



**GOODWE**  
YOUR SOLAR ENGINE

Technical Information

# GOODWE EMS PROTOCOL (MODBUS RTU)

For ES/EM/S-BP/BP Series

VER: 2.5    UPDATED ON FEBRUARY 24<sup>TH</sup> , 2020



# CONTENTS

CHANGE RECORDS .....	01
<b>1.</b> General Protocol Information .....	02
<b>2.</b> Data Frame Format .....	03
<b>3.</b> System Wiring Instruction .....	04
<b>4.</b> Address and Property of Register .....	04
<b>5.</b> Read Only Data Table List .....	09
<b>6.</b> Operation Examples .....	16
<b>7.</b> CRC16 Method .....	17

CHANGE RECORDS

Ver.	Date	Modification	Prepared by	Approved by
1.0				
1.1	20171030	Add register 0x0560-0x059C	Xu	
1.2	20171103	Add register 0x0535-0x0543	Xu	
1.3	20171110	Adjust the order of address 0x561-0x577	Xu	
1.4	20171222	add self-test register 0x7100-0x7118 , 0x059E 0x59F	Xu	
1.5	20180112	Add DSP and ARM internal edit version 0x229-0x22E Add E-Total-PV register 0x52D-0x52E	Xu	
1.6	20180323	Add register 0x0547~0x054D	Xu	
1.7	20180531	Delete 0x229-0x22E Add 0x229~0x22B , 0x5A0~0x5A1 , 0x7119 Add 0x200~0x207 and 0x210~0x214 Write Function	LS	Xu
1.8	20180614	Add 0x6000~0x601C meter data	LS	Xu
1.9	20181123	ADD 0x05A2~0x05A5	LS	Xu
2.0	20190923	ADD register 0x0600 ADD register 0x0700~0x0710 ADD register 0x0780~0x07FF ADD register 45200~45509 ADD register 47010 ADD Table8-6 (register 0x050F Inverter Warning Code)	LS	Xu
2.1	20191114	Correct Table error	LS	Xu
2.2	20191202	1.Table association error correction 2.Add 0x05A7 "" 0x05A8 registers	LS	Xu
2.3	20191211	Add 0x711A 0x711B registers(cei-021:27.s2)	LS	xu
2.4	20191221	Add 35250~35261 registers. Add Table 8-30, Table 8-31, Table 8-32.	Ls	xu
2.5	20200220	Add Bit 16 ~Bit 19 Error Message in Table 8-8 Change Mode code description in Table 8-11 Add Explanation in Table 8-14		

## 1. PROTOCOL DESCRIPTION

This is a map document of standard MODBUS RTU protocol for only GoodWe energy storage inverters compatible with LV battery – ES, EM, SBP series.

Inverter Address: Can be assigned from 1~247. 247 is factory default assignment.

Communication baud rate: The default baud rate is 9600 bps, which is adjustable up to 38400 bps

Function Code:

03H: Read Operation (NOTE: can read more than one registers at once)

10H: Write Operation (NOTE: All data support single write, the same background color can be written continuously.)

CRC Code Verification

CRC multinomial:  $X^{16}+X^{12}+X^5+1$

CRC verification covers first byte to the last byte before CRC data.

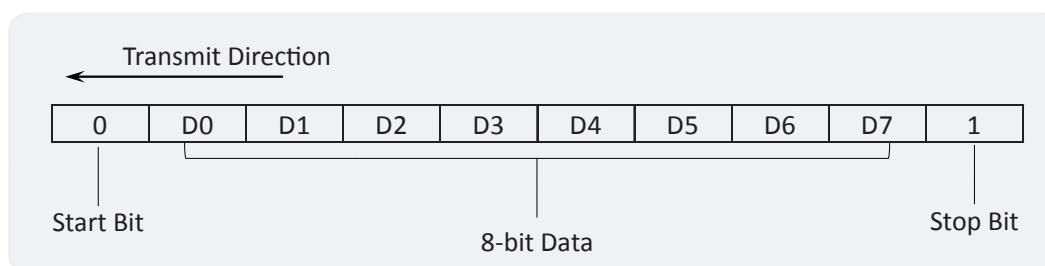
Refer to chapter 11 to implement CRC verification

Character Explanation:

**INT16U**: Unsigned Integer;    **INT16S**: Signed Integer;    **INT32U**: Long Integer ;    **INT8U**: Byte  
**R**----Read Only;    **W**----Write Only;    **R/W**----Read and Write

**Byte Format:**

Every byte consists of one start bit, eight-bit data and one stop bit, 10 bit in total. The byte transmit sequence is described as below. D0 is the lowest bit of data and D7 is the highest bit of data.



**Communication Data Format:**

Data is transmitted as word or double word format.

