RS485_MODBUS RTU energy storage

grid-connected inverter communication protocol

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Amendment record

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V000B000D001	Translated to English	Dr.B.A.Coghlan[†]	2018.11.08
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1. Overview

This document applies to the communication between the Ginlong/Solis PV grid-connected inverter and the host computer monitoring software, consistent with the MODBUS RTU protocol. This protocol can read the operating information of the inverter and control the operation of the inverter in real time.

2. Physical interface

2.1. RS485 Protocol

This interface implements the RS485 protocol in asynchronous transceiver mode, master-slave mode, with the fixed baud rate and format below:

---- Baud rate：9600bps

---- Parity：None

---- Data bits：8

---- Stop bits：1

2.2. Interframe time requirements

A communication frame interval of 300ms or more (excluding 300ms) is required. The maximum number of data frame bytes is recommended to be 100 (50 register addresses).

3. Data frame format

Slave Address	Function code	Data	CRC Check
8-Bits	8-Bits	Nx8-Bits	16-Bits

Slave Address field：is the corresponding slave address and must match the slave address of the inverter.

Function codefield：Function code, currently only 03H, 04H, 06H and 10H function codes are available.

Function code (Hex)	Meaning	Register address	Function
02H	Read status flag	10001-19999	Read status bit
03H	Read parameter	40001-49999	Read configuration register
04H	Read information	30001-39999	Read information register
05H	Write control flag	00001-09999	Set/reset control bit
06H	Write single-byte parameter	40001-49999	Write to single-byte configuration register
10H	Write multi-byte parameter	40001-49999	Write to multi-byte configuration register

Data field：including start register address, data length, number of data bytes, data content. All are high byte first and low byte last.

CRC Check field：CRC check table check mode, high byte first and low byte last.

4. Error message and data processing

Slave reply (hex)：

Slave Address	Function code	Error code	CRC Check	
			Low byte	High byte
xx	xx|0x80	xx	xx	xx

When the inverter communication module detects an error other than the CRC code error, it must send back information to the host. The most significant bit of the function code is 1, that is, 128 is added to the function code sent by the host.

The error code of the inverter communication module in response to the loopback：

0x01 Illegal function code. The server does not understand the function code.

0x02 Illegal data address related to request

0x03 Illegal data value related to request

0x04 service failure; the inverter communication module cannot accomodate data failure during execution.

5. Detailed protocol description

00001-09999 (**0X**) register address is a writable register type, supports 0x05 function code, 10001-19999 (**1X**) register address is a read-only register type, supports 0x02 function code, 30001-39999 (**3X**) register address is a read-only register type, supports 0x04 function code, 40001-49999 (**4X**) register address is a readable and writable holding register address type, supports 0x03, 0x06 and 0x10 function codes.

5.1. Read one or more input states

The corresponding function code is 0x02. The addresses in the table below are the same as those in the actual information frame and no further offsets or other conversions are required.

Register Address (Decimal)	Meaning	Remarks NB: these status bits are read-only
12501	No grid	0—No 1—Yes
12502	Grid overvoltage	0—No 1—Yes
12503	Grid undervoltage	0—No 1—Yes
12504	Grid overfrequency	0—No 1—Yes
12505	Grid underfrequency	0—No 1—Yes
12506	Grid imbalance	0—No 1—Yes
12507	Grid frequency jitter	0—No 1—Yes
12508	Grid impedance is too large	0—No 1—Yes
12509	Grid current tracking fault	0—No 1—Yes
12510	METER communication failed	0—No 1—Yes
12511	FailSafe	0—No 1—Yes
12512	Reserved	0—No 1—Yes
12513	Reserved	0—No 1—Yes

12514	Reserved	0—No 1—Yes
12515	Reserved	0—No 1—Yes
12516	Reserved	0—No 1—Yes
12517	Bypass overvoltage fault	0—No 1—Yes
12518	Bypass overload fault	0—No 1—Yes
12519	Reserved	0—No 1—Yes
12520	Reserved	0—No 1—Yes
12521	Reserved	0—No 1—Yes
12522	Reserved	0—No 1—Yes
12523	Reserved	0—No 1—Yes
12524	Reserved	0—No 1—Yes
12525	Reserved	0—No 1—Yes
12526	Reserved	0—No 1—Yes
12527	Reserved	0—No 1—Yes
12528	Reserved	0—No 1—Yes
12529	Reserved	0—No 1—Yes
12530	Reserved	0—No 1—Yes
12531	Reserved	0—No 1—Yes
12532	Reserved	0—No 1—Yes
12533	Battery not connected	0—No 1—Yes
12534	Battery overvoltage detection	0—No 1—Yes
12535	Battery undervoltage detection	0—No 1—Yes
12536	Reserved	0—No 1—Yes
12537	Reserved	0—No 1—Yes
12538	Reserved	0—No 1—Yes
12539	Reserved	0—No 1—Yes
12540	Reserved	0—No 1—Yes
12541	Reserved	0—No 1—Yes
12542	Reserved	0—No 1—Yes
12543	Reserved	0—No 1—Yes
12544	Reserved	0—No 1—Yes
12545	Reserved	0—No 1—Yes
12546	Reserved	0—No 1—Yes
12547	Reserved	0—No 1—Yes
12548	Reserved	0—No 1—Yes
12549	DC overvoltage	0—No 1—Yes
12550	DC bus overvoltage	0—No 1—Yes
12551	DC bus uneven voltage	0—No 1—Yes
12552	DC bus undervoltage	0—No 1—Yes
12553	DC busbar uneven voltage 2	0—No 1—Yes
12554	DC A path overcurrent	0—No 1—Yes
12555	DC B path overcurrent	0—No 1—Yes
12556	DC input disturbance	0—No 1—Yes

