PV Series Variable Speed Drive

for Fan & Pumps Applications

User Manual

E1-20031111-C-1.0 (BOM:31010945)

Emerson Industrial Automation

Contents

Preface

Thank you for using PV Series variable speed drive made by Emerson Network Power Co., Ltd..

PV Series satisfies high performance requirements by using a unique control method to achieve high torque, high accuracy and wide speed-adjusting range. Its anti-tripping function and capabilities of adapting to severe power network, temperature, humidity and dusty environment exceed those of similar product made by other companies, which improves the product's reliability noticeably;

PV Series can satisfy the customers' requirements on low noise and EMI by using optimized PWM technology and EMC design.

This manual provides information on installation, wiring, parameter setting, trouble-shooting, and routine maintenance. In order to ensure the correct installation and operation of the drive, please read this manual carefully before using and keep it in a safe place.

Unpacking and Inspection

Upon unpacking, please check for:

Any damage occurred during transportation;

Check whether the rated values on the nameplate of the drive are in accordance with your order.

Our product is manufactured and packed at factory with great care. If there is any error, please contact any of our distributors or us.

The user manual is subjected to change without notifying the customers due to the continuous process of product improvements.

Ordering Information

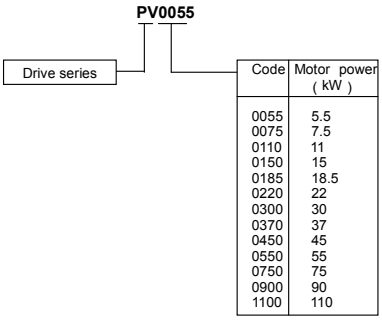


Fig. A-1 Explanations of Drive Models

The nameplate is located at the bottom right hand side of the heatsink. The contents are shown in Fig.A-2. A barcode on the plastic cover also contains information about the drive, as shown in Fig.A-3.

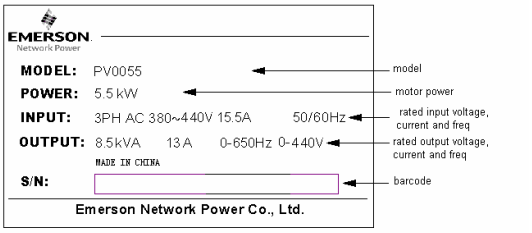


Fig. A-2 Nameplate description

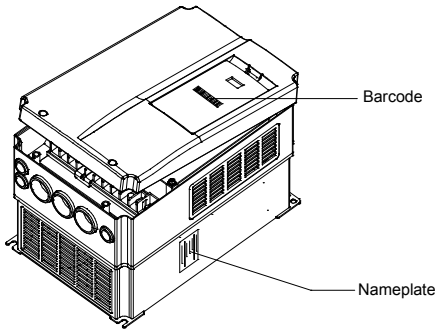


Fig. A-3 Locations of Nameplate and Barcode

Chapter 1 Safety Information

1.1 Danger and Warning Definitions

Danger — Operations without following instructions can cause personal injury or death

Attention — Operations without following instructions can cause personal injury or damage to product or other equipment.

1.2 Notes for Installations

Danger

- Please install the drive on inflammable material.
- Keep the drive away from combustible materials
- Keep the drive away from explosive gas
- Only qualified personnel shall wire the drive
- Never wire the drive unless the input AC supply is totally disconnected
- The drive must be properly earthed to reduce electrical accident
- Install the cover before switching on the drive, to reduce the danger of electric shock and explosion.
- For drives that have been stored for longer than 2 years, increase its input voltage gradually before supplying full rated input voltage to it, in order to avoid electric shock and explosion
- Don't touch the live control terminals with bare hands
- Don’t operate the drive with wet hands
- Perform the maintenance job after confirming that the charging LED is off or the DC Bus voltage is below 36V.
- Only trained professionals can change the components, it is prohibited to leave wires or metal parts inside the drive so as to avoid the risk of fire.
- Parameter settings of the control board that has been changed must be revised, otherwise accidents may occur.
- The bare portions of the power cables must be bound with insulation tapes

Attention

- Don’t carry the drive with its cover. The cover cannot support the weight of the drive and may drop.
- Please install the drive on a strong support, failing which the drive may fall off.
- Don’t install the drive in places where water pipes may leak onto it.
- Don't allow screws, washers and other metal foreign matters to fall inside the drive, otherwise there is a danger of fire or damage;
- Don't operate the drive if parts are not complete, otherwise there is a danger of a fire or human injury;
- Don't install the drive under direct sunshine, otherwise it may be damaged;
- Don’t short circuit P1/PB and terminal (-), otherwise there is a danger of fire or the drive may be damaged.
- Cable lugs must be connected to main terminals firmly
- Don’s apply supply voltage (AC 110V or higher) to control terminals except terminals TA, TB and TC.
- The control circuits are isolated from the main circuits in the drive by basic insulation only. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation rated for use at the AC supply voltage. If the control circuits are to be connected to other circuits classified as Safety Extra Low Voltage (SELV)- for example, to a personal computer- an additional isolating barrier must be included in order to maintain the SELV classification.

1.3 Notes for Using PV Drive

Pay attention to the following issues when using PV Series drive:

1.3.1 About Motor and Load

Compared to power frequency operation, there will be some increase in temperature, noise and vibration in the motor. The PV Series are voltage source inverters. Its

output voltage is PWM wave. Being non-sinuosoidal, there will be some harmonics.

Low Speed Rotating with Constant Torque

When a standard motor is driven at low speed for a long time, there will be insufficient cooling for a self-ventilated motor. Overheating can result in insulation damaged. Special variable frequency motor is recommended for constant torque operation at low speed.

Motor's over-temperature protecting threshold

The drive can protect the motor from over-temperature. If the ratings of the driven motor are not in compliance with the drive, be sure to adjust the protective threshold to ensure the motor is properly protected.

Operate above 50Hz

When running the motor above 50Hz, there will be increase in vibration and noise. The rate at which the torque is available from the motor is inversely proportionally to its increase in running speed. Ensure that the motor can still provide sufficient torque to the load.

Lubrication of mechanical devices

Over time, the lubricants in mechanical devices, such as gear box, geared motor, etc. when running at low speed, will deteriorate. Frequent maintenance is recommended.

Braking Torque

Braking torque is developed in the machine when the drive is hoisting a load down. The drive will trip when it cannot cope with dissipating the regenerative energy of the load. Therefore, a braking unit with proper parameters setting in the drive is required.

The mechanical resonance point of load

The drive system may encounter mechanical resonance with the load when operating within certain band of output frequency. Skip frequencies have be set to avoid it.

Frequent start and stop application

The drive should be started and stopped via its control terminals. It is prohibited to start and stop the drive directly through input line contactors, which may damage the drive with frequent operations.

Insulation of Motors

Before using the drive, the insulation of the motors must be checked, especially, if it is used for the first time or if it has been stored for a long time. This is to reduce the risk of the Drive from being damaged by the poor insulation of the motor. Wiring diagram is shown in Fig. 1-1. Please use 500V insulation tester to measure the insulating resistance. It should not be less than 5MΩ.

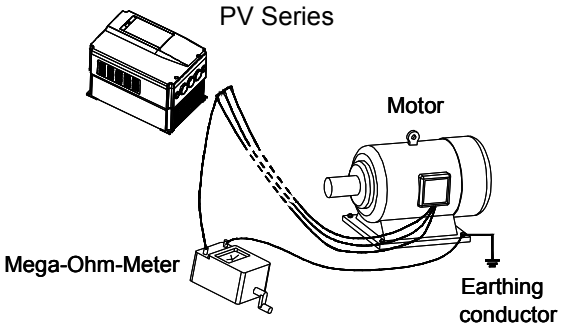


Fig. 1-1 Checking the insulation of motor

1.3.2 About Variable Speed Drive

Varistors or Capacitors Used to Improve the Power Factor

Don't connect any varistor or capacitor to the output terminals of the drive, because the drive's output voltage waveform is pulse wave, otherwise tripping or damaging of components may occur; in addition, don't install circuit breaker or contactor at the output side of the drive as shown in Fig.1-2.

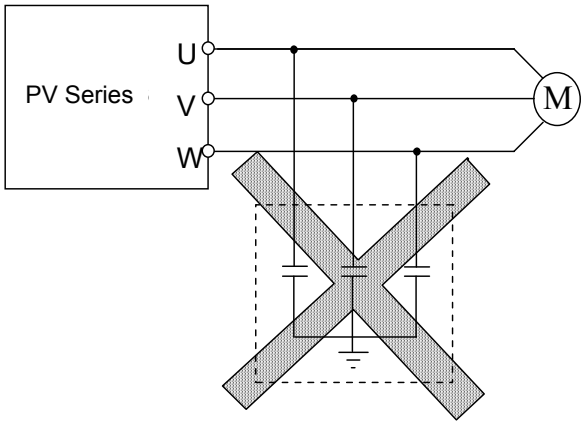


Fig. 1-2 Capacitors are prohibited to use.

Circuit breakers connected to the output of the drive

If circuit breaker or contactor needs to be connected between the drive and the motor, be sure to operate these circuit breakers or contactor when the drive has no output, to avoid damaging of the drive.

Using outside the range of rated voltage

The drive is not suitable to be used out of the specified range of operation voltage. If needed, please use suitable voltage regulation device.

Change from 3-phase to 2-phase

It is not recommended to change the drive from 3-phase input to 2-phase input. If it is necessary to use on two phases, the phase-loss protection function of the drive should be disabled. The Drive must be derated for this operation. For motors at which power is above 30kW, if it is changed into 2-phase input, then the input phases must be at phase R and phase T, or else the drive will not work.

After the 3-phase input is changed into 2-phase input, bus-voltage and current ripple may increase, which not only influences the life of electrolytic capacitor but it also deteriorates the performance of the drive. The drive's operating current should be derated and should not exceed 67% of rated value.

Protection against lightning strike

There are transient surge suppressors inside the Drive which protects it against lighting strike.

Derating due to Altitude

Derating must be considered when the drive is installed at high altitude, greater than 1000m. This is because the cooling effect of Drive is deteriorated due to the thin air, as shown in Fig.1-3 that indicates the relationship between the elevation and rated current of the Drive.

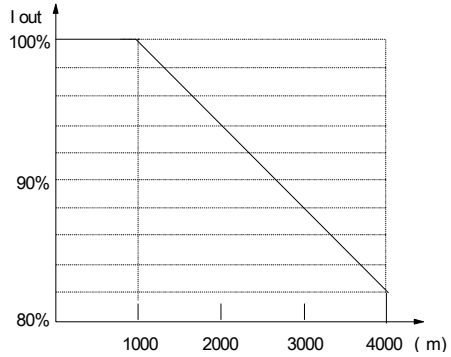


Fig. 1-3 The derating of Drive's output current at different altitudes.

1.4 Attentions in Disposing Unwanted Drive

When disposing the Drive, pay attention to the following factors:

The capacitors may explode when they are burnt.

Poisonous gas may be generated when the plastic parts like front covers are burnt.

Disposing method: Please dispose the Drive as industrial waste.

Chapter 2 Product Information

2.1 Specifications

Table 2-1 General specifications

Item		Description
Input	Rated voltage & frequency	three-phase,380V~440V;50Hz/60Hz
	Permissible fluctuation range	Voltage:320V~460V;Voltage unbalance rate:<3%;Frequency:±5%
Output	Rated voltage	380V
	Frequency	0Hz~650Hz
	Over load ability	120% rated current for 1 minute; 150% rated current for 1 second
Main control functions	Modulation mode	Flux vector PWM modulation
	Speed range	1:100
	Starting torque	180% rated torque at 0.50Hz
	Steady accuracy of speed	≤±0.5% rated synchronous speed
	Accuracy of frequency	Digital setting: highest frequency×±0.01%. Analog setting: highest frequency×±0.2%
	Setting frequency resolution	Digital setting:0.01Hz. Analog setting: highest frequency×0.1%
	Torque boost	Auto torque boost, Manual torque boost0.1%~30.0%
	V/F curve	4 modes: linear V/F curve mode and 3 kinds of quadratic V/F modes (2.0 order, 1.7 order, and 1.2 order)
	On-board PI controller	Be able to configure close-loop control system easily
	Auto-energy saving operation	V/F curve is optimized automatically according to the load condition to perform energy-saving operation.
	Auto current limiting	Operating current is limited automatically to avoid frequent tripping of the drive.
Operating function	Methods of inputting operating commands	Via keypad panel, terminals and serial ports.
	Methods of setting up frequency	Selectable setting modes:- Digital setting; Analog voltage/current setup; set via serial port
	Pulse output terminal	0~50kHz pulse signal output. Signals can be reference frequency and output frequency
	analog output terminals	2 analog outputs of 0/4~20mA and 0/2~10V(selectable). Be able to output signals like reference frequency and output frequency.
Control panel	LED keypad	Able to show frequency setting, output frequency, output power and current during operation; frequency setting at stop mode. Hot swappable.
	LCD keypad (Optional)	Bilingual--English/Chinese, with parameter copy, and key lock functions. Hot swappable.
Protection function		Phase failure, Over/Under current, Over/Under voltage protection, Over heat, and Overload protections
Optional parts		LCD keypad, braking resistors, flush mount face plate, remote keypad cables and Profibus-DP gateway

Item		Description
Environment	Operating environment	In-door, free from moisture, and contaminants such as electrically conductive material.
	Altitude	Less than 1000m
	Ambient temperature	-10℃~+40℃(derating is required from 40℃ to 50℃)
	Humidity	Less than 95%RH, without condensation
	Vibration	Less than 5.9m/s^2 (0.6g)
	Storage temperature	-40℃~+70℃
Enclosure	Protection level	IP20
	Cooling	Fan cooling

2.2 Product Series

2.2.1 Ratings

Table 2-2 Drive series

Drive Model	Rated Capacity (kVA)	Rated input current (A)	Rated output current (A)	Motor power (kW)
PV0055	8.5	15.5	13	5.5
PV0075	11	20.5	17	7.5
PV0110	17	26	25	11
PV0150	21	35	32	15
PV0185	24	38.5	37	18.5
PV0220	30	46.5	45	22
PV0300	40	62	60	30
PV0370	50	76	75	37
PV0450	60	92	90	45
PV0550	72	113	110	55
PV0750	100	157	152	75
PV0900	116	180	176	90
PV1100	138	214	210	110

2.2.2 Parts of Variable Speed Drive

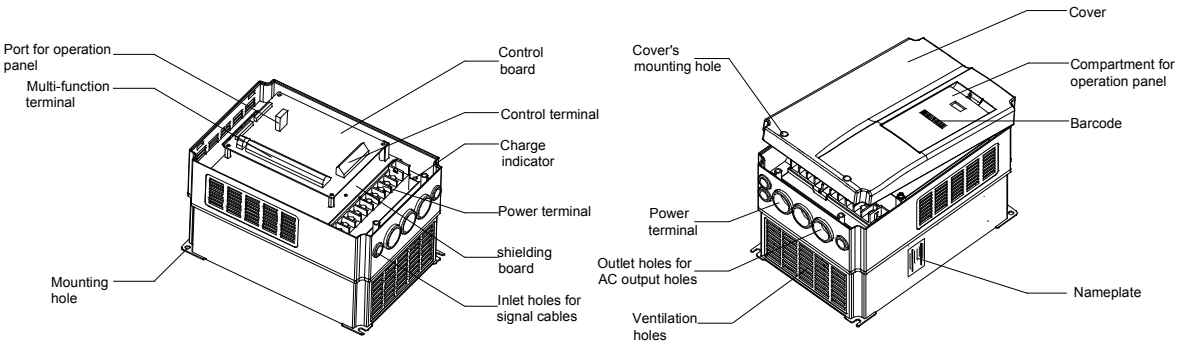


Fig. 2-1 Parts of Drive

2.2.3 Outline and Gross Weight

1. Outline

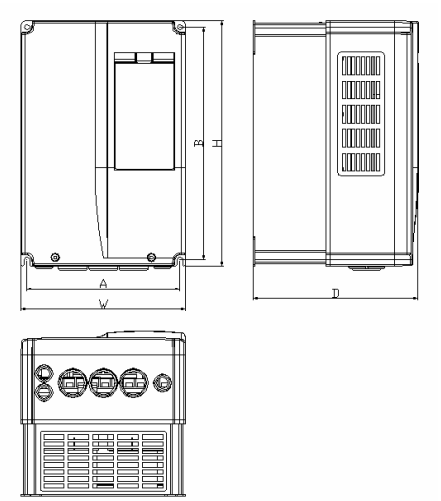


Fig. a PV0055~ PV0185

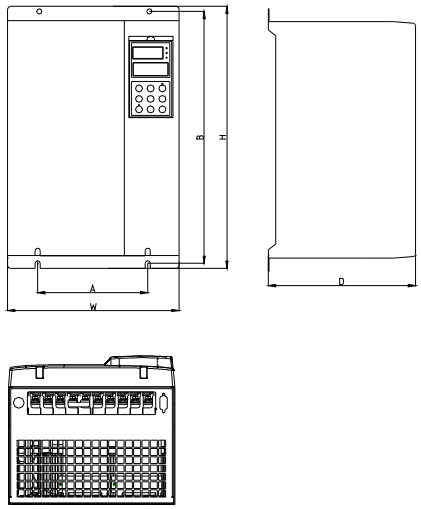


Fig. b PV0220~ PV0450

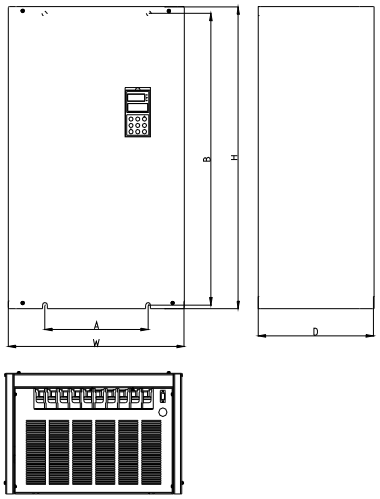


Fig. c PV0550

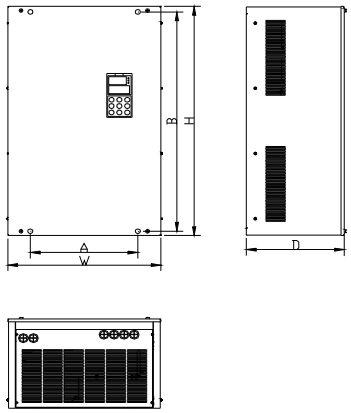


Fig. d PV0750~PV1100

Fig. 2-2 Outline of PV Series

2. Mechanical parameters

Table 2-3 Dimensions and Weights

Drive model	Motor(kW)	A(mm)	B(mm)	H(mm)	W(mm)	D(mm)	Diameter of mounting hole(mm)	Fig. Number	Gross weight(kg)
PV0055	5.5	186	285	300	200	202	6.8	Fig. a	7.5
PV0075	7.5								
PV0110	11								
PV0150	15	236	365	380	250	209	6.8	Fig. a	12
PV0185	18.5								
PV0220	22	180	421	435	260	226	7	Fig. b	12
PV0300	30	200	486	500	310	252	7	Fig. b	15
PV0370	37	250	600	622	360	255	9	Fig. b	25
PV0450	45								
PV0550	55	270	637.5	660	408	265	10	Fig. c	40
PV0750	75	300	747	770	468	301	10	Fig. d	50
PV0900	90	300	747	770	468	301	10	Fig. d	90
PV1100	110	300	747	770	468	301	10	Fig. d	90

🕮 Notes:

1. For 90kW drive or above, DC reactor is included in its standard configuration. The weight of DC reactor in the above table is not included in the gross weight. Outline and dimensions of DC reactor are shown below.

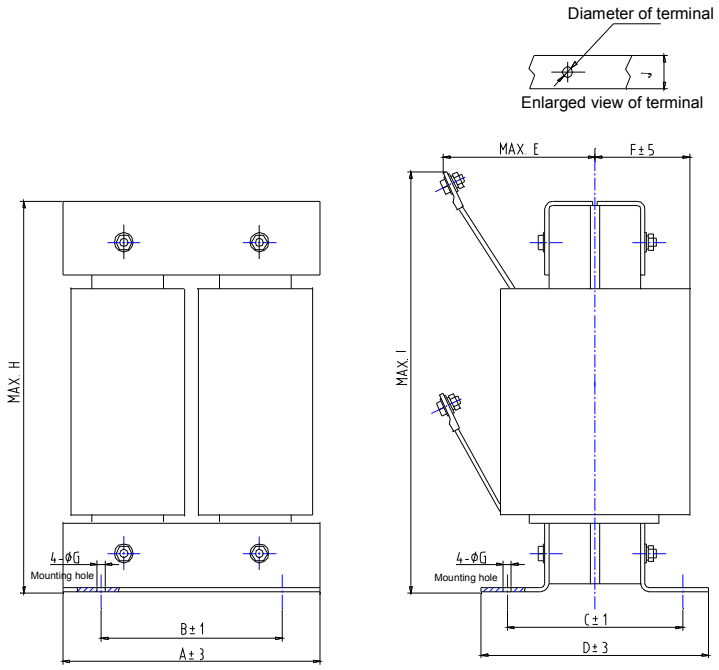


Fig. 2-3 Dimensions of DC reactor

Table 2-4 Mechanical Parameters of DC Reactor

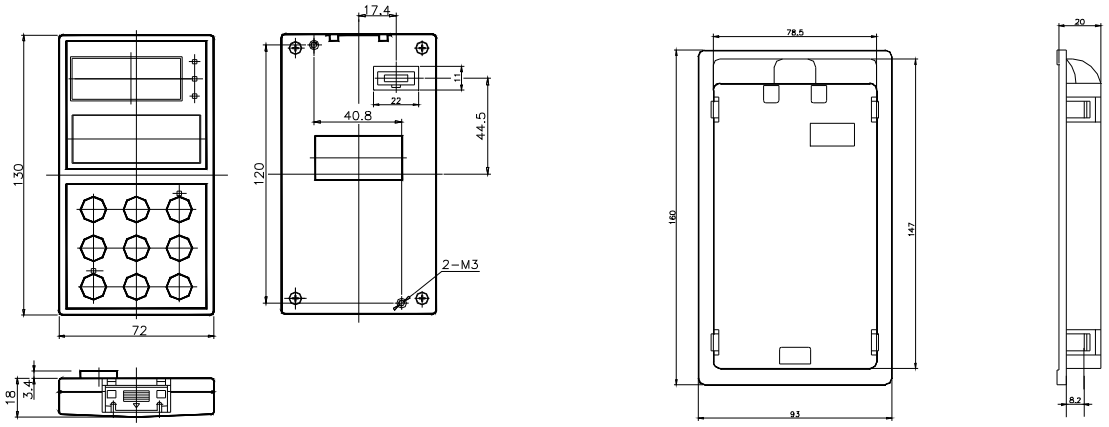
Applicable drive (kW)	Model of DC reactor	Recommended size of copper cable (mm2)	Size(mm)											gross weight (kg)
			A	B	C	D	E	F	G	H	I	J	Terminal diameter	
90	TDL-4DI01-0900	60	190	160	125	161	120	80	10	250	280	25	Φ12	23
110	TDL-4DI01-1100	100												25

Notes:

1. Columns B and C in Table 2-4 are the sizes of mounting holes of DC reactor.

2. DC reactor should be installed at the bottom of the cabinet if it is to be installed inside a cabinet. The clearance between reactor and the drive should be at least 35cm, and the reactor should be as far away from the air inlet port of the drive as possible.

3. Operation keypad and Flush Mount Faceplate



a) LCD Keypad (optional) b) Flush Mount Faceplate

Fig. 2-4 Operation Keypad and flush mount faceplate

2.3 Optional parts

All the optional parts are given below, make additional orders if needed.

2.3.1 LCD Keypad

Model:TDP-LCD03

Language: English, Chinese (optional)

LCD keypad can perform fast parameter copy.

Interface: As shown in Fig.2-5, the interface is divided into main display area, operation instruction area and explanations for operation instructions.

Main display area: Display the status, parameters.

Operation display area: Display the next operation, if there are several operations for selection, the operation contents will be displayed in this area one by one.

Explanations for operations: Display the explanations for the “operation display area”

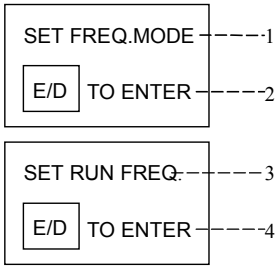


Fig. 2-5 LCD display interface

2.3.2 Braking Kits

1. Braking unit

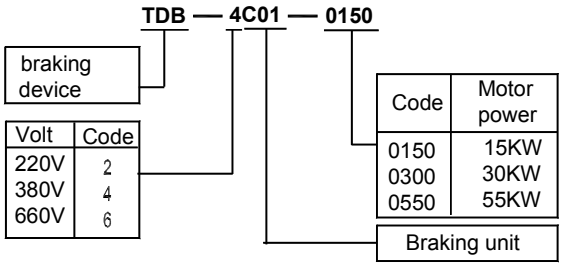


Fig. 2-6 Model of braking unit

2. Braking resistor

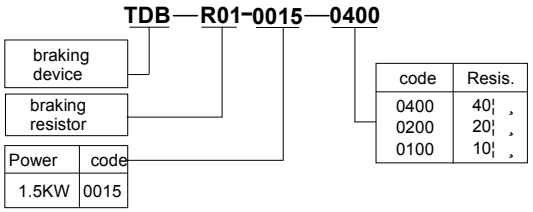


Fig. 2-7 Model of braking resistor

3. Configurations

Table 2-5 Specifications of braking unit and resistor

Rated motor power (kW)	Model of braking resistor	Ratio of working time of braking unit to drive’s total working time (%)	Braking torque(%)	Maximum continuous operating time(s)	Model of braking unit
5.5	-	10	100	10	Built-in
7.5	-	10	100	10	Built-in
11	-	10	100	10	Built-in
15	TDB-R01-0015-0400	10	100	10	TDB-4C01-0150
18.5	TDB-R01-0015-0400	10	100	10	TDB-4C01-0150
22	TDB-R01-0015-0400	10	100	10	TDB-4C01-0150
30	TDB-R01-0030-0200	10	100	10	TDB-4C01-0300
37	TDB-R01-0030-0200	10	100	10	TDB-4C01-0300
45	TDB-R01-0030-0200	10	100	10	TDB-4C01-0300
55	TDB-R01-0050-0100	10	100	10	TDB-4C01-0550
75	TDB-R01-0050-0100	10	100	10	TDB-4C01-0550

Notes

1. There is a braking unit inside the 11kW drive or below. An external braking resistor is needed to be connected if dynamic braking is required and the recommended resistor is 1000W/100Ω .

2. The 90kW drive or above should use several braking units connected in parallel (TDB-4C01-0550).

4. Outline and installation sizes

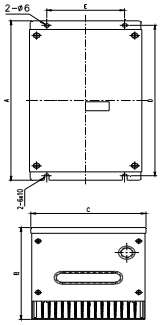


Fig. 2-8 Installation dimensions of braking unit

Table 2-6 Installation dimensions of braking unit(unit: mm)

Model of braking unit	A	B	C	D	E	gross weight (kg)
TDB-4C01-0150	254	143	144	240	100	3
TDB-4C01-0300	254	143	144	240	100	3
TDB-4C01-0550	254	130	170	240	126	4

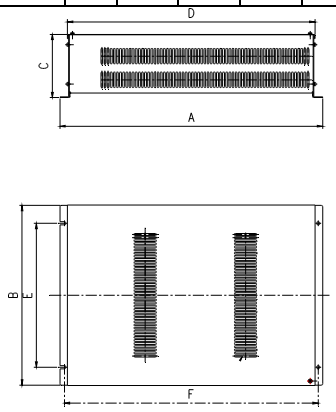


Fig. 2-9 Installation dimensions of braking resistor

Table 2-7 Installation dimensions of braking resistor (unit: mm)

Model of braking resistor	A	B	C	D	E	F	gross weight (kg)
TDB-4R01-0015-0400	475	228	127	447	177	460	3
TDB-4R01-0030-0200	500	350	128	480	298	490	6
TDB-4R01-0050-0100	540	520	170	520	470	530	8

5. Functions and wiring

A. Wire connections braking resistor and braking unit

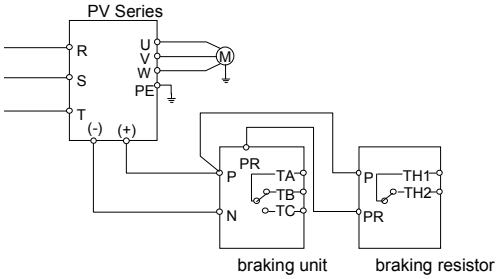


Fig. 2-10 Connecting the braking unit to Drive

TA-TB and TA-TC are contacts of relay used for outputting fault indicating signal, and TH1 and TH2 are contacts of temperature relay(relay used for outputting over-heat indicating signal).

B. Main functions of braking unit

Activation voltage for braking is adjustable;

Protection function against excessive duty-cycle of braking resistor;

Overheat protection of heatsink;

Alarm indication for power module's fault;

Fault indication and indication for fault relay output;

The braking resistor will be disconnected automatically if it is over-heated and the relay will output alarming signal.

The cables connected between the braking unit and the drive, and those between the braking unit and braking resistor should be less than 5m. If longer than 5m, twisted-pair cable should be used and the maximum length is 10m.

2.3.3 Communication Parts

1. Communication cables

A. Cables for Keypad

Model: TDC-CB0015(1.5m)

TDC-CB0030(3.0m)

The cables are used to connect the keypad to the drive.

B. Cables for Flush Mount Faceplate

Two models:

Models: FRC21W1(3.0m)

FRC21W2 (30m)

The cables are used to connect the flush mount faceplate to the drive.

2. Flush Mount Faceplate

Model: TDO-RC02

It uses the same structure with operation panel of the Drive. It can be easily installed and secured and convenient for hand-held operation. Its display is similar to that of the operation panel.

RS485 serial communication mode is used between the drive and the remote control panel. A 4-core cable is used to connect the drive and the panel, and the maximum distance is up to 1000m. Master/slave communication mode is used. The panel is the master and the drive is the slave. Cable terminals can be secured by common screws, which make it convenient for maintenance. One flush mount faceplate can control several drives by connecting the communication cables of 485+ and 485- of each drive to form a RS485 network.

Functions:

1. Be able to control the start, stop, jog operation, fault reset of slave drives and change the frequency settings and operation direction.

2. Identify the type of slave machine automatically. Be able to monitor the operating frequency, frequency setting, output voltage and current, analog close-loop feedback, analog close-loop setting and external counting value automatically.

3. Profibus-DP Gateway

Model: TDS-PA01

Be able to connect ENYDRIVE drive to PROFIBUS-DP network via the TDS-PA01. In the PROFIBUS-DP network system, the drive operates as a slave.

Functions:

1. To send control commands to drive (such as: start, stop and jog);

2. To send speed or frequency reference signal to the drive;

3. To read operating status information and actual values from the drive;

4. To reset the drive when fault occurs in it.

Chapter 3 Installation and Wiring

3.1 Installation Environment

Please mount the drive vertically inside a well-ventilated location.

When selecting mounting environment, the following issues should be taken into account:

Ambient temperature should be within the range of -10℃~40 ℃. If the temperature is higher than 40 ℃, the drive should be derating and forced ventilation is required;

Humidity should be lower than 95% non-condensing

Mount in the location where vibration is less than 5.9m/ s^2 (0.6G);

Mount in the location free of direct sunlight, dust, metal powder, corrosive gas or combustible gas.

If there are any special requirements for installation, please contact us for clarifications.

The requirements on mounting space and clearance are shown in Fig. 3-1 and Fig. 3-2.

When two Variable Speed Drives are mounted one on top the other, an air flow diverting plate should be fixed in between as shown in Fig. 3-3.

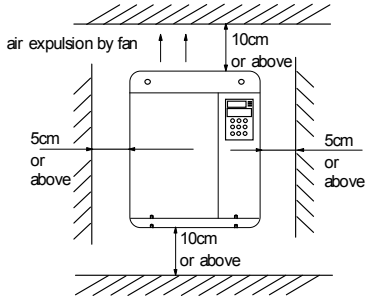


Fig. 3-1 Installation clearances(55kW or below)

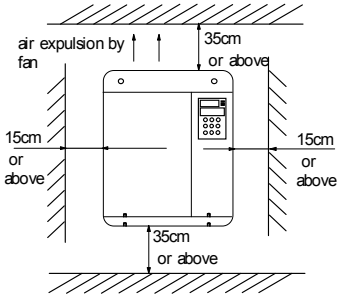


Fig. 3-2 Installation clearance(75kW or above)

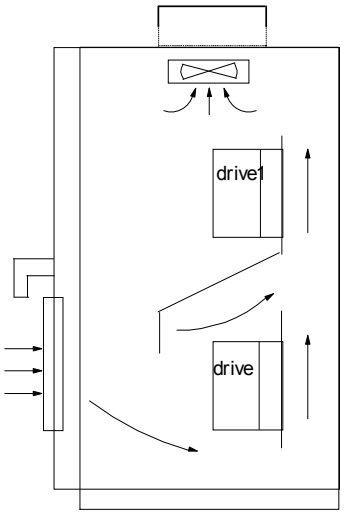


Fig. 3-3 Installation of several drives

3.2 Removing and Mounting of Parts

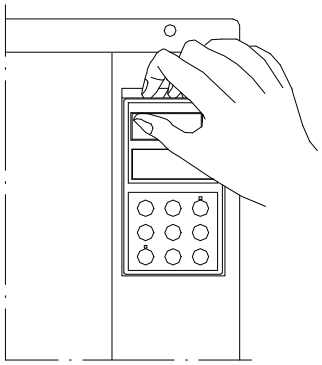
3.2.1 Removing and Installation of Operation Panel

1. Disassembly

Put your middle finger into the hole on the top of operation panel, press down the snapper and pull the panel outward as shown in Fig. 3-4.

2. Installation

Place the bottom edge of the operation panel at the hooks of the mounting groove and press down the snapper with your middle finger. Then press the panel inward to snap it in position as shown in Fig. 3-4.



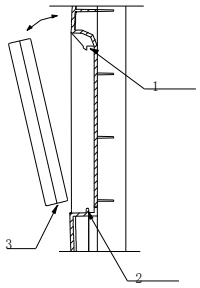


Fig. 3-4 Removing and Mounting of Operation Panel

Where: 1&2: holding clamp 3:panel

3.2.2 Removing and Mounting of Cover

PV Series have two kinds of cover, plastic or metallic one. Follow the steps below to remove and mount the cover.

1. Removing and mounting of plastic covers

1) Removing:

① Remove the operation panel

② Remove two screws at bottom

③ Lift the bottom of cover up to 5~10 degrees, move it upward at least 10mm until the holding clamps are out of the holes on the cabinet, then remove the front panel.

2) Mounting of plastic cover:

①Tilt the cover 5~10 degree;

②Insert the top holding clamp into the slot at the top of the panel's compartment;

③Mount the screws at the bottom part of the cover;

④Install the operation panel

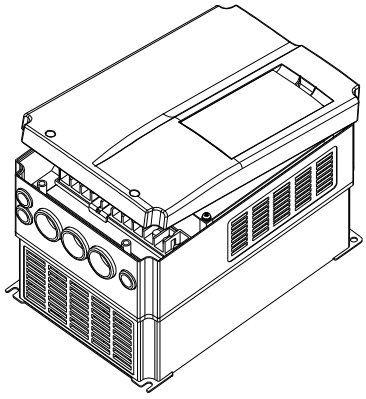


Fig. 3-5 Removing and installation of plastic cover

🕮 Note:

Pull out or insert the plastic cover gently, to avoid damaging the mounting clamp.

2. Procedures of removing and mounting the metal cover

1) Procedures of removing the metal cover:

①Remove the operational panel;

②Remove all the screws on the cover;

③Take out the cover horizontally.

2) Procedures of installing the metal cover:

①Mount the cover on the frame by screws;

②Install the operation panel.

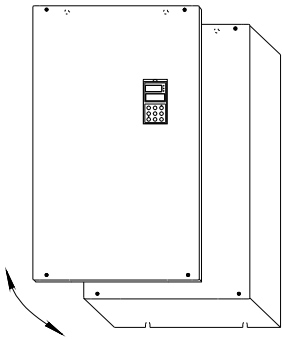


Fig. 3-6 Procedures of removing and mounting the metal cover

3.3 Wire connections of Drive

⚠ Danger

• Wiring can only be done after the drive's AC power is disconnected, all the LEDs on the operation panel are off and waiting for at least 5 minutes. Then, you can remove the panel.

• Wiring job can only be done after confirming the charge indicator on the right bottom has extinguished and the voltage between main circuit power terminals + and - is below DC36V.

•Wire connections can only be done by trained and authorized personnel.

• Check the wiring carefully before connecting emergency stopping or safety circuits.

• Check the drive's voltage level before supplying power to it, otherwise human injuring or equipment damage may happen.

• The control circuits are isolated from the main

Danger

circuits in the drive by basic insulation only. The installer must ensure that the external control circuits are insulated from human contact by at least one layer of insulation rated for use at the AC supply voltage. If the control circuits are to be connected to other circuits classified as Safety Extra Low Voltage(SELV)- for example, to a personal computer- an additional isolating barrier must be included in order to maintain the SELV classification.

Attention

- Check whether the drive's rated input voltage is in compliant with the AC supply voltage before using.
- Dielectric strength test of the drive has been done in factory and the user needs not do it again.
- Refer to chapter 2 on how to connect braking resistor or braking kit.
- It is prohibited to connect the AC supply cables to the drive's terminals U, V and W.
- Grounding cables should be copper cables with cross-sectional area bigger than 3.5mm^2, and the grounding resistance should be less than 10Ω.
- The drive should be connected to the AC supply via a circuit breaker or fuse to provide input over-current protection

Wire the drive according to Fig. 3-7 during commissioning :

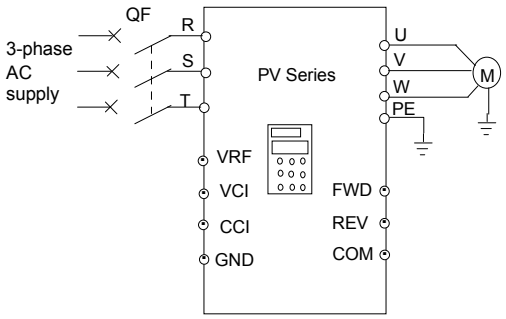


Fig. 3-7 Wiring

3.3.1 Wire Connections of Main Terminals

1. Connection between drive and optional parts

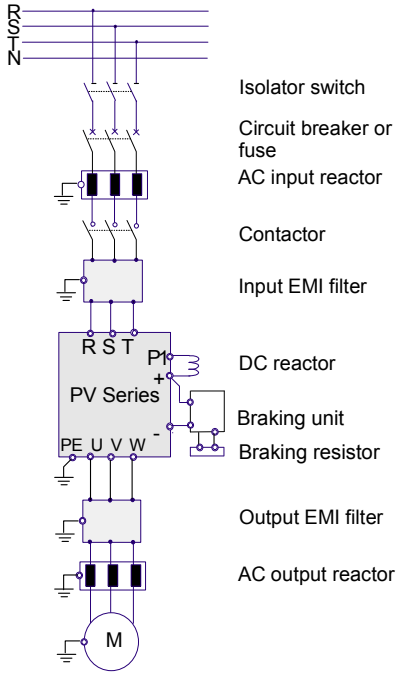


Fig. 3-8 Wire connection between the drive and optional parts

1). Isolation switch should be connected between the AC supply and the drive to ensure the safety of the maintenance engineer.

2). Circuit breaker(QF) or fuse should be connected between the AC supply and the drive to isolate the fault of other equipment. Refer to Table 3-1 for the selection of circuit breaker.

Note:

Parameters in the table are recommended values

Table 3-1 Recommended capacity of circuit breaker and the cross sectional area of copper cable

Model	Input switch	Main circuit (mm^2)		Control circuit (mm^2)
	Circuit breaker QF(A)	Input cable	Output cable	Control terminal
PV0055	32	4	4	1
PV0075	32	4	4	1
PV0110	40	6	6	1
PV0150	63	6	6	1
PV0185	63	6	6	1
PV0220	100	10	10	1

Model	Input switch	Main circuit (mm^2)		Control circuit (mm^2)
	Circuit breaker QF(A)	Input cable	Output cable	Control terminal
PV0300	100	16	16	1
PV0370	125	25	25	1
PV0450	160	25	25	1
PV0550	200	35	35	1
PV0750	250	70	70	1
PV0900	315	70	70	1
PV1100	400	95	95	1

3). When a contactor is used for controlling the AC supply, don't use it to switch on or off the Variable Speed Drive.

4). DC reactor

DC reactor is required for the drive where power is greater than PV0900. For drives where power is lower than PV0750, it is optional.

