

2. Protocol Description

The MODBUS protocol consists of hardware layer, data layer and application layer.

2.1.1. Hardware Layer

- z Communication by serial port with standard 2 cables(pins) RS485 connection.
- z Default baud rate 9600.
- z RTU data transfer based on asynchronous mode.
- z 1 start bit
- z 8 data bits
- z No checkout code
- z 1 stop bit

2.1.2. Data Layer

2.1.2.1. Frame Structure

Address	Function Code	Data
1	0	0

2.1.2.2. Error Handling

Address	Function Code	Data	Checksum
1	0	0	0

Note:

- z No more than 256 bytes for each data frame.
- z CRC Check-out code, low byte+high byte
- z All data frames in this protocol only consists of function code and data.

2.1.2.3. Application Layer

Address	Function Code	Data
1	0	0

z Address (1-255)


```

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 CRC16(INT8U *puchMsg, INT16U usDataLen)
{
    INT8U uchCRCHi = 0xFF ;
    INT8U uchCRCLo = 0xFF ;
    INT8U uIndex=0 ;
    while (usDataLen--)
    {
        uIndex = uchCRCLo ^ *puchMsg++;
        uchCRCLo = uchCRCHi ^ auchCRCHi[uIndex];
        uchCRCHi = auchCRCLo[uIndex];
    }
    return (((INT16U)uchCRCHi << 8) | (INT16U)uchCRCLo) ;
}

```

2.3 Application Layer

Function Code

Function Code	Description
03 (0x03)	Read Register
06 (0x06)	Write Single Register
16 (0x10)	Write Multi Registers

Items and Definitions

Items	Definition
Register/Address	One Register store 2 bytes value
U16	Unsigned 16 bits int Data
U32	Unsigned 32 bits int Data
I16	Signed 16 bits int Data
I32	Signed 32 bits int Data
STR	String
N/A	None
RO	Read only
WO	Write only
RW	Read and write

2.3.1 Function Code 03(0x03)

Master Node Request Data Frame:

Data Field	Byte(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x03
Register Start Address	2	0x0000~0xFFFF
Register Numbers	2	1~125
CRC	2	N/A

Slave Node Normal Reply Data Frame

Data Field	Byte(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x03
Bytes	1	2*N
Register Value	2*N	N/A
CRC	2	N/A

Slave Node Abnormal Reply Data Frame

Data Field	Bytes(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x83
Abnormal Code	1	1/2/3
CRC	2	N/A

2.3.2 Function Code 06(0x06)

Master Node Normal Request Data Frame

Data Field	Byte(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x06
Register Address	2	0x0000~0xFFFF
Register Value	2	0x0000~0xFFFF
CRC	2	N/A

Slave Node Normal Reply Data Frame

Data Field	Byte(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x06
Register Address	2	0x0000~0xFFFF
Register Value	2	0x0000~0xFFFF
CRC	2	N/A

Slave Node Abnormal Reply Data Frame

Data Field	Byte(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x86
Abnormal Code	1	1/2/3
CRC	2	N/A

2.3.3 Function Code 16(0x10)

Master Normal Request Data Frame:

Data Field	Byte(s)	Description
Slave Node Address	1	0~247
Function Code	1	0x10
Register Address	2	0x0000~0xFFFF
Register Numbers	2	0x0000~0x007b
Byte(s)	1	2*N
Register Value	2*N	Value
CRC	2	N/A

Note: N is register numbers (0x0000~0x007b)

Slave Node Normal Reply Data Frame

Data Field	Byte(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x10
Register Address	2	0x0000~0xFFFF
Register Numbers	2	0x0000~0x007b
CRC	2	N/A

Slave Node Abnormal Reply Data Frame

Data Field	Byte(s)	Description
Slave Node Address	1	1~247
Function Code	1	0x90
Abnormal Code	1	1/2/3
CRC	2	N/A

三、Registers Table

Table 3.1 Hybrid Inverter RO Registers Table

ID	Register	Bytes	Description	R/W	Data Type	Unit	Accuracy	Note
1	10000	8	Inverter SN	RO	STR	N/A	1	Read Bytes to string
							
