HZP COMMUNICATION PROTOCOL

V2.5

Founded in 2017, Hangzhi is located in the most innovative city in Shenzhen. With a strong research and development team, adhering to the concept of technology innovation as the driving force and market results-oriented, Hangzhi is based on the field of high-precision DC sensors, and striving to develop into an international leading enterprise of precision electronics in the field of DC systems.

Based on technology integration and innovation, Hangzhi developed the first high-precision digital current sensor and the high-precision, low-cost, full-range analog current sensor in the industry. This product has the leading position in the industry in terms of reducing industry costs, improving industry efficiency and enhancing user experience, and has won numerous achievements in innovation and entrepreneurship competitions, which has won wide attention and support from all walks of life.

High Accuracy, Broad Bandwidth! Let the high precision DC sensor enter into the popular era, this is the dream of the people of Hangzhi. As an enterprise with a strong sense of responsibility and mission, Hangzhi is driving the market with service-oriented brand marketing and customized product concept, and successfully driving the operation quality through capital financing, striving to build a sharing enterprise with constant innovation!

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1 Overview

This article describes the support contents and usage limitations of the HZP communication protocol.

HZP communication protocol is a general communication protocol for our High Precision Portable AC/DC Standard Meter, High Precision Portable AC/DC Tester, High Precision Portable AC/DC Power Analyzer, High Precision Digital Current Sensor and other products. This agreement is only applicable to one master-many slave or one master-slave networking mode, and only applicable to half duplex communication mode, applicable to but not limited to RS232/RS485 physical channel communication.

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2 Contents of Protocol

2.1 Frame Format

This protocol provides for the use of byte type asynchronous communication mode, 1 bit start bit, 8 bit data bit, no check bit and 1 bit stop bit, the transmission bit rate is 38400bps. Devices running on the same physical channel adopt the same transmission bit rate, and the physical transmission sequence of command frames is shown in the following table.

Index	0	1	2	3	4	5,6……N-3,N-2	N-1
Identifier	FrmHd	RxID	TxID	Flen	Cmd	DataBody	ChkSum
Explain	Start Character	Trusted Node	Transmitting Node	Frame Length	Command Code	Data Body	Check Code

2.2 Start Character FrmHd

Fixed 0x81.

2.3 Communication Node RxID and TxID

Communication node ID is also called device address code. Any communication node connected on the same physical channel must be assigned a unique node ID. RxID is the address code of the receiving data device, and TxID is the address code of the sending data device.

2.4 Frame Length Flen

Frame length is adopted as a single-byte unsigned integer to represent the number of bytes of the whole frame. Frame length represents the number of bytes from Start Character FrmHd to Frame Check ChkSum, including FrmHd and ChkSum.

$$8 \leq Flen \leq 255$$

2.5 Frame Check ChkSum

The frame check code is the one byte preceding the FrmHd to ChkSum, sampling the Xor check method.

Example: the frame data is 81 01 00 0F 82 00 01 00 00 00 00 00 00 00 0C, then ChkSum = 81H^01H^00H^0FH^82H^00H^ 00H^00H^00H^00H^00H^00H = 0CH

2.6 Command Dode Cmd

S/N	Comman	Command	Explain

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	d Code	Mnemonic Symbol	
1	C0H	Rsp	Response Commands
2	82H	AskDat	Ask Relevant Data
4	42H	AnsDat	Transfer Relevant Data
5	83H	WrtDat	Rewrite Relevant Data
6	84H	AskAry	Ask Relevant Arrays
7	44H	AnsAry	Transfer Relevant Arrays
8	85H	WrtAry	Rewrite Relevant Arrays

Note:

1) Cmd is 1 bit, divided into bit7~bit0

2) bit7~bit6：Range 0~3，

00 Indicates Temporary Reservation
01 Indicates from Slave to Host only
10 Indicates from Host to Slave only
11 Indicates that the host is sent to the slave, and can also be sent from the slave to the host

3) bit5~bit0：Range 0~63

2.6.1 Rsp Command

The frame format is shown in the following table

FrmHd	RxID	TxID	Flen	Rsp	RspCode	ChkSum

Answer this command when the receiving node receives the sending node command, there is an error or data transfer is not necessary.

S/N	Rsp Code	Command Mnemonic Symbol	Explain
1	0x0001	OK	Response command, means "RspOK", correct
2	0x8001	Err	Response command, means "RspErr", error

Note:

1) RspCode is two bytes, divided into bit15~bit0

2) bit15：0 means correct, 1 means error

3) bit14~bit8：Range 0~127 means type

4) bit7~bit0：Range 0~255 means error code

Example: 81 01 C1 08 C0 80 01 08 means respond command “RspErr”

2.6.2 AskDat Commad

FrmHd	RxID	TxID	Flen	AskDat	Page	Grp0	...	Grp7	ChkSum

Ask for data commands. Used to ask a trusted node to return some data from a page in the data dictionary. Where Page represents Page number, value range 00H...FFH; Ary0...7 represents group control word, bit0...7 indicates whether Ary[0... 7] is needed, "0" means No, and "1" means Yes, as shown in the following table.

