AMPTRON

User' s Manual

Multifunction Power Meter

The information contained in this document is believed to be accurate at the time of publication, however, Amptron assumes no responsibility for any errors which may appear here and reserves the right to make changes without notice. Please ask the local represent for latest product specications before ordering.

Please read this manual carefuly before doing installation, operation and mantenance of Ai205.

Following symbols are used in this user's manual and on meter to alert the dangerous or to prompt in the operating or setting process.

Dangerous symbol, Failure to observe the information may result in injury or death.

Alert symbol, Alert the potential dangerous.

Observ the information after the symbol to avoid possible injury or death.

Installation and maintenance of the Ai205 meter should only be performed by qualified, competent personnel that have appropriate training and experience with high voltage and current device.

Content

Copyright I
Notice II
Start III
Content IV
Chapter 1 Introduction 1
The Purpose of Ai205 2
The Application Area of Ai205 4
The Function of Ai205 4
Ai205 Series 5
Chapter 2 Installation 7
Appearance and Dimensions 8
Installation Method 9
Wiring of Ai205 12
Chapter 3 Basic Operation and Setup 29
Display Panel and Keys 30
Metering Data Reading 32
Statistics Display 41
Meter Parameter Setting 44
Introduction of Measurement and Functions of Ai205 52
Chapter 4 Communication 61
Introducing Modbus Protocol 62
Format of the Communication 65
Address Table of Ai205 71
Appendix 93
Appendix A Technical Data and Specification 94
Appendix B Ordering 97

Starting!

Congratulations!

You have got an advanced, Versitil, multifunction power meter. You may call it a Remote terminal unit(RTU). It will benifit your power system.

When you open the package, you will find the following items.

1.Ai205 meter	1
2.14Pin terminal	1 (another for option)
3.Installation clips	4
4.User's operation mannual	1

Please read this manual carefuly before operating or setting the Ai205 meter to avoid unnecessary trouble.

You may read part of this manual depend on how you use the Ai205 meter.

Chapter 1 helps you to understand the fundamental function, specification and application area of Ai205.

Chapter 2 describes in detail the installation and wiring of Ai205.

Chapter 3 tells you the data display and paramenter setting method of Ai205.

Chapter 4 gives the communiaction address table of Ai205.

Appendix lists the technical data and specifications of Ai205 and ordering information.

Chapter 1 Introduction

The purpose of Ai205

The Application Area of Ai205

The Function of Ai205

Ai205 Series

The Purpose of Ai205

Powerful Intelligent Power Meter

Ai205 Series Intelligent power meter was designed by used of latest microprocessor and digital signal process technology. Electric power parameters, energy and demands metering, power quality monitoring, remote control, over range alarming, statistics and records, all these functions are only in one pocket-size unit. There are also alarm on over/under Voltage, Current,Power, Power Factor, Frequency, Unbalance Factors or Demands and Pulse Output based on Energy or Reactive Energy in Ai205. Switch status monitoring is possible by using the 4 digit inputs. It combines high accuracy measurement with intelligent multifunction and simple HMI interface.

Idea Choice for Electric Automation SCADA System

Ai205 can be used to replace all traditional electric meters. It also can be used as Remote Terminal Unit (RTU) for monitoring and controlling in a SCADA system. All the measured data is available via digital RS485 communication ports running the Mobus™ protocol.

Energy Management

Ai205 can measure double directions four quadrants Kwh and Kvarh with accuracy up to 0.5%. It can provide high standard energy data and energy demand data. All these data is important for statistics of each line feeder and total.

Remote Power Control

The main function of Ai205 is measurement, but it has also got some flexible I/O functions. This made the meter can be used as distributed RTU (metering, monitoring, remote controlling in one unit).

Power Quality Analysis

With the powerful digital signal processing ability the Ai205 intelligent power meter can be used as an online power quality analysis instrument. It can simultaneously and continuously give out the analysis results such as THD of voltage and current, harmonics up to 31st and unbalance factor of voltage and current, etc. The main function of Ai205 are listed in table1.1

Table 1.1 Main function of Ai205 series

Metering	**Power Quality**
Phase Voltage: V1, V2, V3, Vlnavg Line Voltage: V12, V23,V31,Vllavg Current: I1, I2, I3, Iavg, In Power: Power of each phase and total Reactive Power: Reactive Power of each phase and total Apparent Power: Apparent Power of each phase and total Power Factor: Power factor of each phase and average Frequency	THD, Even THD and Odd THD of phase/line Voltage Harmonics and Crest factor of phase/line Voltage THD, Even THD and Odd THD of Current Harmonics and K Factor Unbalance Factor of Voltage Unbalance Factor of Current
Statistics	**Energy and Demand**
Maximum value of statistics with time stamp Mininum value of statistics with time stamp Maximum of Demand	Kwh of 4 quadrants: Import, Export, Total, Net Kvarh of 4 quadrants: Import, Export, Total, Net Demand of Power and Reactive Power
Communication	**Remote Control**
RS485 Communication port Modbus RTU Protocol	4 Digital Input (DI) (Wet or Dry) 2 Relay Output 2 Digital Output (DO)

The Application Area of Ai205

Power Distribution Automation	Intelligent Electric Switch Gear
Industry Automation	Building Automation
Energy Manage System	Large UPS System

The Function of Ai205

Multifunction, High Accuracy

Ai205 Series Intelligent power meter was designed by use of latest microprocessor and digital signal processing technology. Electric power parameters metering, energy and demand recording, power quality monitoring, remote controlling, over range alarming, statistics and records, all these functions are only in one pocket-size unit. There are also basic alarm on over/under Current, Voltage, Power, Power Factor, Frequency, Unbalance Factors or Demands and Pulse Output based on Energy or Reactive Energy in Ai205. Status monitoring is possible using the 4 digital inputs. It combines high accuracy measurement with intelligent multifunction and friendly HMI interface.

Accuracy of Voltage and Current is 0.2%

Accuracy of Power and Energy is 0.5%

Small Size and Easy Installation

With the size of DIN96 × 96 and 55mm depth after mounting, the Ai205 can be installed in a small cabin. The clips are used for easy installation and remove.

Easy to Use

By using of large screen high density LCD, the display of Ai205 is easy to read and use. All the setting parameters can be access by using panel keys or communication port. The setting parameters are protected in EEprom, which will maintain its content after the meter is power off. With the backlight of the LCD,

the display can be easily read in the dim environment. The back light “on” time is selectable.

Multiple Wiring Modes

In either high voltage or low voltage or three phase three wire or three phase four wire or single phase system, the Ai205 can be easily used.

Ai205 series

The Ai205 series have two kinds of product, the standard Ai205 and the advanced Ai205. Both these two products have multiple choice of I/O. Advanced Ai205 has the basic measuring function of Ai205. It also gets extra function as harmonics analysis, Max/Min record and over/under limit alarming.

Comparison of Ai205 Series

Table 1.2 Comparison of Ai205

		FUNCTION	Parameter	P0	P1	P2	P3
METERING	REAL TIME MEASURING	Phase Voltage	V1,V2,V3,Vlnavg	√	√	√	√
		Line Voltage	V12,V23,V31,Vllavg	√	√	√	√
		Current	I1,I2,I3,In,Iavg	√	√	√	√
		Power	P1,P2,P3,Psum	√	√	√	√
		Reactive Power	Q1,Q2,Q3,Qsum	√	√	√	√
		Apparent Power	S1,S2,S3,Ssum	√	√	√	√
		Power Factor	PF1,PF2,PF3,PF	√	√	√	√
		Frequency	Frequency	√	√	√	√
	ENERGY& DEMAND	Energy	Ep_imp,Ep_exp,Ep_total,Ep_net	√	√	√	√
		Reactive Energy	Eq_imp,Eq_exp,Eq_total,Eq_net	√	√	√	√
		Demand	Dmd_P,Dmd_Q,Dmd_S	√	√	√	√

FUNCTION			Parameter	P0	P1	P2	P3
MONITORING	POWER QUALITY	Voltage Unbalance Factor	U_unbl	√	√	√	√
		Current Unbalance Factor	I_unbl	√	√	√	√
		Voltage THD	THD_V1,THD_V2, THD_V3,THD_Vavg	√	√	√	√
		Current THD	THD_I1, THD_I2, THD_I3, THD_Iavg	√	√	√	√
		Harmonics	Harmonics 2nd to 31st			√	√
		Voltage Crest Factor	Crest Factor			√	√
		TIF	THFF			√	√
		Current K factor	K Factor			√	√
	STATIS-TICS	MAX with Time Stamp				√	√
		MIN with Time Stamp				√	√
	I/O	Switch Status(DI)		√	√	√	√
OTHERS		Relay Output					√
		Pulse Output			√		√
	ALARM	Over/Under Limit Alarm				√	√
	COMM	RS485 Port	Modbus™ Protocol	√	√	√	√
	TIME	Real Time Clock	Year,Month,date,Hour, minute,Second	√	√	√	√

Note: 1. There are two DIs in the basic Module of Ai205. The Option module can provide additional 2 DIs, DI Auxilary Power, 2 DOs and 2 Relay Outputs.
2. The 2 DOs may be used as Alarm or Pulse output.

Chapter 2 Installation

Appearance and Dimensions

Installation method

Wiring of Ai205

The installation method is introduced in this chapter. Please read this chapter carefully before beginning installation work.

Appearance and Dimensions

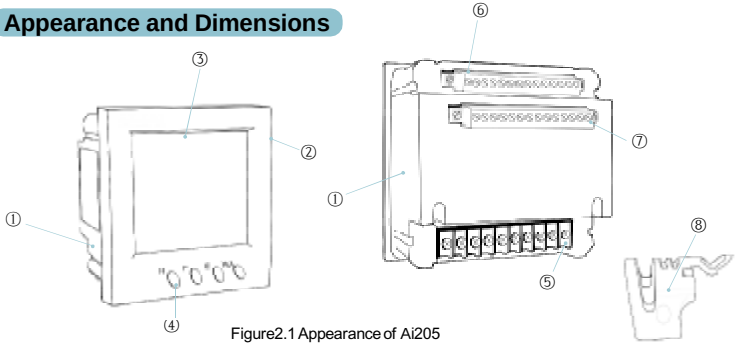


Figure2.1 Appearance of Ai205

Part Name	Description
1. Enclosure	The Ai205 enclosure is made of high strength anti-combustion engineering plastic
2. Front Casing	After the installation, this part is in front of panel. The color of the front casing is selectable.
3. LCD Display	Large bright blue backlight LCD Display
4. Key	Four keys are used to select display and to set parameters of the meter
5. Input Wiring Terminal	Used for Voltage and Current input
6. Auxiliary Wiring Terminal	Used for auxiliary power, communication and DI
7. Extend Wiring Terminal	Auxiliary I/O wiring terminals
8. Installation Clip	When installation the clips are used for fixing the meter to the panel

Table2.1 Part name of Ai205

Dimensions

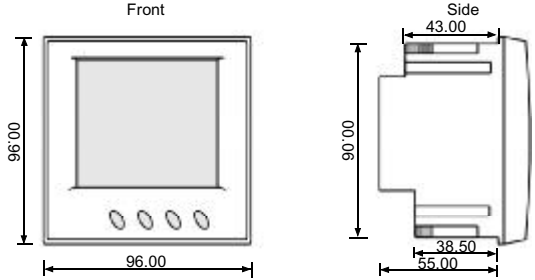


Fig.2.2 Dimensions

Installation Method

• Note

The installation environment should fulfill the temperature and humidity that Ai205 meter requires. Otherwise it may cause the meter damaged.

Environmental

Please check the environment temperature and humidity to ensure the satisfaction of Ai205 meter's requirement before the meter installation.

Temperature

Operation: -20°C to 70°C

Storage: -40°C to 85°C

Humidity

5% to 95% non-condensing

Ai205 meter should be installed in dry and dust free environment and avoid heat, radiation and high electrical noise source.

Installation Steps

Normally, Ai205 was installed on the panel of switch gear.

1. Cut a square hole on the panel of the switch gear.

The cutting size is as fig.2.3 Unit (mm)

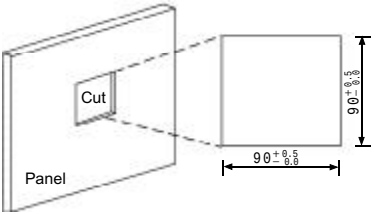


Fig.2.3 Panel Cutting

2. Remove the clips from the meter and insert the meter into the square hole from the front side.

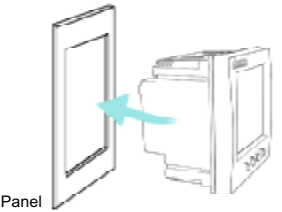


Fig.2.4 Put the meter into the square hole

3. Put clips back to the meter from the backside and push the clip tightly so that the meter is fixed on the panel.

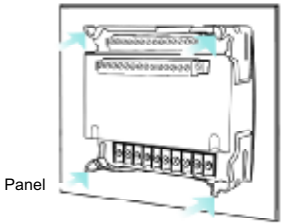


Fig.2.5 Use the clips to fasten the meter on the panel

Space required for Installation

The space around the meter should be large enough so that the meter removing, terminal strip wiring and wire arrangement could be done easily. The recommend minimum space around the meter is show in Table2.2 and Fig.2.6.

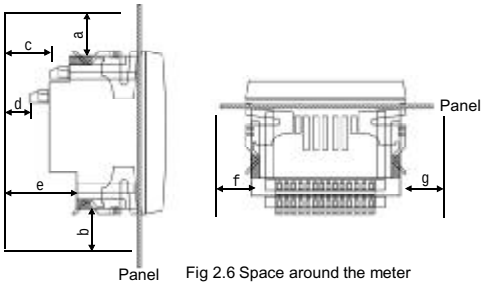


Fig 2.6 Space around the meter

Environment	Minimum Distance(mm)						
Temperature	a	b	c	d	e	f	g
＜50℃	25	25	38	38	64	25	25
＞50℃	38	38	51	51	76	38	38

Table 2.2 Minimum Space

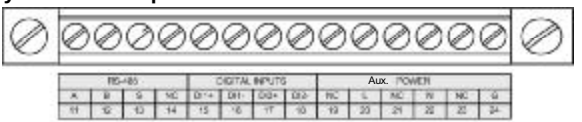
Wiring of Ai205

Terminal Strips

There are three terminal strips on the back of Ai205, Voltage & Current Input Terminal Strip, Auxiliary Terminal Strip and Extend Terminal Strip. Only the Ai205 with PRIO option has the Extend Terminal Strip. The 1, 2 and 3 are used to represent each phase of three phase system. They have the same meaning with A, B and C or R, S and T in three phase system.