12557	Grid overcurrent	0—No 1—Yes
12558	IGBT overcurrent	0—No 1—Yes
12559	Grid disturbance 02	0—No 1—Yes
12560	Arc self-test protection	0—No 1—Yes
12561	Arc fault reservation	0—No 1—Yes
12562	Grid current sampling abnormality	0—No 1—Yes
12563	Reserved	0—No 1—Yes
12564	Reserved	0—No 1—Yes
12565	Grid disturbance	0—No 1—Yes
12566	DC component is too large	0—No 1—Yes
12567	Over temperature protection	0—No 1—Yes
12568	Relay detection protection	0—No 1—Yes
12569	Under temperature protection	0—No 1—Yes
12570	PV insulation fault	0—No 1—Yes
12571	12V undervoltage protection	0—No 1—Yes
12572	Leakage current protection	0—No 1—Yes
12573	Leakage current self-test protection	0—No 1—Yes
12574	DSP initialization protection	0—No 1—Yes
12575	DSP_B protection	0—No 1—Yes
12576	Battery overvoltage hardware failure	0—No 1—Yes
12577	LLC hardware overcurrent	0—No 1—Yes
12578	Network side current transient overcurrent	0—No 1—Yes
12579	CAN communication failed	0—No 1—Yes
12580	DSP communication failed	0—No 1—Yes
12581	normal operation	0—No 1—Yes
12582	Initial standby	0—No 1—Yes
12583	Control shutdown	0—No 1—Yes
12584	Downtime	0—No 1—Yes
12585	Standby	0—No 1—Yes
12586	Derating operation (derating due to temperature frequency, etc.)	0—No 1—Yes
12587	Limit operation (due to external derating)	0—No 1—Yes
12588	Bypass overload	0—No 1—Yes
12589	Load status	0—No 1—Yes
12590	Grid status	0—No 1—Yes
12591	Battery status	0—No 1—Yes
12592	Reserved	0—No 1—Yes
12593	Reserved	0—No 1—Yes
12594	Reserved	0—No 1—Yes
12595	Reserved	0—No 1—Yes

Note: 12501-12516: Grid fault status. 12517-12532: Load failure status. 12533-12548: Battery failure status. 12549-12580: Equipment failure status. 12581-12595: Normal state, 12581-12587 belongs to the normal state of the device.

5.2. Inverter operation information parameter address definition

The corresponding function code is 0x04. The address in the table below is the same as the address in the actual information frame. No further offset or other conversion is required.

Register Address (Decimal)	Meaning	Data Type	Unit	Remarks NB: these registers are read-only
33000	Product model	U16		See Appendix 1 (hexadecimal display)
33001	DSP software version	U16		(hexadecimal display)
33002	LCD software version	U16		(hexadecimal display)
33003	Protocol software version	U16		(hexadecimal display)
33004-33019	Machine serial number	U16		32-bit ASCII code value literal translation display, such as: 33004 = '01' 33005 = '23' Corresponding display: '0123' Ginlong only takes the upper 15 bits as the effective SN number. 33004 is the most significant and 33019 is the least significant.
33020	Reserved	U16		
33021	Reserved	U16		
33022	System time year	U16	Year	0-99 years
33023	System time month	U16	Month	
33024	System time day	U16	Day	
33025	System time	U16	Hour	
33026	System time	U16	Minute	
33027	System time second	U16	Second	
33028	Reserved	U16		
33029-33030	Inverter total power generation	U32	1kWh	
33031-33032	Inverter power generation in the month	U32	1kWh	
33033-33034	Inverted last month's power generation	U32	1kWh	

33035	Inverter power generation today	U16	0.1kWh	
33036	Inverter yesterday's power generation	U16	0.1kWh	
33037-33038	Inverter power generation this year	U32	1kWh	
33039-33040	Inverter last year's power generation	U32	1kWh	
33041	Reserved	U16		
33042	Reserved	U16		
33043	Reserved	U16		
33044	Reserved	U16		
33045	Reserved	U16		
33046	Reserved	U16		
33047	Reserved	U16		
33048	Reserved	U16		
33049	DC voltage 1	U16	0.1V	
33050	DC current 1	U16	0.1A	
33051	DC voltage 2	U16	0.1V	
33052	DC current 2	U16	0.1A	
33053	DC voltage 3	U16	0.1V	
33054	DC current 3	U16	0.1A	
33055	DC voltage 4	U16	0.1V	
33056	DC current 4	U16	0.1A	
33057-33058	Total DC output power	U32	1W	
33059-33069	Reserved	U16		
33070	Reserved	U16		
33071	DC bus voltage	U16	0.1V	
33072	DC bus half voltage	U16	0.1V	
33073	AB line voltage / phase A voltage	U16	0.1V	
33074	BC line voltage / phase B voltage	U16	0.1V	
33075	CA line voltage / C phase voltage	U16	0.1V	
33076	Phase A current	U16	0.1A	
33077	Phase B current	U16	0.1A	
33078	Phase C current	U16	0.1A	
33079-33080	Active power	S32	1W	

