Chapter 5 Function and Software

Introducing Modbus Protocol

Format of the communication

Data Address Table and Application Details of Acuvim II

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This chapter will mainly discuss how to handle the meter via the communication port using software. To master this chapter, you should be familiar with Modbus and have read other chapters of this manual, and you have generously mastered the function and application of this product.

This chapter includes: Modbus protocol, format of communication and data address table and Acuvim II application details.

5.1 Introducing Modbus Protocol

The Modbus RTU protocol is used for communication in Acuvim II. The data format and error check methods are defined in Modbus protocol. The half duplex query and respond mode is adopted in Modbus protocol. There is only one master device in the communication net. The others are slave devices, waiting for the query of the master.

Transmission mode

The mode of transmission defines the data structure within a frame and the rules used to transmit data. The mode is defined in the following which is compatible with Modbus RTU Mode*.

Coding System	8-bit binary
Start bit	1
Data bits	8
Parity	no parity
Stop bit	1
Error checking	CRC check

Framing

Address	Function	Data	Check
8-Bits	8-Bits	N×8-Bits	16-Bits

Table5.1 Data Frame Format

Address Field

The address field of a message frame contains eight bits. Valid slave device addresses are in the range of 0~247 decimal. A master addresses a slave by placing the slave address in the address field of the message. When the slave sends its response, it places its own address in this address field of the response to let the master know which slave is responding.

Function Field

The function code field of a message frame contains eight bits. Valid codes are in the range of 1~255 decimal. When a message is sent from a master to a slave device the function code field tells the slave what kind of action to perform.

Code	Meaning	Action
01	Read Relay Output Status	Obtain current status of Relay Output
02	Read Digital Input(DI) Status	Obtain current status of Digital Input
03	Read Data	Obtain current binary value in one or more registers
05	Control Relay Output	Force Relay to a state of on or off
16	Press Multiple-Register	Place specific binary values into a series of consecutive Multiple-Registers

Table5.2 Function Code

Data Field

The data field is constructed using sets of two hexadecimal digits, in the range of 00 to FF hexadecimal. The data field of messages sent from a master to slave devices contains additional information which the slave must use to take the action defined by the function code. This can include items like discrete and register addresses, the quantity of

items to be handled, and the count of actual data bytes in the field. For example, if the master requests a slave to read a group of holding registers (function code 03), the data field specifies the starting register and how many registers are to be read. If the master writes to a group of registers in the slave (function code 10 hexadecimal), the data field specifies the starting register, how many registers to write, the count of data bytes to follow in the data field, and the data to be written into the registers.

If no error occurs, the data field of a response from a slave to a master contains the data requested. If an error occurs, the field contains an exception code that the master application can use to determine the next action to be taken. The data field can be nonexistent (of zero length) in certain kinds of messages.

Error Check Field

Messages include an error's checking field that is based on a Cyclical Redundancy Check (CRC) method. The CRC field checks the contents of the entire message. It is applied regardless of any parity check method used for the individual characters of the message. The CRC field is two bytes, containing a 16 bit binary value. The CRC value is calculated by the transmitting device, which appends the CRC to the message.

The receiving device recalculates a CRC during receipt of the message, and compares the calculated value to the actual value it received in the CRC field. If the two values are not equal, an error will result. The CRC is started by 66 first preloading a 16-bit register to all 1's. Then a process begins of applying successive 8-bit bytes of the message to the current contents of the register. Only the eight bits of data in each character are used for generating the CRC. Start and stop bits, and the parity bit, do

not apply to the CRC. During generation of the CRC, each 8-bit character is exclusive ORed with the register contents. Then the result is shifted in the direction of the least significant bit (LSB), with a zero filled into the most significant bit (MSB) position. The LSB is extracted and examined. If the LSB was a1, the register is then exclusive ORed with a preset, fixed value. If the LSB was a 0, no exclusive OR takes place. This process is repeated until eight shifts have been performed. After the last (eighth) shift, the next 8-bit byte is exclusive ORed with the register current value, and the process repeats for eight more shifts as described above. The final contents of the register, after all the bytes of the message have been applied, is the CRC value. When the CRC is appended to the message, the low-order byte is appended first, followed by the high-order byte.

5.2 Format of Communication

Explanation of frame

Addr	Fun	Data start reg hi	Data start reg lo	Data #of regs hi	Data #of regs lo	CRC 16 Hi	CRC 16 Lo
06H	03H	00H	00H	00H	21H	84H	65H

Table 5.3 Explanation of frame

In table5.3, the meaning of each abbreviated word is,

Addr: address of slave device
Fun: function code
Data start reg hi: start register address high byte
Data start reg lo: start register address low byte
Data #of reg hi: number of register high byte
Data #of reg lo: number of register low byte
CRC16 Hi: CRC high byte
CRC16 Lo: CRC low byte

1. Read Status of Relay

Function Code 01

This function code is used to read status of relay in Acuvim II.
1=On 0=Off
Relay1's address is 0x0000, Relay2's address is 0x0001, and so on.
The following query is to read relay status of Acuvim II with the address of 17.

Query

Addr	Fun	Relay start reg hi	Relay start reg lo	Relay #of regs hi	Relay #of regs lo	CRC 16 Hi	CRC 16 Lo
11H	01H	00H	00H	00H	02H	BFH	5BH

Table 5.4 Read the status of Relay1 and Relay2 Query Message

Response

The Acuvim II response includes the Acuvim II address, function code, quantity of data byte, the data, and error checking. An example response to read the status of Relay1 and Relay2 is shown as Table5.5. The status of Relay1 and Relay2 are responding to the last 2 bits of the data.