Voltage & Current Input Terminal Strip

Auxiliary Terminal Strip



Note: NC means No Connection

Extend Terminal Strip

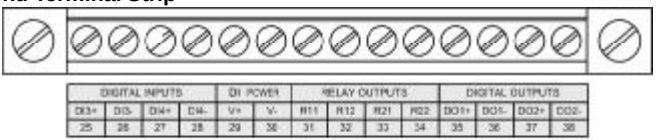


Fig 2.7 Terminal Strips

⚠ DANGEROUS
Only the qualified personnel could do the wire connection work. Make sure the power supply is cut off and all the wires are electroless. Failure to observe it may result in severe injury or death.

Safety Earth Connection

Before doing the meter wiring connection, please make sure that the switch gear has a safety Earth system. Connect the meter safety earth terminal to the switch gear safety earth system.

The following safety earth symbol is used in the user's manual.

• Note
Make sure the voltage of power supply is the same as what the meter needed for its auxiliary power.

Auxiliary Power

The auxiliary power supply of the Ai205 meter is 85-264Vac (50/60Hz) or 100-300Vdc. Typical power consumption of the meter is less than 2W. A regulator or a UPS should be used when the power supply undulates too much. The terminals for the auxiliary power supply are 20, 22 and 24 (L, N, G).

• Note
Make sure the auxiliary power terminal of the meter G is connected to the safety Earth of switchgear.

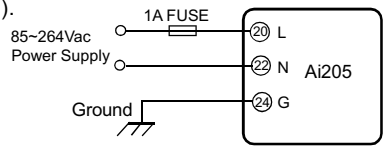


Fig 2.8 Power supply

A fuse (typical 1A/250Vac) should be used in auxiliary power supply loop.

No. 24 terminal must be connected to the safety earth system of switchgear.

An isolated transformer or EMI filter should be used in the auxiliary power supply loop if there is power quality problem in the power supply.

• Note
A filter should be used if there is EMI problem

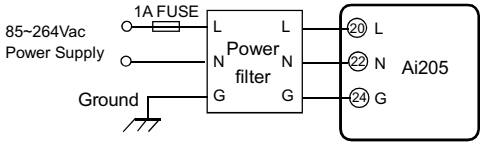


Fig.2.9 Wiring of Auxiliary Power supply under EMI

The choice of wire of power supply could be AWG16-22 or 0.6-1.5mm^2

Voltage Input

Two Voltage Input options of Ai205 are 100Vac and 400Vac.

100Vac option is suitable for low voltage system that less than 120Vac or high or medium voltage system that the secondary of PT is 100Vac. The input voltage V1, V2 and V3 against Vn of Ai205 should be less than 120Vac if the 100Vac option is selected.

400Vac option is suitable for low voltage system that less than 480Vac. The voltage input could be directly connected to the terminal of Ai205 without the use of PT. The input voltage V1, V2 and V3 against Vn of Ai205 should be less than 480Vac. If the input voltage is higher than 480Vac, the PT should be used.

• Note
The secondary of PT can not be shorted, otherwise it may cause the severe damage of the instrument.

A fuse (typical 1A/250Vac) should be used in voltage input loop.

PT should be used to transform the high voltage into measurement range of Ai205 if it is used in high voltage system.

The wire number of voltage input could be AWG16-22 or 0.6-1.5mm^2

Note: In no circumstance could the secondary of PT be shorted. The secondary of PT should be well grounded.

Current Input

In a practical engineering application, CTs should be installed in the loop of measuring. Normally the secondary of CT is 5A. 1A is possible in the ordering option. A CT of accuracy over 0.5% (rating over 3VA) is recommended and it will influence the measuring accuracy. The wire between CT and Ai205 should be as shorter as possible. The length of the wire may increase the error of the measurement.

The wire number of current input could be AWG15-16 or 1.5-2.5mm^2

The CT loop should not be open circuit in any circumstance when the power is on. There should not be any fuse or switch in the CT loop and one end of the CT loop should be connected to the ground.

Vn Connection

Vn is the reference point of Ai205 voltage input. The lower is wire resistance the less is the error.

Three phase wiring diagram

Ai205 can satisfy almost all kinds of three phase wiring diagram. Please read this part carefully before you begin to do the wiring so that you may chose a wiring diagram suitable for your power system.

The voltage and current input wiring mode can be set separately in the meter parameter setting process. The voltage wiring mode could be 3 phase 4 line Wye mode (3LN), 3 phase 4 line 2PT Wye mode (2LN) and 3 phase 3 line open Delta mode (2LL). The current input wiring mode could be 3CT, 2CT and 1CT. Any voltage mode could be group with one of the current mode.

Voltage Input Wiring

3-Phase 4-Line Wye mode (3LN)

The 3-Phase 4-Line Wye mode is popularly used in low voltage electric distribution power system. The power line can be connected to the meter voltage input directly as in fig 2.10. In the high voltage input system, 3PT Wye mode is often used as in fig 2.11. The voltage input mode of the Ai205 should be set 3LN for both voltage input wiring mode.

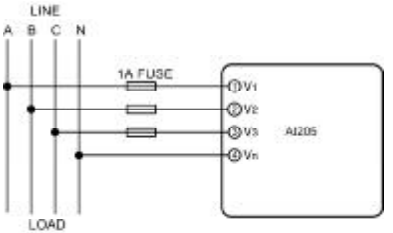


Fig 2.10 direct connection

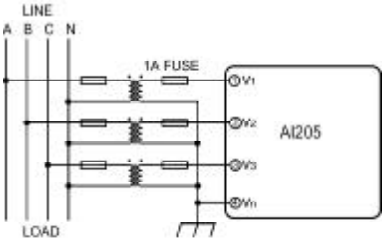


Fig 2.11 3LN with 3PTs

3-Phase 4-Line 2PT mode (2LN)

In some 3-Phase 4-Line Wye system, 2PT Wye mode is often used as in fig 2. 12. It is supposed that the 3 phases of power system are balance. The voltage of V2 is calculated according to the V1 and V3. The voltage input mode of the Ai205 should be set 2LN for 2PT voltage input wiring mode.

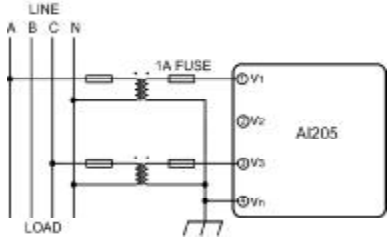


Fig 2.12 2LN with 2PTs

3-Phase 3-Line open Delta Mode (2LL)

Open delta wiring mode is often used in high voltage system. V2 and Vn connected together in this mode. The voltage input mode of the Ai205 should be set 2LL for voltage input wiring mode.

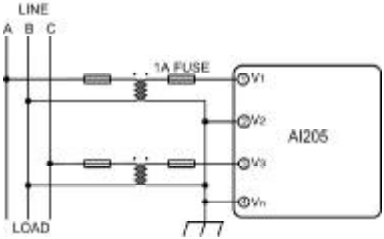


Fig 2.13 2LL with 2PTs

Current Input Wiring

3CT

All the current input of three phase system can be looked as 3CT one, whether there are 2 CTs or 3 CTs in the input side. The current input mode of the Ai205 should be set 3CT for this current input wiring mode.

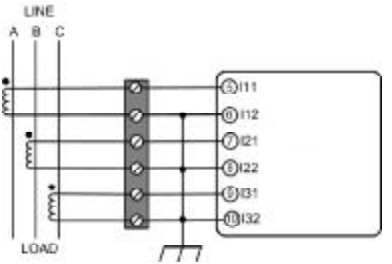


Fig 2.14 3CT-a

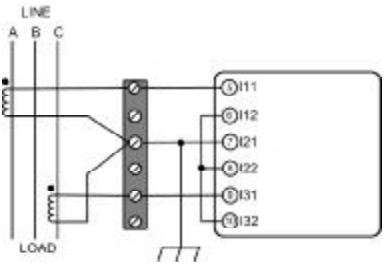


Fig 2.15 3CT-b

2CT

The difference of the fig.2.16 and the fig.2.15 is that there is not current input in the I21 and I22 terminals. The I2 value is calculated from formula i1+i2+i3=0. The current input mode of the Ai205 should be set 2CT for this current input wiring mode.

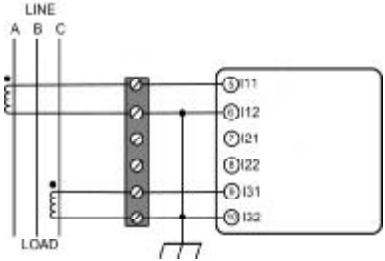


Fig 2.16 2CT

1CT

If it is a three phase balance system, 1 CT connection method can be used. All the other two current are calculated according to the balance supposing.

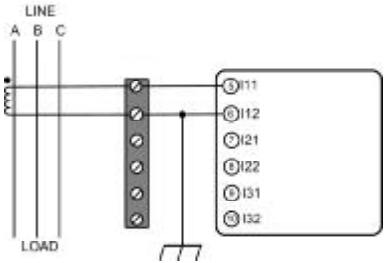


Fig 2.17 1CT

Frequent used wiring method

The voltage and current wiring method are put together in one drawing. The Ai205 meter will display normally only that the setting of the meter is assorted with the wiring of the voltage and current input.

1. 3LN, 3CT with 3 CTs

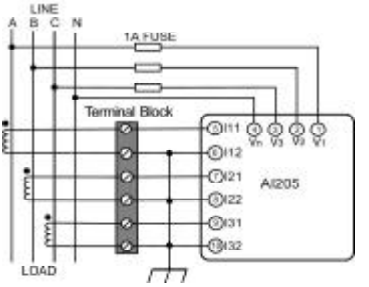


Fig 2.18 3LN,3CT with 3CTs

2. 3LN, 3CT with 2 CTs

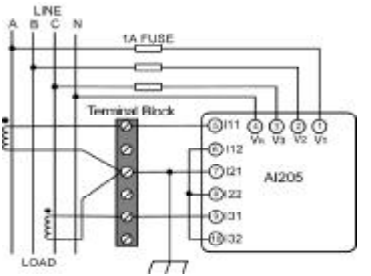


Fig 2.19 3LN, 3CT with 2 CTs

3. 2LN, 2CT

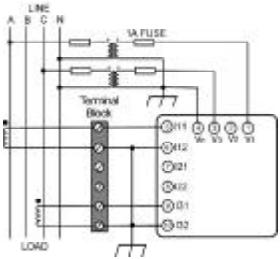


Fig 2.20 2LN, 2CT

4. 2LN, 1CT

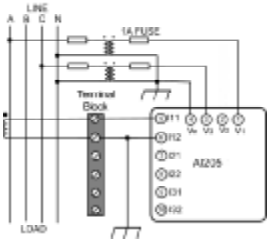


Fig 2.21 2LN, 1CT

5. 2LL, 3CT

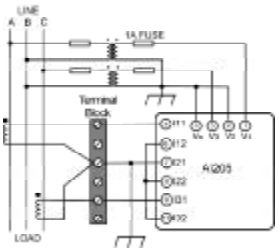


Fig 2.22 2LL, 3CT

6. 2LL, 2CT

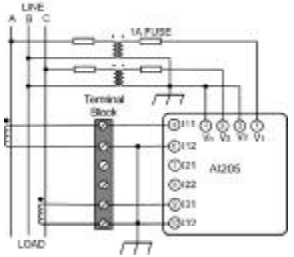


Fig 2.23 2LL, 2CT

7. 2LL, 1CT

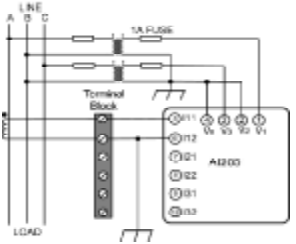


Fig 2.24 2LL, 1CT

8. Single Phase 2 Line (wiring mode setting 3LN, 3CT)

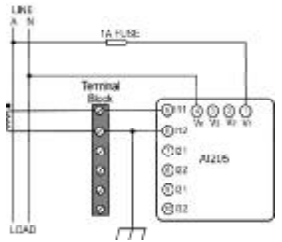


Fig 2.25 Single Phase 2 Lines

9. Single Phase 3 Line (Wiring mode setting 3LN, 3CT)

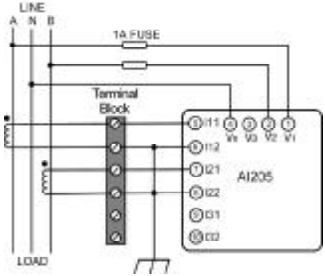


Fig 2.26 Single Phase 3 Line

Wiring of Digital (Switch Statues) Input

There are two digital input of wet contact in standard Ai205. The terminals of the two Digital input are DI1+, DI1- (15, 16) and DI2+, DI2- (17, 18). Additional two digital inputs are optional. The terminals of the two additional are DI3+, DI3-(25, 26) and DI4+, DI4-(27, 28). The circuit drawing of the digital input is simplified as Fig. 2.27.

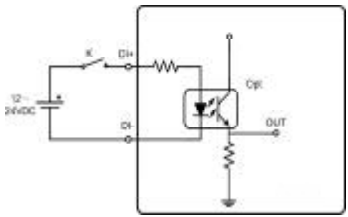


Fig 2.27 Digital Input Circuit of A

Auxiliary power supply for the digital input is 12-24Vdc. If the connection wire is too long, a relative higher voltage should be adopted. The current in the loop line should be less than 10mA-15mA, and the Max current is 30mA.

