inverter.com

User Manual

EM15-SP Series VFD

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Preface

Thank you for purchasing the solar drive developed by our company.

Features:

- MPPT algorithm of fast tracking of maximum power point of PV cells, efficiency >99%.
- Solar battery working point voltage can be manually or automatically MPPT tracking.
- All weather automatic operation,can also be manually or automatically,
- Realize"sunrise work and sunset sleep".
- 35 kinds protection function. including auto detecting short circuit after power on.
- Auto sleep function/pump dry protect/low frequency protection/over load protection and etc.
- Full protections:overload,over current, overvoltage,under voltage,short circuit, dry pumping etc.
- Output frequency range: V/F(0~3000hz); vector control(0~300HZ).
- Overload capacity:60s with 150% of rated current,3s with 180% of rated current.
- Speed accuracy:±0.5%(SVC);±0.02%(VC).
- Pulse setting input:0Khz~100Khz.
- Remote control, support RS232/RS485 protocol, terminal control, analog control.

Before unpacking, please check carefully:

1. Whether the nameplate model of solar drive are consistent with your order ratings. The box contains the solar drive , user manual.
2. Whether the solar drive is damaged during transportation. If you find any omission or damage, please contact us or your local supplier immediately.

First-time Use

For the users who use this product for the first time, read the manual carefully. If in doubt concerning some functions or performances, contact the technical support personnel to ensure correct use.

Due to the continuous improvement of solar inverter, this document will be updated without prior notice.

Solar drive complies with the following international standards. All products have passed the CE certification.

IEC/EN61800-5-1: 2003 Variable speed electric drive system safety requirements;

IEC/EN61800-3: 2004 Variable speed electric drive system, Part 3: The Electro Magnetic Compatibility (EMC) Standards of Product and its specific testing methods.

Version:V1.0.0

Contents

1. Safety Information and Precautions

In this manual, the notices are graded based on the degree of danger:

 **Danger:** Indicates that failure to comply with the notice will result in severe personal injury or even death.

 **Warning:** Indicates that failure to comply with the notice will result in personal injury or property damage.

Read this manual carefully so that you have a thorough understanding. Installation, commissioning or maintenance may be performed in conjunction with this chapter. Our company will assume no liability or responsibility for any injury or loss caused by improper operation.

1.1 Safety Information

 **Danger**

- Do not use damaged or missing components solar drive. Failure to comply will result in personal injury.
- Please use the electric motor with upper B insulation class. Failure to comply will result in personal injury.
- Install the solar drive on incombustible objects such as metal, and keep it away from combustible materials. Failure to comply may result in a fire.
- Wiring must be performed only by qualified personnel under instructions described in this manual. Failure to comply may result in unexpected accidents.
- A circuit breaker must be used to isolate the power supply and the solar drive. Failure to comply may result in a fire.
- Ensure that the power supply is cut off before wiring. Failure to comply may result in electric shock.
- Connect the solar drive to ground properly by standard. Failure to comply may result in electric shock. Cover
- the solar drive properly before power-on to prevent electric shock.
- Do not open the solar inverter’s cover after power-on to prevent from electric shock.
- Do not touch the solar drive with wet hand and its peripheral circuit to prevent from electric shock.
- Do not touch the terminals of the solar drive (including the control terminals). Failure to comply may result in electric shock.
- Do not touch the U, V, W terminal or motor connecting terminals when solar drive automatically does safety testing for the external high-voltage electrical circuit. Failure to comply may result in electric shock.
- Do not go close to the equipment when selected the restart function. Failure to comply may result in personal injury.
- Do not touch the fan or the discharging resistor to check the temperature. Failure to comply will result in personal injury.
- Signal detection must be performed only by qualified personal during operation

Warning:

- When two solar inverters are laid in the same cabinet, arrange the installation positions properly to ensure the enough cooling effect.
- Do not drop wire residue or screw into the solar drive. Failure to comply will result in damage to the solar drive.
- Never connect the power supply cables to the output terminals (U, V, W) of the solar drive. Failure to comply will result in damage to the solar drive.
- Make sure that all the connecting wires comply with the requirement of EMC and the safety standard in the region. Use wire sizes recommended in the manual. Failure to comply may result in accidents.
- Never connect the braking resistor between the DC bus terminals (P+) and (P-). Failure to comply may result in a fire.
- Do not perform the voltage resistance test on any part of the solar drive because such test has been done in the factory. Failure to comply will result in accidents.
- All peripheral devices must be connected properly under the instructions described in this manual. Failure to comply will result in accidents.
- Note the danger during the rotary running of motor when check the parameters. Failure to comply will result in accidents.
- Do not change the factory default settings of the solar drive. Failure to comply will result in damage to the solar drive.
- Avoid objects falling into the solar drive when it is running. Failure to comply will result in damage to solar drive.
- Do not start/stop the solar drive by turning the contactor ON/OFF. Failure to comply will result in damage to the solar drive.

2. Product Information

2.1 Designation Rules

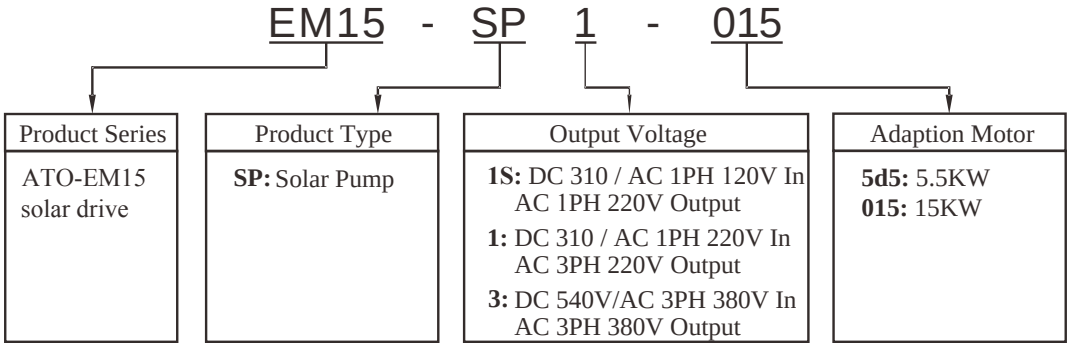


Diagram 2-1 Designation rules

2.2 EM15-SP series

Table 2-1EM15-SP Models and technical datas

EM15-SP1[S] / Description	d75	1d5	2d2	004	5d5	7d5	011	015	018	022	030	037	045
DC input (+, -)													
Rated power/KW	0.75	1.5	2.2	4	5.5	7.5	11	15	18.5	22	30	37	45
Min. DC voltage/V	120												
Max.DC voltage/V	400												
Recommended MPPT range /V	250~400												
AC output(U, V, W)													
Output current/A	3.8	5.1	9	13	25	32	45	60	75	91	112	150	176

EM15-SP3 / Description	d75	1d5	2d2	004	5d5	7d5	011	015	018	022	030	037	045
	055	075	090	110	132	160	200	220	250	280	315	355	400
DC input (+, -)													
Rated power/KW	0.75	1.5	2.2	4	5.5	7.5	11	15	18.5	22	30	37	45
	55	75	90	110	132	160	200	220	250	280	315	355	400
Min. DC voltage/V	280												
Max.DC voltage/V	750												
Recommended MPPT range /V	350~750												
AC output(U, V, W)													
Output current	2.1	3.8	5.1	9	13	17	25	32	37	45	60	75	91
	112	150	176	210	253	304	377	426	465	520	585	650	725

Output frequency	0~50/60Hz
Power factor	>0.99
Communication mode	RS485 communication
Protection class	IP20
Ambient temperature	-10℃~ +40℃(ambient temperation at 40℃~50℃， please keep derated use)
Storage temperature	-20℃~ +60℃
Humidity	Smaller than 95%RH, non-condensation
Cooling	Forced Air cooling
Altitude	Lower than 1000 m
Humidity	Less than 95%RH, without condensing
Vibration	Less than 5.9 m/s2 (0.6 g)

2.3 Product appearance and installation dimension

2.3.1 Product appearance

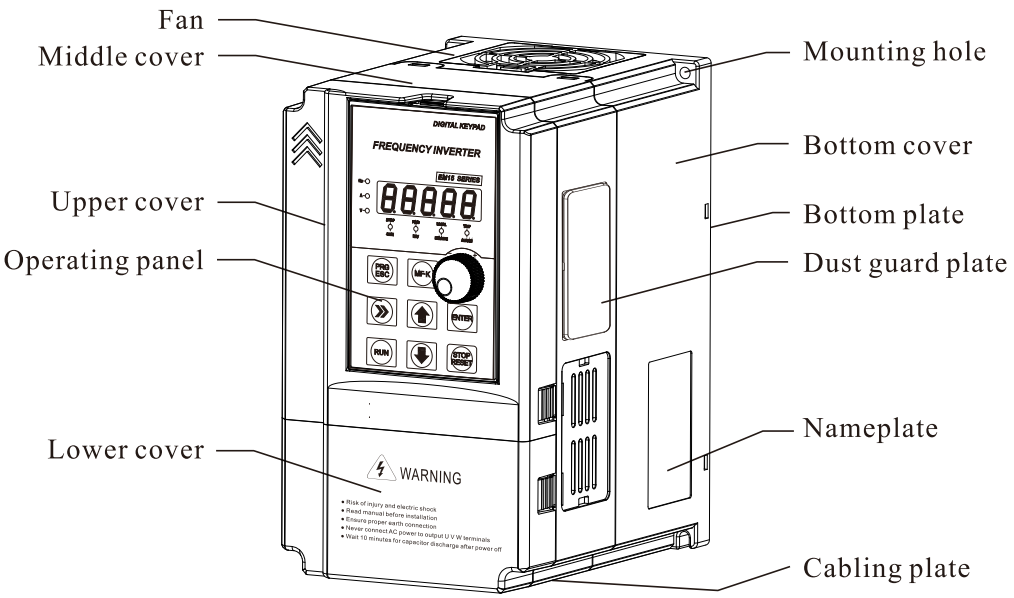


Diagram 2-2 Product appearance (With potentiometer)

2.3.2 EM15-SP variabe frequency drive appearance and installing dimension(mm)

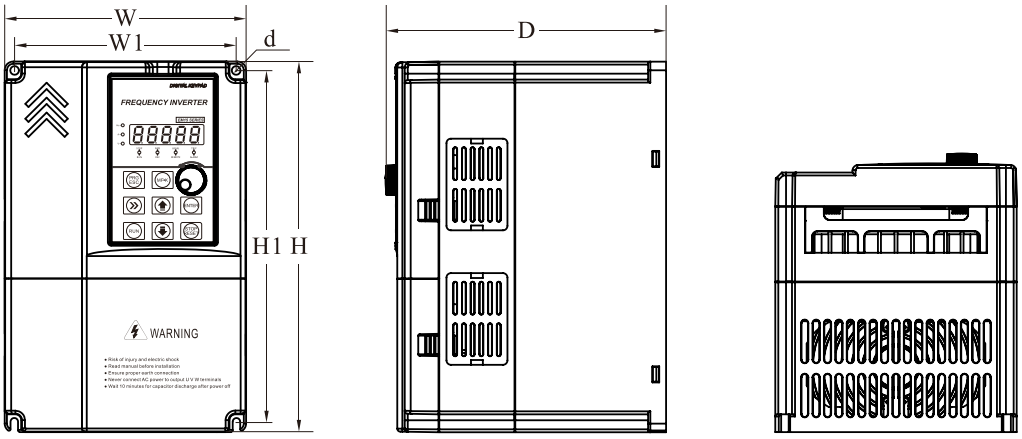


Diagram 2-3 Appearance and installation dimension of EM15 series (Plastic housing structure)

Matching inverter		Appearance and installing dimension (Unit: mm)					
Voltege	Power Range	W	W1	H	H1	D	d
1PH 220V	0.75~2.2kW	120	108	205	195	166	Φ4.5
3PH 220V	0.75~2.2kW						
3PH 380V	4~5.5kW						
3PH 220V	4~5.5kW	162	148	250	238	191	Φ5.5
3PH 380V	7.5~11kW						
3PH 220V	7.5~11kW	223	207	323	307	207	Φ5.5
3PH 380V	15~22kW						

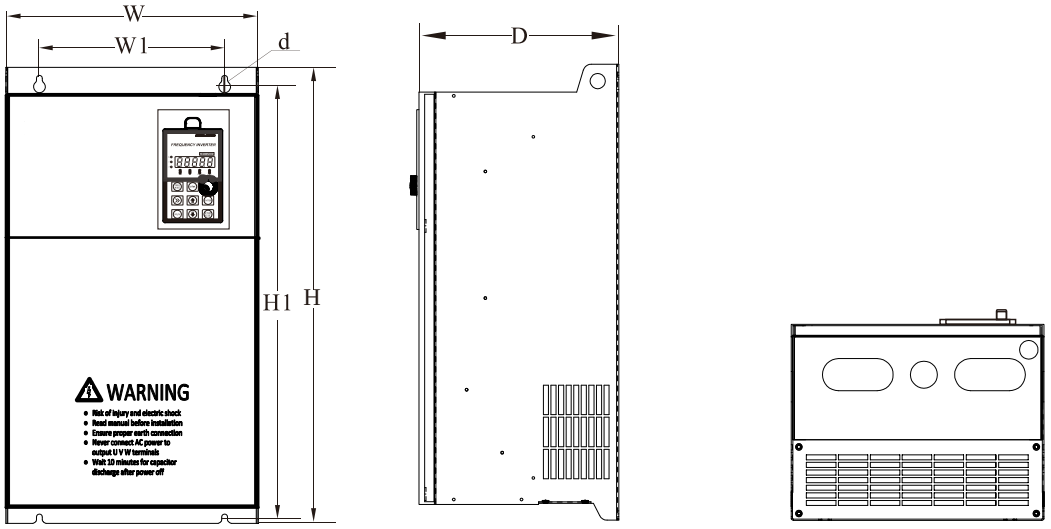


Diagram 2-4 Appearance and installation dimension of EM15 series (Metal housing structure)

