AMC72（96）L-E4(3)

智能电量采集监控装置

AMC72（96）L-E4(3)

Manual of intelligent electricity collection and control device

安装使用说明书 V1.7

Installation and Operation Instruction V1.7

安科瑞电气股份有限公司

申　　　明

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1 简介 Introduction

AMC72(96)L-E4(3)是一款经济实用，集电参量采集、监测、控制于一体的智能电量采集监控装置。

AMC72(96)L-E4(3) is an economical and practical, intelligent electricity collection and control device for collecting, monitoring and controlling the electrical parameters.

■电量测量：

相电压、线电压、相电流；
分相有功功率、总有功功率；
分相无功功率、总无功功率；
分相视在功率、总视在功率；
分相功率因数、总功率因数；
四象限电能。

■Electrical measurement:

Phase voltage, line voltage and phase current
Split-phase active power and total active power
Split-phase reactive power and total reactive power
Split-phase apparent power and total apparent power
Split power factor and total power factor
Four-quadrant energy

■开关量：

AMC72L-E4(3)：2 路 DI、2 路 DO、1 路通讯；
AMC72L-E4(3)/2C：2 路通讯；
AMC96L-E4(3)：4 路 DI、1 路 DO、1 路通讯。

■Switching inputs and outputs:

AMC72L-E4(3)：2 switching inputs, 2 switching outputs，1 RS485；
AMC72L-E4(3)/2C：2 RS485；
AMC96L-E4(3)：4 switching inputs, 1 switching output，1 RS485.

2 技术指标 Technical indexes

技术参数 Technical parameters		指标 Indexes
网络 Network		三相三线、三相四线 Three-phase three-wire、three-phase four-wire
电压 Voltage	测量范围 Measuring range	10～230V 相电压 10～230V phase voltage
		15～415V 线电压 15～415V line voltage
	过载 Overload	瞬时 2 倍/1s Instantaneous 2 times/1s
电流 Current	测量范围 Measuring range	5A 输入，一次电流 0～9999A 5A input, primary current 0～9999A；
	过载 Overload	持续 1.2 倍，瞬时 10 倍/1s Continue 1.2 times, instantaneous 10 times/1s
频率 Frequency		45Hz～65Hz
辅助电源 Auxiliary power supply	AC	85V～265V
	DC	100V～350V
精度 Accuracy	电流、电压 Current, voltage	0.5 级 Class 0.5
	功率、电能 Power, energy	1 级 Class 1

1

功耗 Power dissipation	<5VA
开关量输入 Switch input	干接点输入，内置电源 Dry contact input, built-in power supply
继电器输出 Relay output	3A 250VAC/3A 30VDC

环境 Environment	工作温度 Operating temperature	-10℃～55℃
	贮存温度 Storage temperature	-20℃～70℃
	相对湿度 Relative humidity	≤93%（无凝露） ≤93%(without condensation)
	海拔 Altitude	≤2500m
电磁兼容 Electromagnetic compatibility	快速脉冲群 Electrical Fast Transients	4kV 5kHz
	静电放电 Electrostatic discharge	接触 6kV/空气 8kV Contact 6kV/air 8kV
	射频电磁场 Radiofrequency electromagnetic field	10V/m
通讯 Communication	RS485

3 安装接线说明 Instruction of installing connection

3.1 安装尺寸 Outlinge and installing dimension

外形 单位：mm Outline Unit: mm	面板尺寸 Panel size		壳体尺寸 Body dimension			开孔尺寸 Hole size	
	宽 width	高 height	宽 width	高 height	深 depth	宽 width	高 height
72	75	75	66	66	98	67	67
96	96	96	86	86	92	88	88
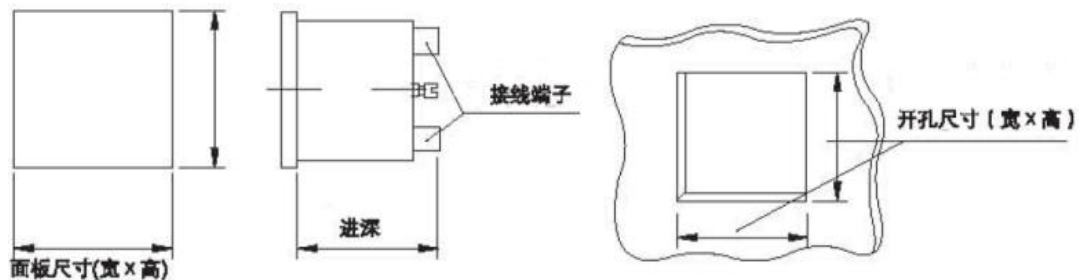
3.2 接线方法

根据不同的设计要求，推荐在电源、电压输入端子增加保险丝（BS88 2A gG）以满足相关电气规范的安全性要求。

Method of connection

According to varied design requirements, power and voltage input terminals are recommended with fuse (BS88 2A gG) to meet with the safety performance requirements of prevailing electric codes.

3.2.1 仪表信号端子接线方法

信号端子："4, 5, 6, 7, 8, 9"为输入电流信号的端子号；"10, 11, 12, 13"为输入电压信号的端子号；

Terminal connection method of instrument signal terminal

Signal terminal: "4,5,6,7,8,9" is the terminal number of current signal; "10,11,12,13" is the terminal number of voltage signal;

三相四线3CT
3P3W 3CT

三相四线3PT、3CT
3P4W 3PT、3CT

三相三线2CT
3P3W 2CT

三相三线2PT、2CT
3P3W 2PT、2CT
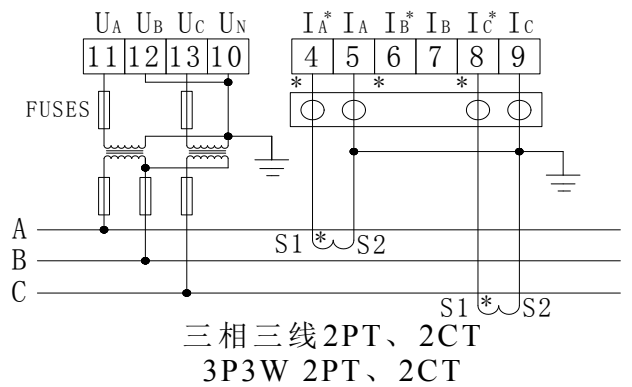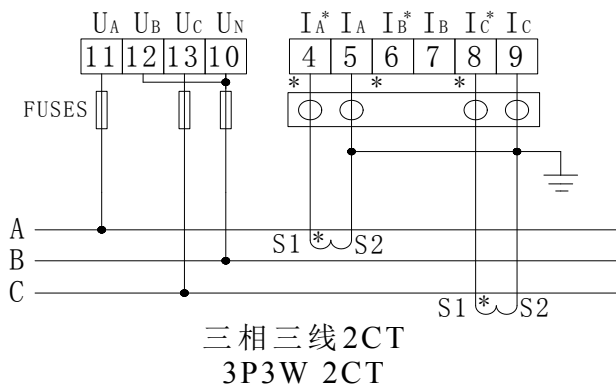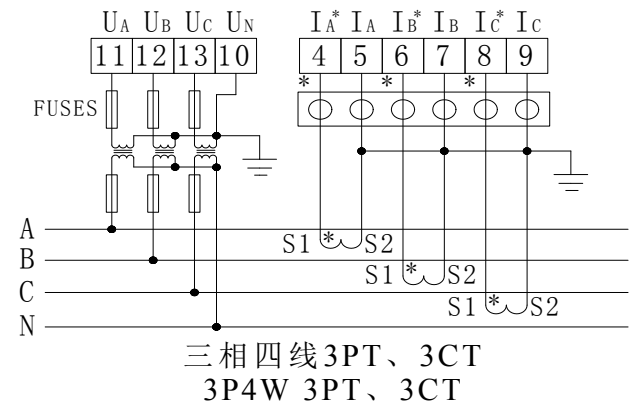
注：⬭⬭⬭⬭⬭⬭ 为用于CT二次侧短接的试验端子