Relay1: bit0 Relay2: bit1

Address	Function code	Byte count	Data	CRC high	CRC low
11H	01H	01H	02H	D4H	89H

Table 5.5 Relay status responds

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	0

MSB LSB

Relay1 = OFF (LSB), Relay2=ON (Left to LSB)

2. Read the Status of DI

Function Code 02

1=On 0=Off

DI1's address is 0x0000, DI2's address is 0x0001, and so on.

The following query is to read the Status of 4 DIs of Acuvim II with the address of 17.

Query

Addr	Fun	DI start addr hi	DI start addr lo	DI num hi	DI num lo	CRC 16 Hi	CRC 16 Lo
11H	02H	00H	00H	00H	04H	7BH	59H

Table 5.6 Read 4 DIs Query Message

Response

The Acuvim II response includes the Acuvim II address, function code, quantity of data characters, the data characters, and error checking. An example response to read the status of 4 DIs are shown as Table 5.7. The status of 4 DIs are responding to the last 4 bits of the data.

DI1: bit0; DI2: bit1; DI3: bit2; DI4: bit3.

Address	Function code	Byte count	Data	CRC high	CRC low
11H	02H	01H	03H	E5H	49H

Table 5.7 Read Status of DI

The content of the data is:

7	6	5	4	3	2	1	0
0	0	0	0	0	0	1	1

MSB LSB

DI1=On, DI2=On, DI3=Off, DI4=Off.

3. Read Data (Function Code 03)

Query

This function allows the master to obtain the measurement results of Acuvim II. Table5.8 is an example to read the 3 measured data (F, V1 and V2) from slave device number 17, the data address of F is 4000H, 4001H; V1's address is 4002H, 4003, and V2's address is 4004H, 4005H.

Addr	Fun	Data start addr hi	Data start addr lo	Data #of regs hi	Data #of regs lo	CRC 16 regs Hi	CRC 16 regs Lo
11H	03H	40H	00H	00H	06H	D2H	98H

Table 5.8 Read F, V1, V2 Query Message

Response

The Acuvim II response includes the Acuvim II address, function code, quantity of data byte, data, and error checking. An example response to read F, V1 and V2 (F=42480000H (50.00Hz), V1=42C7CCCDH (99.9V), V2=42C83333H (100.1V)) is shown:

Addr	Fun	Byte count	Data1 hi	Data1 Lo	Data 2 hi	Data2 lo	Data3 hi	Data3 lo	Data4 hi	Data4 lo
11H	3H	0CH	42H	48H	00H	00H	42H	C7H	CCH	CDH

Data5 hi	Data5 Lo	Data 6 hi	Data6 lo	CRC16 hi	CRC16 lo
42H	C8H	33H	33H	CAH	7FH

Table 5.9 Read F, V1 and V2 Message

4. Control Relay (Function Code 05)

Query

This message forces a single relay either on or off. Any relay that exists within the Acuvim II can be forced to be either status (on or off). The

data value FF00H will set the relay on and the value 0000H will turn it off; all other values are illegal and will not affect that relay.

The example below is a request to the Acuvim II with the address of 17 to turn on Relay1.

Addr	Fun	DO addr hi	DO addr lo	Value hi	Value lo	CRC 16 Hi	CRC 16 Lo
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table5.10 Control Relay Query Message

Response

The normal response to the command request is to retransmit the message as received after the relay status has been altered.

Addr	Fun	Relay addr hi	Relay addr lo	Value hi	Value lo	CRC Hi	CRC Lo
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table5.11 Control Relay Response Message

5. Preset / Reset Multi-Register (Function Code 16)

Query

Function 16 allows the user to modify the contents of a Multi-Register. Some Registers of Acuvim II can have their contents changed by this message. The example below is a request to an Acuvim II with the address of 17 to preset Ep_imp as "17807783.3KWh", while its HEX value is 0A9D4089H. Ep_imp data address is 0x4048 and 0x4049.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of reg hi	Data #of reg lo	Byte Count
11H	10H	40H	48H	00H	02H	04H

Value hi	Value Lo	Value hi	Value lo	CRC hi	CRC lo
0AH	9DH	40H	89H	F1H	6AH

Table5.12 Preset Multi-Register Query Message

Response

The normal response to a preset Multi-Register request includes the Acuvim II address, function code, data start register, the number of registers, and error checking.

Addr	Fun	Data start reg hi	Data start reg lo	Data #of reg hi	Data #of Reg lo	CRC16 hi	CRC16 lo
11H	10H	40H	48H	00H	02H	D6H	8EH

Table5.13 Preset Multi-Register Response Message

5.3 Data Address Table and Application Details of Acuvim II

There are several rules to follow in using the meter:

1. Data type:

"bit" refers to binary.

"word" refers to 16-bit unsigned integer using one data address and 2 bytes of memory, it varies from 0 to 65535.

"int" refers to 16-bit integer using one data address and 2 bytes of memory, it varies from -32768 to32767.

"dword" refers to 32-bit unsigned integer using two data addresses and 4 bytes of memory with high word at the front and low word at the end, it varies from 0 to 4294967295. Rx=high word *65536+low word.

"float" refers to 32-bit single value using two data addresses and 4 bytes of memory, it varies from -1.175494E-38 to 3.402823E+38.

2. Relationship between communication value and numerical value.

The numerical value may not the communication value, it is important to notice this. The following table shows how they respond to each other.