2	10008	1	Equipment Info	RO	U16	N/A	1	Please refer to table 3.2
3	10011	2	Firmware Version	RO	U32	N/A	1	Read Bytes
	10012							
4	10100	1	Date: Y/M	RO	U16	N/A	1	
5	10101	1	Time: D/H	RO	U16	N/A	1	
6	10102	1	Time: M/S	RO	U16	N/A	1	
7	10104	1	Grid Regulation	RO	U16	N/A	1	
8	10105	1	Inverter Running Status	RO	U16	N/A	1	0:wait, wait for on-grid 1:check, self-check 2:On Grid 3:fault 4:flash, firmware update 5.Off Grid
9	10112	2	Fault FLAG1	RO	U32	N/A	1	Please refer to table 3.3
	10113							
10	10114	2	Fault FLAG2	RO	U32	N/A	1	
	10115							
11	10120	2	Fault FLAG3	RO	U32	N/A	1	
	10121							
12	10994	2	Phase A Power on Meter	RO	I32	kW	1000	
	10995							
13	10996	2	Phase B Power on Meter	RO	I32	kW	1000	
	10997							
14	10998	2	Phase C Power on Meter	RO	I32	kW	1000	
	10999							
15	11000	2	Total Power on Meter	RO	I32	kW	1000	
	11001							
16	11002	2	Total Grid-Injection Energy on Meter	RO	U32	kWh	100	

	11003							
17	11004	2	Total Purchasing Energy from Grid on Meter	RO	U32	kWh	100	
	11005							
18	11006	1	Grid Lines A/B Voltage	RO	U16	V	10	
19	11007	1	Grid Lines B/C Voltage	RO	U16	V	10	
20	11008	1	Grid Lines C/A Voltage	RO	U16	V	10	
21	11009	1	Grid Phase A Voltage	RO	U16	V	10	
22	11010	1	Grid Phase A Current	RO	U16	A	10	
23	11011	1	Grid Phase B Voltage	RO	U16	V	10	
24	11012	1	Grid Phase B Current	RO	U16	A	10	
25	11013	1	Grid Phase C Voltage	RO	U16	V	10	
22	11014	1	Grid Phase C Current	RO	U16	A	10	
23	11015	1	Grid Frequency	RO	U16	Hz	100	
24	11016	2	P_AC	RO	I32	kW	1000	
	11017							
25	11018	2	Total PV Generation on that day	RO	U32	kWh	10	
	11019							
26	11020	2	Total PV Generation from Installation	RO	U32	kWh	10	
	11021							
27	11022	2	Total PV Generation Time from Installation	RO	U32	H	1	
	11023							
28	11028	2	PV Input Total Power	RO	U32	kW	1000	
	11029							
29	11032	1	Temperature Sensor 1	RO	I16	°C	10	

30	11033	1	Temperature Sensor 2	RO	I16	°C	10	
31	11034	1	Temperature Sensor 3	RO	I16	°C	10	
32	11035	1	Temperature Sensor 4	RO	I16	°C	10	
33	11038	1	PV1 Voltage	RO	U16	V	10	
34	11039	1	PV1 Current	RO	U16	A	10	
35	11040	1	PV2 Voltage	RO	U16	V	10	
36	11041	1	PV2 Current	RO	U16	A	10	
37	11062	2	PV1 Input Power	RO	U32	kW	1000	
	11063							
38	11064	2	PV2 Input Power	RO	U32	kW	1000	
	11065							
39	18000	2	ARM Fault FLAG1	RO	U32	N/A	1	Please refer to table 3.3
	18001							
							
40	40200	1	Backup_A_V	RO	U16	V	10	AC Voltage
41	40201	1	Backup_A_I	RO	U16	A	10	AC Current
42	40202	1	Backup_A_F	RO	U16	Hz	100	Frequency
43	40204	2	Backup_A_P	RO	I32	kW	1000	AC Active Power
	40205							
44	40210	1	Backup_B_V	RO	U16	V	10	AC Voltage
45	40211	1	Backup_B_I	RO	U16	A	10	AC Current
46	40212	1	Backup_B_F	RO	U16	Hz	100	Frequency
47	40214	2	Backup_B_P	RO	I32	kW	1000	AC Active Power
	40215							
48	40220	1	Backup_C_V	RO	U16	V	10	AC Voltage
49	40221	1	Backup_C_I	RO	U16	A	10	AC Current
50	40222	1	Backup_C_F	RO	U16	Hz	100	Frequency
51	40224	2	Backup_C_P	RO	I32	kW	1000	AC Active Power
	40225							
52	40230	2	Total_Backup_P	RO	I32	kW	1000	AC Active Power
	40231							
53	40236	2	Invt_A_P	RO	I32	kW	1000	Phase A Active Power
	40237							
54	40242	2	Invt_B_P	RO	I32	kW	1000	Phase B Active Power
	40243							
55	40248	2	Invt_C_P	RO	I32	kW	1000	Phase C Active Power
	40249							
56	40254	1	Battery_V	RO	U16	V	10	DC Voltage
57	40255	1	Battery_I	RO	I16	A	10	DC Current
58	40256	1	Battery_Mode	RO	U16	N/A	1	0:discharge;1:charge