A DI auxiliary power supply (optional) is provided for the convenient of the factory field used. The voltage of the DI auxiliary power supply is 15Vdc (1W). The wiring terminals are V+ and V- (29, 30). This power supply can not be used for other purpose.

The 4 DIs with auxiliary power supply is drawing as in fig 2.28.

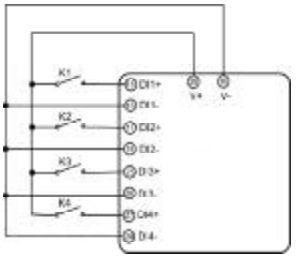


Fig 2.28 Digital Input with Auxiliary Power

The wire of digital input should be chose between AWG22 (0.5mm^2)-AWG16 (1.5mm^2).

Relay Output

There are two additional relay output for option in Ai205. The terminal are R11, R12 (31, 32) and R21, R22 (33, 34). These two relay output are used to remote control electric switch in power system.

Relay type is mechanical Form A contact with 3A/250V or 3A/30Vdc. A mediate relay is recommended in the output circuit as in fig. 2.29.

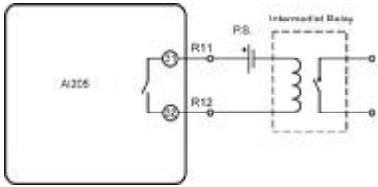


Fig 2.29 Relay output

There are two relay output modes for selection, one is latching, and the other is momentary. For the latching mode, the relay can be used to output two statues on or off. For the momentary mode, the output of the relay changes from off to on for a period of time Ton and than goes off. Ton can be setting from 50-300ms.

The wire of relay output should be chose between AWG22 (0.5mm^2)-AWG16 (1.5mm^2).

Digital Output

There are two digital outputs for option. The terminals of the digital output are DO1+, DO1-(35, 36) and DO2+, DO2-(37, 38). These two digital output can be used as energy pulse output or over limit alarming output.

Digital output circuit form is open collector. The simplified circuit is as fig. 2.30.

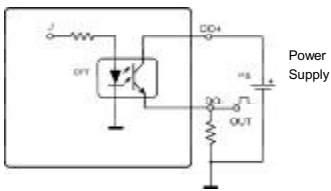


Fig 2.30 Digital output Circuit

The Max working voltage and current are 100V and 50mA.

When the digital output is used as pulse output, DO1 and DO2 can be programmed as energy pulse output. For example, DO1 is used as energy pulse output and DO2 is used as reactive energy pulse output. The pulse wide and pulse constant can be set.

When the digital output is used as over limit alarm output, the up and low limit of the parameter, time interval and output port can be set.

A drawing of the alarming output with beeper is as fig. 2.31

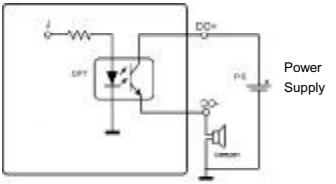


Fig 2.31 DO
Alarming Circuit

The wire of digital output should be chose between AWG22 (0.5mm^2)-AWG16 (1.5mm^2).

Communication

The communication port and protocol of Ai205 are RS485 and Modbus-RTU. The terminals of communication are A, B, and S (11, 12, 13). A is differential signal +, B is differential signal - and S connected to shield of twisted pair cable. Up to 32 devices can be connected on a RS485 bus. Use good quality shielded twisted pair cable, AWG22 (0.5mm2) or larger. The overall length of the RS485 cable connecting all devices can not exceed 1200m (4000ft). Ai205 is used as a slave device of master like PC, PLC, data collector or RTU.

If the master does not have RS485 communication port, a converter has to be used. Normally a RS232/RS485 or USB/RS485 is adopted. The topology of RS485 net can be line, circle and star.

1. Line

The connection from master to Ai205 meter is one by one in the RS485 net as in fig. 2.32.

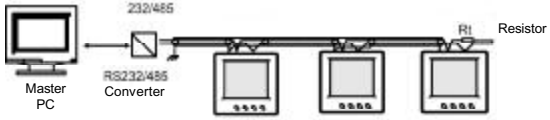


Fig 2.32 Line mode

In fig. 2.32 the Rt is a anti signal reflecting resistor 120-300 Ohm/0.25W. Normally, it added to the circuit beside the last Ai205 meter, if the communication quality is not good.

2. Circle

Ai205 meters are connected in a closed circle for the purpose of high reliability. There is no need of anti signal reflecting resistor.

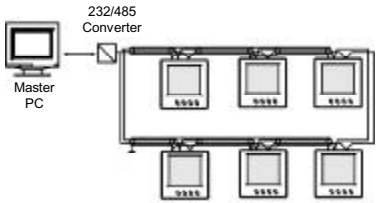


Fig 2.33 Circle mode

3. Star

The connection of RS485 net is in Wye mode. Anti signal reflecting resistor may be needed in each line.

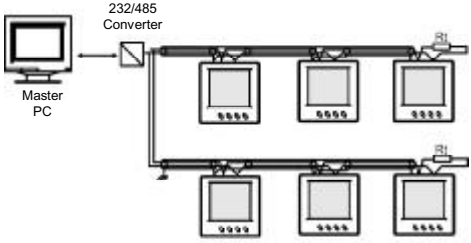


Fig 2.34 Star mode

The recommendations for the high quality communication,

Good quality shielded twisted pair of cable AWG22 (0.6mm2) or larger is very important.

The shield of each segment of the RS485 cable must be connected to the ground at one end only.

Keep cables away as much as possible from sources of electrical noise.

Use RS232/RS485 or USB/RS485 converter with optical isolated output and surge protection.

Chapter 3 Meter Operation and Parameter Setting

Display panel and keys

Metering data reading

Statistics display

Meter parameter setting

Introduction of measurement and functions of Ai205

Detail man-machine interface will be discripted in this chapter. This includes how to get the electric metering data and how to do the parameter setting.

Display panel and keys

There are one display panel and four keys in the front of Ai205. All the display segments are illustrated in fig 3.1.

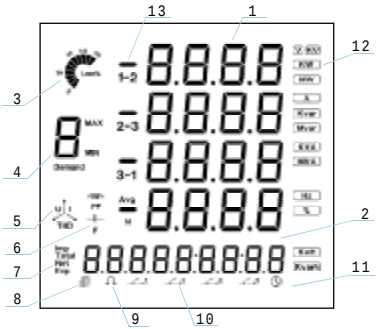


Fig 3.1 All Display Segments

SN	Display	Discription
1	Four lines of 8 letter in the metering area	Display metering data Voltage, current, power, power factor, frequency, THD, demand, unbalance factor, max, min etc.
2	One line of letter 8 in the energy display area	Energy data display or real time clock
3	Load rating 	Display load current percentage

Table 3.1 Display Panel discription

SN	Display	Discription
4	Item label Letter , MAX, MIN, Demand, PF and F	Item label: U: voltage, I: current, P: power, q: reactive power, S: apparent power, PF: power factor, F: frequency MAX: Maximum value, MIN: minimum Value, Demand: Demand value, Avg: average value, I with N: nutrual current, PF, F, Avg and N indicate the fourth line data.
5	Three phase unbalance label 	With letter U: voltage unbalance factor With letter I: Current unbalance factor
6	Load nature 	Capacitor label: capacitive load Inductor: inductive load
7	Energy label	imp: consumption energy exp: generating energy total: absolute sum of imp and exp energy net: algebraic sum
8	Communication indicator 	No label: no communication One label: inquiry Two labels: inquiry and answer
9	Energy pulse output indicator 	No label: no pulse output With label: pulse output
10	Digital input indicator 	Switch 1 to 4 indicate DI1 to DI4
11	Time label	Time display in energy area
12	Unit 	Indicate data unit Voltage: V, KV, Current: A, Power: KW and MW, Reactive Power: Kvar and Mvar, Apparent Power: KVA and MVA, Frequency: Hz, Energy: Kwh, Reactive Power: Kvarh, Percentage: %

There are four delicacy keys labeled as H, P, E and V/A. Use these four keys to read metering data and do parameter setting.

Metering data reading

Normally, Ai205 display the metering data, such as voltage, current, power etc. To read the metering data simply press the keys H, P, E and V/A.

Press V/A to read voltage and current in the metering area.

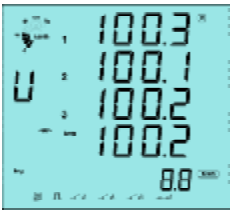


Fig 3.2 Three phase voltage

The first screen: display U1, U2, U3 and Ulnavg as in fig. 3.2.

U1=100.3V, U2=100.1V, U3=100.2V and Ulnavg=100.2V. Load rating is 50%, inductive load, imp energy is 8.8Kwh, communication state normal, pulse output, DI1, DI2 and DI3 are open, DI4 is close.

Press V/A, go to the second screen.

Fig 3.3 Three phase current

The second screen: display current of each phase, I1, I2, I3 and In as in fig 3.3. I1=2.498, I2=2.499, I3=2.491, In=0.008A.

Press V/A, go to the third screen.

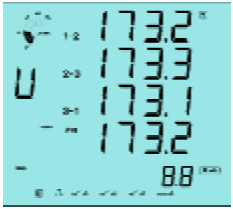


Fig 3.4 Three phase voltage

The third screen: display voltage of line to line, U12, U23, U31 and average Ullavg, as in fig. 3.4, U12=173.2V, U23=173.3V, U31=173.1V, Ullavg=173.2V.

Press V/A, go to the fourth screen.

Fig 3.5 Three phase current

The fourth screen: display current of each phase and average current as in fig 3.5, I1=2.498A, I2=2.499A, I3=2.491A, Iavg=2.496A.

Press V/A, go back to the first screen.

Note: when the meter is set to "2LL", there is no phase voltage and phase current screen, no first and second screen, only third and fourth screen.

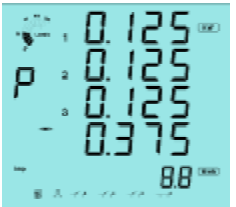


Fig 3.6 Three phase power

Press P, display power related data.

The first screen: display power of each phase P1, P2, P3 and system total power Psum.

As in fig 3.6, P1=0.125KW, P2=0.125KW, P3=0.125KW, Psum=0.375KW.

Press P, go to the second screen.

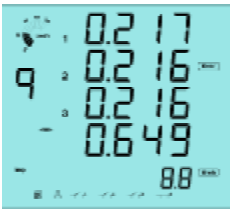


Fig 3.7 Three phase reactire power

The second screen, display reactive power of each phase, Q1, Q2, Q3 and system total reactive power Qsum.

As in fig 3.7 Q1=0.217Kvar, Q2=0.216Kvar, Q3=0.216Kvar and Qsum=0.649Kvar

Press P, go to the third screen.

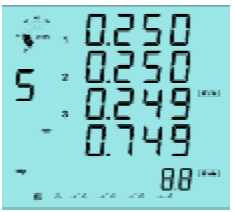


Fig 3.8 Three phase apparent power

The third screen: display apparent power of each phase S1, S2, S3 and system total apparent power Ssum.

As in fig 3.8, S1=0.250KVA, S2=0.250KVA, S3=0.249KVA and Ssum=0.749KVA.

Press P, go to the fourth screen.

Fig 3.9 Three phase PF

The fourth screen: power factor of each phase PF1, PF2, PF3 and system average power factor PF. As in fig 3.9, PF1=0.500, PF2=0.500, PF3=0.500 and PF=0.500.

Press P, go to the fifth screen.

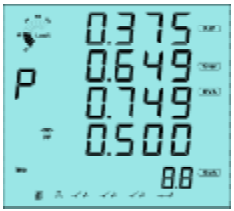


Fig 3.10 System power and power factor

The fifth screen: system total power Psum, system total reactive power Qsum, system total apparent power and system average power factor. As in fig 3.10, Psum=0.375, Qsum=0.649Kvar, Ssum=0.749 and PF=0.500.

Press P, go to the sixth screen.

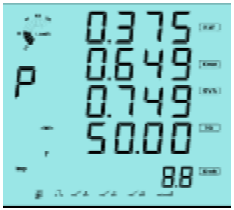


Fig 3.11 System power and frequency

The sixth screen: system total power Psum, system total reactive power Qsum, system total apparent power Ssum and system frequency F.

As in fig 3.11, Psum=0.375KW, Qsum=0.649Kvar, Ssum=0.749 KVA and F=50.00Hz.

Press P, go to seventh screen.

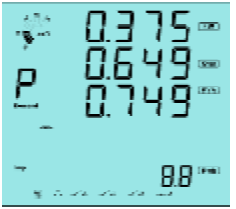


Fig 3.12 System power demand

The seventh screen: display three phase system power demand, power demand Dmd_P, reactive power demand Dmd_Q and apparent Dmd_S.

As in fig 3.12, Dmd_P=0.375KW, Dmd_Q=0.649Kvar, Dmd_S=0.749KVA.

Press P, go back to the first screen.

Note: There is not phase power to be display when the wiring of voltage setting is 2LL.

Press H, display power quality data.

The first screen, display THD of voltage.

The display will be THD of line to line voltage THD_U12, THD_U23, THD_U31 and THD of average line to line voltage THD_Ull when the wiring of voltage input is 2LL. The display will be THD of phase voltage THD_U1, THD_U2, THD_U3 and THD of average phase voltage THD_UIn when the wiring of the voltage is input 2LN or 3LN.

Fig 3.13 THD of line voltage

As in fig 3.13, THD of three phase voltage, THD_U12=0.68%, THD_U23=0.68%, THD_U31=0.68%, THD_Ull=0.68%.

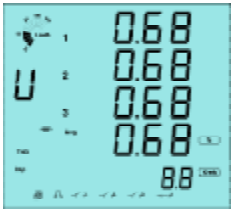


Fig 3.14 THD of phase voltage

As in fig 3.14, when the wiring of the voltage is set to be 2LN or 3LN, The display will be THD of phase voltage. THD_U1=0.68%, THD_U2=0.68%, THD_U3=0.68% and THD_Uln=0.68%.

Press H key, go to the second screen.

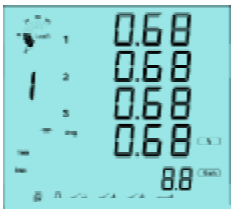


Fig 3.15 THD of line corrent

The second screen: display THD of phase current THD_I1, THD_I2, THD_I3 and THD of average current THD_Iavg.