	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
Grp0	Ary07	Ary06	Ary05	Ary04	Ary03	Ary02	Ary01	Ary00
Grp1	Ary15	Ary14	Ary13	Ary12	Ary11	Ary10	Ary09	Ary08
Grp2	Ary23	Ary22	Ary21	Ary20	Ary19	Ary18	Ary17	Ary16
Grp3	Ary31	Ary30	Ary29	Ary28	Ary27	Ary26	Ary25	Ary24
Grp4	Ary39	Ary38	Ary37	Ary36	Ary35	Ary34	Ary33	Ary32
Grp5	Ary47	Ary46	Ary45	Ary44	Ary43	Ary42	Ary41	Ary40
Grp6	Ary55	Ary54	Ary53	Ary52	Ary51	Ary50	Ary49	Ary48
Grp7	Ary63	Ary62	Ary61	Ary60	Ary59	Ary58	Ary57	Ary56

Example: send frame: 81 C1 01 0F 82 01 02 05 11 00 81 40 00 00 1A, parsing as follows:

81：FH(frame header)

C1：Address code of the trusted device

01：Address of sending device

0F：Full frame length

82：AskDat Command Code

01：Page, represents page 01

02 05 11 00 81 40 00 00：Request return Ary01(02H)、Ary08、Ary10(05H)、Ary16、Ary20(11H)、Ary32、Ary39(81H)、Ary46(40H), 8 data in total.

2.6.3 AnsDat Command

81H	RxID	TxID	Flen	42H	Page	Grp0	(data block)	Grp1	(data block)

Grp2	(data block)	Grp3	(data block)	Grp4	(data block)	Grp5	(data block)	Grp6	(data block)
Grp7	(data block)	ChkSum							

The basic structure of the AnsDat command is similar to the AskDat command, except in Grp0...7 is followed by corresponding data. Data returned is restricted by read permissions.

Note: When GrpX is 00H, (data block) is empty.

2.6.4 WrtDat Command

81H	RxID	TxID	Flen	83H	Page	Grp0	(data block)	Grp1	(data block)
Grp2	(data block)	Grp3	(data block)	Grp4	(data block)	Grp5	(data block)	Grp6	(data block)
Grp7	(data block)	ChkSum							

The WrtDat command and AnsDat command have the same frame structure and are used to overwrite parameters. Overwritten data is restricted by write permissions.

Note: When GrpX is 00H, (data block) is empty.

2.6.5 AskAry Command

81H	RxID	TxID	0AH	84H	Page	Ary	Start0	Start1	ChkSum

The AskAry command is used to ask trusted nodes to return arrays. Because the AskDat command carries a single piece of data, only the number zero data can be passed to an array, and the rest of the array must be accessed by the AskAry command.

The 64 data in any page of the data dictionary are treated as an array Ary00…Ary63. The Ary value range here [0-63] represents the array index to be accessed. Start0 represents the starting index of the array, and Start1 represents the terminating index of the array, with a range of [0-255].

2.6.6 AnsAry Command

81H	RxID	TxID	Flen	44H	Page	Ary	Start0	Start1	Data block	ChkSum

The AnsAry command is used for the trusted node return array. Data returned is restricted by read permissions.

2.6.7 WrtAry Command

81H	RxID	TxID	Flen	85H	Page	Ary	Start0	Start1	Data block	ChkSum

The WrtAry command and AnsAry command have exactly the same frame structure for rewriting the parameters. Overwritten data is restricted by write permissions.

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2.7 Frame Communication

	Transmitting node	Trusted node	Remark
Data manipulation	AskDat	AnsDat	
		EchErr	
	WrtDat	EchOK	
		EchErr	
Array manipulation	AskAry	AnsAry	
		EchErr	
	WrtAry	EchOK	
		EchErr	

3 Data Dictionary

This agreement only provides data dictionary format, legal data type definition and other parameters. For the data meaning of specific product data dictionary, please refer to the appendix "Product XXX Data Dictionary".

3.1 Data attribute description table

The data attribute description table must be managed in a controlled file form as an integral part of product design input. The data attribute description table style is shown in the appendix. The data attributes in the data attribute description table are shown in the following table:

S/N	Attribute	Number of bytes	Explain
1	Memory address	4	The first address of the data
2	Number of bytes	1	Size of single data, value [1... 240]
3	Number of elements	1	Number of data elements in the array, value [1... 65535]

3.2 Standard data type

All multi-byte data requires the low order in front and the high order behind.

S/N	Attribute	Number of bytes	Explain

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1	UINT8	1	
2	UINT16	2	1B 75 = "29979"
3	UINT32	4	
4	UINT64	8	A0 86 01 00 00 00 00 00 = "100000"
5	FLOAT	4	99.9997 = D8 FF C7 42
6	DOUBLE	8	

4 Cautions

4.1 Protocol Limits

1) This agreement only applies to a master-multi-slave network, not applicable multi-host network.
2) This agreement applies to but is not limited to communication on RS232/RS485 physical channel
3) When a command frame is transmitted, there is no interval between each character, and if the interval is greater than 100ms, the frame is invalidated.
4) When any trusted node receives the correct command frame, it sends a reply frame within 10ms
5) If the sending node does not start to receive the reply frame within 10ms after sending the command frame, the communication failure of the trusted node can be judged once, and the offline or fault of the node can be judged for three consecutive failures

