

Project No.	NA	MODBUS PROTOCOL	Security	Confidential
Project Name	NA		Version	1.2

# Modbus Protocol

PREPARED BY:	Devin Wang	Date:	2023-11-8
APPROVED BY:	Ted Chen	Date:	2023-11-8

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## Revision History

*\*The version is denoted with 1.0, or 1.1 or 1.2...*

Version	Date	Description	Prepared	Approved
1.2	2023-11-8	<ol style="list-style-type: none"> <li>1. Delete firmware build date</li> <li>2. <a href="#">Modify PV1~PV4 to MPPT1~4</a></li> <li>3. Add all parameter setting range value</li> <li>4. <a href="#">Modify 0x2009/0x200A type from U32 to S32</a></li> <li>5. <a href="#">Modify 0x2100 item 2 definition</a></li> <li>6. <a href="#">Add 0x2106~210F, 2122~213C, 2141, 2143, 2146~2149 register address</a></li> <li>7. <a href="#">Add 0x5021/5022/5029/5063~5067/506C /506D/507F/5081~5084 register address</a></li> <li>8. Delete 0x502B, 5051~5058 register address</li> <li>9. <a href="#">Add 0x5106/5107 register address</a></li> <li>10. Delete 0x510F/5110/5111/5113 register address</li> <li>11. <a href="#">Add 0x600F/6010 register address</a></li> <li>12. <a href="#">Modify 0x2136 register address unit from hour to minute</a></li> <li>13. <a href="#">Add 0x2150 register address</a></li> <li>14. <a href="#">Add 0x2168~217F register address</a></li> <li>15. <a href="#">Add 0x3005 register address</a></li> <li>16. <a href="#">Add 0x5101 register address 0x48 for EN50549-1: Ireland</a></li> <li>17. <a href="#">Charger and Discharger word delete at last "r"</a></li> <li>18. <a href="#">Add 0x30B1 setting value 9 for EM530 digital meter, 10 for EM540 digital meter</a></li> <li>19. <a href="#">Add the note about the nominal voltage and nominal power setting range</a></li> </ol>	Devin Wang	Ted Chen
1.1	2023-3-20	<ol style="list-style-type: none"> <li>1. Update error code</li> <li>2. Add 0x1080~1092 MPPT5~9 register address</li> </ol>	Devin Wang	Ted Chen
1.0	2021-1-2	Initial version	Devin Wang	Yanming Jia

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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.

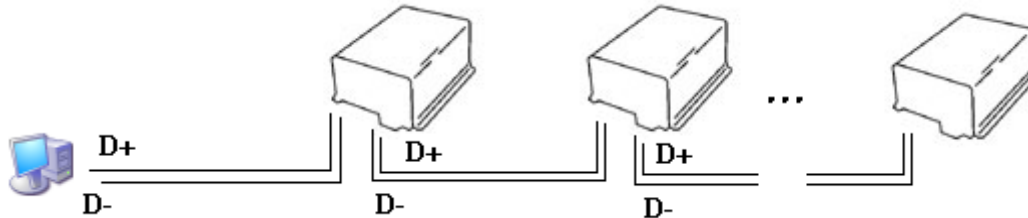


Figure 1

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
S16	Signed integer of 16-bit
S32	Signed integer of 32-bit
CRC	Modbus CRC 16-bit, low byte in front
RO	Read only, only support 0x03 command
WO	Write only, only support 0x06 command
RW	Read and write, support 0x03、0x6、0x10 command

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## 2 Register Definition

### 2.1 Device information

Index	Definition	Address	Register Number	Type	Comment	R/W	Unit
1	Device Model name	0x1A00	8	string	Ex.: PV 30KTL	RO	ASCII
2	Device Serial number	0x1A10	8	string	Ex.: 1234-123456789	RO	ASCII
3	Master firmware version	0x1A1C	3	string	Ex.: 123456	RO	ASCII
4	Slave firmware version	0x1A26	3	string	Ex.: 123456	RO	ASCII
5	MPPT Number	0x1A3B	1	U16	Ex.: 1=1 MPPT	RO	
6	<a href="#">Nominal Voltage</a>	0x1A44	1	U16	Ex.: 2200 = 220V	RO	0.1V <a href="#">Note1</a>
7	<a href="#">Nominal Frequency</a>	0x1A45	1	U16	Ex.: 5000 = 50Hz	RO	0.01Hz <a href="#">Note2</a>
8	Nominal Active Power (Low word)	0x1A46	1	U16	Ex.: 1500 = 1500W	RO	1W
9	Nominal Active Power (High word)	0x1A4E	1	U16	Ex.: 1 = (1*65536)W	RO	1W
10	Grid Phase Number	0x1A48	1	U16	1=single phase 2=split phase 3=three phases	RO	
11	Production type	0x1A5A	1	U16	0: On grid 1: AC couple no smart load 2: Hybrid no smart load 3: Hybrid with smart load 4: AC couple with smart load	RO	
12	EMS Firmware Version	0x1A60	3	string	Ex.: 123456	RO	ASCII
13	DCDC Firmware Version	0x1A6F	3	string	Ex.: 123456	RO	ASCII <a href="#">Note3</a>

Note:

1. Nominal Voltage: Probably include of 200/220/230/240/380/440/460/480V power system.
2. Nominal Frequency: Include of 50/60Hz power system.
3. Only for some hybrid model.

