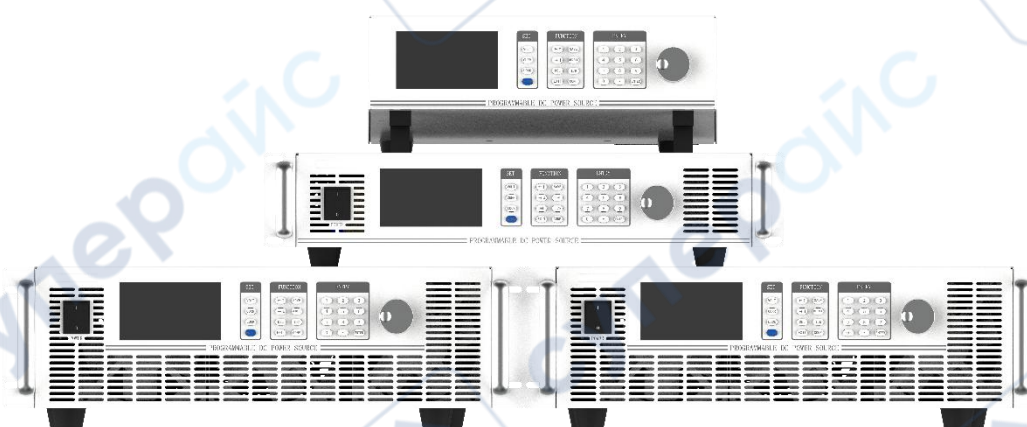


# ModbusRTU communication protocol



Ver: V1.10

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## Contents

<b>1</b>	Introduction .....	3
1.1	Electrical interface .....	3
1.2	Transmission mode .....	3
1.3	Data frame format .....	3
<b>2</b>	Detailed communication command .....	4
2.1	Read single/multi- hold register (0x03) .....	4
2.2	Read single/multi- input register (0x04) .....	6
2.3	Write Single Hold Register (0x06) .....	7
2.4	Write Single/Multi- Hold Register (0x10) .....	9
2.5	Error frame format .....	10
	Appendix .....	11
	Registers list: .....	11
	Status/Mode register .....	14
	Error status register: .....	15
	CRC-16 in C language version .....	16

## Lists of Table

<i>Table 1: Electrical interface</i> .....	3
<i>Table 2: Data frame format</i> .....	3
<i>Table 3: 0x03 operation</i> .....	4
<i>Table 4: 0x04 operation</i> .....	6
<i>Table 5: 0x06 operation</i> .....	7
<i>Table 6: 0x10 operation</i> .....	9
<i>Table 7: Error frame format</i> .....	10
<i>Table 8: Registers list</i> .....	13
<i>Table 9: Status/Mode register</i> .....	14

Table 10: Error status register.....15



# 1 Introduction

## 1.1 Electrical interface

TIA/EIA - 485 – A

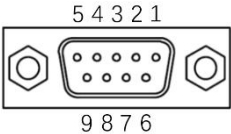
<i>DB9 socket</i>	<i>Pin</i>	<i>Signal</i>	<i>Description</i>
	1	A	485-A
	2	B	485-B
	3~9	N. C.	Unused

Table 1: Electrical interface

## 1.2 Transmission mode

This protocol uses RTU transmission mode. The default setting is 8 data bits, no parity bits, 1 stop bit, and the baud rate is 9600bps.

## 1.3 Data frame format

<i>Address</i>	<i>Function code</i>	<i>Data domain</i>	<i>CRC</i>
8 bits	8 bits	N×8 bits	16 bits

Table 2: Data frame format

- Address: Host address is “0”, slave address is “1~247”, the default address of this product is: 0x01;
- Function code: Read hold register(0x03); Read input register(0x04); Write Single hold registers(0x06); Write multiple hold registers(0x10); The error function code is the corresponding function code + 0x80;
- Data Domain: Data required to perform specific functions or the terminal responds to queries to collected data;
- Validation code: Using a 16-bit cyclic redundancy method (CRC16). Low byte first, high byte later;

## 2 Detailed communication command

80V60A 3000W specification as an example.

