Instructions of string combiner monitoring assembles

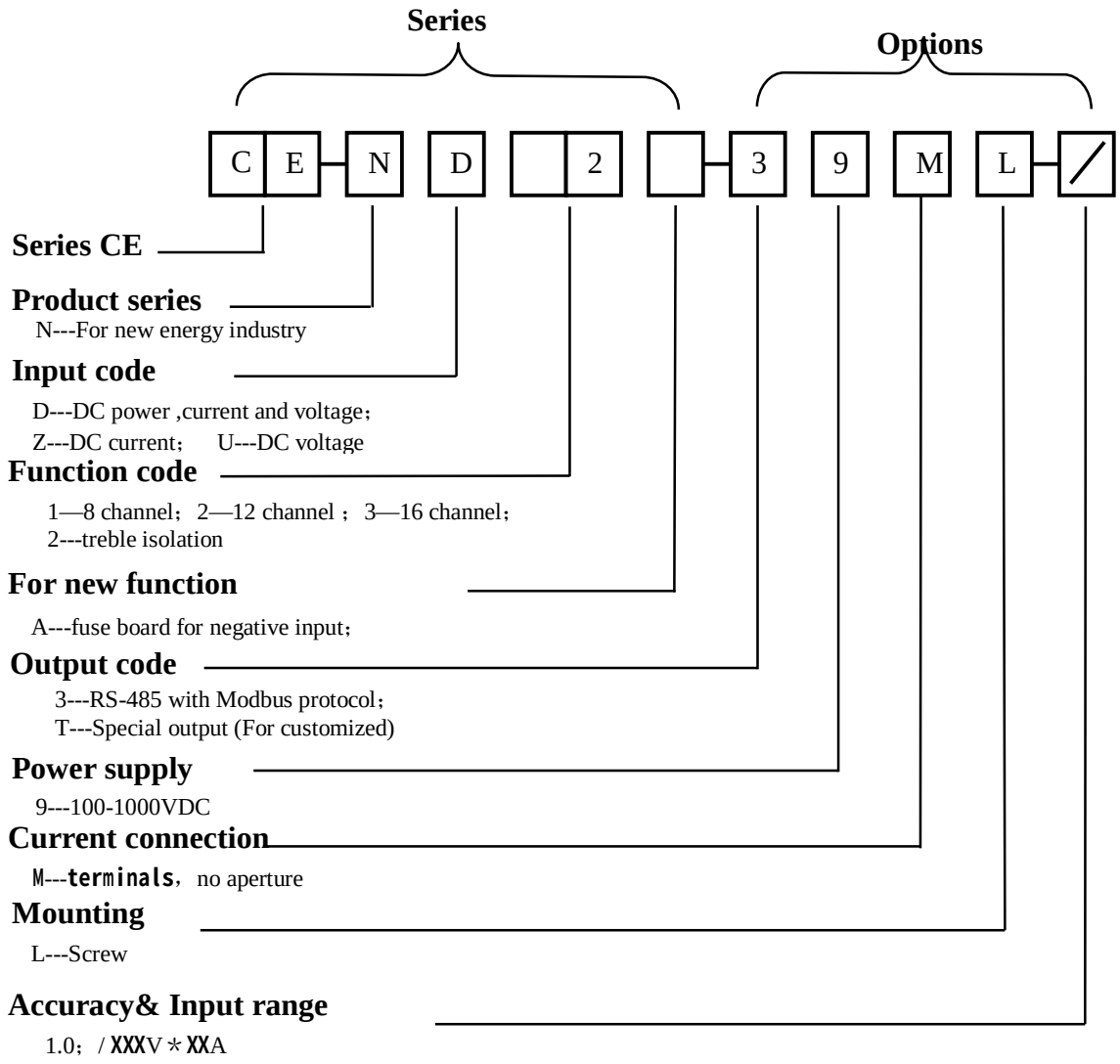
CE-ND

1. Overview

This series product could be used to be mounted in the string combiner as its monitoring function part. It can measure the current, voltage, power of the solar panels, with RS485, relay and analog outputs which could be connected with environment sensors, like wind, temperature and sunlight radiation meter

2. Part number

Please follow the instruction below to fix the full part number, one square one code.