33081-33082	Reactive power	S32	1Var	
33083-33084	Apparent power	S32	1VA	
33085	Reserved	U16		
33086	Reserved	U16		
33087	Reserved	U16		
33088	Reserved	U16		
33089	Reserved	U16		
33090	Reserved	U16		
33091	Standard working mode	U16		Working mode: 00: No response mode 01: Volt–watt default 02: Volt–var 03: Fixed power factor 04: Fix reactive power 05: Power-PF 06: Rule21Volt–watt These modes are useful for grid-tied distributed energy resources (DER) regulations such as California's Rule 21 or Hawaii's Rule 14H. Refer to registers 43051-43083.
33092	National standard	U16		See Appendix III
33093	Inverter temperature	U16	0.1℃	
33094	Grid frequency	U16	0.01Hz	
33095	Current state of the inverter	U16		See Appendix II
33096	Reserved	U16		
33097	Reserved	U16		
33098	Reserved	U16		
33099	Reserved	U16		
33100-33101	Limited active power adjustment rated power output value	S32	1W	
33102-33103	Reactive power regulation rated power output value	S32	1Var	
33104	Actual power limit	U16	1%	10000 ↔ 100% Setting range (0-100%） 100% refers to the nominal nominal power.
33105	Actual power	S16	0.01	Power factor low:

	factor adjustment value			(800 ↔ 0.80, 1000 ↔ 1.00) (-800 ↔ -0.80, -1000 ↔ -1.00) (power factor 1.00 same as -1.00) Setting range (-0.80 to 0.80) This function does not exist for models rated at 15KW and below.
33106	Reactive power	S16	1%	10000 ↔ 100% Setting range (-6000 to 6000) Default: 0 This function is only for standard mode 4 reactive power setting
33107	Reserved	U16		
33108	Reserved	U16		
33109	Reserved	U16		
33110	Reserved	U16		
33111	Reserved	U16		
33112	Reserved	U16		
33113	Reserved	U16		
33114	Reserved	U16		
33115	Set the flag bit	U16		See Appendix VIII
33116	Fault code 01	U16		See Appendix V
33117	Fault code 02	U16		
33118	Fault code 03	U16		
33119	Fault code 04	U16		
33120	Fault code 05	U16		
33121	Working status	U16		See Appendix VI
33122	Reserved	U16		
33123	Reserved	U16		
33124	Reserved	U16		
33125	Reserved	U16		
33126-33127	Electricity meter total active power generation	U32	1Wh	1 ↔ 1Wh
33128	Meter voltage	U16		10 ↔ 1V
33129	Meter current	U16		10 ↔ 1A
33130-33131	Meter active power	S32		1 ↔ 1W Positive: export power to Grid Negative: import power from Grid
33132	Energy storage control switch	U16		See Appendix VII

33133	Battery voltage	U16	0.1V	10 ↔ 1V
33134	Battery current	S16	0.1A	10 ↔ 1A Positive：charging Negative：discharging
33135	Battery current direction	U16		Battery charging and discharging direction. 0: charging 1: discharging
33136	LLCbus voltage	U16	0.1V	10 ↔ 1V
33137	Bypass AC voltage	U16	0.1V	10 ↔ 1V
33138	Bypass AC current	U16	0.1A	10 ↔ 1A
33139	Battery capacity SOC	U16		100 ↔ 100%
33140	Battery health SOH	U16		100 ↔ 100%
33141	Battery voltage	U16	0.01V	100 ↔ 1V (from BMS information)
33142	Battery current	S16	0.01A	100 ↔ 1A (from BMS information)
33143	Battery charge current limit	U16	0.1A	10 ↔ 1A (from BMS information)
33144	Battery discharge current limit	U16	0.1A	10 ↔ 1A (from BMS information)
33145	Battery failure information 01	U16		(from BMS information) BIT00: Reserved BIT01: Overvoltage protection BIT02: Undervoltage protection BIT04: Over temperature protection BIT04: Under temperature protection BIT05: Over temperature charging protection BIT06: Under temperature charging protection BIT07: Discharging overcurrent protection
33146	Battery failure information 02	U16		(from BMS information) BIT00: Charging overcurrent protection BIT01: Reserved BIT02: Reserved BIT03: BMS internal protection BIT04: Battery module unbalanced BIT05: Reserved

				BIT06: Reserved BIT07: Reserved
33147	House load power	U16		1 ↔ 1W
33148	Bypass load power	U16		1 ↔ 1W
33149-33150	Battery power	S32		1 ↔ 1W
33151	Reserved	U16		
33152	Reserved	U16		
33153	Reserved	U16		
33154	Reserved	U16		
33155	Reserved	U16		
33156	Reserved	U16		
33157	Reserved	U16		
33158	Reserved	U16		
33159	Reserved	U16		
33160	Reserved	U16		
33161-33162	Total battery charge	U32	1kWh	1 ↔ 1kWh
33163	Battery charge today	U16	0.1kWh	10 ↔ 1kWh
33164	Battery charge yesterday	U16	0.1kWh	10 ↔ 1kWh
33165-33166	Total battery discharge	U32		1 ↔ 1kWh
33167	Battery discharge capacity	U16		10 ↔ 1kWh
33168	Battery discharge power yesterday	U16		10 ↔ 1kWh
33169-33170	Total power imported from Grid	U32		1 ↔ 1kWh
33171	Grid power imported today	U16		10 ↔ 1kWh
33172	Grid power imported yesterday	U16		10 ↔ 1kWh
33173-33174	Total power exported to Grid	U32		1 ↔ 1kWh
33175	Power imported from Grid today	U16		10 ↔ 1kWh
33176	Power imported from Grid yesterday	U16		10 ↔ 1kWh

33177-33178	Total house load	U32		1 ↔ 1kWh
33179	House load today	U16		10 ↔ 1kWh
33180	House load yesterday	U16		10 ↔ 1kWh
33181	Reserved	U16		
33182-33249	Reserved	U16		
33250	Meter placement	U16		BIT00: Meter is on the house side BIT01: Meter is on the Grid side BIT02: Reserved BIT03: Reserved BIT04: Reserved BIT05: Reserved BIT06: Reserved BIT07-BIT15: Reserved
33251	Meter AC voltage A	U16	0.1V	10 ↔ 1V
33252	Meter AC current A	U16	0.01A	100 ↔ 1A
33253	Meter AC voltage B	U16	0.1V	10 ↔ 1V
33254	Meter AC current B	U16	0.01A	100 ↔ 1A
33255	Meter AC voltage C	U16	0.1V	10 ↔ 1V
33256	Meter AC current C	U16	0.01A	100 ↔ 1A
33257	Meter active power A	S32	0.001kW	1000 ↔ 1kW
33259	Meter active power B	S32	0.001kW	1000 ↔ 1kW
33261	Meter active power C	S32	0.001kW	1000 ↔ 1kW
33263	Meter total active power	S32	0.001kW	1000 ↔ 1kW
33265	Meter reactive power A	S32	1Var	1 ↔ 1Var
33267	Meter reactive power B	S32	1Var	1 ↔ 1Var
33269	Meter reactive power C	S32	1Var	1 ↔ 1Var
33271	Meter total reactive power	S32	1Var	1 ↔ 1Var
33273	Meter apparent power A	S32	1VA	1 ↔ 1VA

