ModBus-RTU Protocol Specification

SOFAR PV Inverter

Version 1.01

2019-06-17

Table of Contents

1 Summary

1.1 Physical Layer

Physical Transmission: RS485/RS422

Address： 1 ～ 63

Baud rate: 9600bps

Maximum Distance: 1000 m

Medium: Shielded twisted pair (STP)

Mode: MODBUS — RTU

1.2 Link Layer

Transmission: Master-slave + Half duplex

First, The Host addressing the terminal device (Slave) , then on the opposite direction, Slave transmit the response to the Host. The protocol only used for data transmit between Host and Slave. Data Transmit through independent devices are prohibit. So that the data from independent device will not occupy the communication channel during the initialization, it is limit to signal inquiry request to the Host

Data Transmission Format: 1 Starting byte; 8 data byte; 1 stop byte; No CRC16 byte

Data Transmission Format:

Slave Address	Function Code	Data	CRC
1-Byte	1-Byte	N-Byte	2byte

The Protocol defines CRC, DATA and other other related parameters, these are necessary for specific data exchange. When data frame arrive at the slave, it will addressing to its specific device, then problematic head will be remove, the data will read by the device.If there are no errors, the slave will perform the tasks request by the data, the slave will have data back to the sender, by add problematic head and send the data back to the sender, the response data send back from the slave contains the following contents: The terminal slave address (Address) , the executed commands (Function) , data generated after executed the requested command (Data) and a parity check code (Check) , The Salve can identify the wrong message from the Host, and make different response.

1.3 Address

Address is the beginning of the frame, compose by one byte (value 1-63) . This address indicates the identity of the device that specified by user. This slave will get the data from the connected Host. For whole system, Address for each slaves must be unique. The slave will feedback when it addressed, when slave back with response, The Slave address data will show which slave connect with Host.

1.4 Function

Function show the operation that slave will take after addressed. All Function code & meaning support by monitor device list in Table 2

Function Code	Range of Register Address	Meaning
0x03	0x0000-0x00FF Read the register data from inverter input	Get one or more values from Register
	0x0100-0x01FF Read the register data from built- in combiner' input	Get one or more values from Register
0x04	0x1000-0x10FF Read the register data keep by inverter	Get one or more values from Register
	0x1100-0x11FF Read the register data keep by built-in combiner	Get one or more values from Register
0x13	0x1000-0x10FF Write Setting or parameters to inverter	Offer one or more values from Register
	0x1100-0x11FF Write setting or parameter to built-in combiner	Offer one or more values from Register
0x21	Ext Code 0x2000-0x20ff Inverter	
	Ext Code 0x2100-0x21ff Bulit-in combine	
0x07	Conceal Function 0x3000 Calibration (with password?)	
0x08	Conceal Function 0x4000 Maintaining information	
0x02	Auto Timing	
0x01	Remote on/off control, power limit; power factor	

0x50	EEPROM Read Storage data from EEPROM	
0x51	EEPROM Write in EEPROM storage data	
0x61	SD Read the data from SD	
0x10	Read access time	
0x30	Factory Reset	
0x31	Clear today's energy	
0x32	Recovery the fault setting of current country code setting	
0x33	Clear the total energy	
0x34	Clear the event list	
0x35	Read the control character of relay	
0x36	write the control character to Relay	
0x37	Alarm (configable) ID Read the control character of relay, set the fault ID, WHEN WE get alarm for control character (configable)	
0x38	Alarm (configable) ID set the fault ID (alarm, can configable) as the control character to relay	
0x45	Read the testing Flag	
0x46	Write in the test Flag	

1.5 Data

Data Consists by two different hexadecimal number systems, range 00H～FFH. It made up of RTU character according to the network transmission mode. The data from Host to Slave need contains the additional information: Slave must execute the behavior defined by function code. (in-consecutive register address included) ; number of the pending items need to be process; actual number of data bytes in domain. For example: Function Code to Slave, read a register, data need indicate start and number of specific register, embedded address data types, different slave will have different result, because the features of slaves are different.

