士林電機
Shihlin Electric

Shihlin inverter built-in PLC Instruction Manual

V1.00.3

CONTENT

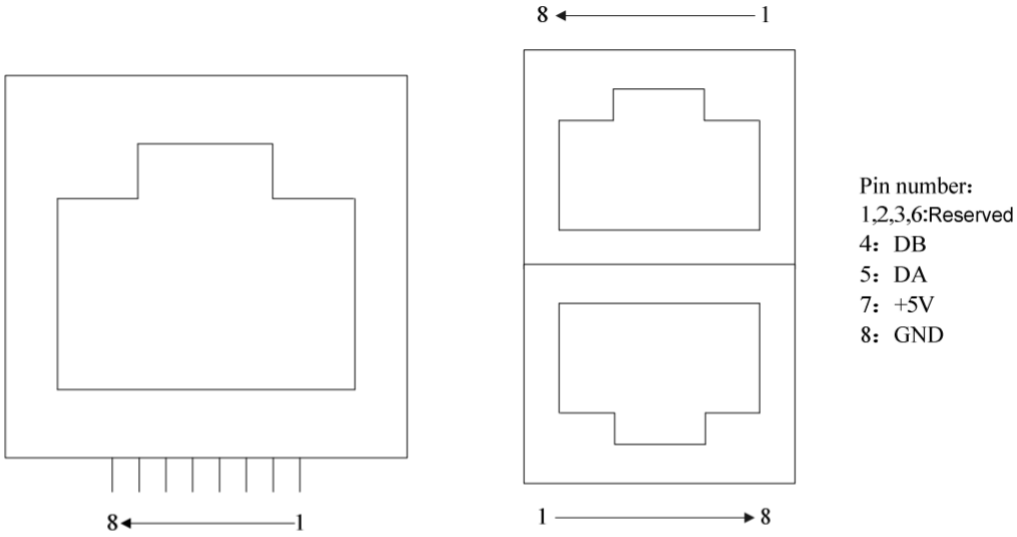
1. PLC Function Application

1.1 PLC Introduction

- The PLC function built-in in SA3/SE3/SF3 series provides a simple programmable controller, It uses the Ladder diagram editing tools SL - Ladder Developer, with 21 basic instructions and 12 application instructions.

1.2 Precautions of using the PLC function

- When downloading PLC programs, please keep the communication frame format consistent with SL-Ladder Developer and the inverter
- The inverters with PLC provide two communication ports to download the PLC program. The two communication ports have different channels but the same functions. Both support RS485 communication. Definition of communication port pins: 1, 2, 3, 6 reserved, 4: DB, 5: DA, 7: +5V, 8: GND.



PU PORT COM1 PORT

- When downloading the PLC program, make sure that the built-in PLC is in the STOP state. Otherwise, the program will fail to download.
- The input and output terminals used in the PLC program are all occupied by the PLC after the PLC function is selected (that is, P.780 is not 0).
- The operation commands from other sources are invalid when the PLC controls the inverter operation.
- Other target frequency sources become invalid when the target frequency is given by the PLC.
- Other target linear speed sources are invalid when the target linear speed is given by the PLC.
- Other feedback linear speed sources are invalid when the feedback linear speed is given by the PLC.
- Other tension sources are invalid when the tension is given by the PLC.
- Other torque sources are invalid when the torque is given by the PLC.

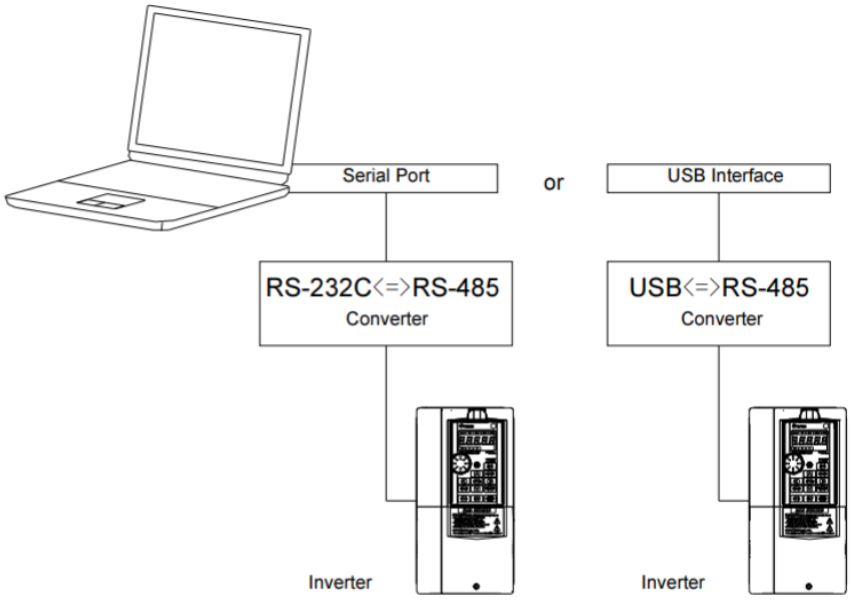
1.3 System Configuration

1.3.1 Editing Tools SL-Ladder Developer

SL-Ladder Developer is a special editing software for PLC installed on Windows XP/win7/win8/win10 system. It supports programming in two languages, ladder diagram and instruction list.

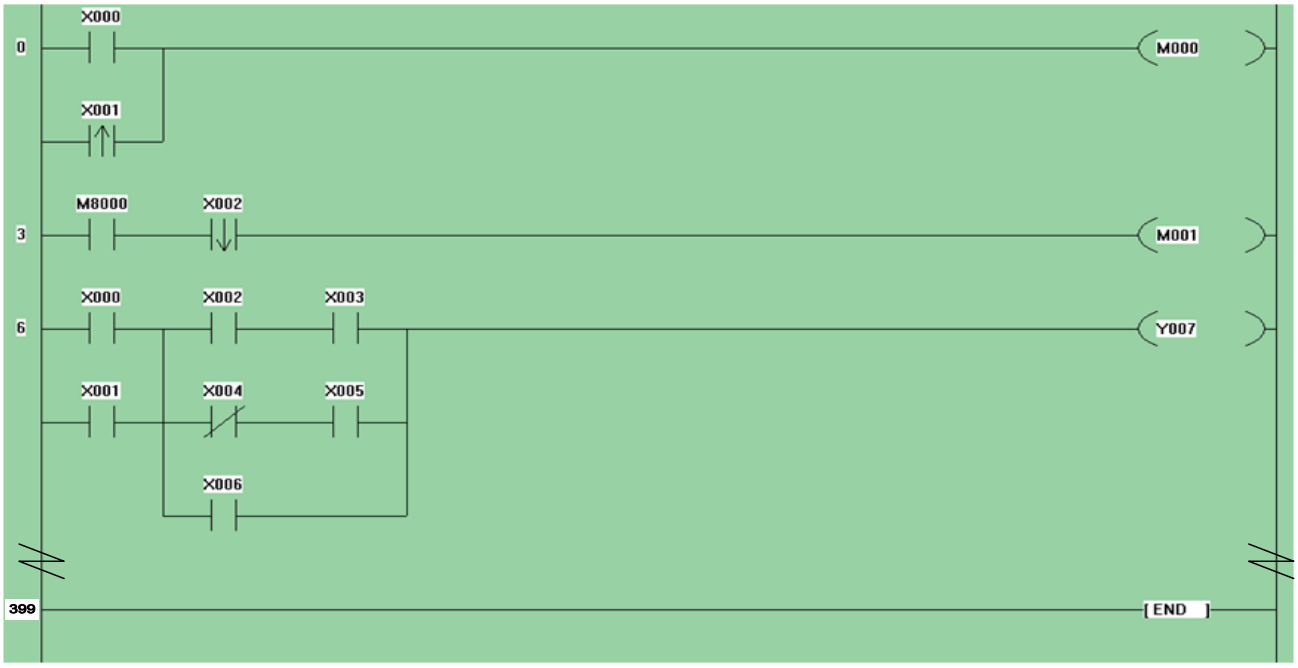
1.3.2 Connect with computer configuration

Please connect the inverter to the computer through 485 communication.

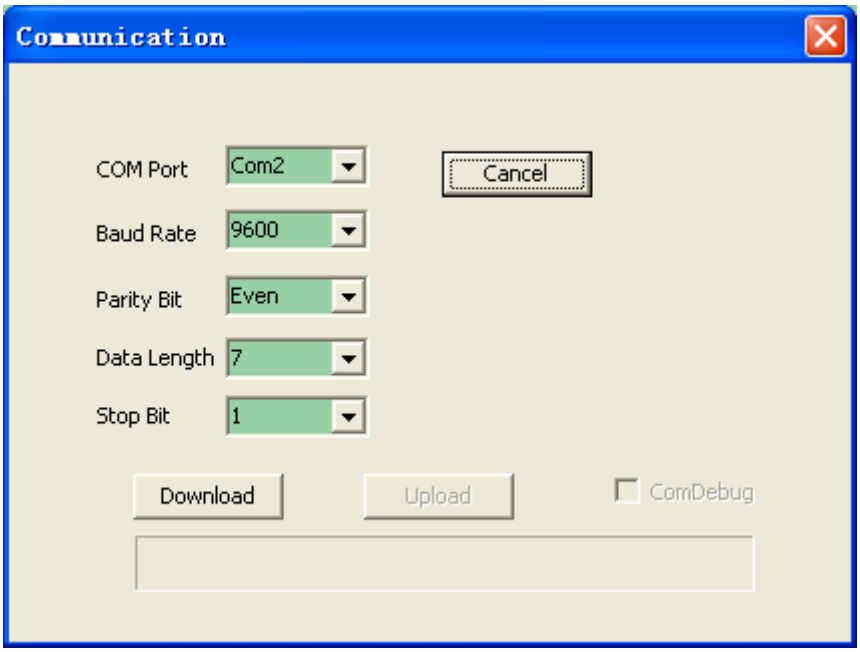


1.3.3 Program download

- Use "SL-Ladder Developer" software to write PLC programs.