Note：⬭⬭⬭⬭⬭⬭ is a test terminal for shorting the secondary side of the CT

3.2.2 仪表辅助电源、通信端子接线方法

仪表辅助电源及通信端子："1，2"为辅助电源端子号，"30,31"为第1路通讯端子号，"24,25"为第2路通讯端子号。

Connection method of instrument auxiliary power supply and communication terminal

Instrument auxiliary power and communication terminal: "1, 2" is the auxiliary power terminal number, "30,31" is the first communication terminal number，"24,25" is the second communication terminal number.

辅助电源

第1路
RS485通讯

第2路
RS485通讯
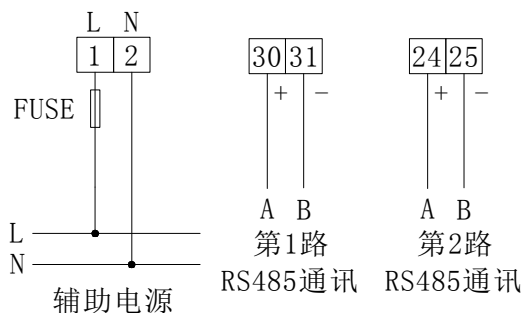
注： 1、电流输入必须使用 CT。

2、CT 的精度影响本装置的测量精度。CT 的角差将影响装置的功率、电能等测量精度。

3、输入信号为 1A/5A 时，IE（额定电流）选择 1/5，CT 值设置与外部 CT 变比一致；

4、应用于无 PT 的直接接入系统时应装设 2A 的保险丝。

5、建议装置上电流输入的 CT 接地端应分别引至接地端子上。

3.2.3 仪表开关量输入输出端子

AMC72L-E4(3)开关量输入输出端子："50，51，52"为开关量输出端子号，"60，61，62"为开关量输入端子号。

Note:1、CT must be used during the current input.

2、The accuracy of CT affects the measurement accuracy of this device. The angle difference of CT will affect the measuring accuracy of the power and electric energy of the device.

3、When the input signal is 1A/5A, the IE (rated current) selects 1/5, and the CT value setting is consistent with the external CT ratio.

4、When it is applied to a direct access system without PT, a 2A fuse shall be installed.

5、It is suggested that the CT grounding end of the current input shall be introduced to the grounding terminal respectively.

Switching input and output terminals of meter

Switching input and output terminals of AMC72L-E4(3): "50，51，52" is the switching output terminal number, and "60，61，62" is the switching input terminal number.

50	51	52	61	62	60

DO₁ DO₂   DI₁ DI₂

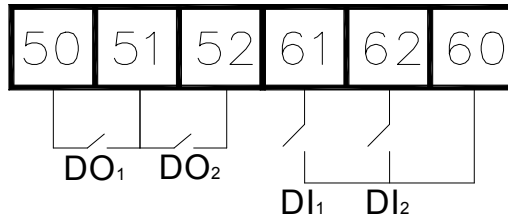AMC96L-E4(3)开关量输入输出端子："50，51"为开关量输出端子号，"60，61，62，63，64"为开关量输入端子号。

Switching input and output terminals of AMC96L-E4(3): "50，51" is the switching output terminal number, "60，61，62，63，64" is the switching input terminal number.

50	51	61	62	63	64	60

DO₁   DI₁ DI₂ DI₃ DI₄
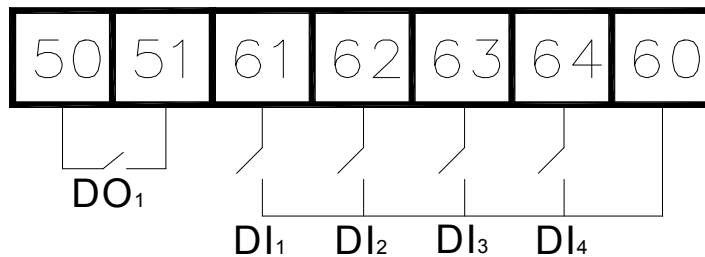
4 操作说明 Instructions

4.1 AMC72(96)L-E4(3)按键功能说明

仪表四个按键从左到右依次为 SET 键、左键、右键、回车键。

AMC72 (96) L-E4 (3)key function description

The four keys of the meter are SET key, left key, right key and enter key from left to right.

SET 键 SET key	测量模式下，按该键进入编程模式，仪表提示输入密码 PASS，输入正确密码后，可对仪表进行编程设置；编程模式下，用于返回上一级菜单。 In the measurement mode, press this key to enter the programming mode, the meter prompts to enter the password PASS, after entering the correct password, the meter can be programmed; in the programming mode, it is used to return to the previous menu.

左键 Left key	测量模式下，用于切换显示项目； 编程模式下，用于切换同级菜单或个位数的减小。 In measurement mode, it is used to switch display items; In programming mode, it is used to switch between the same level menu or single digit reduction.	
右键 Right key	测量模式下，用于切换显示项目； 编程模式下，用于切换同级菜单或个位数的增加。 In measurement mode, it is used to switch display items; In programming mode, it is used to switch the same level menu or increase in single digits.	
回车键 Enter key	编程模式下，用于菜单项目的选择确认和参数的修改确认。 In programming mode, it is used for the selection confirmation for menu items and the modification confirmation of parameters.	
左键+回车键 Left key + enter key	编程模式下，该组合键用于百位数的减小。 In programming mode, this key combination is used for the reduction of hundreds of digits.	
右键+回车键 Right key + enter key	编程模式下，该组合键用于百位数的增加。 In programming mode, this key combination is used for the increase of hundreds of digits.	