As in fig 3.15, THD of three phase voltage, THD_I1=0.68%, THD_I2=0.68%, THD_I3=0.68%, THD_Iavg=0.68%.

Press H key, go to the third screen.

Fig 3.16 Unbalance factor

The third screen: display three phase voltage unbalance factor and three phase current unbalance factor.

As in fig 3.16, voltage unbalance factor=0.8%, current unbalance factor=0.9%.

Press H key, go back to the first screen.

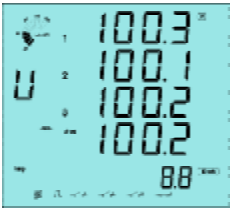


Fig 3.17 Import energy

Press E key: display energy and real time clock.

The first screen: display the consumption energy Ep_imp=8.8Kwh

Press E key, go to the second screen.

Fig 3.18 Export energy

The second screen: Display the generation energy Eq_exp=0.0

As in fig 3.18, Ep_exp=0.0Kwh

Press E key, go to the third screen.

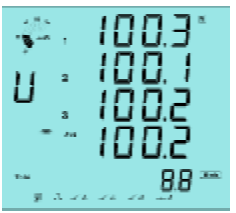


Fig 3.19 Total energy

The third screen: Display absolute sum of imp and exp energy Ep_total.

As in fig 3.19, Ep_total=8.8Kwh

Press E key, go to the fourth screen.

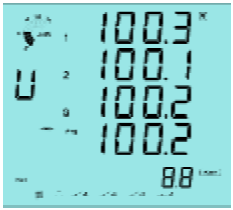


Fig 3.20 Net energy

The fourth screen: Display algebraic sum of imp and exp energy Ep_net.

As in fig 3.20, Ep_net=8.8Kwh.

Press E key, go to the fifth screen.

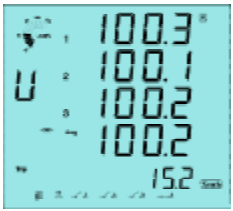


Fig 3.21 Inducfive reactive energy

The fifth screen: Display inductive reactive energy Eq_imp.

As in fig 3.21, Eq_imp=15.2Kvarh

Press E key, go to the sixth screen.

Fig 3.22 Capacitive reactive energy

The sixth screen: Display the capacitive reactive energy Eq_exp.

As in fig 3.22, Eq_exp=0.0Kvarh.

Press E key, go to the seventh screen.

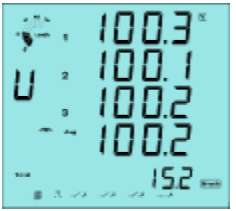


Fig 3.23 Total reactive energy

The seventh screen: display absolute sum of the reactive energy Eq_total.

As in fig 3.22, Eq_total=15.2Kvarh.

Press E key, go to the eighth screen.

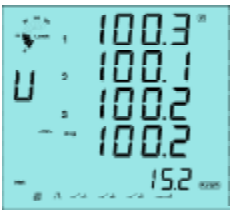


Fig 3.24 Net reactive energy

The eighth screen: Display algebraic sum of reactive energy.

As in fig 3.24, Eq_net=15.2Kvarh.

Press E key, go to the ninth screen.

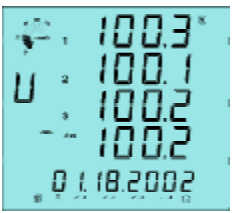


Fig 3.25 Date

The ninth screen: Display date. Format: mm: dd:yyyy

As in fig 3.25, the date is Jan. 18, 2002.

Press E key, go to the tenth screen.

Fig 3.26 Time

The tenth screen: Display time. Format: hh: mm:ss.

As in fig 3.26, the time is 13:20:29.

Press E key, go back to the first screen.

Statistics Display

Press P and V/A Keys simultaneously, the Max and Min value of metering data will display on the screen. The time stamp can be access through communication.

Press the P and V/A keys simultaneously, go to the statistics screen.

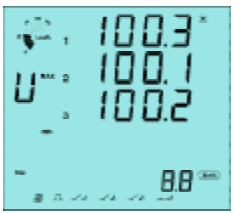


Fig 3.27 Max phase voltage

The first screen: Display the Max value of voltage. The Max label display on up right of letter U.

As in fig 3.27, U1_max=100.3V, U2_max=100. 1 and U3_max=100.2V.

Press P key, to display the Min value of voltage. The Min label display on the low right of the letter U. Press P key again, go back to display the Max value of voltage.

Fig 3.28 Min phase voltage

As in fig 3.28 U1_min=0.0V, U2_min=0.0V and U3_min=0.0V.

Press V/A key, go to the next screen.

The second screen: Display the Max and Min value of line to line voltage.

The third screen: Display the Max and Min value of Current.

The fourth screen: Display the Max and Min value of power and power factor.

The fifth screen: Display the Max and Min value of Demand and frequency.

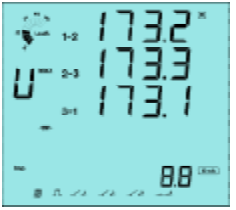


Fig 3.29 Max line voltage

The second screen: Max value of the line to line voltage.

As in fig 3.29, U12_max=173.2V, U23_max=173.3V and V31_max=173.1V

Press P key to change display from Max to Min and vice versa.

Press V/A key, go to the next screen.

Fig 3.30 Max Current

The third screen: Max value of the current.

As in fig 3.30, I1_max=2.498A, I2_max=2.499A and I3_max=2.491A.

Press P key to change display from Max to Min and vice versa.

Press V/A key, go to the next screen.

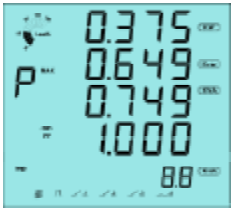


Fig 3.31 Max value of system power

The fourth screen: Max value of power and power factor.

As In fig 3.31, Max value of system total power P_max=0.375W, Max value of system total reactive power Q_max=0.649Kvar, Max value of system apparent power S_max=0.749KVA and Max value of system average power factor PF_max=1.000.

Press P key to change display from Max to Min and vice versa.

Press V/A key, go to the next screen.

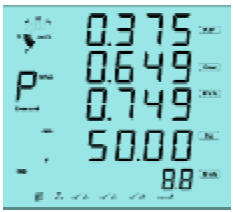


Fig 3.32 Max value of system demand and frequency

The fifth screen: Max value of demand and frequency

As in fig 3.32, Max value of system total power demand Dmd_P_max=0.375KW, Max value of system total reactive power demand Dmd_P_max=0.649Kvar, Max value of system total apparent power demand Dmd_P_max=0.749KVA and Max value of system frequency.

Press P key to change display from Max to Min and vice versa.

Press V/A key, go to the next screen.

Note: Only Ai205-P2 OR -P3 has the function of Max and Min record.

Meter Parameter Setting

Under the metering data display mode, press the H and V/A key simultaneously, get into the meter parameter setting mode.

> • Note
> The setting should be done by the professional personnel after he has read this user's manual and understand the application situation.

In the meter parameter setting mode, press H key to move cursor. Right move one digit each time. Press P for increasing and press E for decreasing. Press V/A for acknowledgment and going to the next setting item page. Press H and V/A page keys simultaneously to exit in any setting item page.

> • Note
> When pressing H and V/A keys simultaneously to exit the setting mode, the setting of current page will not be stored.

Access code needed for going into the parameter setting mode. Only the person who know the access code can do the parameter setting. The access code is 4 digits decimal number. It is from 0000 to 9999. The factory default is 0000. After key in the right access code, press V/A to go to the first parameter setting page, otherwise go back to the metering data display page.

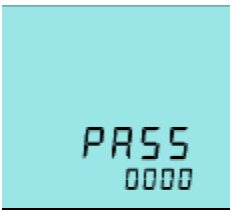


Fig 3.33 access code page

As in fig 3.33 is access code page .

Fig 3.34 Address setting page

The first screen: setting Ai205 address page for the communication purpose. It is any digit number from 1 to 247. As in fig 3.34, the Ai205 Address is 17. Changing method is simple, press H to move the curser to the digit wanted, press P for increasing and press E for decreasing. Press V/A for the acknowledgment.

Note: Each meter on same RS485 net should have different address according to the Modbus-RTU protocol.

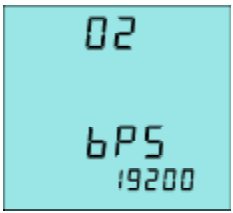


Fig 3.35 Baud rate setting page

The second screen: Baud rate setting page

The asynchronies communication setting of the Ai205 is 8 data bit, no parity, 1 star bit and 1 stop bit. Baud rate could be one of the seven, 600, 1200, 2400, 4800, 9600, 19200, 38400. as in fig 3.35, the baud rate of the Ai205 is 19200bps. Press P or E to select one. Press V/A Key, go to the next page.

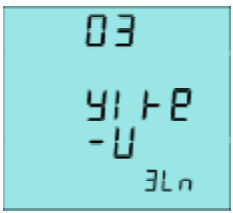


Fig 3.36 Voltage input wiring

The third screen: voltage input wiring setting page

Voltage input could be one of the three modes, 3LN, 2LN and 2LL. (refer to chapter 2)

As in fig 3.36, the setting of voltage input mode is 3LN.

Press P or E to select from 3LN, 2LN and 2LL. Press V/A key for acknowledgment and going to the next page.

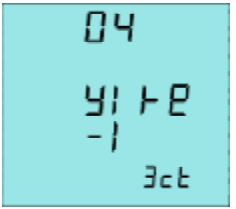


Fig 3.37 Current input wiring

The fourth screen: Current input wiring setting page

Current input wiring could be one of the three modes, 3CT, 2CT and 1CT. (Refer to chapter 2)

As in fig 3.37, current input mode setting is 3CT. Press P or E keys to select from 3CT, 2CT and 1CT. Press V/A key for acknowledgment and going to the next setting page.

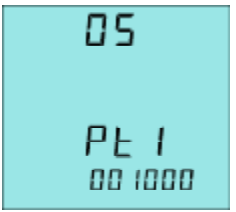


Fig 3.38 PT primary

The fifth screen: PT primary rating voltage PT1 setting page

PT1 value is an integer from 100 to 500,000. The unit is volt.

As in fig 3.38, PT1=1000V, press P, E and H to change the value. Press V/A key for acknowledgment and going to the next setting page.

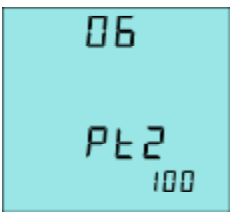


Fig 3.39 PT secondary

The sixth screen: PT secondary rating voltage PT2 setting page.

PT2 value is an integer from 100 to 400. The unit is volt.

As in fig 3.39, PT2=100V, press P, E and H to change the value. Press V/A key for acknowledgment and going to the next setting page.

Note: If there is no PT on the voltage input side of Ai205, the PT1 and PT2 should be the

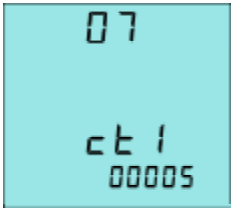


Fig 3.40 CT primary

same and equal to the input rating voltage.

The seventh screen: CT primary rating current CT1 setting page

CT1 value is an integer from 5 to 10000. The unit is Amp.

As in fig 3.40, CT1=5A, pressing P, E and H keys to change the value. Press V/A key for acknowledgment and going to the next setting page.

Fig 3.41 DO mode

The eighth screen: Digital output mode setting

The digital output mode can be set as alarm output or pulse output.

As in fig 3.41, the digital output is set as pulse output. Press V/A key for acknowledgment and going to the next setting page.

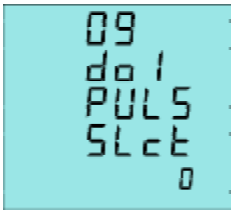


Fig 3.42 DO1 output item

The ninth screen: DO1 output item selecting

The DO1 output can be one of the following 8 energy items as in Table3.2.

Setting number	0	1	2	3	4
Energy item	No output	Ep_imp	Ep_exp	Eq_imp	Eq_exp
Setting Number	5	6	7	8	
Energy item	Ep_total	Ep_net	Eq_tota	Eq_net	

Table3.2 DO1 output item

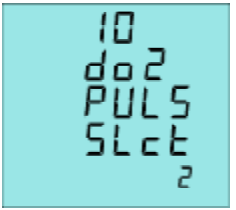


Fig 3.43 DO2 output item

The tenth screen: DO2 output item selecting

The DO2 output can be one of the 8 energy items as in Table3.2.

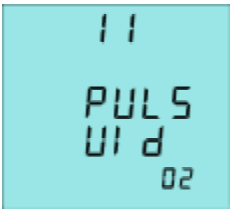


Fig 3.44 Pulse width

The eleventh screen: The DO pulse width setting

The DO pulse width is integer from 1 to 50. One digit represents 20ms.

As in fig 3.44, the pulse width is set to be 2, that is 2x20=40ms.

Fig 3.45 Pulse rate

The twelfth screen: Energy pulse rate setting page.

Pulse rate means the energy value per pulse. It can be the integer of 1 to 6000. One digit represents 0.1Kwh or 0.1Kvarh.

As in fig 3.45, the pulse rate is 10.

Fig 3.46 Relay1 mode

The thirteenth screen: Relay1 mode setting page

There are two relay output in Ai205. There are two relay output modes for selection, one is latching, the other is momentary. For the latching mode, the relay can be used to output two statues on or off. For the momentary mode, the output of the relay changes from off to on for a period of time Ton and than goes off. Ton can be setting from 50-300ms. 0: latching 1: momentary

As in fig 3.46, Relay1 is set momentary mode.

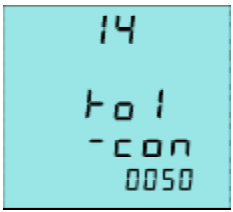


Fig 3.47 Relay1 closing time

The fourteenth screen: Relay1 closing time setting

When the relay mode is set momentary, the closing time Ton is integer from 50 to 3000ms.

