PMAC211
MODBUS PROTOCOL
AND REGISTER LIST
V1.0

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CONTENTS

1. Introduction

This document describes the input and output command, information and data of the PMAC211 under MODBUS communication mode. So it is convenient for the 3rd part using and developing.

1.1 Purpose of the Communication Protocol

The purpose of the PMAC211 MODBUS communications protocol is to allow setup information and measured data to be efficiently transferred between a MODBUS Master Station and PMAC211. It includes:

1) Allowing setting and reading all PMAC211 set-up parameters from a MODBUS Master Station.

2) Allowing reading all data measured by a PMAC211 and SOE (Event log).

1.2 Version of Communication Protocol

This document is proper for all versions of PMAC211 meters. It will be declared, if any change happens later.

2. Detailed Description of the PMAC211 Modbus Protocol

2.1. PMAC211 Modbus Protocol Rules

The following rules define the protocol rules for information transfer between a MODBUS Master device and the PMAC211 in a RS-485 serial communications loop.

1) All communications on the RS-485 loop conforms to a MASTER/SLAVE scheme. In this scheme, information and data is transferred between a MODBUS MASTER device and up to 32 SLAVE monitoring devices.

2) The MASTER will initiate and control all information transfer on the RS-485 communications loop.

3) Under no circumstances will a SLAVE device initiate a communications sequence.

4) All communications activity on the RS-485 loop occurs in the form of "PACKETS", a packet being simply a serial string of 8-bit bytes. The maximum number of bytes contained within one packet is 255. The bytes that comprise a packet consist of standard asynchronous serial data, which are generated using equipment similar to that used for RS-232C.

5) The packages from MASTER are named request. The packages from SLAVE are named response.

6) Under any circumstance, Slave can just respond one request.

2.2. Modes of Transmission

MODBUS protocol supports ASCII and RTU modes of transmissions. The PMAC211 supports only the RTU mode of transmission with 8 data bits, no parity, and one stop bit.

2.3. Description of the Modbus Packet Structure

Every MODBUS packet consists of four fields:

1) The Address Field

2) The Function Field

3) The Data Field

4) The Error Check field

2.3.1 Address Field

The address field is 1-byte long and identifies which slave device the packet is for. Valid addresses range between 1 and 247. The slave device whose address matches the value in this field will perform the command specified in the packet.

2.3.2 Function Field

The function field is 1-byte long and tells the addressed salve which function to perform. Slave response packet should

include same function field byte as request. The Modbus functions supported by PMAC211 are listed as below:

Function Code	Meaning	Action
0x03	Read Holding Registers	Obtains the current value in one or more holding registers of the PMAC211.
0x10	Preset Multiple Registers	Places specific binary values into a series of consecutive holding registers of the PMAC211

2.3.3 Data Field

The length of Data Field is varies in length depending on its function. In general, MODBUS supports “BIG INDIAN” mode, it means high-order byte first, low-order byte second.

For example,

One 16 byte register value is 0x12AB; register is transmitted in below sequence:

High-order byte = 0x12

Low-order byte = 0xAB

2.3.4 Error Check Field

In Modbus RTU mode, the 16-bit Cyclic Redundancy Check (CRC-16) is used. The sending device calculates a 16-bit value, based on the information stored in the address, function and data fields using the CRC-16 algorithm and appends it to the end of the packet. The receiving device performs the same calculation upon the reception of a packet. If the result does not match the checksum stored in the packet, transmission errors have occurred and the packet will be ignored by the receiving device.

For detail of CRC16 parity arithmetic, please refer to Section 4 .

2.4. Abnormal Responses

If a Modbus master device sends a non-effective command to a PMAC211 or attempts to read a non-effective holding register, an exception response will be generated. The exception response consists of the slave address, function code, error code, and error check field. The high order bit of the function code is set to 1 to indicate that the packet is an exception response.

Below list describes the meanings of exception codes:

Function Code	Meaning
01 illegal function code	PMAC211 Modbus support the function code include: 01H, 02H, 03H, 05H, and 10H. This code means the slave device receive an illegal function code, or the PMAC211 receive the error command.
02 illegal function code	PMAC211 receive the address referenced in the data field is an invalid address.
03 illegal function code	The requested register number is too long.