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## 2.2 Real time data

Index	Definition	Address	Register Number	Type	Comment	R/W	Unit
1	L1 Voltage	0x1001	1	U16		RO	0.1V
2	L1 Current	0x1002	1	U16		RO	0.01A
3	L1 Power	0x1003	2	S32		RO	0.1W
4	L1 Frequency	0x1005	1	U16		RO	0.01Hz
5	L2 Voltage	0x1006	1	U16		RO	0.1V
6	L2 Current	0x1007	1	U16		RO	0.01A
7	L2 Power	0x1008	2	S32		RO	0.1W
8	L2 Frequency	0x100A	1	U16		RO	0.01Hz
9	L3 Voltage	0x100B	1	U16		RO	0.1V
10	L3 Current	0x100C	1	U16		RO	0.01A
11	L3 Power	0x100D	2	S32		RO	0.1W
12	L3 Frequency	0x100F	1	U16		RO	0.01Hz
13	MPPT1 Voltage	0x1010	1	U16		RO	0.1V
14	MPPT1 Current	0x1011	1	U16		RO	0.01A
15	MPPT1 Power	0x1012	2	U32		RO	0.1W
16	MPPT2 Voltage	0x1014	1	U16		RO	0.1V
17	MPPT2 Current	0x1015	1	U16		RO	0.01A
18	MPPT2 Power	0x1016	2	U32		RO	0.1W
19	MPPT3 Voltage	0x1018	1	U16		RO	0.1V
20	MPPT3 Current	0x1019	1	U16		RO	0.01A
21	MPPT3 Power	0x101A	2	U32		RO	0.1W
22	Inner Temperature	0x101C	1	S16		RO	1°C
23	Inverter Mode	0x101D	1	U16	<a href="#">Inverter Mode Table</a>	RO	
24	Error Code1	0x101E	1	U16	<a href="#">Error Code Table 1</a>	RO	
25	Error Code2	0x101F	1	U16	<a href="#">Error Code Table 2</a>	RO	
26	Error Code3	0x1020	1	U16	<a href="#">Error Code Table 3</a>	RO	
27	Total Energy	0x1021	2	U32		RO	kWh
28	Total generation time	0x1023	2	U32		RO	Hour
29	Today Energy	0x1027	2	U32		RO	Wh
30	Grid total Active Power	0x1037	2	S32	(L1+L2+L3)	RO	0.1W
31	Grid total Reactive Power	0x1039	2	S32	(L1+L2+L3)	RO	0.1Var
32	PV Today Peak Power	0x103B	2	S32		RO	0.1W
33	Power Factor	0x103D	1	S16		RO	0.001

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34	MPPT4 Voltage	0x103E	1	U16		RO	0.1V
35	MPPT4 Current	0x103F	1	U16		RO	0.01A
36	MPPT4 Power	0x1040	2	U32		RO	0.1W
37	PV total input power	0x1048	2	U32	(Add all MPPT)	RO	0.1W
38	Decimals of total energy	0x104C	1	U16	Relate to 0x1021, if total energy is 220.836kWh, then 0x104C is 836Wh	RO	Wh
39	MPPT5 Voltage	0x1080	1	U16		RO	0.1V
40	MPPT5 Current	0x1081	1	U16		RO	0.01A
41	MPPT5 Power	0x1082	2	U32		RO	0.1W
42	MPPT6 Voltage	0x1084	1	U16		RO	0.1V
43	MPPT6 Current	0x1085	1	U16		RO	0.01A
44	MPPT6 Power	0x1086	2	U32		RO	0.1W
45	MPPT7 Voltage	0x1088	1	U16		RO	0.1V
46	MPPT7 Current	0x1089	1	U16		RO	0.01A
47	MPPT7 Power	0x108A	2	U32		RO	0.1W
48	MPPT8 Voltage	0x108C	1	U16		RO	0.1V
49	MPPT8 Current	0x108D	1	U16		RO	0.01A
50	MPPT8 Power	0x108E	2	U32		RO	0.1W
51	MPPT9 Voltage	0x1090	1	U16		RO	0.1V
52	MPPT9 Current	0x1091	1	U16		RO	0.01A
53	MPPT9 Power	0x1092	2	U32		RO	0.1W
54	L1 watt of grid	0x1300	2	S32	+: Grid to inverter -: Inverter to grid	RO	0.1W
55	L2 watt of grid	0x1302	2	S32	+: Grid to inverter -: Inverter to grid	RO	0.1W
56	L3 watt of grid	0x1304	2	S32	+: Grid to inverter -: Inverter to grid	RO	0.1W
57	Accumulated energy of import	0x1306	2	U32	Grid to inverter	RO	10Wh
58	Accumulated energy of export	0x1308	2	U32	Inverter to grid	RO	10Wh
59	L1 watt of load	0x130A	2	U32		RO	0.1W
60	L2 watt of load	0x130C	2	U32		RO	0.1W
61	L3 watt of load	0x130E	2	U32		RO	0.1W
62	Accumulated energy of load	0x1310	2	U32		RO	10Wh
63	L1-N phase voltage of grid	0x131A	1	U16		RO	0.1V
64	L2-N phase voltage of grid	0x131B	1	U16		RO	0.1V

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65	L3-N phase voltage of grid	0x131C	1	U16		RO	0.1V
66	L1 current of grid	0x131D	2	S32	+ : Grid to inverter - : Inverter to grid	RO	0.01A
67	L2 current of grid	0x131F	2	S32	+ : Grid to inverter - : Inverter to grid	RO	0.01A
68	L3 current of grid	0x1321	2	S32	+ : Grid to inverter - : Inverter to grid	RO	0.01A
69	L1-N phase voltage of load	0x1323	1	U16		RO	0.1V
70	L2-N phase voltage of load	0x1324	1	U16		RO	0.1V
71	L3-N phase voltage of load	0x1325	1	U16		RO	0.1V
72	L1 current of load	0x1326	2	U32		RO	0.01A
73	L2 current of load	0x1328	2	U32		RO	0.01A
74	L3 current of load	0x132A	2	U32		RO	0.01A
75	Today import Energy	0x1332	2	U32		RO	10Wh
76	Today export Energy	0x1334	2	U32		RO	10Wh
77	Today load Energy	0x1336	2	U32		RO	10Wh
78	Frequency of grid	0x1338	1	U16		RO	0.01Hz
79	L1 voltage of Backup	0x1350	1	U16		RO	0.1V
80	L1 current of Backup	0x1351	2	U32		RO	0.01A
81	L1 watt of Backup	0x1353	2	U32		RO	0.1W
82	Frequency of Backup	0x1355	1	U16		RO	0.01Hz
83	L2 voltage of Backup	0x1356	1	U16		RO	0.1V
84	L2 current of Backup	0x1357	2	U32		RO	0.01A
85	L2 watt of Backup	0x1359	2	U32		RO	0.1W
86	L3 voltage of Backup	0x135B	1	U16		RO	0.1V
87	L3 current of Backup	0x135C	2	U32		RO	0.01A
88	L3 watt of Backup	0x135E	2	U32		RO	0.1W
89	Today energy to Backup	0x1360	2	U32		RO	10Wh
90	Accumulated energy to Backup	0x1362	2	U32		RO	10Wh
91	Battery SOC	0x2000	1	U16		RO	%
92	Battery temperature	0x2001	1	S16		RO	1°C
93	Battery voltage	0x2006	1	U16		RO	0.1V
94	Battery current	0x2007	2	S32		RO	0.01A
95	Battery power	0x2009	2	S32		RO	0.1W
96	Battery today charge energy	0x200B	2	U32		RO	10Wh
97	Battery accumulated charge energy	0x200D	2	U32		RO	10Wh