As in fig 3.47, the closing time Ton of relay1 is 50ms.

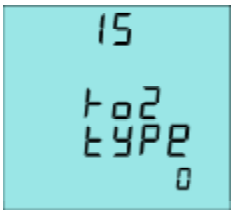


Fig 3.48 Relay2 mode

The fifteenth screen: Relay2 mode setting page

The setting method is the same as that of relay1.

As in fig 3.48, Relay2 is set momentary mode.

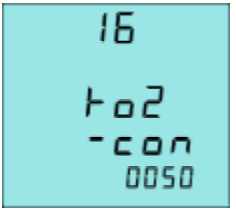


Fig 3.49 Relay2 closing time

The sixteenth screen: Relay2 closing time setting

The setting method is the same as that of relay1. As in fig 3.49, the closing time Ton of relay1 is 50ms.

Note: If the relay mode is set to be latching, the setting of relay closing time Ton do not has any interference on the relay state.

Fig 3.50 Back light “on”time

The seventeenth screen: Display back light “on” time setting page

The backlight will go to“off ”for the purpose of energy saving and component duration if the key does not be touched for a period time. The “on” time can be set from 0 to 120 Minute. The back light will always be “on” if the setting value is 0.

As in fig 3.50, the setting time of the back light is 5 minute. The back light will automatically go to “off ” if there is no touch on the keys.

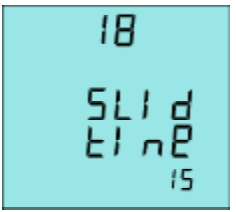


Fig 3.51 Sliding window time

The eighteenth screen: Sliding window time of demand setting page

Sliding window time of demand is from 1 to 30 Minute. The window slid once per Minute.

As in fig 3.51, the sliding window time is 15 Minute.

Note: There are not eighteenth screen to twenty first screen in Ai205-P0 and -P1.

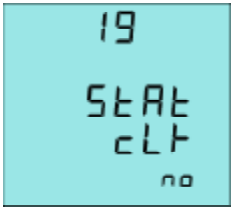


Fig 3.52 Clearance of the max and min value

The nineteenth screen: Clearance of the Max and Min value

The Max and Min statistics value can be cleared by operating the front keys. Clear means to begin record new Max and Min statistics value.

As in fig 3.52, press E or P keys to select Yes or No.

Yes: Clear the Max and Min statistics value

No: Do not clear the Max and Min statistics value

Press V/A key, go to the next setting page.

Fig 3.53 Date

The twentieth screen: System date setting page

Display format is MM:DD:YYYY

MM: 1 to 12

DD: 1 to 31

YYYY: 2000 to 2099

As in fig 3.53, the setting date is Jan. 18, 2002.

Press V/A key, go to next setting page.

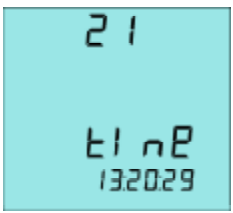


Fig 3.54 Time

The twenty first screen: system time setting page

The display format is hh:mm:ss.

hh: 0 to 23

mm: 0 to 59

ss: 0 to 59

As in fig 3.54, the system time is 13:20:29

Press V/A key, go to next setting page.

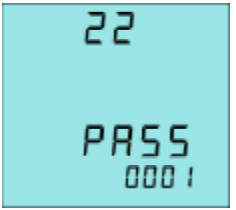


Fig 3.55 Access code setting

The twenty second screen: Access code setting page (It is the eighteenth screen in Ai205)

This is the last screen of the setting page. The access code can be changed in this setting page. It is important to remember the new access code.

As in fig 3.55, the access code is 0001. Press the V/A key, let the access code be stored in Ai205 and go back to the first setting page. All the setting has been finished. Press H and V/A keys, exit the setting mode.

Introduction of measurement and functions of Ai205

Almost all electric parameters in power systems can be measured by Ai205 series intelligent power meter. Some parameters that do not be familiar by users will be introduced in this part.

Voltage (U): True RMS value of three phase voltages, three line to line voltages and their average are measured and displayed in Ai205.

Current (I): True RMS value of three phase currents, neutral current and their average are measured and displayed in Ai205.

Power (P): Three phase power and system total power are measured and display in Ai205.

Reactive power (Q): Three phase reactive power and system total reactive power are measured and displayed in Ai205.

Apparent power (S): Three phase apparent power and system total apparent power are measured and displayed in Ai205.

Frequency (F): The frequency of U1 phase voltage input is measured as system frequency.

Energy (Kwh): Energy is time integral of power. The unit is Kwh. As power has direction, positive means consumption and negative means generating. So the energy has also the nature of consumption or generating.

Import (imp): Consumption energy

Export (exp): Generating energy

Total: Absolute sum of import and export energy

Net: Algebraic sum of import and export energy

Reactive power: Reactive energy is time integral of reactive power. The unit is Kvarh. As reactive power has direction, positive means inductive and negative means capacitive, so the reactive energy has also got the nature of inductive and capacitive.

Import (imp): Inductive reactive energy

Export (exp): Capacitive reactive energy

Total: Absolute sum of import and export reactive energy

Net: Algebraic sum of import and export reactive energy

Each of the four reactive energies is measured and stored independently.

Demand: Demand of power, reactive power and apparent power. The demand statistics method in Ai205 is sliding window. The sliding window time can be chose between 1 to 30 Minutes. The window slides one Minute each time. For example, the sliding window time is supposed to be 3 Minute. If average power of the first Minute is 12, average power of the second Minute is 14 and average power of the third Minute is 10, then the total demand of the 3 minutes is (12+14+10)/3=12 at the end of the three Minute. If another Minute passed, the average power of the Minute is 8, then the total power demand of the last three Minute is (14+10+8)/3=10 at the end of the fourth Minute.

Crest factor (CF): The crest factor is used to express the distortion of waveform. This is an important factor to scale the influence to the system insulation. The expression is as following:

In the expression, U1 is the RMS of fundamental and Uh is the RMS of the h^{th} harmonic.

$$CF = 1.414\sum_{h=1}^{50}\frac{Uh}{U1}$$

The function of Crest factor only exists in Ai205-P2 or -P3.

Total harmonic distortion: This factor is often used to express the power quality of the electric power system. The expression is as following,

$$THD = \sqrt{\sum_{h=2}^{50}\left(\frac{Uh}{U1}\right)^2} \times 100\%$$

In the expression, U1 is the RMS of fundamental and Uh is the RMS of the h^{th} harmonic.

This function exists in Ai205.

$$HRUh = \frac{Uh}{U1} \times 100\%$$

Each harmonic rate: The percentage of each harmonic divided by fundamental.

$$HRIh = \frac{Ih}{I1} \times 100\%$$

Total Even harmonics distortion: Root of the sum of each even harmonics square.

Total Odd harmonics distortion: Root of the sum of each odd harmonics square.

Telephone Interference Factor (THFF): The interference factor to telephone communication system. The expression of the THFF is as following,

$$THFF = \sqrt{\sum_{h=1}^{100}\left(\frac{50 \times h \times Ph \times Uh}{800 \times 1000 \times U1}\right)^2} \times 100\%$$

In the expression, the Uh is the voltage of the h^{th} harmonic and the Ph is coefficient which is defined by CCITT committee.

The function of the THFF exists in Ai205.

K factor: This is an important factor to scale the power quality of current.

$$K\ factor = \frac{\sum_{n=1}^{k}(n \times Fn)^2}{\sum_{n=1}^{k}(Fn)^2}$$

In the expression, the Fn is the RMS of the nth harmonic.

Three phase unbalance factor: three phase voltage unbalance factor and three phase current unbalance factor can be measured in Ai205-P2 or -P3. The unbalance factor is express in percentage.

$$\text{Voltage unbalance factor} = \frac{\text{The Max different value of three voltages}}{\text{Average value of three voltages}}$$

$$\text{Current unbalance factor} = \frac{\text{The Max different value of the three currents}}{\text{Average value of three currents}}$$

Max/Min statistics: The maximum and minimum value of the metering data is stored in unvaluntable RAM and can be accessed or cleared from front panel or through communication in Ai205-P2 or -P3. These metering data is phase voltage, line to line voltage, current, power, reactive power, apparent power, power factor, frequency, demand.

Real time clock: There is a real time clock in the Ai205-P2 or -P3. The date, month, year, hour, minute and second can be read or set from front panel or through communication.

Phase Angle different: the phase angel difference gives the phase angle relationship between the voltage and current. It is from 0 to 360°. When the wiring of voltage input is set to be 2LL, it gives the phase difference U23, i1, i2 and i3 relative to U12. When the wiring of voltage input is set to be 2LN and 3LN, it gives the phase difference U2, U3, i1, i2, i3 relative to U1.

Over limit alarming

In Ai205-P2 or -P3, when the metering data is over the pre-setting limit and over presetting period of time, the over limit alarming will be picked up. The over limit value and time will be recorded and the maximum number of records is 9. The digital output (DO) can be used as light or sound alarming trigger.

There can be maximum 9 inequations related to the over limit alarming. Any satisfaction of the inequations will trigger the over limit alarming. Any one of the 9 equations can be assigned to one of the digital output (DO). An example is given in the following to describe how the first inequation is being set and determined.

Start :	
Enable inequation1	Enable the first inequation
Var1 := Parameter	Let the variable1 to represent the alarming parameter
Ref1 := Value	Set the limit value to the Ref1
Limit_t := time	Set the time limit to the Limit_t
Setting inequality_sign	Select the inequatity sign > or <
Setting associatedDO	Select the related digital output (DO)
If Var1 inequality Ref1="True" and Last_time>Limit_t	Determine if the parameter is over the limit and over the time limit
Then	If it is true, then
{ record envent	Record the value, date and time
Output associatedDO }	Setting the related Digital output (DO)
end	Finish

The related registers should be preset in order to finish the above process. The registers are preset through communication.

Inequation enable register: register EN_INEQU, bit0~bit8 corresponding to 1 to 9 inequation.

Bit(n)=0 forbid the nth inequation

Bit(n)=1 enable the nth inequation

The 9 variables (var1 to var9) can be any of the 34 parameters.

Var number	0	1	2	3	4	5	6	7	8
Var name	F	V1	V2	V3	Vlnavg	V12	V23	V31	Vllavg
Var number	9	10	11	12	13	14	15	16	17
Var name	I1	I2	I3	Iavg	In	P1	P2	P3	Psum
Var number	18	19	20	21	22	23	24	25	26
Var name	Q1	Q2	Q3	Qsum	S1	S2	S3	Ssum	PF1
Var number	27	28	29	30	31	32	33	34	
Var name	PF2	PF3	PF	U_unbl	I_unbl	Dmd_P	Dmd_Q	Dmd_S	

Table 3.3 parameter name and number

Limit setting register: register Ref1 to Ref9

The setting of the Ref register should be the up limit or the low limit of the parameter. The range of the parameter limit is related to the format of the register.

Time limit setting register: register Limit_t

Limit_t is the time limit. It is an integer from 0 to 255. One digit is 300ms. Zero means no time limit. Trigger the record and alarming output immediately on the over limitation. All the inequations have the same time limit. If the Limit_t=20, the time limitation is 20x300=6000ms.

Inequation sign register: INEQU_Sign1 to INEQU_Sign9

INEQU_Sign=0, select <, the low limit

INEQU_Sign=1, select >, the up limit

The DO select register:

AssociatedDO1 register bit0~bit8 correspond to the first to ninth inequation.

Bit(n)=0, DO1 do not associate with the nth inequation

Bit(n)=0, DO1 associate with the nth inequation

AssociatedDO2 register bit0~bit8 correspond to the first to ninth inequation.

Bit(n)=0, DO2 do not associate with the nth inequation

Bit(n)=0, DO2 associate with the nth inequation

Example:

If current I1 goes over the up limit and time limit 15 Seconds, trigger the over limit alarm record and DO1 output. The CT ratio of the current I1 is 200:5. The up limit of current I1 is set to be 180A. The setting of the registers is as following.

Enable the inequation1: EN_INEQU register bit(0)=1

The current I1 is number 9 in Table3.3. The setting of the Var1 is 9.

The relation of real current and the data stored in register is,

Real current=(data in registerxCT1/5)/1000

The CT1 is 200 and up limit of current is 180A, then the data in register is 4500. The setting of the Ref1 is 4500.

Time limit is 15 Seconds and the one digit is 300ms, then the setting of Limit_t1 is 50.

As it is the up limit, the INQU_Sign1 should be 1.

Use DO1as alarm signal output, then the bit0 of the associatedDO1 should be 1.

The output mode of DO should be set alarming through front panel or communication.

Address	Content	Remark
Alarming record addr	Alarming parameter number: Var	Refer to Table3.3
Addr +1	Alarming value	Record the value of alarming
Addr +2	Year	parameter
Addr+3	Month	Alarming date
Addr+4	Date	
Addr+5	Hour	
Addr+6	Minute	Alarming time
Addr+7	Second	

Table3.4 Alarm record

Only recent 9 groups of the alarming record can be stored in memory of Ai205-P2 or -P3. The format of the record is,

When the alarming parameter resume normal (no longer over the limit), it is also recorded. User can get the total period of over limit time.

Note: when the alarming parameter resume to normal, the highest bit of Var bit15 is set to be 1.

Energy pulse output: The two digital outputs (DO) can be select as energy pulse output. Any two of the 8 energy and reactive energy can be assigned to be as the pulse output. The pulse width and pulse ratio can be set, while pulse width means how long the duration of the pulse is and pulse ratio means how much energy that one pulse is represented. When the energy accumulates to the setting limit, there will be a pulse output from the assigned DO port.

Pulse output assignment register: any integer from 0 to 8. The digit 0 means no assignment, while 1 to 8 corresponding to Ep_imp, Ep_exp, Eq_imp, Eq_exp, Ep_total, Ep_net, Eq_total and Eq_net respectively.

Pulse ratio register: any integer from 1 to 6000. One digit represents 0.1Kwh or Kvarh. This value is the minimum resolution of energy pulse output.

Pulse width setting register: any integer from 1 to 50. One digit represents 20ms.

