

Modbus Protocol V4.16

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1 Protocol Description

The Modbus communication adopts 2-line RS-485 interface, and a single host can connect up to 247 inverters.

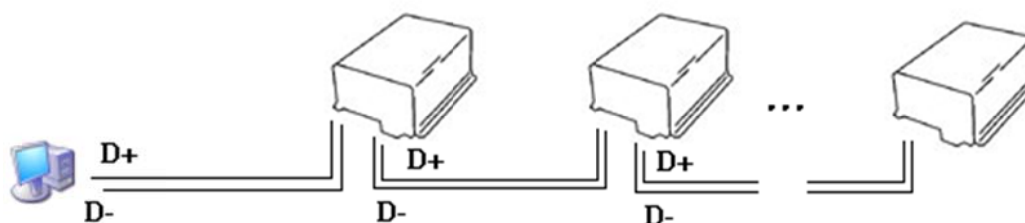


Figure 1

Modbus communication parameters:

Parameter	Description
Transfer mode	RTU mode
Communication mode	Half duplex
Baud rate	9600
Start bit	1
Data bit	8
Check bit	None
Stop bit	1

Technical terms :

Item	Description
Host	The one that initiates communication is called the host
Slave	The one that passive responses command called the slave
Broadcast address	0
Default address	1
U16	Unsigned integer of 16-bit
U32	Unsigned integer of 32-bit
I16	Integer of 16-bit
I32	Integer of 32-bit
CRC check	16 bit CRC check, low byte in front
RO	Read only, only support 0x03 command
WO	Write only, only support 0x06 command
RW	Read and write, support 0x03、0x06、0x10 command

2 Register definition

2.1 Device information

Index	Definition	Address	Register Number	Type	Comment	R/W	Unit
1	Device Model	0x1A00	8	U16	Ex. : PV 30KTL	RO	ASCII
2	Device Serial Number	0x1A10	8	U16	Ex. : 1234-123456789	RO	ASCII
3	Modbus Protocol Version	0x1A18	1	U16	Ex. : 0x1234=V12.34	RO	
4	Software Version	0x1A1C	3	U16	Ex. : 123456	RO	ASCII
5	Software Build Date	0x1A23	3	U16	Ex. : 123456	RO	ASCII
6	MPPT Number	0x1A3B	1	U16	Ex. : 1=1 MPPT	RO	
7	Rated Voltage	0x1A44	1	U16	Ex. : 2200 = 220V	RO	0.1V
8	Rated Frequency	0x1A45	1	U16	Ex. : 5000 = 50Hz	RO	0.01Hz
9	Rated Power	0x1A46	1	U16	Ex. : 1500 = 1500W	RO	1W
10	Grid Phase Number	0x1A48	1	U16	Ex. : 1=single phase 3=3 phase	RO	

2.2 Real time data

Index	Definition	Address	Register Number	Type	Comment	R/W	Unit
1	Phase A Voltage	0x1001	1	U16		RO	0.1V
2	Phase A Current	0x1002	1	U16		RO	0.01A
3	Phase A Power	0x1003	2	U32		RO	0.1W
4	Phase A Frequency	0x1005	1	U16		RO	0.01Hz
5	Phase B Voltage	0x1006	1	U16		RO	0.1V
6	Phase B Current	0x1007	1	U16		RO	0.01A
7	Phase B Power	0x1008	2	U32		RO	0.1W
8	Phase B Frequency	0x100A	1	U16		RO	0.01Hz
9	Phase C Voltage	0x100B	1	U16		RO	0.1V
10	Phase C Current	0x100C	1	U16		RO	0.01A
11	Phase C Power	0x100D	2	U32		RO	0.1W
12	Phase C Frequency	0x100F	1	U16		RO	0.01Hz
13	PV1 Voltage	0x1010	1	U16		RO	0.1V
14	PV1 Current	0x1011	1	U16		RO	0.01A
15	MPPT1 Power	0x1012	2	U32		RO	0.1W
16	PV2 Voltage	0x1014	1	U16		RO	0.1V
17	PV2 Current	0x1015	1	U16		RO	0.01A
18	MPPT2 Power	0x1016	2	U32		RO	0.1W
19	PV3 Voltage	0x1018	1	U16		RO	0.1V
20	PV3 Current	0x1019	1	U16		RO	0.01A
21	MPPT3 Power	0x101A	2	U32		RO	0.1W
22	Inner Temperature	0x101C	1	I16		RO	1°C
23	Inverter Mode	0x101D	1	U16	refer " InverterModeTable "	RO	
24	Error Code	0x101E	2	U32	refer " ErrorCodeTable "	RO	
25	Total Energy	0x1021	2	U32		RO	kwh
26	Total Generation Time	0x1023	2	U32		RO	Hour
27	Today Energy	0x1027	2	U32		RO	wh
28	Active Power	0x1037	2	U32		RO	0.1W
29	Reactive Power	0x1039	2	I32		RO	0.1Var
30	Today Peak Power	0x103B	2	U32		RO	0.1W
31	Power Factor	0x103D	1	I16		RO	0.001
32	PV4 Voltage	0x103E	1	U16	Note¹	RO	0.1V
33	PV4 Current	0x103F	1	U16	Note¹	RO	0.01A
34	MPPT4 Power	0x1040	2	U32	Note¹	RO	0.1W

