Multifunction Power Analyzer
User Manual -English-

This user manual is only valid for Article:

RC-72

True RMS

Network Monitor for low voltage

Three-phase network 340...450V (phase - phase)
single-phase network 195...260V (phase - neutral)
Connection with dedicated CT
Programmable primary CT
True RMS value measurement

Safety instructions

Thank you for choosing the products from RiedConn GmbH. In order to facilitate your purchase and safely, correctly and efficiently use this product, please read this manual carefully and pay attention to the following points when using it.

CAUTION:

◆The equipment must be installed and repaired only by qualified personnel.

◆Before performing any internal or external operation to the equipment, make sure the CT input signal and the power supply are switched off

◆Always use a properly rated voltage sensing device to conform that all power is off.

◆The electrical parameters supplied to the equipment should be within the rated range

The following situations may result in damages to the meter or cause mistakes in the operation of the meter.

◆The voltage of the auxiliary power supply goes beyond the rated range.

◆The frequency of the power distribution system goes beyond the rated range.

◆The input polarity of the voltage or the current is incorrect.

◆Remove or connect the communication plugs without powering off.

◆Terminal connection is not connected as required

Please don't touch the terminals when the meter is in operation!

This manual can be downloaded to the latest version on the company's homepage, as well as some corresponding test software downloads. If you need an electronic version of the user manual you can request it from our technical service department.

Contents

1. Product description

1.1 Overview

RC-72 multifunction power meter can measure all electrical parameters and bi-directional electric energy, with functions such as communication and energy pulse output. The instrument adopts ultra-thin design and is easy to be installed. As an advanced intelligent and digital grid front-end acquisition component, it can be applied for power monitoring systems and energy management systems to realize power data collection.

1.2 Model selection

		RC-72
Real-time measurement	U/I/P/Q/S/PF/F	■
	Demand	■
Energy metering	Bi-directional energy	■
	Four-quadrant reactive energy	■
Power quality	Sequence component and phase position of voltage and current	■
	Voltage and current unbalance	■
Input and output	Input and output	■
	RS485 communication interface	■
Appearance dimension	Display mode	LCD
	Panel size(mm)	72×72

Note: "■" indicates that this function is available.

2. Technical parameters

2.1 Technical specification

Working environment	
Working temperature	-10°C -- 55°C
Storage temperature	-25°C -- 70°C
Relative humidity	≤95% RH, no condensation
Working altitude	≤2500m
Anti-pollution level	Non-corrosive gas
Protection degree	Front case IP54, rear case IP20.
Insulation	Between signal, power supply, output terminal to case resistance >100MΩ
Withstand voltage	Input and power supply ≥ 2kV, input and output ≥ 2kV, power supply and output ≥ 2kV
Display	
Display method	LCD
Working power supply	
Rated range	AC/DC（80～270）V
Power consumption	≤5VA
Withstand voltage	≥2kV
Voltage input	
Range	3×230/400V
Resolution	0.1 V
Impedance	≥1.7 MΩ/ per phase
Power consumption	≤0.1 VA / per phase
Overload	Continuous:1.2Vn Instantaneous：2Vn/1min
Frequency	45 Hz-65 Hz
Current input	
Range	3×5A/1A

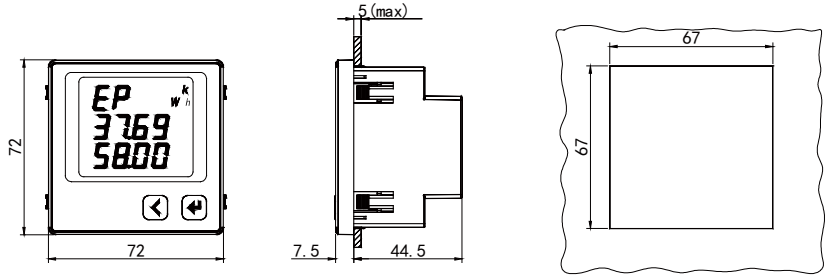
Resolution	1mA
Impedance	≤20mΩ/ per phase
Power consumption	≤0.2 VA/ per phase
Overload	Continuous:1.2Vn Instantaneous：10In/5s
Energy pulse output	
Pulse width	80ms±20%
Max. terminal voltage	35V
Max. terminal current	10mA
Pulse frequency	≤10Hz
Output object	Import active energy, import reactive energy
Communication interface	
Physical interface	RS-485
Communication speed	Up to 9.6 kbps
Communication protocol	Modbus-RTU
Isolation voltage	2000 VAC (1 min)
Electromagnetic compatibility	
Electrostatic discharge immunity	IEC 61000-4-2-III
Radiated, radio-frequency, electromagnetic field immunity	IEC 61000-4-3-III
Electrical fast transient/burst immunity	IEC 61000-4-4-IV
Impact (surge) immunity	IEC 61000-4-5-IV
Immunity to conducted disturbances, induced by radio-frequency fields	IEC 61000-4-6-III
Power frequency magnetic field immunity	IEC 61000-4-8-III
Voltage dips, short interruptions and voltage variations immunity	IEC 61000-4-11-III