5 Future Additions

5.1 Read-write access permission

Write permissions with passwords

S/N	Read-write permission	Explain
1	RD	Read only
2	WR	Write only
3	RW	Read-write
4	NRW	Neither read nor write

5.2 Error Code

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5.3 Data Threshold Range Restriction

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6 Appendix A Data attribute description table style

Data attribute description table style

Product Model:						Total Pages The Page 页			
Product Name:						Device address:			
Grp0		Ary07	Ary06	Ary05	Ary04	Ary03	Ary02	Ary01	Ary00
	Memory address								
	Number of bytes								
	Number of elements								
Grp1		Ary15	Ary14	Ary13	Ary12	Ary11	Ary10	Ary09	Ary08
	Memory address								
	Number of bytes								
	Number of elements								
Grp2		Ary23	Ary22	Ary21	Ary20	Ary19	Ary18	Ary17	Ary16
	Memory address								
	Number of bytes								
	Number of elements								
Grp3		Ary31	Ary30	Ary29	Ary28	Ary27	Ary26	Ary25	Ary24
	Memory address								
	Number of bytes								
	Number of elements								
Grp4		Ary39	Ary38	Ary37	Ary36	Ary35	Ary34	Ary33	Ary32
	Memory address								

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	Number of bytes								
	Number of elements								
Grp5		Ary47	Ary46	Ary45	Ary44	Ary43	Ary42	Ary41	Ary40
	Memory address								
	Number of bytes								
	Number of elements								
Grp6		Ary55	Ary54	Ary53	Ary52	Ary51	Ary50	Ary49	Ary48
	Memory address								
	Number of bytes								
	Number of elements								
Grp7		Ary63	Ary62	Ary61	Ary60	Ary59	Ary58	Ary57	Ary56
	Memory address								
	Number of bytes								
	Number of elements								

7 Appendix B Product Data Dictionary

Product Data Attribute Description Table 1

Product Model:		**Total___3___Pages The__1__Page**				
Product Name:		**Device Address: 0xC1**				
	Memory address	**Data type**	**Number**	**Number of**	**Explain**	**Product support**

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			of bytes	elements		
Ary00	g_software_ver	UINT8	1	9	Software version, ASCII format Example: "V1.0.0770"	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary01	g_bootloader_ver	UINT8	1	4	Bootloader version, ASCII format Example: "V1.8"	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary02	g_hardware_ver	UINT8	1	12	Hardware version, ASCII format	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary03	gc_hzt_ver	UINT8	1	4	HZT communication protocol version, ASCII format Example: "V2.1"	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary04	g_product_type	UINT8	1	12	Product model, ASCII format	◆ Tester ◆ Standard Meter ◆ Digital Transducer
Ary05	g_product_sn	UINT8	1	12	Product SN code, ASCII format	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary06	g_pc_heart_beat	UINT8	1	1	Heartbeat packet, hexadecimal format, fixed	◆ Tester ◆ Standard

					value 0x01, can be used for online, device online or uninterrupted communication functions	Module ◆ Measuring Module ◆ Digital Transducer
Ary07						
Ary08						
Ary09						
Ary10						
Ary11						
Ary12						
Ary13						
Ary14						
Ary15						
Ary16						
Ary17						
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Ary59						
Ary60						
Ary61						
Ary62						
Ary63						

Product Data Attribute Description Table 2

Product Model:		**Total___3___Pages The___2__Page**				
Product Name:		**Device Address: 0xC1**				
	Memory address	**Data type**	**Numbers of bytes**	**Numbers of elements**	**Explain**	**Product support**
Ary00	g_all_value.ac_rm	FLOAT	4	1	AC Voltage	◆ Tester

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	s[UI_U]					◆ Standard Meter ◆ Measuring Module
Ary01	g_all_value.ac_rms[UI_I]	FLOAT	4	1	AC Current	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary02	g_all_value.dc_avg[UI_U]	FLOAT	4	1	DC Voltage	◆ Tester ◆ Standard Meter ◆ Measuring Module
Ary03	g_all_value.dc_avg[UI_I]	FLOAT	4	1	DC Current	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary04	g_all_value.freq	FLOAT	4	1	Frequency	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary05	g_all_value.phase	FLOAT	4	1	Phase	◆ Tester ◆ Standard Meter ◆ Measuring Module
Ary06	g_all_value.ac_power	FLOAT	4	1	AC Power	◆ Tester ◆ Standard Meter ◆ Measuring Module
Ary07	g_all_value.dc_power	FLOAT	4	1	DC Power	◆ Tester ◆ Standard Meter ◆ Measuring Module
Ary08	g_adj_amp_data[CAL_ACU].std_val	FLOAT	4	1	AC voltage calibration standard value 1	* User prohibited ◆ Tester