2.3 Parameters

Index	Definition	Address	Register Number	Type	Comment	R/W	Unit
1	Date : Year	0x3000	1	U16	Example: 0x07E1 = 2017	RW	
2	Date : Month + Day	0x3001	1	U16	High Byte=Month Low Byte=Day	RW	
3	Date : Hour + Minute	0x3002	1	U16	High Byte =Hour Low Byte =Minute	RW	
4	Date : Second + 0	0x3003	1	U16	High Byte =Second Low Byte =0	RW	
5	Soft start time	0x5000	1	U16	[10, 600]	RW	s
6	Reconnect time	0x5001	1	U16	[10, 900]	RW	s
7	Grid frequency high loss level 1 limit	0x5002	1	U16	[1, 1.2] * rated Frequency	RW	0.01Hz
8	Grid frequency low loss level 1 limit	0x5003	1	U16	[0.8, 1] * rated Frequency	RW	0.01Hz
9	Grid voltage high loss level 1 limit	0x5004	1	U16	[1, 1.36] * rated Voltage	RW	0.1V
10	Grid voltage low loss level 1 limit	0x5005	1	U16	[0.3, 1] * rated Voltage	RW	0.1V
11	Grid frequency high loss level 1 trip time	0x5006	1	U16	[50, 60000]	RW	1ms
12	Grid frequency low loss level 1 trip time	0x5007	1	U16	[50, 60000]	RW	1ms
13	Grid voltage high loss level 1 trip time	0x5008	1	U16	[50, 60000]	RW	1ms
14	Grid voltage low loss level 1 trip time	0x5009	1	U16	[50, 60000]	RW	1ms
15	Grid frequency high loss level 2 limit	0x500A	1	U16	[1, 1.2] * rated Frequency	RW	0.01Hz
16	Grid frequency low loss level 2 limit	0x500B	1	U16	[0.8, 1] * rated Frequency	RW	0.01Hz
17	Grid voltage high loss level 2 limit	0x500C	1	U16	[1, 1.36] * rated Voltage	RW	0.1V
18	Grid voltage low loss level 2 limit	0x500D	1	U16	[0.3, 1] * rated Voltage	RW	0.1V
19	Grid frequency high loss level 2 trip time	0x500E	1	U16	[50, 60000]	RW	1ms
20	Grid frequency low loss level 2 trip time	0x500F	1	U16	[50, 60000]	RW	1ms
21	Grid voltage high loss level 2 trip time	0x5010	1	U16	[50, 60000]	RW	1ms
22	Grid voltage low loss level 2 trip time	0x5011	1	U16	[50, 60000]	RW	1ms
23	Power factor setting	0x5031	1	I16	[-1000, -800],[800, 1000]		0.001pf
24	Regulation code	0x5101	1	U16	refer " RegulationCodeTable "	RW	
25	Derating Watt Percent	0x5104	1	U16	[10, 100], percent of rated power		%
26	Islanding detection	0x510E	1	U16	0: disable,1: enable	RW	