59	40258	2	Battery_P	RO	I32	kW	1000	Battery Power
	40259							
60	41000	1	Grid Injection Energy on that day[Meter]	RO	U16	kWh	10	
61	41001	1	Grid Purchasing Energy on that day[Meter]	RO	U16	kWh	10	
62	41002	1	Backup Output Energy on that day	RO	U16	kWh	10	
63	41003	1	Battery Charge Energy on that day	RO	U16	kWh	10	
64	41004	1	Battery Discharge Energy on that day	RO	U16	kWh	10	
65	41005	1	PV Generation Energy on that day	RO	U16	kWh	10	
66	41006	1	Loading Energy on that day	RO	U16	kWh	10	
67	41008	1	Energy Purchased from Grid on that day	RO	U16	kWh	10	
68	41102	2	Total Energy injected to grid	RO	U32	kWh	10	
	41103							
69	41104	2	Total Energy Purchased from Grid from Meter	RO	U32	kWh	10	
	41105							
70	41106	2	Total Output Energy on backup port	RO	U32	kWh	10	
	41107							
71	41108	2	Total Energy Charged to Battery	RO	U32	kWh	10	
	41109							
72	41110	2	Total Energy Discharged from Battery	RO	U32	kWh	10	
	41111							

73	41112	2	Total PV Generation	RO	U32	kWh	10	
	41113							
74	41114	2	Total Loading Energy consumed at grid side	RO	U32	kWh	10	
	41115							
75	41118	2	Total Energy Purchased from Grid at inverter side	RO	U32	kWh	10	
	41119							
	...							
76	42000	1	Battery Types	RO	U16	N/A	1	
77	42001	1	Battery strings	RO	U16	N/A	1	
78	42002	1	Battery protocol	RO	U16	N/A	1	
79	42003	1	Software Version	RO	U16	N/A	1	
80	42004	1	Hardware Version	RO	U16	N/A	1	
81	42005	1	BMS Charge I _{max}	RO	U16	A	10	
82	42006	1	BMS Discharge I _{max}	RO	U16	A	10	
82	43000	1	SOC	RO	U16	%	100	
83	43001	1	SOH	RO	U16	%	100	
84	43002	1	BMS Status	RO	U16	N/A	1	
85	43003	1	BMS Pack Temperature	RO	U16	°C	10	
86	43008	1	Max Cell Temperature ID	RO	U16	N/A	1	
87	43009	1	Max Cell Temperature	RO	U16	°C	10	
88	43010	1	Min Cell Temperature ID	RO	U16	N/A	1	
89	43011	1	Min Cell Temperature	RO	U16	°C	10	
90	43012	1	Max Cell Voltage ID	RO	U16	N/A	1	
91	43013	1	Max Cell Voltage	RO	U16	V	1000	
92	43014	1	Min Cell Voltage ID	RO	U16	N/A	1	
93	43015	1	Min Cell Voltage	RO	U16	V	1000	
94	43016	2	BMS ERROR CODE	RO	U32	N/A	1	
	43017							
95	43018	2	BMS WARN CODE	RO	U32	N/A	1	

	43019						
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Table 3.2 Equipment Info

Inverter Type (10008 high bit)		Three Phase Hybrid	Single Phase Hybrid
		30	31
Model Info (10008 low bit)	0	WTS-4KW-3P	N/A
	1	WTS-5KW-3P	N/A
	2	WTS-6KW-3P	WTS-4.2KW-1P
	3	WTS-8KW-3P	WTS-4.6KW-1P
	4	WTS-10KW-3P	WTS-5KW-1P
	5	WTS-12KW-3P	WTS-6KW-1P
	6	N/A	WTS-7KW-1P
	7	N/A	WTS-8KW-1P
	8	N/A	WTS-3KW-1P
	9	N/A	WTS-3.6KW-1P

Table 3.3 Fault Registers Map

Fault Code	Registers	BIT	HEX	DEC	Fault Description
1	10112 (Fault FLAG1)	BIT0	0x00000001	1	Mains Lost
2		BIT1	0x00000002	2	Grid Voltage Fault
3		BIT2	0x00000004	4	Grid Frequency Fault
4		BIT3	0x00000008	8	DCI Fault
5		BIT4	0x00000010	16	ISO Over Limitation
6		BIT5	0x00000020	32	GFCI Fault
7		BIT6	0x00000040	64	PV Over Voltage
8		BIT7	0x00000080	128	Bus Voltage Fault
9		BIT8	0x00000100	256	Inverter Over Temperature
34	10112 (Fault FLAG2)	BIT1	0x00000002	2	SPI Fault
35		BIT2	0x00000004	4	E2 Fault
36		BIT3	0x00000008	8	GFCI Device Fault
37		BIT4	0x00000010	16	AC Transducer Fault
38		BIT5	0x00000020	32	Relay Check Fail
39		BIT6	0x00000040	64	Internal Fan Fault
40		BIT7	0x00000080	128	External Fan Fault
10001	18000 (ARM Fault FLAG1)	BIT0	0x00000001	1	SCI Fault
10002		BIT1	0x00000002	2	FLASH Fault
10003		BIT2	0x00000004	4	Meter Comm Fault