Data Type	Amount of Register	Amount of Byte	Description
Short integer	1	1	
Integer	1	2	High byte first, and low byte follow
Long integer	2	4	As 2 words, high word first and low word follow
Float			

## 2. Data Frame Format

### 2.1 Data Frame Format from AP

Data NO	Content	Sample	Description
1	Inverter Address	1	Communication address (1-247)
2	03H	03H	Function code
3	High byte of first register	00H	Address of first register
4	Low byte of first register	01H	
5	High byte of amount	00H	Amount of register
6	Low byte of amount	02H	
7	High byte of CRC16 code	95H	CRC Code of verification
8	Low byte of CRC16 code	CBH	

### 2.2 Data Frame Format from Inverter (When OK)

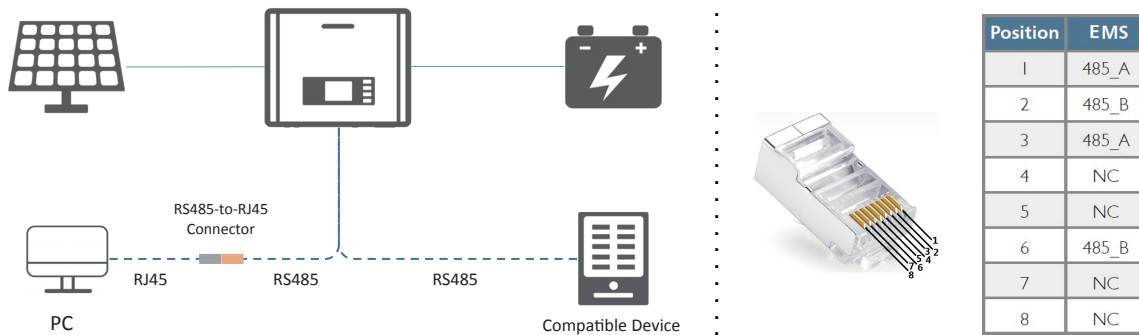
Data NO	Content	Description
1	Inverter Address	Communication address (1-247)
2	03H	Function code
3	Amount of byte of data (2N)	Amount of byte of data
4	High byte of data of first register	High byte of first register
5	Low byte of data of first register	Low byte of first register
...	...	...
2N+2	High byte of data of the Nth register	High byte of the Nth register
2N+3	Low byte of data of the Nth register	Low byte of the Nth register
2N+4	High byte of CRC16 verification code	High byte of CRC16 verification code
2N+5	Low byte of CRC16 verification code	Low byte of CRC16 verification code

### 2.3 Data Frame Format from Inverter (When NG)

Data NO	Content	Description
1	Inverter Address	Communication Address (1-247)
2	83H	Function code
3	02H	Fault Code
4	High byte of CRC16 verification code	High byte of CRC16 verification code
5	Low byte of CRC16 verification code	Low byte of CRC16 verification code

### 3. System Wiring Instruction

This is the basic wiring and instructions before starting reading interactive log between GoodWe energy storage inverter and the compatible device, which is to be connected by EMS port on inverter.



Solar inverter must be powered up by DC or AC power before it can communicate successfully to the compatible device. And the laptop is connected in parallel with compatible device by RS485 cable and a RS485-to-RJ45 connector to PC.

### 4. Address and Property of Register

Note: Registers under the same table head (separated by color) could be send at the same time

Address (Hex)	Name of Data	Cont.	Unit	Data Format	(R.W)	Data Range	Remarks
<b>Hybrid Inverter Information Data</b>							
0200~0207 (8)	Serial Number of Inverter			ASCII	R		ASCII code, 16 bytes
0208~0209 (2)	Nom Vpv			ASCII	R		ASCII code, 4 bytes
020A~020C (3)	Firmware Version			ASCII	R		ASCII code, 6 bytes
0210~0214 (5)	Model Name of Inverter			ASCII	R		ASCII Code, 10 Bytes
0215~021A (6)	DSP Firmware Ver			ASCII	R		Example '410-00000-00'
021B~0220 (6)	ARM Firmware Ver			ASCII	R		Example '410-02000-00'
0221~0228 (8)	Manufacturer Info			ASCII	R		'GOODWE' = 'xxh xxh xxh xxh xxh 20h 20h...20h'
0229	Firmware Version(0x16)			INT1 6U	R		0x01 0x81 Index :0x16
022A	ARM Updata Result			INT1 6U	R		0x00: normal 0x01: Bin file OK
022B	DSP Updata Result			INT1 6U	R		0x02: Update Success 0x14: Bin file NG 0x15 :Update Fail

Addr. (Hex)	Name of Data	Cont.	Unit	Data Format	(R.W)	Data Range	Remarks
Hybrid Inverter Run Data							
0500	Vpv1		0.1V	INT16U	R		PV1 voltage
0501	Ipv1		0.1A	INT16U	R		PV1 current
0502	PV1 Mode		NA	INT16U	R		PV1 Module work mode, see Table 8-4
0503	Vpv2		0.1V	INT16U	R		PV2 voltage
0504	Ipv2		0.1A	INT16U	R		PV2 current
0505	PV2 Mode		NA	INT16U	R		PV2 Module work mode, see Table 8-4
0506	Vbattery1		0.1V	INT16U	R		First group battery voltage
0507	TBD		NA	INT16U	R		
0508	BMS Status		NA	INT16U	R		BMS Status, see Table 8-5
0509	BMS Pack Temperature		0.1°C	INT16U	R		
050A	Ibattery1		0.1A	INT16U	R		First group battery current
050B	BMS Charge I <sub>max</sub>		1A	INT16U	R		
050C	BMS Discharge I <sub>max</sub>		1A	INT16U	R		
050D	BMS Error Code		NA	INT16U	R		see Table 8-8