1.6 CRC

The verification allow the error exist during the transmission between Host and Slave. Sometimes because of the electrical noise and other interruptions, a set of data may change during the transmission from one device to another. The CRC verification ensure that Host or Slave not respond to the incorrect data that has changed during the transmission. This verification improve the security and efficiency of whole system. We are using 16-bit circulation Redundary Check (CRC16) , CRC occupies two bytes, contained one 16-bit Binary value. CRC value calculated by transmitting device, then attach to the data frame, the receiving device recalculate the CRC value . Compare with the received CRC value, if two value are not equal, an error arise.

Set all bytes to “1” for a 16-bit register, Then operation by 8 bit byte in frame and current value of register continuity, only 8 data bits per byte participate in generation CRC value. Start bits; stop bits and other possible parity bits will not affect CRC value generation. During the CRC value generation, each 8-bit byte XOR with the content in register, then shift the result to low-bit, high-bit supplement with “0”， the last significant bit (LSB) remove and test. If the LSB is “1”, the register XOR with a preset fixed value, if the LSB show ”0”, not do any treatment. Repeat the above process until perform 8 times shift operation. The next 8-bit bytes XOR with current value of register, also perform another 8 shift XOR operation as above-mentioned, the final value we get is the CRC value.

CRC： The Process of generating a CRC value

Step1: Preset all bytes to “1” For 16-bit register, defined as CRC register

Step2: XOR the first 8-bit byte in data frame with the low byte in CRC register

Step3: Shift the CRC register one bit to the right, high-bit supplement with “0”, the LSB remove and test

Step4: If the LSB is “0”, repeat step3 (Next Shift) , if the LSB is “1”, the register XOR with a preset fixed value, (0A001H)

Step 5: Repeat step 3 &4, until perform 8 times shift operation.

Step 6: Repeat from step2 to 5 to deal with next 8-bit byte, until end of all bytes processing complete.

Step 7: Finally, the value of CRC register is the value of CRC

2 Instructions

2.1 Broadcast data frame information (address 0x88)

Broadcast data with no response

2.1.1 Auto Timing

(Slave Address)	0x88
(Function Code)	0x02
Register Address (Hi)	0x50
Register Address (Lo)	0x00
Number of Registers (Hi)	0x00
Number of Registers (Lo)	0x03
Data Field (Second)	
Data Field (Minute)	

Data Field (Hour)	
Data Field (Date)	
Data Field (Month)	
Data Field (Year)	
CRC16 Lo	
CRC16 Hi	

Address Table (Auto Timing)

Address	**Definition**	**Variable Type**	**Length**	**Range**	**Fault Value**	**Remarks**
0x5000	Auto Timing	BCD				

2.1.2 ON/OFF SINGAL

1.Remote ON/OFF Control

Slave Address	0x88
Function Code	0x01
Register Address (Hi)	0x01
Register Address (Lo)	0x42
Value of Registers (Hi)	0x00
Value of Registers (Lo)	0x55/0x66
CRC16 Lo	0x82
CRC16 Hi	0xBB

Remarks :

Inverter ON Register Lo=0x55

Inverter Off Register Lo=0x66

2.1.3 Active power Derated Setting

1. Active power Derated

(Slave Address)	0x88
(Function Code)	0x01

Register Address (Hi)	0x01
Register Address (Lo)	0x41
Value Number of Register (Hi)	
Value of Register (Lo)	
CRC16 Lo	
CRC16 Hi	

2.1.4 Power factor Setting (Reactive power)

1. Power factor Setting (Reactive power)

(Slave Address)	0x88
(Function Code)	0x01
Register Address (Hi)	0x01
Register Address (Lo)	0x61
Value of Register (Hi)	
Valuer of Register (Lo)	
CRC16 Lo	
CRC Hi CRC16 Hi	

2.1.5 Reactive Power Setting

1.Reactive power setting

(Slave Address)	0x88
(Function Code)	0x01
Register Address (Hi)	0x01
Register Address (Lo)	0x62
Value of Register (Hi)	
Valuer of Register (Lo)	
CRC16 Lo	
CRC16 Hi	

2.2 Power real-time control command (function code 0x06)

2.2.1 Data Format

Through 0x06 function code, limit output power in real-time

Host request message format:

Slave address	Function code	Starting address	Power control byte	CRC16
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes
Byte	0x06	0x90 0x00		Lo Byte Hi Byte

Slave response message format:

Slave address	Function code	Starting address	Power control byte	CRC16
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes
Byte	0x06	0x90 0x00		Lo Byte Hi Byte

Power control byte is the percentage of output power, if the percentage is 100%, then the power control byte should be 0x00 0x64

2.3 Read command (function code 0x03)

Through the 0x03 function code, queries allow the register information, data format is as follows:

2.3.1 Read data format

Host request message Format:

Slave Address	Function Code	Starting Address	Number of Registers	CRC16
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte
Byte	Byte	Hi Byte Lo Byte	Hi Byte Lo Byte	Lo Byte Hi Byte

Slave response message Format：

Slave Address	Function Code	Byte Count	Register-1 value		Regiser-N value	CRC16

1 Byte	1 Byte	1 Byte	1 Byte	N-2	1 Byte	1 Byte
Byte	Byte	Byte	Hi Byte Lo Byte	。。。	Hi Byte Lo Byte	Lo Byte Hi Byte

Example (query the state of the Inverter)

Query:

Slave Address	0x01
Function Code	0x03
Register Address Hi	0x00
Register Address Lo	0x00
Hi Number of Registers Hi	0x00
Number of Registers Lo	0x01
CRC16 Lo	0x84
CRC16 Hi	0x0A

Response:

Slave Address	0x01
Function Code	0x03
Byte Count	0x02
Value of Register Hi	0x00
Value of Register Lo	0x00
CRC16 Lo	0xB8
CRC16 Hi	0x44

2.3.2 Read inverter data through Address List

Operating state

00： wait

01：check

02：Normal

03：Fault

04：Permanent

Fault Message:

Byte0

bit	Error Message	Detailed (ID code)
Bit0	GridOVP	Grid Over Voltage Protection ID01
Bit1	GridUVP	Grid Under Voltage Protection ID02
Bit2	GridOFP	Grid Over Frequency Protection ID03
Bit3	GridUFP	Grid Under Frequency Protection ID04
Bit4	PVUVP	PV Under Voltage Protection ID05
Bit5	GridLVRT	Grid Low Voltage Ride Protection ID06
Bit6		7
Bit7		8

Byte1

Bit	Error Message	Detailed (ID code)
Bit0	PVOVP	PV Over Voltage Protection ID09
Bit1	IpvUnbalance	PV Input Current Unbalance ID10
Bit2	PvConfigSetWrong	PV Input Mode Configure Wrong ID11
Bit3	GFCIFault	Ground-Fault Circuit Interrupters Fault ID12
Bit4	PhaseSequenceFault	Phase Sequence Fault ID13
Bit5	HwBoostOCP	Hardware Boost Over Current Protection ID14
Bit6	HwAcOCP	Hardware AC Over Current Protection ID15
Bit7	AcRmsOCP	The Grid Current is too high ID16

Byte2

Bit	Error Message	Detailed (ID code)
Bit0	HwADFaultIGrid	The Grid Current Sampling Fault ID17
Bit1	HwADFaultIGrid	The DCI Sampling Fault ID18
Bit2	HwADFaultVGrid	The Grid Voltage Sampling Fault ID19
Bit3	GFCIDeviceFault	GFCI Device Sampling Fault ID20
Bit4	MChip_Fault	Main Chip Fault ID21
Bit5	HwAuxPowerFault	Hardware Auxiliary Power Fault ID22
Bit6	BusVoltZeroFault	BUS Voltage Zero Fault ID23
Bit7	IacRmsUnbalance	The unbalance output current ID24

Byte3

Bit	Error Message	Detailed (ID code)
Bit0	BusUVP	Bus Under Voltage Protection ID25
Bit1	BusOVP	Bus Over Voltage Protection ID26
Bit2	VbusUnbalance	Bus Voltage Unbalance ID27
Bit3	DciOCP	DCI Over Current Protection ID28
Bit4	SwOCPInstant	The Grid Current is too high ID29
Bit5	SwBOCPInstant	The Input Current is too high ID30 (Software protection)
Bit6	reserved	31
Bit7	reserved	32