Matching inverter		Appearance and installing dimension (Unit: mm)					
Voltege	**Power Range**	**W**	**W1**	**H**	**H1**	**D**	**d**
3PH 220V	15~18.5kW	300	220	540	500	240	Φ7
3PH 380V	30~37kW						
3PH 220V	22kW	340	260	580	540	270	Φ10
3PH 380V	45~55kW						
3PH 220V	37~45KW	410	260	610	575	280	Φ12
3PH 380V	75~90kW						
3PH 380V	110~132kW	460	320	710	690	335	Φ12
3PH 380V	160~220kW	535	360	885	830	370	Φ12
3PH 380V	250~315kW	650	360	1040	985	415	Φ12
3PH 380V	355~400kW	815	600	1350	1250	445	Φ12

2.3.3 Appearance and installation dimension of external keypad (keypad tray)

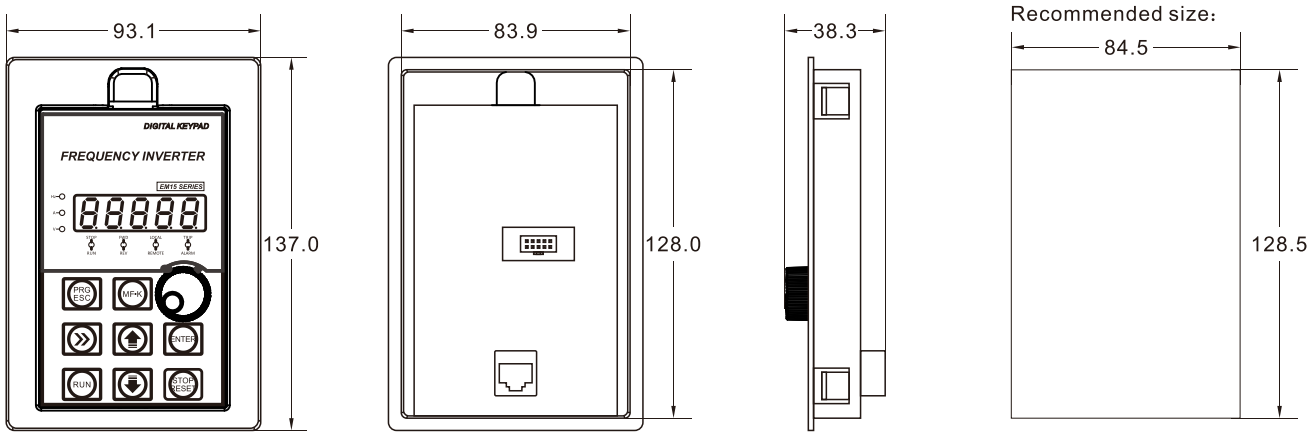


Diagram 2-5 Appearance and installation dimension of external keypad (keypad tray)

3.Installation of variable frequency drive

3.1 Installation environment

1. The place with indoor vents or ventilation devices.
2. The environment temperature shall be -10℃~40℃. If the temperature is over 40℃but less than 50℃, better to take down the cover of variable frequency drive or open the front door of cabinet to facilitate heat dissipation.
3. Try to avoid high temperature and wet place; the humidity shall be less than 90% without frost deposit.
4. Avoid direct sunlight.
5. Keep away from flammable, explosive and corrosive gas and liquid.
6. No dust, floating fiber and metal particles.
7. Install on the place without strongly vibration. And the vibration should be not over 0.6G, Especially pay attention to far away from the punching machine, etc.
8. Keep away from electromagnetic interference source.

3.2 Installation direction and space

In order to not affect the service life of variable frequency drive and reduce its performance, note for its installation direction and space and correctly fasten it.

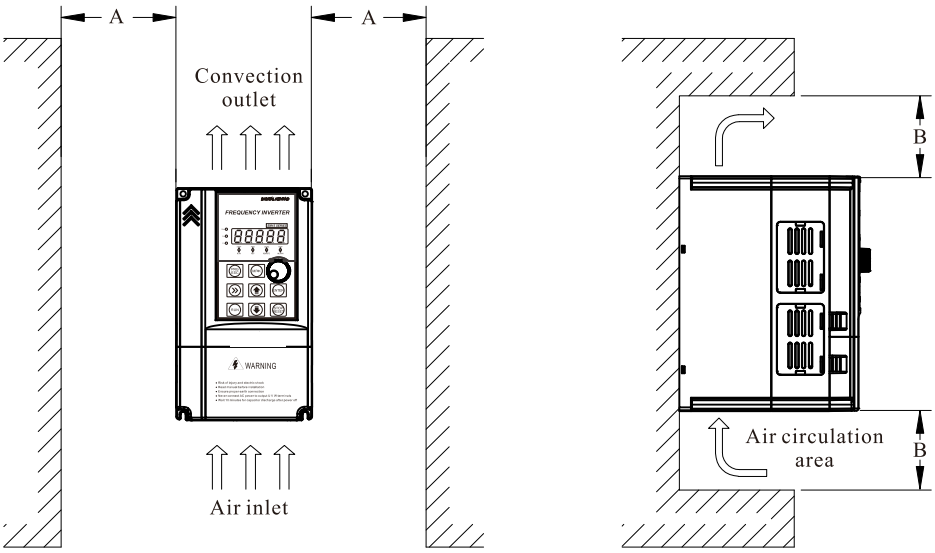


Diagram3-1 Ventilating duct installation dimension diagram of variable frequency drive

Power class	Installation dimension	
	A	B
≤7.5kW	≥ 20mm	≥ 100mm
11kW - 30kW	≥ 50mm	≥ 200mm
≥ 37kW	≥ 50mm	≥ 300mm

Please install the variable frequency drive vertically, to send out the heat upward, and pay attention to direction of variable frequency drive to avoid inversion.

If there are several units of variable frequency drive installed, please install them side by side, do not to install up and down.

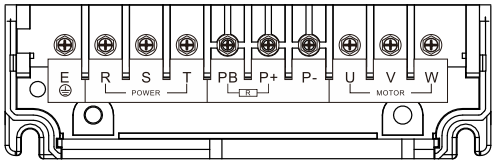
3.3 Sketch and Description of Main Circuit Terminals

3.3.1 Function and description of Main Circuit Terminals

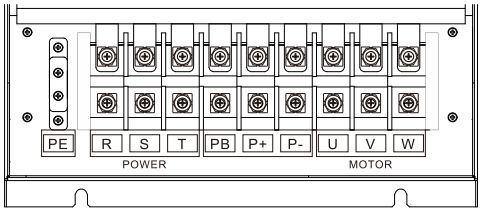
Single phase 220V output：EM15-SP1S-d75 ~ EM15-SP1S-011

Three phase 220V output：EM15-SP1-d75~EM15-SP1-011

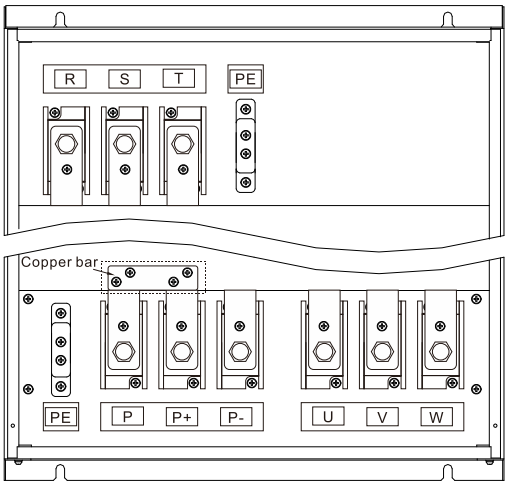
Three phase 380V output：EM15-SP3-d75～EM15-SP3-022



Three phase 380V output：EM15-SP3-030～EM15-SP3-090



Three phase 380V output：EM15-SP3-110～EM15-SP3-400



Terminal symbol	Function description
L,N or R,T	DC power input terminals
P+,PB	Braking resistor connectin
P,P+	External DC reactor connecting terminals,shorted by bronze before delivery
P+,P-	DC power input terminals；External brake unit DC output terminal
⏚ or E/PE	Grounding terminal
U,V,W	Three-phase AC power output terminals