### 2.1 Read single/multi- hold register (0x03)

<i>Register Address (Hex)</i>	<i>Name</i>	<i>Number of register(Hex)</i>	<i>Number of bytes returned (Hex)</i>
0x0000~0x0002	System config register	0x0001~0x0003	Num of reg×0x02
0x012C~0x0135	Normal register	0x0001~0x000A	Num of reg×0x02
0x01F4~0x01F9	Reference register	0x0001~0x0006	Num of reg×0x04
0x03E8~0x03F8	Protection register	0x0001~0x0014	Num of reg×0x02
0x076C~0x076E	Special register	0x0001~0x0003	Num of reg×0x02
0x07CC~0x07CF		0x0001~0x0004	Num of reg×0x10

Table 3: 0x03 operation

■ Read voltage reference:

- Host request: 01 03 01 2C 00 01 *44 3F*  
Slave response: 01 03 02 13 88 *B5 12*  
(The voltage reference value is 5000, the unit is 0.01V.)
- Host request: 01 03 01 F4 00 01 *C4 04*  
Slave response: 01 03 04 00 00 *C3 50 AA FF*  
(The voltage reference value is 50000, the display accuracy is 0.001V.)

■ Read current reference:

- Host request: 01 03 01 2D 00 01 *15 FF*  
Slave response: 01 03 02 17 70 *B6 50*  
(The current reference value is 6000, the unit is 0.01A.)
- Host request: 01 03 01 F5 00 01 *95 C4*  
Slave response: 01 03 04 00 00 *EA 60 B5 7B*  
(The current reference value is 60000, the display accuracy is 0.001A.)

■ Read power reference:

- Host request: 01 03 01 2E 00 01 *E5 FF*  
Slave response: 01 03 02 0B B8 *BF 06*  
(The power reference value is 3000, the unit is 1W.)
- Host request: 01 03 01 F6 00 01 *65 C4*  
Slave response: 01 03 04 00 00 *75 30 DC B7*  
(The power reference value is 30000, the display accuracy is 0.1W.)

■ Read multi-hold registers (Voltage reference, Current reference, Power reference):

- Host request: 01 03 01 2C 00 03 *C5 FE*  
Slave response: 01 03 06 13 88 17 70 0B B8 *C0 E4*  
(The voltage reference is 50.00V; The current reference is 60.00A; The power reference is 3000W.)
- Host request: 01 03 01 F4 00 03 *45 C5*  
Slave response: 01 03 0C 00 00 C3 50 00 00 EA 60 00 00 75 30 *2A 06*  
(The voltage reference is 50.000V; The current reference is 60.000A; The power reference is 3000.0W.)
- Read device address:
  - Host request: 01 03 00 00 00 01 *84 0A*  
Slave response: 01 03 02 00 01 *79 84*  
(The device address is "0x01".)
- Read device status/mode:
  - Host request: 01 03 01 33 00 01 *75 F9*  
Slave response: 01 03 02 01 07 *F8 16*  
(The output mode is power on and work mode is constant voltage.)
- Read voltage rise time, the unit of voltage rise time, voltage fall time and the unit of voltage fall time:
  - Host request: 01 03 02 59 00 04 *95 A2*  
Slave response: 01 03 08 00 1E 00 00 00 00 00 00 *6B D6*  
(The voltage rise time of the device is set to 30ms and the fall time is set to 0ms)
- Read device protection switches:
  - Host request: 01 03 03 E8 00 01 *04 7A*  
Slave response: 01 03 02 07 E3 *FB FD*  
(The protection switch code is "0x07E3".)
- Read voltage specification:
  - Host request: 01 03 07 6C 00 01 *45 63*  
Slave response: 01 03 02 00 50 *B8 78*  
(The voltage specification is 80V.)
- Read device specification(voltage, current and power specification):
  - Host request: 01 03 07 6C 00 03 *C4 A2*  
Slave response: 01 03 06 00 50 00 3C 0B B8 *26 37*  
(The device specification is 80V, 60A and 3000W.)
- Read device SN:
  - Host request: 01 03 07 CF 00 01 *B5 41*  
Slave response: 01 03 10 57 32 31 31 32 31 32 30 38 30 36 30 42 30 31 20 *9B 91*

(The device SN is “W21121208060B01”, “0x20” indicates a space.)