27	Unbalance voltage limit	0x510F	1	U16	[1, 20], percent of rated voltage Note¹	RW	%
28	Ground current limit	0x5110	1	U16	[10, 300]	RW	mA
29	PV String detection	0x5111	1	U16	0: disable,1: enable Note¹	RW	
30	Low voltage through detection	0x5112	1	U16	0: disable,1: enable Note¹	RW	
31	Insulate Type	0x5113	1	U16	0: with ground line, no transformer 1: no ground line, with transformer 2: with ground line, with transformer Note¹	RW	
32	Reactive Power Percent	0x5114	1	U16	[1, 100], percent of rated power	RW	%
33	Adjust Resistance	0x5115	1	U16	0: open,1: close Note¹	RW	
34	Insulation Resistor Detection	0x5117	1	U16	0: disable,1: enable	RW	
35	Ground Current Detection	0x5118	1	U16	0: disable,1: enable	RW	
36	Inverter control	0x6001	1	U16	0: power on,1: shut down	WO	

2.4 History Log

Index	Definition	Address	Number	Type	Comment	R/W	Unit
1	history 1	0xB000	4	U16	0xB000: bit15~10: Year (6bits) bit09~06: Month (4its) bit05~00: Second (6bits) 0xB001: bit15~11: Day (5bits) bit10~06: Hour (5bits) bit05~00: Minute (6bits) 0xB002: High word of Error code 0xB003: Low word of Error code refer " ErrorCodeTable "	RO	
2	history 2	0xB004	4	U16	See above	RO	
...	...	...	...	...	...	RO	
127	history 127	0xB1F8	4	U16	See above	RO	
128	history 128	0xB1FC	4	U16	See above	RO	

Example :

(1) Query history 1 : 01 03 B0 00 00 04 62 C9

(2) Reply history 1 : 01 03 08 46 B3 A4 97 00 00 00 05 3F FC

(3) Parsing :

◆ Register 0xB000 = 0x46B3 = 0b010001 1010 110011

Year=0b010001=17(add 2000); Month=0b1010=10; Second=0b110011=51

◆ Register 0xB001 = 0xA497= 0b10100 10010 010111

Day=0b10100=20; Hour=0b10010=18; Minute=0b010111=23

◆ Error Code= 0x00000005=0b0000 0000 0000 0000 0000 0000 0101

Based on error code table, bit0=1 and bit2=1 mean "Grid AC over voltage" and "Grid AC absent"

◆ So history 1 : 2017-10-20 18:23:51 "Grid AC over voltage" and "Grid AC absent"

(Format: YYYY-MM-DD hh:mm:ss history)

2.5 Day Energy

Hourly energy of last 31 days, total number is $31 * 24 = 744$, query length of 1 day fixed as 48(0x30).

Index	Definition	Address	Number	Type	Comment	R/W	Unit
1	Hour1 energy	0xC000	2	U16	0xC000: High byte: Day, low byte: Hour 0xC001: Energy Data	RO	0.01 KWh
2	Hour2 energy	0xC002	2	U16	See above	RO	
...	...	...	...	...	...	...	...
24	Hour24 energy	0xC02E	2	U16	See above	RO	
25	A new day start Hour25 energy	0xC030	2	U16	See above	RO	
...	...	...	...	...	...	...	
744	Hour744 energy	0xC5CE	2	U16	See above	RO	

Example:

(1) Query today energy: 01 03 **C0 00 00 30** 79 DE (Today data is always read from 0xC000)