3.4 Control Circuit and Main Circuit Terminals Description

3.4.1 Control Circuit and Main Circuit Wiring

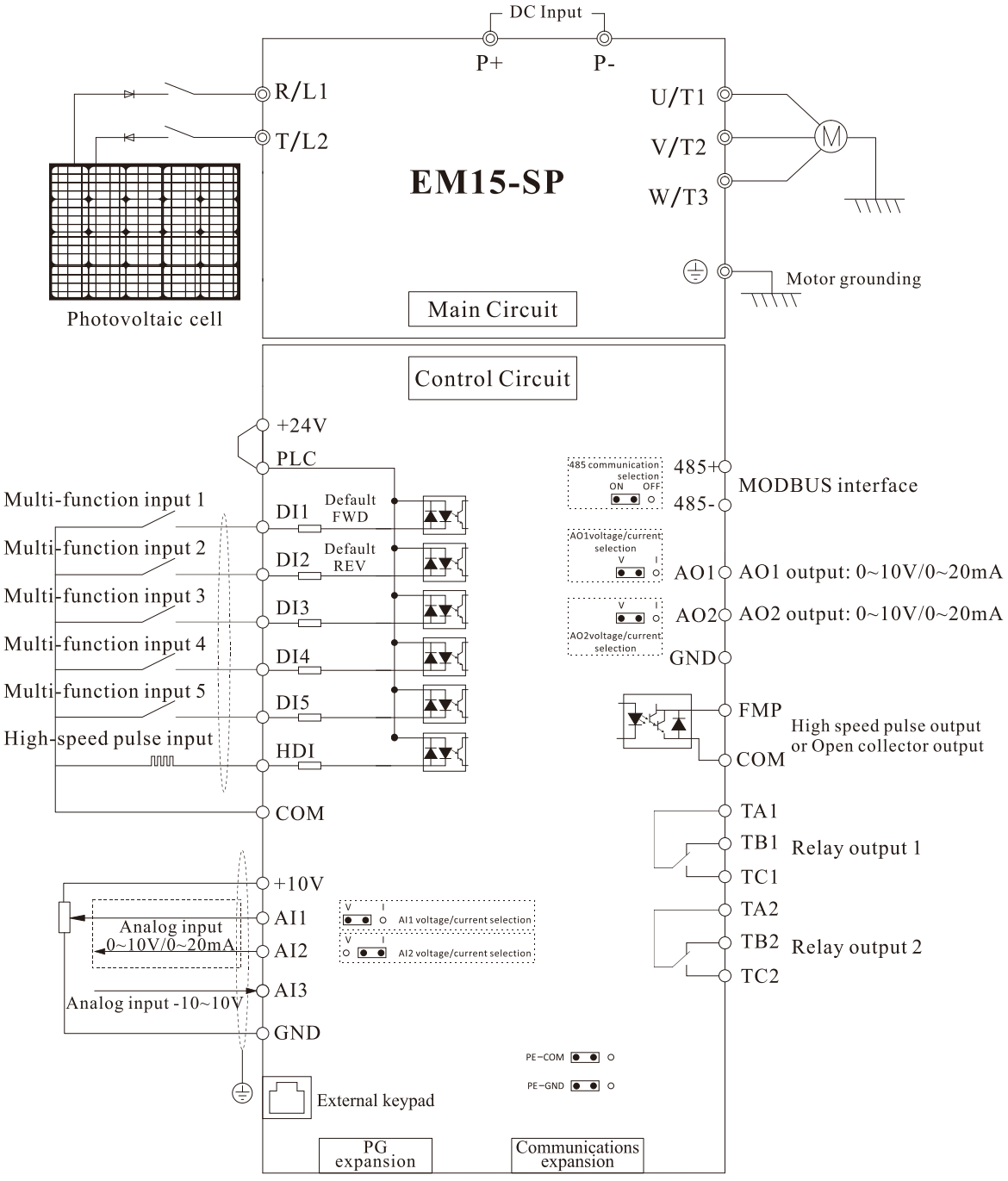


Diagram3-2 EM15-SP control circuit and main circuit wiring

3.4.2 Control Circuit Terminal Layout

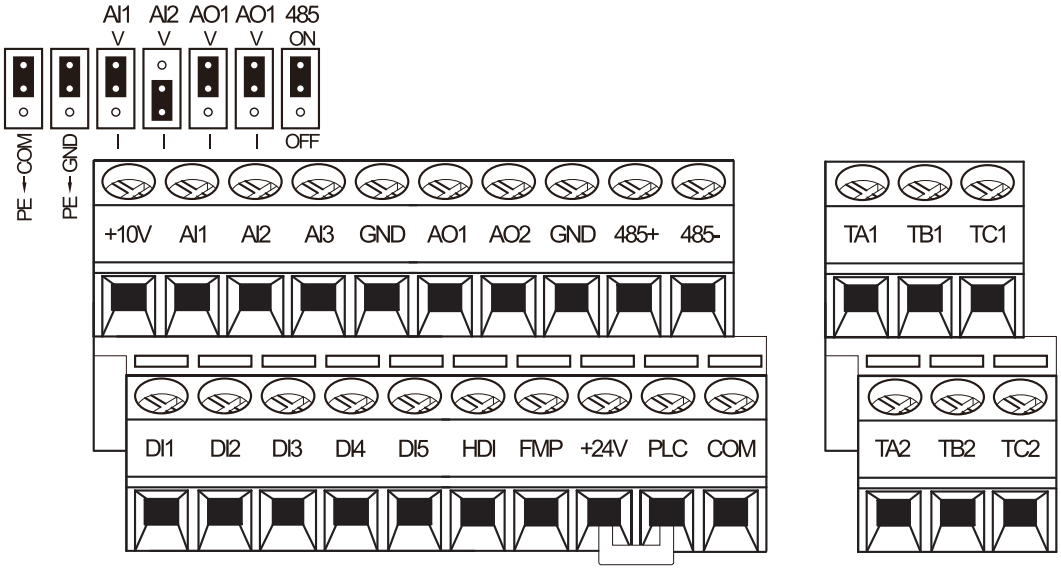


Diagram3-3 EM15-SP control circuit terminal sketch diagram

3.4.3 Description of control circuit terminals

Type	Terminal Symbol	Terminal Name	Terminal function description
Power Supply	+10V-GND	External +10V power supply	Provide +10V power supply to external unit. Maximum output current:10Ma Generally, it provides power supply to external potentiometer with resistance range of 1 kΩ~5kΩ
	+24V-COM	External +24V power supply	Provide +24 V power supply to external unit. Generally, it provides power supply to DI/DO terminals and external sensors.Maximum output current: 200 mA
	PLC	External power supply input terminals	It connect with +24V default
Analog input	AI1-GND	Analog input 1	1. Input range: DC 0V~10V/ 0mA~20mA(decided by jumper AI1/AI2 on the control board); AI3: DC -10V~+10V 2. Impedance: 22 kΩ (voltage input), 500 Ω (current input)
	AI2-GND	Analog input 2	
	AI3-GND	Analog input 3	
Digital input	DI1-COM	Digital input 1	1. Optical coupling isolation, compatible with dual polarity input 2.Input Impedance: 2.4 kΩ 3. Voltage range for level input: 9V~30 V
	DI2-COM	Digital input 2	
	DI3-COM	Digital input 3	
	DI4-COM	Digital input 4	
	DI5-COM	Digital input 5	
	HDI-COM	High Speed Pulse Input	Maximum input frequency: 100 kHz
Analog output	AO1-GND	Analog output 1	Voltage or current output is decided by jumper AO1/AO2. Output voltage range: 0V~10 V Output current range: 0mA~20 mA
	AO2-GND	Analog output 2	
	FMP- COM	High Speed Pulse Output	Constrained by function code b4-00 "FMP terminal output mode selection" as the high-speed pulse output, the highest frequency is 100kHz; when use as an open collector output,

Type	Terminal Symbol	Terminal Name	Terminal function description
			specifications is the same as DO.
Relay output	TA1-TB1	NC terminal	Contact driving capacity: 250 VAC, 3 A, COSø = 0.4 DC 30 V, 1 A
	TA2-TB2		
	TA1-TC1	NO terminal	
	TA2-TC2		
Auxiliary interface	PG card interface		PG cards: Open-collector, differential are selectable options.
	Communications expansion		Reversed
	External keypad interface		Connected to an external keypad
Jumper	PE-COM		COM grounding PE selection ,default connection. In the case of interference, connecting PE to COM can improve anti-interference
	PE-GND		GND grounding PE selection ,default connection. In the case of interference, connecting PE to COM can improve anti-interference.
	AI1		AI1 output selection. Voltage or Current output, voltage output by default.
	AI2		AI2 output selection. Voltage or Current output, current output by default.
	AO1/AO2		AO1/AO2 output selection. Voltage or Current output, voltage output by default.
	458		485 communication resistor selection, default connection ON. In the case of interference, anti-interference can be improved.

3.4 Collection Diagram For Different Motor

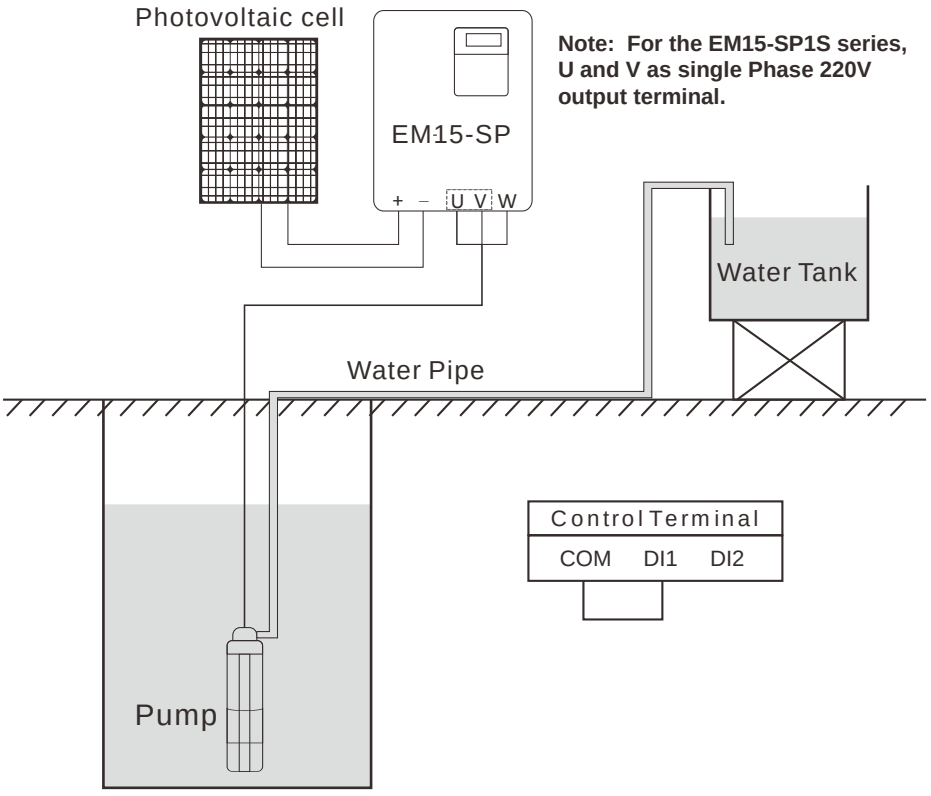


Diagram3-4 220V three phase installed without water level sensor (PV Input)

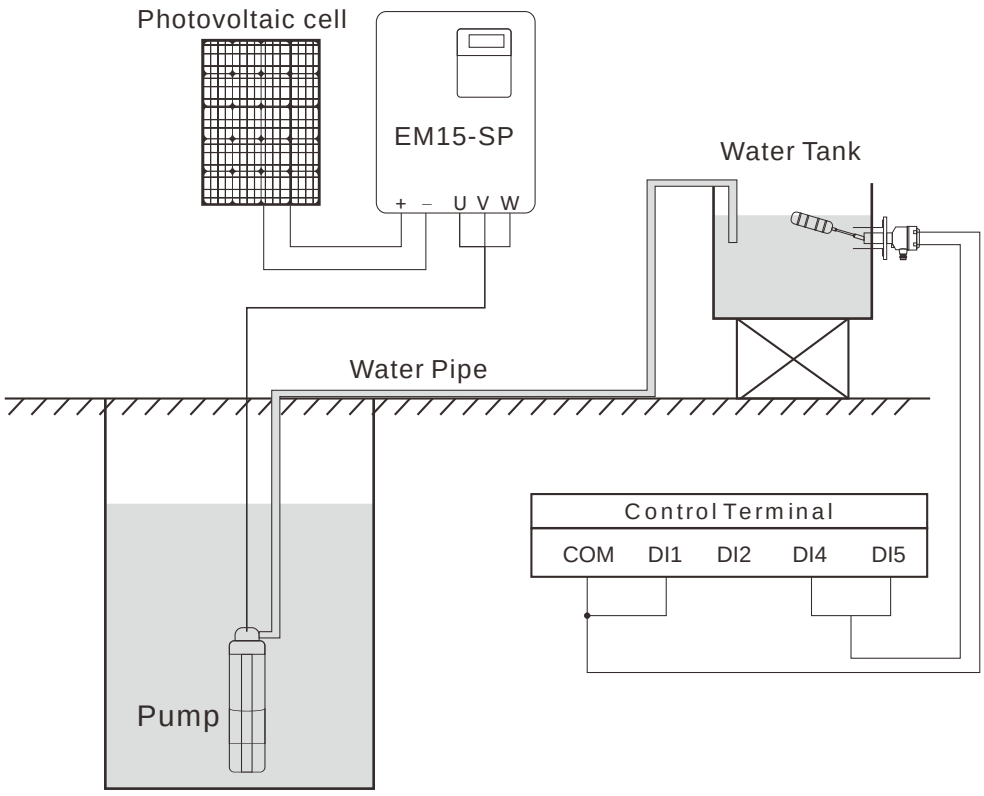


Diagram3-5 Diagram of 3phsae inverter connection method (PV Input)

3.5. 1 The wiring of water-level automatic control

The wiring for floater water-level switch connected by cable

The common port, which using floate water-level switch connected by cable, is fed to the terminal "COM" of EM15-SP. And then, connected to DI1.

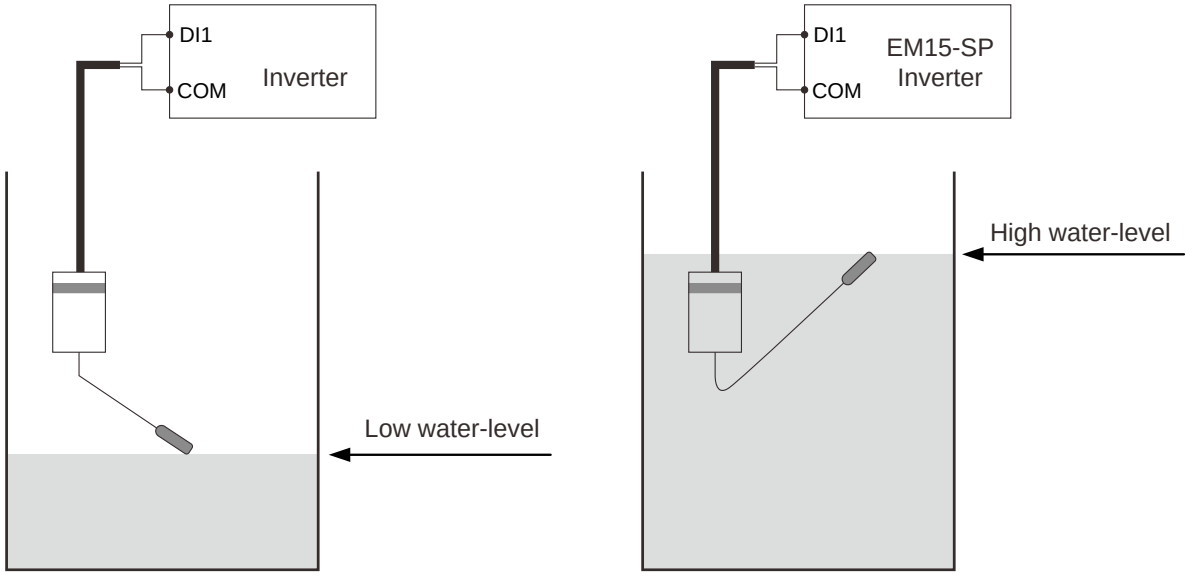


Diagram3-6 Diagram of Low water level and high water level

Remarks:

When the actual water-level in the wells is higher than the horizontal line of high water-level, DI1 will be connected to the "COM" as well as controller automatically will start the pump. On the contrary, if the actual water-level is lower than the horizontal line of low water-level, DI1 will be disconnected from

"COM" as well as controller automatically stop the pump to prevent anhydrous idling.

The wiring for floater water-level switch mounted on a side

The floater water-level switch mounted on a side is the normally open contact to output and its common wire is connected to the terminal COM of EM15-SP inverter. At the same time, the low level-water wire is connected to terminal DI4 and the high water-level wire is connected the terminal DI5.

