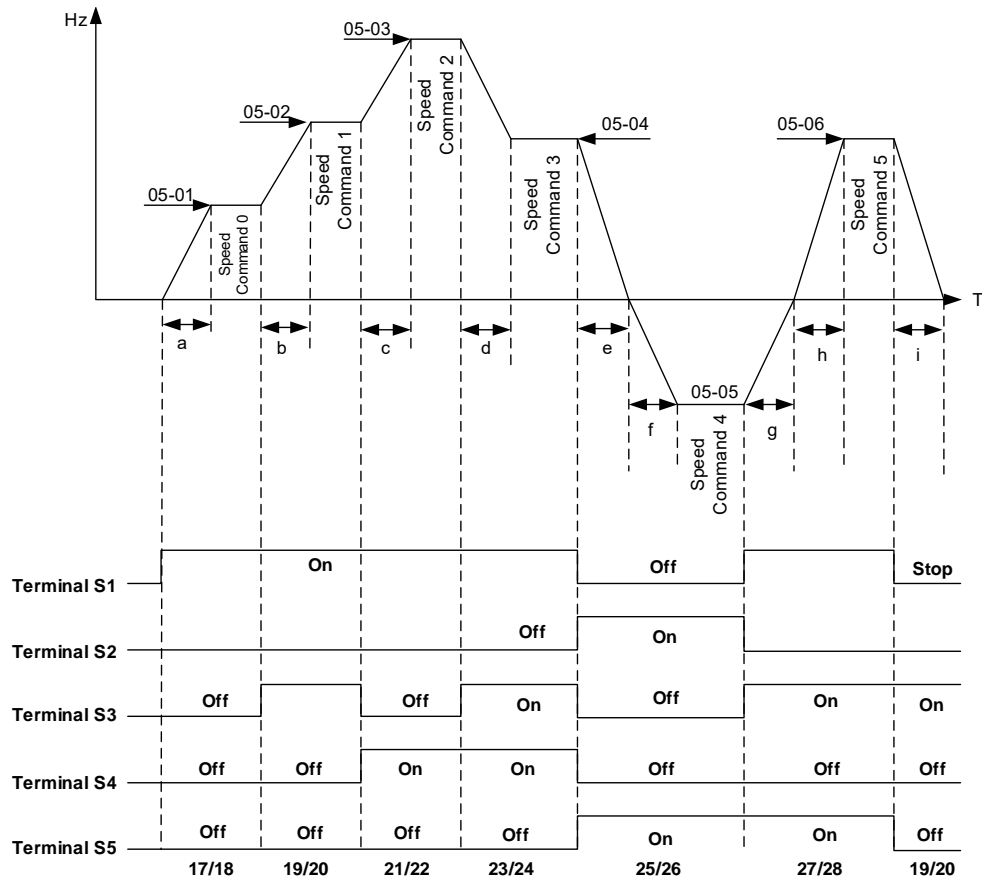


$$a = \frac{(05-17) \times (05-01)}{(01-02)} \quad b = \frac{(05-18) \times (05-01)}{(01-02)} \quad c = \frac{(05-19) \times (05-02)}{(01-02)} \quad \text{in sec.}$$

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

Acceleration / Deceleration Calculation Mode 2:

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



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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

05-19	Acceleration time setting for multi speed 1
Range	【0.1~6000.0】 Sec

05-20	Deceleration time setting for multi speed 1
Range	【0.1~6000.0】 Sec

05-21	Acceleration time setting for multi speed 2
Range	【0.1~6000.0】 Sec

05-22	Deceleration time setting for multi speed 2
Range	【0.1~6000.0】 Sec

05-23	Acceleration time setting for multi speed 3
Range	【0.1~6000.0】 Sec

05-24	Deceleration time setting for multi speed 3
Range	【0.1~6000.0】 Sec

05-25	Acceleration time setting for multi speed 4
Range	【0.1~6000.0】 Sec

05-26	Deceleration time setting for multi speed 4
Range	【0.1~6000.0】 Sec

05-27	Acceleration time setting for multi speed 5
Range	【0.1~6000.0】 Sec

05-28	Deceleration time setting for multi speed 5
Range	【0.1~6000.0】 Sec

05-29	Acceleration time setting for multi speed 6
Range	【0.1~6000.0】 Sec

05-30	Deceleration time setting for multi speed 6
Range	【0.1~6000.0】 Sec

05-31	Acceleration time setting for multi speed 7
Range	【0.1~6000.0】 Sec

05-32	Deceleration time setting for multi speed 7
Range	【0.1~6000.0】 Sec

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

Group 06 Automatic Program Operation Parameters

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

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

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

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

Notes:

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

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

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

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

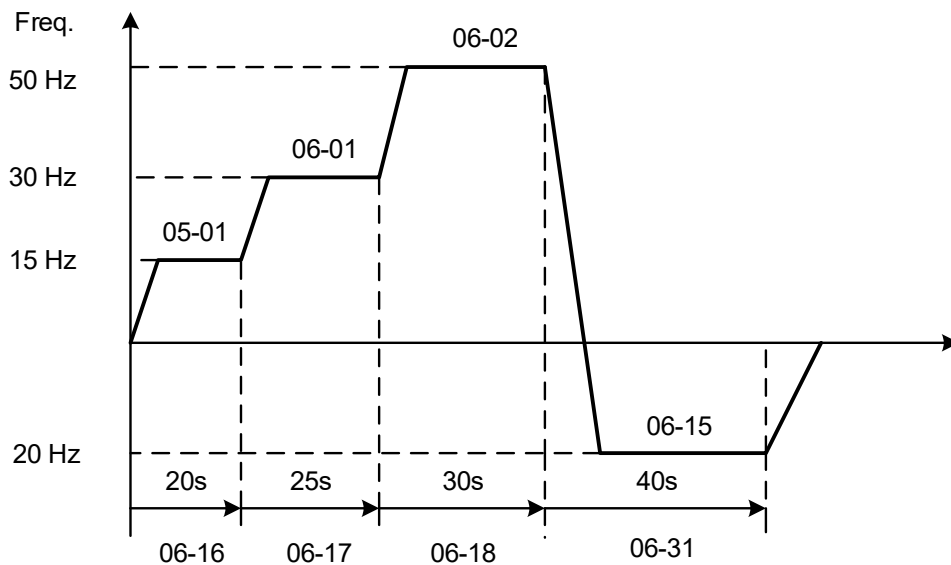
Automatic operation direction settings	
06-32	Direction Selection of Operation -Stage 0
06-33	Direction Selection of Operation -Stage 1
06-34	Direction Selection of Operation -Stage 2
06-35	Direction Selection of Operation -Stage 3
06-36	Direction Selection of Operation -Stage 4
06-37	Direction Selection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

Example 1: Automatic operation mode – Single cycle

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

Parameter Settings:

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

**Figure 4.3.42 Single cycle automatic operation (stop)****Example 2:** Automatic operation mode – Continuous cycle

In this example the inverter repeats the same cycle.

Parameter Settings:

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

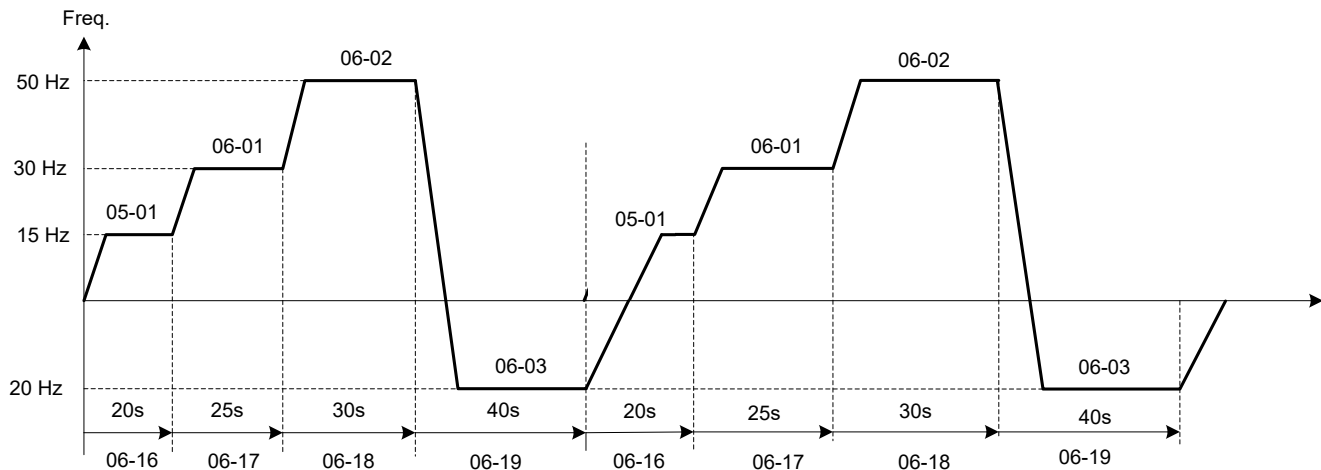


Figure 4.3.43 Periodic automatic operation

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

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

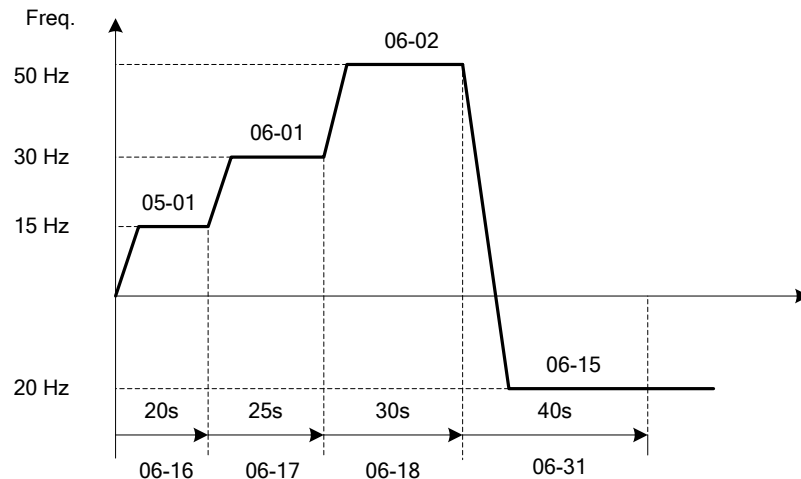


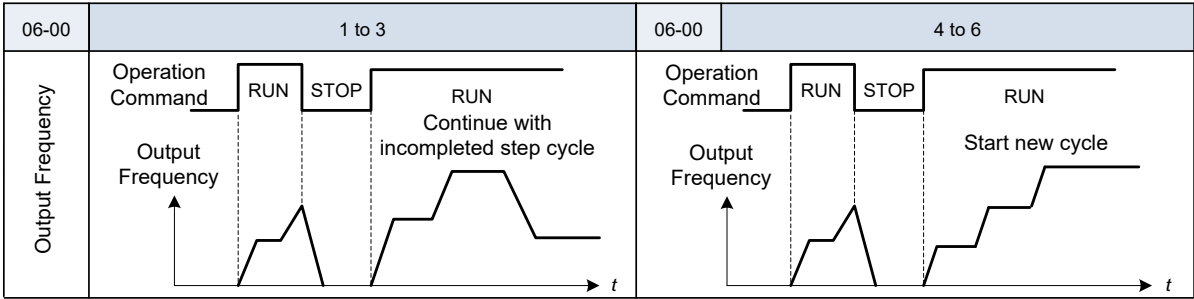
Figure 4.3.44 Single cycle automatic operation (continuous)

06-00= 1 to 3:

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

06-00= 4 to 6:

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



Notes:

- Acceleration/ deceleration time is set with parameters 00-14 and 00-15 in automatic operation mode.
- Automatic operation mode is disabled when parameter 06-16 ~ 06-31 are set to 0.

Group 07: Start /Stop Parameters

07- 00	Momentary Power Loss/Fault Restart Selection
Range	【0】 : Disable 【1】 : Enable

07-00=0: Inverter trips on “UV” fault if power is lost for more than 8ms.

07-00=1: Inverter restarts after power to the inverter is restored.

Note: When 07-00=1, inverter restore automatically the motor rotation after restarting the power even if momentary power loss occurs.

07- 01	Fault Auto-Restart Time
Range	【0~7200】 Sec

07-01 = 0 sec.: Automatic restart time interval is set by minimum baseblock time (07-18).

07-01 < 07-18: Automatic restart time interval is set by minimum baseblock time (07-18).

07-01 > 07-18: Automatic restart time interval is set by fault reset time (07-01).

Note:

Automatic restart time interval is time specified in 07-18 plus 07-01 and speed search delay time (07-22).

Refer to Fig.4.3.45 for setting automatic restart interval.

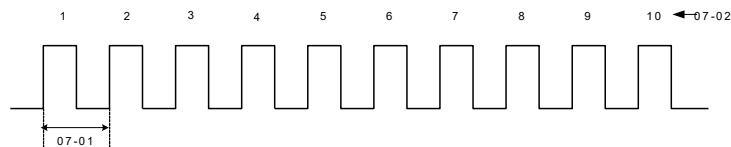


Figure 4.3.45 Automatic restart operation

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

When the total number of restart attempts has exceeded the number of automatic restart attempts set in parameter 07-02, the inverter will turn off the output and the fault contact is activated. Manually resetting the inverter is required at this time.

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

1. No fault occurs in 10 minutes or longer after the automatic restart
2. Reset command to clear fault via input terminal or using the keypad (press reset/◀ key)
3. Power to the inverter is turned off and back on again

Note:

Multi-function digital output R1A-R1C, R2A-R2C, R3A-R3C can be programmed to activate during an automatic reset attempt, refer to parameter 03-11, 03-12 and 03-39.

Automatic restart operation:

Inverter trips and inverter output is turned off, keypad shows the active fault. Next inverter waits for the minimum baseblock time parameter 07-18 to expire before accepting an automatic restart command.

After the minimum baseblock time (07-18) and speed search delay time have expired, the active fault is reset and a speed search operation is performed. The time between each fault restart attempt is set by parameter 07-01.

When the total number of restart attempts has 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. Manually resetting the inverter is required at this time.

Please refer to Figure 4.3.46 for the automatic restart operation.

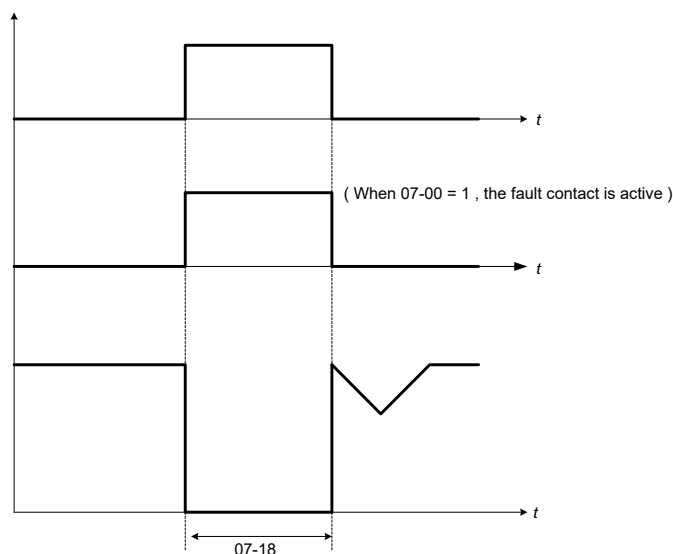


Figure 4.3.46 Auto-restart operation

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

Parameter Name	Faults		Numbers of Restart
07-00	UV (under voltage)		Unlimited
07-01	OC (over current) OCA (over current in ACC.) OCC (over current in constant speed) 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 performs a momentary power loss restart and auto reset restart.
2. Refer to chapter 10 for the details for troubleshooting and fault diagnostics of the inverter.
3. Refer to speed search function (07-19~07-24) for the selection of speed search modes.

Note: If this mode is required for the application all safety measures must be taken to ensure safe operation, including adding and posting warning labels.

Warning - Excessively use of the automatic restart function will damage the inverter.

07- 04	Automatic start at power up
Range	【0】 : Automatic start at power up when external run command is enabled 【1】 : Without automatic start at power up when external run command is enabled

When direct run on power up is enabled (07-04=0) and the inverter is set to accept an external run command (00-02/00-03=1), the inverter will automatically start when power is applied and the run switch is ON.

It is recommend turning off the run switch when power to the inverter is turned off to avoid possibility of injury to operators and damage to machines when power is applied to the inverter.

Note: If this mode is required for the application all safety measures must be taken to ensure safe operation, including adding and posting warning labels.

When direct run is disabled (07-04 =1) and the inverter is set to accept an external run command (00-02/00-03=1), the inverter will not start when power is applied. In this condition the display will flash with STP1. To start the inverter turn the run switch to OFF and back ON again.

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

When 07-04=0 the inverter will wait for the time specified in 07-05 to start after power is applied.

Note: If this mode is required for the application all safety measures must be taken to ensure safe operation, including warning labels.

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

DC Injection braking functionality depends on the selected control mode (00-00), please refer to the description below for each control mode.

V/f or SLV Control mode (00-00 = 0, 2):

DC Injection Brake Start Frequency parameter (07-06) is the level the output frequency has to reach before DC braking injection function is de-activated at start and activated at stop.

DC Injection Brake Level (07-07) is set as percentage of the inverter rated current. Increasing this level will increase the amount of heat generated by the motor windings. Do not set this parameter higher than the level necessary to hold the motor shaft.

DC Injection Brake Time at Start (07-16) specifies the time DC injection braking time is active at start. DC injection braking at stop is disabled when parameter 07-08 is set to 0 sec.

DC Injection Brake Time at Stop (07-08) specifies the time DC injection braking is active during a stop operation. DC injection braking at stop is disabled when parameter 07-08 is set to 0 sec.

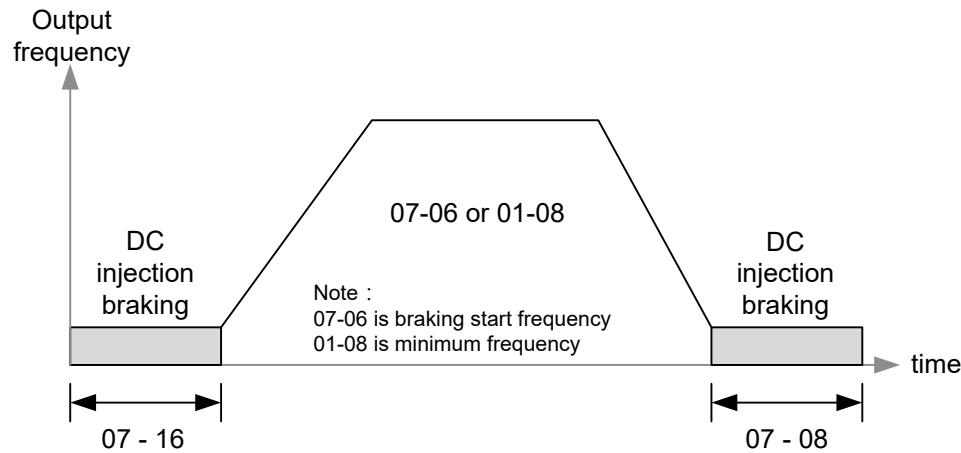


Figure 4.3.47a VF and SLV DC injection braking

Note: When 07-06 < 01-08, DC injection braking starting frequency becomes frequency set in parameter 01-08.

PMSLV Control Mode (00-00=5):

In this control mode short-circuit braking is used.

Short Circuit Braking Start Frequency parameter (07-06) is the level the output frequency has to reach before Short Circuit Braking function is de-activated at start. The same level is used to activate Short Circuit Braking when the output frequency falls below this level.

DC Injection Brake Level (07-07) is set as percentage of the inverter rated current. Increasing this level will increase the amount of heat generated by the motor windings. Do not set this parameter higher than the level necessary to hold the motor shaft.

Start Short-circuit Braking Time (07-34) specifies the time short-circuit braking is active at start. Short Circuit Braking at stop is disabled when parameter 07-34 is set to 0 sec.

Stop Short-circuit Braking Time (07-35) specifies the time short-circuit braking is active during a stop operation. Start Short-circuit Braking Time at stop is disabled when parameter 07-35 is set to 0 sec.

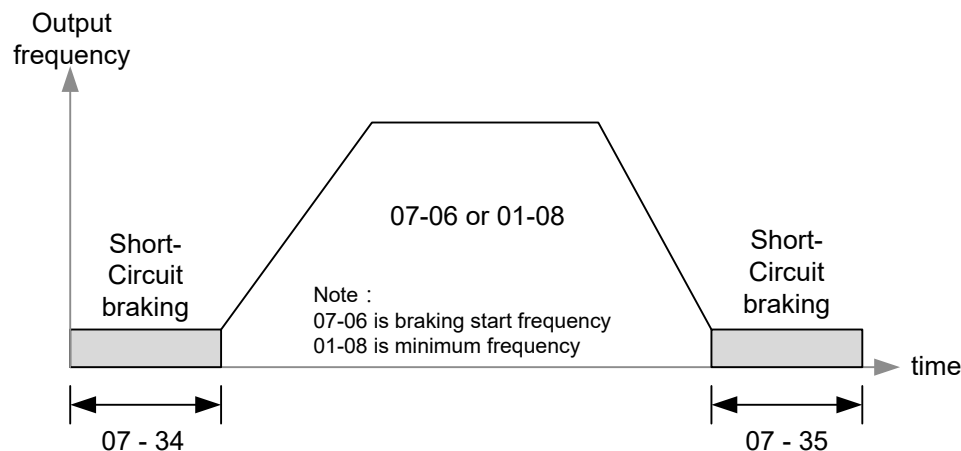


Figure 4.3.47b PMSLV short-circuit braking

Note: When 07-06 < 01-08, DC injection braking starting frequency becomes frequency set in parameter 01-08.

07- 07	DC Injection Braking Current
Range	【0~100】 %

DC Injection braking current as percentage of the inverter rated current. Increasing this level will increase the amount of heat generated by the motor windings. Do not set this parameter higher than the level necessary to hold the motor shaft.

07- 08	DC Injection Braking Time at Stop
Range	【0.00~10.00】 Sec

Duration of DC injection braking is during a stop operation. DC injection braking at stop is disabled when parameter 07-08 is set to 0 sec.

07- 16	DC Injection Braking Time at Start
Range	【0.00~100.00】 Sec

Duration of DC injection braking is during a start operation. DC injection braking at start is disabled when parameter 07-16 is set to 0 sec.

DC Injection Braking Operation

When DC Injection braking is active DC voltage is applied to the motor, increasing the braking current and resulting in an increase in the strength of the magnetic field trying to lock the motor shaft.

To enable DC injection braking during a start operation set the DC injection braking current (07-07) and the DC injection braking time (07-16) at start to a value greater than 0. DC injection braking at start can be used to prevent “wind milling effect” in fan applications.

To enable DC injection braking during a stop operation set the DC injection braking current (07-07) and the DC injection braking time at stop (07-08) to a value greater than 0.

Notes:

- When parameter 07-16 is set to 0 sec (DC injection braking off). the inverter will start from the minimum output frequency.
- Increasing the DC braking time (07-08, 07-16) can reduce the motor stop time.
- Increasing the DC braking current (07-07) can reduce the motor stop time.
- During stop operation: If the DC braking start frequency < minimum output frequency (01-08), DC braking is activated when the output frequency reaches the minimum output frequency level.

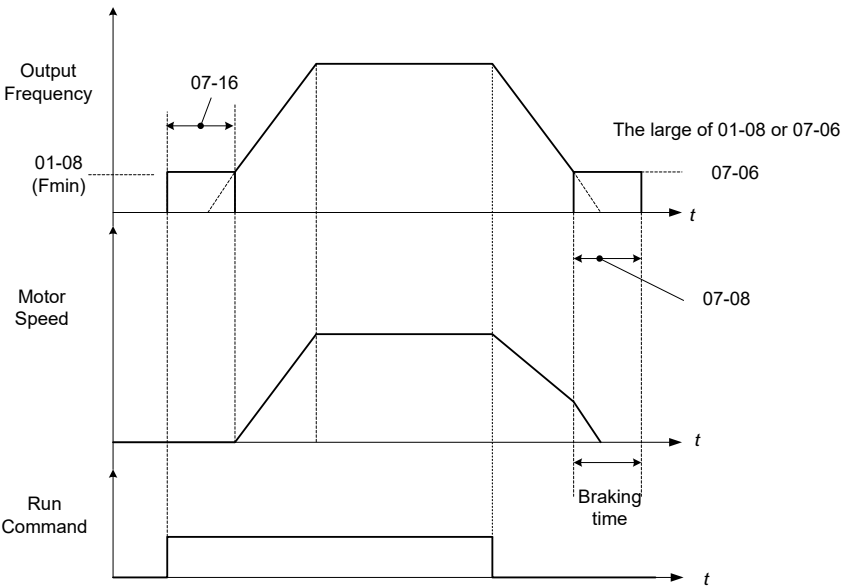


Figure 4.3.47c DC braking operation

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

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

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

Short-circuit braking is available only in PMSLV control mode (00-00 = 5) and functions switching the IGBTs to producing braking torque. Use parameters 07-06, 07-34 and 07-36 to adjust braking settings. The value of 07-36 is set as a percentage of the inverter rated current.

When 07-35 is set to 0 short-circuit braking during stop is disabled.

Short-circuit Braking can be controlled via any one of the multi-function input terminals (03-00 to 05) set to function 65.

07- 09	Stop Mode Selection
Range	【0】 : Deceleration to Stop 【1】 : Coast to Stop 【2】 : DC Braking Stop 【3】 : Coast to Stop with Timer

When a stop command is issued the inverter stops according to the stop mode selected. There are four types of stop modes,

Note: When using the permanent magnet motor, only the option of deceleration to stop mode is available.

07-09=0: Deceleration to stop

When a stop command is issued, the motor will decelerate to the minimum output frequency (01-08) F_{min} and then stop. Deceleration rate depends on the deceleration time (factory default: 00-15).

When the output frequency reaches the DC braking stop frequency (07-06) or the minimum output frequency (01-08), DC injection braking is activated and the motor stops.

$$\text{Deceleration time} = \frac{\text{Output frequency when stop command is issued}}{\text{Maximum output frequency } F_{max} \text{ (01-02)}} \times \text{deceleration time setting}$$

Note: S curve setting will add to the overall stop time

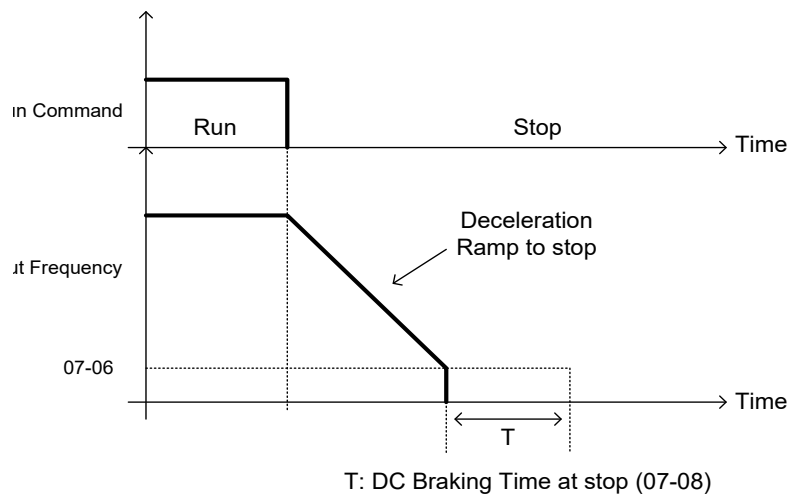


Figure 4.3.48 Deceleration to stop

07-09=1: Coast to stop

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

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

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

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

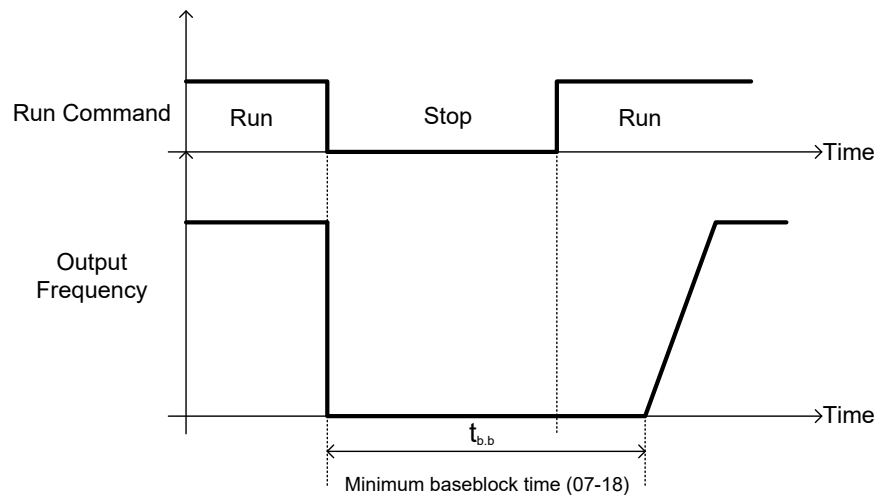


Figure 4.3.49 Coast to stop

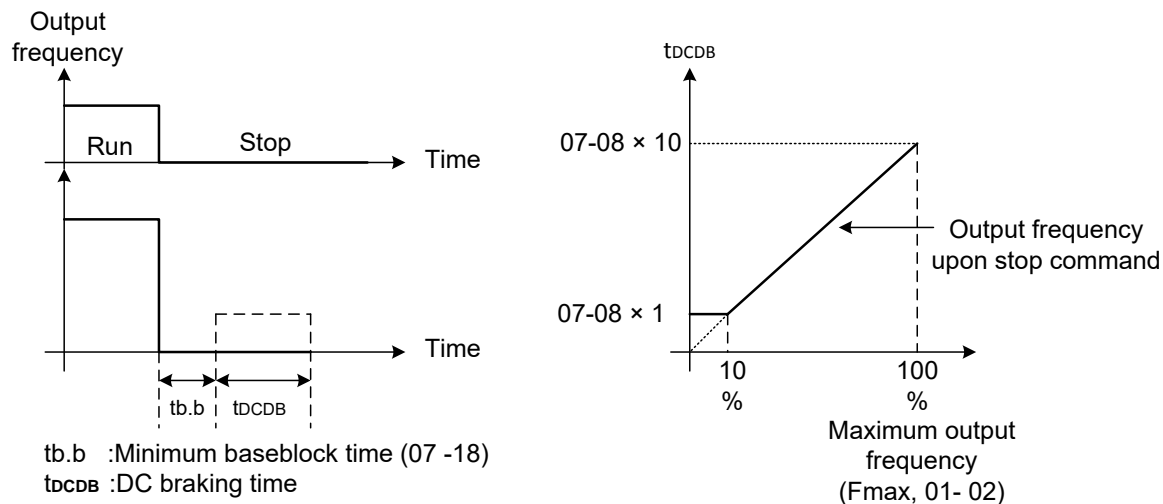
07-09=2: DC braking to stop

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

The DC braking time (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.



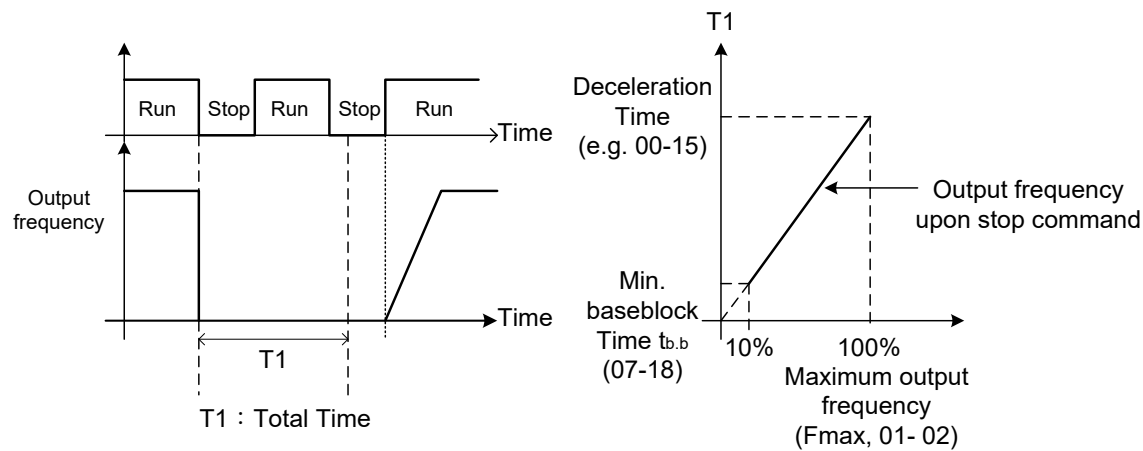
4.3.50 DC braking to stop

Figure

07-09=3: Coast to stop with timer

When a stop command is issued the motor will coast to a stop after the minimum Baseblock time (07-18) has expired. The inverter ignores the run command until the total time of the timer has expired.

The total time of the timer is determined by the deceleration time (00-15, 17, 22 or 24) and the output frequency upon stop. Refer to Fig.4.3.51



Figure

4.3.51 Coast to stop with timer

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

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

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

Set preventive measures:

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

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

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

07-14: Pre-excitation time

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

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

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

07-15: Pre-excitation initial level

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

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

If 07-15 is set greater than 100%, providing a high excitation current during the pre-excitation time (07-14), motor's magnetization time is shortened. When the setting reaches 200%, magnetization is reduced by roughly half.

A high pre-excitation level (07-15) might result in excessive motor sound during pre-excitation.

When the flux reaches 100%, pre-excitation current reverts back to 100% and pre-excitation is completed.

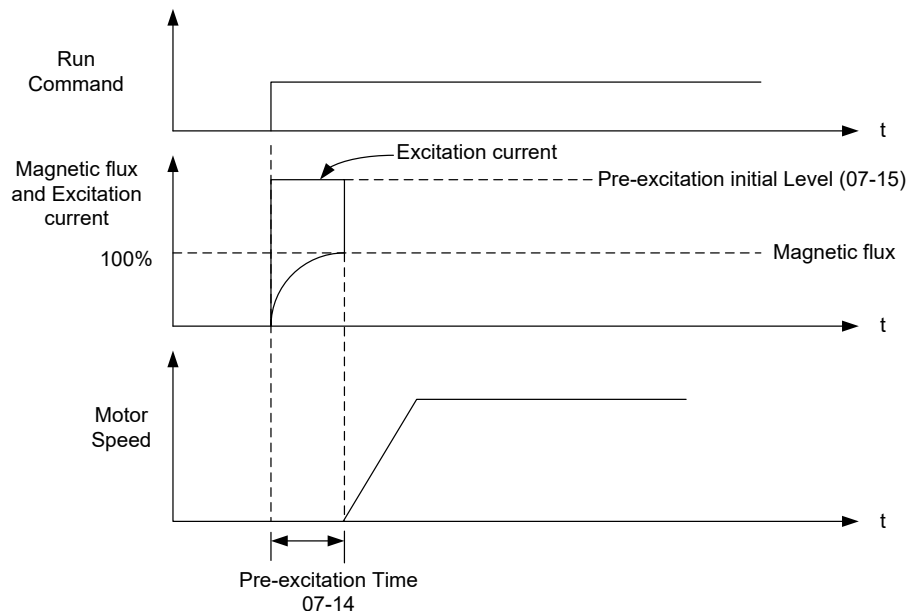


Figure 4.3.52 Pre-excitation operation

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

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

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

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

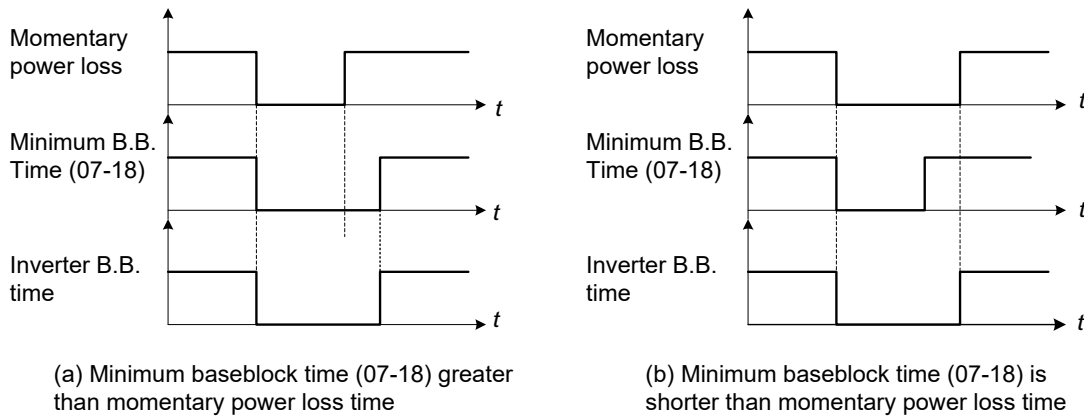


Figure 4.3.53 Minimum B.B time and momentary power loss time

Minimum base block time (07-18) is also used for the DC braking function in combination with speed search as follows:

- Set the minimum base block time required (07-18).
- Execute speed search or DC braking function.
- Increase minimum Baseblock time if over-current "OC" condition occurs.
- After speed search is completed, normal operation continues.

07- 19	Direction-Detection Speed Search Operating Current
Range	【0~100】 %
07- 20	Speed Search Operating Current
Range	【0~100】 %
07- 21	Integral Time of Speed Searching
Range	【0.1~10.0】 Sec
07- 22	Delay Time of Speed Search
Range	【0.0~20.0】 Sec
07-23	Voltage Recovery Time
Range	【0.1~5.0】 Sec
07- 24	Direction-Detection Speed Search Selection
Range	【0】 : Disable 【1】 : Enable
07- 26	SLV Speed Search Function
Range	【0】 : Enable 【1】 : Disable
07- 27	Start Selection after Fault during SLV Mode
Range	【0】 : Speed search start 【1】 : Normal Start
07- 28	Start after External Base Block
Range	【0】 : Speed search start 【1】 : Normal Start
07- 32	Speed Search Mode Selection
Range	【0】 : Disable 【1】 : Mode1: Start a Speed Search at Power on 【2】 : Mode2: Start Speed Search upon the Motor Run

07- 33	Start Frequency of Speed Search Selection
Range	【0】 : Maximum Output Frequency of Motor 【1】 : Frequency Command

Speed search function is used to find the speed of a coasting motor and continue operation from that point. The speed search function is active after a momentary power loss.

Speed Search from Multi-function digital inputs

Set the multi-function digital input to external speed search command 1 or 2. External speed search command 1 (value = 19) and 2 (value = 34) cannot be set at the same time, otherwise "SE02" (digital input terminal error) warning occurs.

Speed search function must be enabled before applying the run command to ensure proper operation. See relay logic in Fig. 4.3.54.

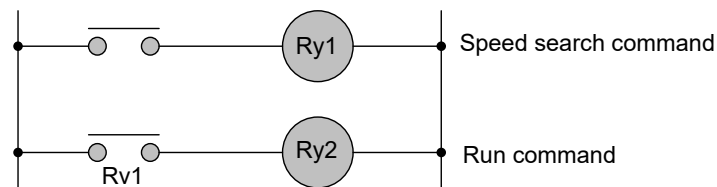


Figure 4.3.54 Speed search and operation commands

Notes: Speed Search Operation

- The speed search cannot be used when the motor rated power is greater than the inverter rated power.
- The speed search cannot be used when the motor rated power is two inverter sizes smaller than the inverter currently used.
- The speed search cannot be used in combination with a high-speed motor.
- In V/F mode, it is necessary to perform a static auto-tune.
- In SLV mode, it is necessary to perform a rotational auto-tune. Perform a static auto-tune when using long motor leads.

Speed search uses current detecting. Use parameter 07-24 to select detection direction.

07-19: Speed Direction Search Operating Current

- Used in bidirectional speed search only (07-24 = 1).
- Set bidirectional current level.
- Increase value if speed search is not successful at low speeds (above 5Hz)

Note: If value is too high may cause DC braking effect.

07-20: Speed Search Operating Current

- Can be used for bidirectional (07-24 = 1) or unidirectional (07-24 = 0) speed search.
- Sets speed search current Level.
- The set value must be lower than the excitation current (02-09) and must equal to the no-load current. If the no-load current is unknown it is recommended to set value at 20%.

- Excessive speed search current will cause inverter output to saturate.
- It is recommended to use speed search in case of a momentary power loss. Increase the minimum base block time (07-18) in case of an over-current condition.

07-21: Integral time of speed searching

- Can be used for bidirectional (07-24 = 1) or unidirectional (07-24 = 0) speed search.
- Set the integral time during speed search.
- If OV occurs, increase the set value to increase the speed search time. Decrease the value if a quick start is required

07-22: Delay time of speed search

- Use delay time when using a contactor on the inverter output side.
- The inverter speed search starts after the delay time expires.
- Speed search delay time is disabled when set to 0.0 sec. (07-22 = 0.0)

07-23: Voltage recovery time

- Sets the voltage recovery time.
- Sets the time for the inverter to restore the output voltage from 0V to the specified V/f level after speed search function is completed.

07-24: Direction-Detection Speed Search Selection

07-24=0: Disable Direction-Detection Speed Search

Speed search is executed using speed search operating current defined in parameter 07-20. In case speed search is not successful (e.g. motor speed is too low) a speed search time-out warning is displayed. Set 07-19 to value greater than 0 to enable DC braking at speed search if a time-out occurs frequently.

07-24=1: Enable Direction-Detection Speed Search

At start the current controller will send a step current to the motor (07-19) to determine the motor direction. Once direction is determined the current controller will perform a speed search using speed search operating current defined in parameter 07-20. Speed search is executed after a momentary power loss (external speed search command 2, 03-00 to 03-05 = 34) or from max. frequency (external speed search command 1, 03-00 to 03-05 = 19). Speed search direction will follow the speed command.

07-26: SLV Speed Search Function

- In SLV mode (00-00 = 2) set the stop mode to the coast stop (07-09 = 1) or to the coast to stop with timer (07-09 = 3). After a stop command is issued (coast to stop or coast to stop with times) the speed search function is automatically activated for the next start.

07-26=0: Enable (No mechanical brake is installed)

07-26=1: Disable (Mechanical brake is installed)

07-27: Start Selection after fault during SLV mode

07-27=0: Speed search start: Speed search is executed after a fault in SLV mode.

07-27=1: Normal start: Speed search is not enabled.

Note: Set the parameter to 1 (normal start) after a fault has occurred and a mechanical brake is used to stop the motor.

07-28: Start after external Baseblock

07-28=0: Speed search start: Speed search is executed after base block is removed.

07-28=1: Normal start: Speed search is not enabled.

07-32: Speed Search Mode Selection

0: Disable: Speed search is disabled and inverter start from minimum output frequency.

1: Execute a Speed Search at Power On: Speed search is executed after first run command at power up from motor rotation speed.

2: The inverter will execute speed search at each run command.

07-33: Start Frequency of Speed Search Selection

07-33=0: The speed search starts from the maximum output frequency of motor.

07-33=1: The speed search starts from frequency command.

Notes:

- Set parameter to 1 for the control mode of SLV mode (00-00 = 2) when the external base block active time is longer than the time the motor needs to come to a complete stop. After the external base block command is removed the inverter will accelerate from min. frequency.
- In PM mode the inverter performs a normal start.

■ Speed search based on current detection

(a) Speed search at starting

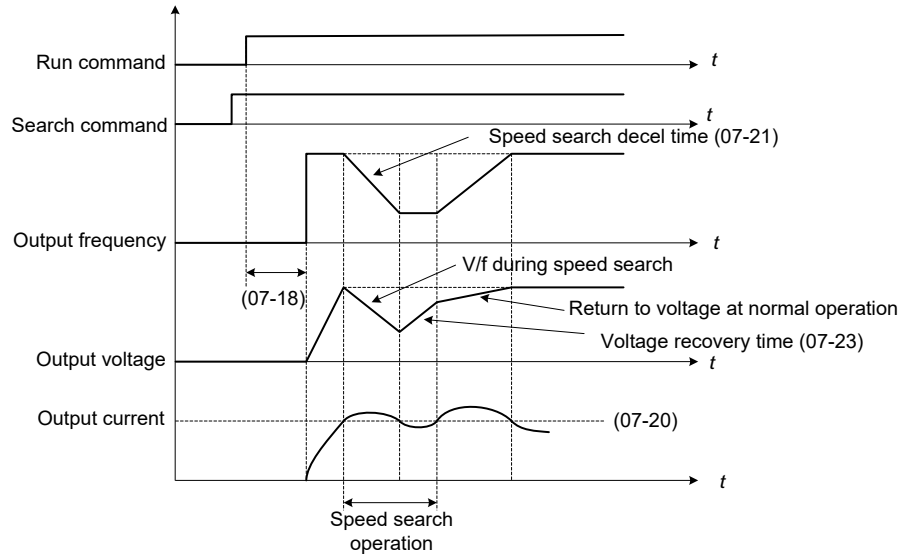


Figure 4.3.55 Speed search at starting

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

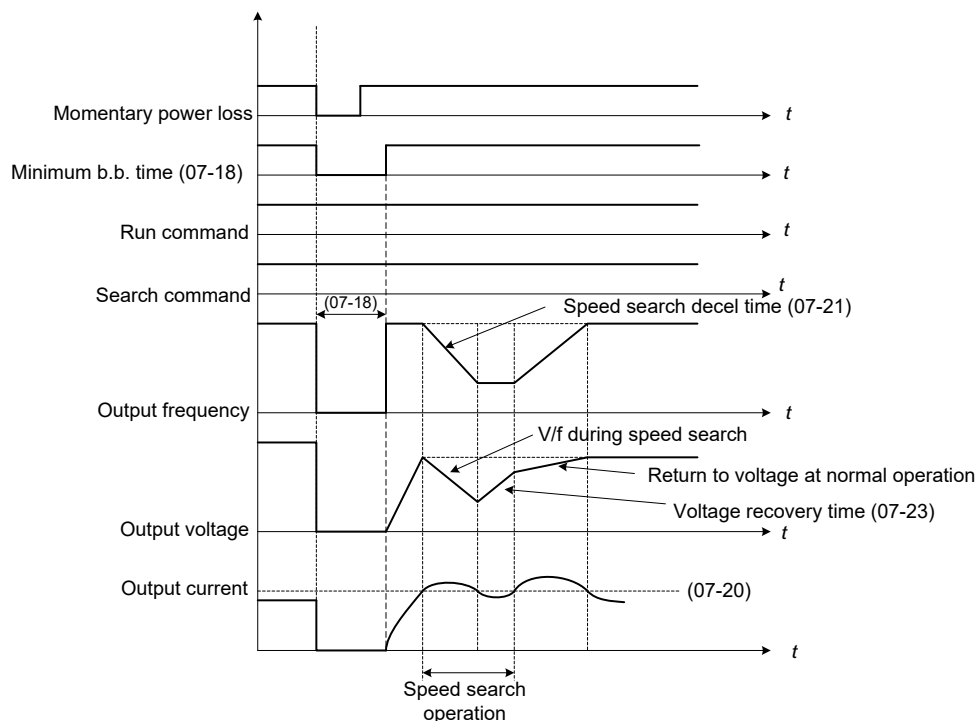


Figure 4.3.56 Speed search in recovery period of momentary power failure

Notes:

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

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

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

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

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

In case of motor saturation increase this parameter to limit the output voltage.

Setting this value to high may result in lower than required output torque.

07- 43	Short-circuit Braking Time of PM Motor Speed Search
Range	【0.00~100.00】 Sec
07- 44	DC Braking Time of PM Motor Speed Search
Range	【0.00~100.00】 Sec

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

If the motor is rotating due to inertia and the rotation speed is greater than the minimum speed control range, the motor will start at the found rotational frequency regardless of the setting value of parameter 07-43 or 07-44.

If parameters 07-43 and 07-44 are set to 0, the motor starts at the found rotational frequency.

Group 08 Protection Parameters

08- 00	Stall Prevention Function
Range	【xxx0b】 : Stall prevention is enabled in acceleration. 【xxx1b】 : Stall prevention is disabled in acceleration. 【xx0xb】 : Stall prevention is enabled in deceleration. 【xx1xb】 : Stall prevention is disabled in deceleration. 【x0xxb】 : Stall prevention is enabled in operation. 【x1xxb】 : Stall prevention is disabled in operation. 【0xxxb】 : Stall prevention in operation decelerates based on deceleration time 1 【1xxxb】 : Stall prevention in operation decelerates based on deceleration time 2
08- 01	Stall Prevention Level in Acceleration
Range	【20~200】 %
08- 02	Stall Prevention Level in Deceleration
Range	【330~410】 V : 200V 【660~820】 V : 400V
08- 03	Stall Prevention Level in Operation
Range	【30~200】 %
08-21	Limit of Stall Prevention in Acc over Base Speed
Range	【1~100】 %
08-22	Stall Prevention Detection Time in Operation
Range	【2~100】 msec

Stall prevention during acceleration (08-00=xxx0b)

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

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

Notes:

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

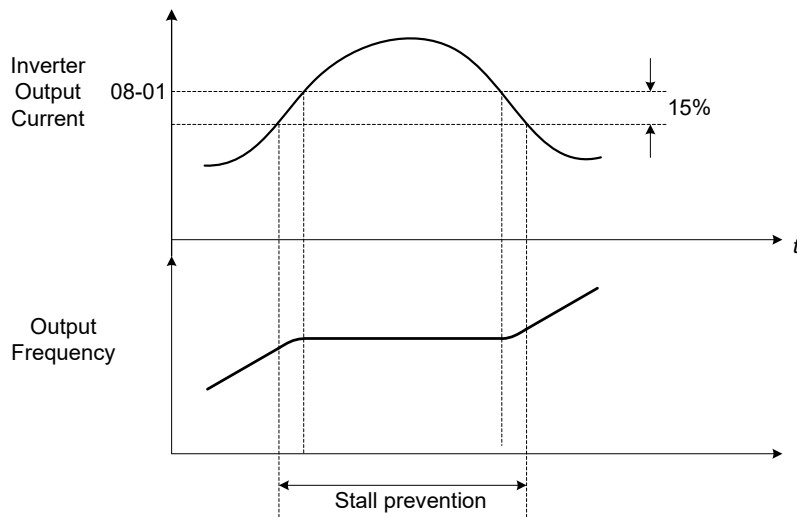


Figure 4.3.57 Stall prevention during acceleration

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

Stall prevention level during acceleration (Constant horsepower)

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

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

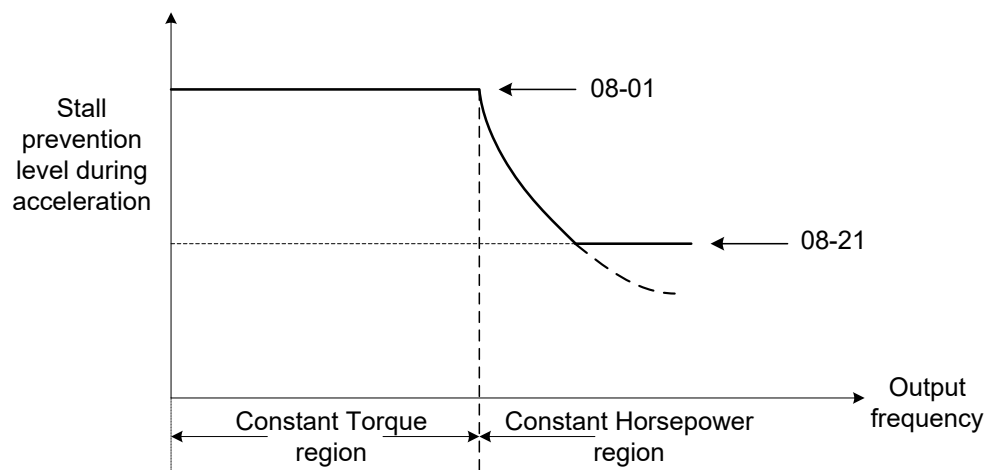


Figure 4.3.58 Stall prevention level and limit in acceleration

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

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

When the DC-bus voltage exceeds the stall prevention level deceleration will stop and the inverter will wait for the DC-bus voltage to fall below the stall prevention level before continuing deceleration. Stall prevention level can be

set by 08-02, see Table 4.3.10.

Table 4.3.10 Stall prevention level

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

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

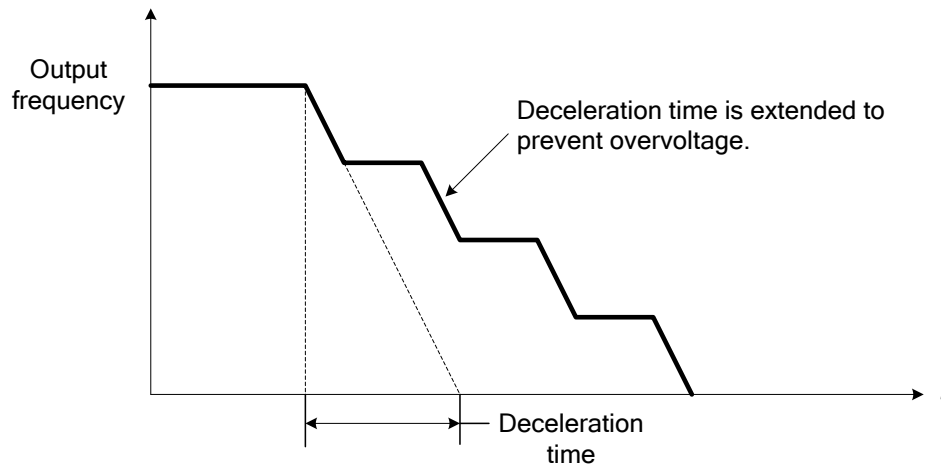


Figure 4.3.59 Stall prevention selection in deceleration

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

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

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

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

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

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

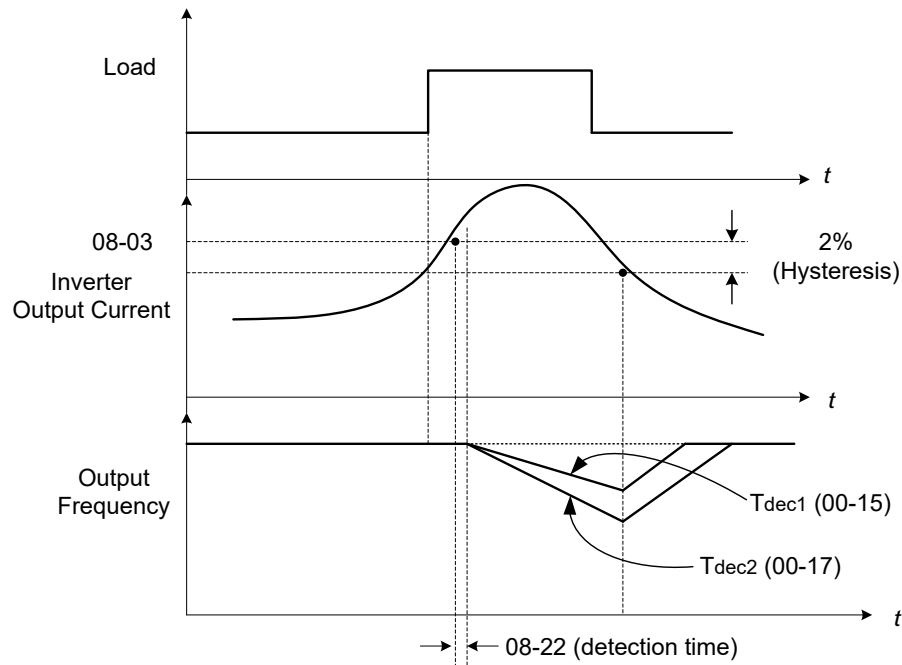


Figure 4.3.60 Stall prevention selection in operation

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

The motor overload protection function estimates the motor overload level based on the output current, output frequency, motor characteristics and time. The motor overload trip time depends on the motor rated current when the output frequency is higher than 60Hz.

At power-up the motor overload protection internal thermal accumulation register is automatically reset.

To use the built-in motor overload protection function parameter 02-01 (motor rated current) has to match the motor rated current on the motor nameplate.

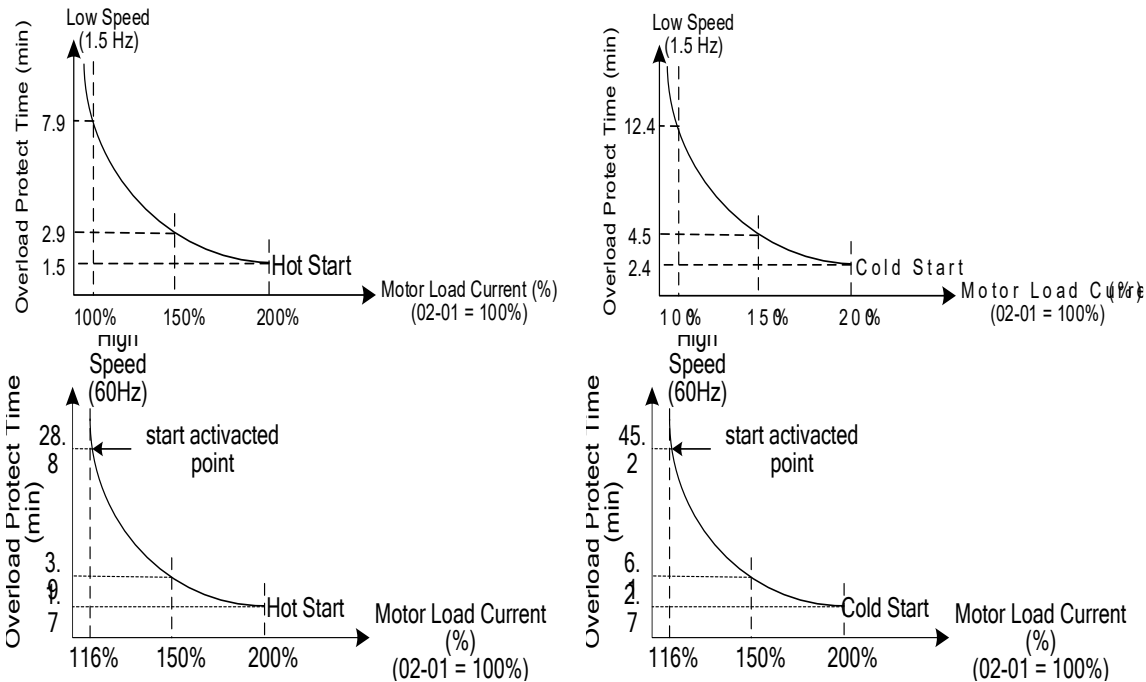
Turn off the motor overload protection when using two or more motors connected to the inverter (set 08-05 = xxx0b), and provide external overload protection for each motor (e.g. thermal overload switch).

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

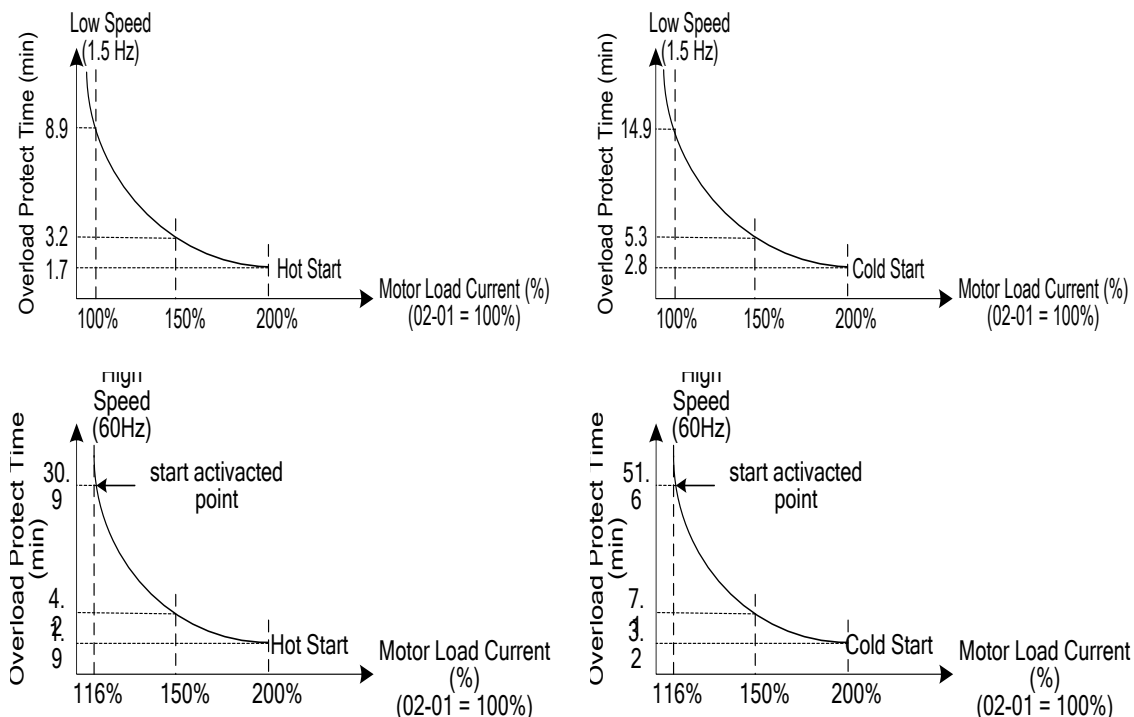
With hot start enabled (08-05 = xx1xb), motor overload protection activates in 3 and a half minutes when operating the motor at 150% of the motor rated current at an output frequency greater than 60Hz.

Refer to the following Fig.4.3.61 for motor overload protection curves based on parameter 08-07 selection.

08-07=0:



08-07=1:



08-07=2:

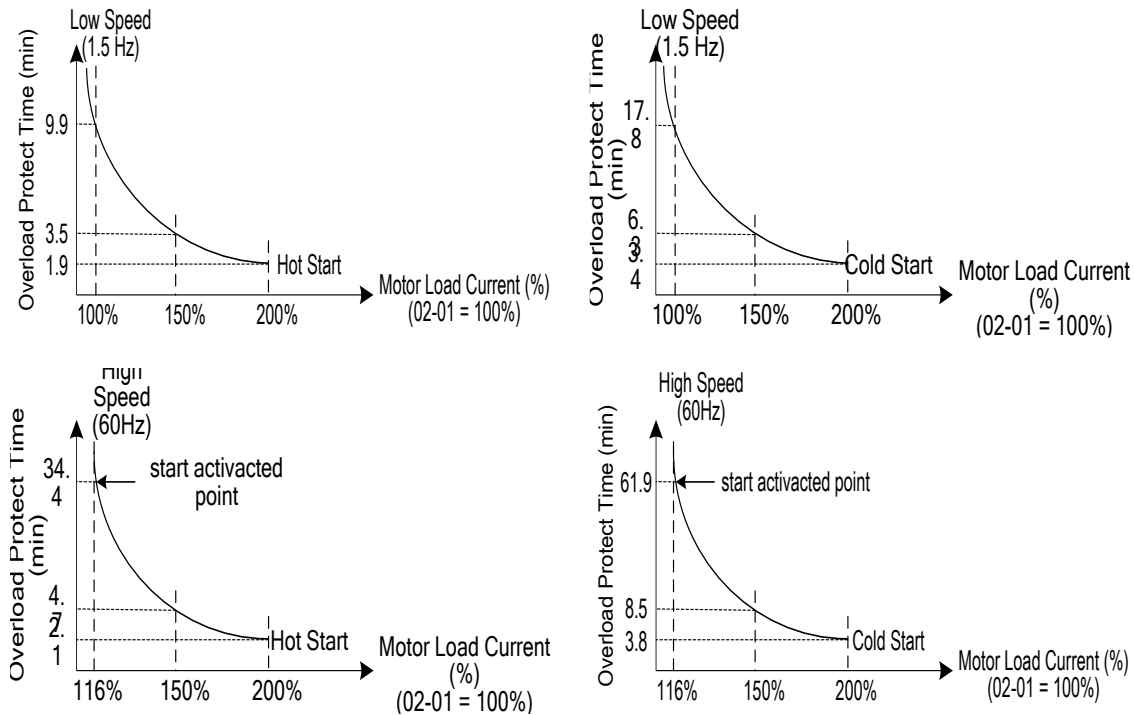


Figure 4.3.61 Motor overload protection curve (example: standard motor)

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

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

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

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

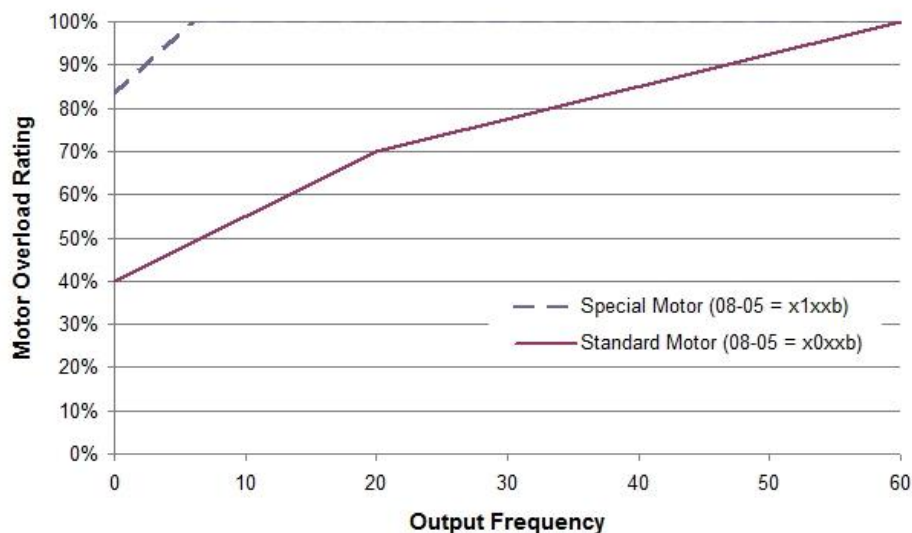


Figure 4.3.62 Motor overload rating at different output frequencies

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

08-06=0: When the inverter detects a motor overload the inverter output is turned off and the OL1 fault message will flash on the keypad. Press RESET button on the keypad or activate the reset function through the multi-function inputs to reset the OL1 fault.

08-06=1: When the inverter detects a motor overload the inverter will continue running and the OL1 alarm message will flash on the keypad until the motor current falls within the normal operating range.

08- 08	Automatic Voltage Regulation (AVR)
Range	【0】 : AVR is enabled 【1】 : AVR is disabled

Automatic voltage regulation stabilizes the motor voltage independent of fluctuation to the input voltage.

08-08=0: Automatic voltage regulation is active. It will limit the maximum output voltage. When the inverter three-phase input voltage fluctuates and the voltage level is smaller than the value of 01-14, the output voltage will fluctuate with the fluctuation of input voltage.

08-08=1: Automatic voltage regulation is not active, motor voltage follows the input voltage fluctuation. When the inverter three-phase input voltage fluctuates, the output voltage will fluctuate based on the input voltage.

08- 09	Selection of Input Phase Loss Protection
Range	【0】 : Disable 【1】 : Enable

08-09=0: Input phase loss detection is disabled.

08-09=1: Input phase loss detection is enabled. Keypad shows "IPL input Phase Loss" (IPL), when an input phase loss is detected and the inverter output is turned off and the fault contact is activated.

Note: Input phase loss detection is disabled when the output current is less than 30% of the inverter rated current.

08- 10	Selection of Output Phase Loss Protection
Range	【0】 : Disable 【1】 : Enable

08-10=0: Output phase loss detection is disabled.

08-10=1: Output phase loss detection is enabled. Keypad shows "OPL Output Phase Loss" (OPL), when an output phase loss is detected and the inverter output is turned off and the fault contact is activated.

Note: Output phase loss detection is disabled when the output current is less than 10% of the inverter rated current.