2.5. Broadcast Packets

PMAC211 support broadcast commands when communicating in MODBUS mode.

Do write command 0x10 for timing.

3. Packet Communication

Two MODBUS functions are supported by the PMAC211. The standard MODBUS protocol supports only 16-bit registers, which limit the maximum value of any measurement to 65535.

Section 3.1 will describe the format of Read/ Response Packet of holding register.

Section 3.2 will describe Preset Multiple Registers packet and the acknowledge packet.

3.1. Read Holding Registers (Function Code 03H)

This command packet requests that the PMAC211 responds all valid registers. The value of reserved registers is 0.

Request Packet (Master→PMAC211)		**Response Packet (PMAC211→Master)**	
Unit ID/ Slave address	1 byte	Unit ID/ Slave address	1 byte
03 H (Function Code)	1 byte	03 H (Function Code)	1 byte
Start register address	2 bytes	Byte num. (2 * register num.)	1 byte
Registers num.	2 bytes	First register data	2 bytes
CRC check code	2 bytes	Second register data	2 bytes
		... ...	
		CRC check code	2 bytes

3.2. Preset Multiple Registers (Function code 10H)

Preset Registers Format (Master→PMAC211)		**Response Format (PMAC211→Master)**	
Unit ID/ Slave address	1 byte	Unit ID/ Slave address	1 byte
10 H (Function Code)	1 byte	10 H (Function Code)	1 byte
Start register address	2 bytes	Start register address	2 bytes
Register num.	2 bytes	Register num.	2 bytes
Byte num. (2 * register num.)	1 byte	CRC check code	2 bytes
First register data			
Second register data			
...			
CRC check code	2 bytes		

This command packet allows the Master to program the PMAC211 setup parameters.

Note: PMAC211 presume all registers are continuous from the first one.

4. Calculating the CRC-16 Error Check Field

This section describes the procedure for obtaining the CRC-16 error check field. A packet can be considered as a continuous, serial stream of binary data (0, 1). The 16-bit checksum is obtained by multiplying the serial data stream by 216 (10000000000000000) and then dividing it by the ***generator polynomial*** $x^{16}+x^{15}+x^2+1$, which can be expressed as a binary data 11000000000000101. The quotient is ignored and the 16-bit remainder is the checksum and is appended to end of the

packet.

In calculating the CRC, all arithmetic operations (additions and subtractions) are performed using MODULO TWO, or EXCLUSIVE OR operation.

Steps for the Generating the CRC-16 Checksum:

1) Form a new polynomial by dropping the MSB (Most Significant Bit) of the generator polynomial and reversing the bit sequence. This yields the binary number 1010 0000 0000 0001 or A0 01 Hex.

2) Load a 16-bit register with initial value FF FF Hex.

3) Exclusive OR the first data byte with the loworder byte of the 16-bit register, storing the result in the 16-bit register.

4) Shift the 16-bit register one bit to the right. If overflow bit is 1, then turn to step 5). Otherwise, turn to step 6)

5a) If the bit shifted out to the right is one, Exclusive OR the 16-bit register with the new generator polynomial, with result stored in the16-bit register. Return to step 4.

5b) If the bit shifted out to the right is zero, return to step 4.

6) Repeat steps 4 and 5 until 8 shifts have been performed.

7) Exclusive OR the next data byte with the 16-bit register.

8) Repeat steps 4 through 7 until all bytes of the packet have been calculate by XOR

9) The content of the 16-bit register is CRC-16

Procedure for Calculating the 6403 Bytes of 16 Hex.