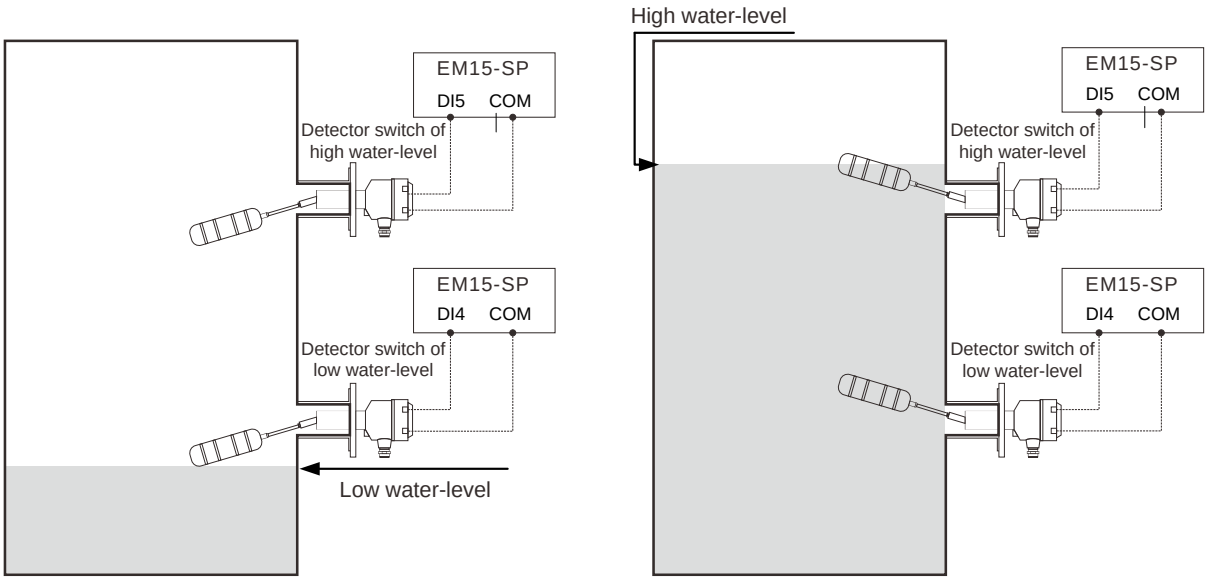


Diagram3-7 Diagram of Low water level and high water level

Remarks:

When the actual water-level in the reservoir is lower than horizontal line of low water-level, DI4 and DI5 will be disconnected from the COM as well as controller automatically strat the pum. On the contrary, if the actual water-level is higher than the horizontal line of high water-level, DI4 and DI5 will be connected to COM as well as controller automatically stop the pump to prevent water overflow.

Notice:

1. If only use one detection signal of water-level in the reservoir, DI4 and DI5 must be connected together by conductor.

4 Operation and display

4.1 Instruction of operation and display

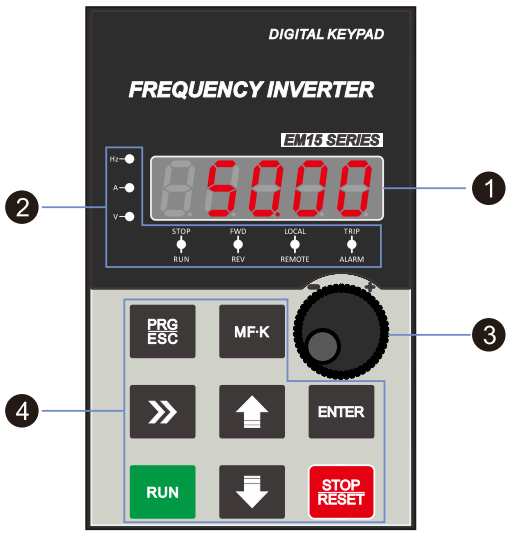


Diagram 4-1 Operating panel

No.	Name	Function	
❶	LED display area	The 5-digit LED display is able to display the set frequency, output frequency, monitoring data and fault codes.	
❷	Unit / Status Indicator area	Hz	Frequency unit
		A	Current unit
		V	Voltage unit
		STOP/ RUN	OFF indicates that the variable frequency drive is in the stop state and ON indicates that the variable frequency drive is in the running state.
		FWD/REV	It is Forward/Reversal indicator, ON indicates forward rotation.
		LOCAL /REMOTE	It indicates whether the variable frequency drive is operated by operation keypad, terminals or remoter (communication). OFF indicates keypad operation control state; ON indicates terminals operation control state; Blinking indicates remote operation control state.
		TRIP /ALARM	Tunning/ Torque Control/Fault indicator When the indicator is ON, it indicates torque control mode. When the indicator is blinking slowly, it indicates the auto-tuning state. When the indicator is blinking quickly, it indicates the fault state.
❸	Encoder knob	Frequency, data or function code increase or decrease; the encoder knob has the confirmation key function	
❹	Operation key area	PRG ESC	Programming key: Enter or exit menu level I.
		ENTER	Confirmation key: Enter the menu interfaces level by level, and confirm the parameter setting.
		MF·K	Multi-function key: Perform function switchover according to the setting of b9-01
		»	Shift key: Select the displayed parameters in turn in the stop or running state, and select the digit to be modified when modifying parameters.
		↑	Increment key: Increase data or function code.
		↓	Decrement key: Decrease data or function code.
		RUN	Running key: Start the variable frequency drive in the keypad control mode.
		STOP RESET	Stop/Reset key: Stop the variable frequency drive when it is in the running state and perform the reset operation when it is in the fault state. The functions of this key are restricted by b9-00.

4.2 Function Code Table

If FP-00 set to a non-zero number, parameter protection is enabled. You must write in correct user password to enter the menu.

To cancel the password protection function, enter with password and set FP-00 to 0。

The parameter menu under the user-defined parameter mode can directly enter without password.

A is variable frequency drive system parameter. Group “F” is basic function parameters .Group “U” is monitoring function parameters.

Code	Name	Description	Default
		F0: Basic function parameters	
F0-00	G/P type selection	1: G type(Constant torque load models) 2: P type(Fan, water pump load models)	Model dependent
F0-02	Command source selection	0: Keypad control (LED off) 1: Terminal control (LED on) 2: Communication control (LED blinking)	0
F0-03	Main frequency source X selection	0: Digital setting (Preset frequencyF0-08, UP/DOWN modifiable, no-record after power off) 1: Digital setting (Preset frequencyF0-08 , UP/DOWN modifiable, record after power off) 2: AI1 3: AI2 4: Keypad potentiometer 9: Communication setting	4
F0-08	Preset frequency	0.00Hz～maximum frequency(F0-10)	50.00Hz
F0-09	Rotation direction	0: Forward；FWD/REV lights off； 1: Reverse；FWD/REV lights on；	0
F0-10	Maximum frequency	50.00Hz～500.00Hz	50.00Hz
F0-11	Source of frequency upper limit	0: Set by(F0-12) 1: AI1 2: AI2 3: AI3 5: Communication setting	0
F0-12	Frequency upper limit	Frequency lower limit(F0-14)～maximum frequency(F0-10)	50.00Hz
F0-13	Frequency upper limit offset	0.00Hz～maximum frequencyF0-10	0.00Hz
F0-14	Frequency lower limit	0.00Hz～frequency upper limit(F0-12)	0.00Hz
F0-15	Carrier frequency	0.5kHz～16.0kHz	Model dependent
F0-16	Carrier frequency adjustment with temperature	0: No 1: Yes	1
F0-17	Acceleration time 1	0.00s～650.00s(F0-19=2) 0.0s～6500.0s(F0-19=1) 0s～65000s(F0-19=0)	Model dependent
F0-18	Deceleration time 1	0.00s～650.00s(F0-19=2) 0.0s～6500.0s(F0-19=1) 0s～65000s(F0-19=0)	Model dependent
F0-19	Acceleration/Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s	1
F0-23	Record of digital setting frequency of power failure	0: not record 1: record	0
F0-25	Acceleration/Deceleration time base frequency	0: Maximum frequency (F0-10) 1: Set frequency 2: 100Hz	0
F0-26	Base frequency for UP/ DOWN modification during running	0: Running frequency 1: Setting frequency	0
F0-27	Binding command source to frequency source	Unit's digit: Binding keypad command to following frequency source.	0000

Code	Name	Description	Default
		0: No binding 1: Frequency source by digital setting 2: AI1 3: AI2 4: Keypad potentiometer 9: Communication setting Ten's digit:: Binding terminal command to frequency source. Hundred's digit: Binding communication command to frequency source.	
F0-28	Serial communication protocol	0: MODBUS-RTU protocol	0
		F1: Motor parameter	
F1-00	Motor type selection	0: General asynchronous motor 1: Variable frequency asynchronous motor	0
F1-01	Rated motor power	0.1kW～1000.0kW	Model dependent
F1-02	Rated motor voltage	1V～2000V	Model dependent
F1-03	Rated motor current	0.01A～655.35A(variable frequency drive power≤55kW) 0.1A～6553.5A(variable frequency drive power >55kW)	Model dependent
F1-04	Rated motor frequency	0.01Hz～maximum frequency	Model dependent
F1-05	Rated motor rotational speed	1rpm～65535rpm	Model dependent
		F4: input terminals parameters	
F4-00	DI function selection	0: No function	01
F4-01	DI2 function selection	1: Forward RUN (FWD) or running command	09
F4-02	DI3 function selection	2: Reverse RUN (REV) or the direction of FED/REV	53
F4-03	DI4 function selection	4: Forward JOG(FJOG)	51
F4-04	DI5 function selection	5: Reverse JOG(RJOG)	52
F4-05	DI6 function selection	8: Free stop 9: Fault reset(RESET) 10: Run pause 11: Normally open(NO) input of external fault 33: Narmally closed (NC) input of external fault 36: External STOP terminal 1 44: User-defined fault 1 47: Emergercy stop 48: External STOP terminal 2 51: Full-water detection 1 52: Full-water detection 2 53: MPPT stop/ Photovoltaic control stop	02
F4-13	AI curve1 Min. input Value	00.00V～F4-15	00.00V
F4-14	Corresponding setting of AI curve1 Min.input	-100.0%～+100.0%	000.0%
F4-15	AI curve1 input maximum value	F4-13～+10.00V	10.00V
F4-16	Corresponding setting of AI curve1 input maximum value	-100.0%～+100.0%	100.0%
F4-17	AI1 input filter time	0.00s～10.00s	00.10s
F4-18	AI curve 2 Min. input Value	0.00V～F4-20	00.00V
F4-19	Corresponding of AI curve 2 Min. input Value	-100.0%～+100.0%	000.0%
F4-20	AI curve2 input maximum value	F4-18～+10.00V	10.00V
F4-21	Corresponding of AI curve2 input maximum value	-100.0%～+100.0%	100.0%
F4-22	AI2 filter time	0.00s～10.00s	00.10s
F4-35	DI1delay time	0.0s～3600.0s	0.0s
F4-36	DI2 delay time	0.0s～3600.0s	0.0s
F4-37	DI3 delay time	0.0s～3600.0s	0.0s

Code	Name	Description	Default
F9: Fault and Protection parameters			
F9-09	Fault auto reset times	0～20	20
F9-10	Relay action selection during fault auto reset	0: Not act 1: Act	0
F9-11	Time interval of fault auto reset	0.1s～100.0s	5.0s
F9-12	Input phase loss protection/contactor energizing protection selection	Unit's digit: Input phase loss protection Ten's digit: Contactor energizing protection 0: Disabled 1: Enabled	00
F9-13	Output phase loss protection	0: Disabled 1: Enabled	0
F9-14	Fault types	0: No fault 2: Over current during acceleration 3: Decelerated current during acceleration 4: Over current at constant speed 5: Overvoltage during acceleration 6: Decelerated voltage during deceleration 7: Overvoltage at constant speed 9: Less voltage fault 10: variable frequency drive overload 11: Motor overload 12: Power input phase loss 13: Power output phase loss 14: IGBT Module overheat 15: External equipment fault 16: Communication fault 18: Current detection fault 21: EEPROM read- write fault 22: variable frequency drive hardware fault 23: Short circuit to ground 26: Accumulative running time reached 27: User-defined fault 1 28: User-defined fault 2 29: Accumulative power-on time reached 40: Fast current limit fault 43: Motor over-speed 55: Load distribution slave failure	00
F9-37	Frequency of fault	—	—
F9-38	Current of fault	—	—
F9-39	DC Bus voltage of fault	—	—
F9-40	Input terminals status of fault	—	—
F9-41	Output terminal status of fault	—	—
F9-42	variable frequency drive status of fault	—	—
F9-43	Power-on time of fault	—	—
F9-44	Running time of fault	—	—
FE: parameters for solar water pump control			
FE-00	PV inverter Selection	0: Disabled 1: Enabled	1
FE-01	Vmpp voltage Selection	0: Manual setting 1: MPPT Automatic algorithm tracking	1
FE-02	Vmpp voltage manual Reference value	0-1000.0V	500.0V
FE-03	Motor Selection	0: General three phase ac motor 1: Single phase motor with capacitor 2: Single phase motor without capacitor	0
FE-04	CVT proportional gain 1	0.0%-999.9%	100.0%

Code	Name	Description	Default
FE-05	CVT Integral gain1	0.0%-999.9%	100.0%
FE-06	Reserved	--	--
FE-07	Reserved	--	--
FE-08	Reserved	--	--
FE-09	Reserved	--	--
FE-10	Mppt search upper limit voltage	0-1000.0V	750.0V
FE-11	Mppt search lower limit voltage	0-1000.0V	300.0V
FE-12	MPPT search gain	0%-500%	100%
FE-13	MPPT search time interval	0.0-10.0s	1.0sec
FE-14	Reserved	0	0
FE-15	Reserved	0	0
FE-16	Dormancy voltage	0.0-1000.0V	300.0V
FE-17	Dormancy wake-up voltage	0.0-1000.0V	350.0V
FE-18	Dormancy wake-up time	0-30000sec	60sec
FE-19	detection frequency of low frequency protection	0.00Hz～300.00Hz	10.00Hz
FE-20	Detection time of low frequency protection	0-30000s	10sec
FE-21	low frequency protection automatic recovery time	0-30000s	60sec
FE-22	detection current of dry pumping protection	0.0-999.9A	0.0A
FE-23	detection time of dry pumping protection	0-30000s	10sec
FE-24	automatic recovery time of dry pumping protection	0-30000s	60sec
FE-25	detection current of overcurrent protection	0.0-999.9A	0.0A
FE-26	detection time of overcurrent protection	0-30000s	10sec
FE-27	over current protection automatic recovery time	0 -30000s	60sec
FE-28	Min. power protection value	0.00kw - 650.00kw	0.00kw
FE-29	Detection time of Min. power protection	0 - 30000s	0sec
FE-30	Min. power protection automatic recovery time	0 - 30000s	0sec
FE-31	Full water detection mode	0: terminal 1: AI1 2: AI2	0
FE-32	Analog full-water detection Thresholds	0-100.0%	25.0%
FE-33	detection time of full-water protection	0-30000s	10sec
FE-34	exit time of full-water protection	0-30000s	60sec
FE-35	analog sensor damaged Thresholds	0-100.0%	0.0%
FE-36	PV DC correction coefficient	0.0-200.0%	100.00%
FE-37	PV DC correction offset	-100.00A-100.00A	0.00A
FE-38	power curve point 0	0.0kw-999.9kw	0.5kw
FE-39	power curve point 1	0.0kw-999.9kw	1.0kw
FE-40	power curve point 2	0.0kw-999.9kw	1.5kw
FE-41	power curve point 3	0.0kw-999.9kw	2.0kw
FE-42	power curve point 4	0.0kw-999.9kw	2.5kw
FE-43	flow curve point 0	0.0-999.9m^3/h	0.0 m^3/h
FE-44	flow curve point 1	0.0-999.9m^3/h	5.0 m^3/h
FE-45	flow curve point 2	0.0-999.9m^3/h	10.0m^3/h
FE-46	flow curve point 3	0.0-999.9m^3/h	15.0m^3/h
FE-47	flow curve point 4	0.0-999.9m^3/h	20.0m^3/h