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98	Battery <b>today</b> discharge energy	0x200F	2	U32		RO	10Wh
99	Battery accumulated discharge energy	0x2011	2	U32		RO	10Wh
100	Error message 4	0x2013	1	U16	<a href="#">Error Code Table 4</a>	RO	

Note:

1. L1/L2/L3 Voltage/Current/Power register address for all model even single phase or split phase model.
2. MPPT1~4 Voltage/Current/Power register address for all model.
3. MPPT5~9 Voltage/Current/Power register address depend on model.
4. 0x1350~0x1362 register address for Hybrid only.
5. 0x2000~0x2013 register address for Hybrid only.

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### 2.3 Parameters for Hybrid only

Index	Definition	Address	Register Number	Type	Comment	R/W	Unit
1	Hybrid work mode	0x2100	1	U16	[0, 3] 0: Self used mode 1: Feed-in priority mode 2: Reserved 3: Back-up mode	RW	
2	Once/Everyday	0x2101	1	U16	Time-based control [0, 1] 0: Once 1: Every day	RW	
3	Charge start time 1	0x2102	1	U16	Time-based control [0, 23] High Byte: Hour [0, 59] Low Byte: Minute	RW	
4	Charge end time 1	0x2103	1	U16	Time-based control [0, 23] High Byte: Hour [0, 59] Low Byte: Minute	RW	
5	Discharge start time 1	0x2104	1	U16	Time-based control [0, 23] High Byte: Hour [0, 59] Low Byte: Minute	RW	
6	Discharge end time 1	0x2105	1	U16	Time-based control [0, 23] High Byte: Hour [0, 59] Low Byte: Minute	RW	
7	Once/Everyday 2	0x2106	1	U16	Time-based control [0, 1] 0: Once 1: Every day	RW	

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8	Charge start time 2	0x2107	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59] Low Byte : Minute	RW	
9	Charge end time 2	0x2108	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59] Low Byte : Minute	RW	
10	Discharge start time 2	0x2109	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59] Low Byte : Minute	RW	
11	Discharge end time 2	0x210A	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59] Low Byte : Minute	RW	
12	Once/Everyday 3	0x210B	1	U16	Time-based control [0, 1] 0: Once 1: Every day	RW	
13	Charge start time 3	0x210C	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59] Low Byte : Minute	RW	
14	Charge end time 3	0x210D	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59] Low Byte : Minute	RW	
15	Discharge start time 3	0x210E	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59]	RW	

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					Low Byte : Minute		
16	Discharge end time 3	0x210F	1	U16	Time-based control [0, 23] High Byte : Hour [0, 59] Low Byte : Minute	RW	
17	Battery type selection	0x2110	1	U16	[0, 5] 0: Unavailable 1: Lead-Acid battery 2: PYLON Lithium-ion 3: Dyness Lithium-ion 4: Aobo Lithium-ion 5: UZ Lithium-ion	RW	
18	BMS RS485 Comm Address	0x2111	1	U16	[0, 250] BMS Communication Address of Lithium- ion battery	RW	
19	Battery Ah (Ah)	0x2112	1	U16	[0, 65535] Capacity of lead-acid battery	RW	Ah
20	Stop discharge voltage	0x2113	1	U16	[0, 400] Stop discharge voltage of lead-acid battery	RW	0.1V
21	Stop charge voltage	0x2114	1	U16	[0, 600] Stop charge voltage of lead-acid battery	RW	0.1V
22	Grid charge	0x2115	1	U16	[0, 1] 0: disable,1: enable	RW	
23	Maximum grid charge power (W)	0x2116	1	U16	[0, 65535]	RW	W
24	Capacity of grid charge end (%)	0x2117	1	U16	[0, 100]	RW	%
25	Maximum charge power(W)	0x2118	1	U16	[0, 65535]	RW	W
26	Capacity of charge end (%)	0x2119	1	U16	[0, 100]	RW	%
27	Maximum discharge power (W)	0x211A	1	U16	[0, 65535]	RW	W

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28	Capacity of discharge end (%)	0x211B	1	U16	[0, 100]	RW	%
29	Off-grid mode	0x211C	1	U16	[0, 1] 0: disable,1: enable	RW	
30	Nominal output voltage (V)	0x211D	1	U16	[0, 9999] Output nominal voltage in off-grid mode 200/220/230/240	RW	0.1V
31	Nominal output frequency (Hz)	0x211E	1	U16	[4000, 7000] Output nominal frequency in off-grid mode 50/60Hz	RW	0.01Hz
32	Off-grid start-up battery capacity (%)	0x211F	1	U16	[0, 100] The minimum battery capacity to transfer off-grid mode	RW	%
33	Maximum discharge current	0x2120	1	U16	[0, 10000]	RW	0.01A
34	Maximum charge current	0x2121	1	U16	[0, 10000]	RW	0.01A
35	GEN Port	0x2122	1	U16	[0, 3]	RW	
36	Lithium battery activation function	0x2123	1	U16	[0, 1] 0: disable,1: enable	RW	
37	Capacity Mode	0x2124	1	U16	[0, 1] 0: SOC(%), 1: Battery voltage (V)	RW	
38	Maximum Input power from Grid	0x2125	1	U16	[0, 9000]	RW	W
39	Maximum GEN charge power (W)	0x2126	1	U16	[0, 6000]	RW	W
40	Maximum Input power from Generator	0x2127	1	U16	[0, 9000]	RW	W
41	Connect GEN to Grid port function	0x2128	1	U16	[0, 1] 0: disable,1: enable	RW	
42	Generator start SOC (%)	0x2129	1	U16	[0, 100]	RW	%
43	Generator end SOC (%)	0x212A	1	U16	[0, 100]	RW	%
44	Minimum PV power of Smart Load On	0x212B	1	U16	[0, 65535]	RW	W
45	Battery SOC of Smart Load On	0x212C	1	U16	[0, 100]	RW	%
46	Battery SOC of Smart Load Off	0x212D	1	U16	[0, 100]	RW	%