08- 13	Selection of Over-Torque Detection
Range	【0】 : Over-Torque Detection is Disabled. 【1】 : Start to Detect when Reaching the Set Frequency. 【2】 : Start to Detect when the Operation is Begun.
08- 14	Selection of Over-Torque Operation
Range	【0】 : Deceleration to Stop when Over- Torque is Detected. 【1】 : Display Warning when Over- Torque is Detected. Go on Operation. 【2】 : Coast to Stop when Over Torque is Detected.
08- 15	Level of Over-Torque Detection
Range	【0~300】 %
08- 16	Time of Over-Torque Detection
Range	【0.0~10.0】 Sec
08- 17	Selection of Low-Torque Detection
Range	【0】 : Low-Torque Detection is Disabled. 【1】 : Start to Detect when Reaching the Set Frequency. 【2】 : Start to Detect when the Operation is Begun.
08- 18	Selection of Low-Torque Operation
Range	【0】 : Deceleration to Stop when Low- Torque is Detected. 【1】 : Display Warning when Low- Torque is Detected. Go on Operation. 【2】 : Coast to Stop when Low-Torque is Detected.
08- 19	Level of Low-Torque Detection
Range	【0~300】 %
08- 20	Time of Low-Torque Detection
Range	【0.0~10.0】 Sec

The over torque detection function monitors the inverter output current or motor torque and can be used to detect increases in inverter current or motor torque (e.g. heavy load).

The low torque detection function monitor the inverter output current or motor torque and can be used to detect a decrease in inverter current or motor torque (e.g. belt break).

The torque detection levels (08-15, 08-19) are based on the inverter rated output current (100% = inverter rated output current) when operating the inverter in V/F control mode and motor output torque (100% = motor rated torque) when operating the inverter in SLV control mode.

Over-torque detection

Parameter 08-13 selects over-torque detection function. An over-torque condition is detected when the output current / torque rises above the level set in parameter 08-15 (Over-torque detection level) for the time specified in parameter 08-06 (Over-torque detection time).

08-13=0: Over-torque detection is disabled.

08-13=1: Over-torque detection is enabled when the output frequency reaches the set frequency.

08-13=2: Over-torque detection is enabled during running.

Parameter 08-14 selects the way the inverter acts when an over-torque condition is detected.

08-14=0: When an over-torque condition is detected the inverter displays an over-torque detection fault and the motor decelerates to a stop.

08-14=1: When an over-torque condition is detected the inverter displays an over-torque detection alarm and continues to run.

08-14=2: When an over-torque condition is detected the inverter displays an over-torque detection fault and the motor coasts to a stop.

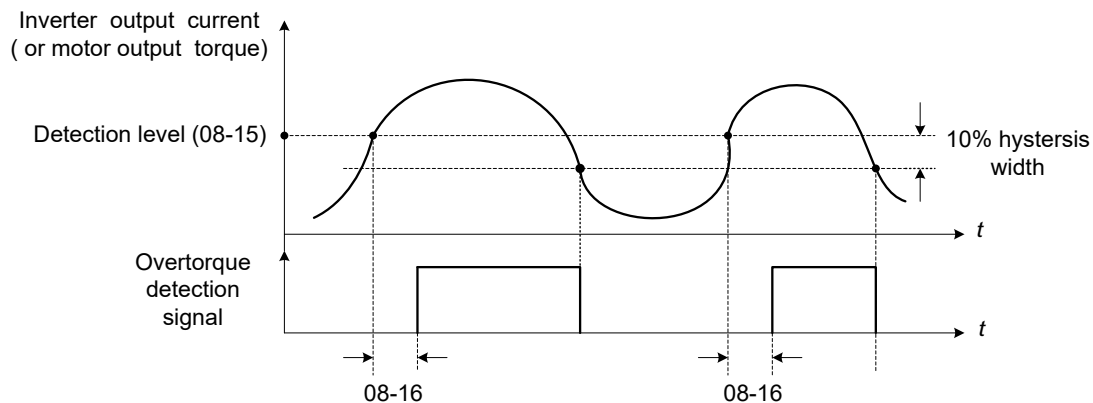


Figure 4.3.63 Over-torque detection operation

Low-torque detection

Parameter 08-18 selects low-torque detection function. A low-torque condition is detected when the output current / torque falls below the level set in parameter 08-19 (low-torque detection level) for the time specified in parameter 08-20 (Low-torque detection time).

08-17=0: Low-torque detection is disabled.

08-17=1: Low-torque detection is enabled when the output frequency reaches the set frequency.

08-17=2: Low-torque detection is enabled during running.

Parameter 08-18 selects the way the inverter acts when an over-torque condition is detected.

08-18=0: When a low-torque condition is detected the inverter displays a low-torque detection fault and the motor decelerates to a stop.

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

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

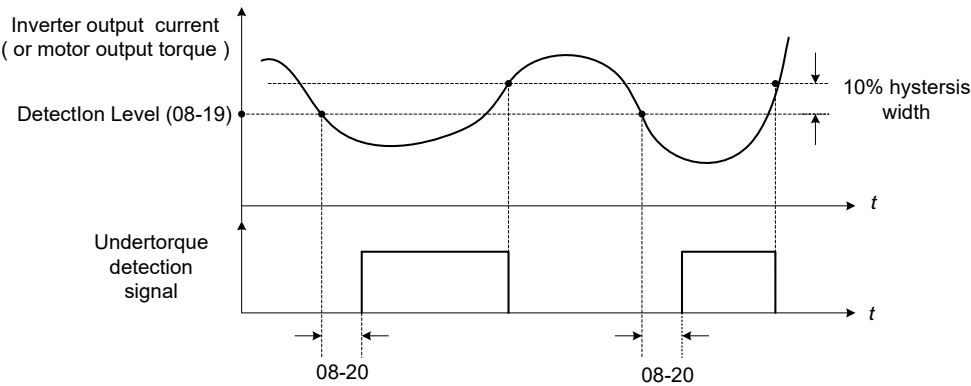


Figure 4.3.64 Low torque detection operation

The multi-function digital outputs (R1A-R1C, R2A-R2C, R3A-R3C) can be used to indicate an over and low torque detection condition by setting parameters 03-11, 03-12 and 03-39 to 12 or 25. Refer to Fig. 4.3.65 for more information.

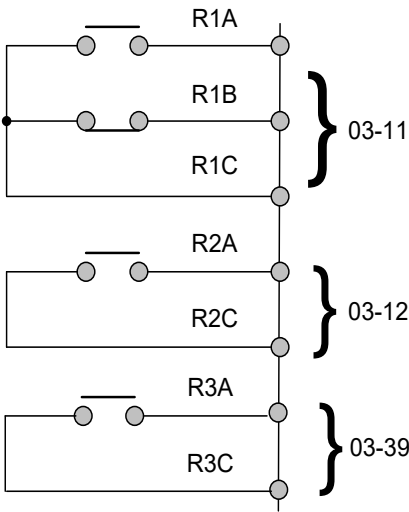


Figure 4.3.65 Over-torque / low torque detection multi-function digital output terminal

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

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

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

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

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

External fault detection selection:

08-25=0: External fault detection active at power up.

08-25=1: External fault detection active during running.

08- 30	Selection of Safety Function
Range	【0】 : Deceleration to Stop 【1】 : Coast to Stop

If multi-function digital input terminal is set to 58 (Safety Function), inverter will stop based on value set in parameters 08-30 when safety function is activated.

08- 37	Fan Control Function
Range	【0】 : Start at Operation 【1】 : Permanent Start 【2】 : Start at High Temperature
08- 38	Delay Time of Fan Off
Range	【0~600】 Sec

08-37=0: Start at Operation

Fan starts when the inverter starts running.

If the inverter stops the fan will turn off after the delay time (08-38).

08-37=1: Permanent Start

Fan starts running when the inverter is at powered on and will run permanently.

08-37=2: Start at High Temperature

When the heatsink temperature rises above maximum allowed heatsink temperature the fan turns on.

If the temperature falls below maximum allowed heatsink temperature the fan will turn off after the delay time of fan off (08-38) timer has expired.

Note: The fan control function is not available for IP20 models of 60HP and above (200V) and 100HP and above (400V).

08- 35	Fault Selection of Motor Overheat
Range	【0】 : Disable 【1】 : Deceleration to Stop 【2】 : Coast to Stop

08- 36	Time Coefficient of PTC Input Filter
Range	【0.00 ~ 5.00】
08- 39	Delay Time of Motor Overheat Protection
Range	【1 ~ 300】 Sec
08 - 42	PTC Trip Level
Range	【0.1~10】 V
08 - 43	PTC Reset Level
Range	【0.1~10】 V
08-45	PTC Disconnection Detection
Range	【0】 : Disable 【1】 : Warning 【2】 : Fault

Enable the motor overheat protection by using the motor's built in PTC resistor. Connect the PTC resistor between MT and GND. If the motor overheats the keypad will display the OH4 error code.

08-35=0: Motor overheating fault is disabled.

08-35=1, 2: Motor stops running inverter displays a warning.

08-35=1, 2: Motor stops running inverter displays a fault.

A motor overheating condition occurs when 08-45 is enabled and the motor temperature rises where the MT voltage level rises above the 08-42 PTC trip level for the time specified in 08-39. The keypad will display "OH4 Motor overheat" and fault output is activated.

When the motor temperature drops, and the MT voltage level falls below the 08-43 PTC reset level, the "OH4 Motor overheat" fault can be reset.

Note: The stop mode of the inverter when a fault occurs is set by 08-35.

08-35=1: Deceleration to stop when the inverter fault occurs.

08-35=2: Coast to stop when the inverter fault occurs

Note: The resistor (PTC) according to the British Standards Institution:

Tr is 150°C for Class F and is 180°C for Class H

Tr - 5°C : $RT \leq 550\Omega$, insert value of RT into formula (1) and set 08-43 to the calculated value.

Tr + 5°C: $RT \geq 1330\Omega$, put the value of RT in formula (1), and set 08-42 to the calculated value..

Formula (1) can also be used for different values of PTC resistors.

Notes:

1. Use formula 1 to calculate the value of 8-42 and 8-43 if the specification of the PTC is different..

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

2. Use formula (1) to calculate level when PTC is not connected and the voltage value is between 3.3~4V. If PTC is disconnected, the inverter trips and a PTCLS warning or fault signal occur. Select fault selection using parameter 08-45. There will be a ten second delay for disconnect detection. If the PTC is reconnected within this time the inverter will not trip and the delay timer is reset.
3. When measuring the voltage-across from MT and GND terminals and the measured voltage is not equal to the input level one use formula (1) to calculate the new value.

Refer to Fig. 4.3.66 shows PTC connection and PTC Characteristics.

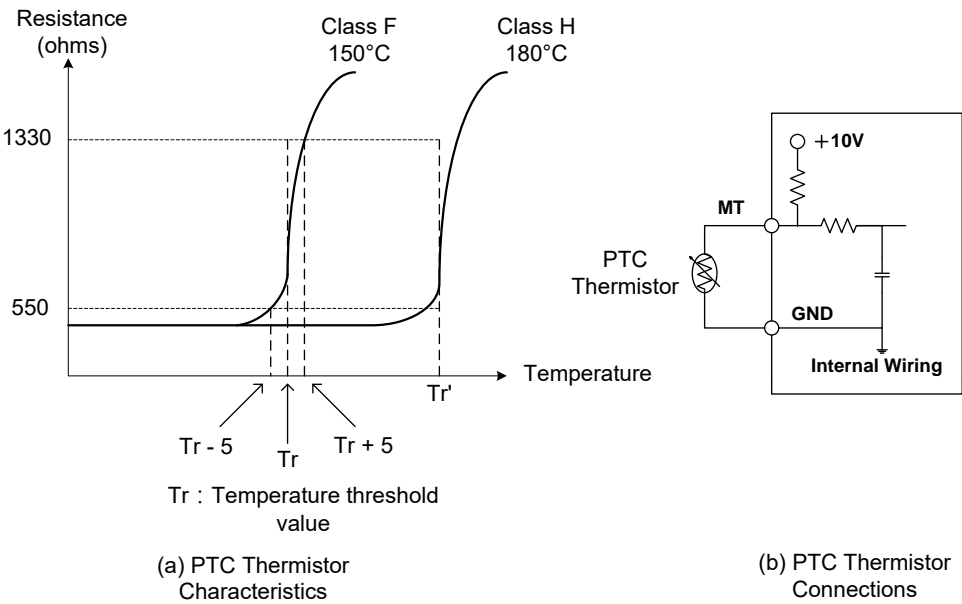


Figure 4.3.66 (a) PTC Thermistor Characteristics

(b) PTC Thermistor Connections

Group 09: Communication Parameters	
09- 00	INV Communication Station Address
Range	【1~31】
09- 01	Communication Mode Selection
Range	【0】 : MODBUS 【1】 : BacNET 【2】 : MetaSys 【3】 : PUMP in Parallel Connection 【4】 : PROFIBUS
09- 02	Baud Rate Setting (bps)
Range	【0】 : 1200 【1】 : 2400 【2】 : 4800 【3】 : 9600 【4】 : 19200 【5】 : 38400
09- 03	Stop Bit Selection
Range	【0】 : 1 Stop Bit 【1】 : 2 Stop Bits
09- 04	Parity Selection
Range	【0】 : No Parity 【1】 : Even Bit 【2】 : Odd Bit
09-05	Communications Data Bits Selection
Range	【0】 : 8 bits data 【1】 : 7 bits data
09- 06	Communication Error Detection Time
Range	【0.0~25.5】 Sec
09- 07	Fault Stop Selection
Range	【0】 : Deceleration to Stop Based on Deceleration Time 1 【1】 : Coast to Stop when Communication Fault Occurs. 【2】 : Deceleration to Stop Based on Deceleration Time 2 【3】 : Keep Operating when Communication Fault Occurs. 【4】 : Run at the Frequency Command given by AI2
09- 08	Comm. Fault Tolerance Count
Range	【1~20】
09- 09	Waiting Time
Range	【5~65】 msec
09- 10	Device Instance Number
Range	1~254

The Modbus communication port RJ45 (S+, S-) can be used to monitor, control, program and trouble-shoot the inverter. The built-in RS-485 can support the following communication protocols:

- Modbus communication protocol
- BacNet communication protocol (Refer to section 4.7 for more details)
- MetaSys communication protocol (Refer to section 4.8 for more details)
- Profibus communication protocol (Refer to section 11.9 Profibus communication option card for more details and this function is required to install Profibus card to be enabled.

Modbus communication can perform the following operations, independent of the frequency command selection (00-05) setting and operation command selection (00-02) setting:

- Monitor inverter signals
- Read and write parameters.
- Reset fault
- Control multi-function inputs

Modbus (RS-485) communication specification:

Items	Specification
Interface	RS-485
Communication type	Asynchronous (start - stop synchronization)
Communication parameters	Baud rate: 1200, 2400, 4800, 9600, 19200 and 38400 bps Data Length: 8 bits (Fixed) Parity: options of none, even and odd bit. For even and odd selection stop bit is fixed at 1 bit.
Communication protocol	Modbus RTU / ASCII
Number of inverters	Maximum 31 units

Communication wiring and setup

- (1) Turn off power to the inverter.
- (2) Connect communication lines of the controller to the inverter (RJ45).
- (3) Turn power on.
- (4) Set the required communication parameters (09-00) via the keypad.
- (5) Turn off power to the inverter and wait until keypad is completely off.
- (6) Turn power on
- (7) Start communication between controller and inverter.

Modbus (485) communication architecture

- (1) Modbus communication configuration uses a master controller (PC, PLC), communicating to a maximum of 31 inverters.
- (2) The master controller is directly connected to the inverter via the RS-485 interface. If the master controller has a RS-232 port, a converter must be used to convert the signals to RS-485 to connect the master controller to the inverter.
- (3) A maximum 31 inverters can be connected to a network, following the Modbus communication standard.

Communication Parameters:

09-00: Inverter station addresses: Range 1-31

09-02: RS-485 communication baud rate setting

- = 0: 1200 bps (bits / second)
- = 1: 2400 bps
- = 2: 4800 bps
- = 3: 9600 bps
- = 4: 19200 bps
- = 5: 38400 bps

09-03: Stop bit selection

- = 0: 1 stop bit
- = 1: 2 stop bits

09-04: Parity selection

- = 0: No parity.
- = 1: even parity.
- = 2: odd parity.

09-05: Communications Data Bits Selection

- = 0: 8 bits data
- = 1: 7 bits data

09-06: RS-485 communication error detection time**09-07: Stop selection of RS-485 communication failure**

- = 0: Deceleration to stop by deceleration time set by 00-15
- = 1: Coast to stop
- = 2: Deceleration to stop using the deceleration time set by 00-26 (emergency stop time)
- = 3: Continue to operate (only shows a warning message, press the stop button to stop operation)
- = 4: Run at the frequency command given by AI2 after delay time set by Communication Error Detection Time (09-06). When an RS-485 communication error occurs a warning message will be display and AI2 will be used for frequency command. When the stop key is pressed, the inverter stops.

09-08: Comm. fault tolerance count

When the number of communication errors exceeds the value set in parameter 09-08 the inverter will display the comm. Fault alarm "ERR6".

09-09: Wait time of inverter transmission (09-09).

Sets the inverter response delay time. This is the time between the controller message and the start of the inverter response message. Refer to Figure 4.3.76. Set the controller receive time-out to a greater value than the wait time parameter (09-09).

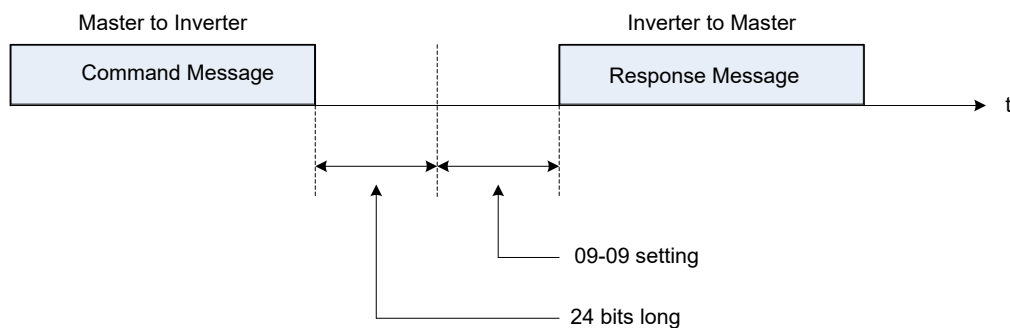


Figure 4.3.67 Communication Message Timing

Group 10: PID Parameters

10- 00	PID Target Value Source Setting
Range	【0】 : Keypad (for PUMP or HVAC mode) 【1】 : AI1 (Analog Input 1) 【2】 : AI2 (Analog Input 2) 【3】 : Reserved 【4】 : 10-02 Parameter 【5】 : Reserved 【6】 : Frequency Command (00-05) 【7】 : Multi-speed Frequency Command

Operation Pressure Setting (23-02) or Target Value of Flow Meters (PUMP or HVAC function selection) can be used as PID's target value (setpoint) only when 10-00=0 and 23-00=1 or 2.

10-00=1 or 2,

PID Target Value (Setpoint) is set via analog input terminal AI1 or AI2.

For example:

0~10V is corresponding to 0~100% target value. Analog input level set to 2V, corresponds to a 20% target value.

10-00=4

10-02 (PID target value) is set as percentage and PID setting is at main screen monitor (12-38).

Maximum target value is set by parameter 10-33 (PID feedback maximum value), the number of decimals are determined by parameter 10-34 (PID decimal width), and the unit is set by parameter 10-35 (PID unit).

Example:

Set 10-33 = 999, 10-34 = 1, 10-35 = 3, and set 10-02 to 10%

Main monitor 12-38 shows 9.9 PSI. Maximum value is 99.9 PSI (limited by value of parameter 10-33).

10-00=6

The PID target value (setpoint) is the percentage of frequency reference corresponding to the rated frequency.

(Example: setpoint = 50 %, if the frequency reference is 30Hz and the rated frequency is 60Hz). Frequency command refers to the setting of 00-05.

10-00=7

The PID target value (setpoint) is set by the multi-speed frequency commands (refer to parameter group 3).

(Example: setpoint = 50 %, if one of the multi-speed frequencies is set for 30Hz and is active based on a rated frequency is 60Hz). Multi-speed stage frequency setting can be set using parameters 05-01~05-16.

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

10- 01	PID Feedback Value Source Setting
Range	【1】 : AI1 (Analog Input 1) 【2】 : AI2 (Analog Input 2) 【3】 : Reserved 【4】 : AI1 - AI2 Analog Input

Note: Parameter 10-00 and 10-01 cannot be set to the same source. If both parameters are set to the same source the keypad will show a SE05 alarm.

Note: When AI1 - AI2 is negative minus, PID feedback value will be 0.

10- 02	PID Target Value
Range	【0.0~100.0】 %
10- 03	PID Control Mode
Range	【xxx0b】 : PID Disable 【xxx1b】 : PID Enable 【xx0xb】 : PID Positive Characteristic 【xx1xb】 : PID Negative Characteristic 【x0xxb】 : PID Error Value of D Control 【x1xxb】 : PID Feedback Value of D Control 【0xxxb】 : PID Output 【1xxxb】 : PID Output + Frequency Command

PID target value source (setpoint) is selected by parameter 10-00 and PID feedback value source setting (10-01).

Please check parameter 04-00 for the correct input level (0V~10 V or 4mA~20mA) if AI2 is used as PID target or PID feedback use switch SW2 on the control board to selected between (V and I), please refer to wiring diagram for more details.

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

Note: PID Mode Enabled

- LCD keypad is automatically switched to show PID Target / Feedback (16-00).
- Main Screen Monitoring will be changed to PID Target (Setpoint) (12-38).
- Sub-Screen Monitoring 1 will be changed to PID Feedback (12-39).
- Sub-Screen Monitoring 2 will be changed to Output Frequency (12-17).

When PID is disabled the display automatically switches back to frequency command. When enabling PID mode using an LED keypad the information displayed is set by parameter 23-05.

Note: when 23-05=0, set 10-33 to a value smaller than 1000 and 10-34=1, otherwise the inverter will display PID setting error (SE05).

10-03= xx0xb: PID output is set to forward; If PID input is negative the output frequency of PID will decrease and increase when PID input is positive.

10-03= xx1xb: PID output is reverse. If PID input is negative the output frequency of PID will increase and decrease when PID input is positive.

10-03=x1xxb: PID control with feedback differential control.

10-03=x0xxb: Basic PID control. Refer to Fig.4.3.69 and Fig.4.3.70.

10-03 =0xxxb: PID output is enabled and corresponds to the frequency of 01-02 at 100%.

When 10-03 is set to 1xxxb, PID output and frequency command are both enabled. The output percentage of frequency command (corresponding to the selected main frequency command of 00-05/ 00-06) will accumulate when the inverter starts to run and PID control starts.

10- 04	Feedback Gain
Range	【0.01~10.00】
10- 05	Proportional Gain (P)
Range	【0.00~10.00】
10- 06	Integral Time (I)
Range	【0.0~100.0】 Sec
10- 07	Differential Time (D)
Range	【0.00~10.00】 Sec
10- 09	PID Bias
Range	【-100~100】 %
10- 10	PID Primary Delay Time
Range	【0.00~10.00】 %
10-14	PID Integral Limit
Range	【0.0~100.0】 %
10-23	PID Limit
Range	【0.00~100.0】 %
10-24	PID Output Gain
Range	【0.0~25.0】
10-25	PID Reversal Output Selection
Range	【0】 : Do not Allow Reversal Output 【1】 : Allow Reversal Output
10-26	PID Target Acceleration/ Deceleration Time
Range	【0.0~25.5】 Sec

PID Adjustments

10-05 Proportional Gain: The error signal (deviation) between the input command (PID target value) and the actual control value (PID feedback). This error signal or deviation is amplified by the proportional gain (P) to control the offset between the set value and the feedback value.

10-06 Integral Time: The output of this control is the integral of the error signal (difference between PID target value and feedback value) and is used to minimize the offset signal that is left over from the gain control. When the integral time (I) is increased, the system response becomes slower.

10-07 Differential Time: This control is the inverse from integral control and tries to guess the behavior of the error signal by multiplying the error with the differential time. The result is added to the PID input. Differential control slows down the PID controller response and may reduce system oscillation. **Note:** Most applications that use PID control (fan and pump) do not require differential control.

Refer to Fig. 4.3.68 for PID control operation

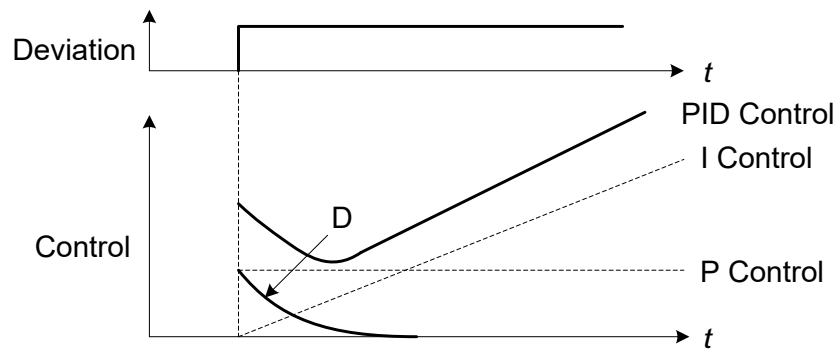


Figure 4.3.68 PID Control

PID Control Type

The inverter offers two types of PID control:

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

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

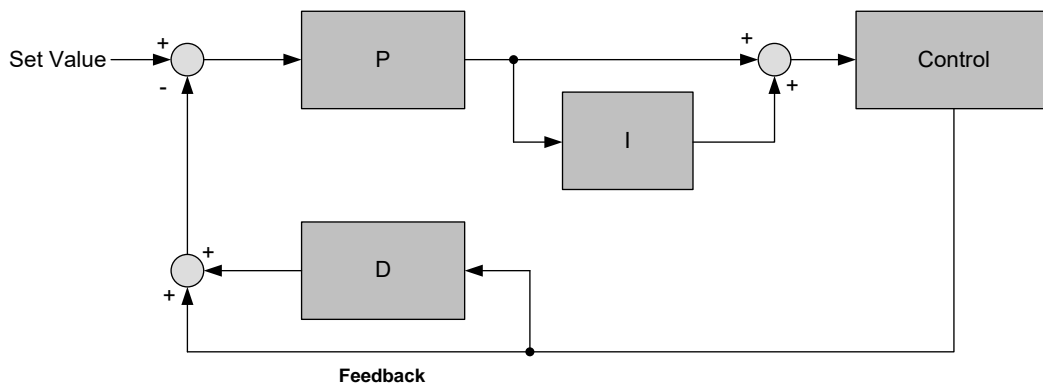


Figure 4.3.69 PID control for feedback differential value

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

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

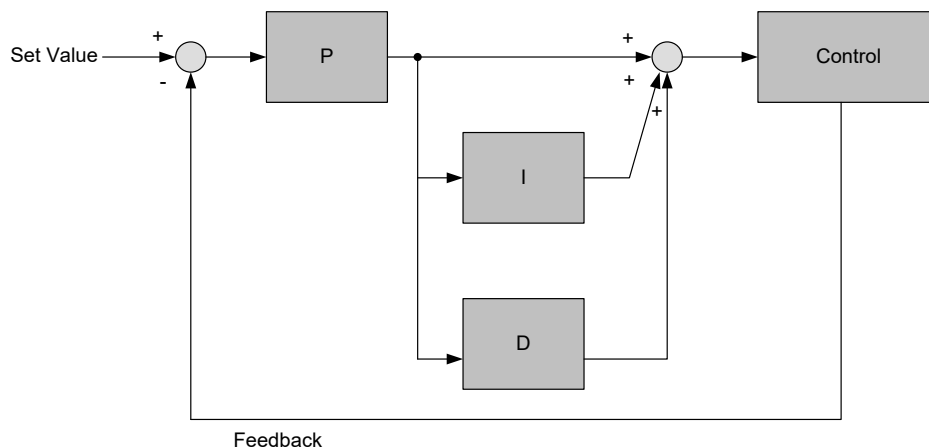


Figure 4.3.70 Basic PID control

PID Setup

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

10-00: PID target (setpoint) value

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

10-01: PID feedback value

- = 1: AI1 Analog Input
- = 2: AI2 Analog Input
- = 3: Reserved

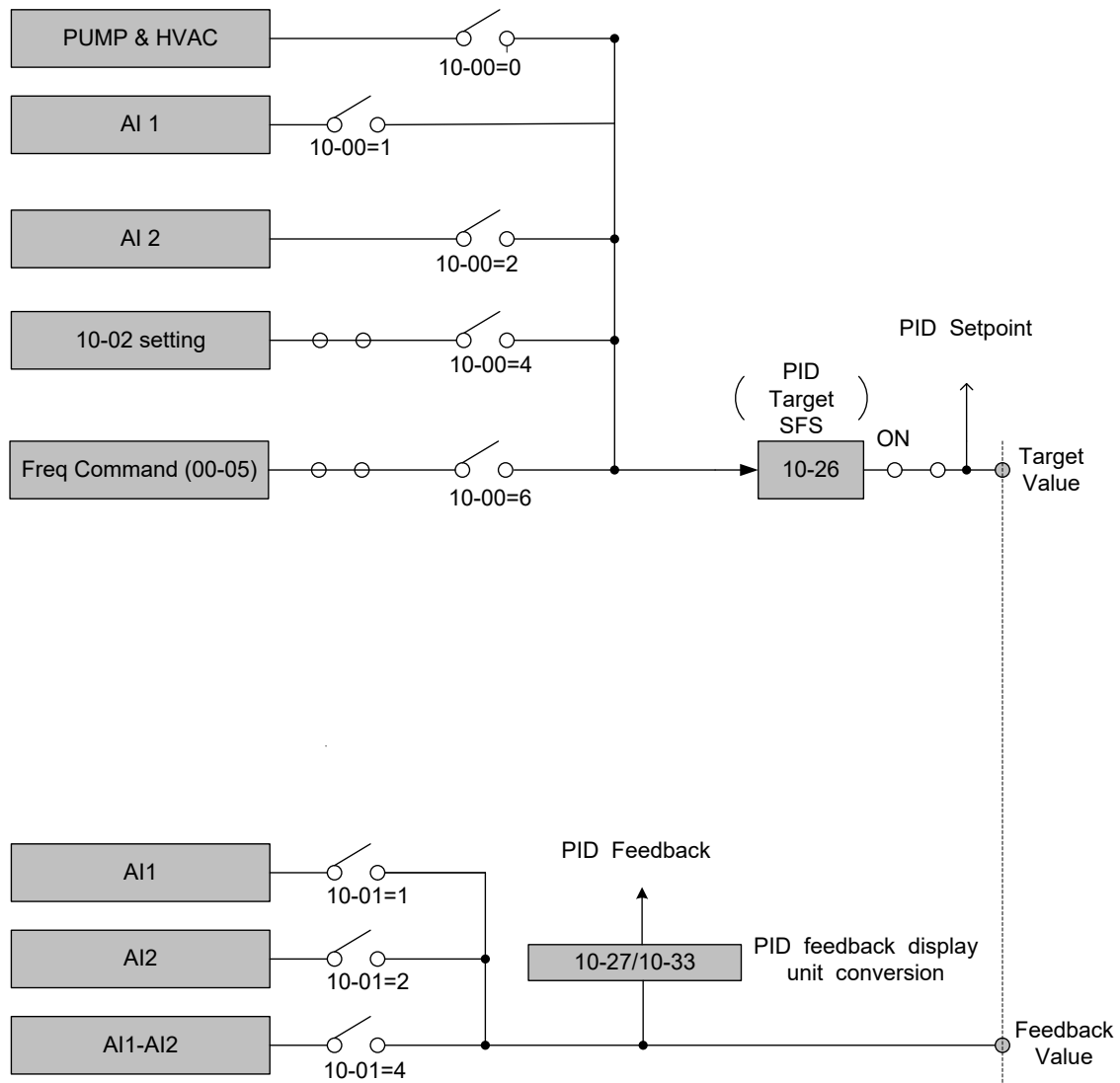


Figure 4.3.71 PID input selection

PID Control Setting

PID control block diagram.

The following diagram shows the PID control block diagram.

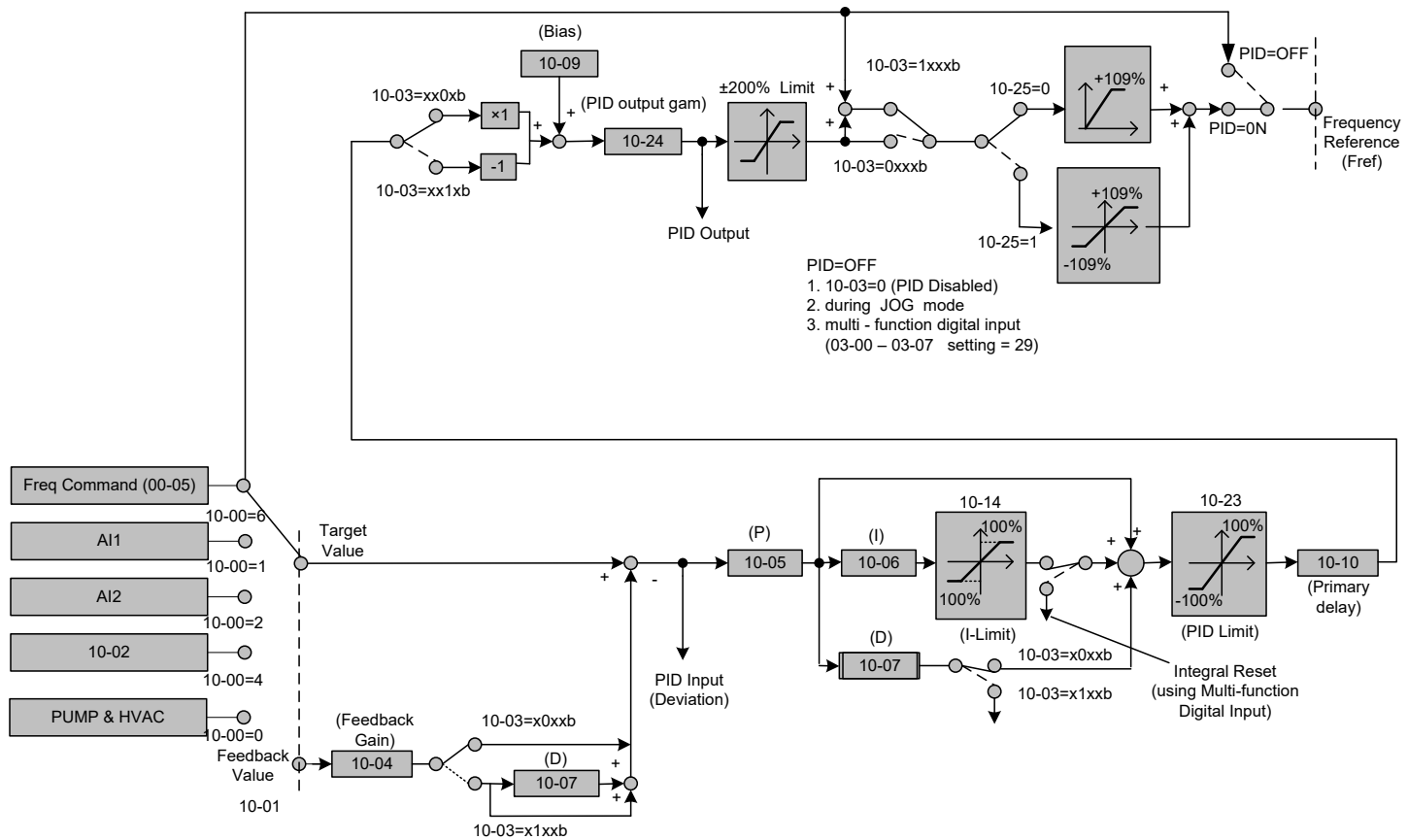


Figure 4.3.72 PID control block diagram

PID Tuning

Use the following procedures to start PID control,

- (1) Enable PID control (set 10-03 to a value greater than "xxx0b").
- (2) Increase the proportional gain (10-05) to the highest value possible without causing the system to become unstable.
- (3) Decrease the integral time (10-06) to the lowest value possible without causing the system to become unstable.
- (4) Increase the differential time (10-07) to the highest value possible without causing the system to become unstable.

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

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

To correct this instability, the response time of the system may be **slowed** down by increasing the **Integral time**

set by parameter **10-06**. However slowing the system down too much may be unsatisfactory for the process.

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

PID output polarity can be selected with parameter 10-03 (setting = xx0xb: PID output forward, setting = xx1xb: PID output reversal). When PID output is set to reverse operation, and PID input is negative, the output frequency of PID will increase. When the PID output is set for forward (normal) operation and the PID input goes negative, the output frequency of PID will decrease.

PID feedback value can be adjusted using parameter 10-04 (PID feedback gain) as well as with the analog input gain and bias for terminal AI1 or AI2.

10-14: PID integral limit: Used to limit the integral output to prevent motor from stalling or damage to the system in case of a rapid change in the feedback signal. Reduce the value of 10-14 to increase the inverter response.

10-23: PID limit: Used to limit the output of the PID control. Maximum output frequency is 100%.

10-10: Primary delay time: Low pass filter located after the PID limit block that can be used to prevent PID output resonance. Increase the time constant to a value greater than the resonance frequency cycle and reduce time constant to increase the inverter response.

10-09: PID bias: Used to adjust the offset of the PID control. The offset value is added to the frequency reference as compensation. Use parameter 10-24 (PID output gain) to control the amount of compensation.

In case the PID control output value goes negative, parameter 10-25 (PID reversal output selection) can be used to reverse the motor direction.

Note: The PID output remains at zero when reverse operation is disabled.

10-26: PID target SFS: Sets the PID target value acceleration and deceleration ramp time. The PID target SFS can be disabled by setting the multi-function digital inputs 03-00 ~ 03-05 to 36 (PID target SFS is off). Reduce the acceleration / deceleration time when experiencing load resonance or system instability.

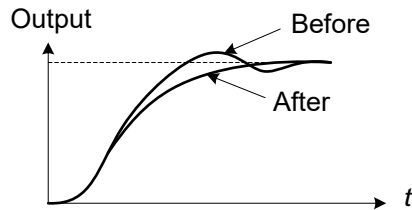
PID Fine Tuning

All PID control parameters are related to each other and require to be adjusted to its proper values. When the PID loop is operating within range the instructions can be used to fine tune PID operation.

- (1) Increase or decrease the proportion (P) gain until the system is stable using the smallest possible control change.
- (2) The integral (I) reduces the system stability which is similar to increasing the gain. Adjust the integral time so that the highest possible proportional gain value can be used without affecting the system stability. An increase in the integral time reduces system response.
- (3) Adjust the differential time if necessary to reduce overshoot on startup. The acceleration / deceleration time can also be used for the same purpose.

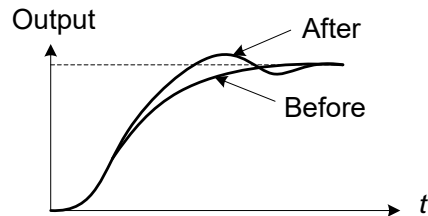
Fine-tuning PID control parameters:

(1) Reduce overshoot



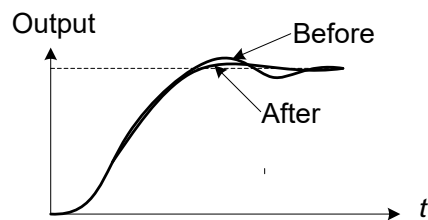
In case overshoot occurs, reduce the derivative time (D) and increase the integral time (I).

(2) Stabilize PID control



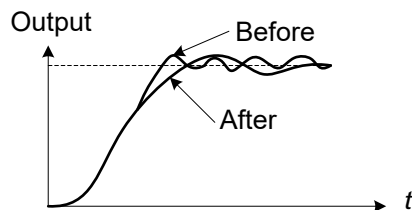
To quickly stabilize the PID control, reduce the integral time (I) and increase the differential time (D) in case overshoot occurs.

(3) Reduce long-period oscillation



Adjust the integral time (I) in case of long-periodical system oscillation.

(4) Reduce short-period oscillation



Adjusting the differential time (D) and proportional (P) gain when experiencing short-periodical oscillation.

10-11	PID Feedback Loss Detection Selection
Range	【0】 : Disable 【1】 : Warning 【2】 : Fault
10-12	PID Feedback Loss Detection Level
Range	【0~100】 %
10-13	PID Feedback Loss Detection Time
Range	【0.0~10.0】 Sec

The PID control function provides closed-loop system control. In case PID feedback is lost, the inverter output frequency may increase to the maximum output frequency.

It is recommended to enable the PID feedback loss when the PID function is used.

PID feedback loss detection

10-11=0: Disable

10-11=1: Warning

A feedback loss condition is detected when the PID feedback value falls below the value set in parameter 10-12 (PID feedback loss detection level) for the time set in parameter 10-13 (PID feedback loss detection time). PID feedback loss warning message "Fb" will be displayed on the keypad and the inverter will continue to operate.

10-11=2: Fault

A feedback loss condition is detected when the PID feedback value falls below the value set in parameter 10-12 (PID feedback loss detection level) for the time set in parameter 10-13 (PID feedback loss detection time). PID feedback loss fault message "Fb" will be displayed on the keypad, the inverter stops and the fault contact is activated.

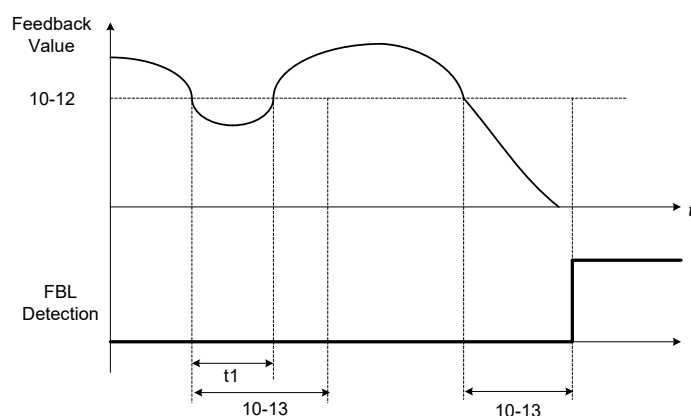


Figure 4.3.73 PID feedback loss detection

10-17	*Start Frequency of PID Sleep
Range	【0.00~400.00】 Hz
10-18	Delay Time of PID Sleep
Range	【0.0~255.5】 Sec
10-19	*Frequency of PID Waking up
Range	【0.00~400.00】 Hz
10-20	Delay Time of PID Waking up
Range	【0.0~255.5】 Sec
10-29	PID Sleep Selection
Range	【0】 : Disable 【1】 : Enable 【2】 : Set by DI
10-40	Compensation Frequency Selection of PID Sleep
Range	【0】 : Disable 【1】 : Enable

The PID Sleep function is used to stop the inverter when the PID output falls below the PID sleep level (10-17) for the time specified in the PID sleep delay time parameter (10-18).

The inverter wakes up from a sleep condition when the PID output (Reference frequency) rises above the PID

wake-up frequency (10-19) for the time specified in the PID wake-up delay time (10-20).

Use parameter 10-29 to enable / disable PID sleep function.

10-29 =0: PID Sleep function is disabled.

10-29 =1: PID sleep operation is based on parameters of 10-17 and 10-18.

10-29 =2: PID sleep mode is enabled by multi-function digital input

Refer to Fig.4.3.74 (a), (b) and (c) for PID sleep / wakeup operation.

Note: Parameter 10-17 PID sleep start frequency does not apply to constant pressure operation (parameter 23-10).

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

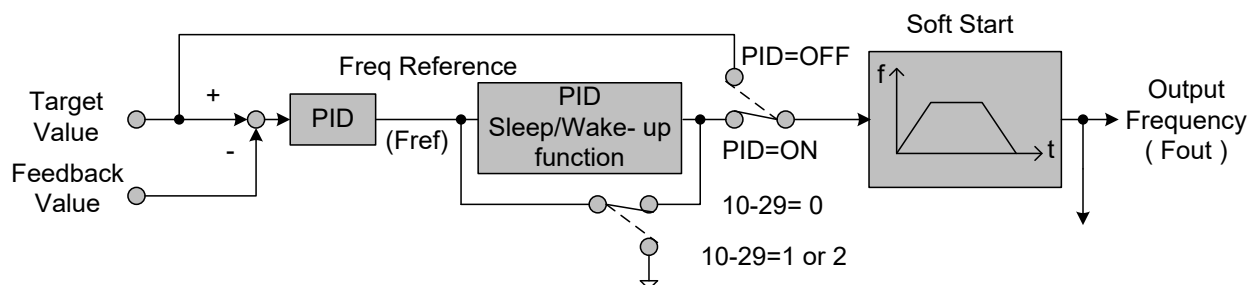


Figure 4.3.74: (a) PID control block diagram

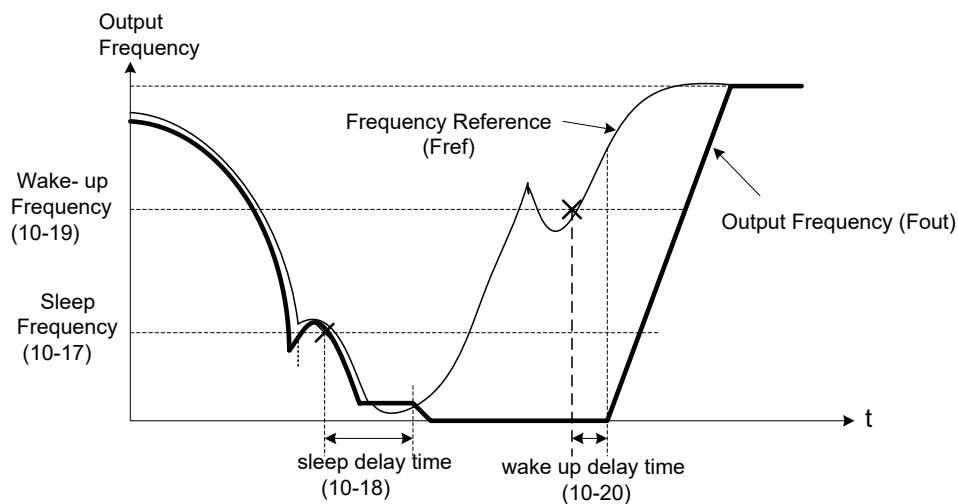


Figure 4.3.74: (b) Timing diagram PID sleep / wakeup

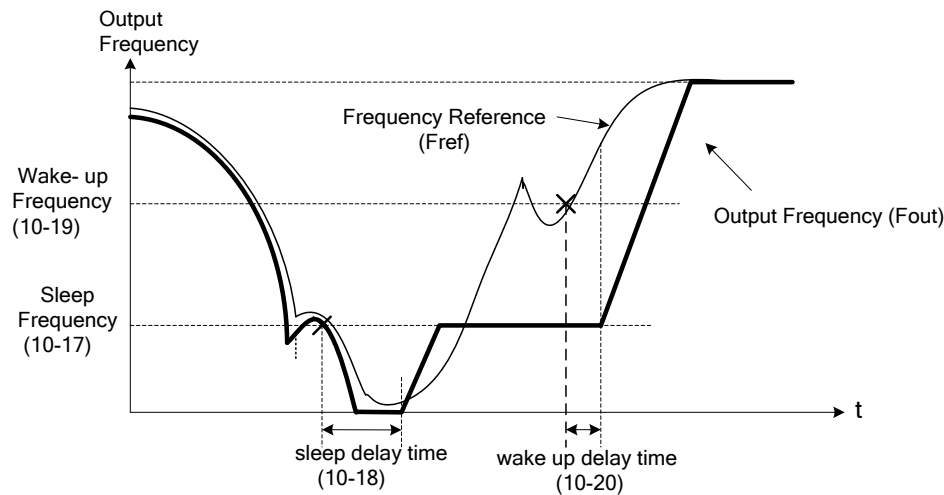


Figure 4.3.74: (c) Timing diagram of PID sleep compensation frequency/ wakeup

10-40: Selection of PID Sleep Compensation Frequency

10-40=0, refer to Figure 4.3.83(b)

When the output frequency (Fout) falls below the PID sleep frequency (10-17) for the time specified in the PID sleep delay time (10-18) the inverter will decelerate to a stop and enter sleep mode.

10-40=1, refer to Figure 4.3.83(c)

When the output frequency (Fout) falls below the PID sleep frequency (10-17), the PID sleep timer starts and the inverter decelerates to the minimum output frequency (Fmin) set by 01-08. When the sleep timer expires the inverter will enter sleep mode and run at the sleep frequency set by 10-17.

While sleep mode is active and the motor has stopped, the internal PID control is still operating. When the reference frequency increases and exceeds the wakeup frequency parameter 10-19 for the time specified in the wakeup delay time parameter 10-20, the inverter will restart and the output frequency will ramp up to the reference frequency.

Notes:

- If the wakeup frequency < sleep frequency, sleep mode is activated when the output frequency reaches the wakeup frequency. If the wakeup frequency > sleep frequency, sleep mode is activated when the output frequency reaches the sleep frequency.
- Sleep mode is only active in positive direction. When 10-25=1 (Reverse Output), sleep mode has to be disabled.
- Parameter 10-00 and 10-01 cannot be set to the same source otherwise "SE05" (PID selection error message) will be displayed on the keypad.
- When PID sleep selection is enabled or activated by digital input (10-29= 1 or 2) and PID reverse output selection 10-25=1 is selected "SE05" (PID selection error message) will be displayed on the keypad.
- When PID sleep selection is enabled or activated by digital input (10-29= 1 or 2) and PID control mode (10-03) = 1xxxb, "SE05" (PID selection error message) will be displayed on the keypad.

10-22	Start Level of PID Enable
Range	【0~400.00】

Parameter 10-22 is active when 23-00=1 (PUMP) and 10-03=xxx1b (PID enabled).

When the output frequency \geq 10-22, PID Group 1 is used to setup the PID to reduce the error between setpoint and feedback value, (P) Proportional Gain, (I) Integral Time, and (D) Differential Time are set with 10-05 / 10-06 and 10-07.

When the output frequency $<$ 10-22, PID Group 2 is used to setup the PID to reduce the error between setpoint and feedback value, (P) Proportional Gain, (I) Integral Time, and (D) Differential Time are set with 10-36 / 10-37 and 10-38.

10-27	PID Feedback Display Bias
Range	【0~9999】

PID Feedback Display Scaling

The PID feedback signal can be scaled to represent actual engineering units. Use parameter 10-33 to set the feedback signal gain for the feedback signal range maximum and parameter 10-27 to the feedback signal minimum.

Example: 0-10V or 4-20mA feedback scaled in PSI for to display pressure feedback, use 10-27 to set the pressure at 0V or 4mA feedback signal and use 10-33 to set the pressure at 10V or 20mA.

Refer to the Fig.4.3.75 for displaying the unit conversion.

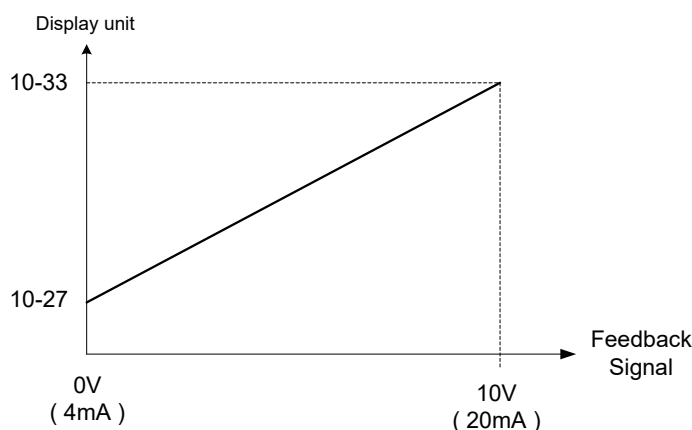


Figure 4.3.75 Feedback signal scaling

Example: Feedback signal: 0V = 0% = 1.0 PSI
 10V = 100% = 20.0 PSI
 Parameter setting: 10-27 = 10 (0% feedback)
 10-33 = 200 (100% feedback)

10-30	Upper Limit of PID Target
Range	【0 ~ 100】 %
10-31	Lower Limit of PID Target
Range	【0 ~ 100】 %

Note: PID target value will be limited to the upper and lower limit range of PID target.

10- 32	PID Switching Function
Range	【0】 : PID1 【1】 : PID2 【2】 : Set by DI 【3】 : Set by RTC

10-32=0: PID 1 function is enabled.

PID target value (setpoint) is set by 10-02 and proportional gain, integral time and differential time are set by 10-05, 10-06 and 10-07.

10-32=1: PID 2 function is enabled.

PID target value (setpoint) is set by 10-02 and proportional gain, integral time and differential time are set by 10-36, 10-37 and 10-38.

10-32=2: Set by Digital Input

If the digital input terminal is active (digital multi-function terminal set to 54), PID2 is selected. If the digital input terminal is not active PID1 is selected.

10-32=3: Set by RTC

When RTC timer is enabled, PID1 switches to PID2.

10- 33	PID Maximum Feedback Value
Range	【1~10000】

Set the PID feedback scaling, 100% of the PID feedback equals value set in 10-33.

10- 34	PID Decimal Width
Range	【0~4】

Set PID target and feedback value decimal point.

Example: 10-34=1, keypad displays shows XXX.X; 10-34=2, keypad displays XX.XX.

10- 35	PID Unit (Only display in LCD Keypad)
Range	【0~24】

Select PID engineering unit (e.g. PSI) depending on the application.

When 10-35=0, parameter of 12-38 will be used and unit will be in %.

10- 36	PID2 Proportional Gain (P)
Range	【0.00~10.00】
10- 37	PID2 Integral Time (I)
Range	【0.0~100.0】 Sec
10- 38	PID2 Differential Time (D)
Range	【0.00~10.00】 Sec

Refer to the PID function for additional information on PID2.

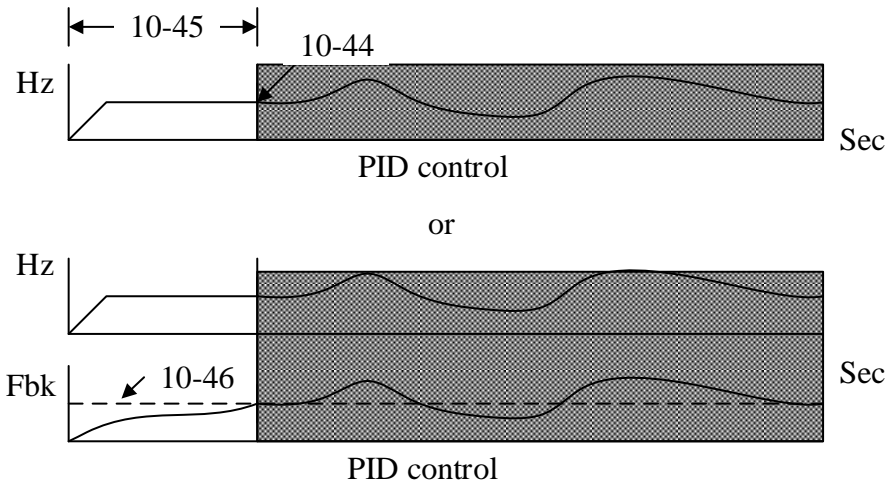
10- 39	PID Output Frequency Setting during disconnection *
Range	【0~400】 Hz

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

During a PID feedback loss condition (10-11=1) the inverter will run at a fixed output frequency set by parameter 10-39. PID operation continues when feedback loss condition is no longer active.

10-44	Precharge Frequency
Range	【0~120.0】 Hz
10-45	Precharge Time
Range	【0~250】 Sec
10-46	Precharge Target Level
Range	【0~10000】

When parameter 10-44 is set to a value greater then 0 and PID control mode is set to be 10-03=XXX1B (PID enable) precharge is enabled. Upon start the inverter will run at the precharge frequency and stops precharge operation when the precharge time set by parameter 10-45 has expired or the PID feedback signal is equal or higher than the precharge target level (parameter 10-46). Once precharge function is completed the inverter will operate in PID control.



Parameter 10-46 decimal places are set by parameter 10-34 and engineering units by 10-35. Upper limit is determined by parameter 10-33 when 10-00 (PID target value source0 is set to 4.

Group 11: Auxiliary Parameters

11- 00	Direction Lock Selection
Range	【0】 : Allow Forward and Reverse Rotation 【1】 : Only Allow Forward Rotation 【2】 : Only Allow Reverse Rotation

If Direction Lock Selection parameter 11-01 is set to 1 or 2, the motor only operates in that specific direction. A run command for the opposite direction will run in the selected direction. Forward or reverse commands can be issued via the control terminals, keypad or communication.

Note: This parameter can be used in fan and pump application where reverse rotation is prohibited.

11- 01	Carrier Frequency
Range	【0】 : Carrier Output Frequency Tuning 【1~16】 KHz

Notes:

- (1) Value 1 to 16 represents KHz.
- (2) When 11-01=0, variable carrier frequency is used see parameter 11-30~11-32.
- (3) For SLV mode, the minimum value of 11-01 is 2 kHz, due to the sample rate; It is suggested to use 4 KHz, with a motor cable length of maximum 300ft (100m).
- (4) Setting range is determined by the inverter rating (13-00).
- (5) Refer to section 3 inverter derating based on carrier frequency.
- (6) A low carrier frequency increases motor noise but reduces motor losses and temperature.
- (7) A low carrier frequency decreases RFI, EMI interference and motor leakage current.

Refer to the carrier frequency Table 4.3.11.

Carrier Frequency	1KHz	6KHz	10KHz	16KHz
Motor noise	High	-----		Low
Output current waveform (similar to sinusoidal wave)	Fair	-----	Good	----- Better
Noise interference	Low	-----		High
Leakage current	Low	-----		High
Heat loss	Low	-----		High

Table 4.3.11 Carrier frequency settings

If wire length between the inverter and the motor is too long, the high-frequency leakage current will cause an increase in inverter output current, which may affect peripheral devices. Adjust the carrier frequency to avoid this as shown in Table 4.3.12.

Table 4.3.12 Wire length and carrier frequency

Wire length	< 30 Meter (98ft)	up to 50 Meter (164 ft)	up to 100 Meter (328ft)	> 100 Meter > 328ft
Carrier frequency (11-01 value)	Max. value 16KHz (11-01=16KHz)	Max. value 10KHz (11-01=10KHz)	Maxi. value 5KHz (11-01=5KHz)	Max. value 2KHz (11-01=2KHz)

Notes:

- Reduce the carrier frequency if the torque does not match the speed.
- In V/F control mode, the carrier frequency is determined by parameters 11-30 (Carrier frequency max. limit), 11-31 (Carrier frequency lower limit) and 11-32 (Carrier frequency proportional gain) when 11-01 is set to 0.

11- 02	Soft PWM Function Selection
Range	【0】 : Disable 【1】 : Soft PWM 1 【2】 : Soft PWM 2

11-02=0: Soft PWM control disabled.

11-02=1: Soft PWM 1 control enabled. Software PWM control can improve noise produced by the motor, more comfortable for the human ear. At the same time, Software PWM also limits RFI noise to a minimum level. The default setting of Soft PWM control is disabled.

11-02=2: Soft PWM 2 control enabled. Use parameters 11-66 (2_3 Phase PWM Switch Frequency), 11-67 (Soft PWM 2 Frequency Range) and 11-68 (Soft PWM 2 Switch Frequency) to manually adjust for noise coming from the motor.

11- 66	2 Phase/ 3 Phase PWM Switch Frequency
Range	【6.00~60.00】

When the inverter's output frequency rises above the value set in 11-66 the inverter will between 2 and 3 phase modulation.

11- 67	Detection Range at Soft PWM Function 2
Range	【0~12000】
11- 68	Detecting Start Frequency at Soft PWM Function 2
Range	【6.00~60.00】

Noise detection function is enabled when the inverter output frequency rises above the value set in parameter 11-68 and the Inverter will change the electromagnetic noise in operation according to the PWM mode setting of parameter 11-67.

Notes:

When 11-02=2, the sum of 11-01+11-67 cannot higher than the upper limit of carrier frequency, please refer to the error conditions:

An error message is shown when parameter 11-02=2 and the sum of 11-66+11-67 is higher than the upper limit of the carrier frequency, adjust the value of 11-02 or 11-67.

11- 03	Automatic Carrier Lowering Selection
Range	【0】 : Disable 【1】 : Enable

11-03=0: Automatic carrier frequency reduction during an overheat condition is disabled.

11-03=1: Carrier frequency is automatically lowered in case the inverter heatsink overheated and will return to carrier frequency set in parameter 11-01 when the inverter temperature returns to normal. See section 3 for more information.

11- 04	S-curve Time Setting at the Start of Acceleration
11- 05	S-curve Time Setting at the End of Acceleration
11- 06	S-curve Time Setting at the Start of Deceleration
11- 07	S-curve Time Setting at the End of Deceleration
Range	【0.00~2.50】 Sec

The S curve function for acceleration / deceleration is used to reduce mechanical impact caused by the load during momentary starting and stopping of the inverter. To use the S curve function set the time for acceleration start point (11-04), acceleration end point (11-05), deceleration start point (11-06) and deceleration end point (11-07). Refer to Fig.4.3.76 for more information.

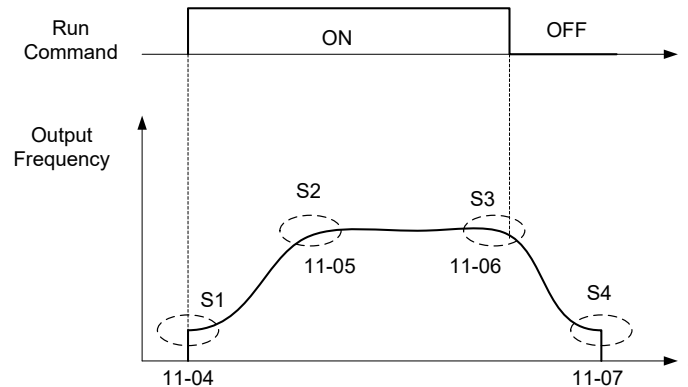


Figure 4.3.76 S curve characteristic

Total acceleration and deceleration time when the S curve is used:

$$\text{Accelerating time} = \text{Accelerating time 1 (or 2)} + \frac{(11-04) + (11-05)}{2}$$

$$\text{Deceleration time} = \text{Deceleration time 1 (or 2)} + \frac{(11-06) + (11-07)}{2}$$

11- 08	Jump Frequency 1
11- 09	Jump Frequency 2
11-10	Jump Frequency 3
Range	【0.0~400.0】 Hz
11-11	Jump Frequency Width
Range	【0.0~25.5】 Hz

These parameters allow “jumping over” of certain frequencies that can cause unstable operation due to resonance within certain applications.

Note: Prohibit any operation within the jump frequency range. During acceleration and deceleration the frequency is continuous without skipping the jump frequency.

To enable jump frequency 1 – 3 (11-08 – 11-10) set the frequency to a value greater than 0.0 Hz.

Use the jump frequency width (11-11) to create a jump frequency range. Refer to Fig.4.3.77.

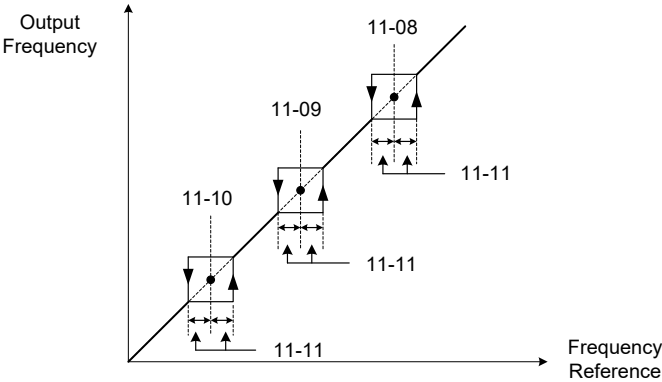


Figure 4.3.77 Jump frequency operation

Jump frequency via Analog Input.

Set parameter 04-05 (AI2 function selection) to 9 (frequency jump setting 4) for controlling the jump frequency via analog input AI2. Refer to Fig. 4.3.38.

Note: When jump frequency overlap the sum of the overlapped jump frequencies will be used as the jump frequency range. Refer to Fig.4.3.78.

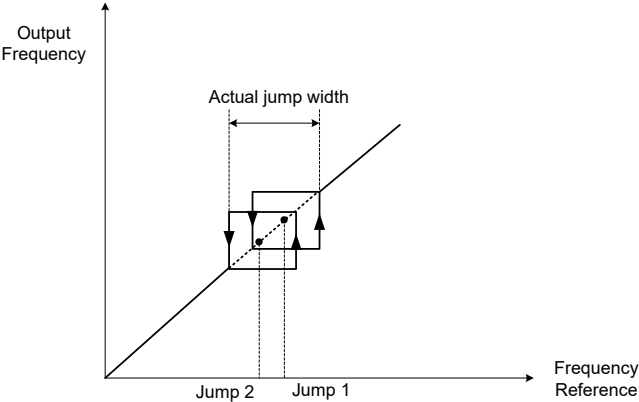


Figure 4.3.78 Jump frequency overlap

11- 13	Automatic Return Time
Range	【0~120】 Sec

If no keypad button is pressed within the time set by 11-13, it will automatically return to the mode screen.

When it is set to 0, function of automatic return key is off. Press the return key to return to the previous directory.

11- 12	Manual Energy Saving Gain
Range	【0~100】 %
11- 18	Manual Energy Saving Frequency
Range	【0.00~400.00】 Hz

Manual energy savings reduces the output voltage for the purpose of saving energy.

To enable manual energy savings set one of the multi-function digital input (03-00 to 03-05) to 20 and activate the input or use parameter 11-18 to set the manual energy savings activation frequency.

When the output frequency rises above the value set in parameter 11-18 manual energy savings function is enabled. Setting parameter 11-18 manual energy savings frequency to 0.0 Hz disables the manual energy savings frequency activation function. Refer to Figure 4.3.88 for more information.

Note: Only use manual energy savings functions in combination with light loads.

Manual energy saving gain (11-12) determines the output voltage of the inverter when manual energy savings is enabled. Output voltage is percentage gain times the V/F voltage.

Manual energy saving control uses the voltage recovery time (07-23) to change the output voltage, refer to figure 4.3.79.

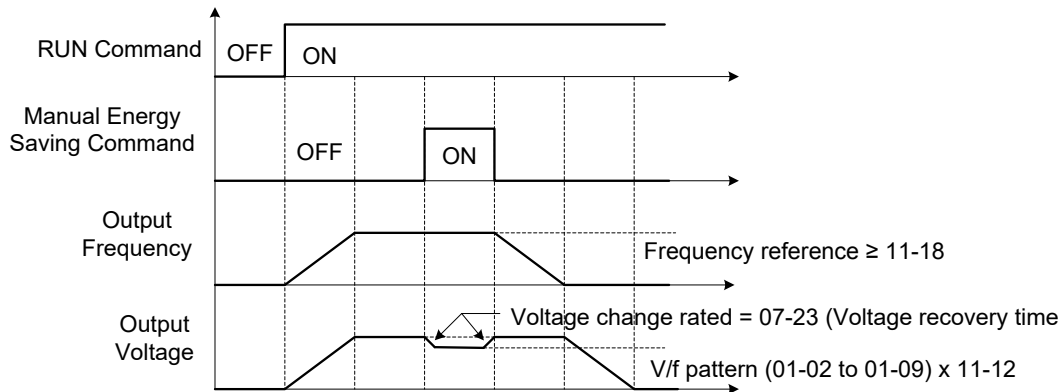


Figure 4.3.79 Manual energy saving operation

11- 19	Automatic Energy Saving Function
Range	【0】 : Automatic Energy Saving is Disabled. 【1】 : Automatic Energy Saving is Enabled.
11- 20	Filter Time of Automatic Energy Saving
Range	【0~200】 msec
11- 21	Voltage Upper Limit of Energy Saving Tuning
Range	【0~100】 %
11- 22	Adjustment Time of Automatic Energy Saving
Range	【0~5000】 msec
11- 23	Detection Level of Automatic Energy Saving
Range	【0~100】 %
11- 24	Coefficient of Automatic Energy Saving
Range	【0.00~655.34】

In the V/F control mode the automatic energy saving (AES) function automatically adjusts the output voltage and reduces the output current of the inverter to optimize energy savings based on the load. The output power changes proportional to the motor load. Energy savings is minimal when the load exceeds 70% of the output power and savings is greater when the load decreases.