Byte4, byte5

Bit	Error Message	Detailed (ID code)
Bit0	reserved	33/41
Bit1	reserved	34 /42

Bit2	reserved	35/43
Bit3	reserved	36/44
Bit4	reserved	37/45
Bit5	reserved	38/46
Bit6	reserved	39/47
Bit7	reserved	40/48

Byte6

Bit	Error Message	Detailed (ID code)
Bit0	ConsistentFault_VGrid	The Grid voltage sampling consistency error between the master and slave DSP ID49
Bit1	ConsistentFault_FGrid	The Grid frequency sampling consistency error between the master and slave DSP ID50
Bit2	ConsistentFault_DCI	The DCI sampling consistency error between the master and slave DSP ID51
Bit3	ConsistentFault_GFCI	The GFCI sampling consistency error between the master and slave DSP ID52
Bit4	SpiCommLose	The communication Fail between the master and slave DSP ID53
Bit5	SciCommLose	The communication Fail between the slave and communication board ID54
Bit6	RelayTestFail	The relay Fault ID55
Bit7	PvIsoFault	Low insulation resistance between the PV array and earth ID56

Byte7

Bit	Error Message	Detailed (ID code)
Bit0	OverTempFault_Inv	The inverter temp is too high ID57
Bit1	OverTempFault_Boost	The boost temp is too high ID58

Bit2	OverTempFault_Env	The environment temp is too high ID59
Bit3	PEConnectFault	No PE wire connect for inverter ID60
Bit4	reserved	61
Bit5	reserved	62
Bit6	reserved	63
Bit7	reserved	64

Byte8

Bit	rror Message	Detailed (ID code)
Bit0	unrecoverHwAcOCP	The Grid current is too high, and cause unrecoverable fault ID65
Bit1	unrecoverBusOVP	The bus voltage is too high, and cause unrecoverable fault ID66
Bit2	unrecoverIacRmsUnbalance	The Grid current is unbalance, and cause unrecoverable fault ID67
Bit3	unrecoverIpvUnbalance	The unbalance input current cause unrecoverable fault ID68
Bit4	unrecoverVbusUnbalance	The unbalance bus voltage cause unrecoverable fault ID69
Bit5	unrecoverOCPInstant	The Grid current is too high, and cause unrecoverable fault ID70
Bit6	unrecoverPvConfigSetWrong	PV Input Mode configure wrong, and cause unrecoverable fault ID71
Bit7	reserved	

Byte9

Bit	Error Message	Detailed (ID code)
Bit0	reserved	73
Bit1	unrecoverIPVInstant	The input current is too high, and cause unrecoverable fault ID74
Bit2	unrecoverWRITEEEPROM	The EEPROM Fault ID75

Bit3	unrecoverREADEEPROM	The EEPROM Fault ID76
Bit4	unrecoverRelayFail	The relay Fault cause unrecoverable fault ID77
Bit5	reserved	78
Bit6	reserved	79
Bit7	reserved	80

Inverter alert message: byte0

Bit	Error Message	Detailed (ID code)
Bit0	OverTempDerating	The inverter derated because of the high temperatureID81
Bit1	OverFreqDerating	The inverter derated because of the High Grid frequency ID82
Bit2	RemoteDerating	The inverter derated by remote control ID83
Bit3	RemoteOff	The inverter has shut down by remote control ID84
Bit4	UnderFreqDerate	The inverter has derated because of the lower Grid frequency ID 85
Bit5	reserved	Reserved ID86
Bit6	reserved	Reserved ID87
Bit7	RefluxDerating	The inverter has derated because of the reflux power ID88

Inverter alert message: byte1

Bit	Error Message	Detailed (ID code)
Bit0	reserved	reserved
Bit1	reserved	reserved
Bit2	reserved	reserved
Bit3	reserved	reserved
Bit4	reserved	reserved
Bit5	reserved	reserved
Bit6	reserved	reserved