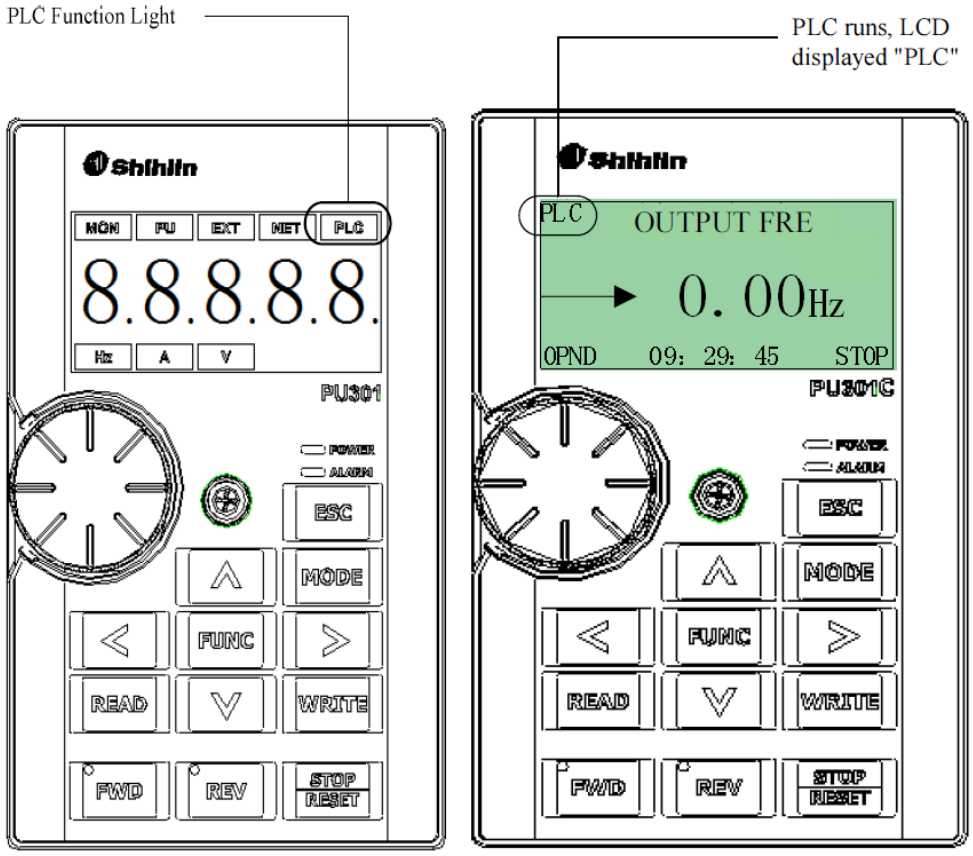


- After the hardware connection is completed, the inverter is powered on and the parameters are modified (refer to 1.4.1 for related parameters) to set the communication format and communication protocol when downloading the program. After the parameter setting is completed, the inverter needs to be powered off and on to make the setting effective.
- After writing the PLC program, press the F4 key to complete the compilation of the PLC program. Select "Online->Transfer Setup" in the pop-up dialog box, set the communication format of the upper computer, the same as the setting of the inverter. Click "Download" again to download the PLC program to the inverter. After the download is over, the PLC program in the inverter has been updated, and the original PLC program has been cleared.



1.3.4 Keypad description

- When the PLC program is running, the keypad will have the following display.



- PLC status

Display		PLC state
PU301(LED)	PU301C(LCD)	
ON	Show “PLC”	PLC runs
OFF	OFF	PLC stop

1.4 Related Parameter Description

1.4.1 Parameter Description

Number	Name	Setting Range	Content
P.32	Serial communication Baud rate for COM1	0~5（Note 1）	1:9600bps 2:19200bps
P.812	Serial communication Baud rate for PU		
P.33	Communication protocol selection for COM1	0~2	0: Modbus Protocol 1: Shihlin Protocol 2: PLC P.810 07-25 Communication Protocol
P.810	Communication protocol selection for PU		
P.36	COM1 station	0~254	Built-in PLC supports MODBUS protocol station number 1~254
P.811	PU station		
P.48	COM1 data length	0,1	0: 8bit 1: 7 bit
P.813	PU data length		
P.49	COM1 stop bit length	0,1	0: 1bit 1: 2bit
P.814	PU stop bit length		
P.50	COM1 Parity check	0~2	0: No parity check 1: Odd 2: Even
P.815	PU Parity check		
P.154	COM1 Modbus format	0~5	0:1、7、N、2 (Modbus, ASCII) 1:1、7、E、1 (Modbus, ASCII) 2:1、7、O、1 (Modbus, ASCII) 3:1、8、N、2 (Modbus, RTU) 4:1、8、E、1 (Modbus, RTU) 5:1、8、O、1 (Modbus, RTU)
P.817	PU Modbus format		
P.780	PLC action	0~2	0: PLC function is invalid 1: The PLC function is valid, and the PLC RUN signal comes from the external terminal input signal or P.781. 2: The PLC function is valid, and the PLC RUN signal comes from the external terminal input signal.
P.781	Control PLC RUN/STOP	0,1	0: No effect 1: If 10-55(P.780) = 1, PLC will run.
P.782	Erase PLC program	0,1	0: invalid 1: Erase the PLC program, the parameter value is 0 after the erase is successful.
P.783	PLC component monitoring selection	0~326	0: Invalid monitoring 1~326: Corresponding to different types of component monitoring.
P.784	PLC component monitoring value	Read only	The parameter value is the state of the component

1.4.2 Communication configuration for Program downloads

P.33 is set to 2 to select the communication protocol as PLC protocol. P.32 sets the baud rate to 9600bps or 19200bps. Other communication parameters are shared with Shihlin protocol. The default communication format of SL-Ladder Developer is 1,7,E,1. When downloading the PLC program, make sure that the communication format of the inverter is the same as that of the SL-Ladder Developer.

Note: 1. SL-Ladder Developer only supports 9600bps and 19200bps.

1.4.3 PLC execution method

- The effective RUN signal of the built-in PLC is related to the setting of P.780. When P.780 is set to 1, the effective RUN signal comes from the input signal of the external terminal set to PLC_ON_STOP function or P.781 is 1. The effective RUN signal when the value of P.780 is 2 only comes from the external terminal input signal set to PLC_ON_STOP function. Select one of the external input terminals of the main body and the input terminals of the external expansion board EB308R or EB362R and set its corresponding function to PLC_ON_STOP, that is, the corresponding parameter setting value is 60 to control the PLC RUN signal.

PLC State：10-55（P.780） = 1

P.781	External PLC on/off signal	PLC state
0	0	STOP
1	0	RUN
0	1	RUN
1	1	RUN

PLC running status when P.780 = 2

External PLC on/off signal	PLC state
0	STOP
1	RUN

- All external digital output or input terminals used by the PLC program can only be used by the PLC when the PLC is valid, that is, when P.780 is 1 or 2. If X0 and Y0 are used in the PLC program, they will act according to the PLC program command, and the settings of P.80 and P.40 are invalid.

  Note: 1. When using the PLC function, make sure that the terminal set as the PLC RUN/STOP switch is not used by the PLC program. Otherwise, this terminal loses the ability to control PLC RUN.

  2. When the PLC program gives a run command or target frequency, other sources of run command and target frequency are invalid.

1.4.4 Clear PLC internal storage

- Erase PLC program

  When the value of P.782 is written as 1, the inverter will clear the PLC program. After the clear is successful, the value of P.782 will be restored to 0, and the value of P.782 will not be restored to 0 if the clearing fails. The clearing procedure must be in the STOP state of the PLC, otherwise the clearing will fail.

- Erase power off keep part of the memory

  When the special M relay M8032 is ON, the storage content of the latched area is cleared.

1.4.5 PLC component monitoring

P.783 selects the type of monitoring element, P.784 is the status of the current monitoring element.

P.783	P.784	P.783	P.784
1	X0~X17(Name is octal)	20	T0~T7 (Bit)
2	X20~X25(Name is octal)	21	C0~C7 (Bit)
3	Y0~Y17(Name is octal)	22	M8000~M8015
4	Y20~Y23(Name is octal)	23	M8016~M8031
5	M0~M15	24	M8032~M8047
6	M16~M31	25	M8048~M8063
7	M32~M47	26	M8064~M8079
8	M48~M63	27~52	reserved
9	M64~M79	53~60	T0~T7 value (word)
10	M80~M95	61~68	reserved
11	M96~M111	69~76	C0~C7 value
12	M112~M127	77~84	reserved
13	M128~M143	85~92	T0~T7 value (word)
14	M144~M159	93~100	reserved
15	M160~M175	101~108	C0~C7 value (word)
16	M176~M191	109~116	reserved
17	M192~M207	117~164	D0~D47
18	M208~M223	165~326	D8000~D8161
19	M224~M239		

For example, when P.783 = 5, P.784 = 4241, converted to binary is 0001000010010001, 16-bit bit from low to high corresponds to the state of M0~M15, 1 is ON, 0 is OFF. Therefore, it can be seen that M0, M4, M7, and M12 are in the ON state, and the others are in the OFF state.

