SUNGROW

Communication Protocol of Residential Hybrid Inverter

V1.0.20

Version number	Date	Note
1.0.12	2016/02/22	Initial released version .
1.0.13	2016/10/13	Modify the register content. 5003-5005、13036-13038、13055
1.0.14	2017/12/05	Add the Firmware version to 2582~2626 register address.
1.0.15	2018/03/12	1） Modify 13008~13009 registers U32 data type to S32。 2） Add the error code analysis instructions to the Appendix 1.4.
1.0.16	2018/06/13	1) Add the valid device types description。 2）Add device code definition to the 5000 register address. 3）The register 13061 data range is Modified from 30.0~48.0V to 32.0~48.0V.
1.0.17	2018/07/17	Delete the 13076~13079 and 13081~13082 registers content.
1.0.18	2019/01/05	Add "Meter Comm. Detection"

		definition in the register 13086.
1.0.19	2019/05/28	Add new valid device types . SH5K-30/SH3K6-30/SH4K6-30 SH5.0RS/SH3.6RS/SH4.6RS/SH6.0RS SH10RT/SH8.0RT/SH6.0RT/SH5.0RT
1.0.20	2020/04/07	Add ARM software version 4954 and DSP software version 4969 Add Export Power Limitation 13087 SH10RT/SH8.0RT/SH6.0RT/SH5.0RT
		Add Appendix 1.1 system state Running in External EMS mode 0x4000 SH10RT/SH8.0RT/SH6.0RT/SH5.0RT

Valid device types:

SH5K-20 / SH3K6 / SH4K6 / SH5K-V13

SH5K-30/SH3K6-30/SH4K6-30

SH5.0RS/SH3.6RS/SH4.6RS/SH6.0RS

SH10RT/SH8.0RT/SH6.0RT/SH5.0RT

1.Introduction

This communication protocol, complies ModBus , applies to the communication between

Sungrow grid-connected hybrid inverters (SH-inverter) and monitoring system.

2.Communication Interface

1.1 RS485

Item	Default setting
Address	Inverter: 1 – 247 settable PC: 1 – 247 settable
Broadcast	Yes
Baud rate	9600 bit/s
Check bit	Null or settable
Data bit	8
Stop bit	1
Mode	RTU
Appliance interface	RS485-2W cable connection

1.2 Ethernet (optional)

Default:

– DHCP: ON

– Port: 502

3. Address Definition

- Read-only register type supports the command code of 0x04.

- Holding register type supports the command codes of 0x03, 0x10 and 0x06.

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3.1　Running information variable address definition (read-only register)

No.	Name	Address	Data type	Data range	Unit	Note
1	Protocol No.	4950 - 4951	U32			
2	Protocol ver.	4952 - 4953	U32			
3	Arm software ver	4954 - 4968	U16*15			
4	Dsp software ver	4969 - 4983	U16*15			
5	Reserved					
6	SN	4990 - 4999	U16*10			UTF-8
Run-info						
6	Device type code	5000	U16			SH5K-20 0xD09 SH3K6 0xD06 SH4K6 0xD07 SH5K-V13 0xD03 SH5K-30 0xD0C SH3K6-30 0xD0A SH4K6-30 0xD0B SH5.0RS 0xD0F SH3.6RS 0xD0D

						SH4.6RS 0xD0E
						SH6.0RS 0xD10
						SH10RT 0xE03
						SH8.0RT 0xE02
						SH6.0RT 0xE01
						SH5.0RT 0xE00
7	Nominal output power	5001	U16		0.1kW	
8	Output type	5002	U16	0-Single phase; 1-3P4L; 2-3P3L		
9	Daily Output Energy	5003	U16		0.1kWh	Hybrid active power accumulation (Include PV generation and battery discharge energy)
10	Total Output Energy	5004 - 5005	U32		0.1kWh	
11	Reserved	5006 - 5007				
12	Inside Temperature	5008	S16		0.1℃	
13	Reserved	5009~5010				
14	MPPT 1 Voltage	5011	U16		0.1V	

15	MPPT 1 Current	5012	U16		0.1A	
16	MPPT 2 Voltage	5013	U16		0.1V	
17	MPPT 2 Current	5014	U16		0.1A	
18	Reserved	5015 - 5016	U16			
19	Total DC power	5017 - 5018	U32		W	PV Power
20	A-B line voltage/phase A voltage	5019	U16		0.1V	Refer to Output type (address: 5002) 0: phase voltage; 1: phase voltage; 2: line voltage
21	B-C line voltage/phase B voltage	5020	U16		0.1V	Refer to Output type (address: 5002) 0: phase voltage; 1: phase voltage; 2: line voltage
22	C-A line voltage/phase Cvoltage	5021	U16		0.1V	Refer to Output type (address: 5002) 0: phase voltage; 1: phase voltage; 2: line voltage
23	Reserved	5022~5032				
24	Reactive power	5033~5034	S32		var	

25	Power factor	5035	S16		0.001	
26	Grid frequency	5036	U16		0.1Hz	
27						
28	PV Power of today	6100 - 6195	U16		1W	
29	Daily PV energy yields	6196 - 6226	U16		0.1KWh	
30	Monthly PV energy yields	6227 - 6238	U16		1KWh	
31	Reserved	6239 - 6243				
32	Yearly PV energy yields	6250 - 6289	U32*20		0.1kWh	
33	Direct power consumption of today from PV	6290 - 6385	U16*96		1W	
34	Daily direct energy consumption from PV	6386 - 6416	U16*31		0.1kWh	
35	Monthly direct energy consumption	6417 - 6428	U16*12		0.1kWh	

	from PV				
36	Yearly direct energy consumption from PV	6429 - 6468	U32*20		0.1kWh	
37	Export power from PV of today	6469 - 6564	U16*96		1W	
38	Daily export energy from PV	6565 - 6595	U16*31		0.1kWh	
39	Monthly export energy from PV	6596 - 6607	U16*12		0.1kWh	
40	Yearly export energy from PV	6608 - 6647	U32*20		0.1kWh	
41	Battery charge power of today	6648 - 6743	U16*96		1W	
42	Daily battery charge energy from PV	6744 - 6774	U16*31		0.1kWh	
43	Monthly battery charge energy from PV	6775 - 6786	U16*12		0.1kWh	

44	Yearly battery charge energy from PV	6787 - 6826	U32*20		0.1kWh	
45						
46	System state	13000	U16			Refer to Appendix 1.1
47	Running state	13001	U16		0.1kWh	Refer to Appendix 1.2
48	Daily PV Generation	13002	U16		0.1kWh	
49	Total PV Generation	13003 - 13004	U32		0.1kWh	
50	Daily export power from PV	13005	U16		0.1kW	
51	Total export energy from PV	13006 - 13007	U32		0.1kWh	
52	Load power	13008 - 13009	S32		1W	
53	Export power	13010 - 13011	S32		1W	
54	Daily battery charge energy from PV	13012	U16		0.1kWh	
55	Total battery charge energy	13013 - 13014	U32		0.1kWh	

	from PV				
56	CO_2-reduction	13015 - 13016	U32		0.1kg	
57	Daily direct energy consumption	13017	U16		0.1kWh	
58	Total direct energy consumption	13018 - 13019	U32		0.1kWh	
59	Battery voltage	13020	U16		0.1V	
60	Battery current	13021	U16		0.1A	
61	Battery power	13022	U16		1W	
62	Battery level	13023	U16		0.1%	
63	Battery state of healthy	13024	U16		0.1%	
64	Battery temperature	13025	S16		0.1℃	
65	Daily battery discharge energy	13026	U16		0.1kWh	
66	Total battery discharge energy	13027 - 13028	U32		0.1kWh	

67	Self-consumpti on of today	13029	U16		0.1%	
68	Grid state	13030	U16		-	0xAA: Off grid; 0x55: On Grid
69	Phase A current	13031	S16		0.1A	
70	Phase B current	13032	S16		0.1A	Refer to Output type (address: 5002) 0: Invalid; 1/2: Valid
71	Phase C current	13033	S16		0.1A	Refer to Output type (address: 5002) 0: Invalid; 1/2: Valid
72	Total active power	13034 - 13035	S32		W	
73	Daily Import Energy	13036	U16		0.1kWh	
74	Total Import Energy	13037~13038	U32		0.1kWh	
75	Battery Capacity	13039	U16		0.1kwh /Ah	Li-ion：kwh Lead-acid：Ah

					Applicable types： SH5K-20 SH3K6 SH4K6 SH5K-V13 SH5K-30 SH3K6-30 SH4K6-30
76	Daily Charge Energy	13040	U16	0.1kWh	
77	Total Charge Energy	13041~13042	U32	0.1kWh	
78	DRM State	13043	U16	1~9： DRM0~DRM8 Other Value： Invalid	
79	Reserved	13044			
80	Daily export energy	13045	U16	0.1kWh	
81	Total export	13046~13047	U32	0.1kWh	

	energy				
82	Reserved	13048~13049			
83	Inverter alarm	13050 - 13051	U32		
84	Grid-side fault	13052 - 13053	U32		
85	System fault 1	13054 - 13055	U32		
86	System fault 2	13056 - 13057	U32		
87	DC-side fault	13058 - 13059	U32		
88	Permanent fault	13060 - 13061	U32		
89	BDC-side fault	13062 - 13063	U32		
90	BDC-side permanent fault	13064 - 13065	U32		Refer to Appendix 1.3
91	Battery fault	13066 - 13067	U32		
92	Battery alarm	13068 - 13069	U32		
93	BMS alarm	13070 - 13071	U32		
94	BMS protection	13072 - 13073	U32		
95	BMS fault 1	13074 - 13075	U32		
96	BMS fault 2	13076 - 13077	U32		
97	BMS alarm 2	13078~13079	U32		
98	Reserved	13080 - 13099			
99	BMS Status	13100	U16		BMS info.
100	Max. charging	13101	U16	A	Applicable types :

						SH5K-20
101	Max. discharging current	13102	U16		A	SH3K6 SH4K6 SH5K-V13
102	Warning	13103	U16			SH5K-30
103	Protection	13104	U16			SH3K6-30
104	Fault 1	13105	U16			SH4K6-30
105	Fault 2	13106	U16			
106	SOC	13107	U16		1%	
107	SOH	13108	U16			
108	Battery Current	13109	U16			
109	Battery Voltage	13110	U16		0.01V	
110	Cycle Count	13111	U16			
111	Average cell voltage	13112	U16			
112	Max cell voltage	13113	U16			
113	Min cell voltage	13114	U16			
114	Battery Pack voltage	13115	U16			
115	Average cell temp.	13116	S16			
116	Max cell temp.	13117	S16			

| 117 | Min cell temp. | 13118 | S16 | | | |

Note: please refer to the troubleshooting chapter in SH-inverter manuals for fault code explanations.

3.2   Parameter setting address definition (holding register)

No.	Name	Address	Data type	Data range	Unit	Note
1	System clock: Year	5000	U16			
2	System clock: Month	5001	U16			
3	System clock: Day	5002	U16			
4	System clock: Hour	5003	U16			
5	System clock: Minute	5004	U16			
6	System clock: Second	5005	U16			
7						
8	Start/Stop	13000	U16	0xCF(Start) 0xCE(Stop) Others (no operation)		
9	Battery maintenance	13001	U16	0xAA(Maintenance) Others (no operation)		Applicable types： SH5K-20