Parameters	Relationship	Unit	Format code
System parameters	Numerical value equals to communication value	No unit	F1
Run time	T=Rx/100	Hour	F2
Clock	Numerical value equals to communication value	Unit of time	F3
Energy(primary)	Ep=Rx/10	kWh	F4
Reactive energy(primary)	Eq=Rx/10	kvarh	F5
Apparent energy(primary)	Es=Rx/10	KVA	F6
Energy(secondary)	Ep=Rx/1000	KWh	F7
Reactive energy (secondary)	Eq=Rx/1000	Kvarh	F8
Apparent energy (secondary)	Es=Rx/1000	KVA	F9
frequency	F=Rx/100	Hz	F10
Voltage	U=Rx X(PT1/PT2)/10	V	F11
Current	I=Rx X(CT1/CT2)/1000	A	F12
Power, demand	P=Rx X(PT1/PT2)X(CT1/CT2)	W	F13
Reactive power, demand	Q=Rx X(PT1/PT2)X(CT1/CT2)	var	F14
Apparent power, demand	S=Rx X(PT1/PT2)X(CT1/CT2)	VA	F15
Power factor	PF=Rx/1000	No unit	F16
Unbalance factor	Unbl=(Rx/1000)X100%	No unit	F17
THD	THD=(Rx/10000) X 100%	No unit	F18
Harmonics	HDn=(Rx/10000) X 100%	No unit	F19
Total odd HD	HDo=(Rx/10000) X 100%	No unit	F20
Total even HD	HDe=(Rx/10000) X 100%	No unit	F21
Crest factor	CF=Rx/1000	No unit	F22
K factor	KF=Rx/10	No unit	F23

THFF	THFF=(Rx/10000) X 100%	No unit	F24
Phase angle	Phase angle=Rx/10	Degree	F25
temperature	Temperature= Rx/10	˚C	F26

Important Note: Regions from “System parameters settings” to “AO transforming parameter settings” are the regions that can be set and modified. Please follow the rules when you communicate with Acuvim II.

1. Using function code 10H, one communication order can only modify contents in one region, such as “System parameters settings”, ”System status parameter”, “Date and Time table”, “Over-range alarming-Global settings”, “Over-range alarming-Single settings”, “I/O Modules settings”. It can not be accomplished in one communication order to modify contents in both of two or more regions above.

2. Using function code 03H, there is no such rules described above.

System parameter setting

System parameters determine how the meter works. User should understand them clearly by referring to chapter 3 and chapter 4.

Function code: 03H for reading, 10H for presetting. Data type: word. Format code: F1.

Address	Parameter	Default	Range	
1000H	Pass Word	0	0~9999	R/W
1001H	Communication Address	1	1~247	R/W
1002H	Baud Rate	19200	600~38400	R/W
1003H	Voltage Input Wiring Type	0	0:3LN,1:2LN,2:2LL,3:3LL	R/W
1004H	Current Input Wiring Type	0	0:3CT,1:1CT,2:2CT	R/W
1005H	PT1 (High 16 bit)	0	50.0~500000.0	R/W
1006H	PT1 (Low 16 bit)	220.0		R/W

1007H	PT2	220.0	50.0~400.0	R/W
1008H	CT1	5	1~50000	R/W
1009H	CT2	5	1,5	R/W
100aH	kWh pulse constant	1	1~6000	R/W
100bH	kvarh pulse constant	1	1~6000	R/W
100cH	LCD Back light Time	1	0-120	R/W
100dH	Demand Slid Window Time	15	1~30	R/W
100eH	Demand calculating mode	1	1:sliding window 2:thermal	R/W
100fH	Clear demand memory	0	Only 1 works	R/W
1010H	Max/Min clear	0x55	Only 0x0A works	R/W
1011H	Run time clear	0	Only 1 works	R/W
1012H	Current I1 direction	0	0: Positive 1: Negative	R/W
1013H	Current I2 direction	0	0: Positive 1: Negative	R/W
1014H	Current I3 direction	0	0: Positive 1: Negative	R/W
1015H	VAR/PF convention	0	0:IEC,1:IEEE	R/W
1016H	Energy clear	0	Only 1 works	R/W
1017H	Energy calculating mode	1	0:fundamental 1:full-wave	R/W
1018H	Reactive power measuring mode	0	0:real,1:general	R/W
1019H	Energy display mode	0	0:primary，1:secondary	R/W
101aH	Ethernet Module reset	0	0:none, 1:reset, 2:load default and reset	R/W
101bH	SOE enable	0	0:none; 1:AXM-IO11; 2:AXM-IO21; 3:AXM-IO31; 4:AXM-IO12; 5:AXM-IO22; 6:AXM-IO32;	R/W

101cH	Pulse counter clear	0	0:none； 1:AXM-IO11; 2:AXM-IO21; 3:AXM-IO31; 4:AXM-IO12; 5:AXM-IO22; 6:AXM-IO32;	R/W
101dH	Basic parameter mode	0	0:secondary; 1:primary	R/W

System status parameter

"System status" indicates what events happened in the meter, what kinds of flags are read by user and to be the index of the storage of the events. Flags should be cleared after being read by the controller, otherwise new data will not be stored properly.

Function code: 03H for reading, 10H for writing. Data type: word.

Address	Parameter	Format code	Range	Property
101eH~102dH	Recording pointer bj_st0-15		1： new data	R/W
102eH	System status		Bit0:new alarming or not Bit1 new SOE or not	R
102fH~ 1031H	Reserved			
1032H	Alarming group number	F1	0~15	R
1033H	SOE group number	F1	0~19	R
1034H	Run time (high)	F2	0~999999999	R
1035H	Run time (low)			R
1036H	Expanded IO Modules connecting status		Bit0: AXM-IO11; Bit1:AXM-IO12; Bit2:AXM-IO21; Bit3: AXM-IO22; Bit4:AXM-IO31; Bit5:AXM-IO32; 0:disconnected 1:connected	R
1037H	Temperature	F26		R
1038H~103fH	Reserved			

Please refer to chapter 3 and chapter 4 for more details about parameter settings.