1.5. PLC configuration

1.5.1 SA3 PLC specifications

Item		SA3 PLC function specifications
Control method		Repeated operation
I/O control mode		Refresh input and output
Programming language		Relay symbolic language (ladder) Function block
No. of instructions	Basic instructions	21
	Application instructions	12
Processing speed	Basic instructions	Several us
	Application instructions	Dozens us
Program capacity		400 (0 to 399 steps)
Number of analog I/O points		3 input points built-in (Terminals 2, 3 and 4) 2 output points (AM1 and AM2)
High-speed pulse input function		HDI High-speed input count
I/O configuration	Input（X）	22 points（X0~X25，octal）
	Output（Y）	20 points（Y0~Y23，octal）
Auxiliary relay M(coil)	General	160 points M0~M159
	Power off keep	80 points M160~M239
	Special	80 points M8000~M8079
Timer（T）	100ms	8 points，T0~T7, range：0~6553.5s
Counter（C）	Up-counter	8 points，C0~C7, range：0~65535
Data register（D）	General	32 points，D0~D31
	Power off keep	16 points，D32~D47
	Parameter	1300 points，D1000~D2299
	Special	162 points，D8000~D8161
Constant（K）		0~65535

1.5.2 SE3 PLC specifications

Item		SE3 PLC function specifications
Control method		Repeated operation
I/O control mode		Refresh input and output
Programming language		Relay symbolic language (ladder) Function block
No. of instructions	Basic instructions	21
	Application instructions	12
Processing speed	Basic instructions	Several us
	Application instructions	Dozens us
Program capacity		400 (0 to 399 steps)
Number of analog I/O points		2 input points built-in (Terminals 2 and 4) 1 output points (AM)
High-speed pulse input function		HDI High-speed input count
I/O configuration	Input (X)	12 points (X0~X5,X12~X17, octal)
	Output (Y)	10 points (Y0,Y2,Y4~Y13, octal)
Auxiliary relay M(coil)	General	160 points M0~M159
	Power off keep	80 points M160~M239
	Special	80 points M8000~M8079
Timer (T)	100ms	8 points T0~T7, range：0~6553.5s
Counter (C)	Up-counter	8 points C0~C7，range：0~65535
Data register (D)	General	32 points D0~D31
	Power off keep	16 points D32~D47
	Parameter	1300 points D1000~D2299
	Special	162 points D8000~D8161
Constant (K)		0~65535

1.5.3 SF3 PLC specifications

Item		SF3 PLC function specifications
Control method		Repeated operation
I/O control mode		Refresh input and output
Programming language		Relay symbolic language (ladder) Function block
No. of instructions	Basic instructions	21
	Application instructions	12
Processing speed	Basic instructions	Several us
	Application instructions	Dozens us
Program capacity		400 (0 to 399 steps)
Number of analog I/O points		3 input points built-in (Terminals 2, 3 and 4) 2 output points (AM1 and AM2)
High-speed pulse input function		HDI High-speed input count
I/O configuration	Input (X)	16 points (X0~X17，octal)
	Output (Y)	12 points (Y0~Y13，octal)
Auxiliary relay M(coil)	General	160 points，M0~M159
	Power off keep	80 points，M160~M239
	Special	80 points，M8000~M8079
Timer (T)	100ms	8 points，T0~T7, range：0~6553.5s
Counter (C)	Up-counter	8 points，C0~C7，range：0~65535
Data register (D)	General	32 points，D0~D31
	Power off keep	16 points，D32~D47
	Parameter	1300 points，D1000~D2299
	Special	162 points，D8000~D8161
Constant (K)		0~65535

1.5.4 I/O device corresponding description

- Input (X), output (Y)

  The input terminal is the port through which the PLC receives external switch signals. There are countless normally open and normally closed contacts that can be used indefinitely, but the input terminal cannot be driven by a program. The address number is coded in octal.

  The output terminal is the port through which the PLC sends signals to the outside. It also has countless normally open and normally closed contacts, which can be used for unlimited times. The address number is coded in octal.

  - SA3 Built-in PLC terminal

    - Input terminal

X number	SA3 terminal	EB362R on SLOT3	EB362R on SLOT2
X0	M0		
X1	M1		
X2	M2		
X3	STF		
X4	STR		
X5	RES		
X6	M3		
X7	M4		
X10	M5		
X11	HDI		
X12		M10	
X13		M11	
X14		M12	
X15		M13	
X16		M14	
X17		M15	
X20			M10
X21			M11
X22			M12
X23			M13
X24			M14
X25			M15

Note: When the HDI terminal is used as an embedded PLC input terminal, the value of P.550 cannot be 41, 54, 57, otherwise the HDI will be abnormal when used as an input terminal.

- Output terminal

Y number	SA3 terminal	EB308R on SLOT3	EB308R on SLOT2	EB362R on SLOT3	EB362R on SLOT2
Y0	SO1-SE				
Y1	SO2-SE				
Y2	A1B1C1				
Y3	A2B2C2				
Y4		ABC10		ABC10	
Y5		ABC11		ABC11	
Y6		ABC12			
Y7		ABC13			
Y10		ABC14			
Y11		ABC15			
Y12		ABC16			
Y13		ABC17			
Y14			ABC10		ABC10
Y15			ABC11		ABC11
Y16			ABC12		
Y17			ABC13		
Y20			ABC14		
Y21			ABC15		
Y22			ABC16		
Y23			ABC17		

◆ SE3 Built-in PLC terminal

- Input terminal

X number	SE3 terminal	EB362R terminal
X0	M0	
X1	M1	
X2	M2	
X3	STF	
X4	STR	
X5	RES	
X12		M10
X13		M11
X14		M12
X15		M13
X16		M14
X17		M15

Note: When the M2 terminal is used as an embedded PLC input terminal, the value of P.82 cannot be 41,54,57, otherwise it will be abnormal if M2 is used as an input terminal.

- Output terminal：

Y number	SE3 terminal	EB308R terminal	EB362R terminal
Y0	SO-SE		
Y2	A1B1C1		
Y4		ABC10	ABC10
Y5		ABC11	ABC11
Y6		ABC12	
Y7		ABC13	
Y10		ABC14	
Y11		ABC15	
Y12		ABC16	
Y13		ABC17	

◆ SF3 Built-in PLC terminal：

- Input terminal

X number	SF3 terminal	EB362R terminal
X0	M0	
X1	M1	
X2	M2	
X3	STF	
X4	STR	
X5	RES	
X6	M3	
X7	M4	
X10	M5	
X11	HDI	
X12		M10
X13		M11
X14		M12
X15		M13
X16		M14
X17		M15

Note: When HDI terminal is used as input terminal, the value of P.550 cannot be 41,54,57, otherwise HDI will be abnormal when used as input terminal.

- Output terminal：

Y number	SF3 terminal	EB308R terminal	EB362R terminal
Y0	SO1-SE		
Y1	SO2-SE		
Y2	A1B1C1		
Y3	A2B2C2		
Y4		ABC10	ABC10
Y5		ABC11	ABC11
Y6		ABC12	
Y7		ABC13	
Y10		ABC14	
Y11		ABC15	
Y12		ABC16	
Y13		ABC17	

1.5.5 Device function specification

- Auxiliary relay (M)

There are many auxiliary relays in PLC, they can be divided into general, power off keep and special three categories, the address code of auxiliary relay is according to decimal code. Specific configurations are as follows:

General	160 points，M0~M159
Power off keep	80 points，M160~M239
Special	80 points，M8000~M8079

- General auxiliary relay

The general-purpose auxiliary relay is similar to the intermediate relay in the electrical control circuit, and can be used as an intermediate state storage and signal conversion. The auxiliary relay can only be driven by the contacts of various soft devices in the PLC. The auxiliary relay has countless normally open and normally closed contacts that can be used indefinitely, but it cannot directly drive an external load.

- Power off keep auxiliary relay

In the PLC running state, the power off keep auxiliary relay will save the state before the inverter is completely powered off. When the inverter is powered again, the power off keep auxiliary relay will continue to be used in the state before the power failure.

- Special auxiliary relay

Special auxiliary relays are auxiliary relays with a certain function. Do not use undefined special auxiliary relays. For detailed description, see 1.5.4.

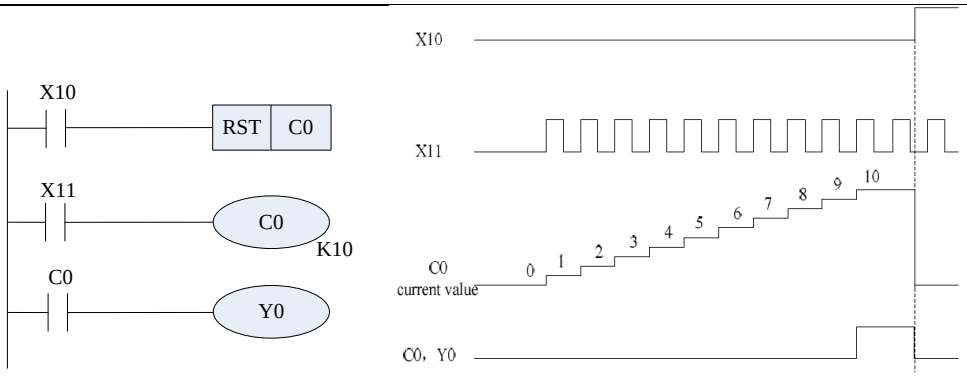
- Timer T

The timer is equivalent to the time relay in the electrical control circuit and can be used for delay control in the program. The address number is a decimal code. The built-in PLC function has only one type of timer, the timing mode is upward timing, which is accumulated once in 100ms, and the range is 0~6553.5s. There are eight points, namely T0~T7, and their address numbers are decimal coded.

In addition to its own numbered memory, the timer also occupies a set value register and a current value register. The current set value register stores the timing set value set by the program. The current value of the current register records the timing. These registers are all hexadecimal memory. The actual timing time is the set value * time unit. When the current register count value is equal to the set value in the set value register, the timer output contact will act. The timer can use a decimal constant (K) as the set value, or it can be set indirectly using the data register (D).

- Counter C

The counter is used for counting control in the program. The built-in PLC counter has only one type of 16-bit up counter, ranging from 0 to 65535. Eight points are C0~C7. 16-bit means that its set value register and current value register are binary 16-bit registers, and its set value is in the range of 0~65535.



As shown in the figure above, the current value of C0 will increase by 1 once X11 ON->OFF. When the count value reaches K10, the C0 contact will act and Y0 will be output. After X1 triggers C0 again, it will not accumulate and stay at K10. When the power supply is normal, the current value register of the counter has a memory function, so the RST reset instruction must be used to reset the current value register before the counter restarts counting.

- Data register

Data register is divided into general data register and special data register.

- General data register

Once data is written in the general purpose data register, it will not change as long as no other data is written. The data will be cleared when PLC operation is OFF or power failure. The data register used for power failure retention can retain its data when the PLC is OFF or power failure.

- Special data register

The special purpose data register refers to the data register whose purpose has been defined. For the definition of special data registers of the built-in PLC, see 1.5.5.

1.5.6 Special M relay function description

Special auxiliary relays are auxiliary relays with a certain meaning. Do not use undefined special auxiliary relays. The specific contents are as follows:

Number	Name	Description	R/W
M8000	RUN monitoring	This contact is On when running	R
M8001	RUN monitoring	This contact is Off when running	R
M8002	Initial pulse	Normal open contact (Pulse width=scan period.)	R
M8003	Initial pulse	Normal closed contact (Pulse width=scan period.)	R
M8011	10ms time pulse	5ms on/5ms off	R
M8012	100ms time pulse	50ms on/50ms off	R
M8013	1s time pulse	0.5s on/0.5s off	R
M8014	1min time pulse	30s on/30s off	R
M8020	Zero	1: The result of addition and subtraction is 0 (Clearing method: (1) The next addition and subtraction result is not zero. (2) Clear through PLC program or communication)	R/W
M8023	Zero divisor	1: The divisor is 0 (Clear method: PLC program or communication)	R/W
M8030	Save the parameter value to memory area selection	0: Save 1: Don't save	R/W
M8032	Clear power off keep data	Clear all data in power off keep memory	R/W
M8034	Inhibit all output	Inhibit all PLC output terminals (Y) output	R/W
M8035	End of special operation	0: Allow special operation or in progress 1: End (Note 1)	R/W
M8036	Mode setting enable	0: Modification of the inverter mode is not allowed 1: Allow to modify the inverter mode (it will be automatically cleared after modifying the mode once)	R/W
M8038	Failed to restore factory value	1: Failed to restore factory settings (Clearing method: (1) The next time the factory value is restored successfully. (2) Clear through PLC program or communication)	R/W
M8041	State Control (STF)	PLC controls the inverter to run forward	R/W
M8042	State Control (STR)	PLC controls the inverter to run reverse	R/W
M8043	State Control (RL)	Set the target frequency as multi-speed low speed.	R/W
M8044	State Control (RM)	Set the target frequency as multi-speed medium speed.	R/W
M8045	State Control (RH)	Set the target frequency as multi-speed high speed.	R/W
M8046	State Control (RT)	Enable the second function of the inverter	R/W
M8047	State Control (MRS)	Control the inverter to stop output immediately.	R/W
M8048	Character control starts	After being set, the status control of the inverter is controlled by D8040.	R/W
M8049	Analog output starts	After being set, the two analog outputs can be output. (Note 3)	R/W
M8058	Analog input start	After being set, it starts to monitor the analog input.	R/W
M8050	Status monitoring (RUN)	Inverter running status	
M8051	Status Monitoring (STF)	Inverter runs forward	
M8052	Status Monitoring (STR)	Inverter runs reverse	
M8053	Status Monitoring (SU)	Output frequency reached	
M8054	Status Monitoring (OL)	Overload	
M8055	Status Monitoring (END)	Parameter restoration to factory value completed	
M8056	Status Monitoring (FU)	Output frequency detection	

M8057	Status Monitoring (ALARM)	Alarm occurred	
M8059	Custom status output	Monitor the output selected by D8059.	
M8060	High-speed input count start	After setting, start high-speed input pulse counting.	R/W
M8061	High-speed input count value clear	After setting, the high-speed input count value is reset to zero.	R/W
M8065	Overvoltage	0: Inverter PN is not over-voltage 1: Inverter PN is over-voltage	R
M8066	low voltage	0: Inverter PN is not under low voltage 1: Inverter PN low voltage	R
M8067	PLC operation monitoring	0: PLC is not running 1: PLC is in RUN state	R
M8068	Inverter is about to reset	0: The inverter will not be reset 1: The inverter will reset (Note 2)	R
M8069	Inverter Tuning status monitoring	0: The inverter is not in Tuning state 1: The inverter is in Tuning state	R
M8070	Power-off sign	0: Not sure 1: The inverter is in a power-off state	R

Note: 1. Special operations can be performed only when M8035 is 0. The special operation refers to the operation of D8153. M8035 can be cleared through communication, PLC program and PLC STOP.

2. When M8068 is 1, it means the inverter is about to be reset. At this time, the customer can make preparations for the inverter reset in advance.

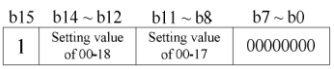
3. When M8049 is OFF, D8059 and the existing record data of D8060 will not be cleared.

1.5.7 Special D registers function description

The special purpose data register refers to the data register whose purpose has been defined. The special data registers of the built-in PLC are defined as follows:

number	Name	Note	R/W
D8001	PLC signal and system version information	Read PLC version	R
D8002	Memory capacity	Obtain PLC program capacity information	R
D8010	Current value of time when scanning	In units of 0.1ms	R
D8011	Minimum time when scanning	In units of 0.1ms	R
D8012	Maximum time during scanning	In units of 0.1ms	R
D8013	Monitor if the external input terminal is used by the PLC program X0~X7, X10~X17	Monitor the external terminals used by the PLC. (The external terminals used by the PLC can no longer be used for other purposes). The read data bits, from the highest bit to the lowest bit (high left and low right) correspond to the soft device number from large to small.	R
D8014	Monitor if the external input terminal is used by the PLC program X20~X25		R
D8015	Monitor if the external input terminal is used by the PLC program Y0~Y7，Y10~Y17		R
D8016	Monitor if the external input terminal is used by the PLC program Y20~Y23		R
D8021	Current program capacity	The number of steps in the current PLC program	R
D8040	Inverter control word b8~b15: reserved b7: Inverter emergency stop (MRS) b6: second function (RT) b5: High speed (RH) b4: Medium speed (RM) b3: Low speed (RL) b2: Reverse (STR) b1: Forward rotation (STF) b0: reserved	Corresponding to the word control of M8041~8047.	R/W
D8041	Target frequency setting	Set the target frequency, the minimum setting unit is 0.01Hz	R/W
D8045	AM1-5 terminal analog output (SA3, SF3)	Set the output percentage, The minimum setting unit is 0.1%, and the range is 0%~100%.	R/W
	AM-5 terminal analog output (SE3)		
D8046	AM2-5 terminal analog output (SA3, SF3)	Set the output percentage, The minimum setting unit is 0.1%, and the range is 0%~100%.	R/W
D8050	Inverter status word monitoring B15: Tuning B14: The inverter is about to reset B11~b13: Keep B10: PLC running B9: Low voltage B8: Over voltage B7: Alarm B6: Frequency detection B5: End of parameter restore to default B4: Overload B3: Frequency reached B2: Reverse B1: Forward B0: In operation		R
D8051	Output frequency monitoring	Monitor output frequency, unit 0.01Hz	R

D8052	Output current monitoring	Monitor output current, unit 0.01A	R
D8053	Output voltage monitoring	Monitor output voltage, unit 0.01V	R
D8054	Alarm record 1, 2	Surveillance alarm 1, 2	R
D8055	Alarm record 3, 4	Surveillance alarm 3, 4	R
D8056	2-5 terminal analog input	Monitor 2-5 terminal analog input, The smallest unit is 0.1%, and the range is -100%~100%.	R
D8057	4-5 terminal analog input	Monitor 4-5 terminal analog input, The smallest unit is 0.1%, and the range is 0% to 100%.	R
D8058	3-5 terminal analog input (SA3, SF3)	Monitor 3-5 terminal analog input, The smallest unit is 0.1%, and the range is 0% to 100%.	R
D8059	Monitoring status type customization	The setting is equivalent to the external output terminal function setting. Refer to P.40 for instructions.	R/W
D8060	High-speed input counter current value (lower sixteen digits)	Monitor the lower 16 bits of the current count.	R
D8061	Current value of high-speed input counter (high sixteen digits)	Monitor the high 16 bits of the current count. (Note 1)	R
D8128	Inverter mode setting	P.79 = 0 0: set to PU mode 1: Set to external mode 2: Set to JOG mode P.79 = 1 0: set to PU mode 1: invalid 2: Set to JOG mode P.79 = 3 0: P.35 = 0 is set to CU mode, P.35 = 1 is set to external mode 1: Set to external mode 2: Set to communication JOG mode The above mode can be modified only when M8036 bit is 1.	R/W
D8129	Linear speed feedback setting	Minimum unit 0.1 m/min	R/W
D8130	Linear speed target value setting	Minimum unit 0.1 m/min	R/W
D8131	Tension setting	Minimum unit 1N	R/W
D8132	Torque setting	H0000~H0FA0(0~400.0%) HF060~HFFFF (-400.0%~0) minimum unit 0.1%	R/W
D8135	2-5 terminal input monitoring	H0000~H03E8(0~10.00) HFF9C~HFFFF(-10.00~0) The smallest unit is 0.01V	R
D8136	4-5 terminal input monitoring	The smallest unit is 0.01mA/V	R
D8137	3-5 terminal input monitoring (SA3, SF3)	The smallest unit is 0.01mA/V	R
D8138	AM1-5 terminal output monitoring (SA3, SF3)	The smallest unit is 0.01mA/V	R
	AM-5 terminal output monitoring (SE3)		
D8139	AM2-5 terminal output monitoring (SA3, SF3)	The smallest unit is 0.01mA/V	R
D8140	DC bus voltage monitoring	Minimum unit 1V	R

D8141	Electronic relay heat accumulation rate monitoring	The smallest unit is 0.01%	R
D8142	Output power monitoring	The smallest unit is 0.01KW	R
D8143	Temperature rise accumulation rate monitoring	The smallest unit is 0.01%	R
D8144	NTC temperature accumulation monitoring	The smallest unit is 0.01℃	R
D8145	Motor electronic heat accumulation rate	The smallest unit is 0.01%	R
D8146	Target pressure monitoring	The smallest unit is 0.01%	R
D8147	Feedback pressure monitoring	The smallest unit is 0.01%	R
D8148	PG feedback speed	The smallest unit is 0.01Hz	R
D8149	HDI terminal input frequency (SA3, SF3) M2 terminal input frequency (SE3)	The smallest unit is 0.01kHz	R
D8151	Inverter output torque monitoring	Minimum unit 0.1%	R
D8152	Target frequency monitoring	The smallest unit is 0.01Hz	
D8153	Special operation	1: P.996 2: P.997 3: P.998 4: P.999_1 part of the parameters restored to factory values 5: P.999_2 other parameters other than user parameters restored to factory values 6: P.999_3 user parameters, other parameters restore factory value 7: Communication P.998 8: Communication P.999_1 The other parameters except communication parameters are restored to factory values 9: Communication P.999_2, except for communication parameters and user parameters, other parameters are restored to factory values 10: Communication P.999_3 Except communication parameters and user parameters, other parameters are restored to factory values (Note 4)	R/W
D8154	Inverter mode monitoring	H0000: communication mode; H0001: external mode; H0002: JOG mode; H0003: Mixed 1 mode; H0004: Mixed 2 mode; H0005: Mixed 3 mode; H0006: Mixed 4 mode; H0007: Mixed 5 mode; H0008: PU mode  ：The second mode of operation.	R
D8155	Line speed feedback monitoring	Minimum unit 0.1 m/min	R
D8156	Line speed target value monitoring	Minimum unit 0.1 m/min	R
D8157	Tension set monitoring	Minimum unit 1N	R
D8158	Torque reference monitoring	Minimum unit 0.1%	R

D1000~ D2299	Corresponding to the value of P.0~P.1299	Only P parameter can be operated. The number of D-1000 is the P parameter number. M8030 decides whether the setting of P parameter is saved after power-off. (Note 2, 3)	R/W

Note: 1. HDI terminal can only be used by PLC when M8060 and M8061 are referenced by PLC program and PLC is valid.

2. Whether the value written to the parameter through D1000~D2299 is saved after power-off depends on the value of M8030. M8030=0, save when power off, M8030=1, not save when power off. The operation on the parameter D register is equivalent to the operation on the parameter.

3. D1996~D1999 corresponding to P.996~P.999 are reserved.

4. The value read by D8153 is 0.

1.5.8 Analog output

P.54 is set to 13, the output of AM1-5 is controlled by PLC. M8049 ON AM1-5 output starts. OFF output stops.
P.64 controls the signal type (voltage or current and range) output by AM1-5, switch SW3 is set to output voltage from AM1-5, and switch SW3 is set to output current from AM1-5.
D8045 is used to set the percentage of AM1-5 output signal (the minimum unit is 0.1%, the range is 0~100%, the range corresponding to the percentage is set by P.64.)

P.64	Range	percentage	Switch SW3
0	0~10V	0~100%	Dial up
1	Reserved	----	----
2	0~20mA	0~100%	Dial down
3	4~20mA	0~100%	Dial down

P.537 is set to 13, the output of AM2-5 is controlled by PLC. M8049 ON AM2-5 output starts. OFF output stops.
P.538 controls the type of AM2-5 output signal (voltage or current and range). Switch SW4 dials AM2-5 to output voltage, switch SW4 dials AM2-5 to output current.
D8046 is used to set the percentage of AM2-5 output signal (the minimum unit is 0.1%, the range is 0~100%, the range corresponding to the percentage is set by P.538).

P.538	Range	percentage	Switch SW4
0	0~10V	0~100%	Dial up
1	Reserved	----	----
2	0~20mA	0~100%	Dial down
3	4~20mA	0~100%	Dial down

Note: 1. SA3 and SF3 have two output terminals, namely AM1-5, AM2-5, SE3 has only one analog output, that is, AM-5 usage and parameter settings are the same as AM1-5.

1.5.9 Analog input

M8058 ON analog input monitoring starts. OFF input monitoring stops.

P.73 sets the analog input range of terminals 2-5 (the minimum unit is 0.1%, the range is -100~100%, the range corresponding to the percentage is set by P.73).

P.73	Range	Percentage
0	0~5V	0~100%
1	0~10V	0~100%
2	0~-5V	0~-100%(Note)
3	0~-10V	0~-100%(Note)
4	-5~5V	-100%~100%(Note)
5	-10~10V	-100%~100%(Note)

P.531 sets the analog input signal type and monitoring range of terminals 3-5 (the minimum unit is 0.1%, the range is 0~100%, the range corresponding to the percentage is set by P.531). SW1 dials up 3-5 terminals to monitor the input voltage, SW1 dials down 3-5 terminals to monitor the input current.

P.531	Range	Percentage
0	4~20mA	0~100%
1	0~10V	0~100%
2	0~5V	0~100%

P.17 sets the analog input signal type and monitoring range of terminals 4-5 (the minimum unit is 0.1%, the range is 0~100%, the range corresponding to the percentage is set by P.17). SW2 dial up 4-5 terminals to monitor the input current, SW2 dial down 4-5 terminals to monitor the input voltage.

P.17	Range	Percentage
0	4~20mA	0~100%
1	0~10V	0~100%
2	0~5V	0~100%

Note: The percentage is negative when a negative voltage is input to the 1.2-5 terminal. But the D register is 16-bit unsigned, so when the percentage is negative, the value of D8056 is 65536-the absolute value of the negative percentage. For example, when the percentage is -100.0%, the value of D8056 is 65536 – 1000 = 64536.

2. SE3 has no 3 terminals.

1.5.10 Pulse train input function

M8060 is a start command for the built-in PLC high-speed input counting function.

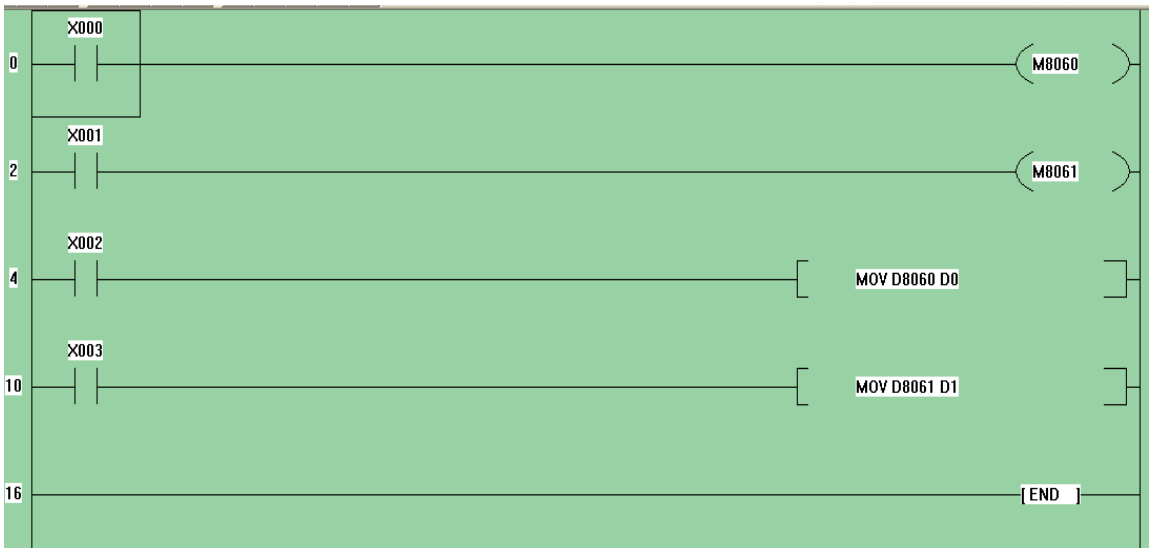
M8061 is a built-in PLC high-speed input count clear command.

D8060 is the low 16 bits of the built-in PLC high-speed input count value.

D8061 is the high 16 bits of the built-in PLC high-speed input count value.

The pulse is counted by the HDI port input of SA3 and SF3. At this time, P.550 is set to 54 or input from the M2 terminal of SE3. At this time, P.82 should be set to 54. The wiring method is the same as that in the general mode. The highest pulse frequency that can be identified by high-speed counting is 100KHZ.

As shown in the figure below, when X0 closes and M8060 is set, the high-speed input count is started. The current count value is stored in D8060 and D8061. D8060 transmits the low sixteen bits of the current count value to D0, and D8061 transmits the current high-speed count value to D1. When X1 is closed, the values in D8060 and D8061 return to zero.



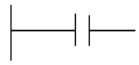
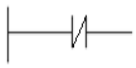
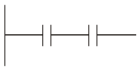
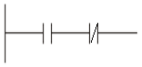
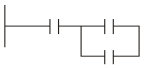
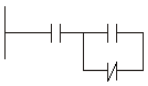
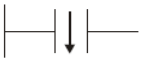
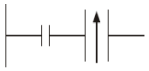
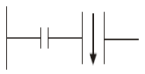
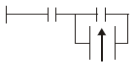
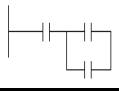
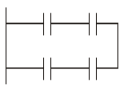
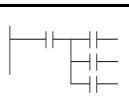
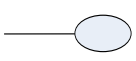
Note: When M8060 or M8061 is edited in the PLC program, the original function of HDI with P.550 set to 54 in SA3 and SF3 becomes invalid when PLC is valid, and the original function of M2 terminal with P.82 set to 54 in SE3 becomes invalid.