4.2 AMC72(96)L-E4(3)参数查看　　　　　　　　　AMC 72 (96) L-E4(3) parameters view

　　AMC72L-E4(3)液晶显示电量查看流程如下：　　　　　Parameters of The AMC72L-E4(3) liquid crystal display viewing process is as follows:
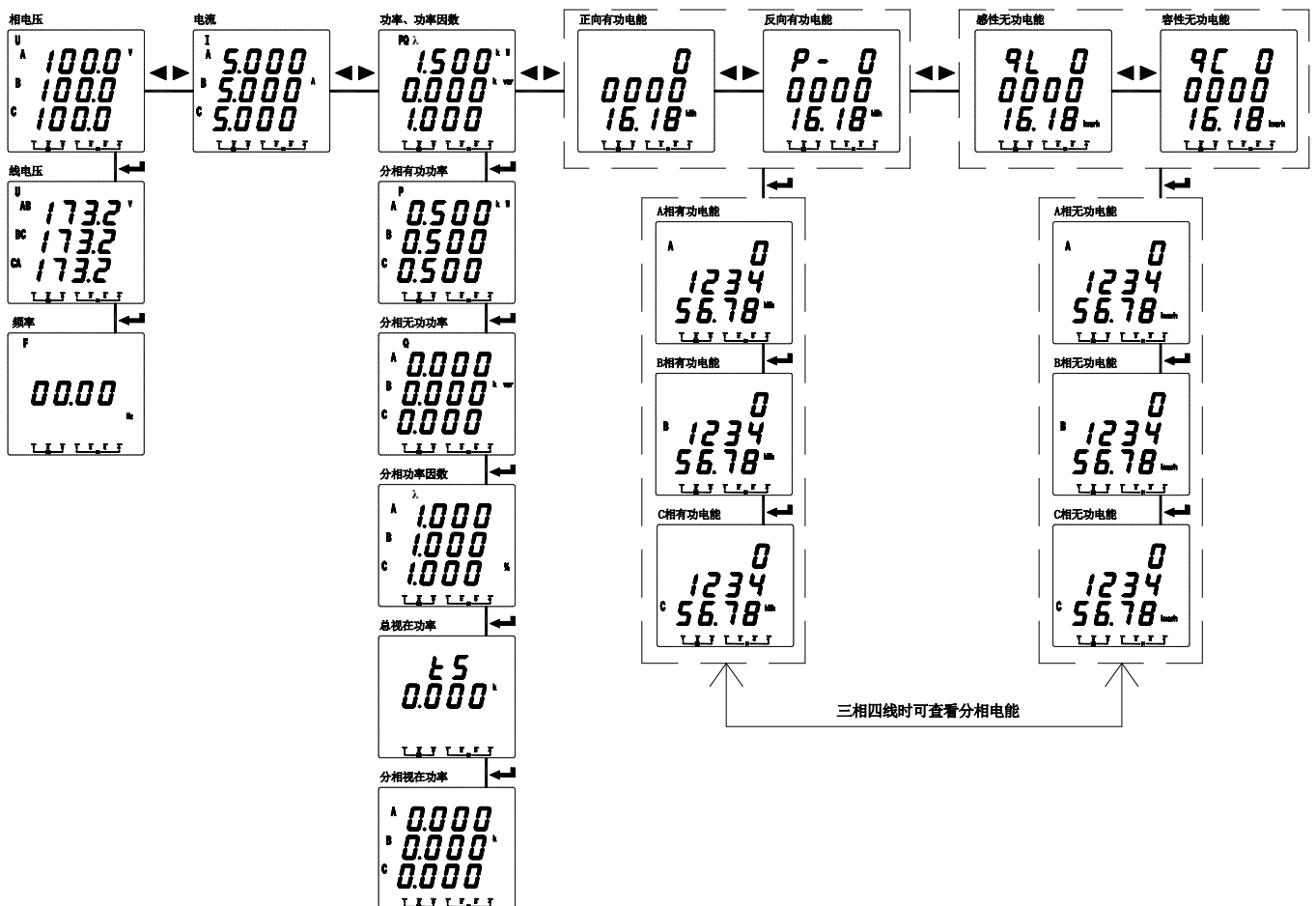
相电压：Phase voltage　　　　　　线电压：Line voltage　　　　　　频率：Frequency

电流：Current	功率：Power		功率因数：Power factor

电流：Current　　　　　　　　　功率：Power　　　　　　功率因数：Power factor

分相有功功率：Split phase active power　　　　　分相无功功率：Split phase reactive power

分相功率因数：Split-phase power factor　　　　　总视在功率：Total apparent power

分相视在功率：Split-phase apparent power　　　　正向有功电能：Positive active energy

反向有功电能：Negative active energy　　　　　A 相有功电能：A phase active energy

B 相有功电能：B phase active energy　　　　　C 相有功电能：C phase active energy

感性无功电能：Inductive reactive energy　　　　容性无功电能：Capacitive reactive energy

A 相无功电能：A phase reactive energy　　　　　B 相无功电能：B phase reactive energy

C 相无功电能：C phase reactive energy

三相四线时可查看分相电能：

注 1：总电能计量为各相电能绝对值相加。

注 2：AMC72L 外形液晶显示为以上菜单，AMC96L 外形液晶显示略有差别，线电压显示时无"AB、BC、CA"字符显示，相电压→线电压→频率界面如下图所示，其他界面基本一致。

View Split-phase energy when three-phase four-wire

Note 1: The total energy metering is the sum of the absolute values of the energy of each phase.

Note 2: The AMC72L LCD display is the above menu. The AMC96L LCD display is slightly different. There is no "AB, BC, CA" character display when the line voltage is displayed. The phase voltage → line voltage → frequency interface is shown in the figure below. Other interfaces are basically Consistent.
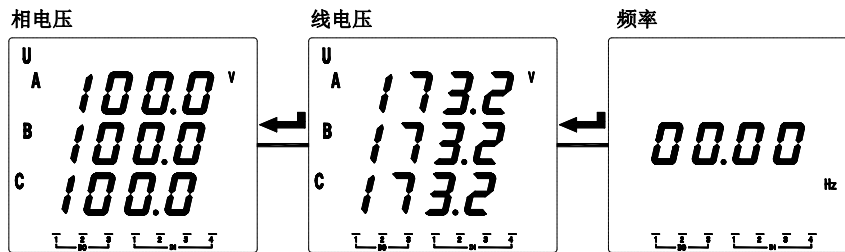
5 仪表通用编程菜单

按"SET"键->pass->按"↵"键->输入密码（默认 0001）进入设置。设置好参数后按"SET"键退出->save yes（按"↵"键保存设置/按"SET"键不保存设置）。

Meter general programming menu

Press the "SET" key -> pass-> press the "↵" key -> enter the password (default 0001) to enter the settings. After setting the parameters, press "SET" to exit -> save yes (press "↵" to save the settings / press "SET" to not save the settings).

第一级菜单 First level menu	第二级菜单 Second level menu	第三级菜单 Third level menu	说明 Description
5Y5	d I5P		开机显示画面选择，为零自动翻页 Boot display selection, zero is automatic page turning
	CodE	0-9999	密码设置（初始密码 0001） Password setting (initial password 0001)
	CLr.E		电能清零,清除成功显示 OK Electrical energy clearing, clearing successful show OK
	b.LCd	0-9999	设置为 0 时，背光常亮，设计为 1-9999 时，背光在亮 1-9999 秒后熄灭 When set to 0, the backlight is always on. When the design is 1-9999, the backlight is off after 1-9999 seconds.