3. Features

- Two isolation principle version for option: hall effect and high precise resistance
- Bi-direction measurement
- PV-powered, saving installation time and material costs for the power supply
- Max voltage input 1000V
- Integrated with fuse holders, work for different size fuses, max. 1000V.
- Two channel analog 0-10V& 0-20mA inputs for other environment sensors
- With LED display
- RS485 output with Modbus-RTU protocol

4. Function

- Short circuit of the solar panel alarmed by LED display and data transmission
- Switch input for DC breaker or lightning device status monitoring
- Relay output for automatic control of DC breaker switch on and off
- Analog inputs for temperature, sunlight radiation, wind speed sensors data acquisition
- Output 12V or 24Vdc power for the extra environment sensors(optional)
- 6 digit LED display each channel current in circle, with power saving mode
- Standard Mobus RTU protocol, the address, baud rate, data format could be modified in local or remote control
- Total voltage measurement, with power calculation for each channel
- PV powered, no need extra power source device/ mains connection

5. Specification

Series	CE-ND12	CE-ND22	CE-ND32
Input channel	8 channel	12 channel	16 channel
Input range	DC 0-10A		
Accuracy	1.0 for solar panel, 0.5 for analog inputs		
Temperature drift	500ppm		
Communication	RS485、Modbus protocol、odd/even parity/ none checking 4800/9600/19200/57600bps		
Data update period	1S		
Isolation	Power supply/gathered input/digital output/voltage input/switch input/relay output isolated from each other，2500V DC/1 min.		
Operating temperature	-25-+60°C		
Humility	95%, no dew ,no corroding gas		
Power supply	220AC or PV powered100-1000VDC		
Power consumption	50mA(100V); 12mA(1000V);		
Surge protection	Power supply:4KV;voltage input terminals:4KV; communication terminals: 2KV		
Optional function			
Relay output	1channel, 8A/AC250V(8A/DC 30V)		
Switch input	3 group inputs（Dry contact）		
Analog input	DC0(4)-20mA、DC0-10V（or customized）		

6. Connection Diagram

There are 3 boards, control board, upper and bottom current combining board)