AES function is suitable for variable torque loads such as fan or pump application. Do not use this function to when the motor load is unstable to avoid having not enough output torque required for the application.

These parameters have been factory set and for most application does not to be adjusted. If the motor characteristic are different from the TECO standard adjusting may be required, please refer to the following commands for adjusting these parameters:

Enable Automatic Energy Savings Function

- (1) To enable automatic energy saving function set 11-19 to 1.
- (2) Adjust automatic energy savings filter time (11-20)
- (3) Adjust energy savings parameters (11-21 to 11-22)

In AES mode, the optimum voltage value is calculated based on the load power requirement. Adjusting motor voltage will also affect motor temperature and motor performance.

In certain applications the optimum AES voltage needs to be adjusted in order to achieve optimum energy savings. Use the following AES parameters for manual adjustment:

11-21: Voltage limit value of AES commissioning operation

Set the voltage upper limit during automatic energy saving. 100% corresponds to the value in parameter 01-03 (Maximum Output Voltage) depending on the inverter class used. Refer to the Fig.4.3.80.

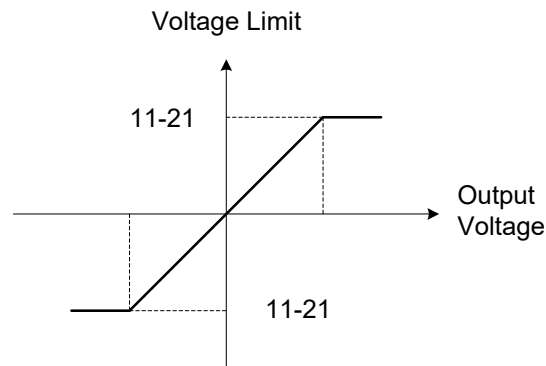


Figure 4.3.80 Voltage limit value of commissioning operation

11-22: Adjustment time of automatic energy saving

Set sample time constant for measuring output power.

Reduce the value of 11-22 to increase response when the load changes.

Note: If the value of 11-22 is too low and the load is reduced the motor may become unstable.

11-23: Detection level of automatic energy saving

Set the automatic energy saving output power detection level.

11-24: Coefficient of automatic energy saving

The coefficient is used to tune the automatic energy saving. Adjust the coefficient while running the inverter on light load while monitoring the output power. A lower setting results in a lower output voltage.

Notes:

- If the coefficient is set to low the motor may stall.
- Coefficient default value is based on the inverter rating. Adjust parameter 13-00 if the motor power does not match the inverter rating.

11- 29	Auto De-rating Selection
Range	【0】 : Disable 【1】 : Enable

The automatic de-rating function automatically reduces the output frequency by 30% of the nominal motor speed when the inverter detects an overheat condition (heatsink).

Automatic de-rating function depends on the automatic carrier frequency reduction selection (11-03).

If automatic carrier frequency reduction is disabled (11-03=0), the output frequency is reduced by 30% of the nominal motor speed when an overheat condition is detected.

If automatic carrier frequency reduction is enabled (11-03=1), the output frequency is reduced by 30% of the nominal motor speed when the carrier frequency is at its minimum setting.

11-29=0: Auto de-rating selection disabled, carrier frequency is based on 11-01 or 11-03.

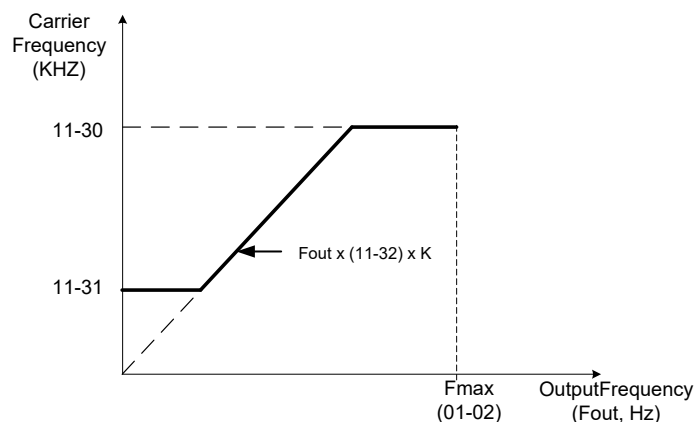
11-29=1: Auto de-rating selection is enabled.

11- 30	Variable Carrier Frequency Max. Limit
Range	【2~16】 KHz
11- 31	Variable Carrier Frequency Min. Limit
Range	【1~16】 KHz
11- 32	Variable Carrier Frequency Proportional Gain
Range	【00~99】

Carrier frequency method depend on the selected control mode.

Control Mode	Variable Carrier Frequency (11-01 = 0)	Fixed Carrier Frequency (11-01 = 2-16 kHz)
V/F	Available	Available
SLV	Not available	Available

Variable carrier frequency can be adjust with parameter 11-30 ~ 11-32.



K is a coefficient; the value of K is based on the following based on the maximum carrier frequency:

K=1: when 11-30 < 5 KHz

K=2: when 10 KHz > 11-30 ≥ 5 KHz

K=3: when 11-30 ≥ 10KHz

Notes:

- In V/F control mode if the speed and torque are constant, the variable carrier frequency mode (11-01=0) can be selected to reduce the carrier frequency based on output frequency.
- If the carrier frequency proportional gain (11-32) > 6 and 11-30 < 11-31, error message "SE01" out of range will appear on the keypad.
- If the minimum limit (11-31) is set higher than the maximum limit (11-30), the minimum limit will be ignored and the carrier frequency will be set at the highest limit (11-30).
- In fixed carrier frequency mode (11-01 = 2-16) parameters 11-30, 11-31 and 11-32 are not used.
- In SLV control mode, the maximum limit of the carrier frequency is fixed at 11-30.

11- 28	Frequency Gain of Overvoltage Prevention 2
Range	【1~200】 %
11- 33	Rise Amount of DC Voltage Filter
Range	【0.1~10.0】 V
11- 34	Fall Amount of DC Voltage Filter
Range	【0.1~10.0】 V
11- 35	Dead band Level of DC Voltage Filter
Range	【0.0~99.0】 V

11- 36	Frequency gain of OV prevention
Range	【0.000~1.000】
11- 37	* Frequency limit of OV prevention
Range	【0.00~400.00】 Hz
11- 38	Deceleration start voltage of OV prevention
Range	200V : 【200~400】 V 400V : 【400~800】 V
11- 39	Deceleration end voltage of OV prevention
Range	200V : 【300~400】 V 400V : 【600~800】 V
11- 40	OV prevention selection
Range	【0】 : Disable 【1】 : OV prevention Mode 1 【2】 : OV prevention Mode 2 【3】 : OV Prevention Mode 3

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

Overvoltage suppression is used in application that will likely cause regenerative energy.

Example: Press Application

In this application there are two conditions causing regenerative energy back to the inverter and therefore recharging the DC bus.

- (1) When the brake is not set, the motor will accelerate and rotate the flywheel. When motor decelerates, the rotation speed will exceed the motor speed due to the large flywheel's inertia feeding back regenerative energy to the inverter resulting in an increased DC bus.
- (2) When the brake is set, the motor will rotate the flywheel and compress the spring. At the highest point when the press moves beyond its center, the spring will release its stored energy back to the flywheel and therefore feeding back regenerative energy to the inverter resulting in an increased DC bus.

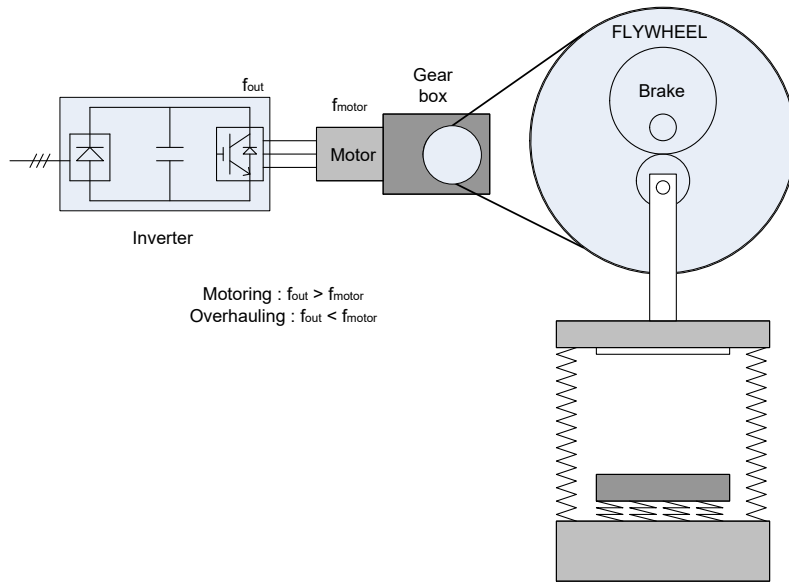


Figure 4.3.80.a Stamping Operation

Over-voltage prevention (OVP) function monitors the DC-bus voltage and adjusts the speed reference, acceleration and deceleration rate, to prevent the inverter from tripping on an overvoltage condition.

When the speed reference is reduced, the motor will start to decelerate. When the inverter is operating at a fixed output frequency and excessive regenerative energy back to the inverter is detected the inverter will accelerate the motor in order to reduce the DC-bus voltage. Refer to Figure 4.3.80.b.

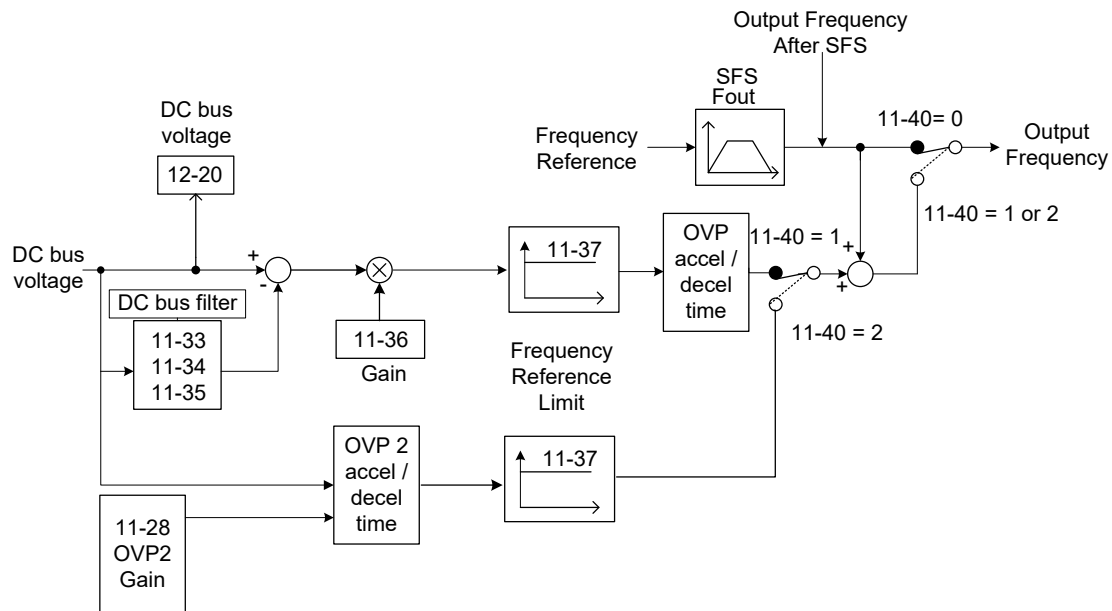


Figure 4.3.80.b operation

11-40=1: OV prevention Mode 1

1) DC voltage filter is used to provide a stable reference value for determining the change in DC voltage during regenerative operation.

- Adjust the DC voltage filtering increase rate parameter 11-33 (DC Voltage Filter Rise Amount). When the DC voltage exceeds 11-33 +11-35 (DC Voltage Filter Dead-band Level), the output of the filter will increase.
- Adjust the DC voltage filtering decrease rate parameter 11-34 (DC Voltage Filter Fall Amount). When the DC voltage exceeds 11-33 +11-35 (DC Voltage Filter Dead-band Level), the output of the filter will decrease.
- Monitor the DC voltage filter output by 12-20 (DC voltage filter value).
- Set the DC voltage filter decrease rate (11-34) to a greater value than the value of the DC voltage filtering increase rate (11-33).

2) When the inverter is operating at a fixed output frequency, the OVP function will monitor the DC-bus voltage to detect regenerative operation.

In case of a regenerative condition the inverter calculates the delta DC bus voltage value and multiplies the value with parameter 11-36, the result is added to the frequency reference accelerating the motor to prevent on an overvoltage condition.

When the regenerative energy decreases, the inverter output frequency will return to the actual frequency reference. Deceleration rate is based on the DC voltage, as shown in Figure 4.3.80.c.

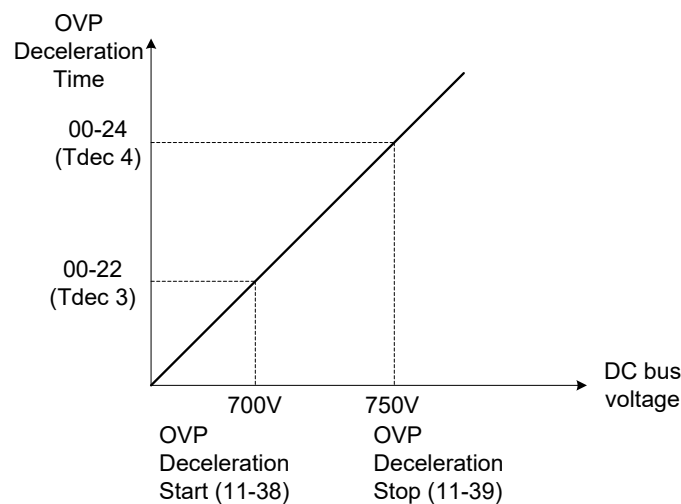


Figure 4.3.80.c OVP deceleration time

3) When the inverter is stopped, the deceleration rate can be set with parameter 00-15 (Tdec1). In case the DC voltage is too high, the inverter will decelerate based on the OVP deceleration time as shown in Figure 4.3.80c.

- Set DC-bus voltage in parameter 11-38 (start voltage of OVP deceleration) and set OVP deceleration rate in 00-22 (Tdec3).
- When the DC voltage reaches this level, it is necessary to decelerate rapidly in order to prevent the delta DC voltage of becoming too large.
- When DC voltage reaches the setting of 11-39 (stop voltage of OVP deceleration), it will decelerate based on the set value of 00-24 (Tdec4)
- Deceleration rate is linear based on the slope defined by the start point (11-38) and end point (11-39).

4). Enable the OVP function with parameter 11-40 set to 1 or 2. The following parameter default values will be

changed when the OVP function is enabled:

07-09=1 (Stop mode: coast to stop)

00-14(Tacc1) = 5.0 Sec (the frequency reference acceleration rate when DC voltage is too high.)

00-22(Tdec3) = 20.0 Sec (low setting point of OVP deceleration rate).

00-24(Tdec4) = 100.0 Sec (high setting point of OVP deceleration rate).

Note: S curve should be disabled when using the OVP function (11-04~11-07=0.0sec).

11-40=2: OV prevention Mode 2

This mode is similar to OV prevention mode 1 but uses frequency gain of OV prevention 2 (11-28) in combination with the accel/decel times, see Fig. 4.4.80b and 4.4.80c for additional information.

11-40=3: OV prevention Mode 3

In this mode the inverter will raise the output frequency temporarily to avoid an OV condition; the output frequency will not go higher than the value of 01-02 (Maximum Output Frequency of Motor 1). Please adjust the value of 01-02 according to application. Raise the value of 11-64 in 0.1 increments if an OV condition still occurs when 11-40=3 is selected.

11- 64	Acceleration Speed Gain Adjustment
Range	【0.1~10.0】
11- 65	Target Main Circuit Voltage
Range	200V : 【200~400】 V 400V : 【400~800】 V

When 11-40 =3 (OV Prevention Mode 3), user can temporarily increase the output frequency to avoid an OV condition from occurring. The maximum output frequency of motor 1 is limited to the value set in parameter 01-02 (maximum output frequency of motor 1); adjust 10-02 depending on the application.

Adjustment modes

If an OV condition still occurs in using prevention mode 3, increase the value of parameter 11-64 in 0.1 increments. Note: increasing value of parameter 11-64 results in an increase in motor speed and current.

11- 41	Reference Frequency Loss Detection
Range	【0】 : Deceleration to Stop when Reference Frequency Disappears 【1】 : Operation is Set by 11-42 when Reference Frequency Disappears
11- 42	Reference Frequency Loss Level
Range	【0.0~100.0】 %

A reference frequency loss is detected when the frequency command falls 90% within 360ms.

When 11-41=1, the main frequency command is continuously compared with the previous value of the reference within the 360ms sample rate

When a frequency reference loss occurs the inverter set the Frequency command to the maximum output frequency of motor 1 (01-02) x the level set in parameter 11-42

Note: When reference command is restored reference operation returns to before the reference loss condition.

Notes:

1. Frequency command (11-42) 100% corresponds to the maximum output frequency of motor 1 (01-02).
2. Reference loss detection can only be use when frequency reference is set via an analog signal (1: AI1; 7: AI2) see main frequency source (00-05).

Fig.4.3.81 shows the operation of the multi-function digital output (03-11~03-12) set for reference loss during a frequency reference loss condition.

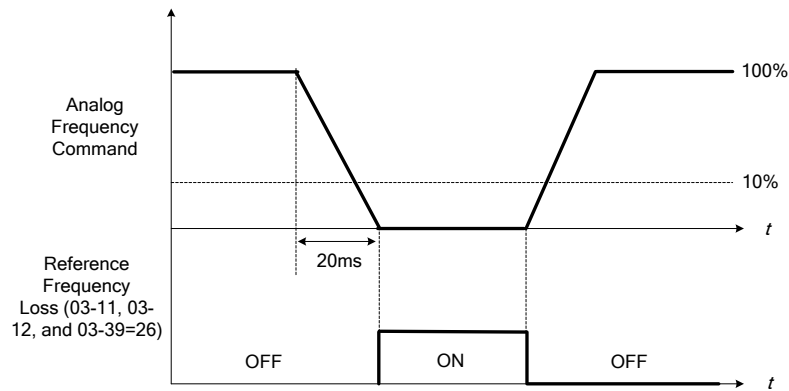


Figure 4.3.81 Operation for reference frequency loss

11- 43	Hold Frequency at Start
Range	【0.0~400.0】 Hz
11- 44	Frequency Hold Time at Start
Range	【0.0~10.0】 Sec
11- 45	Hold Frequency at Stop
Range	【0.0~400.0】 Hz
11- 46	Frequency Hold Time at Stop
Range	【0.0~10.0】 Sec

The hold function is used to temporarily hold the reference frequency, in order to prevent stalling the motor or preventing an over current condition during starting or stopping due to load conditions.

During start, the inverter will operate at the hold frequency at start for the time specified in the parameter 11-44 in order to establish the magnetic flux.

Note: The acceleration or deceleration time does not include the start and stop hold time. Refer to the Fig. 4.3.82.

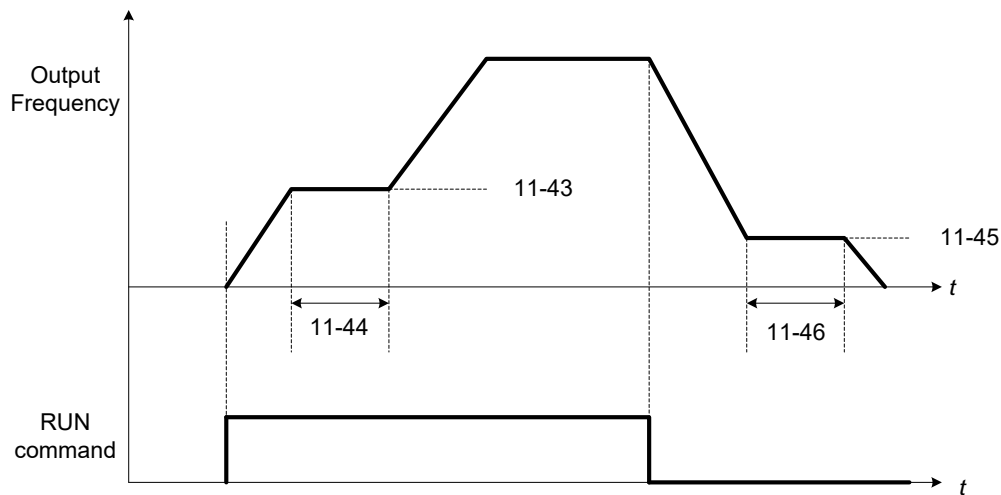


Figure 4.3.82 Reserved function

When the inverter is in stop mode, this function can also be used to prevent wind milling. In addition, it can be used for the purpose of braking using the motor to consume the braking energy resulting in a better controlled stop. Refer to the DC brake parameter 07-16 for DC braking during start.

Notes:

- The hold function at start is inactive when the hold frequency at start (11-43) is set to a value less than Fmin (01-08).
- The hold function at stop is inactive when the hold frequency at stop (11-45) is set to a value less than Fmin (01-08).

11- 47	KEB Deceleration Time
Range	【0.0~25.5】 Sec
11- 48	KEB Detection Level
Range	200V : 【190~210】 V 400V : 【380~420】 V

KEB function can be used to keep the inverter from tripping on a under voltage condition due to a momentary power-loss. To enable the KEB function set parameter 11-47 to a value greater than 0.0 sec.

Upon detection of a power-loss the inverter uses the KEB deceleration time (11-47) to decelerate the motor and using the regenerative energy from the motor to maintain the DC-bus at a nominal level.

11-48: KEB detection level

If the DC-bus voltage falls below the value set in 11-48, the KEB is activated and the inverter starts decelerating according to the value set in 11-47.

To accelerate back to the original output frequency one of the digital inputs (03-00 to 03-05) set for 48 (KEB acceleration) has to be activated and the DC voltage has to rise above 11-48 + delta V (Delta V = +10V for 200V series, Delta V = +20 V for 400V series).

Refer to the example in Fig.4.3.83.

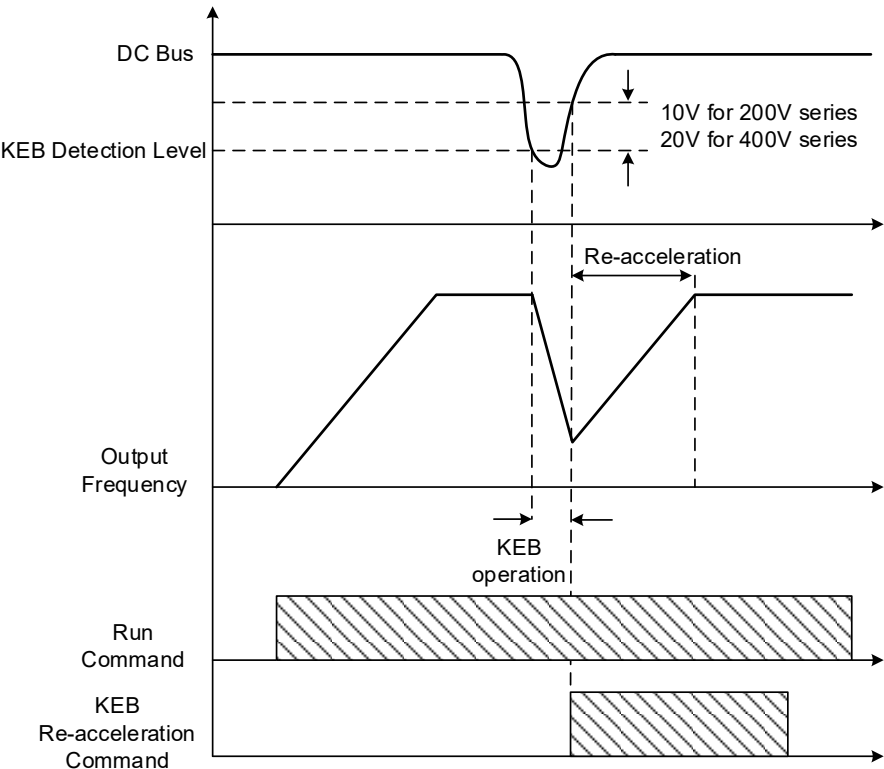


Figure 4.3.83 KEB operation

11- 51	Braking Selection of Zero Speed
Range	【0】 : Disable 【1】 : Enable

11-51: Operation selection of zero-speed braking

In V/F control mode, the DC braking operation can be used to the motor shaft.
Set 11-51 to select zero-speed braking operation to 1 to enable this function.

To use DC braking operation set parameter 00-02 (operation command selection) to 1 and parameter 00-05 (frequency reference selection) to 1, the operation command and frequency reference are now set for external control. When the frequency reference is 0V (or less than 4mA), and the operation command is turned on, the zero-speed 'DC' braking operation is activated and holding torque is generated using DC braking.

Refer to Fig.4.3.84 for more information on zero-speed DC braking operation.

Note: DC braking 07-07 is limited to 20% of the inverter rated current.

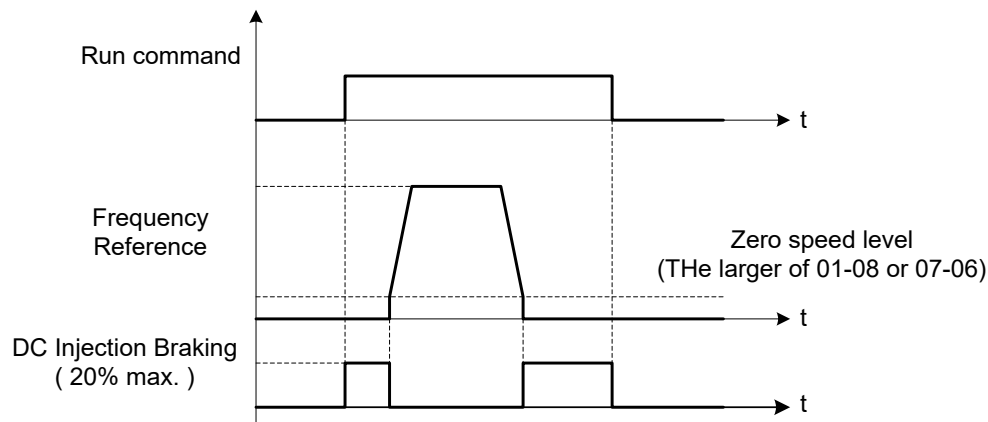


Figure 4.3.84 Zero-speed braking operation

11- 54	Initialization of Cumulative Energy
Range	【0】 : Do not Clear Cumulative Energy 【1】 : Clear Cumulative Energy

Reset the cumulative energy (kWhr) (12-67) and the cumulative energy (MWhr) (12-68) via parameter 11-54.

11- 55	STOP Key Selection
Range	【0】 : Stop Key is Disabled when the Operation Command is not Provided by Keypad. 【1】 : Stop Key is Enabled when the Operation Command is not Provided by Keypad.

11-55= 0: Stop button disabled when operation command is set for terminals (00-02=1) or communication (00-02=3).

11-55= 1: Stop button enabled.

11- 56	UP/DOWN Selection
Range	【0】 : When UP/DOWN in Keypad is Disabled, it will be Enabled if Pressing ENTER after Frequency Modification. 【1】 : When UP/DOWN in Keypad is Enabled, it will be Enabled upon Frequency Modification.

11-56= 0: Changing the reference frequency on the keypad in UP/DOWN control requires the ENTER button to be pressed for the inverter to accept the modified reference frequency.

11-56= 1: Changing the reference frequency on the keypad in UP/DOWN control immediately changes the reference frequency and there for the output frequency.

Note: The reference frequency can be changed (up or down) via the keypad or by setting one of multi-functional digital input terminals (03-00 to 03-05) to 8 and 9. Refer to instructions of (03-00 to 03-05 = 8 or 9).

11- 58	Record Reference Frequency
Range	【0】 : Disable 【1】 : Enable

This function is enabled only when one of multi-function digital input terminals (03-00 to 03-07) is set to 11 (ACC / DEC Inhibition command).

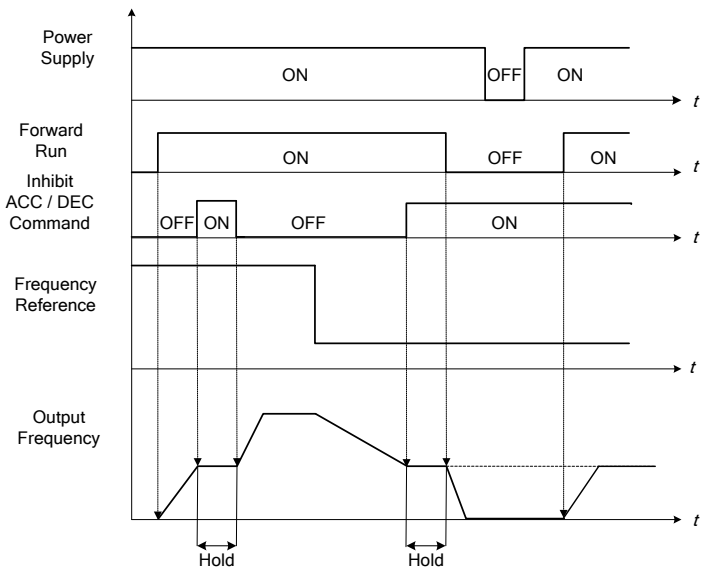
11-58= 0: When ACC / DEC inhibit command is enabled, the motor will stop accelerating or decelerating and the frequency at that moment will be used as frequency command. If ACC / DEC inhibit command is disabled or a stop command is active, the frequency command will return to its original frequency.

When a stop command active, power is turned off the frequency will be set to 0 Hz

Note: If ACC/DEC inhibit command is enabled before running, the display shows STP0 after running to indicate that there is no reference frequency record.

11-58= 1: When ACC / DEC inhibit command is enabled, the output frequency is recorded and used as frequency command. When the inverter is stopped with ACC / DEC inhibit command active and power is turned off, the frequency command is recorded and restored after power has been restored.

Please refer to the following figure.



11- 59	Gain of Preventing Oscillation
Range	【0.00~2.50】

This parameter is used to prevent motor oscillation (hunting prevention).
If oscillation (hunting) occurs under normal operation (normal duty mode), increase the setting value by 0.01 increments.

11- 60	Upper Limit of Preventing Oscillation
Range	【0~100】 %

Motor oscillation (hunting) prevention upper limit.

11- 61	Time Parameter of Preventing Oscillation
Range	【0~100】

Hunting prevention response delay time is the delay time used to prevent motor oscillation.

11- 62	Prevention of Oscillation Selection
Range	【0】 : Mode 1 【1】 : Mode 2 【2】 : Mode 3

11-62=0: Mode 1, lower response to prevent oscillation.

11-62=1: Mode 2, medium response to prevent oscillation.

11-62=2: Mode 3, fast response to preventing oscillation.

11- 63	Flux- Strengthening Selection
Range	【0】 : Disable 【1】 : Enable

11-63=0: It has no function of flux-strengthening, the no-load current of high speed and low speed are the same.

11-63=1: It has function of flux-strengthening, the torque of low speed is higher, but the no-load current is also higher, it is suitable for big load in low speed.

11- 69	Gain of Preventing Oscillation 3
Range	0.00~200.00 %

Increase value in steps of 0.01 in case of motor vibration in ND mode.

11- 70	Upper Limit of Preventing Oscillation 3
Range	0.01~100.00 %

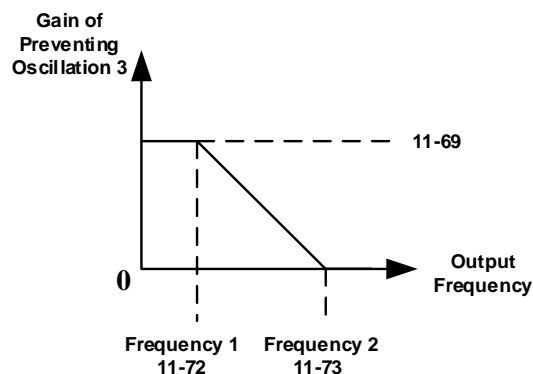
Set upper limit for the oscillation prevention function.

11- 71	Time Parameter of Preventing Oscillation 3
Range	0~30000 ms

Set oscillation 2 prevention response time. A lower value increases response time but may cause instability.

11- 72	Switch Frequency 1 for Preventing Oscillation Gain
Range	0.01~300.00 Hz
11- 73	Switch Frequency 2 for Preventing Oscillation Gain
Range	0.01~300.00 Hz

Parameters 11-72 and 11-73 define the oscillation prevention mode switching frequencies.



Group 12: Monitoring Parameters
--

12- 00	Display Screen Selection (LED)	
Range	Highest bit => <u>0 0 0 0 0</u> <= lowest bit The value range of each bit is 0~7 from the highest bit to the lowest bit,	
	【0】 : No display 【2】 : Output Voltage 【4】 : heatsink Temperature 【6】 : AI1 Value	【1】 : Output Current 【3】 : DC Bus Voltage 【5】 : PID Feedback 【7】 : AI2 Value

Note: The highest bit is used for power-up monitor. The 4 least significant bits can be used to customize the display sequence see section 4.1.3.

12- 01	PID Feedback Display Mode (LED)	
Range	【0】 : Display the Feedback Value as Integer (xxx) 【1】 : Display the Feedback Value with one decimal place (xx.x) 【2】 : Display the Feedback Value with two decimal places (x.xx)	
12- 02	PID Feedback Display Unit Setting (LED)	
Range	【0】 : xxxxx (no unit) 【1】 : xxxPb (pressure) 【2】 : xxxFL (flow)	

When 12-00= xxx5, PID Feedback value is based on the scaling set in parameter 10-33 and displays the feedback value as XXX.XX.

For example, when parameter 10-33= 9999,
 12-01=0, the default display is 99;
 12-01=1, the default display is 99.9;
 12-01=2, the default display is 99.99;

When 12-01=1 and 12-02=1, the display will show 99.9Pb using five segments; when 12-01=2 and 12-02=2, the display shows 9.99FL and tenth digit most significant digit 9 is not shown.

12- 03	Line Speed Display (LED)	
Range	【0~60000】 RPM	
12- 04	Line Speed Display Mode (LED)	
Range	【0】 : Display Inverter Output Frequency 【1】 : Line Speed Display as Integer.(xxxxx) 【2】 : Line Speed Display with One Decimal Place. (xxxx.x) 【3】 : Line Speed Display with Two Decimal Places. (xxx.xx) 【4】 : Line Speed Display with Three Decimal Places. (xx.xxx)	

12-04≠0, line speed is always displayed in run or stop mode. Set 12-03 to the maximum line speed that corresponds to the maximum output frequency.

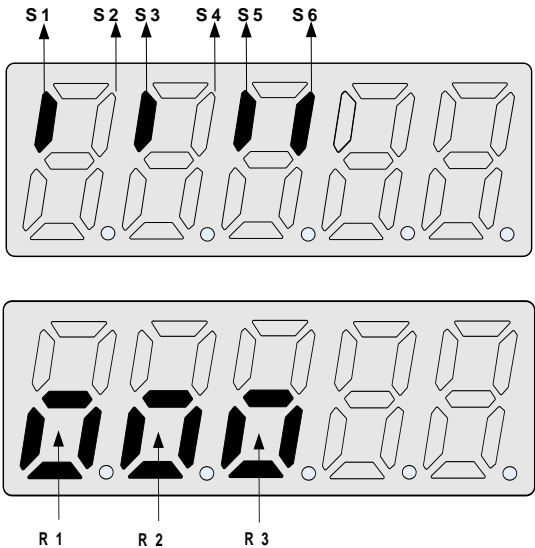
Example: Line speed display 12-03 is 1800, the keypad display will show 900 when the output frequency is 30Hz.

12- 05	Status Display of Digital Input Terminal (LED/LCD)
Range	Read-only

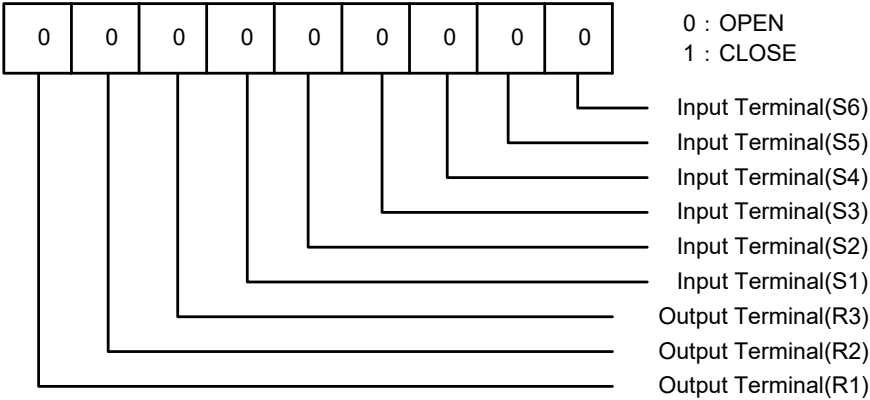
Terminals S1-S6 are represented using two segments of each digit. Segment turns on when input is active. The bottom segments of each of the first three digits are used to represent the digital outputs (R1, R2, R3). Segments turn on when output is active.

When operation command is changed to PLC, press RUN key and it will light up.

Example1: S1~S6, R1, R2 and R3 are ON



Example2: S1~S6, R1, R2 and R3 are OFF



Note: Refer to section 4.3 for other monitor parameters 12-11~12-79.

Monitor parameters 12-67 (KWHr) and 12-68 (MWHr) displays energy used.

Note: Parameter 11-54 can clear the monitor parameter.

If monitor parameter 12-76 (No-load voltage) is required refer to the descriptions of parameter 02-09 (Motor 1 excitation current) and 17-09 (Motor excitation current).

Group 13 Maintenance Function Group
--

13- 00	Inverter Rating Selection
Range	----

Inverter model	13- 00 display	Inverter model	13- 00 display
F510-2001-XXX	201	F510-4001-XXX	401
F510-2002-XXX	202	F510-4002-XXX	402
F510-2003-XXX	203	F510-4003-XXX	403
F510-2005-XXX	205	F510-4005-XXX	405
F510-2008-XXX	208	F510-4008-XXX	408
F510-2010-XXX	210	F510-4010-XXX	410
F510-2015-XXX	215	F510-4015-XXX	415
F510-2020-XXX	220	F510-4020-XXX	420
F510-2025-XXX	225	F510-4025-XXX	425
F510-2030-XXX	230	F510-4030-XXX	430
F510-2040-XXX	240	F510-4040-XXX	440
F510-2050-XXX	250	F510-4050-XXX	450
F510-2060-XXX	260	F510-4060-XXX	460
F510-2075-XXX	275	F510-4075-XXX	475
F510-2100-XXX	2100	F510-4100-XXX	4100
F510-2125-XXX	2125	F510-4125-XXX	4125
F510-2150-XXX	2150	F510-4150-XXX	4150
F510-2175-XXX	2175	F510-4175-XXX	4175
		F510-4215-XXX	4215
		F510-4250-XXX	4250
		F510-4300-XXX	4300
		F510-4375-XXX	4375
		F510-4425-XXX	4425
		F510-4535-XXX	4535
		F510-4670-XXX	4670
		F510-4800-XXX	4800

13- 01	Software Version
Range	0.00-9.99
13- 02	Clear Cumulative Operation Hours Function
Range	【0】 : Disable 【1】 : Clear Cumulative Operation Hours
13- 03	Cumulative Operation Hours 1
Range	【0~23】 hours
13- 04	Cumulative Operation Hours 2
Range	【0~65534】 days
13- 05	Selection of Accumulative Operation Time
Range	【0】 : Accumulative time in power on 【1】 : Accumulative time in operation

When 13-02 is set to 1, values in 13-03/13-04 will be cleared.

13-05= 0: Inverter logs the time when the inverter is powered-up.

13-05= 1: Inverter logs the time when the inverter is running.

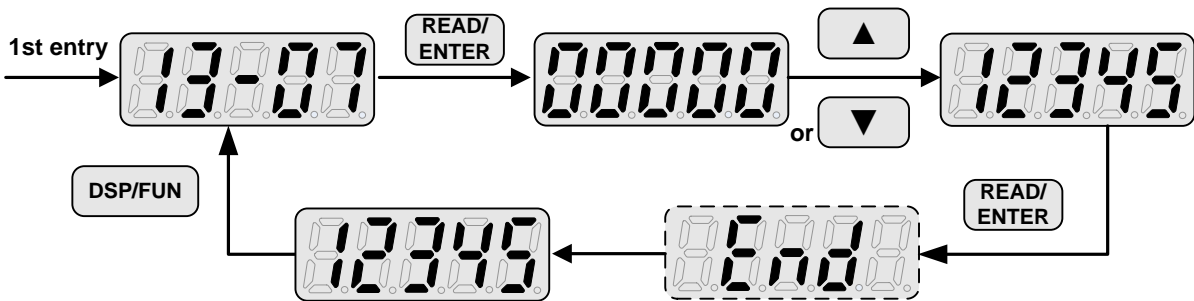
13- 06	Parameters Locked
Range	【0】 : Parameters are read-only except 13-06 and main frequency 05 【1】 : Only user parameter are enabled. 【2】 : All parameters are writable.

13- 07	Parameter Password Function
Range	【00000~65534】

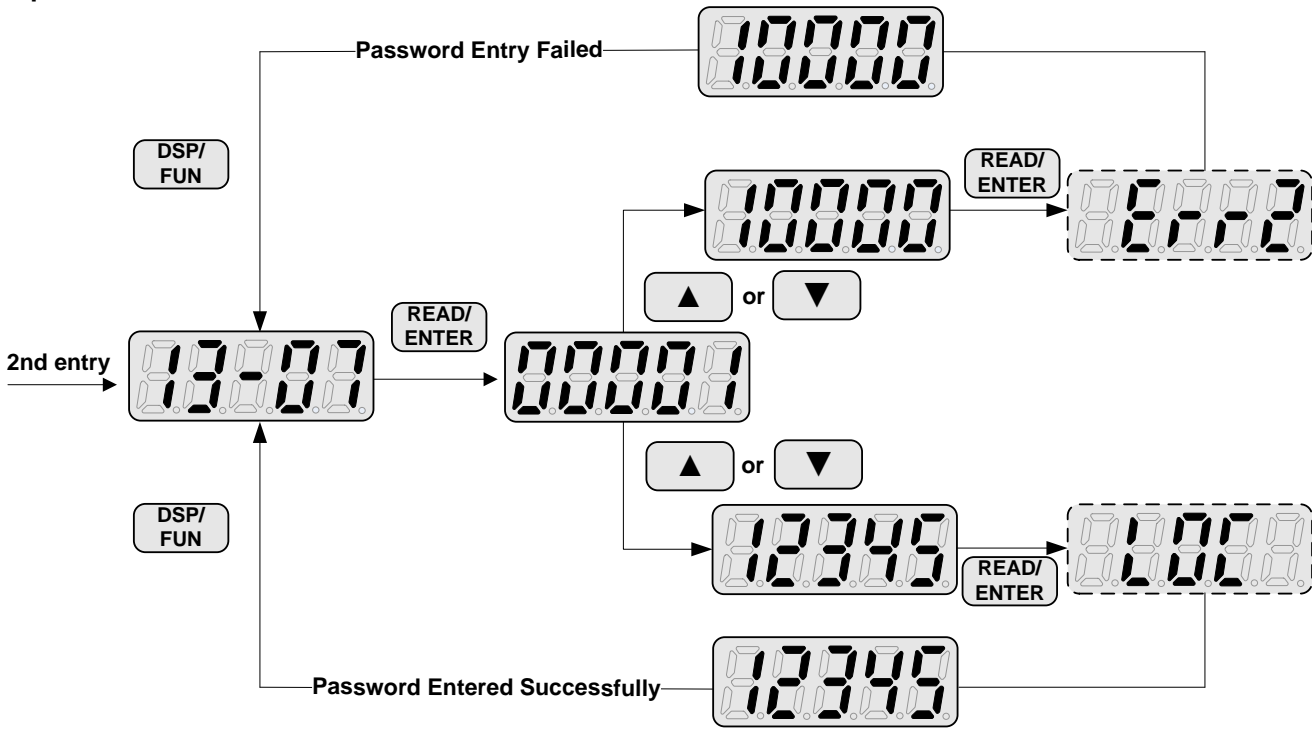
When parameter lock key code is enabled (13- 07>0), all parameters except the main frequency can be modified.

Example: Setting parameter lock key number

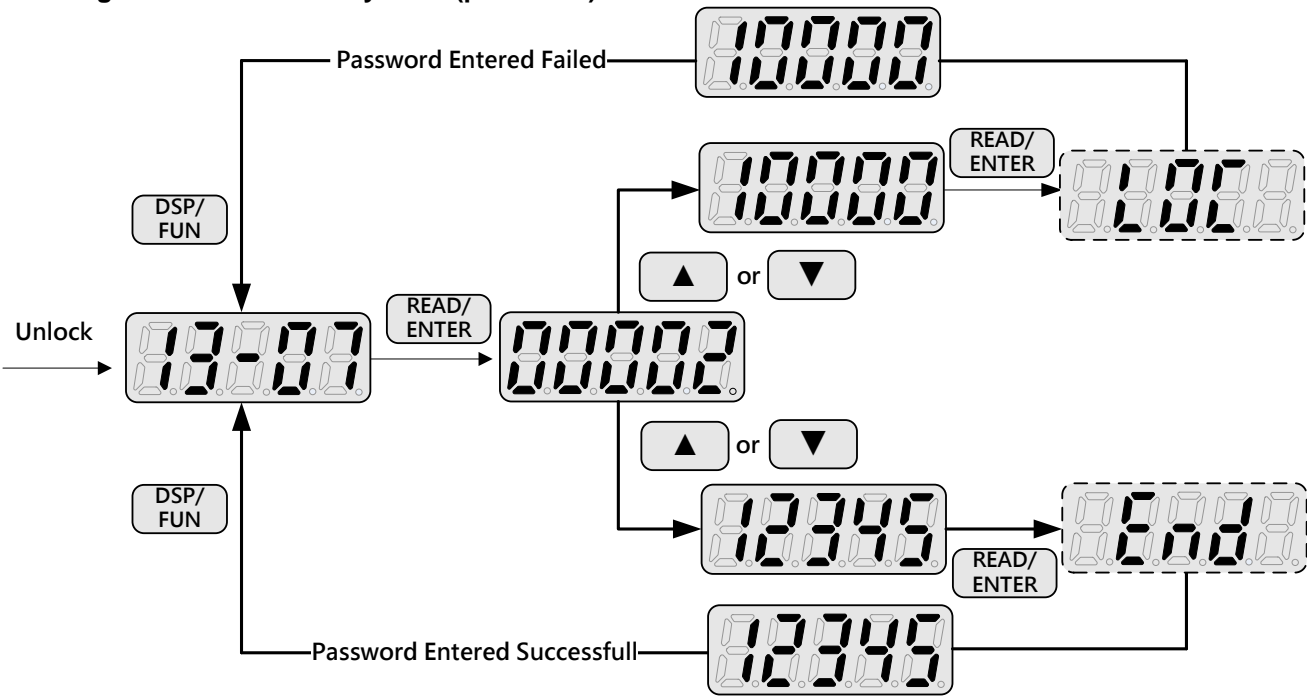
Step 1:



Step 2:



Unlocking the inverter with key code (password):



13- 08	Restore Factory Setting
Range	【0】 : No Initialization
	【1】 : Reserved
	【2】 : 2 Wire Initialization (220/440V, 60Hz)
	【3】 : 3 Wire Initialization (220/440V, 60Hz)
	【4】 : 2 Wire Initialization (230/415V, 50Hz)
	【5】 : 3 Wire Initialization (230/415V, 50Hz)
	【6】 : 2 Wire Initialization (200/380V, 50Hz)
	【7】 : 3 Wire Initialization (200/380V, 50Hz)
	【8】 : PLC Initialization
	【9】 : 2 Wire Initialization (230V/460V, 60Hz)
	【10】 : 3 Wire Initialization (230V/460V, 60Hz)
	【11】 : 2 wire Initialization (230V/400V, 60Hz)
	【12】 : 3 wire Initialization (230V/400V, 60Hz)
	【13】 : 2 wire Initialization (230V/400V, 50Hz)
	【14】 : 3 wire Initialization (230V/400V, 50Hz)
	【15】 : 2 wire Initialization (220V/380V, 50Hz)
	【16】 : 3 wire Initialization (220V/380V, 50Hz)
	【Others】 : Reserved

Note: Main frequency setting 12-16 value is equal to frequency setting of speed-stage 0 (05-01)

Use parameter 13-08 to initialize the inverter back to factory default. It is recommended to write down the modified parameters before initializing the inverter. After initialization, the value of 13-08 will return to zero automatically.

13-08=2: 2-wire initialization (220V/440V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 220V (200V class) or 440V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 60Hz.

13-08=3: 3-wire initialization (220V/440V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode.

Inverter input voltage (01-14) is automatically set to 220V (200V class) or 440V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 60Hz.

13-08=4: 2-wire initialization (230V/415V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 230V (200V class) or 415V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=5: 3-wire initialization (230V/415V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command.

Inverter input voltage (01-14) is automatically set to 230V (200V class) or 415V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=6: 2-wire initialization (200V/380V)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1.

Inverter input voltage (01-14) is automatically set to 200V (200V class) or 380V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=7: 3-wire initialization (200V/380V)

Multi-function digital input terminal S5 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command.

Inverter input voltage (01-14) is automatically set to 200V (200V class) or 380V (400V class).
When 01-00 (V/F curve) set to F, Inverter maximum frequency (01-12) is automatically set to 50Hz.

13-08=8: PLC initialization

Clear built-in PLC ladder logic and related values.

13-08=9: 2 wire initialization (230V/460V, 60Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 460V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=10: 3 wire initialization (230V/460V, 60Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 460V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=11: 2 wire initialization (230V/400V, 60Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=12: 3 wire initialization (230V/460V, 60Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 60Hz automatically.

13-08=13: 2 wire initialization (230V/400V, 50Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Figure 4.3.1. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=14: 3 wire initialization (230V/460V, 50Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 230V (200V class) or 400V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=15: 2 wire initialization (220V/380V, 50Hz)

Multi-function digital input terminal S1 controls forward operation / stop command, and S2 controls reverse operation / stop command. Refer to Fig.4.3.1. The input voltage (01-14) will be set to 220V (200V class) or 380V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

13-08=16: 3 wire initialization (220V/380V, 50Hz)

Multi-function digital input terminal S7 controls the forward / reverse direction, and terminals S1 and S2 are set for 3-wire start operation and stop command. Refer to Figure 4.3.2 and Figure 4.3.3 for 3-wire type operation mode. The input voltage (01-14) will be set to 220V (200V class) or 380V (400V class) automatically and when 01-00 (V/F curve) is set to F, the maximum frequency of 01-12 will be set to 50Hz automatically.

Note: Restore factory setting (13-08) will not affect the setting of 01-00 (V/F curve).

The following parameters are not affected parameter 13-08 Restore to Factory / Initialization

No.	Parameter Name
00-00	Control Mode Selection
00-04	Language Selection
01-00	V/F Curve Selection
13-00	Inverter Rating Selection
13-03	Cumulative Operation Hours 1
13-04	Cumulative Operation Hours 2
13-05	Selection of Accumulative Operation Time

13- 09	Fault History Clearance Function
Range	【0】 : Do not Clear Fault History 【1】 : Clear Fault History

13-09=1: Clear inverter fault history including (12-11~12-15/12-45~12-64)

13- 10	Situation 2
Range	0 ~ 9999

13- 11	C/B CPLD Ver.	*1
Range	【0.00~9.99】	

This parameter displays CPLD version of the control board.

13- 12	Option Card Id	*1
Range	【0~255】	

This parameter displays option card ID when an option card is plugged into the control board.

【0】 : None

【6】 : CM-PBUS

【8】 : IO-8DO

13- 13	Option Card CPLD Ver.	*1
Range	【0.00~9.99】	

***1: It is new added in inverter software V1.4.**

This parameter displays option card CPLD version when an option card is plugged into the control board.

13- 14	Fault Storage Selection
Range	【0】 : Auto Restart Fault Messages are not saved in fault history during Auto-Restart. 【1】 : Auto Restart Fault Messages are saved in fault history during Auto-Restart.

13-14=0,

Fault messages are not saved in fault history (12-46~12-49 & 13-21~13-50) during the process when auto restart function is active.

13-14=1,

Fault messages are saved in fault history (12-46~12-49 & 13-21~13-50) during the process when auto restart function is active.

Group 14: PLC Setting Parameters

14-00	T1 Set Value 1
14-01	T1 Set Value 2 (Mode 7)
14-02	T2 Set Value 1
14-03	T2 Set Value 2 (Mode 7)
14-04	T3 Set Value 1
14-05	T3 Set Value 2 (Mode 7)
14-06	T4 Set Value 1
14-07	T4 Set Value 2 (Mode 7)
14-08	T5 Set Value 1
14-09	T5 Set Value 2 (Mode 7)
14-10	T6 Set Value 1
14-11	T6 Set Value 2 (Mode 7)
14-12	T7 Set Value 1
14-13	T7 Set Value 2 (Mode 7)
14-14	T8 Set Value 1
14-15	T8 Set Value 2 (Mode 7)
Range	【0~9999】

14-16	C1 Set Value
14-17	C2 Set Value
14-18	C3 Set Value
14-19	C4 Set Value
14-20	C5 Set Value
14-21	C6 Set Value
14-22	C7 Set Value
14-23	C8 Set Value
Range	【0~65534】

14-24	AS1 Set Value 1
14-25	AS1 Set Value 2
14-26	AS1 Set Value 3
14-27	AS2 Set Value 1
14-28	AS2 Set Value 2
14-29	AS2 Set Value 3
14-30	AS3 Set Value 1
14-31	AS3 Set Value 2
14-32	AS3 Set Value 3
14-33	AS4 Set Value 1
14-34	AS4 Set Value 2
14-35	AS4 Set Value 3
Range	【0~65534】

14-36	MD1 Set Value 1
14-37	MD1 Set Value 2
14-38	MD1 Set Value 3
14-39	MD2 Set Value 1
14-40	MD2 Set Value 2
14-41	MD2 Set Value 3
14-42	MD3 Set Value 1
14-43	MD3 Set Value 2
14-44	MD3 Set Value 3
14-45	MD4 Set Value 1
14-46	MD4 Set Value 2
14-47	MD4 Set Value 3
Range	【0~65534】

Please refer to section 4.5 for built-in PLC function.

Group 15: PLC Monitoring Parameters

15- 00	T1 Current Value 1
15- 01	T1 Current Value 2 (Mode 7)
15- 02	T2 Current Value 1
15- 03	T2 Current Value 2 (Mode 7)
15- 04	T3 Current Value 1
15- 05	T3 Current Value 2 (Mode 7)
15- 06	T4 Current Value 1
15- 07	T4 Current Value 2 (Mode 7)
15- 08	T5 Current Value 1
15- 09	T5 Current Value 2 (Mode 7)
15- 10	T6 Current Value 1
15- 11	T6 Current Value 2 (Mode 7)
15- 12	T7 Current Value 1
15- 13	T7 Current Value 2 (Mode 7)
15- 14	T8 Current Value 1
15- 15	T8 Current Value 2 (Mode 7)
Range	【0~9999】

15-16	C1 Current Value
15-17	C2 Current Value
15-18	C3 Current Value
15-19	C4 Current Value
15-20	C5 Current Value
15-21	C6 Current Value
15-22	C7 Current Value
15-23	C8 Current Value
Range	【0~65534】

15-24	AS1 Results
15-25	AS2 Results
15-26	AS3 Results
15-27	AS4 Results
15-28	MD1 Results
15-29	MD2 Results
15-30	MD3 Results
15-31	MD4 Results
15-32	TD Current Value
Range	【0~65534】

Group 16: LCD Function Parameters

16- 00	Main Screen Monitoring
Range	【5~79】
16- 01	Sub-Screen Monitoring 1
Range	【5~79】
16- 02	Sub-Screen Monitoring 2
Range	【5~79】

At power-up the inverter shows two monitor section on the display, main monitor section and the sub-screen monitor section (smaller font).

Choose the monitor signal to be displayed as the main-screen monitor screen in parameter 16-00, and the monitor signals to be displayed on the sub-screen monitor in parameters 16-01 and 16-02, similar to monitor parameters 12-5 ~ 12-79.

Note: The setting value of 16-00, 16-01 and 16-02 can be modified. It also can reset except PID modes (refer to the setting description of parameter 10-03) and PUMP modes (refer to the setting description of parameter 23-00), but these two modes can be modified in inverter software V1.4.

16- 03	Selection of Display Unit
Range	【0】 : Display unit is Hz (Resolution is 0.01Hz) 【1】 : Display unit is % (Resolution is 0.01%) 【2】: Rpm display; motor rotation speed is set by the control modes to select IM (02-07)/ PM (22-03) motor poles to calculate. 【3~39】 : Reserved 【40~9999】 : 100% is XXXX with no decimals (integer only) 【10001~19999】 : 100% is XXX.X with 1 decimal 【20001~29999】 : 100% is XX.XX with 2 decimals 【30001~39999】 : 100% is X.XXX with 3 decimals
16- 04	Selection of Engineering Unit
Range	【0】 : No Unit 【1】 : FPM 【2】 : CFM 【3】 : PSI 【4】 : GPH 【5】 : GPM 【6】 : IN 【7】 : FT 【8】 : /s 【9】 : /m 【10】 : /h 【11】 : °F 【12】 : inW 【13】 : HP 【14】 : m/s 【15】 : MPM 【16】 : CMM 【17】 : W 【18】 : KW

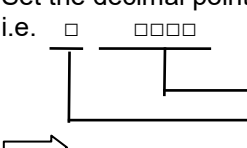
	【19】 : m 【20】 : °C 【21】 : RPM 【21】 : RPM 【22】 : Bar 【23】 : Pa 【24】 : KPa
--	---

16-03: Display unit of digital operator

Set the units of the following items to be displayed, the frequency reference (05-01, 00-18, 06-01~06-15) and the monitoring frequency 12-16, 12-17 (Output frequency)

16-04: Display unit of engineering

When 16-03 = 00040-39999, engineering units are enabled. The displayed set range and the frequency range of unit (05-01, 06-01~06-15) as well as the monitoring frequency (12-16, 12-17) are changed by parameters 16-04 and 16-03.

16-03	Set / displayed contents			
0	0.01 Hz			
1	0.01 % (maximum output frequency 01-02=100%)			
2	RPM (RPM = 120 x reference frequency / numbers of motor pole. The numbers of motor pole is set by 02-07 in the control modes of V/F or SLV and is set by 22-03 in PMSLV.)			
3-39	Reserved			
00040 - 39999	Set the decimal point by using the fifth place. i.e. 			
	00040 - 09999 : □□□□ (Integer only e.g. 1000) 10001 - 19999 : □□□. □ (1 decimal place e.g. 10.0) 20001 - 29999 : □□. □□ (2 decimal places, e.g. 10.00) 30001 - 39999 : □. □□□ (3 decimal places, e.g. 10.000)			
	<example>			
	16-03	Display	Display unit	Display example
	00040 - 09999	□□□□	use 16-04 setting	Example: 100 % speed is 0200 > set 16-03=00200 (from 05-01, 06-01 to 06-15, set range from 0040 to 9999). > set 16-04=0 (no unit)
	10001 - 19999	□□□. □		Example: 100 % speed is 200.0 CFM > set 16-03=12000 (05-01, 06-01 to 06-15, set range from 0000 to 9999). > set 16-04=2 (CFM) > 60% speed will be displayed as 120.0 CFM
	20001 - 29999	□□. □□		Example: 100 % speed is 65.00°C > set 16-03=26500 (05-01, 06-01 to 06-15, set range from 0000 to 9999) > set 16-04=20 (°C) > 60% of speed is displayed as 39.00 °C
	30001 - 39999	□. □□□		Example: 100 % speed is 2.555 m/s > set 16-03=32555 > set 16-04=14 (m/s) > 60% speed is displayed as 1.533 m/s

16- 05	LCD Backlight
Range	【0~7】

Adjust the screen contrast of the digital operator. If it is set to 0, the screen backlight is turned off.

16- 07	Copy Function Selection
Range	【0】 : Do not copy parameters 【1】 : Read inverter parameters and save to the operator. 【2】 : Write the operator parameters to inverter. 【3】 : Compare parameters of inverter and operator.
16- 08	Selection of Allowing Reading
Range	【0】 : Do not allow to read inverter parameters and save to the operator. 【1】 : Allow to read inverter parameters and save to the operator.

LCD digital operator with built-in memory (EEPROM) can be used to store and retrieve parameters:

- (1) Read: Save inverter parameters to the digital operator (INV → OP).
- (2) Write: Write the parameters from the digital operator to the inverter and save (OP → INV).
- (3) Verify: Compare the inverter parameters against the parameters in the digital operator.

16-07=0: No action

16-07=1: Read (all parameters are copied from the inverter to the keypad).

16-07=2: Write (all parameter are copied from the keypad to the inverter).

16-07=3: Verify (Compare the set value of the inverter to the parameter of the digital operator).

Set 16-08 = 0, to prevent the saved parameter data stored in the digital operator from accidentally being overwritten.

When parameter 16-08=0 and the read operation is executed (16-07=1) a warning message of "RDP Read Prohibited" will be displayed on the keypad and the read operation is cancelled.

Refer to the following steps for copy function operation.

For the write-in operation requires the following items to match.

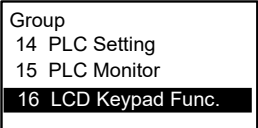
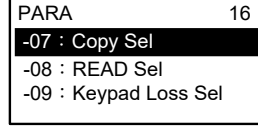
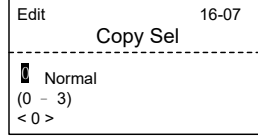
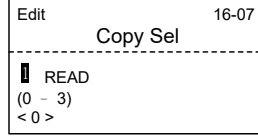
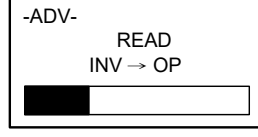
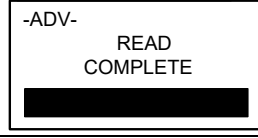
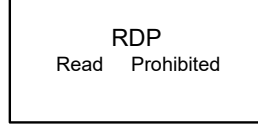
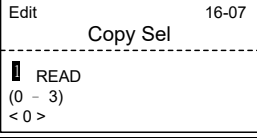
- (1) Software version
- (2) Control method
- (3) Inverter type
- (4) Inverter rated capacity and voltage

Set one of the parameters 03-00 to 03-05 (multi-function digital input selection) to 49 (Enable the parameter write-in function) to enable or disable the parameter write-in function.

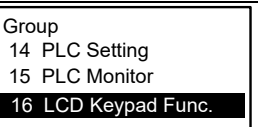
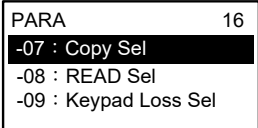
When terminal is active, parameters can be copied from the digital operator to the inverter. When the terminal is not active inverter parameters are prohibited from write-in, excluding the reference frequency (00-05).

Note: Parameter 16-11 (RTC date setting) and 16-12 (RTC time setting) require resetting, after parameter setting in the keypad is written and saved in the inverter (OP→INV).

■ READ: Copy inverter parameters to the keypad

Steps	LCD Display (English)	Description
1		Select the copy function group (16) from the group menu.
2		Press the Read / Enter key and select parameter (16-07) copy sel.
3		Press the Read / Enter key to display the data setting / read screen (LCD display is inversed).
4		Change the set value to 1 (read) by using the up arrow key.
5		<ul style="list-style-type: none"> • Use Read / Enter key to enable the read operation, the display is shown as the left. • The bottom of LCD display will show a bar to indicate the read progress s.
6		"READ COMPLETE" will be displayed on the keypad when reading was successful.
		<ul style="list-style-type: none"> • The error message of "RDP Read Prohibited" may occur on the keypad when reading parameters from the inverter is prohibited. • If the error is displayed, press any key to remove the error message and go back to parameter 16-07.
7		When DSP/FUN key is pressed, the display returns to parameter 16-07.



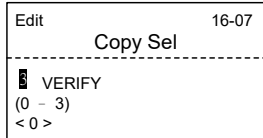
■ WRITE: Copy Keypad parameters to the Inverter

Steps	LCD Display (English)	Description
1		Select the copy function group (16) from the group menu.
2		Press the Read / Enter key and select parameter (16-07) copy sel.

Steps	LCD Display (English)	Description
3	<div> Edit 16-07 Copy Sel Normal (0 - 3) < 0 > </div>	Press the Read / Enter key to display the data setting / read screen (LCD display is inversed).
4	<div> Edit 16-07 Copy Sel WRITE (0 - 3) < 0 > </div>	Change the set value to 2 (write) by using the up arrow key.
5	<div> -ADV- WRITE INV → OP </div>	<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	<div> -ADV- WRITE COMPLETE </div>	"WRITE COMPLETE" will be displayed on the keypad when writing was successful.
	<div> WRE Write Error </div>	<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	<div> Edit 16-07 Copy Sel WRITE (0 - 3) < 0 > </div>	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	<div> Group 14 PLC Setting 15 PLC Monitor 16 LCD Keypad Func. </div>	Select the copy function group (16) from the group menu.
2	<div> PARA 16 -07 : Copy Sel -08 : READ Sel -09 : Keypad Loss Sel </div>	Press the Read / Enter key and select parameter (16-07) copy sel.
3	<div> Edit 16-07 Copy Sel Normal (0 - 3) < 0 > </div>	Press the Read / Enter key to display the data setting / read screen (LCD display is inversed).
4	<div> Edit 16-07 Copy Sel VERIFY (0 - 3) < 0 > </div>	Change the set value to 3 (verify) by using the up arrow key.
5	<div> -ADV- VERIFY INV → OP </div>	<ul style="list-style-type: none"> Use Read / Enter key to enable the read operation, the display is shown as the left. The bottom of LCD display will show a bar to indicate the read progress.

Steps	LCD Display (English)	Description
6		"VERIFY COMPLETE" will be displayed on the keypad when writing was successful.
		<ul style="list-style-type: none"> The error message of "VRYE Verify Error " may occur on the keypad when writing parameters to the inverter is prohibited. If the error is displayed, press any key to remove the error message and go back to parameter 16-07.
7		When DSP/FUN key is pressed, the display returns to parameter 16-07.

16- 09	Selection of Operator Removed (LCD)
Range	【0】 : Keep operating when LCD operator is removed. 【1】 : Display fault to stop when LCD operator is removed

16-09=0: Continue operating when keypad is removed.

16-09=1: Trip inverter when keypad is removed while operating in local mode.

16- 10	RTC Time Display Setting
Range	【0】 : Hide 【1】 : Display
16- 11	RTC Date Setting
Range	【12.01.01 ~ 99.12.31】
16- 12	RTC Time Setting
Range	【00:00 ~ 23:59】

Note: Set the internal clock before using the function of Real Time Clock (RTC).

RTC date is set with parameter 16-11 and RTC time is set with parameter 16-12.

RTC is displayed in the top line of the keypad, please refer to Fig.4.3.85, RTC time display (16-10) set to 1.

Monitor	00:00
Freq Ref	
12-16 =	000.00 Hz
12-17 =	000.00 Hz
12-18 =	0000.0A

Figure 4.3.85 RTC Time Display (Example)

Notes:

- RTC is not enabled when the keypad is connected to the inverter.
- The operation/run timer operates independent of the RTC.

Users can set parameters 12-72 and 12-73 to monitor the RTC date and time.