The minimum time interval between two adjoining output pulses is 20ms in Ai205. If the pulse width is 20ms, then maximum number of output pulses is 25 in one Second. If the pulse width is 80ms, then the maximum number of output pulse is 10.

In practice the pulse width and the pulse ratio are selected according to system power. The relation of the two parameters should satisfied following expression,

$$\text{Pulse ratio} > \frac{(\text{pulse width} + 1) \times \text{Pmax}}{18000}$$

In the expression, the Pmax is the maximum power or reactive power. The unit is KW or Kvar. Recommend pulse ratio is 3 to 5 times the right side value of the above expression.

Relay output: The two relay output (option) in Ai205 can be used to control electric switch or equipment. There are two output mode of the relay, latching or momentary. Momentary mode is often used to control the electric switch. The closing time interval can be selected between 50ms to 3000ms.

Chapter 4 Communication

Introducing Modbus Protocol

Format of Communication

Data Address Table

Introducing Modbus Protocol

The Modbus RTU protocol is used for communication in Ai205. The data format and error check method 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

Modbus is trademark of Modicon, Inc.

Framing

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

Table4.1 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	Preset Multiple-Registers	Place specific binary values into a series of consecutive Multiple-Registers

Table4.2 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 results. The CRC is started by 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.

Format of communication

Explanation of frame

Addr	Fun	Data start	Data start	Data #of	Data #of	CRC16	CRC16
		reg hi	reg lo	regs hi	regs lo	Hi	Lo
06H	03H	00H	00H	00H	21H	84H	65H

Table4.3 Explanation of frame

In table4.3, 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 in Ai205.
1=On 0=Off
There are 2 Relays in Ai205. The Address of each Relay is
Relay1=0000H and
Relay2=0001H.
The following query is to read Relay Status of Ai205 Number 17.

Query

Addr	Fun	relay start reg hi	relay start reg lo	relay #of regs hi	relay #of regs lo	CRC16 Hi	CRC16 Lo
11H	01H	00H	00H	00H	02H	BFH	5BH

Table4.4 Read the status of Relay1 and Relay2 Query Message

Response

The Ai205 response includes the Ai205 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 Table4.5. The status of Relay1 and Relay2 is responding to the last 2 bit of the data.

Relay1: bit0 Relay2: bit1

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

Table4.5 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

There are 4 DIs in Ai205. The Address of each DI is

DI1=0000H, DI2=0001H, DI3=0002H and DI4=0003H.

The following query is to read the 4 DI Status of Number 17 Ai205.

Query

Addr	Fun	DI start addr hi	DI start addr lo	DI num hi	DI num lo	CRC16 hi	CRC16 lo
11H	02H	00H	00H	00H	04H	7BH	59H

Table4.6 Read 4 DIs Query Message

Response

The Ai205 response includes the Ai205 address, function code, quantity of data characters, the data characters, and error checking. An example response to read the status of 4 DIs is shown as Table4.7. The status of each is responding to the last 4 bit of the data.

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

Table 4.7 Read Status of DI

addr	Fun	Byte count	Data	CRC16 hi	CRC16 lo
11H	02H	01H	03H	E5H	49H

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 Ai205. Table4.8 is an example to read the 3 measured data (F, V1 and V2) from slave device number 17, the data address of F is 0130H, V1 is 0131H and V2 is 0132H.

Addr	Fun	Data start addr hi	Data start addr lo	Data #of regs hi	Data #of regs lo	CRC16 regs hi	CRC16 regs lo
11H	03H	01H	30H	00H	03H	06H	A8H

Table 4.8 Read F,V1,V2 Query Message

Response

The Ai205 response includes the Ai205 address, function code, quantity of data byte, data, and error checking. An example response to read F, V1 and V2 (F=1388H (50.00Hz), V1=03E7H (99.9V), V2=03E9H (100.1V) is shown as Table4.9.

Addr	Fun	Byte count	Data1 hi	Data1 Lo	Data 2 hi	Data2 lo	Data3 hi	Data3 lo	CRC16 hi	CRC16 lo
11H	03H	06H	13H	88H	03H	E7H	03H	E9H	7FH	04H

Table4.9 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 Ai205 can be forced to be either status (on or off). The address of Relays starts at 0000H (Relay1=0000H, Relay2=0001H). 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 Ai205 number 17 to turn on Relay1.

Addr	Fun	DO addr hi	DO addr Lo	Value Hi	Value lo	CRC16 hi	CRC16 lo
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table4.10 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 address high	Relay address Low	Value High	Value low	CRC high	CRC low
11H	05H	00H	00H	FFH	00H	8EH	AAH

Table4.11 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. Any Register that exists within the Ai205 can have its contents changed by this message.

The example below is a request to an Ai205 number 17 to Preset Ep_imp (17807783.3KWH), while its Hex Value 0A9D4089H. Ep_imp data address is 0156H and 0157H.

Address	11H
Function	10H
Data start register high	01H
Data start register low	56H
Data register high	00H
Data register low	02H
Byte count	04H
Value high	0AH
Value low	9DH
Value high	40H
Value low	89H
CRC high	4DH
CRC low	B9H

Table4.12 Preset KWH Query Message

Response

The normal response to a preset Multi-Register request includes the Ai205 address, function code, data start register, the number of registers, and error checking.

Address	11H
Function code	10H
Data start address high	01H
Data start address low	56H
Data register high	00H
Data register low	02H
CRC high	A2H
CRC low	B4H

Table4.13 Preset Multi-Registers Response Message

Data address table

The measured data in shadow only exists in Ai205-P2 or -P3.

Basic Analog measurements

Function code: 03

Address	Parameter	Range	Object Type	Type of access
0130H	Frequency F	0~7000	word	R
0131H	Phase Voltage V1	0~65535	word	R
0132H	Phase Voltage V2	0~65535	word	R
0133H	Phase Voltage V3	0~65535	word	R
0134H	Average Phase Voltage Vlnavg	0~65535	word	R
0135H	Line Voltage V12	0~65535	word	R
0136H	Line Voltage V23	0~65535	word	R
0137H	Line Voltage V31	0~65535	word	R
0138H	Average Line Voltage Vllavg	0~65535	word	R
0139H	Current I1	0~65535	word	R
013AH	Current I2	0~65535	word	R
013BH	Current I3	0~65535	word	R
013CH	Average Current Iavg	0~65535	word	R
013DH	Neutral Line Current In	0~65535	word	R
013EH	Phase Power P1	-32768~32767	Integer	R
013FH	Phase Power P2	-32768~32767	Integer	R
0140H	Phase Power P3	-32768~32767	Integer	R
0141H	System Power Psum	-32768~32767	Integer	R
0142H	Phase Reactive Power Q1	-32768~32767	Integer	R
0143H	Phase Reactive Power Q2	-32768~32767	Integer	R
0144H	Phase Reactive Power Q3	-32768~32767	Integer	R

0145H	System Reactive Power Qsum	-32768~32767	Integer	R
0146H	Phase Apparent Power S1	0~65535	word	R
0147H	Phase Apparent Power S2	0~65535	word	R
0148H	Phase Apparent Power S3	0~65535	word	R
0149H	System Apparent Power Ssum	0~65535	word	R
014AH	Phase Power Factor PF1	-1000~1000	Integer	R
014BH	Phase Power Factor PF2	-1000~1000	Integer	R
014CH	Phase Power Factor PF3	-1000~1000	Integer	R
014DH	System Power Factor	-1000~1000	Integer	R
014EH	Voltage Unbalance Factor U_unbl	0~3000	word	R
014FH	Current Unbalance Factor I_unbl	0~3000	word	R
0150H	Load Type RT (L/C/R)	76/67/82	word	R
0151H	Power Demand Dmd_P	-32768~32767	Integer	R
0152H	Reactive power Demand Dmd_Q	-32768~32767	Integer	R
0153H	Apparent Power Demand Dmd_S	0~65535	word	R

Table 4.14 Metering data address table

The Relationship between numerical value in register of Ai205 and the real physical value is as following table. (Rx is the numerical value in register of Ai205)

Parameter	Relationship	Unit
Voltage V1, V2, V3, V12, V23, V31, Vllavg	U=Rx × (PT1/PT2)/10	Volt(V)
Current I1, I2, I3, Iavg, In	I =Rx × (CT1/5)/1000	Amp(A)
Power P1, P2, P3, Psum, Power Demand Dmd_P	P=Rx × (PT1/PT2) × (CT1/ 5)	Watt(W)
Reactive Power Q1, Q2, Q3, Qsum, Reactive Power Demand Dmd_Q	Q=Rx × (PT1/PT2) × (CT1/5)	Var
Apparent Power S1, S2, S3, Ssum Demand Power Dmd_S	S=Rx × (PT1/PT2) × (CT1/5)	VA

Power Factor PF1, PF2, PF3, PF	PF=Rx/1000	NA
Frequency	F=Rx/100	Hz
Load Type RT (L/C/R)	ASCII of L, C, R Low 8 bit of Register	NA
Voltage or Current Unbalance Factor U_unbl, I_unbl	unbl=(Rx/1000)× 100%	NA

Table 4.15 Measareing data convert table

Energy measurement

Function code : 03 Read 16, Preset

Address	Parameters	Range	Object Type	Type of access
0156H(High 16 Bit) 0157H(Low 16 bit)	Import Energy Ep_imp	0~99999999.9	Dword	R/W
0158H(High 16 Bit) 0159H(Low 16 bit)	Export Energy Ep_exp	0~99999999.9	Dword	R/W
015AH(High 16 Bit) 015BH(Low 16 bit)	Import Reactive Energy Eq_imp	0~99999999.9	Dword	R/W
015CH(High 16 Bit) 015DH(Low 16 bit)	Export Reactive Energy Eq_exp	0~99999999.9	Dword	R/W
015EH(High 16 Bit) 015FH(Low 16 bit)	Absolute Sum of Energy Ep_total	0~99999999.9	Dword	R/W
0160H(High 16 Bit) 0161H(Low 16 bit)	Algebra Sum of Energy Ep_net	0~99999999.9	Dword	R/W
0162H(High 16 Bit) 0163H(Low 16 bit)	Absolute Sum of Energy Eq_total	0~99999999.9	Dword	R/W
0164H(High 16 Bit) 0165H(Low 16 bit)	Algebra Sum of Energy Eq_net	0~99999999.9	Dword	R/W

Table 4.16 Energy data address table

Power Quality Measurements

Function code: 03

Parameter	Relationship	Unit
Energy Ep_imp, Ep_exp, Ep_total, Ep_net	Ep=Rx / 10	Kwh
Reactive Energy Eq_imp,Eq_exp,Eq_total,Eq_net	Eq=Rx / 10	Kvarh

Table 4.17 Energy data converting table

Power Quality Measurements

Function code: 03

Address	Parameter	Range	Object Type	Type of access
0168H	Total Harmonic Distortion of V1 or V12, THD_V1	0~10000	word	R
0169H	Total Harmonic Distortion of V2 or V23, THD_V2	0~10000	word	R
016AH	Total Harmonic Distortion of V3 or V31, THD_V3	0~10000	word	R
016BH	Average Total Harmonic Distortion of Voltage,THD_V	0~10000	word	R
016CH	Total Harmonic Distortion of I1 , THD_I1	0~10000	word	R
016DH	Total Harmonic Distortion of I2, THD_I2	0~10000	word	R
016EH	Total Harmonic Distortion of I3, THD_I3	0~10000	word	R
016FH	Average Total Harmonic Distortion of Current, THD_I	0~10000	word	R
0170H-018DH	Harmonic Content of V1 or V12 (2nd to 31st)	0~10000	word	R
018EH	Total Odd Harmonic Distortion of V1 or V12	0~10000	word	R
018FH	Total Even Harmonic Distortion of V1 or V12	0~10000	word	R
0190H	Crest factor of V1 or V12	0~65535	word	R
0191H	Telephone interference factor of V1 or V12, THFF	0~10000	word	R
0192H-01AFH	Harmonic Content of V2 or V23 (2nd to 31st)	0~10000	word	R
01B0H	Total Odd Harmonic Distortion of V2 or V23	0~10000	word	R

01B1H	Total Even Harmonic Distortion of V2 or V23	0~10000	word	R
01B2H	Crest factor of V2 or V23	0~65535	word	R
01B3H	Telephone interference factor of V2 or V23, THFF	0~10000	word	R
01B4H-01D1H	Harmonic Content of V3 or V31 (2^{nd} to 31^{st})	0~10000	word	R
01D2H	Total Odd Harmonic Distortion of V3 or V31	0~10000	word	R
01D3H	Total Even Harmonic Distortion of V3 or V31	0~10000	word	R
01D4H	Crest factor of V3 or V31	0~65535	word	R
01D5H	Telephone interference factor of V3 or V31, THFF	0~10000	word	R
01D6H-01F3H	Harmonic Content of I1 (2^{nd} to 31^{st})	0~10000	word	R
01F4H	Total Odd Harmonic Distortion of I1	0~10000	word	R
01F5H	Total Even Harmonic Distortion of I1	0~10000	word	R
01F6H	K Factor of I1	0~65535	word	R
01F7H-0214H	Harmonic Content of I2 (2^{nd} to 31^{st})	0~10000	word	R
0215H	Total Odd Harmonic Distortion of I2	0~10000	word	R
0216H	Total Even Harmonic Distortion of I2	0~10000	word	R
0217H	K Factor of I2	0~65535	word	R
0218H-0235H	Harmonic Content of I3 (2^{nd} to 31^{st})	0~10000	word	R
0236H	Total Odd Harmonic Distortion of I3	0~10000	word	R
0237H	Total Even Harmonic Distortion of I3	0~10000	word	R
0238H	K Factor of I3	0~65535	word	R

The Relationship between numerical value in register of Ai205 and the physical value is as following table. (Rx is the numerical value inregister of Ai205)

Parameter	Relationship	Unit
THD	THD=Rx / 10000 × 100%	NA
Harmonic Content	HDn=Rx / 10000 × 100%	NA

Odd THD	HDo=Rx / 10000 × 100%	NA
Even THD	HDe=Rx / 10000 × 100%	NA
Crest Factor	CF=Rx / 1000	NA
K Factor	KF=Rx / 10	NA
THFF	THFF=Rx / 10000 × 100%	NA