Table 3.4 Hybrid Inverter RW Registers Map

NO.	Register	Bytes	Function	R/W	Type	Unit	Accuracy	Note
1	20000	1	Inverter RTC date and time	RW	RW	U16	N/A	High Bit Year [19-99] Low Bit Month [1-12]
2	20001	1		RW	RW	U16	N/A	High Bit Day [1-31] Low Bit Hour [0-23]
3	20002	1		RW	RW	U16	N/A	High Bit Minute [0-59] Low Bit Second [0-59]
4	25100	1	Grid Injection Power Limit Switch	RW	U16	N/A	1	0:Off; 1:ON
5	25103	1	Grid Injection Power Limit Setting	RW	U16	N/A	1000	[0.0%-100.0%]
6	25104	1	Smart Meter COM. Status	WO	U16	N/A	1	0:Meter COM. Abnormal 1:Meter COM. Normal
7	25105	2	Phase A Power On Meter	WO	I32	W	1	
8	25107	2	Phase B Power On Meter	WO	I32	W	1	
9	25109	2	Phase C Power On Meter	WO	I32	W	1	
	...							
10	50000	1	Hybrid Inverter Working Mode Setting	RW	U16	N/A	1	Please refer to table 3.6
11	50001	1	EPS/UPS function Switch	RW	U16	N/A	1	0:OFF; 1:ON
12	50004	1	Off-grid Voltage Setting	RW	U16	V	10	
13	50005	1	Off-grid Frequency Setting	RW	U16	Hz	100	[45.00-65.00]Hz
14	50006	1	Off-grid asymmetric output function switch	RW	U16	N/A	1	0:OFF; 1:ON
15	50007	1	Peak Load Shifting Switch	RW	U16	N/A	1	0:OFF; 1:ON
16	50009	1	Max. Grid Power Value Setting	RW	U16	kVA	10	
	...							
17	50202	1	Inverter AC Power Setting	RW	U16	N/A	1	0:Off

								1: Total Power Setting, Register: 50203 2: Power on each Phase Setting, Registers: 50204- 50206
18	50203	1	Total AC Power Setting	RW	I16	kW	100	总功率调度设置
19	50204	1	Phase A Power Setting	RW	I16	kW	100	A 相功率调度设置
20	50205	1	Phase B Power Setting	RW	I16	kW	100	B 相功率调度设置
21	50206	1	Power C Power Setting	RW	I16	kW	100	C 相功率调度设置
22	50207	1	Battery Power Setting	RW	I16	kW	100	
23	50208	1	Max. AC Power Limit Setting	RW	I16	kW	100	
24	50209	1	Min. AC Power Limit Setting	RW	I16	kW	100	
25	50210	1	Priority Power Output Setting	RW	U16	NA	1	0: PV Output Priority 1: Battery Output Priority
26	50211	1	PV Power Setting	RW	U16	kW	100	
	...							
27	52500	1	Battery Configuration	RW	U16	N/A	1	Please Refer to Table 3.7
28	N/A							
29	52502	1	On-grid Battery SOC Protection Switch	RW	U16	N/A	1	0:OFF, 1:ON
30	52503	1	On-grid Battery DOD	RW	U16	N/A	1000	[0.0%-100.0%]
31	52504	1	Off-grid Battery SOC Protection Switch	RW	U16	N/A	1	0:OFF, 1:ON
32	52505	1	Off-grid Battery DOD	RW	U16	N/A	1000	[0.0%-100.0%]
	...							
33	N/A							
34	53006	1	Scheduled Charge&Discharge	RW	U16	N/A	1	bit0- bit5 stands for period1-period6, bit7-bit15 Reserved; 0: disable 1: enable