The RTC function has the following features:

- Four independent start/stop times per day over a span of 4 weeks.
- RTC offset function (preset time)
- RTC can be enabled via a multi-function digital input
- RTC controlled constant speed for fixed time period
- RTC controlled multi-function digital output

16- 13	RTC Timer Function
Range	【0】 : Disable 【1】 : Enable 【2】 : Set by DI
16- 14	P1 Start Time
16- 15	P1 Stop Time
16- 18	P2 Start Time
16- 19	P2 Stop Time
16- 22	P3 Start Time
16- 23	P3 Stop Time
16- 26	P4 Start Time
16- 27	P4 Stop Time
Range	【00:00 ~ 23:59】
16- 16	P1 Start Date
16- 17	P1 Stop Date
16-20	P2 Start Date
16- 21	P2 Stop Date
16- 24	P3 Start Date
16- 25	P3 Stop Date
16- 28	P4 Start Date
16- 29	P4 Stop Date
Range	【1】 : Mon 【2】 : Tue 【3】 : Wed 【4】 : Thu 【5】 : Fri 【6】 : Sat 【7】 : Sun
16- 30	Selection of RTC Offset
Range	【0】 : Disable 【1】 : Enable 【2】 : Set by DI
16- 31	RTC Offset Time Setting
Range	【00:00 ~ 23:59】
16- 32	Source of Timer 1
16- 33	Source of Timer 2
16- 34	Source of Timer 3
16- 35	Source of Timer 4
Range	【0~31】 : Refer to Table 4.3.13

16- 36	Selection of RTC Speed
Range	【0】 : Off 【1】 : By Timer 1 【2】 : By Timer 2 【3】 : By Timer 3 【4】 : By Timer 4 【5】 : By Timer 1+2
16- 37	Selection of RTC Rotation Direction
Range	【xxx0 B】 : RTC Run1 Forward Rotation 【xxx1 B】 : RTC Run1 Reverse Rotation 【xx0x B】 : RTC Run2 Forward Rotation 【xx1x B】 : RTC Run2 Reverse Rotation 【x0xx B】 : RTC Run3 Forward Rotation 【x1xx B】 : RTC Run3 Reverse Rotation 【0xxx B】 : RTC Run4 Forward Rotation 【1xxx B】 : RTC Run4 Reverse Rotation

Source of timer can be selected to link multiple time periods and one time period can be set to multiple timers.

Follow these steps to set the timer:

① **Start the timer:**

Enable RTC timer function by setting parameter 16-13.

② **Set the time period:**

Set the start/stop time and date. If the start time is set the same as the stop time, timing period is disabled.

③ **Set timer period:**

Set time period for specific timer (16-32~16-35).

④ **Link timer to relay output and other parameters:**

The timer can be linked to the relay output. One relay output can be linked to one timer (example: 03-11, 03-12 and 03-39, 16-36).

Note: If the stop time is set to 12:00, Motor transfers from start to stop at 12:01.

Refer to Fig.4.3.86 for RTC structure.

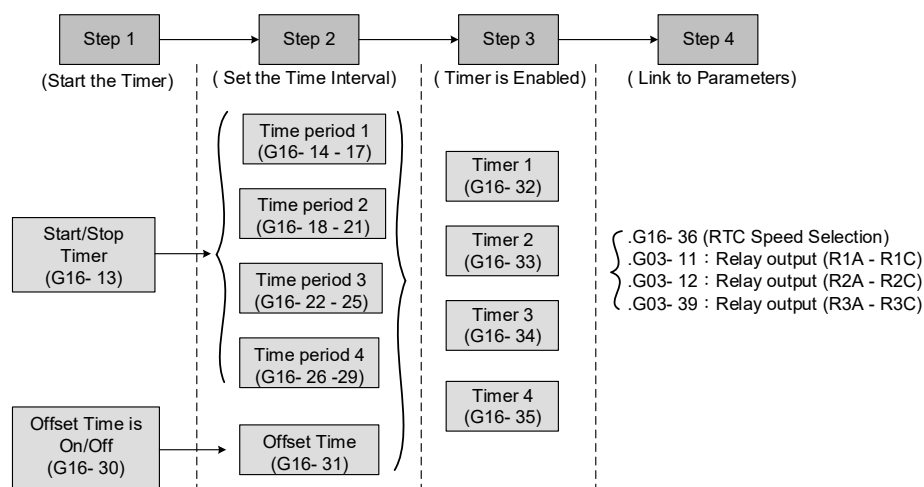


Figure 4.3.86 RTC structure

Refer to the following Table 4.3.13 for the selection of timer operation cycles.

Table 4.3.13 Available time period settings for timer function

16-32 ~ 16-35	O	P4	P3	P2	P1	Timer Function	Display
0	0	0	0	0	0	Without the selection of timer	None
1	0	0	0	0	1	Time Period 1	P1
2	0	0	0	1	0	Time Period 2	P2
3	0	0	0	1	1	Time Period 1 and 2	P1+P2
4	0	0	1	0	0	Time Period 3	P3
5	0	0	1	0	1	Time Period 1 and 3	P1+P3
6	0	0	1	1	0	Time Period 2 and 3	P2+P3
7	0	0	1	1	1	Time Period 1 , 2 and 3	P1+P2+P3
8	0	1	0	0	0	Time Period 4	P4
9	0	1	0	0	1	Time Period 1 and 4	P1+P4
10	0	1	0	1	0	Time Period 2 and 4	P2+P4
11	0	1	0	1	1	Time Period 1 , 2 and 4	P1+P2+P4
12	0	1	1	0	0	Time Period 3 and 4	P3+P4
13	0	1	1	0	1	Time Period 1 , 3 and 4	P1+P3+P4
14	0	1	1	1	0	Time Period 2 , 3 and 4	P2+P3+P4
15	0	1	1	1	1	Time Period 1 , 2 , 3 and 4	P1+P2+P3+P4
16	1	0	0	0	0	Offset selection	Offset (O)
17	1	0	0	0	1	Offset and time period 1	O+P1
18	1	0	0	1	0	Offset and time period 2	O+P2
19	1	0	0	1	1	Offset and time period 1 and 2	O+P1+P2
20	1	0	1	0	0	Offset and time period 3	O+P3
21	1	0	1	0	1	Offset and time period 1 and 3	O+P1+P3
22	1	0	1	1	0	Offset and time period 2 and 3	O+P2+P3
23	1	0	1	1	1	Offset and time period 1 , 2 and 3	O+P1+P2+P3
24	1	1	0	0	0	Offset and time period 4	O+P4
25	1	1	0	0	1	Offset and time period 1 and 4	O+P1+P4
26	1	1	0	1	0	Offset and time period 2 and 4	O+P2+P4
27	1	1	0	1	1	Offset and time period 1 , 2 and 4	O+P1+P2+P4
28	1	1	1	0	0	Offset and time period 3 and 4	O+P3+P4
29	1	1	1	0	1	Offset and time period 1 , 3 and 4	O+P1+P3+P4
30	1	1	1	1	0	Offset and time period 2 , 3 and 4	O+P2+P3+P4
31	1	1	1	1	1	Offset and time period 1 , 2 , 3 and 4	O+P1+P2+P3+P4

Reference frequency and motor rotation direction are controlled by RTC function.

16-36=0: RTC speed selection is disabled.

16-36=1: Timer 1 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=2: Timer 2 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=3: Timer 3 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=4: Timer 4 is enabled.

Reference frequency = Frequency Setting of Speed-Stage 0 (05-01)

16-36=4: Timer 1 and 2 are enabled.

Reference frequency is enabled by the simultaneous operation of timer 1 and 2.

Notes:

- The inverter runs via the start of the specific timer without the influence of other timers.
- The RTC speed setting selection (16-36) is depends on time period 1 to 4 (P1~P4) which is corresponding to the selection of RTC rotation direction (16-37).

Example:

When the selection of RTC speed is set to 5 (by timer 1+2), run command source (00-02) and source of frequency command (00-05) are required to be set to RTC, so reference frequency is controlled by RTC timer 1 and 2 and the inverter continues running.

Refer to Table 4.3.14 for the RTC reference frequency.

Note: RTC Rotation Direction (16-37) depends on the Motor Direction Lock Selection (11-00).

Table 4.3.14 Reference frequency is determined by timer 1 and 2

Timer 1	Timer 2	Main Frequency Command Source Selection (00-05)	Source of frequency setting	Selection of rotation direction
0	0	6(RTC)	Set by frequency setting of speed-stage 0 (05-01)	By RTC 1 (16-37)
1	0	6(RTC)	Set by frequency setting of speed-stage 1 (05-02)	By RTC 2 (16-37)
0	1	6(RTC)	Set by frequency setting of speed-stage 2 (05-03)	By RTC 3 (16-37)
1	1	6(RTC)	Set by frequency setting of speed-stage 3 (05-04)	By RTC 4 (16-37)

Important Notes:

RTC function cannot run normally when:

- When multi-function terminal (03-00~03-05) is set to fire mode.
- When KEB function is enabled
 - Main frequency source of the RTC function is set according to Table 4.3.14; settings pertain to the main and alternative frequency command modes (00-07).
 - If main run command source selection (00-02) is set to 0~3 (0: keypad, 1: external terminal, 2: communication control, 3: PLC), refer to Table 4.3.15 for the relationship between the master run command and RTC timer status.

Table 4.3.15 Relationship between main run command and RTC timer status

Main run command 00-02	RTC timer x status	Inverter status
0~3	0	Inverter cannot run (without run command)
0~3	1	Inverter cannot run (without run command)
4	0	Inverter cannot run (RTC timer is disabled)
4	1	Inverter runs and rotates depending on the function of 16-37.

Example: RTC timer using multiple parameters:

Inverter running on Monday from 6:00 AM to 10:00 PM.
Inverter running from Tuesday to Friday from 8:00 AM to 8:00 PM.
Inverter running on Saturday from 8:00 AM to 6:00 PM.
Inverter running on Sunday from 8:00 AM to 12:00 PM.
Motor runs on weekdays (Mon. to Fri.) at speed 1 and on weekends at speed 2.

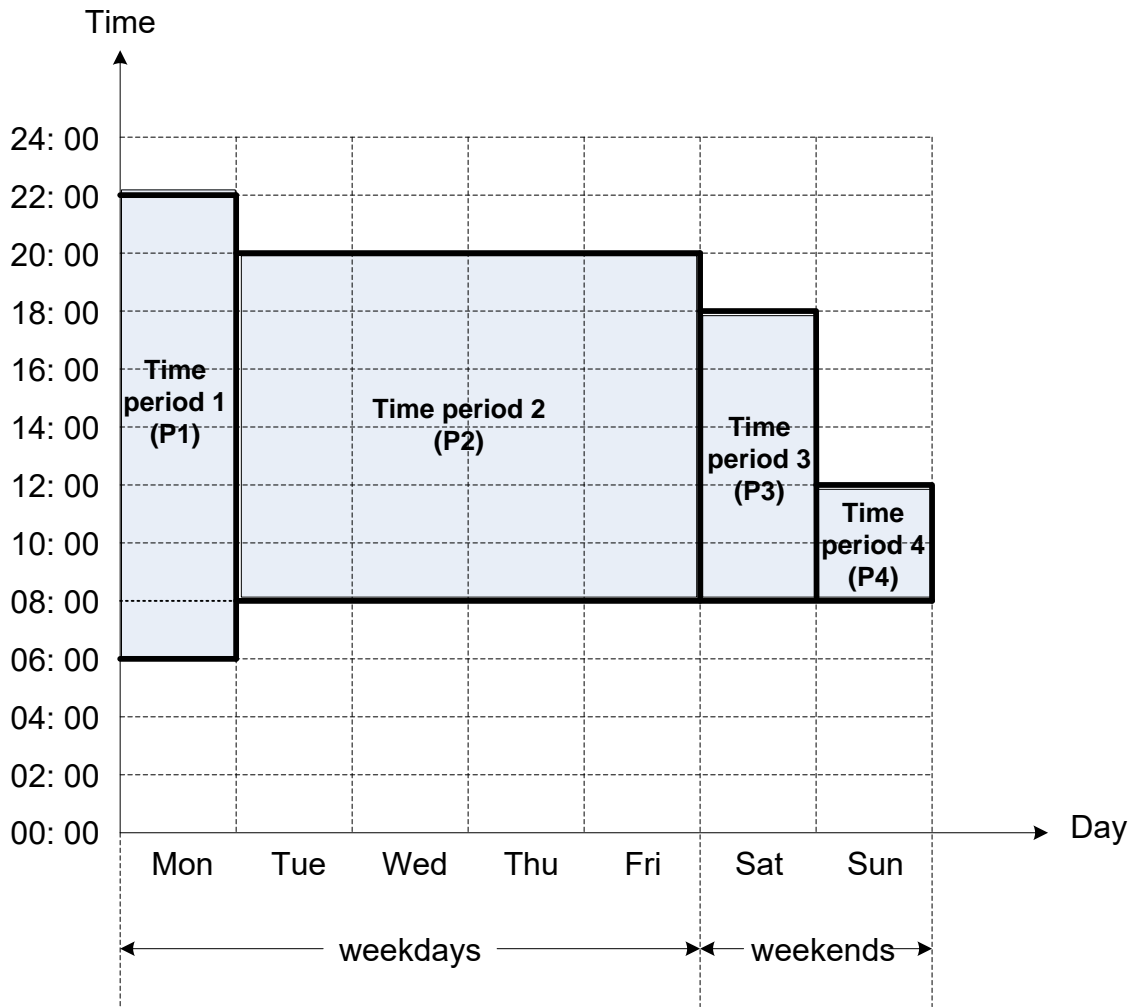


Figure 4.3.87 RTC timer (example)

① Initialize the RTC Timer in parameter group 16

Set the correct date and time in the parameters 16-11 and 16-12 and set parameter 16-13 to 1 (enable RTC timer function).

② Set time period 1 (P1)

Start time 1: 16-14 = 06:00:00 (6:00 AM)
 Stop time 1: 16-15 = 22:00:00 (10:00 PM)
 Start date 1: 16-16 = 1 (Monday)
 Stop date 1: 16-17 = 1 (Monday)

③ Set time period 2 (P2)

Start time 2: 16-18 = 08:00:00 (8:00 AM)
 Stop time 2: 16-19 = 20:00:00 (8:00 PM)
 Start date 2: 16-20 = 2 (Tuesday)
 Stop date 2: 16-21 = 5 (Friday)

④ Set time period 3 (P3)

Start time 3: 16-22 = 08:00:00 (8:00 AM)
 Stop time 3: 16-23 = 18:00:00 (6:00 PM)
 Start date 3: 16-24 = 6 (Saturday)
 Stop date 3: 16-25 = 6 (Saturday)

⑤ Set time period 4 (P4)

Start time 4: 16-26 = 08:00:00 (8:00 AM)
 Stop time 4: 16-27 = 12:00:00 (12:00 AM)
 Start date 4: 16-28 = 7 (Sunday)
 Stop date 4: 16-29 = 7 (Sunday)

⑥ Timer 1 is enabled to set all the time periods (P1, P2, P3, and P4)

16-32 = 15: Source of timer 1 = P1 + P2 + P3 + P4)

⑦ Selection of RTC speed is determined by timer 1

16-36 = 1: Timer 1 is enabled.
 Frequency reference setting is speed-stage 0 (05-01).
 Rotation direction (16-37) is set to 0000b.
 Rotation direction for time period 1~4 (P1~P4) is determined by parameter 16-37.

⑧ Choose two constant speeds (speed 1 & speed 2)

16-36 = 5: Timer 1+2 is enabled.
 When timer 1 is active frequency reference setting is speed-stage 1; when timer 2 is active, frequency reference setting is speed-stage 2.
 Rotation direction (16-37) is set to 0000b.
 When timer 1 and timer 2 are active motor direction is forward.

Note: To enable the offset time function select RTC offset (16-30) and set RTC offset time (16-31). The Inverter runs depending on the set time period. Refer to the following Fig.4.3.88.

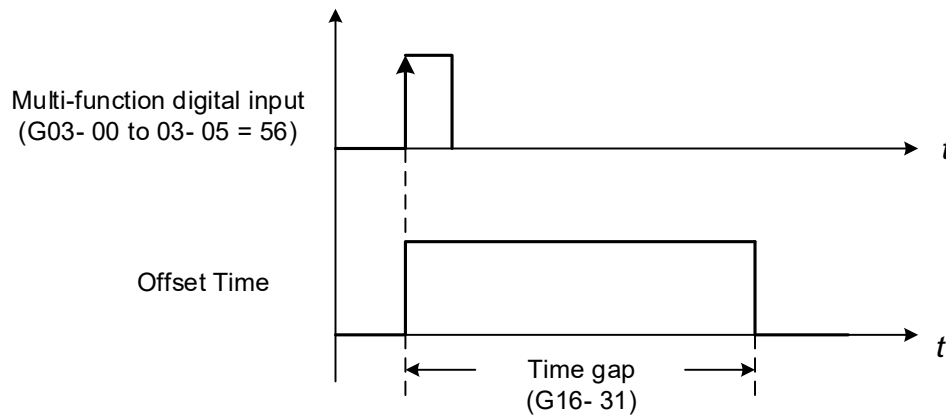


Figure 4.3.88 Operation of offset time

For example:

Inverter runs at the time period exclusive P1:

When 16-36=1 (selection of RTC speed is set to timer 1) and 16-32=17 (offset + PI), RTC offset (16-30) is activated via a digital input and the offset time is set in 16-31. When digital input is activated the RTC function starts.

If the source of the timer is set to 15 (P1+P2+P3+P4), and the “STOP” key is pressed while time period 1 (P1) is active the inverter will stop and the RTC will re-start automatically at the next time period (P2). The RTC can also be re-started via a digital input by setting 16-30 to 2 (set by DI).

Notes:

If press “STOP” key is pressed during a time period the inverter can be re-started by:

- Set the selection of RTC offset (16-30) to 2 (set by DI) and set DI to 56 (RTC Offset Enable).
- Switch the selection of RTC offset (16-30) to enable.

Note:

RTC Accuracy:

Temperature	Deviation
+25 °C (77 °F)	+/-3 sec./ day
-20 / +50 °C (-4/ 122°F)	+/-6 sec./ day

Group 17: IM Motor Automatic Tuning Parameters

17- 00	Mode Selection of Automatic Tuning
Range	【0】 : Rotation Auto-tune 【1】 : Static Auto-tune 【2】 : Stator Resistance Measurement 【4】 : Loop Tuning 【5】 : Rotational Auto-tuning Combination (Item: 4+2+0) 【6】 : Static Auto-tuning Combination (Item: 4+2+1)
17- 01	Motor Rated Output Power
Range	【0.00~600.00】 KW
17- 02	Motor Rated Current
Range	10%~200% of the inverter rated current in V/F control mode 25%~200% of the inverter rated current in SLV control mode
17- 03	Motor Rated Voltage
Range	200V: 【50.0~240.0】 V 400V: 【100.0~480.0】 V
17- 04	Motor Rated Frequency
Range	【4.8~400.0】 Hz
17- 05	Motor Rated Speed
Range	【0~24000】 rpm
17- 06	Pole Number of Motor
Range	【2~16】 pole (Even)
17- 08	Motor No-load Voltage
Range	200V: 【50~240】 V 400V: 【100~480】 V
17- 09	Motor Excitation Current
Range	【0.01~600.00】 A (15%~70% motor rated current)
17- 10	Automatic Tuning Start
Range	【0】 : Disable 【1】 : Enable
17- 11	Error History of Automatic Tuning
Range	【0】 : No Error 【1】 : Motor Data Error 【2】 : Stator Resistance Tuning Error 【3】 : Leakage Induction Tuning Error 【4】 : Rotor Resistance Tuning Error 【5】 : Mutual Induction Tuning Error 【6】 : Reserved 【7】 : DT Error 【8】 : Motor Acceleration Error 【9】 : Warning
17-12	Leakage Inductance Ratio
Range	【0.1~15.0】 %
17-13	Slip Frequency
Range	【0.10~20.00】 Hz

17-14	Rotational Tuning Mode Selection
Range	【0】 : VF Mode 【1】 : Vector Mode

Auto-tuning

Based on the motor nameplate set the motor rated output power (17-01), motor output rated current (17-02), motor rated voltage (17-03), motor rated frequency (17-04), motor rated speed (17-05) and number of motor poles (17-06) to perform an auto-tune.

Automatic tuning mode selection (17-00=0)

Rotational auto-tuning (17-00=0)

Perform rotational auto-tune (High performance auto-tune)

Static auto-tuning (17-00=1)

Motor does not rotate during auto-tuning and this tuning causes lower power at low speed.

Stator resistance measurement (17-00=2)

Perform stator resistance non-rotational auto-tune (V/F mode) suitable when using long motor leads. This tuning mode causes results in lower torque at low speed.

Loop tuning (17-00=4)

Performance improvement (speed and torque regulation) in vector control mode

Rotation Auto-tuning Combination (17-00=5)

This tuning mode is a combination of three auto-tuning modes, Loop tuning (17-00=4), Stator resistance tuning (17-00=2) and Rotational auto-tuning (17-00=0).

Static Auto-tune Combination (17-00=6)

This tuning mode is a combination of three auto-tuning modes, Loop tuning (17-00=4), Stator resistance measurement (17-00=2) and Static auto-tuning (17-00=1)

Motor rated output power (17-01)

Set motor power rating based on the motor nameplate, input range depends on the inverter rating (13-00).

Motor rated current (17-02)

- (1) Set motor FLA based on the motor nameplate, input range depends on the inverter rating (13-00).
- (2) In V/F mode, range is 10~200 % of the inverter rated current.
- (3) In SLV mode, range is 25~200% of the inverter rated current.

Motor rated voltage (17-03)

Set motor voltage based on the motor nameplate. Prevent motor from saturating when the motor rated voltage is greater than the inverter input voltage (see Example 1).

Motor rated frequency (17-04)

Set motor base frequency based on the motor nameplate.

Motor rated speed (17-05)

Set motor base speed frequency based on the motor nameplate.

Number of poles (17-06)

Set number of motor poles, range is 2~16 poles.

Motor no-load voltage (17-08)

- (1) Motor no-load voltage is mainly used in SLV mode, set to a value of 10~50V lower than the input voltage to ensure good torque performance at the motor rated frequency.
- (2) Set 17-08 to 85~95% of the motor rated voltage. In general, the no-load voltage can be closer to the motor rated voltage for larger motors, but cannot exceed the motor rated voltage.
- (3) The motor no-load voltage can be set to a value greater than the actual input voltage. In this condition the motor can only operate at relatively low frequency. If the motor operates at the rated frequency an over voltage condition may occur.
- (4) The higher the motor power, the higher the no-load voltage is.
- (5) A smaller no-load voltage will reduce the no-load current. When a load is applied the magnetic flux weakens and the motor current increases.
- (6) A higher no-load voltage results in a higher no-load current. When a load is applied the magnetic flux weakens and the motor current increases. Increasing the magnetic flux generates back EMF and results in poor torque control.

Motor excitation current (17-09)

- (1) Only available for static-type or stator resistance measurement auto-tuning (17-00=1 or 17-00=2). The data can be obtained by manual tuning. Normally this parameter does not have to be adjusted.
- (2) Motor excitation current is used for rotational auto-tune.
- (3) Set motor excitation current to 33% of the motor rated current. During auto-tune the keypad will display "Atune" to indicate Auto-tuning is in progress. When the motor is successfully tuned, the keypad shows "AtEnd".

Automatic tuning start (17-10)

Set parameter 17-10 to 1 and press ENTER the inverter will display "Atrdy" for Auto-tune ready. Next, press RUN key to start the auto-tune procedure. During auto-tuning the keypad will display "Atune" for Auto-tune in progress. When the motor is successfully tuned, the keypad shows "AtEnd".

Error history of automatic tuning (17-11)

- (1) If auto-tuning fails the keypad will display the "AtErr" message and the auto-tune cause is shown in parameter 17-11.
- (2) Refer to section 10 for auto-tuning troubleshooting and possible causes.

Note:

The motor tuning error history (17-11) shows the tuning result of the last auto-tune. Tuning history does not show any error when auto-tune is aborted or when the last auto-tune was successful.

Proportion of Motor Leakage Inductance (17-12)

- (1) Parameter can only be set when using stator resistance auto tuning (17-00=2).
- (2) Static non-rotational and rotational type auto tuning automatically measure the proportion of motor leakage inductance so there for this parameter is not active in these tuning modes.
- (3) Default value is 4%. It is required to perform an auto tune to save the adjusted value into parameter 02-33.

Motor Slip Frequency (17-13)

- (1) Parameter can only be set when using stator resistance auto tuning (17-00=2).
- (2) Static non-rotational and rotational type auto tuning automatically measure the proportion of motor leakage inductance so there for this parameter is not active in these tuning modes.
- (3) It is required to perform an auto tune to save the adjusted value into parameter 02-34.

Example 1:

Motor rated voltage (440V/60Hz) is higher than the inverter input voltage (380V/50 Hz).

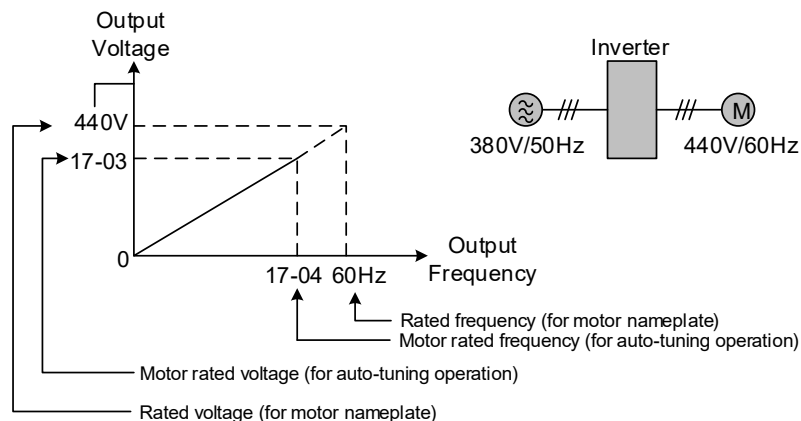


Figure 4.3.89 Rated voltage and frequency settings

- Step 1:** Select auto-tuning mode (17-00) and set motor rated output power (17-01) and motor rated current (17-02) based on the motor nameplate data.
- Step 2:** Set the motor rated voltage (17-03) to 440V based on the motor nameplate data.
- Step 3:** Set the motor rated frequency (17-04) to 60Hz
- Step 4:** Set the motor no-load speed (17-05) and number of motor poles (17-06)
- Step 5:** Set the motor no-load voltage (17-08) to 360V and value 20V lower than input voltage when using torque control.
- Step 6:** Execute auto-tuning by setting auto-tuning parameter 17-10 to 1, next go to main screen and press RUN to start auto-tuning. The value of motor rated frequency (17-04) is automatically set the base frequency of motor 1. The inverter will automatically adjust the value of maximum output frequency of motor 1 (01-02) to the same value as base frequency of the motor 1 (01-12) if the maximum output frequency set in parameter 01-02 is different from the base frequency of the motor 1 (01-12),

When the inverter input voltage (or frequency) is higher than the motor rated voltage (or frequency), set the motor rated voltage (17-03) and the motor rated frequency (17-04) to the values of the motor nameplate.

Example 2:

The inverter input voltage and frequency (460V/50Hz) are higher than the motor rated voltage and frequency (380V/33Hz), set 17-03 to 380V (rated motor voltage) and 17-04 to 33Hz (motor rated frequency).

Rotational Auto-tuning (17-14)

- (1) The parameter can only be set when rotational auto-tuning (17-00=0) or rotational auto-tuning combination (17-00=5) is selected.
- (2) VF type rotational auto-tuning (17-14=0) is best suited for unloaded IM motors
- (3) Vector type rotational auto-tuning (17-14=1) is best suited for unloaded vector duty IM motors. This tuning mode can be used for high speed motors. Use Vector type rotational auto-tuning if VF type rotational auto-tuning (17-14=0) is unsuccessfully.
- (4) Vector type rotational auto-tuning (17-14=1) measures the motor no-loading current to avoid motor current oscillation that can be present in V/F mode.

Group 18: Slip Compensation Parameters

18- 00	Slip Compensation Gain at Low Speed
Range	【0.00~2.50 】
18- 01	Slip Compensation Gain at High Speed
Range	【-1.00~1.00】
18- 02	Slip Compensation Limit
Range	【0~250】 %
18- 03	Slip Compensation Filter Time
Range	【0.0~10.0】 sec
18- 04	Regenerative Slip Compensation Selection
Range	【0】 : Disable 【1】 : Enable
18- 05	FOC Delay Time
Range	【1~1000】 msec
18- 06	FOC Gain
Range	【0.00~2.00】

Slip compensation automatically adjusts the output frequency based on the motor load to improve the speed accuracy of the motor mainly in V/F mode.

The slip compensation function compensates for the motor slip to match the actual motor speed to the reference frequency.

Slip compensation adjustment in V/F mode

18-00: Slip compensation gain at low speed

The adjustment of slip compensation gain at low speed follows the below procedure:

1. Set the rated slip and the motor no-load current (02-00).
2. Set the slip compensation (18-00) to 1.0 (factory default setting is 0.0 in V / F control mode)
3. For the operation with a load attached, measure the speed and adjust the slip gain (18-00) accordingly (increase in steps of 0.1).
 - If the motor speed is lower than frequency reference, increase the value of 18-00.
 - If the motor speed is higher than frequency reference, decrease the value of 18-00.

When the output current is greater than the no-load current (02-00), the slip compensation is enabled and the output frequency increases from f1 to f2. Refer to Fig.4.3.90, the slip compensation value is calculated as follows:

$$\text{Slip Compensation Value} = \text{Motor rated slip frequency} \times \frac{[\text{Output current (12-18)} - \text{no-load current of Motor 1 (02-00)}]}{[\text{Rated current of Motor 1(02-01)} - \text{no-load current of Motor 1 (02-00)}]}$$

$$\text{Motor Rated Slip Frequency (f)} = \frac{(\text{Motor no-load synchronous speed} - \text{Motor full load rated speed})(N) \times \text{Motor Poles (P)}}{120}$$

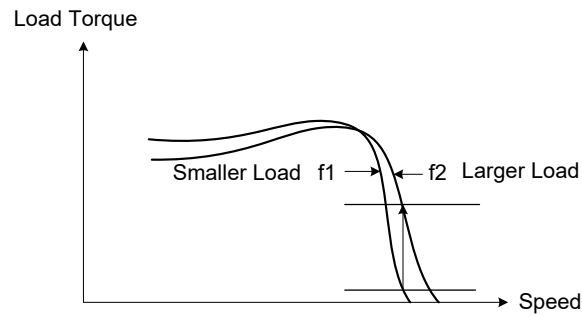


Figure 4.3.90 Slip compensation output frequency

18-01: Slip compensation gain at high speed

- (1) It is not required to adjust the Slip compensation gain at high speed for a loaded motor.
- (2) After adjusting parameter 18-00 it is recommended to increase the reference frequency and check the motor speed. Increase the value of 18-01 to adjust the slip compensation in case the motor speed does not match.
- (3) To reduce speed errors Increase the motor rated frequency (01-12 base frequency) and increase the value of 18-01.
- (3) Compared to 18-00, 18-01 serves as a variable gain for the full speed range.
- (4) If the speed accuracy becomes worse due to an increase in motor temperature it is recommended to use a combination of 18-00 and 18-01 to adjustment motor slip.

Parameter 18-01 determines the slip compensation at the motor rated speed and is calculated follows:

$$\text{Slip Compensation Gain} = (\text{Slip Compensation Gain at low speed} + \text{Slip Compensation Gain at high speed}) \times \frac{\text{Reference Frequency}}{\text{Motor rated frequency (01-12)}}$$

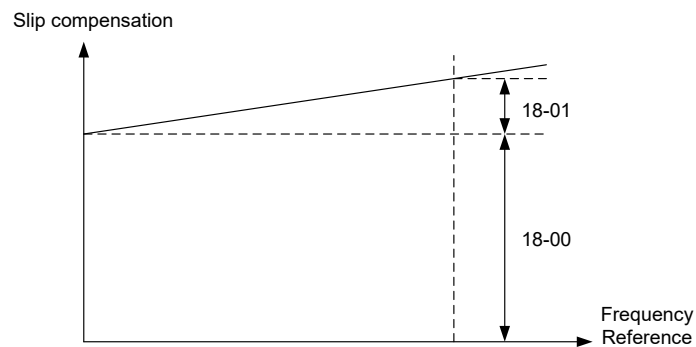


Figure 4.3.91 Parameter 18-00/18-01 Slip compensation gain versus frequency reference

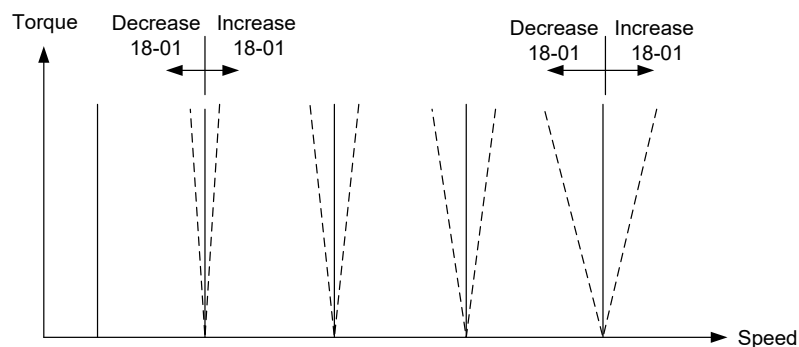


Figure 4.3.92 Parameter 18-01 Effect on speed/torque curve

18-02: Slip compensation limit

Sets slip compensation limit in constant torque and the constant power operation (Figure 4.3.93). If 18-02 is set to 0%, the slip compensation limit is disabled.

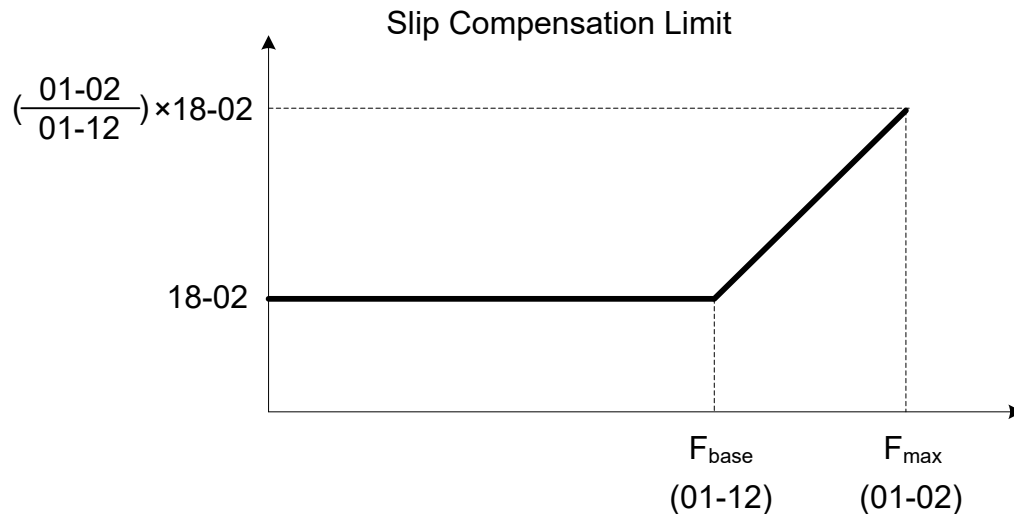


Figure 4.3.93 Slip compensation limit

When the slip compensation gain 18-00 at low speed is adjusted, and the actual motor speed is still lower than the reference frequency, the motor may be limited by the slip compensation limit.

18-03: Slip compensation filter

Sets slip compensation filter time in V/F mode

18-04: Regenerating slip compensation selection

Enable or disable slip compensation during regeneration.

Enable slip compensation during regeneration (18-04=1) in case speed accuracy is required when experiencing regeneration caused by deceleration (SLV mode). When the slip compensation function is used regenerative energy might increase temporarily (18-04=1) and a braking module might be required.

SLV mode adjustment**18-00: Slip compensation gain**

- a) Slip compensation can be used to control the full range speed accuracy under load condition.
- b) If the output frequency is lower than 2 Hz and the motor speed decreases, increase the value of 18-00.
- c) If the output frequency is lower than 2 Hz and the motor speed increases, reduce the value of 18-00.

Slip compensation gain uses a single value for the full speed range. As a result the slip compensation accuracy at low speed is high but slight inaccuracies might occur at high speeds. Slip compensation gain is fixed for the full speed range. Adjust 18-00 or 18-01 to improve speed accuracy at higher speed, however adjusting these parameters might impact the accuracy at lower speeds.

The impact of 18-00 on the speed and torque are shown in figure 4.3.94

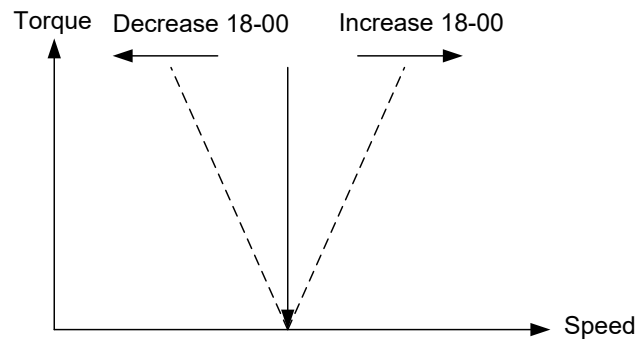


Figure 4.3.94 18-00 Effect on the torque and speed

18-05: FOC (Flux Orient Control) delay time (18-05)

In the SLV mode, the slip compensation of the magnetic flux depends on the torque current and excitation current. If the motor load rises above 100% while running at the motor rated frequency, the motor voltage and resistance drop sharply, which may cause the inverter output to saturate and current jitter may occur.

The magnetic flux slip compensation will independently control the torque current and the excitation current to prevent increasing and decreasing of the current (jitter). For slow speed or fixed speed operation, 18-05 may be increased. For fast operation adjust 18-06.

18-06: Slip compensation gain (18-06)

If the motor is jittering at the rated frequency under full load, the value of 18-06 may gradually be reduced to zero to reduce current jitter.

Group 20 Speed Control Parameters
--

20- 00	ASR Gain 1
Range	【0.00~250.00】
20- 01	ASR Integral Time 1
Range	【0.001~10.000】 Sec
20- 02	ASR Gain 2
Range	【0.00~250.00】
20- 03	ASR Integral Time 2
Range	【0.001~10.000】 Sec
20- 04	ASR Integral Time Limit
Range	【0~300】 %
20- 07	Selection of Acceleration and Deceleration of P/PI
Range	【0】 : PI speed control will be enabled only in constant speed. For accel/decel, only use P control. 【1】 : Speed control is enabled either in constant speed or accel/decal.
20- 08	ASR Delay Time
Range	【0.000~0.500】 Sec
20- 09	Speed Observer Proportional (P) Gain 1
Range	【0.00~2.55】
20- 10	Speed Observer Integral(I) Time 1
Range	【0.01~10.00】 Sec
20- 11	Speed Observer Proportional (P) Gain 2
Range	【0.00~2.55】
20- 12	Speed Observer Integral(I) Time 2
Range	【0.01~10.00】 Sec
20- 13	Low-pass Filter Time Constant of Speed Feedback 1
Range	【1~1000】 mSec
20- 14	Low-pass Filter Time Constant of Speed Feedback 2
Range	【1~1000】 mSec
20- 15	ASR Gain Change Frequency 1
Range	【0.0~400.0】 Hz
20- 16	ASR Gain Change Frequency 2
Range	【0.0~400.0】 Hz
20- 17	Torque Compensation Gain at Low Speed
Range	【0.00~2.50】
20- 18	Torque Compensation Gain at High Speed
Range	【-10~10】 %
20-33	Constant Speed Detection Level
Range	【0.1~5.0】 %

Parameter 20-33 is used when 20-07 is set to 0 and frequency command source is set to analog input. A noisy analog input signal might cause a problem where the inverter determines that the operation does not reach its constant speed. Adjust parameter 20-33 according to avoid this situation from occurring.

The following diagram is an overview of the automatic speed regulator (ASR) block.

SLV control mode:

The ASR function adjusts the output frequency to control the motor speed to minimize the difference between the frequency reference and actual motor speed.

The ASR controller in SLV mode uses a speed estimator to estimate the motor speed. In order to reduce speed feedback signal interference, a low-pass filter and speed feedback compensator can be enabled.

The ASR integrator output can be disabled or limited (03-00 to 03-05= 43). The ASR output is passed through a low-pass filter.

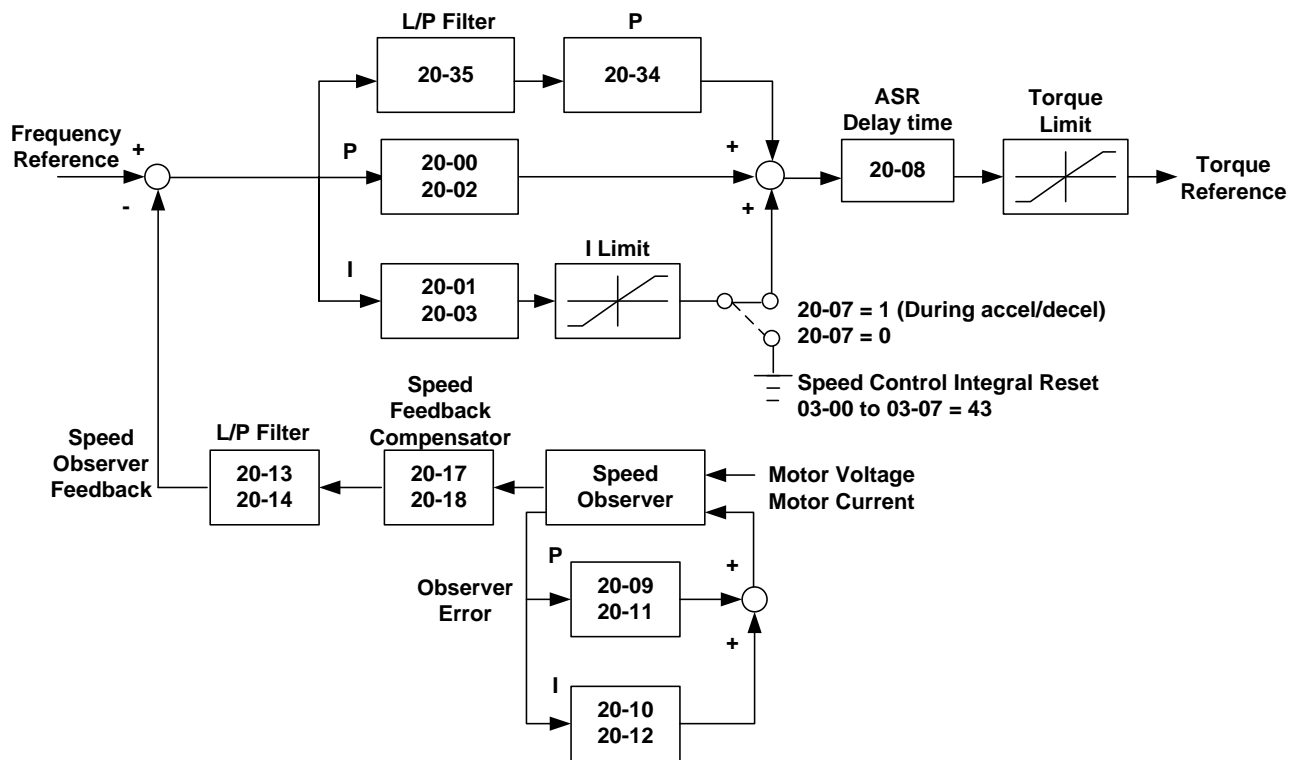


Figure 4.3.95 ASR block diagram (SLV mode)

ASR setting (SLV control mode)

In SLV mode the ASR gain is divided into a high-speed and low-speed section. The speed controller has a high-speed gain 20-00/20-01 and a low-speed gain 20-02/20-03 that can be set independently.

- 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.

- d) 20-18 sets the high-speed compensation gain of the speed feedback.
- e) When the frequency reference rises above the value set in 20-16, the ASR gain used is set by parameters 20-00 and 20-01.
- f) When the frequency reference falls below the value set in 20-15, the ASR gain used is set by parameters 20-02 and 20-03.
- g) Gain time constant is adjusted linearly when the speed command falls within the range of 20-15 to 20-16, for a smooth operation.

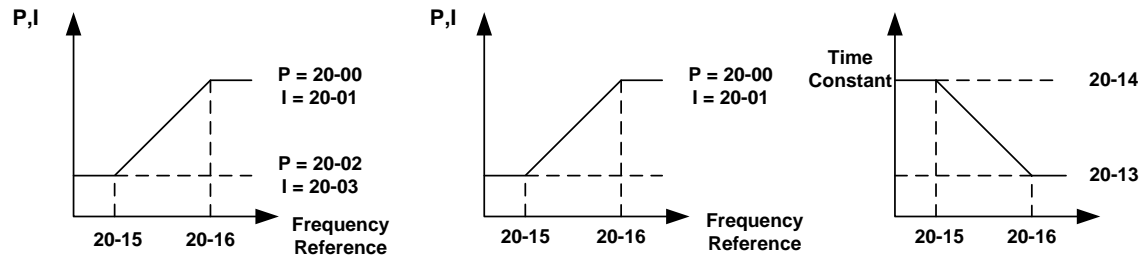


Figure 4.3.96 ASR gain setting (SLV mode)

Tune the speed control gain

Refer to the following steps:

- a. Gain adjustment at minimum output frequency
 - Motor running at minimum output frequency (Fmin, 01-08).
 - Increase value of ASR proportional gain 2 (20-02) make sure setting does not affect stability.
 - Decrease value of ASR integration time 2 (20-03), make sure setting does not affect stability.
 - Ensure the output current is lower than 50% of inverter rated current. If the output current is greater than 50% of inverter rated current, decrease the value of parameter 20-02 and increase value of parameter 20-03.
- b. Gain adjustment at maximum output frequency
 - Motor running at maximum output frequency (Fmax, 01-02).
 - Increase ASR proportional gain1 (20-00), make sure setting does not affect stability.
 - Decrease ASR integration time 1 (20-02) make sure setting does not affect stability.
- c. Gain adjustment of accel./ decel. integral control
 - When 20-07=1, PI speed control is enabled for constant speed and during accel./ decel.
 - Integral control allows the motor speed to quickly reach its the target speed but may cause overshoot or instability. Refer to Fig. 4.3.97 & Fig.4.3.98.

When 20-07=1, ASR Proportion (P) and Integer (I) control during accel/ decel. and constant speed.

When 20-07=0, ASR Proportion (P) and Integer (I) control only during constant state and ASR P control is used during accel/ decel..

Parameter 20-33 (Constant Speed Detection Level) is active when 20-07 is set to 0 and frequency command source is set to analog input. Adjust the value of parameter 20-33 when noise of the analog causes the inverter not being able to determine a constant speed condition.

During ASR gain tuning, the multi-function analog output (AO1 and AO2 terminal) can be used to monitor the output frequency and motor speed (as shown in Fig.4.3.96).

SLV mode gain tuning (20-00~20-03, 20-09~20-18)

- a) Complete the parameter tuning in normal operation.
- b) Increase ASR proportional gain 1 (20-00), ASR proportional gain 2 (20-02) and carefully monitor system stability.

Use parameter 20-00 and 20-02 to adjust the speed response for each cycle. Increasing the values of 20-00, 20-02 increases system response, but may cause system instability. See Fig.4.3.97.

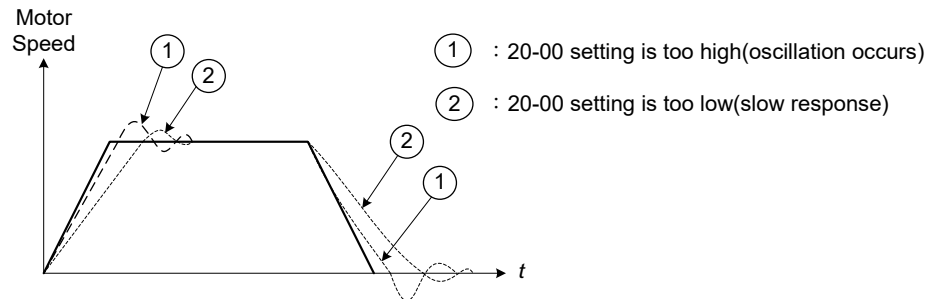


Figure 4.3.97 System response of ASR proportion gain

- a) Reduce ASR integral time 1(20-01), ASR integral time 2 (20-02) and carefully monitor system stability.
 1. A long integral time will result in poor system response.
 2. If the integral time is set to small, the system may become unstable. Refer to the following figure.

While tuning ASR P and I gain the system may overshoot and an over voltage condition may occur. A braking unit (braking resistor) can be used to avoid an over voltage condition.

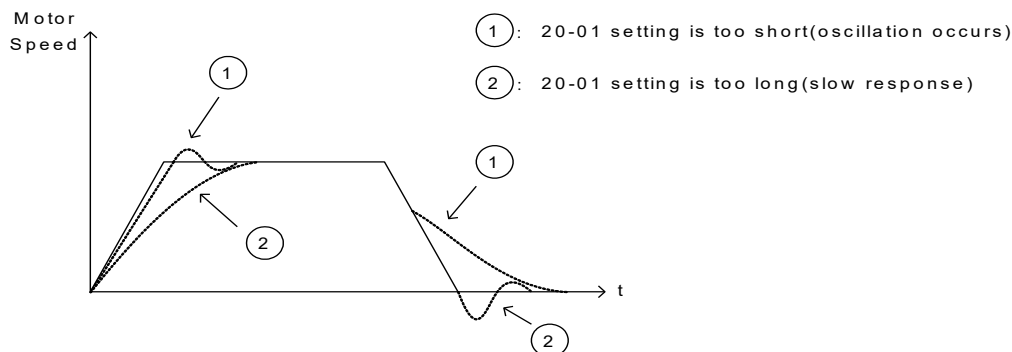


Figure 4.3.98 The response of ASR integral time

Both low-speed ASR gain and the high-speed gain can be set to the same values and only require to be adjusted in case of system instability.

In case tuning of the ASR P and I gain 20-00~20-03 does not improve the system response, reduce the low-pass filter time constant 20-13~20-14 to increase the bandwidth of the feedback system and re-tune the ASR gain.

- 1) Tune the low-speed ASR P and I gain 20-02 ~ 20-03, make sure the reference frequency is set below the value of parameter 20-15.
- 2) Tune the high-speed ASR PI gain 20-00~20-01, make sure the reference frequency is above the value set in parameter 20-16 value.
- 3) Both low-speed ASR gain and the high-speed gain can be set to the same values and only require to be adjusted in case of system instability.
- 4) reduce the low-pass filter time constant 20-13~20-14 to decrease the bandwidth of the feedback system and

re-tune the ASR gain, in case tuning of the ASR P and I gain 20-00~20-03 does not improve the system response.

- 5) Tune low-speed low-pass filter time constant 20-14, make sure the reference frequency is below parameter 20-15 value.
- 6) Tune high-speed low-pass filter time constant 20-13 at frequency reference, make sure the reference frequency is above parameter 20-16 value.
- 7) Increasing the low-pass filter time constant can limit the bandwidth of the speed feedback system and may reduce the system response. Increasing the low-pass time reduces the speed feedback signal interference but may 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.
- 8) Decreasing the low-pass filter time constant may increase the bandwidth of the speed feedback and the system response. Decreasing the low-pass time may increase the speed feedback interference resulting in system instability when the load suddenly changes. Decrease the low-pass filter time 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.
- 9) In case tuning 20-00~20-03 and the low-pass filter time constant 20-13~20-14 do not improve the system response time, tuning the PI gain 20-09~20-12 of the speed estimator may be required.
- 10) Setting a high gain for the speed estimator (high proportion (P) gain and small integral (I) time) increases the bandwidth of the speed feedback, but may cause speed feedback interference resulting in system instability.
- 11) Setting a low gain for the speed estimator (small proportion (P) gain and high integral time) decreases the bandwidth of the speed feedback, may improve speed feedback interference resulting in a more stable system.
- 12) The default values for the ASR can be used in most applications, no adjustment is required. Adjusting the low-pass filter time and speed estimator gain requires a good understanding of the overall system. If a high-speed system response in combination with stable operation is required consider using SLV control mode.
- 13) Parameter 20-15 sets the gain switch frequency at low-speed and parameter 20-16 sets the gain switch frequency at high-speed.
- 14) Operating at a speed below 20-15 will result in an increased excitation current for low-speed operation accuracy. When the frequency reference rises above 20-16, the inverter will output the rated excitation current at the no-load voltage (02-19).
- 15) For general purpose applications parameter 20-15 should be set to a value of 5~50% of the motor base frequency. If this value is too high, the inverter output may saturate. Parameter 20-16 should be set to a value of 4Hz or more above the value of 20-08.
- 16) When experiencing speed jitter at high speed and stable operation during mid-range speed while operating a heavy load (>100%), it is recommended to reduce the no-load voltage (02-19) or tune the FOC parameters (18-05 ~ 18-06).
- 17) Parameter 20-17 and 20-18 are for compensating speed feedback at low speed and high speed.

- 18) Use parameter 20-17 to adjust the torque compensation gain for the low speed range. By tuning 20-17 an offset is added to the torque-speed curve. Increase 20-17 when the no-load speed is lower than the frequency reference. Decrease 20-17 when the no-load speed is higher than the frequency reference.

The effect on the torque-speed curve from 20-17 is shown as the following figure:

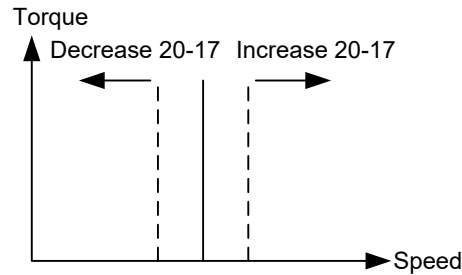


Figure 4.3.99 Effect on the torque-speed curve from 20-17

- Use parameter 20-18 to adjust the torque compensation gain for middle to high speed range. For most general purpose applications it is not necessary to adjust the 20-18. By tuning 20-18 an offset is added to the torque-speed curve. Increase 20-18 when the no-load speed is lower than the frequency reference. Decrease 20-18 when the no-load speed is higher than the frequency reference. The effect on the torque-speed curve from 20-18 is shown as the following Fig.4.3.100.

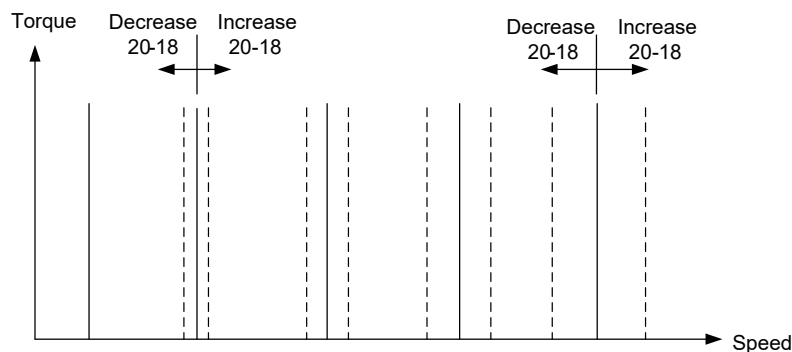


Figure 4.3.100 Effect on the torque-speed curve from 20-18

- ASR main delay time (20-08).
 - a) Does not required to be adjusted for general purpose applications
 - b) When the set value of 20-08 is set high, the speed response will and therefore system response will decrease improving system stability.
- a. ASR Integral Time Limit (20-04)
 - a) Setting a small value may prevent system response when the load suddenly changes.

Note:

- Response specifications of no-load speed circuit bandwidth at vector control:
 1. 50 Hz is at the control modes of SV / PMSV.
 2. 10 Hz is at the control modes of SLV / PMSLV.
- Speed response will be affected by kp adjustment, inertia, load and motor temperature, etc. so that the bandwidth decrease slightly in application.

20- 34	Derating of Compensation Gain
Range	【0.00~25600】
20- 35	Derating of Compensation Time
Range	【0~30000】 mSec

Derating of torque compensation function can reduce the ASR impact during a sudden load change. Refer to Fig. 4.3.97 & Fig. 4.3.98.

Parameter 20-34 functions the same as ASR proportional gain (20-00, 20-02) but with an additional low-pass filter time constant (20-35) to avoid oscillation. Typical value for parameter 20-34 is between 30~50.

This time constant is used for suppressing the oscillation produced by 20-34. Increasing the compensation time constant results in a slower output response and might affect the overall application. Typical value for parameter 20-34 is between 50~100ms.

Decreasing the torque compensation value can reduce the response of the ASR during a sudden load change. Refer to Fig. 4.3.108 & Fig. 4.3.109.

20-34 Compensation Gain During Speed Drop:

The effect of parameter 20-34 is the same as the proportional gain of the ASR (20-00, 20-02) but active only for the time specified in 20-35 for large speed fluctuation to prevent system instability.

20-35 Compensation Time During Speed Drop:

This parameter sets the time constant used to prevent system instability caused by parameter 20-34. An increased compensation time can lead to a slower output response which can affect derating compensation in a negative way.

The recommended setting value of 20-34 is between 30~50 and for 20-35 between 50~100ms.

Group 21 Torque Control Parameters

21- 05	Positive Torque Limit
Range	【0~160】 %
21- 06	Negative Torque Limit
Range	【0~160】 %
21- 07	Forward Regenerative Torque Limit
Range	【0~160】 %
21- 08	Reversal Regenerative Torque Limit
Range	【0~160】 %

Torque limit can be set in two ways:

- Use torque limit parameters (21-05 to 21-08) to set a fixed torque limit.
- Set the torque limit by using the multi-function analog input (AI2).

There are four torque limits that can be set separately, one for each quadrant:

- I. Positive torque limit in forward direction (21-05 positive torque limit)
- II. Positive torque limit of reverse direction (21-06 negative torque limit)
- III. Negative torque limit in reverse direction (21-07 forward regenerating torque limit)
- IV. Negative torque limit in forward direction (21-08 reversal regenerating torque limit)

Refer to Fig.4.3.101.

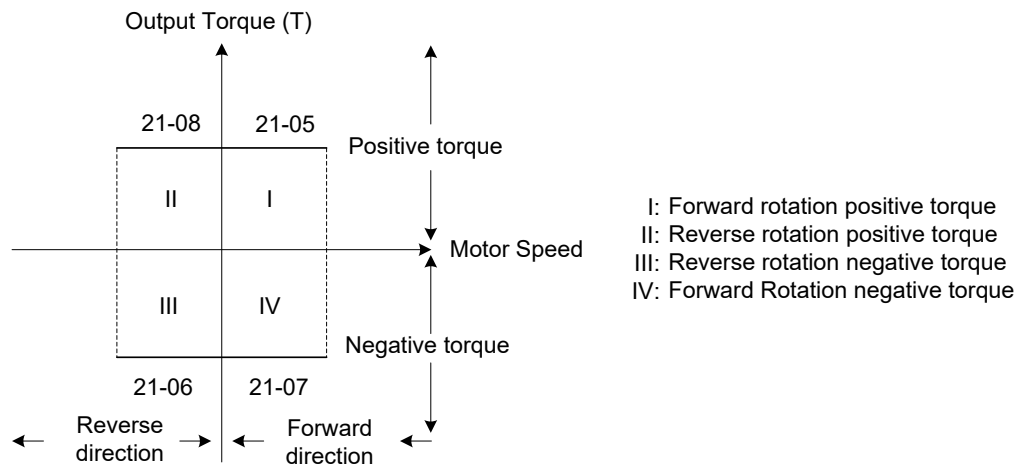


Figure 4.3.101 Torque limit setting

Torque limit setting using multi-function analog input AI2 (04-05)

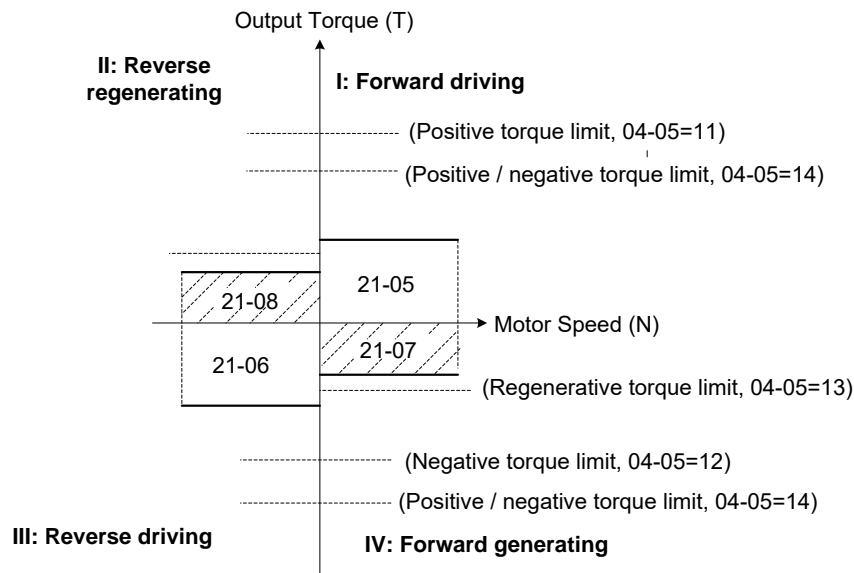
Table 4.3.16 Torque limit analog input

04-05 (AI2)	Function
11	Positive torque limit
12	Negative torque limit
13	Regenerative torque limit (for both forward and reversal directions).
14	Positive/negative torque limit (positive and negative detection torque limit)

Set the analog input terminal (AI2) signal level (04-00), gain (04-07) and bias (04-08)

The default setting for the analog input AI2 is 0 -10V representing 0 – 100% of the motor rated torque.

Fig.4.3.102 shows the relationship between the output torque and the torque limit.

**Figure 4.3.102 Analog input torque limit (AI2)**

When the analog input is set to positive torque limit (value = 11) the torque limit is active in the third and fourth quadrant in reverse direction (regenerative torque in the second quadrant).

When the analog input is set to negative torque limit (value = 12) the torque limit is active in the third and fourth quadrant.

When the analog input is set to regenerative torque limit (value = 13) the torque limit is active in the second and fourth quadrant can be controlled.

When the analog input is set to positive/negative torque limit (value = 14) the torque limit is active in all four quadrants.

When the analog input is at maximum (10V or 20mA), the torque limit is 100% of the motor rated torque. In order to increase the torque limit above 100% the analog input gain (04-07) has to set to a value greater than 100%. For example: 160.0% of the gain will result in the torque limit of 160% of motor rated torque at 10V (20mA) analog input level.

Group 22: PM Motor Parameters

Note: Parameters in Group 22 are only available when PM Control Mode is selected

22- 00	Rated Power of PM Motor
Range	【0.00~600.00】 Kw
22- 02	Rated Current of PM Motor
Range	25%~200% of inverter's rated current
22- 03	Pole Number of PM Motor
Range	【2~96】 Poles
22- 04	Rated Rotation Speed of PM Motor
Range	【6~60000】 rpm
22- 05	Maximum Rotation Speed of PM Motor
Range	【6~60000】 rpm
22- 06	PM Motor Rated Frequency
Range	【4.8~400.0】 Hz
22- 10	PM SLV Start Current
Range	【20 ~ 200】 %
22- 11	I/F Mode Start Frequency Switching Point
Range	【1.0 ~ 20.0】 %
22- 12	Speed Estimation kp Value
Range	【1 ~ 10000】
22- 13	Speed Estimation ki Value
Range	【1 ~ 1024】
22- 14	PM Motor Armature Resistance
Range	【0.001 ~ 30.000】 Ω
22- 15	PM Motor D-axis Inductance
Range	【0.01 ~ 300.00】 mH
22- 16	PM Motor Q-axis Inductance
Range	【0.01 ~ 300.00】 mH
22- 17	Reserved
Range	Reserved
22- 18	Flux-Weakening Control
Range	【0 ~ 100】 %

The PM parameter group can be restored to factory default by initializing the inverter (13-08). Set the motor rating before initializing the inverter (13-00).

22-00: PM motor rated power

Set the motor power according to the motor nameplate.

22-02: PM motor rated current

Set the motor full load according to the motor nameplate.

22-03: PM motor pole number

Set the number of motor poles according to the motor nameplate.

22-04: PM motor rated speed

Set parameter 22-04 or 22-06, the inverter will automatically calculate one or the other.

Set the motor rated speed in rpm according to the motor nameplate.

Note:

Only set parameter 22-04 or 22-06, the inverter will automatically calculate the other one.

Formula (22-04) = $120 \times f(22-06) / \text{Number of Poles (22-03)}$

22-05: PM motor maximum rotation speed

Set the maximum motor rated speed in rpm according to the motor nameplate.

22-06: PM motor rated frequency

Set the motor rated frequency according to the motor nameplate.

Only one of the two values is required, either PM motor rated speed (22-04) or PM motor rated frequency (22-06), the inverter will automatically calculate the other upon entering the data based on the formula below:

$$(\text{PM motor rated speed}) N = \frac{120 \times f(\text{PM motor rated frequency})}{P(\text{PM motor pole number})}$$

22-10: PMSLV Start Current

Set the torque current at start up as % of motor rated current.

22-11: I/F Mode Start Frequency Switching Point

Function for the switching from open-loop to closed-loop in PMSLV mode. The unit is percentage of rated speed of the motor. It recommended setting this parameters to a value greater than 5% for 400V and a value greater than 10% for 200V.

22-12 Speed Estimation kp Value & 22-13 Speed Estimation ki Value

Performance of speed response adjustment

The greater the value, the faster the motor response; Please note system may become unstable when value is set too high.

The lower the value, the greater the speed deviation. Please adjust setting based on system requirements.

22-14: Armature Resistance of PM Motor

Set resistor for each phase of the motor in increments of 0.001Ω. Value is set automatically during motor tuning (22-21).

22-15: D-axis Inductance of PM Motor

Set motor D-axis inductance in increments of 0.001mH. Value is set automatically during motor tuning (22-21).

22-16: Q-axis Inductance of PM Motor

Set motor's Q-axis Inductance in increments of 0.001mH. Value is set automatically during motor tuning (22-21).

22-18: Flux-Weakening Limit

Sets the flux-weakening limit as a percentage of the motor rated current. If the motor maximum rotation speed (22-05) is set to a value greater than the motor rated rotation speed (22-04) the inverter will automatically enable flux-weakening control.

22- 21	SLV PM Motor Tuning
Range	【0】 : Disable 【1】 : Enable
22- 22	Fault History of SLV PM Motor Tuning
Range	【0】 : No Error 【1】 ~ 【4】 : Reserved 【5】 : Circuit tuning time out 【6】 : Reserved 【7】 : Other motor tuning errors 【8】 : Reserved 【9】 : Current Abnormality Occurs while Loop Adjustment 【10】 : Reserved 【11】 : Stator Resistance Measurement is Timeout 【12】 : Reserved
22- 25	Detection Mode Selection of Default Magnetic Pole
Range	【0】 : Angle before Stop 【1】 : Mode 1 【2】 : Mode 2 【3】 : Mode 3
22- 27	Mode 2 Voltage Command
Range	【5~100】 %
22- 28	Mode 2 Frequency Division Ratio
Range	【0~4】
22- 29	Field-Weakening Voltage Control
Range	【80~100】 %

SLV PM Motor Tuning (22-21)

WARNING!

Sudden start: The inverter and motor may start unexpectedly during Auto-Tuning, which could result in death or serious injury. Make sure the area surrounding of the motor and load are clear before proceeding with Auto-Tuning.

WARNING! Electric Shock Hazard

High voltage is applied to the motor when performing an auto-tune, even when the motor is stopped, which could result in death or serious injury. Do not touch the motor before performing the auto-tuning procedure is completed.

WARNING! Holding Brake

Do not perform an auto-tuning procedure when the motor is connected to a mechanical brake this may result in incorrect motor data calculation. Disconnect the motor and the load and confirm the motor can operate freely.

1. Before selecting PM motor tuning, enter the motor data (22-00) - (22-06) according to the motor nameplate.
2. Use parameter 22-21 to select tuning mode.
 - a) Next press the enter key to go to the PM motor tuning screen. The keypad will show "IPrdy" (Ready to Tune).
 - b) Press run to start the PM motor tuning. The keypad will display the "IPtun" message during auto-tune.
 - c) If the motor is successfully tuned, the message of "IPEnd " will be displayed. If auto-tune is aborted with the stop key, the operator will display the message of " IPbrd " (PM motor tuning aborted).