Step	Byte	Action	Register	Bit #	Shift
2		Initial Value	1111 1111 1111 1111		
	1	Load the first byte	0000 0000 0110 0100		
3		XOR	1111 1111 1001 1011		
4		SHIFT 1 bit to the right	0111 1111 1100 1101	1	1
5a		XOR polynomial	1101 1111 1100 1100		
4		SHIFT 1 bit to the right	0110 1111 1110 0110	2	0
4		SHIFT 1 bit to the right	0011 0111 1111 0011	3	0
4		SHIFT 1 bit to the right	0001 1011 1111 1001	4	1
5a		XOR polynomial	1011 1011 1111 1000		
4		SHIFT 1 bit to the right	0101 1101 1111 1100	5	0
4		SHIFT 1 bit to the right	0010 1110 1111 1110	6	0
4		SHIFT 1 bit to the right	0001 0111 0111 1111	7	0
4		SHIFT 1 bit to the right	0000 1011 1011 1111	8	1
5a		SHIFT 1 bit to the right	1010 1011 1011 1110		
	2	Load the second byte	0000 0000 0000 0011		
7		XOR	1010 1011 1011 1101		
4		SHIFT 1 bit to the right	0101 0101 1101 1110	1	1
5a		XOR polynomial	1111 0101 1101 1111		
4		SHIFT 1 bit to the right	0111 1010 1110 1111	2	1
5a		XOR polynomial	1101 1010 1110 1110		
4		SHIFT 1 bit to the right	0110 1101 0111 0111	3	0
4		SHIFT 1 bit to the right	0011 0110 1011 1011	4	1
5a		XOR polynomial	1001 0110 1011 1010		

4		SHIFT 1 bit to the right	0100 1011 0101 1101	5	0
4		SHIFT 1 bit to the right	0010 0101 1010 1110	6	1
5a		XOR polynomial	1000 0101 1010 1111		
4		SHIFT 1 bit to the right	0100 0010 1101 0111	7	1
5a		XOR polynomial	1110 0010 1101 0110		
4		SHIFT 1 bit to the right	0111 0001 0110 1011	8	0
		CRC-16	0111 0001 0110 1011		

5. Description of PMAC211 Registers

All PMAC211 measured and setup parameters are treated as HOLDING REGISTERS having addresses **4xxxx** when communicating in MODBUS protocol. According to the MODBUS Protocol, in response to a request for register **4xxxx** of a particular slave device (PMAC211), the MODBUS master reads register **xxxx-1** from the slave (PMAC211). For example register 40011 corresponds to register 10.

Access and Type of Register

Items	Access and Type	Description
1	RO	Read only
2	WO	Write only
3	RW	Read or Write
4	U16	16 bit, un-sign integer
5	S16	16 bit, sign integer
6	U32	32 bit, un-sign integer
7	S32	32 bit, sign integer

5.1 Real-time data register list

Register address	Access	Type	Description	Remarks
40001	RO	U16	Va (ph-N)	× 0.1, unit: V
40002	RO	U16	Vb (ph-N)	× 0.1, unit: V
40003	RO	U16	Vc (ph-N)	× 0.1, unit: V
40004	RO	U16	Reserved	
40005	RO		Reserved	
40006	RO	U16	Reserved	
40007	RO	U16	Reserved	
40008	RO	U16	Reserved	
40009	RO	U16	Reserved	
40010	RO	U16	Frequency	× 0.01, unit: Hz

40011	RO	U16	Circuit 1, Ia	× 0.1, unit: A
40012	RO	U16	Circuit 1, Ib	× 0.1, unit: A
40013	RO	U16	Circuit 1, Ic	× 0.1, unit: A
40014	RO	U16	Circuit 2, Ia	× 0.1, unit: A
40015	RO	U16	Circuit 2, Ib	× 0.1, unit: A
40016	RO	U16	Circuit 2, Ic	× 0.1, unit: A
40017	RO	U16	Circuit 3, Ia	× 0.1, unit: A
40018	RO	U16	Circuit 3, Ib	× 0.1, unit: A
40019	RO	U16	Circuit 3, Ic	× 0.1, unit: A
40020	RO	U16	Circuit 4, Ia	× 0.1, unit: A
40021	RO	U16	Circuit 4, Ib	× 0.1, unit: A
40022	RO	U16	Circuit 4, Ic	× 0.1, unit: A
40023	RO		Reserved	
40024	RO		Reserved	
40025	RO		Reserved	
40026	RO		Reserved	
40027	RO	S32	Circuit 1, Pa (low)	× 0.1, unit: W
40028	RO		Circuit 1, Pa (high)	
40029	RO	S32	Circuit 1, Pb (low)	× 0.1, unit: W
40030	RO		Circuit 1, Pb (high)	
40031	RO	S32	Circuit 1, Pc (low)	× 0.1, unit: W
40032	RO		Circuit 1, Pc (high)	
40033	RO	S32	Circuit 2, Pa (low)	× 0.1, unit: W
40034	RO		Circuit 2, Pa (high)	
40035	RO	S32	Circuit 2, Pb (low)	× 0.1, unit: W
40036	RO		Circuit 2, Pb (high)	
40037	RO	S32	Circuit 2, Pc (low)	× 0.1, unit: W
40038	RO		Circuit 2, Pc (high)	
40039	RO	S32	Circuit 3, Pa (low)	× 0.1, unit: W
40040	RO		Circuit 3, Pa (high)	
40041	RO	S32	Circuit 3, Pb (low)	× 0.1, unit: W
40042	RO		Circuit 3, Pb (high)	
40043	RO	S32	Circuit 3, Pc (low)	× 0.1, unit: W
40044	RO		Circuit 3, Pc (high)	
40045	RO	S32	Circuit 4, Pa (low)	× 0.1, unit: W
40046	RO		Circuit 4, Pa (high)	
40047	RO	S32	Circuit 4, Pb (low)	× 0.1, unit: W
40048	RO		Circuit 4, Pb (high)	
40049	RO	S32	Circuit 4, Pc (low)	× 0.1, unit: W
40050	RO		Circuit 4, Pc (high)	
40051	RO	S32	Circuit 1, Ptot (low)	× 0.1, unit: W
40052	RO		Circuit 1, Ptot (high)	
40053	RO	S32	Circuit 2, Ptot (low)	× 0.1, unit: W
40054	RO		Circuit 2, Ptot (high)	