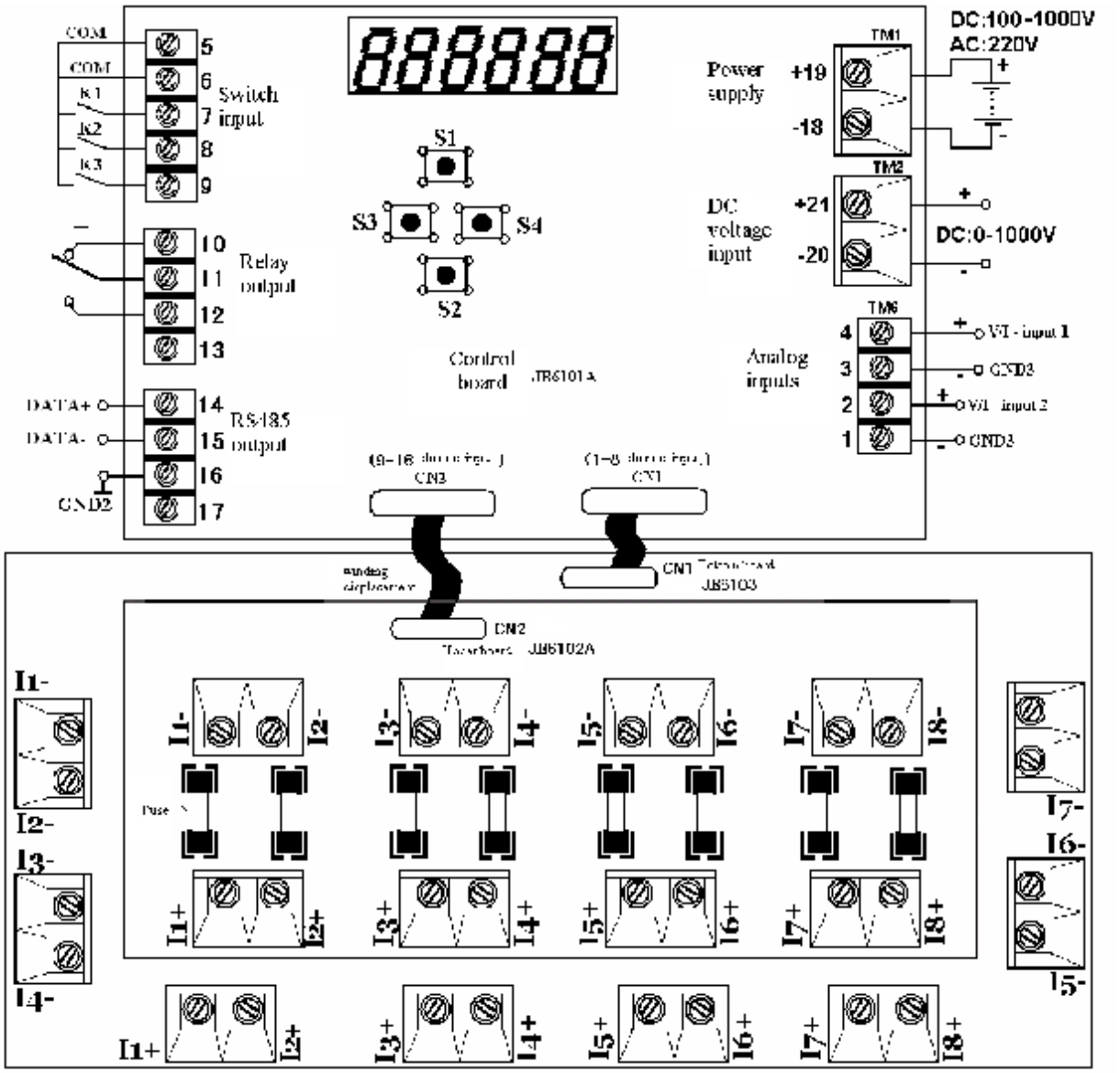


Fig 6.1 Connection diagram

Remark:

1. "+" here means positive current input while "-" means negative, the number strands for the corresponded channel, for example I1+ means positive current input of the fist channel
2. Ensure the connections of winding displacement matched the input numbers, On CN1, I1~I8 port for the 1~8 channel input, and on CN2, I9~I16 port for the 9~16 channel input.
3. The upper and bottom boards are flexible to be chosen according to the number of input channels

7. Dimension and mounting

When there are more than 8 channel inputs, two current gathering board needed, each one can take 8 channel input. The bottom one is a little bigger.