Bit7	reserved	reserved

byte0

Communication board inner message: byte0

bit	Error Message	Detailed (ID code)
Bit0	Fan1 alarm	Fan 1 alarm ID91
Bit1	Fan2 alarm	Fan 2 alarm ID92
Bit2	Lightning protection alarm	Lightning protection alarm ID93
Bit3	Software version is not consistent	Software version is not consistent ID94
Bit4	Communication board EEPROM fault	The communication board EEPROM is fault ID95
Bit5	RTC clock chip anomaly	RTC clock chip is fault ID96
Bit6	InValidCountry	The country code is invalid ID97
Bit7	SDfault	The SD card is fault ID98

Communication board inner message: byte1

Bit	Error Message	Detailed (ID code)
Bit0	Fan3 alarm	Fan 3 alarm ID90
Bit1	reserved	reserved
Bit2	reserved	reserved
Bit3	reserved	reserved
Bit4	reserved	reserved
Bit5	reserved	reserved
Bit6	reserved	reserved
Bit7	reserved	reserved

Inverter Data Address table

Address	Definition	Variable type	Length	Range	Default value	Remarks
0x0000	Operating state	Uint	16			Only Low-Byte availability

0x0001	Fault 1	Uint	16			High-Byte: byte1 Low-Byte: byte0
0x0002	Fault 2	Uint	16			High-Byte: byte3 Low-Byte: byte2
0x0003	Fault 3	Uint	16			High-Byte: byte5 High-Byte: byte4
0x0004	Fault 4	Uint	16			High-Byte: byte7 Low-Byte: byte6
0x0005	Fault 5	Uint	16			High-Byte: byte9 Low-Byte: byte8
PV Input Data						
Address	**Definition**	**Variable type**	**Length**	**Range**	**Default value**	**Remarks**
0x0006	PV1 voltage	Uint	16	0-1000V		Unit: 0.1V
0x0007	PV1 current	Uint	16	0-100A		Unit: 0.01A
0x0008	PV2 voltage	Uint	16	0-1000V		Unit: 0.1V
0x0009	PV2 current	Uint	16	0-100A		Unit: 0.01A
0x000A	PV1 power	Uint	16	0-100kw		Unit: 0.01kw
0x000B	PV2 power	Uint	16	0-100kw		Unit: 0.01kw
Output Grid Data						
Address	**Definition**	**Variable type**	**Length**	**Range**	**Default value**	**Remarks**
0x000C	Active power (output)	Uint	16	0-1000V		Unit: 0.01kw
0x000D	Reactive power (output)	Uint	16	0-1000V		Unit: 0.01kVar
0x000E	Grid frequency	Uint	16	0-1000V		Unit: 0.01Hz
0x000F	A-phase voltage	Uint	16	0-1000V		Unit: 0.1V
0x0010	A-phase current	Uint	16	0-1000V		Unit: 0.01A
0x0011	B-phase voltage	Uint	16	0-1000V		Unit: 0.1V
0x0012	B-phase current	Uint	16	0-1000V		Unit: 0.01A
0x0013	C-phase voltage	Uint	16	0-1000V		Unit: 0.1V

0x0014	C-phase current	Uint	16	0-1000V		Unit: 0.01A
Inverter Generation Message						
Address	**Definition**	**Variable type**	**Length**	**Range**	**Default value**	**Remarks**
0x0015	Total production high-byte	Uint	16	0-65536		Unit: 1kWh
0x0016	Total production low-byte	Uint	16	0-65536		
0x0017	Total generation time high-byte	Uint	16	0-65536		Unit: 1 hour
0x0018	Total generation time low-byte	Uint	16	0-65536		
0x0019	The day generation	Uint	16	0-1000V		Unit: 0.01kWh
0x001A	The day generation time	Uint	16	0-65536		Unit: 1 minute
Inverter Inner Message						
Address	**Definition**	**Variable type**	**Length**	**Range**	**Default value**	**Remarks**
0x001B	Inverter module temperature	Uint	16	0-1000V		Unit: 1℃
0x001C	Inverter inner temperature	Uint	16	0-1000V		Unit: 1℃
0x001D	Inverter Bus voltage	Uint	16	0-1000V		Unit: 0.1V
0x001E	PV1 inout voltage sampling by slave CPU	Uint	16	0-1000V		Unit: 0.1V
0x001F	PV2 input voltage sampling by slave CPU	Uint	16	0-1000V		Unit: 0.1V
0x0020	Count-down time	Uint	16			
0x0021	Inverter alert message	Uint	16			
0x0022	Input mode					0x00: in parallel 0x01: independent
0x0023	Inverter inner					