40055	RO	S32	Circuit 3, Ptot (low)	× 0.1, unit: W
40056	RO		Circuit 3, Ptot (high)	
40057	RO	S32	Circuit 4, Ptot (low)	× 0.1, unit: W
40058	RO		Circuit 4, Ptot (high)	
40059	RO	S32	Circuit 1, Qa (low)	× 0.1, unit: Var
40060	RO		Circuit 1, Qa (high)	
40061	RO	S32	Circuit 1, Qb (low)	× 0.1, unit: Var
40062	RO		Circuit 1, Qb (high)	
40063	RO	S32	Circuit 1, Qc (low)	× 0.1, unit: Var
40064	RO		Circuit 1, Qc (high)	
40065	RO	S32	Circuit 2, Qa (low)	× 0.1, unit: Var
40066	RO		Circuit 2, Qa (high)	
40067	RO	S32	Circuit 2, Qb (low)	× 0.1, unit: Var
40068	RO		Circuit 2, Qb (high)	
40069	RO	S32	Circuit 2, Qc (low)	× 0.1, unit: Var
40070	RO		Circuit 2, Qc (high)	
40071	RO	S32	Circuit 3, Qa (low)	× 0.1, unit: Var
40072	RO		Circuit 3, Qa (high)	
40073	RO	S32	Circuit 3, Qb (low)	× 0.1, unit: Var
40074	RO		Circuit 3, Qb (high)	
40075	RO	S32	Circuit 3, Qc (low)	× 0.1, unit: Var
40076	RO		Circuit 3, Qc (high)	
40077	RO	S32	Circuit 4, Qa (low)	× 0.1, unit: Var
40078	RO		Circuit 4, Qa (high)	
40079	RO	S32	Circuit 4, Qb (low)	× 0.1, unit: Var
40080	RO		Circuit 4, Qb (high)	
40081	RO	S32	Circuit 4, Qc (low)	× 0.1, unit: Var
40082	RO		Circuit 4, Qc (high)	
40083	RO	S32	Circuit 1, Qtot (low)	× 0.1, unit: Var
40084	RO		Circuit 1, Qtot (high)	
40085	RO	S32	Circuit 2, Qtot (low)	× 0.1, unit: Var
40086	RO		Circuit 2, Qtot (high)	
40087	RO	S32	Circuit 3, Qtot (low)	× 0.1, unit: Var
40088	RO		Circuit 3, Qtot (high)	
40089	RO	S32	Circuit 4, Qtot (low)	× 0.1, unit: Var
40090	RO		Circuit 4, Qtot (high)	
40091	RO	U16	Circuit 1, PFa	× 0.001
40092	RO	U16	Circuit 1, PFb	× 0.001
40093	RO	U16	Circuit 1, PFc	× 0.001
40094	RO	U16	Circuit 2, PFa	× 0.001
40095	RO	U16	Circuit 2, PFb	× 0.001
40096	RO	U16	Circuit 2, PFc	× 0.001
40097	RO	U16	Circuit 3, PFa	× 0.001
40098	RO	U16	Circuit 3, PFb	× 0.001