7.1 Diagram for current gathering boards (upper and bottom board)

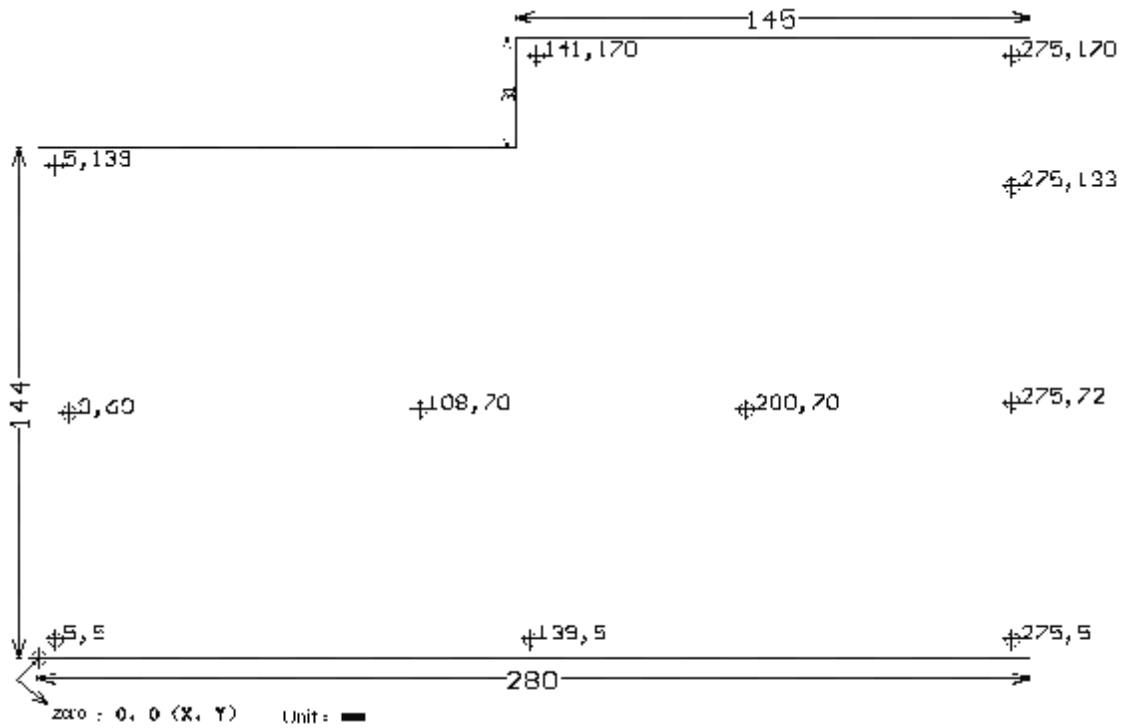


Fig 7.1 Mounting diagram for the bottom current gathering board

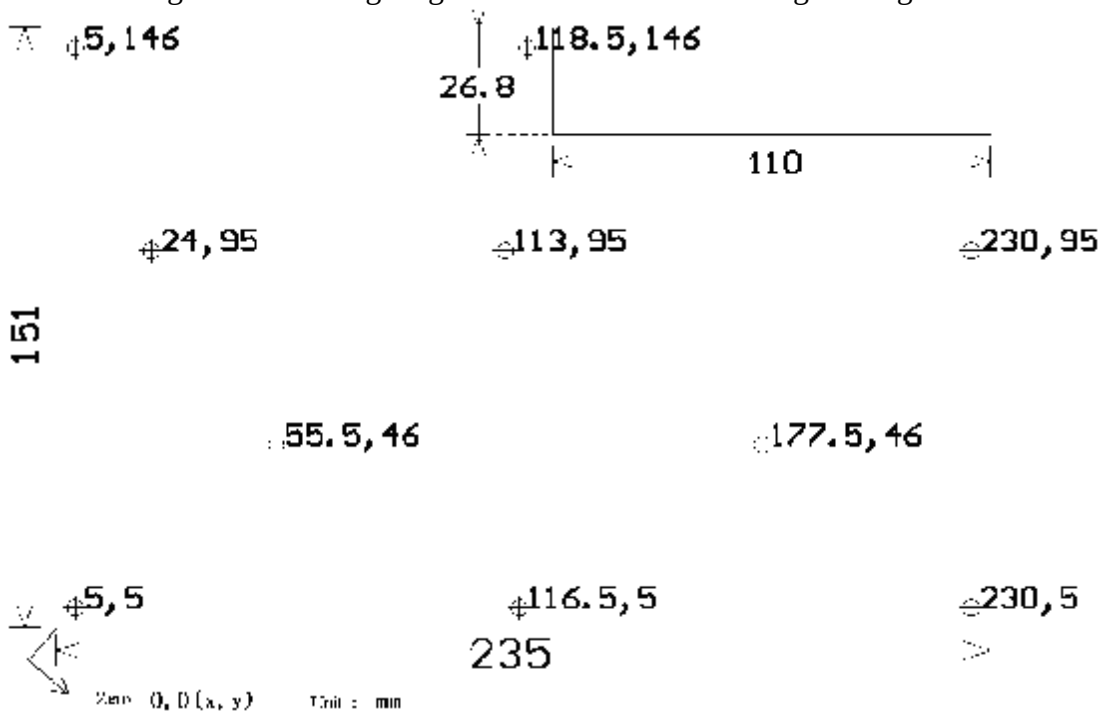


Fig7.2 Mounting diagram for the upper current gathering board

Description: The diameter of all the screw holes on the board is 4mm. The locates (the centre of the screw hole) shown in the shown in x,y coordinate system.