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	1					◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary09	g_adj_amp_data[CAL_ACU].std_val2	FLOAT	4	1	AC voltage calibration standard value 2	*User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary10	g_adj_amp_data[CAL_ACU].start_flag	UINT8	1	1	AC voltage calibration start	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary11	g_adj_amp_data[CAL_ACI].std_val1	FLOAT	4	1	AC current calibration standard value 1	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary12	g_adj_amp_data[CAL_ACI].std_val2	FLOAT	4	1	AC current calibration standard value 2	*User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary13	g_adj_amp_data[CAL_ACI].start_flag	UINT8	1	1	AC current calibration start	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital

						Transducer
Ary14	g_adj_amp_data[CAL_DCU].std_val1	FLOAT	4	1	DC voltage calibration standard value 1	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary15	g_adj_amp_data[CAL_DCU].std_val2	FLOAT	4	1	DC voltage calibration standard value 2	*User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary16	g_adj_amp_data[CAL_DCU].start_flag	UINT8	1	1	DC voltage calibration start	*User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary17	g_adj_amp_data[CAL_DCI_P].std_val1	FLOAT	4	1	DC forward current calibration standard value 1	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary18	g_adj_amp_data[CAL_DCI_P].std_val2	FLOAT	4	1	DC forward current calibration standard value 2	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary19	g_adj_amp_data[CAL_DCI_P].start_flag	UINT8	1	1	DC forward current calibration start	* User prohibited ◆ Tester ◆ Standard Meter

						◆ Measuring Module ◆ Digital Transducer
Ary20	g_adj_amp_data[CAL_DCI_N].std_val1	FLOAT	4	1	DC reverse current calibration standard value 1	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary21	g_adj_amp_data[CAL_DCI_N].std_val2	FLOAT	4	1	DC reverse current calibration standard value 2	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary22	g_adj_amp_data[CAL_DCI_N].start_flag	UINT8	1	1	DC reverse current calibration start	*User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Module
Ary23	g_adj_phase_data.std_val1	FLOAT	4	1	Phase calibration standard value	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary24	g_adj_phase_data.start_flag	UINT8	1	1	Phase calibration start	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary25	g_pc_gear_select	UINT8	1	1	Voltage manual range	* User prohibited

	_menu[UI_U]				position, hexadecimal format 0x00 ： Automatic range position 0x01~0x07：Switch to the corresponding range position others：Invalid value Note: the greater the value, the greater the range position	◆ Tester ◆ Standard Meter ◆ Measuring Module
Ary26	g_pc_gear_select_menu[UI_I]	UINT8	1	1	Current manual range position, hexadecimal format 0x00 ： Automatic range position 0x01~0x07：Switch to the corresponding range position others：Invalid value Note: the greater the value, the greater the range position	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary27	g_enegry_acdc_mode	UINT8	1	1	Power output mode, hexadecimal format 0x00：AC Mode 0x01：DC Mode others：Invalid value	◆ Standard Meter ◆ Measuring Module
Ary28	g_i_rg	UINT8	1	1	Current range, hexadecimal format	* User prohibited ◆ Tester ◆ Standard Meter

					0x00：60A 0x01：200A 0x02：300A 0x03：600A 0x04：1000A 0x05：1200A others：Invalid value	◆ Measuring Module ◆ Digital Transducer
Ary29	g_iap_flag	UINT8	1	1	Online upgrade	* User prohibited ◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Transducer
Ary30	g_gps_beijing_time_buf	UINT8	1	14	GPS Beijing time, ASCII format, when g_gps_is_valid= 'A', the data is valid. Example：”201808301754 26”，data：0x32 0x30 0x31 0x38 0x30 0x38 0x33 0x30 0x31 0x37 0x35 0x34 0x32 0x36，means 17:54:26 on August 30, 2018	◆ Measuring Module
Ary31	g_gps_snr	UINT8	1	1	GPS signal strength, hexadecimal format, range is 0~99dB, the larger the data value is, the stronger the signal is. Generally, the GPS location is effective at	◆ Measuring Module

					30dB~50dB, and the data is valid at g_gps_is_valid= 'A'. Example： 0x21, indicates signal strength is 33dB	
Ary32	g_gps_is_valid	UINT8	1	1	Whether the GPS signal is valid or not, hexadecimal format 'A'： GPS data valid 'V'： GPS data invalid 'N'： GPS unconnected others： Invalid value	◆ Measuring Module
Ary33	g_sht25_t_dat	FLOAT	4	1	The temperature value, in FLOAT format, ranges from -40℃~+125℃	◆ Standard Meter ◆ Measuring Module
Ary34	g_sht25_rh_dat	FLOAT	4	1	Humidity value, FLOAT format, range 0%~100%	◆ Standard Meter ◆ Measuring Module
Ary35	g_enegry_err_ctrl [ACDC_AC]	UINT8	1	1	AC power error test control, hexadecimal format 0x00： Initialization 0x01： Start 0x02： Stop others： Invalid value	◆ Standard Meter ◆ Measuring Module
Ary36	g_enegry_err_state[ACDC_AC]	UINT8	1	1	AC power error test state, hexadecimal format 0x00： Initialization	◆ Standard Meter ◆ Measuring Module