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47	Always On with Grid function	0x212E	1	U16	[0, 1] 0: disable,1: enable	RW	
48	Off-grid start-up battery Voltage (V)	0x212F	1	U16	[0, 65535]	RW	0.1V
49	Battery Voltage of Smart Load On	0x2130	1	U16	[0, 65535]	RW	0.1V
50	Battery Voltage of Smart Load Off	0x2131	1	U16	[0, 65535]	RW	0.1V
51	Backup minimum output voltage (V)	0x2132	1	U16	[0.5, 1] * nominal voltage	RW	0.1V
52	Backup maximum output voltage (V)	0x2133	1	U16	[1, 1.5] * nominal voltage	RW	0.1V
53	Generator start battery voltage (V)	0x2134	1	U16	[0, 65535]	RW	0.1V
54	Generator end battery voltage (V)	0x2135	1	U16	[0, 65535]	RW	0.1V
55	Generator Max Runtime (Min)	0x2136	1	U16	[0, 65535]	RW	Minute
56	Generator Down time (Min)	0x2137	1	U16	[0, 65535]	RW	Minute
57	Battery SOC of Inverter On (%)	0x2138	1	U16	[0, 100]	RW	%
58	Battery SOC of Inverter Off (%)	0x2139	1	U16	[0, 100]	RW	%
59	Battery Voltage of Inverter On (V)	0x213A	1	U16	[0, 65535]	RW	0.1V
60	Battery Voltage of Inverter Off (V)	0x213B	1	U16	[0, 65535]	RW	0.1V
61	AC couple frequency high	0x213C	1	U16	[0, 7000]	RW	0.01Hz
62	Support Normal Load function	0x2141	1	U16	[0, 1] 0: disable,1: enable	RW	
63	Parallel Mode function	0x2143	1	U16	[0, 1] 0: disable,1: enable	RW	
64	Force Charge Start SOC (%)	0x2144	1	U16	[0, 100]	RW	%
65	Force Charge End SOC (%)	0x2145	1	U16	[0, 100]	RW	%
66	Force Charge Start Voltage (V)	0x2146	1	U16	[0, 65535]	RW	0.1V
67	Force Charge End Voltage (V)	0x2147	1	U16	[0, 65535]	RW	0.1V
68	Battery Voltage of grid charge end (V)	0x2148	1	U16	[0, 65535]	RW	0.1V
69	Feed in Grid function	0x2149	1	U16	[0, 1] 0: disable,1: enable	RW	
70	Maximum Grid Forced Charge	0x2150	1	U16	[0, 65535]	RW	W

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71	Charge power in time 1(High Word)	0x2168	1	U16	[0, Pnom] relation with [0x2102] & [0x2103]	RW	W
72	Charge power in time 1(Low Word)	0x2169	1	U16		RW	
73	Charge end SOC in time 1	0x216A	1	U16	[0, 100] relation with [0x2102] & [0x2103]	RW	%
74	Charge end battery voltage in time 1	0x216B	1	U16	[0, 65535] relation with [0x2102] & [0x2103]	RW	0.1V
75	Discharge power in time 1(High Word)	0x216C	1	U16	[0, Pnom] relation with [0x2104] & [0x2105]	RW	W
76	Discharge power in time 1(Low Word)	0x216D	1	U16		RW	
77	Discharge end SOC in time 1	0x216E	1	U16	[0, 100] relation with [0x2104] & [0x2105]	RW	%
78	Discharge end battery voltage in time 1	0x216F	1	U16	[0, 65535] relation with [0x2104] & [0x2105]	RW	0.1V
79	Charge power in time 2(High Word)	0x2170	1	U16	[0, Pnom] relation with [0x2107] & [0x2108]	RW	W
80	Charge power in time 2(Low Word)	0x2171	1	U16		RW	
81	Charge end SOC in time 2	0x2172	1	U16	[0, 100] relation with [0x2107] & [0x2108]	RW	%
82	Charge end battery voltage in time 2	0x2173	1	U16	[0, 65535] relation with [0x2107] & [0x2108]	RW	0.1V
83	Discharge power in time 2(High Word)	0x2174	1	U16	[0, Pnom] relation with [0x2109] & [0x210A]	RW	W
84	Discharge power in time 2(Low Word)	0x2175	1	U16		RW	
85	Discharge end SOC in time 2	0x2176	1	U16	[0, 100] relation with [0x2109] &	RW	%

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					[0x210A]		
86	Discharge end battery voltage in time 2	0x2177	1	U16	[0, 65535] relation with [0x2109] & [0x210A]	RW	0.1V
87	Charge power in time 3(High Word)	0x2178	1	U16	[0, Pnom] relation with [0x210C] & [0x210D]	RW	W
88	Charge power in time 3(Low Word)	0x2179	1	U16		RW	
89	Charge end SOC in time 3	0x217A	1	U16	[0, 100] relation with [0x210C] & [0x210D]	RW	%
90	Charge end battery voltage in time 3	0x217B	1	U16	[0, 65535] relation with [0x210C] & [0x210D]	RW	0.1V
91	Discharge power in time 3(High Word)	0x217C	1	U16	[0, Pnom] relation with [0x210E] & [0x210F]	RW	W
92	Discharge power in time 3(Low Word)	0x217D	1	U16		RW	
93	Discharge end SOC in time 3	0x217E	1	U16	[0, 100] relation with [0x210E] & [0x210F]	RW	%
94	Discharge end battery voltage in time 3	0x217F	1	U16	[0, 65535] relation with [0x210E] & [0x210F]	RW	0.1V