Notes:

1. Perform a magnetic pole alignment auto-tune before adjusting the speed loop.
2. It is not required to perform a magnetic pole alignment auto-tune each time the inverter is powered up.

Fault History of SLV PM Motor Tuning (22-22)

If PM motor tuning has failed, the "IPErr" message is shown on the keypad (PM motor tuning failure). Refer to section 10 for the possible error causes and trouble shooting.

PM motor tuning fault history (22-22) only stores the result of the last auto-tune performed .If auto-tuning was successful or aborted, no error will be displayed.

22-25: Initial position detection of PM motor

Used in PMSLV control mode only. When 22-25=1, the inverter will automatically detect the initial position of motor rotor while the motor running to prevent the motor from running in the opposite direction.

22-25=0: detection function is disabled

22-25=1: Mode 1

Pulse input signals are used to detect the rotor position by using a successive pulses.

22-25=2, Mode 2

Variable frequency signals are used to detect the rotor position.

22-25=3, Mode 3

Pulse input signals are used to detect the rotor position.

22-27 Mode 2 Voltage Command)

When 22-25=2 (Mode 2), if the rotor position is unstable at start, increase the value of mode 2 voltage command to ensure the accuracy of the detection angle.

Note: When the voltage value is set too high, an overcurrent condition may be occurs.

22-28 Mode 2 Frequency Division Ratio

When 22-25=2 (Mode 2), the input continuous signal frequency of mode 2 depends on the carrier frequency setting (parameter 11-01). The higher the carrier frequency then higher the frequency ratio needs to be to reduce the input continuous signal frequency to ensure the accuracy of the detection angle.

22-29 Field-Weakening Voltage Control

Parameter is used to prevent output voltage saturation. This value is used to control field-weakening as a percentage of the inverter's input voltage to limit the inverter output voltage. If parameter 22-18 (Flux-Weakening Control) is set too low, the inverter's output voltage will rise above the inverter voltage command.

Group 23 Pump & HVAC Function Parameters

23- 00	Function Selection
Range	【0】 : Disable 【1】 : Pump 【2】 : HVAC 【3】 : Compressor

Select between pump, HVAC or compressor application. This parameter automatically enables PID control mode (10-03) when Pump or HVAC is selected and enabled parameter group 23.

When 23-00=1, LCD keypad switches main screen monitoring automatically (16-00) to operating pressure setting (12-74), the sub-screen monitoring 1 (16-01) to pressure feedback value (12-75) and sub-screen monitoring 2 (16-02) to output frequency (12-17).

When 23-00=2, LCD keypad switches main screen monitoring automatically (16-00) to flow meter target setting (12-77), the sub-screen monitoring 1 (16-01) to flow meter feedback (12-71) and sub-screen monitoring 2 (16-02) to output frequency (12-17).

When 23-00=3, PID option for main frequency command source (00-05) cannot be selected and V/F curve is limited to F (01-00). Middle output voltage (01-07) is automatically set to half of then maximum output voltage and parameter 01-00 is hidden.

Notes:

- It is required to set parameters 00-05 and 10-03 in inverter software V1.3.
- It is disabled in switching display setting in inverter software V1.3.
- Refer to parameter 23-05 when using a LED keypad.
- Pump or Compressor selections are only available when control mode (00-00) is set for V/f.

23- 01	Setting of Single & Multiple Pumps and Master & Alternative
Range	【0】 : Single Pump 【1】 : Master 【2】 : Slave 1 【3】 : Slave 2 【4】 : Slave 3

Select inverter as the Master or Slave 1~3 via parameter 23-01. Refer to Fig.4.3.111 for the description of a duplex pump system. Inverter needs to reconnect after parameter is changed.

23- 02	Operation Pressure Setting
Range	【0.10 ~ 650.00】 PSI

Set the setpoint pressure value based on the pressure transducer of the pump system after setting 10-00 to 0 (keypad entered).

23- 03	Maximum Pressure of Pressure Transmitter
Range	【0.10 ~ 650.00】 PSI

Set the maximum pressure value based on the pressure transducer of the pump system. Parameter 23-02 is limited to this maximum value.

23- 04	Pump Pressure Command Source
Range	【0】 : Set by 23-02 【1】 : Set by AI
23-71	Maximum Pressure Setting
Range	【0.10 ~ 650.00】 PSI

Pressure command source can be entered in 23-02 (Operation Pressure Setting) or by using an analog input. Refer to parameter 10-00 on how to select AI terminal.

Note: Refer to section 3.3.4.1 for single/ Multi-pump wiring diagram.

23-02 (Operation pressure setting) is limited by 23-71 (Maximum pressure setting). 23-71 is limited by 23-03 (Maximum Pressure of Pressure Transducer)

23- 20	Switching of Pressure and Percentage
Range	【0】 : Pressure 【1】 : Percentage

23-20=1: Parameters 23-09, 23-24, 23-34, 23-38 and 23-39 are set as a percentage of parameter 23-02 and parameters 23-12 & 23-15 are set as a percentage of parameter 23-03.

23-20=0: Parameters 23-09, 23-24, 23-34, 23-38, 23-39, 23-12 and 23-15 are set as absolute value in Pump units (23-36).

For example, 23-02=4.00PSI, 23-03=10.00PSI, 23-09=0.5PSI, 23-12=5.00PSI

When **23-20=0→1**,

$$((23-09) \div (23-02)) \times 100 \Rightarrow 23-09 = 13\% \text{ (Rounded to integer)}$$

$$((23-15) \div (23-03)) \times 100 \Rightarrow 23-15 = 50\% \text{ (Rounded to integer)}$$

When **23-20=1→0**,

$$((23-09)/100) \times 23-02 \Rightarrow 23-09 = 0.52\text{PSI}$$

$$((23-15)/100) \times 23-03 \Rightarrow 23-15 = 5.00\text{PSI}$$

23- 36	PUMP Unit Display (LCD Keypad only)
Range	【0】 : PSI 【1】 : inW 【2】 : Bar 【3】 : Pa

When 23-00=1 and 23-20=0, the LCD keypad displays engineering unit based on the value set in parameter for parameters 12-74, 12-75, 23-02, 23-03, 23-09, 23-12, 23-15, 23-23-24, 23-34, 23-38 and 23-39.

23- 05	Display Mode Selection *2
Range	【0】 : Display Target (setpoint) and Pressure Feedback 【1】 : Only Display Target (setpoint) Pressure 【2】 : Only Display Pressure Feedback

Select main display setup for target (setpoint) and feedback pressure.

① When 23-05=0000: Led keypad displays pressure setpoint value and pressure feedback value.

20 18
2.0 1.8

Two-digit to the left is pressure setpoint value setting and two-digit to the right is the pressure feedback value when using an LED keypad.

Note: When 23-00=2 (HVAC), the unit are multiplied by 1000 times. A value of 5.0, means 5000 GPM.

② When 23-05=0001: Led keypad only displays the pressure setpoint value.

20
2.0

③ When 23-05=0002: Led keypad only displays the pressure feedback value.

18
1.8

Notes:

- When the target (setpoint) value is greater than 10, the target (setpoint) value is only shown as an "integer" value instead of a "decimal" value when 10-33 is set below 1000 and 10-34=1 using PID mode.
- If Pump mode is used parameter 23-03 requires needs set to value smaller than 10.0 PSI.

23- 06	Proportion Gain (P)
Range	【0.00~10.00】
23- 07	Integral Time (I)
Range	【0.0~100.0】 Sec
23- 08	Differential Time (D)
Range	【0.00~10.00】 Sec

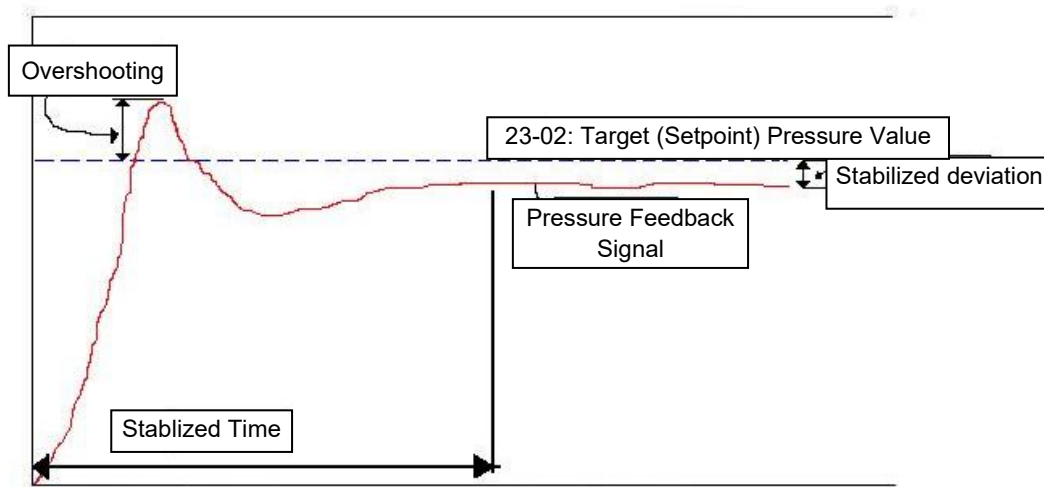


Figure 4.3.103 Diagram of pressure feedback value

Table 4.3.17 Guide for PID parameter adjustment

	Increase Setting Value	Decrease Setting Value	Main Feature
Proportional Gain (P)	(Pros) Increase response time	(Pros) Reduce instability	Increase stabilization time
	(Cons) Might cause pump instability	(Cons) Slow down response	
Integral Time (I)	(Pros) Smooth output frequency	(Pros) Fast response	For smooth feedback variations
	(Cons) Slow down response	(Cons) Change rapidly output frequency	
Differential Time (D)	(Pros) Avoid overshooting	(Pros) System stability	Respond to system rapid variations
	(Cons) System instability or motor instability	(Cons) Overshooting easily	

Notes:

- PID parameters can be modified while the inverter is running.
- Cons: Disadvantage, Pros: Advantage.

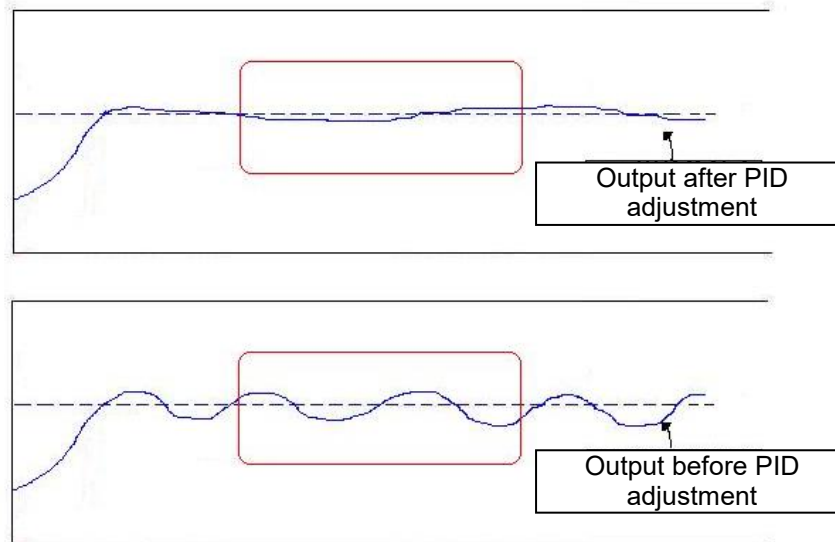


Figure 4.3.104 Diagram for PID parameter adjustment

23- 09	Tolerance Range of Constant Pressure	
Range	【0.01~650.00】 PSI	*1
	【1~100】 %	*2
23- 34	Tolerance Range of Constant Pressure 2	
Range	【0.01 ~ 650.00】 PSI	*1
	【1~100】 %	*2

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

When pressure feedback value rises above value set in 23-02 (operation pressure setpoint setting), inverter output frequency will decrease go to sleep when output frequency falls below value set in (23-10) for time specified in (23-11). PID starts (output frequency will increase) when pressure feedback value falls below (23-02) – (23-09).

23- 10	*Sleep Frequency of Constant Pressure
Range	【0.0~400.0】 Hz

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

When inverter output frequency falls below 23-10 (sleep frequency) for time specified in (23-11) the inverter will enter sleep mode.

23- 11	Sleep Time of Constant Pressure
Range	【0.0~255.5】 Sec

When the inverter output frequency falls below 23-10 (sleep frequency) for the time specified in (23-11) the inverter will enter sleep mode.

Note: Parameter 23-10 (sleep frequency for constant pressure) is a dedicated parameter for pump applications (23-00=1) do not use 10-17 (start frequency of PID sleep).

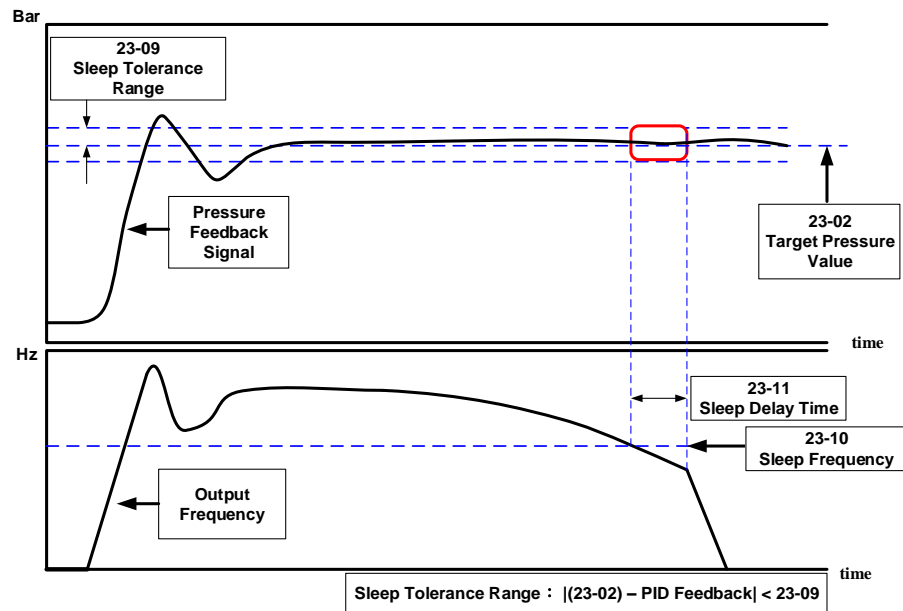


Figure 4.3.105 Sleep function for constant pressure applications

23- 12	Maximum Pressure Limit	
Range	【0.10 ~ 650.00】 PSI	*1
	【0~100】 %	*2

Parameter 23-12 sets the high pressure limit. When the pressure feedback exceeds the value set in 23-12 for the time specified in 23-13 the inverter displays high pressure warning, when time exceeds value set in 23-14 the inverter displays high pressure fault and stop.

23- 15	Minimum Pressure Limit	
Range	【0.00 ~650.00】 PSI	*1
	【0~100】 %	*2

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

Parameter 23-15 sets the low pressure limit. When the pressure feedback falls below the value set in 23-15 for the time specified in 23-16 the inverter displays low pressure warning, when time exceeds value set in 23-16 the inverter displays low pressure fault and stop.

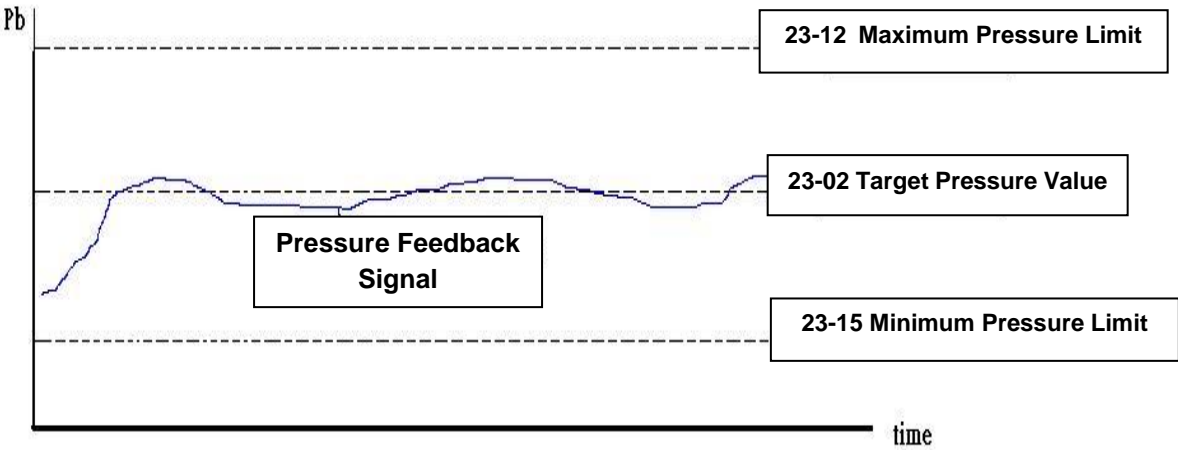


Figure 4.3.106 Diagram for pressure feedback limit

Note: The pressure under the control of PID is between the maximum pressure limit (23-12) and minimum pressure limit (23-15).

23- 13	Warning Time of High Pressure
Range	【0.0 ~ 600.0】 Sec

When the pressure feedback exceeds the value set in 23-12 for the time specified in 23-13 the inverter displays high pressure warning (HIPb).

23- 14	Stop Time of High Pressure
Range	【0.0 ~ 600.0】 Sec

When the pressure feedback exceeds the value set in 23-12 for the time specified in 23-14 the inverter displays high pressure fault (OPbFt) and stops.

Note: To disable the high pressure detection function set the warning time of high pressure to zero.

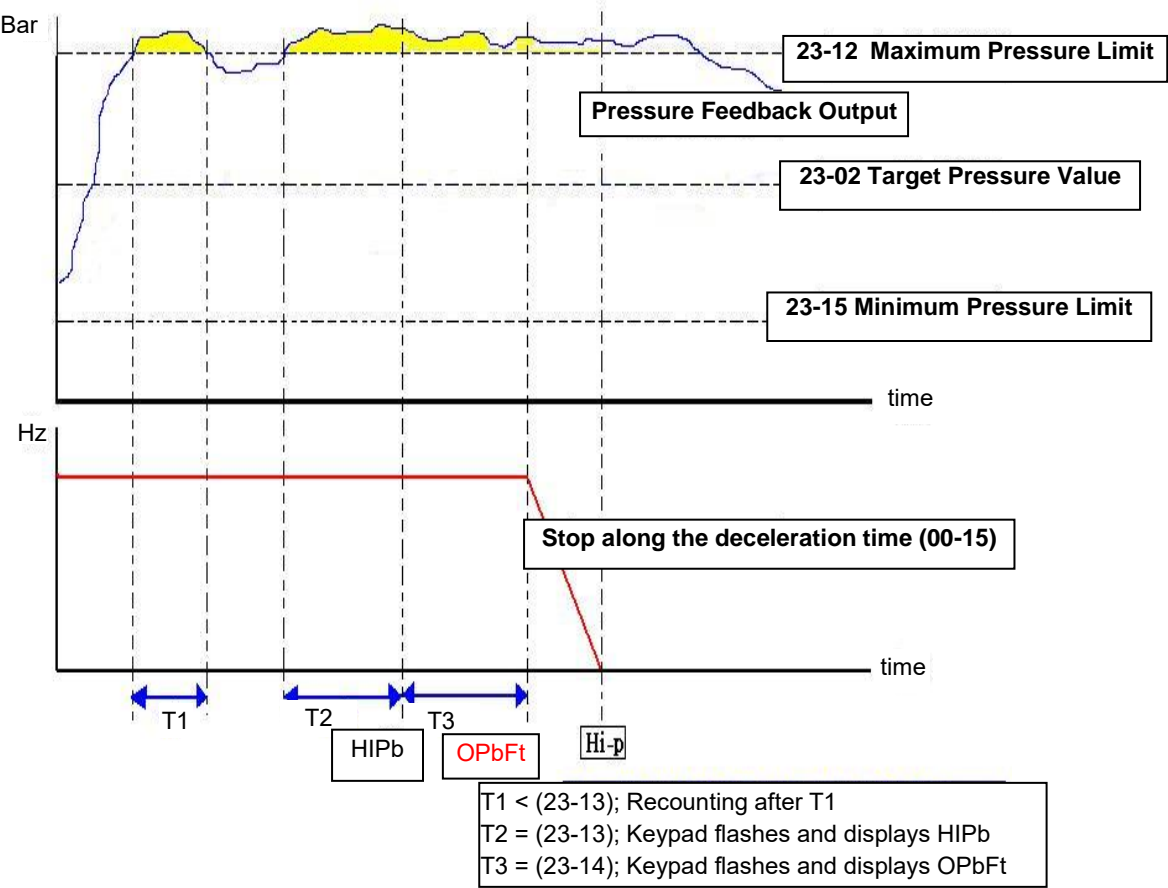


Figure 4.3.107 Diagram for warning to stop under the limit of high pressure

23- 16	Warning Time of Low Pressure
Range	【0.0 ~ 600.0】 Sec

When the pressure feedback falls below the value set in 23-15 for the time specified in 23-16 the inverter displays low pressure warning (LoPb).

23- 17	Fault Stop Time of Low Pressure
Range	【0.0 ~ 600.0】 Sec

When the pressure feedback falls below the value set in 23-15 for the time specified in 23-17 the inverter displays low pressure fault (LPbFt).

Note: To disable the low pressure detection function set the warning time of low pressure to zero.

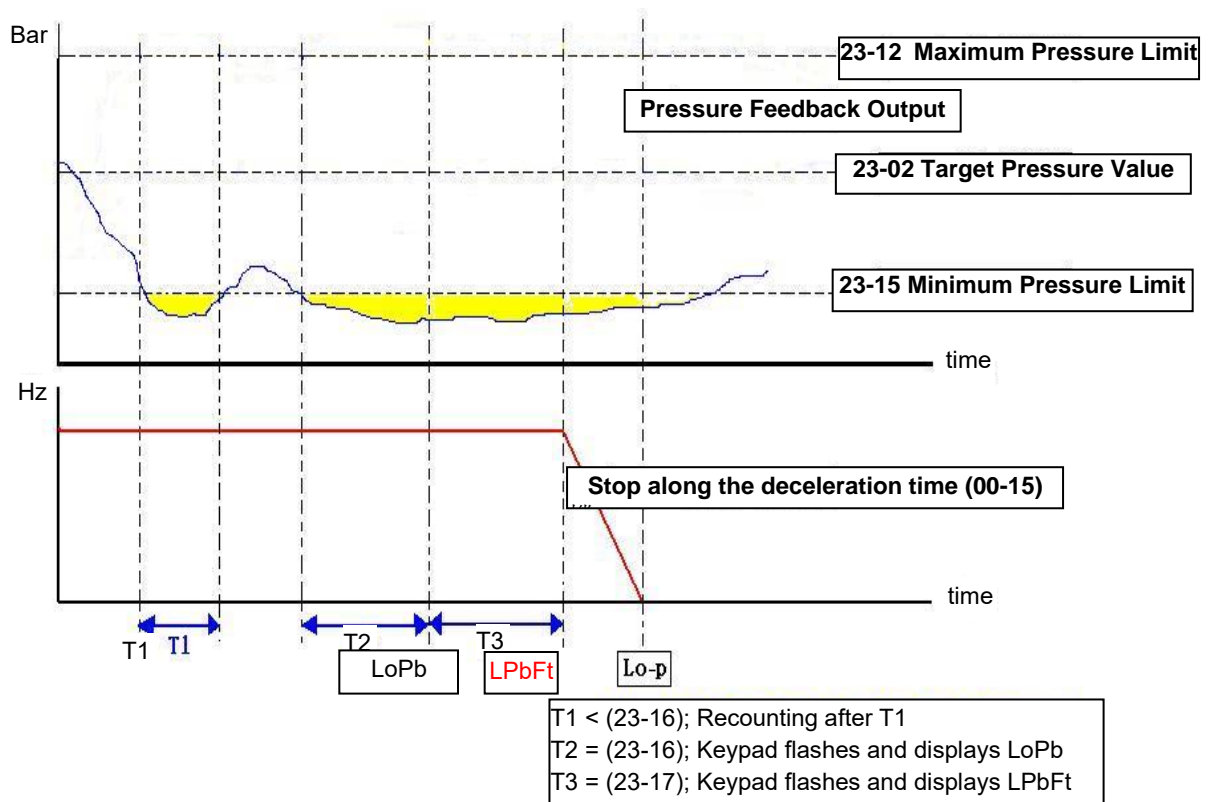


Figure 4.3.108 Diagram for warning to stop under the limit of low pressure

23- 18	Detection Time of Loss Pressure
Range	【0.0 ~ 600.0】 Sec
23- 19	Detection Proportion of Loss Pressure
Range	【0 ~ 100.0】 %

23-19 = 0: Disabled

23-19 > 0: If the feedback pressure value falls below the value calculated by 【 (23-02) x (23-19) 】 for the time specified in time of loss pressure (23-18), the inverter shows a FBLSS fault and stops.

23-23	Direction of Water Pressure Detection
Range	【0】 : Upward Detection 【1】 : Downward Detection
23- 24	Range of Water Pressure Detection
Range	【0.0 ~ 65.00】 PSI *1 【0~10】 % *2
23- 25	Period of Water Pressure Detection
Range	【0.0 ~ 200.0】 Sec
23- 26	Acceleration Time of Water Pressure Detection
Range	【0.1 ~ 600.0】 Sec
23- 27	Deceleration Time of Water Pressure Detection
Range	【0.1 ~ 600.0】 Sec

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

Water pressure detection (23-26) acceleration and deceleration time (23-27) are the same acceleration time 2 (00-16) and the deceleration time 2 (00-17), so when setting of 23-26 the value of 00-16 also change. Avoid using the multi-speed application function when the PUMP application function is enabled.

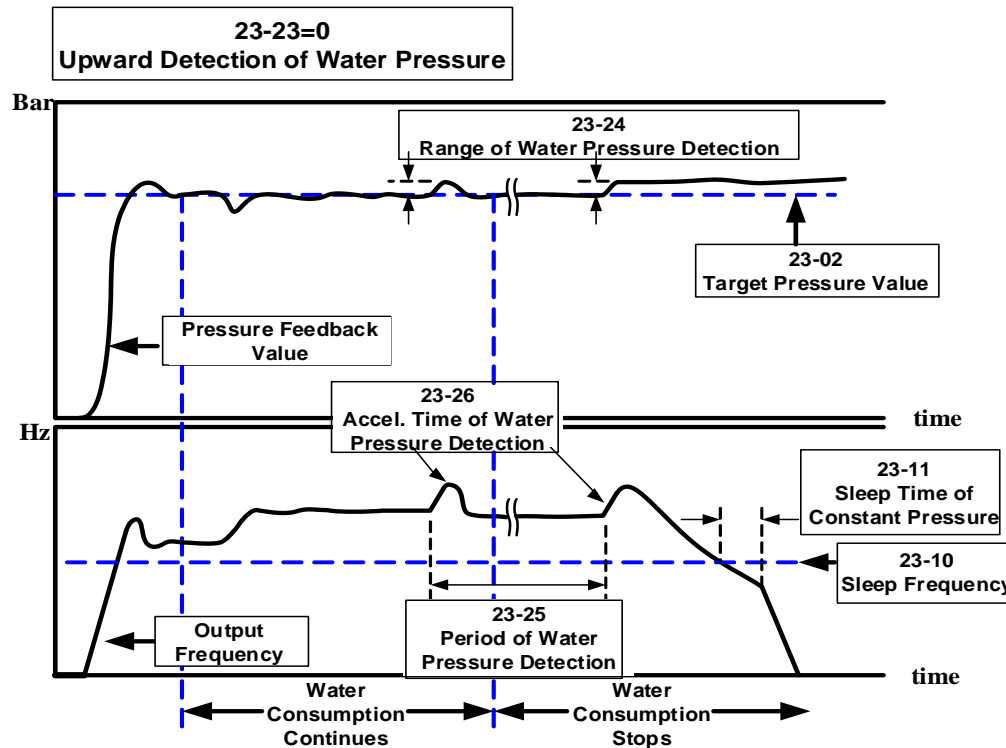


Figure 4.3.109 Diagram for upward detection of water pressure

23-25 = 0.0 (sec) water pressure detection is disabled.

Water pressure detection detects a no-flow or small leak condition and allows the inverter to go sleep.

It is recommended to extend the water pressure detection time (23-25) to avoid cycling in and out of sleep mode in case a no-flow detection occurs too often.

During a no-flow check, pressure increases slightly. During this time the pressure can fluctuate if there is flow. To reduce fluctuation of the pressure lower the water pressure detection range (23-24). Please note that lowering the setting for 23-24 will extend the time it takes for the inverter to detect a no-flow or small leak condition.

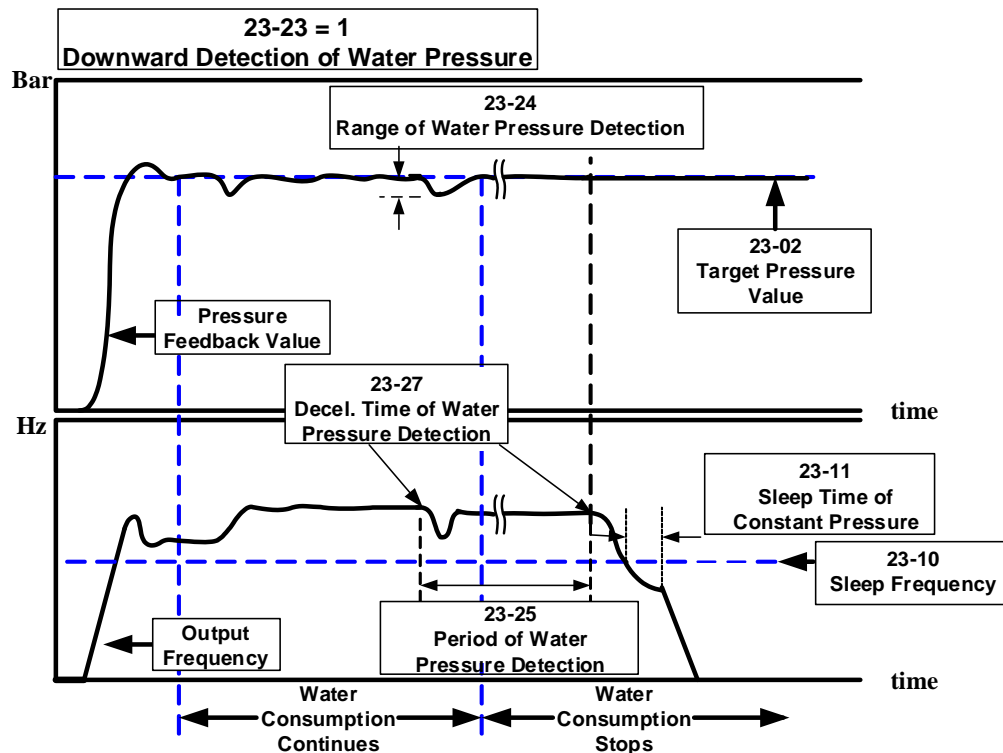


Figure 4.3.110 Diagram for downward detection of water pressure

23-25 = 0.0 (sec) means to disable the function of water pressure detection.

When function of water pressure detection is enabled, it can shorten the time of inverter jumping into sleep without water consumption or with mild water consumption.

It is recommended to extend the water pressure detection time (23-25) to avoid cycling in and out of sleep mode in case a no-flow detection occurs too often.

During a no-flow check, the output frequency will be lowered using the deceleration time 23-27 and pressure reduces slightly. During this time the pressure can fluctuate if there is flow. To reduce fluctuation of the pressure lower the water pressure detection range (23-24). Please note that lowering the setting for 23-24 will extend the time it takes for the inverter to detect a no-flow or small leak condition.

If pressure feedback value falls below the target (setpoint) pressure value (23-02) minus the range of water pressure detection (23-24), the output frequency will increase again.

Table 4.3.18 Guideline for no-flow detection direction

	Pros	Cons
Upward detection of water pressure	<ul style="list-style-type: none"> Keeps the pressure above the target pressure during the detection process. Recommended for strict and precise applications 	<ul style="list-style-type: none"> If minimum head is too high, operation frequency is greater during a no-flow or leak condition preventing the system from going to sleep. Minimal energy-saving because slave pumps don't go to sleep when multiple pumps in parallel are used.
Downward detection of water pressure	<ul style="list-style-type: none"> Goes to sleep when no-flow or small leak occurs. Save energy, when using multiple pumps in parallel to regulating pumps for best optimum operation. Startup sequence is Master, Slave 1, Slave 2, and Slave 3. Sleep sequence is Slave 1, Slave 2, and Slave 3 and Master last. After the alternation timer has expires. 	<ul style="list-style-type: none"> Pressure fluctuations may occur during this process if range of water pressure detection (23-24) and the deceleration time of water pressure detection (23-27) are set incorrectly.

23- 28	*Forced Run Command (Hand Mode)
Range	【0.00 ~ 400.00】 Hz

* Frequency resolution is 0.1Hz when set to a value greater than 300 Hz.

This function is enabled when PID mode (10-03) is selected.

When PID is disabled (Multi-function digital input (S1~S6) is set to 16 (PID control disable) and active, pump operation is not regulated based on feedback and runs at the selected frequency source set by 00-05 (Frequency command). Multi-function digital input (S1~S6) is set to 16 (PID control disable).

When digital input is set to 57(forced frequency run) with PID disabled, the inverter will run at frequency set in parameter 23-28 (forced run command) when input is activated. If PID function is enabled the inverter is controlled by the PID.

Forced run command is applied to the situation when pressure sensor disconnects, control inverter output via the external pressure sensor (ex. differential pressure switch).

23-29	Switching Time of Multiple Pumps in Parallel
Range	【0 ~ 240】 hour/min
23-72	Switching Time of Alternation in Parallel
Range	【0】 : Hour 【1】 : Minute

23-35	Selection of Multiple Pumps Shift Operation
Range	【0】 : No function 【1】 : Timer Alternative Selection 【2】 : Sleep Stop Alternative Selection 【3】 : Timer and Sleep Stop Alternative Selection 【4】 : Multiple Pumps Test Mode

If the multi-pump function is enabled, the alternation sequence is Master→Slave1→ Slave2→Slave3 → Master → ... and the alternation time is set by parameter 23-29.

Parameter 23-72 Switching Time for Pump Alternation

23-72=0, parameter 23-29 (Alternating Time) is set hours.

23-72=1, parameter 23-29 (Alternating Time) is set in minutes.

Note: Alternation timer is reset when parameter 23-29 is changed and power to the inverter is cycled.

Multiple Pump Alternation Operation Selection (23-35)

23-35=1: Timer Alternative Selection

The Master and Slave pumps alternate after alternation timer expires.

23-35=2: Sleep Stop Alternative Selection

Alternate on next start when system is in sleep mode. Please refer to the diagram of sleep stop alternate selection.

23-35=3: Timer and Sleep Stop Alternative Selection

Alternate on next start when system is in sleep mode and alternation timer has expired. Please refer to the diagram of sleep stop alternate selection.

23-35=4: Multiple Pumps Test Mode

When then master stops running and the slave pump needs to run set 23-35=4, alternation is disabled.

23- 30	Detection Time of Multiple Pumps in Parallel Running Start
Range	【0.0 ~ 30.0】 Sec

When parameter 23-31 is set to 1 or 3, the detection time to bring on multiple pumps is enabled. If water pressure cannot meet setpoint and falls outside the detection bandwidth and water flow time exceeds the detection time (23-30) the master will bring on an additional slave pump.

23- 31	Synchronous Selection of Multiple Pumps in Parallel
Range	【0】 : Disable 【1】 : Pressure Setting and Run/ Stop 【2】 : Pressure Setting 【3】 : Run/Stop

23-31=0: Disabled

23-31=1: Pressure Setting and Run/ Stop

Set 23-01 to 1, Pressure setting and Run/ Stop command are controlled by the Master; the slave follows the Master's command and setpoint. Run/Stop command from the Slave is disregarded except the emergency stop command which has the highest priority.

23-31=2: Pressure Setting

Set 23-01 to 2, Pressure setpoint setting is controlled by then Master and Slave follows Master's setpoint command.

23-31=3: Run/Stop

Set 23-01 to 3, Run/ Stop command is controlled by the Master and Slave follows Master's command. Run/Stop command from the Slave is disregarded except the emergency stop command which has the highest priority.

Notes:

- When setpoint pressure of the Master is changed it is required to press the ENTER key to modify the pressure setpoint of the slave pumps.
- Alternation time is reset when the Alternation time for multiple pumps in parallel (23-29) is changed.

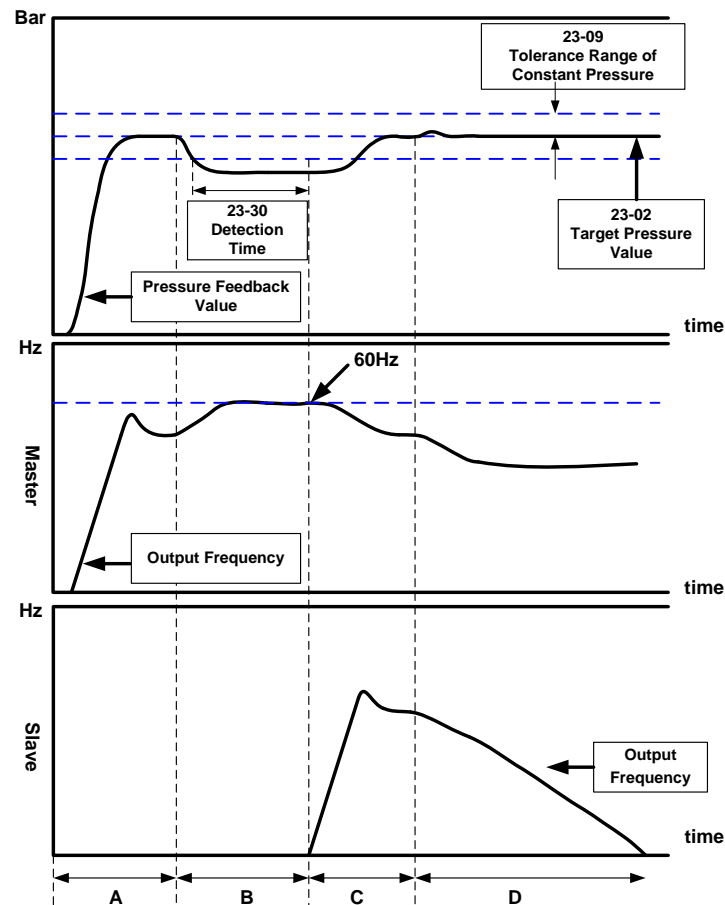


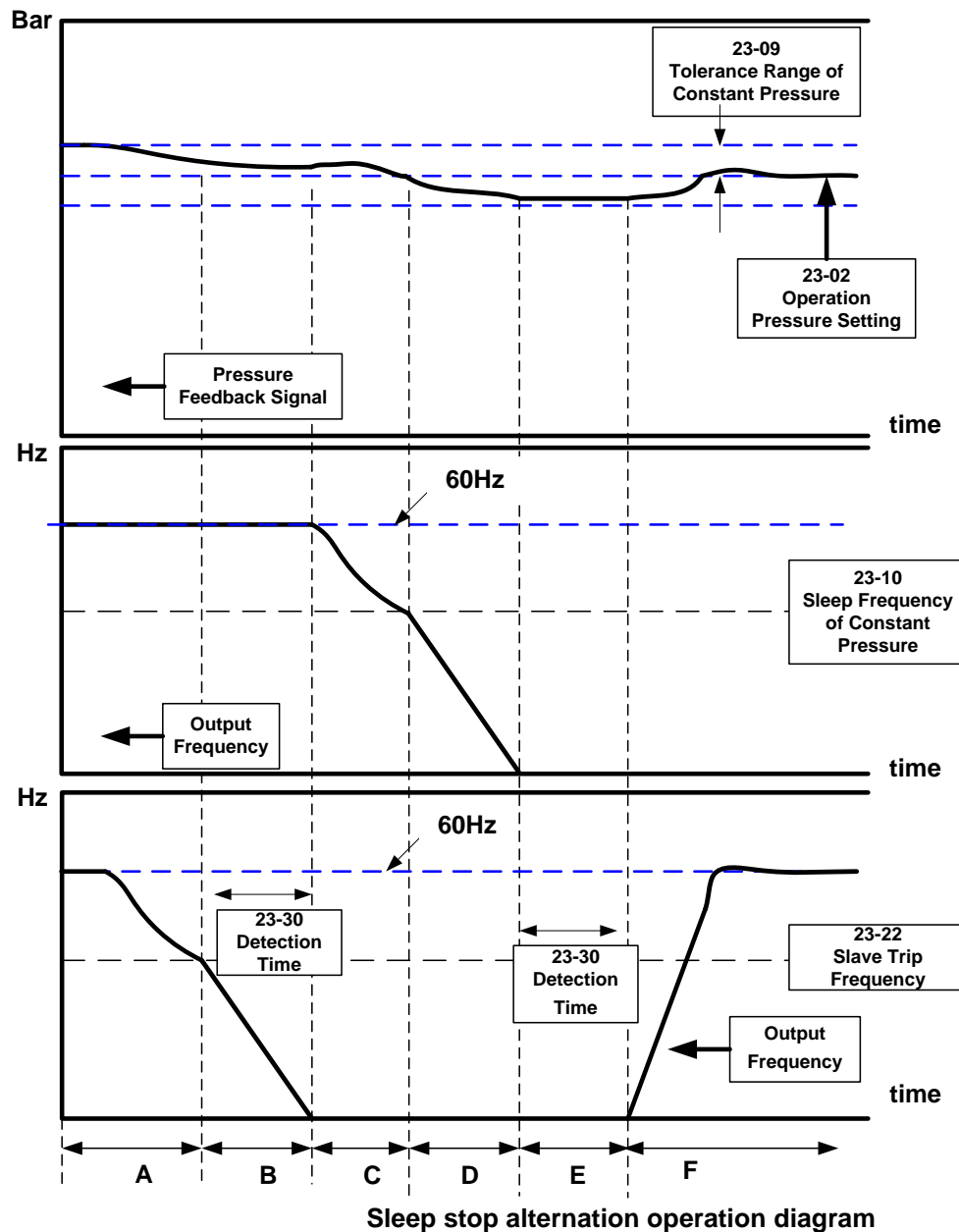
Figure 4.3.111 Dual pumps start up process

- Dual pump control is enabled. Master pump starts first and Slave pump is in standby in constant-pressure operation.
- Higher operation frequency of the Master results in an increased system flow. If the system pressure cannot reach the setpoint but does not falls outside the pressure detection bandwidth and the operation time has not expired (23-30) the Slave does not come on and is still in standby.
- If the Master runs at 60Hz and operation detection time (23-30) has expired the Master turns on the slave pump. When the master and slave are both running the operation frequency of the master and slave are automatically reduced to meet setpoint pressure.

- D. When both the master and slave pumps are running and flow demand decreases the output frequency of the slave also decreases. When then slave pump output frequency falls below the sleep frequency for the time specified by the sleep detection time the slave will go to sleep and the master operates to meet the constant pressure setpoint (please refer to parameter 23-22 for dual pump slave sleep requirements).

Notes:

- When 23-35=3, If the pump run time is greater than alternation time (23-29) or the inverter goes from sleep to stop when operating dual pumps, the Master and Slave will alternate.
- When 23-01≠0, parameter 23-01 of the two inverters cannot be simultaneously set to 1 or 2. One inverter needs to be set to 1 and that of the other inverter should be set to 2.



Notes:

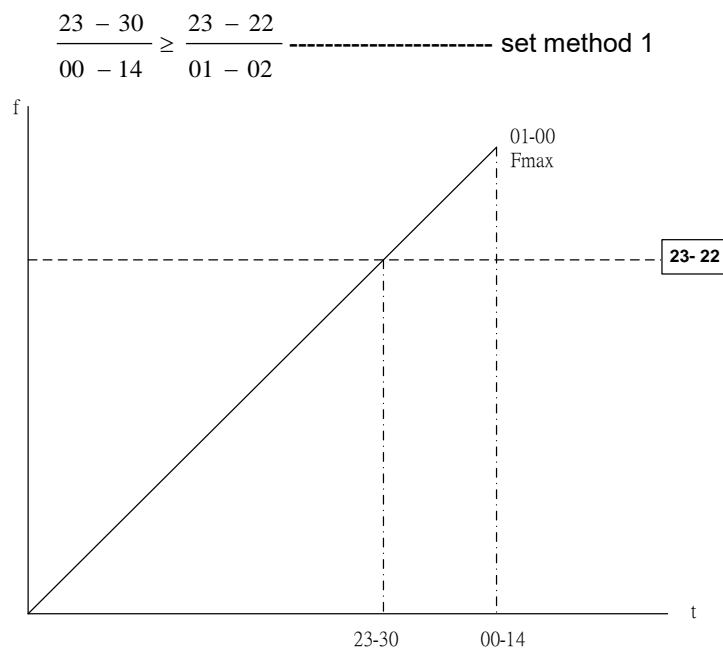
- A: Dual pumps are enabled during this time. When system pressure rises the Master keeps operation and Slave output frequency decreases.

- B: Master operation frequency remains at 60Hz. If system pressure does not decrease to the system setpoint pressure the Slave continuously decreases until it reaches the trip frequency (23-22). Once the detection time (23-30) expires the Slave decelerates to a stop.
- C: The Master output frequency decreases after the detection time (23-30) expires when the Slave is in sleep mode and a low system flow in combination with a higher system pressure occurs.
- D: When then Master operation frequency reaches the sleep frequency (23-10), Master will decelerate to a stop, system flow and pressure will reduce slowly.
- E: When there is no flow the Master will go to sleep, system pressure remains constant and Slave's detection time (23-30) starts.
- F: When the detection time (23-30) expires, operation stops and virtual Master now becomes the Slave. The new Master inverter now regulates system pressure based on the target (setpoint) pressure value.

23-73	Slave Wake-up Selection
Range	【0】 Disable 【1】 Enable

Set parameter 23-73=1 and follow instructions in a multi-pump system where slaves do not wake-up due to system characteristics.

1. Master is running at full speed operation (01-02 maximum output frequency) but system pressure feedback value is unable to reach target (setpoint) pressure value.
2. Slave is forced to start after one minute and stays operating to achieve the target pressure value. (Even if the requirement of sleep to wake-up is not achieved and the pressure feedback value is under the tolerance range of constant pressure).
3. It is required to follow the formula (23-73=1) and refer to the following diagram to set the wake-up requirements.



Slave wake-up diagram

23- 22	Slave Trip Frequency
Range	【0.0~400.0】 Hz

If Master and Slave are running, the Slave will stop depending on the condition described below.

23-22=0 Hz: if the Slave output frequency falls below 23-10 (Sleep Frequency of Constant Pressure) for the time specified in 23-11 (Sleep Time of Constant Pressure), the Slave will stop automatically.

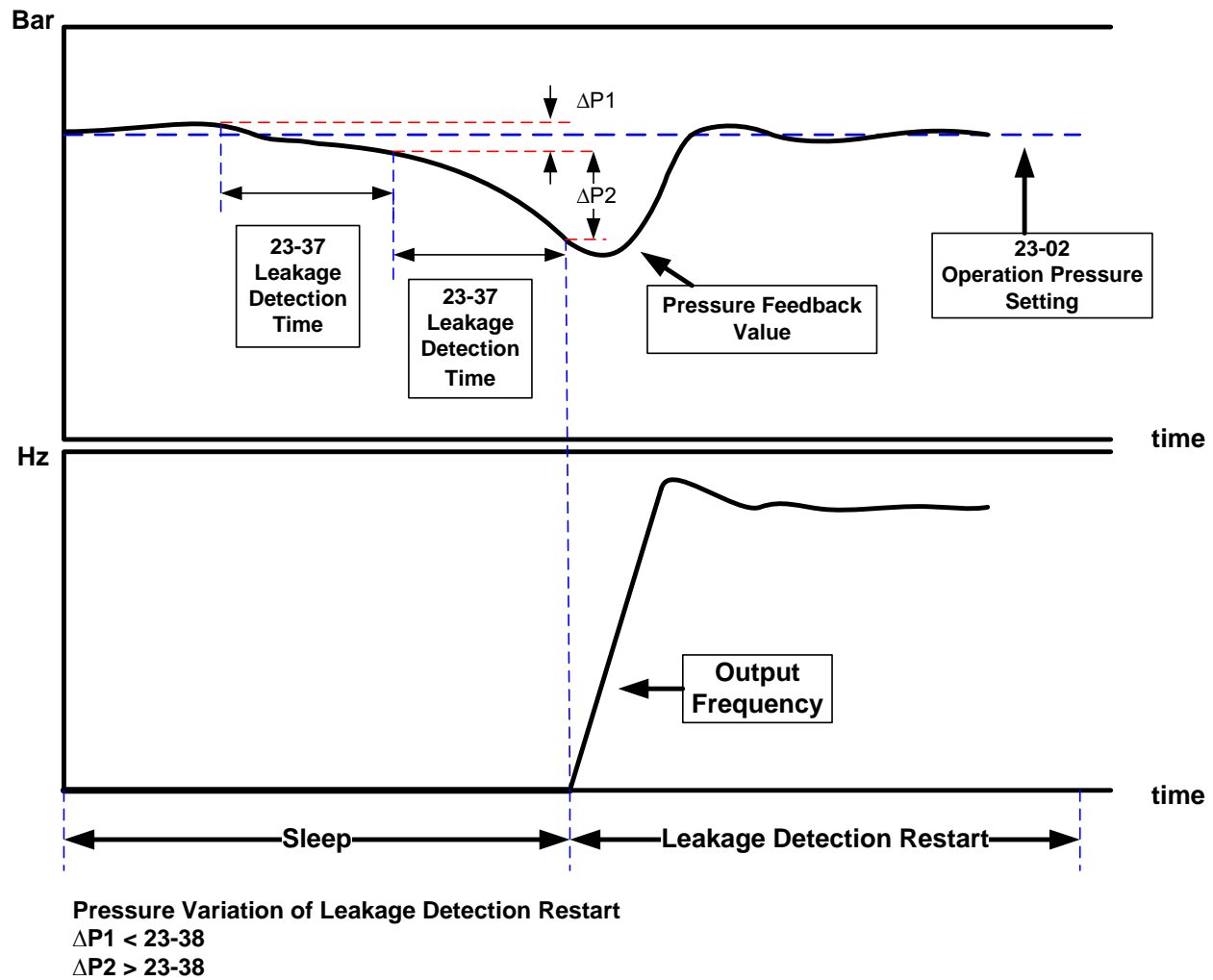
23-22 = 1 ~ 400 Hz: (The maximum frequency set by 01-02), if the output frequency of Slave falls below 23-22, the Master will inform the Slave to stop and enter sleep mode. If the Slave output frequency of falls below 23-10 (Sleep Frequency of Constant Pressure) for time specified in 23-11 (Sleep Time of Constant Pressure), the Slave will stop automatically.

23-37	Leakage Detection Time	*3
Range	【0.0~100.0】 Sec	
23-38	Pressure Variation of Leakage Detection Restart	*3
Range	【0.01~65.00】 PSI *1 【1~10】 % *2	
23-39	Pressure Tolerance Range of Leakage Detection Restart	*3
Range	【0.01~650.00】 PSI *1 【1~100】 % *2	

*1: 23-20=0, represents the unit and range.

*2: 23-20=1, represents the unit and range.

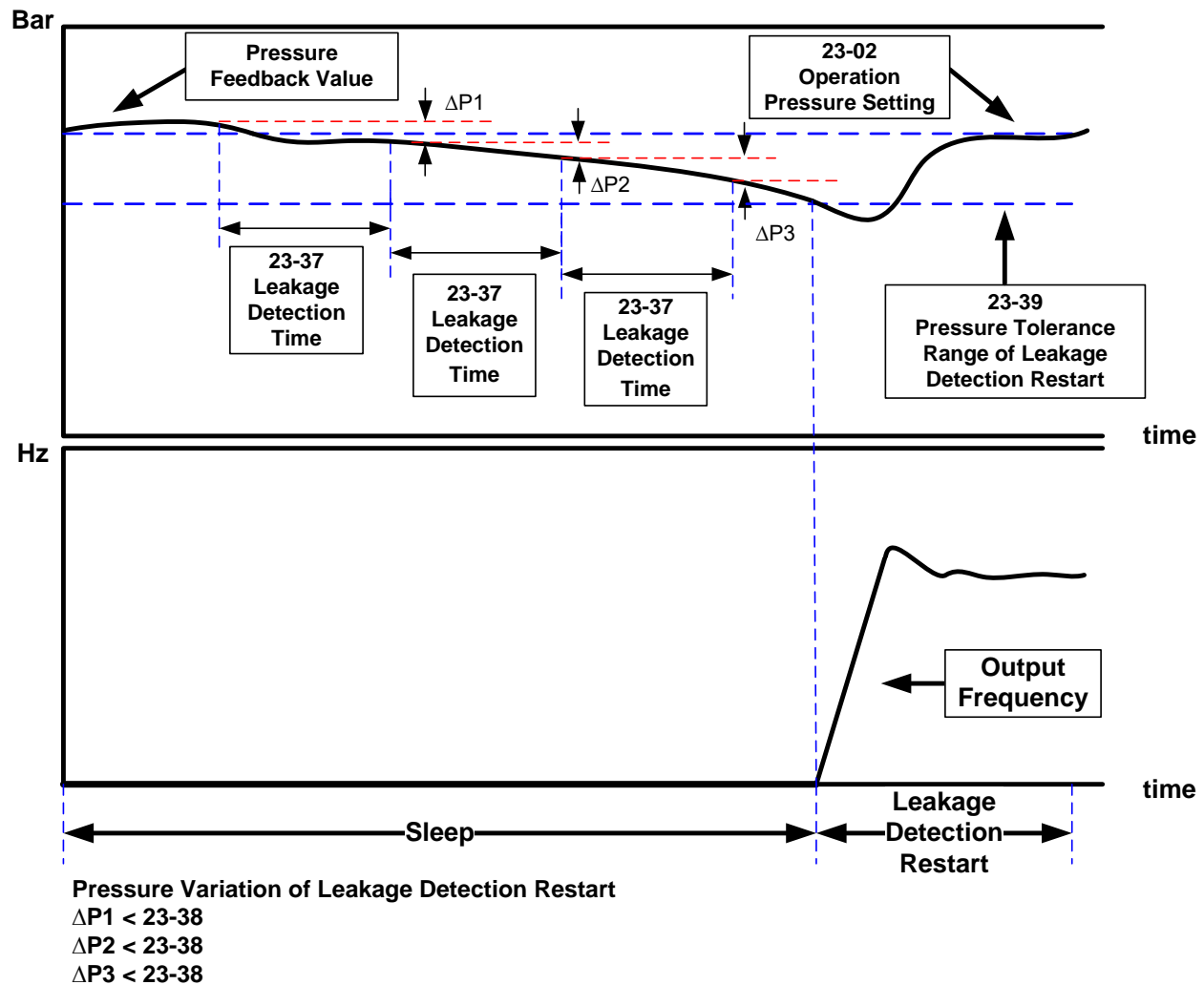
Leakage Detection Case #1: Pressure Variation > 23-38



Notes:

- 23-37 = 0.0 (sec), function is disabled
- Pump will start if pressure variation is greater than the value of parameter 23-38 for time specified in detection time (23-37).

Leakage Detection Case #2: Pressure Variation <23-38



Notes:

- 23-37 = 0.0 (sec), function is disabled
- When pump is at shutdown state, pressure will drop over time if pipeline leaks.
- Pump will stay in sleep mode if pressure variation is smaller than parameter 23-38 for time specified in detection time (23-37) and restart when pressure variation is greater than 23-38 for time specified in detection time (23-37) or pressure variation is greater than pressure tolerance range of leak detection restart (23-39).
- Adjust parameters 23-37, 23-38 and 23-39 for proper pump start / stop control based on system pressure characteristics.
- Leakage detection function is only available for single pump applications.

23-41	Local/ Remote Key
Range	【0】 : Disable 【1】 : Enable

Switch between Local/Remote mode for frequency reference and run/stop command.

Frequency command is set by (00-05) and the operation command is set by (00-02).

23-41=0: Disable

Frequency command is controlled by terminal AI1 and AI2 and run command is controlled by terminal S1, S2 or RS485 when both SEQ and REF lights are on.

23-41=1: Enable

User can control FWD/REV with Local / Remote key.

Frequency command and run/stop command are controlled by the keypad when SEQ and REF signal light are off.

Note: Local mode is controlled by the keypad and remote mode is controlled by control circuit terminals or RS485 connection.

23-42	Energy Recalculating
Range	【0】 : Disable (Energy Accumulating) 【1】 : Enable
23-43	Electricity Price per kWh
Range	【0.000~5.000】

When the inverter is powered up, user can view energy usage by checking parameter 12-67 (unit: kWhr) and 12-68 (unit: MWhr) and adjust by setting parameter 23-42 to 1.

Set utility price in kWh (23-43), View parameter 12-69 and 12-70 for total energy cost.

23-44	Selection of Accumulative Electricity Pulse Output Unit
Range	【0】 : Disable 【1】 : Unit for 0.1kWh 【2】 : Unit for 1kWh 【3】 : Unit for 10kWh 【4】 : Unit for 100kWh 【5】 : Unit for 1000kWh

Sets pulse output signal (23-44) energy usage units in kWh. Pulse output activates for 200msec each time the specified kWh setting is consumed. Pulse output signal can be used for auxiliary electric meter or PLC.

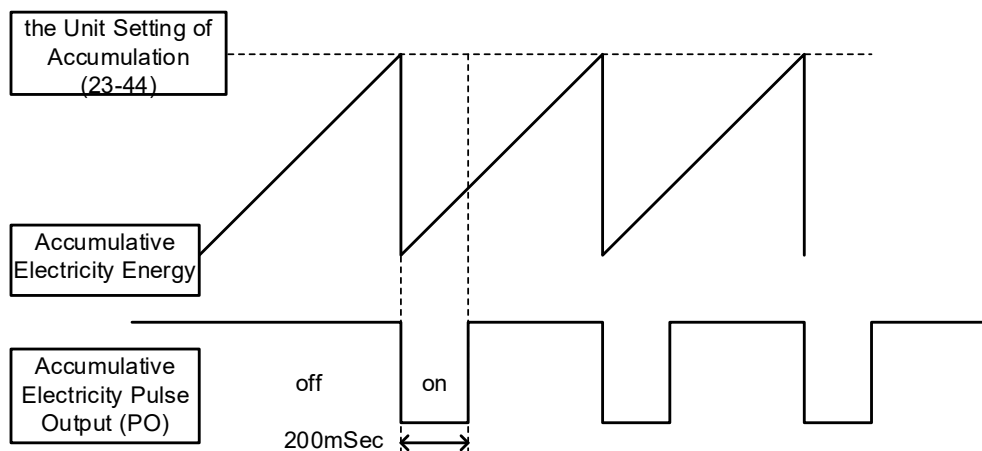


Figure 4.3.112 Diagram for accumulative electricity pulse output

23-45	Given Modes of Flow Meters Feedback
Range	【0】 : Disable 【1】 : Analog Input 【2】 : Pulse Input
23- 46	Maximum Value of Flow Meters
Range	【1~50000】 GPM
23- 47	Target Value of Flow Meters
Range	【1~50000】 GPM

Flow meter function is enabled when HVAC mode is selected (23-00-2) and main frequency command source (00-05) is set to 5 (PID given) and PID mode is enabled (10-03).

23-45: Given Modes of Flow Meters Feedback

Select flow meter input source; Analog input (AI) or pulse input (PI).

Flow meter feedback value can be viewed in parameters (12-71).

23-46: Maximum Value of Flow Meters

Specify flow meter maximum value

23-47: Target Value of Flow Meters

Specify target (setpoint) value when flow meters is used in HVAC system

Note: Requires 10-00 set to 0 (PID target value source is set by keypad.)

23- 60	HVAC Unit Display (only for LCD)
Range	【0】 : GPM 【1】 : FPM 【2】 : CFM 【3】 : GPH

When 23-00=2, the LCD keypad displays the engineering unit based on value of parameter 23-6. Engineering unit is used by parameters 12-71, 12-77, 23-46, 23-47.

23-48	Maximum Flow Value of Feedback
Range	【0.01~99.00】 %

Set the maximum flow limit value. When the flow feedback value rises above the maximum flow value the inverter will display a warning when the warning timer (23-49) expires and stop when the stop timer expires (23-50).

Note: Disable high flow limit by setting 23-48 to 0.

23- 49	Maximum Flow Warning Time of Feedback
Range	【0~255】 Sec

When the flow feedback value rises above the maximum flow value for time specified in 23-49 the inverter will display a warning HFPb. When flow falls below the maximum flow value the flow warning timer is reset.

23- 50	Maximum Flow Stop Time of Feedback
Range	【0~255】 Sec

When the flow feedback value rises above the maximum flow value for time specified in 23-49 the inverter will display fault H1bFt and stop. When flow falls below the maximum flow value the flow stop timer is reset.

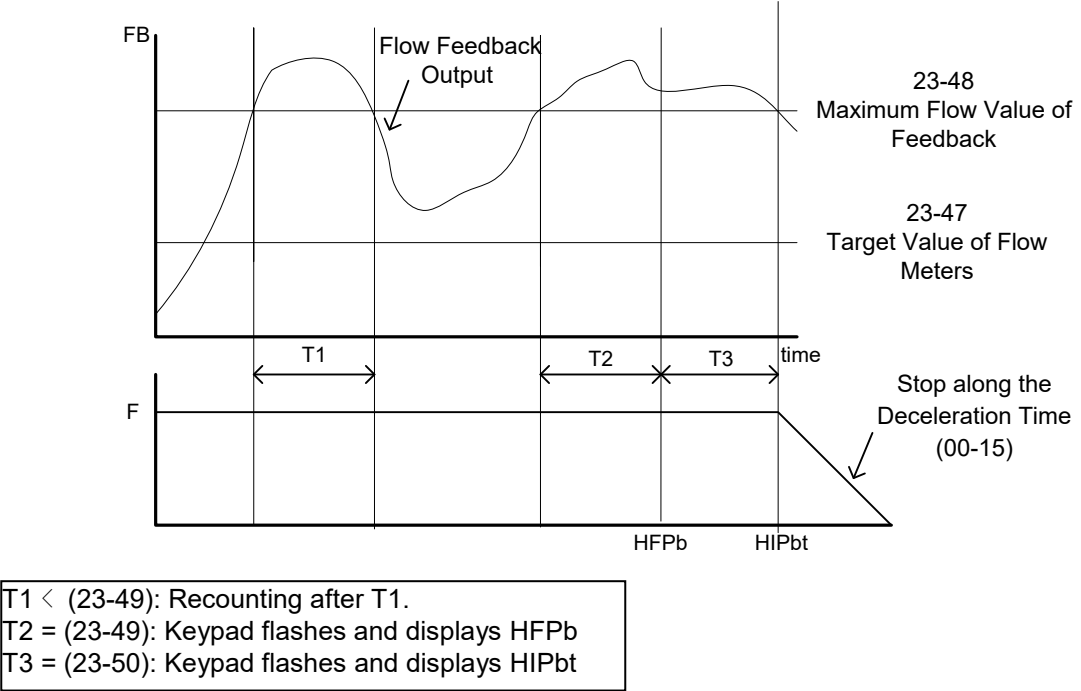


Figure 4.3.113 Diagram for high flow limited warning of stop

23-51	Minimum Flow Value of Feedback
Range	【0.01~99.00】 %

Set the minimum flow limit value. When the flow feedback value falls below the minimum flow value the inverter will display a warning when the warning timer (23-52) expires and stop when the stop timer expires (23-53).

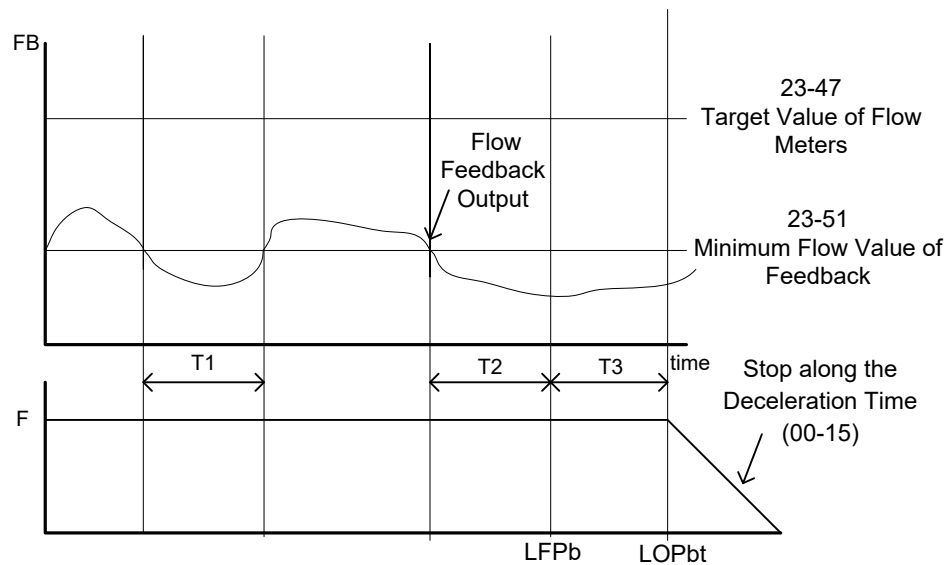
Note: Disable low flow limit by setting 23518 to 0.

23- 52	Minimum Flow Warning Time of Feedback
Range	【0~255】 Sec

When the flow feedback value falls below the minimum flow value for time specified in 23-52 the inverter will display a warning LFPb. When flow falls below the minimum flow value the flow warning timer is reset.

23- 53	Minimum Flow Stop Time of Feedback
Range	【0~255】 Sec

When the flow feedback value falls below the minimum flow value for time specified in 23-53 the inverter will display fault LObFt and stop. When flow falls below the minimum flow value the flow stop timer is reset.



T1 < (23-52): Recounting after T1.
 T2 = (23-52): Keypad flashes and displays LFPb
 T3 = (23-53): Keypad flashes and displays LOPbt

Figure 4.3.114 Diagram for low flow limited warning of stop

23-54	Detection Function of Low Suction
Range	【0】 : Disable 【1】 : PID Error Value 【2】 : Current 【3】 : Current and PID Error Value
23- 55	Detection Time of Low Suction
Range	【0~30.0】 Sec
23- 56	PID Error Level of Low Suction
Range	【0 ~ 30】 %
23- 57	Current Level of Low Suction (Motor Rated Current)
Range	【0 ~ 100】 %
23- 58	Reaction of Low Suction
Range	【0】 : Disable 【1】 : Warning 【2】 : Fault 【3】 : Fault & Restart

For storage tank applications having insufficient water results in a low suction condition. The inverter can be setup to detect a low suction condition and how to react with parameter 23-58. The process signal to use for detecting a Low suction condition is set by parameter 23-54. Refer to Fig.4.3.115 for low suction detection diagram.