## 2.2 Read single/multi- input register (0x04)

<i>Register Address (Hex)</i>	<i>Name</i>	<i>Number of register(Hex)</i>	<i>Number of bytes returned (Hex)</i>
0x0064~0x0067	Input register	0x0001~0x0004	Num of reg×0x02
0x00C8~0x00CB	Input register	0x0001~0x0004	Num of reg×0x04

Table 4: 0x04 operation

### ■ Read output voltage:

- Host request: 01 04 00 64 00 01 70 15  
Slave response: 01 04 02 13 88 B4 66  
(Output voltage value is 5000, the unit is 0.01V.)
- Host request: 01 04 00 C8 00 01 B0 34  
Slave response: 01 04 04 00 00 C3 52 2A 89  
(Output voltage value is 50002, the display accuracy is 0.001V.)

### ■ Read output current:

- Host request: 01 04 00 65 00 01 21 D5  
Slave response: 01 04 02 0F A0 BC B8  
(Output current value is 4000, the unit is 0.01A.)
- Host request: 01 04 00 C9 00 01 E1 F4  
Slave response: 01 04 04 00 00 9C 48 92 B2  
(Output current value is 40008, the display accuracy is 0.001A.)

### ■ Read output power:

- Host request: 01 04 00 66 00 01 D1 D5  
Slave response: 01 04 02 07 D1 7B 5C  
(Output power value is 2001, the unit is 1W.)
- Host request: 01 04 00 CA 00 01 11 F4  
Slave response: 01 04 04 00 00 4E 2B 8E 3B  
(Output power value is 20011, the display accuracy is 0.1W.)

### ■ Read Multi-input register(Output voltage, output current, output power and device status/error status):

- Host request: 01 04 00 64 00 04 B0 16  
Slave response: 01 04 08 13 88 0F 89 07 C4 01 07 B0 E7  
(Output voltage value is 50.00V; Output current value is 39.77A; Output power

value is 1988; Device status: Remote control, Power on, Voltage priority, Normal mode, CV mode;)

- Host request: 01 04 00 C8 00 04 70 37
  - Slave response: 01 04 10 00 00 C3 59 00 00 9B 5C 00 00 4D B1 00 00 00 00 E6 2A
- (Output voltage is 50.009V; Output current is 39.772A; Output power is 1988.9W; No error;)

## 2.3 Write Single Hold Register (0x06)

<i>Register Address (Hex)</i>	<i>Name</i>	<i>Number of register (Hex)</i>	<i>Number of bytes returned (Hex)</i>
0x0000~0x0002	System config register	0x0001	0x02
0x012C~0x0135	Normal register	0x0001	0x02
0x01F4~0x01F9	Reference register	0x0001	0x04
0x03E8~0x03F8	Protection register	0x0001	0x02

Table 5: 0x06 operation

### ■ Write device address:

- Host request: 01 06 00 00 00 02 08 0B
  - Slave response: 01 06 00 00 00 02 08 0B
- (Set device address is "0x02".)

### ■ Write voltage reference:

- Host request: 01 06 01 2C 13 88 44 A9
- (Set voltage reference value 5000, the unit is 0.01V.)
- Slave response: 01 06 01 2C 13 88 44 A9
- Host request: 01 06 01 F4 00 00 C3 50 07 0F
- (Set voltage reference value 50000, the display accuracy 0.001V.)
- Slave response: 01 06 01 F4 00 00 C3 50 07 0F

### ■ Write current reference:

- Host request: 01 06 01 2D 17 70 16 2B
- (Set current reference value 6000, the unit is 0.01A.)
- Slave response: 01 06 01 2D 17 70 16 2B
- Host request: 01 06 01 F5 00 00 EA 60 25 4B
- (Set current reference value 60000, the display accuracy 0.001A.)
- Slave response: 01 06 01 F5 00 00 EA 60 25 4B

### ■ Write power reference:

- Host request: 01 06 01 2E 0B B8 EF 7D
- (Set power reference value 3000, the unit is 1W.)