Under following conditions, a DC reactor should be used to reduce the impact of AC supply to the drive and to protect the drive and suppress the high-order harmonics.

(1) If a capacitor tank used for reactive power compensation or a SCR load shares the same AC supply with the drive, the harmonics caused by the SCR load or the capacitor tank when it is switched on or off may damage the drive's input rectifying circuit;

(2) When the 3-phase AC supply of the drive is greater than 3% imbalance;

(3) If the input power factor of the drive is required to be greater than 0.93;

(4) When a large capacity transformer is connected to the drive, the input current of the drive may damage the rectifying circuit. Generally, if the input AC supply capacity of the drive is above 550KVA, or if the input AC supply capacity is 10 times that of the drive, a DC reactor is required to connect to the drive.

5). Input AC Line Reactor

A line reactor should be used if the distortion of power network is severe or the input current harmonic level is high even after a DC reactor has been connected to the drive. It can also be used to improve the AC input power factor of the drive.

6). Output AC Line Reactor

When the cables from the drive to motor are longer than 80m, multi-stranded cables and an AC line reactor should be used to suppress the high frequency harmonics. Thus, the motor insulation is protected against heat due to harmonics, leakage current is reduced and the drive will not trip frequently.

7). Input EMI filter

An EMI filter can be used to suppress the high frequency noise generated by the drive's power cables.

8). Output EMI filter

An EMI filter can be used to suppress the drive's output noise and leakage current of cables.

📖 Notes:

1. PV Series drive can meet the requirements of IEC 61800-3 after EMI filter is installed.

2. Installation of input and output EMI filters must be as close to the drive as possible. Refer to Section 3.4 of Chapter 3 for EMC installation instructions.

3. Refer to Section 2.3 of Chapter 2 for the technical parameters of optional parts.

2. Wire Connections of Drive for Basic Operation

Models: PV0055~PV0110

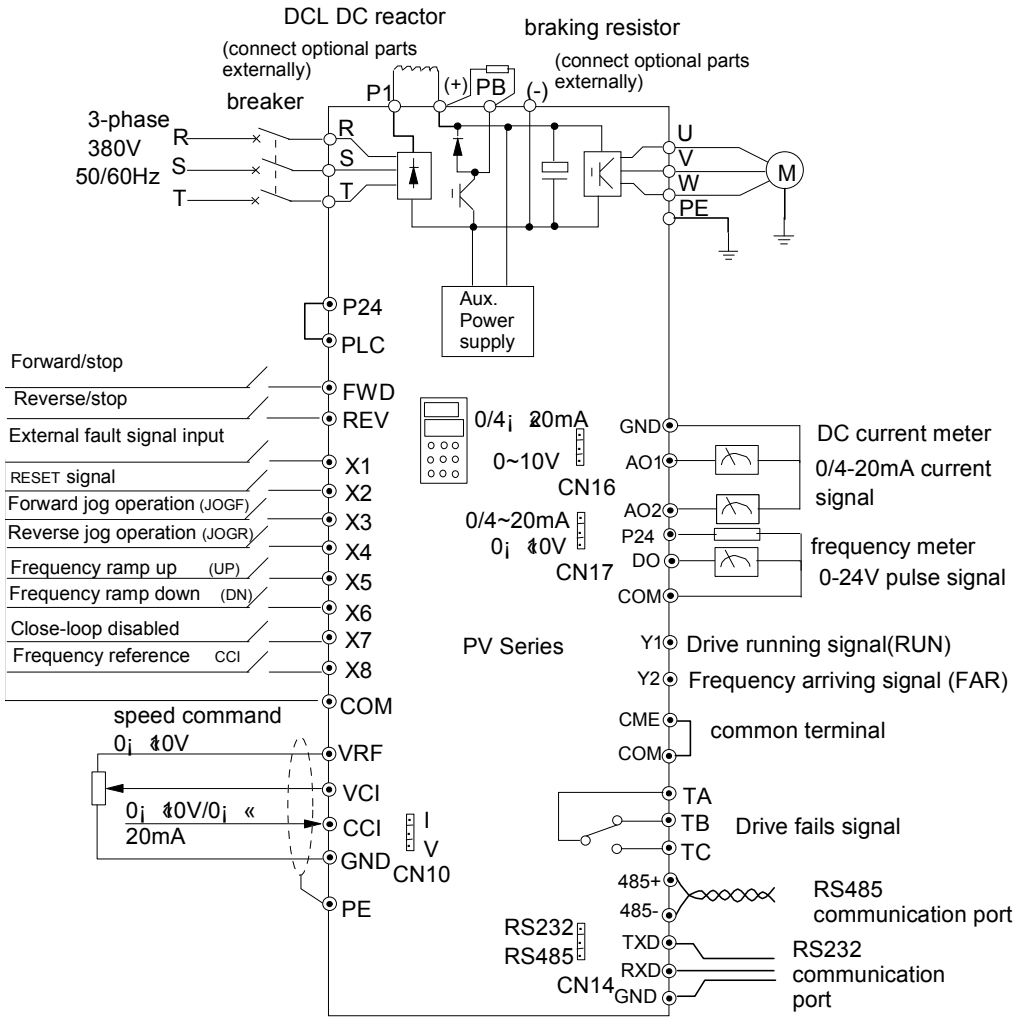


Fig. 3-9 Basic wiring 1

Notes:

1. Terminal CCI can input voltage or current signal by switching the jumper CN10 on control board;
2. The auxiliary power supply comes from the plus bus (+) and minus bus(-);
3. Built-in braking kit is installed and a braking resistor is required to be connected between (+) and PB;
4. In the above Figure., “O” is the terminal in main circuit, and “⊙” is the control terminal;
5. Refer to section 3.3.2 for the using of control terminals.

Applicable models:PV0150~PV1100

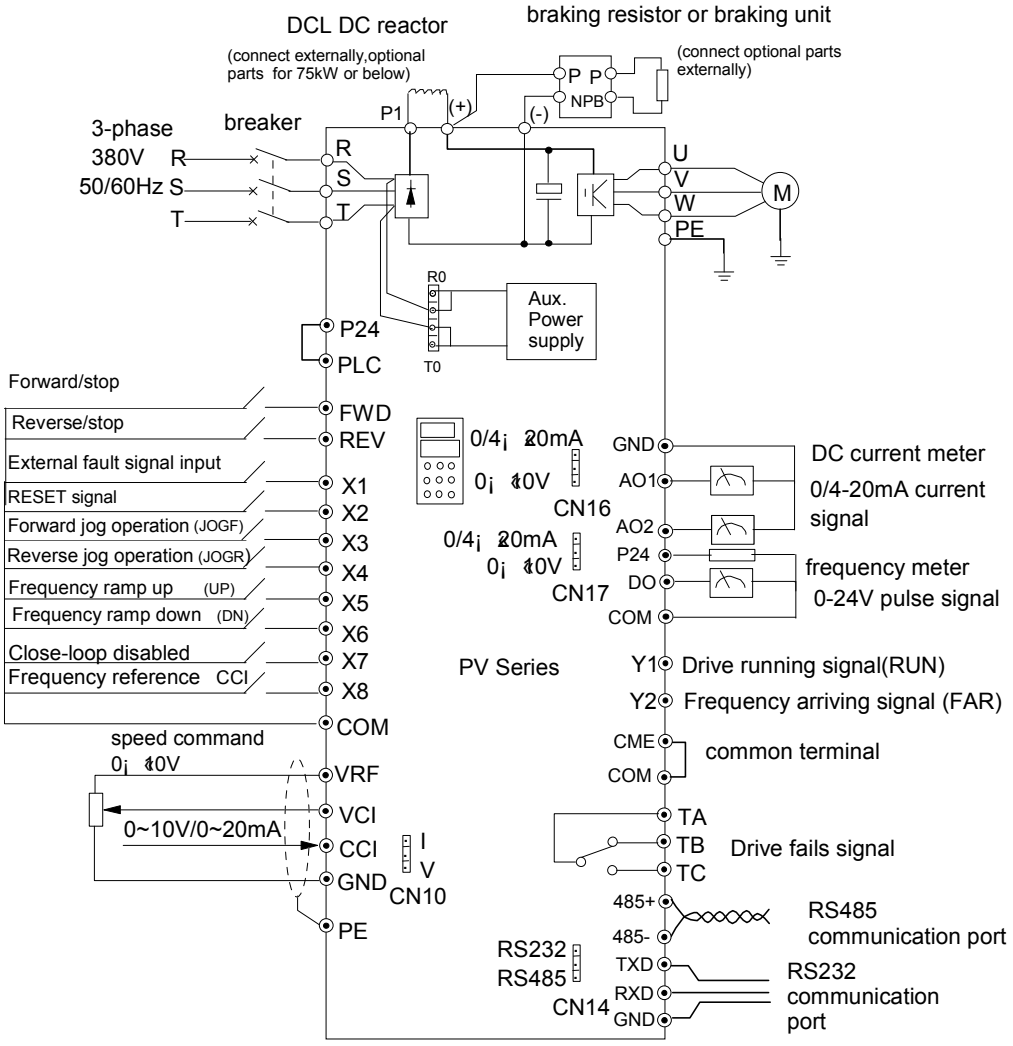


Fig. 3-10 Basic wiring 2

Notes:

1. Terminal CCI can input voltage or current signal by switching the jumper CN10 on control board;

2. The auxiliary power supply's AC supply comes from R0 &T0 which are shorted with R&T of 3-phase input. If user wants to use an external AC supply, the shorting bars between R&R0, T&T0 have to be removed before connecting the external AC supply via R0&T0. Otherwise, short-circuit will occur.

3. It is prohibited to connect to the control power supply without disconnecting the short-circuit bar, so as to avoid accidental short-circuit;

4. If external braking parts are needed, then braking kit and braking resistors should be included; Pay attention to the polarity of the braking kit when wiring.

5. In the above Figure., "O" is the terminal in main circuit, and "⊙" is the control terminal;

6. Refer to section 3.3.2 for the using of control terminals.

3. Input/Output Terminals in Main Circuit

1) Applicable models:

PV0055~PV0185

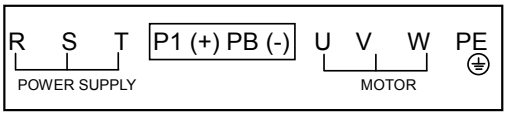


Table 3-2 Terminals of main circuit

Terminals	Function
R, S, T	3-phase 380V AC supply input terminals
P1, (+)	Reserved terminals for DC reactor
(+), PB	Reserved terminals for braking resistor
(-)	Output terminal for DC Minus Bus
U, V, W	3-phase AC output terminals
PE	Earth terminal

Notes:

Terminals PB of PV0150 and PV0185 are suspended.

2) Applicable models:

PV0220~PV0550

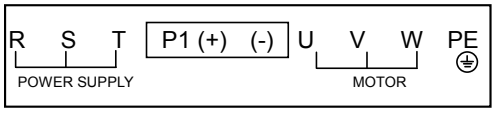


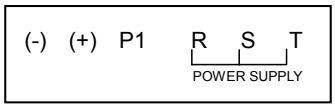
Table 3-3 Terminals of main circuit

Terminals	Function
R. S. T	3-phase 380V AC supply input terminals
P1. (+)	Reserved terminals for DC reactor
(-)	Output terminal for DC Minus Bus
U. V. W	3-phase AC output terminals
PE	Earth terminal

3) Applicable models:

PV0750

Top：



Bottom：

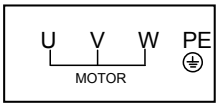


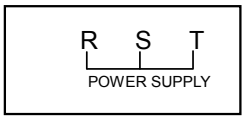
Table 3-4 Terminals of main circuit

Terminals	Function
R, S, T	3-phase 380V AC supply input terminals
P1, (+)	Reserved terminals for DC reactor
(-)	Output terminal for DC Minus Bus
U, V, W	3-phase AC output terminals
PE	Earth terminal

4) Applicable models:

PV0900~PV1100

Top：



Bottom：

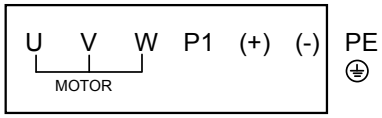


Table 3-5 Terminals of main circuit

Terminals	Function
R. S. T	3-phase 380V AC supply input terminals
P1. (+)	Reserved terminals for DC reactor
(-)	Output terminal for DC Minus Bus
U. V. W	3-phase AC output terminals
PE	Earth terminal

3.3.2 Wire Connections of Control Circuit

1. Terminals and jumpers of control board

Locations of terminals CN5, CN6 and CN7 and jumpers CN10, CN14, CN16 and CN17 are shown in Fig. 3-11.

Terminal functions are given in Table 3-6. Refer to table 3-7 for the functions and settings of jumpers. Wire the terminals and set the jumpers correctly before using the Variable Speed Drive. It is recommended to use cables bigger than 1mm^2 to connect to the terminals.

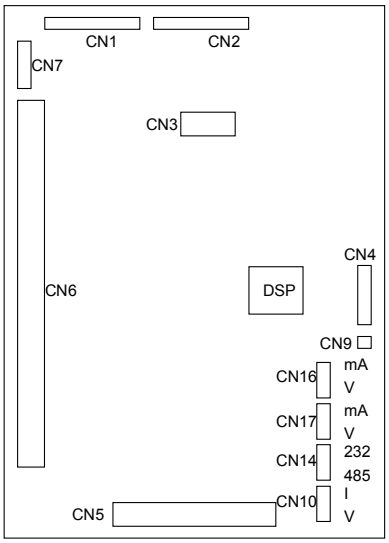


Fig. 3-11 Locations of jumpers on the control board

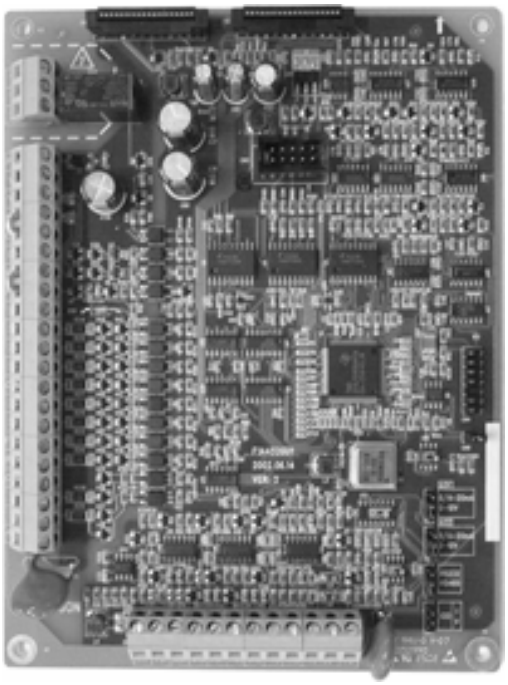


Fig. 3-12 Photo of control board

Table 3-6 Functions of terminals provided to users

SN	Function
CN5	Analog input and output terminal, RS232 and RSRS485 communication port
CN6	Digital input/output terminal
CN7	Relay output terminal

Table 3-7 Functions of jumpers provided to users

SN	Function and settings	Factory settings
CN10	Used for selecting CCI current/voltage input I:0/4~20mA current signal, V:0~10V voltage signal	0~10V
CN14	Used for selecting communication ports(RS232 or RS485) RS232: Select RS232 port, RS485: Select RSRS485 port	RS485
CN16	Used for selecting the output signal(current or voltage) of analog output terminal AO1; 0/4~20mA:AO1 output current signal; 0~10V:A01 output voltage signal	0~10V
CN17	Used for selecting the output signal(current or voltage) of analog output terminal AO2; 0/4~20mA:AO2 output current signal; 0~10V:AO2 output voltage signal	0~10V

2. Wire connections of terminals on control board

1) Terminal CN5 on control board

Arrangements of terminals of CN5:

VRF	VCI	CCI	GND	AO1	AO2	GND	TXD	RXD	485+	485-	PE

Functions of terminals of CN5 are given in Table 3-8.

Table 3-8 Functions of terminals

Category	Terminals	Name	Function		Specification
Communication	RS485+	RS485 communication port	RS485 +	RS232/RS485 can be selected by jumper CN14, RS485 mode is the default mode.	Standard RS-485 communication port, please use twisted-pair cable or shielded cable.
	RS485-		RS485 -		
	TXD	RS232 communication port	Transmitting pin (reference ground: GND)		Standard RS232 communication port, 3-wire connection(only use TXD, RXD and GND). Maximum distance: 15m
	RXD		Receiving pin(reference ground: GND)		
Analog input	VCI	Analog input VCI	Be able to accept analog voltage input (reference ground: GND)		Input voltage range:0~10V (input resistance:100kΩ) resolution:1/2000
	CCI	analog input CCI	Be able to accept analog voltage/current input. Jumper CN10 can select voltage or current input mode, Voltage input mode is the default mode.(reference ground: GND)		Input voltage range:0~10V(input resistance:100kΩ) Input current range:0~20mA(input resistance:500Ω) resolution:1/2000
Analog output	AO1	analog output 1	Be able to output analog voltage/current (total 12 kinds of signals). Jumper CN16 can select voltage or current input mode, Voltage input mode is the default mode. Refer to F7.26 for details. (reference ground: GND)		Output current range:0/4~20mA Output voltage range:0/2~10V
	AO2	analog output 2	Be able to output analog voltage/current (total 12 kinds of signals). Jumper CN17 can select voltage or current input mode, Voltage input mode is the default mode. Refer to F7.27 for details.(reference ground: GND)		
Power supply	VRF	+10V power supply	Provide +10V power supply		Maximum output current is 50mA
	GND	GND of +10V power supply	reference ground of analog signal and 10V power supply		Isolated with COM and CME
Shielding layer	PE	GND of shielding layer	Terminal used for the earthing the shielding layer. The shielding layers of analog signal cable, RS485 communication cable and motor cable can be connected to the terminal.		Connected to PE inside the drive.

1.Wire connections for analog input terminal

①VCI can accept analog voltage signal input and wiring is shown below:

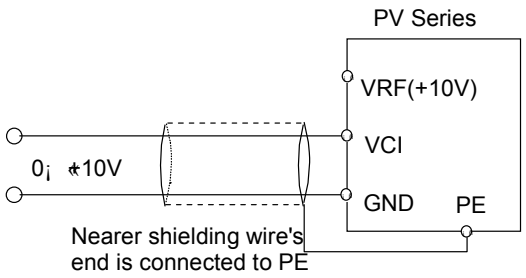


Fig. 3-13 Wire connections for terminal VCI

②CCI can accept analog signal input and the jumper can be used to select voltage input (0~10V) and current input (0/4~20mA). The wiring is shown below:

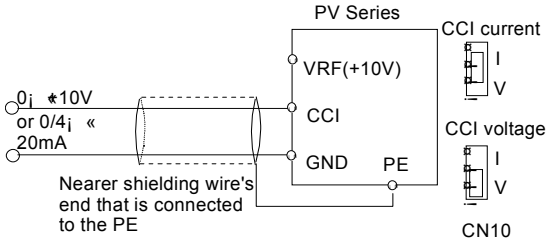


Fig. 3-14 Wire connections CCI

2. Wire connections for analog output terminal

If the analog output terminals AO1 and AO2 are connected to analog meters, then various kinds of physical values can be indicated. The jumper can select current output (0/4~20mA) and voltage output(0/2~10V). The wiring is shown in Fig.3-15..

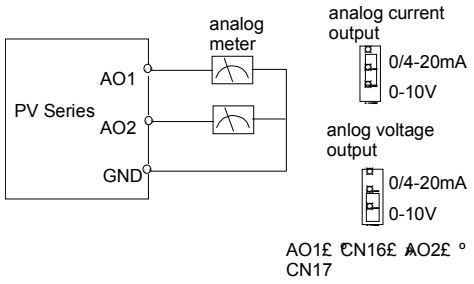


Fig. 3-15 Wire connections for analog output terminal

Notes:

(1) When using analog input, a common mode inductor can be installed between VCI and GND or CCI and GND.

(2) Analog input and output signals are easily disturbed by noise, so shielded cables must be used to transmit these signals and the cable length should be as short as possible.

3. Wiring of Serial Communication Port

Wire connections of serial communication port

PV Series drive provides the user with two kinds of serial ports that are RS232 and RS485 and can be selected by Jumper CN14.

Using the following wire connections, a “single-master single slave” system or a “single-master multi-slaves” system can be formed. The drives in the network can be monitored, and be controlled remotely and automatically in real time by using a PC or PLC controller. Thus more complicated operation control can be realized.

①The drive connects to the host via its RS232 port:

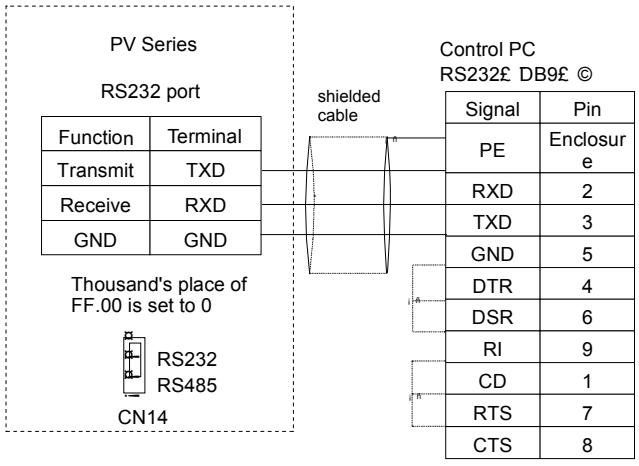


Fig. 3-16 RS232-RS232 communication cables

② Connection between the drive’s RS485 port and the host PC:

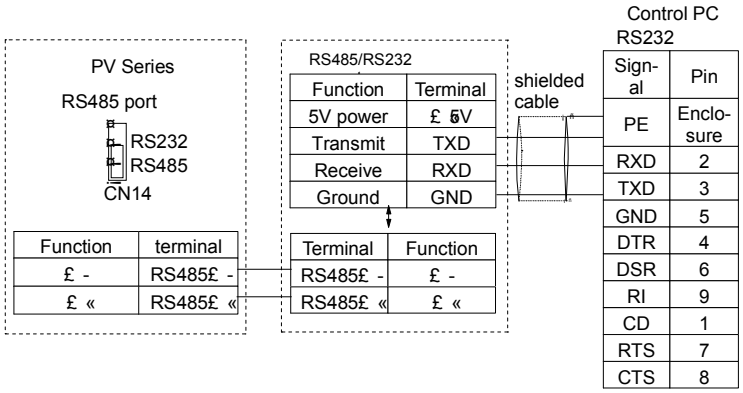


Fig. 3-17 RS485-(RS485/RS232)-RS232 communication cable

③ Connect the drive to the host PC via a MODEM:

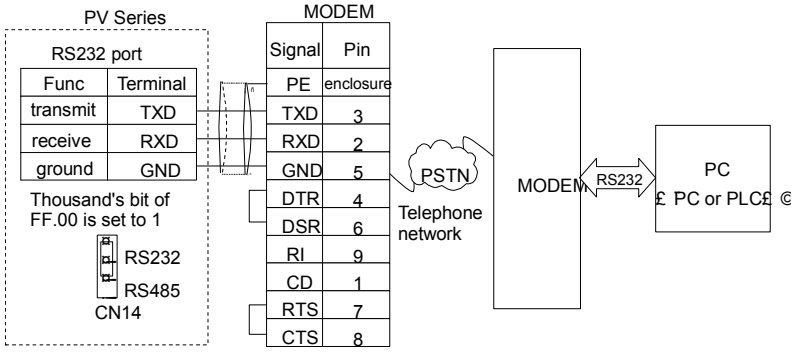


Fig. 3-18 Wire connections of RS232-(MODEM-PSTN-MODEM)-RS232 communication

④The drive's RS485 port connects to PROFIBUS-DP via the TDS-PA01(made by ENPC):

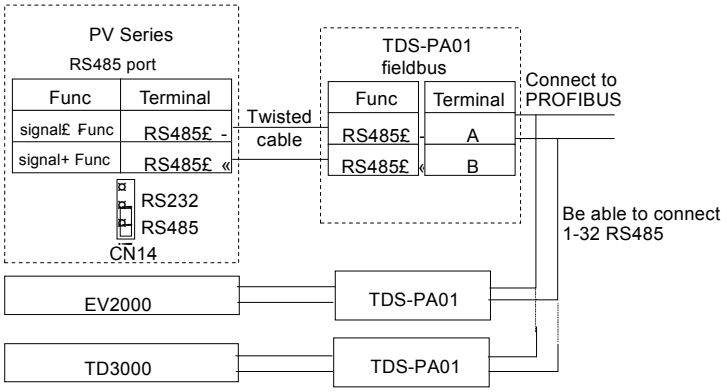


Fig. 3-19 Wire connections of RS485-(TDS-PA01)-PROFIBUS communication

If several drives are connected in the network via RS485, the disturbance to the communication system increases. So the wiring is especially important, the user can connect the cables according to the figure below:

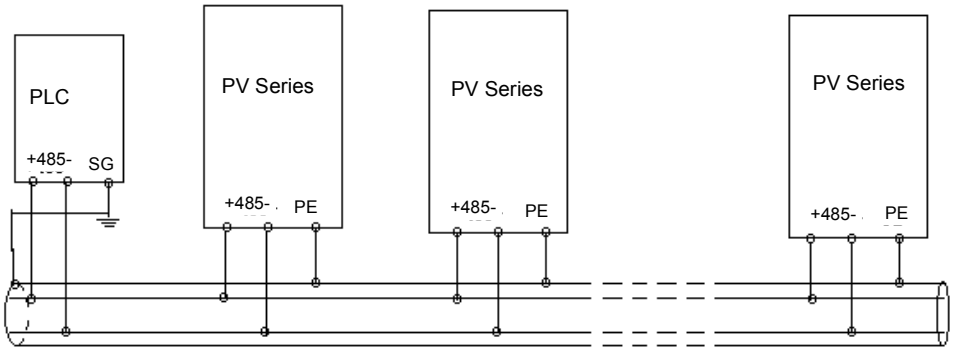


Fig. 3-20: Wiring diagram for communication between PLC and the drive (the drive and motor are grounded well)

If the communication is still abnormal, then the following actions can be taken:

① Feed a separately AC supply to the PLC(or host PC) and isolate the AC supply;

② If RS485/RS232 conversion module is used, then the module should be powered by a separately power supply;

③ Mount magnetic core to the communication cable, reduce the carrier frequency if the field conditions permit.

2). Description of control terminals CN6 and CN7

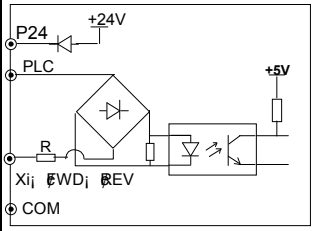
Layout of CN6:

P24	Y1	Y2	CME	COM	DO	P24	PLC	X1	X2	X3	X4	COM	X5	X6	FWD	REV	COM	X7	X8	PE

Layout of CN7:

TA	TB	TC

Table 3-9 Functions of terminals of CN6 and CN7

Category	Terminal	Name	Functions	Specifications
Operation control terminals	FWD	Terminal for inputting run forward operation command	The commands of run forward and run reverse (common terminal: PLC)	Optical-isolator input input resistance: R＝2kΩ maximum input frequency: 200Hz Input voltage range: 9~30V
	REV	Terminal for inputting run reverse operation command		
multi-function input terminal	X1	multi-function input terminal 1	See section 5.8 Chapter 8 for the programmable multi-function digital input terminal (common terminal: PLC)	
	X2	multi-function input terminal 2		
	X3	multi-function input terminal 3		
	X4	multi-function input terminal 4		
	X5	multi-function input terminal 5		
	X6	multi-function input terminal 6		
	X7	multi-function input terminal 7	Terminals X7 and X8 can be used as common multi-function terminals(same with X1~X6), they can also be used as high speed pulse input port. See section 5.8 Chapter 8 for details. (common terminal: PLC)	Equivalent circuit of optical-isolator input is shown above. input resistance: R＝2kΩ Max input frequency:100kHz(single phase)/50kHz(dual phase) Input voltage range: 15~30V
	X8	multi-function input terminal 8		
multi-function output terminal	Y1	Open collector output terminal 1	Multi-function digital output terminal can be defined. See section 5.8 Chapter 5 for details. (common terminal: CME)	Optical-isolator output Operating voltage range:9~30V Max output current:50mA Refer to the explanations of F7.10~F7.11 for the using methods.
	Y2	Open collector output terminal 2		
	DO	Open collector pulse output terminal	Multi-function pulse signal output terminal can be defined. See section 5.8 Chapter 5 for details. (reference ground: COM)	Output frequency range: dependent on F7.32, and the Max frequency is 50kHz
Relay's output terminals	TA	output terminals of relay	Multi-function relay output terminal can be defined. See section 5.8 Chapter 5 for details.	TA-TB: normally closed, TA-TC: normally open Capacity of contacts: AC250V/2A(COSΦ=1) AC250V/1A(COSΦ=0.4) DC30V/1A
	TB			
	TC			

Category	Terminal	Name	Functions	Specifications
Power supply	P24	+24V power supply	Provide +24V power supply for external equipment.	Maximum output current:200mA
	PLC	Common terminal of multi-function input terminal	Common terminal of multi-function input terminal (short circuit with P24)	Common terminal of X1~X8., FWD and REV. PLC is isolated from P24.
	COM	Common terminal of +24V power supply	Total 3 common terminals, which are used in conjunction with other terminals.	COM is isolated with CME and GND.
	CME	Common terminal of Y1 and Y2 output	Common terminal of multi-function Y1 and Y2 output (Short circuit with COM by manufacturer)	
Shielding	PE	Shielded GND	Grounding terminal connected to shielding layer	Connected to PE inside the drive

1) Wire connections multi-function input terminals, terminals FWD and REV:

PV Series X1~X8 multi-function input terminals use full-bridge rectifying circuits as shown in Fig. 3-21. PLC is the common terminal of terminals X1~X8, FWD and REV. The PLC terminal can sink or source current. Wire connections X1~X8, FWD and REV is flexible and the typical wiring is shown below:

A) connection method 1 (Dry contacts)

①If internal 24V power supply is used, the Wire connections is shown in Fig. 3-21.

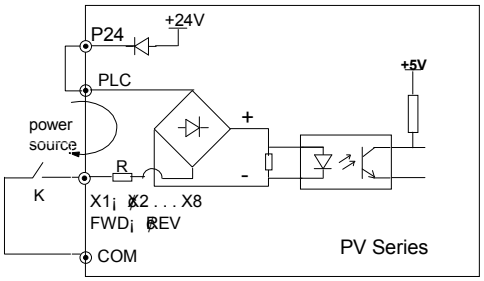


Fig. 3-21 Wire connections when using internal 24V power supply

②If an external power supply is used, then use the Wire connections shown in Fig. 3-22. (be sure to disconnect the cable between P24 and PLC)

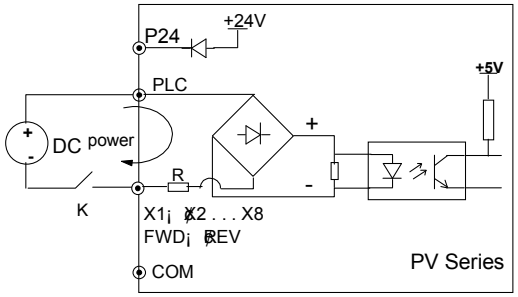


Fig. 3-22 Wire connections when an external power supply is used

B). connection method 2

①Drive's internal +24V power supply is used and the external controller uses NPN transistors whose common emitters are connected, as shown in Fig. 3-23.

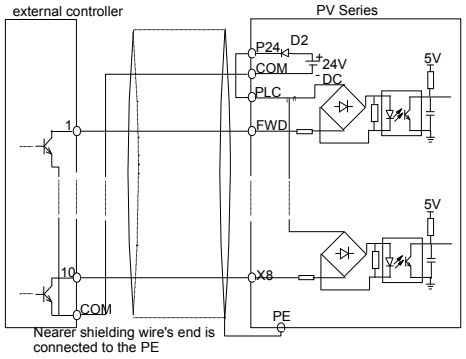


Fig. 3-23 Connection method 2 (a)

②Drive's internal +24V power supply is used and the external controller uses PNP transistors whose common emitters are connected, as shown in Fig. 3-24.

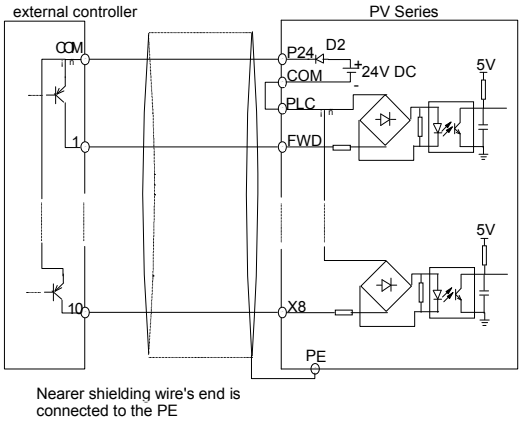


Fig. 3-24 Connection method 2 (b)

③Use external power supply:

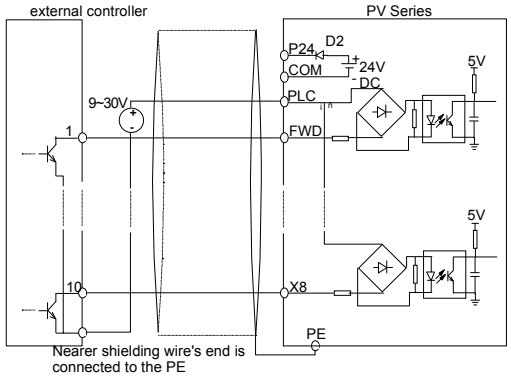


Fig. 3-25 Connection method 2 (c)

④Use external power supply:

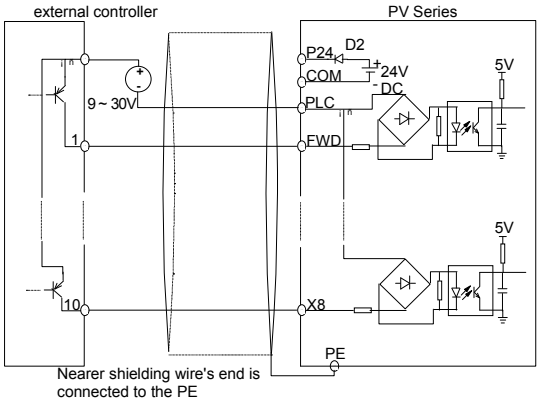


Fig. 3-26 Method 2 of connections(d)

2) Wire connections of multi-function output terminal

①Multi-function output terminals Y1 and Y2 can use the 24V power supply inside the drive and the wiring mode is shown in Fig. 3-27.

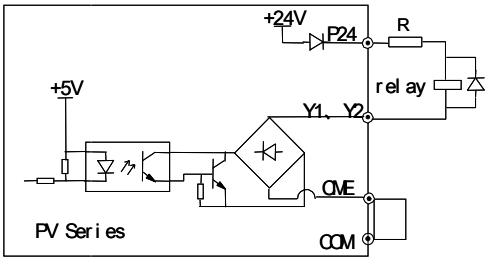


Fig. 3-27 Wire connections 1 of multi-function output terminal

②Multi-function output terminals Y1 and Y2 can also use the 9~30V power supply outside the drive and the wiring mode is shown in Fig.3-28.

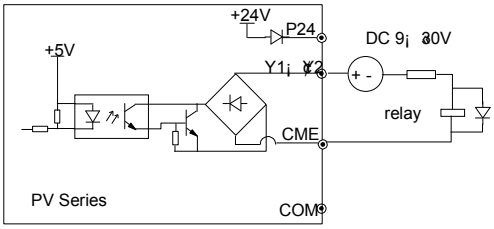


Fig. 3-28 Wire connections 2 of multi-function output terminal

③Pulse output terminal DO can use the 24V power supply inside the drive and the wiring is shown in Fig.3-29.

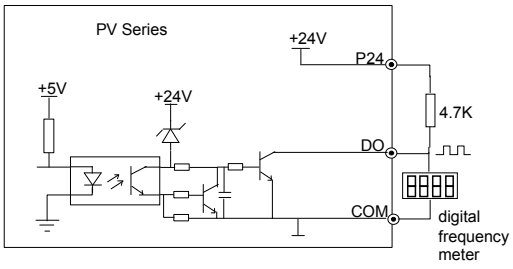


Fig. 3-29 Wire connections 1 of output terminal DO

④Pulse output terminal DO can also use the external 9~30V power supply and the wiring is shown in Fig.3-30.

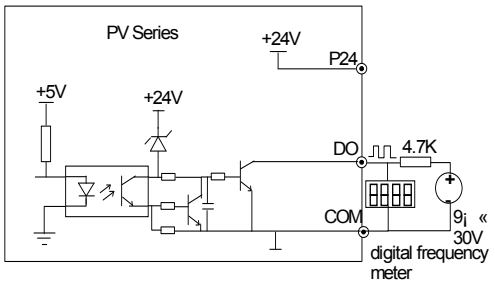


Fig. 3-30 Wire connections 2 of output terminal DO

3) Wire connections relay output terminals TA, TB and TC.

If the relay drives an inductive load (such as another relay or contactor), then a surge suppressing circuit should be added, such as RC snubber circuit (pay attention that the leakage current must be smaller than the holding current of the controlled relay or contactor) and varistor or a free-wheeling diode (used in the DC electro-magnetic circuit and pay attention to the polarity during installation). Snubbing components should be located as close as possible to the coils of relay or contactor.

Notes:

1. Don't short circuit terminals P24 and COM, otherwise the control board may be damaged.

2. Please use multi-core shielded cable or multi-stranded cable (above 1mm) to connect the control terminals.

3. When using a shielded cable, the shielded layer's end that is nearer to the drive should be connected to PE.

4. The control cables should be as far away (at least 20cm) as possible from the main circuits and high voltage cables (including power supply cables, motor cables, relay cables and cables of contactor). The cables should be vertical to each other to reduce the disturbance to minimum.

5. The resistors R in Fig. 3-27 and Fig.3-28 should be removed for 24V input relays, and the resistance of R should be selected according the parameters of relay, for non-24V relay.

3.4 Installation Methods Compliant With EMC Requirements

The drive inevitably generates noise due to its high switching frequency, so relevant EMC problems must be solved so as to reduce the drive's disturbance to external equipment. This chapter deals with the installation methods compliant with EMC requirements from the aspects of noise suppression, field wiring, grounding, leakage current and the using of power filter. This chapter can be used as a reference for field installation.

3.4.1 Noise Suppressing

The noise generated by the drive may disturb the equipment nearby. The degree of disturbance is dependent on the drive system, immunity of the equipment, Wire connections, installation clearance and earthing methods.

1. Noise categories

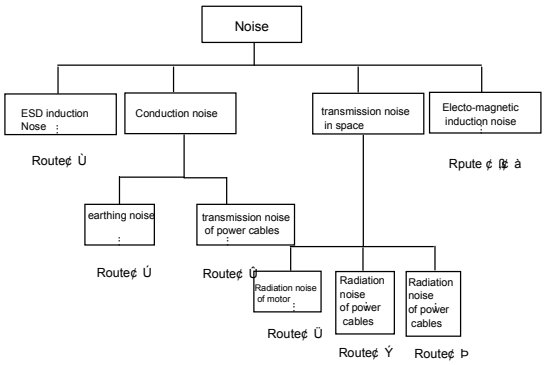


Fig. 3-31 Noise categories

2. Noise emission paths

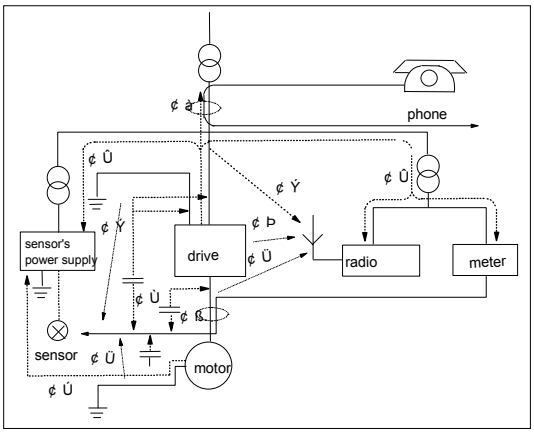


Fig. 3-32 Noise emission paths

3. Basic methods of suppressing the noise

Table 3-10 Basic methods of suppressing the noise

Noise emission paths	Actions to reduce the noise
②	When the external equipment forms a loop with the drive, the equipment may suffer nuisance tripping due to the drive's earth leakage current. The problem can be solved if the equipment is not grounded.
③	If the external equipment shares the same AC supply with the drive, the drive's noise may be transmitted along its input power supply cables, which may cause nuisance tripping to other external equipment. Take the following actions to solve this problem: Install noise filter at the input side of the drive, and use an isolation transformer or line filter to prevent the noise from disturbing the external equipment.
④⑤⑥	If the signal cables of measuring meters, radio equipment and sensors are installed in a cabinet together with the drive, these equipment cables will be easily disturbed. Take the actions below to solve the problem: (1)The equipment and the signal cables should be as far away as possible from the drive. The signal cables should be shielded and the shielding layer should be grounded. The signal cables should be placed inside a metal tube and should be located as far away as possible from the input/output cables of the drive. If the signal cables must cross over the power cables, they should be placed at right angle to one another. (2)Install radio noise filter and linear noise filter(ferrite common-mode choke) at the input and output sides of the drive to suppress the emission noise of power lines. (3)Motor cables should be placed in a tube thicker than 2mm or buried in a cement conduit. Power cables should be placed inside a metal tube and be grounded by shielding layer (Motor cable should be a 4-core cable, where one core should be connected to the PE of the drive and another should be connected to the motor's enclosure).
①⑦⑧	Don't route the signal cables in parallel with the power cables or bundle these cables together because the induced electro-magnetic noise and induced ESD noise may disturb the signal cables. Other equipment should also be located as far away as possible from the drive. The signal cables should be placed inside a metal tube and should be placed as far away as possible from the input/output cables of the drive. The signal cables and power cables should be shielded cables. EMC interference will be further reduced if they could be placed inside metal tubes. The clearance between the metal tubes should be at least 20cm.