050E	SOC		1%	INT16U	R		Battery SOC
050F	Inverter Warning Code		NA	INT16U	R		Warning Code, see Table 8-6
0510	TBD		NA	INT16U	R		
0511	BMS SOH		1%	INT16U	R		
0512	Battery Mode		NA	INT16U	R		Battery work mode, Table 8-9
0513	BMS Warning Code H		NA	INT16U	R		refer to Table 8-8
0514	BMS Warning Code L		NA	INT16U	R		refer to Table 8-8
0515	Meter Status		NA	INT16U	R		1: OK, 0: NG
0516	Vgrid		0.1V	INT16U	R		Grid voltage
0517	Igrid		0.1A	INT16U	R		Grid current(Inv)
0518	Pgrid		1W	INT16S	R		MTPower/Grid Power
0519	Fgrid		0.01Hz	INT16U	R		Grid Frequency
051A	Grid Mode		NA	INT16U	R		Grid mode, Table 8-10
051B	Vload		0.1V	INT16U	R		Load voltage
051C	Iload		0.1A	INT16U	R		Load current
051D	OnGrid Load Power		1W	INT16U	R		Ongrid Load Power
051E	Fload		0.01Hz	INT16U	R		Load Frequency
051F	Load Mode		NA	INT16U	R		Load work mode, Table 8-11

0520	Work Mode		NA	INT16U	R		Storage Inverter work mode, see Table 8-12
0521	Temperature		0.1 °C	INT16U	R		Inverter internal temperature
0522	Error Message H		NA	INT16U	R		Failure description for status 'failure' Table 8-2
0523	Error Message L		NA	INT16U	R		Failure description for status 'failure' Table 8-2
0524	E-Total H		0.1kW.Hr	INT16U	R		Total Feed Energy to grid
0525	E-Total L		0.1KW.Hr	INT16U	R		Total Feed Energy to grid
0526	h-Total H		Hr	INT16U	R		Total feeding hours
0527	h-Total L		Hr	INT16U	R		Total feeding hours
0528	E-Day		0.1KW.Hr	INT16U	R		Export Energy to grid today
0529	E-Load-Day		0.1KW.Hr	INT16U	R		Energy of load day
052A	E-Total-Load H		0.1KW.Hr	INT16U	R		High Byte of total load Energy
052B	E-Total-Load L		0.1KW.Hr	INT16U	R		Low Byte of total load energy

052C	TotalPower		1W	INT16S	R		Total Power of inverter
052D	E-PV-Total-H		0.1KW.Hr	INT16U	R		High Byte of total PV Energy
052E	E-PV-Total-L		0.1KW.Hr	INT16U	R		Low Byte of total PV Energy
052F	Grid in-out flag		NA	INT16U	R		Inverter export to Grid or get power from Grid, Table 8-13
0530	Back-Up Load Power		1w	INT16U	R		Back-Up Load Power
0531	MeterPowerFactor		1%	INT16S	R		
0532	DiagStatusH		NA	INT16U	R		Refer Table 8-14
0533	DiagStatusL		NA	INT16U	R		Refer Table 8-14
0534	DRMStatus		NA	INT16U	R		Refer Table 8-15
0535	E-Total-Sell H		NA	float	R		cumulative power capacity sold to grid revealed by meter, High Byte in the upfront
0536	E-Total-Sell L		NA	float	R		
0537	E-Total-Buy H		NA	float	R		cumulative power capacity buy from grid revealed by meter, high byte in upfront
0538	E-Total-Buy L		NA	float	R		
0539	Vpv3		0.1V	INT16U	R		PV3 voltage
053A	Ipv3		0.1A	INT16U	R		PV3 current
053B	PV3 Mode		NA	INT16U	R		refer to Table 8-4
053C	VgridUo		0.1V	INT16U	R		Grid Uo voltage
053D	IgridUo		0.1A	INT16U	R		Grid Uo current
053E	VgridWo		0.1V	INT16U	R		Grid Wo voltage
053F	IgridWo		0.1A	INT16U	R		Grid Wo current
0540	E-BatteryCharge H		0.1Kwh	INT16U	R		Cumulative Charge Energy H
0541	E-BatteryCharge L		0.1Kwh	INT16U	R		Cumulative Charging Energy L



0542	E-BatteryDischarge H		0.1Kwh	INT16U	R		Cumulative Discharge Energy H
0543	E-BatteryDischarge L		0.1Kwh	INT16U	R		Cumulative Discharge Energy L
0544	Ppv1		1w	INT16U	R		Pv1 Power
0545	Ppv2		1w	INT16U	R		Pv2 Power
0546	Ppv3		1w	INT16U	R		Pv3 Power
0547	BatteryPower		1W	INT16U	R		Battery Power
0548	INT E-Total-Sell H		0.1Kwh	INT16U	R	0-42949 67295	cumulative power capacity sold to grid revealed by meter, High Byte positioned in the upfront
0549	INT E-Total-Sell L		0.1Kwh	INT16U	R		
054A	INT E-Total-Buy H		0.1Kwh	INT16U	R	0-42949 67295	cumulative power capacity buy from grid revealed by meter, high byte in upfront
054B	INT E-Total-Buy L		0.1Kwh	INT16U	R		
054C	E-BatCharge-Today		0.1Kwh	INT16U	R	0-65535	Daily Cumulative Charging Energy
054D	E-BatDischarge-Today		0.1Kwh	INT16U	R	0-65535	Daily Cumulative Discharging Energy