	message					
0x0024	Insulation of PV1+ to ground					
0x0025	Insulation of PV2+ to ground					
0x0026	Insulation of PV- to ground					
0x0027	Country code					
0x0028	CT current	int	16			Unit 0.01A, the highest bit is the sign bit, and the negative number means the current flows to the inverter
0x0029	CT power	Int	16			Unit 0.01KW, the highest digit is the sign bit, and the negative number indicates the power flow to the inverter
0x002A	GCFI Valid Value	Uint16	16			Unit 1mA
0x002B	DCI value phase R	Int	16			Unit 1mA
0x002C	DCI value phase S	Int	16			Unit 1mA
0x002D	DCI value phase T	Int	16			Unit 1mA

2.3.3 Read Built-in Combiner Data through address List

Fault List

Byte0

bit	Description	Remarks
Bit0		PV11 over voltage Alarm
Bit1		PV12 over voltage Alarm
Bit2		PV13 over voltage Alarm
Bit3		PV14 over voltage Alarm
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte1

bit	Description	
Bit0		PV21 over voltage alarm
Bit1		PV22 over voltage alarm
Bit2		PV23 over voltage alarm
Bit3		PV24 over voltage alarm
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte2

bit	Description	Remarks
Bit0		PV11 Under voltage alarm
Bit1		PV12 Under Voltage Alarm
Bit2		PV13 Under Voltage Alarm
Bit3		PV14 Under Voltage alarm
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte3

bit	Description	Remarks
Bit0		PV21 Under Voltage Alarm
Bit1		PV22 Under Voltage Alarm
Bit2		PV23 Under Voltage Alarm
Bit3		PV24 Under Voltage Alarm
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte4

bit	Description	Remarks
Bit0		PV11 Reflux Power Fault
Bit1		PV12 Reflux Power Fault
Bit2		PV13 Reflux Power Fault
Bit3		PV14 Reflux Power Fault
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte5

Bit	**Description**	**Remarks**
Bit0		PV21 Reflux Power Fault
Bit1		PV22 Reflux Power Fault
Bit2		PV23 Reflux Power Fault
Bit3		PV24 Reflux Power Fault
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte6

Bit	**Description**	**Remarks**
Bit0		PV11 Over Current Alarm
Bit1		PV12 Over Current Alarm
Bit2		PV13 Over Current Alarm
Bit3		PV14 Over Current Alarm
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved

Bit7		Reserved

Byte7

Bit	**Description**	**Remarks**
Bit0		PV21 Over Current Alarm
Bit1		PV22 Over Current Alarm
Bit2		PV23 Over Current Alarm
Bit3		PV24 Over Current Alarm
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte8

Bit	**Description**	**Remarks**
Bit0		PV11 FUSE Fault
Bit1		PV12 FUSE Fault
Bit2		PV13 FUSE Fault
Bit3		PV14 FUSE Fault
Bit4		Reserved
Bit5		Reserved
Bit6		Reserved
Bit7		Reserved

Byte9

Bit	**Description**	**Remarks**
Bit0		PV21 FUSE Fault
Bit1		PV22 FUSE Fault
Bit2		PV23 FUSE Fault
Bit3		PV24 FUSE Fault
Bit4		Reserved
Bit5		Reserved