35	53007	1	Charge/Discharge Setting	RW	U16	N/A	1	Period1: 0:NONE 1:charge 2:discharge
36	53008	1	Battery Charge By		U16	N/A	1	Period1: 0:PV 1:PV+GRID
37	53009	1	rsved		U16	N/A	1	Period1: Reserved: 0xFF
38	53010	1	Power Limit		U16	N/A	1000	Period1: [0.0-100.0%]
39	53011	1	rsved		U16	N/A	1	Period1: Reserved: 0xFF
40	53012	1	Start Time		U16	N/A	1	Period1:
41	53013	1	Stop Time		U16	N/A	1	High 8bits(Hour):[0,23] Low 8bits(Mins):[0,59]
42	53014	1	Charge/Discharge	RW	U16	N/A	1	Period2 Same Period1
43	53015	1	Battery Charge By		U16	N/A	1	
44	53016	1	rsved		U16	N/A	1	
45	53017	1	Power Limit		U16	N/A	1000	
46	53018	1	rsved		U16	N/A	1	
47	53019	1	Start Time		U16	N/A	1	
48	53020	1	Stop Time	U16	N/A	1		
49	53021	1	Charge/Discharge	RW	U16	N/A	1	Period3 Same as Period1
50	53022	1	Battery Charge By		U16	N/A	1	
51	53023	1	rsved		U16	N/A	1	
52	53024	1	Power Limit		U16	N/A	1000	
53	53025	1	rsved		U16	N/A	1	
54	53026	1	Start Time		U16	N/A	1	
55	53027	1	Stop Time	U16	N/A	1		
56	53028	1	Charge/Discharge	RW	U16	N/A	1	Period4 Same as Period1
57	53029	1	Battery Charge By		U16	N/A	1	
58	53030	1	rsved		U16	N/A	1	
59	53031	1	Power Limit		U16	N/A	1000	
60	53032	1	rsved		U16	N/A	1	
61	53033	1	Start Time		U16	N/A	1	
62	53034	1	Stop Time	U16	N/A	1		
63	53035	1	Charge/Discharge	RW	U16	N/A	1	Period5 Same as Period1
64	53036	1	Battery Charge By		U16	N/A	1	
65	53037	1	rsved		U16	N/A	1	
66	53038	1	Power Limit		U16	N/A	1000	
67	53039	1	rsved		U16	N/A	1	
68	53040	1	Start Time		U16	N/A	1	

69	53041	1	Stop Time		U16	N/A	1	
70	53042	1	Charge/Discharge	RW	U16	N/A	1	Period6 Same as Period1
71	53043	1	Battery Charge By		U16	N/A	1	
72	53044	1	rsved		U16	N/A	1	
73	53045	1	Power Limit		U16	N/A	1000	
74	53046	1	rsved		U16	N/A	1	
75	53047	1	Start Time		U16	N/A	1	
76	53048	1	Stop Time		U16	N/A	1	
	...							
77	53500	8	BMSVersion	WO	STR	N/A	1	Only for EMS
78	53508	1	BMS Status		U16	N/A	1	Please refer to Table 3.8, only for EMS
79	53509	2	BMS ErrorCode		U32	N/A	1	Please refer to Table 3.9, only for EMS
80	53511	2	BMS ProtectionCode		U32	N/A	1	
81	53513	2	BMS WarnCode		U32	N/A	1	
82	53515	1	BMSChargeVoltLi mit		U16	V	10	Only for EMS
83	53516	1	BMSChargeCurrM ax		U16	A	10	
84	53517	1	BMSDischargeVoltL imit		U16	V	10	Only for EMS
85	53518	1	BMSDischargeCurr Max		U16	A	10	
86	53519	1	BMSBatSOC		U16	%	100	
87	53520	1	BMSBatSOH		U16	%	100	
88	53521	1	BMSBatVoltage		U16	V	10	
89	53522	1	BMSBatCurrent		I16	A	10	
90	53523	1	BMSBatTemp		I16	°C	10	

Table 3.5 Hybrid Inverter WO Registers Map

NO.	Registers	Bytes	Function	R/W	Type	Unit	Accuracy	Note
1	50200	1	Off-grid function Switch	WO	U16	N/A	1	0:OFF; 1:ON
2	50201	1	Clear Off-grid Over-loading Protection Flag	WO	U16	N/A	1	Write 1 to clear

Table 3.6

NO.	Hybrid Inverter Working Mode		Description	Note
	50000 high 8bits	50000 low 8bits		
1	01	01	General Mode	
2		02	Economic Mode	
3		03	UPS Mode	
4	02	N/A	Off Grid Mode	
5	03	01	EMS_ACtrlMode	Valid Registers: 50202-50206
6		02	EMS_GeneralMode	
7		03	EMS_BattCtrlMode	Valid Registers: 50207-50211
8		04	EMS_OffGridMode	

Table 3.7 Battery Configuration (52500)