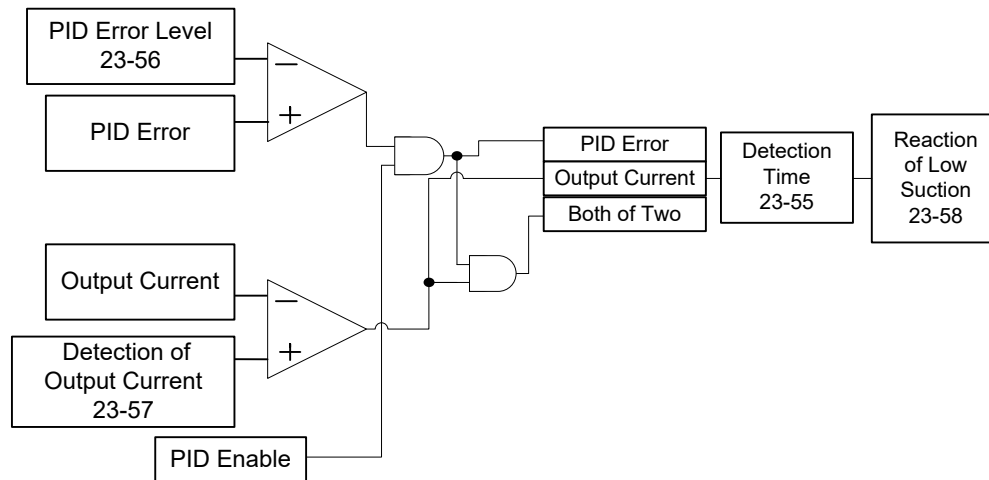


Figure 4.3.115 Diagram for the process of low suction

When 23-54=0, low suction detection is disabled.

Refer to Table 4.3.19 for the detection logic based on parameter 23-54. Select between PID error and/or inverter output current as the detection signal.

Table 4.3.19 the detection logic of low suction

23-54	Detection Signal	
	PID Error	Output Current
1	1	0
2	0	1
3	1	1

Set the detection level parameter 23-56 when using PID error level and detection level parameter 23-57 when using the inverter output current signal or both.

A low suction condition is detected when the selected low suction process signal (23-54) rises above the low suction detection level (PID Error / Output Current) for the time specified by the low suction detection time (23-55).

The inverter response in case of a low suction condition is based on setting of parameter 23-58.

Refer to Table 4.3.20.

Table 4.3.20 Detection signal of water used

23-58	Inverter Status	Keypad Signal	Error Signal
0	Continuous Running	None	None
1	Continuous Running	LSCFT(Flash)	Warning of Low Suction
2	Stop	LSCFT	Jump to Error for Low Suction
3	Stop and Restart	LSCFT	Jump to Error for Low Suction and Restart

23- 59	Source of HVAC Pressure Command
Range	【0】 : Set by 23-47 【1】 : Set by AI

23-59=0: Target (setpoint) value set by parameter 23-47.

23-59=1: Target (setpoint) value set by AI1 input voltage value. Refer to parameter 10-00 for the setting of AI terminal.

23- 66	Derating of Current Level (for Compressor Current)
Range	【10 ~ 200】 %
23- 67	Derating of Delay Time
Range	【1.0 ~ 20.0】 Sec
23- 68	Derating of Frequency Gain
Range	【1~100】 %
23- 69	OL4 Current Level
Range	【10~200】 %
23-70	OL4 Delay Time
Range	【0.0 ~ 20.0】 Sec

The inverter has a built-in two- stage protection function for use in compressor applications to prevent damage when operating at rated current for several minutes.

First stage protection:

When the inverter is at constant speed and the current is higher than the derating current level (23-66) (set as a percentage of the compressor rated current), the derating delay timer starts. When the timer expires the frequency command is multiplied by the frequency gain (23-68) reducing the output frequency and so lowering the current of the compressor.

When the current falls below the derating current level (23-66), the output frequency is restored to its previous level. When the cycle of derating and restore exceeds 3 times the output frequency will remain at the last derating frequency until the current falls below the derating current level (23-66).

Example: Set 23-66 set to 80%, 23-67 set to 10sec, 23-68 set to 90% and frequency command set to 60.0 Hz. The rated current of compressor is 30A. When the output current reaches 27A, which is higher than 24A (30A x 80%) for 10 sec (derating of delay time), the output frequency decreases to 54 Hz (frequency command 60Hz x 90%). If the output current decreases to 25A, which is still above 24A and another 10 sec pass, the output frequency becomes 60Hz x 81%=48.6Hz. Once the output current drops to 23A the output frequency is restored to 60Hz. If the output current rises again to 27A and this cycle repeats itself for a maximum of three times, after this the output frequency will remain at 48.6Hz until the output current drops to 23A.

Second stage protection:

After the current reaches the OL4 current level (23-69) for the time specified in the OL4 delay time (23-70) the inverter will decelerate to a stop and display OL4 Compressor Overload.

If a fault occurs, the run command has to be removed in order to reset the inverter when the inverter command source (00-02) is not set to 0 (Keypad).

Note: It is recommended to set the rated current of compressor lower than that of the inverter.

Group 24 Pump Control Function Parameters
--

24- 00	Selection of Pump Control Function
Range	<p>【0】 : Function of 1 to 8 Pump Card and 1 to 3 Relay are Disabled.</p> <p>【1】 : Fixed Modes of Inverter Pump: First on and Last off; then Stop All.</p> <p>【2】 : Fixed Modes of Inverter Pump: Only Stop Inverter Pump.</p> <p>【3】 : Fixed Modes of Inverter Pump: First on and First Off; then Stop All.</p> <p>【4】 : Cycle Modes of Inverter Pump: First on and First Off; then Stop All.</p> <p>【5】 : Cycle Modes of Inverter Pump: Only Stop Inverter Pump.</p> <p>【6】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First off; then Stop All.</p> <p>【7】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling.</p> <p>【8】 : Cycle Modes of Inverter Pump: First on and First Off; then Stop All. And First Boot Relay in Cycling.</p> <p>【9】 : 1 to 3 Relay of Cycle Modes of Inverter Pump: Only Stop Inverter Pump. And First Boot Relay in Cycling.</p>

An inverter with built-in PID controller alongside a simple programmable logic controller (PLC) is widely used to control a pump system. With the available 1 to 8 pump option card is no longer required to use a separate PLC and the pump system can be controlled directly by the inverter.

The inverter controls the power to each of the pumps and uses the build-in PID controller to regulate pressure.

There are two basic operation modes for use with the 1 to 8 pump card:

1. Fixed Mode:

Up to 8 non-alternating pumps controlled by the inverter

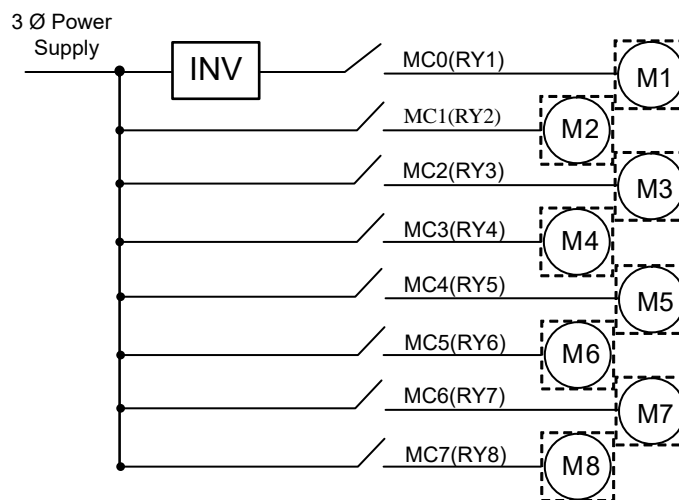


Figure 4.3.116 Fixed modes of inverter pump

2. Alternation Mode:

Up to 4 alternating pumps controlled by the inverter

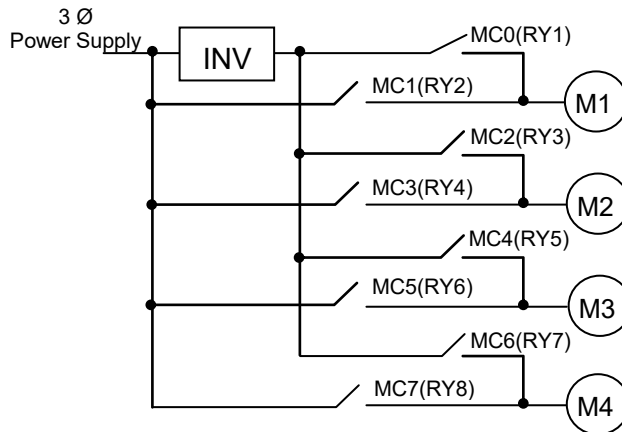


Figure 4.3.117 Cycle modes of inverter pump

In addition to the two basic operation modes provided by the 1 to 8 pump card, the relay outputs on the control board can also be used to control up to 3 alternating pumps.

* Cycle modes of inverter pump in the control board:

Run via a Relay with a pump to start the cycle modes of inverter pump.

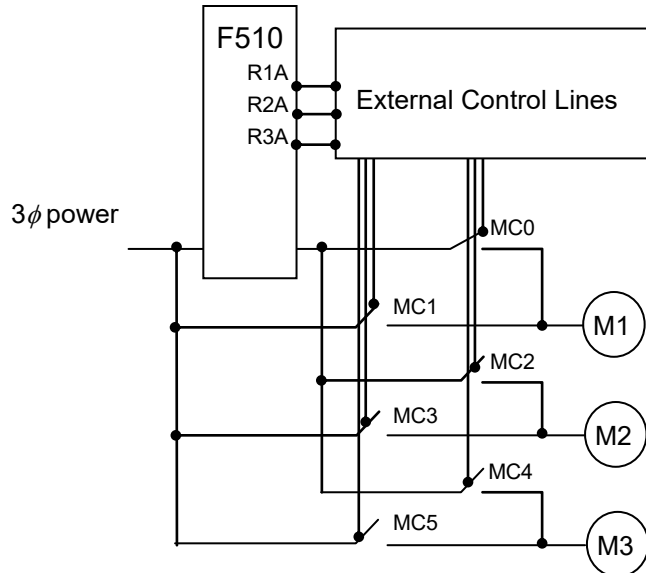


Figure 4.3.118 Cycle modes of inverter pump in the control board

24-00=0: Pump Control is disabled

24-00=1: Fixed mode (non-alternation), first on and last off; then stop all.

Pump (motor) controlled by the inverter does not alternate. Pumps (motor) are controlled in sequence First on and last off. This mode can be used when the pump system uses different size pump (motor) ratings.

24-00=2: Fixed mode (non-alternation), only inverter controlled pump stops.

Pump control without alternation. When the inverter sends a stop command only the pump motor controlled by the inverter stops all other control relays stay on.

24-00=3: Fixed mode (non-alternation), first on and first off; then stop all.

Switching off a pump (motor) is based on pump motor runtime so each pump has equal pump wear. This mode is can be used in systems with similar size pump motors.

24-00=4: Alternation Mode, first on and first off; then stop all.

All the pump motors except for the main pump are controlled by the inverter. Pump control is based on first on and first off.

24-00=5: Alternation Mode, only inverter pump stops.

Pump control with alternation. When the inverter sends a stop command only the pump motor controlled by the inverter stops all other control relays stay on.

24-00=6: Alternating Inverter Pump: 1 to 3 Relay: First on and first off; then Stop All.

This mode uses the output relays on the control board and can be used to control up to 3 pumps with alternation. Set 24-07=1 to enable the relays on the control board.

24-00=7: Alternating Inverter Pump: 1 to 3 Relay: First on and First Off; then stop all and alternate on startup.

Pump motor selected to be controlled by the inverter depends on the Relay switching time (24-08).

24-00=8: Alternating Inverter Pump: First on and First Off; then stop all and alternate on startup.

Pump motor selected to be controlled by the inverter depends on the Relay switching time (24-08). Users can switch the alternation order for each pump with the setting of parameter 24-07.

24-00=9: Alternating Inverter Pump 1 to 3 Relay: Only Stop Inverter Pump. And First Boot Relay in Cycling.

Similar to fixed modes, first on and first off, only stops the inverter driven pump. At start the inverter drives the motor depending on the Relay switching time (24-08). (Relay switching is enabled only in one motor.)

Notes:

- When the 1 to 8 pump card is not installed, parameter 24-00 is set to 0.
- When parameter 24-00 (pump control selection) is enabled, DI functions selection 16 (PID function disable) and 57 (forced frequency run) are disabled.
- Set 24-07=1 to enable the relays on the control board to control pump system up to three pumps.
- Setting of parameter 24-00 determines if 1 to 8 pump card is enabled or disabled.
- PID Setting:

PID function is enabled when PID control mode (10-03) is set to xxx1b (PID enable). Set PID target (setpoint) value source (10-00) to 4 (10-02 given) and the target (setpoint) value is set 10-02. If the feedback value source (10-01) is set to 2 (AI2 given) and AI input signal type (04-00) is set to 0 (AI2: 0~10V), requires SW2 to be set to the V position on the control board.

24- 01	Selection of Relay 2-4 Function
Range	【xxx0b】 : Reserved 【xxx1b】 : Reserved 【xx0xb】 : Relay 2 Disable 【xx1xb】 : Relay 2 Enable 【x0xxb】 : Relay 3 Disable 【x1xxb】 : Relay 3 Enable 【0xxxb】 : Relay 4 Disable 【1xxxb】 : Relay 4 Enable
24- 02	Selection of Relay 5-8 Function
Range	【xxx0b】 : Relay 5 Disable 【xxx1b】 : Relay 5 Enable 【xx0xb】 : Relay 6 Disable 【xx1xb】 : Relay 6 Enable 【x0xxb】 : Relay 7 Disable 【x1xxb】 : Relay 7 Enable 【0xxxb】 : Relay 8 Disable 【1xxxb】 : Relay 8 Enable

Fixed modes of inverter pump:

In the fixed pump control mode (non-alternating), RY1 is permanently used and RY2~RY8 can be used if required.

PID control is temporarily disabled when Inverter decelerates / accelerates to lower / upper limit frequency when demand increases / decreases. When the inverter reaches the lower / upper limit frequency, PID control is restored and the inverter output is determined by the feedback.

Alternation modes (1-8 Pump Card):

When alternation mode is active, RY2 and RY1 are always used. RY3~RY8 is split into groups of two, RY3/RY4, RY5/RY6, and RY7/RY8. If any one of the relays in the group is set to disabled the group is disabled.

The inverter output is automatically disconnected from the pump that switches to the new pump that is brought online. Switching time of the magnetic contactor (24-05) needs to be set to a value greater than the contactor switching delay time.

Switch off the motor of the first on when user decreases pumps to make the pump (motor) be the equal using frequency.

Alternation modes (Control board Relays):

When alternation mode is active, RY1 is permanently used and RY2~RY3 can be used if required. 24-01 can only be set to 0xxx (Relay 4 cannot be set.) and 24-02 can only be set to 0000 (Relay 5-8 cannot be set.).

24- 03	Duration of Upper Limit Frequency
Range	【1.0 ~ 600.0】 Sec

Parameter specifies the time required for the inverter controlled pump motor operating at the upper limit frequency (00-12) before turning on the next pump inline.

If the value for 24-03 is set to low value the pump system might switch pumps on and off to quickly causing system oscillation.

24- 04	Duration of Lower Limit Frequency
Range	【1.0 ~ 600.0】 Sec

Parameter specifies the time required for the inverter controlled pump motor operating at the lower limit frequency (00-13) before shutting down the pump and switching to the previous pump in line.

If the value for 24-03 is set to low value the pump system might switch pumps on and off to quickly causing system oscillation.

24- 05	Switching Time of Magnetic Contactor
Range	【0.1 ~ 20.0】 Sec

When a motor controlled by the inverter is switched across the line (commercial AC power supply) or switched from across the line to inverter control, parameter 24-05 is used to set the external magnetic contactor switching delay to avoid a short circuit between the inverter output and AC power supply.

The setting value of 24-05 requires to be set greater than the time it takes to switch from the inverter Relay controlling the external magnetic contactor. In general the transition from off to on for a magnetic contactor takes longer than the on to off time. Set parameter 24-05 greater than the longest time.

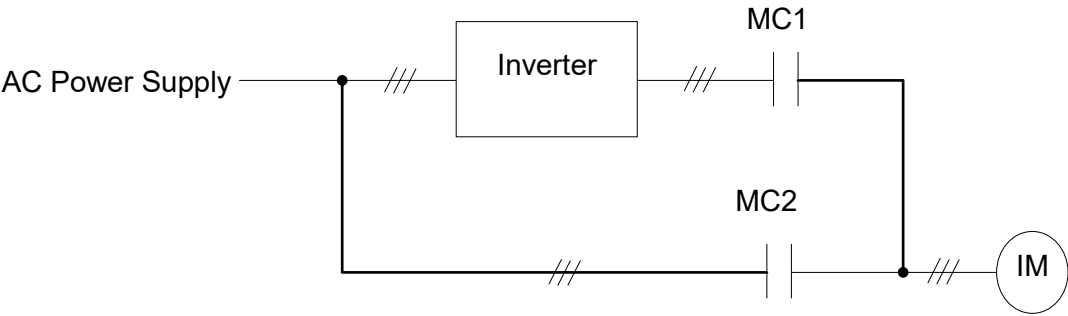


Figure 4.3.119 Diagram for the single cycle modes of inverter pump

24- 06	Allowable Bias of Pump Switch
Range	【0.0~20.0】 %

This parameter specifies the frequency bandwidth used when adding and removing a pump from the pump system.

To turn on the next pump in line the output frequency has to reach the upper limit frequency (00-12) minus the bandwidth set by 24-06 for the time specified in 24-03.

To turn off the active pump and switch to the previous pump in line the output frequency has to fall below the lower limit frequency (00-13) plus the bandwidth set by 24-06 for the time specified in 24-04.

Example, 00-12 = 80% and 00-13 = 20%, then:

- If 24-06 = 0% switching frequency to add a pump is 80% of the maximum frequency and to remove a ump the switching frequency is 20% of the maximum frequency.
- If 24-06 = 5%, switching frequency to add a pump is 75% of the maximum frequency and to remove a ump the switching frequency is 25% of the maximum frequency.

24- 07	Pump Control Source Selection
Range	【0】 : 1 to 8 Pump Card 【1】 : Built-in 1 to 3 Control Mode

24-07 = 0: 1 to 8 Pump Card

1 to 8 pump card is used for pump control function.

24-07 = 1: Built-in 1 to 3 Control Mode

Relay R1A~R3A on the control board are used for pump control function.

Note: 1 to 8 pump card cannot be used when 24-07 is set to 1.

Set the following parameters to enable pump control mode using the 3 relays on the control card"

1. 24-00 set to 1~3 or 6~9.
2. 24-01 set to 0xxx (Relay 4 disabled).
3. 24-02 set to 0000 (Relay 5~8 disabled).

Note: Not setting parameter 24-00, 24-01, 24-02, and 24-07 to the required settings results in pump system control errors.

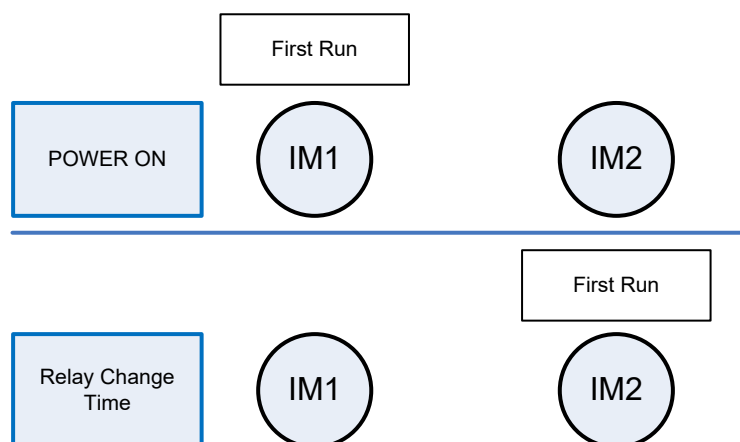
Refer to the following table for controlling the maximum number of pump based on 24-00 and 24-07 settings.

Setting value of 24-00	Inverter pump Modes	One pump with Relay	24-07=0 (Relay in 1 to 8 pump Option card)	24-07=1 (Relay in the control board)
1,2,3	Fixed Modes	1	8 PUMP	3 PUMP
4,5,8	Cycle Modes	2	4 PUMP	None
6,7,9	Cycle Modes	1	None	3 PUMP

- If 24-07=1, R1A (Relay 1) is used for pump control and parameter 03-11 is disabled.
- If 24-07=1 and 24-01= xx1x, R2A (Relay 2) is used for pump control and parameter 03-12 is disabled.
- If 24-07 = 1 and 24-01 = x1xx, R3A (Relay 3) is used for pump control and parameter 03-39 is disabled.

24- 08	Relay Switching Time
Range	【0 ~ 240】 hour

Active when 24-00 = 7 or 8. Upon start the first motor starts running. When the relay switching time expires and all motors are in sleep condition, motor 2 will start when the system wakes up. Please refer to the following figure.



Note: Timer will reset when pump control mode is active and settings of 24-08 is changed or power is cycled to the inverter.

24- 09	Frequency/ Target Switch
Range	【0】 Disable 【1】 Enable
24- 10	Stop Mode Selection on Mode 6/7/9
Range	【0】 Disable 【1】 Enable

When 24-09=0, Uses lower limit frequency and the delay time of lower limit frequency to de-stage a pump.

When 24-09=1, Uses PID feedback (12-39) > PID setting (12-38) to de-stage pump.

When 24-10=1, all relays open when stopped and first relay closes upon next start.

Note: 24-10 is enabled only when 24-00=6, 7 or 9.

24- 11	High Voltage Limit Level
Range	【0~10000】
24- 14	Low Voltage Limit Level
Range	【0~10000】

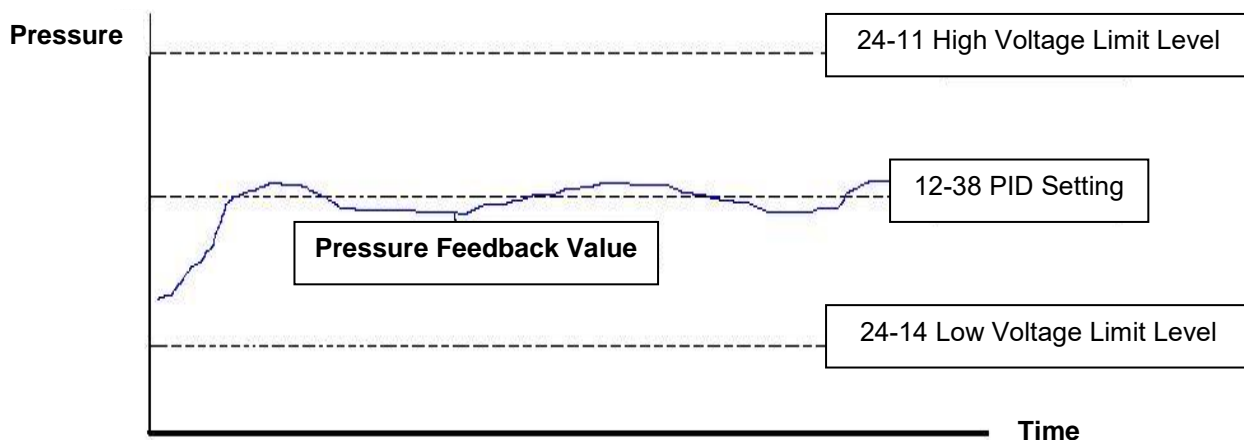
24-11 High Voltage Limit Level:

When pressure feedback value rises above the high voltage limit level for the time specified in 24-13 the inverter shows a fault and stops.

24-14 Low Voltage Limit Level:

When pressure feedback value falls below the low voltage limit level for the time specified in 24-16 the inverter shows a fault and stops.

Parameters 24-11& 24-14 are active when 10-00=4. Set upper limit value with parameter 10-33. Set decimal point position with parameter 10-34 and engineering unit with parameter 10-35.



Pressure feedback value limit diagram

Note: Pressure feedback value operates between the high voltage limit level (24-11) and the low voltage limit level.

24- 12	Delay Time of High Voltage Warning
Range	【0.0 ~600.0】 Sec
24- 13	Delay Time of High Voltage Error
Range	【0.0 ~ 600.0】 Sec

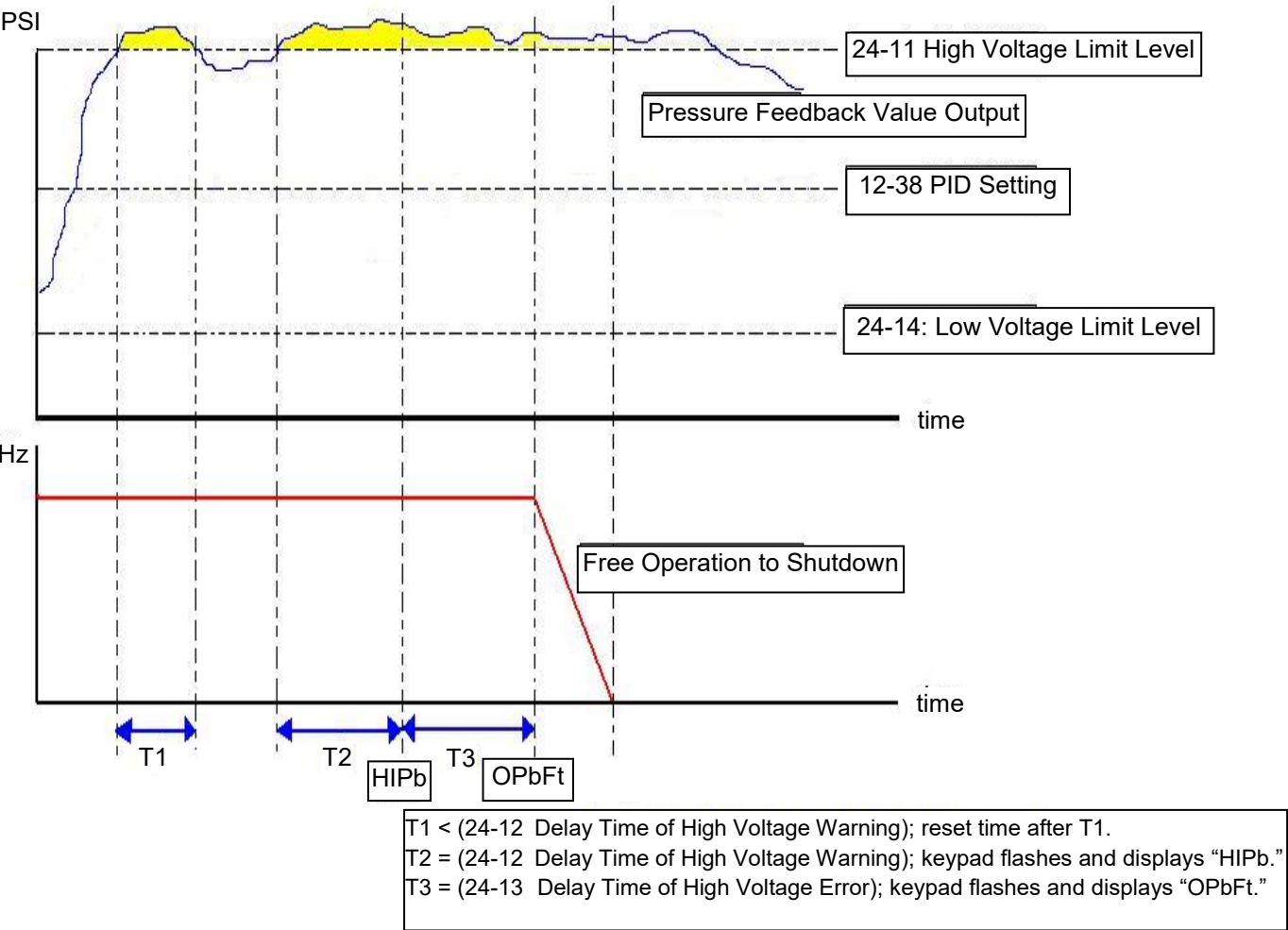
24-12 Delay Time of High Voltage Warning

When pressure feedback value rises above the high voltage limit level (24-11) for the time specified in 24-12 the inverter displays “HIPb” warning. Timer will reset when pressure falls below the limit level 24.11.

24-13 Delay Time of High Voltage Error

When pressure feedback value rises above the high voltage limit level (24-11) for the time specified in 24-12 the inverter displays “OPbFt” fault and stops. Timer will reset when pressure falls below the limit level 24.11.

Note: To disable the high voltage limit set 24-12 to 0.



High voltage limit warning and shutdown diagram

24- 15	Delay Time of Low Voltage Warning
Range	【0.0 ~ 600.0】 Sec
24- 16	Delay Time of Low Voltage Error
Range	【0.0 ~ 600.0】 Sec

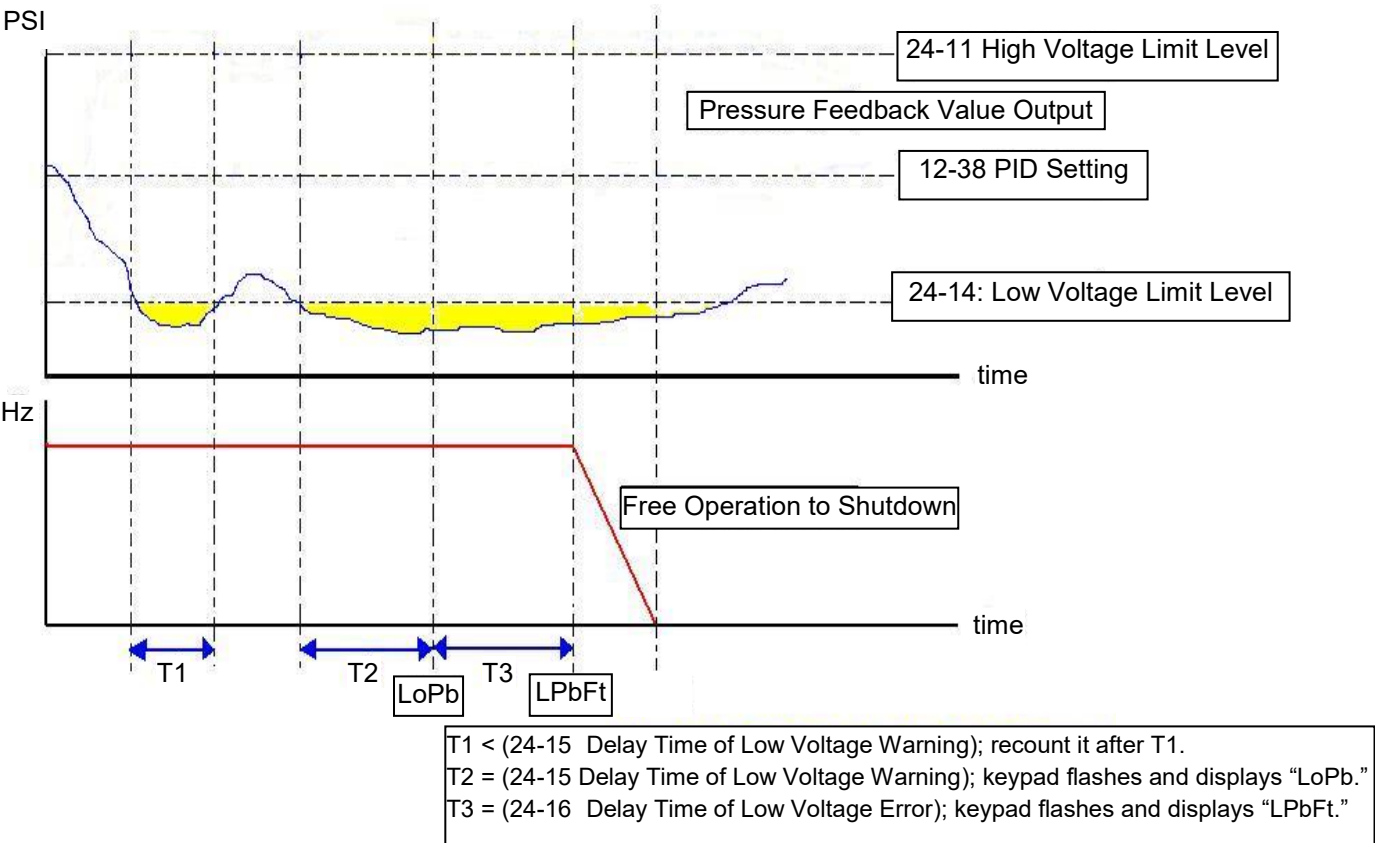
24-15 Delay Time of Low Voltage Warning

When pressure feedback value falls below the low voltage limit level (24-14) for the time specified in 24-15 the inverter displays “LoPb” warning. Timer will reset when pressure rises above the limit level 24.12.

24-16 Delay Time of Low Voltage Error

When pressure feedback value falls below the low voltage limit level (24-14) for the time specified in 24-16 the inverter displays “LPbFt” fault and stops. Timer will reset when pressure rises below the limit level 24.14.

Note: To disable the high voltage limit set 24-15 to 0



Low voltage limit warning and shutdown diagram

The following examples show staging and de-staging of pumps operating in fixed inverter mode. Relay 1~Relay 4 of 1 to 8 pump card are enabled. Motor 1 is connected to inverter and motor 2~4 are connected to the AC power supply via a magnetic contactor which is controlled by the relays. Refer to Fig. 4.3.126.

The following diagram shows operation when 24-00=1, 24-06=0 and PID settings are set based on the system requirements.

- When the output frequency (Fout) is greater or equal to the upper limit frequency (00-12) for the time specified by the duration of the upper limit frequency (24-03), relay 2 is activated and pump 2 is turned on.

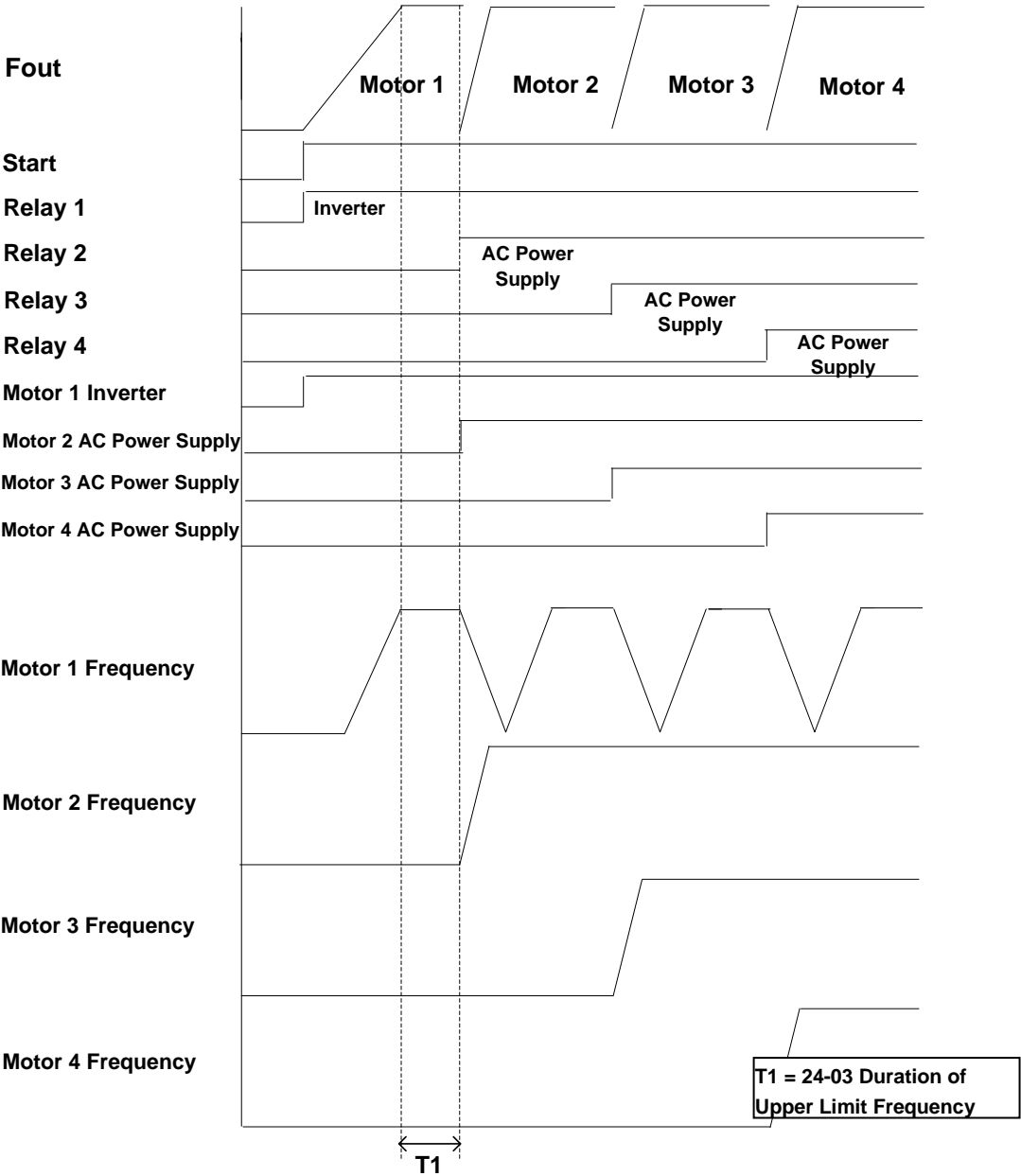


Figure 4.3.120 Staging pumps operating in fixed inverter mode

- When output frequency (F_{out}) falls below the lower limit frequency (00-13) for the time specified by the duration of the upper limit frequency (24-04), relay 4 is de-activated turning off pump 4 and the inverter accelerates to the upper limit frequency (00-12). When the output frequency (F_{out}) reaches the upper limit frequency (00-12) the inverter starts to decelerate.

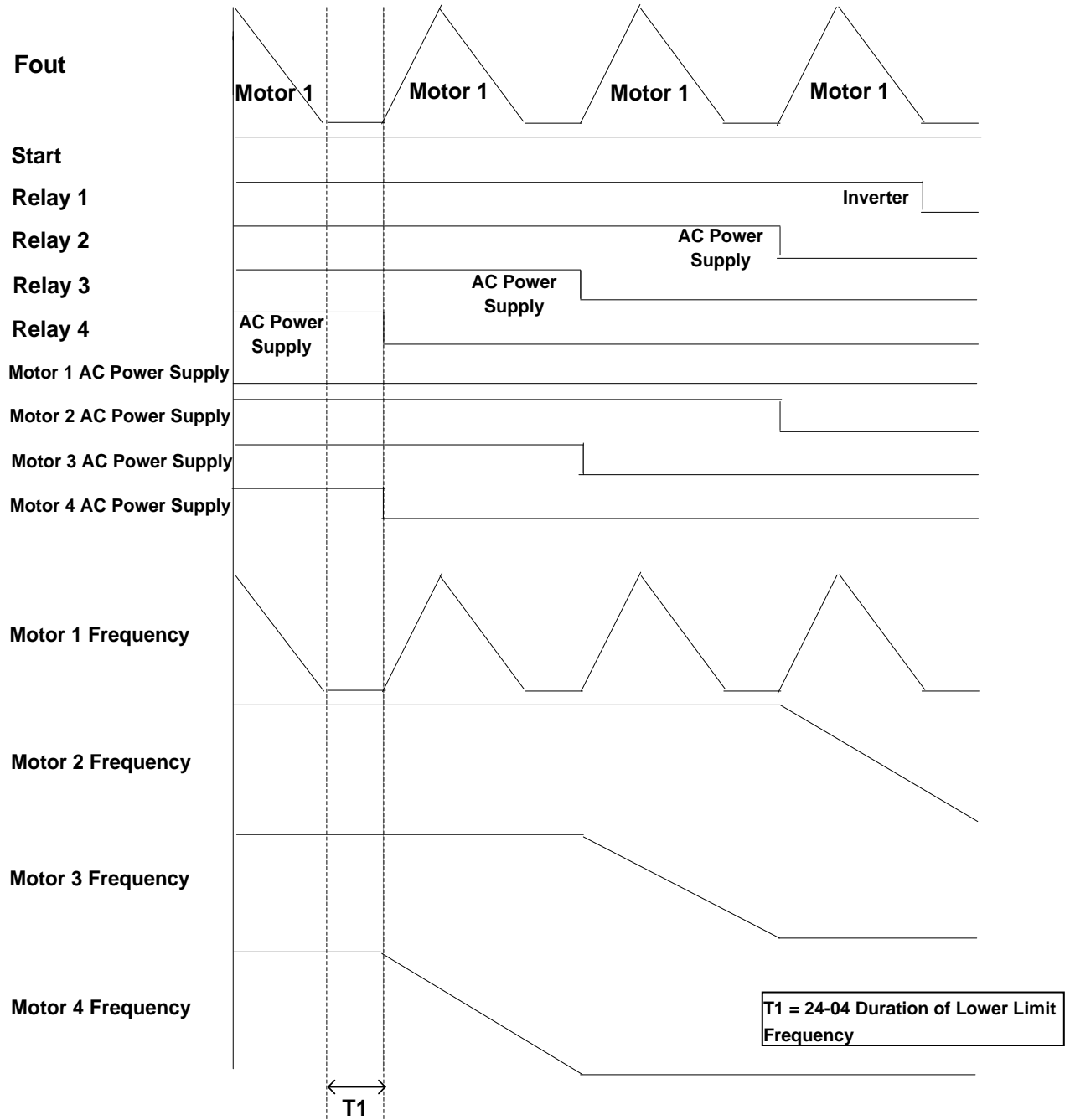


Figure 4.3.121 De-staging pumps in fixed inverter mode

The following examples show staging and de-staging of pumps operating in inverter alternation mode. Relay 1~Relay 4 of 1 to 8 pump card are enabled. Motor 1 is connected to inverter and motor 2~4 are connected to the AC power supply via a magnetic contactor which is controlled by the relays. Refer to Fig. 4.3.127.

The following diagram shows operation when 24-00=1, 24-06=0 and PID settings are set based on the system requirements.

- When the output frequency (F_{out}) is greater or equal to the upper limit frequency (00-12) for the time specified by the duration of the upper limit frequency (24-03), relay 1 is de-activated and the inverter stops.
- Relay 1 and Relay 2 are turned on and the inverter starts to accelerate after the switching time for the magnetic contactor (24-05) expires.

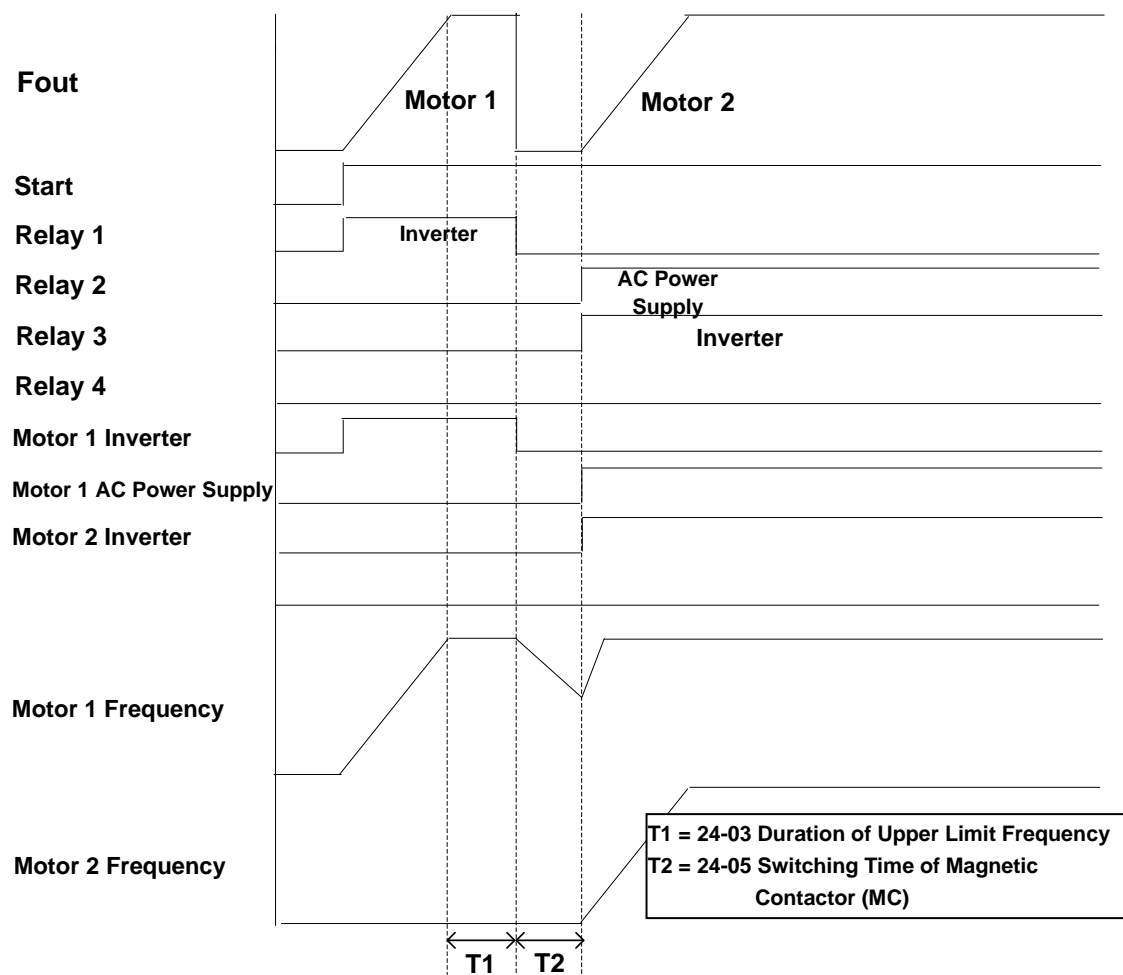


Figure 4.3.122 Staging pumps in inverter alternation mode

- When output frequency (Fout) falls below the lower limit frequency (00-13) for the time specified by the duration of the upper limit frequency (24-04), relay 1 and 2 are de-activated. Relay 1 is turned on and the inverter starts to decelerate after the switching time for the magnetic contactor (24-05) expires.

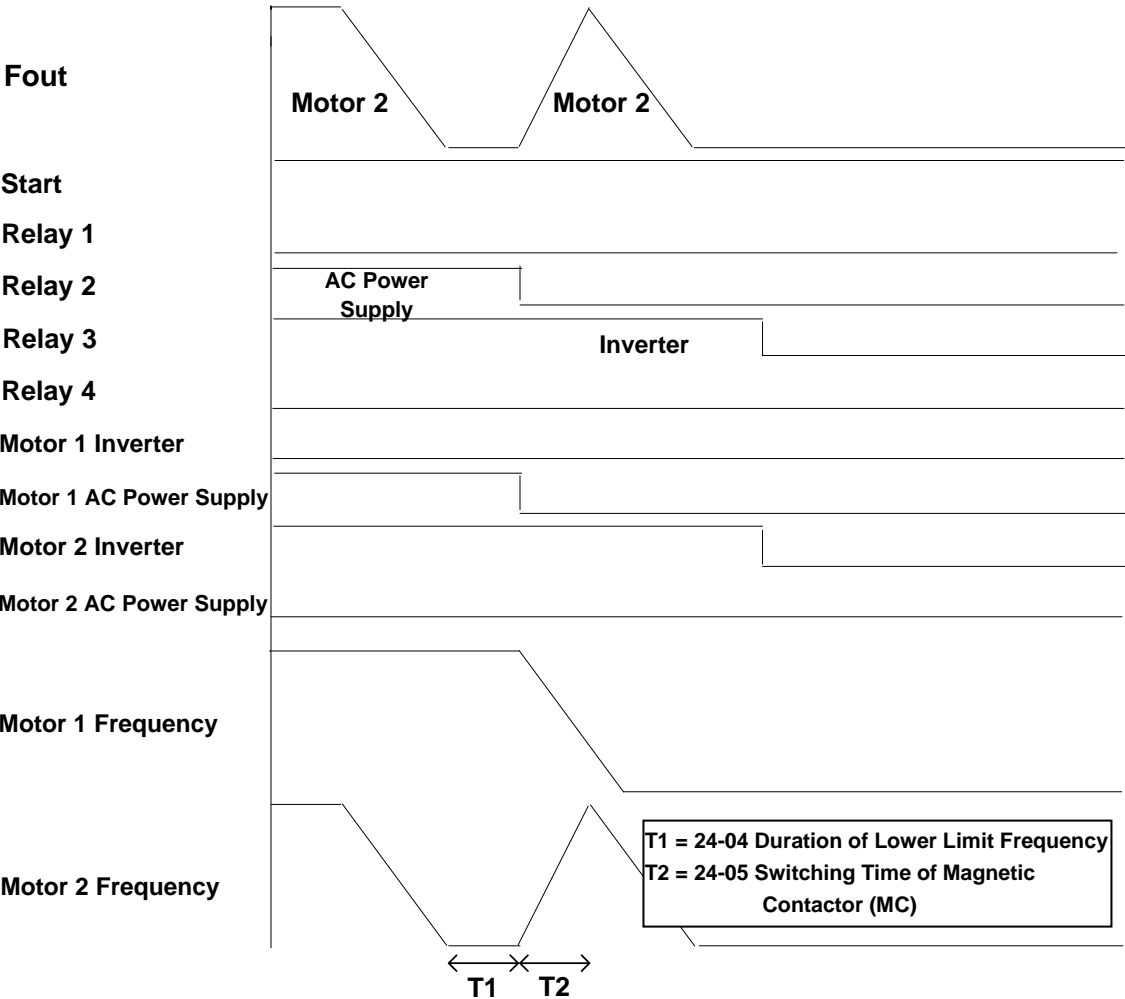


Figure 4.3.123 De-staging pumps in the inverter alternation mode

The following examples show staging and de-staging of pumps operating in fixed inverter mode. Relay 1~Relay 3 (R1A-R3A on the control board are enabled). Motor 1 is connected to the inverter and motor 2 and 3 are connected to the AC power supply via a magnetic contactor controlled by the relays. Refer to Fig. 4.3.128.

The following diagram shows operation when 24-00=1, 24-06=0 and PID settings are set based on the system requirements.

- When the output frequency (F_{out}) is greater or equal to the upper limit frequency (00-12) for the time specified by the duration of the upper limit frequency (24-03), relay 1 is de-activated and the inverter is turned off.
- Relay 2 is activated after the switching time of magnetic contactor (24-05) expires.
- Relay 1 is activated and the inverter starts to accelerate after relay 2 and after the switching time of magnetic contactor (24-05) expires

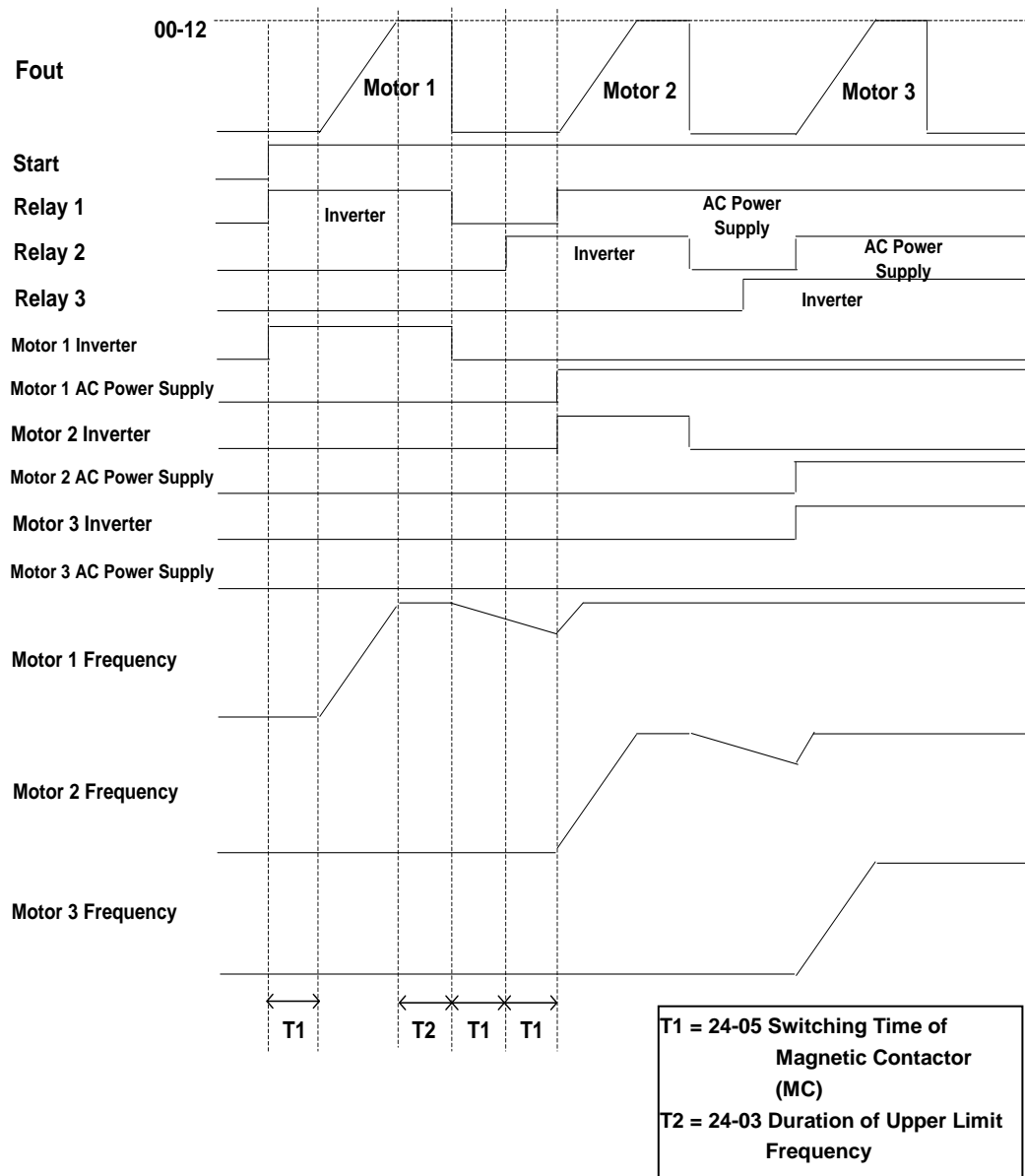


Figure 4.3.124 Staging of pumps in 1 to 3 Relay modes

- When pressure feedback value rises above the target (setpoint) value, inverter output frequency (F_{out}) decreases. Relay 1 is de-activated when the output frequency reaches to the lower limit frequency (00-13) and remains there for the duration of lower limit frequency (24-04).

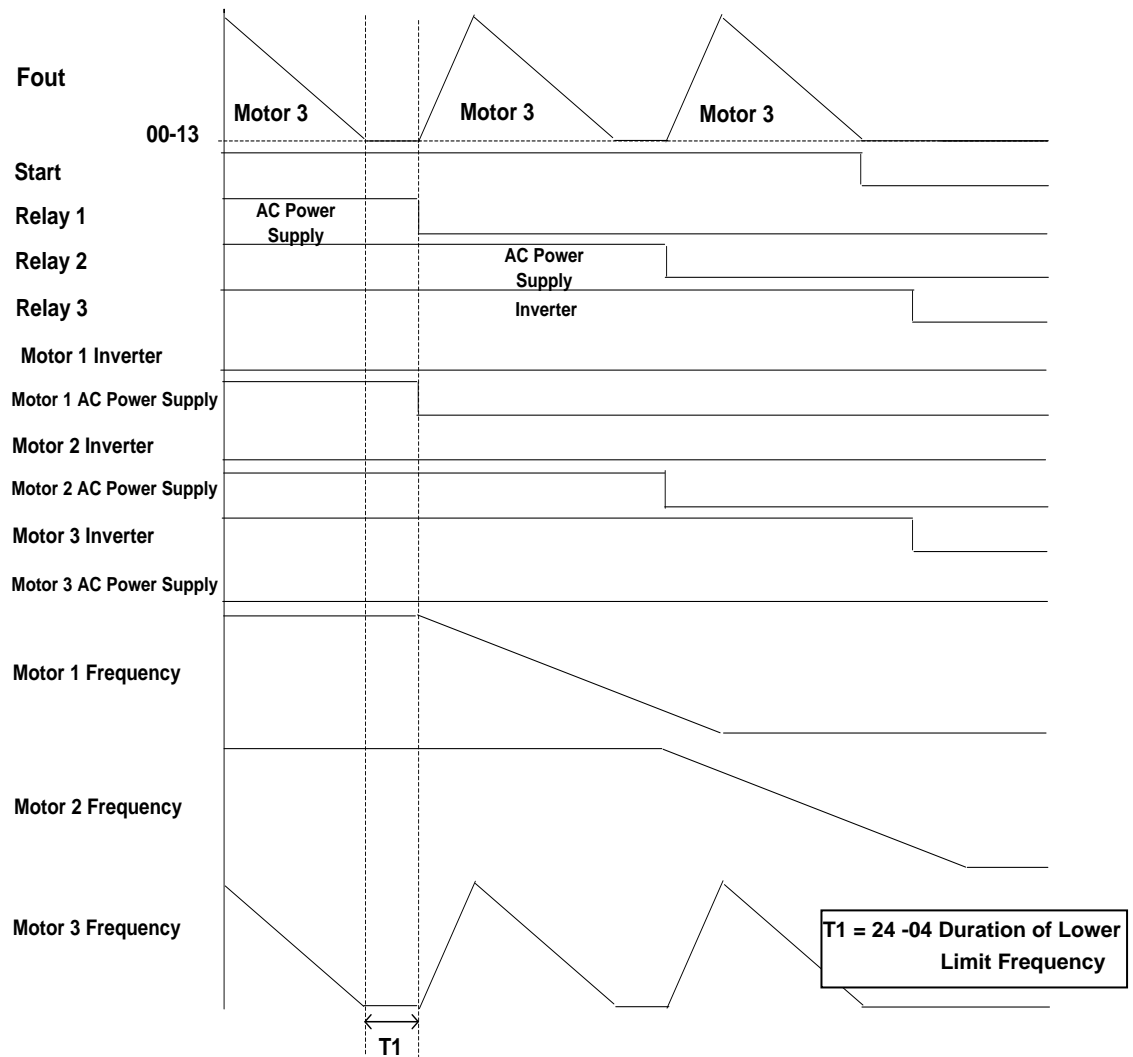


Figure 4.3.125 De-staging pumps in 1 to 3 Relay modes

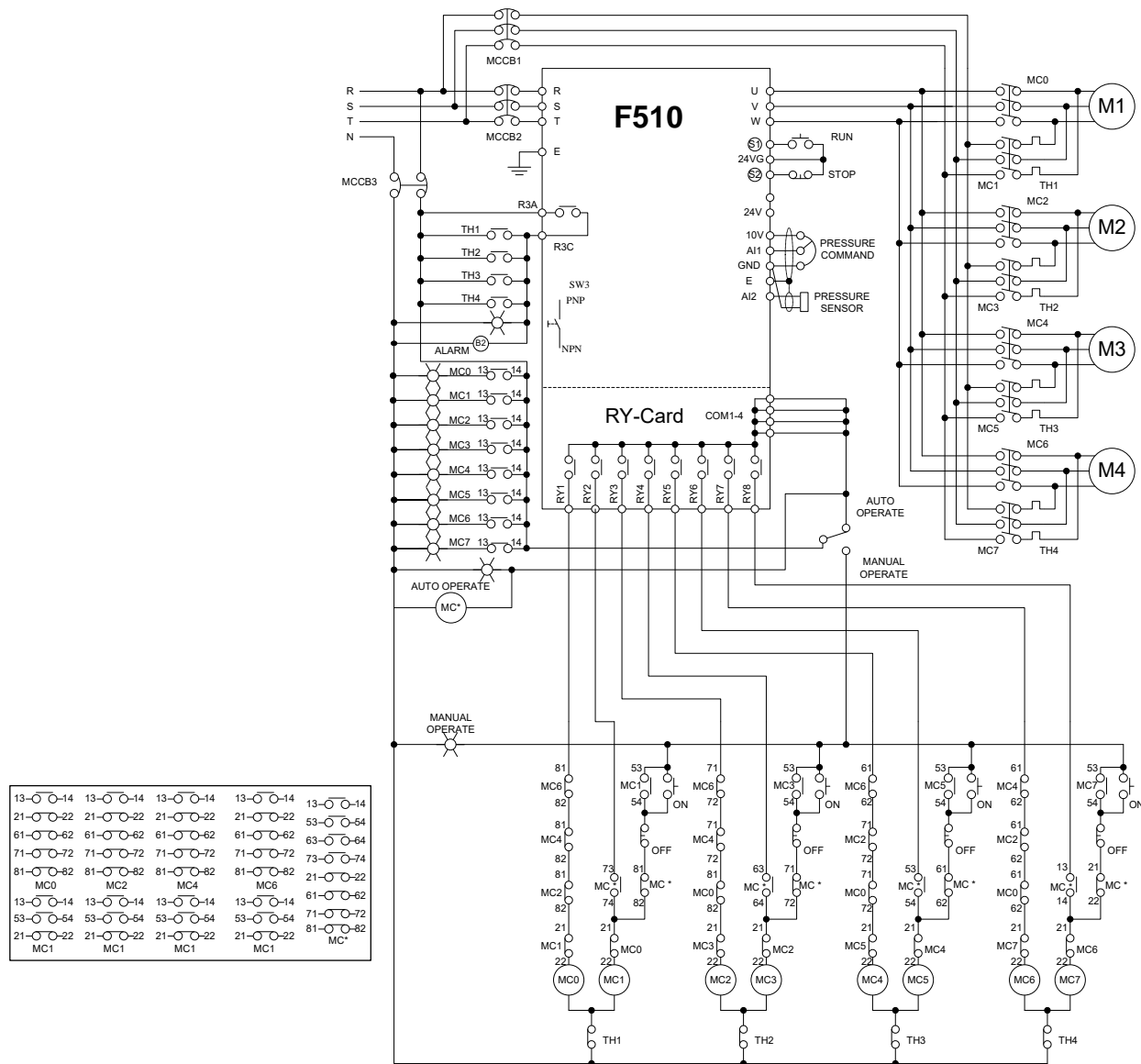


Figure 4.3.127 Inverter alternation mode wiring

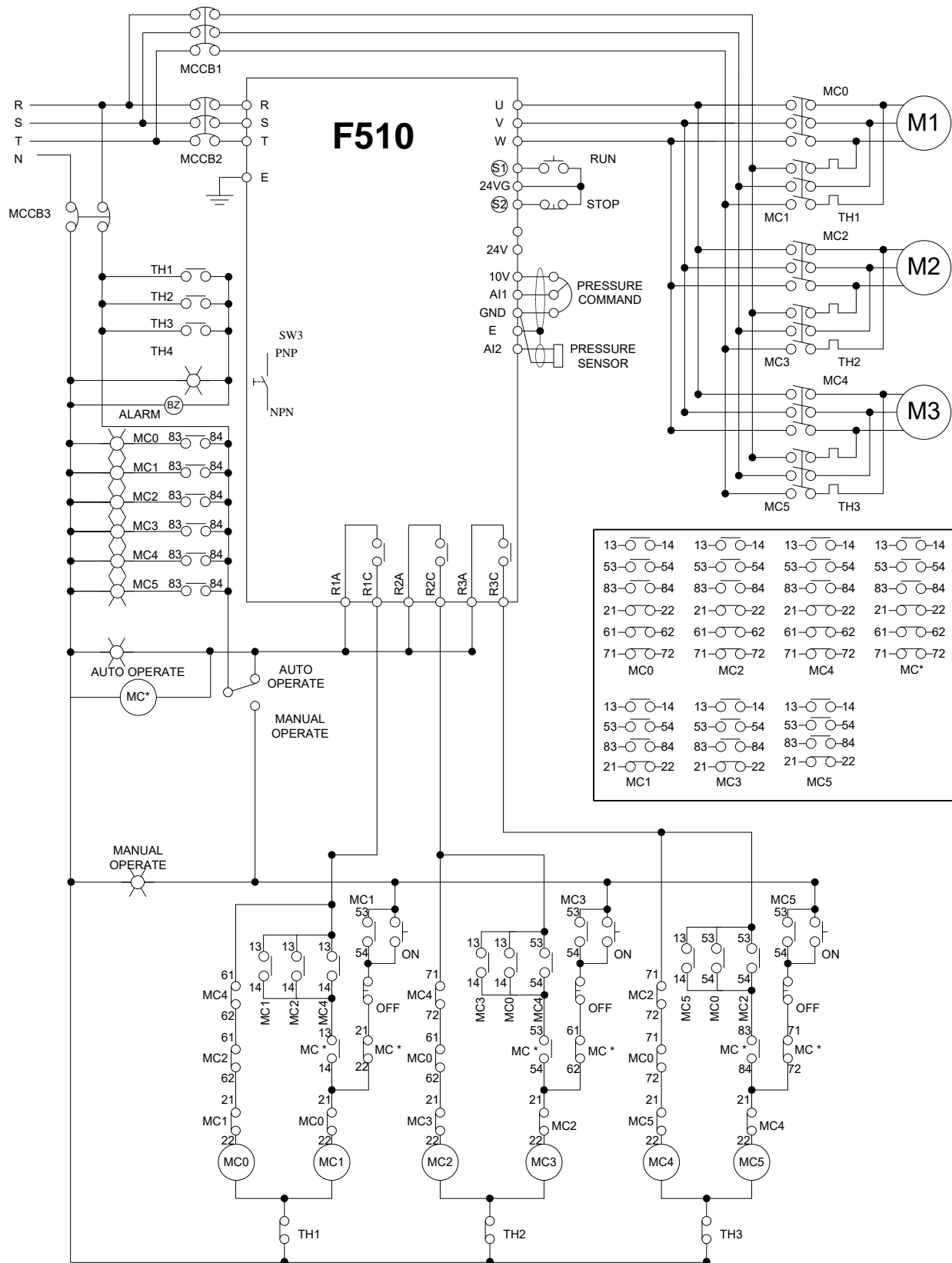


Figure 4.3.128 Inverter alternation mode wiring for 1 to 3 relay modes

5. Check motor rotation and direction

This test is to be performed solely from the inverter keypad. Apply power to the inverter after all the electrical connections have been made and protective covers have been re-attached. At this point, **DO NOT RUN THE MOTOR**, the keypad should display as shown below in Fig. 5.1 and the speed reference 12-16=005.00Hz should be blinking at the parameter code “12-16”.

Important: Motor rotation and direction only applies to standard AC motors with a base frequency of 60Hz. For 50Hz or other frequency AC motors please set the max frequency and base frequency in group 01 accordingly before running the motors.



Fig 5.1: Keypad (Stopped)



Fig 5.2: Keypad (Running)

Next press the **RUN** key, see Fig 5.2. The motor should now be operating at low speed running in forward (clockwise) direction. The parameter code 12-17 shown at the bottom left corner of the screen will change from 12-17=000.00Hz to 12-17=005.00Hz. Next press **STOP** key to stop the motor.

If the motor rotation is incorrect, power down the inverter.

After the power has been turned OFF, wait at least ten minutes until the charge indicator extinguishes completely before touching any wiring, circuit boards or components.

Using Safety precaution, and referring to section 3.8 exchange any two of the three output leads to the motor (U/T1, V/T2 and W/T3). After the wiring change, repeat this step and recheck motor direction.

6. Speed Reference Command Configuration

The inverter offers users several choices to set the speed reference source. The most commonly used methods are described in the next sections.

Frequency reference command is selected with parameter 00-05.

00-05: Main Frequency Command (Frequency Source)

This function sets the frequency command source.

Setting Range: 0 to 7

To set parameter 00-05:

- After power-up press the **DSP/FUN** key
- Select **00 Basic Fun**
- Press **READ/ ENTER** key
- Select parameter -05 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

In the parameter list move cursor to 00-05 with the **UP/DOWN** keys and press **READ/ ENTER** key to select.