33275	Meter apparent power B	S32	1VA	1 ↔ 1VA
33277	Meter apparent power C	S32	1VA	1 ↔ 1VA
33279	Meter total apparent power	S32	1VA	1 ↔ 1VA
33281	Meter power factor	S16		-1.0~-0.8 +0.8~+1.0
33282	Meter Grid frequency	U16	0.01Hz	100 ↔ 1Hz
33283	Meter total active energy imported from Grid	U32	0.01kWh	100 ↔ 1kWh
33285-33286	Meter total active energy exported to Grid	U32	0.01kW	100 ↔ 1kW

Note: The METER (electric meter) S/N number uses the S/N number of the inverter plus the slave address of the inverter to indicate the serial number of the METER, which is used to distinguish whether the device has a meter device. The single phase data is based on the data of phase A. The METER active power value is positive for powering (exporting to) the grid, and negative for taking power (importing) from the grid.

5.3. Inverter switch machine setting parameter address definition

The corresponding function code is 0x05. The address in the table below is the same as the address in the actual information frame. No further offset or other conversion is required.

Register address (decimal)	Meaning	Data Type	Remarks NB: these registers are write-only
05000	Switching machine setting	U16	1: turn power ON 0: turn power OFF

5.4. Inverter setting parameter address definition

The corresponding function codes are 0x03, 0x06 and 0x10. The address in the table below is the same as the address in the actual information frame. No further offset or other conversion is required.

Register address (decimal)	Meaning	Data Type	Unit	Remarks NB: these registers are read/write
43000	Real time clock: year	U16	Year	00-99 years
43001	Real time clock: month	U16	Month	
43002	Real time clock: day	U16	Day	

43003	Real time clock: hour	U16	Hour	
43004	Real time clock: minute	U16	Minute	
43005	Real time clock: seconds	U16	Second	
43006	Slave address setting	U16		1-99
43007	Power on/off	U16		0xBE: boot 0xDE: shutdown
43008	Reserved	U16		
43009	Reserved	U16		
43010	Reserved	U16		
43011	Reserved	U16		
43012	Reserved	U16		
43013-43049	Reserved	U16		
43050	Reserved	U16		
43051	Reactive power limit setting	S16	1%	10000 ↔ 100% Setting range（-6000 to +6000） Default：0 This function is only for standard mode 4 reactive power setting (see registers 33091 and 43070-71).
43052	Power limit setting	U16	1%	10000 ↔ 100% Setting range（0-100%） 100% refers to the nominal power. (see registers 33091 and 43070-71)
43053	Power factor setting	S16	0.01	Power factor： （800 ↔ 0.80，1000 ↔ 1.00） （-800 ↔ -0.80，-1000 ↔ -1.00） （power factor 1.00 same as -1.00） Setting range（-0.80 to 0.80） This function does not exist for models rated at 15KW and below (see registers 33091 and 43070-71).
43054	Power factor setting 02	S16	0.01	Power factor 02： （800 ↔ 0.80，1000 ↔ 1.00） （-800 ↔ -0.80，-1000 ↔ -1.00） （power factor 1.00 same as -1.00） Setting range（-0.80 to 0.80） This function only sets 3 fixed power factor functions for standard mode (see registers 33091 and 43070-71).
43055	Reserved	U16		

43056-43057	Calibrate total power generation	U32	1kWh	Calibrate is a function used when installing a replacement inverter to set accumulated energy values to match the original inverter (see user manual).
43058-43059	Calibrate power generated this month	U32	1kWh	
43060-43061	Calibrate power generated last month	U32	1kWh	
43062	Calibrate power generated today	U16	0.1kWh	
43063	Calibrate power generated yesterday	U16	0.1kWh	
43064-43065	Calibrate power generated this year	U32		This function does not exist for models rated at 15KW and below.
43066-43067	Calibrate power generated last year	U32		This function does not exist for models rated at 15KW and below.
43068	National standard	U16		See Appendix III
43069	Reserved	U16		
43070	Power limit switch	U16		0xAA: enable limited power switch 0x55: disable limited power switch [limits power recovery to 100%] (for registers 43052 and 43081).
43071	Reactive power switch	U16		0x55: off, power factor recovery 1, reactive power ratio recovery 0 0xA1: reactive power ratio setting is valid and power factor is restored to 1 (for registers 43051 and 43083); 0xA2: power factor 02 is valid and reactive power ratio is restored to 0 (for register 43054).
~~43072~~	~~LVRT switch~~	~~U16~~		~~0xAA enabled， 0x55 closed, Default： off~~
43073	Reserved	U16		
43074	Reserved	U16		
43075	Reserved	U16		
43076	Reserved	U16		
43077	Reserved	U16		
43078	Reserved	U16		
43079	Reserved	U16		
43080	Reserved	U16		