40099	RO	U16	Circuit 3, PFc	× 0.001
40100	RO	U16	Circuit 4, PFa	× 0.001
40101	RO	U16	Circuit 4, PFb	× 0.001
40102	RO	U16	Circuit 4, PFc	× 0.001
40103	RO	U16	Circuit 1, PF tot	× 0.001
40104	RO	U16	Circuit 2, PF tot	× 0.001
40105	RO	U16	Circuit 3, PF tot	× 0.001
40106	RO	U16	Circuit 4, PF tot	× 0.001
40107	RO	U32	Circuit 1, Sa (low)	× 0.1, unit: VA
40108	RO		Circuit 1, Sa (high)	
40109	RO	U32	Circuit 1, Sb (low)	× 0.1, unit: VA
40110	RO		Circuit 1, Sb (high)	
40111	RO	U32	Circuit 1, Sc (low)	× 0.1, unit: VA
40112	RO		Circuit 1, Sc (high)	
40113	RO	U32	Circuit 2, Sa (low)	× 0.1, unit: VA
40114	RO		Circuit 2, Sa (high)	
40115	RO	U32	Circuit 2, Sb (low)	× 0.1, unit: VA
40116	RO		Circuit 2, Sb (high)	
40117	RO	U32	Circuit 2, Sc (low)	× 0.1, unit: VA
40118	RO		Circuit 2, Sc (high)	
40119	RO	U32	Circuit 3, Sa (low)	× 0.1, unit: VA
40120	RO		Circuit 3, Sa (high)	
40121	RO	U32	Circuit 3, Sb (low)	× 0.1, unit: VA
40122	RO		Circuit 3, Sb (high)	
40123	RO	U32	Circuit 3, Sc (low)	× 0.1, unit: VA
40124	RO		Circuit 3, Sc (high)	
40125	RO	U32	Circuit 4, Sa (low)	× 0.1, unit: VA
40126	RO		Circuit 4, Sa (high)	
40127	RO	U32	Circuit 4, Sb (low)	× 0.1, unit: VA
40128	RO		Circuit 4, Sb (high)	
40129	RO	U32	Circuit 4, Sc (low)	× 0.1, unit: VA
40130	RO		Circuit 4, Sc (high)	
40131	RO	U32	Circuit 1, Stot (low)	× 0.1, unit: VA
40132	RO		Circuit 1, Stot (high)	
40133	RO	U32	Circuit 2, Stot (low)	× 0.1, unit: VA
40134	RO		Circuit 2, Stot (high)	
40135	RO	U32	Circuit 3, Stot (low)	× 0.1, unit: VA
40136	RO		Circuit 3, Stot (high)	
40137	RO	U32	Circuit 4, Stot (low)	× 0.1, unit: VA
40138	RO		Circuit 4, Stot (high)	
40139	RO		Reserved	
40140	RO		Reserved	
40141	RO		Reserved	
40142	RO		Reserved	

40143	RO		Reserved	
40144	RO		Reserved	
40145	RO		Reserved	
40146	RO		Reserved	
40147	RO		Reserved	
40148	RO		Reserved	
40149	RO		Reserved	
40150	RO	U16	Voltage alarm information	BIT0: Va lower limit alarm BIT1: Va upper limit alarm BIT2: Vb lower limit alarm BIT3: Vb upper limit alarm; BIT4: Vc lower limit alarm BIT5: Vc upper limit alarm
40151	RO	U16	Current alarm information	BIT0: Circuit 1, Ia upper limit alarm BIT1: Circuit 1, Ib upper limit alarm BIT2: Circuit 1, Ic upper limit alarm; BIT3: Circuit 2, Ia upper limit alarm BIT4: Circuit 2, Ib upper limit alarm; BIT5: Circuit 2, Ic upper limit alarm; BIT6: Circuit 3, Ia upper limit alarm; BIT7: Circuit 3, Ib upper limit alarm; BIT8: Circuit 3, Ic upper limit alarm; BIT9: Circuit 4, Ia upper limit alarm BIT10:Circuit 4, Ib upper limit alarm; BIT11: Circuit 4, Ic upper limit alarm;
40152	RO	U16	Power-on storage self- test information	0: means storage check normal, Non-zero means storage check abnormal
40153	RO	U16	Keys test information	
40154	RO		Reserved	
40155	RO		Reserved	
40156	RO		Reserved	
40157	RO		Reserved	
40158	RO		Reserved	
40159	RO		Reserved	
40160	RO		Reserved	