Slave response: 01 06 01 2E 0B B8 *EF 7D*

➤ Host request: 01 06 01 F6 00 00 75 30 *08 87*

(Set power reference value 30000, the display accuracy 0.1W.)

Slave response: 01 06 01 F6 00 00 75 30 *08 87*

■ Write device status/mode:

➤ Host request: 01 06 01 33 80 03 *59 F8*

(Set device status/mode: remote control, open output, set error bit "1" to clear error.)

Slave response: 01 06 01 33 80 03 *59 F8*

➤ Host request: 01 06 01 33 80 01 *D8 39*

(Set device status/mode: remote control, close output, set error bit "1" to clear error.)

Slave response: 01 06 01 33 80 01 *D8 39*

■ Turn output on/off:

➤ Host request: 01 06 01 2F 00 01 *78 3F* (Power on)

Slave response: 01 06 01 2F 00 01 *78 3F*

➤ Host request: 01 06 01 2F 00 00 *B9 FF* (Power off)

Slave response: 01 06 01 2F 00 00 *B9 FF*

## 2.4 Write Single/Multi- Hold Register (0x10)

<i>Register Address (Hex)</i>	<i>Name</i>	<i>Number of register(Hex)</i>	<i>Number of bytes returned (Hex)</i>
0x0000~0x0002	System config register	0x0001~0x0003	Num of reg×0x02
0x012C~0x0135	Normal register	0x0001~0x000A	Num of reg×0x02
0x01F4~0x01F9	Reference register	0x0001~0x0006	Num of reg×0x04
0x03E8~0x03F8	Protection register	0x0001~0x0014	Num of reg×0x02

Table 6: 0x10 operation

■ Write voltage reference:

- Host request: 01 10 01 2C 00 01 02 17 70 BF 28  
(Set voltage reference value 6000, the unit is 0.01V.)  
Slave response: 01 10 01 2C 00 01 C1 FC
- Host request: 01 10 01 F4 00 01 04 00 00 EA 60 BF F3  
(Set voltage reference value 60000, the display accuracy 0.001V.)  
Slave response: 01 10 01 F4 00 01 41 C7

■ Write current reference:

- Host request: 01 10 01 2D 00 01 02 17 70 BE F9  
(Set current reference value 6000, the unit is 0.01A.)  
Slave response: 01 10 01 2D 00 01 90 3C
- Host request: 01 10 01 F5 00 01 04 00 00 EA 60 7E 3F  
(Set current reference value 60000, the display accuracy 0.001A.)  
Slave response: 01 10 01 F5 00 01 10 07

■ Write Turn on/off:

- Host request: 01 10 01 2F 00 01 02 00 01 70 CF (Turn on)  
Slave response: 01 10 01 2F 00 01 31 FC
- Host request: 01 10 01 2F 00 01 02 00 00 B1 0F (Turn off)  
Slave response: 01 10 01 2F 00 01 31 FC

■ Write voltage, current, power reference and turn output on/off:

- Host request: 01 10 01 2C 00 04 08 0B B8 17 70 0B B8 00 01 5D C1  
(Set voltage reference 30.00V, set current reference 60.00A, set power reference 3000W, and turn on.)  
Slave response: 01 10 01 2C 00 04 01 FF
- Host request: 01 10 01 2C 00 04 08 0B B8 17 70 0B B8 00 00 9C 01  
(Set voltage reference 30.00V, set current reference 60.00A, set power reference 3000W, and turn off.)  
Slave response: 01 10 01 2C 00 04 01 FF