43081	Actual power limit adjustment value	S16	10W	1 ↔ 10W Range: -327680W to 327680W (see register 43070).
43082	Reserved	U16		
43083	Reactive power adjustment value	S16	10Var	1 ↔ 10Var Range: -327680Var to 327680Var (see register 43071).
43084	Leakage current protection value	U16	1mA	1 ↔ 1mA Range: 50-800mA, Default: 240mA
43085	Insulation resistance protection value	U16	1kOhm	1 ↔ 1k Range: 20k-1000k, Default: 200K
43086	Reserved	U16		
43087	Reserved	U16		
43088	Reserved	U16		
43089	Reserved	U16		
43090	Grid level overvoltage threshold	U16	1V	1 ↔ 1V Single phase range：236-335V; Default：254V Three-phase range：410-580V, Default：440V
43091	Grid level overvoltage delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-9.0s, Default：1.0s
43092	Grid secondary overvoltage threshold	U16	1V	1 ↔ 1V Single phase range：248-341V, Default：265V Three-phase range：430-590V, Default：460V
43093	Grid secondary overvoltage delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-1.0s, Default：0.2s
43094	Grid level undervoltage threshold	U16	1V	10 ↔ 1V Single phase range：173-236V, Default：190V Three-phase range：300-410V, Default：330V
43095	Grid level undervoltage delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-9.0s, Default：1.0s
43096	Grid secondary undervoltage threshold	U16	1V	1 ↔ 1V Single phase range：132-219V, Default：173V

				Three-phase range：230-380V, Default：300V
43097	Grid secondary undervoltage delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-1.0s, Default：0.2s
43098	Grid level overfrequency threshold	U16	0. 1Hz	10 ↔ 1Hz Range：50.2-53.0Hz, Default：51.0Hz Range：60.2-63.0Hz, Default：61.0Hz
43099	Grid level overfrequency delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-9.0s, Default：1.0s
43100	Grid secondary overfrequency threshold	U16	0. 1Hz	10 ↔ 1Hz Range：51.0-53.0Hz, Default：51.0Hz Range：61.0-63.0Hz, Default：51.0Hz
43101	Grid secondary overfrequency delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-9.0s, Default：0.2s
43102	Grid level underfrequency threshold	U16	0. 1Hz	10 ↔ 1Hz Range：47.0-49.5Hz, Default：48.0Hz Range：57.0-59.5Hz, Default：48.0Hz
43103	Grid level underfrequency delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-9.0s, Default：1.0s
43104	Grid secondary underfrequency threshold	U16	0. 1Hz	10 ↔ 1Hz Range：47.0-49.0Hz, Default：47.0Hz Range：57.0-59.0Hz, Default：47.0Hz
43105	Grid secondary underfrequency delay threshold	U16	100ms	1 ↔ 100mS Range：0.10-9.0s, Default：0.2s
43106	Power-on startup time	U16	1s	1 ↔ 1s Range：10-600s, Default：60s
43107	Failure recovery time	U16	1s	1 ↔ 1s Range：10-600s, Default：60s
43108	Reserved	U16		

43109	Reserved	U16		
43110	Energy storage control switch	U16		See Appendix VII
43111	Bypass power enable setting	U16		0000H: not enabled，0001H: enabled, Default: enabled
43112	Bypass power supply reference voltage setting	U16	0.1V	10 ↔ 1V， Default: 230V, Accuracy: 0.1V
43113	Bypass power supply reference frequency setting	U16	0.01Hz	100 ↔ 1Hz， Default: 50Hz, Accuracy: 0.1Hz
43114	Battery charge and discharge enable setting	U16		0000H: not enabled，0001H: enabled, Default: enabled
43115	Battery charge and discharge direction setting	U16		0000H: charge，0001H: discharge, Default: charge
43116	Battery charge and discharge current setting	U16	0.1A	10 ↔ 1A， The maximum charging current can be set by the user, Range: 0-70A； The maximum discharge current can be set by the user, Range：0-70A， Precision: 1A
43117	Battery charge current maximum setting	U16	0.1A	10 ↔ 1A， Maximum: 70A，Default: 70A, Accuracy: 1A
43118	Battery discharge current maximum setting	U16	0.1A	10 ↔ 1A， Maximum: 70A，Default: 70A, Accuracy: 1A
43119	Battery undervoltage protection setting	U16	0.1V	10 ↔ 1V； Default：46；Range：40—48； Protection backlash: 2V
43120	Battery float voltage setting	U16	0.1V	10 ↔ 1V； Default：53.5；Range：50-58
43121	Battery charge voltage setting	U16	0.1V	10 ↔ 1V； Default：56.4；Range：54-60
43122	Battery overvoltage protection setting	U16	0.1V	10 ↔ 1V； Default：59.5；Range：54-62
43123	Overload buck setting	U16		0000H: not enabled，0001H: enabled, Default: not enabled
43124	Reserved	U16		
43125-43140	Reserved	U16		
43141	Timed charge	U16	0.1A	1 ↔ 0.1A，

	current			Maximum: 70A， Default: 50A, Accuracy: 0.1A
43142	Timed discharge current	U16	0.1A	1 ↔ 0.1A， Maximum: 70A， Default: 50A, Accuracy: 0.1A
43143	Timed charge start hour	U16	hour	
43144	Timed charge start minute	U16	minute	
43145	Timed charge end hour	U16	hour	
43146	Timed charge end minute	U16	minute	
43147	Timed discharge start hour	U16	hour	
43148	Timed discharge start minute	U16	minute	
43149	Timed discharge end hour	U16	hour	
43150	Timed discharge end minute	U16	minute	
43151	Reserved	U16		
43152-43249	Reserved	U16		
43250-43251	Data logger S/N	U32		Convert the uploaded S/N to decimal and display it again
43252	Reserved	U16		Reserved for data logger S/N
43253	Reserved	U16		Reserved for data logger S/N
43254	Reserved	U16		Reserved for data logger S/N
43255-43256	Data logger IP address	U32		Convert the uploaded IP address to decimal and display it again
43257	Data logger signal strength	U16		Reserved for wireless devices
43258	Data logger status word 1	U16		All bits 0000: normal operation; BIT00:0: The inverter and data logger are connected normally 1: Inverter and data logger failed to connect. BIT01: 0: The data logger and server are connected properly. 1: Data logger and server failed to connect BIT02: Reserved BIT03-BIT15:Reserved
43259-43300	Reserved	U16		

6. RS485 Communication Examples

000218-Tx:01 04 80 E8 00 0C 59 FB

000219-Rx:01 04 18 00 F8 00 0C 00 0E 00 01 46 46 46 46 46 46 46 46 46 46 46 46 46 46 00
          85 A4

000230-Tx:01 04 81 5B 00 0A 29 E2

000231-Rx:01 04 14 00 00 00 04 00 00 00 01 00 00 00 04 06 08 00 00 00 00 00 00 EE EB

000242-Tx:01 04 81 05 00 0A 48 30

000243-Rx:01 04 14 00 00 00 71 00 00 00 00 00 00 00 00 00 00 00 00 00 00 71 21 EE

000324-Tx:01 06 A7 FF 00 BE 1A FE

000325-Rx:01 06 A7 FF 00 BE 1A FE

000328-Tx:01 10 A7 FF 00 01 02 00 DE E4 CD

000329-Rx:01 10 A7 FF 00 01 12 8D

000340-Tx:01 10 A7 F8 00 08 10 00 13 00 03 00 14 00 01 00 1B 00 2C 00 01 00 BE 93 A5

000341-Rx:01 10 A7 F8 00 08 63 4A

000356-Tx:01 05 13 88 00 00 49 64

000357-Rx:01 05 13 88 00 00 49 64

000366-Tx:01 05 13 88 FF 00 08 94

000367-Rx:01 05 13 88 FF 00 08 94

            01 05 13 88 00 01 88 A4

            01 85 03 02 91

            01 05 13 66 00 00 29 51

            01 85 02 C3 51

            01 01 13 66 00 00 D8 91

            01 81 01 81 90

000412-Tx:01 06 A7 FF 00 22 1A 97

000413-Rx:01 86 03 02 61

000436-Tx:01 10 A7 FF 00 01 02 00 22 E4 8C

000437-Rx:01 90 03 0C 01

000217-Tx:01 05 13 88 00 00 49 64

7. Appendices

7.1. Appendix I：

Product model and software versions (see read-only registers 33000-33003).

Example RS485 query:　　000217-Tx:01 05 13 88 00 00 49 64

Header	Model	DSP Software Version	LCD Software Version	RS485 Protocol Software Version
000217-Tx:	01 05	13 88	00 00	49 64

7.2. Appendix II：

Current state of inverter versus inverter status display (read-only register 33095):

3044H register	Status		Inverter display	
	Single-phase 2nd generation machine	1: 30KWseries 2: 15KW three-phase 3: All 4th generation machines	Single-phase 2nd generation machine	1: 30KWseries 2: 15KW three-phase 3: All 4th generation machines
0000H	Normal operation	Waiting state	Generating	Waiting
0001H	\	Open loop operation	\	OpenRun
0002H	Waiting	Soft start	Waiting	SoftRun
0003H	Initialization	On-Grid operation	Initializing	Generating
1004H	Control off-Grid	\	Off-Grid	\
…………	…………		…………	
1010H	Grid overvoltage		OV-G-V	
1011H	Grid undervoltage		UN-G-V	
1012H	Grid overfrequency		OV-G-F	
1013H	Grid underfrequency		UN-G-F	
1014H	Grid impedance is too large		G-IMP	
1015H	No Grid		NO-Grid	
1016H	Grid imbalance		G-PHASE	
1017H	Grid frequency jitter		G-F-FLU	
1018H	Grid overcurrent		OV-G-I	
1019H	Grid current tracking fault		IGFOL-F	
…………	…………		…………	
1020H	DC overvoltage		OV-DC	
1021H	DC bus overvoltage		OV-BUS	
1022H	DC busbar uneven voltage		UNB-BUS	
1023H	DC bus undervoltage		UN-BUS	
1024H	DC busbar uneven voltage 2		UNB2-BUS	

1025H	DC A way overcurrent	OV-DCA-I
1026H	DC B path overcurrent	OV-DCB-I
1027H	DC input disturbance	DC-INTF.
…………	…………	…………
1030H	Grid disturbance	GRID-INTF.
1031H	DSP initialization ~~malfunction~~ protection	INI-FAULT
1032H	~~Temperature protection~~ Overtemperature protection	OV-TEM
1033H	~~Ground protection~~ PV insulation fault	~~GROUND-FAULT~~ PV ISO-PRO
1034H	~~Leakage current fault~~ Leakage current protection	~~ILeak-FAULT~~ ILeak-PRO
1035H	~~Relay failure~~ Relay detection protection	~~Relay-FAULT~~ RelayChk-FAIL
1036H	DSP_B ~~failure~~ protection	DSP-B-FAULT
1037H	DC component is too large	DCInj-FAULT
1038H	12V undervoltage ~~fault~~ protection	12Power-FAULT
1039H	Leakage current self-test protection	ILeak-Check
103AH	Under temperature protection	UN-TEM
…………	…………	…………
1040H	Arc self-test protection	AFCI-Check
1041H	Arc ~~malfunction~~ protection	ARC-FAULT
1042H	DSP on-chip SRAM exception	RAM-FAULT
1043H	DSP on-chip FLASH exception	FLASH-FAULT
1044H	DSP on-chip PC pointer is abnormal	PC-FAULT
1045H	DSP key register exception	REG-FAULT
1046H	Grid disturbance 02	GRID-INTF02
1047H	Grid current sampling abnormality	IG-AD
1048H	IGBT overcurrent	IGBT-OV-I
…………	…………	…………
1050H	Network side current transient overcurrent	OV-IgTr
1051H	Battery overvoltage hardware failure	OV-Vbatt-H
1052H	LLC hardware overcurrent	OV-ILLC
1053H	Battery overvoltage detection	OV-Vbatt
1054H	Battery undervoltage detection	UN-Vbatt
1055H	Battery no connected	NO-Battery
1056H	Bypass overvoltage fault	OV-VBackup
1057H	Bypass overload fault	Over-Load
…………	…………	…………
…………	…………	…………

7.3. Appendix III：

National Standards (read-only register 33092 and read/write register 43068):

3054H	National Standard			
	Single phase (0.7-5K)	Three phase (6-15K)	Three phase (20-60K)	Single-phase fourth-generation machine
01H	G83/2 / G59/3 (G83 for 3.6kW and below; G59 for 3.6kW or more)	G59/3	G59/3	G59/3
02H	UL-240V(60Hz240V)	UL1741(60Hz480V) Note：Low voltage (60Hz270V)	UL-480V(60Hz480V) Note：Low voltage (60Hz270V)	UL-240V
03H	VDE0126	VDE0126	VDE0126	VDE0126
04H	AS4777	AS4777	AS4777	AS4777
05H	AS4777-NQ	AS4777-NQ	AS4777-NQ	AS4777-NQ
06H	CQCA/CQC	CQC(CQC-380V)	CQC-380A	CQCA/CQC
07H	ENEL	ENEL	ENEL	ENEL
08H	UL-208V(60Hz208V)	UL-380V(60Hz380V) Note：Low voltage UL-220V(60Hz220V)	UL-380V(60Hz380V) Note：Low voltage UL-220V(60Hz220V)	UL-208V
09H	MEX-CFE	MEX-CFE	MEX-CFE	MEX-CFE
0AH	Custom	Custom	Custom	Custom
0BH	VDE4105	VDE4105	VDE4105	VDE4105
0CH	EN50438DK	EN50438DK	EN50438DK	EN50438DK
0DH	EN50438IE	EN50438IE	EN50438IE	EN50438IE
0EH	EN50438NL	EN50438NL	EN50438NL	EN50438NL
0FH	EN50438T	EN50438T	EN50438T	EN50438T
10H	EN50438L	EN50438L	EN50438L	EN50438L
11H	UL-240V-A	UL-240V-A	UL-480V-A	UL-240V-A
12H	UL-208V-A	UL-208V-A	UL-380V-A	UL-208V-A
13H	BRAZIL	BRAZIL	BRAZIL	BRAZIL
14H	AUS-Q-0.9	AUS-Q-0.9	AUS-Q-0.9	AUS-Q-0.9
15H	AUS-Q-0.8	AUS-Q-0.8	AUS-Q-0.8	AUS-Q-0.8
16H	G83/1	G83/1	G83/1	G83/1
17H	RD1699B	RD1699B	RD1699B	RD1699B
18H	IEC61727	IEC61727	IEC61727	IEC61727
19H	G59/3	GN-380L	GN-380L	G83/1-A
1AH	UL-HECO	GN-HV-L	CQC-480A	CQCB/GNB
1BH	NewZeal	NewZeal	GN-HV-L	CQCC/GNC
1CH	Barbados	G83/2	G59/3-A	NewZeal
1DH	Chile	4105/480	4105/480	G83/2
1EH	France	AS4777_480	AS4777_480	Chile

1FH	~~CQCB~~/GNB	N4105-BEL	NewZeal	NRS097
20H	~~CQCC~~/GNC		CQC500	Philippin
21H	Philippin		CQC540	N4105-BEL
22H			GN540L	
23H			N4105-BEL	

7.4. Appendix V：

Fault status 01 bit definition (read-only register 33116):

BIT bit number	Fault status	Encoding
BIT00	No grid	0—No 1—Yes
BIT01	Grid overvoltage	0—No 1—Yes
BIT02	Grid undervoltage	0—No 1—Yes
BIT03	Grid overfrequency	0—No 1—Yes
BIT04	Grid underfrequency	0—No 1—Yes
BIT05	Grid imbalance	0—No 1—Yes
BIT06	Grid frequency jitter	0—No 1—Yes
BIT07	Grid impedance is too large	0—No 1—Yes
BIT08	Grid current tracking fault	0—No 1—Yes
BIT09	METER communication failed	0—No 1—Yes
BIT10	FailSafe	0—No 1—Yes
BIT11	Reserved	0—No 1—Yes
BIT12	Reserved	0—No 1—Yes
BIT13	Reserved	0—No 1—Yes
BIT14	Reserved	0—No 1—Yes
BIT15	Reserved	0—No 1—Yes

Fault status 02 bit definition (read-only register 33117):

BIT bit number	Fault status	Encoding
BIT00	Bypass overvoltage fault	0—No 1—Yes
BIT01	Bypass overload fault	0—No 1—Yes
BIT02	Reserved	0—No 1—Yes
BIT03	Reserved	0—No 1—Yes
BIT04	Reserved	0—No 1—Yes
BIT05	Reserved	0—No 1—Yes
BIT06	Reserved	0—No 1—Yes
BIT07	Reserved	0—No 1—Yes
BIT08	Reserved	0—No 1—Yes
BIT09	Reserved	0—No 1—Yes
BIT10	Reserved	0—No 1—Yes
BIT11	Reserved	0—No 1—Yes

BIT12	Reserved	0—No 1—Yes
BIT13	Reserved	0—No 1—Yes
BIT14	Reserved	0—No 1—Yes
BIT15	Reserved	0—No 1—Yes

Fault status 03 bit definition (read-only register 33118):