5.2 Energy data register list

Register address	Access	Type	Description	Remarks
40201	RO	U32	Circuit 1, phase A kWh (low)	× 0.1, unit: kWh
40202	RO		Circuit 1, phase A kWh (high)	
40203	RO	U32	Circuit 1, phase B kWh (low)	× 0.1, unit: kWh
40204	RO		Circuit 1, phase B kWh (high)	
40205	RO	U32	Circuit 1, phase C kWh (low)	× 0.1, unit: kWh
40206	RO		Circuit 1, phase C kWh (high)	
40207	RO	U32	Circuit 2, phase A kWh (low)	× 0.1, unit: kWh
40208	RO		Circuit 2, phase A kWh (high)	
40209	RO	U32	Circuit 2, phase B kWh (low)	× 0.1, unit: kWh
40210	RO		Circuit 2, phase B kWh (high)	
40211	RO	U32	Circuit 2, phase C kWh (low)	× 0.1, unit: kWh
40212	RO		Circuit 2, phase C kWh (high)	
40213	RO	U32	Circuit 3, phase A kWh (low)	× 0.1, unit: kWh
40214	RO		Circuit 3, phase A kWh (high)	
40215	RO	U32	Circuit 3, phase B kWh (low)	× 0.1, unit: kWh
40216	RO		Circuit 3, phase B kWh (high)	
40217	RO	U32	Circuit 3, phase C kWh (low)	× 0.1, unit: kWh
40218	RO		Circuit 3, phase C kWh (high)	
40219	RO	U32	Circuit 4, phase A kWh (low)	× 0.1, unit: kWh
40220	RO		Circuit 4, phase A kWh (high)	
40221	RO	U32	Circuit 4, phase B kWh (low)	× 0.1, unit: kWh
40222	RO		Circuit 4, phase B kWh (high)	
40223	RO	U32	Circuit 4, phase C kWh (low)	× 0.1, unit: kWh
40224	RO		Circuit 4, phase C kWh (high)	
40225	RO	U32	Circuit 1, total kWh (low)	× 0.1, unit: kWh
40226	RO		Circuit 1, total kWh (high)	
40227	RO	U32	Circuit 2, total kWh (low)	× 0.1, unit: kWh
40228	RO		Circuit 2, total kWh (high)	
40229	RO	U32	Circuit 3, total kWh (low)	× 0.1, unit: kWh
40230	RO		Circuit 3, total kWh (high)	
40231	RO	U32	Circuit 4, total kWh (low)	× 0.1, unit: kWh
40232	RO		Circuit 4, total kWh (high)	
40233	RO		Reserved	
40234	RO		Reserved	
40235	RO		Reserved	
40236	RO		Reserved	
40237	RO		Reserved	

40238	RO		Reserved	
40239	RO		Reserved	
40240	RO		Reserved	
40241	RO		Reserved	
40242	RO		Reserved	
40243	RO		Reserved	
40244	RO		Reserved	
40245	RO		Reserved	
40246	RO		Reserved	
40247	RO		Reserved	
40248	RO		Reserved	
40249	RO		Reserved	
40250	RO		Reserved	
40251	RO		Reserved	
40252	RO		Reserved	
40253	RO		Reserved	
40254	RO		Reserved	
40255	RO		Reserved	
40256	RO		Reserved	
40257	RO		Reserved	
40258	RO		Reserved	
40259	RO		Reserved	
40260	RO		Reserved	
40261	RO		Reserved	
40262	RO		Reserved	
40263	RO		Reserved	
40264	RO		Reserved	
40265	RO	U32	Circuit 1, phase A kvarh (low)	× 0.1, unit: kvarh
40266	RO		Circuit 1, phase A kvarh (high)	
40267	RO	U32	Circuit 1, phase B kvarh (low)	× 0.1, unit: kvarh
40268	RO		Circuit 1, phase B kvarh (high)	
40269	RO	U32	Circuit 1, phase C kvarh (low)	× 0.1, unit: kvarh
40270	RO		Circuit 1, phase C kvarh (high)	
40271	RO	U32	Circuit 2, phase A kvarh (low)	× 0.1, unit: kvarh
40272	RO		Circuit 2, phase A kvarh (high)	
40273	RO	U32	Circuit 2, phase B kvarh (low)	× 0.1, unit: kvarh
40274	RO		Circuit 2, phase B kvarh (high)	
40275	RO	U32	Circuit 2, phase C kvarh (low)	× 0.1, unit: kvarh
40276	RO		Circuit 2, phase C kvarh (high)	
40277	RO	U32	Circuit 3, phase A kvarh (low)	× 0.1, unit: kvarh