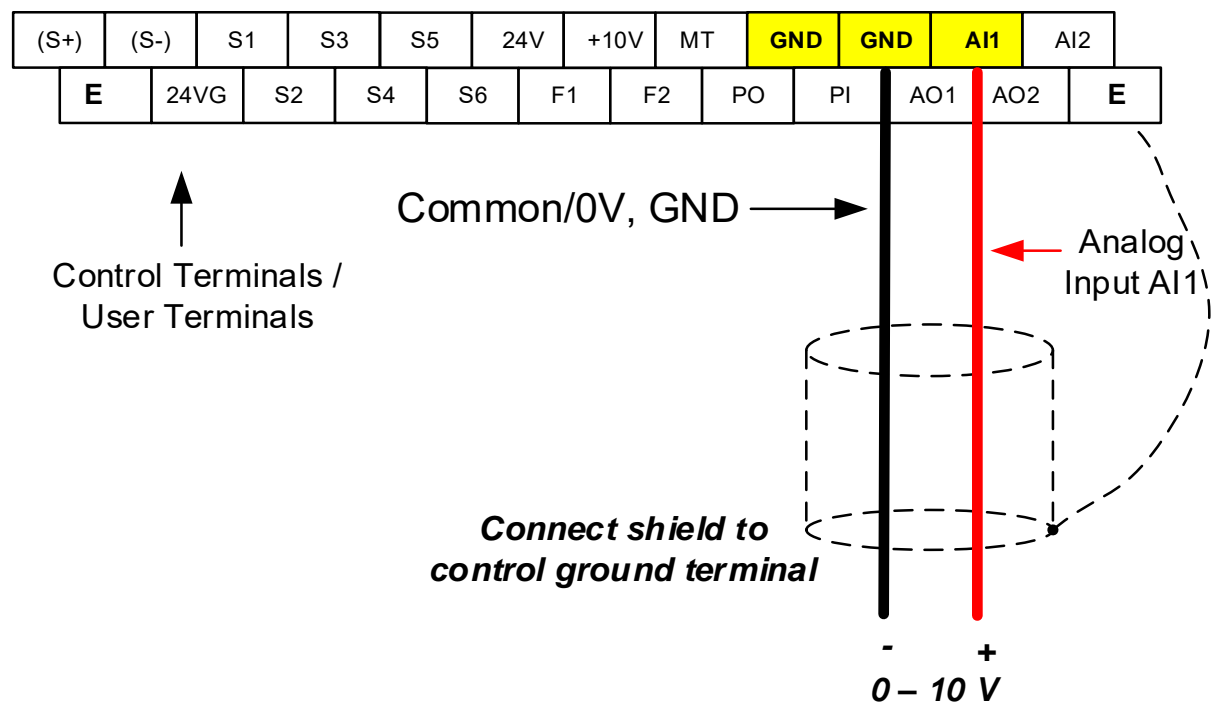
00-05	Main Frequency Command Source Selection
Range	0: Keypad 1: External control (analog) 2: Terminal UP / DOWN 3: Communication control 6: RTC 7: AI2 Auxiliary Frequency

6.1 Reference from Keypad

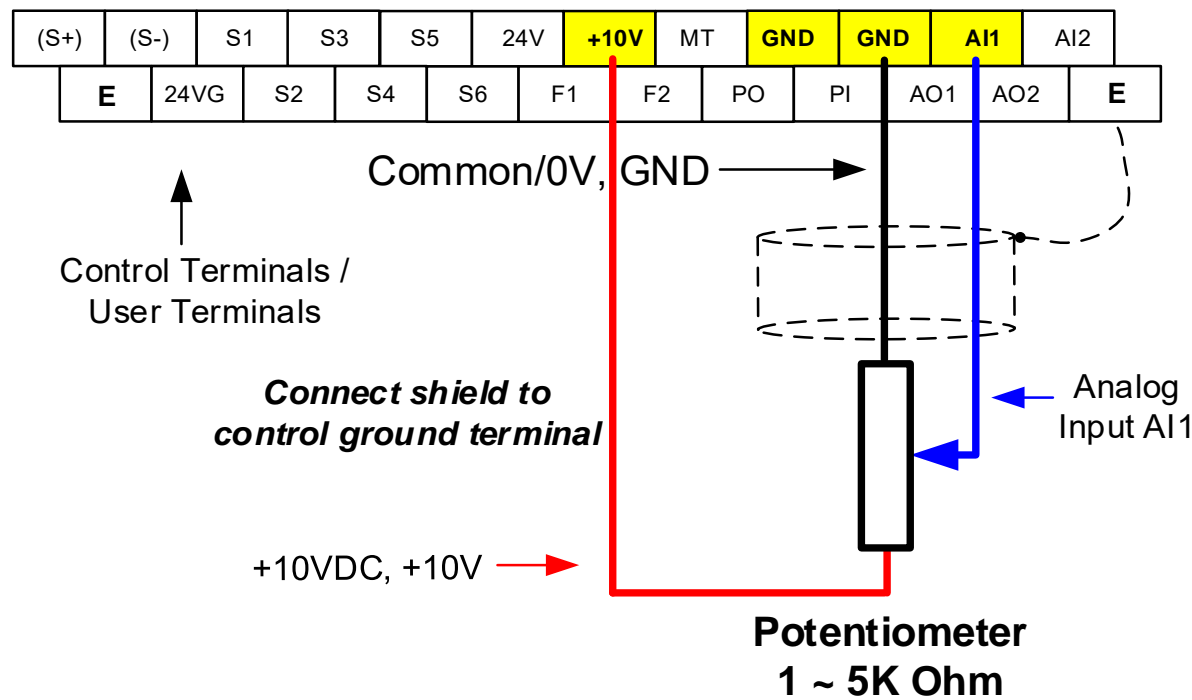
Speed reference from the keypad is the default setting. Press the **READ/ ENTER** key first and use the **</RESET**, **▲** and **▼** keys to change the speed reference.

6.2 Reference from External Analog Signal (0-10V / 4-20mA)

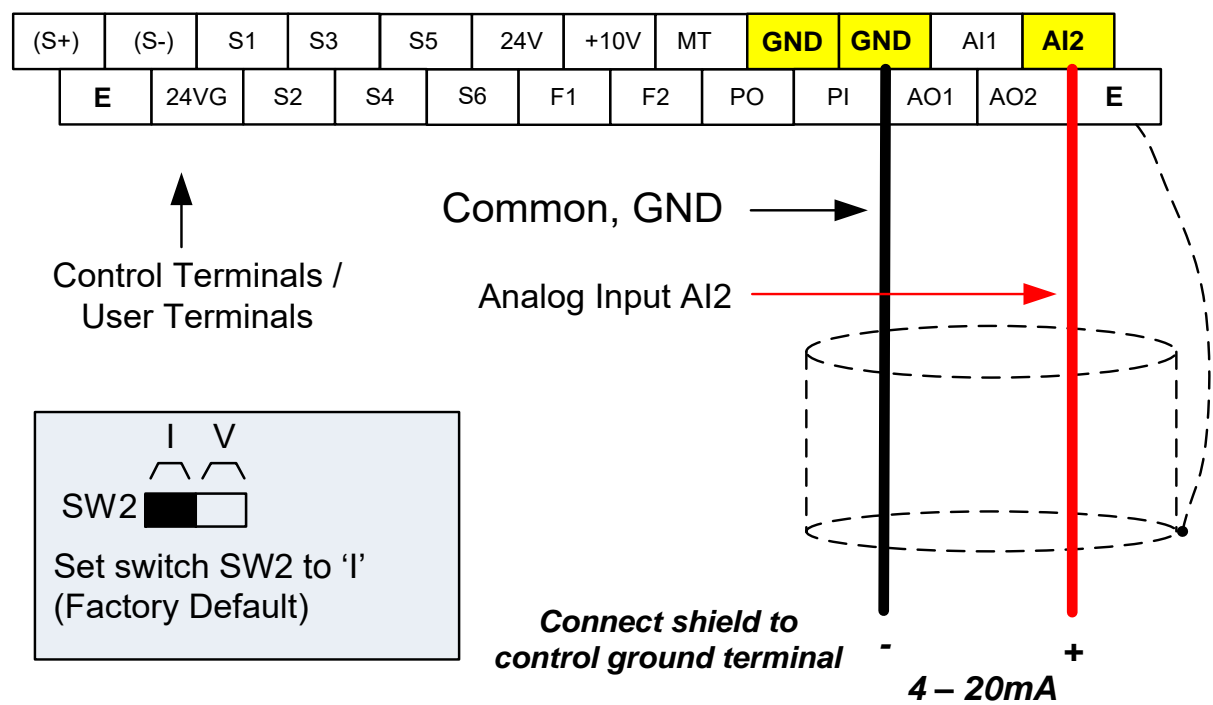
Analog Reference: 0 – 10 V (Setting 00-05 = 1)



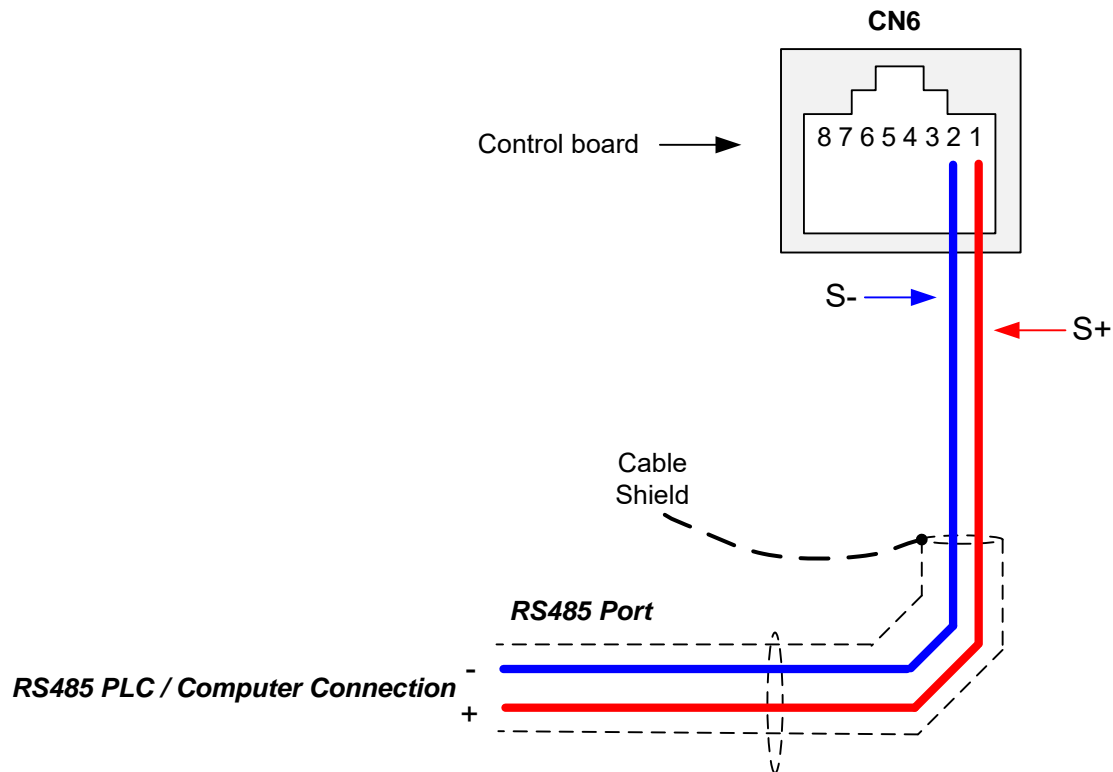
Analog Reference: Potentiometer / Speed Pot (Setting 00-05 = 1)



Analog Reference: 4 – 20mA (Setting 00-05 = 1)



6.3 Reference from Serial Communication RS485 (00-05=3)



To set the speed reference for the inverter via serial communication parameter 00-05 has be set to “3” for frequency command via serial communication.

Default Communication Setting is: Address “1”, 9600 Bits/sec, 1 Start Bit, 1 Stop Bit, and No Parity

The serial communication link function uses RS485 Modbus RTU protocol and allows for:

- 1) Monitoring (data monitoring, function data check).
- 2) Frequency setting.
- 3) Operation command (FWD, REV, and other commands for digital input).
- 4) Write function data.

Frequency Reference Command Register

Inverter Frequency Reference Register: 2502 (Hexadecimal) - Bit 0 – Bit 15: 0.00 ~ 400.00 Hz

Examples:**Frequency Reference Command: 10.00 Hz (Inverter Node Address: 01)**

Command String (hexadecimal): 01 06 25 02 03 E8 23 B8

To set the frequency reference to 10.00, a value of '1000' (03E8h) has to be send to the inverter.

Frequency Reference Command: 30.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 0B B8 24 44

To set the frequency reference to 30.00, a value of '3000' (0BB8h) has to be send to the inverter.

Frequency Reference Command: 60.00 Hz (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 02 17 70 2D 12

To set the frequency reference to 60.00, a value of '6000' (1770h) has to be send to the inverter

Note: The last 2 bytes of the command strings consist of a CRC16 checksum.

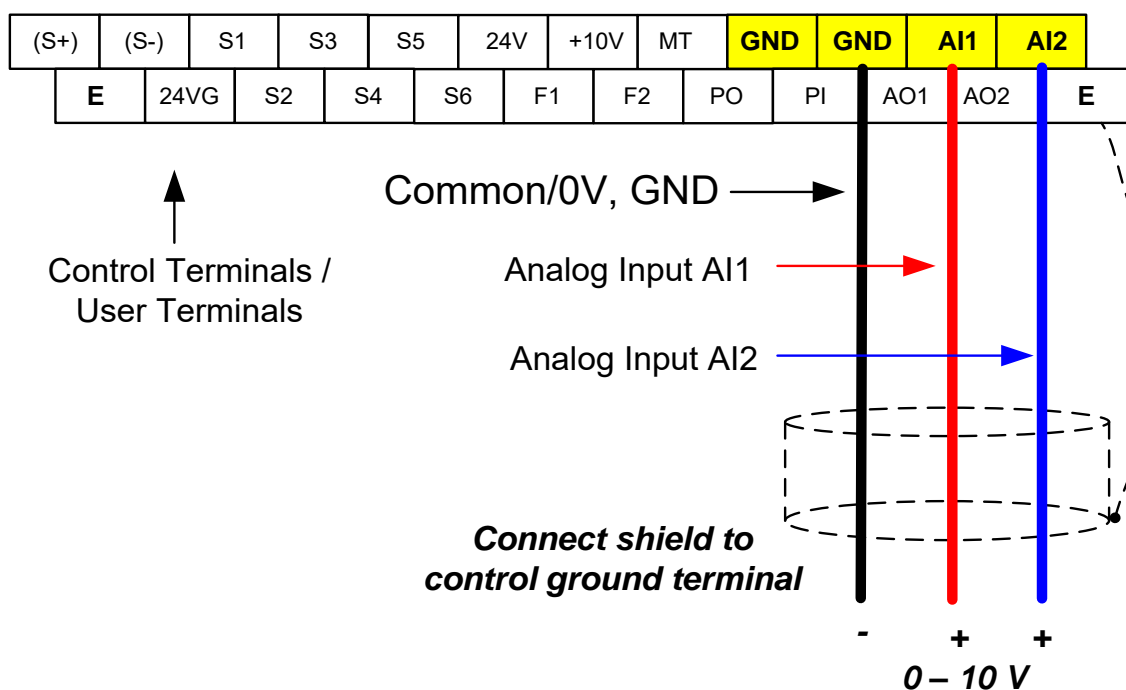
6.4 Reference from two Analog Inputs

Analog input AI1 is used as master frequency reference and analog input AI2 is used as auxiliary frequency reference.

Analog Reference AI1: 0 – 10 V (Setting 00-05 = 1)

Analog Reference AI2: 0 – 10 V (Setting 00-06 = 7, 00-07 = 1, 04-05 = 0)

AI1 – Analog Input 1	AI2 – Analog Input 2	04-00 Setting (Default = 1)	Dipswitch SW2 (Default 'V')
0 ~ 10V	0 ~ 10V	0	Set to 'V'
0 ~ 10V	4 ~ 20mA	1	Set to 'I'



6.5 Change Frequency Unit from Hz to rpm

Enter the number of motor poles in 16-03 to change the display units from Hz to rpm.

16-03	Display unit
Range	<p>0: Display unit is Hz (Resolution is 0.01Hz)</p> <p>1: Display unit is % (Resolution is 0.01%)</p> <p>2~39: Display unit rpm, (uses number of motor poles to calculate)</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, 16-03 = 4.

7. Operation Method Configuration (Run / Stop)

The inverter offers users several choices to run and stop from different sources. The most commonly used methods are described in the next sections.

Operation command is selected with parameter 00-02.

00-02: Run Command Selection

This function sets the frequency command source.

Setting Range: 0 to 4

To set parameter 00-01:

- After power-up press the **DSP/FUN** key
- Select **00 Basic Fun**
- Press **READ/ ENTER** key
- Select parameter -01 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

In the parameter list move cursor to 00-01 with the **UP/DOWN** keys and press **READ/ ENTER** key to select.

00-02	Run Command Selection
Range	0: Keypad control 1: External terminal control 2: Communication control 3: PLC 4: RTC

7.1 Run/Stop from the Keypad (00-02=0) – Default Setting

Use the **RUN** key to run the drive in forward direction and the **FWD/REV** key to change the motor direction. (Note: to disable reverse direction set parameter 11-00 to 1)

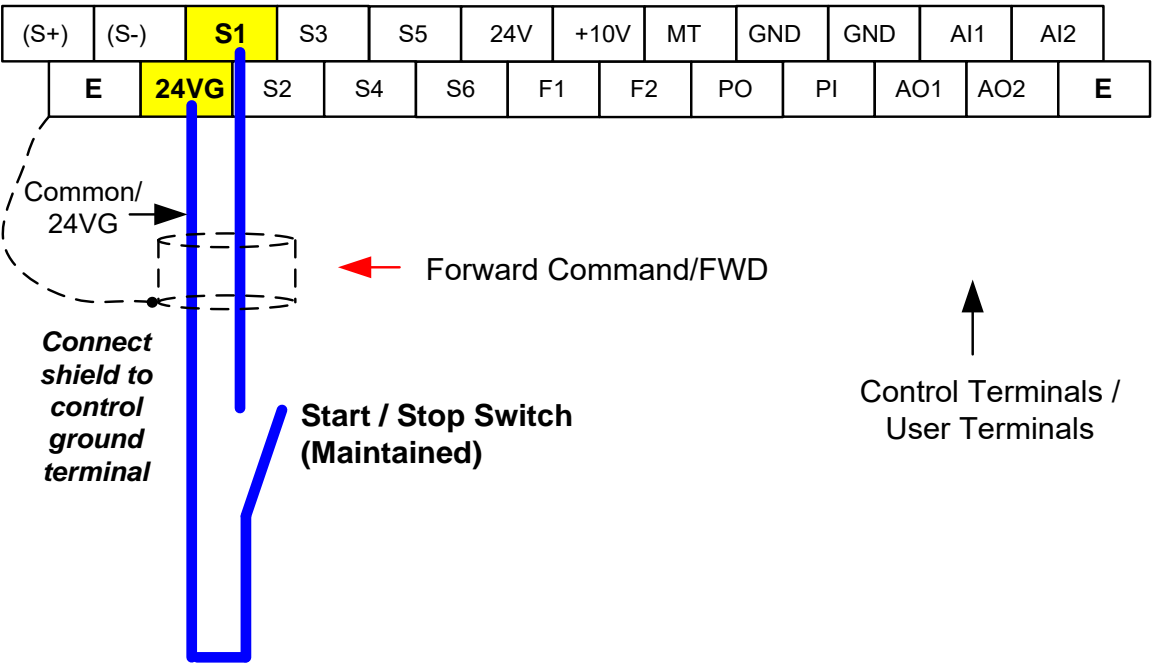
Press **STOP** key to stop the inverter. (Note: Stop method can be set with parameter 07-09, default is **deceleration to stop**).



7.2 Run/Stop from External Switch / Contact or Pushbutton (00-02=1)

Use an external contact or switch to Run and Stop the inverter.

Permanent Switch / Contact



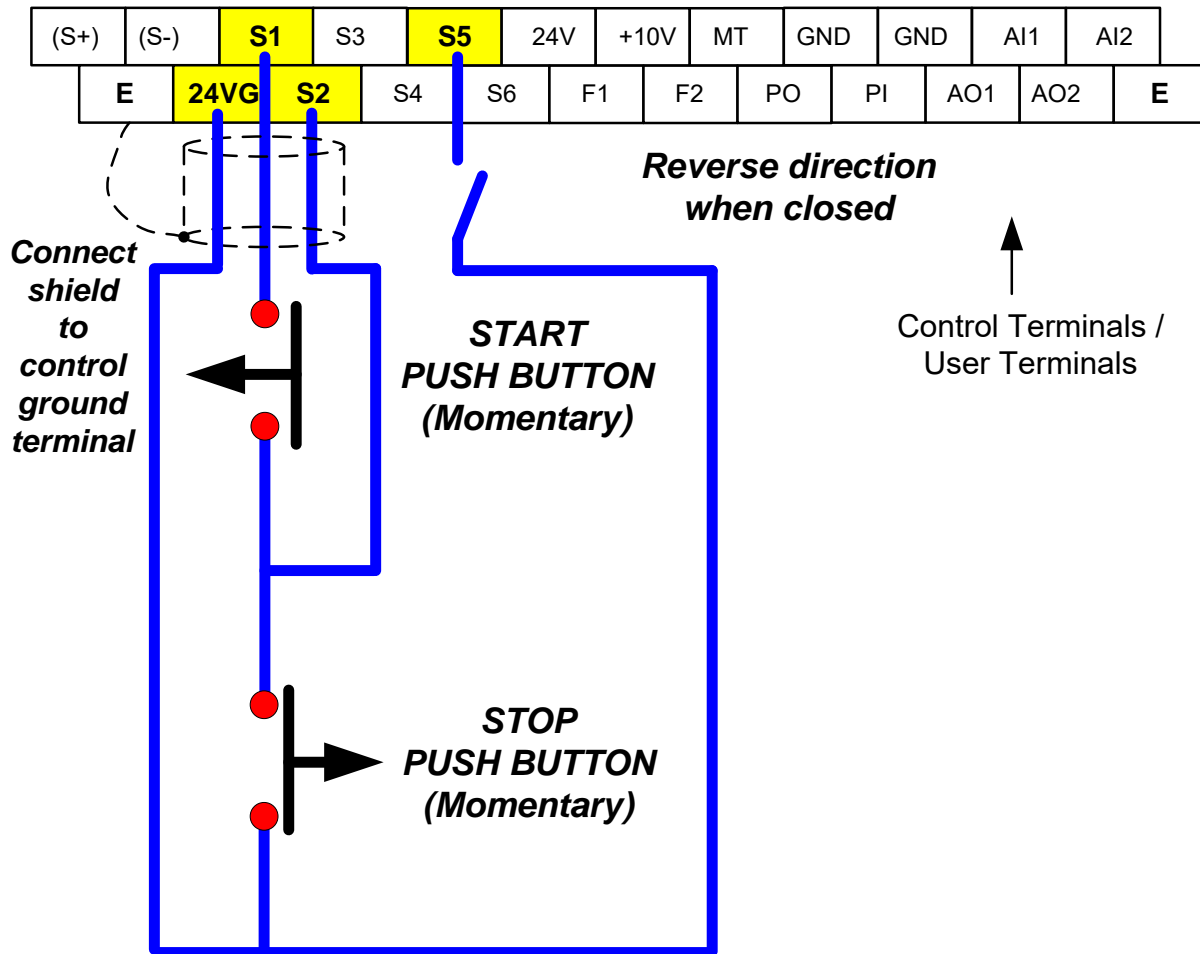
Momentary Contacts (Push Buttons)

Use push button / momentary switch to Run and Stop the inverter.

Set parameter 13-08 to 3, 5 or 7 for 3-wire program initialization, multi-function input terminal S1 is set to run operation, S2 for stop operation and S5 for forward/reverse command.

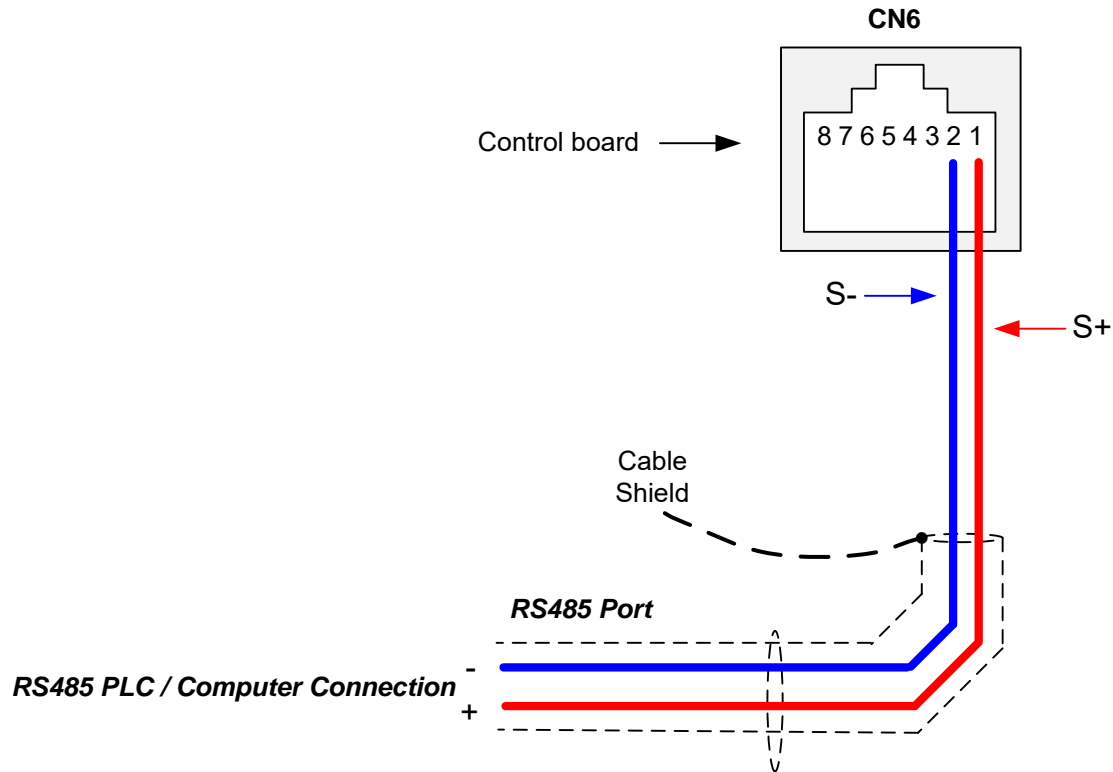
00-01 Operation Method = 1

03-05 Terminal S5 Function = 26



Note: Stop mode selection can be set with parameter 07-09, default is **deceleration to stop**.

7.3 Run/Stop from Serial Communication RS485 (00-02=3)



To control (Run/Stop) the inverter via serial communication parameter 00-02 has be set to either a “3” for communication control.

Default Communication Setting is: Address “1”, 9600 Bits/sec, 1 Start Bit, 1 Stop Bit, and No Parity

The serial communication link function uses RS485 Modbus RTU protocol and allows for:

- 1) Monitoring (data monitoring, function data check).
- 2) Frequency setting.
- 3) Operation command (FWD, REV, and other commands for digital input).
- 4) Write function data.

Command Register

Inverter Command Register: 2501 (Hexadecimal)

Bit 0: Run Forward

Bit 1: Run Reverse

Bit 2 ~ Bit 15: Refer to the chapter XX of this manual

Examples:

Run Forward Command (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 01 00 01 12 C6

Run Reverse Command (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 01 00 03 93 07

Stop Command (Inverter Node Address: 01)

Command String (hexadecimal): 01 06 25 01 00 00 D3 06

Note: The last 2 bytes of the command strings consist of a CRC16 checksum.

8. Motor and Application Specific Settings

It is essential that before running the motor, the motor nameplate data matches the motor data in the inverter.

8.1 Set Motor Nameplate Data (02-01, 02-05)

02-05 Rated power of motor 1

The nominal motor rated capacity is set at the factory. Please verify that the motor name plate data matches the motor rated capacity shown in parameter 02-05. The setting should only be changed when driving a motor with a different capacity.

Range: 0.00 to 600.00 kW (1HP = 0.746 kW)

To set parameter 02-05:

- After power-up press the **DSP/FUN** key
- Select **02 Motor Parameter**
- Press **READ/ ENTER** key
- Select parameter -01 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

Default values vary based on the inverter model.

02-01 Rated current of motor 1

The motor rated current is set at the factory based on the inverter model. Enter the motor rated current from the motor nameplate if it does not match the value shown in parameter 02-01.

Setting range: 0.01 to 600.00A

To set parameter 02-01:

- After power-up press the **DSP/FUN** key
 - Select **02 Motor Parameter**
 - Press **READ/ ENTER** key
 - Select parameter -01 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.
-

8.2 Acceleration and Deceleration Time (00-14, 00-15)

Acceleration and Deceleration times directly control the system dynamic response. In general, the longer the acceleration and deceleration time, the slower the system response, and the shorter time, the faster the response. An excessive amount of time can result in sluggish system performance while too short of a time may result in system instability.

The default values suggested normally result in good system performance for the majority of general purpose applications. If the values need to be adjusted, caution should be exercised, and the changes should be in small increments to avoid system instability.

00-14 Acceleration time 1

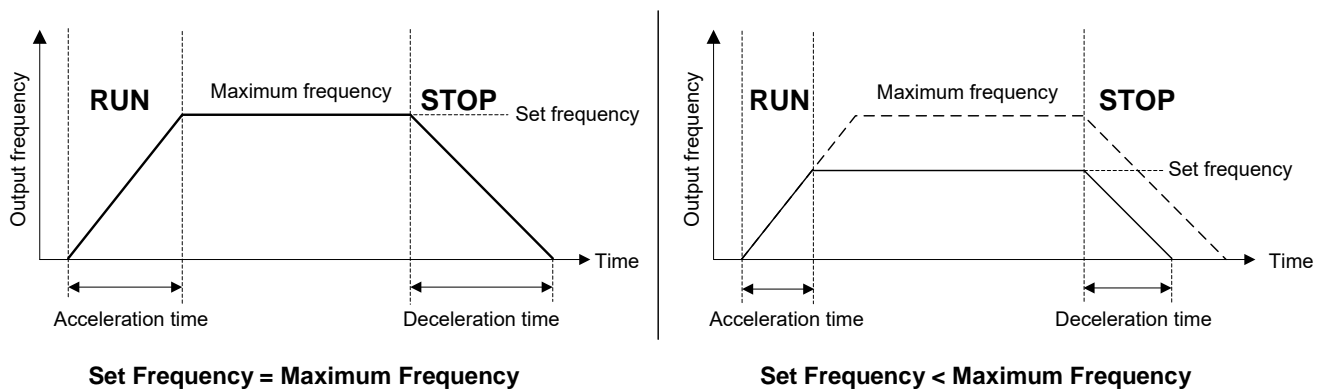
00-15 Deceleration time 1

These parameters set the acceleration and deceleration times of the output frequency from 0 to maximum frequency and from maximum frequency to 0.

To set parameter 00-14 or 00-15:

- After power-up press the **DSP/FUN** key
- Select **00 Basic Fun**
- Press **READ/ ENTER** key
- Select parameter -14 or -15 with the **UP/DOWN ▲ and ▼** keys and press the **READ/ ENTER** key.

Acceleration and deceleration times are represented by the three most significant (high order) digits. Set acceleration and deceleration times with respect to maximum frequency. The relationship between the set frequency value and acceleration/deceleration times is as follows:



Note: If the set acceleration and deceleration times are set too low, the torque limiting function or stall prevention function can become activated if the load torque and or inertia are relatively high. This will prolong the acceleration and or deceleration times and not allow the set times to be followed. In this case the acceleration and or the deceleration times should be adjusted.

8.3 Automatic Energy Savings Function (11-19)

In the V/F control mode the automatic energy saving (AES) function automatically adjusts the output voltage and reduces the output current of the inverter to optimize energy savings based on the load.

The output power changes proportional to the motor load. Energy savings is minimal when the load exceeds 70% of the output power and savings become greater when the load decreases.

The parameter of automatic energy saving function has been set at the factory before shipment. In general, it is no need to adjust. If the motor characteristic has significant difference from TECO standard, please refer to the following commands for adjusting parameters:

Enable Automatic Energy Savings Function

To set parameters 11-19 to 11-24:

- After power-up press the **DSP/FUN** key
- Select **11 Auxiliary Function Group**
- Press **READ/ ENTER** key
- Select parameter -19 to -24 with the **UP/DOWN ▲ and ▼** keys and press the **READ/ ENTER** key.

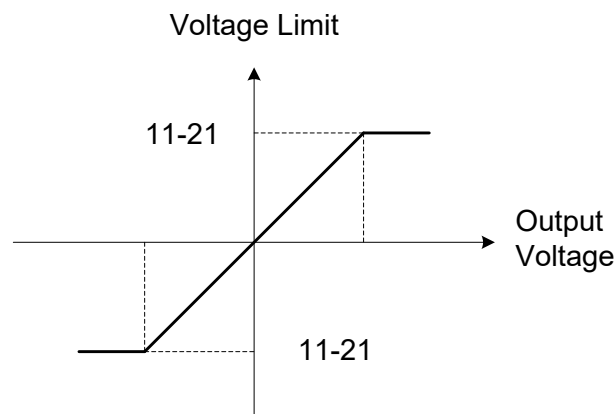
- (1) To enable automatic energy saving function set 11-19 to 1.
- (2) Filter time of automatic energy saving (11-20)
- (3) Commissioning parameter of energy saving (11-21 to 11-22)

In AES mode, the optimum voltage value is calculated based on the load power requirement but is also affected by motor temperature and motor characteristic.

In certain applications the optimum AES voltage needs to be adjusted in order to achieve optimum energy savings. Use the following AES parameters for manual adjustment:

11-21: Voltage limit value of AES commissioning operation

Sets the voltage upper limit during automatic energy saving. 100% corresponds to 230V or 460V depending on the inverter class used.



Voltage limit value of commissioning operation

11-22: Adjustment time of automatic energy saving

Sets sample time constant for measuring output power.

Reduce the value of 11-22 to increase response when the load changes.

Note: If the value of 11-22 is too low and the load is reduced the motor may become unstable.

11-23: Detection level of automatic energy saving

Sets the automatic energy saving output power detection level.

11-24: Coefficient of automatic energy saving

The coefficient is used to tune the automatic energy saving. Adjust the coefficient while running the inverter on light load while monitoring the output power. A lower setting means lower output voltage.

Notes:

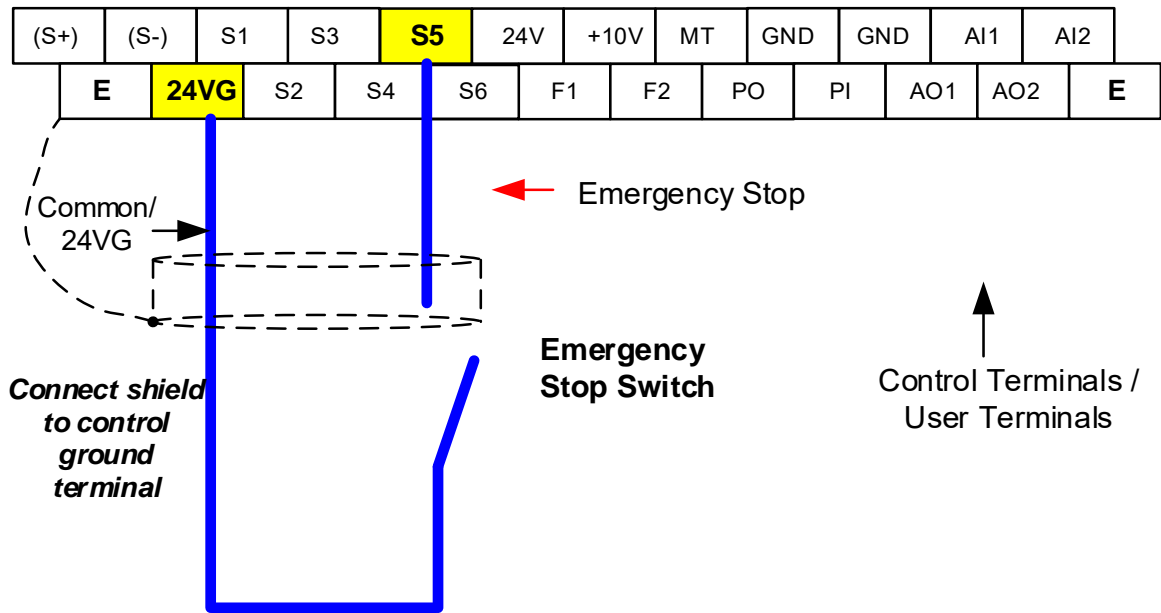
- If the coefficient is set to low the motor may stall.
- Coefficient default value is based on the inverter rating. Set parameter 13-00. If the motor power does not match the inverter rating.

8.4 Emergency Stop

The emergency stop time is used in combination with multi-function digital input function #14 (Emergency stop). When emergency stop input is activated the inverter will decelerate to a stop using the Emergency stop time (00-26) and display the [EM STOP] condition on the keypad.

Note: To cancel the emergency stop condition the run command has to be removed and emergency stop input deactivated.

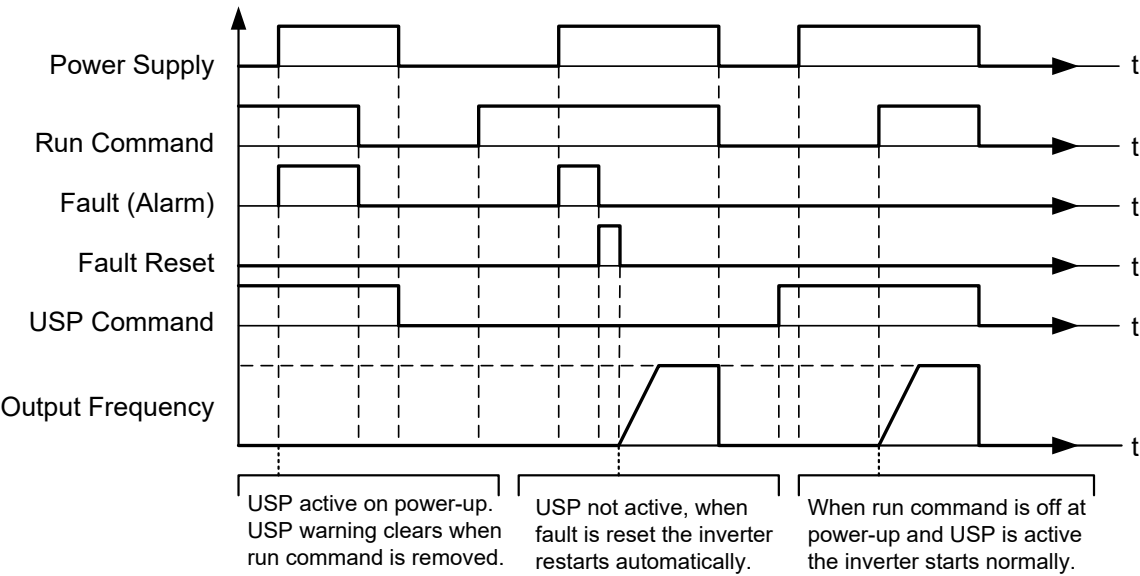
Example: Emergency Stop Switch set for input terminal S5 (03-04 = 14).



00-26	Emergency stop time
Range	0.0~6000.0 Sec

8.5 Direct / Unattended Startup

The unattended startup function prevents the inverter from starting automatically when a run command is present at time of power-up. To use USP command set one of the multi-function digital input functions to #50 (USP Startup).



Unattended Startup Protection

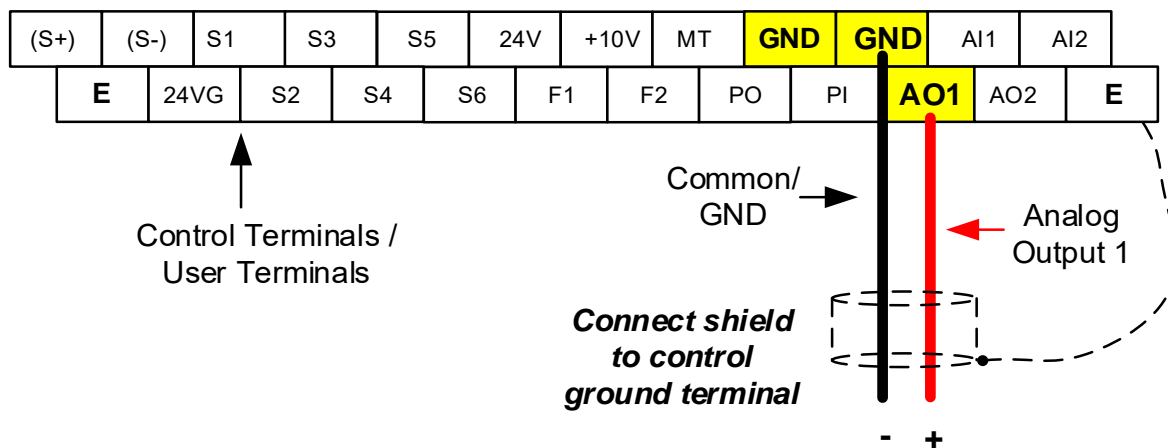
8.6 Analog Output Setup

Signal: Use parameter 04-11 to select the analog output signal for AO1 and parameter 04-16 to select the analog output signal for AO2.

Gain: Use parameter 04-12 to adjust the gain for AO1 and parameter 04-17 to adjust the gain for AO2. Adjust the gain so that the analog output (10V/20mA) matches 100% of the selected analog output signal (04-11 for AO1 and 04-16 for AO2).

Bias: Use parameter 04-13 to adjust the bias for AO1 and parameter 04-18 to adjust the bias for AO2. Adjust the bias so that the analog output (0V/4mA) matches 0% of the selected analog output signal (04-11 for AO1 and 04-16 for AO2).

Example: Analog Output 1 Wiring



04-11	AO1 function Setting	
Range	0: Output frequency	14: Reserved
	1: Frequency command	15: ASR output
	2: Output voltage	16: Reserved
	3: DC voltage	17: q-axis voltage
	4: Output current	18: d-axis voltage
	5: Output power	19: Reserved
	6: Motor speed	20: Reserved
	7: Output power factor	21: PID input
	8: AI1 input	22: PID output
	9: AI2 input	23: PID target value
	10: Torque command	24: PID feedback value
	11: q -axis current	25: Output frequency of the soft starter
	12: d-axis current	26 ~ 27: Reserved
	13: Speed deviation	28: Communication Control

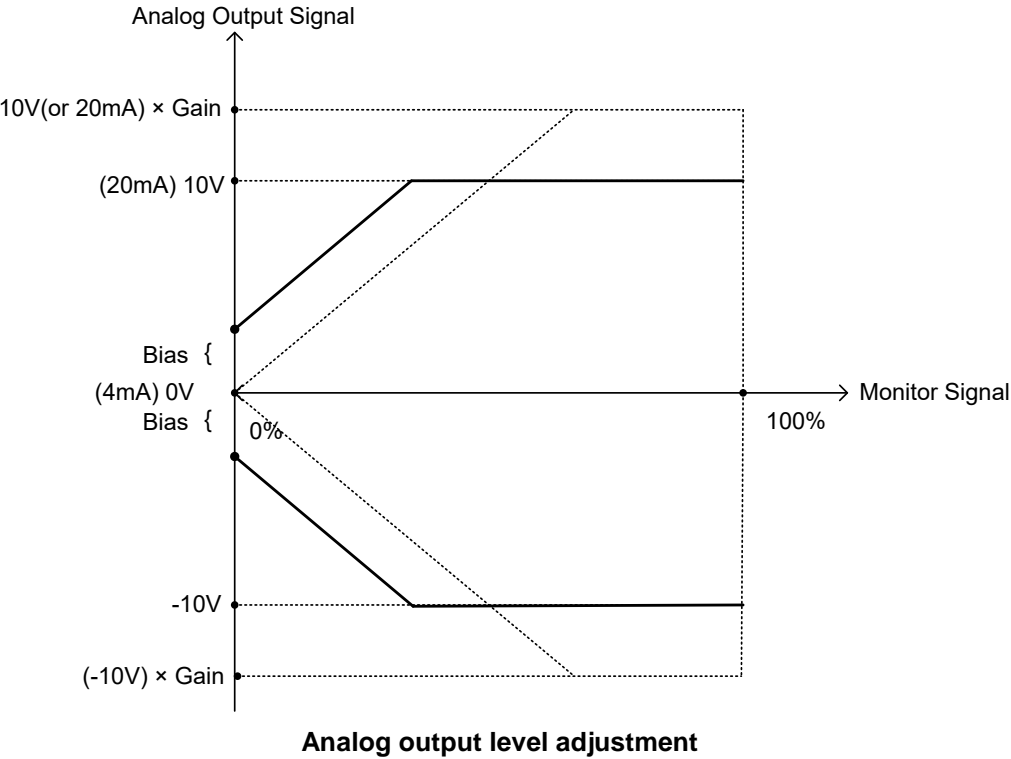
04-12	AO1 gain value
Range	0.0~1000.0%

04-13	AO1 bias-voltage value
Range	-100.0~100.0%

04-16	AO2 function Setting
Range	See parameter 04-11

04-17	AO2 gain value
Range	0.0~1000.0%

04-18	AO2 bias-voltage value
Range	-100.0~100.0%



Example 1:

Gain = 1.0

Set-Point = 80%

Feedback = 78%

Error = Set-point - Feedback = 2%

Control Error = Gain x Error = 2%

Example 2:

Gain = 2.0

Set-Point = 80%

Feedback = 78%

Error = Set-point - Feedback = 2%

Control Error = Gain x Error = 4%

Please note that an excessive gain can make the system unstable and oscillation may occur.

The response time of the system can be adjusted with the Integral Gain set by parameter 10-06. Increasing the Integral Time will make the system less responsive and decreasing the Integral Gain Time will increase response but may result in instability of the total system.

Slowing the system down too much may be unsatisfactory for the process. The end result is that these two parameters in conjunction with the acceleration (00-14) and deceleration (00-15) times are adjusted to achieve optimum performance for a particular application.

For typical fan and pump applications a Proportional Gain (10-05) of 2.0 and an Integral Time (10-06) of 5.0 sec is recommended.

10-03 PID control mode

PID control can be enabled by setting parameter 10-03 to 'xxx1b'

10-03	PID control mode
Range	xxx0b: PID disable xxx1b: PID enable xx0xb: PID positive characteristic xx1xb: PID negative characteristic x0xxb: PID error value of D control x1xxb: PID feedback value of D control 0xxxb: PID output 1xxxb: PID output +target value

Commonly used PID control modes

0001b: Forward operation: PID operation enabled, motor speeds increases when feedback signal is smaller than set-point (most fan and pump applications)

0011b: Reverse operation: PID operation enabled, motor slows down when feedback signal is smaller than set-point (e.g. level control applications)

To set parameter 10-03:

- After power-up press the **DSP/FUN** key
- Select **10 PID Control**
- Press **READ/ ENTER** key
- Select parameter -03 with the **UP/DOWN ▲** and **▼** keys and press the **READ/ ENTER** key.

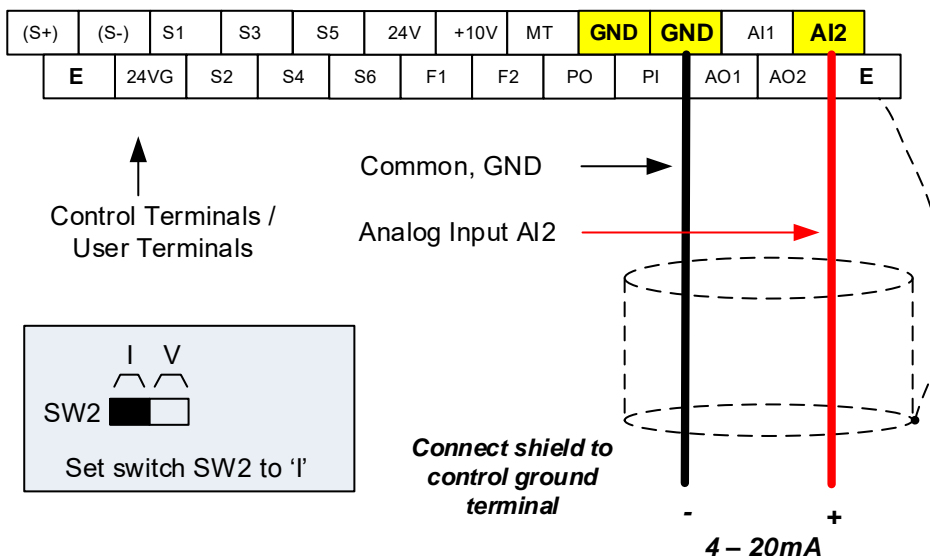
Important: To use the PID function parameter 00-05 (Main Frequency Command Source Selection) has to be set to 5 for PID reference.

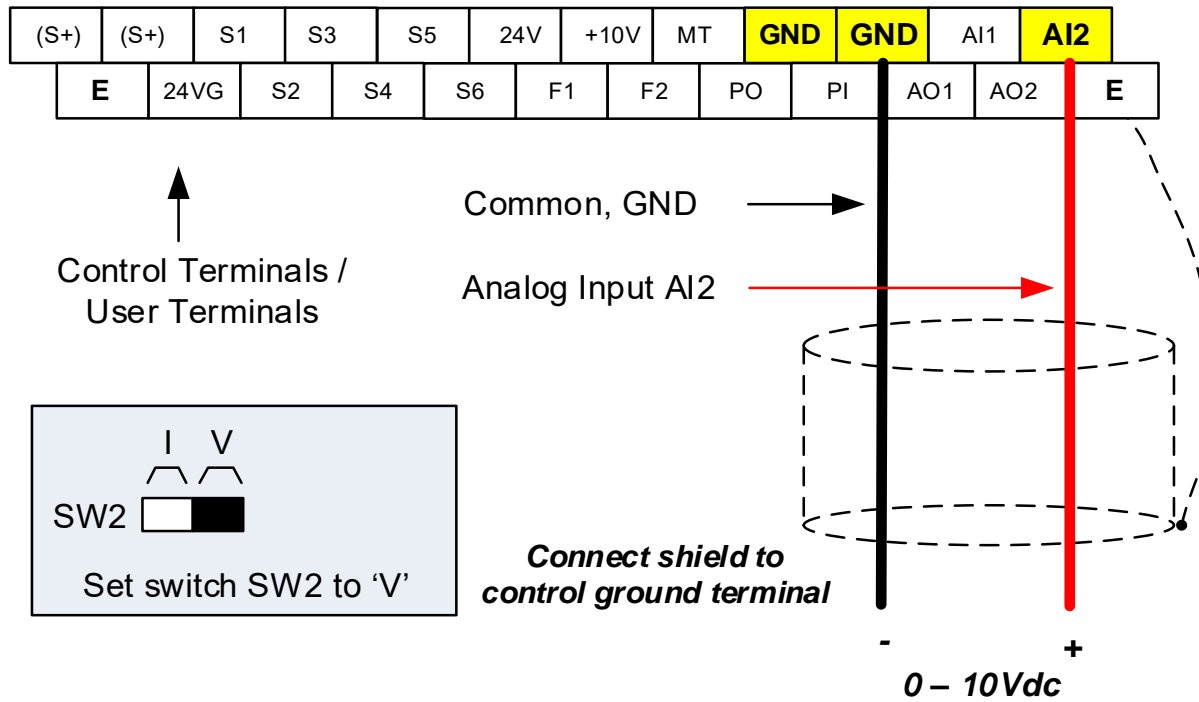
9.2 Connect Transducer Feedback Signal (10-01)

The PID function in the inverter

Depending on the type of feedback transducer used, the inverter can be setup for either 0-10V or a 4-20mA feedback transducer.

Feedback Signal 4 – 20mA (10-01 = 2) – SW2 = I



Feedback Signal 0 – 10V (10-01 = 1) – SW2 = V**9.3 Engineering Units**

The PID setpoint scaling can be selected with parameter 16-03 and 16-04.

Example: 0 – 200.0 PSI Setpoint, set 16-03 to 12000 (1 decimal, range 0 – 200) and 16-04 to 2 (PSI).

9.4 Sleep / Wakeup Function

The PID Sleep function can be used to prevent a system from running at low speeds and is frequently used in pumping application. The PID Sleep function is turned on by parameter 10-29 set to 1. The inverter output turns off when the PID output falls below the PID sleep level (10-17) for the time specified in the PID sleep delay time parameter (10-18).

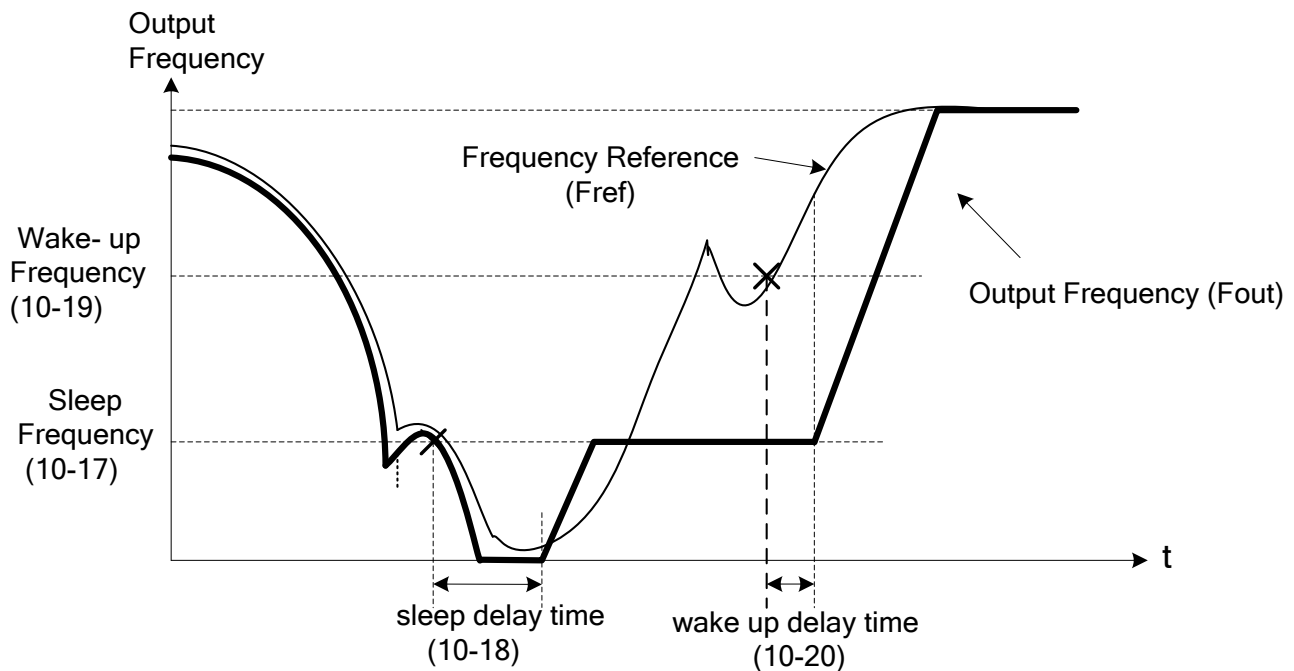
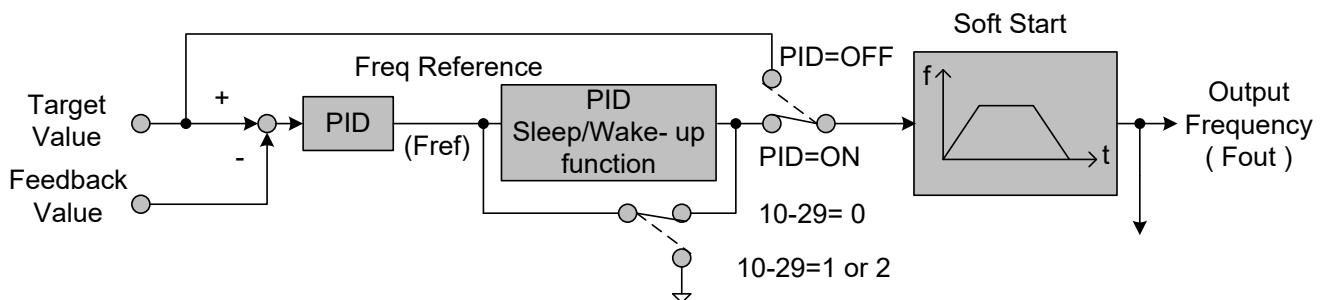
The inverter wakes up from a sleep condition when the PID output (Reference frequency) rises above the PID wake-up frequency (10-19) for the time specified in the PID wake-up delay time (10-20).

10-29 =0: PID Sleep function is disabled.

10-29 =1: PID sleep operation is based on parameters of 10-17 and 10-18.

10-29 =2: PID sleep mode is enabled by multi-function digital input

Refer to figure 4.3.74 (a) and (b) for PID sleep / wakeup operation.



PID Sleep Function

10. Troubleshooting and Fault Diagnostics

10.1 General

Inverter fault detection and early warning / self-diagnosis function. When the inverter detects a fault, a fault message is displayed on the keypad. The fault contact output energizes and the motor will coast to stop (The stop method can be selected for specific faults).

When the inverter detects a warning / self-diagnostics error, the digital operator will display a warning or self-diagnostic code, the fault output does not energize in this case. Once the warning is removed, the system will automatically return to its original state.

10.2 Fault Detection Function




When a fault occurs, please refer to Table 10.2.1 for possible causes and take appropriate measures.

Use one of the following methods to restart:

1. Set one of multi-function digital input terminals (03-00, 03-07) to 17 (Fault reset); activate input
2. Press the reset button on the keypad.
3. Power down inverter wait until keypad goes blank and power-up the inverter again.

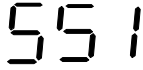
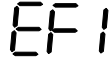
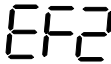
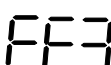
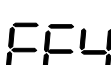
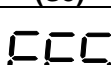
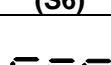
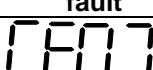

When a fault occurs, the fault message is stored in the fault history (see group 12 parameters).


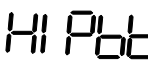


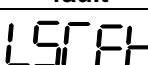
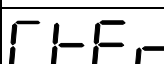
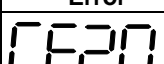
Table 10.2.1 Fault information and possible solutions

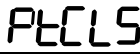



LED display	Description	Cause	Possible solutions
OC over current	The inverter output current exceeds the overcurrent level (200% of the inverter rated current).	<ul style="list-style-type: none"> • Acceleration / Deceleration time is too short. • Contactor at the inverter output side. • A special motor or applicable capacity is greater than the inverter rated value. • Short circuit or ground fault. 	<ul style="list-style-type: none"> • Extend acceleration / deceleration time. • Check the motor wiring. • Disconnect motor and try running inverter.
			
SC short circuit	Inverter output short circuit or ground fault.	<ul style="list-style-type: none"> • Short circuit or ground fault (08-23 = 1). • Motor damaged (insulation). • Wire damage or deterioration. 	<ul style="list-style-type: none"> • Check the motor wiring. • Disconnect motor and try running inverter.
			
GF Ground fault	The current to ground exceeds 50% of the inverter rated output current (08-23 = 1, GF function is enabled).	<ul style="list-style-type: none"> • Motor damaged (insulation). • Wire damage or deterioration. • Inverter DCCT sensors defect. 	<ul style="list-style-type: none"> • Replace motor. • Check the motor wiring. • Disconnect motor and try running inverter. • Check resistance between cables and ground. • Reduce carrier frequency.
			

LED display	Description	Cause	Possible solutions
OV Over voltage	DC bus voltage exceeds the OV detection level: 410Vdc: 230V class 20Vdc: 460V class (For 440V class, if input voltage 01-14 is set lower than 460V, the OV detection value will be decreased to 700Vdc).	<ul style="list-style-type: none"> Deceleration time set too short, resulting in regenerative energy flowing back from motor to the inverter. The inverter input voltage is too high. Use of power factor correction capacitors. Excessive braking load. Braking transistor or resistor defective. Speed search parameters set incorrectly. 	<ul style="list-style-type: none"> Increase deceleration time Reduce input voltage to comply with the input voltage requirements or install an AC line reactor to lower the input voltage. Remove the power factor correction capacitor. Use dynamic braking unit. Replace braking transistor or resistor. Adjust speed search parameters.
OU			
UV Under voltage	DC bus voltage is lower than the UV detection level or the pre-charge contactor is not active while the inverter is running. 190Vdc: 230V class; 380Vdc: 460V class (The detection value can be adjusted by 07-13).	<ul style="list-style-type: none"> The input voltage is too low. Input phase loss. Acceleration time set too short. Input voltage fluctuation. Pre-charge contactor damaged. DC bus voltage feedback signal value not correct. 	<ul style="list-style-type: none"> Check the input voltage. Check input wiring. Increase acceleration time. Check power source Replace pre-charge contactor Replace control board or complete inverter.
UU			
IPL input phase loss	Phase loss at the input side of the inverter or input voltage imbalance, active when 08-09 = 1 (enabled).	<ul style="list-style-type: none"> Wiring loose in inverter input terminal. Momentary power loss. Input voltage imbalance. 	<ul style="list-style-type: none"> Check input wiring / faster screws. Check power supply.
IPL			
OPL output phase loss	Phase loss at the output side of the inverter, active when 08-10 = 1 (enabled).	<ul style="list-style-type: none"> Wiring loose in inverter output terminal. Motor rated current is less than 10% of the inverter rated current. 	<ul style="list-style-type: none"> Check output wiring / faster screws. Check motor & inverter rating.
OPL			
OH1 Heatsink overheat	The temperature of the heat sink is too high. Note: when OH1 fault occurs three times within five minutes, it is required to wait 10 minutes before resetting the fault.	<ul style="list-style-type: none"> Ambient temperature too high. cooling fan failed Carrier frequency set too high. Load too heavy. 	<ul style="list-style-type: none"> Install fan or AC to cool surroundings. Replace cooling fan. Reduce carrier frequency. Reduce load / Measure output current
OH1			
OL1 Motor overload	Internal motor overload protection tripped, active when protection curve 08-05 = xxx1.	<ul style="list-style-type: none"> Voltage setting V/F mode too high, resulting in over-excitation of the motor. Motor rated current (02-01) set incorrectly. Load too heavy. 	<ul style="list-style-type: none"> Check V/f curve. Check motor rated current Check and reduce motor load, check and operation duty cycle.
OL1			

LED display	Description	Cause	Possible solutions
OL2 Inverter overload	Inverter thermal overload protection tripped.	<ul style="list-style-type: none"> Voltage setting V/F mode too high, resulting Over-excitation of the motor. Inverter rating too small. Load too heavy. 	<ul style="list-style-type: none"> Check V/f curve. Replace inverter with larger rating. Check and reduce motor load, check and operation duty cycle.
OL2	If an inverter overload occurs 4 times in five minutes, it is required to wait 4 minutes before resetting the fault.		
OT Over torque detection	Inverter output torque is higher than 08-15 (over torque detection level) for the time specified in 08-16. Parameter 08-14 = 0 to activate.	<ul style="list-style-type: none"> Load too heavy. 	<ul style="list-style-type: none"> Check over torque detection parameters (08-15 / 08-16). Check and reduce motor load, check and operation duty cycle.
OT			
UT Under torque detection	Inverter output torque is lower than 08-19 (under torque detection level) for the time specified in 08-20. Parameter 08-18 = 0 to activate.	<ul style="list-style-type: none"> Sudden drop in load. Belt break. 	<ul style="list-style-type: none"> Check under torque detection parameters (08-19 / 08-20). Check load / application.
UT			
CE communicatio n error	No Modbus communication received in for the time specified in 09-06 (communication error detection time). Active when 09-07(= 0 to 2).	<ul style="list-style-type: none"> Connection lost or wire broken. Host stopped communicating. 	<ul style="list-style-type: none"> Check connection Check host computer / software.
CE			
FB PID feedback loss	PID feedback signal falls below level specified in 10-12 (PID feedback loss 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 08-30 is set to 1: Coast to stop and digital input (58) is active. 	<ul style="list-style-type: none"> Check F1 and F2 connection
STO			

LED display	Description	• Possible causes	• Corrective action
DEV Speed deviation 	Inverter safety switches open.	<ul style="list-style-type: none"> When 08-30 is set to 0: Deceleration to stop, and digital input (58) is active. 	<ul style="list-style-type: none"> Check if digital terminal (58) is active.
EF1 External fault (S1) 	External fault (Terminal S1) Active when 03-00= 25, and Inverter external fault selection 08-24=0 or 1.	<ul style="list-style-type: none"> Multifunction digital input external fault active. 	<ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring
EF2 External fault (S2) 	External fault (Terminal S2) Active when 03-01= 25, and Inverter external fault selection 08-24=0 or 1.		
EF3 External fault (S3) 	External fault (Terminal S3) Active when 03-02= 25, and Inverter external fault selection 08-24=0 or 1.		
EF4 External fault (S4) 	External fault (Terminal S4) Active when 03-03= 25, and Inverter external fault selection 08-24=0 or 1.		
EF5 External fault (S5) 	External fault (Terminal S5) Active when 03-04= 25, and Inverter external fault selection 08-24=0 or 1.		
EF6 External fault (S6) 	External fault (Terminal S6) Active when 03-05= 25, 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 unable to run motor. 	<ul style="list-style-type: none"> Perform rotational or stationary auto-tune Increase minimum output frequency (01-08)
FU fuse open 	DC bus fuse blown DC fuse (Models 230V 50HP and above, 460V 75HP and above) open circuit.	<ul style="list-style-type: none"> IGBT damaged. Short circuit output terminals. 	<ul style="list-style-type: none"> Check IGBTs Check for short circuit at inverter output. Replace inverter.

LED display	Description	• Possible causes	• Corrective action
LOPBT Low flow fault 	Low flow fault	<ul style="list-style-type: none"> The feedback signal is disconnected. Feedback value is lower than minimum flow limit. 	<ul style="list-style-type: none"> Check feedback signal connection. Check if feedback value is lower than minimum flow limit (23-51).
HIPBT High flow fault 	High flow fault	<ul style="list-style-type: none"> Feedback value is greater than maximum flow value. 	<ul style="list-style-type: none"> Check feedback value Check if feedback value is lower than maximum flow limit (23-48).
LPBFT Low pressure fault 	Low pressure fault	<ul style="list-style-type: none"> The feedback signal is not connected. Feedback value is lower than minimum feedback value. 	<ul style="list-style-type: none"> Check feedback signal connection. Check if feedback value is lower than minimum limit (23-15).
OPBFT High pressure fault 	High pressure fault	<ul style="list-style-type: none"> Feedback value is greater than maximum feedback value. 	<ul style="list-style-type: none"> Check feedback signal connection. Check if feedback value is greater than maximum limit (23-12).
LSCFT Low suction fault 	Low suction fault	<ul style="list-style-type: none"> Low water flow or not enough suction Difference between setpoint and feedback value is too high. Output current is too low. 	<ul style="list-style-type: none"> Check water flow Check feedback value Check output current
CF00 Operator Communication Error LCD display only*	LCD keypad data communication fault	<ul style="list-style-type: none"> No communication between LCD keypad and inverter for more than 5 seconds after power up. 	<ul style="list-style-type: none"> Disconnect the keypad and then reconnect. Replace the control board Check keypad cable
CF01 Operator Communication Error 2 LCD display only*	LCD keypad data communication fault	<ul style="list-style-type: none"> Communication errors between LCD keypad and inverter for more than 2 seconds. 	<ul style="list-style-type: none"> Disconnect the keypad and then reconnect. Replace the control board Check keypad cable
CT Fault 	Input voltage fault	<ul style="list-style-type: none"> Abnormal input voltage, too much noise or malfunctioning control board. 	<ul style="list-style-type: none"> Check input voltage signal and the voltage on the control board.
Double Communication Error 	Both Profibus and Modbus communication selected	<ul style="list-style-type: none"> Two communication protocols are active simultaneously. 	<ul style="list-style-type: none"> Select only one communication protocol.