Battery Brand(52500)		Protocol Configuration (52501)	Note
2	EMS	N/A	Only for EMS
10	Li-HV		
14—	Rsvd		

Table 3.8

Registers(53508)	Bits	Function	Description
High 8 bits BMS Control Status	Bit15	Rsvd	
	Bit14		
	Bit13		
	Bit12		
	Bit11	ForceCharge	1: ForceCharge Command (ChargeCommand Bit10 must write 1) 0: Invalid(Null)
	Bit10	ChargeCommand	1:Enable 0:Disable
	Bit9	Off-grid DischargeCommand	1:Enable 0:Disable
	Bit8	On-grid DischargeCommand	1:Enable 0:Disable
Low 8bits BMS Running Status	Bit0~Bit7	0:Sleep 1:Charge 2:Discharge 3:Standby 4:Fault	

Table 3.9

Registers	Bits	Hex	Dec	Fault Description	Note
53509 (BMS Error Code)	BIT0	0x00000001	1	Internal COM Fault	
	BIT1	0x00000002	2	Voltage Sensor Fault	
	BIT2	0x00000004	4	Temperature Sensor Fault	
	BIT3	0x00000008	8	Relay Fault	
	BIT4	0x00000010	16	Cells Damage Fault	
53511 (BMS Protection Code)	BIT0	0x00000001	1	Cells Low Voltage Protection	
	BIT1	0x00000002	2	Cells High Voltage Protection	
	BIT2	0x00000004	4	Battery Module Discharge Low Voltage Protection	
	BIT3	0x00000008	8	Battery Module Charge Over Voltage Protection	
	BIT4	0x00000010	16	Charge Low Temperature Protection	
	BIT5	0x00000020	32	Charge High Temperature Protection	
	BIT6	0x00000040	64	Discharge Low Temperature Protection	
	BIT7	0x00000080	128	Discharge High Temperature Protection	
	BIT8	0x00000100	256	Battery Module Charge Over-current Protection	
	BIT9	0x00000200	512	Battery Module Discharge Over-current Protection	
	BIT10	0x00000400	1024	Battery Module Low Voltage Protection	
	BIT11	0x00000800	2048	Battery Module Over Voltage Protection	
	BIT12	0x00001000	4096	Power Terminal Over Temperature Protection	
	BIT13	0x00002000	8192	Ambient Low Temperature Protection	
	BIT14	0x00004000	16384	Ambient High Temperature Protection	
BIT15	0x00008000	32768	Leakage Current Protection		
53513 (BMS Alarm Code)	BIT0	0x00000001	1	Cells Low Voltage Warning	
	BIT1	0x00000002	2	Cells High Voltage Warning	
	BIT2	0x00000004	4	Battery Module Discharge	

				Low Voltage Warning	
	BIT3	0x00000008	8	Battery Module Charge Over Voltage Warning	
	BIT4	0x00000010	16	Charge Low Temperature Warning	
	BIT5	0x00000020	32	Charge Over Temperature Warning	
	BIT6	0x00000040	64	Discharge Low Temperature Warning	
	BIT7	0x00000080	128	Discharge Over Temperature Warning	
	BIT8	0x00000100	256	Battery Module Charge Over-current Warning	
	BIT9	0x00000200	512	Battery Module Discharge Over Current Warning	
	BIT10	0x00000400	1024	Battery Module Low Voltage Warning	
	BIT11	0x00000800	2048	Battery Module Over Voltage Warning	
	BIT12	0x00001000	4096	Power Terminal Over Temperature Warning	
	BIT13	0x00002000	8192	Ambient Low Temperature Warning	
	BIT14	0x00004000	16384	Ambient Over Temperature Warning	

Annex-1 (EMS Applications)

Application #1: AC Power Control

EMS_ACCtrlMode						
AC Power Setting	Registers					Note
	Power Mode Setting(50202)	Total Power Setting(50203)	Phase A Power Setting (50204)	Power B Power Setting (50204)	Phase C Power Setting (50204)	
AC Total Power Setting	1	Set Power	--	--	--	Note: Set Power is to set the total input/output power of inverter $P_{inv}^{(1)} = \text{Set Power Set}$; $\text{PowerA} = \text{PowerB} = \text{PowerC} = \text{Set Power} / 3$
AC Three Phases Independent Setting	2	--	Set PowerA	Set PowerB	Set PowerC	
	Note: Set PowerA, Set PowerB, Set PowerC is to set PhaseA/B/C power independently, which shall follow the rule as below $P_{inv} = \text{Set PowerA} + \text{Set PowerB} + \text{Set PowerC}$					