Date and Time table

Function code: 03H for reading, 10H for presetting.

Address	Parameter	Format code	Range	Property
1040H	Year	F3	2000-2099	R/W
1041H	Month	F3	1-12	R/W
1042H	Day	F3	1-31	R/W
1043H	Hour	F3	0-23	R/W
1044H	minute	F3	0-59	R/W
1045H	second	F3	0-59	R/W

Over-range alarming setting

This setting consists of global settings and single settings. The global settings contain settings of all global variables. There are 16 groups of records with the same format. Function code: 03H for reading, 10H for writing. Please refer to chapter 4 for more details.

Global settings

Address	Parameter		Range	Property
1046H	Global alarming enable		0:disable;1:enable	R/W
1047H	Alarming flash enable		0:disable;1:enable	R/W
1048H	Alarming channel enable setting		0~65535 Bit0:channel 1 1:enable; 0:disable Bit1: channel 2 ..... Bit15: channel 16	R/W

1049H	Logical “And ” between alarming setting		0~255 Bit0: first logic switch 1:enable;0:disable Bit1: second logic switch …… Bit7: eighth logic switch	R/W
104aH	Alarming output to DO1 setting		0~65535 Bit0: channel 1 output 1:enable;0:disable Bit1: channel 2 output …… Bit15: channel 16 output	R/W
104bH	Alarming output to DO2 setting		0~65535 The same as previous	R/W
104cH	Alarming output to DO3 setting		0~65535 The same as previous	R/W
104dH	Alarming output to DO4 setting		0~65535 The same as previous	R/W

Single settings

Address	Parameter	Format code	Range	Property
104eH	First group: parameter code	F1	0~44	R/W
104fH	First group: comparison mode	F1	1：more，2：equal,3:less	R/W
1050H	First group: setting value	F10~F18	Related with parameters	R/W
1051H	First group: delay	F1	0~3000(*10ms)	R/W
1052H	First group: output to relay	F1	0：none，1-8：related relay	R/W
1053H~109dH	2nd to 16th group		Same as the first group	R/W

Alarming parameter code table

Setting value	Alarming object		Alarming object		Alarming object
0	frequency	1	Va	2	Vb
3	Vc	4	Average phase voltage	5	Uab
6	Ubc	7	Uca	8	Average line voltage
9	Line current of phase A	10	Line current of phase B	11	Line current of phase C
12	Average line current	13	Neutral current	14	Power of phase A
15	Power of phase B	16	Power of phase C	17	Power of all
18	Reactive power of phase A	19	Reactive power of phase B	20	Reactive power of phase C
21	Reactive power of all	22	Apparent power of phase A	23	Apparent power of phase B
24	Apparent power of phase C	25	Apparent power of all	26	PF of A
27	PF of B	28	PF of C	29	PF
30	Voltage unbalance factor U_unbl	31	Current unbalance factor I_unbl	32	Load characteristic(R/L/C)
33	THD_V1(V1 or V12)	34	THD_V2(V2 or V31)	35	THD_V3(V3 or V23)
36	Average THD_V	37	THD_I1	38	THD_ I2
39	THD_ I3	40	Average THD_I	41	AI1 sampling value
42	AI2 sampling value	43	AI3 sampling value	44	AI4 sampling value

I/O Modules settings

These settings are for some extended I/O modules, if there is no any extended I/O modules, all the settings are of no use. Please check the I/O connecting status before you do any settings. Function code: 03H for reading, 10H for writing. Please refer to <<User's manual of extended I/O Modules>>for more details.

AXM-IO11

Address	Parameter	Default	Range	Property
109eH	DI1-6 type	0	Bit0-DI1, Bit1-DI2 Bit2-DI3, Bit3-DI4 Bit4-DI5, Bit5-DI6 0-DI,1-pulse counter	R/W
109fH	DI pulse constant	0	1~65535	R/W
10a0H	Working mode of relay 1 and 2	0	0-control output 1-alarming output	R/W
10a1H	Output mode of relay 1 and 2	0	0-latch, 1-momentary	R/W
10a2H	Pulse width	50	50-3000ms	R/W

AXM-IO21

Address	Parameter	Default	Range	Property
10a3H	DI7-10 type	0	Bit0-DI7, Bit1-DI8 Bit2-DI9, Bit3-DI10 0-DI,1-pulse counter	R/W
10a4H	DI pulse constant	0	1~65535	R/W
10a5H	Working mode of DO	0	0-pulse output 1-alarming output	R/W
10a6H	DO pulse width	20	20-1000ms	R/W
10a7H	DO1 output	0	0-none 1-consumption power 2-gererating power 3-absorption reactive power 4-generating reactive power	R/W

10a8H	DO2 output	0	Same as above	R/W
10a9H	AO1,2 type	0	0:0-20mA, 1:4-20mA,2:0-5V, 3:1-5V	R/W

AXM-IO31

Address	Parameter	Default	Range	Property
10aaH	DI11-14 type	0	Bit0-DI11,Bit1-DI12, Bit2-DI13, Bit3-DI14 0-DI,1-pulse counter	R/W
10abH	DI pulse constant	0	1-65535	R/W
10acH	Working mode of relay 3 and 4	0	0-control output 1-alarming output	R/W
10adH	Output mode of relay 3 and 4	0	0-latch, 1-momentary	R/W
10aeH	Pulse width	50	50-3000ms	R/W
10afH	AI1,2 type	0	0:0-20mA, 1:4-20mA, 2:0-5V, 3:1-5V	R/W