## 2.5 Error frame format

The error frame format of the reply form the slave:

<i>Address</i>	<i>Error function</i>	<i>Error information</i>	<i>Check code</i>
8 bits	8 bits	8 bits	16 bits

Table 7: Error frame format

Note: Error information: 1. Illegal function code(0x01); 2. Error of register address(0x02);  
3. Error of the data domain(0x03); 4. Error of number of bytes(0x02);  
5. Error of the L/R mode(0x04);

■ Illegal function code:

Host request: 01 07 01 2F 00 00 84 3F

Slave response: 01 87 01 82 30

■ Error of register address:

Host request: 01 06 01 2B 13 88 F5 68

Slave response: 01 86 02 C3 A1

■ Error of the data domain:

Host request: 01 10 01 2C 00 01 02 17 71 7E E8

Slave response: 01 90 03 0C 01

■ Error of number of bytes:

Host request: 01 03 01 2C 00 01 01 FE F3

Slave response: 01 83 04 40 F3

■ Error of the L/R mode:

Host request: 01 06 01 2F 00 01 78 3F

Slave response: 01 86 04 43 A3

## Appendix

### Registers list:

<i>Address</i>	<i>Meaning</i>	<i>Num</i>	<i>Att</i>	<i>Description</i>
System config register (Single word; Read/Write)				
0/0x0000	Device address	1	RW	1~247
0/0x0001	Baud rate	1	RW	0:9600bps;1:19200 bps;2:57600 bps;3:115200 bps;4:320400 bps;
0/0x0002	CRC alignment	1	RW	0: Little endian; 1:Big endian;
Input register (Single Word; Read-Only)				
100/0x0064	Output voltage	1	RO	Unit: 0.01V <sup>(1)</sup>
101/0x0065	Output current	1	RO	Unit: 0.01A <sup>(2)</sup>
102/0x0066	Output power	1	RO	Unit: 1W <sup>(3)</sup>
103/0x0067	Status/Mode	1	RO	See "Status/Mode register"
Input register (Double Word; Read-Only)				
200/0x00C8	Output voltage	2	RO	Unit: According to display accuracy <sup>(4)</sup>
201/0x00C9	Output current	2	RO	Unit: According to display accuracy <sup>(5)</sup>
202/0x00CA	Output power	2	RO	Unit: According to display accuracy <sup>(6)</sup>
203/0x00CB	Error status	2	RO	See "Error register"
Normal register (Single word; Read/Write)				
300/0x012C	Voltage reference	1	RW	Do not save; Unit: 0.01V <sup>(1)</sup> ;
301/0x012D	Current reference	1	RW	Do not save; Unit: 0.01A <sup>(2)</sup> ;
302/0x012E	Power reference	1	RW	Do not save; Unit: 1W <sup>(3)</sup> ;
303/0x012F	Output status	1	RW	0: Power on; 1: Power off;
304/0x0130	Voltage reference	1	RW	Save; Unit: 0.01V <sup>(1)</sup> ;
305/0x0131	Current reference	1	RW	Save; Unit: 0.01A <sup>(2)</sup> ;
306/0x0132	Power reference	1	RW	Save; Unit:1W <sup>(3)</sup> ;
307/0x0133	Status/Mode	1	RW	See "Status/Mode register"
308/0x0134	Working mode	1	RW	See "Working mode" In Status/Mode register
309/0x0135	Priority	1	RW	0:No priority; 1:Voltage priority; 2:Current priority;
Reference register (Double Word; Read/Write)				
500/0x01F4	Voltage reference	2	RW	Do not save; Unit: According to display accuracy <sup>(4)</sup>

501/0x01F5	Current reference	2	RW	Do not save; Unit: According to display accuracy <sup>(5)</sup>
502/0x01F6	Power reference	2	RW	Do not save; Unit: According to display accuracy <sup>(6)</sup>
503/0x01F7	Voltage reference	2	RW	Save; Unit: According to display accuracy <sup>(4)</sup>
504/0x01F8	Current reference	2	RW	Save; Unit: According to display accuracy <sup>(5)</sup>
505/0x01F9	Power reference	2	RW	Save; Unit: According to display accuracy <sup>(6)</sup>
Function register (Single word; Read/Write)				
600/0x0258	Startup mode	2	RW	0: Local; 1: Remote;
601/0x0259	Rise time of voltage	2	RW	0~60000
602/0x025A	The unit of rise time of voltage	2	RW	0: mS; 1: S; 2: Min;
603/0x025B	Fall time of voltage	2	RW	0~60000
604/0x025C	The unit of fall time of voltage	2	RW	0: mS; 1: S; 2: Min;
605/0x025D	Rise time of current	2	RW	0~60000
606/0x025E	The unit of rise time of current	2	RW	0: mS; 1: S; 2: Min;
607/0x025F	Fall time of current	2	RW	0~60000
608/0x0260	The unit of fall time of current	2	RW	0: mS; 1: S; 2: Min;
609/0x0261	Auto-Recovery (Fault)	2	RW	0~60000
610/0x0262	Time of Auto-Recovery	2	RW	1: S; 2: Min;
611/0x0263	Auto-output (Hold)	2	RW	0:Close; 1:Enable; Default: Close;
612/0x0264	Time of auto-output	2	RW	Unit: S; Range: 0~60000
613/0x0265	Switch of auto-output	2	RW	0:Close; 1:Enable; Default: Close;
Protection register (Single word; Read/Write)				
1000/0x03E8	Protection switch	1	RW	See "Error status register"
1001/0x03E9	Over voltage value	1	RW	Unit:0.01V <sup>(1)</sup> ;Range:10%~110%rated V;
1002/0x03EA	Time of duration of over voltage	1	RW	Unit: mS; Range: 0~60000mS
1003/0x03EB	Over current value	1	RW	Unit:0.01A <sup>(2)</sup> ;Range:10%~110%rated I;

1004/0x03EC	Time of duration of over current	1	RW	Unit: mS; Range: 0~60000mS
1005/0x03ED	L1 over load value	1	RW	Unit:1W <sup>(3)</sup> ; Range:10%~120% rated P;
1006/0x03EE	Time of duration of L1 over current	1	RW	Unit: mS; Range: 0~60000mS
1007/0x03EF	L2 over load value	1	RW	Unit:1W <sup>(3)</sup> ; Range:10%~120% rated P;
1008/0x03F0	Time of duration of L2 over current	1	RW	Unit: mS; Range: 0~60000mS
1009/0x03F1	L3 over load value	1	RW	Unit:1W <sup>(3)</sup> ; Range:10%~120% rated P;
1010/0x03F2	Time of duration of L3 over current	1	RW	Unit: mS; Range: 0~60000mS
1011/0x03F3	Under voltage value	1	RW	Unit:0.01V <sup>(1)</sup> ;Range:10%~110%rated V;
1012/0x03F4	Under voltage delay	1	RW	Unit: mS; Range: 0~60000mS
1013/0x03F5	Time of duration of under voltage	1	RW	Unit: mS; Range: 0~60000mS
1014/0x03F6	Under current value	1	RW	Unit:0.01A <sup>(2)</sup> ;Range:10%~110%rated I;
1015/0x03F7	Under current delay	1	RW	Unit: mS; Range: 0~60000mS
1016/0x03F8	Time of duration of under current	1	RW	Unit: mS; Range: 0~60000mS
1017/0x03F9	Voltage value in short-circuit	1	RW	Unit:0.01V <sup>(1)</sup> ;Range:10%~110%rated V;
1018/0x03FA	Short-circuit delay	1	RW	Unit: mS; Range: 0~60000mS
1019/0x03FB	Time of duration of short-circuit	1	RW	Unit: mS; Range: 0~60000mS
Special register(Multi-word; Read-Only)				
1900/0x076C	Voltage specification	1	RO	Unit: 1V
1901/0x076D	Current specification	1	RO	Unit: 1A
1902/0x076E	Power specification	1	RO	Unit: 1W
1996/0x07CC	User Code1	8	RO	16 characters; The space indicates undefined;
1997/0x07CD	User Code2	8	RO	16 characters; The space indicates undefined;
1998/0x07CE	User Code3	8	RO	16 characters; The space indicates undefined;
1999/0x07CF	SN	8	RO	The SN coding; The space indicates undefined;

Table 8: Registers list

## Note:

- (1) The Voltage unit: 0.01V(Specification is less than 1000V);  
The unit: 0.1V(Specifications greater than or equal to 1000V);
- (2) The current unit: 0.01A(Specification is less than 1000A);  
The unit: 0.1A(Specifications greater than or equal to 1000A);
- (3) The power unit: 1W(Specification is less than 10KV);  
The unit: 10W(Specifications greater than or equal to 10W);
- (4) The voltage Display accuracy unit:0.001V (10~99V specification) ;  
0.01V (100~999V specification); 0.1V (Greater than or equal to 1000V specification);
- (5) The current Display accuracy unit:0.0001A (0~9.9A specification) ;  
0.001A (10~99A specification); 0.01A (Greater than or equal to 100A specification);
- (6) The power Display accuracy unit:0.1W (0~999W specification) ;  
0.1W (1kW~9.999KW specification); 1W (Greater than or equal to 10KW specification);

## Status/Mode register

<i>183/0x00B7 (Read-Only) , 207/0x00CF (Read/Write)</i>			
Bits	Name	Att	Description
0	Local/Remote mode	RW	0: Local control; 1: Remote control;
1	Turn on/off Status	RW	0: Turn off; 1: Turn on;
2-3	Priority	RO	1: Voltage priority; 2: Current priority;
4-7	Working mode	RO	0: Normal mode (CV/CC/CP); 1: CV Steps; 2: CC Steps; 3: Hybrid Steps; 4: Charge mode; 5: Saved; 6: Sine wave mode; 7: STW mode; 8: Rectangle wave mode; 9: Line wave mode; 10: Hybrid wave mode;
8-9	Output mode	RO	1: CV output; 2: CC output; 3: CP output;
10-11	Voltage slope status	RO	0: Not in slope stage; 1: In rising stage; 2: In falling stage;
12-13	Current slope status	RO	0: Not in slope stage; 1: In rising stage; 2: In falling stage;
14	Saved	---	---
15	Error status	RW	0: No Error; 1: Error; Write "1" in this bit to clear the error;

Table 9: Status/Mode register

## Error status register:

<i>203/0x00CB (Read-Only)</i>			
Bits	Name	Att	Description
0	Over voltage Protection	R0	Detect software OVP
1	Over current Protection		Detect software OCP
2	Over load Protection		Detect software OPP
3	Under Voltage Protection		Detect software UVP
4	Under current Protection		Detect software UCP
5	Short-circuit protection		Detect software SCP
6	Over temp Protection		Detect OTP
7	Saved		---
8	HW over voltage Protection		Detect hardware OVP
9	HW over current Protection		Detect hardware OCP
10	Error of Failover		10 Failovers were detected
11-13	Saved		---
14	Driver error		Detect the driver error
15	Main board error		Detect the main board error
16	Write EEPROM Error		
17	Read EEPROM Error		
18	Write Flash Error		
19	Read Flash Error		
20-31	Saved		---

Table 10: Error status register

## CRC-16 in C language version

```
#define u8 unsigned char
#define u16 unsigned int

u16 CRC16(u8 *buf, u8 len)
{
    u16 crc = 0xFFFF;
    u8 i = 0;
    u8 j = 0;
    u8 Data = 0;

    for (j = 0; j < len; j++)
    {
        crc=crc^*buf++;
        for (i=0; i<8; i++)
        {
            if((crc&0x0001) > 0)
            {
                crc=crc>>1;
                crc=crc^0xa001;
            }
            else
            {
                crc=crc>>1;
            }
        }
    }
    return crc;
}
```