2.2 Measurement parameter

Measurement variable	Accuracy	Instant	Demand	Sum	Unit
V1/V2/V3	0.2	●	—	—	[V,kV]
U12/U23/U31	0.2	●	—	—	[V,kV]
I1/I2/I3	0.2	●	●	—	[A,kA]
F	±0.01Hz	●	—	—	[Hz]
P1/P2/P3	0.5	●	—	—	[kW,MW,GW]
P	0.5	●	●	—	[kW,MW,GW]
Q1/Q2/Q3	0.5	●	—	—	[kvar,Mvar,Gvar]
Q	0.5	●	●	—	[kvar,Mvar,Gvar]
S1/S2/S3	0.5	●	—	—	[kVA,MVA,GVA]
S	0.5	●	●	—	[kVA,MVA,GVA]
PF1/PF2/PF3	0.5	●	—	—	—
PF	0.5	●	—	—	—
EP+/EP-	0.5S	—	—	●	[kWh,MWh]
EQ+/EQ-	2	—	—	●	[kvarh,Mvarh]
EQ1/EQ2/EQ3/EQ4	2	—	—	●	[kvarh,Mvarh]

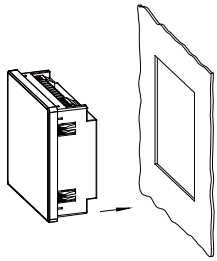
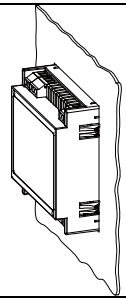
3. Installation