					0x01：Started 0x02：Measuring 0x03：Stopped 0x04：Completed others：Invalid value	
Ary37	g_enegry_clk_freq[ACDC_AC]	UINT64	8	1	AC watt-hour meter constant, hexadecimal format, setting range as [1, 2,000,000,000] Example： 10000： 0x10 0x27 0x00 0x00 0x00 0x00 0x00 0x00	◆ Standard Meter ◆ Measuring Module
Ary38	g_enegry_chk_n[ACDC_AC]	UINT64	8	1	AC calibrating winding number, hexadecimal format, setting range is [1, 999,999,999]	◆ Standard Meter ◆ Measuring Module
Ary39	g_enegry_err[ACDC_AC][0]	FLOAT	4	1	AC power error 1, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary40	g_enegry_err[ACDC_AC][1]	FLOAT	4	1	AC power error 2, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary41	g_enegry_err[ACDC_AC][2]	FLOAT	4	1	AC power error 3, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary42	g_enegry_err[ACDC_AC][3]	FLOAT	4	1	AC power error 4, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary43	g_enegry_err[ACDC_AC][4]	FLOAT	4	1	AC power error 5, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary44	g_enegry_err_avg	FLOAT	4	1	AC power error average,	◆ Standard Meter

	[ACDC_AC]				FLOAT format, unit is %	◆ Measuring Module
Ary45	g_enegry_err_stand[ACDC_AC]	FLOAT	4	1	AC power error standard deviation, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary46	g_enegry_err_progress[ACDC_AC]	UINT8	1	1	AC power error test progress value, hexadecimal format, unit %, range [0, 100]	◆ Standard Meter ◆ Measuring Module
Ary47	g_enegry_err_time_delta [ACDC_AC]	UINT64	8	1	AC power error test time in hexadecimal format, in seconds	◆ Standard Meter ◆ Measuring Module
Ary48	g_enegry_err_ctrl [ACDC_DC]	UINT8	1	1	DC power error test control, hexadecimal format 0x00：Initialization 0x01：Start 0x02：Stop others：Invalid value	◆ Standard Meter ◆ Measuring Module
Ary49	g_enegry_err_state[ACDC_DC]	UINT8	1	1	DC power error test status, hexadecimal format 0x00：Initialization 0x01：Started 0x02：Measuring 0x03：Stopped 0x04：Completed others：Invalid value	◆ Standard Meter ◆ Measuring Module
Ary50	g_enegry_clk_freq[ACDC_DC]	UINT64	8	1	DC watt-hour meter constant, hexadecimal	◆ Standard Meter ◆ Measuring

					format, setting range is [1, 2,000,000,000]	Module
Ary51	g_enegry_chk_n[ACDC_DC]	UINT64	8	1	DC watt-hour meter constant, hexadecimal format, setting range is [1, 999,999,999]	◆ Standard Meter ◆ Measuring Module
Ary52	g_enegry_err[ACDC_DC][0]	FLOAT	4	1	DC power error 1, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary53	g_enegry_err[ACDC_DC][1]	FLOAT	4	1	DC power error 2, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary54	g_enegry_err[ACDC_DC][2]	FLOAT	4	1	DC power error 3, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary55	g_enegry_err[ACDC_DC][3]	FLOAT	4	1	DC power error 4, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary56	g_enegry_err[ACDC_DC][4]	FLOAT	4	1	DC power error 5, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary57	g_enegry_err_avg[ACDC_DC]	FLOAT	4	1	DC power error average, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary58	g_enegry_err_stand[ACDC_DC]	FLOAT	4	1	DC power error average, FLOAT format, units is %	◆ Standard Meter ◆ Measuring Module
Ary59	g_enegry_err_progress[ACDC_DC]	UINT8	1	1	DC power error test progress value, hexadecimal format, unit %, range [0, 100]	◆ Standard Meter ◆ Measuring Module
Ary60	g_enegry_err_time_delta[ACDC_DC]	UINT64	8	1	DC error test time in hexadecimal format, in seconds	◆ Standard Meter ◆ Measuring Module
Ary61						
Ary62						
Ary63						

Product Data Attribute Description Table 3

Product Model:		Total___3___Pages The___3__Page				
Product Name:		Device Address：0xC1				
	Memory address	Data Type	Number of bytes	Number of elements	Explain	Product support
Ary00	g_daily_err_ctrl	UINT8	1	1	Daily timing error test control, hexadecimal format 0x00：Initialization 0x01：Start 0x02：Stop others：Invalid value	◆ Standard Meter ◆ Measuring Module
Ary01	g_daily_err_state	UINT8	1	1	Daily timing error test status, hexadecimal format 0x00：Initialization 0x01：Started 0x02：Measuring 0x03：Stopped 0x04：Completed others：Invalid value	◆ Standard Meter ◆ Measuring Module
Ary02	g_daliy_clk_freq	FLOAT	4	1	Daily timing error clock frequency, FLOAT format, setting range: [0.01, 50,000.00]	◆ Standard Meter ◆ Measuring Module
Ary03	g_daliy_chk_n	UINT64	8	1	Daily timing error calibrating	◆ Standard