7.2 Diagram for controlling boards

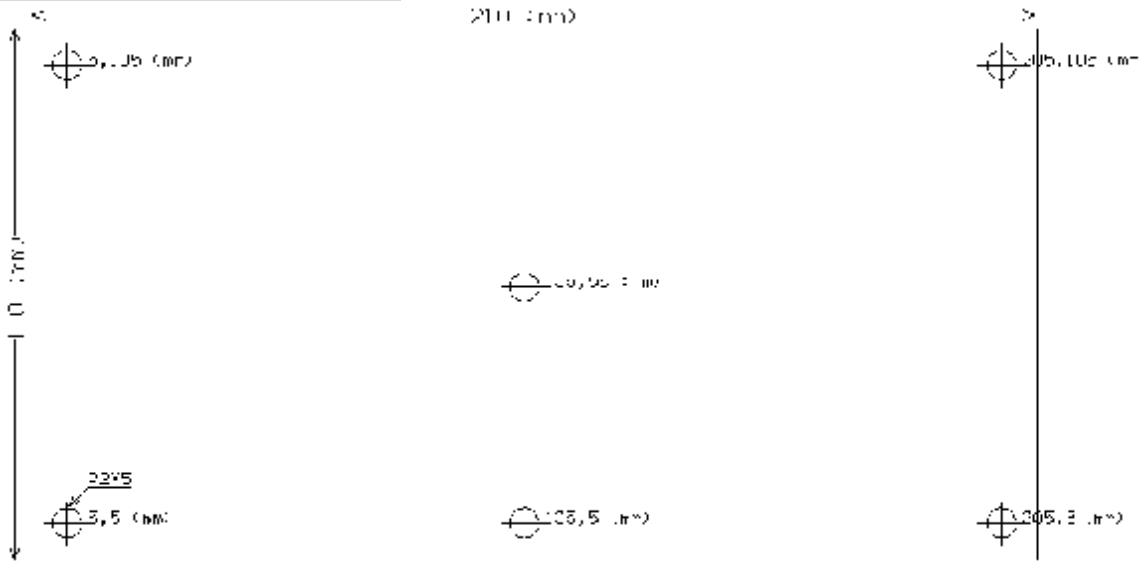


Fig7.3 Mounting diagram for the controlling board

8. Configuration

Function button	Display menu	Contents	Remard
← **Left**	Adr	0-255	The address of the adapter
	bAud	1200、2400、4800、9600、19200、57600	Baud rate, bps
	mode	1stop、2stop、odd、EvEn	1stop：8 bits, no check,1 bit stop； 2stop：8 bits,2 bits stop(**not available now**)； odd：8 bits, odd check, 1 bit stop； EvEn: 8 bits, parity check, 1 bit stop；
	code	None	
→ **Right**	None	U.xxx.x、I.xxx.x、W.xxx.x、 i. xx.xx、u.xx.xx、t.xx.x	U.xxx.x：DC voltage (V)、I.xxx.x：total current (A) W.xxx.x：total power (kW)、i.xx.xx：the second analog input channel（mA or V）、u.xx.xx：the first analog input channel（mA or V)、t.xxx.x: temperature（℃）
↑ **Up** (power per channel)	None	1.x.xxx、……9.x.xxx、A.x.xxx、b.x.xx、C.x.xxx、D.x.xxx、E.x.xxx、F.x.xxx、G.x.xxx	One press switch to one channel power(Kw)，Ex. “1.9.112”， means the power for the 1st channel is 9.112kW. And A、b、C、d、E、F、G stands for 10-16 channel separately.
↓ **Down** Current per channel	None	01xx.xx、02xx.xx、03xx.xx、……、14xx.xx、15xx.xx、16xx.xx	One press switch to one channel current (A). Ex., “0110.12”， means the current for the 1st channel is 10.12A.

9.MODBUS PROTOCOL

9.1 Format of data

9.1.1 Format of message

9.1.1.1 Function code 01H/02H —— To read the switch input and relay output from the slave equipment.

The Message from the master equipment:

Address of the slave equipment	01H-FFH	1 byte
Function code	01/02H	1 byte
Address of the first register		2 bytes
Quantity of Registers		2 bytes
CRC code		2 bytes

The correct responded message from the slave equipment:

Address of the slave equipment	01H-FFH	1 byte
Function code	01H/02H	1 byte
Byte count		1 byte
Data section (contents of registers)		**N*** x 2 bytes
CRC code		2 bytes

***N** = Quantity of Registers

9.1.1.2 Function code 03H —— To read data of registers of the slave equipment

The Message from the master equipment

Address of the slave equipment	01H-FFH	1 byte
Function code	03H	1 byte
Address of the first register		2 bytes
Quantity of Registers		2 bytes
CRC code		2 bytes

The correct responded message from the slave equipment:

Address of the slave equipment	01H-FFH	1 byte
Function code	03H	1 byte
Byte count	2* **N***	1 byte
Data section (contents of registers)		**N*** x 2 bytes
CRC code		2 bytes

***N** = Quantity of Registers

9.1.1.3 Function code 05H —— To write data to control the relay input

The Message from the master equipment

Address of the slave equipment	01H-FFH	1 byte
Function code	05H	1 byte
Address of the first register		2 bytes
Quantity of Registers		2 bytes
CRC code		2 bytes

The correct responded message from the slave equipment:

Address of the slave equipment	01H-FFH	1 byte
Function code	05H	1 byte
Address of the register		2 bytes
The data written to the registers		2 bytes
CRC code		2 bytes

9.1.1.4 Function code 06H —— To set (write) data for single register of the slave equipment

The Message from the master equipment

Address of the slave equipment	01H-FFH	1 byte
Function code	06H	1 byte
Address of the first register		2 bytes
Quantity of Registers		2 bytes
CRC code		2 bytes

The correct responded message from the slave equipment:

Address of the slave equipment	01H-FFH	1 byte
Function code	06H	1 byte
Address of the registers		2 bytes
The data written to the registers		2 bytes
CRC code		2 bytes

9.1.1.5 Function code 10H —— To set (write) data for multi-registers of the slave equipment

The Message from the master equipment

Address of the slave equipment	01H-FFH	1 byte
Function code	10H	1 byte
Address of the first register		2 bytes
Quantity of Registers		2 bytes
Byte count	2 x **N***	1 byte
The data written to the registers		2 x **N***
CRC code		2 bytes

***N** = Quantity of Registers

The correct responded message from the slave equipment:

Address of the slave equipment	01H-FFH	1 byte
Function code	10h	1 byte
Address of the first register		2 bytes
Quantity of Registers		2 bytes
CRC code		2 bytes

Note: 1. For all Address of register, Quantity of registers and Contents of register (Data), their high order byte is before their low order byte. But the low order byte of CRC code is before its high order byte.