3.1 Dimension

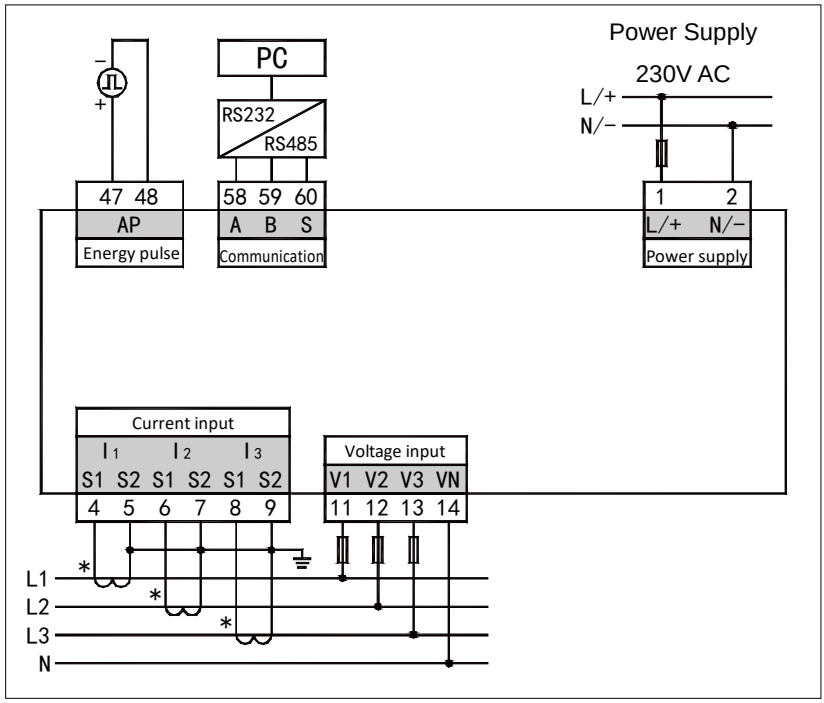


Picture 3-1 RC-72 installation dimension

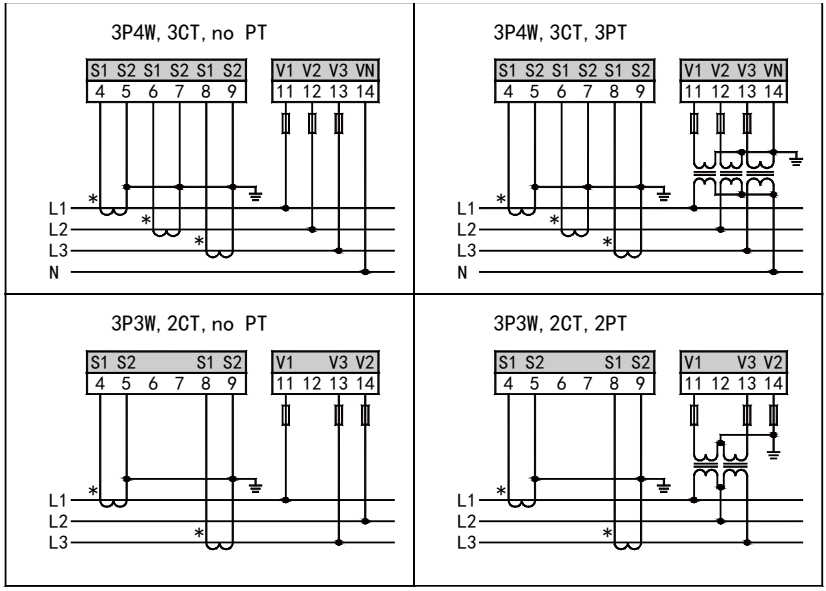
3.2 Installation

	Install the meter from the outside of the panel into the mounting hole.
	Install it to the end and fix the meter with a snap spring.

3.3 Wiring



Signal input wiring diagram



Wiring instruction:

1) Input voltage can not be higher than the rated input voltage of the product, or PT shall be considered to be used. For ease of maintenance, we recommend to use the terminal block.

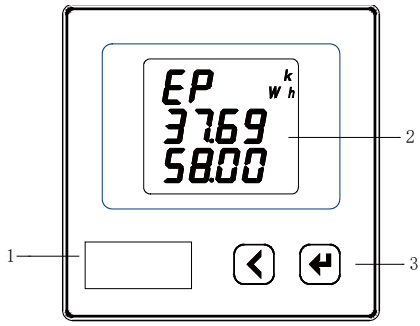
2) Standard rated input current is 5A or 1A. For larger than 5A, CT shall be considered to be used. If the external CT is connected with other meters, the tandem way shall be used for wiring. Before removing the product's current input wiring please cut off CT primary circuit or short-circuit secondary circuit. For ease of maintenance, we recommend to use the terminal block.

3) To ensure the input voltage corresponding to the current, the phase sequence and direction shall be consistent, or values and symbol errors such as power and energy may occur.

4) The meter can work in three-phase three-wire or three-phase four-wire mode. Users should select the corresponding wiring method according to the site usage. It should be noted that the wiring mode of the site must be consistent with the internal wiring setting of meter, otherwise there will be a larger deviation for data measured by meter.

4. Operation

4.1 Panel descriptio



1—Model

2—Display window

3—Touch type keys

4.2Display

The meter can display the measurement data cyclically through the "<" or "↵" key. The overview of the display interface is as follows:

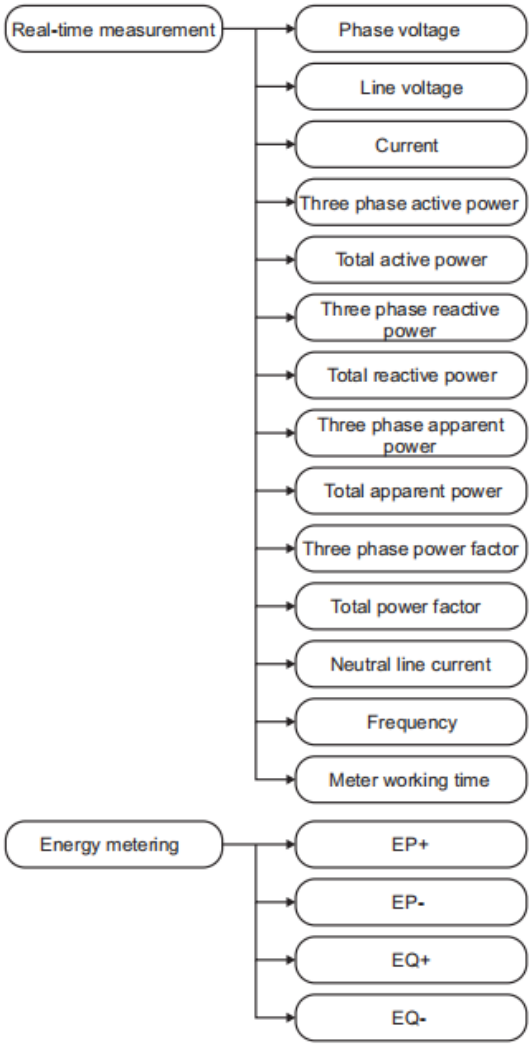
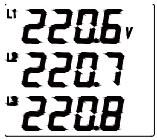
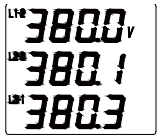
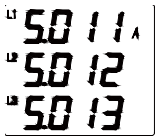
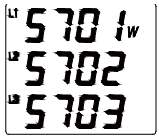


Table 4-1 Electrical variables display pages

Display interface	Instruction
	Three-phase voltage V1＝220.6V V2＝220.7V V3＝220.8V
	Three-line voltage U12＝380.0V U23＝380.1V U31＝380.3V
	Three-phase current I1＝5.011A I2＝5.012A I3＝5.013A。
	Three-phase active power P1＝5701W P2＝5702W P3＝5703W
	Total active power P＝5700W
	Three-phase reactive power. Q1＝680.5va Q2＝680.6var Q3＝680.7var
	Total reactive power Q＝2200var

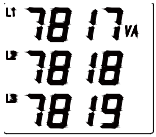
	Three-phase apparent power. S1＝7817VA S2＝7818VA S3＝7819VA
	Total apparent power S＝6700VA
	Three-phase power factor PF1＝0.932 PF2＝0.931 PF3＝0.930
	Total power factor PF＝0.980
	Neutral line current In=0.108A
	Frequency. F＝50Hz
	Working time Time=271536 minutes

Table 4-2 Energy display pages

Display interface	Instruction
	Import total active energy. EP+＝38866.77kWh
	Export total active energy. EP-＝162003kWh
	Import total reactive energy. EQ+＝300201.05kvarh
	Export total reactive energy. EQ-＝150020.05kvarh。

Table 4-3 Error message page of voltage phase sequence

Display interface	Instruction
	If the connection of voltage phase sequence is wrong, this page is displayed. After pressing the Enter key, the normal display is shown again. Single-phase and voltage phase loss are not detected for phase sequence errors message.

4.3 Setting

The setting menu adopts hierarchical management mode: the first row displays the first level menu information, the second row displays the second level menu information, and the third row displays the setting parameters. The setting menu overview map is as follows:

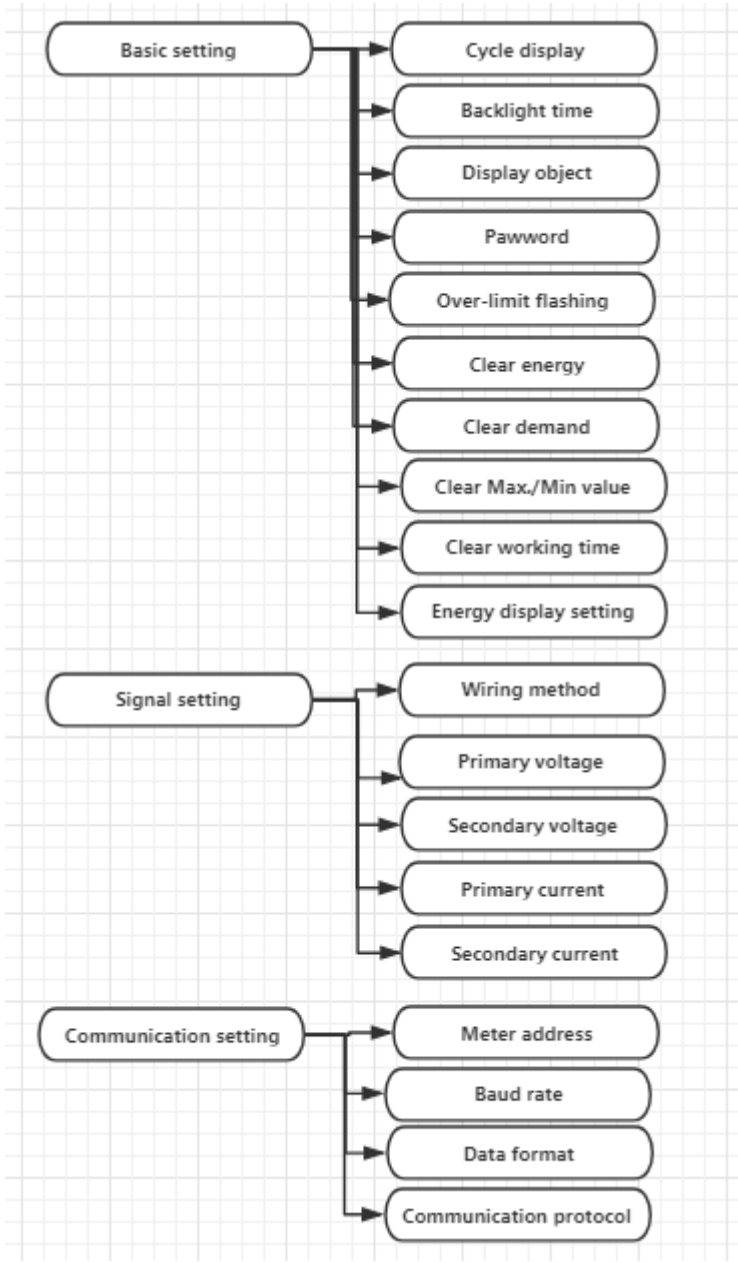


Table 4-3 set menu instruction

First level	Second level	Third level	Instruction
System setting SYS	Password CodE	0000~9999	User password
	Cyclic display CYC	no or YES	NO：no cyclic display YES：cyclic display, three seconds interval time
	Backlight time LIGH	**0～180**	Unit s, 0: always bright
	Display item diSP	Voltage, current etc.	First display page after power on
	Flashing alarm ALr	**0** **30～120**	0: Turn off the limit alarm flashing function 30～120: Over the threshold value, unit %
	Clear energy CLr.E	no or YES	NO：not clear energy YES：clear energy
	Clear demand CLr.d	no or YES	NO：not clear demand YES：clear demand
	Clear Max/Min value CLr.n	no or YES	NO：not clear Max/Min value YES： clear Max/Min value
	Working time CLrH	no or YES	NO：not clear data YES：clear data
	Energy display EdiS	ON or OFF	OFF：not display energy ON： display energy
Signal input InPt	Wiring mode nEt	n.33 n.34 n.12	n.33 ：three phase three wire n.34 ：three phase four wire n.12 ：single phase
	Primary voltage Pt. 1	**0～9999 kV**	Primary side voltage rating

	Primary voltage PT. 1	**0～9999 kV**	Primary side voltage rating
	Secondary voltage PT. 2	**0～690 V**	secondary side voltage rating
	Primary current CT. 1	**0～9999 kA**	Primary side current rating
	Secondary current CT. 2	**0～6 A**	Secondary side current rating
First communication Conn	Meter address Addr	0001~0247	Communication address：1～247
	Baud rate bAUd	2400~9600	Unit bps
	Data format dAtA	n.8.1 o.8.1 E.8.1 n.8.2	n.8.1：no check, one stop bit o.8.1：odd check,o ne stop bit E.8.1：even check, one stop bit n.8.2：no check, two stop bits
	Communication protocol Prot	rtU dLt	rtU：Modbus-RTU dLt：DLT645
version number uEr	3000 189A		Software version number

Operation instruction for keys

The "<" key is used to add and subtract the menu's toggle key and value. The "↵" key is used to enter the lower menu and confirm the value after modification.

To increase or decrease the value of a hundred thousand bits:

Press the "↵" key to move the cursor to the value you want to modify, press the "<" key to modify the corresponding value.

Enter the setting status:

Enter the setting state to pass the password authentication. Press the "↵" button in the meter display state, the meter displays "CodE", press the "↵" button to confirm the password authentication interface, and enter the password through the "<" and "↵" keys. The initial password of the system is 0001. Press "↵" to confirm. If the password is correct, the meter enters the setting interface. If the password is incorrect, the interface will not change.