Code	Name	Description	Default
FP: Parameters for User password			
FP-00	User password	0 ～ 65535	00000
FP-01	Restore default settings	0: No operation 1: Restore default settings except motor parameters and accumulation record. 02: Clear records 04: Back up present user parameters 501: Restore user backup parameters	0
FP-02	Function parameter group display selection	Unit's digit: U group display selection 0: Not displayed 1: Display Ten's digit: A Show Select 0: Not displayed 1: Display	01
FP-04	Parameter modification property	0: modifiable 1: Not modifiable	0
U0: Monitoring parameters			
U0-00	Running frequency(Hz)	--	0.01Hz
U0-01	Setting frequency(Hz)	--	0.01Hz
U0-02	PV voltage(V)	--	0.1V
U0-03	Output voltage(V)	--	1V
U0-04	Output current(A)	--	0.01A
U0-05	PV power (KW)	--	0.1KW
U0-06	PV current(A)	--	0.01A
U0-07	DI input status	--	1
U0-08	DO output status	--	1
U0-09	AI1	--	0.01V
U0-10	AI2	--	0.01V
U0-11	KAI	--	0.01V
U0-12	PVopen circuit voltage	--	0.1V
U0-13	Pump flow speed	--	0.1m^3/hr
U0-14	Daily flow	--	0.1m^3
U0-15	Cumulative flow(low water level)	--	0.1m^3
U0-16	Cumulative flow (high water level)	--	0.1Km^3
U0-17	Daily generated electricity	--	0.1kwh
U0-18	Cumulative electricity consumption(low water level)	--	0.1kwh
U0-19	Cumulative electricity consumption(high water level)	--	1Mwh
Ar: Parameters for Alarm			
Ar.01	Dormancy		81
Ar.02	Low frequency protection		82
Ar.03	Dry pumping rotection /underload		83
Ar.04	Overcurrent protection		84
A4.05	Min.power protection		85
A4.06	Full-water protection		86
A4.07	Analog sensor fault		87

5. Description of Function Codes

F0: Basic Function Parameters Group

F0-00	G/P type selection	1: G type(Constant torque load models) 2: P type(Fan, water pump load models)	Model dependent

This parameter is used to display the delivered model and cannot be modified.

1: **Applicable to constant torque general load with rated parameters specified.**

2: **Applicable to variable torque load (fan and pump) with rated parameters specified.**

F0-02	Command source selection	0: Keypad control (LED off) 1: Terminal control (LED on) 2: Communication control (LED blinking)	0

It is used to determine the input channel of the variable frequency drive control commands, such as run, stop, forward rotation, reverse rotation and jog operation. You can input the commands in the following three channels:

0: Keypad control ("LOCAL/REMOT" indicator off)

Commands are given by pressing keys “RUN” and “STOP/RESET” on the operation panel.

1: Terminal control ("LOCAL/REMOT" indicator on)

Commands are given by means of multifunctional input terminals with functions such as FWD, REV, JOGF, and JOGR.

2: Communication control ("LOCAL/REMOT" indicator blinking)

Commands are given from host computer. For more details please refer to the appendix of communication protocol.

F0-03	Main frequency source X selection	0: Digital setting(Preset frequencyF0-08， UP/DOWNUP/DOWN modifiable, no-record after power off) 1: Digital setting (Preset frequencyF0-08， UP/DOWNUP/DOWN modifiable, record after power off) 2: AI1 3: AI2 4: Keypad potentiometer 9: Communication setting	4

It is used to select the setting channel of the main frequency. You can set the main frequency in the following 10 channels:

0: Digital setting (not record at power failure)

The initial value of the set frequency is the value of F0-08 (Preset frequency). You can change the set frequency by pressing ▲ and ▼ on the operation panel (or using the UP/DOWN function of input terminals).

When the VFD is powered on again after power failure,the set frequency reverts to the value of F0-08

(record digital setting frequency)

1: Digital setting (record at power failure)

The initial value of the set frequency is the value of F0-08(Preset frequency). You can change the set frequency by pressing keys ▲ and ▼ on the operation panel (or using the UP/DOWN functions of input terminals).

When the variable frequency drive is powered on again after power failure, the setting frequency is the value memorized at the moment of the last power failure.

Note that F0-23 (record digital setting frequency of power failure) F0-23 determines whether the set frequency is memorized or cleared when the variable frequency drive stops.It is related to stopping rather than power failure.

2: AI1

3: AI2

The frequency is set by analog input. The EM15 control board provides two analog input (AI) terminals (AI1, AI2).

Including:

AI1: 0V~10 V voltage input or 0mA ～ 20mA current input, determined by jumper JP2 on the control card;

AI2: 0V~10 V voltage input or 0mA ～ 20mA current input, determined by jumper JP3 on the control card;

The corresponding relationship curve between the input voltage of AI1, AI2 and the target frequency can be user-defined.

EM15-SP provides 5 corresponding curves, 3 groups curves are linear relation (2 point correspondence), 2 curves are arbitrary curve of 4 points corresponding relationship,User can set by F4-13 ~ F4-27 function code and A6 group function code. F4-33 is used to set the AI1~AI2 two analog input. When AI is used as the frequency setting source, the corresponding value 100% of the voltage/current input corresponds to the value of F0-10 (Maximum frequency).

4: Keypad potentiometer

9: Communication setting

The frequency is set by communication mode.

F0-08	Preset frequency	0.00Hz～ maximum frequency(F0-10)	50.00Hz

If the frequency source is digital setting he value of this parameter is the initial frequency of the variable frequency drive (digital setting).

F0-09	Rotation direction	0: Forward direction 1: Reverse direction	0

You can change the rotation direction of the motor just by modifying this parameter without changing the motor wiring. Modifying this parameter is equivalent to exchanging any two phase of the motor's U, V, W wires.

Note:

The motor will restore original running direction after parameter initialization. Do not use this function in applications where changing the rotating direction of the motor is prohibited after system commissioning is complete.

F0-10	Maximum frequency	50.00Hz～500.00Hz	50.00Hz

When the frequency source is AI, pulse setting (HDI), or Multi-segment speed, the 100% of input corresponds to the value of this parameter.

F0-11	Source of frequency upper limit	0: Set byF0-12 1: AI1 2: AI2 3: Keypad potentiometer 5: Communication setting	0

It is used to set the source of the frequency upper limit, including digital setting(F0-12)，AI, pulse setting or communication setting.

F0-12	Frequency upper limit	Frequency lower limit(F0-14)～maximum frequency(F0-10)	50.00Hz

Setting Frequency upper limit.

F0-13	Frequency upper limit offset	0.00Hz～maximum frequency(F0-10)	0.00Hz

If the source of the frequency upper limit is analog input, set F0-13 as the offset value,the final frequency upper limit is obtained by adding the offset in this parameter to the frequency upper limit set in F0-11

F0-14	Frequency lower limit	0.00Hz～frequency upper limit (F0-12)	0.00Hz

If the frequency command is lower than the value of this parameter set by F0-14, the variable frequency drive can stop, r run at the frequency lower limit, or run at zero speed.The result can be determined byF8-14(setting frequency lower than frequency lower limit running mode).

F0-17	Acceleration time 1	0.00s～650.00s(F0-19=2) 0.0s～6500.0s(F0-19=1) 0s～65000s(F0-19=0)	Model dependent
F0-18	Deceleration time 1	0.00s～650.00s(F0-19=2) 0.0s～6500.0s(F0-19=1) 0s～65000s(F0-19=0)	Model dependent

Acceleration time indicates the time required by the variable frequency drive to accelerate from 0 Hz to "Acceleration / Deceleration base frequency"(F0-25) that is, t1 in Diagram 6-1.

Deceleration time indicates the time required by the variable frequency drive to decelerate from "Acceleration / Deceleration base frequency" (F0-25)， to 0 Hz, that is, t2 in Diagram 5-1.

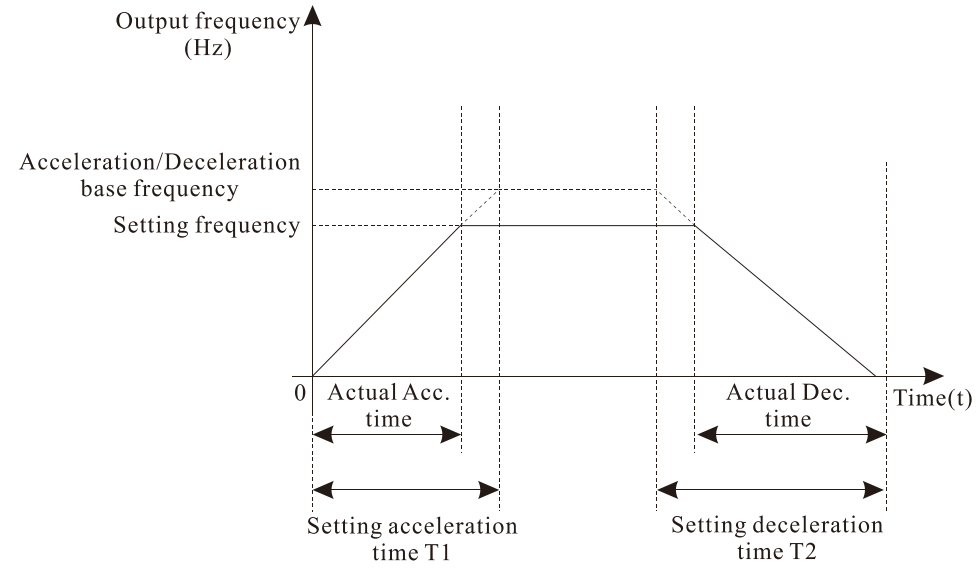


Diagram 5-1 Acceleration/Deceleration time

F0-19	Acceleration/Deceleration time unit	0: 1s 1: 0.1s 2: 0.01s	1

To satisfy requirements of different applications ， the EM15 provides three acceleration/ deceleration time units, 1s, 0.1s and 0.01s.

Note: Modifying this parameter will make the decimal places of all frequency-related parameters change and corresponding frequency values change. Pay attention for this in on-site application.

F0-23	Record of digital setting frequency of power failure	0: not record 1:record	0

This parameter is valid only when the frequency source is digital setting.

If F0-23 is set to 0, the digital setting frequency value restore to the value of F0-08(Preset frequency)after the variable frequency drive stops. The modification by using keys ▲ and ▼ or the terminal UP/DOWN function is cleared to zero.

If F0-23 is set to 1, the digital setting frequency value “Reserved”is the set frequency at the moment when the variable frequency drive stops. The modification by using keys▲ and ▼ or the terminal UP/ DOWN function remains is record and valid.

F0-25	Acceleration/Deceleration time base frequency	0: Maximum frequency(F0-10) 1: Set frequenc 2: 100Hz	0

The acceleration/deceleration time indicates the time for the variable frequency drive to increase from 0 Hz to the frequency set in F0-25， figure 6-1 is the acceleration/deceleration time diagram.

If this parameter is set to 1, the acceleration/deceleration time is related to the set frequency. If the set frequency changes frequently, the motor's acceleration/deceleration also changes.

Pay attention for this in on-site application.

F0-26	Base frequency for UP/ DOWN modification during running	0: Running frequency 1: Setting frequency	0

This parameter is valid only when the frequency source is digital setting.

It is used to set the base frequency to be modified by using keys ▲ and ▼ or the terminal UP/DOWN function.If the running frequency and setting frequency are different, there will be a large difference between the frequency inverter's performance during the acceleration/ deceleration process.

F0-27	Binding command source to frequency source	Unit's digit: Binding keypad command to following frequency source. 0: No binding 1: Frequency source by digital settin 2: AI1 3: AI2 4: AI3 9: Communication setting Ten's digit: Binding terminal command to frequency source. Hundred's digit: Binding communication command to frequency source.	0000

It is used to bind the three running command sources with the nine frequency sources, facilitating to implement synchronous switchover.

For details on the frequency sources, see the description of F0-03 (Main frequency source X selection).Different running command sources can be bound to the same frequency source.

If a command source has bound to a frequency source, this frequency source set in ， F0-03~F0-07no longer takes effect when this command source is effective.