2. The length of the register is 16 bits (2 bytes).

9.2.1.1 Definitions of registers

Function code 03H of Modbus could read all the contents below

Address of register	Data content	Data representation	Attribute of register	Remark（Data range）
0	Name of the device	unsigned int	Read only	0X5549
1	Version	unsigned int	Read only	
2	Communication address*	unsigned int	Read/write	0-255
3	Baud rate*	unsigned int	Read/write	1200，2400，4800，9600，19200，57600
4	Check mode*	unsigned int	Read/write	Could be written as 0，1，2，3（Reference10.5）

***：The write function only be available while the fourth switch of S6 turned on 1, S6 is located on the controlling board.**

5-7	Reserved			
8	8-1 channel operating status	int	Read only	bit1， bit0 0 ， 0 =Channels un-installation，no Led blink 0 ， 1=Open circuit for over current，red Led blink 1 ， 0=Work normally，green Led blink 1 ， 1=The direction of the current is negative The bit1,bit0 of address 8 correspond to input status of channel one, bit3,bit2 for channel two, and so on
9	16-9 channel operating status	int	Read only	
10	1-16 channel alam	int	Read only	bit0 for the 1st channel，bit1 for 2nd channel…bit15 for 16th channel. “1” refers to alarm
11	Switch input （DI） /Output(DO)	int	Read only	bit0 for the 1st channel’s DO(low 8 bit); bit8 for the 1st channel’s DI， bit9 for 2nd channel’s DI，bit10 for 3rd channel’s DI(high 8 bit) 0 means open，1 means close
12	2nd analog input	int	Read only	Data rounded up to percentile, mA/V
13	1st analog input	int	Read only	Data rounded up to percentile，mA/V
14	Temperature	int	Read only	Be accurate to one decimal place,℃，
15	Gathered volt.	int	Read only	Be accurate to one decimal place, V
16	Total current	int	Read only	Be accurate to one decimal place，A
17	Total power	int	Read only	Be accurate to one decimal place，KW
18	Current for 1st channel(I1)	int	Read only	With real-time monitoring, Two decimal place For example: 1000 strands for10.00A
19	I2	int	Read only	
20	I3	int	Read only	
21	I4	int	Read only	
22	I5	int	Read only	
23	I6	int	Read only	
24	I7	int	Read only	
25	I8	int	Read only	
26	I9	int	Read only	
27	I10	int	Read only	
28	I11	int	Read only	
29	I12	int	Read only	
30	I13	int	Read only	
31	I14	int	Read only	
32	I15	int	Read only	
33	I16	int	Read only	
34	Power for 1st channel(P1)	int	Read only	Calculated from total voltage and current per each channel. Three decimal place, KW
35	P2	int	Read only	
36	P3	int	Read only	
37	P4	int	Read only	
38	P5	int	Read only	
39	P6	int	Read only	
40	P7	int	Read only	
41	P8	int	Read only	

42	P9	int	Read only	For example:1000 means 1.000KW here
43	P10	int	Read only	
44	P11	int	Read only	
45	P12	int	Read only	
46	P13	int	Read only	
47	P14	int	Read only	
48	P15	int	Read only	
49	P16	int	Read only	
50-65	Counting for1-16 channel's open circuit times	unsigned int	Read only	Reserved
66-68	Counting for the open circuit times of 1~3 channel switch input	unsigned int	only	Reseved
69-78	Reserved			
79	Definition of relay output	unsigned int	Read/write	"1'Relay would close while the current lower/over than the threshold value; in other situations , relay release "2' relay would close while the current lower/over than the threshold value; with other inputs, relay release. Meanwhile the relay could be controlled by the communication bus Other value except "1",The communication bus controls the relay
80	Response time for the relay output	unsigned int	Read/write	If effective value as 1-255, the relays would take action automatically after 1-255 seconds; If effective value fixed as 0, the action of the relay will be controlled by communication, couldn't be release automatically
81	Reserved			
82	Over current threshold for 1st channel(TH1)	unsigned int	Read/write	Set for over current threshold(absolute value) For example, write 1200 means the threshold is 12.00 A. The default threshold value is 1.2 times of the rated input. When the input current is over the threshold value, check the register with 10 address of the corresponding alarm status.
83	TH2	unsigned int	Read/write	
84	TH3	unsigned int	Read/write	
85	TH4	unsigned int	Read/write	
86	TH5	unsigned int	Read/write	
87	TH6	unsigned int	Read/write	
88	TH7	unsigned int	Read/write	
89	TH8	unsigned int	Read/write	
90	TH9	unsigned int	Read/write	
91	TH10	unsigned int	Read/write	
92	TH11	unsigned int	Read/write	
93	TH12	unsigned int	Read/write	