AXM-IO12

Address	Parameter	Default	Range	Property
10b0H	DI15-20 type	0	Bit0-DI15,Bit1-DI16, Bit2-DI17,Bit3-DI18, Bit4-DI19, Bit5-DI20 0-DI,1-pulse counter	R/W
10b1H	DI pulse constant (high)	0	1-65535	R/W
10b2H	Working mode of relay 5 and 6	0	0-control output 1-alarming output	R/W
10b3H	Output mode of relay 5 and 6	0	0-latch,1-momentary	R/W
10b4H	Pulse width	50	50-3000ms	R/W

AXM-IO22

Address	Parameter	Default	Range	Property
10b5H	DI21-24 type	0	Bit0-DI21,Bit1-DI22, Bit2-DI23, Bit3-DI24 0-DI,1-pulse counter	R/W
10b6H	DI pulse constant	0	1-65535	R/W
10b7H	Working mode of DO3,4	0	0-pulse output 1-alarming output	R/W
10b8H	DO Pulse width	20	20-1000ms	R/W
10b9H	DO3 output	0	0-none 1-consumption power 2-gererating power 3-absorption reactive power 4-generating reactive power	R/W
10baH	DO4 output	0	Same as above	R/W
10bbH	AO3,4 type	0	0:0-20mA, 1:4-20mA, 2:0-5V, 3:1-5V	R/W

AXM-IO32

Address	Parameter	Default	Range	Property
10bcH	DI25-28 type	0	Bit0-DI25, Bit1-DI26 Bit2-DI27, Bit3-DI28 0-DI, 1-pulse counter	R/W
10bdH	DI pulse constant	0	1-65535	R/W
10beH	Working mode of relay 7 and 8	0	0-control output 1-alarming output	R/W
10bfH	Output mode of relay 7 and 8	0	0-latch, 1-momentary	R/W
10c0H	Pulse width	50	50-3000	R/W
10c1H	AI3,4 type	0	0:0-20mA, 1:4-20mA, 2:0-5V, 3:1-5V	R/W

AO transforming select

Address	Parameter	Default	Range	
10c2H	AO1 transforming parameter		Refer to following table	R/W
10c3H	AO2 transforming parameter		Refer to following table	R/W
10c4H	AO3 transforming parameter		Refer to following table	R/W
10c5H	AO4 transforming parameter		Refer to following table	R/W

AO transforming parameter settings

Setting value	Ttransforming object	Setting value	Transforming object	Setting value	Transforming object
0	Frequency	1	Va	2	Vb
3	Vc	4	Average phase voltage	5	Uab
6	Ubc	7	Uca	8	Average line voltage
9	Line current of phase A	10	Line current of phase B	11	Line current of phase C
12	Average line current	13	Neutral current	14	Power of phase A
15	Power of phase B	16	Power of phase C	17	Power of all
18	Reactive power of phase A	19	Reactive power of phase B	20	Reactive power of phase C
21	Reactive power of all	22	Apparent power of phase A	23	Apparent power of phase B
24	Apparent power of phase C	25	Apparent power of all	26	PF of A
27	PF of B	28	PF of C	29	PF

Basic Analog measurements

There are two different modes to read basic analog measurements, one is secondary mode, and another is primary mode. In primary mode, the numerical value in register of Acuvim II is equal to the real physical

value. In secondary mode, the relationship between numerical value in register and the real physical value is as following table. (Rx is the numerical value in register of Acuvim II)

Function code: 03H for reading.

Address	Parameter	Code	Relationship	
4000H-4001H	Frequency	F1	F = Rx	R
4002H-4003H	Phase voltage V1	F1	U=Rx×(PT1/PT2)	R
4004H-4005H	Phase voltage V2	F1	U=Rx×(PT1/PT2)	R
4006H-4007H	Phase voltage V3	F1	U=Rx×(PT1/PT2)	R
4008H-4009H	Average voltage Vavg	F1	U=Rx×(PT1/PT2)	R
400aH-400bH	Line voltage V12	F1	U=Rx×(PT1/PT2)	R
400cH-400dH	Line voltage V23	F1	U=Rx×(PT1/PT2)	R
400eH-400fH	Line voltage V31	F1	U=Rx×(PT1/PT2)	R
4010H-4011H	Average line voltage Vlavg	F1	U=Rx×(PT1/PT2)	R
4012H-4013H	Phase(line)current I1	F1	I=Rx×(CT1/CT2)	R
4014H-4015H	Phase(line)current I2	F1	I=Rx×(CT1/CT2)	R
4016H-4017H	Phase(line)current I3	F1	I=Rx×(CT1/CT2)	R
4018H-4019H	Average current Iavg	F1	I=Rx×(CT1/CT2)	R
401aH-401bH	Neutral current In	F1	I=Rx×(CT1/CT2)	R
401cH-401dH	Phase A power Pa	F1	P=Rx×(PT1/PT2)×(CT1/CT2)	R
401eH-401fH	Phase B power Pb	F1	P=Rx×(PT1/PT2)×(CT1/CT2)	R
4020H-4021H	Phase C power Pc	F1	P=Rx×(PT1/PT2)×(CT1/CT2)	R
4022H-4023H	System power Psum	F1	P=Rx×(PT1/PT2)×(CT1/CT2)	R
4024H-4025H	Phase A reactive power Qa	F1	Q=Rx×(PT1/PT2)×(CT1/CT2)	R
4025H-4027H	Phase B reactive power Qb	F1	Q=Rx×(PT1/PT2)×(CT1/CT2)	R
4028H-4029H	Phase C reactive power Qc	F1	Q=Rx×(PT1/PT2)×(CT1/CT2)	R