Application #2: General Mode

EMS_GeneralMode						
Control Mode	Registers					Note
	--	--	--	--	--	
General Mode	Note: For maximum PV Self-consumption, shall follow the rule as below: $P_{load}^{(2)} = P_{pv}^{(3)} + P_{bat}^{(4)} - P_{meter}^{(5)}$					

Application #3: Battery Charge/Discharge Control

EMS_BattCtrlMode					
Battery charge/discharge control mode	Registers				Note:
	Battery Power Setting(50207)	AC Top Limit Setting(50208)	AC Bottom Limit Setting(50209)	Supply Power Priority (50210)	
Battery Charge	Set Pbat	Set PupLimit	Set PloverLimit	0: PV Supply Priority	1. Pbat<0, battery charging; 2. Pbat>0, battery discharging; 3. Pinv<0, purchasing power from grid; 4. Pinv>0, power injection to grid; 5. Set PupLimit is setting the top limit of Pin, Set PloverLimit is setting the bottom limit of Pinv, please make sure Set PupLimit >= Set PloverLimit 6. According to inverter power balance formula: Pinv = Pbat + Ppv, when Pbat confirmed, as well as the Pinv limits set(Set PupLimit and Set PloverLimit) and Ppv priority, EMS can confirm the inverter running logic with much flexibility.
	E.g. Setting Map: Set Pbat = -1000W; Set PupLimit = 10000W; Set PloverLimit = -500W; PV Supply with Priority; Target: Battery Charge: 1000W, Maximum Grid Injection: 10000W, Maximum Grid Purchasing: 500W 1. E.g. Ppv = 0W, battery charge power is 500W(Pbat = -500W), Inverter Grid Purchasing 500W(Pinv = -500W); 2. E.g. Ppv = 200W, battery charge power is 700W(Pbat = -700W), Inverter Grid Purchasing is 500W(Pinv = -500W); 3. E.g. Ppv = 2000W, battery charge power is 1000W(Pbat = -1000W), Inverter Grid Injection Power is 1000W (Pinv = 1000W)				
Battery Discharge	Set Pbat	Set PupLimit	Set PloverLimit	0: PV Supply with Priority	
	E.g. Setting Map: Set Pbat = 1000W; Set PupLimit = 2000W; Set PloverLimit = -10000W; PV Supply with Priority Target: Battery Discharge: 1000W, Max. Grid Injection Power: 2000W, Max. Grid Purchasing Power: 10000W; 1. E.g. Ppv = 0W, Battery Discharge Power: 1000W(Pbat = 1000W), Inverter Grid Injection Power: 1000W(Pinv = 1000W) 2. E.g. Ppv = 500W, Battery Discharge Power: 1000W(Pbat = 1000W), Inverter Grid Injection Power: 1500W(Pinv = 1500W) 3. E.g. Ppv = 1500W, Battery Discharge Power: 500W(Pbat = 500W), Inverter Grid Injection Power 2000W(Pinv = 2000W);				
Battery Force Charge	Set Pbat	Set PupLimit	Set PloverLimit	0: PV Supply with Priority	
	E.g. Setting Map: Set Pbat = -1000W; Set PupLimit = 10000W; Set PloverLimit = -500W; PV Supply with Priority Target: Battery Charge Power:1000W, Max. Grid Injection Power: 10000W, release inverter grid purchasing power limit and Set PloverLimit = -Pn;				

	<ol style="list-style-type: none"> 1. E.g. Ppv = 0W, battery charge power is 1000W(Pbat =-1000W), Inverter Grid Purchasing Power: 1000W(Pinv =-1000W); 2. E.g. Ppv = 200W, battery charge power is 1000W(Pbat = -1000W), Inverter Grid Purchasing Power: 800W(Pinv =-800W); 3. E.g. Ppv = 2000W, battery charge power is 1000W(Pbat = -1000W), Inverter Grid Injection Power:1000W(Pinv =-1000W) 			
Battery Force Discharge	Set Pbat	Set PupLimit	Set PlowerLimit	1: Battery Supply with Priority
	<p>E.g. Setting Map: Set Pbat = 1000; Set PupLimit = 2000; Set PlowerLimit =-10000; Battery Supply with Priority; Target: Battery Discharge Power:1000W, Max. Inverter Grid Injection Power: 2000W, Max. Grid Purchasing Power: 10000W;</p> <ol style="list-style-type: none"> 1. E.g. Ppv=0W, Battery Discharge Power: 1000W(Pbat=1000W), Inverter Grid Injection Power:1000W(Pinv = 1000W); 2. E.g. Ppv=500W, Battery Discharge Power:1000W(Pbat=1000W), Inverter Grid Injection Power:1500W(Pinv =1500W); 3. E.g. Ppv =1500W(Limit Ppv<=1000W, battery supply with priority), Battery Discharge Power: 1000W(Pbat = 1000W), Inverter Grid Injection Power: 2000W(Pinv = 2000W); 			