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## 2.4 Parameters for Hybrid and PV Inverter

Index	Definition	Address	Register Number	Type	Comment	R/W	Unit
1	Date: Year	0x3000	1	U16	[2000, 2099]	RW	
2	Date: Month + Day	0x3001	1	U16	[1, 12] High Byte=Month [1, 31] Low Byte=Day	RW	
3	Date: Hour + Minute	0x3002	1	U16	[0, 23] High Byte =Hour [0, 59] Low Byte =Minute	RW	
4	Date: Second + 0	0x3003	1	U16	[0, 59] High Byte =Second Low Byte =0	RW	
5	Power derating percent by Modbus	0x3005	1	U16	[0, 110] <b>Dynamic active power regulation.</b>	RW	
6	Modbus Address	0x303E	1	U16	[1, 247] Default 1	RW	
7	RS485 baud rate	0x304C	1	U16	[1, 5] 1: 2400 2: 4800 3: 9600 4: 14400 5: 19200	RW	
8	WIFI STA SSID	0x3060	16	string		RW	ASCII
9	WIFI STA password	0x3070	16	string		RW	ASCII
10	Digital meter Modbus address	0x30B0	1	U16	[1, 255] Default 1	RW	<a href="#">Note1</a>
11	Digital meter Type	0x30B1	1	U16	[0, 10] 0: Unknown 1: Gavazzi/ EM340DINAV23XS1X 2: CHINT/DTSU666 3: Reserved 4: Lovato/DMG210 5: Reserved	RW	<a href="#">Note1</a>

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					6: Gavazzi/ET112 7: Reserved 8: CHINT/DDSU666 9: Gavazzi/ EM530DINAV53XS1X 10: Gavazzi/ EM540DINAV53XS1X		
12	Power flow direction	0x30B2	1	U16	[0, 1] 0: Grid to inverter 1: Inverter to grid	RW	
13	Power limit function	0x30B3	1	U16	[0, 3] 0: Disable 1: Power limit by external device 2: Power limit by PVI external CT 3: Power limit by digital meter	RW	
14	Power limit CT ratio	0x30B4	1	U16	[0, 8] 0: Unknown 1: 1000 : 1 2: 2000 : 1 3: 2500 : 1 4: 3000 : 1 5: 4000 : 1 6: 5000 : 1 7: 6000 : 1 8: 10000 : 1	RW	<a href="#">Note1</a>
15	Meter location	0x30B5	1	U16	[0, 1] 0: CT on Grid (Meter on Grid) 1: CT on Load (Meter on Load)	RW	
16	Maximum feed in grid power	0x30B9	2	U32	<a href="#">[0, Pnom]</a> Pnom : nominal power	RW	W
17	First connect start time	0x5000	1	U16	[10, 600]	RW	s
18	Reconnect time	0x5001	1	U16	[10, 900]	RW	s
19	Grid frequency high loss level 1 limit	0x5002	1	U16	50Hz: [5001, 5500] 60Hz: [6001, 6500]	RW	0.01Hz

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20	Grid frequency low loss level 1 limit	0x5003	1	U16	50Hz: [4500, 4999] 60Hz: [5500, 5999]	RW	0.01Hz
21	Grid voltage high loss level 1 limit	0x5004	1	U16	<a href="#">[1, 1.5] * nominal voltage</a>	RW	0.1V
22	Grid voltage low loss level 1 limit	0x5005	1	U16	<a href="#">[0.1, 1] * nominal voltage</a>	RW	0.1V
23	Grid frequency high loss level 1 trip time	0x5006	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
24	Grid frequency low loss level 1 trip time	0x5007	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
25	Grid voltage high loss level 1 trip time	0x5008	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
26	Grid voltage low loss level 1 trip time	0x5009	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
27	Grid frequency high loss level 2 limit	0x500A	1	U16	50Hz: [5001, 5500] 60Hz: [6001, 6500]	RW	0.01Hz
28	Grid frequency low loss level 2 limit	0x500B	1	U16	50Hz: [4500, 4999] 60Hz: [5500, 5999]	RW	0.01Hz
29	Grid voltage high loss level 2 limit	0x500C	1	U16	[1, 1.5] * nominal voltage	RW	0.1V
30	Grid voltage low loss level 2 limit	0x500D	1	U16	[0.1, 1] * nominal voltage	RW	0.1V
31	Grid frequency high loss level 2 trip time	0x500E	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
32	Grid frequency low loss level 2 trip time	0x500F	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
33	Grid voltage high loss level 2 trip time	0x5010	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
34	Grid voltage low loss level 2 trip time	0x5011	1	U16	[0, 65535]	RW	1ms <a href="#">Note3</a>
35	10 min average sustained voltage	0x5018	1	U16	[1, 1.5] * nominal voltage	RW	0.1V
36	<b>Reconnect</b> soft output power percent	0x5019	1	U16	[1,100]	RW	%/min
37	Over frequency power reduction droop	0x501A	1	U16	[20,120]	RW	0.1%/Hz
38	Insulation resistance active limit	0x501B	1	U16	[10,5000]	RW	1KΩ

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39	Grid over voltage de-rating point	0x501E	1	U16	[1, 1.5] * nominal voltage	RW	0.1V
40	Grid frequency high Level 1 trip time (High word)	0x501F	1	U16	[0,15]	RW	ms
41	Grid frequency low Level 1 trip time (High word)	0x5020	1	U16	[0,15]	RW	ms
42	Grid over frequency de-rating start point	0x5021	1	U16	50Hz: [5001, 5500] 60Hz: [6001, 6500]	RW	0.01Hz
43	Grid over frequency de-rating end point	0x5022	1	U16	50Hz: [5001, 5500] 60Hz: [6001, 6500]	RW	0.01Hz
44	Grid Voltage High Level 1 trip time (High word)	0x5025	1	U16	[0,9]	RW	ms
45	Grid Voltage Low Level 1 trip time (High word)	0x5026	1	U16	[0,9]	RW	ms
46	First connect soft start output power percent	0x5029	1	U16	[1,100]	RW	%
47	Output reactive power mode	0x5030	1	U16	[0,9] 0: Pure active power 1: $\cos\phi = \text{const.}$ relation with [0x5031] 2: $Q = \text{const.}$ relation with [0x5032]   [0x5114] 3: $\cos\phi(P)$ , relation with [0x5034~0x503B], [0x5045,0x5046 CEI-021 only] 4: $Q(U)$ , relation with [0x503C~0x5044], [0x5047,0x5048 CEI-021 & PEA only] 5: AUTO P(U) 6: Watt(U) AS4777, Pure active power, relation with [0x5049~0x5050] 7: $Q(U)$ AS4777, relation with [0x5051~0x5058] 8: $Q = \text{const.}$ (P priority), relation with [0x5114] 9: $Q(P)$ Curve, relation	RW	