402aH-402bH	System reactive power Qsum	F1	Q=Rx×(PT1/PT2)×(CT1/CT2)	R
402cH-402dH	Phase A Apparent power Sa	F1	S=Rx×(PT1/PT2)×(CT1/CT2)	R
402eH-402fH	Phase B Apparent power Sb	F1	S=Rx×(PT1/PT2)×(CT1/CT2)	R
4030H-4031H	Phase C Apparent power Sc	F1	S=Rx×(PT1/PT2)×(CT1/CT2)	R
4032H-4033H	System Apparent power Ssum	F1	S=Rx×(PT1/PT2)×(CT1/CT2)	R
4034H-4035H	Phase A power factor PFa	F1	PF = Rx	R
4036H-4037H	Phase B power factor PFb	F1	PF = Rx	R
4038H-4039H	Phase C power factor PFc	F1	PF = Rx	R
403aH-403bH	System power factor PFsum	F1	PF = Rx	R
403cH-403dH	Voltage unbalance factor U_unbl	F1	Unbalance = Rx × 100%	R
403eH-403fH	Current unbalance factor I_unbl	F1	Unbalance = Rx × 100%	R
4040H-4041H	Load characteristic(L/C/R)	F1	76.0/67.0/82.0(ASCII)	R
4042H-4043H	Power demand	F1	P=Rx×(PT1/PT2)×(CT1/CT2)	R
4044H-4045H	Reactive Power demand	F1	P=Rx×(PT1/PT2)×(CT1/CT2)	R
4046H-4047H	Apparent power demand	F1	P=Rx×(PT1/PT2)×(CT1/CT2)	R

Real time energy measurement

Data stored in this block can be preset or cleared.
Function code: 03H for reading, 10H for writing. Data type: dword.

It can be set as primary energy or secondary energy according to user. Please refer to F7, F8, and F9 for more details about the relationship between numerical value in register and the real physical value.

Address	Parameter	Code	Range	Property
4048H-4049H	Energy IMP	F4/F7	0-999999999	R/W
404aH-404bH	Energy EXP	F4/F7	0-999999999	R/W
404cH-404dH	Reactive energy IMP	F5/F8	0-999999999	R/W
404eH-404fH	Reactive energy EXP	F5/F8	0-999999999	R/W
4050H-4051H	Energy TOTAL	F4/F7	0-999999999	R/W
4052H-4053H	Energy NET	F4/F7	0-999999999	R/W
4054H-4055H	Reactive energy TOTAL	F5/F8	0-999999999	R/W
4056H-4057H	Reactive energy NET	F5/F8	0-999999999	R/W
4058H-4059H	Apparent energy	F6/F9	0-999999999	R/W

Harmonics:

THD, Harmonics, odd HD, even HD, Crest Factor, THFF, K factor etc are all stored here. The data type is “word”. Voltage parameters refer to line voltage when it is set to “2LL/3LL” and phase voltage for others. Function code: 03H for reading.

Address	Parameter	code	Range	Property
The following are the THD of voltage and current				
405aH	THD_V1 of V1(V12)	F18	0~10000	R
405bH	THD_V1 of V2(V31)	F18	0~10000	R
405cH	THD_V1 of V3(V23)	F18	0~10000	R
405dH	Average THD_V	F18	0~10000	R
405eH	THD_I1	F18	0~10000	R
405fH	THD_I2	F18	0~10000	R
4060H	THD_I3	F18	0~10000	R
4061H	Average THD_I	F18	0~10000	R

Voltage Harmonics, even HD, odd HD, Crest Factor are shown as below				
4062H-407fH	Harmonics of V1(V12) (the 2nd to 31st)	F19	0~10000	R
4080H	Odd HD of V1(V12)	F20	0~10000	R
4081H	Even HD of V1(V12)	F21	0~10000	R
4082H	Crest Factor of V1(V12)	F22	0~65535	R
4083H	THFF of V1(V12)	F24	0~10000	R
4084H-40a5H	Parameters of V2(V31)	Same as V1		R
40a6H-40c7H	Parameters of V3(V23)	Same as V1		R
40c8H-40e5H	Harmonics of I1 (the 2nd to 31st)	F19	0~10000	R
40e6H	Odd HD of I1	F20	0~10000	R
40e7H	Even HD of I1	F21	0~10000	R
40e8H	K Factor of I1	F23	0~65535	R
40e9H-4109H	Parameters of I2	Same as I1		R
410aH-412aH	Parameters of I3	Same as I1		R

MAX/MIN records

MAX/MIN value and stamp time. Function code: 03H for reading.

Address	Parameter	Code	Range	Property
4136H	MAX of V1	F11	-32768~32767	R
4137H-413cH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
413dH	MAX of V2	F11	-32768~32767	R
413eH-4143H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4144H	MAX of V3	F11	-32768~32767	R

4145H-414aH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
414bH	MAX of V12	F11	-32768~32767	R
414cH-4151H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4152H	MAX of V23	F11	-32768~32767	R
4153H-4158H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4159H	MAX of V31	F11	-32768~32767	R
415aH-415fH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4160H	MAX of I1	F12	-32768~32767	R
4161H-4166H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4167H	MAX of I2	F12	-32768~32767	R
4168H-416dH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
416eH	MAX of I3	F12	-32768~32767	R
416fH-4174H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4175H	MAX of system power	F13	-32768~32767	R
4176H-417bH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
417cH	MAX of system reactive power	F14	-32768~32767	R
417dH-4182H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4183H	MAX of system apparent power	F15	-32768~32767	R
4184H-4189H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
418aH	MAX of power factor	F16	-32768~32767	R
418bH-4190H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4191H	MAX of frequency	F10	-32768~32767	R