3.4.2 Field Wire Connections

Control cables, input power cables and motor cables should be installed separately, and enough clearance should be left among the cables, especially when the cables are laid in parallel and are long. If the signal cables must cross over the power cables, they should cross at right angle to each other.

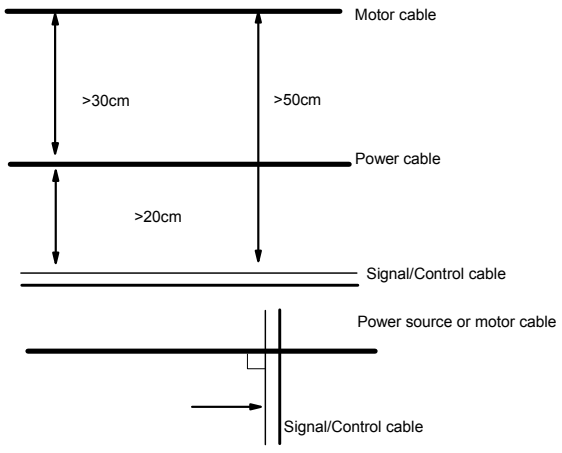


Fig. 3-33 Wire connections

The motor cables should be derated if they are too long or their cross sectional area (CSA) is too big. The drive's cables should be the cables with specified CSA (See Table 3-1) because the capacitance of the cable to

ground is proportional to the cable's CSA. If the cable with big CSA is used, its current should be reduced.

Shielded/armoured cable: High frequency low impedance shielded cable should be used. For example: Copper net, aluminum net or iron net.

Generally, the control cables should be shielded cables and the shielding metal net must be connected to the metal enclosure of the drive by cable clamps.

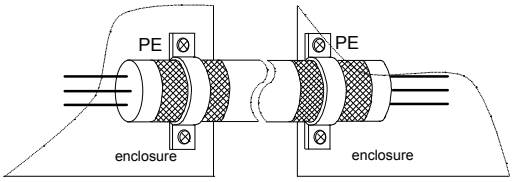


Fig. 3-34 Correct shielding method of shielding layer

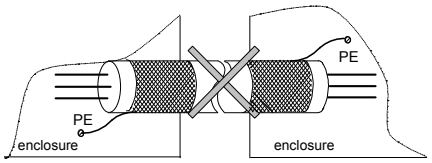


Fig. 3-35 Incorrect earthing method of shielding layer

3.4.3 Earthing

Independent earthing poles (best)

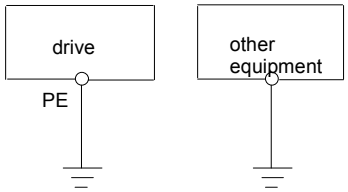


Fig. 3-36 Earthing diagram 1

Shared earthing pole (good)

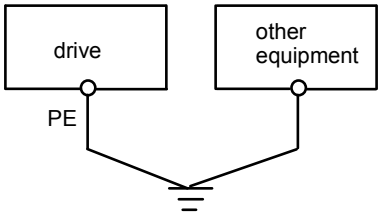


Fig. 3-37 Earthing diagram 2

Shared earthing cable (not good)

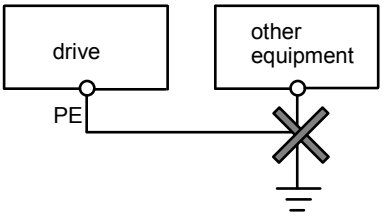


Fig. 3-38 Earthing diagram 3

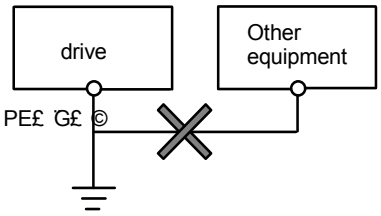


Fig. 3-39 Earthing diagram 4

Besides, pay attention to the following points:

In order to reduce the earthing resistance, flat cable should be used because the high frequency impedance of flat cable is smaller than that of round cable with the same CSA.

For 4-core motor cable, the end of one cable should be connected to the PE of the drive, and the other end should be connected to the motor's enclosure. If the motor and the drive each has its own earthing pole, then the earthing effect is better.

If the earthing poles of different equipment in one system are connected together, then the leakage current will be a noise source that may disturb the whole system. Therefore, the drive's earthing pole should be separated with the earthing pole of other equipment such as audio equipment, sensors and PC, etc.

In order to reduce the high frequency impedance, the bolts used for fixing the equipment can be used as the high frequency terminal. The paints on the bolt should be cleaned.

The earthing cable should be as short as possible, that is, the earthing point should be as close as possible to the drive.

Earthing cables should be located as far away as possible from the I/O cables of the equipment that is sensitive to noise, and lead should also be as short as possible.

3.4.4 Installation Requirements of Relay, Contactor and Electro-magnetic Braking Kit

The devices such as relay, contactor and electro-magnetic braking kit, which may generate great noises, should be installed outside of the drive cabinet and should be installed with surge suppressors.

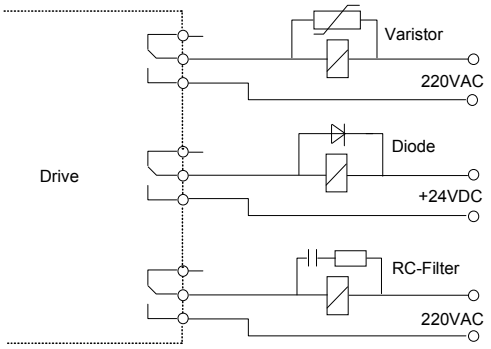


Fig. 3-40 Relay, contactor and electro-magnetic braking kit

3.4.5 Leakage Current

Leakage current may flow through the drive's input and output capacitors and the motor's capacitor. The leakage current value is dependent on the distributed capacitance and carrier wave frequency. The leakage current includes ground leakage current and the leakage current between lines.

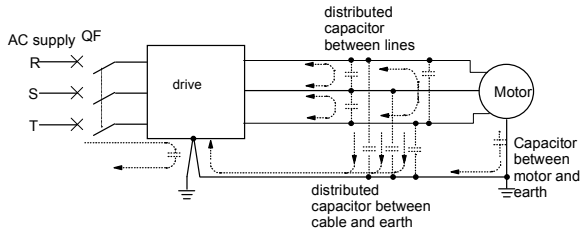


Fig. 3-41 Flowing path of leakage current

Ground leakage current

The ground leakage current not only flows into the drive system, but also into other equipment via earthing cables. It may cause leakage current circuit breaker and relays to be falsely activated. The higher the drive's carrier wave frequency, the bigger the leakage current, and also, the longer the motor cable, the greater is the leakage current,

Suppressing methods:

Reduce the carrier wave frequency, but the motor noise may be higher.

Motor cables should be as short as possible;

The drive and other equipment should use leakage current circuit breaker designed for protecting the product against high-order harmonics/surge leakage current;

Leakage current between lines

The line leakage current flowing outside through the distribution capacitors of the drive may false trigger the thermal relay, especially for the drive of which power rating is less than 7.5kW. When the cable is longer than 50m, the ratio of leakage current to motor rated current may increase to a level that can cause the external thermal relay to trigger unexpectedly.

Suppressing methods:

Reduce the carrier wave frequency, but the motor audible is greater.

Install reactor at the output side of the drive.

In order to protect the motor reliably, it is recommended to use a temperature sensor to detect the motor's temperature, and use the drive's over-load protection device (electronic thermal relay) instead of an external thermal relay.

3.4.6 Correct EMC Installation

Divide the installation space into different areas

In drive control system, the drive, control equipment and sensors are installed in the same cabinet. The noise should be suppressed at the main connecting points, with RFI filter and input reactor installed in the cabin to fulfill the EMC requirements.

The most inexpensive and effective measure to reduce the interference is to isolate the noise source and the noise receiver. This should be considered in mechanical/system design phase. In a drive control system, the noise source may be drive, brake unit and the contactor. Noise receiver can be automation equipment, encoder and sensor.

The mechanical/system is divided into different EMC area according to its electrical characteristics. The recommended installation positions are shown in the following figure:

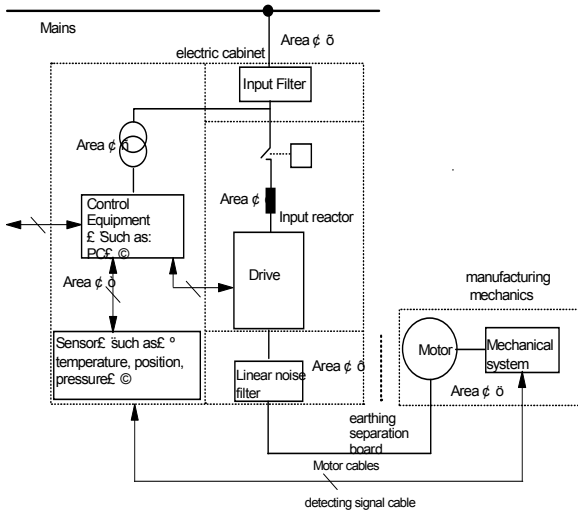


Fig. 3-42 Divide installation space into different sections according to EMC rules

Attention:

• Area Ⅰ should be used to install transformers for control power supply, control system and sensor.

• Area Ⅱ should be used for interface signal and control cables of correct immunity level

• Area Ⅲ should be used to install noise generating devices such as input reactor, drive, brake unit and contactor.

• Area Ⅳ should be used to install output noise filter

•Area Ⅴ should be used to install power source and cable connecting the RFI filter.

• Area Ⅵ should be used to install the motor and motor cables.

• Areas should be isolated in space, so that electro-magnetic decoupling effect can be achieved.

• The shortest distance between areas should be 20cm.

•Earthing bars should be used for decoupling among areas, the cables from different area should be placed in different tubes.

• The filter should be installed at the interfaces between different areas if necessary.

• Bus cable(such as RS485) and signal cable must be shielded

Electrical installation of the drive

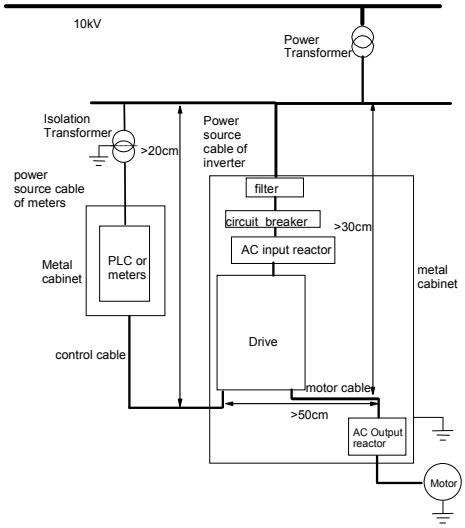


Fig. 3-43 Installation of the drive

• Motor cable should be earthed at the drive side. If possible, the motor and drive should be earthed separately;

•Motor cable and control cable should be shielded or armored. The shield must be earthed with cable fastener to improve high frequency noise immunity.

• Assure good conductivity among installation plates, installation screws and the metal case of drive; Use tooth-shape washer and conductive installation plate;

Generally, if there are some sensitive equipment in the installation, it is more cost effective to install a power filter at the sensitive equipment side.

3.4.7 Applications of Power Filter

Power source filter should be used in the equipment that may generate strong EMI or the equipment that is sensitive to EMI. The power source filter should be a low pass filter through which only 50Hz current can flow and high frequency current should be rejected

Function of power line filter

The power line filter ensures the equipment can satisfy the conducting emission and conducting sensitivity in EMC standard. It can also suppress the radiated emission of the equipment.

Prevent the EMI generated by the equipment from entering power cable, and at the same time prevent the EMI generated by power cable from entering equipment.

Common mistakes in using power line filter

1. Too long power cable

The filter inside the cabinet should be located near to the input power source. The length of the power cables should be as short as possible.

2. The input and output cables of the AC supply filter are too close

The distance between input and output cables of the filter should be as far apart as possible, otherwise the high frequency noise may be coupled between the cables and bypass the filter. Thus, the filtering effect becomes ineffective.

3. Bad earthing of filter

The filter's enclosure must be earthed properly to the metal case of the drive. In order to be earthed well, make use of a special earthing terminal on the filter's enclosure. If you use one cable to connect the filter to the case, the earthing is useless for high frequency interference. When the frequency is high, so is the impedance of cable, hence there is little bypass effect.

The filter should be mounted on the enclosure of equipment. Ensure to clear away the insulation paint between the filter case and the enclosure for good earthing contact.

3.4.8 EMI of The Drive

The drive's operating theory decides that its EMI is unavoidable.

The drive is usually installed in a metal cabinet, the instruments outside the metal cabinet is disturbed by the drive lightly. The cables are the main EMI source, if you connect the cables according to the manual, the EMI can be suppressed effectively.

If you install the drive and other control equipment in one cabinet, so the area rule must be observed, pay attention to the isolation between different area, cable layout and shielding.

Chapter 4 Operation Procedures

4.1 Notices

In the follow-up sections, you may encounter the terms describing the control, running and status of drive many times. Please read this section carefully. It will help you to understand and use the functions to be discussed correctly.

4.1.1 The Drive's Control Modes

It defines the methods by which drive receives operating commands like START, STOP, FWD, REV, JOG and others.

Panel control: The drive is controlled by RUN, STOP and JOG keys on the operation panel;

Terminal control: The drive is controlled by terminals FWD, REV and COM.

Host control: The operations such as START and STOP is controlled by host PC.

The control modes can be selected by parameter F0.03.

Warning:

The user must ensure that the control mode selected is suitable for the application. Wrong selection of control mode may cause damage to equipment or human injury!

4.1.2 Reference Selector

Irrespective of the operating modes, the PV Series has 6 possible ways of setting the input frequency reference. The reference frequency can be input by:

▲ and ▼ keys on the operation panel;

Terminals UP/DN (Motorized Potentiometer);

Serial port;

Analog Voltage Command Input (VCI);

Analog Current Command Input (CCI);

Pulse terminal (PULSE)

4.1.3 Drive's Operating Status

There are 3 operating status: stopping status, operating status and Motor parameters auto-tuning status.

Stopping status: After the drive is switched on and initialized, if no operating command is accepted or the stopping command is executed, then the drive enters stopping status.

Operating status: The drive enters operating status after it receives the operating command.

Motor parameters auto-tuning status: If there is an operating command after FH.09 is set to 1 or 2, the drive then enters motor parameters auto-tuning status, and then enters stopping status after auto-tuning process is over.

4.1.4 Operating Modes

PV Series has 4 kinds of operating modes which can be arranged in the sequence of "Jog>Close loop operation>Multi-step speed operation>Simple operation" according to the priority, as shown in Fig. 4-1.

Jog:

When the drive is in stopping status, it will operate according to Jog frequency after it receives the Jog operation command (e.g. after the JOG key is pressed).

Close-loop operation:

If the close-loop operating function is enabled (F5.00=1), the drive will select the close-loop operation mode meaning that it will perform PI regulation according to the reference and feedback values (See explanations of Parameter F5). Close-loop operating function can be disabled by terminal X7, and the drive will select the simple operating mode.

Multi-step speed operation:

Select multi-step frequency 1~7(F3.23~F3.29) to start multi-step speed operation by the non-zero combinations of the multi-function terminals (No.1, 2, and 3 functions).

Simple operation:

Simple operation is actually the open-loop operation mode.

PV Series operating status is shown in Fig. 4-1:

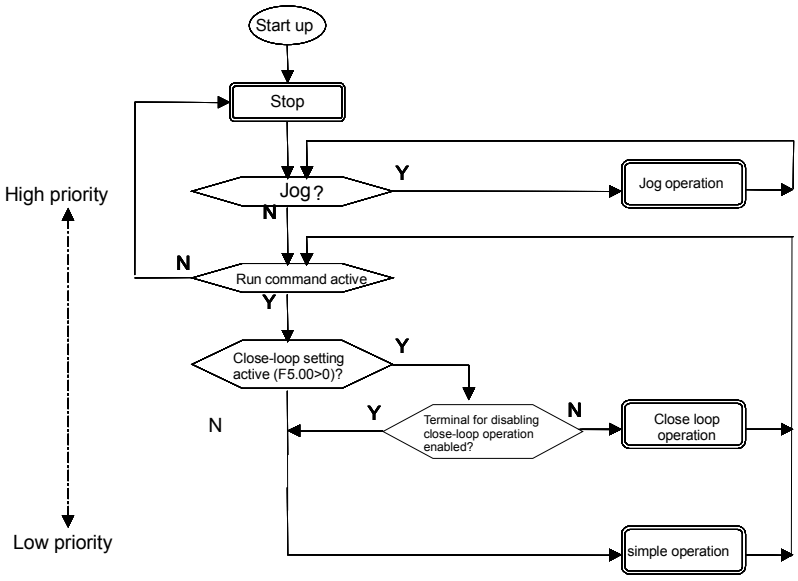


Fig. 4-1 Operating status of PV Series

Four operating modes provide 4 basic frequency sources.

4.2 Detailed Operating Instructions

4.2.1 Methods Using of the Operation Panel

The operation panel is used to setup the drive and display parameters. There are two types of operation panels, one with LED display and the other, LCD display. The LED display is the standard operation panel. The LCD operation panel is an optional accessory. It can display in English and Chinese characters, with description for the displayed data. The outlines, dimensions and operating methods of these two types of operation panels are the same, as shown in Fig. 4-2. For convenience, the operation of the LCD panel is described below:

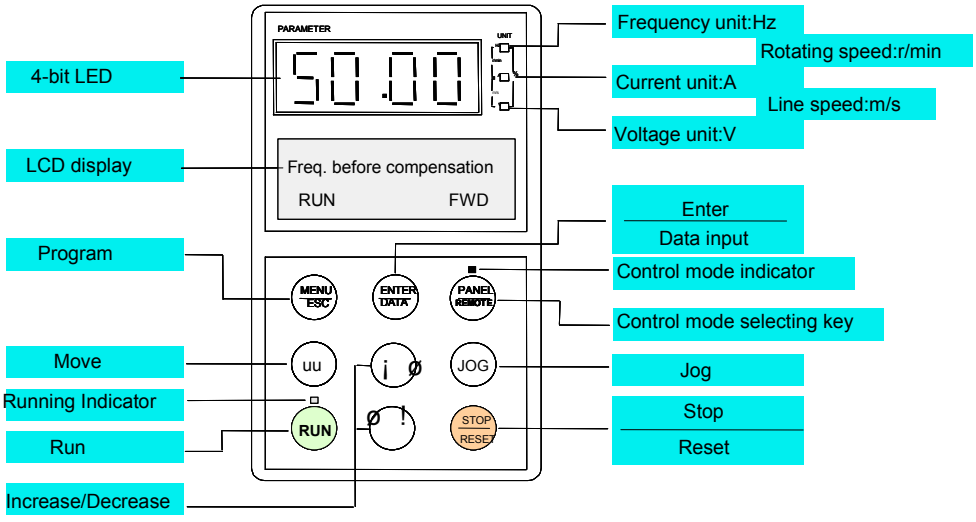


Fig. 4-2 Illustration of operation panel

⚠Attention The operation panel of the PV Series is not compatible with the panel of other Emerson Electric variable speed drives!

4.2.2 Functional Description of the Keys

There are 9 keys on the operation panel of the drive and the functions of each key is described in Table 4-1.

Table 4-1 Function of operation panel

Key	Name	Function
MENU/ESC	Program/exit key	Enter or exit programming status
ENTER/DATA	Function/data key	Enter lower level menu or enter data
▲	Increase	Increase data or parameter
▼	Decrease	Decrease data or parameter
▶▶	Shift	In editing status, pressing this key select the bit to be modified. In other status, this key is used to scroll through the parameters.
PANEL/ REMOTE	reserved	reserved
JOG	Jog key	In panel control mode, press this key to start Jog operation.
RUN	Run key	In panel control mode, press this key to start running the drive.
STOP/RESET	Stop/reset key	Press this key to stop or reset the drive.

4.2.3 Functional Description of LEDs and Indicators

The operation panel consists of a 4-bit seven segments display, 3 LED indicators that indicate unit and 2 status indicators as shown in Fig. 4-3. The seven segments can display the status parameters, parameters and fault codes of the drive. These 3 unit indicators have 7 different combinations and each combination corresponds to one type of unit. The relationship between the combination of the indicators and the unit is shown in Fig. 4-3:

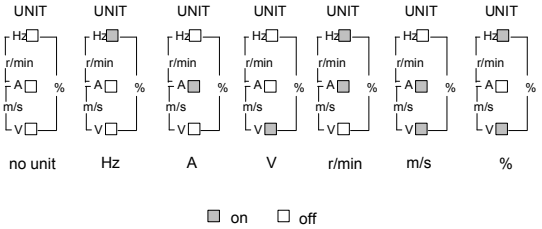


Fig. 4-3 Relationship between the combination of the indicators and the unit

Two status indicators: Operating status indicator is above the RUN key. The control mode indicator is above the PANEL/REMOTE key, and the functions of these indicators are shown in Table 4-2.

Table 4-2 Functions of status indicators

Indicator	Display status	Current status of the drive
Operating status indicator	Off	Stopping status
	On	Operating status
Control mode indicator	On	Panel control status
	Off	Terminal control status
	Flash	Serial port control status

4.2.4 Displaying status of the Drive

PV Series operation panel can display the parameters in stopping process, parameters in operating status, editing status of parameters and fault alarming status.

1. Parameters displaying in stopping status

When the drive stops operation, the panel will display reference frequency

2. Parameters displaying in operating status

When the drive receives operating command, it starts running and its panel will display the status parameters in operating status, as shown in Fig.c of Fig. 4-4. The unit indicator at right indicates the unit of the parameter.

Different parameters in operating status can be displayed by pressing ▶▶ key (as shown in Fig 4-7).

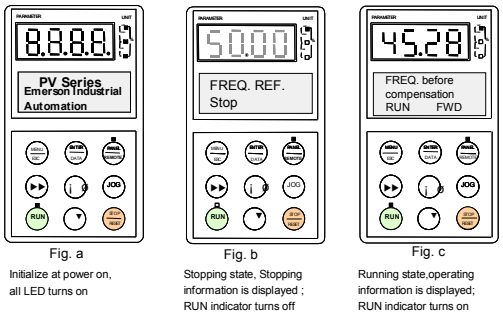


Fig. 4-4 Information displayed when the drive is initialized, stopping and operating

3. Displaying Alarm information

When the drive detects a fault signal, its panel will display a flashing alarm message, that is, display the fault code (as shown in Fig. 4-5);

Reference frequency can be viewed by pressing the ▶▶ key in stopping status. Fault information can be queried by pressing MENU/ESC key. The drive can be reset by pressing the STOP/RESET key, or sending the reset commands via the control terminal X2 or serial port. The fault code will continue to be displayed if the fault has not been cleared.

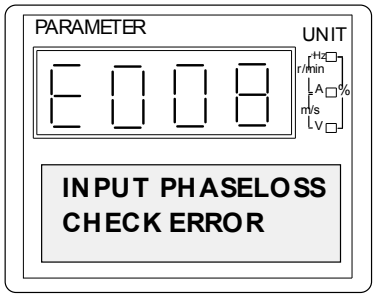


Fig. 4-5 Alarm displaying status

4. Configuring status of parameters

When the drive is in stopping, operating or alarming status, pressing MENU/ESC can enter configuring status (Refer to explanations of FP.00 and Fig. 4-13, if user's password is available). Configuring status can be displayed in 3-level menu as shown in Fig. 4-6, and the displaying sequence is: Group of parameter→Parameter →Parameter value. The user can enter these 3 levels by pressing ENTER/DATA. In parameter displaying status, press ENTER/DATA to save the parameter settings, and press MENU/ESC to exit.

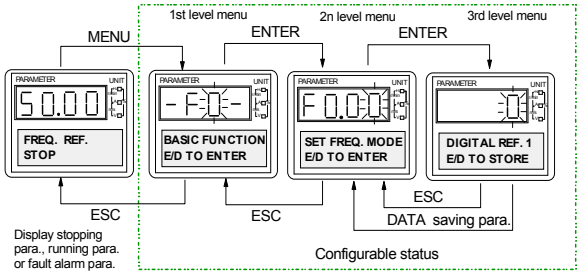


Fig. 4-6 Configuring status

4.2.5 Operating Methods of Panel

The user can operate the drive via the panel. Examples are given below:

Status Parameter displaying:

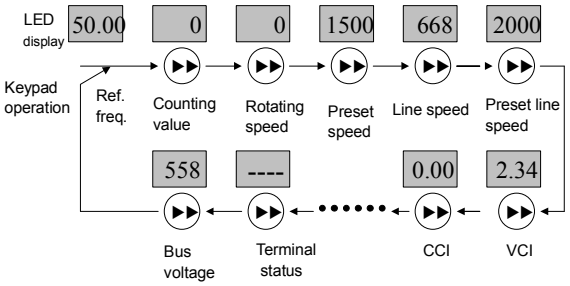


Fig. 4-7 Display parameters in running status

(When stopped, only reference frequency is displayed.)

Parameter setup:(Change the setting of F3.30 from 50.00Hz to 6.50Hz. The bold faced digits in Fig. 4-8 means the flashing bits)

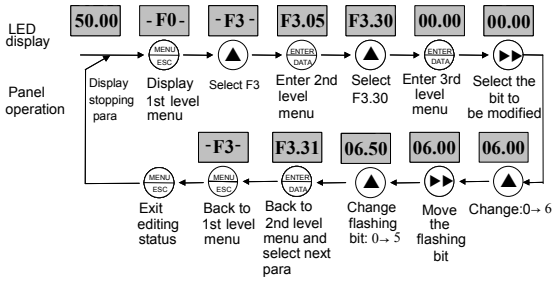


Fig. 4-8 Example of setting the parameters

In 3-level menu, the settings of the parameter cannot be changed if its parameter has no flashing bit. The possible reasons are:

1) The settings of this parameter such as the actual detected parameters or recorded parameters cannot be changed;

2) The settings of this parameter cannot be changed when the drive is operating, and can only be changed when the drive stops;

3) The parameters are protected, that is, if FP.01 is set to 1 or 2, the settings of all the parameters cannot be changed to avoid wrong operation. If the user really wants to change the settings, he should first set FP.01 to 0.

Adjusting the reference frequency:(An example of changing the reference frequency from 50.00Hz to 40.00Hz)

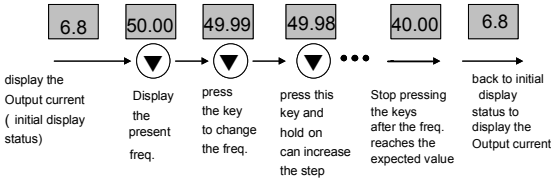


Fig. 4-9 An example of changing reference frequency

This method is suitable for adjusting the reference frequency when the initial displayed parameters are not operating speed, reference speed, operating line speed and reference line speed.

When the initial displayed parameters are operating speed, reference speed, operating line speed and reference line speed, the user can change the displayed reference speed or line speed by pressing ▲ or ▼. If the user needs to change the reference frequency directly, he must press ▶▶ first to enter the reference frequency displaying status.

Changing the control modes:(An example of changing the terminal control mode to panel control mode) Set F9.07 to "x1x" (command of changing the control modes is active in the stopping process), or "x2x" (commands of changing the control modes and running the drive are all active in the stopping process)

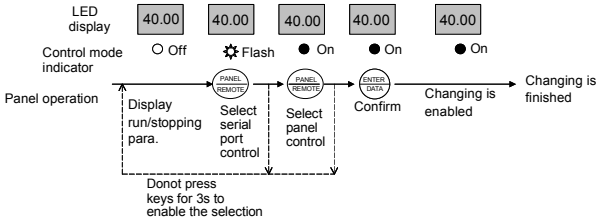


Fig. 4-10 An example of changing control modes

Start and stop the drive:(Set the control mode to serial port control, the drive is in stopping status)

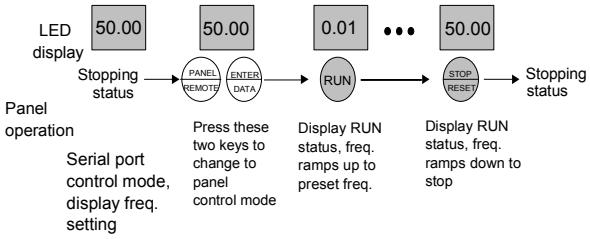


Fig. 4-11 An example of starting and stopping the drive

Jog operation:(Set the control mode to panel control, the drive is in stopping status.)

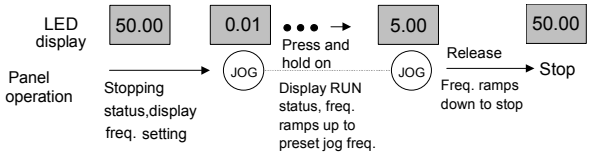


Fig. 4-12 Jog operation

User's password verification:(Suppose FP.00(user's password) is "1368". The boldfaced digits in Fig. 4-13 means the flashing bits.)

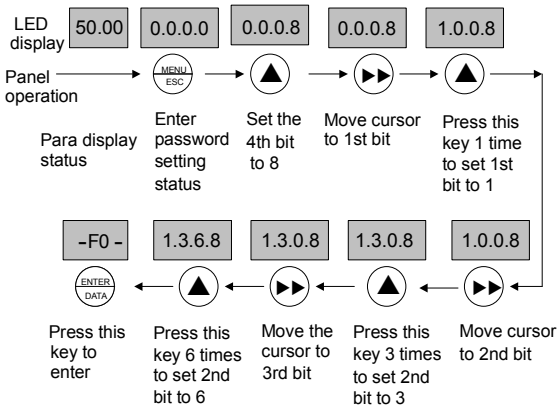


Fig. 4-13 User's password verification

Lock the keys of the panel:(First set the hundred's place of F9.07, then lock the keys.)

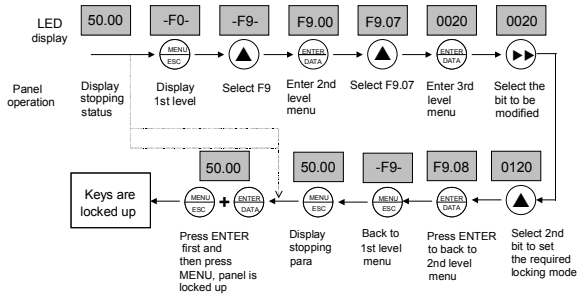


Fig. 4-14 An example of locking the keys of the panel

Unlock the keys:(The keys have already been locked)

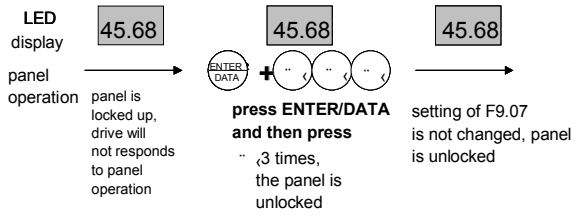


Fig. 4-15 An example of unlocking the keys of the panel

Note: Even if the hundred's place of F9.07 is not set to zero (panel locking function is enabled), the panel is in unlocking status each time when the drive is switched on.

4.3 Start-up

4.3.1 Checking Before Start-up

Please wire the drive according to Section 3.3 Chapter 3, and refer to **Fig. 3-7**.

4.3.2 Startup the Drive for the First Time

After checking the wiring and AC supply, switch on the circuit breaker of the drive to supply AC power to it. The drive's panel will display "8.8.8.8." at first, and the contactor closes. If the 7-segments panel displays the frequency settings, the initialization of the drive is completed.

If the LED on the PANEL/REMOTE is on, the drive is in panel control mode.

Procedures of first-time start-up:

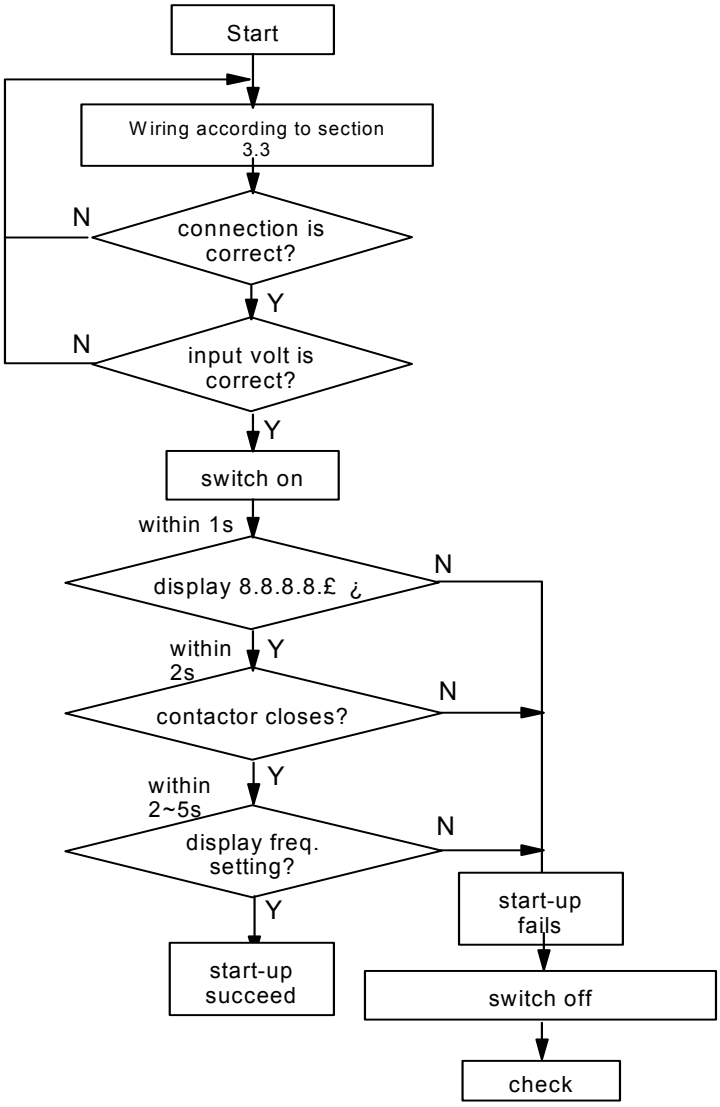


Fig. 4-16 Procedures of starting the drive for the first-time

Chapter 5 Parameter Set

🕮 Notes:

The values in "【】" are the factory settings.

5.1 Basic Functions (F0)

F0.00 Set frequency mode	Range:0~5 【0】

0:digital setting 1:set the reference frequency via ▲ and ▼ keys on the panel.

Initial frequency is the value of F0.02 and it can be adjusted via ▲ and ▼ keys on the panel.

1: digital setting 2:set the reference frequency via terminal UP/DN

Initial frequency is the value of F0.02 and it can be adjusted via terminal UP/DN.

2: digital setting 3: set the reference frequency via serial port

Initial frequency is the value of F0.02 and it can be adjusted via serial port.

3:VCI analog input (VCI-GND)

The reference frequency is set by analog voltage input via terminal VCI and the input voltage range is DC 0~10V.

4:CCI analog input(CCI-GND)

The reference frequency is set by analog voltage or current input via terminal CCI and the input range is DC 0~10V(if jumper CN10 is placed at side V) or DC0~20mA(if jumper CN10 is placed at side I).

5: Pulse input(PULSE)

Set the reference frequency by pulse input via pulse terminal (can only be input via terminal X7 or X8, see the definitions of F7.06~F7.07). Input pulse signal: Voltage range:15~30V; Frequency range:0~50.0kHz.

🕮 Note:

Frequency calculations of Modes 3 and 4 are decided by F1.04~F1.07, please refer to section 5.2.

F0.01 Digital frequency control	Range:00~11 【00】

Only valid when F0.00=0, 1 or 2.

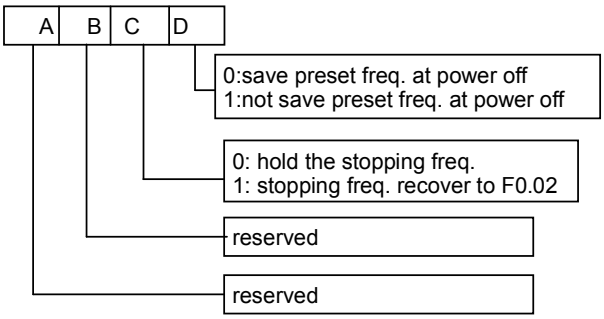


Fig. 5-1 LED setting

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

Unit's place of LED:

0(frequency setting can be saved at powered off): When the drive is switched off or under voltage fault occurs, the setting of F0.02 will be refreshed to the present frequency value.

1(frequency setting cannot be saved when power is off): When the drive is switched off or under voltage fault occurs, the setting of F0.02 will not be changed.

Ten's place of LED:

0(Maintaining the frequency setting in stopping process):When the drive is stopping, the frequency setting is the final frequency value.

1(frequency setting is refreshed to the setting of F0.02): When the drive is stopped, the frequency setting will be refreshed to the setting of F0.02 automatically.

F0.02 Set run frequency in digital mode	Range: Lower limit of frequency ~upper limit of frequency【50.00Hz】

When the reference frequency is set in digital mode(F0.00＝0, 1, 2), this setting of F0.02 is the drive's initial frequency value.

F0.03 Set run commands	Range:0. 1. 2 【0】

PV Series has 3 control modes (Methods of inputting operating commands)

0:Keypad control: Input operating commands via panel

Start and stop the drive by pressing RUN, STOP and JOG on the panel.

1: Terminal control: Input operating commands via terminals

Use terminals FWD, REV, X3(JOGF)and X4(JOGR) to start and stop the drive.

2: Serial port control: Input operating commands via serial port

Use serial port to start and stop the drive.

🕮 Notes

Please be careful that during operating process, the control modes can be changed by changing the setting of F0.03 .

F0.04 Set run direction	Range:0. 1 【0】

This function is active in panel control mode and serial port control mode, and inactive in terminal control mode.

0:Run forward

1:Run reverse

F0.05 Max output frequency	Range: Max{50.00,F0.12 upper limit of frequency}~650.00Hz 【50.00Hz】
F0.06 Rated motor frequency	Range:1.00~650.00Hz 【50.00Hz】
F0.07 Max output voltage	Range:1~480V 【drive's rating values】

Max output frequency is the highest permissible output frequency of the drive, as shown in Fig. 5-2 as f_{max};

Base frequency normally corresponds with the rated frequency of the motor. It is the Min frequency when the drive outputs the highest voltage, as shown in Fig. 5-2 as f_b

Max output voltage is the drive's output voltage when the drive outputs base frequency, as shown in Fig. 5-2 as $V_{max.}$ This corresponds to the rated voltage of the motor.

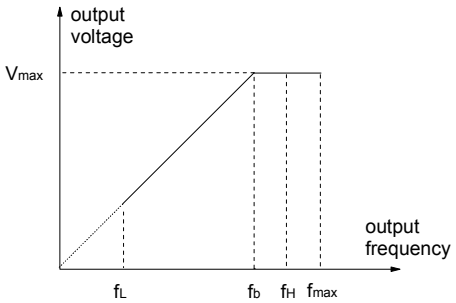


Fig. 5-2 Characteristic parameters

The f_H and f_L are defined by F0.12 and F0.13 as upper limit of frequency and lower limit of frequency respectively.

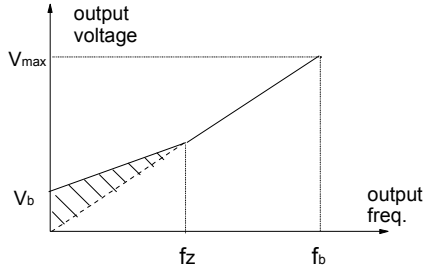
🕮 Note:

Please set fmax, fb and Vmax according to motor parameters, found on its nameplate. Failing to do so may damage the motor.