Addr. (HEX)	Name of Data	Cont.	Unit	Data Format	(R.W) Property	Data Range	Remarks
Meter Data Address							
6000	ACRMeterType			INT16U	R	0~2	0:Unknow 1:ACR 1Phase 2 : ACR 3Phase
6001	MeterStatus			INT16U	R	0~1	0: NG 1: OK
6002	Phase A voltage		0.1V	INT16U	R	0~3276 7	A-phase voltage in 3P meter /1P meter voltage
6003	Phase B voltage		0.1V	INT16U	R		B-phase voltage in 3P meter
6004	Phase C voltage		0.1V	INT16U	R		C-phase voltage in 3P meter
6005	Phase A current		0.01A	INT16U	R		A-phase current in 3P meter /1P meter current
6006	Phase B current		0.01A	INT16U	R		B-phase current in 3P meter
6007	Phase C current		0.01A	INT16U	R		C-phase current in 3P meter
6008	Phase A active power		1W	INT16S	R		-32766 ~32767
6009	Phase B active power		1W	INT16S	R	B-phase active power in 3P meter	
600A	Phase C active power		1W	INT16S	R	C-phase active power in 3P meter	
600B	Total active power		1W	INT16S	R	Total active power	

600C	Phase A reactive power		1Var	INT16S	R	99~100	A-phase Reactive power in 3P meter / 1P meter Reactive power
600D	Phase B reactive power		1Var	INT16S	R		B-phase reactive power in 3P meter
600E	Phase C reactive power		1Var	INT16S	R		C-phase reactive power in 3P meter
600F	Total reactive power		1Var	INT16S	R		Total reactive power
6010	Phase A apparent power		1VA	INT16S	R		A-phase apparent power in 3P meter / 1P meter apparent power
6011	Phase B apparent power		1VA	INT16S	R		B-phase apparent power in 3P meter
6012	Phase C apparent power		1VA	INT16S	R		C-phase apparent power in 3P meter
6013	Total apparent power		1VA	INT16S	R		Total apparent power
6014	Phase A power factor			INT16S	R		A-phase PF in 3P meter / 1P meter power factor
6015	Phase B power factor			INT16S	R		B-phase PF in 3P meter
6016	Phase C power factor			INT16S	R		C-phase PF in 3P meter
6017	Total power factor			INT16S	R		Total power factor
6018	Frequency		0.01Hz	INT16U	R		Frequency
6019	E-Total-Sell H		w	float	R	Cumulative power capacity sold to grid revealed by meter. High Byte in the upfront	
601A	E-Total-Sell L		w	float	R		
601B	E-Total-Buy H		w	float	R	Cumulative power capacity buy from grid revealed by meter. High Byte in the upfront	
601C	E-Total-Buy L		w	float	R		

Address (Decimal)	Name of Data	Gain	Unit	Data Format	(R.W) Property	Data Range	Remarks
Function setting data address							
35250	ExtGridDetailedErrH	1	NA	U32	R	NA	Grid detailed fault display refer to Table 8-30
35252	ExtGridDetailedErrL	1	NA	U32	R	NA	
35254	ExtInvDetailedErrH	1	NA	U32	R	NA	Inverter detailed error display refer to Table 8-31
35256	ExtInvDetailedErrL	1	NA	U32	R	NA	
35258	ExtInvDetailedStat usH	1	NA	U32	R	NA	Inverter detailed status display refer to Table 8-32

## 5. Read Only Data Table List

**Table 8-1**

Mode	Code	Description
Wait	0x00 0x00	Loss, inverter disconnects to Grid
Normal	0x00 0x01	OK, inverter connects to Grid
OffGrid	0x00 0x02	PV inputs to Inverter(First),Battery inputs to Inverter (Second), Inverter work as AC source
Permanent Fault	0x00 0x03	System is seriously abnormal. Inverter will restart after 20s.The conditions to enter this status are as follows: 1.Grid current DC offset 2.Eeprom cannot be read or write in 3.Communication between CPU failure 4.Bus Voltage too high 5.Compare measured values from two CPU 6.relay check fail 7.GFCI Device check fail 8.HCT check fail
Flash	0x04	Inverter upgrade
Check	0x05	Power on self-check of inverter

**Table 8-2**

Bit NO	Error message	Description
Bit31	Internal Communication Failure	Communication between microcontrollers is failure
Bit30	EEPROM R/W Failure	EEPROM cannot be read or written
Bit29	Fac Failure	The grid frequency is out of tolerable range
Bit28	TBD	NA
Bit27	TBD	NA
Bit26	TBD	NA
Bit25	Relay Check Failure	Relay check is failure
Bit24	TBD	NA
Bit23	Vac Consistency Failure	Different value between Master and Slave for grid voltage
Bit22	Fac Consistency Failure	Different value between Master and Slave for grid frequency
Bit21	TBD	NA
Bit20	TBD	NA
Bit19	DC Injection High	The DC injection to grid is too high
Bit18	Isolation Failure	Isolation resistance of PV-plant out of tolerable range
Bit17	Vac Failure	Grid voltage out of tolerable range
Bit16	External Fan Failure	The external fan failure