40278	RO		Circuit 3, phase A kvarh (high)	
40279	RO	U32	Circuit 3, phase B kvarh (low)	× 0.1, unit: kvarh
40280	RO		Circuit 3, phase B kvarh (high)	
40281	RO	U32	Circuit 3, phase C kvarh (low)	× 0.1, unit: kvarh
40282	RO		Circuit 3, phase C kvarh (high)	
40283	RO	U32	Circuit 4, phase A kvarh (low)	× 0.1, unit: kvarh
40284	RO		Circuit 4, phase A kvarh (high)	
40285	RO	U32	Circuit 4, phase B kvarh (low)	× 0.1, unit: kvarh
40286	RO		Circuit 4, phase B kvarh (high)	
40287	RO	U32	Circuit 4, phase C kvarh (low)	× 0.1, unit: kvarh
40288	RO		Circuit 4, phase C kvarh (high)	
40289	RO	U32	Circuit 1, total kvarh (low)	× 0.1, unit: kvarh
40290	RO		Circuit 1, total kvarh (high)	
40291	RO	U32	Circuit 2, total kvarh (low)	× 0.1, unit: kvarh
40292	RO		Circuit 2, total kvarh (high)	
40293	RO	U32	Circuit 3, total kvarh (low)	× 0.1, unit: kvarh
40294	RO		Circuit 3, total kvarh (high)	
40295	RO	U32	Circuit 4, total kvarh (low)	× 0.1, unit: kvarh
40296	RO		Circuit 4, total kvarh (high)	
40297	RO		Reserved	
40298	RO		Reserved	
40299	RO		Reserved	
40300	RO		Reserved	
40301	RO		Reserved	
40302	RO		Reserved	
40303	RO		Reserved	
40304	RO		Reserved	
40305	RO		Reserved	
40306	RO		Reserved	
40307	RO		Reserved	
40308	RO		Reserved	
40309	RO		Reserved	
40310	RO		Reserved	
40311	RO		Reserved	
40312	RO		Reserved	
40313	RO		Reserved	
40314	RO		Reserved	
40315	RO		Reserved	
40316	RO		Reserved	
40317	RO		Reserved	

40318	RO		Reserved	
40319	RO		Reserved	
40320	RO		Reserved	
40321	RO		Reserved	
40322	RO		Reserved	
40323	RO		Reserved	
40324	RO		Reserved	
40325	RO		Reserved	
40326	RO		Reserved	
40327	RO		Reserved	
40328	RO		Reserved	

5.3 List of configuration registers

Register address	**Access**	**Type**	**Description**	**Remark**
45004	RW	U16	Communication address	1-247
45005	RW	U16	Baudrate	0: 4800bps 1: 9600bps Default set to 1
45006			Reserved	
45007	RW	U16	Pulse output object	0~31 0: Circuit 1, phase A kWh 1: Circuit 1, phase B kWh 2: Circuit 1, phase C kWh 3: Circuit 1, total kWh …… 12: Circuit 4, phase A kWh 13: Circuit 4, phase B kWh 14: Circuit 4, phase C kWh 15: Circuit 4, total kWh 16: Circuit 1, phase A kvarh 17: Circuit 1, phase B kvarh 18: Circuit 1, phase C kvarh 19: Circuit 1, total kvarh …… 28: Circuit 4, phase A kvarh 29: Circuit 4, phase B kvarh 30: Circuit 4, phase C kvarh 31: Circuit 4, total kvarh
45008	RW	U16	Pulse constant	100-1000, default set to 1000
45009			Reserved	