F0.08	Reserved

F0.09 Torque boost	Range:0~30.0%【0.0%】

In order to compensate the torque drop at low frequency, the drive can boost the voltage so as to increase the torque. If F0.09 is set to 0, auto torque boost is enabled and if F0.09 is set non-zero, manual torque boost is enabled, as shown in Fig. 5-3.



Vb£ manual torque boost Vmax£ Max output voltage
fz£ cut-off freq. for torque boost
fb£ basic operating freq.

Fig. 5-3 Torque boost(shadow area is the boosted value)

🕮 Note:

1. Wrong parameter setting can cause overheating of the motor or triggers the over-current protection of the drive.

2. Refer to F0.21 for definition of fz.

F0.10 Acc time 1	Range:0.1~3600s【6.0s/20.0s】
F0.11 Dec time 1	Range:0.1~3600s【6.0s/20.0s】

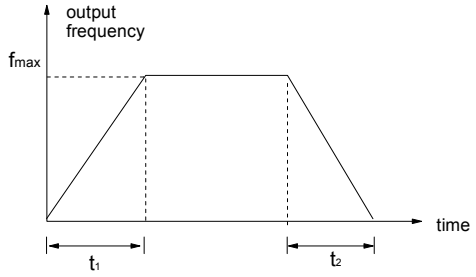


Fig. 5-4 Acc/Dec time definition

Acceleration time is the time taken for the motor to accelerate from 0Hz to the maximum frequency (as set in F0.05), see t_1 in Fig. 5-4.

Deceleration time is the time taken for the motor to decelerate from maximum frequency (F0.05) to 0Hz, see t_2 in Fig. 5-4.

PV series drive has defined 4 kinds of Acc/Dec time. Here only Acc/Dec time 1 is defined, and Acc/Dec time 2~4 will be defined in F3.17~F3.22, please refer to section 5.4.

🕮 Note:

1. Unit(second/minute) of Acc/Dec time 1~4 is dependent on the setting of F9.09, and the default unit is second.

2.For the drive of 37kW or above, the factory setting of Acc/Dec time is 20.0s.

F0.12 Upper limit of frequency	Range: Lower limit of frequency ~Max output frequency【50.00Hz】
F0.13 Lower limit of frequency	Range:0~upper limit of frequency 【0.00Hz】

F0.12 and F0.13 define the upper and lower limit of frequencies respectively, as shown in Fig. 5-2 as f_H and f_L.

🕮 Notes:

It is possible for the actual output frequency to fluctuate within ±2.5Hz in the bus-voltage control process.

F0.14 V/F curve setting	Range:0~3【0】
F0.15 V/F frequency value F3	Range:F0.17~F0.06【0.00Hz】
F0.16 V/F voltage value V3	Range:F0.18~100.0%【0.0%】
F0.17 V/F frequency value F2	Range:F0.19~F0.15【0.00Hz】
F0.18 V/F voltage value V2	Range:F0.20~F0.16【0.0%】
F0.19 V/F frequency value F1	Range:0~F0.17【0.00Hz】
F0.20 V/F voltage value V1	Range:0~F0.18【0.0%】

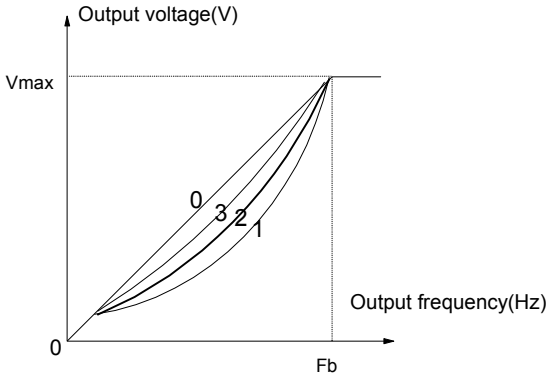
This group of parameters defines the V/F setting modes of PV Series so as to satisfy the requirements of different loads. 4 curves can be selected according to the setting of F0.14.

If F0.14 is set to 1, a 2-order curve is selected, as shown in Fig. 5-5 as curve 1;

If F0.14 is set to 2, a 1.7-order curve is selected, as shown in Fig. 5-5 as curve 2;

If F0.14 is set to 3, a 1.2-order curve is selected, as shown in Fig. 5-5 as curve 3;

The above V/F curves are suitable for the variable-torque loads such as fan & pumps. The user can select the curves according to the actual load so as to achieve best energy-saving effects.

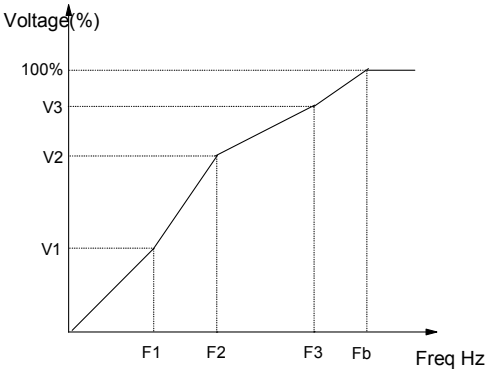


Vmax£ºMax output voltage(F0.07)
Fb£ºBasic operating frequency(F0.06)

Fig. 5-5 Torque-reducing curve

If F0.14 is set to 0, the user can define V/F curve via F0.15~F0.20, as shown in Fig. 5-6. The V/F curve can be defined by connecting 3 points of (V1,F1), (V2,F2) and (V3,F3) so as to adapt to special load characteristics.

Default V/F curve set by factory is a direct line as show in Fig. 5-5 as curve 0.



V1~V3£ºVoltage of sections 1~3
F1~F3£ºFreq of sections 1~3
Fb£ºbasic operating freq. of F0.06

Fig. 5-6 V/F curve defined by user

F0.21 Set boot range	Range:0~50%【10.0%】

F0.21 defines the ratio of the cut-off frequency used for manual torque boost to the base frequency(defined by

F0.06), as shown in Fig. 5-3 as fz. This cut-off frequency adapts to any V/F curve defined by F0.14.

5.2 Reference Frequency (F1)

F1.00 Reference frequency curve selection	Range:000~111【000】
F1.01 Gain of reference frequency selector	Range:0.00~9.99【1.00】
F1.02 Reference constant of filter	Range:0.01~50.00s 【0.50s】
F1.03 Max input pulse frequency	Range:0.1~50.0kHz 【10.0kHz】
F1.04 Min reference of curve 1	Range:0.0%~100.0% 【0.0%】
F1.05 Frequency corresponding to the Min reference of curve 1	Range:0.0~650.0Hz 【0.00Hz】
F1.06 Max reference of curve 1	Range:0.0%~100.0% 【100.0%】
F1.07 Frequency corresponding to the Max reference of curve 1	Range:0.0~650.0Hz 【50.00Hz】
F1.08 Min reference of curve 2	Range:0.0%~100.0% 【0.0%】
F1.09 Frequency corresponding to the Min reference of curve 2	Range:0.0~650.0Hz 【0.00Hz】
F1.10 Max reference of curve 2	Range:0.0%~100.0% 【100.0%】
F1.11 Frequency corresponding to the Max reference of curve 2	Range:0.0~650.0Hz 【50.00Hz】

When VCI or CCI or pulse input(PULSE) is selected, the relationship between reference and the preset frequency is given below:

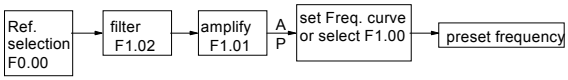


Fig. 5-7 Relationship between reference and the preset frequency

The relationship between Reference frequency signal and the preset frequency is determined by Curve 1 or 2, which Curve 1 is defined by F1.04~F1.07 and Curve 2 is defined by F1.08~F1.011 . Positive and negative characteristics are shown in Fig 5.8.

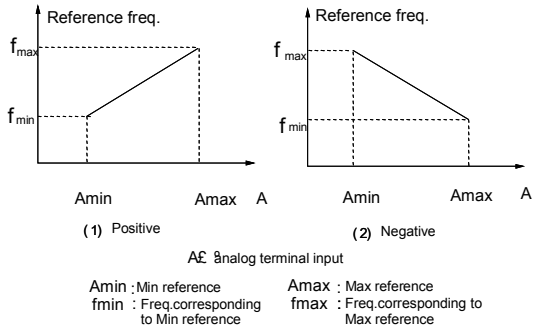


Fig. 5-8 Output frequency curve

Analog input value(A) is a percentage without unit, and 100% corresponds to 10V or 20mA. Pulse frequency(P) is also a percentage without unit, and 100% corresponds to the Max pulse frequency defined by F1.03.

F1.02 defines the time constant of the filter used by the reference selector. The input signal is filtered and the bigger the time constant, the higher the immunity level, but the response time is prolonged with the increase of the time constant. . This means that the smaller the time constant, the shorter the response time, but the lower the immunity level.

F1.00 is used to select the output frequency curve when VCI, CCI or PULSE input is selected, as shown in Fig.5-9.

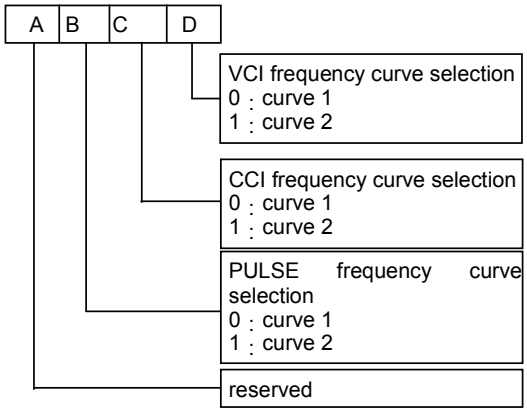


Fig. 5-9 Frequency curve selection

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

For example, the requirements are:

①Use the pulse signal input via terminal to set the reference frequency;

②Range of input signal frequency:1kHz~20kHz;

③1kHz input signal corresponds to 50Hz reference frequency, and 20kHz input signal corresponds to 5Hz reference frequency;

According to above requirements, the parameter settings are:

①F0.00=5, select pulse input to set the reference frequency;

②F7.06=45, input pulse signal via terminal X7;

③F1.00=100, select curve 2;

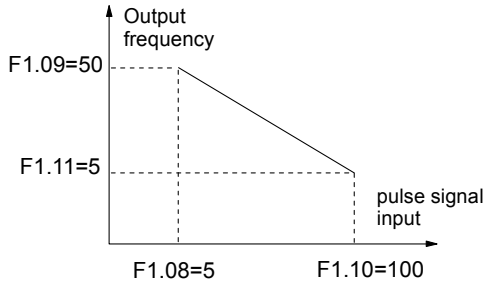
④F1.03=20.0kHz, set the Max input pulse frequency to 20kHz;

⑤F1.08=1÷20×100%=5.0%, the minimum reference of curve 1 is actually the percentage of 1kHz to 20kHz(F1.03);

⑥F1.09=50.00Hz, set the frequency that corresponds to the Min reference (1kHz pulse signal);

⑦F1.10=20÷20×100%=100.0%, the Max reference of curve 2 is actually the percentage of 20kHz to 20kHz(F1.03);

⑧F1.11=5.00Hz, set the frequency that corresponds to the Max reference (20kHz pulse signal);



F0.00=5, F1.00=100, F1.03=20, F7.06=45

Fig. 5-10 Pulse signal input

5.3 Start and Stop Parameters (F2)

F2.00 Start mode	Range:0. 1. 2【0】

0: Start from the starting frequency

Start according to the preset starting frequency (F2.01) and the holding time of starting frequency (F2.02).

1:Brake first and then start

Brake first(refer to F2.03 and F2.04), and then start in mode 0.

2. Start on the fly

Search and catch the motor's running direction and speed, start the rotating motor smoothly without impact, as shown in Fig. 5-8.

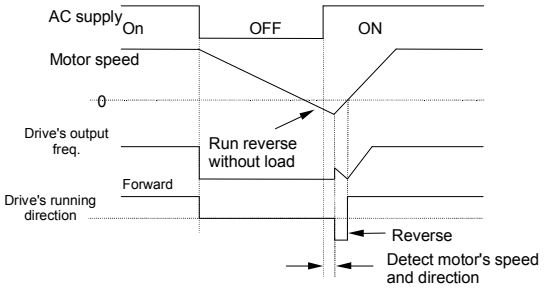


Fig. 5-8 Start on the fly

Notes:

1. Starting mode 1 is suitable for starting the motor that is running forward or reverse with small inertia load when the drive stops. For the motor with big inertial load, it is not recommended to use starting mode 1;

2. Starting mode 2 is suitable for starting the motor that is running forward or reverse with big inertia load when the drive stops.

3. The starting performance of starting mode 2 is dependent on the motor's parameters. Please set the parameter group FH correctly.

4. Starting mode 0 is recommended to be used when the drive drives a synchronous motor.

F2.01 Starting frequency	Range:0.20~60.00Hz【0.50Hz】
F2.02 Holding time of starting frequency	Range:0.0~10.0s【0.0s】

Starting frequency is the initial frequency when the drive starts, as shown in Fig. 5-9 as f_S; Holding time of starting frequency is the time during which the drive operates at the starting frequency, as shown in Fig. 5-9 as t_1

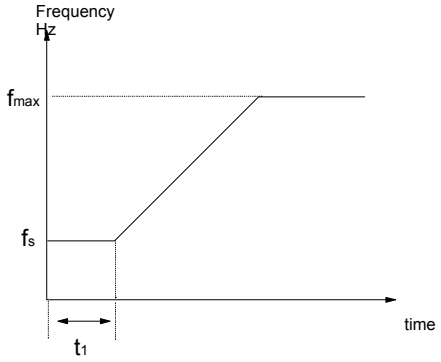


Fig. 5-9 Starting frequency and starting time

🕮 Notes:

Starting frequency is not restricted by the lower limit of frequency.

F2.03 DC injection braking current at start	Range: dependent on drive's model【0.0%】
F2.04 DC injection braking time at start	Range: dependent on drive's model【0.0s】

F2.03 and F2.04 are only active when F2.00 is set to 1(starting mode 1 is selected), as shown in Fig. 5-10.

Ranges of DC injection braking current and time are dependent on the drive's model, see Table 5-1.

DC injection braking current at start is a percentage value of drive's rated current. There is no DC injection braking when the braking time is 0.0s.

Table 5-1 DC injection braking function

Model	Range of DC injection braking current	Range of DC injection braking time
55kW or below	0~100.0%	0.0~60.0s
75kW or above	0~80.0%	0.0~30.0s

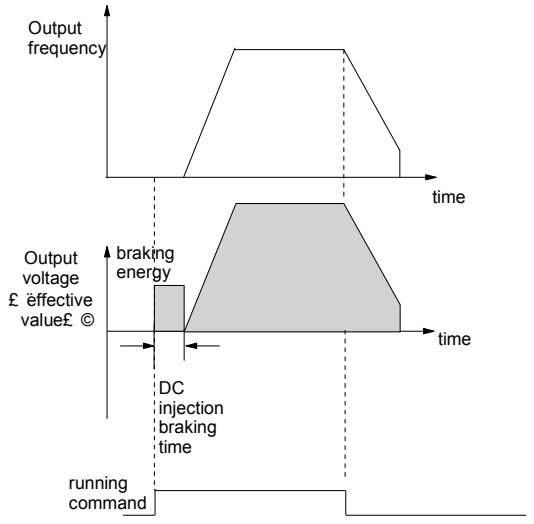


Fig. 5-10 Starting mode 1

F2.05 Acc/Dec mode	Range:0. 1. 2【0】

0: Linear Acc/Dec mode

Output frequency increases or decreases at a constant rate, as shown in Fig. 5-11.

1:S ramp Acc/Dec

Output frequency increases or decreases following a S-shape curve, as shown in Fig. 5-12.

2:Acc/Dec mode with current limiting function

The drive can maintain its output current below the current limiting threshold(see FL.07) automatically and complete the Acc or Dec process depending on the load condition.

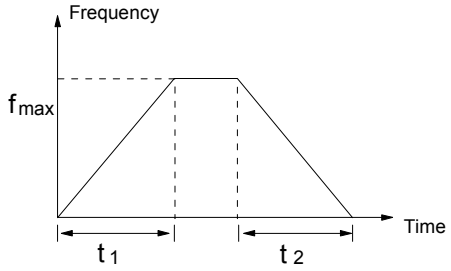


Fig. 5-11 Linear Acc/Dec

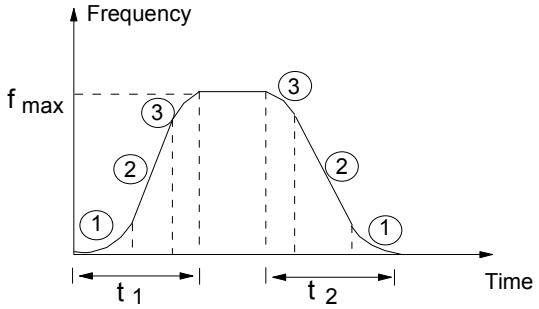


Fig. 5-12 S-ramp Acc/Dec

🕮 Note:

In auto Acc/Dec mode, settings of F0.10, F0.11 and F3.17~F3.22 are invalid.

F2.06 Starting time of S ramp	Range:10~50%【20.0%】
F2.07 Rising time of S ramp	Range:10~80%【60.0%】

F2.06 and F2.07 are only active when the Acc/Dec mode is S-ramp Acc/Dec mode(F2.05=1), and F2.06+F2.07≤90%.

The initial stage of S-shape curve is shown in Fig. 5-12 as "①" , where the changing rate of output frequency increases from 0;

Rising process of S-shape curve is shown in Fig. 5-12 as "②", where the output frequency's changing rate is constant;

Ending process of S-shape curve is shown in Fig. 5-12 as "③", where the changing rate of output frequency decreases to 0;

S-ramp Acc/Dec mode is suitable for the conveying load such as elevator and conveying belt.

F2.08 Stopping mode	Range:0. 1【0】

0:Dec-to-stop

After receiving the stopping command, the drive reduces its output frequency according to the Dec time, and stops when the frequency decreases to 0.

1:Coast-to-stop

After receiving the stop command, the drive stops the output power immediately and the motor stops under the effects of mechanical losses.

2:Dec-to-stop+DC injection braking

After receiving the stopping command, the drive reduces its output frequency according to the Dec time and starts DC injection braking when its output frequency reaches the initial frequency of braking process.

Refer to the introductions of F2.09~F2.12 for the functions of DC injection braking.

F2.09 DC injection braking initial frequency at stop	Range:0.00~60.00Hz【0.00Hz】
F2.10 DC injection braking waiting time at stop	Range:0.00~10.00s【0.00s】
F2.11 DC injection braking current at stop	Range: dependent on drive's model【0.0%】
F2.12 DC injection braking time at stop	Range: dependent on drive's model【0.0s】

DC injection braking waiting time at stop: The duration from the time when operating frequency reaches the DC injection braking initial frequency(F2.09) to the time when the DC injection braking is applied.

The drive has no output during the waiting time. This waiting time can reduce current overshoot in the initial time of braking process when the drive drives a high power motor.

Ranges of DC injection braking current and time are dependent on drive's model, see Table 5-2.

DC injection braking current at stop is a percentage value of drive's rated current. There is no DC injection braking when the braking time is 0.0s.

Table 5-2 DC injection braking function

Model	Braking current at stop	Braking time at stop
55kW or below	0~100.0%	0.0~60.0s
75kW or above	0~80.0%	0.0~30.0s

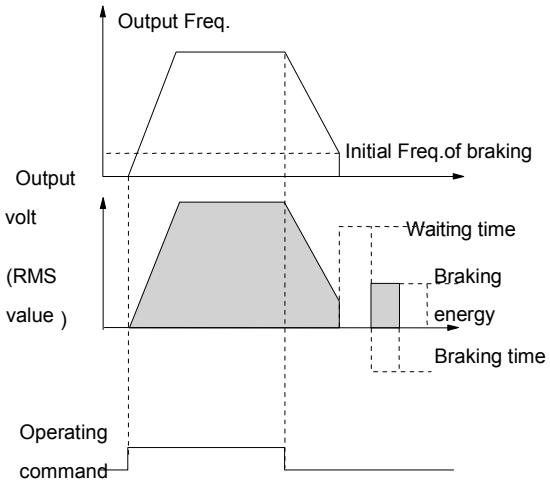


Fig. 5-13 Dec-to-stop + DC injection braking

🕮 Note:

DC injection braking current at stop(F2.11) is a percentage value of drive's rated current.

F2.13 Dynamic braking	Range:0,1【0】

0:Dynamic braking is disabled

1: Dynamic braking is enabled

🕮 Note:

This parameter must be set correctly according to the actual application conditions, otherwise the control characteristics may be affected.

F2.14 Ratio of working time of braking kit to drive's total working time	Range:0.0~100.0%【2.0%】

This function is effective for the drive with built-in braking resistor.

🕮 Note:

Resistance and power of the braking resistor must be taken into consideration when setting this function.

5.4 Auxiliary Running Parameters (F3)

F3.00 Anti-reverse running function	Range:0. 1【0】

0: Run reverse is enabled

1:Run reverse is disabled

🕮 Note:

This function is effective in all control modes.

F3.01 Delay time of run reverse/forward	Range:0~3600s【0.0s】

The delay time is the transition time at zero frequency when the drive starts running forward from reverse or running reverse from forward, as shown in Fig. 5-14 as t_1.

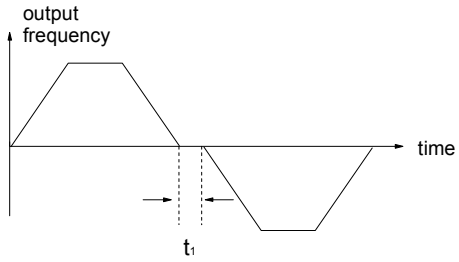


Fig. 5-14 delay time from reverse running to forward running or from forward running to reverse running

F3.02~F3.04	Reserved

Reserved functions.

F3.05 auto energy-saving function	Range:0. 1【0】

0:disabled

1: enabled

When the motor operates without load or with light load, the drive can adjust its output voltage by detecting the load current to achieve the energy-saving effects.

🕮 Note:

This function is especially useful for the fan & pump loads.

F3.06 AVR function	Range:0. 1. 2【2】

0:disabled

1: enabled all the time

2: disabled in Dec process

AVR means automatic voltage regulation.

The function can regulate the output voltage and make it constant. Therefore, generally AVR function should be enabled, especially when the input voltage is higher than the rated voltage.

In Dec-to-stop process, if AVR function is disabled, the Dec time is short but the operating current is big. If AVR function is enabled all the time, the motor decelerates steadily, the operating current is small but the Dec time is prolonged.

F3.07 Gain of slip compensation	Range:0.0~300.0%【100.0%】
F3.08 Limit of slip compensation	Range:0.0~250.0%【200.0%】
F3.09 Compensation time constant	Range:0.1~25.0s【2.0s】

The motor's slip changes with the change of load torque, which results in the change of motor speed. The drive's output frequency can be adjusted automatically through slip compensation according to the load torque. Therefore the change of speed due to the load change is reduced as shown in Fig. 5-15.

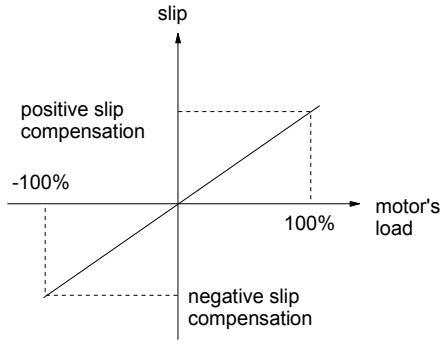


Fig. 5-15 Auto slip compensation

Motoring status: Increase the gain of slip compensation gradually when the actual speed is lower than the reference speed (F3.07).

Regenerating status: Increase the gain of slip compensation gradually when the actual speed is higher than the reference speed (F3.07).

Range of slip compensation: limit of slip compensation(F3.08) × rated slip(FH.08)

🕮 Note:

The value of automatically compensated slip is dependent on the motor's rated slip, therefore the motor's rated slip must be set correctly (FH.08).

F3.10 carrier wave frequency	Range:0.7~15.0kHz【dependent on drive's model】

Table 5-3 Relationship between drive's type and carrier wave frequency(CWF)

Type \ CWF	Highest (kHz)	Lowest (kHz)	Factory setting (kHz)
7.5kW~55kW	15	3	8
75kW~110kW	10	1	3
132kW~280kW	6	0.7	2

Table 5-4 CWF characteristics

CWF	Decrease	Increase
Motor's noise	↑	↓
Leakage current	↓	↑
Disturbance	↓	↑

🕮 Notes:

In order to achieve better control performances, the ratio of carrier frequency to the maximum operating frequency of the drive should not be less than 36.

F3.11 Auto adjusting of CWF	Range:0. 1【1】

0:disabled

1:enabled

When this function is enabled, the drive can adjust the CWF automatically according to the internal temperature of the drive. At this time, the drive's actual Max CWF is restricted by F3.10.

F3.12 Motor tune adjustment	Range:0~10【0】

F3.12 can be used to adjust the motor's tune, and is only effective for the CWF below 6kHz.

If this parameter is set to 0, there is no function of motor tune adjustment.

F3.13 Jog operating frequency	Range:0.10~50.00Hz 【5.00Hz】
F3.14 Interval of Jog operation	Range:0.0~100.0s【0.0s】
F3.15 Acc time of Jog operation	Range:0.1~60.0s 【6.0s/20.0s】
F3.16 Dec time of Jog operation	Range:0.1~60.0s 【6.0s/20.0s】

F3.13~F3.16 define the relevant parameters of Jog operation.

As shown in Fig. 5-16, t_1 and t_3 are the actual Acc time and Dec time respectively. t_2 is the Jog operating time; t_4 is the interval of Jog operation(F3.14); f_1 is the Jog operating frequency(F3.13).

Actual Acc time t_1 can be determined by the following formula, so does the actual Dec time t_3 of jog operation.

$$t_1 = \frac{F3.13 \times F3.15}{F0.05}$$

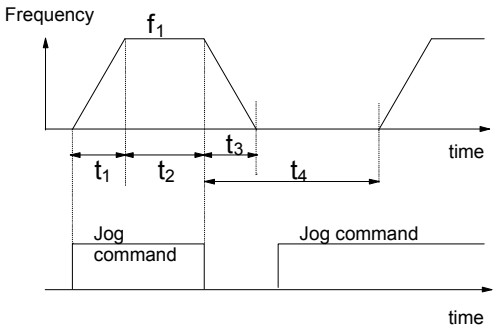


Fig. 5-16 Jog operating parameters

Interval of Jog operation(F3.14) is the interval from the time when the last Jog operation command is ended to the time when the next Jog operation command is executed.

The jog operation command sent during the interval will not enable the drive to operate, and the drive continues to operate at zero frequency. If this command continues to exist, then this command will be executed at the end of the interval.

🕮 Note:

1. In Jog operation process, the drive starts according to starting mode 0 and stops according to stopping mode 0. The unit of Acc/Dec time is second.

2. Jog operation can be controlled by keypad, terminals and serial port.

F3.17 Acc time 2	Range:0.1~3600s(min) 【6.0s/20.0s】
F3.18 Dec time 2	Range:0.1~3600s(min) 【6.0s/20.0s】
F3.19 Acc time 3	Range:0.1~3600s(min) 【6.0s/20.0s】
F3.20 Dec time 3	Range:0.1~3600s(min) 【6.0s/20.0s】
F3.21 Acc time 4	Range:0.1~3600s(min) 【6.0s/20.0s】
F3.22 Dec time 4	Range:0.1~3600s(min) 【6.0s/20.0s】

Three kinds of Acc/Dec time can be defined, and the drive's Acc/Dec time 1~4 can be selected by different combinations of control terminals, refer to the introductions of F7.00~F7.07 for the definitions of terminals used to select Acc/Dec time.

🕮 Note:

1. Acc/Dec time 1 is defined in F0.10 and F0.11.

2. For the drive of 30kW or above, its factory setting of Acc/Dec time is 20.0s.

F3.23 Preset frequency 1	Range: Lower limit of frequency ~upper limit of frequency【 5.00Hz】
F3.24 Preset frequency 2	Range: Lower limit of frequency ~upper limit of frequency【10.00Hz】

F3.25 Preset frequency 3	Range: Lower limit of frequency ~upper limit of frequency【20.00Hz】
F3.26 Preset frequency 4	Range: Lower limit of frequency ~upper limit of frequency【30.00Hz】
F3.27 Preset frequency 5	Range: Lower limit of frequency ~upper limit of frequency【40.00Hz】
F3.28 Preset frequency 6	Range: Lower limit of frequency ~upper limit of frequency【45.00Hz】
F3.29 Preset frequency 7	Range: Lower limit of frequency ~upper limit of frequency【50.00Hz】

These frequencies will be used in simple PLC operation and multi-step speed operation, refer to the introductions of F7.00~F7.07 and group F4 parameters.

F3.30 skip frequency 1	Range:0.00~650.00Hz【0.00Hz】
F3.31 Range of skip frequency 1	Range:0.00~30.00Hz【0.00Hz】
F3.32 skip frequency 2	Range:0.00~650.00Hz【0.00Hz】
F3.33 Range of skip frequency 2	Range:0.00~30.00Hz【0.00Hz】
F3.34 skip frequency 3	Range:0.00~650.00Hz【0.00Hz】
F3.35 Range of skip frequency 3	Range:0.00~30.00Hz【0.00Hz】

F3.30~F3.35 are used to prevent the drive's output frequency from meeting with the mechanical resonant frequency of load.

The drive's preset frequency can skip some frequency values as shown in Fig. 5-20. At most 3 skipping frequency ranges can be set.

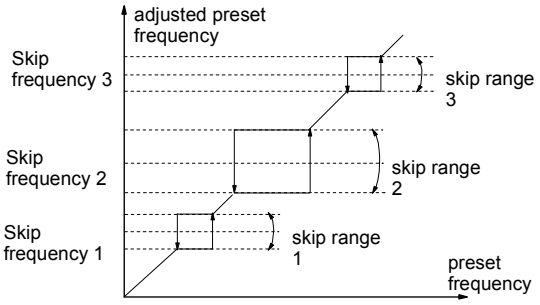


Fig. 5-20 Skip frequency and skip range

5.5 Close Loop Control (F5)

There are two kinds of close loop control systems that are analog close-loop control system(feedback value is analog value) and pulse close-loop control system (feedback value is pulse). Fig. 5-21 and Fig. 5-22 show the typical wiring diagrams of analog close-loop control system and pulse close-loop control system respectively.

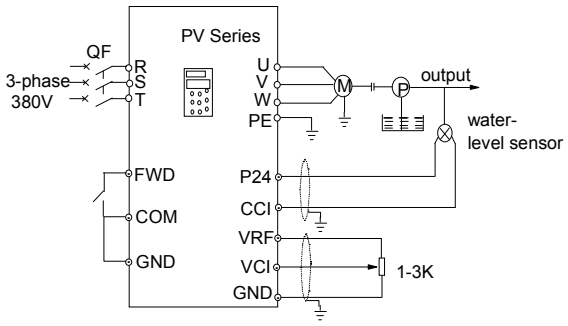


Fig. 5-21 Analog feedback control system with internal PI

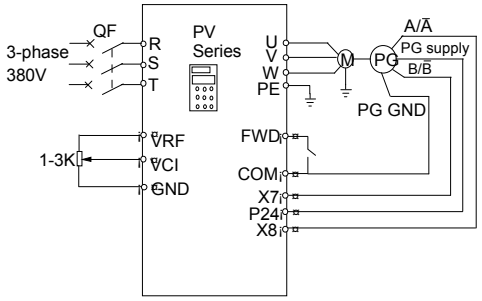


Fig. 5-22 Wiring diagram of Speed close-loop with PG

Analog feedback control system:

An analog feedback control system can be formed by using a water-level sensor as the feedback sensor of the internal PI.

As shown in Fig. 5-21, pressure reference(voltage signal) is input via terminal VCI, while the feedback pressure value is input into terminal CCI in the form of 0(4)~20mA current signal. The reference signal and feedback signal are detected by the analog channel. The start and stop of the drive can be controlled by terminal FWD.

The above system can also use a TG(speed measuring generator) in close speed-loop control

Close speed-loop using PG:

A close speed-loop control system can be formed by using external control terminals X_7 and X_8, and pulse generator(PG).

As shown in Fig. 5-22, reference of close speed-loop can be input by a potentialmeter in the form of voltage signal via terminal VCI, while the feedback value of the close loop is input by PG in pulse mode via terminals X7

and X8. The start and stop of the drive can be controlled by terminal FWD.

In Fig. 5-22:

A and B are PG's dual phase quadrature output;

P24 is connected to the power source of PG;

Speed reference is the voltage signal of 0~10V. The voltage signal corresponds to synchronous speed n_0 that corresponds to 0~Max frequency (F0.05), and f_{max} is Max frequency (F0.05), and P is the number of motor poles (FH.00).

$n_0=120\times f_{max}/P$

Refer to F7.00~F7.07 for the functions of input terminals X7 and X8.

Note:

1. The reference can also be input via panel or serial port;
2. Dual-phase input is good for improving the speed measurement accuracy and the wire connections of single-phase input circuit is simple;
3. Dual-phase pulse can only be input in quadrature mode;
4. If use the drive's terminal P24 to supply the power to the sensor, then the Max load current of the sensor must be less than 100mA.

Operating principles of internal PI of PV Series is shown in the following block diagram:

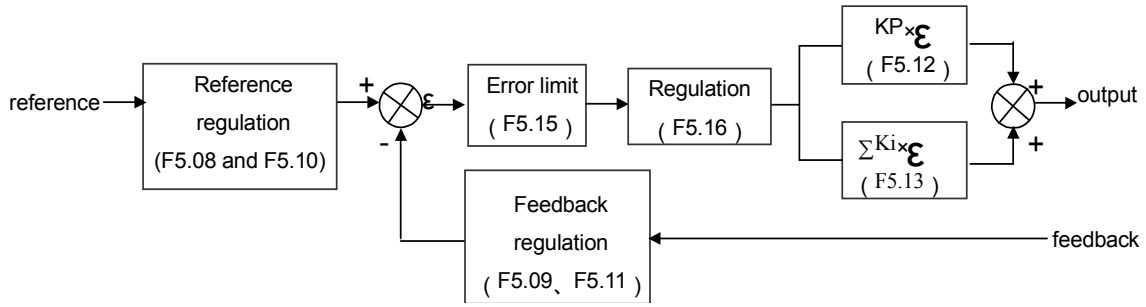


Fig. 5-23 PI block diagram

In the above Figure, KP: proportional gain; Ki: Integral gain, refer to F5.01~F5.15 for the definitions of close-loop reference, feedback, error limit and proportional and Integral parameters.

There are two features of internal PI of PV Series:

The relationship between reference and feedback can be defined by F5.08~F5.11.

For example: In Fig. 5-21, if the reference is analog signal of 0~10V, the controlled value is 0~1MP, and the signal of water-level sensor is 4~20mA, then the relationship between reference and feedback is shown in Fig. 5-24

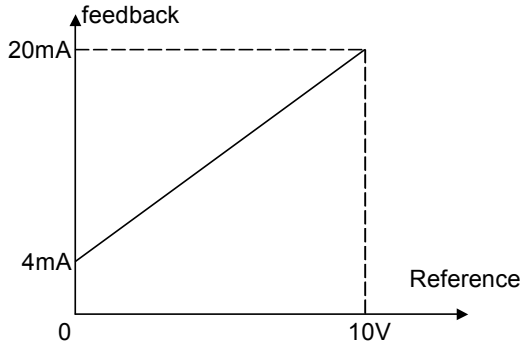


Fig. 5-24 Reference and feedback

The reference value is based on 10V(that is, 10V corresponds to 100%); and the feedback value is based on 20mA(20mA corresponds to 100%).

In Fig. 5-24, "reference regulation" and "feedback regulation" mean that the reference value and feedback value are converted from current or voltage value to percentage values, so that reference value can add or subtract the feedback value.

Close-loop reference is selected via F5.16 to satisfy different application requirements.

In actual control system, in order to meet the control requirements, the motor's speed should be increased when the reference speed is increased. This kind of control characteristic is called positive characteristic. If the motor speed is required to be decreased when the reference value is increased, this control characteristic is called negative characteristic.

These two kinds of control characteristics are shown in Fig. 5-25. F5.16 defines the requirements of these two characteristics.

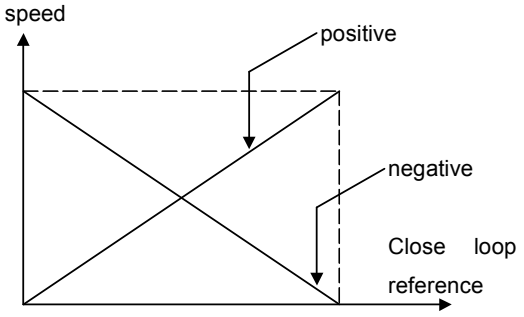


Fig. 5-25 Close-loop control characteristic

After the system type is determined, the following procedures can be used to determine the close loop parameters:

1. Determine the close-loop reference and feedback channel (F5.01 and F5.02);

2. The relationship between close-loop reference and feedback value (F5.08~F5.11) should be defined for close-loop control;

3. For close speed-loop, the close-loop speed reference and the number of revolutions of PG (F5.06~F5.07) need to be determined;

4. Determine the close-loop regulation characteristic, that is, if the reference is disproportional to motor speed, then the close-loop control characteristic should be set to negative (F5.16=1);

5. Set up the integral regulation function and close-loop frequency presetting function (F5.17~F5.19);

6. Adjust the close-loop filtering time, sampling cycle, error limit and gain (F5.12~F5.15).

F5.00 PI function	Range:0. 1【0】

0: PI function is disabled

1: PI function is enabled

F5.01 Reference input selection	Range:0. 1. 2【1】

0: digital input

Take the value of F5.05 (When the setting is analog close-loop, F5.02＝0~5);

Take the value of F5.06 (When the setting is pulse close-loop, F5.02＝6).

1:VCI analog voltage input(0~10V)

2: CCI analog input

Analog input range:0~10V(Jumper CN10 is placed at side V), or 0~20mA(Jumper CN10 is placed at side I).

F5.02 Feedback input selection	Range:0~6【1】

0:VCI 0~10V analog voltage input

1:CCI analog input

2:VCI＋CCI

3:VCI-CCI

4:Min{VCI,CCI}

5:Max{VCI,CCI}

Settings of jumper CCI are the same with the above. When current input is selected, the signal will be converted into voltage signal and the converting formula: voltage value = current value (mA)/2;

6: pulse input

Both single-phase PG feedback(use PG as the feedback device) and dual-phase PG feedback can be used. Refer to the definitions of multi-function input terminal X7 and X8(functions of F7.06~F7.07).

F5.03 Reference filtering constant	Range:0.01~50.00s【0.50s】
F5.04 Feedback filtering constant	Range:0.01~50.00s【0.50s】

Both the reference signal and feedback signal have some noise signals. These signals can be filtered by setting the time constant of filter (settings of F5.03 and F5.04). The bigger the time constant, the better the immunity capability, but the response becomes slow. The smaller the time constant, the faster the response, but the immunity capability becomes weak.

F5.05 Digital setting of reference	Range:0.00~10.00V【0.00】

When analog feedback is used (F5.02=0~5), this function can detect digital setting of reference via keypad or serial port.

F5.06 PG speed reference	Range:0~39000rpm【0 rpm】

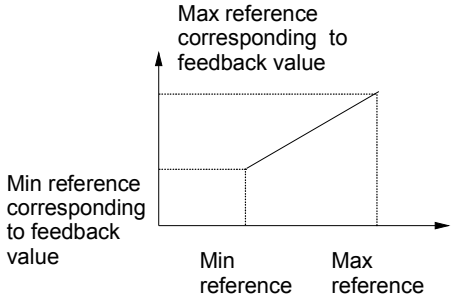
If PG pulse feedback is used(F5.02=6), the speed reference can be set by keypad or serial port

F5.07 Number of pulses per revolution of PG	Range:1~9999【1024】

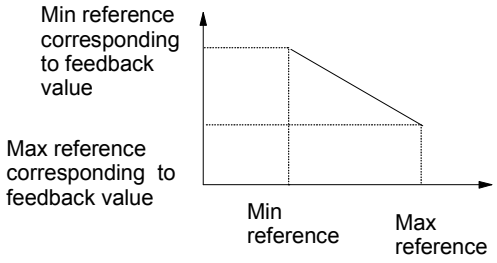
The setting of F5.07 is determined by the parameters of PG.

F5.08 Min PI reference	Range:0.0%~F5.10【0.0%】
F5.09 Minimum PI feedback	Range:0.0~100.0%【20.0%】
F5.10 Max PI reference	Range:F5.08~100.0%【100.0%】
F5.11 Maximum PI feedback	Range:0.0~100.0%【100.0%】

F5.08~F5.11 define the relationship between the close-loop reference and feedback value. The setting is the ratio (percentage value) of input and feedback value to reference (10V or 20mA).