Table 4.19 Power quality data convert table

Max/Min Statistics Value with Time Stamps

Function code: 03

Address	Parameter		Range	Object Type	Type of access
0239H	V1_max		0~65535	word	R
023AH	Time Stamp of V1_max	year	2000~2099	word	R
023BH		mon	1~12	word	R
023CH		day	1~31	word	R
023DH		hour	0~23	word	R
023EH		min	0~59	word	R
023FH		sec	0~59	word	R
0240H	V2_max		0~65535	word	R
0241H	Time Stamp of V2_max	year	2000~2099	word	R
0242H		mon	1~12	word	R
0243H		day	1~31	word	R
0244H		hour	0~23	word	R
0245H		min	0~59	word	R
0246H		sec	0~59	word	R
0247H	V3_max		0~65535	word	R
0248H	Time Stamp of V3_max	year	2000~2099	word	R
0249H		mon	1~12	word	R
024AH		day	1~31	word	R
024BH		hour	0~23	word	R
024CH		min	0~59	word	R

024DH	sec		0~59	word	R
024EH	V12_max		0~65535	word	R
024FH	Time Stamp of V12_max	year	2000~2099	word	R
0250H		mon	1~12	word	R
0251H		day	1~31	word	R
0252H		hour	0~23	word	R
0253H		min	0~59	word	R
0254H		sec	0~59	word	R
0255H	V23_max		0~65535	word	R
0256H	Time Stamp of V23_max	year	2000~2099	word	R
0257H		mon	1~12	word	R
0258H		day	1~31	word	R
0259H		hour	0~23	word	R
025AH		min	0~59	word	R
025BH		sec	0~59	word	R
025CH	V31_max		0~65535	word	R
025DH	Time Stamp of V31_max	year	2000~2099	word	R
025EH		mon	1~12	word	R
025FH		day	1~31	word	R
0260H		hour	0~23	word	R
0261H		min	0~59	word	R
0262H		sec	0~59	word	R
0263H	I1_max		0~65535	word	R
0264H	Time Stamp of I1_max	year	2000~2099	word	R
0265H		mon	1~12	word	R
0266H		day	1~31	word	R
0267H		hour	0~23	word	R
0268H		min	0~59	word	R
0269H		sec	0~59	word	R

026AH	I2_max		0~65535	word	R
026BH	Time Stamp of I2_max	year	2000~2099	word	R
026CH		mon	1~12	word	R
026DH		day	1~31	word	R
026EH		hour	0~23	word	R
026FH		min	0~59	word	R
0270H		sec	0~59	word	R
0271H	I3_max		0~65535	word	R
0272H	Time Stamp of I3_max	year	2000~2099	word	R
0273H		mon	1~12	word	R
0274H		day	1~31	word	R
0275H		hour	0~23	word	R
0276H		min	0~59	word	R
0277H		sec	0~59	word	R
0278H	P_max		-32768~32767	integer	R
0279H	Time Stamp of P_max	year	2000~2099	word	R
027AH		mon	1~12	word	R
027BH		day	1~31	word	R
027CH		hour	0~23	word	R
027DH		min	0~59	word	R
027EH		sec	0~59	word	R
027FH	Q_max		-32768~32767	integer	R
0280H	Time Stamp of Q_max	year	2000~2099	word	R
0281H		mon	1~12	word	R
0282H		day	1~31	word	R
0283H		hour	0~23	word	R
0284H		min	0~59	word	R
0285H		sec	0~59	word	R
0286H	S_max		0~65535	word	R

0287H	Time Stamp of S_max	year	2000~2099	word	R
0288H		mon	1~12	word	R
0289H		day	1~31	word	R
028AH		hour	0~23	word	R
028BH		min	0~59	word	R
028CH		sec	0~59	word	R
028DH	PF_max		-1000~1000	integer	R
028EH	Time Stamp of PF_max	year	2000~2099	word	R
028FH		mon	1~12	word	R
0290H		day	1~31	word	R
0291H		hour	0~23	word	R
0292H		min	0~59	word	R
0293H		sec	0~59	word	R
0294H	F_max		0~7000	word	R
0295H	Time Stamp of PF_max	year	2000~2099	word	R
0296H		mon	1~12	word	R
0297H		day	1~31	word	R
0298H		hour	0~23	word	R
0299H		min	0~59	word	R
029AH		sec	0~59	word	R
029BH	Dmd_P_max		-32768~32767	integer	R
029CH	Time Stamp of Dmd_P_max	year	2000~2099	word	R
029DH		mon	1~12	word	R
029EH		day	1~31	word	R
029FH		hour	0~23	word	R
02A0H		min	0~59	word	R
02A1H		sec	0~59	word	R
02A2H	Dmd_Q_max		-32768~32767	integer	R
02A3H		year	2000~2099	word	R

02A4H	Time Stamp of Dmd_Q_max	mon	1~12	word	R
02A5H		day	1~31	word	R
02A6H		hour	0~23	word	R
02A7H		min	0~59	word	R
02A8H		sec	0~59	word	R
02A9H	Dmd_S_max		0~65535	word	R
02AAH	Time Stamp of Dmd_S_max	year	2000~2099	word	R
02ABH		mon	1~12	word	R
02ACH		day	1~31	word	R
02ADH		hour	0~23	word	R
02AEH		min	0~59	word	R
02AFH		sec	0~59	word	R
Min Record					
02B0H	V1_min		0~65535	word	R
02B1H	Time Stamp of V1_min	year	2000~2099	word	R
02B2H		mon	1~12	word	R
02B3H		day	1~31	word	R
02B4H		hour	0~23	word	R
02B5H		min	0~59	word	R
02B6H		sec	0~59	word	R
02B7H	V2_ min		0~65535	word	R
02B8H	Time Stamp of V2_min	year	2000~2099	word	R
02B9H		mon	1~12	word	R
02BAH		day	1~31	word	R
02BBH		hour	0~23	word	R
02BCH		min	0~59	word	R
02BDH		sec	0~59	word	R
02BEH	V3_ min		0~65535	word	R
02BFH		year	2000~2099	word	R

02C0H	Time Stamp of V3_min	mon	1~12	word	R
02C1H		day	1~31	word	R
02C2H		hour	0~23	word	R
02C3H		min	0~59	word	R
02C4H		sec	0~59	word	R
02C5H	V12_ min		0~65535	word	R
02C6H	Time Stamp of V12_min	year	2000~2099	word	R
02C7H		mon	1~12	word	R
02C8H		day	1~31	word	R
02C9H		hour	0~23	word	R
02CAH		min	0~59	word	R
02CBH		sec	0~59	word	R
02CCH	V23_ min		0~65535	word	R
02CDH	Time Stamp of V23_min	year	2000~2099	word	R
02CEH		mon	1~12	word	R
02CFH		day	1~31	word	R
02D0H		hour	0~23	word	R
02D1H		min	0~59	word	R
02D2H		sec	0~59	word	R
02D3H	V31_ min		0~65535	word	R
02D4H	Time Stamp of V31_min	year	2000~2099	word	R
02D5H		mon	1~12	word	R
02D6H		day	1~31	word	R
02D7H		hour	0~23	word	R
02D8H		min	0~59	word	R
02D9H		sec	0~59	word	R
02DAH	I1_min		0~65535	word	R
02DBH		year	2000~2099	word	R
02DCH		mon	1~12	word	R

02DDH	Time Stamp of I1_min	day	1~31	word	R
02DEH		hour	0~23	word	R
02DFH		min	0~59	word	R
02E0H		sec	0~59	word	R
02E1H	I2_ min		0~65535	word	R
02E2H	Time Stamp of I2_min	year	2000~2099	word	R
02E3H		mon	1~12	word	R
02E4H		day	1~31	word	R
02E5H		hour	0~23	word	R
02E6H		min	0~59	word	R
02E7H		sec	0~59	word	R
02E8H	I3_ min		0~65535	word	R
02E9H	Time Stamp of I3_min	year	2000~2099	word	R
02EAH		mon	1~12	word	R
02EBH		day	1~31	word	R
02ECH		hour	0~23	word	R
02EDH		min	0~59	word	R
02EEH		sec	0~59	word	R
02EFH	P_ min		-32768~32767	integer	R
02F0H	Time Stamp of P_min	year	2000~2099	word	R
02F1H		mon	1~12	word	R
02F2H		day	1~31	word	R
02F3H		hour	0~23	word	R
02F4H		min	0~59	word	R
02F5H		sec	0~59	word	R
02F6H	Q_ min		-32768~32767	integer	R
02F7H	Time Stamp of Q_min	year	2000~2099	word	R
02F8H		mon	1~12	word	R
02F9H		day	1~31	word	R

02FAH		hour	0~23	word	R
02FBH		min	0~59	word	R
02FCH		sec	0~59	word	R
02FDH	S_ min		0~65535	word	R
02FEH	Time Stamp of S_min	year	2000~2099	word	R
02FFH		mon	1~12	word	R
0300H		day	1~31	word	R
0301H		hour	0~23	word	R
0302H		min	0~59	word	R
0303H		sec	0~59	word	R
0304H	PF_ min		-1000~1000	integer	R
0305H	Time Stamp of PF_min	year	2000~2099	word	R
0306H		mon	1~12	word	R
0307H		day	1~31	word	R
0308H		hour	0~23	word	R
0309H		min	0~59	word	R
030AH		sec	0~59	word	R
030BH	F_ min		0~7000	word	R
030CH	Time Stamp of F_min	year	2000~2099	word	R
030DH		mon	1~12	word	R
030EH		day	1~31	word	R
030FH		hour	0~23	word	R
0310H		min	0~59	word	R
0311H		sec	0~59	word	R
0312H	Dmd_P_ min		-32768~32767	integer	R
0313H	Time Stamp of Dmd_P_min	year	2000~2099	word	R
0314H		mon	1~12	word	R
0315H		day	1~31	word	R
0316H		hour	0~23	word	R

0317H		min	0~59	word	R
0318H		sec	0~59	word	R
0319H	Dmd_Q_ min		-32768~32767	integer	R
031AH	Time Stamp of Dmd_Q_min	year	2000~2099	word	R
031BH		mon	1~12	word	R
031CH		day	1~31	word	R
031DH		hour	0~23	word	R
031EH		min	0~59	word	R
031FH		sec	0~59	word	R
0320H	Dmd_S_ min		0~65535	word	R
0321H	Time Stamp of Dmd_S_min	year	2000~2099	word	R
0322H		mon	1~12	word	R
0323H		day	1~31	word	R
0324H		hour	0~23	word	R
0325H		min	0~59	word	R
0326H		sec	0~59	word	R

Table 4.20 Max/Min record address

Date and Time table

Function code: 03 for Reading, 16 for Presetting

Address	Parameter	Range	Object Type	Type of access
032AH	yer	2000~2099	word	R/W
032BH	mon	1~12	word	R/W
032CH	day	1~31	word	R/W
032DH	hou	0~23	word	R/W
032EH	min	0~59	word	R/W
032FH	sec	0~59	word	R/W

Table 4.21 Date and time address

Alarm Parameter Register Setting

Function code: 03 for Reading, 16 for Presetting

Addr.	Parameter	Range	Object Type	Type of access
0330H	9 condition inequalities enable Registers	Bit0~8 corresponding to 1st~9th inequality	Integer	R/W
0331H	Time limit Register	0~255	Integer	R/W
0332H	Register associated DO1 with inequalities, AssociatedDO1	Bit0~8 corresponding to 1st~9th inequality 1:Yes 0:No	Integer	R/W
0333H	Register associated DO2 with inequalities, AssociatedDO2	Bit0~8 corresponding to 1st~9th inequality 1:Yes 0:No	Integer	R/W
0334H	Register associated 1st inequality with one of the 34 variables, var1	0~34	Integer	R/W
0335H	Relation symbol selecting register, INEQU_sign1	0:< low limit 1:> up limit	Integer	R/W
0336H	Limit value for 1st inequality, Ref1	Related with variable	Word or Integer	R/W
0337H	Register associated 2nd inequality with one of the 34 variables, var2	0~34	Integer	R/W
0338H	Relation symbol selecting register, INEQU_sign2	0:< low limit 1:> up limit	Integer	R/W
0339H	Limit value for 2nd inequality, Ref2	Related with variable	Word or Integer	R/W
033AH	Register associated 3rd inequality with one of the 34 variables, var3	0~34	Integer	R/W

033BH	Relation symbol selecting register, INEQU_sign3	0:< low limit 1:> up limit	Integer	R/W
033CH	Limit value for 3rd inequality, Ref3	Related with variable	Word or Integer	R/W
033DH	Register associated 4th inequality with one of the 34 variables, var4	0~34	Integer	R/W
033EH	Relation symbol selecting register: INEQU_sign4	0:< low limit 1:> up limit	Integer	R/W
033FH	Limit value for 4th inequality, Ref4	Related with variable	Word or Integer	R/W
0340H	Register associated 5th inequality with one of the 34 variables, var5	0~34	Integer	R/W
0341H	Relation symbol selecting register, INEQU_sign5	0:< low limit 1:> up limit	Integer	R/W
0342H	Limit value for 5th inequality, Ref5	Related with variable	Word or Integer	R/W
0343H	Register associated 6th inequality with one of the 34 variables, var6	0~34	Integer	R/W
0344H	Relation symbol selecting register, INEQU_sign6	0:< low limit 1:> up limit	Integer	R/W
0345H	Limit value for 6th inequality, Ref6	Related with variable	Word or Integer	R/W
0346H	Register associated 7th inequality with one of the 34 variables, var7	0~34	Integer	R/W
0347H	Relation symbol selecting register, INEQU_sign7	0:< low limit 1:> up limit	Integer	R/W
0348H	Limit value for 7th inequality, Ref7	Related with variable	Word or Integer	R/W
0349H	Register associated 8th inequality with one of the 34 variables, var8	0~34	Integer	R/W
034AH	Relation symbol selecting register, INEQU_sign8	0:< low limit 1:> up limit	Integer	R/W
034BH	Limit value for 8th inequality, Ref8	Related with variable	Word or Integer	R/W