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					with [0x505A~0x5061]		
48	Power factor setting	0x5031	1	S16	[-1000, -800], [800, 1000]	RW	0.001
49	Reactive control response time	0x5033	1	U16	[0,120]	RW	s
50	Q(U) curve node1 percent(U/Un)	0x503C	1	U16	[80,120]	RW	%
51	Q(U) curve node2 percent(U/Un)	0x503D	1	U16	[80,120]	RW	%
52	Q(U) curve node3 percent(U/Un)	0x503E	1	U16	[80,120]	RW	%
53	Q(U) curve node4 percent(U/Un)	0x503F	1	U16	[80,120]	RW	%
54	Q(U) curve node1 value setting (Q/S)	0x5040	1	S16	[-1100,1100]	RW	0.1%
55	Q(U) curve node2 value setting (Q/S)	0x5041	1	S16	[-1100,1100]	RW	0.1%
56	Q(U) curve node3 value setting (Q/S)	0x5042	1	S16	[-1100,1100]	RW	0.1%
57	Q(U) curve node4 value setting (Q/S)	0x5043	1	S16	[-1100,1100]	RW	0.1%
58	Volt-Watt node1 voltage for ESS charging power derating	0x5049	1	U16	[0.8, 1.5] * nominal voltage	RW	0.1V <a href="#">Note2</a>
59	Volt-Watt node2 voltage for ESS charging power derating	0x504A	1	U16	[0.8, 1.5] * nominal voltage	RW	0.1V <a href="#">Note2</a>
60	Volt-Watt node1 voltage for output power derating	0x504B	1	U16	[0.8, 1.5] * nominal voltage	RW	0.1V
61	Volt-Watt node2 voltage for output power derating	0x504C	1	U16	[0.8, 1.5] * nominal voltage	RW	0.1V
62	Volt-Watt node1 ESS charging percent	0x504D	1	U16	[0,110]	RW	% <a href="#">Note2</a>
63	Volt-Watt node2 ESS charging percent	0x504E	1	U16	[0,110]	RW	% <a href="#">Note2</a>
64	Volt-Watt node1 output power percent	0x504F	1	U16	[0,110]	RW	%
65	Volt-Watt node2 output power percent	0x5050	1	U16	[0,110]	RW	%
66	Q(P) curve node 1 percentage setting (P/Pn)	0x505A	1	U16	[0,100]	RW	%

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67	Q(P) curve node 2 percentage setting (P/Pn)	0x505B	1	U16	[0,100]	RW	%
68	Q(P) curve node 3 percentage setting (P/Pn)	0x505C	1	U16	[0,100]	RW	%
69	Q(P) curve node 4 percentage setting (P/Pn)	0x505D	1	U16	[0,100]	RW	%
70	Q(P) curve node 1 value setting (Q/Pn)	0x505E	1	S16	[-600,600]	RW	0.10%
71	Q(P) curve node 2 value setting (Q/Pn)	0x505F	1	S16	[-600,600]	RW	0.10%
72	Q(P) curve node 3 value setting (Q/Pn)	0x5060	1	S16	[-600,600]	RW	0.10%
73	Q(P) curve node 4 value setting (Q/Pn)	0x5061	1	S16	[-600,600]	RW	0.10%
74	LVRT Triggering voltage	0x5063	1	U16	[0.1, 0.9] * nominal voltage	RW	0.1V
75	HVRT Triggering voltage	0x5064	1	U16	[1.1, 1.5] * nominal voltage	RW	0.1V
76	FRT Mode	0x5065	1	U16	[0, 1] 0: Zero current mode, 1: full grid support mode	RW	
77	FRT Zero current mode triggering threshold	0x5066	1	U16	[5, 150]	RW	%
78	FRT grid voltage jump triggering threshold	0x5067	1	U16	[5, 150]	RW	%
79	Grid frequency high Level 2 trip time (High word)	0x506C	1	U16	[0, 15]	RW	ms
80	Grid frequency low Level 2 trip time (High word)	0x506D	1	U16	[0, 15]	RW	ms
81	Over frequency derating reference power	0x507F	1	U16	[0, 1] 0: base on rating power, 1: base on current power	RW	
82	Grid under frequency rise power start point	0x5081	1	U16	50Hz: [4500, 4999] 60Hz: [5500, 5999]	RW	0.01Hz
83	Grid under frequency rise power stop point	0x5082	1	U16	50Hz: [4500, 4999] 60Hz: [5500, 5999]	RW	0.01Hz
84	Under frequency rise power droop	0x5083	1	U16	[20, 120]	RW	0.001
85	Under frequency rise power	0x5084	1	U16	[0, 1]	RW	

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	reference				0: base on rating power, 1: base on current power		
86	Regulation code	0x5101	1	U16	<a href="#">Regulation Code Table</a>	RW	
87	Derating Watt Percent	0x5104	1	U16	[0, 110] Percent of nominal power		%
88	Mppt shadow manage	0x5106	1	U16	[0, 1] 0: disable,1: enable	RW	
89	Mppt shadow manage interval time	0x5107	1	U16	[30, 7200]	RW	s
90	Islanding detection	0x510E	1	U16	[0, 1] 0: disable,1: enable	RW	
91	Low voltage through detection	0x5112	1	U16	[0, 1] 0: disable,1: enable	RW	<a href="#">Note4</a>
92	Reactive Power Percent	0x5114	1	S16	[-60, 60] Percent of nominal power <b><i>Do not use for dynamic regulation.</i></b>	RW	%
93	Adjust Resistance	0x5115	1	U16	[0, 1] 0: open,1: close	RW	<a href="#">Note4</a>
94	Insulation Resistor Detection	0x5117	1	U16	[0, 1] 0: disable,1: enable	RW	
95	Ground Current Detection	0x5118	1	U16	[0, 1] 0: disable,1: enable	RW	
96	Grid high voltage load de-rating function	0x511D	1	U16	[0, 1] 0: disable,1: enable Relation with [0x501E]	RW	
97	Inverter control	0x6001	1	U16	[0, 1] 0: power on,1: shut down	RW	
98	P.F (cosφ)	0x600F	1	S16	[-1000, -800], [800, 1000] (+) Positive: over-excited (lag, inductive) (-) Negative: under-excited (lead, capacitive) <b><i>Dynamic power factor regulation.</i></b>	RW	0.001

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99	Reactive Power Percent	0x6010	1	S16	[0, 65535] (+) Positive: over-excited (lag, inductive) (-) Negative: under-excited (lead, capacitive) <b><i>Dynamic reactive power regulation.</i></b>	RW	0.01%
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Note:

1. Hybrid not support this command, means 0x1A5A = 0.
2. Only Hybrid support this command, means 0x1A5A = 2 or 3.
3. The unit of CN (NB/T 32004) regulation code (0x5101= 0x0E) is 10ms. The unit of other regulation codes is 1ms.
4. Only support for 3 phase model, means 0x1A48 = 3.
5. 0x5000/0x5100 write parameter to EEPROM, write more frequently will reduce the EEPROM life, so forbid send 0x5000/0x5100 group command to do active and reactive power control.
6. Suggestion send 0x3005 to dynamic control active power percent.
7. Suggestion send 0x600F/0x6010 to dynamic control the power factor or reactive power adjust function.
8. If setting range is [0, 65535], it means the setting range probably be limited by Hybrid or PV inverter nominal power, if setting value over nominal power will get the illegal code.
9. If setting range is [1, 1.5] \* nominal voltage, the nominal voltage parameter needs reference the 0x1A44 parameter, for example, if 0x1A44 response value is 2200, it' s means the setting range is [2200, 3300], if 0x1A44 response value is 4800, it' s means the setting range is [4800, 7200]
- 10.If setting range is [0.1, 1] \* nominal voltage, the nominal voltage parameter needs reference the 0x1A44 parameter, for example, if 0x1A44 response value is 2200, it' s means the setting range is [220, 2200], if 0x1A44 response value is 4800, it' s means the setting range is [480, 4800]
- 11.If setting range is [0, Pnom], the Pnom parameter need reference the 0x1A46 & 0x1A4E parameter, for example, if 0x1A46 response value is 10000 and 0x1A4E response value is 0, it' s means the setting range is [0, 10000]



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### 3 Modbus Protocol Command

#### 3.1 Function code list

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

#### 3.2 Read Register (0x03)

(1) Host query command format:

Parameter	Length (Byte)	Description
Slave address	1	1~247
Function code	1	0x03
Register start address	2	0x0000~0xFFFF
Register number	2	1~124
CRC code	2	

(2) Slave normal respond:

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

(3) Slave abnormal respond:

Parameter	Length (Byte)	Description
Slave address	1	1~247
Function code	1	0x83
Illegal code	1	Refer " <a href="#">Illegal CodeTable</a> "
CRC code	2	

(4) 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

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### 3.3 Write a single Register (0x06)

(1) Host query command format:

Parameter	Length (Byte)	Description
Slave address	1	1~247
Function code	1	0x06
Register address	2	0x0000~0xFFFF
Register value	2	0x0000~0xFFFF
CRC code	2	

(2) Slave normal respond:

Parameter	Length (Byte)	Description
Slave address	1	1~247
Function code	1	0x06
Register address	2	0x0000~0xFFFF
Register value	2	0x0000~0xFFFF
CRC code	2	

(3) Slave abnormal respond:

Parameter	Length (Byte)	Description
Slave address	1	1~247
Function code	1	0x86
Illegal code	1	Refer " <a href="#">Illegal CodeTable</a> "
CRC code	2	

(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

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### 3.4 Write multiple Registers (0x10)

(1) Host query command format:

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

(2) Slave normal respond:

Parameter	Length (Byte)	Description
Slave address	1	1~247
Function code	1	0x10
Register start address	2	0x0000~0xFFFF
Register number	2	1~122
CRC code	2	

(3) Slave abnormal respond:

Parameter	Length (Byte)	Description
Slave address	1	1~247
Function code	1	0x90
Illegal code	1	Refer " <a href="#">Illegal CodeTable</a> "
CRC code	2	

(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

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## 4 Appendix

### 4.1 Error Code Table1 (0x101E) [↗](#)

Bit	Description
0	Inverter over dc-bias current
1	Inverter relay abnormal
2	Remote off
3	Inverter over temperature
4	GFCI abnormal
5	PV string reverse
6	System type error
7	Fan abnormal
8	Dc-link unbalance or under voltage
9	Dc-link over voltage
10	Internal communication error
11	Software incompatibility
12	Internal storage error
13	Data inconsistency
14	Inverter abnormal
15	Boost abnormal

### 4.2 Error Code Table2 (0x101F) [↗](#)

Bit	Description
0	Grid over voltage
1	Grid under voltage
2	Grid absent
3	Grid over frequency
4	Grid under frequency
5	PV over voltage
6	PV insulation abnormal
7	Leakage current abnormal
8	Inverter in power limit state
9	Internal power supply abnormal
10	PV string abnormal
11	PV under voltage
12	PV irradiation weak
13	Grid abnormal

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14	Arc fault detection
15	AC moving average voltage high

#### 4.3 Error Code Table3 (0x1020) [↗](#)

Bit	Description
0	Reserved
1	Logger/E-Display EEPROM fail
2	Reserved
3	Single tracker detect warning (PID device abnormal)
4	AFCI lost
5	Data logger lost
6	Meter lost
7	Inverter lost
8	Grid N abnormal
9	Surge Protection Devices (SPD) defective
10	Parallel ID warning
11	Parallel SYN signal warning
12	Parallel BAT abnormal
13	Parallel GRID abnormal
14	Generator voltage abnormal
15	Reserved

#### 4.4 Error Code Table4 (0x2013) [↗](#)

Bit	Description
0	Battery absent
1	Battery over voltage
2	Battery under voltage
3	Battery discharge over current
4	Battery over temperature
5	Battery under temperature
6	Neutral live wire reversed
7	Back up output voltage abnormal
8	Communication error (Inverter-BMS)
9	Internal communication loss(E-M)
10	Internal communication loss(M-D)
11	DCDC abnormal
12	Back up over dc-bias voltage

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13	Back up short circuit
14	Back up over load
15	Reserved

#### 4.5 Regulation code Table (0x5101) [↗](#)

No.	Regulation code
0	0xFFFF : UNKNOWN
1	0x0001 : AU (澳洲 AS/NZS 4777.2 Region B)
2	0x0002 : DE (德國 VDE 0126-1-1/A1)
3	0x0003 : TW (台灣 TW GRID)
4	0x0004 : DE (德國 VDE-AR-N 4105:2011)
5	0x0005 : JP (日本 JETGR0002-1-2.0)
6	0x0006 : IT (義大利 CEI 0-21)
7	0x0007 : SE (瑞典 EIFS-2)
8	0x0008 : UK (英國 G98)
9	0x0009 : UL (美國 UL)
10	0x000A : TH(泰國 PEA)
11	0x000B : SE (瑞典 SWEDEN GRID) 2007
12	0x000C : NL (荷蘭 EN50549-1 2019)
13	0x000D : TH (泰國 MEA)
14	0x000E : CN (中國 NB/T 32004)
15	0x000F : IN (印度 IEC61727)
16	0x0010 : AU (澳洲 AS/NZS 4777.2 Region A)
17	0x0011 : NZ (澳洲 AS/NZS 4777.2 New Zealand)
18	0x0012 : US (美洲 IEEE1547)
19	0x0013 : UA (烏克蘭 VDE-AR-N 4105.)
20	0x0014 : TW (台灣 CNS 15382:2018)
21	0x0015 : DE (德國 VDE0126-1-1/08.13)
22	0x0016 : BR (巴西 ABNT NBR16149 2013)
23	0x0017 : CZ (捷克 Czech EN 50160)
24	0x0018 : UK (英國 G99 Type A)
25	0x0019 : PT (葡萄牙 EN50549-1)
26	0x001A : ES (西班牙 Spain RD1699 / RD413)
27	0x001B : ES (西班牙 Spain RD661 / PO12.2)
28	0x001C : IT (義大利 CEI 0-21 ACEA)
29	0x001D : DE (德國 VDE-AR-N 4105:2018)
30	0x001E : BR (巴西 IEC61727)

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31	0x001F : EU (歐洲 EN50549-1:2019)
32	0x0020 : BE (比利時 C10/11 LV)
33	0x0021 : PL (波蘭 EN50438 2013)
34	0x0022 : DE (德國 VDE4110:2018)
35	0x0023 : EU (歐洲 EN50549-2:2019)
36	0x0024 : IT (義大利 CEI 0-16)
37	0x0025 : ZA (南非 NRS097-2-1)
38	0x0026 : GR (希臘 VDE0126_Continent)
39	0x0027 : GR (希臘 VDE0126_Islands)
40	0x0028 : JO (約旦 IRR-DCC MV 2015)
41	0x0029 : ES (西班牙 Spain UNE206007 / UNE206006)
42	0x002A : AU (澳洲 AS/NZS 4777.2 Region C)
43	0x002B : UK (英國 G99 Type B)
44	0x002C : JO (約旦 IRR-TIC 2015)
45	0x002D : CZ (捷克 Czech EN50549-1)
46	0x002E : AT (奧地利 TOR TypeA)
47	0x002F : CY (塞浦路斯 Cyprus 2019)
48	0x0030 : MX (墨西哥 IEEE1547 : 2014)
49	0x0031 : CL (智利 Chile BT)
50	0x0032 : FR (法國 UTE C15-712-1)
51	0x0033 : CH (瑞士 NA/EEA A2)
52	0x0034 : CH (瑞士 NA/EEA B2)
53	0x0035 : FR (法國 UTE C15-712-1 Island 50Hz)
54	0x0036 : FR (法國 UTE C15-712-1 Island 60Hz)
55	0x0037 : FI (芬蘭 VJV Type A)
56	0x0038 : FI (芬蘭 VJV Type B)
57	0x0039 : NO (挪威 EN50549-1)
58	0x003A : PL (波蘭 NC RFG Type A)
59	0x003B : PL (波蘭 NC RFG Type B)
60	0x003C : BE (比利時 C10/11 MV)
61	0x003D : AT (奧地利 TOR Type B)
62	0x003E : IL (以色列 IS 4777)
63	0x003F : DK1 (西丹麥 Type A & B LV)
64	0x0040 : DK1 (西丹麥 Type B MV)
65	0x0041 : DK2 (東丹麥 Type A & B LV)
66	0x0042 : DK2 (東丹麥 Type B MV)
67	0x0043 : CL (智利 Chile MT HD)

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68	0x0044 : CL (智利 Chile MT LD)
69	0x0045 : ES (西班牙 NTs-A/UNE217002/RD647)
70	0x0046 : ES (西班牙 NTs-B/UNE217002/RD647)
71	0x0047 : AU (澳洲 AS/NZS 4777.2 Vector)
72	0x0048 : IRL (愛爾蘭 EN50549-1: Ireland)

#### 4.6 Inverter Mode Table (0x101D) [↗](#)

No.	Description
0x00	Initial mode
0x01	Standby mode
0x03	On-Grid mode
0x04	Off-Grid mode
0x05	Fault mode
0x09	Shutdown mode

#### 4.7 Illegal code Table [↗](#)

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

#### 4.8 Reference document

APD PV inverter Modbus communication protocol V4.25.xlsx