(1) positive regulation of feedback



(2) negative regulation of feedback

Fig. 5-26 Relationship between feedback and reference

F5.12 proportional gain KP	Range:0.000~9.999【0.050】
F5.13 Integral gain Ki	Range:0.000~9.999【0050】
F5.14 PI cycle	Range:0.01~50.00s【0.50s】

The bigger the proportional gain of K_P, the faster the response, but oscillation may occur easily.

If only proportional gain K_P is used in regulation, the error cannot be eliminated totally. In order to eliminate the error, use the Integral gain Ki to form a PI control system. The bigger the Ki, the faster the response, but oscillation may occur if Ki is too big.

PI cycle reflects to the sampling cycle of feedback value. The PI regulator calculates one time in each sampling cycle. The bigger the sampling cycle the slower the response.

F5.15 PI Error limit	Range:0.0~20%【2.0%】

The system output value is the Max error between system output value and the close-loop reference, as shown in Fig. 5-27. PI regulator stops operation when the feedback value is within this range. Setting this parameter correctly is helpful to improve the system output accuracy and stability.

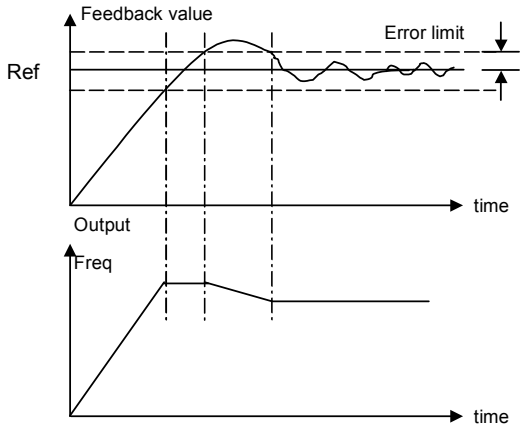


Fig. 5-27 Error limit

F5.16 Close-loop logic	Range:0. 1【0】

0:Positive

Set F5.16 to 0 if the motor speed is required to be increased with the increase of the reference.

1:Negative

Set F5.16 to 1 if the motor speed is required to be decreased with the increase of the reference.

F5.17 PI Integral regulation	Range:0. 1【0】

0: Stop integral regulation when the frequency reaches the upper and lower limits

1: Continue the integral regulation when the frequency reaches the upper and lower limits

It is recommended to disable the integral regulation for the system with a requirement on fast response.

F5.18 Preset PI frequency	Range:0.00~650.00Hz【0.00Hz】
F5.19 Holding time of preset close-loop frequency	Range:0.0~3600s【0.00s】

This function can make the close-loop regulation enter stable status quickly.

When the close-loop function is enabled, the frequency will ramp up to reach the preset close-loop frequency(F5.18) according to the Acc time, and then the drive will start close-loop operation after having been operating at the preset frequency for some time(defined by F5.19).

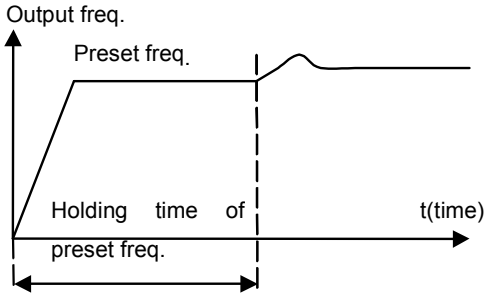


Fig. 5-28 Preset frequency of close-loop operation

🕮 Note:

If there is no need to use the function of F5.18, then set both F5.18 and F5.19 to 0.

5.6 Terminal Control (F7)

F7.00 Function of multi-function terminal X1	Range:0~43【0】
F7.01 Function of multi-function terminal X2	Range:0~43【0】
F7.02 Function of multi-function terminal X3	Range:0~43【0】
F7.03 Function of multi-function terminal X4	Range:0~43【0】
F7.04 Function of multi-function terminal X5	Range:0~43【0】
F7.05 Function of multi-function terminal X6	Range:0~43【0】
F7.06 Function of multi-function terminal X7	Range:0~47【0】
F7.07 Function of multi-function terminal X8	Range:0~48【0】

Functions of multi-function input terminal X1~X8 are extensive and the user can select the functions according to his actual requirements. The user can select functions of X1~X8 by setting F7.00~F7.07. The settings and functions are given in Table 5-5.

F5.20 Preset PI reference 1	Range:0.0~10.00V【0.00V】
F5.21 Preset PI reference 2	Range:0.0~10.00V【0.00V】
F5.22 Preset PI reference 3	Range:0.0~10.00V【0.00V】
F5.23 Preset PI reference 4	Range:0.0~10.00V【0.00V】
F5.24 Preset PI reference 5	Range:0.0~10.00V【0.00V】
F5.25 Preset PI reference 6	Range:0.0~10.00V【0.00V】
F5.26 Preset PI reference 7	Range:0.0~10.00V【0.00V】

Among the close-loop reference selectors, besides the 3 selectors defined by F5.01, the voltage value of preset close-loop reference defined by F5.20~F5.26 can also be used as the close-loop reference frequency.

Voltage of preset close-loop reference 1~7 can be selected by terminals, refer to introductions to F7.00~F7.07 for details. These functions can also be used in conjunction with PLC operating functions, see introductions to group F4 parameters for details.

Preset close-loop reference control priority is higher than the reference selectors defined by F5.01.

Table 5-5 Multi-function selection

Setting	Functions	Setting	Functions
0	No function	1	Preset frequency 1
2	Preset frequency 2	3	Preset frequency 3
4	Acc/Dec time 1	5	Acc/Dec time 2
6	External fault signal normally-open input	7	External fault signal normally-close input
8	RESET signal	9	Forward jog operation
10	External terminals for reverse jog	11	Coast-to-stop(FRS)
12	Frequency ramp up (UP)	13	Frequency ramp down (DN)
14	Reserved	15	Acc/Dec prohibit
16	3-wire operation control	17	External interrupt signal normally-open input
18	External interrupt signal normally-close input	19	DC injection braking command (DB)

Setting	Functions	Setting	Functions
20	Close-loop disabled	21	Reserved
22	Frequency selector 1	23	Frequency selector 2
24	Frequency selector 3	25	Frequency reference is input via terminal CCI forcibly
26	Reserved	27	Terminal control mode is forcibly enabled
28	Control mode selector 1	29	Control mode selector 2
30	Preset close-loop reference 1	31	Preset close-loop reference 2
32	Preset close-loop reference 3	33	Reserved
34	Reserved	35	External stop command
36	Reserved	37	Drive operation prohibiting
38	Reserved	39	Reserved
40	Auxiliary reference frequency clearing	41	Reserved
42	Counter's zero-clearing signal input	43	Counter's trig signal input
44	Reserved	45	Pulse input
46	Single-phase speed measuring input	47	Speed measuring input SM1(only set for X7)
48	Speed measuring input SM2 (only for X8)		

Introductions to functions listed in Table 5-5:

1~3: Functions of setting speed reference

Up to 8 speed references can be set through different ON/OFF combinations of terminals K_3 , K_2 and K_1 .

Table 5-6 On/Off combinations of terminals

K_3	K_2	K_1	Frequency setting
OFF	OFF	OFF	Common operating frequency
OFF	OFF	ON	Preset frequency 1
OFF	ON	OFF	Preset frequency 2
OFF	ON	ON	Preset frequency 3
ON	OFF	OFF	Preset frequency 4
ON	OFF	ON	Preset frequency 5
ON	ON	OFF	Preset frequency 6
ON	ON	ON	Preset frequency 7

These frequency references will be used in multi-step speed operation and simple PLC operation. With multi-step speed operation as an example:

Definitions of terminals X1, X2 and X3:

After setting F7.00 to 1, F7.01 to 2 and F7.03 to 3, terminals X1, X2 and X3 can be used in multi-step speed operation, as shown in Fig. 5-29.

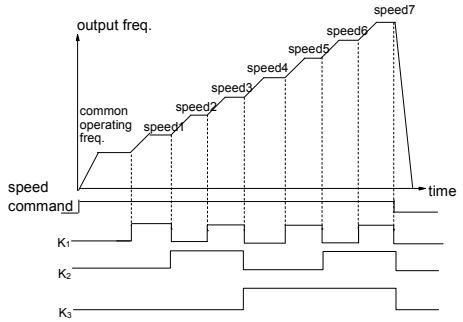


Fig. 5-29 Multi-step speed operation

In Fig. 5-30, with terminal control as an example, the operating direction can be controlled by K_4 and K_5. Common operating frequency and preset frequency1~7 can be selected through different On/Off combinations of K_1, K_2 and K_3.

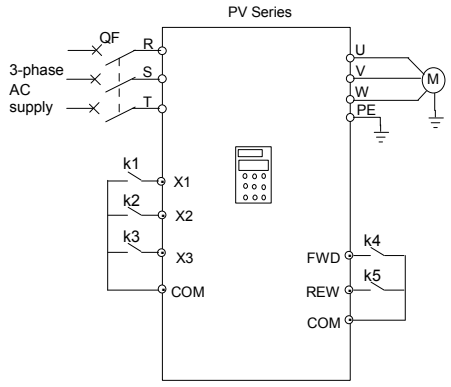


Fig. 5-30 Wiring for multi-speed operation

4~5: Function of selecting Acc/Dec time

Table 5-7 Acc/Dec time selection

Terminal 2	Terminal 1	Acc/Dec time selection
OFF	OFF	Acc time 1/Dec time 1
OFF	ON	Acc time 2/Dec time 2
ON	OFF	Acc time 3/Dec time 3
ON	ON	Acc time 4/Dec time 4

Through the On/Off combinations of terminals for selecting Acc/Dec time, Acc/Dec time 1~4 can be selected.

6~7: Functions of inputting external fault signal(normally-open/close input)

If the setting is 6~7, fault signal of external equipment can be input via the terminal, which is convenient for the drive to monitor the fault of external equipment. Once the drive receives the fault signal, it will display “E015”. The fault signal has two inputting modes of normally-open input and normally-close input.

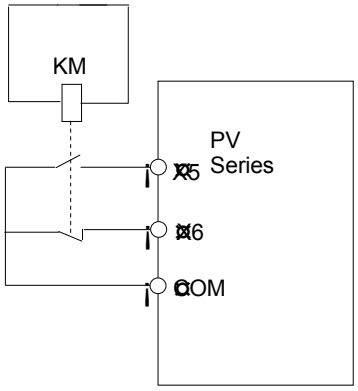


Fig. 5-31 Normally-open/close input

As shown in Fig. 5-, X_5 is normally-open input contact and X_6 is normally-close input command. KM is the relay for inputting external fault signal.

8: Function of inputting external reset signal

If the setting is 8, the drive can be reset via this terminal that is input with reset signal when the drive has a fault. The function of this terminal is same with that of RESET on the panel.

9~10:Function of inputting jog operation signal (JOGF/JOGR)

If the setting is 9~10, this terminal can enable the jog operation. JOGF is terminal for inputting forward jog operation command and JOGR is terminal for inputting reverse jog operation command. Jog operating frequency, interval and Acc/Dec time of jog operation are defined in F3.13~F3.16.

11:Coast-to-stop

If the setting is 11, the function of the terminal is same with that defined by F2.08. But it is detected by terminal, which is convenient for remote control.

12~13:Frequency ramp up UP/frequency ramp down DN

If the setting is 12~13, the terminal can be used to increase or decrease frequency and its function is the same as using ▲ and ▼ keys on the panel, which enables remote control. This terminal is enabled when F0.00=1 or F9.01=2. Increasing or decreasing rate is determined by F7.09.

14: Reserved

15:Acc/Dec prohibiting command

If the setting is 15, the terminal can make the motor operates at present speed without being influenced by external signal (except stopping command).

🕮 Note:

This terminal is disabled in normal Dec-to-stop process.

16: 3-wire operation control.

Refer to introductions to F7.08 about operation mode 2 and 3 (3-wire operation mode 1 and 2).

17~18: Function inputting external stopping signal (Normally-open/close input)

During operating process, the drive stops its output and operates at zero frequency when it receives external stopping signal. Once the external stopping signal is removed, the drive will start on the fly and restores to its normal operation.

There are two inputting modes of external stopping signal, which are normally-open input and normally-close input. As shown in Fig. 5-, X_5 is normally-open contact and X_6 is normally-close contact.

🕮 Note:

Differing from No. 6~7 functions, the external stopping signal will not cause the drive to trigger the alarm and the drive can restore to its normal operation after the stopping signal is removed.

19:Function of inputting DC injection braking signal

If the setting is 19, the terminal can be used to perform DC injection braking to the motor that is running so as to detect the emergency stop and make sure that

location of the motor is accurate. Initial braking frequency, braking delay time and braking current are defined by F2.09~F2.11. Braking time is the bigger value of the time defined by F2.12 and the effective continuous time defined by this control terminal.

20:Terminal for disabling close-loop function

If the setting is 20, the terminal can be used to detect the flexible switching between close-loop operation and low level operating mode(refer to section 4.1.4 for details).

🕮 Note:

The switching between operation modes are only enabled in close-loop operation (F5.00=1).

When the drive is switched to low level operating mode, its start/stop, operating direction, ACC/Dec time should be set to be compliant with corresponding operating modes accordingly.

21:Reserved

22~24: Terminals 1~3 for reference frequency selector.

Different ON/OFF combinations of terminals 1, 2 and 3 can select different reference frequency selectors as shown in Table 5-8. The relationship of the setting of terminal to the setting of F0.00 is that the setting sent later is active.

Table 5-8 Frequency selector

Terminal 3	Terminal 2	Terminal 1	Frequency selector
OFF	OFF	OFF	Hold the frequency setting
OFF	OFF	ON	Digital setting 1
OFF	ON	OFF	Digital setting 2
OFF	ON	ON	Digital setting 3
ON	OFF	OFF	VCI analog input
ON	OFF	ON	CCI analog input
ON	ON	OFF	PULSE terminal input
ON	ON	ON	PULSE terminal input

25:Frequency reference is input via terminal CCI forcibly

If the setting is 25, the frequency reference will be input via terminal CCI forcibly. The frequency selector will be changed to the previous one if this terminal function is disabled.

26:Reserved

27: Terminal control mode is forcibly enabled

When this terminal function is enabled, the operating command is input through this terminal forcibly, and the drive will be controlled in previous control mode if FWD/REV terminal function is disabled.

28~29: On/Off combinations of terminals 1 and 2 for different control modes selection

Table 5-9 Control modes

Terminal 2	Terminal 1	Control modes
OFF	OFF	Hold the control mode
OFF	ON	Panel control mode
ON	OFF	Terminal control mode
ON	ON	Serial port control mode

The control modes in Table 5-9 can be selected by the different On/Off combinations of terminal 1 and 2 that are used to select control modes.

30~32: Selecting preset close-loop reference frequencies via On/Off combinations of terminals 1~3

Table 5-10 Preset close-loop reference selection

Terminal 3	Terminal 2	Terminal 1	Preset close-loop reference selection
OFF	OFF	OFF	Close-loop reference is decided by F5.01
OFF	OFF	ON	Preset close-loop reference 1
OFF	ON	OFF	Preset close-loop reference 2
OF	ON	ON	Preset close-loop reference 3
ON	OFF	OFF	Preset close-loop reference 4
ON	OFF	ON	Preset close-loop reference 5
ON	ON	OFF	Preset close-loop reference 6
ON	ON	ON	Preset close-loop reference 7

The preset close-loop references in Table 5-10 can be selected by the different On/Off combinations of terminals 1~3 that are used to select close-loop references.

33:Reserved

34:Reserved

35:external stopping command

This stopping command is active in all control modes. When terminal 35 is enabled, the drive will stop in the mode defined in F2.08.

36:Reserved

37:Terminal for disabling the drive's operation

If terminal 37 is enabled, the drive that is operating will coast to stop. The drive in ready status will be prohibited to start. This function is mainly used in application with requirements of safety protection.

38:Reserved

39:Reserved

40:Clear the setting of auxiliary reference frequency

This function is only active for auxiliary reference frequency(F9.01=1, 2 and 3). When terminal 40 is enabled, the setting of auxiliary frequency reference is cleared to zero and the reference setting is determined by main reference frequency.

41:Reserved

42:Function of clearing the counter to zero

When the setting is 42, this terminal is used to clear the counter to zero and is used in conjunction with terminal 43.

43:Function of inputting trigging signal to counter

When the setting is 43, this terminal is used to input counting pulse signal to the internal counter of the drive. The highest pulse frequency is 200Hz. The present counting value can be saved at power off. See introductions to F7.33 and F7.34 for details.

44: Function of inputting counting value of length

This function is only effective to multi-function input terminals X7 and X8. The terminal is used in fixed-length control and calculating the length via pulses. See the introductions to F9.14~F9.19 for details.

45: Function of inputting pulse frequency

When the setting is 45, this function is only active and only effective to multi-function input terminals X7 and X8. The terminal is used to input pulse signal that is used as frequency reference. See introductions to Group F1 parameters for the relationship between input pulse frequency and the reference frequency.

46:Single-phase speed measuring input

This function is only effective to multi-function input terminals X7 and X8. See section 3.3.2 of Chapter 3 for inputting characteristics. The speed control accuracy is ±0.1%. Single-phase speed feedback control can be detected by using this terminal and PG.

47: Speed measuring input SM1

48: Speed measuring input SM2

When the setting is 48, this function is active and only effective to multi-function input terminals X7 and X8. See section 3.3.2 of Chapter 3 for inputting characteristics. The speed control accuracy is ±0.1%. Dual-phase speed feedback control can be detected by using this terminal and PG.

🕮 Note:

When the drive is in motor auto-tuning operating status, No. 44~47 functions of X7 are disabled automatically.

F7.08 FWD/REV running modes setup	Range:0~3【0】

This parameter defines four operating modes controlled by external terminals.

0:2-wire operating mode 1

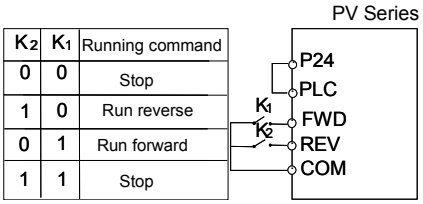


Fig. 5-32 2-wire operating mode 1

1:2-wire operating mode 2

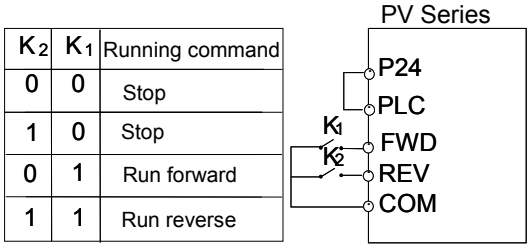


Fig. 5-33 2-wire operating mode 2

2:3-wire operating mode 1

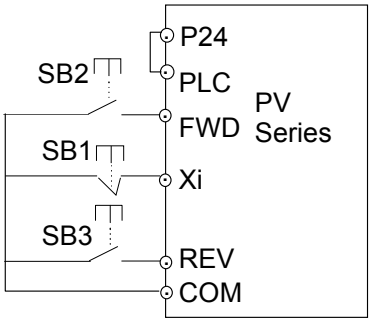


Fig. 5-34 3-wire operating mode 1

Where:

SB1:Stop button

SB2: Run forward button

SB3: Run reverse button

Terminal Xi is the multi-function input terminal of X_1~X_8. At this time, the function of this terminal should be defined as No.16 function of “3-wire operation”.

3:3-wire operation mode 2

K	running direction
0	Forward
1	Reverse

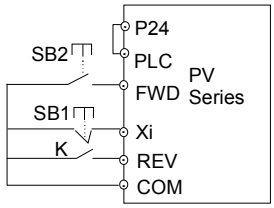


Fig. 5-35 3-wire operating mode 2

Where:

SB1:Stop button

SB2: Run button

Terminal Xi is the multi-function input terminal of X_1~X_8. At this time, the function of this terminal should be defined as No.16 function of “3-wire operation”.

🕮 Note:

In terminal control mode, for 2-wire operating mode 1 and 2, although the terminal is enabled, the drive will not run forward or reverse when the drive stops due to the external stopping command even if the terminal FWD/REV are still active. If the user needs the drive to run again, FWD/REV should be enabled again, such as the functions of terminal 11 and 35(see F7.00~F7.07). When the drive stops due to a fault, it will start immediately if the terminal FWD/REV is enabled and the fault is cleared.

F7.09 UP/DN speed	Range:0.01~99.99Hz/s【1.00Hz/s】

F7.09 is used to define the changing rate of reference frequency that is changed by terminal UP/DN

F7.10 Bi-direction open-collector output terminal Y1	Range:0~19【0】
F7.11 Bi-direction open-collector output terminal Y2	Range:0~19【1】
F7.12 Output functions of relay	Range:0~19【16】

Refer to section 3.3.2 in Chapter 3 for the output characteristics of Y1 and Y2 that are bi-direction open-collector output terminal and the relay’s output terminal. Table 5-11 shows the functions of the above 3 terminals and one function can be selected repeatedly.

Table 5-11 Functions of output terminals

Value	Function	Value	Function
0	Drive running signal (RUN)	1	Frequency arriving signal (FAR)
2	Frequency detection threshold (FDT1)	3	Frequency detection threshold (FDT2)
4	Overload signal (OL)	5	Low voltage lock-up signal (LU)
6	External stopping command (EXT)	7	High limit of frequency (FHL)
8	Lower limit of frequency (FLL)	9	Zero-speed running
10	Reserved	11	Reserved
12	preset counting value arriving	13	Specified counting value arriving
14	Reserved	15	Drive ready (RDY)
16	Drive fails	17	Extended function 1 of host
18	Reserved	19	Preset operating time out

Introductions to the functions listed in Table 5-11:

0: Drive running signal (RUN)

The drive is in operating status and running indicating signal is output by this terminal.

1: Frequency arriving signal (FAR)

See introductions to F7.13 parameters.

2:Frequency detection threshold(FDT1)

See introductions to F7.14~F7.15 parameters.

3:Frequency detection threshold(FDT2)

See introductions to F7.16~F7.17 parameters.

4: Overload signal (OL)

The terminal outputs the indicating signal if the drive’s output current is bigger than the value defined by FL.05 and the overload time is longer than the time defined by FL.06. This function is usually used in overload pre-alarm. See the descriptions of Fig. 5-64.

5: Low voltage lock-up signal(LU)

The terminal outputs the indicating signal if the DC bus voltage is lower than the low voltage limit, and the LED displays “P.oFF”.

6: External stopping command (EXT)

The terminal outputs the indicating signal if the drive outputs tripping signal caused by external fault (E015).

7: High limit of frequency (FHL)

The terminal outputs the indicating signal if the preset frequency is higher than upper limit of frequency and the operating frequency reaches the upper limit of frequency.

8: Lower limit of frequency (FLL)

The terminal outputs the indicating signal if the preset frequency is higher than lower limit of frequency and the operating frequency reaches the lower limit of frequency.

9: Zero-speed running

The terminal outputs the indicating signal if the drive's output frequency is 0 and the drive is in operating status.

10: Reserved

11: Reserved

12: preset counting value arriving

13: reference length arriving indication

Refer to introductions to F7.33~F7.34 for terminals 12 and 13.

14: Reserved

15: drive ready (RDY)

The RDY signal is output, that means the drive has no fault, its DC bus voltage is normal and it can receive starting command.

16:Drive fails

The terminal outputs the indicating signal if the drive has faults.

17: extended function 1 of host

The output signal of terminal Y1, Y2 or TC is directly controlled by a serial port. Refer to the communicating protocol of EV2000.

18:Reserved

19: preset operating time out

The terminal outputs the indicating signal if the drive's total operating time(Fn.01) reaches preset operating time (Fn.00).

F7.13 Frequency arriving signal(FAR)	Range:0.00~650.00Hz 【2.50Hz】

As shown in Fig. 5-37, if the drive's output frequency is within the detecting range of preset frequency, a pulse signal will be output.

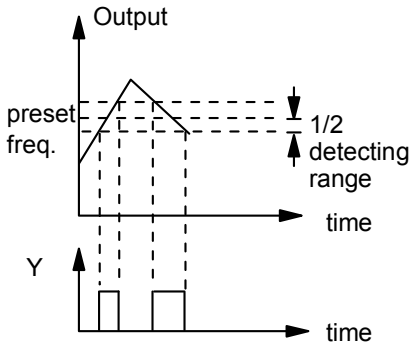


Fig. 5-37 Frequency arriving signal

F7.14 FDT1 level	Range:0.00~650.00Hz【50.00Hz】
F7.15 FDT1 lag	Range:0.00~650.00Hz【1.00Hz】
F7.16 FDT2 level	Range:0.00~650.00Hz【25.00Hz】
F7.17 FDT2 lag	Range:0.00~650.00Hz【1.00Hz】

F7.14~F7.15 is a complement to the No.2 function in Table 5-11. F7.16~F7.17 is a complement to the No.3 function in Table 5-11. Their functions are same. With F7.14~F7.15 as an example: when the drive's output frequency reaches a certain preset frequency (FDT1 level), it outputs an indicating signal until its output frequency drops below a certain frequency of FDT1 level(FDT1 level-FDT1 lag), as shown in Fig. 5-38.

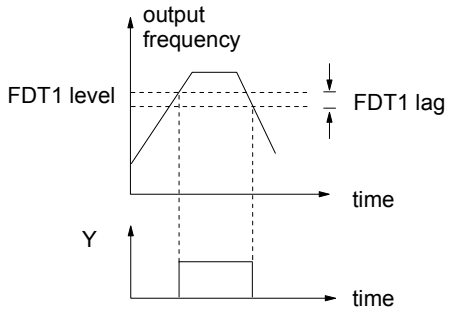


Fig. 5-38 FDT level

F7.18~F7.25	Reserved

Reserved functions.

F7.26 Functions of terminal Analog Output 1 (AO1)	Range:0~11【0】
F7.27 Functions of terminal Analog Output 1 (AO2)	Range:0~11【3】
F7.28 Functions of terminal (Digital Output) DO	Range:0~11【0】

AO1 and AO2 are analog output terminals, and DO is pulse output terminals.

Refer to section 3.3.2 of Chapter 3 for the output characteristics of AO1 and AO2, their analog output ranges are defined by F7.29.

Pulse frequency range of DO: 0~Max output pulse frequency (defined by F7.32).

The relationship between the displaying range and the output values of AO1, AO2 and DO are given in Table 5-12.

Table 5-12 Displaying range of output terminals

Setting	Functions	Indicating range
0	output frequency before slip compensation	0~Max output frequency
1	output frequency after slip compensation	0~Max output frequency
2	preset frequency	0~Max output frequency
3	output current	0~2 times of drive's rated current
4	output current	0~2 times of motor's rated current
5	output torque	0~2 times of motor's rated torque
6	Output voltage	0~1.2 times of drive's rated voltage
7	bus voltage	0~800V
8	VCI	0~10V
9	CCI	0~10V/0~20mA
10	output power	0~2 times of rated power
11	extended function 2 of host	0~65535

If the extended function 2 of host is enabled, the output signal of terminal AO1, AO2 or DO is directly controlled by a serial port. 65535 corresponds to the Max output. Refer to the communicating protocol of PV Series for details.

For an example:

AO1 outputs 4~20mA, and the corresponding indicated bus voltage is 0~800V.

The settings:

①F7.26=7, output bus voltage;

②F7.29=01, output of terminal AO1 is 4~20mA;

③F7.30=100%, output gain is 100%;

④AO1 jumper of CN16 short circuited at 0/4-20mA side.

F7.29 analog output offset	Range:00~11【00】

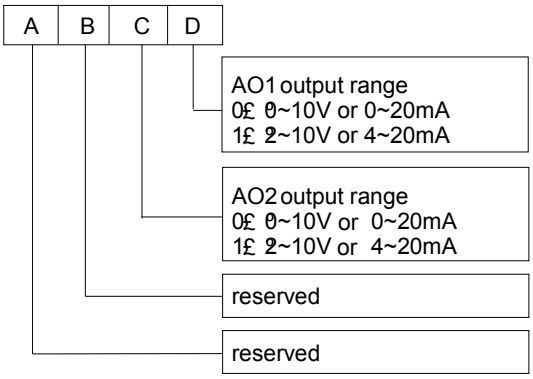


Fig. 5-39 analog output offset settings

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

F7.29 is used to select analog output ranges of AO1 and AO2.

F7.30 Output gain of AO1	Range:0.0~200.0%【100.0%】
F7.31 Output gain of AO2	Range:0.0~200.0%【100.0%】

As to the analog output of AO1 and AO2, the user can adjust the output gain to change the measuring range or calibrate the meter.

🕮 Note:

Changing the settings of F7.30 and F7.31 will influence the analog output.

F7.32 Maximum output frequency of DO	Range:0~50.0kHz【10.0KHz】

F7.32 defines the permissible maximum frequency of DO, refer to the introductions to F7.28.

F7.33 Preset counting value	Range:F7.34~9999【0】
F7.34 Specified counting value	Range:0~F7.33【0】

F7.33 and F7.34 are complements for No. 12 and 13 functions in Table 5-11.

Preset counting value reaches reference value, means the relay or Yi (bi-direction open-collector output terminal) can send out a signal when the number of pulse signals received by terminal Xi is preset counting value.

For example: as shown in Fig. 5-39, when eighth pulse signals are received by terminal Xi, Y1 outputs an indicating signal. At this time F7.33=8.

Specified counting value reaches reference value, means the relay or Yi can send out a signal when the

pulse number received by terminal X1 is the specified counting value until the received number arrives the preset counting value.

As shown in Fig. 5-40, when Xi receives the 5th pulse, Y2 outputs an indication signal when X1 receives the 8th pulse. At this time, F7.34=5. The specified counting value is invalid if it is bigger than the preset counting value.

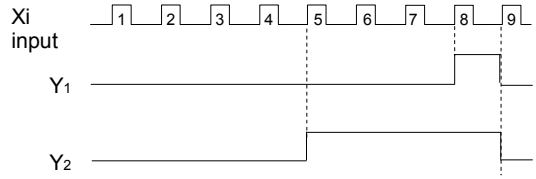


Fig. 5-40 Preset and specified counting value

F7.35 terminal's positive and negative logic	Range:000~FFFH【000H】

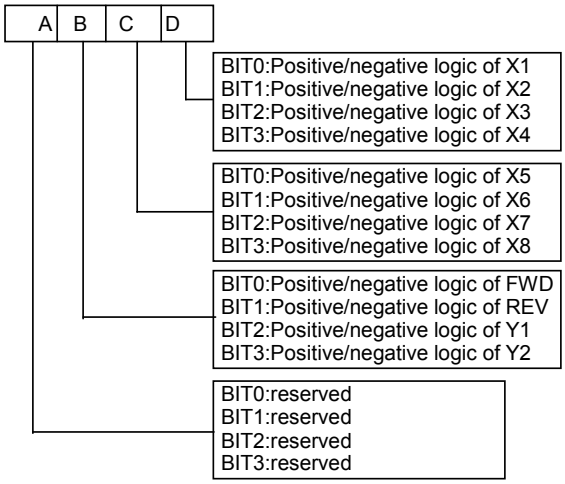


Fig. 5-41 terminal's positive and negative logic

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

F7.35 defines the terminal's positive and negative logic

Positive logic: Terminal Xi is enabled if it is connected to the common terminal;

Negative logic: Terminal Xi is disabled if it is connected to the common terminal;

If BIT is 0, that means positive logic, and if it is 1, that means negative logic.

For example:

If X1~X8 are required to be positive logic, terminals FWD and REV are required to be negative logic, terminal Y1 is positive logic and terminal Y2 is negative logic, then the settings:

Logic status of X4~X1 is 0000, and the hex value is 0, then unit's place of LED displays "0"; Logic status of X8~X5 is 0000, and the hex value is 0, then ten's place of LED displays "0"; Logic status of Y2, Y1, REV and FWD is 1011, and the hex value is B, then hundred's place of LED displays "B". At this time the settings of F7.35 is 0B00.

Table 5-13 give the settings:

Table 5-13 Binary settings and the displaying of LED

Binary settings				Hex value (Displaying of LED)
BIT3	BIT2	BIT1	BIT0	
0	0	0	0	0
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9
1	0	1	0	A
1	0	1	1	B
1	1	0	0	C
1	1	0	1	D
1	1	1	0	E
1	1	1	1	F

Displaying of LED means the displayed values of thousand's place, hundred's place, ten's place and unit's place of the LED.

🕮 Note:

Factory setting of all the terminals is positive logic.

5.7 Display of Parameters (F8)

F8.00 Language selection	Range:0~1【1】

0:Chinese

1:English

F8.00 is only valid for the panel with LCD screen.

F8.01 Running display 1	Range:000~3FFH【3FFH】

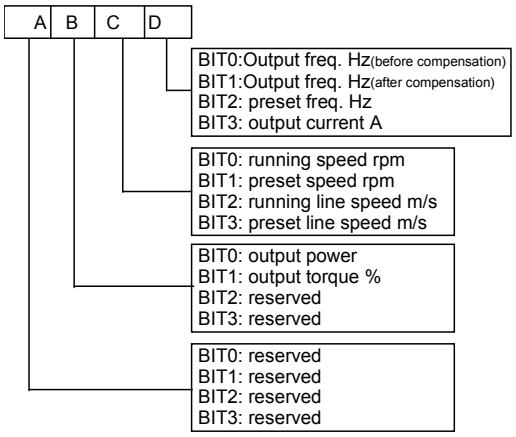


Fig. 5-42 Operating parameters displayed by LED

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

F8.01 and F8.02 define the parameters that can be displayed by LED in operating status.

If BIT is 0, the parameter will not be displayed;

If BIT is 1, the parameter will be displayed.

For example, Unit place of LED (Bit0) is to display the "output frequency before compensation", if Bit0=0, the parameter will not be displayed, if Bit0=1, the parameter will be displayed.

See F7.35 for the relationship between the values of each BIT and the displayed value of LED.

F8.02 Running display 2	Range:000~3FFH【000H】

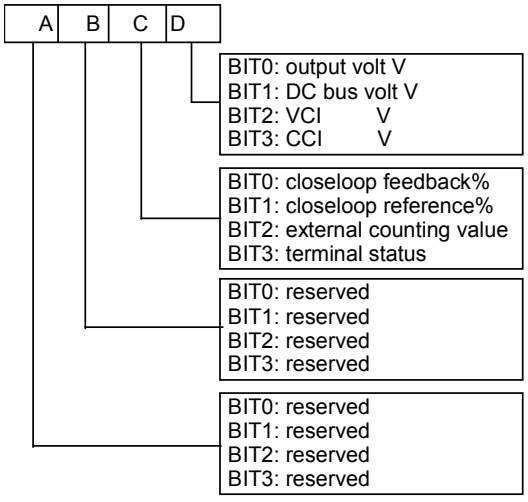


Fig. 5-43 Operating parameter 2 displayed by LED

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

Displayed terminal information includes status of terminal X1~X8, bi-direction open-collector output terminals Y1 and Y2, and relay output terminal TC. The status of terminals are indicated by the "On" or "Off' of LED. If the LED turns on, that means the terminal is enabled, and the terminal is disabled if the LED turns off, as shown in Fig.5-44:

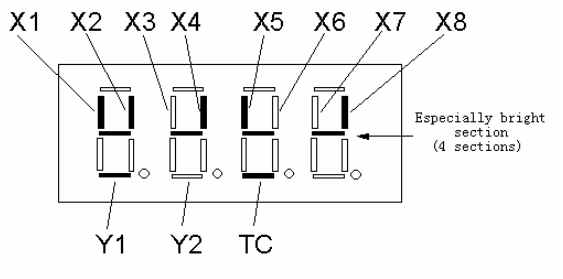


Fig. 5-44 Terminal status

In Fig.5-44, the LEDs display that terminals X1, X2, X4, X5 and X8 are enabled, terminals X3, X6 and X7 are disabled, terminals Y1 and TC are enabled and terminal Y2 is disabled. Four LEDs always illuminate so that the user can observe the LED status easily.

🕮 Note:

When the rotating speed and line speed are displayed, these values can be revised by pressing ▲ and ▼ in real time(no need to transit to frequency displaying status).

When F8.01 and F8.02 are all set to 0, the frequency before compensation will be displayed.

In operating parameter displaying status, pressing ▶▶ can scroll through the parameters to be displayed

F8.03 Stopping display	Range:0000~3FFFH【1FFH】

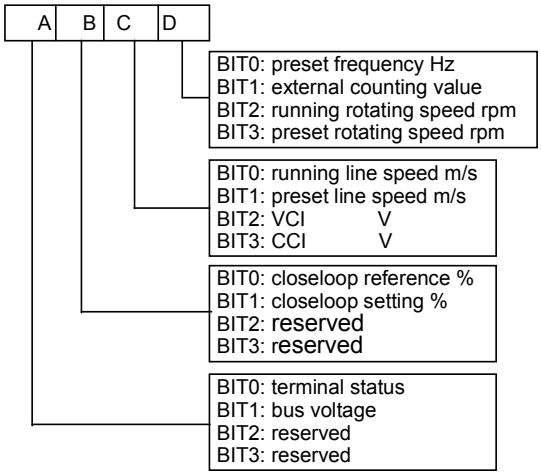


Fig. 5-45 Stopping parameters displayed by LED

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

F8.03 defines the parameters that can be displayed by LED in stopping process.

If BIT is 0, the parameter will not be displayed; If BIT is 1, the parameter will be displayed.

For example, Bit0 decides whether to display the "preset frequency", if Bit0=0, the parameter will not be displayed, if Bit0=1, the parameter will be displayed.

See F7.35 for the relationship between the values of each BIT and the displayed value of LED.

🕮 Note:

When the rotating speed and line speed are displayed, these values can be revised by pressing ▲ and ▼ in real time(no need to change to frequency displaying status).

When the setting of F8.03 is 0, the preset frequency will be displayed.

In stopping parameter displaying status, pressing ▶▶ can scroll through the parameters to be displayed.

F8.04 Rotating Speed displaying coefficient	Range:0.1~999.9%【100.0%】

F8.04 is used to correct the error of displayed rotating speed and it has no influence to actual speed.

F8.05 Line speed displaying coefficient	Range:0.1~999.9%【1.0%】

F8.05 is used to correct the error of displayed line speed and it has no influence to actual speed.

F8.06 Displaying coefficient of close-loop physics values	Range:0.1~999.9%【100.0%】

F8.06 is used to correct error between actual physics values (pressure or flow) and reference or feedback values(voltage or current). It has no influence to close-loop PI regulation.

5.8 Enhanced Function Parameter (F9)

F9.00 Control mode is bundled to frequency selector	Range:000~666 【000】

F9.00 can bundle 3 control modes to 6 reference frequency selectors, that is, if a control mode is selected, then a frequency selector(such as panel input, analog VCI input) will be selected automatically.

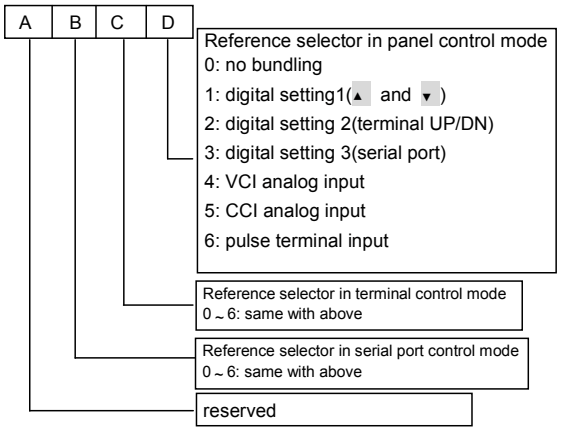


Fig. 5-46 Control mode is bundled to frequency selector

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

The reference frequency selector is defined by F0.00, see section 5.1 for details.

Different control modes can be bundled to one same reference frequency selector.

There are following methods to select control modes:

Method 1:Change F0.03 "Control modes selector";

Method 2: Use PANEL/REMOTE or ENTER/DATA;

Method 3: Use the terminals used for selecting control modes (Functions of terminals X1~X8 should be set to No. 28 and 29 functions.)

For example:

In order to detect remote and local control, it requires that:

①Control modes selection: The control modes can be selected by terminal remotely or by PANEL/REMOTE locally;

②If panel control mode is used, press RUN to run the drive and press STOP to stop the drive. The preset frequency can be adjusted by pressing ▲ and ▼.

③If terminal control mode is used, turn on FWD to run forward and turn on REV to run reverse. The preset frequency is adjusted via VCI.

④ Terminal control mode is enabled after the drive is switched on.