LED display	Description	Possible causes	Corrective action
PTC Signal Loss 	Motor PTC Signal Loss detected.	<ul style="list-style-type: none"> Motor PTC disconnected for more for more than 10 seconds 	<ul style="list-style-type: none"> Check if MT terminal and GND terminal are connected.
OPR Disconnection 	Run command is set to keypad operation (00-02=0). Operator was removed during running. Parameter 16-09 determines if the inverter stops or displays a fault.	<ul style="list-style-type: none"> The inverter set for keypad run (00-02=0), Warning of operator disconnected/ removed occurs. 	<ul style="list-style-type: none"> Check if operator has removed.
FBLSS PID Feedback Signal Loss 	When 23-19 > 0, the inverter will display a fault when the feedback pressure falls below the operation pressure setting (23-02) x detection proportion of loss pressure (23-19) for the times specified in parameters (23-18).	<ul style="list-style-type: none"> Feedback loss (23-19) is enabled feedback signal falls below Feedback device broken wire or not connected properly. 	<ul style="list-style-type: none"> Check if the proportion of loss pressure (23-19) is set correctly. Make sure feedback sensor is wired correctly and PID feedback signal reads correctly.
SC Short Circuit 	Inverter output short circuit.	<ul style="list-style-type: none"> Short circuit or ground fault (08-23=1) occurs from the damage to motor, insulation deterioration or wire break. 	<ul style="list-style-type: none"> Check motor and wiring.

10.3 Warning / Self-diagnosis Detection Function

When the inverter detects a warning, the keypad displays a warning code (flash).

Note: The fault contact output does not energize on a warning and the inverter continues operation. When the warning is no longer active the keypad will return to its original state.



When the inverter detected a programming error (for example two parameters contradict each other or are set to an invalid setting), the keypad displays a self-diagnostics code.








Note: The fault contact output does not energize on a self-diagnostics error. While a self-diagnostics code is active the inverter does not accept a run command until the programming error is corrected.







Note: When a warning or self-diagnostic error is active the warning or error code will flash on the keypad. When the RESET key is pressed, the warning message (flash) disappears and returns after 5 sec. If the warning or self-diagnostic error still exists.






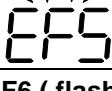

Refer to Table 10.3.1 for an overview, cause and corrective action for inverter warnings and self-diagnostic errors.






Table 10.3.1 warning / self-diagnosis and corrective actions








LED display	Description	Possible causes	Corrective action
OV (flash) Over voltage	DC bus voltage exceeds the OV detection level: 410Vdc: 230V class 820Vdc: 460V class (for 440V class, if input voltage 01-14 is set lower than 460V, the OV detection value will be decreased to 700Vdc)	<ul style="list-style-type: none"> Deceleration time set too short, resulting in regenerative energy flowing back from motor to the inverter. The inverter input voltage is too high. Use of power factor correction capacitors. Excessive braking load. Braking transistor or resistor defective. Speed search parameters set incorrectly. 	<ul style="list-style-type: none"> Increase deceleration time Reduce input voltage to comply with the input voltage requirements or install an AC line reactor to lower the input voltage. Remove the power factor correction capacitor. Use dynamic braking unit. Replace braking transistor or resistor. Adjust speed search parameters.
			
UV (flash) under voltage	DC bus voltage is lower than the UV detection level or the pre-charge contactor is not active while the inverter is running. 190Vdc: 230V class; 380Vdc: 460V class (the detection value can be adjusted by 07-13)	<ul style="list-style-type: none"> The input voltage is too low. Input phase loss. Acceleration time set too short. Input voltage fluctuation. Pre-charge contactor damaged. DC bus voltage feedback signal value not correct. 	<ul style="list-style-type: none"> Check the input voltage. Check input wiring. Increase acceleration time. Check power source Replace pre-charge contactor Replace control board or complete inverter.
			
OH2 (flash) Inverter over heating warning	Inverter overheat warning Multi-function digital input set to 32. (Terminal S1 ~ S8) Active when 03-00 ~ 03-07 = 31).	<ul style="list-style-type: none"> Multifunction digital input overheat warning active. 	<ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring



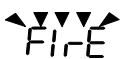




LED display	Description	Possible causes	Corrective action
			
OT (flash) over torque detection	Inverter output torque is higher than 08-15 (over torque detection level) for the time specified in 08-16. Parameter 08-14 = 0 to activate.	<ul style="list-style-type: none">Load too heavy.	<ul style="list-style-type: none">Check over torque detection parameters (08-15 / 08-16).Check and reduce motor load, check and operation duty cycle.
			
UT (flash) under torque detection	Inverter output torque is lower than 08-19 (under torque detection level) for the time specified in 08-20. Parameter 08-18 = 0 to activate.	<ul style="list-style-type: none">Sudden drop in load.Belt break.	<ul style="list-style-type: none">Check under torque detection parameters (08-19 / 08-20).Check load / application.
			
bb1 (flash) External baseblock	External base block (Terminal S1)		
			
bb2 (flash) External baseblock	External base block (Terminal S2)		
			
Bb3 (flash) External baseblock	External base block (Terminal S3)		
			
Bb4 (flash) External baseblock	External base block (Terminal S4)		
			









LED display	Description	Possible causes	Corrective action
bb5 (flash) External baseblock 	External base block (Terminal S5)	<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
bb6 (flash) External baseblock 	External base block (Terminal S6)		
OL1 Motor overload 	Internal motor overload protection tripped, active when protection curve 08-05 = xxx1.	<ul style="list-style-type: none"> • Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Motor rated current (02-01) set incorrectly. • Load too heavy. 	<ul style="list-style-type: none"> • Check V/f curve. • Check motor rated current • Check and reduce motor load, check and operation duty cycle.
OL2 Inverter overload 	Inverter thermal overload protection tripped. If an inverter overload occurs 4 times in five minutes, it is required to wait 4 minutes before resetting the fault.	<ul style="list-style-type: none"> • Voltage setting V/F mode too high, resulting in over-excitation of the motor. • Inverter rating too small. • Load too heavy. 	<ul style="list-style-type: none"> • Check V/f curve. • Replace inverter with larger rating. • Check and reduce motor load, check and operation duty cycle
CE (flash) communication error 	No Modbus communication received for 2 sec. Active when 09-07=3.	<ul style="list-style-type: none"> • Connection lost or wire broken. • Host stopped communicating. 	<ul style="list-style-type: none"> • Check connection • Check host computer / software.
CLB over current protection level B 	Inverter current reaches the current protection level B.	<ul style="list-style-type: none"> • Inverter current too high. • Load too heavy. 	<ul style="list-style-type: none"> • Check load and duty cycle operation.





LED display	Description	Possible causes	Corrective action
Retry (flash) retry 	Automatic reset activated, warning is displayed until restart delay time set (07-01) expires.	<ul style="list-style-type: none"> Parameter 07-01 set to a value greater than 0. Parameter 07-02 set to a value greater than 0. 	<ul style="list-style-type: none"> Warning disappears after automatic reset.
F1 (flash) External fault (S1) 	External fault (Terminal S1) Active when 03-00=25, and Inverter external fault selection 08-24=2.	<ul style="list-style-type: none"> Multifunction digital input external fault active and parameter 08-24 = 2 for operation to continue. 	<ul style="list-style-type: none"> Multi-function input function set incorrectly. Check wiring Multi-function input function set incorrectly. Check wiring
EF2 (flash) External fault (S2) 	External fault (Terminal S2) Active when 03-01=25, and Inverter external fault selection 08-24=2.		
EF3 (flash) External fault (S3) 	External fault (Terminal S3) Active when 03-02=25, and Inverter external fault selection 08-24=2.		
EF4 (flash) External fault (S4) 	External fault (Terminal S4) Active when 03-03=25, and Inverter external fault selection 08-24=2.		
EF5 (flash) External fault (S5) 	External fault (Terminal S5) Active when 03-04=25, and Inverter external fault selection 08-24=2.		
EF6 (flash) External fault (S6) 	External fault (Terminal S6) Active when 03-05=25, and Inverter external fault selection 08-24=2.		

LED display	Description	Possible causes	Corrective action
EF9 (flash) error of forward/reve rsal rotation 	Forward run and reverse run are active within 0.5 sec of each other. Stop method set by parameter 07-09.	<ul style="list-style-type: none"> Forward run and reverse run active (see 2-wire control). 	<ul style="list-style-type: none"> Check run command wiring
SE01 Rang setting error 	Parameter setting falls outside the allowed range.	<ul style="list-style-type: none"> Some parameter ranges are determined by other inverter parameters which could cause an out of range warning when the dependency parameter is adjusted. Example: 02-00 > 02-01, 02-20 > 02-21, 00-12 > 00-13 etc.... 	<ul style="list-style-type: none"> Check parameter setting.
SE02 Digital input terminal error 	Multi-function input setting error.	<ul style="list-style-type: none"> Multi-function digital input terminals (03-00 to 03-07) are set to the same function (not including ext. fault and not used.) or ①UP/DOWN commands are not set at the same time(they must be used together). ②UP/DOWN commands (08 and 09) and ACC/DEC commands (11) are set at the same time. ③Speed search 1(19, maximum frequency) and Speed search 2 (34, from the set frequency) are set at the same time. 	<ul style="list-style-type: none"> Check multi-function input setting.
SE03 V/f curve error 	V/f curve setting error.	<ul style="list-style-type: none"> V/F curve setting error. ① 01-02 > 01-12 > 01-06 > 01-08; • (Fmax) (Fbase) (Fmid1) (Fmin) • ②01-16 > 01-24 > 01-20 > 01-22; • (Fmax2) (Fbase2)(Fmid1) (Fmin2) 	<ul style="list-style-type: none"> Check V/F parameters
SE05 PID selection error 	PID selection error.	<ul style="list-style-type: none"> 10-00 and 10-01are set to the same analog input 1 (AI1) or 2 (AI2) 	<ul style="list-style-type: none"> Check parameters 10-00 and 10-01.

LED display	Description	Possible causes	Corrective action
HPerr Model selection error 	Inverter capacity setting error: Inverter capacity setting 13-00 does not match the rated voltage.	<ul style="list-style-type: none"> Inverter capacity setting does not match voltage class (13-00). 	<ul style="list-style-type: none"> Check inverter capacity setting 13-00.
SE09 PI setting error 			
FB (flash) PID feedback breaking 	PID feedback signal falls below level specified in 10-12 (PID feedback loss detection level) for the time specified in 10-13 (Feedback loss detection time). Active when parameter (10-11 = 1).	<ul style="list-style-type: none"> Feedback signal wire broken Feedback sensor broken. 	<ul style="list-style-type: none"> Check feedback wiring Replace feedback sensor.
USP (flash) Unattended Start Protection 			
LFPB Low flow error 	Low flow error	<ul style="list-style-type: none"> The feedback signal is not connected. Due to HVAC feedback value is lower than limit of minimum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct and with right connection. Check if feedback value is lower than limit of minimum flow.
HFPB High flow error 			
LPBFT Low pressure error 	Low pressure error	<ul style="list-style-type: none"> The feedback signal is not connected. Due to feedback value of pump pressure is lower than limit of minimum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct and with connection. Check if feedback value of pressure is lower than limit of minimum pressure.

LED display	Description	Possible causes	Corrective action
OPBFT High pressure error	High pressure error	<ul style="list-style-type: none"> Due to feedback value of pump pressure is lower than limit of maximum flow. 	<ul style="list-style-type: none"> Check feedback signal is correct. Check if feedback value of pressure is lower than limit of maximum pressure.
			
LSCFT Low suction error	Inadequate suction error	<ul style="list-style-type: none"> Insufficient water of supply tank leads to insufficient suction. PID difference is higher than its level or current is lower than output current level. 	<ul style="list-style-type: none"> Check if water of supply tank is enough, and water supply is regular. Check PID difference is higher than its level or current is lower than output current level
			
FIRE Fire override mode	Fire override mode	<ul style="list-style-type: none"> Fire override mode is active 	<ul style="list-style-type: none"> None (Fire override mode is not a kind of warning).
			
SE10 PUMP/HVAC Setting error	PUMP/HVAC settings of inverter error	<ul style="list-style-type: none"> PUMP selection of inverter (23-02)> (23-03). HVAC selection of inverter (23-46)> (23-47). 	<ul style="list-style-type: none"> Check pump selection of inverter (23-02) and (23-03) settings. Check HVAC selection of inverter (23-02) and (23-03) settings.
			
COPUP PUMP communication breaking error	Breaking error of multiple pumps communication	<ul style="list-style-type: none"> Communication breaking or disconnection of pump cascade control. 	<ul style="list-style-type: none"> Check if it has setting issue or is not properly connected.
			
Parameter Setting Error	Parameter setting error	<ul style="list-style-type: none"> Error of Parameter setting occurs. 	<ul style="list-style-type: none"> Refer to the instruction manual or this parameter is selected to be disabled.
			
Warning of Direct Start	When 07-04 is set to 1, the inverter cannot start directly but displays the warning signal.	<ul style="list-style-type: none"> Set the digital input terminal (S1~S6) to run and simultaneously set 07-04=1. 	<ul style="list-style-type: none"> Check the digital input terminal and disconnect it. Then reconnect the DI terminal after the setting delay time (07-05) ends.
			

LED display	Description	Possible causes	Corrective action
External Terminal Stop Error 	Stop key pressed during running when Inverter Run command set for External (00-02=1) terminal control.	<ul style="list-style-type: none"> Stop key pressed while running from external terminals 	<ul style="list-style-type: none"> Remove the run command from external terminal
ADC Voltage Error 			
EEPROM Archiving Error 	EEPROM memory error	<ul style="list-style-type: none"> EEPROM memory error EEPROM Checksum fault on startup. 	<ul style="list-style-type: none"> Cycle power to the inverter and if EEPROM error occurs again replace control board. Contact TECO for more information.
Control Board Error 			
Wrong running direction Error 	Inverter is only allowed to run in one direction; opposite direction command is not allowed.	<ul style="list-style-type: none"> Run command for opposite direction active on the terminal of control board. 	<ul style="list-style-type: none"> Remove run command for opposite direction.
PTC Signal Loss 	Motor PTC Signal Loss detected.	<ul style="list-style-type: none"> Motor PTC signal disconnected for more for more than 10 seconds 	<ul style="list-style-type: none"> Check if MT terminal and GND terminal are connected.
Parameters Locked 			
Password Setting Error 	Incorrect password entered for 2 nd time while password lock is enabled.	<ul style="list-style-type: none"> Password entered second time is different from password entered first time when the password lock function is enabled. 	<ul style="list-style-type: none"> Enter same password as 1st time.
Operator Reading Error RDE*			

LED display	Description	Possible causes	Corrective action
Operator Writing Error	Operator cannot write data to the inverter.	<ul style="list-style-type: none"> Operator is unable to communicate with the inverter. KVA setting does not match Operator firmware not compatible 	<ul style="list-style-type: none"> Check the inverter's firmware version/ control mode/ models
WRE*			
Operator Verifying Error	Operator data does not match inverter data.	<ul style="list-style-type: none"> The data in the operator is different from the inverter. 	<ul style="list-style-type: none"> Check connection between operator and inverter. Check drive settings.
VRYE*			
Repeat Run Command	The inverter is only allowed to run in one direction and cannot run in forward and reverse direction simultaneously.	<ul style="list-style-type: none"> Forward and reverse command present at inverter terminals. 	<ul style="list-style-type: none"> Remove run reverse command from the external terminal.
			
Operator Read Prohibit	Operator backup parameter function is disabled. Check if parameter 16-08 is set to 0.	<ul style="list-style-type: none"> Parameter 16-08 set to 0. 	<ul style="list-style-type: none"> Set parameter 16-08 to 1 (Allow operator to read inverter parameters and save to the operator).
RDP*			
External Emergency Stop	External emergency stop input active.	<ul style="list-style-type: none"> Parameter 03-00~03-08 is set to 14 (Emergency stop is enabled.) 	<ul style="list-style-type: none"> Remove external emergency stop command from inverter control terminals.
			
Zero Speed Stop Warning	Output frequency command falls below the minimum output frequency (01-08) and DC brake is disabled.	<ul style="list-style-type: none"> Frequency command set too low. 	<ul style="list-style-type: none"> Increase frequency command.
			
Overload of Air Compressor	If the inverter's output current rises above OL4 current level (23-69) for the time specified in OL4 Delay Time (23-70) passed. Inverter will automatically decelerate to stop and displays a warning signal.	<ul style="list-style-type: none"> Current level (23- 69) set too low for compressor application. 	<ul style="list-style-type: none"> Check compressor load.
			

10.4 Auto-tuning Error

When a fault occurs during auto-tuning of a standard AC motor, the display will show the “AtErr” fault and the motor stops. The fault information is displayed in parameter 17-11.

Note: The fault contact output does not energize with an auto-tuning fault. Refer to Table 10.4.1, for fault information during tuning, cause and corrective action.

Table 10.4.1 Auto-tuning fault and corrective actions

Error	Description	Cause	Corrective action
01	Motor data input error.	<ul style="list-style-type: none"> Motor Input data error during auto-tuning. Inverter output current does not match motor rated current. 	<ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check inverter capacity
02	Motor lead to lead resistance R1 tuning error.	<ul style="list-style-type: none"> Auto-tuning is not completed within the specified time Auto-tuning results fall outside parameter setting range. Motor rated current exceeded. Motor was disconnected. 	<ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check motor connection. Disconnect motor load. Check inverter current detection circuit and DCCTs. Check motor installation.
03	Motor leakage inductance tuning error.		
04	Motor rotor resistance R2 tuning error.		
05	Motor mutual inductance Lm tuning error.		
07	Deadtime compensation detection error		
06	Motor encoder error	<ul style="list-style-type: none"> PG feedback noise 	<ul style="list-style-type: none"> Check motor rated current. Check PG card grounding.
08	Motor acceleration error (Rotational type auto-tuning only).	<ul style="list-style-type: none"> Motor fails to accelerate in the specified time (00-14= 20sec). 	<ul style="list-style-type: none"> Increase acceleration time (00-14). Disconnect motor load.
09	Other	<ul style="list-style-type: none"> No load current is higher than 70% of the motor rated current. Torque reference exceeds 100%. Errors other than ATE01~ATE08. 	<ul style="list-style-type: none"> Check the motor tuning data (17-00 to 17-09). Check motor connection.

10.5 PM Motor Auto-tuning Error

When a fault occurs during auto-tuning of a PM motor, the display will show the “IPErr” fault and the motor stops. The fault information is displayed in parameter 22-18.

Note: The fault contact output does not energize with an auto-tuning fault. Refer to Table 10.5.1, for fault information during tuning, cause and corrective action.

Table 10.5.1 Auto-tuning fault and corrective actions for PM motor

Error	Description	Cause	Corrective action
01	Magnetic pole alignment tuning failure (static).	<ul style="list-style-type: none"> Inverter output current does not match motor current. 	<ul style="list-style-type: none"> Check the motor tuning data (22-02). Check inverter capacity
02 - 04	Reserved		
05	Circuit tuning time out.	<ul style="list-style-type: none"> System abnormality during circuit tuning. 	<ul style="list-style-type: none"> Check for active protection functions preventing auto-tuning.
06	Encoder error	<ul style="list-style-type: none"> PG feedback noise 	<ul style="list-style-type: none"> Check motor rated current. Check PG card grounding.
07	Other motor tuning errors.	<ul style="list-style-type: none"> Other tuning errors. 	<ul style="list-style-type: none"> Check the motor tuning data (22-02). Check motor connection.
08	Reserved		
09	Current out of range during circuit tuning.	<ul style="list-style-type: none"> Inverter output current does not match motor current. 	<ul style="list-style-type: none"> Check the motor tuning data (22-02). Check inverter capacity
10	Reserved		
11	Parameter tuning time out.	<ul style="list-style-type: none"> Error relationship between voltage and current. 	<ul style="list-style-type: none"> Check if value for parameter 22-11 is set too low, value cannot exceed 100% of the inverter rated current. Check motor connection.

11. Inverter Peripheral devices and Options

11.1 Braking Resistors and Braking Units

Inverters ratings 230V 5 ~ 30HP / 460V 5 ~ 40HP (IP20) have a built-in braking transistor. For applications requiring more braking torque an external braking resistor can be connected to terminals B1 / P and B2; for inverter ratings above 230V 40HP / 460V 50HP (IP20), an external braking unit (connected to \oplus - \ominus of the inverter) and a braking resistor (connected to two ends of the detection module B-P0) is required.

Table 11.1 List of braking resistors and braking units (IP20)

Inverter			Braking unit		Braking resistor				Braking torque (Peak / Continues)	Minimum resistance	
V	HP	Rated Current (A)	Model	Qty Req	Part Number	Resistor specification	Qty Req.	Resistor dimensions (L*W*H)mm		(Ω)	(W)
3 ϕ 230V	5	14.5	-	-	JNBR-390W40	390W/40Ω	1	395*34*78	126%, 10%ED	25	680
	7.5	21	-	-	JNBR-520W30	520W/30Ω	1	400*40*100	114%, 10%ED	21	800
	10	30	-	-	JNBR-780W20	780W/20Ω	1	400*40*100	126%, 10%ED	18	900
	15	40	-	-	JNBR-2R4KW13R6	2400W/13.6Ω	1	535*50*110 (*2 pcs)	124%, 10%ED	11	1500
	20	56	-	-	JNBR-3KW10	3000W/10Ω	1	615*50*110 (*2 pcs)	126%, 10%ED	9.5	1800
	25	69	-	-	JNBR-4R8KW8	4800W/8Ω	1	535*50*110 (*4 pcs)	126%, 10%ED	7.2	2400
	30	79	-	-	JNBR-4R8KW6R8	4800W/6.8Ω	1	535*50*110 (*4 pcs)	124%, 10%ED	6.5	2400
	40	110	JNTBU-230	2	JNBR-3KW10	3000W/10Ω	2	615*50*110 (*4 pcs)	126%, 10%ED	2.7	3000
	50	138	JNTBU-230	2	JNBR-3KW10	3000W/10Ω	2	615*50*110 (*4 pcs)	105%, 10%ED	2.7	3000
	60	169	JNTBU-230	2	JNBR-4R8KW6R8	4800W/6.8Ω	2	535*50*110 (*8 pcs)	124%, 10%ED	*note1	
	75	200	JNTBU-230	3	JNBR-4R8KW8	4800W/8Ω	3	535*50*110 (*12 pcs)	124%, 10%ED	*note1	
	100	250	JNTBU-230	3	JNBR-4R8KW6R8	4800W/6.8Ω	3	535*50*110 (*12 pcs)	116%, 10%ED	*note1	
	125	312	JNTBU-230	4	JNBR-4R8KW6R8	4800W/6.8Ω	4	535*50*110 (*16 pcs)	119%, 10%ED	*note1	
	150	400	JNTBU-230	5	JNBR-4R8KW6R8	4800W/6.8Ω	4	535*50*110 (*16 pcs)	108%, 10%ED	*note1	

Inverter			Braking unit		Braking resistor				Braking torque (Peak / Continues)	Minimum resistance	
V	HP	Rated Current (A)	Model	Qty Req	Part Number	Resistor specification	Qty Req.	Resistor dimensions (L*W*H)mm		(Ω)	(W)
3 ϕ 460V	5	9.2	-	-	JNBR-400W150	400W/150Ω	1	395*34*78	133%, 10%ED	60	1200
	7.5	11.1	-	-	JNBR-600W130	600W/130Ω	1	400*40*100	107%, 10%ED	60	1200
	10	17.5	-	-	JNBR-800W100	800W/100Ω	1	535*50*110	105%, 10%ED	43	1600
	15	23	-	-	JNBR-1R6KW50	1600W/50Ω	1	615*50*110	133%, 10%ED	43	1600
	20	31	-	-	JNBR-1R5KW40	1500W/40Ω	1	615*50*110	126%, 10%ED	39	1600
	25	38	-	-	JNBR-4R8KW32	4800W/32Ω	1	535*50*110 (*4 pcs)	126%, 10%ED	22	3000
	30	44	-	-	JNBR-4R8KW27R2	4800W/27.2Ω	1	535*50*110 (*4 pcs)	124%, 10%ED	13.5	4800
	40	54	-	-	JNBR-6KW20	6000W/20Ω	1	615*50*110 (*4 pcs)	124%, 10%ED	13.5	4800
	50	72	JNTBU-430	2	JNBR-4R8KW32	4800W/32Ω	2	535*50*110 (*8 pcs)	126%, 10%ED	11	3000
	60	88	JNTBU-430	2	JNBR-4R8KW27R2	4800W/27.2Ω	2	535*50*110 (*8 pcs)	124%, 10%ED	11	3000
	75	103	JNTBU-430	2	JNBR-6KW20	6000W/20Ω	2	615*50*110 (*8 pcs)	133%, 10%ED	11	3000
	100	145	JNTBU-430	3	JNBR-4R8KW27R2	4800W/27.2Ω	3	535*50*110 (*12 pcs)	113%, 10%ED	*note1	
	125	165	JNTBU-430	3	JNBR-6KW20	6000W/20Ω	3	615*50*110 (*12 pcs)	121%, 10%ED	*note1	
	150	208	JNTBU-430	3	JNBR-6KW20	6000W/20Ω	3	615*50*110 (*12 pcs)	104%, 10%ED	*note1	
	175	250	JNTBU-430	5	JNBR-4R8KW27R2	4800W/27.2Ω	5	535*50*110 (*20 pcs)	109%, 10%ED	*note1	
	215	296	JNTBU-430	6	JNBR-4R8KW27R2	4800W/27.2Ω	6	535*50*110 (*24 pcs)	107%, 10%ED	*note1	
	250	328	JNTBU-430	5	JNBR-6KW20	6000W/20Ω	5	615*50*110 (*20 pcs)	105%, 10%ED	*note1	

*1: Minimum resistance is the acceptable minimum value of the braking resistor for a single braking unit.

Note: Keep sufficient space between inverter, braking unit and braking resistor and ensure proper cooling is provided for.

11.2 AC Line Reactors

An AC line reactor can be used for any of the following:

- Capacity of power system is much larger than the inverter rating.
- Inverter mounted close to the power system (in 33ft / 10 meters).
- Reduce harmonic contribution (improve power factor) back to the power line.
- Protect inverter input diode front-end by reducing short-circuit current.
- Minimize overvoltage trips due to voltage transients.

Please select the AC line reactor based on the inverter rating according to the following table.

Table 11.2.1 List of AC Line Reactors (3%) - Chassis

Model		AC reactor	
Voltage	HP	Part Number	Rated Current (A)
3 ϕ 230V	5	KDRULB22L	16.7
	7.5	KDRULB23L	24.2
	10	KDRULD25L	30.8
	15	KDRULD24L	46.2
	20	KDRULD26L	59.4
	25	KDRULC22L	74.8
	30	KDRULF24L	88
	40	KDRULF25L	114
	50	KDRULF26L	143
	60	KDRULH22L	169
	75	KDRULI23L	211
	100	KDRULI24L	273
	125	KDRULG22L	377
	5/7.5	KDRULA3L	7.6
3 ϕ 460V	10	KDRULA4L	11
	15	KDRULA5L	14
	20	KDRULB2L	21
	25	KDRULB1L	27
	30	KDRULD1L	34
	40	KDRULD2L	40
	50	KDRULC1L	52
	60	KDRULF2L	65
	75	KDRULF4L	77
	100	KDRULF3L	96
	125	KDRULH3L	124
	150	KDRULH2L	156
	175/215	KDRULH1L	180
	250	KDRULG3L	240

Contact TWMC for any assistance

Note: AC reactors listed in this table can only be used for the inverter input side. Do not connect AC reactor to the inverter output side. Both 230V class 60HP~125HP (IP20) and 460V class 100HP~425HP (IP20) have built-in DC reactors. If required by the application an AC reactor may be added.

11.3 Output Filters

Table 11.3 List of Output Filters

Model			
Input Voltage	HP	Rated Current(A) HD/ND	Part Number
460V 3Ø	1	3	V1K3A00
	2	4	V1K4A00
	3	6	V1K6A00
	5	8	V1K8A00
	7.5	12	V1K12A00
	10	18	V1K18A00
	15	25	V1K25A00
	20	27	V1K27A00
	25	35	V1K35A00
	30	45	V1K45A00
	40	55	V1K55A00
	50	80	V1K80A00
	60	80	V1K80A00
	75	110	V1K110A00
	100	130	V1K130A00
	125	160	V1K160A00
	150	200	V1K200A00
	200	250	V1K250A00
	250	305	V1K305A00

Contact TWMC for any assistance

11.4 Input Current and Fuse Specifications

230V class (IP20)

Model	Horse power	KVA	100% of rated output current	Rated input current	Fuse rating
F510-2005-C3	5	5.5	14.5	16	30
F510-2008-C3	7.5	8.0	21	22.3	45
F510-2010-C3	10	11.4	30	31.6	60
F510-2015-C3	15	15	40	41.7	80
F510-2020-C3	20	21	56	60.9	125
F510-2025-C3	25	26	69	75	150
F510-2030-C3	30	30	79	85.9	175
F510-2040-C3	40	42	110	119.6	225
F510-2050-C3	50	53	138	150	275
F510-2060-C3	60	64	169	186	325
F510-2075-C3	75	76	200	232	400
F510-2100-C3	100	95	250	275	500
F510-2125-C3	125	119	312	343	600
F510-2150-C3	150	152	400	440	800

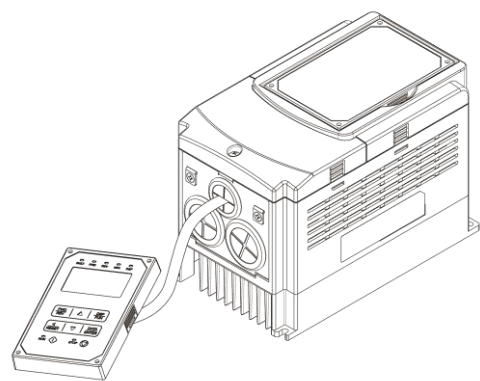
460V class (IP20)

Model	Horse power	KVA	100% of rated output current	Rated input current	Fuse rating
F510-4005-C3	5	7.0	9.2	9.6	20
F510-4008-C3	7.5	8.5	11.1	11.6	20
F510-4010-C3	10	13.3	17.5	18.2	30
F510-4015-C3	15	18	23	24	40
F510-4020-C3	20	24	31	32.3	50
F510-4025-C3	25	29	38	41.3	70
F510-4030-C3	30	34	44	47.8	80
F510-4040-C3	40	41	54	58.7	100
F510-4050-C3	50	55	72	75	125
F510-4060-C3	60	67	88	95.7	150
F510-4075-C3	75	79	103	112	200
F510-4100-C3	100	111	145	141	250
F510-4125-C3	125	126	165	181	300
F510-4150-C3	150	159	208	229	350
F510-4175-C3	175	191	250	275	500
F510-4215-C3	215	226	296	325	600
F510-4250-C3	250	250	328	360	700

11.5 Other Options

A. Blank cover and keypad extension cable

When used for remote control purposes, the keypad can be removed and remotely connected with an extension cable. Extension cables are available in the following lengths: 1m (3.3ft), 2m (6.6ft), 3m (10ft), and 5m (16.4ft).



Name	Model	specification
LED digital operator wire	JN5-CB-01M	1m (3.3ft)
	JN5-CB-02M	2m (6.6ft)
	JN5-CB-03M	3m (10ft)
	JN5-CB-05M	5m (16.4ft)

When using a remote mount keypad a blank cover can be installed in place of the original keypad to prevent dust and debris from entering the inverter.



Name	Model	specification
Blank cover	JN5-OP-A03	Blank cover

Blank keypad cover

B. 1 to 8 Pump Card

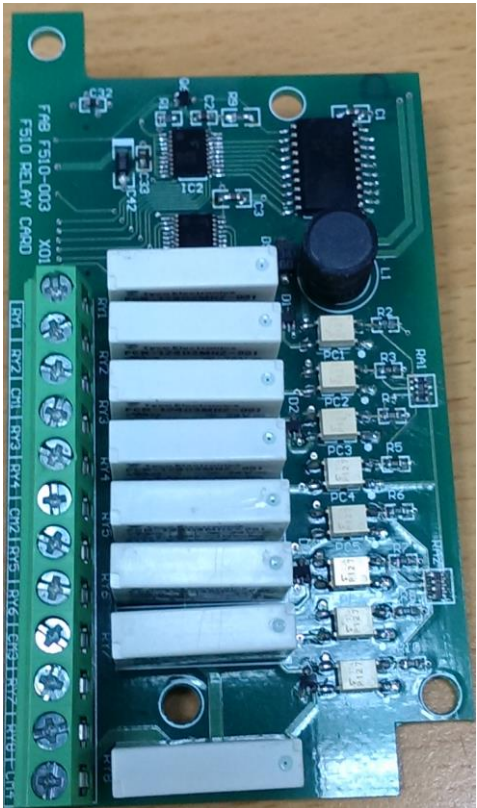
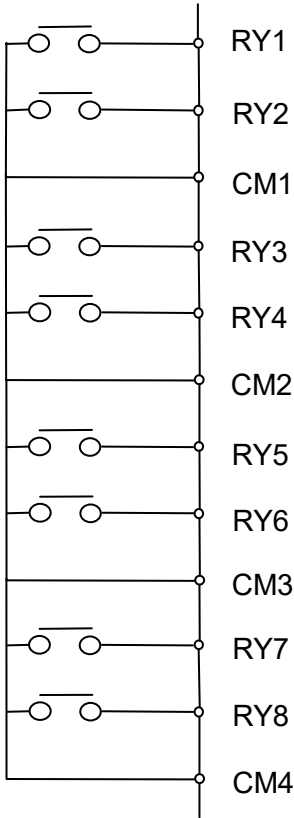
Refer to instruction manual of the option card on how to install.

JN5-IO-8DO Card: 8 Relay Output Card.

Terminals of JN5-IO-8DO:

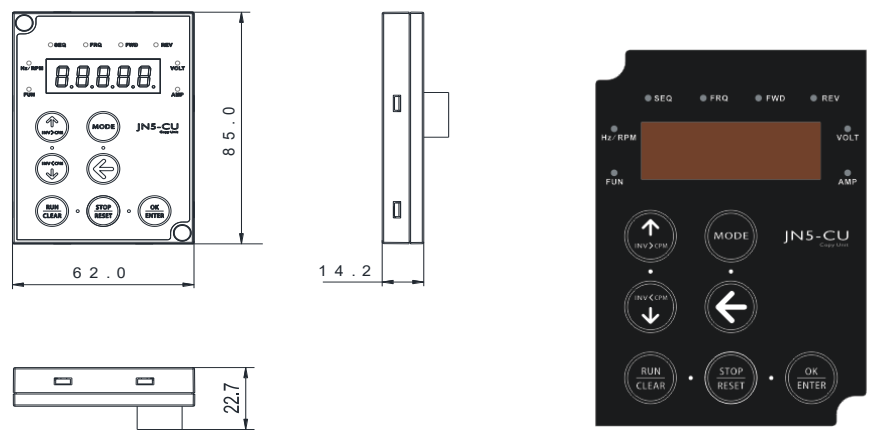
Terminal	Description
RY1~RY8	Relay1~Relay8 Form A output
CM1~CM4	Common terminal output

Wiring of JN5-IO-8DO (Example):



C. Copy Unit (JN5-CU)

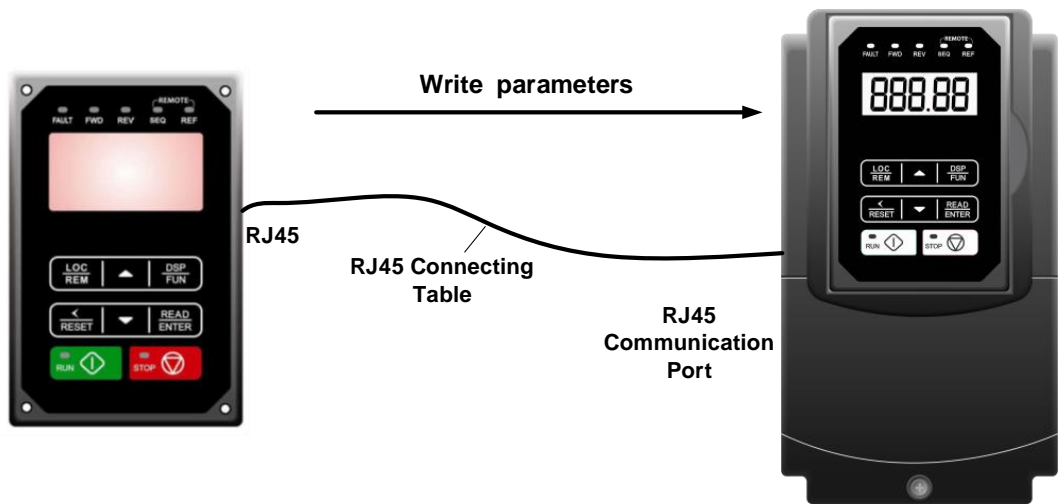
The copy unit is used to copy an inverter parameter setup to another inverter. The copy unit saves time in applications with multiple inverters requiring the same parameter setup.



Copy Unit (JN5-CU) dimensions

D. Copy Module (JN5-CU-M)

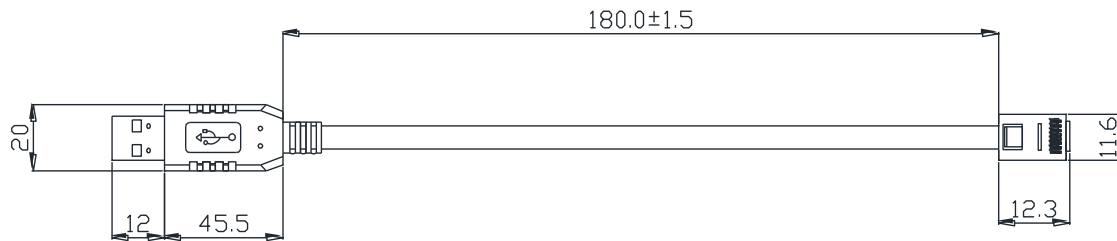
The copy module is used to copy up to 128 parameters from one inverter to another inverter.



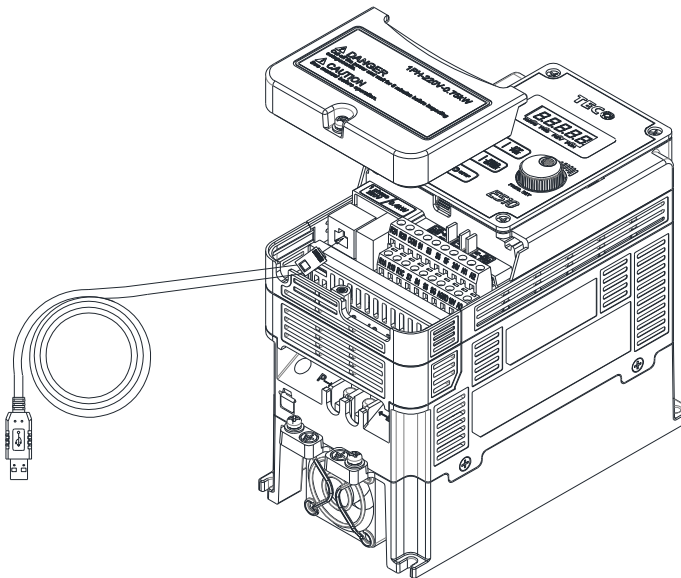
E. RJ45 to USB Communication Cable (6ft / 1.8m) (JN5-CM-USB)

The communication cable is used to communicate with the TECO Link software directly to the inverter using the PC USB port.

- Cable:



- Connect to the RS45 port:



11.6 Communication options

(a) PROFIBUS communication interface module (JN5-CM-PDP)

For wiring example and communication setup refer to JN5-CM-PDP communication option manual.

(b) DEVICENET communication interface module (JN5-CM-DNET)

For wiring example and communication setup refer to JN5-CM-DNET communication option manual.

(c) CANopen communication interface module (JN5-CM-CAN)

For wiring example and communication setup refer to JN5-CM-VAN communication option manual.

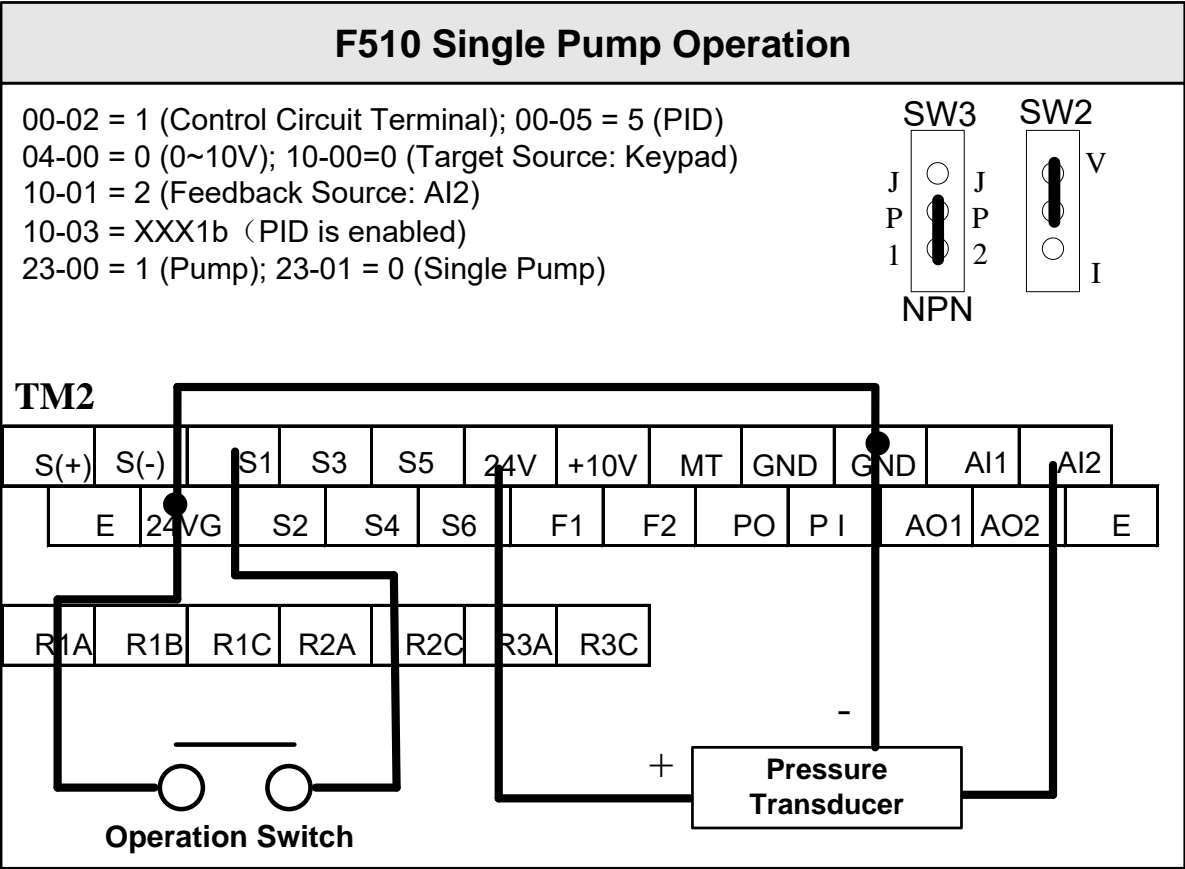
(d) TCP-IP communication interface module (JN5-CM-TCPIP)

For wiring example and communication setup refer to JN5-CM-TCPIP communication option manual.

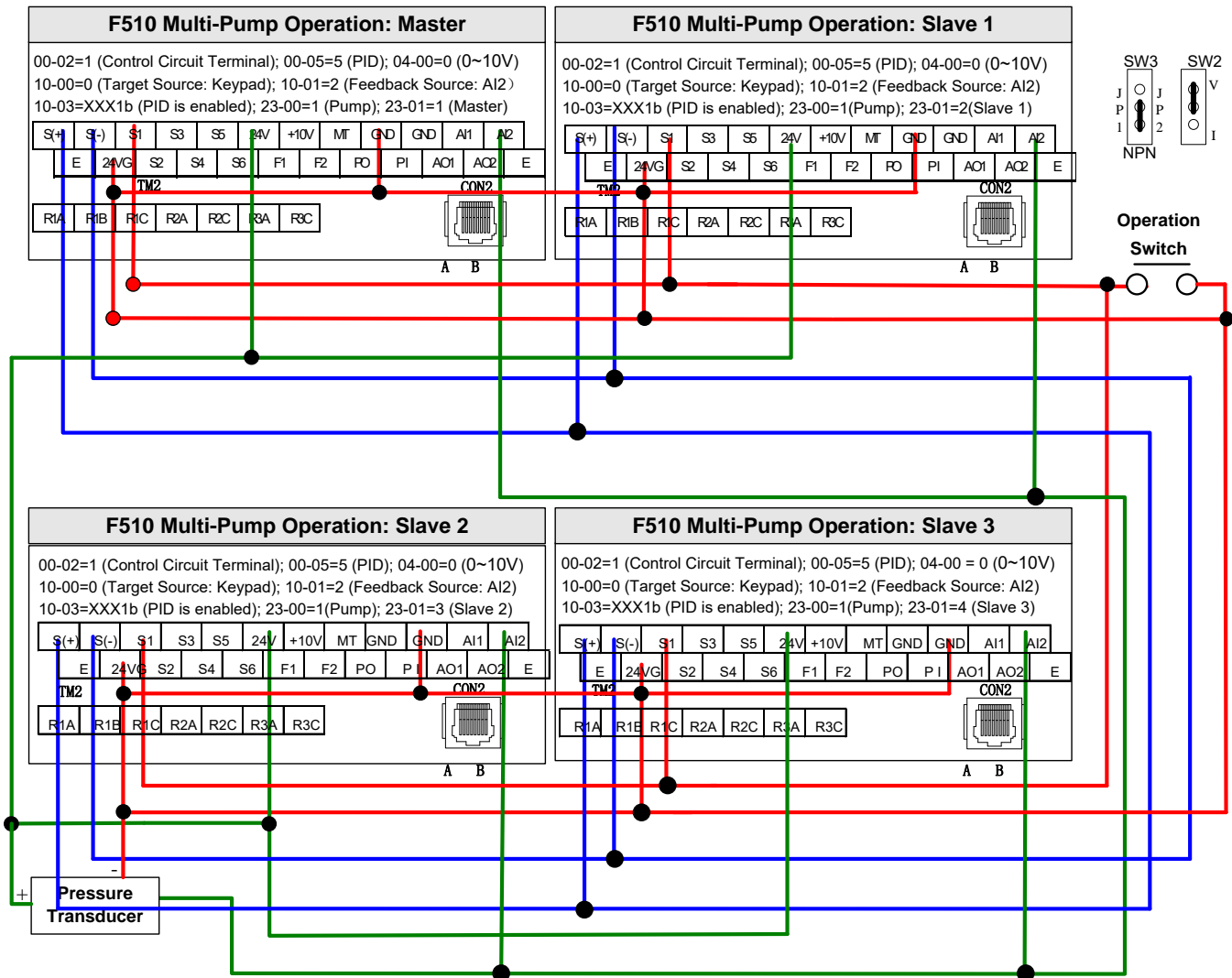
Appendix A: Single and Multi-Pump Wiring

■ PUMP Wiring Diagram for Pressure Sensor of Voltage Type

Single Pump:

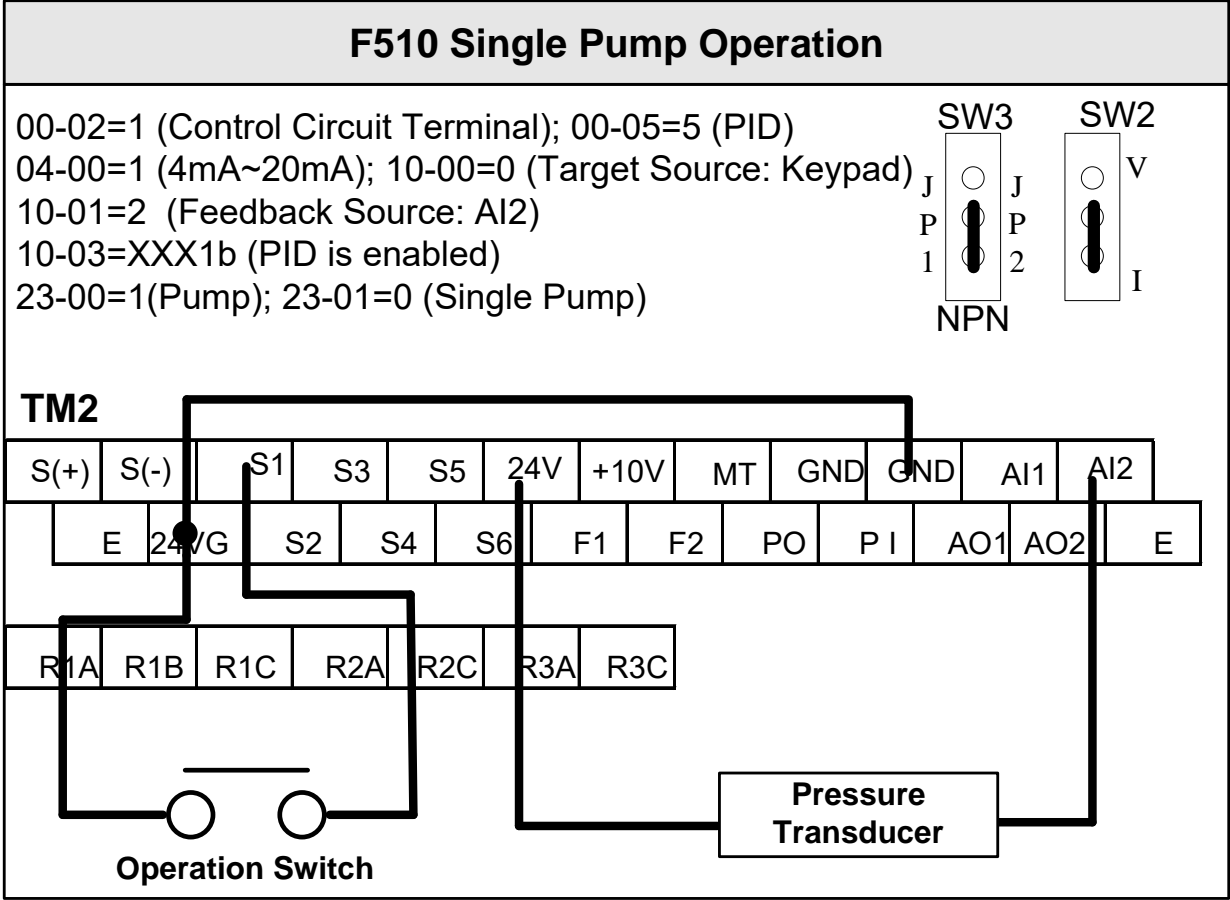


Multi-Pump:

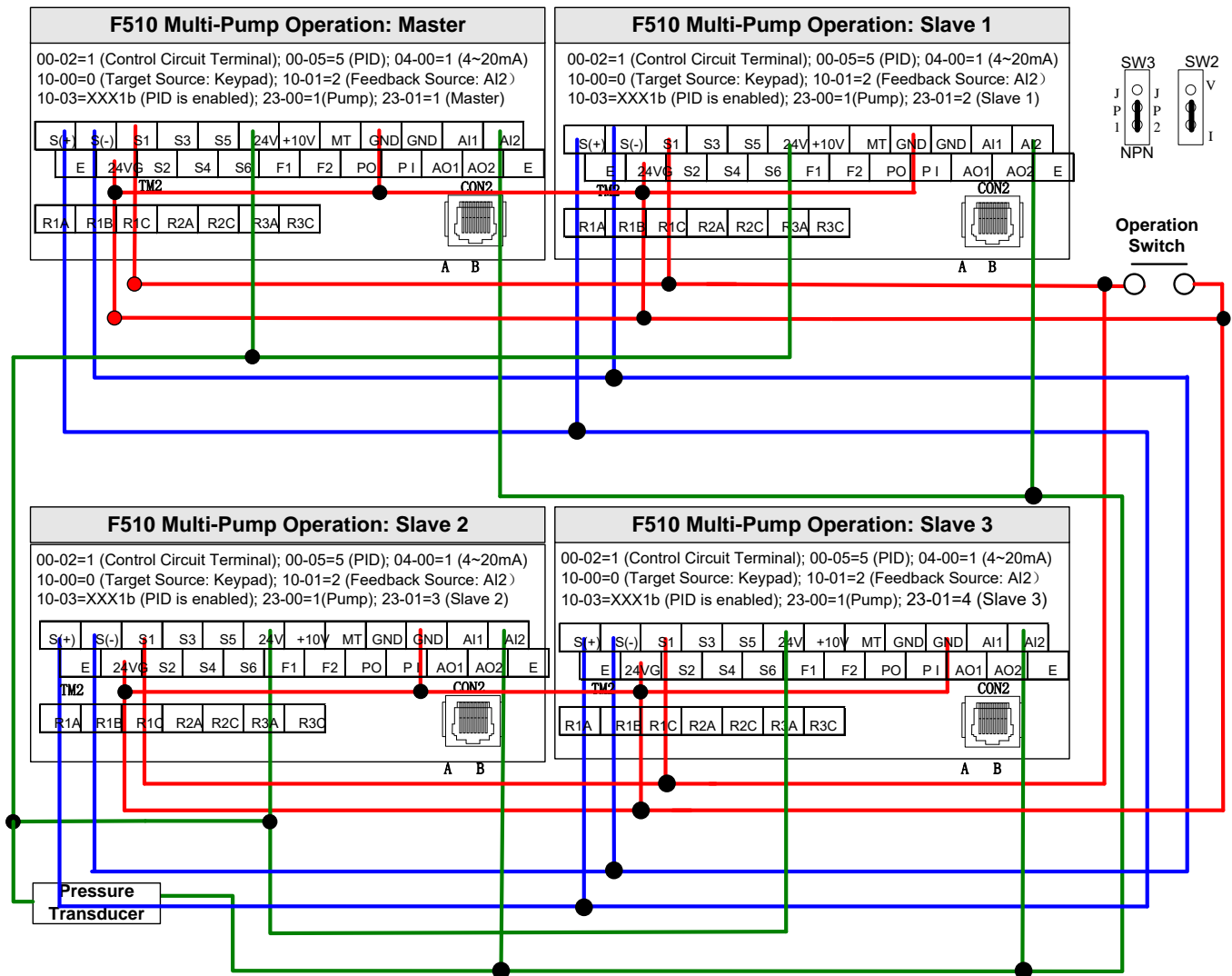


■ PUMP Wiring Diagram for Pressure Sensor of Current Type

Single Pump:



Multi-Pump:



Notes:

1. Check position of dip switch SW2 and SW3.
2. It is required to reconnect after setting Master/ Follower.
3. 24VG and GND have to be connected together.
4. When the communication mode is selected for multiple pumps in parallel connection (09-01=3), baud rate settings (09-02) of both Master and Follower have to be the same. Refer to parameter 23-31.
5. When wiring pressure sensor to multi-pump units make sure to set Follower parameter 04-07(AI2 Gain) =252.0% and 04-08(AI1 Bias) =25.0%.

Appendix B: UL Instructions

Danger

Electric Shock Hazard

Do not connect or disconnect wiring while the power is on.
Failure to comply will result in death or serious injury.

Warning

Electric Shock Hazard

Do not operate equipment with covers removed.

Failure to comply could result in death or serious injury.

The diagrams in this section may show inverters without covers or safety shields to show details. Be sure to reinstall covers or shields before operating the inverters and run the inverters according to the instructions described in this manual.

Always ground the motor-side grounding terminal.

Improper equipment grounding could result in death or serious injury by contacting the motor case.

Do not touch any terminals before the capacitors have fully discharged.

Failure to comply could result in death or serious injury.

Before wiring terminals, disconnect all power to the equipment. The internal capacitor remains charged even after the power supply is turned off. After shutting off the power, wait for at least the amount of time specified on the inverter before touching any components.

Do not allow unqualified personnel to perform work on the inverter.

Failure to comply could result in death or serious injury.

Installation, maintenance, inspection, and servicing must be performed only by authorized personnel familiar with installation, adjustment, and maintenance of inverters.

Do not perform work on the inverter while wearing loose clothing, jewelry, or lack of eye protection.

Failure to comply could result in death or serious injury.

Remove all metal objects such as watches and rings, secure loose clothing, and wear eye protection before beginning work on the inverter.

Do not remove covers or touch circuit boards while the power is on.

Failure to comply could result in death or serious injury.

Warning

Fire Hazard

Tighten all terminal screws to the specified tightening torque.

Loose electrical connections could result in death or serious injury by fire due to overheating of electrical connections.

Do not use an improper voltage source.

Failure to comply could result in death or serious injury by fire.

Verify that the rated voltage of the inverter matches the voltage of the incoming power supply before applying power.

Do not use improper combustible materials.

Failure to comply could result in death or serious injury by fire. Attach the inverter to metal or other noncombustible material.

NOTICE

Observe proper electrostatic discharge procedures (ESD) when handling the inverter and circuit boards.

Failure to comply may result in ESD damage to the inverter circuitry.

Never connect or disconnect the motor from the inverter while the inverter is outputting voltage.

Improper equipment sequencing could result in damage to the inverter.

Do not use unshielded cable for control wiring.

Failure to comply may cause electrical interference resulting in poor system performance. Use shielded twisted-pair wires and ground the shield to the ground terminal of the inverter.

Do not modify the inverter circuitry.

Failure to comply could result in damage to the inverter and will void warranty. TECO is not responsible for any modification of the product made by the user. This product must not be modified.

Check all the wiring to ensure that all connections are correct after installing the inverter and connecting any other devices.

Failure to comply could result in damage to the inverter.

❖ **UL Standards**

The UL/cUL mark applies to products in the United States and Canada and it means that UL has performed product testing and evaluation and determined that their stringent standards for product safety have been met. For a product to receive UL certification, all components inside that product must also receive UL certification.



❖ **UL Standards Compliance**

This inverter is tested in accordance with UL standard UL508C and complies with UL requirements. To ensure continued compliance when using this inverter in combination with other equipment, meet the following conditions:

■ **Installation Area**

Do not install the inverter to an area greater than pollution severity 2 (UL standard).

■ Main Circuit Terminal Wiring

UL approval requires crimp terminals when wiring the inverter's main circuit terminals. Use crimping tools as specified by the crimp terminal manufacturer. TECO recommends crimp terminals made by NICHIFU for the insulation cap.

The table below matches inverter models with crimp terminals and insulation caps. Orders can be placed with a TECO representative or directly with the TECO sales department.

Closed-Loop Crimp Terminal Size

Drive Model F510	Wire Gauge mm ² , (AWG)		Terminal	Crimp Terminal	Tool	Insulation Cap
	R/L1, S/L2, T/L3	U/T1, V/T2, W/T3	Screws	Model No.	Machine No.	Model No.
2008	5.5 (10)		M4	R5.5-4	Nichifu NH 1 / 9	TIC 5.5
2015	14 (6)		M4	R14-6	Nichifu NOP 60	TIC 8
2030	38 (2)		M6	R38-6	Nichifu NOP 60 / 150H	TIC 22
2050	80 (3/0)		M8	R80-8	Nichifu NOP 60 / 150H	TIC 60
2075	150 (4/0)		M8	R150-8	Nichifu NOP 150H	TIC 80
2125	300 (4/0)*2		M10	R150-10	Nichifu NOP 150H	TIC 100
4010	5.5 (10)		M4	R5.5-4	Nichifu NH	9-Jan
4020	8 (8)		M6	R8-6	Nichifu NOP 60	TIC 8
4040	22 (6)		M6	R22-6	Nichifu NOP 60 / 150H	TIC 14
4075	60 (2)		M8	R60-8	Nichifu NOP 60 / 150H	TIC 38
4125	150 (3/0)		M8	R150-8	Nichifu NOP 150H	TIC 80
4250	300 (4/0)*2		M10	R150-10	Nichifu NOP 150H	TIC 100

❖ Type 1

During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used.

Note: Contact TECO for inverter ratings 2125 - 2150 and 4250 - 4425.

230V Class

Drive Model F510	Fuse Type	
	Manufacturer: Bussmann / FERRAZ SHAWMUT	
	Model	Fuse Ampere Rating (A)
200 V Class Three-Phase Drives		
2005	Bussmann 50FE	690V 50A
2008	Bussmann 50FE	690V 50A
2010	Bussmann 63FE	690V 63A
2015	FERRAZ SHAWMUT A50QS100-4	500V 100A
2020	Bussmann 120FEE / FERRAZ A50QS150-4	690V 120A / 500V 150A
2025	FERRAZ SHAWMUT A50QS150-4	500V 150A
2030	FERRAZ SHAWMUT A50QS200-4	500V 200A
2040	FERRAZ SHAWMUT A50QS250-4	500V 250A
2050	FERRAZ SHAWMUT A50QS300-4	500V 300A
2060	FERRAZ SHAWMUT A50QS400-4	500V 400A
2075	FERRAZ SHAWMUT A50QS500-4	500V 500A
2100	FERRAZ SHAWMUT A50QS600-4	500V 600A
2125	FERRAZ SHAWMUT A50QS700-4	500V 700A

460V Class

Drive Model F510	Fuse Type	
	Manufacturer: Bussmann / FERRAZ SHAWMUT	
	Model	Fuse Ampere Rating (A)
400 V Class Three-Phase Drives		
4005	Bussmann 16CT	690V 16A
4008	Bussmann 25ET	690V 25A
4010	Bussmann 40FE	690V 40A
4015	Bussmann 50FE	690V 50A
4020	Bussmann 63FE	690V 63A
4025	Bussmann 80FE	500V 80A
4030	Bussmann 100FE / FERRAZ A50QS100-4	690V 100A / 500V 100A
4040	Bussmann 120FEE	500V 120A
4050	FERRAZ SHAWMUT A50QS150-4	500V 15A
4060	FERRAZ SHAWMUT A50QS200-4	500V 200A
4075	FERRAZ SHAWMUT A50QS250-4	500V 250A
4100	FERRAZ SHAWMUT A50QS300-4	500V 300A
4125	FERRAZ SHAWMUT A50QS400-4	500V 400A
4150	FERRAZ SHAWMUT A50QS500-4	500V 500A
4175	FERRAZ SHAWMUT A50QS600-4	500V 600A
4215	FERRAZ SHAWMUT A50QS700-4	500V 700A
4250	FERRAZ SHAWMUT A50QS700-4	500V 700A

❖ **Motor Over Temperature Protection**

Motor over temperature protection shall be provided in the end use application.

■ **Field Wiring Terminals**

All input and output field wiring terminals not located within the motor circuit shall be marked to indicate the proper connections that are to be made to each terminal and indicate that copper conductors, rated 75°C are to be used.

■ **Inverter Short-Circuit Rating**

This inverter has undergone the UL short-circuit test, which certifies that during a short circuit in the power supply the current flow will not rise above value. Please see electrical ratings for maximum voltage and table below for current.

- The MCCB and breaker protection and fuse ratings (refer to the preceding table) shall be equal to or greater than the short-circuit tolerance of the power supply being used.
- Suitable for use on a circuit capable of delivering not more than (A) RMS symmetrical amperes for DiJ2.IHp in 240 / 480 V class drives motor overload protection.

Horse Power (Hp)	Current (A)	Voltage (V)
1 - 50	5,000	240 / 480
51 - 200	10,000	240 / 480
201 - 400	18,000	240 / 480
401 - 600	30,000	240 / 480

❖ Inverter Motor Overload Protection

Set parameter 02-01 (motor rated current) to the appropriate value to enable motor overload protection. The internal motor overload protection is UL listed and in accordance with the NEC and CEC.

■ 02-01 Motor Rated Current

Setting Range Model Dependent

Factory Default: Model Dependent

The motor rated current parameter (02-01) protects the motor and allows for proper vector control when using open loop vector or flux vector control methods (00-00 = 2 or 3). The motor protection parameter 08-05 is set as factory default. Set 02-01 to the full load amps (FLA) stamped on the nameplate of the motor. The operator must enter the rated current of the motor (17-02) in the menu during auto-tuning. If the auto-tuning operation completes successfully (17-00 = 0), the value entered into 17-02 will automatically write into 02-01.

■ 08-05 Motor Overload Protection Selection

The inverter has an electronic overload protection function (OL1) based on time, output current, and output frequency, which protects the motor from overheating. The electronic thermal overload function is UL-recognized, so it does not require an external thermal overload relay for single motor operation. This parameter selects the motor overload curve used according to the type of motor applied.

08-05	Selection for motor overload protection (OL1)
Range	xxx0b : Motor overload is disabled xxx1b : Motor overload is enabled xx0xb : Cold start of motor overload xx1xb : Hot start of motor overload x0xxb : Standard motor x1xxb : Special motor

Sets the motor overload protection function in 08-05 according to the applicable motor.

08-05 = ---OB: Disables the motor overload protection function when two or more motors are connected to a single inverter. Use an alternative method to provide separate overload protection for each motor such as connecting a thermal overload relay to the power line of each motor.

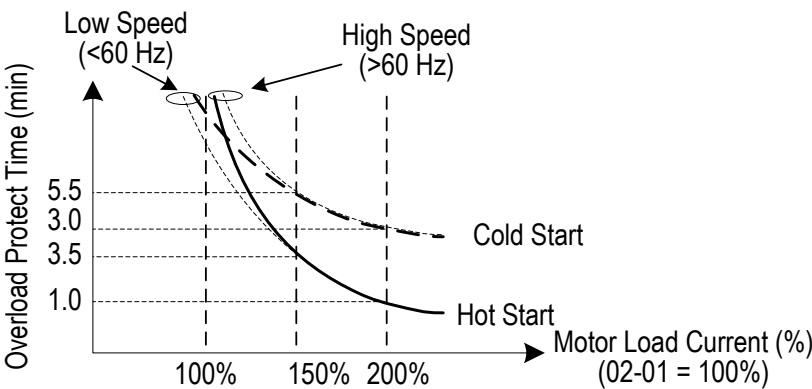
08-05 = --1-B: The motor overload protection function should be set to hot start protection characteristic curve when the power supply is turned on and off frequently, because the thermal values are reset each time when the power is turned off.

08-05 = -0—B: For motors without a forced cooling fan (general purpose standard motor), the heat dissipation capability is lower when in low speed operation.

08-05 = -1—B: For motors with a forced cooling fan (inverter duty or VIF motor), the heat dissipation capability is not dependent upon the rotating speed.

To protect the motor from overload by using electronic overload protection, be sure to set parameter 02-01 according to the rated current value shown on the motor nameplate.

Refer to the following "Motor Overload Protection Time" for the standard motor overload protection curve example: Setting 08-05 = -0--B.



08-06 Motor Overload Operation Selection

08-06	Start-up mode of overload protection operation (OL1)
Range	0: Stop output after overload protection 1: Continuous operation after overload protection.

- 08-06=0:** When the inverter detects a motor overload the inverter output is turned off and the OL1 fault message will flash on the keypad. Press RESET button on the keypad or activate the reset function through the multi-function inputs to reset the OL1 fault.
- 08-06=1:** When the inverter detects a motor overload the inverter will continue running and the OL1 alarm message will flash on the keypad until the motor current falls within the normal operating range.

UL- Additional Data**Closed-Loop Crimp Terminal Size**

Drive Model F510	Wire Gauge mm2 (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			R200-12S*2	Nichifu NOH 300K	TIC 200
4375	253 (500)*2		M12	R325-12S*2	Nichifu NOH 300K	TIC 325
4425	253 (500)*2		M12	R325-12S*2	Nichifu NOH 300K	TIC 325

❖ **Type 1**

During installation, all conduit hole plugs shall be removed, and all conduit holes shall be used

Recommended Input Fuse Selection

Drive Model F510	Fuse Type	
	Manufacturer: Bussmann / FERRAZ SHAWMUT	
	Model	Fuse Ampere Rating (A)
200 V Class Three-Phase Drives		
2150	Bussmann 170M5464	690V 800A
2175	Bussmann 170M5464	690V 800A

Drive Model F510	Fuse Type	
	Manufacturer: Bussmann / FERRAZ SHAWMUT	
	Model	Fuse Ampere Rating (A)
400 V Class Three-Phase Drives		
4300	Bussmann 170M5464	690V 800A
4375	Bussmann 170M5464	690V 800A
4425	Bussmann 170M5466	690V 1000A
4425	Bussmann 170M5466	690V 1000A



INVERTER

F510

Distributor

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