					winding number, hexadecimal format, setting range: [1, 999,999,999]	◆ Meter ◆ Measuring Module
Ary04	g_daliy_err[0]	FLOAT	4	1	Daily timing error 1, FLOAT format, unit is s/d	◆ Standard Meter ◆ Measuring Module
Ary05	g_daliy_err[1]	FLOAT	4	1	Daily timing error 2, FLOAT format, unit is s/d	◆ Standard Meter ◆ Measuring Module
Ary06	g_daliy_err[2]	FLOAT	4	1	Daily timing error 3, FLOAT format, unit is s/d	◆ Standard Meter ◆ Measuring Module
Ary07	g_daliy_err[3]	FLOAT	4	1	Daily timing error 4, FLOAT format, unit is s/d	◆ Standard Meter ◆ Measuring Module
Ary08	g_daliy_err[4]	FLOAT	4	1	Daily timing error 5, FLOAT format, unit is s/d	◆ Standard Meter ◆ Measuring Module
Ary09	g_daliy_err_avg	FLOAT	4	1	Daily timing error average, FLOAT format, unit is s/d	◆ Standard Meter ◆ Measuring Module
Ary10	g_daliy_err_stand	FLOAT	4	1	Daily timing error standard deviation, FLOAT format, unit is s/d	◆ Standard Meter ◆ Measuring Module
Ary11	g_daliy_err_progress	UINT8	1	1	Daily timing error test progress value, hexadecimal format, unit %, range [0, 100]	◆ Standard Meter ◆ Measuring Module
Ary12	g_word_test_ctrl[ACDC_AC]	UINT8	1	1	AC word movement test control, hexadecimal format 0x00：Initialization	◆ Standard Meter ◆ Measuring Module

					0x01：Start 0x02：Stop others：Invalid value	
Ary13	g_word_test_state[ACDC_AC]	UINT8	1	1	AC word movement test status, hexadecimal format 0x00：Initialization 0x01：Started 0x02：Measuring 0x03：Stopped others：Invalid value	◆ Standard Meter ◆ Measuring Module
Ary14	g_word_test_energy_delta[ACDC_AC]	FLOAT	4	1	Standard power value of AC word movement test, FLOAT format, unit is kWh	◆ Standard Meter ◆ Measuring Module
Ary15	g_word_test_energy_cnt_delta[ACDC_AC]	UINT64	8	1	AC word movement test power pulse number, hexadecimal format	◆ Standard Meter ◆ Measuring Module
Ary16	g_word_test_time_delta[ACDC_AC]	UINT64	8	1	AC word movement test power pulse number, hexadecimal format	◆ Standard Meter ◆ Measuring Module
Ary17	g_word_test_ctrl[ACDC_DC]	UINT8	1	1	DC word movement test control, hexadecimal format 0x00：Initialization 0x01：Start 0x02：Stop	◆ Standard Meter ◆ Measuring Module

					others：Invalid value	
Ary18	g_word_test_state[ACDC_DC]	UINT8	1	1	DC word movement test status, hexadecimal format 0x00：Initialization 0x01：Started 0x02：Measuring 0x03：Stopped others：Invalid value	◆ Standard Meter ◆ Measuring Module
Ary19	g_word_test_energy_delta[ACDC_DC]	FLOAT	4	1	Standard power value of DC word movement test, FLOAT format, unit is kWh	◆ Standard Meter ◆ Measuring Module
Ary20	g_word_test_energy_cnt_delta[ACDC_DC]	UINT64	8	1	DC word movement test power pulse number, hexadecimal format	◆ Standard Meter ◆ Measuring Module
Ary21	g_word_test_time_delta[ACDC_DC]	UINT64	8	1	DC word movement test time, hexadecimal format, in second	◆ Standard Meter ◆ Measuring Module
Ary22	g_pulse_const_mode[ACDC_AC]	UINT8	1	1	AC pulse constant mode, hexadecimal format, default value is 0x00 0x00：Automatic constant 0x01：Manual constant Others：Invalid	◆ Standard Meter ◆ Measuring Module
Ary23	g_pulse_const_man_set[ACDC_AC]	UINT64	8	1	AC pulse constant manual setting, hexadecimal format, default value is 10000	◆ Standard Meter ◆ Measuring Module

Ary24	g_pulse_const_cur [ACDC_AC]	UINT64	8	1	Current value of AC impulse constant, hexadecimal format	◆ Standard Meter ◆ Measuring Module
Ary25	g_pulse_const_mode[ACDC_DC]	UINT8	1	1	DC pulse constant mode, hexadecimal format, default value 0x00 0x00：Automatic constant 0x01：Manual constant Others：Invalid	◆ Standard Meter ◆ Measuring Module
Ary26	g_pulse_const_man_set[ACDC_DC]	UINT64	8	1	DC pulse constant manual setting, hexadecimal format, default value is 10000	◆ Standard Meter ◆ Measuring Module
Ary27	g_pulse_const_cur [ACDC_DC]	UINT64	8	1	Current value of DC impulse constant, hexadecimal format	◆ Standard Meter ◆ Measuring Module
Ary28	g_current_mode	UINT8	1	1	Current mode, hexadecimal format, default value 0x00 0x00：High current gear 0x01：Low current gear Others：Invalid	◆ Standard Meter ◆ Measuring Module
Ary29	g_fft_thd[UI_U]	FLOAT	4	1	Total voltage harmonic content, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary30	g_fft_amp[UI_U][64]	FLOAT	4	64	Voltage each harmonic amplitude, FLOAT format g_fft_hdf[UI_U][0]：DC g_fft_hdf[UI_U][1]：50Hz	◆ Standard Meter ◆ Measuring Module