F0-28	Serial communication protocol	0: Protocol MODBUS-RTU	0

The use of EM15-SP serial port communication protocol MODBUS.

F1 Motor Parameter

F1-00	Motor type selection	0: General asynchronous motor 1: Variable frequency asynchronous motor	0
F1-01	Rated motor power	0.1kW～1000.0kW	Model dependent
F1-02	Rated motor voltage	1V～2000V	Model dependent
F1-03	Rated motor current	0.01A～655.35A(variable frequency drive power≤55kW) 0.1A～6553.5A(variable frequency drive power >55kW)	Model dependent
F1-04	Rated motor frequency	0.01Hz～maximum frequency	Model dependent
F1-05	Rated motor rotational speed	1rpm～65535rpm	Model dependent

Set the parameters according to the motor nameplate no matter whether V/F control or vector control is adopted.

To achieve better V/F or vector control performance, motor auto-tuning is required. The motor auto-tuning accuracy depends on the correct setting of motor nameplate parameters.

F4 Input Terminals

The EM15 provides six digital input (DI) terminals (HDI can be used for high-speed pulse input) and two analog input (AI) terminals. The optional extension card provides another six DI terminals (DI7 to DI12) and one AI terminal (AI3).

F4-00	DI1 function selection	1: Forward RUN (FWD)	Standard
F4-01	DI2 function selection	9	Standard
F4-02	DI3 function selection	53	Standard
F4-03	DI4 function selection	51	Standard
F4-04	DI5 function selection	52	Standard
F4-05	DI6 function selection	2	Standard

The following table lists the functions available for the DI terminals.

Value	Function	Description
0	No function	Set 0 for reserved terminals to avoid malfunction.
1	Forward RUN (FWD) or running command	The terminal is used to control forward or reverse running of the variable frequency drive.
2	Reverse RUN (REV) or the direction of FED/REV	
4	Forward JOG (FJOG)	FJOG for the JOG forward running, RJOG for the JOG reverse running.
5	Reverse JOG (RJOG)	
8	Free stop	
9	Fault reset (RESET)	
10	RUN pause	
11	Normally open (NO) input of external fault	
33	Normally closed (NC) input of external fault	
36	External STOP terminal 1	
44	User-defined fault 1	
47	Emergency stop	
48	External STOP terminal 2	
51	Full-water detection 1	Two probes any access, from the water-full position to maintain a certain height difference in the installation
52	Full-water detection 2	
53	MPPT stop/ Photovoltaic control stop	Into the common speed mode

F4-13	AI curve1 Min.input	0.00V ～ F4-15	0.00V
F4-14	Corresponding setting of AI curve1 Min.input	-100.00% ～ 100.0%	0.0%
F4-15	AI curve1 input maximum value	F4-13 ～ 10.00V	10.00V
F4-16	Corresponding setting of AI curve1 input maximum value	-100.00% ～ 100.0%	100.0%
F4-17	AI1 filter time	0.00s ～ 10.00s	0.10s

These parameters are used to define the relationship between the analog input voltage and the corresponding setting value.

When analog input voltage is larger than setting" Max. input" (F4-15), Analog voltage should be calculated as " Max. input". The same, When analog input voltage is smaller than setting" Min. input" (F4-13), Analog voltage should be calculated as " Min. input" F4-34.

When the analog input is current input, 1 mA current corresponds to 0.5 Volts.

(AI1 filter time) is used to set the software filter time of AI1. If the analog input is liable to interference, increase

the value of this parameter to stabilize the detected analog input. However, increase of the AI filter time will slow down the response of analog detection. Set this parameter properly based on actual conditions.

In different applications, 100% of analog input corresponds to different nominal values. For details, refer to the description of different applications.

Following tables for reference:

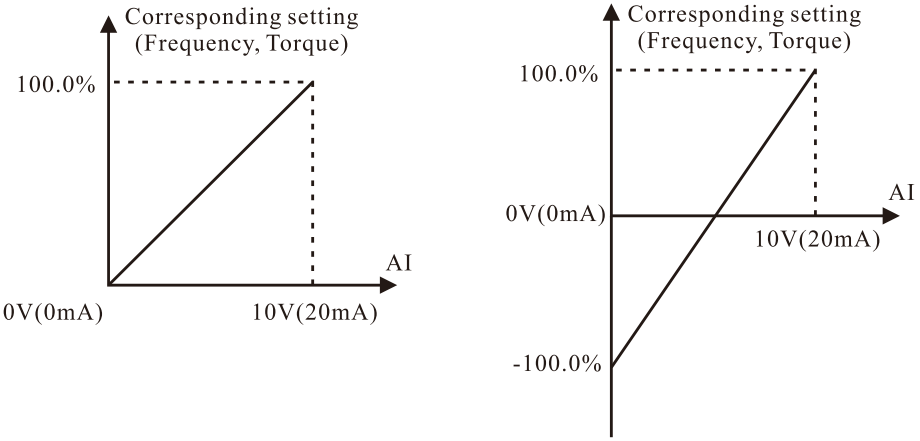


Diagram 5-2 The relationship between analog given and setting value

F4-35	DI1 delay time	0.0s ～ 3600.0s	0.0s
F4-36	DI2 delay time	0.0s ～ 3600.0s	0.0s
F4-37	DI3 delay time	0.0s ～ 3600.0s	0.0s

For setting DI changing status, Inverter's delay for this actives.

Only DI1、DI2、DI3 has delay time functions

F9 Faults and protection parameters

F9-09	Fault auto reset times	0~20	20

It is used to set the times of fault auto resets if this function is used. After the value is exceeded, the variable frequency drive will remain in the fault state.

F9-10	Do action selection during fault auto reset	0: Not act 1: Act	0

It is used to decide whether DO acts during the fault auto reset if the fault auto reset function is used.

F9-11	Time interval of fault auto reset	0.1s ～ 100.0s	5.0s

is used to set the waiting time from the variable frequency drive alarm to fault auto reset.

F9-12	Input phase loss protection/contactor energizing protection selection	Unit's digit: Input phase loss protection Ten's digit: Contactor energizing protection 0: Disabled 1: Enabled	00

It is used to determine whether to perform input phase loss or contactor energizing protection.

F9-13	Output phase loss protection	0: Disabled 1: Enabled	0

It is used to determine whether to perform output phase loss protection.

F9-14	Fault type	0 ～ 99	00

It is used to record the types of the most recent three faults of the variable frequency drive. 0 indicates no fault.

F9-37	Frequency of fault	It displays the frequency when the latest fault occurs.
F9-38	Current of fault	It displays the current when the latest fault occurs.
F9-39	DC Bus voltage of fault	It displays the DC bus voltage when the latest fault occurs.
F9-40	Input terminals status of fault	It displays the status of all DI terminals when the latest fault occurs. The sequence is as follows: BIT9 BIT8 BIT7 BIT6 BIT5 BIT4 BIT3 BIT2 BIT1 BIT0 DI0 DI9 DI8 DI7 HDI DI5 DI4 DI3 DI2 DI1 If a DI is ON, the setting is 1. If the DI is OFF, the setting is 0. The value is the equivalent decimal number converted from the DI status.
F9-41	Output terminal status of fault	It displays the status of all output terminals when the latest fault occurs. The sequence is as follows: BIT4 BIT3 BIT2 BIT1 BIT0 DO2 DO1 REL REL FMP If an output terminal is ON, the setting is 1. If the output terminal is OFF, the setting is 0. The value is the equivalent decimal number converted from the DI statuses.
F9-42	variable frequency drive status of fault	Reserved
F9-43	Power-on time of fault	It displays the present power-on time when the latest fault occurs.
F9-44	Running time of latest fault	It displays the present running time when the latest fault occurs.

FE Solar water pump control parameters

FE-00	PV inverter selection	0: Disabled 1: Enabled	1

If set to 0, inverter will be working as normal variable frequency drive.

FE-01	Vmpp voltage reference selection	0: Manual 1: MPPT Automatic algorithm tracking	1
FE-02	Vmpp voltage manual setting value	0 - 1000.0V	500.0V

It is for setting solar panels working point voltage Vmpp. Solar water pump's working theory as below: Vmpp is selected between FE-01 MPPT running result and FE-02, then output running frequency by CVT controller.

FE-03	Motor Selection	0: General three phase ac motor 1: Single phase motor with capacitor 2: Single phase motor without capacitor	--

0: General three phase ac motor
1: Single phase motor with capacitor
2: Single phase motor without capacitor

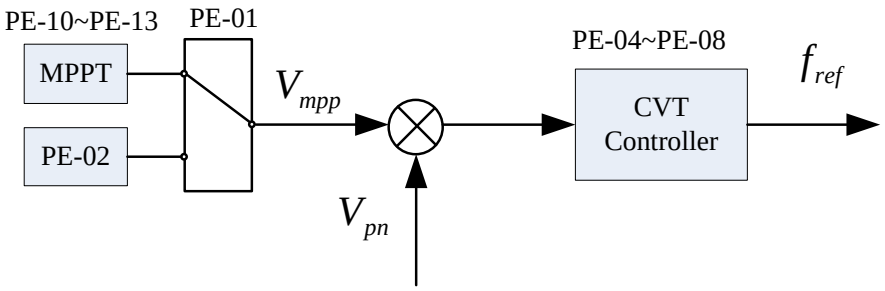
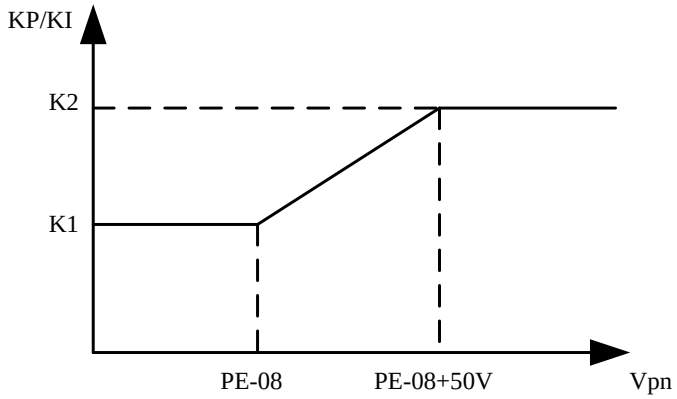


Diagram 5-3 Photovoltaic water pump control schematic

FE-04	CVT proportional gain 1	0.0% - 999.9%	100.0%
FE-05	CVT Integral gain1	0.0% - 999.9%	100.0%

It is CVT controller's PI parameters，it should be switchover in two groups according to solar cells Vpn voltage , switchover point is FE-08V; switchover point FE-08 default as 0.0V. It is for enable the first group parameters, switchover theory as below diagram:



Diagarm 5-4 Switch the schematic

CVT controller is the core parts for solar water pump control, if any unbalance output frequency, please close MPPT(select manual reference Vmpp), then adjust proportional gain or Integral gain till frequency is stable; after that, open MPPT search again;

FE-10	Mppt search upper limit voltage	0 - 1000.0V	750.0V
FE-11	Mppt search lower limit voltage	0 - 1000.0V	300.0V
FE-12	MPPT search gain	0% - 500%	100%
FE-13	MPPT search time interval	0.0 - 10.0sec	1.0sec

FE-10/FE-11set MPPT search Vmpp's upper or limit value,FE-12 set search gain, FE-13 set search time interval，If open MPPT, frequency fluctuation is very large, decrease search gain and increase search time interval to improve its stability.

FE-31	Full-water detection mode	0: terminal 1: AI1 2: AI2	0
FE-32	Analog full-water detection Thresholds	0 - 100.0%	25.0%

FE-33	detection time of full-water protection	0 - 30000sec	10sec
FE-34	exit time of full-water protection	0 - 30000sec	60sec
FE-35	analog sensor damaged Thresholds	0 - 100.0%	0.0%

FE-31 is for Full-water detection mode.

If set to 0, set any terminals(default DI4/DI5)function code to 51/52，two terminals enabled in same time could activate Full-water protection and two terminals disabled in same time could activate exit Full-water protection. One of the terminals enabled, remains its status without any change.

FE-33/FE-34 for detection time of full-water protection and exit time of full-water protection;

FE-35 for analog sensor damaged Thresholds，if FE-31 set to analog detection, and analog feedback is larger than the setting detectionThreshold value of FE-35. Judge it as analog sensor faults. Display A.Prb, and stop running;

FE-31 set to 0, close sensor faults detection.

FE-36	PV DC correction coefficient	0.0 - 200.0%	100.00%
FE-37	PV DC correction offset	-100.00A - 100.00A	0.00A

As software estimating solar cells' DC current value, this parameters will correction this estimation value, U0-06 displays correction current, correction formula is U0-06 =(estimation value * FE-36)+ FE-37 ；

FE-38	power curve point 0	0.0kw - 999.9kw	0.5kw
FE-39	power curve point 1	0.0kw - 999.9kw	1.0kw
FE-40	power curve point 2	0.0kw - 999.9kw	1.5kw
FE-41	power curve point 3	0.0kw - 999.9kw	2.0kw
FE-42	power curve point 4	0.0kw - 999.9kw	2.5kw
FE-43	flow curve point 0	0.0 - 999.9m^3/h	0.0 m^3/h
FE-44	flow curve point 1	0.0 - 999.9m^3/h	5.0 m^3/h
FE-45	flow curve point 2	0.0 - 999.9m^3/h	10.0m^3/h
FE-46	flow curve point 3	0.0 - 999.9m^3/h	15.0m^3/h
FE-47	flow curve point 4	0.0 - 999.9m^3/h	20.0m^3/h

According output power(U0-05) calculate output flow speed(U0-13), User reference(P-Q curve), input to FE-38～FE-47, software automatically calculate U0-13；Generally, P-Q curve as below:

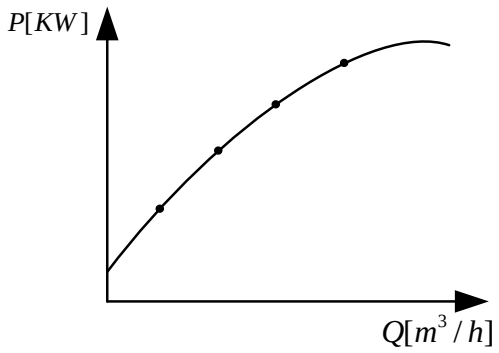


Diagram 5-5 P-Q curve

FP User password parameters

FP-00	User password	0 ～ 65535	0

If it is set to any non-zero number, the password protection function is enabled. After a password has been set and taken effect, you must enter the correct password in order to enter the menu. If the entered password is incorrect you cannot view or modify parameters.