45010	RW	U16	Pulse width	60-100, unit: ms Default set to 60
45011			Reserved	
45012	RO	U16	Alarm action time	5, unit: s (fixed, can not set)
45013			Reserved	
45014	RW	U16	Channel num.	4 (fixed, can not set)
45015			Reserved	
45016	RW	U16	COM light config	0: Communication status indicator 1: Pulse output indicator
45017			Reserved	
45018			Reserved	
45019			Reserved	
45020			Reserved	
45021	RW	U16	CT primary	50-600,unit: A Default set to 100A
45022	RW	U16	Phase adjust for Circuit 1, Ia	0: Va (forward +) 1: Vb (forward +) 2: Vc (forward +") 3: Va (reverse -) 4: Vb (reverse -)
45023	RW	U16	Phase adjust for Circuit 1, Ib	0: Va (forward +) 1: Vb (forward +) 2: Vc (forward +") 3: Va (reverse -) 4: Vb (reverse -) 5: Vc (reverse -)
45024	RW	U16	Phase adjust for Circuit 1, Ic	Description same as Register 45022
45025	RW	U16	Phase adjust for Circuit 2, Ia	Description same as Register 45022
45026	RW	U16	Phase adjust for Circuit 2, Ib	Description same as Register 45022
45027	RW	U16	Phase adjust for Circuit 2, Ic	Description same as Register 45022
45028	RW	U16	Phase adjust for Circuit 3, Ia	Description same as Register 45022
45029	RW	U16	Phase adjust for Circuit 3, Ib	Description same as Register 45022

45030	RW	U16	Phase adjust for Circuit 3, Ic	Description same as Register 45022
45031	RW	U16	Phase adjust for Circuit 4, Ia	Description same as Register 45022
45032	RW	U16	Phase adjust for Circuit 4, Ib	Description same as Register 45022
45033	RW	U16	Phase adjust for Circuit 4, Ic	Description same as Register 45022
45034			Reserved	
45035	RW	U16	Password on LCD	0~ 9999, default set to 1;
45036			Reserved	

5.4 Reset

Register address	Access	Type	Description	Remark
45201	WO	U16	Clear energy data	Write: 201
45210	WO		Reset system to default	Write: 201

5.5 Register List of Alarm Setting

Register address	Access	Type	Description	Remark
45501	RW	U16	Voltage upper limit	0-2800, (× 0.1), unit: V Default set to 0, means unable alarm
45502	RW	U16	Voltage lower limit	0-2200, (× 0.1), unit: V Default set to 0, means unable alarm
45503	RW	U16	Reserved	
45504	RW	U16	Circuit 1, Ia_upper limit	0-8000, (× 0.1), unit: A Default set to 0, means unable alarm
45505	RW	U16	Circuit 1, Ib_upper limit	
45506	RW	U16	Circuit 1, Ic_upper limit	
45507	RW	U16	Circuit 2, Ia_upper limit	
45508	RW	U16	Circuit 2, Ib_upper limit	
45509	RW	U16	Circuit 2, Ic_upper limit	
45510	RW	U16	Circuit 3, Ia_upper limit	
45511	RW	U16	Circuit 3, Ib_upper limit	
45512	RW	U16	Circuit 3, Ic_upper limit	
45513	RW	U16	Circuit 4, Ia_upper limit	
45514	RW	U16	Circuit 4, Ib_upper limit	
45515	RW	U16	Circuit 4, Ic_upper limit	
45516	RW	U16	Reserved	
45517	RW	U16	Reserved	

45518	RW	U16	Reserved	
45519	RW	U16	Reserved	
45520	RW	U16	Reserved	
45521	RW	U16	Reserved	

5.6 Device Information Register

Register address	Access	Type	Description	Remark
49001	RW	U16	Reserved	
49002	RW		Reserved	
49003	RW	U16	Reserved	
49004	RW		Reserved	
49005	RW	U16	Hardware version No.	
49006	RW	U16	Software version No.	
49007	RW		Reserved	
49008	RW	U16	Reserved	
49009	RW		Reserved	