					…… g_fft_hdf[UI_U][63]：3150Hz	
Ary31	g_fft_hdf[UI_U][64]	FLOAT	4	64	Voltage each harmonic amplitude, FLOAT format, unit is % g_fft_hdf[UI_U][0]：DC g_fft_hdf[UI_U][1]：50Hz …… g_fft_hdf[UI_U][63]：3150Hz	◆ Standard Meter ◆ Measuring Module
Ary32	g_fft_thd[UI_I]	FLOAT	4	1	Total current harmonic content, FLOAT format, unit is %	◆ Standard Meter ◆ Measuring Module
Ary33	g_fft_amp[UI_I][64]	FLOAT	4	64	Current each harmonic amplitude, FLOAT format g_fft_hdf[UI_I][0]：DC g_fft_hdf[UI_I][1]：50Hz …… g_fft_hdf[UI_I][63]：3150Hz	◆ Standard Meter ◆ Measuring Module
Ary34	g_fft_hdf[UI_I][64]	FLOAT	4	64	Current each harmonic amplitude, FLOAT format, unit is % g_fft_hdf[UI_I][0]：DC g_fft_hdf[UI_I][1]：50Hz …… g_fft_hdf[UI_I][63]：3150Hz	◆ Standard Meter ◆ Measuring Module
Ary35	g_gear_cur[E_GEAR_U]	UINT8	1	1	Voltage current range position, hexadecimal format	◆ Tester ◆ Standard Meter

					0x00~0x07：Corresponding position value Others：Invalid Note: the greater value, the greater range position	◆ Measuring Module ◆ Digital Transducer
Ary36	g_gear_cur[E_GEAR_I]	UINT8	1	1	Current current range position, hexadecimal format 0x00~0x07：Corresponding position value Others：Invalid Note: the greater value, the greater range position	◆ Tester ◆ Standard Meter ◆ Measuring Module ◆ Digital Sensor
Ary37	g_bmp280_press_dat	UINT32	4	1	Atmospheric pressure, hexadecimal format, unit is Pa	◆ Measuring Module
Ary38						
Ary39						
Ary40						
Ary41						
Ary42						
Ary43						
Ary44						
Ary45						
Ary46						
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Ary58						
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Ary60						
Ary61						
Ary62						
Ary63						

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8 Appendix C Communication Example

8.1 Read software version

Send frame：81 C1 01 0A 84 00 00 00 08 C7

Received frame：81 01 C1 13 44 00 00 00 08 56 31 2E 30 2E 30 36 39 32 44

Frame parsing：

Send frame			Received frame	
81	Frame Header		81	Frame Header
C1	Receiving node address		01	Receiving node address
01	Sending node address		C1	Sending node address
0A	Frame length		13	Frame length
84	Command Code AskAry		44	Command Code AnsAry
00	The 00 pp.		00	The 00 pp.
00	Ary00		00	Ary00
00	Start0		00	Start0
08	Start1		08	Start1
C7	Check Code		56 31 2E 30 2E 30 36 39 32	Software version, ASCII format, byte size 1 byte, number of elements 9, in this case represents string "V1.0.0692"
			44	Check Code

8.2 Read the bootloader version

Send frame：81 C1 01 0A 84 00 01 00 03 CD

Received frame：81 01 C1 0E 44 00 01 00 03 56 31 2E 34 74

Frame parsing：

Send frame			Received frame	
81	Frame Header		81	Frame Header
C1	Receiving node address		01	Receiving node address
01	Sending node address		C1	Sending node address
0A	Frame length		0E	Frame length
84	Command Code AskAry		44	Command Code AnsAry
00	The 00 pp.		00	The 00 pp.
01	Ary01		01	Ary01
00	Start0		00	Start0
03	Start1		03	Start1
CD	Check Code		56 31 2E 34	Bootloader version, ASCII format, byte size is 1 byte, number of elements is 4, in this case, represents string "V1.4"
			74	Check Code

8.3 Read DC current

Send frame：81 C1 01 0F 82 01 08 00 00 00 00 00 00 00 C5

Received frame：81 01 C1 13 42 01 08 04 00 26 BA 00 00 00 00 00 00 00 81

Frame parsing：

Send frame			Received frame	
81	Frame Header		81	Frame Header
C1	Receiving node address		01	Receiving node address
01	Sending node address		C1	Sending node address
0F	Frame length		13	Frame length
82	Command Code AskDat		42	Command Code AnsDat
01	The 01 pp.		01	The 01 pp.
08	Grp0Ary03		08	Grp0Ary03
00 00 00 00	Grp1-Grp7		04 00 26 BA	Page01Ary03 data, represents the DC current, the

00 00 00				data format is FLOAT, and the number of bytes is 4 bytes
C5	Check Code		00 00 00 00 00 00 00	Grp1-Grp7
			81	Check Code

Error Frame	
81	Frame Header
01	Receiving node address
C1	Sending node address
08	Frame length
C0	Command Code Rsp
80 01	Response command, means "RspErr", error
08	Check Code