Application #4: Off-grid Mode

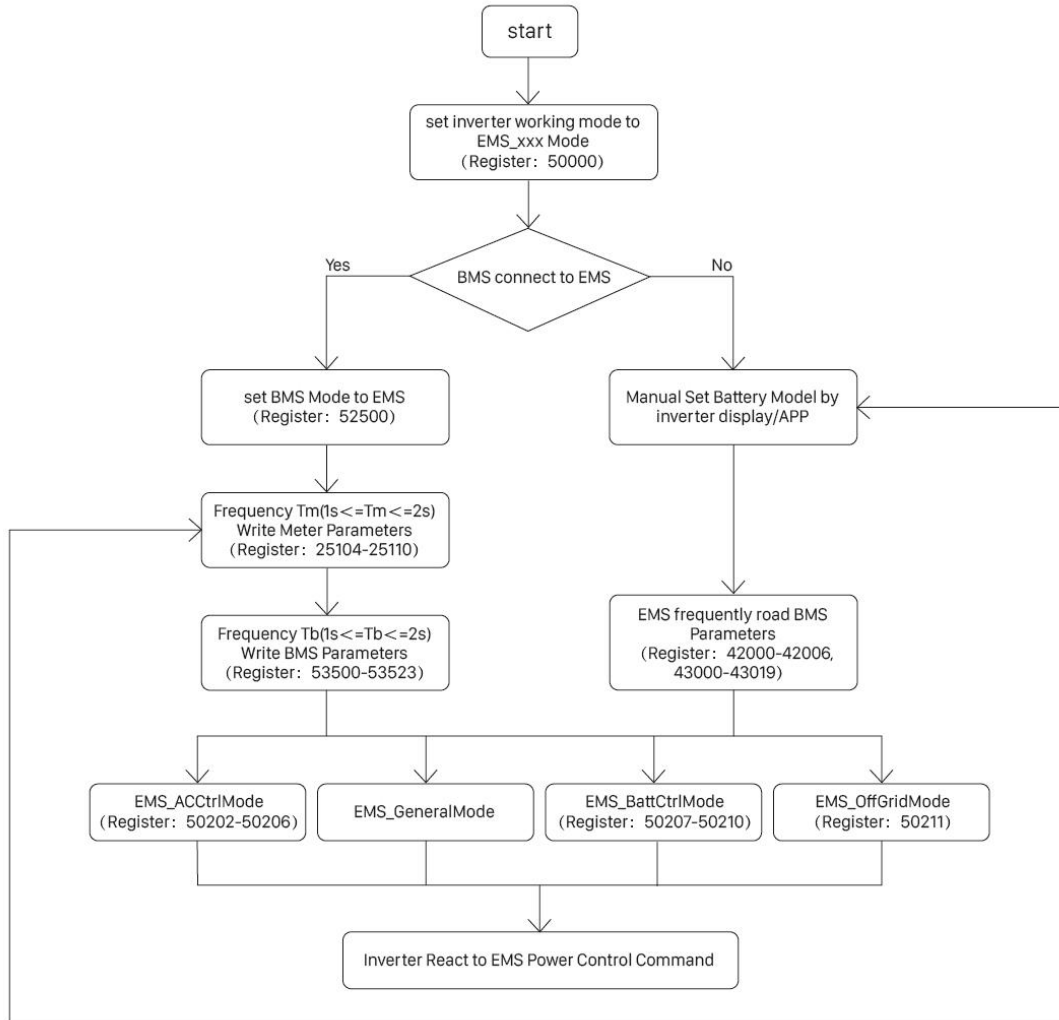
EMS_OffGridMode							
Control Mode	Registers					Note	
	PV Power Setting(50211)	--	--	--	--		
	Set Ppv						
Off-grid Mode	Ppv = Set Ppv Note: Pbackup ⁽⁶⁾ = Pbat + Ppv						

Note:

1. Hybrid Inverter AC Power
2. Total Loading Power(grid loading+backup loading)
3. PV Output Power
4. Battery Charge/Discharge Power
5. Grid Injection/Purchasing Power
6. Hybrid inverter backup loading Power

Annex-2 (EMS Control Procedure)

Procedure: EMS Control Procedure



Note: When BMS Connect to EMS, if EMS failed to write meter values (registers: 25104~25110)and BMS parameter(53500~53523) within certain period, inverter will fall into protection mode.