Bit15	PV Over Voltage	Pv input voltage is over the tolerable maximum value
Bit14	Auto Test Failure	Auto test failure
Bit13	Over Temperature	Temperature is too high
Bit12	Internal Fan Failure(Back-Up Over Load for ES)	The fan in case failure
Bit11	DC Bus High	Dc bus is too high
Bit10	Ground I Failure	Ground current is too high
Bit9	Utility Loss	Utility is unavailable
Bit8	AC HCT Failure	AC HCT check failure 3 times
Bit7	Relay Device Failure	Relay check failure 3 times
Bit6	GFCI Device Failure	GFCI check failure 3 times
Bit5	TBD	NA
Bit4	GFCI Consistency Failure	Different value between Master and Slave for GFCI
Bit3	DCI Consistency Failure	Different output DC current value between Master & Slave
Bit2	TBD	NA
Bit1	AC HCT Check Failure	The output current sensor is abnormal
Bit0	GFCI Device Check Failure	The GFCI detecting circuit is abnormal

**Table 8-4**

Mode Code	Description
0x00	NO PV, inverter disconnects to PV
0x01	Standby, PV does not output power
0x02	Work, PV output power

**Table 8-5**

BMS Status Code	Description
Bit0	BMS Standby
Bit1	BMS Working
Bit2	BMS Parallel
Bit3	BMS Maintain
Bit4	BMS ChargeEn
Bit5	BMS Must Charge
Bit6	BMS DisChargeEn
Bit7	BMS Charging
Bit8	BMS DisCharging
Bit9	BMS SOC Adjust
Bit...	Reserved

**Table 8-6**

Inverter Warning Code	Description
<b>Warning Code &lt;= 64</b>	
Bit0	LLC hardware overcurrent
Bit1	LLC BOOST hardware overcurrent
Bit2	LLC BOOST software overcurrent or BMS overcurrent fault
Bit3	Battery current RMS overcurrent
Bit4	Off-grid battery current exceeds BMS current limit
<b>Warning Code &gt; 64</b>	
101	PV BOOST hardware overcurrent
105	Load overload
106	Grid voltage sampling is too high
107	Inverter hardware or software sampling over 8 times
108	PV BOOST software overcurrent
109	BUS voltage is too high
120	Off-grid output voltage is too high
121	Off-grid output voltage is too low
122	BUS voltage is too low
123	PV voltage is too low
125	Off-grid mode battery voltage low shutdown protection
126	Triggering inverter hardware single overcurrent
128	Self-test BUS soft start failed
129	No PV grid-connected mode battery disconnect shutdown protection
130	Grid backflow

**Table 8-8**

Bit NO	Error message	Description
Bit0	Battery Over Temperature	Charging: Stop charge, Discharging: reduce discharge current
Bit1	Battery Under Temperature	
Bit2	Battery Cell Voltage Differences	NA
Bit3	Battery Over Total Voltage	Stop charge
Bit4	Battery Discharge Over Current	Stop discharge
Bit5	Battery Charge Over Current	reduce charge current
Bit6	Battery Under SOC	Stop discharge
Bit7	Battery Under Total Voltage	Stop discharge
Bit8	Battery Communication Fail	Stop BMS Function, Inverter manage battery
Bit9	Battery Output Short	Inverter shutdown
Bit10	BMSSOCTooHigh	
Bit11	BMSModuleFault	
Bit12	BMSSystemFault	

Bit13	BMSInternalFault	
Bit...		
Bit16	Battery Charge High Temp.	
Bit17	Battery Discharge High Temp.	
Bit18	Battery Charge Low Temp.	
Bit19	Battery Discharge Low Temp.	
Bit...		
Bit31		

**Table 8-9**

Mode Code	Description
0x00	NO Battery, Inverter disconnects to Battery
0x01	Standby, no discharging and no charging
0x02	Discharging
0x03	Charging
0x04	Waiting for charge
0x05	Waiting for discharge

**Table 8-10**

Mode Code	Description
0x00	Loss, inverter disconnects to Grid
0x01	OK, inverter connects to Grid
0x02	Fault, something is wrong

**Table 8-11**

Mode Code	Description
0x00	OFF, inverter disconnects to Load
0x01	ON, inverter connects to Load

**Table 8-12**

Mode Code	Description
0x00	Inverter self-check(check mode)
0x01	cut off all the connection to Inverter(wait mode)
0x02	PV inputs to Inverter,Inverter outputs to Grid(online mode)
0x04	PV inputs to Inverter(First),Battery inputs to Inverter(Second),Inverter work as AC source(battery mode)
0x10	Fault,fault mode,something is in fault mode(fault mode)

**Table 8-13**

Code	Description
0x00	Inverter neither send power to Grid, nor get power from Grid.
0x01	Inverter sends power to Grid
0x02	Inverter gets power from Grid.

**Table 8-14**

Bit	Description	Explanation	Types
0	BatteryVoltLow	Battery doesn't discharge because of low voltage	Discharge disturbed
1	BatterySOCLow	Battery doesn't discharge because of low SOC	
2	BatterySOCInBack	Battery SOC doesn't recover to dischargeable level	
3	BMSDischargeDisable	BMS doesn't allow discharge	
4	DischargeTimeOn	Discharge time is set. 1: On, 0: Off	
5	ChargeTimeOn	Charge time is set. 1: On, 0: Off	
6	DischargeDriveOn	Discharge drive is ON	
7	BMSDischgCurrentLow	BMS-Allowed discharge current is low	
8	DischargeCurrentLow	Allowed discharge current is low (from APP)	
9	MeterCommLoss	Smart Meter communication fails	
10	MeterConnectReverse	Smart Meter/CT is reversed	
11	SelfUseLoadLight	Load power is low, cannot active discharge ability	
12	EMSDischargeIZero	EMS-control discharge current limit is 0A	
13	DischargeBUSHigh	Cannot discharge caused by high PV voltage	
14	BatteryDisconnect	Battery disconnected or turned off	Charge disturbed
15	BatteryOvercharge	Battery is overcharged	
16	BMSOverTemperature	Lithium Battery temperature is too high	
17	BMSOvercharge	Lithium Battery overcharged (pack or cell)	
18	BMSChargeDisable	Lithium Battery does not allow charging	discharge disturbed
19	SelfUseOff	Self-use mode is turned off	
20	SOCDeltaOverRange	Battery SOC jumps abnormally	Other Problems
21	BatterySelfDischarge	Battery self-discharge > 30% SOC continuously	
22	OffgridSOCLow	Warning on low SOC under off-grid condition	
23	GridWaveUnstable	System switch to off-grid mode frequently because of bad grid wave	
24	FeedPowerLimit	Export power limit is set	
25	PFValueSet	PF value is set	
26	RealPowerLimit	Active power value is set	
27	DCOutputOn		
28	SOCProtectOff		
29	Discharge mode for BP	Only discharge at night (for BP only)	
30	BMS Charge Immediately	Battery charge compulsively (from BMS or APP)	

**Table 8-15**

Bit NO	DRMx	Description
Bit0	DRM0	DRM0 Switch : 1 ON/0 OFF
Bit1	DRM1	DRM1 Switch : 1 ON/0 OFF
Bit2	DRM2	DRM2 Switch : 1 ON/0 OFF
Bit3	DRM3	DRM3 Switch : 1 ON/0 OFF
Bit4	DRM4	DRM4 Switch : 1 ON/0 OFF
Bit5	DRM5	DRM5 Switch : 1 ON/0 OFF
Bit6	DRM6	DRM6 Switch : 1 ON/0 OFF
Bit7	DRM7	DRM7 Switch : 1 ON/0 OFF
Bit8	DRM8	DRM8 Switch : 1 ON/0 OFF
Bit9		
Bit10		
Bit11		
Bit12		
Bit13		
Bit...		
Bit15	DRED Connect Status	DRED Status : 1 Connect / 0 Disconnect

**Table 8-22**

Bit NO	BMS System Status	Description
Bit0	BMS Standby	
Bit1	BMS Working	
Bit2	BMS Parallel	
Bit3	BMS Maintain	
Bit4	BMS Charge Enable	
Bit5	BMS Charge Immediately	
Bit6	BMS DisCharge Enable	
Bit7	BMS Charging	
Bit8	BMS DisCharging	
Bit...		
Bit16		

**Table 8-30**

Bit NO	Grid fault display	Description
Bit0	GridZeroLossErr	电网停电/Power outage
Bit1	GridVoltLowErrSt1	电网欠压一级故障/Grid undervoltage first level failure
Bit2	GridVoltLowErrSt2	电网欠压二级故障/Grid undervoltage second level fault
Bit3	GridVoltLowErrSt3	电网欠压三级故障/Grid undervoltage third level fault
Bit4	GridVoltHighErrSt1	电网过压一级故障/Grid overvoltage first level failure
Bit5	GridVoltHighErrSt2	电网过压二级故障/Grid overvoltage second level fault



Bit6	GridVoltHighErrSt3	电网过压三级故障/Grid overvoltage third level fault
Bit7	Grid10minAvgVoltErr	电网平均电压高故障/Grid average voltage high fault
Bit8	GridFreqLowErrSt1	电网欠频一级故障/Grid underfrequency first level failure
Bit9	GridFreqLowErrSt2	电网欠频二级故障/Grid underfrequency second level fault
Bit10	GridIslandFreqLowErr	孤岛保护欠频故障/Islanding protection underfrequency fault
Bit11	GridFreqHighErrSt1	电网过频一级故障/Grid overfrequency first level failure
Bit12	GridFreqHighErrSt2	电网过频二级故障/Grid overfrequency second level fault
Bit13	GridIslandFreqHighErr	孤岛保护过频故障/Islanding protection overfrequency fault
Bit14	GridFreqShiftChkErr	电网频移故障/Grid frequency shift fault
Bit15	GridWaveCheckErr	电网波形检测故障/Grid waveform check fault
Bit16	GridLLVoltErrFlag	电网线电压故障标志/Grid line voltage fault flag
Bit17	GridLVRTErr	电网低电压穿越故障/Grid low voltage ride-through fault
Bit18	GridHVRTErr	电网高电压穿越故障/Grid high voltage ride-through fault
Bit19	GridVoltSampOverErr	电网电压超出采样上限/Grid voltage exceeds the upper sampling limit
Bit...		
Bit63		

**Table 8-31**

Bit NO	Inverter detailed error	Description
Bit0	BattLLCHardOCErr	LLC 硬件过流/LLC hardware overcurrent
Bit1	BattBoostHardOCErr	电池 boost 硬件过流/Battery boost hardware overcurrent
Bit2	BattBoostSoftOCErr	电池 boost 软件过流/ Battery boost software overcurrent
Bit3	BattBMSFaultErr	电池 BMS 故障/Battery BMS fault
Bit4	BattBMSDischgDisErr	电池 BMS 禁止放电/Battery BMS discharge disable
Bit5	BattCurrRmsOCErr	电池电流有效值过流/Battery current rms overcurrent
Bit6	OffgridBmsCurrLimitErr	离网模式超出 BMS 限流/Off-grid mode exceeds BMS current limit
Bit7	BusSoftStartFailedErr	Bus 电压软启动失败/Bus voltage soft start failed
Bit8	BusVoltTooLowErr	Bus 电压过低/Bus voltage is too low
Bit9	BusSampVoltTooHighErr	Bus 采样电压过高/ Bus voltage is too High
Bit10	InvHardOCErr	逆变硬件过流/Inverter hardware overcurrent
Bit11	InvCurrSoftOCErr	逆变软件过流/Inverter software overcurrent
Bit12	PvBoostHardOCErr	PV boost 硬件过流/PV boost hardware overcurrent
Bit13	PvBoostSoftOCErr	PV boost 软件过流/PV boost software overcurrent
Bit14	GridBackflowErr	电网倒灌/Grid backflow
Bit15	OffgridBattVoltLowErr	离网电池电压低/Off-grid mode battery voltage is low
Bit16	OffgridUpsVoltHighErr	离网 AC 电压过高/Off-grid mode AC voltage is too low
Bit17	OffgridUpsVoltLowErr	离网 AC 电压过低/ Off-grid mode AC voltage is too high
Bit18	UpsOverLoadErr	Backup overload
Bit...		
Bit63		

**Table 8-32**

Bit NO	Inverter detailed Status	Description
Bit0	SafetyOverFreqCurveFlag	进入过频曲线/Over-frequency curve running
Bit1	SafetyUnderFreqCurveFlag	进入欠频曲线/Under frequency curve running
Bit2	SafetyFreqRecoCurveFlag	频率曲线退出恢复中/Frequency curve exiting recovery
Bit3	SafetyPUCurveOVFlag	进入 PU 过压曲线/PU overvoltage curve running
Bit4	SafetyPUCurveUVFlag	进入 PU 欠压曲线/PU undervoltage curve running
Bit5	SafetyQUCurveFlag	进入 QU 曲线/QU curve running
Bit6	SafetyPFCurveFlag	进入 PF 曲线/PF curve running
Bit7	FixedPFSettingFlag	固定 PF 已设定/Fixed PF is set
Bit8	FixedQSettingFlag	固定无功已设定/Fixed reactive power is set
Bit9	InvOverTempFlag	逆变器过温降载/Inverter over-temp. derating curve operation
Bit10	DREDSellPowerLimitFlag	澳洲 DRED 卖电/Australian DRED electricity sale status
Bit11	DREDBuyPowerLimitFlag	澳洲 DRED 买电/Australian DRED purchase status
Bit12	ActivePowerSettingFlag	有功功率限制已设定/Active power limit is set
Bit13	GeDratePowerFlag	德国 70%降额打开 70% derating in Germany has been opened
Bit14	AutoTestEnableFlag	CEI021 selftest running
Bit15	GridVoltSt1DrateFlag	一级电压保护前降载/Inverter first level overvoltage derate
Bit...		
Bit63		

## 6. Operation Examples

**6.1 Read lowest PV voltage** for feeding power (Single register at once), AP sends:

01H	03H	00H	00H	00H,01H	84H	0AH
Inverter Addr.	Read Function	First Addr. of register		Amount of registers	CRC Verification Code	

Inverter Response:

01H	03H	02H	0AH	FOH	BEH	A0H
Inverter Addr.	Read Function	Byte Amount	High Data byte	Low Data Byte	CRC Verification Code	

Data is 2800, and the unit for the data is 0.1v. So actual value is 280.0v

**6.2 Read lowest PV voltage** for feeding power and reconnect time (multiply registers at once) AP sends:

01H	03H	00H	00H	00H,02H	C4H	0BH
Inverter Addr.	Read Function	First Addr. Of register		Amount of registers	CRC Verification Code	

Inverter Response:

01H	03H	04H	0AH	FOH	00H	1EH	79H	D0H
Inverter Addr.	Read Function	Amount of Bytes	High byte of Data1	Low Byte of Data1	High byte of Data2	Low Byte of Data2	CRC Verification Code	

Data1 is 2800, and the unit for the data is 0.1v, so actual value is 280.0v

Data 2 is 30, and the unit for the data is 1s, so actual value is 30s.

### 6.3 Read Serial Number

AP sends:

01H	03H	02H	00H	00H,08H	45H	B4H
Inverter Addr.	Read Function	First Addr. of register	Amount of registers	CRC Verification Code		

Inverter response:

01H	03H	10H	41H,41H,41H,41H,41H,41H,41H,41H, 42H,42H,42H,42H,42H,42H,42H,42H	7EH	B7H
Inverter Addr.	Read Function	Amount of Bytes	Data	CRC Code	

Serial Number is AAAAAAABBBBBBBB (Just as a sample)

### 6.4 Set Reconnect Time

AP sends:

01H	10H	00H	01H	00H,01H	02H	00H	3CH	A7H	90H
Inverter Address	Function Code	First Addr. of register	Amount of registers	Amount of data	Data	CRC Code			

Data is 60 and unit is 1s, so actual setting is 60s.

Inverter response:

01H	10H	00H,01H	00H,01H	50H	09H
Inverter Address	Function Code	First Addr. of register	Amount of registers	CRC Code	

### 6.5 Set Lowest PV voltage for feeding power

AP sends:

01H	10H	00H	00H	00H,01H	02H	0AH	F0H	A0H	B4H
Inverter Address	Function Code	First Address of register	Amount of registers	Amount of data	Data	CRC Code			

Data is 2800 and unit is 0.1v, so actual setting is 280.0v.

Inverter response:

01H	10H	00H	00H	00H,01H	01H	C9H
Inverter Address	Function Code	First Address of register	Amount of registers	CRC Code		

## 7. CRC16 Method:

```
const INT8U auchCRChi[] = { 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0,
```

```
0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1,
0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41,
0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1,
0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80,
0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01,
0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0,
0x80, 0x41, 0x00, 0xC1, 0x81, 0x40, 0x00, 0xC1, 0x81, 0x40, 0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40,
0x01, 0xC0, 0x80, 0x41, 0x01, 0xC0, 0x80, 0x41, 0x00, 0xC1, 0x81, 0x40};
```

```
const INT8U auchCRCLo[] = { 0x00, 0xC0, 0xC1, 0x01, 0xC3, 0x03, 0x02, 0xC2, 0xC6, 0x06, 0x07, 0xC7, 0x05,
0xC5, 0xC4, 0x04, 0xCC, 0x0C, 0x0D, 0xCD, 0x0F, 0xCF, 0xCE, 0x0E, 0x0A, 0xCA, 0xCB, 0x0B, 0xC9, 0x09,
0x08, 0xC8, 0xD8, 0x18, 0x19, 0xD9, 0x1B, 0xDB, 0xDA, 0x1A, 0x1E, 0xDE, 0xDF, 0x1F, 0xDD, 0x1D, 0x1C,
0xDC, 0x14, 0xD4, 0xD5, 0x15, 0xD7, 0x17, 0x16, 0xD6, 0xD2, 0x12, 0x13, 0xD3, 0x11, 0xD1, 0xD0,
0x10, 0xF0, 0x30, 0x31, 0xF1, 0x33, 0xF3, 0xF2, 0x32, 0x36, 0xF6, 0xF7, 0x37, 0xF5, 0x35, 0x34, 0xF4, 0x3C,
0xFC, 0xFD, 0x3D, 0xFF, 0x3F, 0x3E, 0xFE, 0xFA, 0x3A, 0x3B, 0xFB, 0x39, 0xF9, 0xF8, 0x38, 0x28, 0xE8, 0xE9,
0x29, 0xEB, 0x2B, 0x2A, 0xEA, 0xEE, 0x2E, 0x2F, 0xEF, 0x2D, 0xED, 0xEC, 0x2C, 0xE4, 0x24, 0x25, 0xE5, 0x27,
0xE7, 0xE6, 0x26, 0x22, 0xE2, 0xE3, 0x23, 0xE1, 0x21, 0x20, 0xE0, 0xA0, 0x60, 0x61, 0xA1, 0x63, 0xA3, 0xA2,
0x62, 0x66, 0xA6, 0xA7, 0x67, 0xA5, 0x65, 0x64, 0xA4, 0x6C, 0xAC, 0xAD, 0x6D, 0xAF, 0x6F, 0x6E, 0xAE,
0xAA, 0x6A, 0x6B, 0xAB, 0x69, 0xA9, 0xA8, 0x68, 0x78, 0xB8, 0xB9, 0x79, 0xBB, 0x7B, 0x7A, 0xBA, 0xBE,
0x7E, 0x7F, 0xBF, 0x7D, 0xBD, 0xBC, 0x7C, 0xB4, 0x74, 0x75, 0xB5, 0x77, 0xB7, 0xB6, 0x76, 0x72, 0xB2, 0xB3,
0x73, 0xB1, 0x71, 0x70, 0xB0, 0x50, 0x90, 0x91, 0x51, 0x93, 0x53, 0x52, 0x92, 0x96, 0x56, 0x57, 0x97, 0x55,
0x95, 0x94, 0x54, 0x9C, 0x5C, 0x5D, 0x9D, 0x5F, 0x9F, 0x9E, 0x5E, 0x5A, 0x9A, 0x9B, 0x5B, 0x99, 0x59, 0x58,
0x98, 0x88, 0x48, 0x49, 0x89, 0x4B, 0x8B, 0x8A, 0x4A, 0x4E, 0x8E, 0x8F, 0x4F, 0x8D, 0x4D, 0x4C, 0x8C, 0x44,
0x84, 0x85, 0x45, 0x87, 0x47, 0x46, 0x86, 0x82, 0x42, 0x43, 0x83, 0x41, 0x81, 0x80, 0x40};
```

```
INT16U sCRC16(INT8U *puchMsg, INT16U usDataLen)
{
    INT8U uchCRCHi = 0xFF ; // Initialization INT8U
    uchCRCLo = 0xFF ; // Initialization INT8U
    uIndex;
    While (usDataLen--)
    {
        uIndex = uchCRCHi ^ *puchMsg++ ; //Calculate CRC
        uchCRCHi = uchCRCLo ^ auchCRCHi[uIndex] ; uchCRCLo
        = auchCRCLo[uIndex] ;
    }
    return ((INT16U)uchCRCHi << 8 | uchCRCLo) ;
}
```