034CH	Register associated 9th inequality with one of the 34 variables, var9	0~34	Integer	R/W
034DH	Relation symbol selecting register, INEQU_sign9	0:< low limit 1:> up limit	Integer	R/W
034EH	Limit value for 9th inequality, Ref9	Related with variable	Word or Integer	R/W

Table 4.22 Alarming setting table

Alarm Recording

Function code: 03 for Reading

Addr.	Parameter	Range	Object Type	Type of access
0354H	Over limit Status of the 9 inequalities	Bit0~8 corresponding to 1st ~9th inequality 0: No 1: Yes	Integer	R
0355H	Variable Number of the 1st Alarm record	0~34	word	R
0356H	Variable Value of the 1st Alarm Record	-32768~32767	Integer	R
0357H	Year of 1st Alarm Record	2000~2099	word	R
0358H	Month of 1st Alarm Record	1~12	word	R
0359H	Date of 1st Alarm Record	1~31	word	R
035AH	Hour of 1st Alarm Record	0~23	word	R
035BH	Minute of 1st Alarm Record	0~59	word	R
035CH	Second of 1st Alarm Record	0~59	word	R
035DH	Variable Number of the 2nd Alarm record	0~34	word	R
035EH	Variable Value of the 2nd Alarm Record	-32768~32767	Integer	R
035FH	Year of 2nd Alarm Record	2000~2099	word	R
0360H	Month of 2nd Alarm Record	1~12	word	R
0361H	Date of 2nd Alarm Record	1~31	word	R
0362H	Hour of 2nd Alarm Record	0~23	word	R
0363H	Minute of 2nd Alarm Record	0~59	word	R
0364H	Second of 2nd Alarm Record	0~59	word	R

Addr.	Parameter	Range	ObjectType	Type of access
0365H	Variable Number of the 3rd Alarm record	0~34	word	R
0366H	Variable Value of the 3rd Alarm Record	-32768~32767	Integer	R
0367H	Year of 3rd Alarm Record	2000~2099	word	R
0368H	Month of 3rd Alarm Record	1~12	word	R
0369H	Date of 3rd Alarm Record	1~31	word	R
036AH	Hour of 3rd Alarm Record	0~23	word	R
036BH	Minute of 3rd Alarm Record	0~59	word	R
036CH	Second of 3rd Alarm Record	0~59	word	R
036DH	Variable Number of the 4th Alarm record	0~34	word	R
036EH	Variable Value of the 4th Alarm Record	-32768~32767	Integer	R
036FH	Year of 4th Alarm Record	2000~2099	word	R
0370H	Month of 4th Alarm Record	1~12	word	R
0371H	Date of 4th Alarm Record	1~31	word	R
0372H	Hour of 4th Alarm Record	0~23	word	R
0373H	Minute of 4th Alarm Record	0~59	word	R
0374H	Second of 4th Alarm Record	0~59	word	R
0375H	Variable Number of the 5th Alarm record	0~34	word	R
0376H	Variable Value of the 5th Alarm Record	-32768~32767	Integer	R
0377H	Year of 5th Alarm Record	2000~2099	word	R
0378H	Month of 5th Alarm Record	1~12	word	R
0379H	Date of 5th Alarm Record	1~31	word	R
037AH	Hour of 5th Alarm Record	0~23	word	R
037BH	Minute of 5th Alarm Record	0~59	word	R
037CH	Second of 5th Alarm Record	0~59	word	R
037DH	Variable Number of the 6th Alarm record	0~34	word	R
037EH	Variable Value of the 6th Alarm Record	-32768~32767	Integer	R
037FH	Year of 6th Alarm Record	2000~2099	word	R
0380H	Month of 6th Alarm Record	1~12	word	R

Addr.	Parameter	Range	ObjectType	Type of access
0381H	Date of 6th Alarm Record	1~31	word	R
0382H	Hour of 6th Alarm Record	0~23	word	R
0383H	Minute of 6th Alarm Record	0~59	word	R
0384H	Second of 6th Alarm Record	0~59	word	R
0385H	Variable Number of the 7th Alarm record	0~34	word	R
0386H	Variable Value of the 7th Alarm Record	-32768~32767	Integer	R
0387H	Year of 7th Alarm Record	2000~2099	word	R
0388H	Month of 7th Alarm Record	1~12	word	R
0389H	Date of 7th Alarm Record	1~31	word	R
038AH	Hour of 7th Alarm Record	0~23	word	R
038BH	Minute of 7th Alarm Record	0~59	word	R
038CH	Second of 7th Alarm Record	0~59	word	R
038DH	Variable Number of the 8th Alarm record	0~34	word	R
038EH	Variable Value of the 8th Alarm Record	-32768~32767	Integer	R
038FH	Year of 8th Alarm Record	2000~2099	word	R
0390H	Month of 8th Alarm Record	1~12	word	R
0391H	Date of 8th Alarm Record	1~31	word	R
0392H	Hour of 8th Alarm Record	0~23	word	R
0393H	Minute of 8th Alarm Record	0~59	word	R
0394H	Second of 8th Alarm Record	0~59	word	R
0395H	Variable Number of the 9th Alarm record	0~34	word	R
0396H	Variable Value of the 9th Alarm Record	-32768~32767	Integer	R
0397H	Year of 9th Alarm Record	2000~2099	word	R
0398H	Month of 9th Alarm Record	1~12	word	R
0399H	Date of 9th Alarm Record	1~31	word	R
039AH	Hour of 9th Alarm Record	0~23	word	R
039BH	Minute of 9th Alarm Record	0~59	word	R
039CH	Second of 9th Alarm Record	0~59	word	R

Table 4.23 Alarming record address

Phase angle recording

The phase differences between voltage or Current and U1(or U12)are recorded,The phase differences are used to tell the phase sequence

Function code:03 for reading

039DH	Phase difference V1/V2(3$4)	0~3600	Integer	R
039EH	Phase difference V1/V3(3$4)	0~3600	Integer	R
039FH	Phase difference V1/I1(3$4)	0~3600	Integer	R
03A0H	Phase difference V1/I2(3$4)	0~3600	Integer	R
03A1H	Phase difference V1/I3(3$4)	0~3600	Integer	R
03A2H	Phase difference V12/V23(3$3)	0~3600	Integer	R
03A3H	Phase difference V12/I1(3$3)	0~3600	Integer	R
03A4H	Phase difference V12/I3(3$3)	0~3600	Integer	R

Table 4.24 Phase angle table

The ralation between record numerical data and physical data is :(Rx is numerical data)

Phase angle θ =Rx / 10(Degree)

Ai205 Parameter Setting

Function code: 03 for Reading,16 for Presetting

Addr.	Parameter	Range	Object Type	Type of access
0100H	Access Code	0~9999	word	R/W
0101H	Communication Address	1~247	word	R/W
0102H	Baud Rate	600~38400	word	R/W
0103H	Voltage Input Wiring Type	0:3LN, 1:2LN, 2:2LL	word	R/W
0104H	Current Input Wiring Type	0:3CT, 1:1CT, 2:2CT	word	R/W
0105H	PT1 (High 16 bit)	100~500000	Dword	R/W
0106H	PT1 (Low 16 bit)			

0107H	PT2	100~400	word	R/W
0108H	CT1	5~10000	word	R/W
0109H	DO type	0:Pulse Output 1:Alarm Output	word	R/W
010AH	Energy Variable Number associated with DO1	0~8	word	R/W
010BH	Energy Variable Number associated with DO2	0~8	word	R/W
010CH	Pulse Width	1~50	word	R/W
010DH	Pulse Rate	1~6000	word	R/W
010EH	Relay1 Working Mode	0: Latch 1: Momentary	word	R/W
010FH	Relay1 Pulse Width	50~3000	word	R/W
0110H	Relay2 Working Mode	0: Latch 1: Momentary	word	R/W
0111H	Relay2 Pulse Width	50~3000	word	R/W
0112H	LCD Back light Time	0~120	word	R/W
0113H	Demand Slid Window Time	1~30	word	R/W
0114H	Max/Min Clean	0ah	word	R/W

Table 4.25 System parameter address

Status Input (DI)

Function code: 03 for Reading, 16 for Presetting

Addr.	Parameter	Range	Object Type	Type of access
0000H	DI1	1 :ON , 0 :OFF	bit	R
0001H	DI2	1 :ON , 0 :OFF	bit	R
0002H	DI3	1 : ON, 0 :OFF	bit	R
0003H	DI4	1 :ON, 0 : OFF	bit	R

Table 4.26 Digital input(DI) address

Relay Statue and Control

Function code: 01 for Reading, 05 for Controlling

Addr.	Parameter	Range	Object Type	Type of access
0000H	Relay1	1:ON , 0:OFF	bit	R/W
0001H	Relay2	1:ON , 0:OFF	bit	R/W

Table 4.27 Relay address

1.Object type: Bit-binary bit, word-unsign integer of 16 bit, Integer-Sign integer of 16 bit, Dword-ungign integer of 32 bit

2.Type of Access: R-Read only, Digital input Relay statue and Data are read by using function code 02, 01 and 03 respectivly. R/W-Read and Write, Data is writen by using function code 16 and control command is writen by using function code 05. Writing to read only field is forbiden.

3.Energy data is represented in 32 bit. Both high 16 bit and low 16 bit have successive address alone. The high 16 bit data should be multiplied by 65536 and plus low 16 bit data to get the energy data in master software. The unit is 0.1kwh or 0.1kvarh. It will be clear to zero and start again when energy data accumulat to $1x10^9$kwh(kvarh). The energy register can be cleared or preset through communication.

Appendix

Appendix A Technical data and specifications

Appendix B Ordering

Appendix A Technical data and specifications

Input Ratings

(for 3 phase, 2 phase and single phase)

Voltage input		
Voltage rating	-100V option	100Vac nominal F.S.input,VIn with 20% overrang(3LN or 2LN) 100Vac nominal F.S.input,VLL with 20% overrang(2LL)
	-400V option	400Vac nominal F.S.inpu,VLL with 20% overrang
Frequency range		45～65Hz
Overload		2 times for continue 2500Vac for 1 Sec (None recurrence)
Voltage range through PT		500KV highest at primary side
PT burden		<0.2VA
Measuring		True RMS

Current input		
Current rating	5Amp Ordering on special rating	5Amp AC nominal F.S. input with 20% overrang
Current range		10000A highest at primary side
Overload		10A for continue 100A for 1 Sec (None recurrence)
CT burden		< 0.1VA
Measuring		True RMS

Accuracy and resolution

(Testing condition: frequency: 50Hz or 60Hz temperature: 20℃, humidity: 35%, voltage supply: 230Vac)

Parameter	Accuracy	Resolution
Voltage	0.2%	0.1%
Current	0.2%	0.1%
Power	0.5%	0.1%
Reactive power	0.5%	0.1%
Apparent power	0.5%	0.1%
Power factor	1.0%	0.1%
Frequency	0.2%	0.01Hz
Energy	0.5%	0.1Kwh
Reactive energy	0.5%	0.1Kvarh
Harmonics	1.0%	0.01%
Unbalance factor	1.0%	0.1%
Drift with temperature	100ppm/℃	
Stability	0.5‰/year	

Standards	
Measuring	IEC60687 0.5 ANSI C12.16 Class10 IEC61036 class1 IEC61268 class2
Environmental	IEC 60068-2
Safety	IEC 61557-2
EMC	IEC61000-4/2-3-4-5-6-8-11
Dimension	DIN43700

Digital Input (DI)	
Optical Isolation	Isolate voltage 2500Vac rms
Input form	Contact with power supply
Input Resistance	2K ohm (typical)

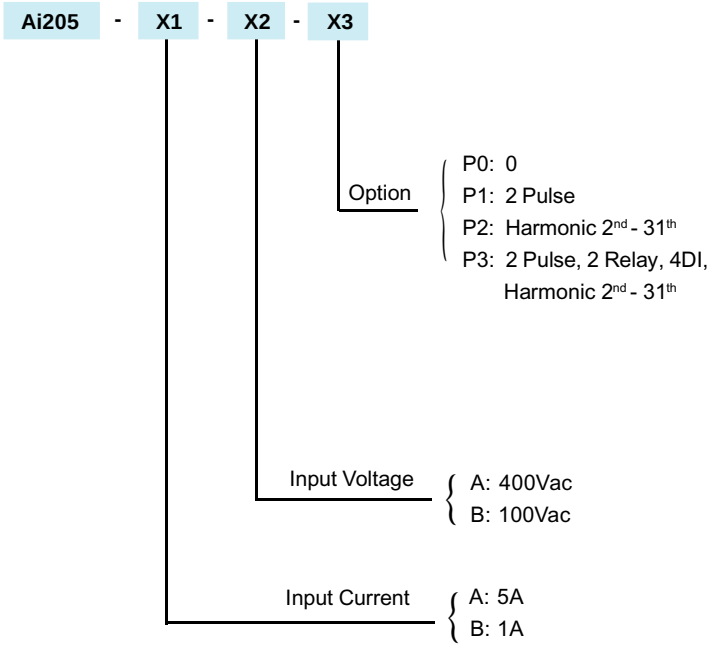
Input voltage range	5～30Vdc
Close voltage	> 10Vdc
Max input current	20mA
DI Aux Power	15Vdc/100mA

Digital Output (DO)	
Output Form	Photo-Mos, NO
Optical Isolation	2500Vac rms
Max Positive Voltage	100Vdc
Max Positive Current	50mA

Relay Output (Relay)	
Output Form	Mechanical Contact
Contact Resistance	100m ohm@1A Initial
Max Break Voltage	250Vac, 30Vdc
Max Break Current	3A
Max Isolated Voltage	2500Vac rms

Suitable Condition	
Dimensions (mm)	96x96x72 (Cut Off 90x90)
Protection Level	IP54 (Front) IP20 (Cover)
Weight	350
Temperature	-25℃～70℃ (-10℃～70℃ LCD Display)
Humidity	5～95% Non-condensing
Power Supply	85～264Vac or 100V～300Vdc
Power	3W (Max) @230V

Appendix B ORDERING




AMPTRON