8.4 Read voltage, current, phase, frequency, etc

Send frame：81 C1 01 0F 82 01 FF 00 00 00 00 00 00 00 32

Received：81 01 C1 2F 42 01 FF 00 00 00 00 00 00 00 00 A3 5B 8E C4 EC AD D5 B9 00 00 00 00 00 00 00 00 00 00 00 00 00 EC A5 ED 3E 00 00 00 00 00 00 00 D7

Frame parsing：

Send frame			**Received frame**	
81	Frame Header		81	Frame Header
C1	Receiving node address		01	Receiving node address
01	Sending node address		C1	Sending node address
0F	Frame length		2F	Frame length
82	Command Code AskDat		42	Command Code AnsDat
01	The 01 pp.		01	The 01 pp.
FF	Grp0Ary00-Ary07		FF	Grp0Ary00-Ary07
00 00 00 00 00 00 00	Grp1-Grp7		00 00 00 00	Page01Ary00 data, represents AC voltage, data format is FLOAT, the number of bytes is 4 bytes
32	Check Code		00 00 00 00	Page01Ary01 data, represents AC current, data

				format is FLOAT, the number of bytes is 4 bytes
			A3 5B 8E C4	Page01Ary02 data, represents DC voltage, data format is FLOAT, the number of bytes is 4 bytes
			EC AD D5 B9	Page01Ary03 data, represents DC current, data format is FLOAT, the number of bytes is 4 bytes
			00 00 00 00	Page01Ary04 data, represents the frequency, data format is FLOAT, the number of bytes is 4 bytes
			00 00 00 00	Page01Ary05 data, represents phase, data format is FLOAT, the number of bytes is 4 bytes
			00 00 00 00	Page01Ary06 data, represents AC power, data format is FLOAT, the number of bytes is 4 bytes
			EC A5 ED 3E	Page01Ary07 data, represents DC power, data format is FLOAT, the number of bytes is 4 bytes
			00 00 00 00 00 00 00	Grp1-Grp7
			D7	Check Code

8.5 DC power error test

Test procedure example:

1) Connect the electrical pulse output of the tested device to the electrical pulse input pin of the device, pay attention to the common ground.
2) Connect voltage and current lines so that the tested equipment and this equipment are on the same circuit.
3) Turn on the power source output (e.g., 500V voltage, 100A current) and wait for the source output to stabilize.
4) Set the power output mode of this device to DC mode.
5) Input the electrical impulse constant (e.g. 1600) and calibration winding number (e.g. 10) of the equipment under test.
6) Send DC power error test control command to start.
7) Wait for a certain test time.
8) Error test status of reading DC power is completed.
9) Turn off power source output.
10) Reading data error.

Cautions:

1) The raise source needs to precede the start command
2) Turn off the source needs to be completed after the test

Example:

1) Set the power mode to DC mode.

Send frame： 81 C1 01 10 83 01 00 00 00 08 01 00 00 00 00 DA

Received frame： 81 01 C1 08 C0 00 01 88

2) Set dc watt-hour meter constant (set value to 100000000)

Send frame： 81 C1 01 17 83 01 00 00 00 00 00 00 04 00 E1 F5 05 00 00 00 00 00 C1

Received frame： 81 01 C1 08 C0 00 01 88

3) Set the number of calibrating turns (set the value to 10000)

Send frame： 81 C1 01 17 83 01 00 00 00 00 00 00 08 10 27 00 00 00 00 00 00 00 EB

Received frame： 81 01 C1 08 C0 00 01 88

4) Send DC power error test control command to start

Send frame： 81 C1 01 10 83 01 00 00 00 00 00 00 01 01 00 D3

Received frame： 81 01 C1 08 C0 00 01 88

5) Read test data

Send frame： 81 C1 01 0F 82 01 FF 00 00 00 00 00 FE 1F D3

Received frame：81 01 C1 65 42 01 FF 00 00 00 00 00 00 00 00 38 F7 37 3D F5 27 B6 BD 00 00 00 00 00 00 00 00 00 00 00 00 79 E6 82 BB 00 00 00 00 00 FE 02 00 E1 F5 05 00 00 00 00 10 27 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 1F 00 00 00 00 00 00 00 00 00 00 00 00 00 15 00 00 00 00 00 00 00 F2

8.6 Daily timing error test

Test procedure:

1) Set the clock frequency and calibration winding number
2) Sending day timing error test control command starts
3) Wait day timing error test status is completed
4) Read error data

8.7 DC word test

Test procedure example:

1) Connect voltage and current lines so that the tested equipment and the equipment are on the same circuit.
2) Set the power output mode of this device to DC mode.

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3) Set the voltage and current range of the equipment as fixed range position.
4) Set the manual pulse constant.
5) Send DC word test control command to start
6) Turn on power source output (e.g. 500V voltage, 100A current).
7) Wait for a certain test time.
8) Send DC word test control command to stop, read standard power value, and at the same time read the power difference of the tested equipment.
9) Turn of power supply.

Cautions:

1) The raise source needs to precede the start command
2) Turn off the source needs to be completed after the test
3)

Examples: