

OffGrid Modbus RS485&RS232 RTU Protocol

V0.17

2022-06-22

No.	Version	Date	Notice	Signature
1	V0.01	2016-12-27	The first version	Zhenyuan.li
2	V0.02	2017-1-12	1、modify input reg 0, system status; 2、add input reg 44 for send DTC to server to identify machine type;	Zhenyuan.li
3	V0.03	2017-2-6	1、modify Holding reg 29, Model Low;	Zhenyuan.li
4	V0.04	2017-2-16	1、add Holding reg 39, battery type; 2、modify Holding reg 0, On/Off; 3、modify Input reg 46, Production Line Mode;	Zhenyuan.li
5	V0.05	2017-3-10	1、modify Input reg 17、28、29, Battery Voltage;	Zhenyuan.li
6	V0.06	2017-3-15	1、modify Holding reg 29, Model L;	Zhenyuan.li
7	V0.07	2017-5-25	1、modify Hold reg 29; 2、modify Input reg 36~39; 3、add Input reg 68~82;	Zhenyuan.li
8	V0.08	2017-5-26	1、add Input reg 90~131 for BMS infomation;	Zhenyuan.li
9	V0.09	2017-7-4	1、add Input reg 135~179 for SolarCharger infomation;	Zhenyuan.li
10	V0.10	2017-7-12	1、add Input reg 83~86 for Machine Rate Power ;	Zhenyuan.li
11	V0.11	2017-8-09	1、Change Machine Rate Power from Input Reg 83~86 to Holding Reg 76~79; 2、Adjust BMS info, and add BMS2 info; 3、Add Solar Charger Info at Input Reg 180~224;	Zhenyuan.li
12	V0.13	2020-06-16		Jianjian.Yu
13	V0.14	2020-10-16	Modify 37,82,95 holding register's description	Jianjian.Yu
14	V0.15	2020-04-20	Add 41 and 42 new function of holding register; Modify 43 of input register;	Xiao.jin

15	V0.16	2021-07-20	Add 102~107 registers for remote debug	Jianjian.yu
16	V0.17	2022-06-22	Modify 45~47 registers for Export to Grid Energy	JianJian.yu

1 Data format	4
2 Command Format	4
3 Device Message Transmission Mode / Framing	7
4 Register map	8
5 Set address	24
6 Notice	24

1 Data format

Address	Function	Data	CRC check
8 bits	8 bits	N×8bits	16bits

Valid slave device addresses are in the range of 0 – 247 decimal.

The individual slave devices are assigned addresses in the range of 1 – 247.

0 is the broadcast address

253 only for debug

It is 16bits (two bytes) unsigned integer for each holding and input register;

2 Command Format

Function 3 Read holding register

QUERY	
Field Name	Example (Hex)
Slave Address	01
Function	03
Starting Address Hi	00
Starting Address Lo	6B
No. of Points Hi	00
No. of Points Lo	03
Error Check (LRC or CRC)	—

RESPONSE	
Field Name	Example (Hex)
Slave Address	01
Function	03
Byte Count	06
Data Hi (Register 40108)	02
Data Lo (Register 40108)	2B
Data Hi (Register 40109)	00
Data Lo (Register 40109)	00
Data Hi (Register 40110)	00
Data Lo (Register 40110)	64
Error Check (LRC or CRC)	—

Response Error:

11 0x80|0x03 Errornum CRC (Errornum as a byte)

Function 4 Read input register

QUERY	
Field Name	Example (Hex)
Slave Address	01
Function	04
Starting Address Hi	00
Starting Address Lo	08
No. of Points Hi	00
No. of Points Lo	01
Error Check (LRC or CRC)	—

RESPONSE	
Field Name	Example (Hex)
Slave Address	01
Function	04
Byte Count	02
Data Hi (Register 30009)	00
Data Lo (Register 30009)	0A
Error Check (LRC or CRC)	—

Response Error:

11 0x80|0x04 Errornum CRC (Errornum as a byte)

Function 6 Preset single register

QUERY	
Field Name	Example (Hex)
Slave Address	01
Function	06
Register Address Hi	00
Register Address Lo	01
Preset Data Hi	00
Preset Data Lo	03
Error Check (LRC or CRC)	—

RESPONSE	
Field Name	Example (Hex)
Slave Address	01
Function	06
Register Address Hi	00
Register Address Lo	01
Preset Data Hi	00
Preset Data Lo	03
Error Check (LRC or CRC)	—

Response Error:

11 0x80|0x06 Errornum CRC (Errornum as a byte)

Function 16 Preset multiple register

QUERY	
Field Name	Example (Hex)
Slave Address	01
Function	10
Starting Address Hi	00
Starting Address Lo	01
No. of Registers Hi	00
No. of Registers Lo	02
Byte Count	04
Data Hi	00
Data Lo	0A
Data Hi	01
Data Lo	02
Error Check (LRC or CRC)	—

RESPONSE	
Field Name	Example (Hex)
Slave Address	01
Function	10
Starting Address Hi	00
Starting Address Lo	01
No. of Registers Hi	00
No. of Registers Lo	02
Error Check (LRC or CRC)	—

Response Error:

11 0x80|0x10 Errornum CRC (Errornum as a byte)

3 Device Message Transmission Mode / Framing

RTU Mode

When controllers are setup to communicate on a Modbus network using RTU (Remote Terminal Unit) mode, each 8-bit byte in a message contains two 4-bit hexadecimal characters. Each message must be transmitted in a continuous stream.

The format for each byte in RTU mode is:

- Coding System: 8-bit binary, hexadecimal 0–9, A–F
- Two hexadecimal characters contained in each 8-bit field of the message

Bits per Byte:

- 1 start bit
- 8 data bits, least significant bit sent first
- None parity
- 1 stop bit
- Error Check Field: Cyclical Redundancy Check (CRC)

The baud rate of the transmission is:

- Baud Rate: 9600 bps

Minimum CMD period (RS485 Time out): 850ms.

- Wait for minimum 850ms to send a new CMD after last CMD. Suggestion is 1s;

Maximum Data Length Define:

- Maximum read data length is 45 words in read command;
- Maximum update data length is 45 words in preset command;
- Read or update registers NO. should in the range of times of 45,
eg: 1~45 or 96~123 are OK, but 40~60 is not OK;

4 Register map

It is 16bits (two bytes) unsigned integer for each holding and input register;

4.1 Holding Reg

Reg NO.	Variable Name	Description	Customer Write	Value	Unit	Initial value	Note
00	On/Off	The Standby On/Off state and the AC output DisEN/EN state; The low byte is the Standby on/off(1/0), the high byte is the AC output disable/enable (1/0).		0x0000: Output enable; 0x0100: Output disable;		0	
01	OutputConfig	AC output set	W	0: BAT First; 1: PV First; 2: UTI First; 3: PV&UTI First		0	
02	ChargeConfig	Charge source set	W	0: PV first; 1: PV&UTI; 2: PV Only;		0	
03	UtiOutStart	Uti Output Start Time	W	0-23	H(hour)	0	
04	UtiOutEnd	Uti Output End Time	W	0-23	H(hour)	0	
05	UtiChargeStart	Uti Charge Start Time	W	0-23	H(hour)	0	
06	UtiChargeEnd	Uti Charge End Time	W	0-23	H(hour)	0	
07	PVModel	PV Input Mode	W	0:Independent; 1: Parallel;		0	
08	ACInModel	AC Input Mode	W	0: APL,90-280VAC; 1: UPS,170-280VAC; 2: GEN		0	
09	Fw version H	Firmware version (high)			ASCII		
10	Fw version M	Firmware version (middle)					
11	Fw version L	Firmware version (low)					
12	Fw version2 H	Control Firmware version (high)			ASCII		

13	Fw version2 M	Control Firmware version (middle)					
14	Fw version2 L	Control Firmware version (low)					
15	LCD language	LCD language	W	0-1		1	English
16	GridV_Adj						
17	InvV_Adj						
18	OutputVoltType	Output Volt Type	W	0: 208VAC; 1: 230VAC 2: 240VAC 3:220VAC 4:100VAC 5:110VAC 6:120VAC		1	
19	OutputFreqType	Output Freq Type	W	0: 50Hz; 1: 60Hz		0	
20	OverLoadRestart	Over Load Restart	W	0:Yes; 1:No; 2: Swith to UTI;		0	Yes(over Load 1mins to restart, after over Load three times to stop output)
21	OverTempRestart	Over Temperature Restart	W	0:Yes; 1:No;		0	Yes(over Temperature to restart , after over Temperature three times to stop output)
22	BuzzerEN	Buzzer on/off enable	W	1:Enable; 0:Disable;		1	
23	Serial NO. 5	Serial number 5	W		ASCII		
24	Serial No. 4	Serial number 4	W				
25	Serial No. 3	Serial number 3	W				
26	Serial No. 2	Serial number 2	W				
27	Serial No. 1	Serial number 1	W				
28	Moudle H	Inverter Moudle (high)	W	0: model can be modify 1: model can't modify			Can be set at standby state Only
29	Moudle L	Inverter Moudle (low)	W	eg: 50 for 5.0KW model	0.1K		Can be set at standby state Only
30	Com Address	Communicate address	W	1~254 , but 253 only for debug		1	

31	FlashStart	Update firmware	W	0x0001: own 0X0100: control broad			
32	Reset User Info	Reset User Information	W	0x0001			
33	Reset to factory	Reset to factory	W	0x0001			
34	MaxChargeCurr	Max Charge Current	W	0~400	1A	70	
35	BulkChargeVolt	Bulk Charge Volt	W	500~640	0.1V	564	
36	FloatChargeVolt	Float Charge Volt	W	500~560	0.1V	540	
37	BatLowToUtiVolt	Bat Low Volt Switch To Uti	W	200~640 (non Lithium) or 5~100 (Lithium)	0.1V Or 1%	460 Or 50%	
38	ACChargeCurr	AC Charge Current	W	0~100	1A	30	
39	Battery Type	Battery Type	W	0: AGM 1: FLD 2: USE 3: Lithium; 4: USE2		1	Can be set at standby state Only
40	Aging Mode	Aging Mode	W	0: Normal Mode; 1: Aging Mode;		0	Can be set at standby state Only
41	Function Mask		W	bit0=Etl check enable			0:Disable; 1:Enable;
				bit1=Pv ISO Check enable			0:Disable; 1:Enable;
				bit2~bit15: reserved			
42	Safety Type		W	1: standard 2. ETL 3. AS4777 4. CQC 5. VDE4105			
43	DTC	Device Type Code		&*6			
44							
45	Sys Year	System time-year	W	Year offset is 2000			
46	Sys Month	System time- Month	W				
47	Sys Day	System time- Day	W				
48	Sys Hour	System time- Hour	W				
49	Sys Min	System time- Min	W				
50	Sys Sec	System time- Second	W				
51							
52	uwAcVoltHighL						
53	uwAcVoltLowL						

54	uwAcFreqHighL						
55	uwAcFreqLowL						
56							
57							
58							
59	Manufacturer Info 8	Manufacturer information (high)			ASCII		
60	Manufacturer Info 7	Manufacturer information (middle)					
61	Manufacturer Info 6	Manufacturer information (low)					
62	Manufacturer Info 5	Manufacturer information (high)					
63	Manufacturer Info 4	Manufacturer information (middle)					
64	Manufacturer Info3	Manufacturer information (low)					
65	Manufacturer Info 2	Manufacturer information (low)					
66	Manufacturer Info 1	Manufacturer information (high)			ASCII		
67	FW Build No. 4	Control FW Build No. 2					
68	FW Build No. 3	Control FW Build No. 1					
69	FW Build No. 2	COM FW Build No. 2					
70	FW Build No. 1	COM FW Build No. 1					
71							
72	Sys Weekly	Sys Weekly	W	0-6			
73	ModbusVersion	Modbus Version		Eg: 207 is V2.07	Int(16bits)		
74							For par avg power
75	SCC_ComMode	SCC Communication Mode					For BMS board, SCC cntrl
76	Rate Watt H	Rate active power(high)			0.1W		
77	Rate Watt L	Rate active			0.1W		

		power(low)					
78	Rate VA H	Rata apparent power (high)			0.1VA		
79	Rate VA L	Rate apparent power (low)			0.1VA		
80	ComboardVer	Communicaiton board Version					For bms boad
81	uwBatPieceNum						
82	wBatLowCutOff	Bat voltage low cutoff		200~640 (non Lithium) or 5~100 (Lithium)	0.1V Or 0.1%	460 Or 50.0%	
83							
84	NomGridVolt						
85	NomGridFreq						
86	NomBatVolt						
87	NomPvCurr						
88	NomAcChgCurr						
89	NomOpVolt						
90	NomOpFreq						
91	NomOpPow						
92							
93							
94							
95	uwAC2BatVolt	AC switch to Battery		200~640 (non Lithium) or 5~100 (Lithium)	0.1V Or 1%	460 Or 50%	
96	BypEnable						
97	PowSavingEn						
98	SpowBalEn						
99	ClrEnergyToday						
100	clrEnergyAll						
101	BurnInTestEn						
102	ManualStartEn						
103	SciLossChkEn						
104	BlightEn						
105	ParaMaxChgCurr	Parallel System Maximum charge current					
106	LiProtocolType	Protocol type for battery			1~99	1	
107	AudioAlarmEn						
108	uwEqEn						

109	uwEqChgVolt						
110	uwEqTime						
111	uwEqTimeOut						
112	uwEqInterval						
113	uwMaxDisChgCurr						
162	BLVersion2	Boot loader version2	R				M3 bootloader version

4.2 Input Reg

(Some of input Registers can be wrote by Manufacturer, write address offset is 0x1000, start at 0x1000. Can not be wrote by customer.)

Reg NO.	Variable Name	Description	Value	Unit	Note
00	System Status	System run state	0: Standby 1: PV&Grid Supporting Loads 2: Battery Discharging 3: Fault 4: Flash 5: PV Charging 6: Grid Charging 7: PV&Grid Charging 8: PV&Grid Charging+Grid Bypass 9: PV Charging+Grid Bypass 10: Grid Charging+Grid Bypass 11: Grid Bypass 12: PV Charging+Loads Supporting 13: Export to Grid		
01	Vpv1	PV1 voltage		0 . 1 V	
02	Vpv2	PV2 voltage		0 .	

				1 V
03	Ppv1 H	PV1 charge power (high)		0 . 1 W
04	Ppv1 L	PV1 charge power (low)		0 . 1 W
05	Ppv2 H	PV2 charge power (high)		0 . 1 W
06	Ppv2 L	PV2 charge power (low)		0 . 1 W
07	Buck1Curr/Pv1Curr	Buck1 current or Pv1 current		0 . 1 A
08	Buck2Curr/Pv2Curr	Buck2 current or Pv2 current		0 . 1 A
09	OP_Watt H	Output active power (high)		0 . 1 W
10	OP_Watt L	Output active power (low)		0 . 1 W
11	OP_VA H	Output apparent power (high)		0 . 1 V A
12	OP_VA L	Output apparent power (low)		0 . 1 V A

13	ACChr_Watt H	AC charge watt (high)		0 . 1 W
14	ACChr_Watt L	AC charge watt (low)		0 . 1 W
15	ACChr_VA H	AC charge apparent power (high)		0 . 1 V A
16	ACChr_VA L	AC charge apparent power (low)		0 . 1 V A
17	Bat Volt	Battery volt (M3)		0 . 0 1 V
18	BatterySOC	Battery SOC	0~100	1 %
19	Bus Volt	Bus Voltage		0 . 1 V
20	Grid Volt	AC input Volt		0 . 1 V
21	Line Freq	AC input frequency		0 . 0 1 H z
22	OutputVolt	AC output Volt		0 . 1 V

23	OutputFreq	AC output frequency		0 . 0 1 H z
24	Ouput DCV	Ouput DC Volt		0 . 1 V
25	InvTemp	Inv Temperature		0 . 1 C
26	DcDc Temp	DC-DC Temperature		0 . 1 C
27	LoadPercent	Load Percent	0~1000	0 . 1 %
28	Bat_s_Volt	Battery-port volt (DSP)		0 . 0 1 V
29	Bat_Volt_DSP	Battery-bus volt (DSP)		0 . 0 1 V
30	Time total H	Work time total (high)		0 . 5 S
31	Time total L	Work time total (low)		0 . 5 S
32	Buck1_NTC	Buck1 Temperature		0 . 1 C

33	Buck2_NTC	Buck2 Temperature		0 . 1 C	
34	OP_Curr	Output Current		0 . 1 A	
35	Inv_Curr	Inv Current		0 . 1 A	
36	AC_InWatt H	AC input watt (high)	(signed int 32) > 0 : get energy from grid	0 . 1 W	
37	AC_InWatt L	AC input watt (low)	< 0: export energy to Grid	0 . 1 W	
38	AC_InVA H	AC input apparent power (high)		0 . 1 V A	
39	AC_InVA L	AC input apparent power (low)		0 . 1 V A	
40	Fault bit	fault bit	&*1		
41	Warning bit	Warning bit	&*1		
42	Warning bit high				
43	warning value	warning value			
44	DTC	Device Type Code	&*6		
45	Export to Grid Today	Today's energy feed to grid		0 . 1 K W H	
46	Export to Grid Total H	Total energy feed to grid H		0 . 1	

				K W H	
47	Export to Grid Total L	Total energy feed to grid L		0 . 1 k W H	
48	Epv1_today H	PV Energy today			
49	Epv1_today L	PV Energy today		0 . 1 k W h	
50	Epv1_total H	PV Energy total			
51	Epv1_total L	PV Energy total		0 . 1 k W h	
52	Epv2_today H	PV Energy today			
53	Epv2_today L	PV Energy today		0 . 1 k W h	
54	Epv2_total H	PV Energy total			
55	Epv2_total L	PV Energy total		0 . 1 k W h	
56	Eac_chrToday H	AC charge Energy today			
57	Eac_chrToday L	AC charge Energy today		0 . 1 k W	

				h	
58	Eac_chrTotal H	AC charge Energy total			
59	Eac_chrTotal L	AC charge Energy total		0	
				.	
				1	
				k	
				W	
				h	
60	Ebat_dischrToday H	Bat discharge Energy today			
61	Ebat_dischrToday L	Bat discharge Energy today		0	
				.	
				1	
				k	
				W	
				h	
62	Ebat_dischrTotal H	Bat discharge Energy total			
63	Ebat_dischrTotal L	Bat discharge Energy total		0	
				.	
				1	
				k	
				W	
				h	
64	Eac_dischrToday H	AC discharge Energy today			
65	Eac_dischrToday L	AC discharge Energy today		0	
				.	
				1	
				k	
				W	
				h	
66	Eac_dischrTotal H	AC discharge Energy total			
67	Eac_dischrTotal L	AC discharge Energy total		0	
				.	
				1	
				k	
				W	
				h	
68	ACChrCurr	AC Charge Battery Current		0	
				.	
				1	
				A	
69	AC_DisChrWatt H	AC discharge watt (high)		0	
				.	
				1	

				W
70	AC_DisChrWatt L	AC discharge watt (low)		0 . 1 W
71	AC_DisChrVA H	AC discharge apparent power (high)		0 . 1 V A
72	AC_DisChrVA L	AC discharge apparent power (low)		0 . 1 V A
73	Bat_DisChrWatt H	Bat discharge watt (high)		0 . 1 W
74	Bat_DisChrWatt L	Bat discharge watt (low)		0 . 1 W
75	Bat_DisChrVA H	Bat discharge apparent power (high)		0 . 1 V A
76	Bat_DisChrVA L	Bat discharge apparent power (low)		0 . 1 V A
77	Bat_Watt H	Bat watt (high)	(signed int 32) Positive: Battery Discharge Power; Negative: Battery	0 . 1 W
78	Bat_Watt L	Bat watt (low)	Charge Power;	0 . 1 W
79	uwSlaveExistCnt	The number for slaves		
80				

81	MpptFanSpeed	Fan speed of MPPT Charger	0~100	1 %	
82	InvFanSpeed	Fan speed of Inverter	0~100	1 %	
83	TotalChgCur	Total Charge current		0 . 1 A	
84	TotalDisChgCur	Total DisCharge current		0 . 1 A	
85	Eop_dischrToday_H	Op discharge Enerday today			
86	Eop_dischrToday_L				
87	Eop_dischrTotal_H	Op discharge Enerday total			
88	Eop_dischrTotal_L				
90	ParaChgCurr	Para system charge current		0 . 1 A	
102	Var1 Value				(Read only)
103	Var2 Value				(Read only)
104	Var1 address				Write offset: 0x1000 Eg: 0x1104 for Var1 write address
105	Var2 address				Write offset: 0x1000
106	Var1 Setting				Write offset: 0x1000
107	Chip Select		01 for Master		Write

			02 for Slave	offset: 0x1000
--	--	--	--------------	-------------------

&*0: run state

value	status description	状态描述
0	Standby	待机模式
1	PV&Grid Supporting Loads	光伏与市电联合带载
2	Battery Discharging	电池放电
3	Fault	故障
4	Flash	烧录模式（监控上不显示）
5	PV Charging	光伏充电
6	Grid Charging	市电充电
7	PV&Grid Charging	光伏与市电联合充电
8	PV&Grid Charging+Grid Bypass	联合充电且旁路带载
9	PV Charging+Grid Bypass	光伏充电且旁路带载
10	Grid Charging+Grid Bypass	市电充电且旁路带载
11	Grid Bypass	旁路带载
12	PV Charging+Loads Supporting	光伏充电且逆变带载
13	Export to Grid	并网发电

&*1: Off Grid Inverter fault code Bit(See &*8):

Fault type value	Means(The message showed on the inverter when the inverter has fault)
1	Fan lock 风扇故障
2	Over Temperature 过温
3	Bat Voltage High 电池电压过高
4	Battery low 电池欠压
5	Output short 输出短路
6	Output voltage high 输出电压过高
7	Over Load 过载
8	Bus voltage high 直流母线电压过高
9	Bus start fail 直流母线软起失败
11	Main relay fail 主机继电器损坏

51	over current 过流
52	Bus voltage low 直流母线电压过低
53	inverter softstart fail 逆变软起失败
56	IGBT Over Current IGBT 过流
58	output voltage low 输出电压过低
60	negtive power 负功过大
61	PV voltage high PV 电压过高
62	SCI com error 内部通讯故障
80	can fault Can 通讯失败
81	host loss 主机丢失

&*6: DTC(Device type code)

Code No.	Device type	Note
03xxx	PV Storage	Front 1 tracker PV Storage

&*8: Off Grid Inverter warning code

Warning code		
Warning bit(41)		
0x0001	Fan lock warning (01)	风扇被锁
0x0002	Over charge (03)	电池过充
0x0004	Battery voltage low (04)	电池电压过低
0x0008	Over load (07)	过载
0x0010	Op power derating (10)	输出功率降额
0x0020	Solar stop due to bat low (12)	电池过低太阳能停止充电
0x0040	Solar stop due to Pv high (13)	太阳能电压过高太阳能停止充电
0x0080	solar stop due to over load (14)	过载太阳能停止充电
0x0100	Grid different(15)	并机市电输入不一致
0x0200	Grid phase error(16)	并机输入相序错误
0x0400	Op phase loss(17)	并机输出缺相
0x0800	Over temprature(02)	过温
0x1000	Buck current over(18)	Buck 电流过大
0x2000	Battery disconnected(19)	电池未接

0x4000	BMS com error(20)	BMS 通讯失败
0x8000	Pv power insufficient(21)	Pv 功率不足
Warning bit high(42)		
0x0001	No bat parallel disable(22)	无电池不并机
0x0002	Parallel version different(23)	并机版本不兼容
0x0004		
0x0008	Capacity different(25)	并机机器容量不一致
0x0010	Host Loss(81)	主机丢失
0x0020	BmsCellOverVolt(34)	BMS 单体过压
0x0040	BmsTotalOverVolt(36)	BMS 整体过压
0x0080	BmsDischgOverCurr(38)	BMS 放电过流
0x0100	BmsChgOverCurr(39)	BMS 充电过流
0x0200	BmsOverTemp(43)	BMS 过温
0x0400	Battery voltage consistent(63)	

5 Set address

You can set any address except 253 (reserve for debug)

6 Notice

- 1) It can drive mostly 32 pv inverters for one rs485 comport.
- 2) There are only read input and hold registers commands even the newest version.
- 3) App user could only care the input register.
- 4) App user could not care the holding registers.