If FP-00 is set to 00000, the previously set user password is cleared, and the password protection function is disabled.

FP-01	restore default settings	0: No operation 1: Restore default settings except motor parameters and accumulation record. 2: Clear records 4: Back up present user parameters 501: Restore user backup parameters	0

1. **Restore default settings except motor parameters**

If FP-01 is set to 1, most function codes are restored to the default settings **except** motor parameters, frequency command resolution (F0-22, fault records, accumulative running time (F7-09), accumulative power-on time (F7-13) and accumulative power consumption (F7-14).

2. **Clear records**

If FP-01 is set to 2, the fault records, accumulative power-on time (F7-13), accumulative running time (F7-09), and accumulative power consumption (F7-14) are cleared.

4. Back up present user parameters

the present parameter settings are backed up, helping you to restore the setting if incorrect parameter setting is performed.

501. Restore user backup parameters

If FP-01 is set to 4, the previous backup user parameters are restored.

FP-04	Parameter modification property	0: Modifiable 1: Not modifiable	0

It is used to set whether the parameters are modifiable to avoid mal-function. If it is set to 0, all parameters are modifiable. If it is set to 1, all parameters can only be viewed.

6. Fault Diagnosis and Solution

6.1 Fault Alarm and Countermeasures

EM15-SP VFD has 35 types of warning information and protection function. In case of abnormal fault, the protection function will be invoked, the inverter will stop output, and the faulty relay contact of the inverter will start, and the fault code will be displayed on the display panel of the inverter. Before consulting the service department, the user can perform self-check according to the prompts of this chapter, analyze the fault cause and find out t solution. If the fault is caused by the reasons as described in the dotted frame, please consult the agents of inverter or our company directly. Among the 35 types of warning information, Err22 is hardware over current or over voltage signal. In most cases, the hardware over voltage fault will cause Err22 alarm.

Table 7-1 Common faults and solution of the variable frequency drive

Fault Code	Err01	**Fault Type**	Inverter unit protection
1: The output circuit is grounded or short circuited. 2: The connecting cable of the motor is too long. 3: The IGBT overheat. 4: The internal connections become loose. 5: The main control board is faulty. 6: The drive board is faulty. 7: The inverter IGBT is faulty.			1: Eliminate external faults. 2: Install a reactor or an output filter. 3: Check the air filter and the cooling fan. 4: Connect all cables properly. 5: Ask for technical support 6: Ask for technical support 7: Ask for technical support
Fault Code	Err02/Err04	**Fault Type**	Over current during acceleration/ at constant speed
1: The output circuit is grounded or short circuited. 2: Motor auto-tuning is not performed. 3: The acceleration time is too short. 4: Manual torque boost or V/F curve is not appropriate. 5: The voltage is too low. 6: The startup operation is performed on the rotating motor. 7: A sudden load is added during acceleration. 8: The variable frequency drive model is of too small power class.			1: Eliminate external faults. 2: Perform the motor auto- tuning. 3: Increase the acceleration time. 4: Adjust the manual torque boost or V/F curve. 5: Adjust the voltage to normal range. 6: Select rotational speed tracking restart or start the motor after it stops. 7: Remove the added load. 8: Select a variable frequency drive of higher power class.
Fault Code	Err03	**Fault Type**	Over current during deceleration
1: The output circuit is grounded or short circuited. 2: Motor auto-tuning is not performed. 3: The deceleration time is too short. 4: The voltage is too low. 5: A sudden load is added during deceleration. 6: The braking unit and braking resistor are not installed.			1: Eliminate external faults. 2: Perform the motor auto-tuning. 3: Increase the deceleration time. 4: Adjust the voltage to normal range. 5: Remove the added load. 6: Install the braking unit and braking resistor.
Fault Code	Err05/ Err06	**Fault Type**	Overvoltage during acceleration/deceleration
1: The input voltage is too high. 2: An external force drives the motor during acceleration. 3: The acceleration/deceleration time is too short. 4: The braking unit and braking resistor are not installed.			1: Adjust the voltage to normal range. 2: Cancel the external force or install a braking resistor. 3: Increase the acceleration/deceleration time. 4: Install the braking unit and braking resistor.
Fault Code	Err07	**Fault Type**	Overvoltage at constant speed
1: The input voltage is too high. 2: An external force drives the motor during deceleration.			1: Adjust the voltage to normal range. 2: Cancel the external force or install the braking resistor.
Fault Code	Err08	**Fault Type**	Control power supply fault
The input voltage is not within the allowable range.			Adjust the input voltage to the allowable range.

Fault Code	Err09	**Fault Type**	Low voltage
1: Instantaneous power failure occurs on the input power supply. 2: The frequency inverter's input voltage is not within the allowable range. 3: The DC bus voltage is abnormal. 4: The rectifier bridge and buffer resistor are faulty. 5: The drive board is faulty. 6: The main control board is faulty.			1: Reset the fault. 2: Adjust the voltage to normal range. 3: Ask for technical support 4: Ask for technical support 5: Ask for technical support 6: Ask for technical support
Fault Code	Err10	**Fault Type**	variable frequency drive overload
1: The load is too heavy or locked- rotor occurs on the motor. 2: The variable frequency drive model is of too small power class.			1: Reduce the load and check the motor and mechanical condition. 2: Select a variable frequency drive of higher power class.
Fault Code	Err12	**Fault Type**	Power input phase loss
1: The three-phase power input is abnormal. 2: The drive board is faulty. 3: The lightningproof board is faulty. 4: The main control board is faulty.			1: Eliminate external faults. 2: Ask for technical support. 3: Ask for technical support. 4: Ask for technical support.
Fault Code	Err13	**Fault Type**	Power output phase loss
1: The cable connecting the variable frequency drive and the motor is faulty. 2: The frequency inverter's three-phase outputs are unbalanced when the motor is running. 3: The drive board is faulty. 4: The IGBT module is faulty.			1: Eliminate external faults. 2: Check whether the motor three phase winding is normal. 3: Ask for technical support. 4: Ask for technical support.
Fault Code	Err14	**Fault Type**	IGBT Module overheat
1: The ambient temperature is too high. 2: The air filter is blocked. 3: The fan is damaged. 4: The thermally sensitive resistor of the IGBT module is damaged. 5: The inverter IGBT module is damaged.			1: Lower the ambient temperature. 2: Clean the air filter. 3: Replace the damaged fan. 4: Replace the damaged thermally sensitive resistor. 5: Replace the inverter module.
Fault Code	Err15	**Fault Type**	External equipment fault
1: External fault signal is input via DI. 2: External fault signal is input via virtual I/O.			1: Reset the operation. 2: Reset the operation.
Fault Code	Err16	**Fault Type**	Communication fault
1: The host computer is in abnormal state. 2: The communication cable is faulty. 3: The communication extension card is set improperly. 4: The communication parameters in group bA are set improperly.			1: Check the cabling of host computer. 2: Check the communication cabling. 3: Set the communication extension card correctly. 4: Set the communication parameters properly.
Fault Code	Err18	**Fault Type**	Current detection fault
1: The HALL device is faulty. 2: The drive board is faulty.			1: Replace the faulty HALL device. 2: Replace the faulty drive board.
Fault Code	Err22	**Fault Type**	variable frequency drive hardware fault
1: Overvoltage exists. 2: Over current exists.			1: Handle based on over voltage. 2: Handle based on over current.

Appendix I. Modbus communication protocol

ATO-EM15-SP VFD provides RS485 communication interface, and adopts MODBUS communication protocol. User can carry out centralized monitoring through PC/PLC to get operating requirements. And user can set the running command, modify or read the function codes, the working state or fault information of variable frequency drive by Modbus communication protocol.

I. About Protocol

This serial communication protocol defines the transmission information and use format in the series communication and it includes master-polling (or broadcasting) format, master coding method and the content includes function code of action, transferring data and error checking. The response of slave is the same structure, and it includes action confirmation, returning the data and error checking etc. If slave takes place the error while it is receiving the information or cannot finish the action demanded by master, it will send one fault signal to master as a response.

II. Application Methods

The variable frequency drive will be connected into a "Single-master Multi-slave" PC/PLC control net with RS485 bus as the communication slave.

III. Bus structure

1) Hardware interface.

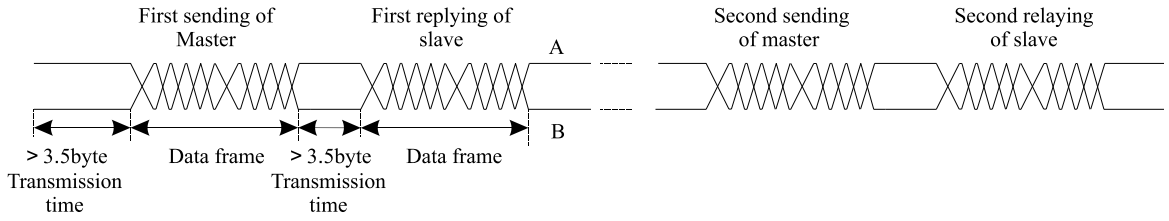
The "485+" and "485-"terminals on variable frequency drive are the communication interfaces of Modbus

2) Topological mode

It is a "Single-master Multi-slave" system. In this network, every communication machine has a unique slave address. One of them is as "master" (usually PC host machine, PLC and HMI, etc.), actively sends out the communication, to read or write the parameters of slave. Other machines will be used as slave and response to the inquiry/command from master. At one time only one machine can send the data and other machines are in the receiving status. The setup range of slave address is 0 to 247. Zero refers to broadcast communication address. The address of slave must is exclusive in the network.

3) Transmission mode

There provide asynchronous series and half-duplex transmission mode. In the series asynchronous communication, the data is sent out frame by frame in the form of message. According to the Modbus-RTU protocol, when the free time of no transmission in communication data lines is more than the transmission time of 3.5byte, it indicates that a new start of communication frame.



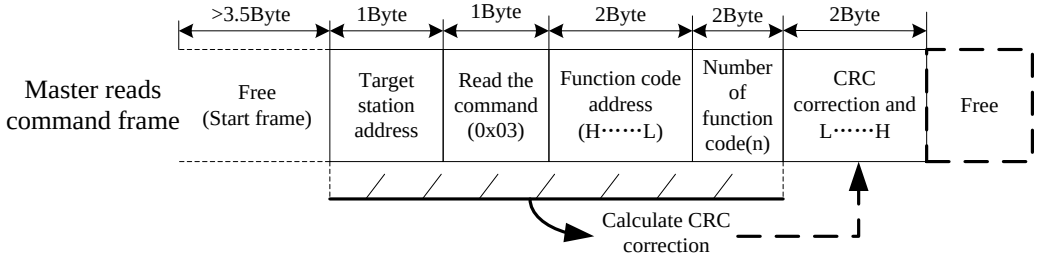
EM15 series inverter has built-in the Modbus-RTU communication protocol, and is applicable to response the slave "Inquiry/command" or doing the action according to the master's "Inquiry / Command" and response to the data.

Here, master is personnel computer (PC), industrial machine or programmable logical controller (PLC), and the slave is inverter. Master not only visits some slave, but also sends the broadcast information to all the slaves. For the single master "Inquiry/Command", all of slaves will return a signal that is a response; for the broadcast

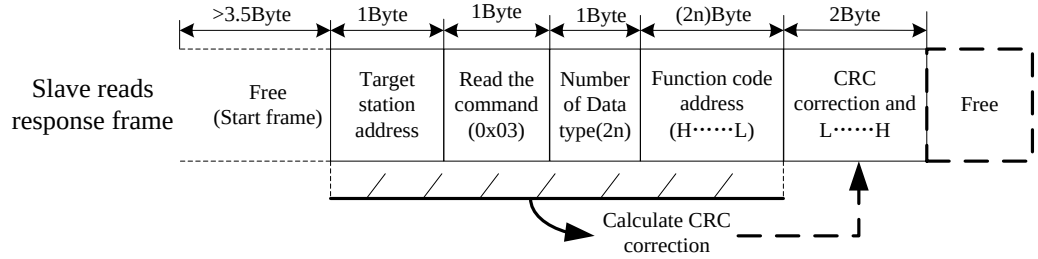
information provided by master, slave needs not feedback a response to master machine.