Bit6		Reserved
Bit7		Reserved

Built-in Combiner Address List

Address	**Definition**	**Variable type**	**Length**	**Range**	**Default Value**	**Remarks**
0x0100	Fault 1	Uint	16			High-Byte: byte1 Low-Byte: byte0
0x0101	Fault 2	Uint	16			High-Byte: byte3 Low-Byte: byte2
0x0102	Fault 3	Uint	16			High-Byte: byte5 Low-Byte: byte4
0x0103	Fault 4	Uint	16			High-Byte: byte7 Low-Byte: byte6
0x0104	Fault 5	Uint	16			High-Byte: byte7 Low-Byte: byte6
PV Input Message						
Address	**Define**	**Variable Type**	**Length**	**Range**	**Default Value**	**Remarks**
0x0105	1 PV1 Voltage	Uint	16	0-1000V		Unit 0.1V
0x0106	1PV1 Current	Uint	16	-20-20A		Unit 0.01A
0x0107	PV2 Voltage	Uint	16	0-1000V		Unit 0.1V
0x0108	PV2 Current	Uint	16	-20-20A		Unit 0.01A
0x0109	3PV3 Voltage	Uint	16	0-1000V		Unit 0.1V
0x010A	PV3 Current	Uint	16	-20-20A		Unit 0.01A
0x010B	PV4 Voltage	Uint	16	0-1000V		Unit 0.1V
0x010C	PV4 Current	Uint	16	-20-20A		Unit 0.01A
0x010D	PV5 Voltage	Uint	16	0-1000V		Unit 0.1V
0x010E	PV5 Current	Uint	16	-20-20A		Unit 0.01A
0x010F	PV6 Voltage	Uint	16	0-1000V		Unit 0.1V
0x0110	PV6 Current	Uint	16	-20-20A		Unit 0.01A
0x0111	PV7 Voltage	Uint	16	0-1000V		Unit 0.1V

0x0112	PV7 Current	Uint	16	-20-20A		Unit 0.01A
0x0113	PV8 Voltage	Uint	16	0-1000V		Unit 0.1V
0x0114	PV8 Current	Uint	16	-20-20A		Unit 0.01A
0x0115 to 0x011F	Reserved					

2.4 Read History energy stored by SD card (function code 0x60)

Through function code 0x60 to search data information of allowed registers, the command format show as follows:

2.4.1 Read Data Format

Host request message format:

Slave address	Function code	Starting address		CRC16
1 Byte	1 Byte	2 Bytes	3 bytes	2 Bytes
Byte	Byte	Hi Byte Lo Byte	3 Byte	Lo Byte Hi Byte

Slave response message format

Slave address	Function code	Number of Bytes	Valid Data	CRC16
1 Byte	1 Byte	1 Byte	N Bytes	2 Bytes
Byte	Byte	Byte	N Bytes	Lo Byte Hi Byte

2.4.2 Read history energy

Address	Definition	Variable type	Length (bytes)	Range	Defaults	Note
0x7000	One day's energy	Hex	2*24			
0x7001	Daily energy of this month	Hex	2*31			
0x7002	Monthly energy of this year	Hex	4*12			

The data format of the information bar of reading one day's total energy from SD card is as follows:

Year YY	Month MM	Day DD
BCD code	BCD code	BCD code

The data format of the information bar of reading one month's total energy from SD card is as follows:

Year YY	Month MM	Reserved
BCD BCD code	BCD BCD code	00

The data format of the information bar of reading one year's total energy from SD card is as follows:

Year YY	Reserved	Reserved
BCD	00	00

2.5 Read time (function code 0x10)

Through function code 0x10 to read time, the command format is as follows:

2.5.1 Read Data Format

Host request message format:

Slave address	Function code	Starting address	Number of Registers	CRC16
1 Byte	1 Byte	2 Bytes	2 Bytes	2 Bytes
Byte	Byte	Hi Byte Lo Byte	0x00 0x00	Lo Byte Hi Byte

Slave response message format:

Slave address	Function code	Number of Byte	Valid parameters	CRC16
1 Byte	1 Byte	2 Bytes	N Bytes	2 Bytes
Byte	Byte	Byte	N Bytes	Lo Byte Hi Byte

2.5.2 The Address of reading time

Address	Definition	Variable type	Length (bytes)	Range	Defaults	Note

0x8000	system time	BCD	7			
0x8001	power-on time on control board today	BCD	7			

The valid data format of the response frame is as follows:

Second ss	Minute mm	Hour hh	Week D	Day DD	Month MM	Year YY