94	TH13	unsigned int	Read/write	
95	TH14	unsigned int	Read/write	
96	TH15	unsigned int	Read/write	
97	TH16	unsigned int	Read/write	
98	Lower current limit threshold (open circuit threshold) for the 1st channel: TL1	unsigned int	Read/write	Set for lower limit current threshold(absolute value) For example, write 30 to set the threshold as 0.3 A. The default threshold value is 0.4A When the input current is lower than the lower limit threshold value, check the register with 10 address of the corresponding alarm status.
99	TL2	unsigned int	Read/write	
100	TL3	unsigned int	Read/write	
101	TL4	unsigned int	Read/write	
102	TL5	unsigned int	Read/write	
103	TL6	unsigned int	Read/write	
104	TL7	unsigned int	Read/write	
105	TL8	unsigned int	Read/write	
106	TL9	unsigned int	Read/write	
107	TL10	unsigned int	Read/write	
108	TL11	unsigned int	Read/write	
109	TL12	unsigned int	Read/write	
110	TL13	unsigned int	Read/write	
111	TL14	unsigned int	Read/write	
112	TL15	unsigned int	Read/write	
113	TL16	unsigned int	Read/write	
114	Delay time for the 1st channel relay: D1	unsigned int	Read/write	The response time for the relays while the input current is beyond the threshold. Unite: S For example wire 10 here means the relay would take action after 10S.
115	D2	unsigned int	Read/write	
116	D3	unsigned int	Read/write	
117	D4	unsigned int	Read/write	
118	D5	unsigned int	Read/write	
119	D6	unsigned int	Read/write	
120	D7	unsigned int	Read/write	
121	D8	unsigned int	Read/write	
122	D9	unsigned int	Read/write	
123	D10	unsigned int	Read/write	
124	D11	unsigned int	Read/write	
125	D12	unsigned int	Read/write	
126	D13	unsigned int	Read/write	
127	D14	unsigned int	Read/write	
128	D15	unsigned int	Read/write	
129	D16	unsigned int	Read/write	

9.3 Read the status of the switch inputs(DI)

Function code 02H of Modbus could read all the contents below, 1=0N， 0=0FF

Address of register	Contents of register	Data representation	Read/write	Function code	Data range
0000H	DI1	BIT	R	02	1=ON,0=OFF

0001H	DI2	BIT	R	02	1=ON,0=OFF
0002H	DI3	BIT	R	02	1=ON,0=OFF

9.4 Read the status of the relay outputs(DO)

Function code 01H of Modbus could read all the contents below, 1=0N， 0=0FF

Address of register	Contents of register	Data representation	Read/write	Function code	Data range
0000H	DO1	BIT	R	01	1=ON,0=OFF

9.5 Read the alarming status of the relay outputs

Function code 05H of Modbus could read all the contents below, 1=0N， 0=0FF/release

Address of register	Contents of register	Read/write	Function code	Data range
0000H	DO1	W	05	0xFF00 =ON, 0x0000 =OFF

Note: The function code 05H works while the content is not “1” in the register with 79 address.

9.6 Examples

EX1, read the current data for channel 1 and 2

Sent the command:

Address of slave equipment	Function code	Address of the first register		Quantity of registers		CRC-L	CRC-H
01H	03H	00H	12H	00H	02H	64H	0EH

Data returned：

Address of slave equipment	Function code	Data bytes count	Contents of register	CRC-L	CRC-H
01H	03H	04H	03H DBH 04H 02H	09H	4DH

Description： The data for the current of 1st channel is 03DBH=987D= 9.87A；
The data for the current of 2nd channel is 0402H=1026D=10.26A。

Ex 2: Set the response time of the relay output

Sent command：

Address of slave equipment	Function code	Address of the first register		Data written to register		CRC-L	CRC-H
01H	06H	00H	50H	00H	05H	49H	D8H