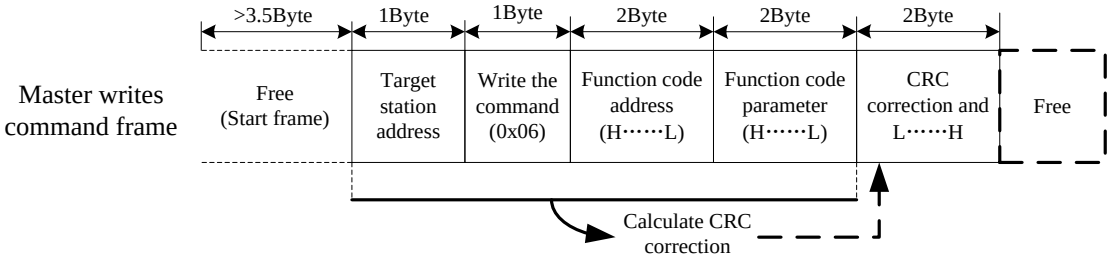
Communication data structure

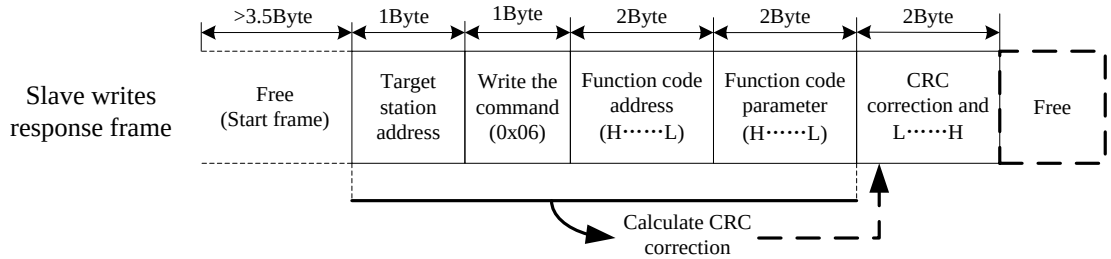
Modbus protocol communication data format of EM15 series inverter is shown as following. The inverter only support the reading and writing of Word type parameters, the corresponding reading operation command is “0x03”, the writing operation command is “0x06”. The writing and reading operation of byte or bit is not supported.



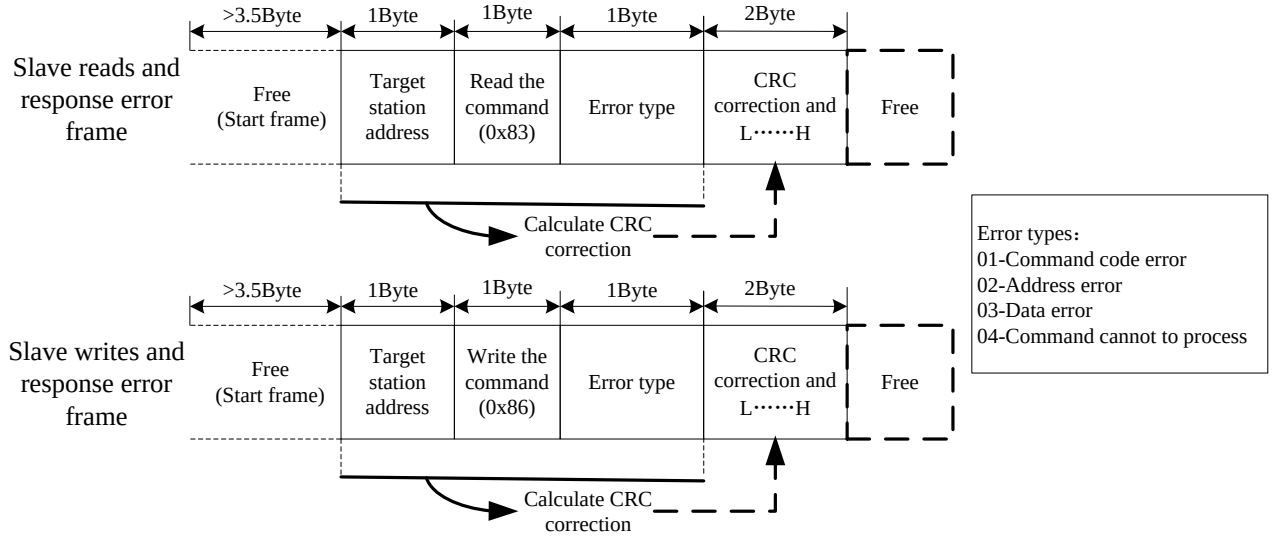
In theory, the host computer can continuously read several function codes once (that is, the maximum value of “n” is 12), but note that not to jump across the last function code in this function group to avoid the wrong reply.







If the wrong communication frame was detected by the salve or other reasons caused the failure of reading and writing, the wrong frame will be replied.



RTU frame format

Frame start (START)	More than the 3.5- character time
Slave address(ADR)	Communication address:1 to 247(0: broadcast address)
Command code(CMD)	03: Read slave parameters 06: Write slave parameters
Function code address(H)	It indicates the external parameter address of variable frequency drive in hexadecimal format; There are functional code or non-functional code (such as running state parameter/ running command parameters) type parameters, for details see the address definition. During the transmission, high bit is put in the front, and low bit is at the back.
Function code address(L)	
Number of function code(H)	It indicates the number of function code ready by the frame. If it is "1", then it indicates that it reads one function code. During the transmission, high bit is put in the front, and low bit is at the back. Only one function code can be modified at one time without the field.
Number of function code(L)	
Data(L)	It indicates the replying data or the data waiting to write-in. During the transmission, high bit is put in the front, and low bit is at the back.
Data(H)	
END	3.5- character time

CRC Checking

In RTU mode, messages include an error-checking field that is based on a CRC method. The CRC field checks the contents of the entire message. The CRC field is two bytes, containing a16-bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message. The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field.

If the two values are not equal, that means transmission is error

The CRC is started by 0xFFFF.Then a process begins of applying successive eight-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do not apply to the CRC. During generation of the CRC, each eight-bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a 1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next eight-bit byte is exclusive ORed with the register's current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value.

When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

```
unsigned int crc_chk_value(unsigned char *data_value,unsigned char length
{
    unsigned int crc_value=0xFFFF;
    int i;
    while(length--)
    {
        crc_value^=*data_value++;
        for(i=0;i<8;i++)
        {
            if(crc_value&0x0001)
            {
                crc_value=(crc_value>>1)^0xa001;
            }
            else
            {
                crc_value=crc_value>>1;
            }
        }
    }
    return(crc_value);
}
```

Definition of communication parameter address

Read and write function-code parameters (Some functional code is not changed, only for the manufacturer use.)

The group number and mark of function code is the parameter address for indicating the rules.

High level bytes: F0~FF(Group F), A0~AF(GroupA), 70-7F(Group U)

Low level bytes: 00 ~ FF

For example: F3-12, address indicates to 0xF30C.

Note: Group U: Only for reading parameter, cannot be changed parameters.

Some parameters cannot be changed during operation, some parameters regardless of what kind of state the inverter in, the parameters cannot be changed. Change the function code parameters, pay attention to the scope of the parameters, units, and relative instructions.

Function code group	Communication inquiry address	Inquiry address When Communication modifies RAM
F0~FE	0xF000~ 0xFEFF	0x0000~ 0x0EFF
A0~FC	0xA000~0xACFF	0x4000~0x4CFF
U0	0x7000~ 0x70FF	

Besides, due to EEPROM be frequently stored, it will reduce the lifetime of EEPROM. In the communication mode, and some function codes don't have to be stored as long as change the RAM value.

Stop/start parameter

Parameter address	Parameter description	Parameter address	Parameter description
1000H	Communication set value(-10000 ~ 10000)(Decimal)	1010H	PID setting
1001H	Running frequency	1011H	PID feedback
1002H	DC Bus voltage	1012H	PLC process
1003H	Output voltage	1013H	Pulse input frequency, unit: 0.01KHz
1004H	Output current	1014H	Feedback speed, unit:0.1Hz
1005H	Output power	1015H	Remaining running time

1006H	Output torque	1016H	Voltage before AI1correction
1007H	Running speed	1017H	Voltage before AI2correction
1008H	DI input terminal	1018H	Voltage before AI3correction
1009H	DO output terminal	1019H	Linear speed
100AH	AI1 voltage	101AH	Present power-on time
100BH	AI2 voltage	101BH	Present running time
100CH	AI3 voltage	101CH	Pulse input frequency, unit:1Hz
100DH	Counting value input	101DH	Communication setting value
100EH	Length value input	101EH	Actual feedback speed
100FH	Load speed	101FH	Main frequency X display
		1020H	Auxiliary frequency Y display

Note: Communication setting value is the percentage of relative value, 10000 corresponds to 100%, -10000 correspond to -100.00%.

Control command input variable frequency drive: (write in only)

Command word address	Command function
2000H	0001: Forward running
	0002: Reverse running
	0003: Forward jog
	0004: Reverse jog
	0005: Free stop
	0006:Decelarating stop
	0007: Fault reset

Read inverter status: (read only)

Command word address	Command function
3000H	0001: Forward running
	0002: Reverse running
	0003: Stop

Parameter locking password collation: (If the feedback is the 8888H, it indicates the password collation passed)

Password address	Contents of input password
1F00H	*****

Digital output terminal control: (write in only)

Address Of locking password command	Contents of locking password command
2001H	BIT0: DO1 output control BIT1: DO2 output control BIT2: Relay 1 output control BIT3: Relay 2 output control BIT4: FMR output control BIT5: VDO1 BIT6: VDO2 BIT7: VDO3 BIT8: VDO4 BIT9: VDO5

Analog output AO1 control: (write in only)

Command word address	Command function
2002H	0~7FFF indicates 0%~100%

Analog output AO2 control: (write in only)

Command word address	Command function
2003H	0~7FFF indicates 0%~100%

Pulse output control: (write in only)

Command word address	Command function
2004H	0~7FFF indicates 0%~100%

Inverter fault description:

Inverter fault description	Inverter fault information	
8000H	0000: No fault 0001: Reserved 0002: acceleration over current 0003: deceleration over current 0004: Constant speed over current 0005: acceleration over voltage 0006: deceleration over voltage 0007:Constant speed over voltage 0008: Buffer resistor fault 0009: less voltage fault 000A:variable frequency drive overload 000B: Motor overload 000C: Input phase failure 000D: Output phase failure 000E: IGBT overheat 000F: External equipment fault 0010: Communication fault 0011: Contactor fault 0012: Current detection fault 0013: Motor auto-tuning fault 0014: Encoder/PG fault	0015: EEPROM read-write in fault 0016: variable frequency drive hardware fault 0017: Short circuit to ground fault 0018: Reversed 0019: Reversed 001A: Accumulative running time reached 001B: User-defined fault 1 001C: User-defined fault 2 001D: Accumulative power-on time reached 001E: Off load 001F: PID lost during running 0028: fast current limit fault 0029: Motor switchover fault during running 002A: Too large speed deviation 002B: Motor over-speed 002D: Motor overheat 005A: Encode lines setting fault 005B: Not connect to the encoder 005C: Initial location fault 005E: Speed feedback fault

Group Fd Communication parameters

Code	Parameter Name	Setting Range		Default
Fd-00	Baud ratio setting	Unit's digit: Modbus baud ratio.		5
		0: 300 BPS	5: 9600 BPS	
		1: 600 BPS	6: 19200 BPS	
		2: 1200 BPS	7: 38400 BPS	
		3: 2400 BPS	8: 57600 BPS	
		4: 4800 BPS	9: 115200 BPS	

This parameter is used to set the data transfer rate from host computer and the variable frequency drive. Please note that baud ratio of the host computer and the inverter should be consistent. Otherwise, the communication is impossible. The higher the baud ratio is, the faster the communication is.

Code	Parameter Name	Setting Range	Default
Fd-01	Modbus Data format	0: No check, data format <8,N,2> 1: Even parity check, data format<8,E,1>	0

Code	Parameter Name	Setting Range	Default
		2: Odd Parity check, data format<8,O,1> 3: No check, data format <8,N,1>	

The host computer and variable frequency drive setup data format must be consistent, otherwise, communication is impossible.

Code	Parameter Name	Setting Range	Default
Fd-02	Broadcast address	0~247 (0: Broadcast address)	1

When the local address is set to 0, that is, broadcast address, it can realize the broadcast function of host computer.

Code	Parameter Name	Setting Range	Default
Fd-03	Modbus response time	0~20 ms	2 ms

Response delay time: it refers to the interval time from the inverter finishes receiving data to sending data to the host machine. If the response time is less than the system processing time, then the response delay time is based on the time delay of the system processing time. If the response delay time is more than the system processing time, after the system processes the data, it should be delayed to wait until the response delay time is reached, then sending data back to host machine.

Code	Parameter Name	Setting Range	Default
Fd-04	Communication timeout	0.0s:invalid 0.1s~60.0s	0.0s

When the function is set to 0.0s, the communication interface timeout parameter is invalid.

When the function code is set to time value, if the interval time between the communication and the next communication is beyond the communication timeout, the system will report communication failure error (Err16). At normal circumstances, it will be set as invalid. If in the continuous communication system, set this parameter, you can monitor the communication status.

Code	Parameter Name	Setting Range	Default
Fd-05	Modbus protocol data transmission format selection	Unit's digit: Modbus protocol. 0: Non-standard Modbus protocol 1: Standard Modbus protocol	1

Fd-05=1: Select standard Modbus protocol.

Fd-05=0: When reading the command, the slave machine return is one byte more than the standard Modbus protocol's, for details, refer to communication data structure of this protocol.

Code	Parameter Name	Setting Range	Default
Fd-06	Communication reading current resolution	0: 0.01A 1: 0.1A	0

It is used to confirm the unit of current value when the communication reads the output current.