In	LinE	3P3L、3P4L	接线方式（三相三线、三相四线） Wiring method (three-phase three-wire、 three-phase four-wire)
	In.U	100、400	输入电压范围 Input voltage range
	In.1	1、5	输入电流范围 Input current range
	In.Pt	0-9999	电压倍数 Voltage multiple
	In.Ct	0-9999	电流倍数 Current multiple
bUS	Addr	1-247	通讯地址 Communication address
	bAUd	4800、9600、 19200、38400	通讯波特率 Communication baud rate
	modE	None/2bit/odd/even	通信模式 （无校验、2 位停止位、奇校验、偶校验） Communication mode (No parity, 2 stop bits, odd parity, even parity)
	bAd.2	4800、9600、 19200、38400	第二路通讯波特率 The second communication baud rate
	mod.2	None/2bit/odd/even	第二路通信模式 （无校验、2 位停止位、奇校验、偶校验） The second communication mode (No parity, 2 stop bits, odd parity, even parity)
do.1-do.2			第一路到第二路开关量输出（详见 5.1） The first to the second switch output (see 5.1)
uEr			软件版本号 Software version number

5.1 开关量输出设置 / Switching output setting

开关量输出采用继电器输出,有两种控制方式:1、报警方式（"SEL"选择不为零）；2、总线控制

The switch output uses relay output, there are two control modes: 1. Alarm mode ("SEL" selection is not zero); 2. Bus control.

方式（"SEL"选择为"0. do",此时"dLy"设置为 0 为电平输出方式,设置非零时,do 动作后延时设置的时间后自动断开）

Mode ("SEL" is selected as "0. do", then "dLy" is set to 0 for level output mode. When non-zero is set, do automatically disconnect after the delay setting time after the action.

"SEL"中设置 DO 输出类型,"0. do"表示为通信控制（此时如果 dly 设置为 0 输出为电平方式,否则为脉冲方式,如果 dly 设置为 2,吸合后 2 秒自动断开）,其他为报警控制（见下表）

The DO output type is set in "SEL", and "0. do" is used for communication control (if dly is set to 0, the output is level mode, otherwise it is pulse mode. If dly is set to 2, the do is automatically broken 2 seconds after the pull-in), the other is alarm control (see table below)

"dLy"为报警延时（报警用时推荐不设置为 0 防止干扰误动,输出类型为 DO 时作脉冲或电平输出控制）

"dLy" is the alarm delay (the alarm time is recommended not to be set to 0 to prevent interference from malfunctioning, and the output type is DO for pulse or level output control).

"bAnd"为不动作带设置
"bAnd" is set for no action band

"AL.Hi"为高报警数值设置（不用设置最大 9999）
"AL.Hi" is set for high alarm value (set maximum 9999 when it is not used)

"AL.Lo"为低报警数值设置（不用设置最小 -9999）

"AL.Lo" is set for low alarm value (do not set minimum -9999)

（以上 3 个设置与电量的显示值对应,显示中含小数点。例:输入 220V 100A/5A,三相四线,则 100%P 总为 220*100*3=66kW。如 100%功率时高报警,90%返回,"AL.Hi"取 66.00,"bAnd"取 6.00；100%电压时高报警,95%返回,"AL.Hi"可取 220.0,"bAnd"取 11.0；100%电流时高报警,95%返回,"AL.Hi"可取 100.0,"bAnd"取 5.0）

(The above three settings correspond to the displayed value of the power, and the display includes a decimal point. For example: input 220V 100A/5A, three-phase four-wire, then 100%P is always 220*100*3=66kW. If 100% power is high Alarm, 90% back, "AL.Hi" takes 66.00, "bAnd" takes 6.00; 100% voltage is high alarm, 95% return, "AL.Hi" takes 220.0, "bAnd" takes 11.0; 100% current is high Alarm, 95% return, "AL.Hi" can take 100.0, "bAnd" take 5.0)

"In.=0"为信号为 0 时是否允许低报警,Lo.on 使能,Lo.of 禁止

"In.=0" indicates whether low alarm is allowed when the signal is 0, Lo.on is enabled, and Lo.of is prohibited.

1	2	3	4	5	6	7	8
UA	UB	UC	三相相电压最值 Three-phase phase voltage extreme value	UAB	UBC	UCA	三相线电压最值 Three-phase line voltage extreme value
9	10	11	12	13	14	15	16
IA	IB	IC	三相电流最值 Three-phase current extreme value	PA	PB	PC	P 总 P_{Total}
17	18	19	20	21	22	23	24
QA	QB	QC	Q 总 Q_{Total}	SA	SB	SC	S 总 S_{Total}

25	26	27	28	29	30	31	32/33
PFA	PFB	PFC	PF	F	电压不平衡 Voltage unbalance	电流不平衡 Current unbalance	DI1/DI2

注：

1. 三相 XX 最值表示：高报警时为三相中最大值，低报警时为三相中最小值。

2. 第 2 路 DO 可设置"34.FL"组合报警功能，设置后二级菜单（原先"SEL"、"dLy"、"bAnd"、"AL.Hi"、"AL.Lo"）变为"SEL"（功能选择）、"dLy"（延时）、"H-U"（过线电压）、"L-U"（欠线电压）、"H-F"（过频率）、"L-F"（欠频率）、"H-P"（过功率）、"L-P"（欠功率）、"H-I"（过电流）、"L-PF"（欠功率因数）、"H-b.U"（过电压不平衡，设置为-1 断相，判定条件至少一相>0.5Ue，至少一相<0.1Ue）、"H-b.I"（过电流不平衡，设置为-1 断相，判定条件至少一相>0.2Ie，至少一相<0.01Ie）

3. 不平衡计算

（偏移平均值最大的值与平均值的差值）/ 平均值 *100%，如果分母的平均值小于额定值，分母为额定值。

电压额定值 Ue：3 相 4 线 Ue 为相电压，菜单中设置的 400V 的仪表为 220V*PT，100V 的仪表为 57V*PT。

电流额定值 Ie：5A 的仪表为 5A*CT，1A 的仪表为 1A*CT。

不平衡度下设置的参数为百分比格式，如设置为 20 表示 20%

6 AMC72（96）L-E4(3)通讯协议

本协议规定了 AMC72（96）L-E4 与数据终端设备进行数据交换的物理连接和通讯协议，其协议方式类同 Modbus_RTU 通信规约。

6.1 协议简述 Brief Description of the Agreement

AMC72（96）L-E4(3)所使用的通讯协议详细定义了地址码、功能码、校验码的数据序列定义，这些都是特定数据交换的必要内容。该协议在一根通讯线上使用主从应答式连接（半双工），这意味着在一根单独的通讯线上信号沿着相反的两个方向传输。首先，主计算机的信号寻址到一台唯一的终端设备（从机），然后，终端设备发出的应答信号以相反的方向传输给主机。

Note:

1. The extreme value of three-phase XX means: the highest value of the three phases in the case of high alarm, and the minimum value among the three phases in the low alarm.

2. The second DO can be set to"34.FL"combined alarm function. After setting, the secondary menu (originally "SEL", "dLy", "bAnd", "AL.Hi", "AL.Lo") becomes "SEL" (function selection), "dLy" (delay), "H-U" (over line-voltage), "L-U" (under line-voltage), "H-F" (overfrequency), "L-F" (underfrequency), "H-P" (overpower), "L-P" (underpower), "H-I" (overcurrent), "L-PF" (under powerfactor), " Hb.U" (overvoltage unbalance, set to -1 is phase failure, decision condition at least one phase >0.5Ue, at least one phase <0.1Ue), "Hb.I" (overcurrent unbalance, set to -1 is phase failure the determination condition is at least one phase > 0.2 Ie, at least one phase < 0.01 Ie)

3. Unbalanc calculation

(The difference between the maximum value of the offset average and the average value) / average value * 100%, if the average value of the denominator is less than the rated value, the denominator is the rated value.

Voltage rating Ue: 3-phase 4-wire Ue is the phase voltage. The 400V meter set in the menu is 220V*PT, and the 100V meter is 57V*PT.

The current rating Ie: 5A meter is 5A*CT, and the 1A meter is 1A*CT.

The parameter set under the unbalance is a percentage format, such as setting 20 to 20%.

AMC72 (96) L-E4(3) communication protocol

This protocol specifies the physical connection and communication protocol for data exchange between AMC72(96)L-E4(3) and data terminal equipment. The protocol is similar to the Modbus_RTU communication protocol.

The communication protocol used by the AMC72(96)L-E4(3) defines the data sequence definition of the address code, function code and check code in

detail, which are necessary for specific data exchange. The protocol uses a master-slave acknowledgment connection (half-duplex) on a single communication line, which means that signals are transmitted in opposite directions on a single communication line. First, the signal of the host computer is addressed to a unique terminal device (slave), and then the response signal from the terminal device is transmitted to the host in the opposite direction.

本协议只允许在主机（PC，PLC 等）和终端设备之间通讯，而不允许独立的终端设备之间的数据交换，这样各终端设备不会在它们初始化时占据通讯线路，而仅限于响应到达本机的查询信号。

This protocol only allows communication between the host (PC, PLC, etc.) and the terminal device, and does not allow data exchange between independent terminal devices, so that each terminal device does not occupy the communication line when they initialize, but only responds to arrival signal to the machine.

6.2 传输方式 Transmission method

信息传输为异步方式，并以字节为单位，在主机和从机之间传递的通讯信息是 11 位字格式，包含 1 个起始位、8 个数据位（最小的有效位先发送）、奇偶效验位(无校验)、2 个停止位。

The information transmission is asynchronous, and the communication information transmitted between the master and the slave is in 11-word format, including 1 start bit and 8 data bits (the smallest valid bit is sent first),parity check digit (no parity), 2 stop bits.

6.2.1 数据帧格式 Data frame format

地址码 Address code	功能码 Function code	数据区 Data area	CRC 效验码 CRC check code
1 字节 1 byte	1 字节 1 byte	n 字节 n bytes	2 字节 2 bytes

6.2.2 地址域 Address Field

地址域在帧的开始部分，由一个字节（8 位二进制码）组成，十进制为 0～255，在我们的系统中只使用 1～247,其它地址保留。这些位标明了用户指定的终端设备的地址，该设备将接收来自与之相连的主机数据。每个终端设备的地址必须是唯一的，仅仅被寻址到的终端会响应包含了该地址的查询。当终端发送回一个响应，响应中的从机地址数据便告诉了主机哪台终端正与之进行通信。

The address field is composed of one byte (8-bit binary code) at the beginning of the frame, and the decimal is 0 to 255. In our system, only 1 to 247 are used, and other addresses are reserved. These bits indicate the address of the user-specified terminal device that will receive the host data from it. The address of each terminal device must be unique, and only the terminal to which it is addressed responds to the query containing the address. When the terminal sends back a response, the slave address data in the response tells the host which terminal is communicating with it.

6.2.3 功能域 Functional Domain

功能域代码告诉了被寻址到的终端执行何种功能。下表列出了该系列装置用到的功能码，以及它们的意义和功能。

The function field code tells the terminal which is being addressed which function to perform. The table below lists the function codes used in this series of devices, as well as their meaning and function.

代码 Code	意义 Meaning	行为 Function.
03	读数据寄存器 Read data register	获得一个或多个寄存器的当前二进制值 Get the current binary value of one or more registers
16	预置多寄存器 Preset multi-register	设定二进制值到一系列多寄存器中 Set binary values into a series of multiple registers

6.2.4 数据域 Data Domain

数据域包含了终端执行特定功能所需要的数据或者终端响应查询时采集到的数据。这些数据的内容可能是数值、参考地址或者设置值。例如：功能域码告诉终端读取一个寄存器，数据域则需要指明从哪个寄存器开始及读取多少个数据，内嵌的地址和数据依照类型和从机之间的不同内容而有所不同。

The data field contains the data required by the terminal to perform a specific function or the data collected by the terminal in response to the query. The contents of these data may be numeric values, reference addresses, or set values. For example, the function field code tells the terminal to read a register, and the data field needs to indicate which register to start and how many data to read. The embedded address and data vary according to the type and the different content between the slaves.

6.2.5 错误校验域 Error Checking Domain

该域允许主机和终端检查传输过程中的错误。有时，由于电噪声和其它干扰，一组数据在从一个设备传输到另一个设备时在线路上可能会发生一些改变，出错校验能够保证主机或者终端不去响应那些传输过程中发生了改变的数据，这就提高了系统的安全性和效率，错误校验使用了 16 位循环冗余的方法（CRC16）。

This field allows hosts and terminals to check for errors during transmission. Sometimes, due to electrical noise and other disturbances, a set of data may change on the line while transferring from one device to another. Error checking ensures that the host or terminal does not respond to data that has changed during transmission. This improves the security and efficiency of the system. The error check uses the 16-bit cyclic redundancy method (CRC16).

6.2.6 错误检测的方法 Method of error detection

错误校验域占用两个字节，包含了一个 16 位的二进制值。CRC 值由传输设备计算出来，然后附加到数据帧上，接收设备在接收数据时重新计算 CRC 值，然后与接收到的 CRC 域中的值进行比较，如果这两个值不相等，就发生了错误。

The error check field occupies two bytes and contains a 16-bit binary value. The CRC value is calculated by the transmitting device and then appended to the data frame. The receiving device recalculates the CRC value when receiving the data, and then compares it with the value in the received CRC field. If the two values are not equal, it occurs error.

CRC 运算时，首先将一个 16 位的寄存器预置为全 1，然后连续把数据帧中的每个字节中的 8 位与该寄存器的当前值进行运算，仅仅每个字节的 8 个数据位参与生成 CRC，起始位和终止位以及可能使用的奇偶位都不影响 CRC。在生成 CRC 时，每个字节的 8 位与寄存器中的内容进行异或，然后将结果向低位移位，高位则用"0"补充，最低位（LSB）移出并检测，如果是 1，该寄存器就与一个预设的固定值（0A001H）进行一次异或运算，如果最低位为 0，不作任何处理。

In the CRC operation, a 16-bit register is first preset to all ones, and then 8 bits in each byte of the data frame are successively operated with the current value of the register, only 8 data per byte. Bit participation in generating the CRC, the start and stop bits and possibly the parity bits do not affect the CRC. When generating the CRC, the 8 bits of each byte are XORed with the contents of the register, and then the result is shifted to the low bit. The high bit is complemented by "0", and the least significant bit (LSB) is shifted out and detected. If it is 1, This register is XORed with a preset fixed value (0A001H). If the lowest bit is 0, no processing is performed.

上述处理重复进行，直到执行完了 8 次移位操作，当最后一位（第 8 位）移完以后，下一个 8 位字节与寄存器的当前值进行异或运算，同样进行上述的另一个 8 次移位异或操作，当数据帧中的所有字节都作了

处理，生成的最终值就是 CRC 值。

The above processing is repeated until 8 shift operations are performed. When the last bit (bit 8) is shifted, the next 8-bit byte is XORed with the current

value of the register, and the other same eight-time shift XOR operation is also performed. The sub-shift XOR 生成一个 CRC 的流程为：

(1) 预置一个 16 位寄存器为 0FFFFH（全 1），称之为 CRC 寄存器。.

把数据帧中的第一个字节的 8 位与 CRC 寄存器中的低字节进行异或运算，结果存回 CRC 寄存器。

将 CRC 寄存器向右移一位，最高位填以 0，最低位移出并检测。

如果最低位为 0：重复第三步（下一次移位）；如果最低位为 1：将 CRC 寄存器与一个预设的固定值（0A001H）进行异或运算。

重复第三步和第四步直到 8 次移位。这样处理完了一个完整的八位。

(2) 重复第 2 步到第 5 步来处理下一个八位，直到所有的字节处理结束。

最终 CRC 寄存器的值就是 CRC 的值。

此外还有一种利用预设的表格计算 CRC 的方法，它的主要特点是计算速度快，但是表格需要较大的存储空间，该方法此处不再赘述，请参阅相关资料。

6.3 功能码简介 Introduction to function codes
6.3.1 功能码 03H：读寄存器 Function Code 03H: Read Register

此功能允许用户获得设备采集与记录的数据及系统参数。主机一次请求的数据个数没有限制，但不能超出定义的地址范围。

下面的例子是从 01 号从机读 3 个采集到的基本数据（数据帧中每个地址占用 2 个字节）UA、UB、UC，其中 UA 的地址为 0011H，UB 的地址为 0012H，UC 的地址为 0013H。

operation, when all the bytes in the data frame are processed, the final value generated is the CRC value.

The process of generating a CRC is:

(1) Preset a 16-bit register to 0FFFFH (all 1), called the CRC register. .

The 8-bit of the first byte in the data frame is XORed with the low byte in the CRC register and the result is stored back in the CRC register.

Move the CRC register one bit to the right, fill the highest bit with 0, and the lowest bit is out and detected.

If the least significant bit is 0: repeat the third step (next shift); if the lowest bit is 1: the XOR register is XORed with a preset fixed value (0A001H).

Repeat steps 3 and 4 until 8 shifts. This completes a complete eight bit.

(2) Repeat steps 2 through 5 to process the next eight bits until all byte processing ends.

The value of the final CRC register is the value of the CRC.

There is also a method for calculating CRC using a preset table. Its main feature is that the calculation speed is fast, but the table requires a large storage space, and the method will not be described here, please refer to related materials.

This feature allows the user to obtain data and system parameters collected and recorded by the device. There is no limit to the number of times a host can request data at a time, but it cannot exceed the defined address range.

The following example is to read the 3 basic data collected from the No. 01 slave (the data frame occupies 2 bytes for each address) UA, UB, UC, where UA's address is 0011H, UB's address is 0012H, UC The address is 0013H.

主机发送 Host sending	发送信息 send Message	从机返回 Return from the slave	返回信息 Returned Message
地址码	01H	地址码	01H

Address code		
功能码 Function code		03H
起始地址 Starting address	高字节 High byte	00H
	低字节 Low byte	11H
寄存器数量 Number of registers	高字节 High byte	00H
	低字节 Low byte	03H
CRC 效验码 CRC check code	低字节 Low byte	55H
	高字节 High byte	CEH

Address code		
功能码 Function code		03H
字节数 Number of bytes		06H
寄存器数据 Register data	高字节 High byte	00H
	低字节 Low byte	00H
寄存器数据 Register data	高字节 High byte	00H
	低字节 Low byte	00H
寄存器数据 Register data	高字节 High byte	00H
	低字节 Low byte	00H
CRC 效验码 CRC check code	低字节 Low byte	21H
	高字节 High byte	75H

6.3.2 功能码 10H：写寄存器 Function Code 10H: Write Register

功能码 10H 允许用户改变多个寄存器的内容，该仪表中系统参数、开关量输出状态等可用此功能号写入。 主机一次最多可以写入 16 个(32 字节)数据。

The function code 10H allows the user to change the contents of a plurality of registers in which the system parameters, the switch output status, and the like can be written with this function number. The host can write up to 16 (32 bytes) of data at a time.

下面的例子是预置地址为01的仪表同时输出开关量D0。开关量输出状态指示寄存器地址为006FH，第12位对应D0。

The following example is a meter with a preset address of 01 and outputs a switch quantity DO at the same time. The digital output status indication register address is 006FH, and the 12th bit corresponds to DO.

主机发送 Host sending		发送信息 Send Message
地址码 Address code		01H
功能码 Function code		10H
起始地址	高字节	00H

从机返回 Return from the slave		返回信息 Returned Message
地址码 Address code		01H
功能码 Function code		10H
起始 地址	高字节	00H

Starting address	High byte	
	低字节 Low byte	6FH
寄存器数量 Number of registers	高字节 High byte	00H
	低字节 Low byte	01H
字节数 Byte count		02H
006FH 待写入数据 006FH to be written data	高字节 High byte	10H
	低字节 Low byte	00H
CRC 效验码 CRC check code	低字节 Low byte	A2H
	高字节 High byte	CFH

Starting address	High byte	
	低字节 Low byte	6FH
寄存器数量 Number of registers	高字节 High byte	00H
	低字节 Low byte	01H
CRC 效验码 CRC check code	低字节 Low byte	31H
	高字节 High byte	D4H

6.4 通讯地址表 Address Table

地址 Address	参数 Parameter	数值 Numerical value	属性 Attributes	符号 Symbol
00H	密码 password	0～9999	R/W	无符号 Unsigned
01H	地址 Address	1～247	R/W	无符号 Unsigned
02H	波特率 Baud rate	38400、19200、9600、4800、2400、1200	R/W	无符号 Unsigned
03H	CT 变比 CT ratio	1～9999	R/W	无符号 Unsigned
04H	接线方式 Wiring	4-三相四线 4- Three-phase four-wire	R/W	无符号 Unsigned
05H	Pt 变比 Pt ratio	1～9999	R/W	无符号 Unsigned
06H	额定电压 Rated voltage	100V、220V、660V	R/W	无符号 Unsigned
07H	额定电流 Rated current	1A、5A	R/W	无符号 Unsigned
07H～0CH 备用 07H～0CH spare		1～9999		无符号 Unsigned
0DH	三相回路 总功率因数 Three-phase circuit Total power factor	-1.000～1.000(小数点 3 位) -1.000~1.000 (3 decimal places)	R	有符号 Signed
0EH、0FH、10H 备用 0EH、0FH、10H spare				

		0～999.9V(小数点 1 位)		
11H	A 相电压 Phase A voltage	二次侧，乘以 PT 变比得一次侧相电压		
12H	B 相电压 Phase B voltage	0 to 999.9V (1 decimal place) On the secondary side, multiplying by PT becomes the primary phase voltage		
13H	C 相电压 Phase C voltage	**例：** **读取 0x11H 地址值为 0x898H（换算成十进制为 2200），则 A 相电压二次侧值为 220.0V；** **实际值：220.0V*PT** **Example:** **Read 0x11H address value is 0x898H (converted to 2200 in decimal), then the secondary side voltage of phase A voltage is 220.0V;** **Actual value: 220.0V*PT**	R	无符号 Unsigned
14H	A 相电流 Phase A current	0～9.999A(小数点 3 位) 二次侧，乘以 CT 变比得一次侧电流		
15H	B 相电流 Phase B current	0 to 9.999A (3 decimal places) The secondary side, multiplied by CT becomes the primary current		
16H	C 相电流 Phase C current	**例：** **读取 0x14H 地址值为 0x1388H（换算成十进制为 5000），则 A 相电流二次侧值为 5.000A；** **实际值：5.000A*CT** **Example:** **Read 0x14H address value is 0x1388H (converted to 5000 in decimal), then the secondary side value of phase A current is 5.000A;** **Actual value: 5.000A*CT**	R	无符号 Unsigned
	17H～1BH 备用 17H～1BH spare			
1DH	U12 线电压 U12 line voltage	0～999.9V(小数点 1 位) 二次侧，乘以 PT 变比得一次侧线电压		
1EH	U23 线电压 U23 line voltage	0 to 999.9V (1 decimal place) On the secondary side, multiplying by PT becomes the	R	无符号 Unsigned
1FH	U31 线电压 U31 line voltage			

		primary side line voltage		
20H	频率 Frequency	0～99.99Hz(小数点 2 位) 0 to 99.99 Hz (2 decimal places)	R	
21H	三相回路 总有功功率 Three-phase circuit Total active power	有符号-9.999～9.999kW (小数点 3 位)，二次侧，乘以 PTCT 变比得一次侧有功功率； Signed -9.999 to 9.999kW (3 decimal places), secondary side, Multiplying the PTCT becomes the primary side active power;	R	有符号 Signed
22H、23H 备用 22H、23H spare				
24H	三相回路 总无功功率 Three-phase circuit Total reactive power			
25H、26H 备用 22H、23H spare				
27H	A 相正（市电）有功电能高字节 A phase positive (mains) active energy high byte	一次侧电能 高字节 0～0xFFFF 低字节 0～0xFFFF Primary side electrical energy High byte 0 to 0xFFFF Low byte 0 to 0xFFFF	T	无符号 Unsigned
28H	A 相正（市电）有功电能低字节 A phase positive (mains) active energy low byte			
29H	B 相正（市电）有功电能高字节 B phase positive (mains) active energy high byte			
2AH	B 相正（市电）有功电能低字节 B phase positive (mains) active energy low byte			
2BH	C 相正（市电）有功电能高字节 C phase positive (mains) active energy high byte			
2CH	C 相正（市电）有功电能低字节 C phase positive (mains) active energy low byte	例： 读取 0x27H 地址值为 0x1234H，读取 0x28H 地址值为 0x5678H，则实际 L1 相一次侧电能值为 0x12345678H（换算成十进制为 3054198.96kWh） Example: Read 0x27H address value is 0x1234H, read 0x28H address value is 0x5678H, then the actual L1 phase primary side energy value is 0x12345678H (converted to decimal 30514189.96kWh)		
2DH	A 相反向有功电能高字节 A phase negative active energy high byte			
2EH	A 相反向有功电能低字节 A phase negative active energy low byte			
2FH	B 相反向有功电能高字节 B phase negative active energy high byte			
30H	B 相反向有功电能低字节 B phase negative active energy low byte			

31H	C 相反向有功电能高字节 C phase negative active energy high byte			
32H	C 相反向有功电能低字节 C phase negative active energy low byte			
	33H～38H 备用 33H～38H spare			
39H	A 相有功功率 A phase active power	有符号-9.999～9.999kW (小数点 3 位)，二次侧，乘以 PTCT 变比得一次侧 Signed -9.999 to 9.999kW (3 decimal places), secondary side, Multiplying by PTCT becomes the primary side **例：** **读取 0x39H 地址值为 0xFBB4H（换算成十进制为-1100），则 A 相有功功率二次侧值为-1.100kW；** **实际值：-1.100kW*PT*CT** **Example:** **Read 0x39H address value is 0xFBB4H (converted to -1100 in decimal), then the secondary side of the A phase active power is -1.100kW;** **Actual value: -1.100kW*PT*CT**	R	有符号 Signed
3AH	B 相有功功率 B phase active power			
3BH	C 相有功功率 C phase active power			
	3CH～41H 备用 3CH～41H spare			
42H	A 相无功功率 A phase reactive power	有符号-9.999～9.999kVar (小数点 3 位)，二次侧，乘以 PTCT 变比得一次侧 Signed -9.999 to 9.999 kVar (3 decimal places), secondary side, Multiplying by PTCT becomes the primary side	R	有符号 Signed
43H	B 相无功功率 B phase reactive power			
44H	C 相无功功率 C phase reactive power			
45H	A 相视在功率 A phase apparent power	无符号 0～9.999kVA (小数点 3 位)，二次侧，乘以 PTCT 变比得一次侧 Unsigned 0 to 9.999 kVA	R	无符号 Unsigned
46H	B 相视在功率 B phase apparent power			
47H	C 相视在功率			

	C phase apparent power	(3 decimal places), secondary side, Multiplying by PTCT becomes the primary side		
48H	三相总视在功率 Three-phase total apparent power			
	49H、4AH 备用 49H、4AH spare			
4BH	A 相功率因数 A phase power factor	-1.000～1.000(小数点 3 位) -1.000～1.000(3 decimal places)	R	有符号 Signed
4CH	B 相功率因数 B phase power factor			
4DH	C 相功率因数 C phase power factor			
	4EH～53H 备用 4EH～53H spare			
54H	A 相感性无功电能高字节 A phase inductive reactive energy high byte	一次侧电能 高字节 0～0xFFFF 低字节 0～0xFFFF Primary side energy High byte 0 to 0xFFFF Low byte 0 to 0xFFFF	R	无符号 Unsigned
55H	A 相感性无功电能低字节 A phase inductive reactive energy low byte			
56H	B 相感性无功电能高字节 B phase inductive reactive energy high byte			
57H	B 相感性无功电能低字节 B phase inductive reactive energy low byte			
58H	C 相感性无功电能高字节 C phase inductive reactive energy high byte			
59H	C 相感性无功电能低字节 C phase inductive reactive energy low byte			
5AH	A 相容性无功电能高字节 A phase capacitive reactive energy high byte			
5BH	A 相容性无功电能低字节 A phase capacitive reactive energy low byte			
5CH	B 相容性无功电能高字节 B phase capacitive reactive energy high byte			
5DH	B 相容性无功电能低字节 B phase capacitive reactive energy low byte			
5EH	C 相容性无功电能高字节 C phase capacitive reactive energy			

	high byte			
5FH	C 相容性无功电能低字节 C phase capacitive reactive energy low byte			
	60H～6EH 备用 60H～6EH spare			
6FH	开关量状态 Switch status	BIT0-3:1-4 路 DI 状态 BIT12-13:1-2 路 DO 状态 BIT0-3: 1-4 DI status BIT12-13: 1-2 DO status	R/W	无符号 Unsigned
70H	三相回路正（市电）总 有功电能高字节 Three-phase total positive (mains) active energy high byte	一次侧电能 高字节 0～0xFFFF 低字节 0～0xFFFF Primary side energy High byte 0 to 0xFFFF Low byte 0 to 0xFFFF 例： 读取 0x70H 地址值为 0x1234H，读取 0x71H 地址值为 0x5678H，则实际 L1 相一次侧电能值为 0x12345678H（换算成十进制为 3054198.96kWh） Example: Read 0x70H address value is 0x1234H, read 0x71H address value is 0x5678H, then the actual L1 phase primary side energy value is 0x12345678H (converted to decimal 3054198.96kWh)	R	无符号 Unsigned
71H	三相回路正（市电）总 有功电能低字节 Three-phase total positive (mains) active energy low byte			
72H	三相回路反向总 有功电能高字节 Three-phase total negative active energy high byte			
73H	三相回路反向总 有功电能低字节 Three-phase total negative active energy low byte			
	72H-75H 备用 72H-75H spare			
76H	三相回路感性总 无功电能高字节 Three-phase total inductive reactive energy high byte			
77H	三相回路感性总 无功电能低字节 Three-phase total inductive reactive energy low byte			
78H	三相回路容性总 无功电能高字节 Three-phase total capacitive reactive energy high byte			
79H	三相回路容性总 无功电能低字节 Three-phase total capacitive reactive energy low byte			
	7AH-81H 备用 7AH-81H spare	（二次侧电能走字，依次 EPI/EPE/EPL/EQC,	R	无符号 Unsigned

		0-999999.999KWH） (Secondary side energy type, followed by EPI/EPE/EPL/EQC, 0-999999.999KWH)		
82H	A 相正向有功电能走满次数 A phase positive active energy full count			无符号 Unsigned
83H	B 相正向有功电能走满次数 B phase positive active energy full count			
84H	C 相正向有功电能走满次数 C phase positive active energy full count			
85H	A 相反向有功电能走满次数 A phase negative active energy full count			
86H	B 相反向有功电能走满次数 B phase negative active energy full count			
87H	C 相反向有功电能走满次数 C phase negative active energy full count			
88H	A 相感性无功电能走满次数 A phase inductive reactive energy full count	0-65536	R	
89H	B 相感性无功电能走满次数 B phase inductive reactive energy full count			
8AH	C 相感性无功电能走满次数 C phase inductive reactive energy full count			
8BH	A 相容性无功电能走满次数 A phase capacitive reactive energy full count			
8CH	B 相容性无功电能走满次数 B phase capacitive reactive energy full count			
8DH	C 相容性无功电能走满次数 C phase capacitive reactive energy full count			
8EH	总正向有功电能走满次数 Total positive active energy full count			
8FH	总反向有功电能走满次数 Total negative active energy full			

	count				
90H	总感性无功电能走满次数 Total inductive reactive energy full count				
91H	总容性无功电能走满次数 Total capacitive reactive energy full count				

注：

1、电能显示值为 1 次侧电能。

2、AMC72（96）L-E4(3)电能通讯数据为 1 次侧数据，单位 0.01kWh；

3、每个单相回路的电能走字最多为 9999999.99kWh，超过此值则自动归零，并从零开始重新计，并且对应的走满次数寄存器加 1。

4、以上地址表寄存器地址采用 16 进制数值表示；

5、用户在读取某个寄存器参数时，要注意该参数所占地址的字节数及高低位，并注意该数值的表示方式（有些数值读取时需用二进制表示，有些数值需用十进制表示，有些数据为有符号数）；

6、数据处理方式为数值说明里面几位小数点，则读取到的数据除以相应 10 的指数位。如 2 位小数点则除以 100，3 位小数点则除以 1000；

例：

1、读取 0x27H 地址值为 0x1234H，读取 0x28H 地址值为 0x5678H，则实际 L1 相一次侧电能值为 0x12345678H（3054198.96kWh）；

2、读取 0x11H 地址值为 0x898H（换算成十进制为 2200），读取 0x05H 地址值 PT 为 0x1H，则 A 相电压二次测值(小数点 1 位)为 2200/10=220.0V；实际值：220.0V*PT=220.0V*1=220.0V

3、读取 0x14H 地址值为 0x1388H（换算成十进制为 5000），读取 0x03H 地址值为 0x32H（换算成十进制为 50），则 A 相电流二次测值（小数点 3 位）为 5000/1000=5.000A；
实际值：5.000A*CT=5.000A*50=250.0A

4、读取 0x39H 地址值为 0xFBB4H（换算成十进制为 -1100），读取 0x03H 地址值 CT 为 0x32H，（换算成十进制为 50），读取 0x05H 地址值 PT 为 0x1H，则 A 相

Note:

1. The energy display value is the primary side energy.

2. AMC72 (96) L-E4(3) energy data in communication is the primary side energy, the unit is 0.01kWh;

3. The energy running of each single-phase loop is up to 9999999.99kWh. If it exceeds this value, it will automatically return to zero and recalculate from zero, and the corresponding full count register will be incremented by 1.

4. The register address of the above address table is represented by a hexadecimal value;

5. When the user reads a certain register parameter, pay attention to the number of bytes and the high and low bits of the address occupied by the parameter, and pay attention to the representation of the value (some values are expressed in binary, some values are decimal and some data is signed);

6. The data processing method is a numerical description of several decimal points inside, then the data read is divided by the corresponding 10 index bits. For example, 2 decimal places are divided by 100, and 3 decimal places are divided by 1000;

Example:

1. Read 0x27H address value is 0x1234H, read 0x28H address value is 0x5678H, then the actual L1 phase primary side energy value is 0x12345678H (3054198.96kWh);

2. Read 0x11H address value is 0x898H (converted to 2200 in decimal), read 0x05H address value PT is 0x1H, then the second measurement of the A phase voltage (1 decimal place) is 2200/10=220.0V;

3. Read 0x14H address value is 0x1388H (converted to 5000 in decimal), read 0x03H address value is 0x32H (converted to 50 in decimal), then the second phase of the A phase current measurement (3 decimal places) is 5000/1000=5.000A;Actual value:
5.000A*CT=5.000A*50=250.0A

有功功率二次测值（小数点 3 位）为 -1100/1000=-1.100kW；

实际值：-1.100kW*PT*CT=-1.100Kw*1*50=-55.00KW

4. Read 0x39H address value is 0xFBB4H (converted to -1100 in decimal), read 0x03H address value CT is 0x32H (converted to 50 in decimal), read 0x05H address value PT is 0x1H, then the secondary measured active power of phase A (3 decimal places) is -1100/1000 = -1.100kW;Actual value: -1.100kW*PT*CT=-1.100Kw*1*50=-55.00KW

总部：安科瑞电气股份有限公司
地址：上海市嘉定区育绿路 253 号
电话：(86)021-591041832
传真：(86)021-691588338
网址：www.acrel.de
邮箱：ACREL008@vip.163.com
邮编：201801
Head office: ACREL Co., Ltd

Address: 253 Yulu Road, Jiading District, Shanghai

Tel: (86) 021-591041832

Fax: (86) 021-691588338

website: www.acrel.de

Email: acrel008 @ vip.163.com

Post code: 201801