Query last day energy: 01 03 **C0 30 00 30** 79 D1

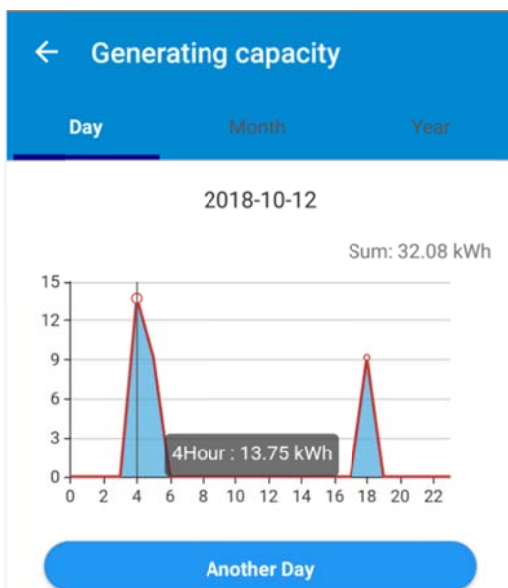
(2) Reply today energy: 01 03 60

0C 00 00 00 0C 01 00 00 0C 02 00 00 0C 03 00 00 0C 04 05 5F 0C 05 03 94 0C 06 00 00 0C 07 00 00
0C 08 00 00 0C 09 00 00 0C 0A 00 00 0C 0B 00 00 0C 0C 00 00 0C 0D 00 00 0C 0E 00 00 0C 0F 00 00
0C 10 00 00 0C 11 00 00 0C 12 07 2A 0C 13 00 00 0C 14 00 00 0C 15 00 00 0C 16 00 00 0C 17 00 00 F6 65

(3) Parsing :

- ◆ Index1 = 0C00 0000, Day=0x0C=12, Hour=0x00, Energy=0x0000, so energy of day12-hour0 is 0
- Index5 = 0C04 055F, Day=0x0C=12, Hour=0x04, Energy=0x055F = 1375 = 13.75kWh,
- ◆ Daily energy data format is: YYYY-MM-DD HH Energy, YYYY-MM is based on APP.

APP display example:



2.6 Month Energy

Daily energy of last 1 year, total number is $31 * 12 = 372$, query length of 1 month fixed as 62(0x3E).

Index	Definition	Address	Num	Type	Comment	R/W	Unit
1	Day1 energy	0xD000	2	U16	0xD000: High byte: Month, low byte: Day 0xD001: Energy Data	RO	KWh
2	Day 2 energy	0xD002	2	U16	See above	RO	
...	...	...	...	...	...	...	...
31	Day 31 energy	0xD02E	2	U16	See above	RO	
32	A new month start Day 32 energy	0xD03E	2	U16	See above	RO	
...	...	...	...	...	...	...	
372	Day 372 energy	0xD2E6	2	U16	See above	RO	

Example:

(1) Query this month energy: 01 03 **D0 00** 00 **3E** FC DA (This month data is always read from 0xD000)

Query last month energy: 01 03 **D0 3E** 00 **3E** 9D 16

(2) Reply this month energy: 01 03 7C

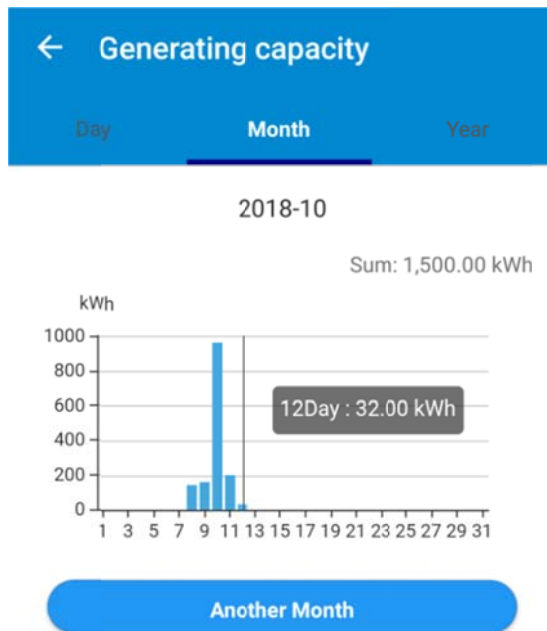
0A 01 00 00 0A 02 00 00 0A 03 00 00 0A 04 00 00 0A 05 00 00 0A 06 00 00 0A 07 00 00 0A 08 00 8F 0A 09 00 A0
0A 0A 03 C0 0A 0B 00 CD 0A 0C 00 20 0A 0D 00 00 0A 0E 00 00 0A 0F 00 00 0A 10 00 00 0A 11 00 00 0A 12 00 00
0A 13 00 00 0A 14 00 00 0A 15 00 00 0A 16 00 00 0A 17 00 00 0A 18 00 00 0A 19 00 00 0A 1A 00 00 0A 1B 00 00
0A 1C 00 00 0A 1D 00 00 0A 1E 00 00 0A 1F 00 00 ED 5B

(3) Parsing :

◆ Index10 = 0A0C 0020, Month=0x0A=10, Day=0x0C=12, Energy=0x0020 = 32 = 32kWh,

◆ Month energy data format is: YYYY-MM-DD Energy, YYYY is based on APP.

APP display example:



2.7 Year Energy

Monthly energy of 25 years, total number is $25 * 12 = 300$, query length of 1 year fixed as 24(0x18).

Index	Definition	Address	Num	Type	Comment	R/W	Unit
1	Month 1 energy	0xE000	2	U16	0xE000: High byte: Year, low byte: Month 0xE001: Energy Data	RO	KWh
2	Month 2 energy	0xE002	2	U16	See above	RO	
...	...	...	...	...	...	...	...
12	Month 12 energy	0xE016	2	U16	See above	RO	
13	A new year start Month 13 energy	0xE018	2	U16	See above	RO	
...	...	...	...	...	...	...	
300	Month 300 energy	0xE256	2	U16	See above	RO	

Example:

(1) Query this year energy: 01 03 **E0 00** 00 **18** 72 00 (This year data is always read from 0xE000)

Query last year energy: 01 03 **E0 18** 00 **18** F2 07

(2) Reply this month energy: 01 03 30

12 01 00 00 12 02 00 00 12 03 00 00 12 04 00 00 12 05 1E 79 12 06 21 56 12 07 00 00 12 08 02 26

12 09 04 47 12 0A 05 DC 12 0B 00 00 12 0C 00 00 F3 14

(3) Parsing :

◆ Index10 = 120A 05EA, Year=0x12=18(Add 2000), Month=0x0A=10,
Energy=0x05DC = 1500 = 1500kWh,

◆ Year energy data format is: YYYY-MM Energy

APP display example:

← Generating capacity

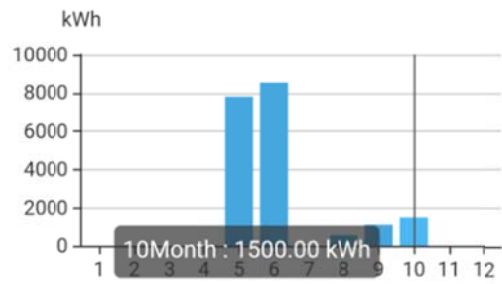
Day

Month

Year

2018

Sum: 19,480.00 kWh



Another Year

3 Modbus Protocol Command

3.1 Function code list

Index	Function code	Description
1	0x03	Read Register
2	0x06	Write a single Register
3	0x10	Write multiple Registers

3.2 Read Register (0x03)

(1) Host query command format :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x03
Register Start address	2 byte	0x0000~0xFFFF
Register number	2 byte	1~124
CRC code	2 byte	

(2) Slave normal respond format :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x03
Byte number	2 byte	Register Number*2
Register value	2 ~248 byte	
CRC code	2 byte	

(1) Slave abnormal respond format :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x83
Abnormal code	1 byte	refer " AbnormalCodeTable "
CRC code	2 byte	

(2) Example :

Host query command : 01 03 10 01 00 01 D1 0A

Slave normal respond : 01 03 02 08 FC BF C5

Slave abnormal respond : 01 83 02 C0 F1

3.3 Write a single Register (0x06)

(1) Host query command format :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x06
Address	2 byte	0x0000~0xFFFF
Register value	2 byte	0x0000~0xFFFF
CRC code	2 byte	

(2) Slave normal respond :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x06
Address	2 byte	0x0000~0xFFFF
Register value	2 byte	0x0000~0xFFFF
CRC code	2 byte	

(3) Slave abnormal respond :

Parameter 定义	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x86
Abnormal code	1 byte	refer " AbnormalCodeTable "
CRC code	2 byte	

(4) Example :

Host query command : 01 06 51 01 00 01 09 36

Slave normal respond : 01 06 51 01 00 01 09 36

Slave abnormal respond : 01 86 04 43 A3

3.4 Write multiple Registers (0x10)

(1) Host query command format :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x10
Register Start address	2 byte	0x0000~0xFFFF
Register Number	2 byte	1~122
Byte number	1 byte	Register Number * 2
Register value	2 ~244 byte	
CRC code	2 byte	

(2) Slave normal respond :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x10
Register Start address	2 byte	0x0000~0xFFFF
Register Number	2 byte	1~122
CRC code	2 byte	

(3) Slave abnormal respond :

Parameter	Length	Description
Slave address	1 byte	1~247
Function code	1 byte	0x90
Abnormal code	1 byte	refer " AbnormalCodeTable "
CRC code	2 byte	

(4) Example :

Host query command : 01 10 30 00 00 04 08 07 E1 01 01 00 00 00 00 7B 73

Slave normal respond : 01 10 30 00 00 04 CE CA

Slave abnormal respond : 01 90 02 CD C1

4 Error Code Table

Notice type: input or output error;

Fault type: inverter error

Bit	Description	Error Type
0	Grid AC over voltage	Notice
1	Grid AC under voltage	Notice
2	Grid AC absent	Notice
3	Grid AC over frequency	Notice
4	Grid AC under frequency	Notice
5	PV DC over voltage	Notice
6	PV insulation abnormal	Notice
7	Leakage current abnormal	Notice
8	Grid AC voltage higher than BUS	Notice
9	Control power low	Fault
10	PV string abnormal	Notice
11	PV DC under voltage	Notice
12	PV irradiation weak	Notice
13	Grid type unknown	Notice
14	Arc fault detection	Fault
15	Ground current > 300mA	Notice
16	Output DC over current	Notice
17	Inverter relay abnormal	Fault
18	Output DC sensor failed	Fault
19	Inverter over temperature	Notice
20	Leakage current HCT abnormal	Fault
21	PV string reverse	Notice
22	System type error	Fault
23	Fan lock	Notice
24	Bus under voltage	Notice
25	Bus over voltage	Notice
26	Internal communication error	Fault
27	Software incompatibility	Fault
28	EEPROM error	Fault
29	Consistent warning	Fault
30	Inverter abnormal	Fault
31	Boost abnormal	Fault

5 Inverter Mode Table

Value	Mode
0x00	Initial mode
0x01	Standby mode
0x03	Online mode
0x05	Fault mode
0x09	Shutdown mode

6 Abnormal code Table

Abnormal code	Description
01	Indicate that function code is not expected code of 0x03, 0x06, 0x10
02	Indicate that read or write register number is too large
03	Indicate that read or write register address is out of range
04	Indicate that read or write register value is out of limit or the register is forbidden to write

7 Regulation code Table

Code	Description
0x0001	AU (Australia AS/NZS 4777.2/.3)
0x0002	DE (Germany VDE 0126-1-1/A1)
0x0003	TW (Taiwan TW GRID)
0x0004	DE (Germany VDE-AR-N 4105)
0x0005	JP (Japan JETGR0002-1-2.0)
0x0006	IT (Italy CEI 0-21)
0x0007	SE (Sweden SWEDEN Grid)
0x0008	UK (British G83/1-1, G59)
0x0009	UL (USA UL)
0x000A	TL (Thailand PEA)
0x000B	SE (Sweden SWEDEN GRID) 2007
0x000C	NL (Netherlands NETHERLANDS Grid)
0x000D	TL (Thailand MEA)
0x000E	CN (China NB/T 32004)
0x000F	IND (India IEC61727)
0x0010	AU (Australia AS/NZS 4777.2:2015)
0x0011	NZ (Australia AS/NZS 4777.2:2015)
0x0012	MX (Mexico IEEE1547)
0xFFFF	Not defined

8 Notice

Notice	Description
1	Only support 3 phase machine, register 0x1A48 = 3
2	
3	