BIT bit number	Fault status	Encoding
BIT00	Battery not connected	0—No 1—Yes
BIT01	Battery overvoltage detection	0—No 1—Yes
BIT02	Battery undervoltage detection	0—No 1—Yes
BIT03	Reserved	0—No 1—Yes
BIT04	Reserved	0—No 1—Yes
BIT05	Reserved	0—No 1—Yes
BIT06	Reserved	0—No 1—Yes
BIT07	Reserved	0—No 1—Yes
BIT08	Reserved	0—No 1—Yes
BIT09	Reserved	0—No 1—Yes
BIT10	Reserved	0—No 1—Yes
BIT11	Reserved	0—No 1—Yes
BIT12	Reserved	0—No 1—Yes
BIT13	Reserved	0—No 1—Yes
BIT14	Reserved	0—No 1—Yes
BIT15	Reserved	0—No 1—Yes

Fault status 04 bit definition (read-only register 33119):

BIT bit number	Fault status	Encoding
BIT00	DC overvoltage	0—No 1—Yes
BIT01	DC bus overvoltage	0—No 1—Yes
BIT02	DC busbar uneven voltage	0—No 1—Yes
BIT03	DC bus undervoltage	0—No 1—Yes
BIT04	DC busbar uneven voltage 2	0—No 1—Yes
BIT05	DC A path overcurrent	0—No 1—Yes
BIT06	DC B path overcurrent	0—No 1—Yes
BIT07	DC input disturbance	0—No 1—Yes
BIT08	Grid overcurrent	0—No 1—Yes
BIT09	IGBT overcurrent	0—No 1—Yes
BIT10	Grid disturbance 02	0—No 1—Yes
BIT11	Arc self-test protection	0—No 1—Yes
BIT12	Arc fault reservation	0—No 1—Yes
BIT13	Grid current sampling abnormality	0—No 1—Yes

BIT14	Reserved	0—No 1—Yes
BIT15	Reserved	0—No 1—Yes

Fault status 05 bit definition (read-only register 33120):

BIT bit number	Fault status	Encoding
BIT00	Grid disturbance	0—No 1—Yes
BIT01	DC component is too large	0—No 1—Yes
BIT02	Over temperature protection	0—No 1—Yes
BIT03	Relay detection protection	0—No 1—Yes
BIT04	Under temperature protection	0—No 1—Yes
BIT05	PV insulation fault	0—No 1—Yes
BIT06	12V undervoltage protection	0—No 1—Yes
BIT07	Leakage current protection	0—No 1—Yes
BIT08	Leakage current self-test protection	0—No 1—Yes
BIT09	DSP initialization protection	0—No 1—Yes
BIT10	DSP_B protection	0—No 1—Yes
BIT11	Battery overvoltage hardware failure	0—No 1—Yes
BIT12	LLC hardware overcurrent	0—No 1—Yes
BIT13	Network side current transient overcurrent	0—No 1—Yes
BIT14	CAN communication failed	0—No 1—Yes
BIT15	DSP communication failed	0—No 1—Yes

7.5. Appendix VI：

Working status bit definition (read-only register 33121):

BIT bit number	Working status	Encoding
BIT00	normal operation	0—No 1—Yes
BIT01	Initial standby	0—No 1—Yes
BIT02	Control shutdown	0—No 1—Yes
BIT03	Downtime	0—No 1—Yes
BIT04	Standby	0—No 1—Yes
BIT05	Derating operation (derating due to temperature frequency, etc.)	0—No 1—Yes
BIT06	Limit operation (due to external derating)	0—No 1—Yes
BIT07	Bypass overload	0—No 1—Yes
BIT08	Load failure	0—No 1—Yes
BIT09	Grid failure	0—No 1—Yes

BIT10	Battery failure	0—No 1—Yes
BIT11	Reserved	0—No 1—Yes
BIT12	Reserved	0—No 1—Yes
BIT13	Reserved	0—No 1—Yes
BIT14	Reserved	0—No 1—Yes
BIT15	Reserved	0—No 1—Yes

7.6. Appendix VII：

Energy storage control switch (read-only register 33132 and read/write register 43110):

BIT bit number	Control status	Encoding
BIT00	Spontaneous mode switch (see user manual)	0—Off 1—On
BIT01	Optimized revenue mode switch (see user manual, timed charge/discharge)	0—Off 1—On
BIT02	Energy storage off-grid mode switch (see user manual)	0—Off 1—On
BIT03	Battery wake-up switch (1 - wake-up enable 0 - wake-up is not enabled, see user manual)	0—Off 1—On
BIT04	Reserved	0—Off 1—On
BIT05	Reserved	0—Off 1—On
BIT06	Reserved	0—Off 1—On
BIT07	Reserved	0—Off 1—On
BIT08	Reserved	0—Off 1—On
BIT09	Reserved	0—Off 1—On
BIT10	Reserved	0—Off 1—On
BIT11	Reserved	0—Off 1—On
BIT12	Reserved	0—Off 1—On
BIT13	Reserved	0—Off 1—On
BIT14	Reserved	0—Off 1—On
BIT15	Reserved	0—No 1—Yes

7.7. Appendix VIII：

Factory setting flags (read-only register 33115):

BIT bit number	Factory setting status	Encoding
BIT00	FLASH read and write timeout	0—No 1—Yes
BIT01	Clear power generation execution flag	0—No 1—Executed
BIT02	Reserved	0—No 1—Yes

BIT03	Reserved	0—No 1—Yes
BIT04	Reserved	0—No 1—Yes
BIT05	Reserved	0—No 1—Yes
BIT06	Reserved	0—No 1—Yes
BIT07	Reserved	0—No 1—Yes
BIT08	Data logger restart flag	0—No 1—Reset
BIT09	Data logger restore factory settings fault	0—No 1—Restore factory settings
BIT10	Reserved	0—No 1—Yes
BIT11	Reserved	0—No 1—Yes
BIT12	Reserved	0—No 1—Yes
BIT13	Reserved	0—No 1—Yes
BIT14	Reserved	0—No 1—Yes
BIT15	Reserved	0—No 1—Yes