					SH3K6
					SH4K6
					SH5K-V13
					SH5K-30
					SH3K6-30
					SH4K6-30
10	Load 1 adjustment mode	13002	U16	0: Timing mode; 1: ON/OFF mode; 2: Power optimized mode	
11	Load 1 timing period 1: Start hour	13003	U16	0 - 23	1h
12	Load 1 timing period 1: Start minute	13004	U16*10	0 - 59	1min
13	Load 1 timing period 1: End hour	13005	U16	0 - 23	1h
14	Load 1 timing period 1: End minute	13006	U16	0 - 59	1min

15	Load 1 timing period 2: Start hour	13007	U16	0 - 23	1h	
16	Load 1 timing period 2: Start minute	13008	U16*10	0 - 59	1min	
17	Load 1 timing period 2: End hour	13009	U16	0 - 23	1h	
18	Load 1 timing period 2: End minute	13010	U16	0 - 59	1min	
19	Load 1 ON/OFF mode	13011	U16	0xAA (ON) 0x55 (OFF)		
20	Load 1 power optimized mode: Start hour	13012	U16	0 - 23	1h	
21	Load 1 power optimized mode: Start minute	13013	U16	0 - 59	1min	
22	Load 1 power optimized mode:	13014	U16	0 - 23	1h	

	End hour					
23	Load 1 power optimized mode: End minute	13015	U16	0 - 59	1min	
24	Optimized power of load 1	13016	U16	0 - 5000	1W	
25	Reserved					
26	EMS mode selection	13050	U16	0: Self-consumption mode (Default); 2: Forced mode (charge/discharge/stop); 3: External EMS mode		
27	Charge/discharge command	13051	U16	0xAA: Charge; 0xBB:Discharge; 0xCC: Stop (Default);		Loss if power down
28	Charge/discharge power	13052	U16	0 - 5000W Default: 1000W	1W	Loss if power down
29	Reserved	13053~13054				
30	Battery type	13055	U16	0 Lead-acid Narada 1 Li-ion Samsung 2 No battery		Applicable types： SH5K-20

			3 Other Lead-acid 4 Li-ion US2000A 5 Li-ion LG 6 Li-ion US2000B 7 Li-ion GCL 8 Li-ion BlueSun 9 Li-ion Sungrow 10 Li-ion BYD		SH3K6 SH4K6 SH5K-V13 SH5K-30 SH3K6-30 SH4K6-30
31	Battery nominal voltage	13056	U16	30.0 - 60.0V	0.1V	
32	Battery capacity	13057	U16	10 - 1000Ah	1Ah	
33	Max. SOC	13058	U16	70 . 0 - 100.0%	0.1%	
34	Min. SOC	13059	U16	0.0 - 50.0%	0.1%	
35	Battery overvoltage threshold	13060	U16	48.0 - 70.0V	0.1V	Applicable types : SH5K-20
36	Battery under voltage threshold	13061	U16	32.0 - 48.0V	0.1V	SH3K6 SH4K6
37	Battery over-temperature threshold	13062	S16	20.0 - 60.0℃	0.1℃	SH5K-V13 SH5K-30 SH3K6-30
38	Battery	13063	S16	(-30.0 - 10.0℃)	0.1℃	SH4K6-30

	under-temperature threshold					
39	Reserved	13064				
40	Terminated current of constant voltage charging	13065	U16	0.005 - 0.050C	0.001C	Applicable types： SH5K-20 SH3K6 SH4K6 SH5K-V13 SH5K-30 SH3K6-30 SH4K6-30
41	Max. discharge current	13066	U16	0.100 - 2.000C	0.001C	
42	Max. charge current	13067	U16	0.050 - 2.000C	0.001C	
43	Constant charge voltage	13068	U16	40.00 - 60.00V	0.01V	
44	Terminated voltage of discharging.	13069	U16	30.000 - 50.000V	0.001V	
45	Emergency charge current	13070	U16	0.025 - 2.000C	0.001C	
46	Time for fully charge	13071	U16	3s - 10800s	1s	
47	Terminated current for fully charge	13072	U16	0.005 - 0.050C	0.001C	

48	Time for constant voltage charge	13073	U16	3s - 10000s	1s	
49	Export power limitation	13074	U16	0 - Nominal output power	1W	
50	Off-grid option	13075	U16	0xAA: Enable 0x55: Disable		
51	Reserved	13076~13079				
52	External EMS heartbeat	13080	U16	0 - 20 If no heartbeat update when timeout , PCS will stop running	1s	Loss if power down
53	Reserved	13081~13082				
54	External Signal of Italy	13083	U16	0：External Signal 0 1：External Signal 1 Other：No External Signal		Applicable types：SH5K-20 SH3K6
55	Start Charging Power	13084	U16	70~10000	W	SH4K6 SH5K-V13
56	Start Discharging Power	13085	U16	70~3000	W	SH5K-30 SH3K6-30 SH4K6-30
57	Meter Comm.	13086	U16	0xAA：Enable		

	Detection			0x55 : Disable		
58	Export Power Limitation	13087	U16	0xAA : Enable 0x55 : Disable		Applicable types : SH5.0RT SH6.0RT SH8.0RT SH10RT
59	Reserved	13088~13099				
60	Reserved SOC for backup	13100	U16	0~100	%	

Note:

Communication address = protocol address – 1. If data of address 5000 is to be inquired, the corresponding sending address data is 4999 (0x1387);

U16: 16-bit unsigned integer, big-endian;

U32: 32-bit unsigned integer; little-endian for double-word data. Big-endian for byte data;

S16: 16-bit signed integer, big-endian;

S32: 32-bit signed integer; little-endian for double-word data. Big-endian for byte data

Power factor: + means leading; - means lagging, 1000 means power factor 1.000, 950 means power factor 0.95.

4.Appendix

Appendix 1.1　System state

Stop	0x0002
Standby	0x0008
Initial standby	0x0010
Startup	0x0020
Running	0x0040
Fault	0x0100
Running in maintain mode	0x0400
Running in forced mode	0x0800
Running in off-grid mode	0x1000
Restarting	0x2501
Running in External EMS mode	0x4000

Appendix 1.2 Running state

Running state (Power flow)			
Bit0	PV power	Bit0 == 0	No power generated from PV
		Bit0 == 1	Power generated from PV
Bit1	Battery charging	Bit1 == 0	Not charging
		Bit1 == 1	Charging
Bit2	Battery	Bit2 == 0	Not discharging

	discharging	Bit2 == 1	Discharging
Bit3	Positive load power	Bit3 == 0	Load is reactive
		Bit3 == 1	Load is active
Bit4	Feed-in power	Bit4 == 0	No power feed-in the grid
		Bit4 == 1	Power feed-in the grid
Bit5	Import Power from grid	Bit5 == 0	No power imported from the grid
		Bit5 == 1	Importing power from grid
Bit6	Reserved	Bit6	
Bit7 (Refitting System)	Negative load power	Bit7 == 0	No power generated from "Load"
		Bit7== 1	Power generated from "Load"

Appendix 1.3   Fault code instructions

Inverter fault analysis by bit：

For example：

Inverter alarm： 0x00102000 (0001 0000 0010 0000 0000 0000b)

bit13 & bit20 is set.

According the following table, the low word base code of the inverter alarm is 70 and the high

word base code is 500. So the bit13 represents a fault code of 083 (i.e. 70+13), and the bit 20

represents a fault code of 504 [i.e. 500+(20-16)].

Inverter alarm 13050 - 13051	Low word base code : 70	DC-side fault 13058 - 13059	Low byte base code : 19	Battery fault 13066 - 13067	Low byte base code : 700	BMS fault 1 13074 - 13075	Low byte base code : 832
	High word base code :500		High word base code : 200		High word base code : 716		High word base code : 848
Grid-side fault 13052 - 13053	Low word base code : 2	Permanent fault 13060 - 13061	Low word base code : 401	Battery alarm 13068 - 13069	Low word base code : 900	BMS fault 2 13076 - 13077	Low word base code : 864
	High word base code :100		High word base code : 417		High word base code : 916		High word base code : 880
System fault 1 13054 - 13055	Low word base code :300	BDC-side fault 13062 - 13063	Low word base code : 600	BMS alarm 13070 - 13071	Low word base code : 932	BMS alarm 2 13078 - 13079	Low word base code : 964
	High		High word		High word		High word

	word base code :316		base code : 616		base code : 948		base code : 980
System fault 2 13056 - 13057	Low word base code : 36	**BDC-side permanent fault** 13064 - 13065	Low word base code : 800	**BMS protection** 13072 - 13073	Low word base code : 732		
	High word base code : 52		High word base code : 816		High word base code : 748		

Appendix 1.4　Examples

Take ComTest for example.

1.1　Acquire one piece of running information

Supposed that the inverter address is 1, it needs to acquire data from address 5000 of 3x address type.

The PC sends (HEX):

01 04 13 87 00 01 85 67

The inverter replies (HEX):

01 04 02 00 22 39 29

Note: The type code of inverter SG4KTL is 0x0022.

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1.2 Acquire multiple running information

Supposed that the inverter address is 1, it needs to acquire 10 data from address starting from 5000 of 3x address type

The PC sends (HEX):

01 04 13 87 00 0A C4 A0

The inverter replies (HEX):

01 04 14 00 22 00 28 00 00 00 00 00 05 00 00 00 26 00 00 00 00 00 00 AF F8

Note: The type code of inverter SG4KTL is 0x0022. The nominal output power is 4.0 kW, two-phase. Daily power generation is 0. The total power generation is 5 kWh. The total running time is 38 h. The internal temperature is 0℃. The internal transformer temperature is 0℃.

1.3 Acquire SN

Supposed that the inverter address is 1, it needs to acquire 10 data from address starting from 4990 of 3x address type

The PC sends (HEX):

01 04 13 7D 00 0A E4 91

The inverter replies (HEX):

01 04 14 31 32 31 32 31 32 30 30 31 00 00 00 00 00 00 00 00 00 00 00 9B 56

Note:

1. SN data type is UTF-8;

2. Serial number is: 121212001

1.4 Read one setting datum

Supposed that the inverter address is 1, it needs to read data from address 5000 of 4x address type.

The PC sends (HEX):

01 03 13 87 00 01 30 A7

The inverter replies (HEX):

01 03 02 07 D8 BA 2E

Note: the data read out is year 2008.

1.5   Read multiple setting data

Supposed that the inverter address is 1, it needs to read 10 data from address starting from 5000 of 4x address type.

The PC sends (HEX):

01 03 13 87 00 0A 71 60

The inverter replies (HEX):

01 03 14 07 DA 00 0A 00 1E 00 09 00 28 00 25 00 CE 00 AA 01 F4 00 00 80 53

Note: The data are October 30th, 2010, 09:40:37; Stop; power limitation enabled, power limitation value is 50%.

1.6   Set one datum

Supposed that the inverter address is 1, it needs to set data from address 5000 of 4x address type.

The PC sends (HEX):

01 10 13 87 00 01 02 07 DA 19 4D

The inverter replies (HEX):

01 10 13 87 00 01 B5 64

Or

The PC sends (HEX):

01 06 13 87 07 DA BE CC

The inverter replies (HEX):

01 06 13 87 07 DA BE CC

Note: The setting data is year 2010

1.7 Set multiple data

Supposed that the inverter address is 1, it needs to set 10 data to address starting from 5000 of 4x address type.

The PC sends (HEX):

01 10 13 87 00 0A 14 07 D9 00 0A 00 1E 00 09 00 10 00 00 00 CE 00 AA 01 F4 00 00 3E 65

The inverter replies (HEX):

01 10 13 87 00 0A F4 A3

Note: The data are October 30th, 2009, 09:16:00, stop, power limitation enabled, power limitation value is 50%.