4192H-4197H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
4198H	MAX of power demand	F13	-32768~32767	R
4199H-419eH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
419fH	MAX of reactive power demand	F14	-32768~32767	R
41a0H-41a5H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41a6H	MAX of apparent power demand	F15	-32768~32767	R
41a7H-41acH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41adH	MAX of voltage unbalance factor	F17	-32768~32767	R
41aeH-41b3H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41b4H	MAX of current unbalance factor	F17	-32768~32767	R
41b5H-41baH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41bbH	MAX of V1(V12) THD	F18	-32768~32767	R
41bcH-41c1H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41c2H	MAX of V2(V31) THD	F18	-32768~32767	R
41c3H-41c8H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41c9H	MAX of V3(V23) THD	F18	-32768~32767	R
41caH-41cfH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41d0H	MAX of I1 THD	F18	-32768~32767	R
41d1H-41d6H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41d7H	MAX of I2 THD	F18	-32768~32767	R
41d8H-41ddH	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41deH	MAX of I3 THD	F18	-32768~32767	R

41dfH-41e4H	Time stamp: yyyy:mm:dd:hh:mm:ss	F3	time	R
41e5H~4293H are the address of previous parameters' MIN having the same format				

Sequence component

U1 (U12), I1 are consisting of real part and complex part. They have positive sequence, negative sequence and zero sequence. Data type is "int". Function code: 03H for reading.

Address	Parameter	code	Range	property
4294H	positive sequence real part of UA	F11	-32768~32767	R
4295H	positive sequence complex part of UA	F11	-32768~32767	R
4296H	negative sequence real part of UA	F11	-32768~32767	R
4297H	negative sequence complex part of UA	F11	-32768~32767	R
4298H	zero sequence real part of UA	F11	-32768~32767	R
4299H	zero sequence complex part of UA	F11	-32768~32767	R
429aH	positive sequence real part of IA	F12	-32768~32767	R
429bH	positive sequence complex part of IA	F12	-32768~32767	R
429cH	negative sequence real part of IA	F12	-32768~32767	R
429dH	negative sequence complex part of IA	F12	-32768~32767	R
429eH	zero sequence real part of IA	F12	-32768~32767	R
429fH	zero sequence complex part of IA	F12	-32768~32767	R

Phase angle

All voltage and current's phase angles corresponding to V1 (V12) are stored here. You can find out the phase sequence according to them. Data type is "word". Function code: 03H for reading.

Address	Parameter	code	Range	property
42a0H	phase angle of V2 to V1	F25	0-3600	R
42a1H	phase angle of V3 to V1	F25	0-3600	R
42a2H	phase angle of I1 to V1	F25	0-3600	R
42a3H	phase angle of I2 to V1	F25	0-3600	R

42a4H	phase angle of I3 to V1	F25	0-3600	R
42a5H	phase angle of V23 to V12	F25	0-3600	R
42a6H	phase angle of I1 to V12	F25	0-3600	R
42a7H	phase angle of I2 to V12	F25	0-3600	R
42a8H	phase angle of I3 to V12	F25	0-3600	R

Alarming records

There are 16 groups of records with the same format. Function code: 03H for reading, 10H for writing. Please refer to chapter 4 for more details.

Address	Parameter	code	Range	property
42a9H	First group: alarming status	F1	0~65535	R
42aaH	First group: alarming parameter code	F1	0~44	R
42abH	First group: over range or reset value	F10-F18	Related with parameters	R
42acH~42b2H	First group: Time stamp: yyyy:mm:dd:hh:mm:ss:ms	F3		R
42b3H~42bcH	Second group	Same as the first group		
42bdH~42c6H	Third group	Same as the first group		
42c7H~42d0H	Fourth group	Same as the first group		
42d1H~42daH	Fifth group	Same as the first group		
42dbH~42e4H	Sixth group	Same as the first group		
42e5H~42eeH	Seventh group	Same as the first group		
42efH~42f8H	Eighth group	Same as the first group		
42f9H~4302H	Ninth group	Same as the first group		
4303H~430cH	Tenth group	Same as the first group		
430dH~4316H	Eleventh group	Same as the first group		
4317H~4320H	Twelfth group	Same as the first group		
4321H~432aH	Thirteenth group	Same as the first group		
432bH~4334H	Fourteenth group	Same as the first group		

4335H-433eH	Fifteenth group	Same as the first group
433fH-4348H	Sixteenth group	Same as the first group

Counting number of I/O Modules

DI are arranged according to expanded I/O module addresses, user can check out the counting number of DI along with those modules. The counting number of I/O modules will be stored in non-volatile memory during power off. They can be cleared up via communication and panel. Data type is "word". Function code: 03H for reading.

Address	Parameter	code	Range	property
AXM-IO11				
4349H-434aH	DI1 pulse counter number	F1	0-4294967295	R
434bH-434cH	DI2 pulse counter number	F1	0-4294967295	R
434dH-434eH	DI3 pulse counter number	F1	0-4294967295	R
434fH-4350H	DI4 pulse counter number	F1	0-4294967295	R
4351H-4352H	DI5 pulse counter number	F1	0-4294967295	R
4353H-4354H	DI6 pulse counter number	F1	0-4294967295	R
AXM-IO21				
4355H-4356H	DI7 pulse counter number	F1	0-4294967295	R
4357H-4358H	DI8 pulse counter number	F1	0-4294967295	R
4359H-435aH	DI9 pulse counter number	F1	0-4294967295	R
435bH-435cH	DI10 pulse counter number	F1	0-4294967295	R
AXM-IO31				
435dH-435eH	DI11 pulse counter number	F1	0-4294967295	R
435fH-4360H	DI12 pulse counter number	F1	0-4294967295	R
4361H-4362H	DI13 pulse counter number	F1	0-4294967295	R
4363H-4364H	DI14 pulse counter number	F1	0-4294967295	R
AXM-IO12				
4365H-4366H	DI15 pulse counter number	F1	0-4294967295	R
4367H-4368H	DI16 pulse counter number	F1	0-4294967295	R
4369H-436aH	DI17 pulse counter number	F1	0-4294967295	R

436bH-436cH	DI18 pulse counter number	F1	0-4294967295	R
436dH-436eH	DI19 pulse counter number	F1	0-4294967295	R
436fH-4370H	DI20 pulse counter number	F1	0-4294967295	R
AXM-IO22				
4371H-4372H	DI21 pulse counter number	F1	0-4294967295	R
4373H-4374H	DI22 pulse counter number	F1	0-4294967295	R
4375H-4376H	DI23 pulse counter number	F1	0-4294967295	R
4377H-4378H	DI24 pulse counter number	F1	0-4294967295	R
AXM-IO32				
4379H-437aH	DI25 pulse counter number	F1	0-4294967295	R
437bH-437cH	DI26 pulse counter number	F1	0-4294967295	R
437dH-437eH	DI27 pulse counter number	F1	0-4294967295	R
437fH-4380H	DI28 pulse counter number	F1	0-4294967295	R

AI input value

The output of AI is mapped to the range of 0~4095 according to its sampling value using some algorithm. Data type is "word". Function code: 03H for reading. Please refer to <<User's manual of expanded I/O modules>> for more details.

Address	Parameter	code	Range	property
4385H	AI1 sampling value	F1	0-4095	R
4386H	AI2 sampling value	F1	0-4095	R
4387H	AI3 sampling value	F1	0-4095	R
4388H	AI4 sampling value	F1	0-4095	R

AO output

The output of AO is the actual value of output. It will get a different unit (V or mA) according to different outputs. Data type is "float". Function code: 03H for reading. Please refer to <<User's manual of expanded I/O modules>> for more details.

Address	Parameter	code	Range	property
438aH-438bH	Value of A01	F1		R
438cH-438dH	Value of A02	F1		R
438eH-438fH	Value of A03	F1		R
4390H-4391H	Value of A04	F1		R

SOE Records

There are 20 groups of records with the same format. Function code: 03H for reading. What you need to know is that the data is got from the SOE enabled I/O module, if this I/O module is not connected, the data is useless. Please refer to <<User's manual of expanded I/O modules>> for more details.

Address	Parameter	code	Range	property
4399H~439fH	First group: time stamp: yyyy:mm:dd:hh:mm:ss:ms	F3		R
43a0H	First group: DI status	F1		R
43a1H-4438H	2nd to 20th group			R
4439H	I/O module of SOE	F1	0:none; 1:AXM-IO11; 2:AXM-IO21; 3:AXM-IO31; 4:AXM-IO12; 5:AXM-IO22; 6:AXM-IO32	R

DI Status

Current DI status, if related I/O module isn't connected, the DI status will be set to 0. Function code: 02H for reading.

Address	Parameter	Range	Data type
AXM-IO11			
0000H	DI1	1=ON,0=OFF	bit
0001H	DI2	1=ON,0=OFF	bit
0002H	DI3	1=ON,0=OFF	bit
0003H	DI4	1=ON,0=OFF	bit
0004H	DI5	1=ON,0=OFF	bit
0005H	DI6	1=ON,0=OFF	bit
AXM-IO21			
0006H	DI7	1=ON,0=OFF	bit
0007H	DI8	1=ON,0=OFF	bit
0008H	DI9	1=ON,0=OFF	bit
0009H	DI10	1=ON,0=OFF	bit
AXM-IO31			
000aH	DI11	1=ON,0=OFF	bit
000bH	DI12	1=ON,0=OFF	bit
000cH	DI13	1=ON,0=OFF	bit
000dH	DI14	1=ON,0=OFF	bit
AXM-IO12			
000eH	DI15	1=ON,0=OFF	bit
000fH	DI16	1=ON,0=OFF	bit
0010H	DI17	1=ON,0=OFF	bit
0011H	DI18	1=ON,0=OFF	bit
0012H	DI19	1=ON,0=OFF	bit
0013H	DI20	1=ON,0=OFF	bit
AXM-IO22			
0014H	DI21	1=ON,0=OFF	bit
0015H	DI22	1=ON,0=OFF	bit
0016H	DI23	1=ON,0=OFF	bit
0017H	DI24	1=ON,0=OFF	bit
AXM-IO32			
0018H	DI25	1=ON,0=OFF	bit

0019H	DI26	1=ON,0=OFF	bit
001aH	DI27	1=ON,0=OFF	bit
001bH	DI28	1=ON,0=OFF	bit

Relay status

Function code: 01H for reading, 05H for controlling output.

Address	Parameter	Range	Data type
AXM-IO11			
0000H	Relay1	1=ON,0=OFF	bit
0001H	Relay2	1=ON,0=OFF	bit
AXM-IO31			
0002H	Relay3	1=ON,0=OFF	bit
0003H	Relay4	1=ON,0=OFF	bit
AXM-IO12			
0004H	Relay5	1=ON,0=OFF	bit
0005H	Relay6	1=ON,0=OFF	bit
AXM-IO32			
0006H	Relay7	1=ON,0=OFF	bit
0007H	Relay8	1=ON,0=OFF	bit