Data returned：

Address of slave equipment	Function code	Address of the first register		Data written to register		CRC-L	CRC-H
01H	06H	00H	50H	00H	05H	49H	D8H

Description： 05H means the relay would take action after 5 seconds

EX3:Set the over current threshold for channel 1 to 3

Sent command：

Address of slave equipment	Function code	Address of the first register		Quantity of registers		Data bytes count	Data written to register			CRC-L	CRC-H
01H	10H	00H	52H	00H	03H	06H	04H B0H	04H 4CH	04H B0H	C7H	C6H

Data returned:

Address of slave equipment	Function code	Address of the first register		Quantity of registers		CRC-L	CRC-H
01H	10H	00H	52H	00H	03H	21H	D9H

Description:

The data for the over current threshold of 1st &3rd channel is 04B0H=1200D= 12.00A;

The data for the over current threshold of 2nd channel is 044CH=1100D=11.00A。

EX4:Read the status of the switch inputs for channel 1 to 3

Sent command:

Address of slave equipment	Function code	Address of the first register		Counting number for switch inputs		CRC-L	CRC-H
01H	02H	00H	00H	00H	03H	38H	0BH

Date returned:

Address of slave equipment	Function code	Data bytes count	Returned data	CRC-L	CRC-H
01H	02H	01H	06H	21H	8AH

Description: 06 converted into binary code is 00000110, the first channel is open while the 2nd and 3rd channel are close, the higher 5 bits 0 with no meaning here.

EX5: Read the alarming status of the relay output

Command sent:

Address of slave equipment	Function code	Address of the first register		Counting number for the relays		CRC-L	CRC-H
01H	01H	00H	00H	00H	01H	FDH	CAH

Data returned:

Address of slave equipment	Function code	Data bytes count	Returned data	CRC-L	CRC-H
01H	01H	01H	01H	90H	48H

Description: 01 converted into binary code is 00000001, relay is in off .The high 7 bits 0 are meaningless here.

10. Configurations for the dip switches

There are two dip switches (named S6 and S7) in the controlling board. 1=ON (close), 0=off(open)

10.1 Definitions for the dip switches

S7（1-8 positions）								S6（1-8 positions）							
S7.1	S7.2	S7.3	S7.4	S7.5	S7.6	S7.7	S7.8	S6.1	S6.2	S6.3	S6.4	S6.5	S6.6	S6.7	S6.8
Address set								Set for baud rate			Fix Mode	Communication mode		Current direction	Display On/off

10.2 Address configuration（S7）

S7.8	S7.7	S7.6	S7.5	S7.5	S7.3	S7.2	S7.1	Address
0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1
.....								
1	1	1	1	1	1	1	0	254
1	1	1	1	1	1	1	1	255

10.3 Baud rate configuration（The 1st, 2nd,3rd positions of S6）

Baud rate	S6.3	S6.2	S6.1
9600bps	0	0	0
1200bps	0	0	1
2400bps	0	1	0
4800bps	0	1	1
57600bps	1	0	0
19200bps	1	0	1
19200bps	1	1	0
19200bps	1	1	1

10.4 Configuration method (The 4th position of S6)

Configuration method	S6.4	Note: while S6.4 switches to software fixing, the address, baud rate and communication mode won't change, they would be acquired and saved automatically.
Hardware configuration (AD., baud rate, communication mode)	0	
Software configuration (AD., baud rate, communication mode)	1	

10.5 Configuration for data format（The 5th and 6th position of S6）

Data format	S6.6	S6.5	Software fixing code
10 bits：1-bit start, 8-bit data, 1-bit stop	0	0	0

11 bits： 1-bit start, 8-bit data, 2-bit stop (reserved)	1	0	1
11 bits：1-bit start, 8-bit data, even parity ,1-bit stop	0	1	2
11 bits：1-bit start, 8-bit data, odd parity,1-bit stop	1	1	3

10.6 Configuration for current direction（The 7th position of S6）

When the direction of all the current input shows negative, they can be showed in positive with this switch turning.

10.7 LED display mode （The 8th position of S6）

LED	S6.8	The LED will turn off without out press after 1 min. in the power saving mode
Keep LED on	0	
LED display off (power saving mode)	1	

11. Notes

- Please ensure which configuration you did chose, hardware or software (Dip switch:S6.4)
- The RED LED3 on controlling board blink per 2s with powered on; and it will keep on when the button pressed; if the LED3 don't blink means the device is not working
- The RED LD51 on controlling board is for communication indicating, it will blink when there is communication
- Button S5 on the controlling board is for hardware resetting