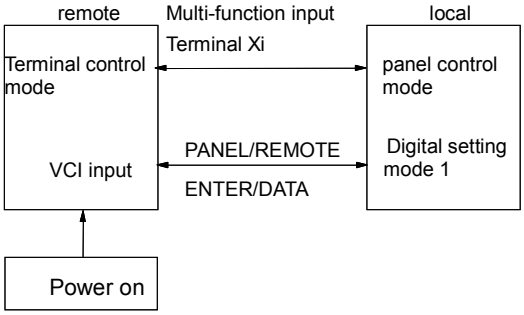


Fig. 5-47 Remote and local control

The following setting should be done to detect remote and local control:

Set F0.03 to 1 to select terminal control mode and remote control is enabled after the drive is switched on;

Set F7.00 to 28, and F7.01 to 29 to select multi-function input terminal X1 and X2 to input operating commands;

Set F7.08 to 1 to select 2-wire control mode 2. The drive runs forward when FWD is enabled, and runs reverse when REV is enabled;

Set F9.07 to 020 to enable PANEL/REMOTE;

If F9.00=041, then terminal control mode is bundled to reference selector of VCI analog input, and the panel control mode is bundled to reference selector of digital setting 1.

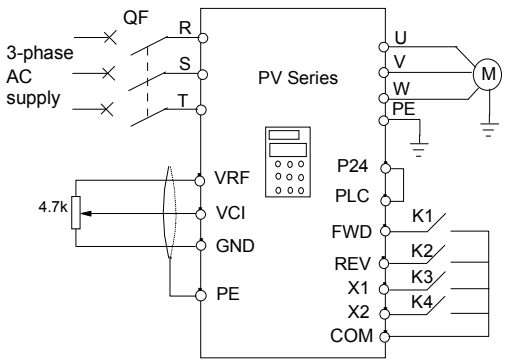


Fig. 5-48 Wiring connections for remote and local control

Note:

Factory setting is 000:Frequency selector will not be bundled to control mode.

F9.01 auxiliary reference frequency selector	Range:0~12【0】
F9.02 auxiliary analog reference frequency coefficient	Range:0.00~9.99【1.00】
F9.03 auxiliary digital reference frequency	Range:0.00~650.0Hz 【0.00Hz】
F9.04 auxiliary digital reference frequency control	Range:000~111【000】

The preset frequency of PV Series drive is combined by main reference frequency and auxiliary reference frequency. F9.01~F9.04 are used to define the auxiliary reference frequency selector. Fig. 5-49 shows the how the preset frequency is made up of main reference frequency and auxiliary reference frequency.

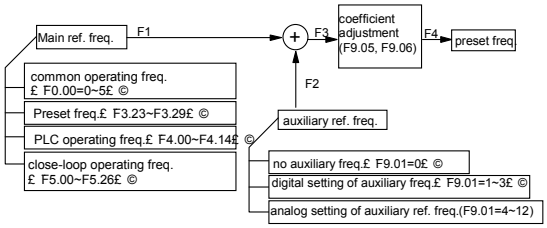


Fig. 5-49 Preset frequency

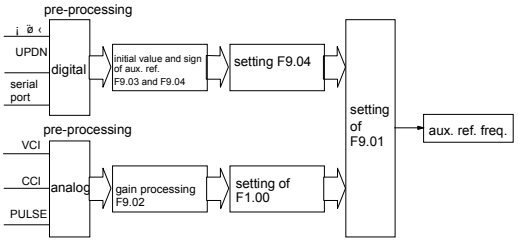


Fig. 5-50 Auxiliary reference frequency selector

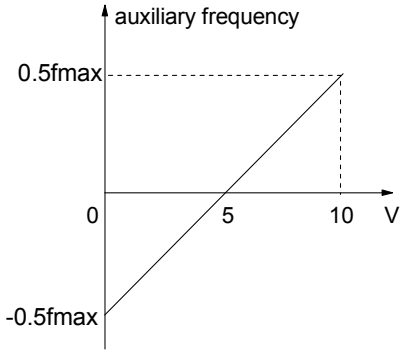
Auxiliary reference frequency is controlled by F9.01~F9.04. F9.01 defines the auxiliary reference frequency selector.

Table 5-12 auxiliary reference frequency selector

SN	Reference selector	Features
0	No auxiliary reference frequency	Zero
1	digital setting 1, set the reference by ▲ and ▼	Reference is set by F9.03, the changed frequency will be saved in F9.03 upon power outage.
2	digital setting 2, set the reference by UP/DN	
3	digital setting 3, set the reference serial port	
4	VCI analog input	Determined by actual input analog value, see F1.00 for frequency curves
5	CCI analog input	
6	PULSE terminal input	
7	- VCI analog input	
8	- CCI analog input	
9	- PULSE terminal input	
10	VCI-5	
11	CCI-5	
12	PULSE-0.5×F1.03	

If digital setting 3 is selected, and the frequency reference is input via the serial port, then the auxiliary frequency can be changed by setting F9.03 through the host.

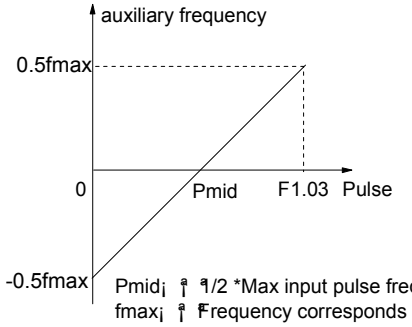
When selecting VCI-5 or CCI-5 to input auxiliary reference frequency, the 5V analog input should be used as a central point, from 0 to 5V, the reference frequency drops with the increase of voltage， while from 5 to 10V, the frequency increases with the increase of voltage. For example, as shown in Fig. 5-51:



fmax¡ ¶ ¶requency corresponding to Max analog value(F1.07 orF1.11)

Fig. 5-51 VCI-5 and CCI-5 are used to input auxiliary reference frequency

When using PULSE-0.5×F1.03 to determine auxiliary reference frequency, 1/2 of F1.03(Max input pulse frequency) is the central point. From 0 to 0.5 times of Max pulse frequency, the reference frequency decreases with the increase of pulse frequency, from 0.5 to 1, the reference frequency increases with the increase of pulse frequency. For example, as shown in Fig. 5-52:



Pmid¡ ¶ ¶1/2 *Max input pulse frequency(F1.03)
fmax¡ ¶ ¶Frequency corresponds to Max analog value(F1.07 or F1.11)

Fig. 5-52 Using PULSE-0.5×F1.03 to determine auxiliary reference frequency

F9.02: Coefficient of analog auxiliary reference

Only valid when F9.01=4~12. First, use F9.02 to calculate the gain and then calculate the auxiliary reference frequency by the frequency curve defined by F1.00.

F9.03: initial value of digital reference frequency

Only valid when F9.01=1~3. F9.03 defines the initial values of digital reference frequency when F9.01=1~3.

F9.04: digital auxiliary reference frequency control

Only valid when F9.01=1~3, as shown in Fig.5-53.

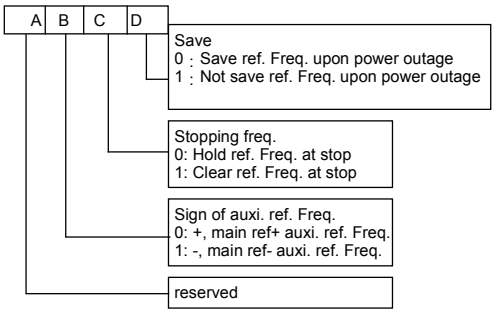


Fig. 5-53 digital auxiliary reference frequency control

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

Unit's place: Setting of parameter-saving function at power off

0: Save the auxiliary reference frequency at power off

Store the auxiliary frequency in F9.03 at power off. The sign of auxiliary reference frequency is saved in F9.04.

1: Do not save the auxiliary reference frequency at power off

Ten's place: Holding of auxiliary reference frequency

0: Hold the auxiliary reference frequency after stopping

Hold the auxiliary reference frequency after the drive stops.

1:Clear the preset frequency after stopping

Clear the auxiliary reference frequency after the drive stops.

Hundred's place: Sign of reference frequency

0:Plus

The result of "main reference frequency + auxiliary reference frequency" is the preset frequency.

1:Minus

The result of "main reference frequency - auxiliary reference frequency" is the preset frequency.

📖 Note:

When the inputting mode(such as input via panel, terminal or serial port) of auxiliary reference frequency is the same with that of main reference frequency, the auxiliary reference frequency setting is invalid.

F9.05 Frequency adjustment	Range:0~2【0】
F9.06 Adjustment coefficient of preset frequency	Range:0.0%~200.0% 【100.0%】

F9.05 and F9.06 defines the adjustment of preset frequency as shown in Fig. 5-49.

0:Disabled

The preset frequency (F4) without adjusting the main auxiliary reference frequency is the setting of F3.

1:Using Max output frequency(F005) to adjust

Preset frequency(F4)=F3+F0.05×(F9.06-100%)

2:Using the present frequency to adjust

Preset frequency(F4)=F3+F3 × (F9.06-100%)

=F3×F9.06。

F9.07 Function of keys	Range:000~422 【000】

F9.07 defines the functions of PANEL/REMOTE and STOP/RESET, and the locking up function of keypad.

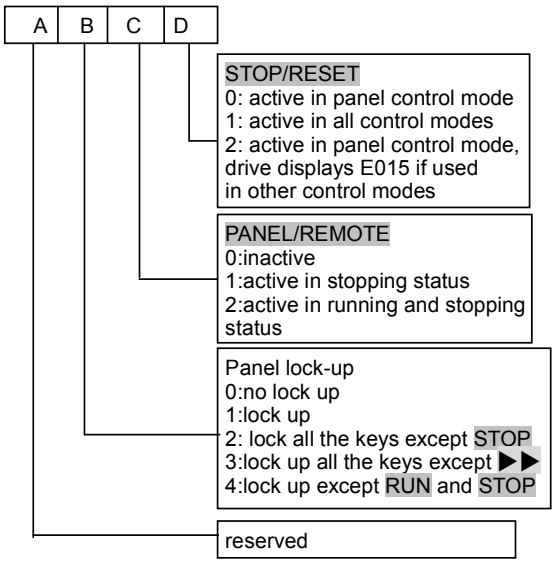


Fig. 5-54 Functions of keys and locking up function of keypad

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

Unit's place: Function of STOP/RESET

This bit is used to define the functions of STOP/RESET as a stopping key of STOP and the operating mode.

0:Enabled only in panel control mode

1:Enabled in panel control mode, terminal and serial control modes. The drive stops in stopping mode when this key is pressed.

2: Enabled in panel control mode, terminal and serial control modes.

In panel control mode, the drive stops in stopping mode when this key is pressed. In terminal and serial control modes, the drive alarms, displays fault code of E015 and coasts to stop when this key is pressed.

If STOP/RESET is used to reset the fault, then it is enabled in all control modes.

Ten's place: Function of PANEL/REMOTE

This bit is used to define the functions of PANEL/REMOTE and the operating range.

0:PANEL/REMOTE is disabled and cannot be used to select the control mode.

1:PANEL/REMOTE is only enabled in stopping mode and cannot be used to select the control mode in operating status.

2:PANEL/REMOTE can be used to select the control mode both in operating status and stopping status.

Procedures to select control modes:

Panel control mode(PANEL/REMOTE LED turns on) →Terminal control mode(PANEL/REMOTE LED turns off) →serial port control mode(PANEL/REMOTE LED flashes) →panel control mode(PANEL/REMOTE LED turns on)

Note:

After selecting a control mode by using PANEL/REMOTE, ENTER/DATA must be pressed in 3 seconds to enable the control mode.

Hundred's place: Lock-up of keypad

This bit is used to define the function of locking up the panel and the operating range.

0:Locking up function is disabled and no key on the panel will be locked up.

1: Locking up function is enabled and all keys on the panel are locked up.

2:Except STOP/RESET, all other keys are locked up. After the locking up function is enabled, all the keys on panel cannot be used except the STOP/RESET.

3:Except ▶▶, all other keys are locked up. After the locking up function is enabled, all the keys on panel cannot be used except the ▶▶.

4: Except RUN and STOP, all other keys are locked up. After the locking up function is enabled, all the keys on panel cannot be used except the RUN and STOP.

After correct setting, follow the procedures described in Fig. 4- to enable the locking up function. And follow the procedures described in Fig. 4- to disable the locking up function.

F9.08 Fan control mode	Range:0. 1【0】

0:Auto stopping mode

The fan runs all the time when the drive is operating. After the drive stops, its internal temperature detecting program will be activated to stop the fan or let the fan continue to run according to the IGBT's temperature.

1: The fan operates continuously.

The fan operates continuously after the drive is switched on.

F9.09 Unit of Acc/Dec time	Range:0. 1【0】

F9.09 decides the unit of Acc/Dec time.

0:Second

1:Minute

This function is active for all the Acc or Dec process except the Jogging process.

Up to 60 hours' Acc/Dec time can be set, and suitable for the application with a requirement of long Acc/Dec time.

🕮 Note

It is recommended to select second as the unit.

F9.10 droop control	Range:0.00~10.00Hz【0.00Hz】

When several drives drive one load, F9.10 can make the drives share the load equally. An example is shown in Fig. 5-55, 5 drives drive one conveying belt of 5 motors.

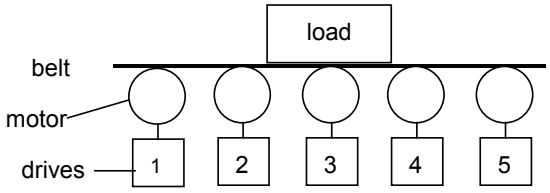


Fig. 5-55 Droop control

When the load of one of the drive is heavier, this drive will reduce its output frequency to shed part of the load according to the settings of F9.10. The setting can be increased from small to big. The relationship between the load and the output frequency is shown in Fig. 5-56:

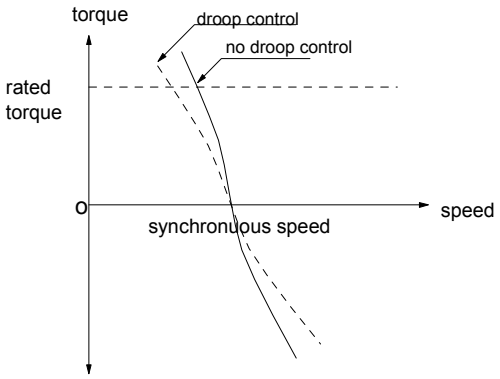


Fig. 5-56 Droop control

F9.11 over-modulation enabling	Range:0. 1【1】

When the AC supply voltage has been low(rated voltage lower than -15%) for a long time or the drive has driven a heavy load for a long time, the drive can improve

its output voltage by improving the utilization rate of DC bus voltage. F9.11 decides whether to enable the over-modulation function.

0: over-modulation function is disabled

1: over-modulation function is enabled

🕮 Note:

When over-modulation function is enabled and active, output current harmonics will increase.

F9.12 threshold of zero-frequency operation	Range:0.00~650.00Hz【0.00Hz】
F9.13 hysteresis of zero-frequency operation	Range:0.00~650.00Hz【0.00Hz】

F9.12 and F9.13 are used to set the zero-frequency operation hysteresis.

With CCI current reference as an example, see Fig. 5-57:

Starting process

After the running command is sent out, the motor will start and accelerate to the frequency corresponding to the CCI input current only when CCI input current reaches or exceeds the preset value of Ib, or the preset frequency reaches fb.

Stopping process:

The drive will not stop immediately when the CCI input current is reduced to Ib and it will stop its output only when the CCI input current drops to Ia and the corresponding frequency is fa.

“fa” is the zero-frequency operation threshold that is defined by F9.12. “fb-fa” is the hysteresis of zero-frequency operation that is defined by F9.13.

By using this function, we can obtain the dormant function so as to achieve energy-saving operation. Besides, the he drive will not start frequently around the threshold of zero-frequency operation if the hysteresis is set suitably.

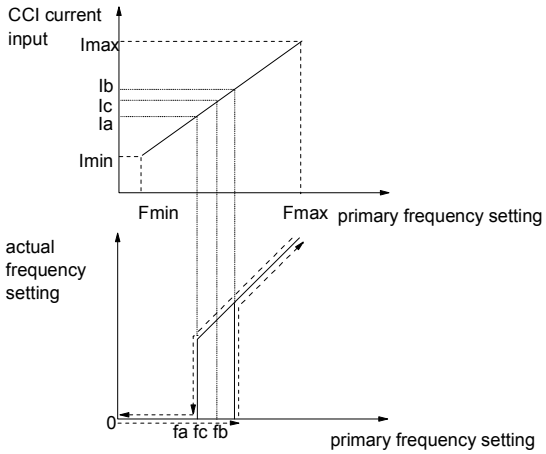


Fig. 5-57 Hysteresis of zero-frequency operation

F9.14 ~F.9.19	Reserved
F9.20 Trip-free operating function	Range:0. 1【0】
F9.21 Frequency slewrate at voltage compensation	Range:0.00~99.99Hz/s 【10.00Hz/s】

Trip-free operating function enables the drive to perform low-voltage compensation when the voltage drops or instantaneous under-voltage occurs. The drive can continue to operate without tripping by reducing its output frequency and feedback energy via motor.

If F9.20 is set to 0, this function is disabled.

If F9.20 is set to 1, this function is enabled and low-voltage compensation is activated.

If the setting of F9.21 (frequency slewrate at voltage compensation) is too big, the feedback energy of motor is too large and over-voltage protection may happen; If the setting of F9.21 is set to small, the feedback energy of motor is too small and therefore there is no low-voltage compensation effect. So, please set F9.21 according to load inertia and the actual load.

🕮 Note:

This function is only active for the drive of 22kW or below.

F9.22 Restart after power failure	Range:0. 1 【0】
F9.23 Delay time for restart after power failure	Range:0.0~10.0s 【0.5s】

F9.22 and F9.23 decide whether the drive will start automatically and the delay time for restart when the

drive is switched off and switched on again in different control modes.

If F9.22 is set to 0, the drive will not operate automatically when it is switched off and then switched on again.

If F9.22 is set to 1, when the drive is switched off and switched on again, it will wait a certain time defined by F9.23 and then start automatically if it meets the starting conditions

Whether the drive will operate automatically is decided by the setting of F9.22, the operating condition of the drive before power off and the control mode when the drive is switched on. See Table 5-13.

Table 5-13 Restarting conditions

Setting of F9.22	Status before power off	Control modes when the drive is switched on				
		Panel	Serial port	3-wire mode 1& 2	2-wire mode 1 & 2	
		None	None	None	None	Yes
0	Stop	0	0	0	0	0
	Run	0	0	0	0	0
1	Stop	0	0	0	0	1
	Run	1	1	1	0	1

🕮 Note:

Table 5-15 shows the drive's action under different conditions. "0" means the drive enter ready status and "1" means the drive start operation automatically.

When using the panel or serial port or 3-wire modes 1 and 2 to start or stop the drive, the command signal is in pulse mode and there is no operating command when the drive is switched on.

If there is a stopping command, the drive will stop first.

When the function of restart after power failure is enabled, the drive will start on the fly if it is not switched off totally(which means that, the motor still runs and drive's LED displays "P.OFF") and then switched on again, and it will start in the starting mode defined in F2.00 if it is switched off totally(LED turns off) and switched on again.

5.9 Communicating Parameters (FF)

FF.00 communication configuration	Range:0000~1127H【0005】

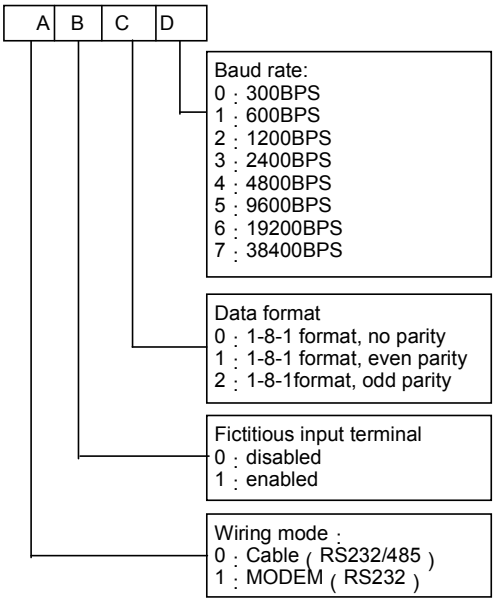


Fig. 5-58 communicating parameters

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

FF.00 is used to set the bits of LED, which is used to set the parameters of serial communicating port.

Fictitious terminal is actual analog terminal used by the control PC to send commands. Each bit of the data represents one terminal and the value of the bit represents the status of corresponding terminal (see the communication protocol of PV Series for details). The actual terminal is disabled if the fictitious terminal is enabled. The fictitious terminal is equivalent to the actual terminal.

The setting of thousand's bit does affect the communication process. If FF.00 is set to MODEM (RS232) mode, the MODEM will be initialized via the RS232 port each time when the drive is switched on, so that the MODEM can answer the dialing automatically after it receives 3 ringing signals. See section 3.3.2 in chapter 3 for the wire connections of remote control circuit that is formed by dialing circuits.

FF.01 Local address	Range:0~127【1】

In serial communication, FF.01 is used to identify the drive's address.

Note:"127" is the broadcasting address. When the address is set to broadcasting address, the drive can

receive and execute the command sent by control PC, but will not answer back.

FF.02 Time threshold for judging the communication status	Range:0~1000.0s【0.0s】

If the drive has not detected the communication signal of the serial port for a certain time, it will judge that communication failure occurs. The time threshold is defined by FF.02.

If FF.02 is set to 0, the drive will not detect the communication signal of serial port and this function is disabled.

FF.03 delay for responding to control PC	Range:0~1000ms【5ms】

The delay for responding to control PC is the waiting time during which the drive waits before it responds to a command sent from the control PC.

5.10 Motor Parameters (FH)

FH.00 MOTOR POLES NUMBER	Range:2~14【4】
FH.01 Rated power	Range:0.4~999.9kW【dependent on drive's model】
FH.02 Rated current	Range:0.1~999.9A 【dependent on drive's model】

FH.00, FH.01 and FH.02 are used to set the motor's parameters.

In order to ensure a good performance, please set FH.00~FH.02 according to the values on the motor's nameplate.

Note:

The motor's power should match the drive. Generally the motor's power is only allowed to be lower than that of the drive by 20% or bigger by 10%, %, otherwise good control performance cannot be ensured

FH.03 Current without load I0	Range:0.1~999.9A【dependent on drive's model】
FH.04 Resistance of stator %R1	Range:0.0~50.00%【dependent on drive's model】
FH.05 Leakage inductance %Xl	Range:0.0~50.00%【dependent on drive's model】
FH.06 Resistance of rotor %R2	Range:0.0~50.00%【dependent on drive's model】
FH.07 Exciting inductance %Xm	Range:0.0~2000.0%【dependent on drive's model】

See Fig. 5-59 for the meanings of above parameters.

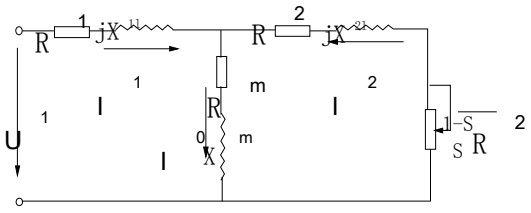


Fig. 5-59 Motor's equivalent circuit

In Fig. 5-, R_1, X_{1l}, R_2, X_{2l}, X_m and I_0 represent stator's resistance, stator's leakage inductance, rotor's resistance, rotor's leakage inductance, exciting inductance and current without load respectively. The setting of FH.05 is the result of "stator's leakage inductance + rotor's inductance".

The settings of FH.04 ~FH.07 are all percentage values and the calculation formula is shown below:

Formula used for calculating stator's resistance or rotor's resistance:

$$\%R = \frac{R}{V/\left(\sqrt{3}\cdot I\right)}\times 100\%$$

R: stator's resistance or rotor's resistance that is converted to the rotor's side;

V:rated voltage;

I:motor's rated current

Formula used for calculating inducatance(leakage inductance or exciting inductance):

$$\%X = \frac{X}{V/\left(\sqrt{3}\cdot I\right)}\times 100\%$$

X:addition of rotor's leakage inductance and stator's leakage inductance or the exciting inductance;

V:rated voltage;

I:motor's rated current

If motor's parameters are available, please set FH.04 ~FH.07 to the values calculated according to the above formula.

If the drive performs auto-tuning of motor's parameters, then the settings of FH.03~FH.07 after the auto-tuning process are upgraded to new values.

After motor power(setting of FH.01) is changed, the drive will set FH.02~FH.07 to corresponding motor's parameters.

FH.08 Rated slip frequency	Range:0.00~20.00Hz 【0.00Hz】

Motor's rated slip frequency can be calculated by the motor's rated speed(nameplate value):

Rated slip frequency = motor's rated frequency(e.g. basic operating frequency F0.06)×(motor's synchronous speed-motor's rated speed) ÷ motor's synchronous speed

Where: motor's synchronous speed = motor's rated frequency ×120÷ number of motor's poles(FH.00)

After setting the slip frequency, the slip compensation will be enabled by F3.07~F3.09.

FH.09 Motor parameter auto-tuning	Range:0~2【0】

FH09 can be used to measure and write-in the motor's parameters automatically.

0:Auto-tuning is disabled

1: Stationary auto-tuning (Start auto-tuning to a standstill motor)

Values on the motor's nameplate must be input correctly before starting auto-tuning.

When starting auto-tuning to a standstill motor,the stator's resistance (%R1), rotor's resistance (%R2) and the leakage inductance(%X1) will be measured and the measured values will be written into FH.04, FH.05 and FH.06 automatically.

2:Rotating auto-tuning

When starting a rotating auto-tuning, the motor is in standstill status, and the stator's resistance (%R1), rotor's resistance (%R2) and the leakage inductance(%X1) will be measured first, and then measured values will be written into FH.04, FH.05, FH.06, FH.07 and FH.03 automatically.

After auto-tuning, FH.09 will be set to 0 automatically.

Auto-tuning procedures:

1. Set the "F0.06 basic operating frequency" and "F0.07 Max output voltage" correctly according to the motor's feature;

2. Set the FH.00, FH.01 and FH.02 correctly;

3. If FH.09 is set to 2, Acc time(F0.10) and Dec time(F0.11) should be set correctly and the load should be removed from the motor and the safety ensured;

4. Set FH.09 to 1 or 2, press ENTER/DATA, and then press RUN to start auto-tuning;

5. When the LED flashes, it means the auto-tuning is over.

🕮 Note:

When setting FH.09 to 2, Acc/Dec time can be increased if over-current or over-voltage fault occurs in the auto-tuning process;

When setting FH.09 to 2, the motor's load must be removed first before starting the rotating auto-tuning;

The motor must be in standstill status before starting the auto-tuning, otherwise the auto-tuning can be executed normally;

In some applications(for example the motor cannot break away from the load), it is not convenient to start auto-tuning or the user has no high requirement for motor's control performance, a stationary auto-tuning can be applied and it is also OK if the auto-tuning is not applied. At this time, please input the values on the motor's nameplate correctly (FH.00~FH.02).

If the auto-tuning cannot be applied and the correct motor's parameters are available, the user should input the values on the motor's nameplate correctly (FH.00~FH.02), and then input the calculated values (FH.03~FH.07). Please set the parameters correctly.

If auto-tuning is not successful, the drive alarms and displays fault code of E024.

FH.10 Motor's stabilization factor	Range:0~255【dependent on drive's model】

FH.10 is used to suppress the oscillation caused by the drive and the motor. If the drive's output current changes at constant load, the oscillation can be reduced o make the motor operate stably by setting FH.10.

For drives of 55kW or below, the setting of FH.10 is 10 and 20 for the drives above 55kW.

FH.11~FH.21	Reserved

5.11 Protection Function (FL)

FL.00 Motor overload protection mode selection	Range:0. 1. 2【1】

0:disabled

The overload protection is disabled. Be careful to use this function because the drive will not protect the motor when overload occurs;

1:Common mode (with low speed compensation)

Since the air convection effects of common motor deteriorates at low speed, the motor's overheat protecting threshold should also be adjusted, this is called low speed compensation, which means reducing the overheat protecting threshold of the motor when its operating frequency is below 30Hz.

2:Variable frequency motor(without low speed compensation)

The air convection effects of variable frequency motor is not affected by the motor's speed, so low speed compensation is not necessary.

FL.01 Motor's overload protection coefficient	Range:20.0~110.0%【100.0%】

In order to apply effective overload protection to different kinds of motors, the Max output current of the drive should be adjusted as shown in Fig. 5-60.

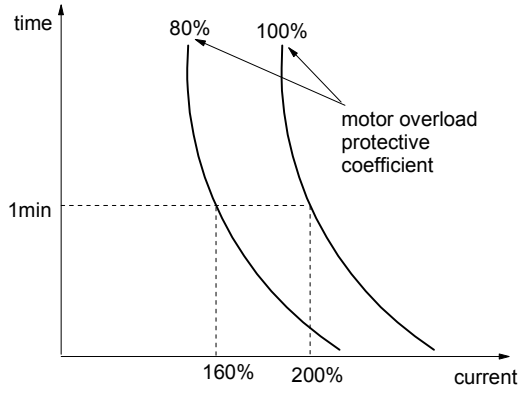


Fig. 5-60 Motor's overload protection coefficient

Use the following coefficient to calculate the coefficient:

$$\text{Motor overload protection coefficient} = \frac{\text{motor's rated current}}{\text{inverter's rated output current}} \times 100\%$$

Generally, the Max load current is the motor's rated current.

🕮 Note:

If the motor's rated current does not match that of the drive, motor's overload protection can be detected by setting FL.00~FL.01.

FL.02 Over voltage suppression	Range:0. 1【1】
FL.03 Over voltage suppression point	Range:120~150%【140.0%】

0: disabled

1: enabled

In the drive's Dec process, the decreasing rate of actual motor's speed may be higher than that of drive's output frequency due to the load inertia. At this time, the motor will feed the energy back to the drive, resulting in the voltage rise on the drive's DC bus. If no measures being taken, tripping will occur due to over voltage.

Function of FL.02: During the Dec process, the drive detects the bus voltage and compares it with the over voltage point at stall defined by FL.03. If the bus voltage exceeds the stall overvoltage point, the drive will stop reducing its output frequency. When the detected bus voltage is lower than the point, the Dec process will be restored as shown in Fig. 5-61.

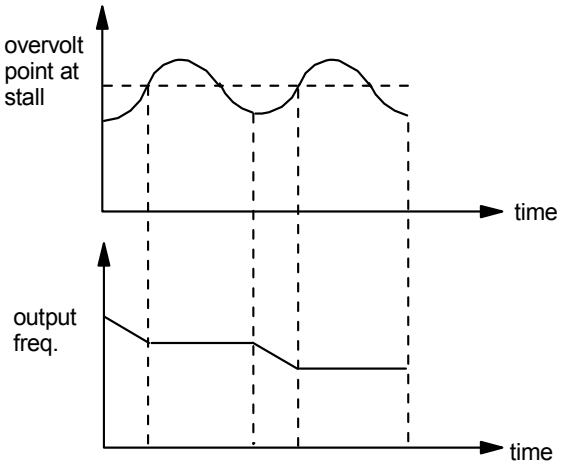


Fig. 5-61 Over voltage at stall

🕮 Note:

The drive will trigger the alarm and display "E015" when of over-voltage at stall occurs for more than 1 minute

If the stall point is set too low, the user can prolong the Acc and Dec time properly.

FL.04 Overload detection	Range:000~111【000】
FL.05 Overload pre-alarm detection threshold	Range:20~150%【130.0%】
FL.06 Overload detection time	Range:0.0~60.0s【5.0s】

PV Series has overload protection and motor overload protection functions. See Table 2-1 for drive overload protection, and see introductions to FL.00 and FL.01 for motor overload protection. FL.04~FL.06 can monitor the overload condition before overload protection happens.

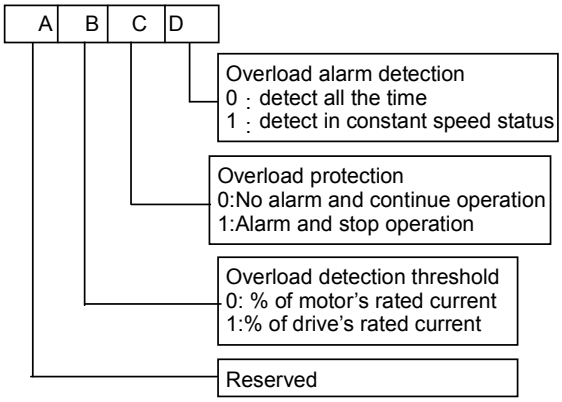


Fig. 5-62 Settings of FL.04

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

Unit's place: overload pre-alarm

0: overload pre-alarm function is active all the time when the drive is operating

1: overload pre-alarm function is active all the time when the motor is operating at constant speed

Ten's place: Actions selection for overload pre-alarm

0:The drive does not trigger the alarm and continue to run when detecting active overload signal

1: The drive trigger the alarm and stops when detecting active overload signal

Hundred's place: Detected threshold selection for overload

0:ratio of load current to motor's rated current((display fault code of E014)

1:ratio of load current to drive's rated current(display fault code of E013)

FL.05 defines the current threshold for overload pre-alarm protection. The setting range is a percentage value of rated current (refer to FL.04).

FL.06 defines the time during which the drive must be in overload pre-alarm status before pre-alarming for overload.

If overload pre-alarming status is active, this means that the drive's operating current is higher than the threshold and the time when the drive is in overload status has exceeded the time defined by FL.06.

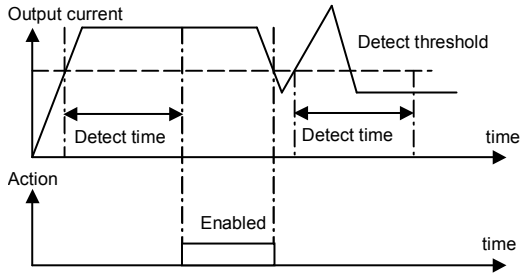


Fig. 5-63 Overload pre-alarm function

Note:

1. Overload pre-alarm detection threshold should be lower than the overload protection threshold;

2. During the overload detection time, if the drive's current is smaller than overload detection threshold, the drive will time again for the overload pre-alarm detection time.

FL.07 Auto current limiting threshold	Range:20.0~200.0%【150%】
FL.08 Frequency slewrate in current limiting	Range:0.00~99.99Hz/s 【10.00Hz/s】
FL.09 Auto current limiting action selection	Range:0~1【1】

Auto current limiting function is used to limit the load current in real time the value defined by FL.07. Therefore the drive will not trip due to surge over-current. This function is especially useful for the applications with high load inertia or fluctuating load.

FL.07 defines the threshold for auto current limiting and the setting range is a percentage value of drive's rated current.

FL.08 defines the decreasing rate of output frequency when the drive is in auto current limiting status.

If FL.08 is set too small, overload fault may occur. If FL.08 is set too big, the drive may be in generating status that may result in overvoltage protection due to frequency adjustment.

Auto current limiting function is always active in Acc or Dec process. Whether the function is active in constant speed operating process is decided by FL.09.

FL.09＝0, Auto current limiting function is disabled in constant speed operating process;

FL.09＝1, Auto current limiting function is enabled in constant speed operating process;

In auto current limiting process, the drive's output frequency may change, therefore it is not recommended to enable auto current limiting function when the drive's output frequency is constant with little change.

FL.10 Auto reset times	Range:0~10【0】
FL.11 Reset interval	Range:2.0~20.0s【5.0s】

Auto reset function can reset the fault in preset times and interval. When FL.10 is set 0, this means "auto reset" is disabled and the drive should be protected against fault.

Note:

The IGBT protection(E010) and external equipment fault (E015) cannot be reset automatically.

During the reset interval, the drive stops operation and restarts on the fly when the reset is finished.

Be careful when using auto-reset function, otherwise human injure or material loss may occur.

FL.12 Protective action 1	Range:000~111【000】
FL.13 Protective action 2	Range:0000~3211【0000】

Under abnormal conditions, the drive can continue to operate without the alarm by setting FL.12 and FL.13.

FL.12 defines the protection actions when communication fault, contactor fault or E^2PROM fault occurs.

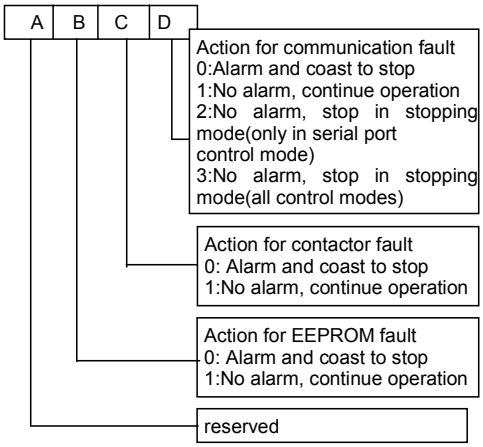


Fig. 5-64 Protective action 1

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

FL.13 defines the protection actions when the drive is in under-voltage status, auto reset interval and fault locking up status.

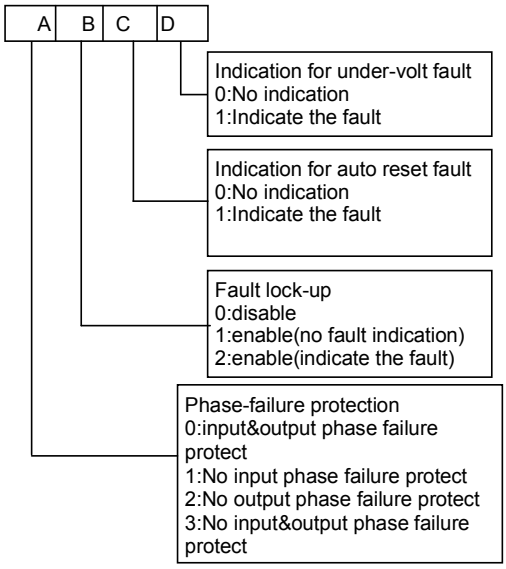


Fig. 5-65 Protective action 2

Where,

A: thousand's place B: Hundred's place

C: Ten's place D: Unit's place

Attention Please use FL.12 and FL.13 carefully, otherwise human injure or material loss may occur.

FL.14 Type of No. 1 fault	Range:0~24【0】
FL.15 Type of No.2 fault	Range:0~24【0】
FL.16 Type of No.3 fault(most recent fault)	Range:0~24【0】
FL.17 DC Bus Voltage at the last fault	Range:0~999V【0V】
FL.18 Output current at the last fault	Range:0~999.9A【0.0A】
FL.19 Frequency at the last fault	Range:0.00~650.00Hz【0.00Hz】

PV Series has 20 kinds of protective alarms and it can memorize the types of 3 latest faults (FL.14~FL.16), and the voltage, current and frequency (FL.17~FL.19) of most recent fault.

See chapter 6 for the detailed introductions to the alarm

5.12 Drive's Parameters (Fn)

Fn.00 Preset operating time	Display Range:0~65.535k hours【0】
Fn.01 Total operating time	Display Range:0~65.535k hours【0】
Fn.02 Temperature of heatsink 1	Display Range:0~100℃【0】
Fn.03 Temperature of heatsink 2	Display Range:0~100℃【0】

When the total operating time reaches the preset operating time(Fn.00), the drive can output an indication signal. See introductions to F7.10~F7.12 for details.

Fn.01 defines the total operating time from the time when the drive is put to use to the present time.

Temperature of heatsink 1 is the temperature of IGBT modules. Different IGBT modules have different over-temperature threshold.

Temperature of heatsink 2 is the temperature of rectifier module. The drive of 55kW or below does not detect this temperature.

Temperature display range:0~100℃; accuracy: 5%

5.13 Protecting of Parameters (FP)

FP.00 User's password	Range:0000~9999【0000】

User's password can prevent unauthorized persons from checking and modifying the functional parameters.

Set FP.00 to 0000 if the user's password is not needed.

If the user's password is necessary, input a 4-digit number, press ENTER/DATA to confirm, and then wait for 5 minutes without pressing any key, the password will become effective.

Changing the password:

Press MENU/ESC, input the primary password, select FP.00(at this time FP.00＝0000), input new password and press ENTER/DATA to confirm. The password will become effective after waiting for 5 minutes without pressing any key.

🕮 Note:

Please memorize the password.

FP.01 Parameter write-in protection	Range:0~2【1】

FP.01 is used to protect the parameter settings:

0: All parameters are allowed to be revised;

1: No revision to parameters except the direct setting frequency(F0.02) and FP.01;

2: No revision to parameters except FP.01.

🕮 Note:

The factory setting of FP.01 is 1. If the user needs to revise parameters, FP.01 must be set to 0; and then set to 1 or 2 after changing the parameters to protect these settings.

FP.02 Parameter initialization	Range:0~2【0】

0: no operation

1: Clear memory

When FP.02 is set to 1, the fault records of FL.14~FL.19 will be cleared.

2: Restore to the factory settings

If FP.02 is set 2, the parameters before FL.11 (except FH.00) are restored to factory settings.

FP.02 will change to 0 automatically after clearing the memory or restoring to factory settings.

FP.03 parameter copy	Range:0~3【0】

FP.03 is only valid for LCD panel.

0: No action

1:parameters uploading

2: parameters downloading

3: parameters downloading (except the parameters related to the type of the drive)

🕮 Note:

1. For LCD keypad, the user must upload parameters to the panel's memory first, otherwise the memory is clean without data. The parameters will then be stored in the memory;
2. Before downloading the parameters to the drive, the drive will check the version and integrity of the parameters stored in panel. The parameters cannot be downloaded if the memory is clean, or the parameters are not complete, or the version of parameters is not same with the version of the drive.
3. After the parameters are downloaded, the parameters in the panel will not be damaged and can be copied to several drives.

FP.04	Reserved

Chapter 6 Troubleshooting

All the possible faults of PV Series have been given in

Table 6-1. Fault code range is E001~E020. The user can check the faults according to the following table himself and record detailed fault phenomena before seeking service. Please contact the sales distributor when seeking service.

Table 6-1 Fault information and diagnosis

Fault code	Fault descriptions	Possible reasons of trip	Actions to take
E001	Over-current in Acc process	Too short Acc time	Prolong the Acc time
		V/F curve is not suitable.	Check and adjust V/F curve, adjust torque boost or set the motor parameters correctly to ensure the normal auto torque boost works well.
		The rotating motor re-starts after the drive stops instantly.	Start when the motor stops, or Set F2.00 to “start on fly” function
		Low AC supply voltage	Check the drive’s input AC supply
		Drive power is too small	Select a higher power drive
E002	Over-current in Dec process	Too short Dec time	Prolong the Dec time
		Negative-torque load or the load inertial is too high	Connect suitable braking device
		Too low drive’s power	Select the drive with bigger power
E003	Over-current in constant speed operation	Sudden change of load	Reduce the change of the load
		Too short Acc/Dec time	Prolong Acc/Dec time
		Abnormal load	Check the load
		Low AC supply voltage	Check the AC supply voltage
		Too low drive’s power	Select the drive with bigger power
E004	Over voltage in Acc process	Abnormal AC supply voltage	Check the AC supply voltage
		Too short Acc/Dec time	Prolong the Acc time
		The drive is re-started with a rotating motor	Start when the motor stops, or Set F2.00 to “start on fly” function
E005	Over voltage in Dec process	Too short Dec time(with reference to generated energy)	Prolong the Dec time
		Negative-torque load or the load inertial is too high	Use suitable dynamic braking device
E006	Over voltage in constant-speed operating process	Abnormal AC supply voltage	Check the AC supply voltage
		Too short Acc/Dec time	Prolong the Acc/Dec time
		Abnormal change of input voltage	Install input reactor
		Too high load inertia	Use suitable dynamic braking device
E007	Over voltage of drive’s control power supply	Abnormal AC supply voltage	Check the AC supply voltage or seek service
E008	Input phase failure	Input phase failure among Phase R, S and T	Check the wiring and installation Check the AC supply voltage
E009	Output phase failure	Output phase failure among Phase U, V and W	Check the drive’s output wiring Check the cable and the motor

Fault code	Fault descriptions	Possible reasons of trip	Actions to take
E010	IGBT protection Active	Instantaneous over-current of drive	Refer to the fault handling methods for over-current
		Short-circuit among 3-phase output or line-to-ground short circuit	Check and re-wire
		Ventilation channel is obstructed or fan does not work	Clear the ventilation channel or replace the fan
		Ambient over-temperature	Lower the ambient temperature
		Wires or connectors of control board are loose	Check and re-wire
		Current waveform distorted due to output phase failure	Check the wiring
		Auxiliary power supply is damaged or IGBT driving voltage is too low	Seek service
		Short-circuit of IGBT bridge	Seek service
		Control board is abnormal	Seek service
E011	IGBT module's heatsink overheat	Ambient over-temperature	Lower the ambient temperature
		Obstruction of ventilation channel	Clear the ventilation channel
		Fan does not work	Replace the fan
		IGBT module is abnormal	Seek service
E012	Rectifier's heatsink overheat	Ambient over-temperature	Lower the ambient temperature
		Obstruction of ventilation channel	Clear the ventilation channel
		Fan does not work	Replace the fan
E013	Drive overload	Too short Acc/Dec time	Prolong the Acc/Dec time
		Improper V/F curve	Adjust V/F curve or torque boost value
		The drive is re-started with a rotating motor	Start when the motor stops, or Set F2.00 to "start on fly" function
		Low AC supply voltage	Check the AC supply voltage
		Too heavy load	Select the drive with bigger power
E014	Motor over-load	Improper V/F curve	Set V/F curve and torque boost value correctly
		Low AC supply voltage	Check the AC supply voltage
		Load changes fast	Check the load
E015	Emergency stop or external equipment fails	Press STOP when the drive is in stall status	Set the operating parameters correctly
		The drive will report E015 fault if it is in stall status for 1 minute	Set the operating parameters correctly
		Terminal used for stopping the drive in an emergency is closed	Disconnect the terminal if the external fault is cleared
E016	E^2PROM R/W fault	R/W fault of control parameters	Press STOP/RESET to reset Seek service
E017	RS232/RS485 communication failure	Wrong baud rate setting	Set the baud rate correctly
		Serial port communication error	Press STOP/RESET to reset Seek service
		Alarming parameters have not been set correctly.	Change the settings of FF.02, FF.03 and FL.12

Fault code	Fault descriptions	Possible reasons of trip	Actions to take
		Host PC does not work	Check whether the host PC is working or not; Check the wiring
E018	Contactor not closed	Low AC supply voltage	Check the AC supply voltage
		Contactor damaged	Replace the contactor in main circuit and seek service
		Soft start resistor is damaged	Replace the soft start resistor and seek service
		Control circuit is damaged	Seek service
E019	Current detection circuit is faulty	Wires or connectors of control board are loose	Check and re-wire
		Auxiliary power supply is damaged	Seek service
		Hall sensor is damaged	Seek service
		Amplifying circuit is abnormal	Seek service
E020	System disturbance	Severe disturbance	Press STOP/RESET to reset or install power filter at the input side of the drive.
		R/W fault of DSP in main control board	Press STOP/RESET to reset Seek service
E021	Reserved	Reserved	Reserved
E022	Reserved	Reserved	Reserved
E023	Parameter copy error	Keypad's parameters are not complete or the version of the parameters are not the same with that of main control board	Update the keypad's parameters and version again. First set FP.03 to 1 to upload the parameters and then set FP.03 to 2 or 3 to download the parameters.
		Keypad's E^2PROM is damaged	Seek service
E024	Auto-tuning fails	Incorrect settings of parameters on the nameplate	Set the parameters correctly according to the nameplate values
		Overtime of auto-tuning	Check the motor's wiring

Table 6-2 Abnormal phenomena and handling methods

Phenomena	Conditions	Possible reasons of fault	Actions to take
No response of operation panel	Part of the keys or all the keys are disabled	Panel is locked up	In stopping status, first press ENTER/DATA and hold on, then pres ▼ 3 times continuously, then the panel is unlocked.
		Panel cables are not well connected	Re-power the drive after it shuts down completely
		Panel's keys are damaged	Replay operation panel or seek service
Settings of parameters cannot be changed	Operating status cannot be changed	Parameter's modification property is×	Settings of parameters are changed in stopping status
	Settings of part of parameters cannot be changed.	Set FP.01 to 1 or 2	Set FP.01 to 0
		Parameter's modification property is *	Actual parameters cannot be changed by user.
	Parameter are not displayed when pressing MENU/ESC. Instead, "0.0.0.0." is displayed	User's password is required	Input correct user's password
			Seek service
The drive stops during operating process.	The drive stops and its "RUN" LED is off, while there is no "STOP" command.	Alarm will occur due to the fault	Find out the reason for the fault and reset the drive
		Function of stopping at fixed length is enabled	Clear the information of actual length or set F9.14(setting length) to 0
		Communication between host or remote control panel and the drive fails	Check the communication circuits and the settings of FF.02, FF.03 and FL.12
		AC supply is interrupted	Check the AC supply condition
		Control mode is changed	Check the setting of relevant parameters
		Logic of control terminal changes	Check the settings of F7.35
	Motor stops when there is no stopping command, while the drive's "RUN" LED illuminates and operates at zero frequency	auto-reset upon a fault	Check the setting of auto-reset
		Stopping command is input from external terminal	Check the setting of this external terminal
		Stops at zero-frequency	Check the settings of F9.12 and F9.13
		Preset frequency is 0	Check the frequency setting
		skip frequency is set incorrectly	Check the setting of skip frequency
		Positive feature: close loop feedback value >reference Negative feature: close loop feedback value <reference	Check the close-loop reference and feedback
		F9.05 is set to 0	Check the settings of F9.05 and F9.06
		Low-voltage compensation is applied when the drive restarts after power failure, besides, the AC supply voltage is too low	Check the settings of restart after power failure and the AC supply voltage

Phenomena	Conditions	Possible reasons of fault	Actions to take
The drive does not work	The drive doesnot work and its “RUN” LED is off when the “RUN” key is pressed.	Terminal used for coasting to stop is enabled	Check the terminal used for coasting to stop
		The terminal used to prohibit the running of the drive is enabled.	Check the terminal
		Terminal used for stopping the drive is enabled	Check the terminal used for stopping the drive
		The drive stops at fixed length	Check the function of stopping at fixed length and the actual length
		In 3-wire control mode, the terminal used to control the 3-wire operation is not closed.	Set and close the terminal
		Alarm will occur due to the fault	Clear the fault
		Fictitious terminal of host is not set correctly	Disable the function of this terminal or use the host to set properly or change the settings of F7.35
		Positive and negative logic of input terminal are not set correctly	Check the settings of F7.35

Chapter 7 Maintenance

Many factors such as ambient temperature, humidity, dust, vibration, internal component aging, wear and tear will give rise to the occurrence of potential faults. Therefore, it is necessary to conduct routine maintenance to the drives.

Notes:

As safety precautions, before carrying out check and maintenance of the drive, please ensure that :

The drive has been switched off;

The charging LED lamp in the drive is off.

Use a volt-meter to test the voltage between terminals (+) and (-) and the voltage should be below 36V.

7.1 Daily Maintenance

The drive must be operated in the environment specified in the Section 2.1. Besides, some unexpected accidents may occur during operation. The user should perform the routine maintenance to ensure a good operation environment according to the table below. A good way to prolong the lifetime of the drive is to record the routine operation data, find out and troubleshoot faults in the early stage.

Table 7-1 Daily checking items

Inspected object	Checking instructions			Judging criterion
	Checking items	Cycle	Checking methods	
Operating environment	(1) temperature and humidity	Any time	(1) thermometer and hygrometer	(1) –10℃ ~+40℃, derating at 40℃ ~50℃
	(2) dust and water dripping		(2) visual inspection	(2) No water dripping
	(3)gas		(3) visual inspection	(3) no strange smell
Drive	(1) vibration and heating	Any time	(1) Touch the case	(1) Stable vibration and proper temperature
	(2) noise		(2) Listen	(2) no abnormal sound
Motor	(1) heating	Any time	(1) Touch by hand	(1) No overheat
	(2) noise		(2) Listen	(2) low and regular noise
Operating status parameters	(1) output current	Any time	(1) current meter	(1) within rated range
	(2) output voltage		(2) volt-meter	(2) within rated range
	(3) Internal temperature		(3) thermometer	(3) temperature rise is smaller than 35 ℃

7.2 Periodic Maintenance

Customer should check the drive every 3 months or 6 months according to the actual environment.

Notes:

1. Only trained personnel can dismantle the drives for repairing or device replacement;

2. Don't leave metal parts like screws or pads in the drive, otherwise the equipment may be damaged.

General Inspection:

1. Whether screws of control terminals are loose. If so, tighten them with a screwdriver;

2. Whether the main circuit terminals are properly connected; whether the mains cables are over heated;

3. Whether the power cables and control cables are damaged, check especially for any wear on the cable tube;

4. Whether the insulating tapes around the cable lugs are stripped;

5. Clean the dust on PCBs and air ducts with a vacuum cleaner;

6. For drives that have been stored for a long time, it must be powered on every 2 years. When supplying AC power to the drive, use a voltage regulator to raise the input voltage to rated input voltage gradually. The drive should be powered for 5 hours without the necessity of driving a motor load.

7. Before performing insulation tests, all main circuit input/output terminals should be short-circuited with conductors. Then proceed insulation test to the ground. Insulation test of single main circuit terminal to ground is forbidden, otherwise the drive might be damaged. Please use a 500V Mega-Ohm-Meter.

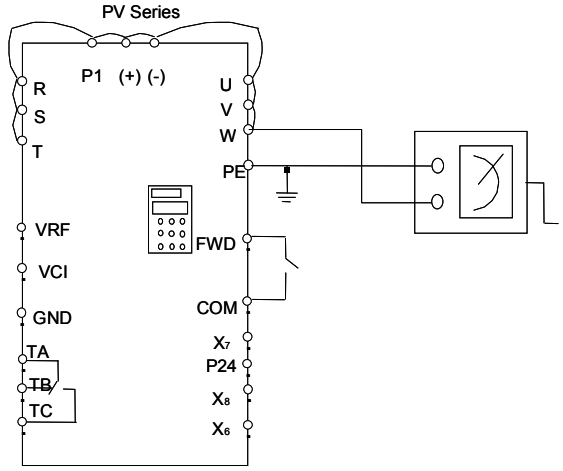


Fig. 7-1 Insulation test of drive

8. Before insulation test of the motor is performed, connections between the motor and the drive must be dismantled. After dismantling, perform the insulation test of the motor separately to avoid damage of the drive.

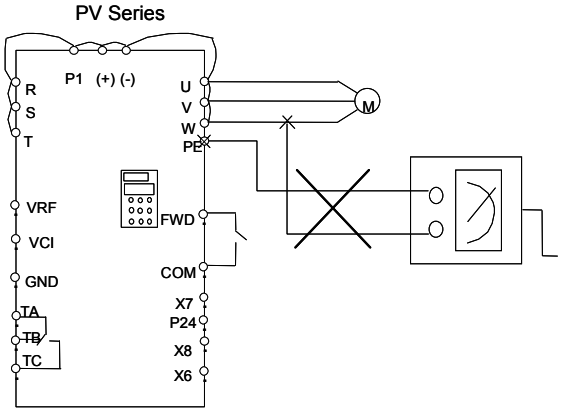


Fig. 7-2 Insulation test of motor

🕮 Notes:

Dielectric test of the drive has already been done in the factory. It is not necessary for the user to do dielectric test again in order to avoid potential damage of its internal components.

7.3 Replacing Wearing Parts

The components that are easily damaged are: cooling fan and electrolytic capacitors of filters. Their lifetime depends largely on their application environment and preservation. Normally, lifetime is:

Components	Life
Fan	3~40,000 hours
Electrolytic capacitor	4~50,000 hours

The user can decide the time when the components should be replaced according to their service time.

3. Cooling fan

Possible cause of damages: wear of the bearing, aging of the fan vanes.

Criteria:

After the drive is switched off, check if abnormal conditions such as crack exists on fan vanes and other parts. When the drive is switched on, check if drive running is normal, and check if there is any abnormal vibration.

2. Electrolytic capacitors

Possible cause of damages: high ambient temperature, aging of electrolyte and large pulse current induced by rapid changing loads.

Criteria: Check if frequent over-current or over-voltage failures occur during drive start-up with load.

Check if there is any leakage of liquids. Check if the safety valve protrudes. Measure static capacitance and insulation resistance.

7.4 Storage

The following points must be followed for the temporary and long-term storage of drive:

1. Store in locations free of high temperature, humidity, dust, metal powder, and with good ventilation.

2. Long-term storage will cause the deterioration of electrolytic capacitors. Therefore, the drive must be switched on for a test within 2 years at least for 5 hours. The input voltage must be boosted gradually by the voltage regulator to the rated value.

7.5 Warranty

ENP will offer warranty service in the case of the following situations:

1.The warranty clause is only confined to the drive;

2. ENP will take the responsibility of 18 months defects liability period for any faults or damages under the normal operation conditions. After 18 months, maintenance will be charged;

3. Even within 18 months, maintenance would be charged under the following conditions:

4.Damages incurred to the drive due to mis-operations which are not in compliance with “User Manual”;

② Damages incurred to the drive due to fire, flood, abnormal voltage and so on;

③ Damages incurred to the drive due to the improper use of drive functions;

5. Service fee will be charged according to the actual costs. If there are any maintenance contracts, priority will be given to the contract.

Appendix 1 Parameters

PV Series drive's parameters are organized in groups. Each group has several parameters that are identified by "Group No.+ Function Code Parameter F X.YZ denotes that the parameter belongs to group "X" and its function code is "YZ". For example, "F5.08" belongs to group 5 and its function code is 8.

For the convenience of setting, parameter group number corresponds to the first level menu, parameter sub-group corresponds to the second level menu and parameter value corresponds to the third level menu.

The parameter descriptions are showed in the tables of following pages:

"Parameter" in first column shows should be filled in parameter group number; The " Description" in second column shows the description of parameter group number; The "LCD display" in third column shows the descriptions displayed on LCD display; The "setting range" in fourth column shows the valid ranges of parameter settings; The "minimum unit" in fifth column shows the minimum unit of parameter's setting; The "factory setting" in sixth column shows the primary factory settings; The "modification" in seventh column the possibility of modification(that is, whether it is allowed to be modified and conditions for modification):

"O" denotes the parameters can be revised when the drive is in operating or stopping status;

"×" denotes the parameters cannot be revised when is drive is operating;

"*" denotes the parameters are actually detected parameter values and cannot be revised;

"-" denotes the parameters are defaulted by factory and cannot be modified ;

("auto-checking" function for every paramater setting is defaulted to avoid wrong modification made by the user.)

Parameter settings are expressed in decimal(DEC) and hexadecimal(HEX). If the parameter is expressed in hexadecimal, the bits are independent on each other. The value of part of the bits can be 0~F.

In the tables, "LCD display" function only available for LCD keypad

"Factory settings" means the parameter settings preset by the manufacturer; Except the actual detected parameter settings and the recorded values, all other values can be refreshed;

The drive provides passwords to protect the parameters against unauthorized modifications. After the user's password is set up (sets FP.00 not to be zero), the drive will require the user to input the password before the user press the MENU/ESC to edit the parameter settings, otherwise user cannot set the parameters. For the parameters defaulted by factory, the user can only set the parameters after inputting factory password(The user should not change the settings of the parameters defaulted by factory because the drive may operate abnormally or be damaged if the parameters are not set correctly).

After setting the password, please don't press the keys within 5 minutes so as to enable the password. If the password is input correctly and the keys have not been pressed for longer than 5 minutes, the drive will be locked by the password again. The user's password can be changed any time if the password protection is not locked up. The user's password that is input last time is the valid password.

The user's password can be disabled by setting FP.00 to 0. If FP.00 is not set to 0, then the parameters will be protected by the password.

The above rules should be observed when changing the password.

⚠ Attention

Except the frequency, all parameters are set to be unchangeable ex-factory. To change the parameters, users should first set FP.01 (parameter write-in protection) from 1 to 0.

Appendix Table 1: Parameters

Group F0: BASIC FUNCTIONS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F0.00	Set frequency mode	SET FREQ. MODE	0:digital input 1:set the reference via ▲ and ▼ keys on panel 1:digital input 2:set the reference via terminal UP/DN 2:digital input 3:set the reference via serial port 3:set the reference via VCI 4:set the reference via CCI 5:set the reference via PULSE terminal	1	0	○
F0.01	Digital frequency control	DIGITAL FREQ. CTRL	Unit's place of LED: 0:frequency value can be saved at power off 1:frequency value can not be saved at power off Ten's place of LED: 0:stopping frequency holding 1:stopping frequency recovery F0.02 Note :Only for F0.00=0,1,2	1	00	○
F0.02	Set run frequency in digital mode	SET RUN FREQ.	F0.13~F0.12 (Only for F0.00=0. 1. 2)	0.01Hz	50.00Hz	○
F0.03	Set run commands	SET RUN COMMAND	0:Input via panel:(LED turns on); 1:Input via terminal:(LED off); 2:Inpuy via serial port:(LED flashes)	1	0	○
F0.04	Set run direction	SET RUN DIRECTION	0:Run forward 1:Run reverse	1	0	○
F0.05	Maximum output frequency	MAX OUTPUT FREQ	Max{50.00,upper limit of frequency F0.12}~650.0Hz	0.01Hz	50.00Hz	×
F0.06	Rated motor frequency	RATED MOTOR FREQ	1.00~650.0Hz	0.01Hz	50.00Hz	×
F0.07	Max output voltage	MAX OUTPUT VOLTS	1~480V	1V	Drive's rated value	×
F0.08	Reserved	Reserved	Reserved	1	1	*
F0.09	Torque boost	TORQUE BOOST	0.0:(auto) 0.1%~30.0%	0.1%	0.0%	○
F0.10	Acceleration time 1	ACCEL. TIME SEC.	0.1~3600s Note:default unit is second; Unit of Acc/Dec time is defined by F9.09	0.1	5.5kW~30kW: 6.0s others: 20.0s	○
F0.11	Deceleration time 1	DECEL. TIME SEC.				

Group F0: BASIC FUNCTIONS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F0.12	Upper frequency limit	UPPER FREQ.LIMIT	Lower limit of frequency F0.13~Maximum frequency F0.05	0.01Hz	50.00Hz	○
F0.13	Lower frequency limit	LOWER FREQ.LIMIT	0.00~upper limit of frequency F0.12	0.01Hz	0.00Hz	○
F0.14	V/F curve setting	V/F CURVE MODE	0: linear curve (decided by F0.15~F0.20) 1: torque-stepdown characteristic curve 1 (2.0 order) 2: torque-stepdown characteristic curve 2 (1.7 order) 3: torque-stepdown characteristic curve 3 (1.2 order)	1	0	×
F0.15	V/F frequency value F3	V/F FREQ3	F0.17~F0.06	0.01Hz	0.00Hz	×
F0.16	V/F voltage value V3	V/F VOLT3	F0.18~100.0%	0.1%	0.0%	×
F0.17	V/F frequency value F2	V/F FREQ2	F0.19~F0.15	0.01Hz	0.00Hz	×
F0.18	V/F voltage value V2	V/F VOLT2	F0.20~F0.16	0.1%	0.0%	×
F0.19	V/F frequency value F1	V/F FREQ1	0.00~F0.17	0.01Hz	0.00Hz	×
F0.20	V/F voltage value V1	V/F VOLT1	0~F0.18	0.1%	0.0%	×
F0.21	Set boot range	BOOST RANGE	0.0~50.0% (ratio of cut-off frequency to setting of F0.06)	0.1%	10.0%	○

Group F1: FREQUENCE REFERENCE						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F1.00	Set frequency reference curve	SET FREQ. REF CURVE	Unit's place of LED:VCI frequency curve selection 0:Curve 1 1:Curve 2 Ten's place of LED:CCI frequency curve selection 0:Curve 1 1:Curve 2 Hundred's place of LED: Pulse frequency curve selection 0:Curve 1 1:Curve 2	1	000	○
F1.01	Set reference gain	SET. REF GAIN	0.00~9.99	0.01	1.00	○
F1.02	Set Reference time constant of filter	FILTER TIME CONST	0.01~50.00s	0.01 s	0.50s	○
F1.03	Maximum input pulse frequency	MAX INPUT PULSE FREQ.	0.1~50.0k	0.1k	10.0k	○
F1.04	Minimum reference 1	MIN REF1	0.0%~F1.06 (Ratio between Min reference 1 and base value of 10V/20mA/F1.03)	0.1%	0.0%	○
F1.05	Minimum reference frequency 1	MIN REF. FREQ.1	0.00~F0.05	1	0.00Hz	○
F1.06	Maximum reference 1	MAX REF.1	F1.04~100.0% (Ratio between Max reference 1 and base value of 10V/20mA/F1.03)	0.1%	100.0%	○
F1.07	Maximum reference frequency 1	MAX REF. FREQ.1	0.00~F0.05	1	50.00Hz	○
F1.08	Minimum reference frequency 2	MIN REF2	0.0%~F1.10 (Ratio between Min reference 2 and base value of 10V/20mA/F1.03)	0.1%	0.0%	○
F1.09	Minimum reference frequency 1	MIN REF. FREQ. 2	0.00~F0.05	1	0.00Hz	○
F1.10	Maximum reference 2	MAX REF2	F1.08~100.0% (Ratio between Max reference and base value of 10V/20mA/F1.03)	0.1%	100.0%	○
F1.11	Maximum reference frequency 2	MAX REF. FREQ.2	0.00~F0.05	1	50.00Hz	○

Note: In order to be simple, all the analog value is expressed by voltage value. The formula that converts the current(mA) into voltage(V) is: Voltage(V) =Current (mA)/2.

Group F2: START & STOP MODE						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F2.00	Start mode	START MODE	0:start at start frequency 1:brake first, then start at start frequency 2:Start on the fly(including direction judgment), start at start frequency when speed is zero Note: Starting process includes switching on the drive for the first time, recover of AC supply after power failure, reset upon external fault and coast-to-stop	1	0	×
F2.01	Start frequency	START FREQ	0.20~60.00Hz	0.01Hz	0.50Hz	○
F2.02	Start frequency holding time	HOLD TIME	0.0~10.0s	0.1s	0.0s	○
F2.03	DC injection braking current at start	BRAKING CURRENT AT START	Dependent on drive's model Drive with power of 75kW or above: 0.0~80.0% drive's rated current Other models: 0.0~100.0% drive's rated current	0.1%	0.0%	○
F2.04	DC injection braking time at start	BRAKING TIME AT START	0.0(disabled), dependent on drive's model 55kW drives or below: 0.1~60.0s Other models: 0.1~30.0s	0.1s	0.0s	○
F2.05	Set acceleration/deceleration mode	ACCEL/DECEL MODE	0:Linear Accelerating/decelerating mode 1:S curve 2:Auto Accelerating/decelerating	1	0	×
F2.06	Start section of S curve	SET S-CURVE START SECTION	10.0%~50.0%(Acc/Dec time) F2.06+F2.07≤90%	0.1%	20.0%	○

Group F2: START & STOP MODE						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F2.07	Rising time of S curve	SET S-CURVE RISING SECTION	10.0%~80.0%(Acc/Dec time) F2.06+F2.07≤90%	0.1%	60.0%	○
F2.08	Stopping Mode	STOP MODE	0: Dec to stop 1: Coast to stop	1	0	×
F2.09	Initial DC braking frequency	INITIAL BRAKING FREQ.	0.00~60.00Hz	0.01Hz	0.00Hz	○
F2.10	DC braking waiting time	BRAKING WAIT TIME	0.00~10.00s	0.01s	0.00s	○
F2.11	DC braking current at stop	BRAKING CURRENT AT STOP	dependent on drive's model Drive with power of 75KW or above: 0.0~80.0% drive's rated current Other models: 0.0~100.0% drive's rated current	0.1%	0.0%	○
F2.12	DC braking time at stop	BRAKING TIME AT STOP	0.0(disabled),dependent on drive's model 55kW drive or below: 0.1~60.0s Other models: 0.1~30.0s	0.1s	0.0s	○
F2.13	Select braking unit	SELECT BRAKING UNIT	0: Braking unit is not used 1: Braking unit is used	1	0	×
F2.14	Running time ratio of braking unit to drive	BRAKING UNIT EFFICIENCY	0.0~100.0% Note: valid for the built-in braking kit of 5.5/7.5kW drive and dynamic brake should be applied in Dec process	0.1%	2.0%	×

Group F3: Auxiliary Running Parameters						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F3.00	Run reverse disabled	RUN REVERSE DISABLE	0:Run reverse enabled 1:Run reverse disabled	1	0	×
F3.01	Run reverse/forward delay time	FORWARD/REVERSE DELAY TIME	0~3600s	0.1s	0.0s	○
F3.02	Reserved	RESERVED	-	-	0	*
F3.03	Reserved	RESERVED	-	-	0	*
F3.04	Reserved	RESERVED	-	-	0	*
F3.05	Auto energy saving operation	ENERGY SAVING OPERATION	0:disabled 1:enabled	1	0	×
F3.06	Automatic voltage regulation function	AVR FUNCTION	0:disabled 1:enabled 2:disabled in decelerating proce	1	2	×
F3.07	Gain of Slip compensation	SLIP COMP. GAIN	0.0%~300.0%	0.1%	100.0%	○
F3.08	Slip compensation limit	SLIP COMP. LIMIT	0.0%~250.0%	0.1%	200.0%	○
F3.09	Compensation time	COMPENSATION TIME CONST.	0.1~25.0s	0.1s	2.0s	×
F3.10	SET carrier wave frequency	CARRIER WAVE FREQ.	7.5kW～55kW: 15k～3k 75kW～110kW: 10k～1k 132kW～280kW: 6k～0.7k	0.1kHz	8.0kHz 3.0kHz 2.0kHz	○
F3.11	Carrier wave frequency auto-tuning	CARRIER WAVE FREQ. AUTOTUNE	0:disabled 1:Enabled	1	1	○
F3.12	Motor tone tuning	MOTOR TUNING	0~10	1	0	○
F3.13	Jog frequency	JOG FREQ	0.10~50.00Hz	0.01Hz	5.00Hz	○
F3.14	Jog interval time	JOG INTERVAL	0.0~100.0s	0.1s	0.0s	○
F3.15	Acceleration time of Jog operation	JOG ACCEL TIME	0.1~60.0s	0.1	5.5kW~30kW:6.0s 37kW and above:20.0s	○
F3.16	Deceleration time of Jog operation	JOG DECEL TIME				

Group F3: Auxiliary Running Parameters						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F3.17	Acceleration time 2	ACCEL TIME2	0.1~3600 Note: Default unit is second; unit of Accel/Decel time is decided by F9.09	0.1	5.5kW~30kW:6.0s 37kW and above:20.0s	○
F3.18	Deceleration time 2	DECEL TIME2				
F3.19	Acceleration time 3	ACCEL TIME3				
F3.20	Deceleration time 3	DECEL TIME3				
F3.21	Acceleration time 4	ACCEL TIME4				
F3.22	Deceleration time 4	DECEL TIME4				
F3.23	Preset frequency 1	PRESET FREQ 1	F0.13(Lower limit of frequency)~F0.12(upper limit of frequency)	0.01Hz	5.00Hz	○
F3.24	Preset frequency 2	PRESET FREQ 2			10.00Hz	
F3.25	Preset frequency 3	PRESET FREQ 3			20.00Hz	
F3.26	Preset frequency 4	PRESET FREQ 4			30.00Hz	
F3.27	Preset frequency 5	PRESET FREQ 5			40.00Hz	
F3.28	Preset frequency 6	PRESET FREQ 6			45.00Hz	
F3.29	Preset frequency 7	PRESET FREQ 7			50.00Hz	
F3.30	skip frequency 1	SKIP FREQ. 1	0.00~650.0Hz	0.01Hz	0.00Hz	×
F3.31	Range of skip frequency 1	SKIP FREQ. BAND 1	0.00~30.00Hz	0.01Hz	0.00Hz	×
F3.32	skip frequency 2	SKIP FREQ2	0.00~650.0Hz	0.01Hz	0.00Hz	×
F3.33	Range of skip frequency 2	SKIP FREQ BAND 2	0.00~30.00Hz	0.01Hz	0.00Hz	×
F3.34	skip frequency 3	SKIP FREQ3	0.00~650.0Hz	0.01Hz	0.00Hz	×
F3.35	Range of skip frequency 3	SKIP FREQ BAND 3	0.00~30.00Hz	0.01Hz	0.00Hz	×

Group F5: CLOSE LOOP CONTROL						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F5.00	PI function selection	PI FUNCTION	0:disabled 1:enabled	1	0	×
F5.01	Reference input selection	REF.INPUT SELECT	0:Digital input; 1:VCI; 2: CCI;	1	1	○
F5.02	Feedback input selection	FEEDBACK INPUT SELECT	0:VCI (0~10V) 1:CCI (analog input) 2:VCI+CCI 3:VCI-CCI 4:Min{VCI,CCI} 5:Max{VCI,CCI}	1	1	○
F5.03	Reference filtering constant	REF. FILTERING CONST	0.01~50.00s	0.01s	0.50s	○
F5.04	Feedback filtering constant	FEEDBACK FILTERING CONST.	0.01~50.00s	0.01s	0.50s	○
F5.05	Digital reference in digital setting	DIGITAL REF.	0.00V~10.00V	0.01	0.00	○
F5.06	PG Speed reference	SPEED REF.	0~39000rpm	1	0	○
F5.07	PG setting	SELECT PULSE NUMBER	1~9999	1	1024	○
F5.08	Minimum PI reference	MIN PI REF.	0.0%~(F5.10) (Ratio of Min reference to base value of 10V/20mA)	0.1%	0.0	○
F5.09	Minimum PI feedback	MIN PI FEEDBACK	0.0~100.0% (Ratio of Min reference to base value of 10V/20mA)	0.1%	20.0%	○
F5.10	Maximum PI reference	MAX PI REF.	(F5.08)~100.0% (Ratio of Max reference to base value of 10V/20mA)	0.1%	100.0%	○
F5.11	Maximum PI feedback	MAX PI FEEDBACK	0.0~100% (Ratio of Max reference to base value of 10V/20mA)	0.1%	100.0%	○
F5.12	Proportional gain KP	PI P GAIN	0.000~9.999	0.001	0.050	○
F5.13	Integral gain Ki	PI I GAIN	0.000~9.999	0.001	0.050	○
F5.14	PI cycle	PI CYCLE	0.01~50.00s	0.01s	0.50s	○
F5.15	PI error limit	PI ERROR LIMIT	0.0~20.0%(corresponding to close loop reference)	0.1%	2.0%	○

Group F5: CLOSE LOOP CONTROL						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F5.16	Close loop logic	CLOSE LOOP LOGIC	0:Forward 1:Reverse Note: reference has no connection with speed	1	0	×
F5.17	PI INTEGRAL REGULATION	PI INTEGRAL REGULATION	0:Stop the Integral adjustment when the frequency reaches the upper limit or lower limit. 1:Continue the Integral adjustment when the frequency reaches the upper limit or lower limit.	1	0	×
F5.18	Preset PI frequency	PI PRESET FREQ	0.00~650.0Hz	0.01Hz	0.00Hz	○
F5.19	Holding time of preset PI frequency	PRESET HOLD TIME SEC.	0.0~3600s	0.1s	0.0s	×
F5.20	Preset PI reference 1	PI REF.1	0.00V~10.00V	0.01V	0.00V	○
F5.21	Preset PI reference 2	PI REF.2	0.00V~10.00V	0.01V	0.00V	○
F5.22	Preset PI reference 3	PI REF.3	0.00V~10.00V	0.01V	0.00V	○
F5.23	Preset PI reference 4	PI REF.4	0.00V~10.00V	0.01V	0.00V	○
F5.24	Preset PI reference 5	PI REF.5	0.00V~10.00V	0.01V	0.00V	○
F5.25	Preset PI reference 6	PI REF.6	0.00V~10.00V	0.01V	0.00V	○
F5.26	Preset PI reference 7	PI REF.7	0.00V~10.00V	0.01V	0.00V	○

Group F7: TERMINAL CONTROL						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F7.00	Function of multi-function terminal X1	TERMINAL X1 FUNCTION	0:No function 1: preset frequency 1 2: preset frequency 2 3: preset frequency 3 4: Acc/Dec time 1 5: Acc/Dec time 2 6:Normally open input terminal for external fault signal 7: Normally open input terminal for external fault signal 8:Terminal for external reset signal(RESET) 9: Terminal for inputting Jog running forward command 10: Terminal for inputting Jog running reverse command 11:Coast to stop(FRS) 12: Terminal for inputting command of increasing frequency(UP) 13: Terminal for inputting command of decreasing frequency (DN) 14. Reserved	1	0	×
F7.01	Function of multi-function terminal X2	TERMINAL X2 FUNCTION				
F7.02	Function of multi-function terminal X3	TERMINAL X3 FUNCTION				
F7.03	Function of multi-function terminal X4	TERMINAL X4 FUNCTION				
F7.04	Function of multi-function terminal X5	TERMINAL X5 FUNCTION				
F7.05	Function of multi-function terminal X6	TERMINAL X6 FUNCTION				
F7.06	Function of multi-function terminal X7	TERMINAL X7 FUNCTION				

Group F7: TERMINAL CONTROL						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F7.07	Function of multi-function terminal X8	TERMINAL X8 FUNCTION	15: Terminal for inputting command of disabling Acc/Dec 16: Terminal for 3-wire operation control 17: Normally open contacts for input external interruption 18: Normally closed contacts for input external interruption 19:DC injection braking at stop 20:PI controller inactive 21. Reserved 22:reference frequency input channel 1 23:reference frequency input channel 2 24:reference frequency input channel 3 25:Frequency reference is input via terminal CCI forcibly 26:Reserved 27:Terminal control mode is forcibly enabled 28:Command input channel 1 29:Command input channel 2 30:Multi-voltage terminal 1 31:Multi-voltage terminal 2 32:Multi-voltage terminal 3 33. Reserved 34. Reserved 35:external stopping command(valid for all control mode) 36:Reserved 37:IDrive operation disabled 38:Reserved 39. Reserved 40:Clear the auxiliary reference frequency 41. Reserved 42:Counter clearing signal input 43:Counter trigger signal input 44. Reserved 45:Pulse frequency input 46:Single phase speed measuring input 47:speed measuring input SM1(only for X7) 48:speed measuring input SM2(only for X8)			

Group F7: TERMINAL CONTROL						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F7.08	FWD/REV running mode setup	RUNNING CTRL. MODE	0: 2-wire operation mode 1 1: 2-wire operation mode 2 2:3-wire control mode 1-self holding function(any terminal of terminals X1~X8) 3:3-wire control mode 2-self holding function(any terminal of terminals X1~X8)	1	0	×
F7.09	UP/DN speed	UP/DOWN FREQ.	0.01~99.99Hz/s	0.01Hz/s	1.00Hz/s	○
F7.10	Bi-direction open collector output terminal Y1	Y1 FUNCTION SELECT	0:Running signal(RUN) 1:frequency arriving signal(FAR) 2:frequency detection threshold (FDT1) 3:frequency detection threshold (FDT2) 4:overload signal(OL) 5:low voltage signal(LU) 6:external fault signal(EXT) 7: Upper frequency limit(FHL) 8: Lower frequency limit(FLL) 9:zero-speed running 10. Reserved 11. Reserved 12:preset counting value arriving 13:specified counting value arriving 14. Reserved 15:drive ready (RDY) 16:drive fault 17:extended functions of host 18. Reserved 19: preset operating time out	1	0	×
F7.11	Bi-direction open collector output terminal Y2	Y2 FUNCTION SELECT		1	1	×
F7.12	Relay output function	RELAY OUTPUT		1	16	×
F7.13	FAR duration	FAR RANGE	0.00~650.0Hz	0.01Hz	2.50Hz	○
F7.14	FDT1 level	FDT1 LEVEL	0.00~650.0Hz	0.01Hz	50.00Hz	○
F7.15	FDT1 lag	FDT1 LAG	0.00~650.0Hz	0.01Hz	1.00Hz	○
F7.16	FDT2 level	FDT2 LEVEL	0.00~650.0Hz	0.01Hz	25.00Hz	○
F7.17	FDT2 lag	FDT2 LAG	0.00~650.0Hz	0.01Hz	1.00Hz	○
F7.18~F7.25	Reserved	RESERVED	-	-	0	*
F7.26	Analog Output 1 (AO1)	ANALOG OUTPUT1	0: output frequency before slip compensation (0~Max output frequency)	1	0	○

Group F7: TERMINAL CONTROL						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F7.27	Analog Output 2 (AO2)	ANALOG OUTPUT2	1:output frequency after slip compensation(0~Max output frequency) 2:preset frequency(0~Max output frequency) 3:output current(0~2 times of drive's rated current) 4:output current(0~2 times of motor's rated current) 5:output torque(0~2 times of motor's rated torque) 6:Output voltage(0~1.2 times of drive's rated voltage) 7:bus voltage(0~800V) 8:VCI(0~10V) 9:CCI(0~10V/0~20mA) 10:output power(0~2 times of rated power) 11:extended function of host 2(0~65535)	1	3	○
F7.28	Digital output (DO)	DIGITAL OUPUT		1	0	○
F7.29	Analog output offset	ANALOG OUTPUT OFFSET	Unit's place of LED:AO1 offset selection 0:0~10V or 0~20mA 1:2~10V or 4~20mA Ten's place of LED:AO2 offset selection 0:0~10V or 0~20mA 1:2~10V or 4~20mA	1	00	○
F7.30	Calibrate AO1	AO1 CALIBRATE	0.0~200.0%	0.1%	100.0%	○
F7.31	Calibrate AO2	A02 CALIBRATE	0.0~200.0%	0.1%	100.0%	○
F7.32	Maximum output frequency of DO	MAX OUTPUT PULSE	0.1~50.0(up to 50k)	0.1	10.0k	○
F7.33	Preset counting value	SET COUNT VALUE	F7.34~9999	1	0	
F7.34	Specified counting value	SPECIFIED COUNT VALUE	0~F7.33	1	0	

Group F7: TERMINAL CONTROL						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F7.35	Set terminal's positive and negative logic	TERMINAL ENABLE STATE	Binary setting: positive logic: Terminal Xi is enabled if it is connected to corresponding common terminal, and disabled if it is disconnected; negative logic: Terminal Xi is disabled if it is connected to corresponding common terminal, and enabled is it is disconnected; Unit's place of LED: BIT0~BIT3:X1~X4 Ten's place of LED: BIT0~BIT3:X5~X8 Hundred's place of LED: BIT0~BIT1:FWD. REV BIT2~BIT3:Y1. Y2	1	000	

Group F8: Display Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F8.00	Language selection (Chinese/English)	LANGUAGE SELECT	0:Chinese 1:English Note :this function is only applicable for LCD panel	1	1	○
F8.01	Operating parameter 1 displayed by LED(no flash, panel keys of ▲ and ▼ are only valid in frequency and speed displaying status; the status will be saved at power off)	RUNNING DISPLAY1	binary settings: 0:No display; 1:display Unit's place of LED: BIT0: output frequency (Hz) (before compensation) BIT1: output frequency (Hz) (after compensation) BIT2:reference frequency (Hz flashes) BIT3:output current(A) Ten's place of LED: BIT0:spinning speed(R/MIN) BIT1:reference speed(R/MIN flashes) BIT2: line speed(M/S) BIT3:reference line speed(M/S flashes) Hundred's place of LED: BIT0:Output power BIT1:output torque(%) Note :The frequency before compensation will be displayed if all the bits are 0.	1	3FF	○
F8.02	Operating parameter 2 displayed by LED(no flash; the status will be saved at power off)	RUNNING DISPLAY2	binary settings: 0:No display; 1:display Unit's place of LED: BIT0:output voltage(V) BIT1:bus voltage BIT2:VCI(V) BIT3:CCI(V) Ten's place of LED: BIT0: analog close loop feedback(%) BIT1: analog close loop feedback(% flashes) BIT2: external counting value(no unit) BIT3: terminal status(no unit) Hundred's place of LED: BIT0: reserved BIT1: reserved	1	000	○

Group F8: Display Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F8.03	LED displaying parameters(flashes, panel keys of ▲ and ▼are only valid in frequency displaying status; the status will be saved at power off)	STOP DISPLAY	binary settings: 0:No display; 1:display Unit's place of LED: BIT0:reference frequency(Hz) BIT1:external counting value(no unit) BIT2: spinning speed(R/MIN) BIT3: reference speed(R/MIN) Ten's place of LED: BIT0: line speed(M/S) BIT1: reference line speed(M/S) BIT2: VCI(V) BIT3: CCI(V) Hundred's place of LED: BIT0: analog close loop feedback(%) BIT1:analog close loop setup(%) BIT2: reserved BIT3: reserved Thousand's place of LED: BIT0: terminal status(no unit) BIT1: bus voltage Note: The reference frequency will be displayed in default if all the bits are 0	1	1FF	○
F8.04	Displayed coefficient of speed	SPEED FACTOR	0.1~999.9% spinning speed = actual spinning speed*F8.04(PG) spinning speed=120*operating frequency/FH.00*F8.04(non PG) reference speed = close loop reference speed*F8.04(PG) reference speed=120*reference frequency/FH.00*F8.04(non PG)) Note:No influence to actual speed	0.1%	100.0%	○
F8.05	Coefficient of line speed	LINE SPEED FACTOR	0.1~999.9% line speed = running frequency*F8.05(non PG)) line speed = spinning speed*F8.05(PG) reference line speed = reference frequency*F8.05(non PG)) reference line speed=reference speed*F8.05(PG) Note: No influence to actual speed	0.1%	1.0%	○

Group F8: Display Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F8.06	Analog close loop parameter setting/ feedback display parameter	CLOSELOOP DISPLAY FACTOR	0.1~999.9% Note :analog close loop reference/feedback displaying range:0~999.9	0.1 %	100.0%	○

Group F9: Enhanced Function Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F9.00	Control mode is bundled to frequency selector	FREQ-COMMAND ATTACHING	Unit's place of LED: Select the frequency reference selector in panel control mode 0:no bundling 1:digital setting 1(set via ▲ and ▼) 2:digital setting 2(set via terminal UP/DN) 3:digital setting 3(set via serial port) 4:Set the reference via VCI 5:Set the reference via CCI 6:Set in pulse mode via terminals Ten's place of LED: Select the frequency reference selector in terminal control mode 0: no bundling 1:digital setting 1(set via ▲ and ▼) 2:digital setting 2(set via terminal UP/DN) 3:digital setting 3(set via serial port) 4:Set the reference via VCI 5:Set the reference via CCI 6:Set in pulse mode via terminals Hundred's place of LED: Select the frequency reference selector in serial port control mode 0: no bundling 1:digital setting 1(set via ▲ and ▼) 2:digital setting 2(set via terminal UP/DN) 3:digital setting 3(set via serial port) 4:Set the reference via VCI 5:Set the reference via CCI 6:Set in pulse mode via terminals	1	000	○

Group F9: Enhanced Function Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F9.01	Auxiliary reference channel	AUX. REF.	0:no auxiliary reference frequency; 1:digital setting 1, set by ▲ and ▼(given by F9.03 directly); 2:digital setting 2, set by terminal UP/DN (given by F9.03 directly); 3:digital setting 3, set by serial port(given by F9.03 directly); 4:Set the reference via VCI 5:Set the reference via CCI 6:Set in pulse mode via terminals 4:Set the reference via VCI 5:Set the reference via CCI 9: Set in pulse mode via terminals 10:VCI-5; 11:CCI-5; 12:PULSE-0.5×F1.03 Note: disabled together with main reference selector Frequencies in items 4~12 use the setting of F1.00.	1	0	○
F9.02	Auxiliary reference coefficient	AUX. REF. FACTOR	0.00~9.99(only for F9.01=4~12)	0.01	1.00	○
F9.03	Digital auxiliary frequency	AUX. FREQ.	0.00~650.0Hz	0.01	0.00Hz	○

Group F9: Enhanced Function Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F9.04	Auxiliary frequency control	AUX. FREQ. CTRL	Unit's place of LED: Saving control 0:Saving auxiliary frequency at power off 1:Not saving auxiliary frequency at power off Ten's place of LED: 0:Holding auxiliary frequency at stop 1:clearing reference frequency at stop Hundred's place of LED: polarities of frequency 0:Positive 1:Negative Note: Only valud at F9.01=1, 2 or 3	1	000	○
F9.05	Frequency adjustment	FREQ. ADJUST	0:disabled 1:percentage of F005 2:percentage of present frequency	1	0	○
F9.06	Adjustment coefficient of reference frequency	FREQ. ADJUST FACTOR	0.0%~200.0%	0.1%	100.0%	○

Group F9: Enhanced Function Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F9.07	Function of keys	KEYPAD CONTROL MODE	Unit's place of LED:STOP/RESET key's function selection 0:valid in panel control mode 1:stop in stopping mode in panel, terminal and serial port control mode 2:Coast to stop in non-panel control mode, stop in stopping mode in panel control mode Ten's place of LED: function of PANEL/REMOTE key 0:inactive 1:stopping status active 2:Valid in stopping and running modes Hundred's place of LED:keypad locking function 0:No locking 1:Locked 2:All the keys except the STOP/RESET key are locked 3:All the keys except the SHIFT key are locked 4:All the keys except the RUN and STOP/RESET keys are locked	1	000	×
F9.08	Fan cooling	FAN COOLING	0:auto operation mode 1:Fan operate continuously when power is on Note :continue to operate for 3 minutes	1	0	×
F9.09	Unit of Acceleration/deceleration time	SET ACCEL/DECEL UNIT	0:(second) 1:(minute)	0	0	×
F9.10	Drop control	DROOP CTR	0.00~10.00Hz	0.01 Hz	0.00Hz	○
F9.11	Over modulation enabled	OVER MODULATION	0:disabled 1:enabled	1	1	×
F9.12	Zero-frequency operation threshold	ZERO FREQ THRESHOLD	0.00~650.00Hz	0.01 Hz	0.00Hz	○

Group F9: Enhanced Function Parameter						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
F9.13	Zero-frequency hysteresis	ZERO FREQ HYSTERESIS	0.00~650.00Hz	0.01 Hz	0.00Hz	○
F9.14~ F9.19	Reserved	Reserved	Reserved	1	0	*
F9.20	Low voltage compensation when mains supply is removed or supply voltage drop	LOW VOLT. COMPENSATION	0: disabled 1: enabled (valid for the drive below 22kW)	1	0	×
F9.21	Frequency decline rate when low voltage compensation	FREQ DECLINE RATE	0.00~99.99Hz/	0.01 Hz/S	10.00Hz/s	○
F9.22	Function of restart after power failure	AUTO RESTART	0:disabled 1:enabled	1	0	×
F9.23	Delay time for restart after power failure	RESTART AWAITING TIME	0.0~10.0s	0.1s	0.5s	○

Group FF: Serial Communication						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FF.00	Communication configuration	COMMS. SETUP	Unit's place of LED:Baud rate selection 0:300BPS 1:600BPS 2:1200BPS 3:2400BPS 4:4800BPS 5:9600BPS 6:19200BPS 7:38400BPS Ten's place of LED: Data format 0:1-8-1 format, no parity 1:1-8-1 format, Even parity 2:1-8-1 format, Odd parity Hundred's place of LED: fictitious input terminal 0:disabled 1:enabled Thousand's place of LED:wiring mode 0:direct connection via cable (RS232/485) 1: MODEM(RS232)	1	0005	×
FF.01	Local address	LOCAL ADDRESS	0~126,127 is the broadcasting address	1	1	×
FF.02	Time threshold for determining the communication status	TIME-OUT SETTING	0.0~1000s	0.1	0.0s	×
FF.03	Delay time for responding to control PC	REPLY DELAY	0~1000ms	1	5ms	×

Group FF: SERIAL COMMUNICATION						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FF.00	Communication configuration	COMMS. SETUP	Unit's place of LED:Baud rate selection 0:300BPS 1:600BPS 2:1200BPS 3:2400BPS 4:4800BPS 5:9600BPS 6:19200BPS 7:38400BPS Ten's place of LED: Data format 0:1-8-1 format, no parity 1:1-8-1 format, Even parity 2:1-8-1 format, Odd parity Hundred's place of LED: fictitious input terminal 0:disabled 1:enabled Thousand's place of LED:wiring mode 0:direct connection via cable(RS232/485) 1: MODEM(RS232)	1	0005	×
FF.01	Local address	LOCAL ADDRESS	0~126,127 is the broadcasting address	1	1	×
FF.02	Time threshold for determining the communication status	TIME-OUT SETTING	0.0~1000s	0.1	0.0s	×
FF.03	Delay time for responding to control PC	REPLY DELAY	0~1000ms	1	5ms	×

Group FH: Motor Map						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FH.00	Number of polarities of motor	MOTOR POLES NUMBER	2~14	2	4	×
FH.01	Rated power	RATED kW	0.4~999.9kW	0.1kW	dependent on drive's model	×
FH.02	Rated current	RATED AMPS.	0.1~999.9A	0.1A	dependent on drive's model	×
FH.03	Current without load	UNLOADED AMPS.	0.1~999.9A	0.1A	dependent on drive's model	×
FH.04	Resistance of stator R1	STATOR RESISTANCE R1	0.00%~50.00%	0.01%	dependent on drive's model	○
FH.05	Leakage inductance X	LEAKAGE INDUCTANCE X	0.00%~50.00%	0.01%	dependent on drive's model	○
FH.06	Resistance of rotor R2	ROTOR RESISTANCE R1	0.00%~50.00%	0.01%	dependent on drive's model	○
FH.07	Exciting inductance Xm	MUTUAL INDUCTANCE Xm	0.0%~2000%	0.1%	dependent on drive's model	○
FH.08	Rated slip	RATED SLIP	0.00~20.00Hz	0.01Hz	0.00Hz	○
FH.09	Motor parameter auto-tuning	MOTOR PARAMETER AUTOTUNE	0:disabled 1:enabled(motor in standstill state) 2:enabled(motor is running)	1	0	×
FH.10	Motor stabilization factor	MOTOR STABILITY FACTOR	0~255	1	dependent on drive's model	○
FH.11~FH.21	Reserved	RESERVED	-	-	0	*

Group FL: PROTECTION AND ALARMS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FL.00	Motor overload protection mode selection	Over load protection	0:disabled 1:common motor(with low speed compensation) 2:variable frequency motor(without low speed compensation)	1	1	×
FL.01	Motor overload protection coefficient setup	OVERLOAD PROTECTION REF.	20.0~110.0%	0.1%	100.0%	×
FL.02	Over voltage suppression	OVERVOLTS SUPPRESSION	0:disabled (when braking resistor is mounted) 1:enabled	1	1	×
FL.03	Over voltage suppression point	OVERVOLTS SUPPRESSION REF.	120.0~150.0%Udce	0.1%	140.0%	×
FL.04	Overload detection setup	OVERLOAD DETECT	Unit's place of LED: 0:detect all the time 1:detect only at constant speed running Ten's place of LED: alarm selection 0: Inverter will not alarm, and continue to operate 1: Inverter alarms and stops Hundred's place of LED: selection of detected value 0:% of rated current of motor(E014) 1:% of rated current of inverter(E013)	1	000	×
FL.05	Overload detection level	OVERLOAD LEVEL	20.0%~200.0%	0.1%	130.0%	×
FL.06	Overload detection time	OVERLOAD DETECT TIME	0.0~60.0s	0.1s	5.0s	×
FL.07	Auto current limiting level	CURRENT LIMIT	20.0%~200.0%Ie	0.1%	150.0%	×

Group FL: PROTECTION AND ALARMS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FL.08	Frequency slewrate in current limiting	FREQ DECLINE RATE 2	0.00~99.99Hz/s	0.01Hz /s	10.00Hz/s	○
FL.09	Auto current limiting action selection	AUTO CURRENT LIMIT	0:invalid at constant speed 1:valid at constant speed Note :Acceleration and deceleration are valid	1	1	×
FL.10	Number of auto reset attempt	AUTO-RESET ATTEMPT TIME	0~10, “0” means no auto reset function Note: No auto reset function for module protection and external equipment fault.	1	0	×
FL.11	Auto reset interval	AUTO-RESET INTERVAL	2.0~20.0s/time	0.1s	5.0s	×
FL.12	Protective action 1	PROTECTION ACTION 1	Unit’s place of LED: Protective action triggered by communication failure 0:alarm and coast to stop 1:No alarm and continue running 2:No alarm and stop in stopping mode(only in serial port control mode) 3: No alarm and stop in stopping mode(in all control modes) Ten’s place of LED: Protective action triggered by contactor failure 0:alarm and coast to stop 1:No alarm and continue running Hundred’s place of LED: Protective action triggered by EEPROM fault 0:alarm and coast to stop 1:No alarm and continue	1	001	×

Group FL: PROTECTION AND ALARMS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FL.13	Protective action 2	PROTECTION ACTION 2	Unit's place of LED: Protective action triggered by under voltage 0:disabled 1:enabled(under voltage is considered as a fault) Ten's place of LED: Fault indication during auto-reset interval enabled 0:disabled 1:enabled Hundred's place of LED:fault locking function selection 0: disabled 1: enabled(fault indication is disabled) 2: enabled(fault indication is enabled) Thousand's place of LED: Phase failure function enabled 0:Input and output phase failure protective function enabled 1:Input phase failure protective function disabled 2:Output phase failure protective function disabled 3:Input and output phase failure protective function disabled	1	0000	×
FL.14	Type of No. 1 fault	1st. FAULT	0:No abnormal record 1:over-current in accelerating process (E001) 2:over-current in decelerating	1	0	*
FL.15	Type of No.2 fault	2nd. FAULT				

Group FL: PROTECTION AND ALARMS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FL.16	Type of No.3 fault(most recent fault)	3rd. FAULT	process (E002) 3:over-current in constant-speed running process (E003) 4:over-voltage in accelerating process (E004) 5:over-voltage in decelerating process (E005) 6:over-voltage in constant-speed running process (E006) 7:Control power supply over voltage (E007) 8:Input phase failure (E008) 9:Output phase failure (E009) 10:IGBT protection (E010) 11:IGBT Heatsink over-temperature (E011) 12:Rectifier Heatsink over-temperature (E012) 13:Drive overload (E013) 14:Motor overload (E014) 15:Emergency stop (E015) 16:E^2PROM read-write error (E016) 17:serial port communication fault (E017) 18:contactor fault (E018) 19:current detection circuit fault (E019)(hall sensor or amplify circuit fault) 20:system disturbance (E020) 21:Reserved 22:Reserved 23:Paremeter copy fault (E023) 24~50: Reserved Note : ①E007 can be detected 3 minutes after 22kW/30kW drive stops. It will not be detected by the drive below 18.5kW, and it will be detected all the time by the drives of other models. ②E010 can be reset after 10 seconds;			
FL.17	DC Bus Voltage at the last fault	VOLTS AT FAULT	0~999V	1V	0V	*

Group FL: PROTECTION AND ALARMS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FL.18	Current at the last fault	CURRENT AT FAULT	0.0~999.9A	0.1A	0.0A	*
FL.19	Frequency at the last fault	FREQ. AT FAULT	0.00Hz~650.0Hz	0.01Hz	0.00Hz	*

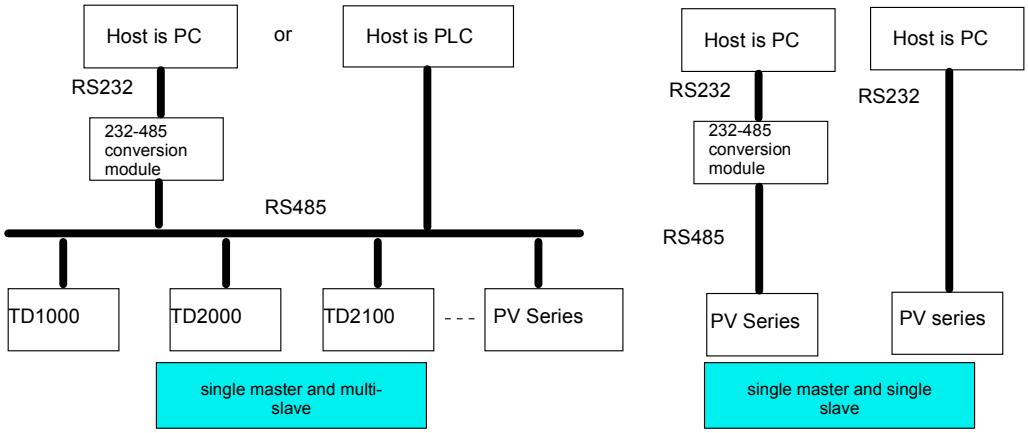
Group Fn: Drive Parameters						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
Fn.00	Set operating time	SET RUN TIME	0~65.535K hours	0.001k hours	0	○
Fn.01	Total operating time	TOTAL RUN TIME	0~65.535K hours	0.001k hours	0	*
Fn.02	Temperature of heatsink 1	HEATSINK1 TEMP.	0.0~100.0℃	0.1	0℃	*
Fn.03	Temperature of heatsink 2	HEATSINK2 TEMP.	0.0~100.0℃	0.1	0℃	*

Group FP: STORE PARAMETERS						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FP.00	User's password	USER PASSWORD	0:No password Others: Protected by Password	0	0	○
FP.01	Selection of parameter write-in states	PARAMETER PROTECTION	0: Modifying all parameters is enabled 1: Modifying other parameters is disabled except F0.02 and FP.01 2: Modifying other parameters is disabled except FP.01	1	1	○
FP.02	Parameter initialization	PARAMETER INITIALISE	0: Parameter modification enabled state 1: clear the memorizing information (FL.14~19) 2: Recover the factory settings (before FL.11)	1	0	×
FP.03	Parameter copy	PARA COPY	0:disabled 1:parameter upload 2:parameter download 3:parameter download partially (except the parameters related to the inverter itself) Note: only valid to LCD panel;	1	00	×
FP.04	Reserved	RESERVED	-	-	0	*

Group FU: DRIVE LABEL/DATA						
Parameter	Name	LCD Display	Setting range	Unit	Factory setting	Modification
FU.00	Factory password	FACTORY PASSWORD	****	1	Factory password	-

Appendix 2 Communication Protocol

1. Networking Mode



Attach Fig.6 Networking diagram of drives

2. Interfaces

RS485 or RS232: asynchronous, semi-duplex

Default: 8-N-1, 9600bps. See Group FF for parameter settings.

3. Communication Modes

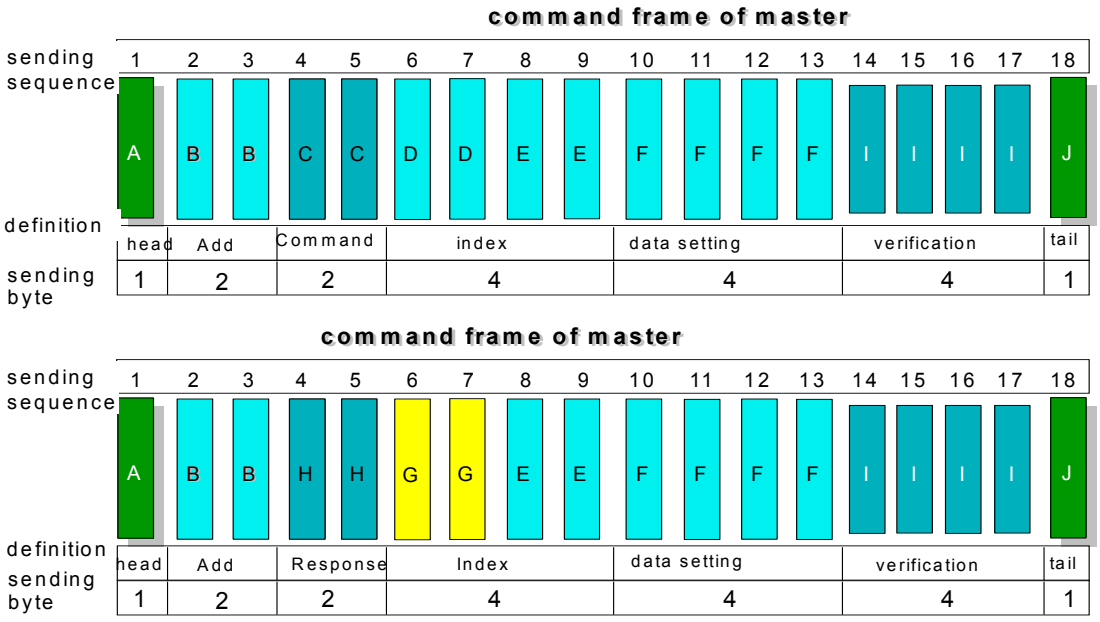
The drive is a slave device, to communicate is in 'point to point' mode. The slave drive will not response to the command sent by the master drive in broadcast address.

Users can set the drive's current address, baud rate and data format by using slave drive' keypads or using the serial communication mode.

The slave drive can report the current fault information when it responses to the polling done by the master drive.

PV Series provides two interfaces such as RS232 and RS485. Pay attention that the Jumper CN14 should be in correct position.

4. Protocol Format



In the above figure, where:

A: Frame head B: Slave address, C: Master command D: Auxiliary index E: Index or command F: Data setting G: Index of Slave H: Response of Slave I: Verify checksum J: Frame tail

- "Configuration data section" and "operation data section" may not exist in the concrete protocol frame. They are labeled with "NULL" in the protocol list.
- In the protocol, the effective characters are: ~, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F and hex ODH. And the low-case ASCII letters such as a, b, d, e, f are invalid.
- The frame for effective command has 14 or 18 bytes. Sometimes, the response frame has 10 bytes. For example, For invalid command or data overflow, the response frame has 10 bytes.
- PV Series only supports commands of Group 3 and 4 'temporarily' so as to support the basic operating functions of the host software developed by the user in earlier stage, so the commands of Group 3 and 4 should not be used in the user's new host communication program. The user should use Group 6 and 7 commands.

5. Explanations of Format

5.1 Head of Frame

"~" (That is hex number of 7E.) Single byte.

5.2 Address of Slave Drive

Definition of Data: the slave drive's address. Two bytes, ASCII format.

Configuration range: "00"~"7F". "7F" is communication broadcast address. The factory-setting of the drive is 01.

5.3 Response of Slave Drive to Master Drive's Command

Definition of Data: The response of slave drive to the command sent by the Master Drive. Two Bytes. ASCII Format.

Classification of Parameters:

Command Code == "00": Master drive asks Slave drive to feed back the current status(ready or not ready) and control status.

Attach Table 6 Meaning of Response Code to Command Code "00"

Respond Code ASCII	Meaning		
	Ready or not ready status of slave drive	Master drive control enabled	Setting frequency enabled
10	Not Ready	No meaning	
11	Ready	Enabled	Enabled
12	Ready	Enabled	Disabled
13	Ready	Disabled	Enabled
14	Ready	Disabled	Disabled
20	Frame wrong		

Command Code **＝"01"～"07"**

Response Code＝ "00" means:

Communication and control of slave computer is normal. The changes of parameters are valid. The password is correct.

Response Code＝ "20" means:

The frame verified to be incorrect. The data of "Command Section" and "Index Section overflow.

Incorrect Frame length/there are characters which are not ASCII besides frame head and frame tail.

Note: Report whether the response code is related to the current configuration status of the slave drive. Refer to the notes of "command code = 5". When reporting the response code, data in "command section", "index section" and "operation data section" will not be reported.

Response Code＝ "30" means:

The control command to the slave drive is inactive. The changes of parameters are invalid. The data in "configuration/operation data" section overflow. The password is incorrect.

Note: Report whether the response code is related to the current configuration status of the slave drive. Refer to the notes of "command code = 5". When reporting the response code, data in "command section", "index section" and "operation data section" will be reported according to the requirements of the protocol.

5.4 Index Section

Meaning of Data: Auxiliary index bytes and command index bytes are included.

For master drive, auxiliary index and command index are used to cooperate with the master computers to accomplish concrete functions.

For slave computers, auxiliary index is used to report malfunction status code. The command code will not be changed but reported directly.

Data type: Hex, four bytes. ASCII format.

Command code uses the lower two bytes, data range: “00”~”FF”.

Auxiliary code uses the higher two bytes, data range: “00”~”FF”.

The malfunction status of the slave drive will take up “auxiliary index” byte, to see table 7.

Attach Table 7 Type of Faults

Fault Index	Description of Fault	Fault Index	Description of Fault
01	Over current in Acc process	02	Over current in Dec process
03	Over current in constant-speed Running process	04	Over voltage in Acc process
05	Over voltage in Dec process	06	Over voltage in constant-speed Running process
07	Over voltage in stopping process	08	Phase failure of AC supply
09	Phase failure of drive’s AC output	10	IGBT fault
11	IGBT overheat	12	Rectifier bridge overheat
13	Drive overload	14	Motor overload
15	External equipment fault of emergent stop	16	E^2PROM fault
17	Serial communication error	18	Contactor unclosed
19	Current detection error	20	CPU error

5.5 Verify Checksum

Meaning of Data: Frame verification. Four bytes. ASCII.

Calculation method: To sum up the ASCII values of all the bytes from “slave drive address” to “operation data”.

5.6 Frame Tail

Hex OD, Single byte.

1) Command list of protocols

In the following explanation, frame head 7E, frame tail OD, address and checksum are omitted. The format is ASCII character.

Attach Table 8 List of Command Protocol

Name		Command of master	Auxiliary index	Index	Range	Example of command sent by master, e.g. the drive is controlled by a computer (C language, slave address is 01)**	Accuracy	Notes
Inquire the slave's status		00	00	00	None	~010000000181\r	1	See table 6
Read the slave's parameters	Current Freq.	01	00	00	None	~010100000182\r	0.01 Hz	
	Current frequency	01	00	01	None	~010100010183\r	0.01 Hz	
	Output voltage	01	00	02	None	~010100020184\r	1V	
	Output current	01	00	03	None	~010100030185\r	0.1A	
	Displayed value without unit	01	00	04	None	~010100040186\r	1	
	Preset rotating speed	01	00	05	None	~010100050187\r	1RPM	
	Running line speed	01	00	06	None	~010100060188\r	0.01 m/Min	
	Preset line speed	01	00	07	None	~010100070189\r	0.01 m/Min	
	Close loop feedback	01	00	08	None	~01010008018A\r	0.01V	
	Close loop setting	01	00	09	None	~01010009018B\r	0.01V	
	External counting value	01	00	0A	None	~0101000A0193\r	1	
	Output torque	01	00	0B	None	~0101000B0194\r	0.1%	
Read the slave's parameters	I/O status	01	00	0C	None	~0101000C0195\r	1	Bit0~14, respectively are X1~X8, Y1, Y2, TC, fan, braking signal, FW D and REV
Read the slave's parameters	Present status	01	00	0D	None	~0101000D0196\r	1	See table 9

Name		Command of master	Auxiliary index	Index	Range	Example of command sent by master, e.g. the drive is controlled by a computer (C language, slave address is 01)**	Accuracy	Notes
	Operating frequency after compens ation	01	00	14	None	~010100140187\r	0.01 Hz	
Operation control and adjustment function	Start-up of slave	02	00	00	None	~010200000183\r	None	
	Set slave's current freq.	02	00	01	0Hz~ upper frequency	~0102000103E80264\r	0.01 Hz	Frequency setting =10.00Hz
	Freq. setting at start-up of the slave	02	00	02	0Hz~ upper frequency limit	~0102000203E80265\r	0.01 Hz	Frequency setting at the start-up of the slave =10.00Hz
	Forward start-up of the slave	02	00	03	None	~010200030186\r	None	
	Reverse start-up of the slave	02	00	04	None	~010200040187\r	None	
	Freq. at slave's forward start-up	02	00	05	0Hz~upper freq. limit	~0102000503E80268\r	0.01 Hz	Frequency setting at the forward start-up of the slave =10.00Hz
	Freq. at slave's reverse start-up	02	00	06	0Hz~ upper freq. limit	~0102000603E80269\r	0.01 Hz	slave's reverse start-up Freq. =10.00Hz
	Slave stop	02	00	07	None	~01020007018A\r	None	
Operation control and adjustment function	Jog operation of slave	02	00	08	None	~01020008018B\r	None	
	Forward jog operation of slave	02	00	09	None	~01020009018C\r	None	
	Reverse jog operation of slave	02	00	0A	None	~0102000A0194\r	None	

Name		Command of master	Auxiliary index	Index	Range	Example of command sent by master, e.g. the drive is controlled by a computer (C language, slave address is 01)**	Accuracy	Notes
	Stop the jog operation of the slave	02	00	0B	None	~0102000B0195\r	None	
	Reset the slave upon failure	02	00	0C	None	~0102000C0196\r	None	
	Coast-to-stop of slave	02	00	0D	None	~0102000D0197\r	None	
	Emergent stop of slave	02	00	0E	None	~0102000E0198\r	None	
	Set the rate of analog output AO1	02	00	13	0~FFFF	~0102001333330253\r	0~65535 corresponding to 0~100%	Set AO1 output to 20%
	Set the rate of analog output AO2	02	00	14	0~FFFF	~0102001433330254\r	0~65535 corresponding to 0~100%	Set AO2 output to 20%
	Set the rate of digital output DO	02	00	15	0~FFFF	~0102001533330255\r	0~65535 corresponding to 0~100%	Set DO to 20%*F7.32 Hz
	Ratio of frequency (preserved)	02	00	16	0~7D0	~0102001603E8026A\r	0.1%	Set the frequency ratio to 100%
Operation control and adjustment	Set the terminal status of fictitious control	02	00	17	0~FFFF	~01020017FFFF02A3\r	1	bit0~12: Fictitious terminal:X1 ~X8, FWD, REV, Y1, Y2 and TC

Name		Command of master	Auxiliary index	Index	Range	Example of command sent by master, e.g. the drive is controlled by a computer (C language, slave address is 01)**	Accuracy	Notes
System configuration	Configure the response of slave	05	00	00	0~7	~010500000007024D\r	1	Bit0~2: whether the slave response to the received wrong data, invalid command, operation control, and adjust functions; 1: response, 0: not response, default is 5
	Inquire the slave's type and software version	05	00	01	0~FFFF	~010500010187\r	1	12000+version number, if the version is V1.0, then the read value is : 12000+10 =12010, that is 2EEA
Read the parameters (Group No.＋Index mode)		06	See table 10		None	See table 10	1	
Read the parameters (Group No.＋Index mode)		07	See table 11		0~FFFF	See table 11	Depend on function codes	

Attach Table 9 Meaning of Operating Status

Bit	Meaning		
	Description	0	1
bit0	Stop/run status	Stop	Run
bit1	Low voltage flag	normal	Low voltage
bit1～6	Reserved		
bit7			
bit8			
bit9			
bit10	Forward/reverse operation mode	Forward	Reverse
bit11	PI close loop operation mode	No	Yes
bit12	Common operation mode	No	Yes
bit13	Jog operation mode□	None	Jog
bit14	Reserved		
bit15			

To read function parameters (Group No.＋Index No.)

All the function parameters of slave drive of PV Series can be read, except the user's password.

Attach Table 10 Read the Parameters of Slave Drive

Function meanings	Read the function parameters: All the function parameters except user's password and factory password						
Meanings	Frame head	Address	Command	Index of command	Operation data	Verify checksum	Frame tail
Master's Command	7EH	ADDR	06	See Remark	None	BCC	0DH
Number of byte	1	2	2	4	0	4	1
Response of slave	7EH	ADDR	00	See Remark	Parameters	BCC	0DH
Number of byte	1	2	2	4	4	4	1
Remark	Index of command is comprised by the group No. of parameters, and HEX number of Parameter No. e.g. If parameters of FF.01 is to be read, then Index of command=0F01; If parameters of FP.02 is to be read, then Index of command=1302;						
	Relationship between the decimal value and Hex. Value						
	Group No. of Parameters	Decimal	HEX.	Group No. of Parameters	Decimal	HEX.	
	F0	0	00H	F8	8	08H	
	F1	1	01H	F9	9	09H	
	F2	2	02H	FA	10	0AH	
	F3	3	03H	FF	15	0FH	
	F4	4	04H	FH	16	10H	
	F5	5	05H	FL	17	11H	
	F6	6	06H	Fn	18	12H	
	F7	7	07H	FP	19	13H	
Valid data	0~FFFF(That is: 0~65535)						
Example	~01060104018C\r Read the parameters of F1.04						

Set Parameters (Group No.＋Index No.)

All the parameters of slave drive of PV Series except the parameters whose property is '*' and the parameter of FP.02 can be set. See "Index of Function Parameters" in this user manual.

When setting the parameters, each value must be legal, wrong value may lead to unexpected results. Please read the function parameters carefully and determine the scope before using.

"User password" should be input before setting function parameters.

Attach Table 11 Set Slave Drive's Parameters

<table>
<tr><td>Function meanings</td><td colspan="7">Set the slave drive's parameters: all parameters</td></tr>
<tr><td>Meanings</td><td>Frame head</td><td>Address</td><td>Command</td><td>Index of command</td><td>Operation data</td><td>Verify checksum</td><td>Frame tail</td></tr>
<tr><td>Master's Command</td><td>7EH</td><td>ADDR</td><td>07</td><td>See Remark</td><td>Parameters</td><td>BCC</td><td>0DH</td></tr>
<tr><td>Number of byte</td><td>1</td><td>2</td><td>2</td><td>4</td><td>4</td><td>4</td><td>1</td></tr>
<tr><td>Response of slave</td><td>7EH</td><td>ADDR</td><td>00</td><td>See Remark</td><td>Parameters</td><td>BCC</td><td>0DH</td></tr>
<tr><td>Number of byte</td><td>1</td><td>2</td><td>2</td><td>4</td><td>4</td><td>4</td><td>1</td></tr>
<tr><td rowspan="11">Remark</td><td colspan="7">Index of command is comprised by the group No. of parameters, and HEX number of Parameter No., for example:
If parameters of FF.01 is to be read, then Index of command=0F01;
If parameters of FP.01 is to be read, then Index of command=1301;</td></tr>
<tr><td colspan="7">Relationship between the decimal value and Hex. Value</td></tr>
<tr><td colspan="2">Group No. of Parameters</td><td>Decimal</td><td>HEX.</td><td>Group No. of Parameters</td><td>Decimal</td><td>HEX.</td></tr>
<tr><td colspan="2">F0</td><td>0</td><td>00H</td><td>F8</td><td>8</td><td>08H</td></tr>
<tr><td colspan="2">F1</td><td>1</td><td>01H</td><td>F9</td><td>9</td><td>09H</td></tr>
<tr><td colspan="2">F2</td><td>2</td><td>02H</td><td>FA</td><td>10</td><td>0AH</td></tr>
<tr><td colspan="2">F3</td><td>3</td><td>03H</td><td>FF</td><td>15</td><td>0FH</td></tr>
<tr><td colspan="2">F4</td><td>4</td><td>04H</td><td>FH</td><td>16</td><td>10H</td></tr>
<tr><td colspan="2">F5</td><td>5</td><td>05H</td><td>FL</td><td>17</td><td>11H</td></tr>
<tr><td colspan="2">F6</td><td>6</td><td>06H</td><td>Fn</td><td>18</td><td>12H</td></tr>
<tr><td colspan="2">F7</td><td>7</td><td>07H</td><td>FP</td><td>19</td><td>13H</td></tr>
<tr><td>Valid data</td><td colspan="7">0~FFFF(That is: 0~65535)</td></tr>
<tr><td>Example</td><td colspan="7">~010713010000024D\r Set FP.01 to 0, all the parameters are enabled to be changed.</td></tr>
</table>

2) Example (Turbo C 2.0): Send the command of running the drive, stopping the drive and setting the frequency (need to set F0.00 to 2, and set F0.03 to 2 first.)

```
#include <dos.h>
#include <bios.h>
#include <conio.h>
#include <stdio.h>
#define COM1                0                   /*serial port 1*/
#define COM2                1                   /*serial port 2*/
#define SET_COMPARA         0                   /* To set the parameters of communication ports */
#define DEFAULT_BAUD        0xE3                /*8-N-1,9600bps*/
#define PORT_ADDR           0x3F8               /* Address of serial port is 13F8H*/
#define delaytime           100                 /*100ms delay time */
char run_drive[20]="~010200000183\r";           /* Command of running the drive */
char stop_drive[20]="~01020007018A\r";          /* Command of stopping the drive*/
void send_comd(char *sendstr,char *display_type);   /* Send the command */
void checksum(char *sendstr,char result_sum[]);     /*Calculate verify checksum*/
main()
{
    char sum_of_cmd[5],buf[25];                 /*store the string of 4-byte verify checksum */
    char set_frequency[25]="010200010BB8";      /* set the running frequency at 30.00Hz */
    bioscom(SET_COMPARA,DEFAULT_BAUD,COM1);     /* set COM1, 8-N-1, 9600bps */
    send_comd(run_drive,"HEX");                 /* Send run command, display in HEX format */
    printf("\nPress anykey to set frequency to 30.00Hz ...");
    while(!kbhit());                            /* wait for pressing any key to input */
    getchar();                                  /* get character */
    checksum(set_frequency,sum_of_cmd);         /* get the verify checksum of the sent command */
    sprintf(buf,"~%s%s\r",set_frequency,sum_of_cmd);
    strcpy(set_frequency,buf);                  /* combine the sent frames */
    send_comd(set_frequency,"HEX");             /* set to 30.00Hz, display in HEX format */
    printf("\nPress anykey to stop ...");
    while(!kbhit());                            /* wait for pressing any key to input */
    send_comd(stop_drive,"ASCII");              /* Send stop command, display in ASCII format */
}
void send_comd(char *sendstr,char *display_type)
{
    unsigned int i;
    char buf[5];                                /* used for character display */
    printf("\nSend(%s):",display_type);
    for(i=0;i<strlen(sendstr);i++){             /* send the frame command */
        outportb(PORT_ADDR,sendstr[i]);
        delay(delaytime);                       /* The delay time should ensure the command can be
                                                   sent */
```

```
            if(display_type[0]=='H')                                    /* determine the display format */
            {printf("%02x ",sendstr[i]);}                              /* display in HEX format */
            else{printf("%c",sendstr[i]);}                              /* display in ASCII format */
        }
}
void checksum(char *sendstr,char result_sum[])
{
    unsigned int i,sum=0;
    static char sum_string[5];                                          /* calculate the sum of all the characters */
    for(i=0;i<strlen(sendstr);i++)sum+=(unsigned int)sendstr[i];
    sprintf(sum_string,"%04x",sum);
    for(i=0;i<4;i++)
        result_sum[i]=toupper(sum_string[i]);                           /* convert into capital letters */
    result_sum[i]=0x0;                                                  /* end of string */
}                                                                       /*result_sum return ASCII string of Verify checksum */
```