2. Command function description

- The built-in PLC has 21 kinds of basic instructions and 12 kinds of application instructions.

2.1 Basic instructions

- Basic instruction list

Basic instruction specification				
Ladder diagram	Command description	Command	Device used	Number range
	Normally open contact	LD	X、Y、M、T、C	X: 0~25, octal encoding Y: 0~23, octal encoding M: 0~239, M8000~M8079 T: T0~T7 C: C0~C7 K: 0~65535
	Normally closed contact	LDI	X、Y、M、T、C	
	Series normally open	AND	X、Y、M、T、C	
	Series normally closed	ANI	X、Y、M、T、C	
	Parallel normally open	OR	X、Y、M、T、C	
	Parallel normally closed	ORI	X、Y、M、T、C	
	Rising edge trigger switch	LDP	X、Y、M、T、C	
	Falling edge trigger switch	LDF	X、Y、M、T、C	
	Series rising edge trigger	ANDP	X、Y、M、T、C	
	Series falling edge trigger	ANDF	X、Y、M、T、C	
	Parallel rising edge trigger	ORP	X、Y、M、T、C	
	Trigger on rising edge in parallel	ORF	X、Y、M、T、C	
	Parallel normally open	ANB	None	
	Block parallel	ORB	None	
	Multiple output	MPS 、MRD、MPP	None	
	Coil drive output	OUT	Y、M	

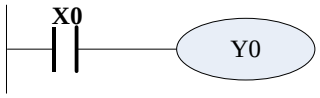
Basic instruction specification				
Ladder diagram	Command explanation	instruction	Use device	Number range
	PLC program end character	END	None	None
	Coil on hold	SET	Y、M	
	Coil on clear	RST	Y、M	

- Detailed explanation of basic instructions

Command	Function					
LD	Connect the contacts to the bus bar. It is used for the logic line starting with a normally open contact.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



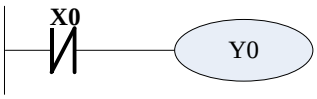
Command :

```
LD    X0
OUT   Y0
```

Command	Function					
LDI	Connect the contacts to the bus bar. It is used to start the logic line of the normally closed contact.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



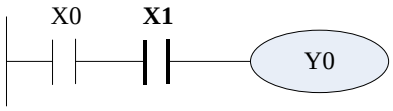
Command :

```
LDI   X0
OUT   Y0
```

Command	Function					
AND	Used for the series connection of normally open contacts. Perform an AND operation between the current state of the serial connection point and the logical result before the connection point, and store the operation result.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



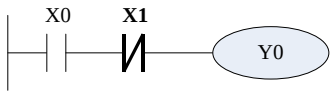
Command :

```
LD    X0
AND   X1
OUT   Y0
```

Command	Function					
ANI	Used for the series connection of normally closed contacts. Perform an AND operation between the current state of the serial connection point and the logical result before the connection point, and store the operation result.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



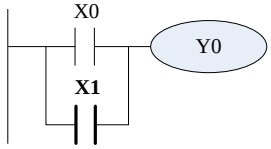
Command :

```
LD    X0
ANI   X1
OUT   Y0
```

Command	Function					
OR	Used for parallel connection of normally open contacts. Perform OR operation on the branch logic result of the parallel connection point and store the operation result.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



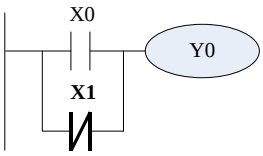
Command :

```
LD    X0
OR    X1
OUT   Y0
```

Command	Function					
ORI	Used for parallel connection of normally closed contacts. The logical result of the parallel connection point is subjected to an "or" operation, and the operation result is stored.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



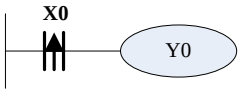
Command :

```
LD    X0
ORI   X1
OUT   Y0
```

Command	Function					
LDP	Connect the contacts to the bus bar. It is used to trigger the logic line of the start of the contact on the rising edge.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



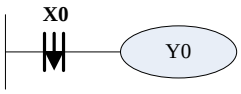
Command :

```
LDP  X0
OUT  Y0
```

Command	Function					
LDF	Connect the contacts to the bus bar. It is used to trigger the logic line at the beginning of the contact at the falling edge.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



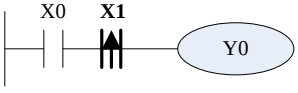
Command :

```
LDF  X0
OUT  Y0
```

Command	Function					
ANDP	Used for rising edge trigger contacts to connect in series. Perform an AND operation between the current state of the serial connection point and the logical result before the connection point, and store the operation result.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



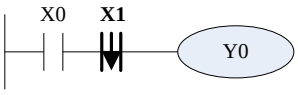
Command :

```
LD     X0
ANDP   X1
OUT    Y0
```

Command	Function					
ANDF	Used for falling edge trigger contacts to connect in series. Perform an AND operation between the current state of the serial connection point and the logical result before the connection point, and store the operation result.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



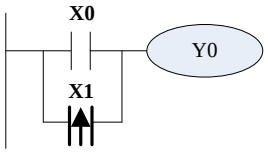
Command :

```
LD      X0
ANDF    X1
OUT     Y0
```

Command	Function					
ORP	Used for the parallel connection of the rising edge trigger contacts. The logical result of the parallel connection point is subjected to an "or" operation, and the operation result is stored.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



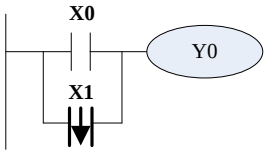
Command :

```
LD      X0
ORP     X1
OUT     Y0
```

Command	Function					
ORF	Used for the parallel connection of falling edge trigger contacts. The logical result of the parallel connection point is subjected to an "or" operation, and the operation result is stored.					
Operand	X	Y	M	T	C	D
	OK	OK	OK	OK	OK	NO

Example:

Ladder :



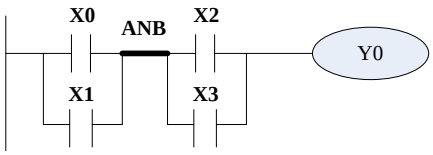
Command :

```
LD      X0
ORP     X1
OUT     Y0
```

Command	Function
ANB	This instruction has no operands. During calculation, the calculation result before the contact and the current parallel circuit result are "ANDed".
Operand	None

Example:

Ladder :



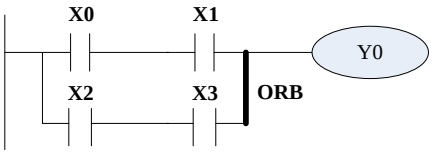
Command :

```
LD   X0
OR   X1
LD   X2
OR   X3
ANB
OUT  Y0
```

Command	Function
ORB	This instruction has no operands. During operation, the result of the previous operation and the result of the current series are ORed.
Operand	None

Example:

Ladder :



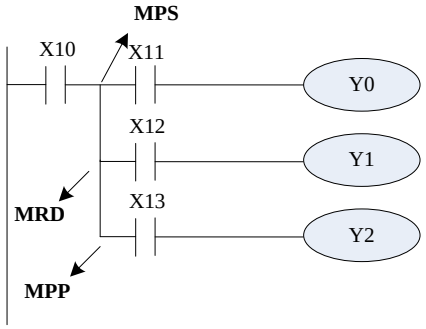
Command :

```
LD   X0
AND  X1
LD   X2
AND  X3
ORB
OUT  Y0
```

Command	Function
MPS	Put the connection point data into the stack, and use the MPS instruction once to send the current intermediate result into the first layer of the stack. Move the data that originally existed in the first layer down one layer.
MRD	Read the top data of the stack. The MPR instruction reads the latest data of the stack memory, and the data of other layers remains unchanged.
MPP	Fetch the topmost data of the stack memory. The uppermost layer data using the MPP stack memory is read out, and other data are sequentially moved to the upper layer.
Operand	None

Example:

Ladder :



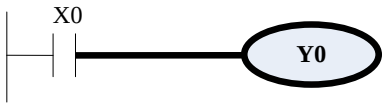
Command :

```
LD    X10
MPS
AND   X11
OUT   Y0
MRD
AND   X12
OUT   Y1
MPP
AND   X13
OUT   Y2
```

Command	Function					
OUT	Output instruction, used to output the logic result to the designated relay coil.					
Operand	X	Y	M	T	C	D
	NO	OK	OK	OK	OK	NO

Example:

Ladder :



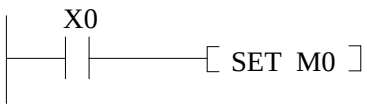
Command :

```
LD    X0
OUT   Y0
```

Command	Function					
SET	Set the instruction to keep the coil (set to 1).					
Operand	X	Y	M	T	C	D
	NO	OK	OK	NO	NO	NO

Example:

Ladder :



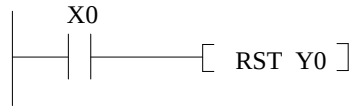
Command :

```
LD    X0
SET   M0
```

Command	Function					
RST	The reset command resets the coil (set to 0).					
Operand	X	Y	M	T	C	D
	NO	OK	OK	OK	OK	OK

Example:

Ladder :



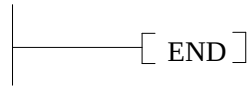
Command :

```
LD    X0
RST   Y0
```

Command	Function
END	PLC program end character
Operand	None

Example:

Ladder :



Command :

```
END
```

2.2 Function instruction

Detailed function instructions

Classification	FNC NO.(Decimal)	Instruction Symbol	Function Description	Number of parameters
Transmission comparison	10	CMP	compare	3
	11	ZCP	Interval comparison	4
	12	MOV	Send	2
	15	BMOV	Batch send	3
Arithmetic operation	20	ADD	Binary addition operation	3
	21	SUB	Binary subtraction operation	3
	22	MUL	Binary multiplication	3
	23	DIV	Binary division operation	3
	24	INC	Binary plus 1 operation	1
	25	DEC	Binary minus 1 operation	1
Rotation and shift	30	ROR	Rotate right	2
	31	ROL	Rotate left	2

FNC 10	CMP	S1 S2 D	A 16-bit instructions	Two output data comparison drive coil

	X	Y	M	K	T	C	D
S1				O	O	O	O
S2				O	O	O	O
D		O	O				
Flag bit: none							

Explanation:

Source operand S1 ：The comparison value is 1. Source operand S2 ：The comparison value is 2. Source operand D ： Comparing results.

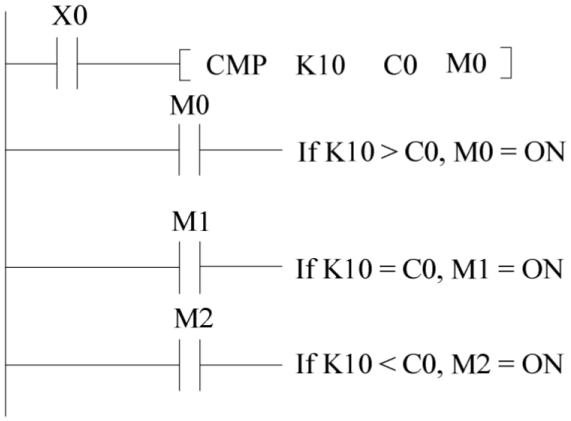
Show the comparison result of S1 S2 through D.

The numbers to be compared are all unsigned 16-bit binary numbers.

Example：

If the target points to M0, it will automatically occupy M0~M2.

CMP instruction is executed when X0 is ON. CMP is not executed when X0 is OFF, and the state remains as before X0 is OFF.



FNC 11	ZCP	(S1) (S2) (S) (D)	A 16-bit instructions	Zone compare

	X	Y	M	K	T	C	D
S1				O	O	O	O
S2				O	O	O	O
S				O	O	O	O
D		O	O				
Flag bit: none							

Explanation:

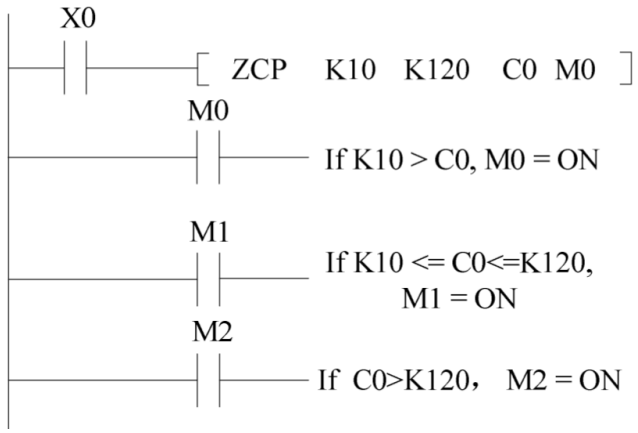
(S1): The lower limit of the area comparison. (S2): The upper limit of the area comparison. (S): Comparison value. (D): Comparing results.

The value of (S1) must be less than the value of (S2). The result of the comparison is shown by (D).

Example:

If the target points to M0, it will automatically occupy M0~M2.

The ZCP instruction is executed when X0 is ON. When X0 is OFF, ZCP is not executed, and the state remains as before X0 is OFF.



FNC 12	MOV	(S) (D)	A 16-bit instructions	Moving the data

	X	Y	M	K	T	C	D
S				O	O	O	O
D					O	O	O
Flag bit: none							

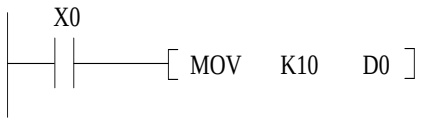
Explanation:

(S)：data. (D)：Data storage destination address.

The instruction sends the data to the destination address. The data in (D) will not change if the instruction is not executed.

Example:

The content of D0 will not change when X0 is OFF. K10 is transferred to D0 when X0 is ON.



FNC 15	BMOV	(S) (D) (N)	A 16-bit instructions	Block move

	X	Y	M	K	T	C	D
S					O	O	O
D					O	O	O
N				O			O
Flag bit: none							

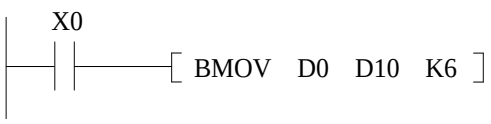
Explanation:

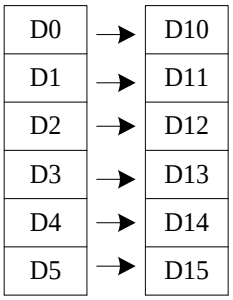
(S)：The data source starts. (D)：Data transfer destination address. (N)：Transmission block length.

Transfer the data block composed of (N) numbers starting from the component designated by (S) to the designated target block.

Example:

When X0 is ON, the data in D0~D5 are transferred to D10~D15.





FNC 20	ADD	S1 S2 D	A 16-bit instructions	BIN addition

	X	Y	M	K	T	C	D
S1				O	O	O	O
S2				O	O	O	O
D					O	O	O
Flag bit: M8020 0: The result of addition and subtraction is not 0. 1: The result of addition and subtraction is 0.							

Explanation:

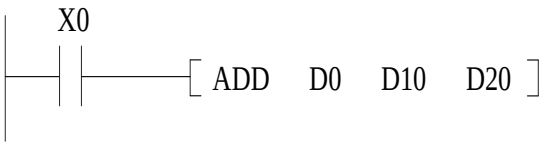
S1 : The summand.。 S2 ： Addend. D ： And.

Add S1 S2 and send the sum to D. The numbers participating in the operation are all unsigned 16-bit binary numbers.

When the operation result is zero, M8020 is set. If the result of addition and subtraction is not zero, M8020 will be cleared.

Example：

When X0 is ON, D0 and D10 are added together, and the result is stored in D20.



FNC 21	SUB	S1 S2 D	A 16-bit instructions	Subtraction

	X	Y	M	K	T	C	D
S1				O	O	O	O
S2				O	O	O	O
D					O	O	O
Flag bit: M8020 0: The result of addition and subtraction is not 0. 1: The result of addition and subtraction is 0.							

Explanation:

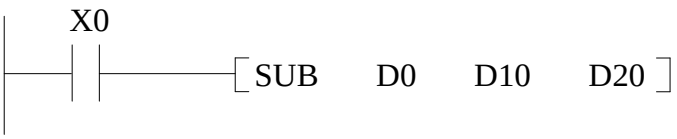
S1 : Subtracted. S2 : Minus. D : Poor.

Subtract S1 from S2, and send the difference to D. The numbers participating in the operation are all positive integers, so S1 >= S2 is required.

When the operation result is zero, M8020 is set. If the result of addition and subtraction is not zero, M8020 will be cleared.

Example:

X0 is ON, the number in D0 is subtracted from the data in D10, and the difference is stored in D20. If the difference obtained is zero, M8020 will be set to 1.



FNC 22	MUL	S1 S2 D	A 16-bit instructions	BIN multiplication

	X	Y	M	K	T	C	D
S1				O	O	O	O
S2				O	O	O	O
D					O	O	O
Flag bit: None.							

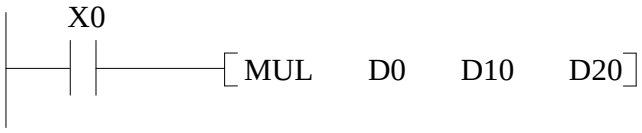
Explanation:

S1 : The multiplicand. S2 : Multiplier. D : Product.

Store the product obtained by multiplying S1 and S2 in D. The data involved in the operation are all unsigned 16-bit binary numbers.

Example:

X0 ON, the data in D0 is multiplied by the data in D10, and the product is sent to D20 for storage.



FNC 23	DIV	S1 S2 D	A 16-bit instructions	BIN division

	X	Y	M	K	T	C	D
S1				O	O	O	O
S2				O	O	O	O
D					O	O	O
Flag bit: M8023 0: The divisor is not 0. 1: The divisor is 0.							

Explanation:

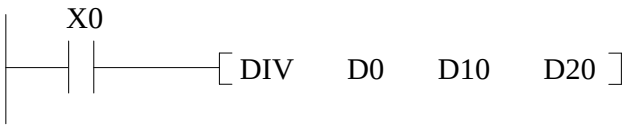
S1 : The dividend. S2 : Divisor. D : Quotient.

The quotient obtained by dividing S1 by S2 is stored in D. The data involved in the operation are all unsigned 16-bit binary numbers.

Only the integer part of the quotient is stored in and the remainder is not stored. When the divisor is 0, M8023 is 1.

Example:

When X0 is ON, the data of D0 is divided by the data of D10, and the quotient obtained is stored in D20.



FNC 24	INC	D	A 16-bit instructions	Increment: BIN plus 1

	X	Y	M	K	T	C	D
D					O	O	O
Flag bit: None.							

Explanation:

D : Target operand.

If the point before INC is not a pulse, it will be automatically incremented by 1 every scan period.

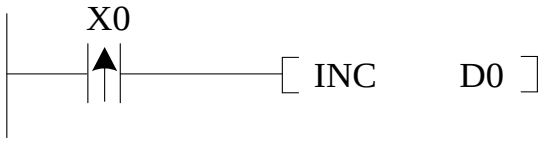
This command generally uses pulse-type execution commands.

The INC instruction has only one operand and does not affect the zero flag.

The calculated data is an unsigned 16-bit binary number.

Example:

D0 will automatically increase by 1 when X0 OFF→ON.



FNC 24	INC	D	A 16-bit instructions	Increment: BIN plus 1

	X	Y	M	K	T	C	D
D					O	O	O
Flag bit: None.							

Explanation:

D : The target operand.

If the point before DEC is not a pulse, it will be automatically decremented by 1 for each scan period

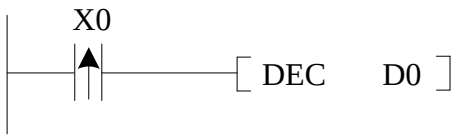
This command generally uses pulse type execution command

The DEC instruction has only one operand and does not affect the zero flag.

The calculated data is an unsigned 16-bit binary number.

Example:

D0 will automatically increase by 1 when X0 OFF→ON.



FNC 30	ROR	D N	A 16-bit instructions	Rotate to the right

	X	Y	M	K	T	C	D
D					O	O	O
N				O			
Flag bit: None.							

Explanation:

D : The device to be moved. N : The number of bits shifted to the right.

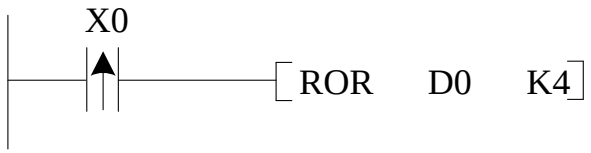
Shift the contents of the device pointed to by D to the right by N bits.

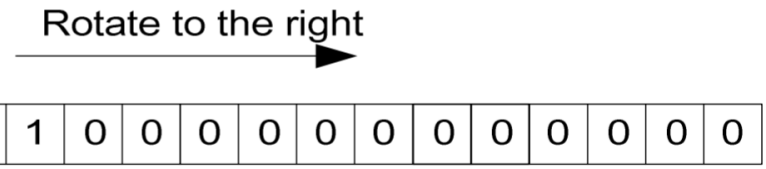
The number of operations is an unsigned 16-bit binary number.

This command generally uses pulse-type execution commands. No more than 15 digits can be moved at a time.

Example:

When X0 OFF→ON, the 16 bits of D0 move to the right in a group of four bits.





FNC 31	ROL	D N	A 16-bit instructions	Rotate to the left

	X	Y	M	K	T	C	D
D					O	O	O
N				O			
Flag bit: None.							

Explanation:

D : The device to be moved. N : The number of bits shifted to the left.

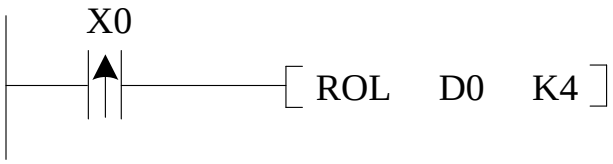
Shift the contents of the device pointed to by D to the left by N bits.

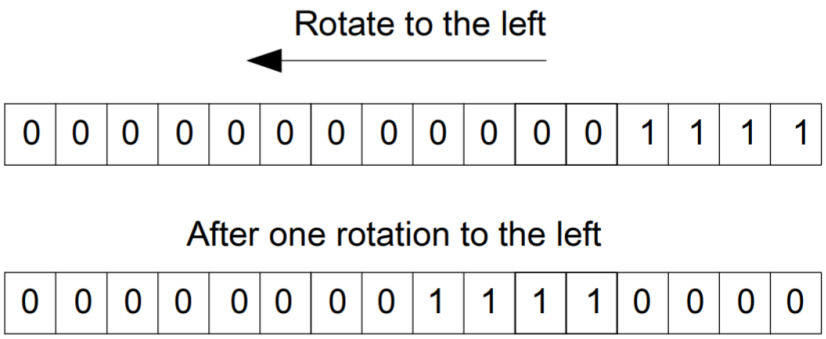
The number of operations is an unsigned 16-bit binary number.

This command generally uses pulse-type execution commands. No more than 15 digits can be moved at a time.

Example:

When X0 OFF→ON, the 16 bits of D0 move to the left in a group of four bits.





3. Communication application note

3.1 Modbus communication protocol

- The embedded PLC supports Modbus RTU and Modbus ASCII protocol for communication to read and write software devices.
- Modbus address of bit soft device is divided into group address and address. The operation of the group address is to read and write 16-bit soft devices at the same time. Up to 416 address operations can be read and written at a time. Word soft devices have only group addresses, and up to 20 read and write at a time. When writing parameter D during communication, ensure that the inverter is in communication mode.

PLC soft device Modbus communication address

soft device	group address	address
X	0x2000~0x2001	0x3000~0x3015
Y	0x2002~0x2003	0x3020~0x3033
M	0x2004~0x2012	0x3040~0x312F
T(Bit)	0x2013	0x3130~0x3137
C(Bit)	0x2014	0x3140~0x3147
Special M	0x2015~2019	0x3150~0x319F
T value	0x2034~0x2043	None
C value	0x2044~0x2053	
T current value	0x2054~0x2063	
C current value	0x2064~0x2073	
D	0x2074~0x20A3	
Special D	0x20A4~0x2145	None
Parameter D	0x000~0x0513	

- Command codes available for communication with PLC

Command code	Function	Operation method	Suitable for
0x01	Coil status reading	Bit operation, single read/multiple read	Y,M,T,C
0x02	Input status read	Bit operation, single read/multiple read	X,Y,M,T,C
0x03	Read single data	Word operation, single read/multiple read	X, Y, M, T, C, D, T current value, T set value, C current value, C set value
0x05	Mandatory single coil	Bit operation, single write	Y,M ,T,C
0x06	Write single data	Word operation, single write	Y,M,T,C,D, T current value, T set value, C current value, C set value
0x10	Write multiple data	Word operation, multiple write	Y,M, T,C,D, T current value, T set value, C current value, C set value

- Communication example

Example 1: Read the status of M16~M33.

Address method:

Enquiry: 01 01 30 50 00 12 B3 16
Reply: 01 01 03 BC ED 03 F0 FB

Analysis of the reply data: 0xBC corresponds to the state of M23 ~ M16. M18, M19, M20, M21, M23 are 1, M16, M17, and M22 are 0.
0xED corresponds to the state of M31~M24. M24, M26, M27, M29, M30, M31 are 1, M25, M28 are 0.
0x03 corresponds to the state of M33~M32. M33, M32 are less than one byte, so the extra part is 0. The status of M33 and M32 is 1.

Group address mode:

Enquiry: 01 03 20 05 00 02 DF CA
Reply: 01 03 04 ED BC A5 67 34 01

Response data analysis: 0XEDBC is the state of M31~M16, M18, M19, M20, M21, M23, M24, M26, M27, M29, M30, M31 are 1,
M16, M17, M22, M25, and M28 are 0.
0XA567 is the state of M47~M32. Since we only care about the status of M33 and M32 here, the others can be ignored.
The usage of command code 0x02 is the same as 0x01, but the scope of use is different.

Example 2: Force M100 ON

Command: 01 05 30 A4 FF 00 C2 D9
Reply: 01 05 30 A4 FF 00 C2 D9
Mandatory M100 OFF
Command: 01 05 30 A4 00 00 83 29
Reply: 01 05 30 A4 00 00 83 29

Analysis: Write the value 0XFF00, that is, the status of the bit soft device operated by the command is ON, that is, the value is 1. Write a value of 0X0000, and the command operated is that the state of the software device is OFF, that is, the value is 0.

Example 3: Read the value of D20

Enquiry: 01 03 20 88 00 01 0F E0
Reply: 01 03 02 17 70 B6 50

Example 4: Read the value of D0~D10

Enquiry: 01 03 20 74 00 0B 4F D7
Reply: 01 03 16 00 19 01 E8 00 10 17 70 13 88 07 DA 00 00 10 00 12 00 21 03 FF FF 06 6A

Example 5: Write 3000 to D20

Command: 01 06 20 88 0B B8 05 62
Reply: 01 06 20 88 0B B8 05 62

Example 6: Write values to D2~D6

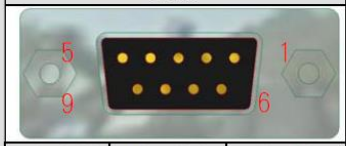
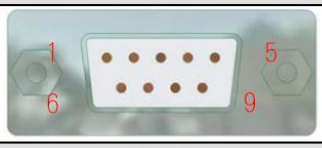
Command: 01 10 20 76 00 05 0A 13 88 07 D0 17 70 10 68 0A 28 F0 AF
Reply: 01 10 20 76 00 05 EA 10

3.2 PLC communication protocol

- PLC communication protocol is selected when P.33 is set to 2, P.48~P.50 set the communication format, P.32 selects the communication baud rate. PLC protocol is a special protocol for PLC program download and communication between embedded PLC and Shihlin HMI. Currently Shihlin HMI EC200 series supports this protocol.
- It can be used with HMI to realize I/O monitoring, internal soft device monitoring and PLC program operation monitoring.

Appendix I

The embedded PLC can be used with Shihlin's HMI to read PLC ladder diagrams and instruction lists, modify instruction lists, and monitor PLC operation. The figure below shows the RS232, RS422 and RS485 pin definitions of Shihlin HMI serial port.

PIN	COM1			COM2			COM3
							
	RS-232	RS-422	RS-485	RS-232	RS-422	RS-485	RS-232
1	–	TX+	A	–	TX+	A	–
2	TX	–	–	TX	–	–	TX
3	RX			RX			RX
4	–	RX+		–	RX+		–
5	GND			GND			GND
6	–	RX–	–	–	RX–	–	–
7	–	–		RTS	–		RTS
8	–			CTS			CTS
9	–	TX–	B	–	TX–	B	–