Exit the setup status:

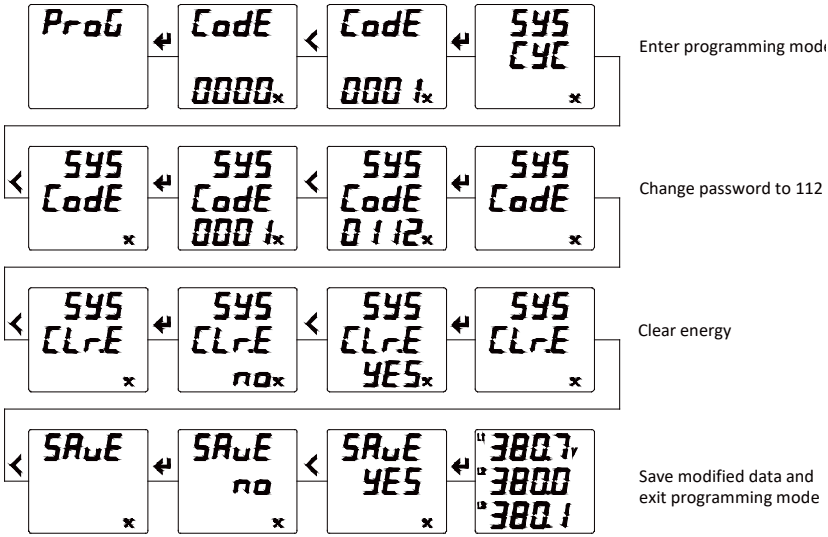
Press "<"+"↵" in any setting interface, the meter will display "SAvE", then press "↵" and the meter will display "no". At this time, there are two operations:

(1) Save and exit: press "<" to switch to "SAvE--YES", then press "↵" to save the setting parameters to exit;

(2) Exit without saving: Press "↵" to exit without saving the setting parameters.

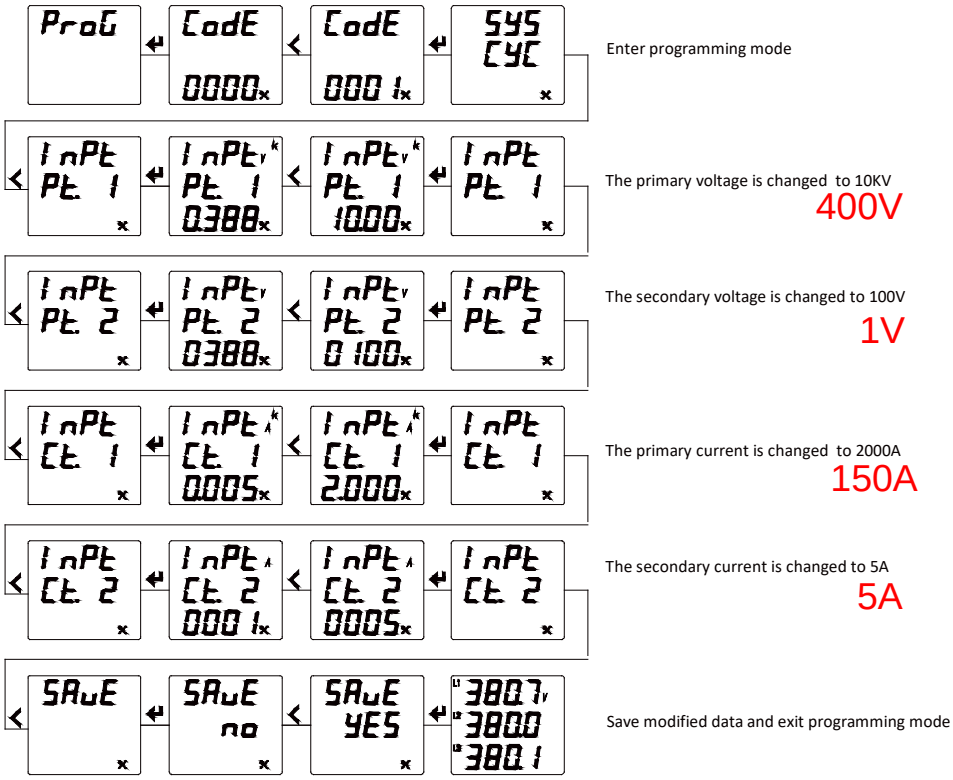
4.3.1 System parameter setting

If the user password is changed to 112 and the energy data is cleared, the menu operation steps are as follows:



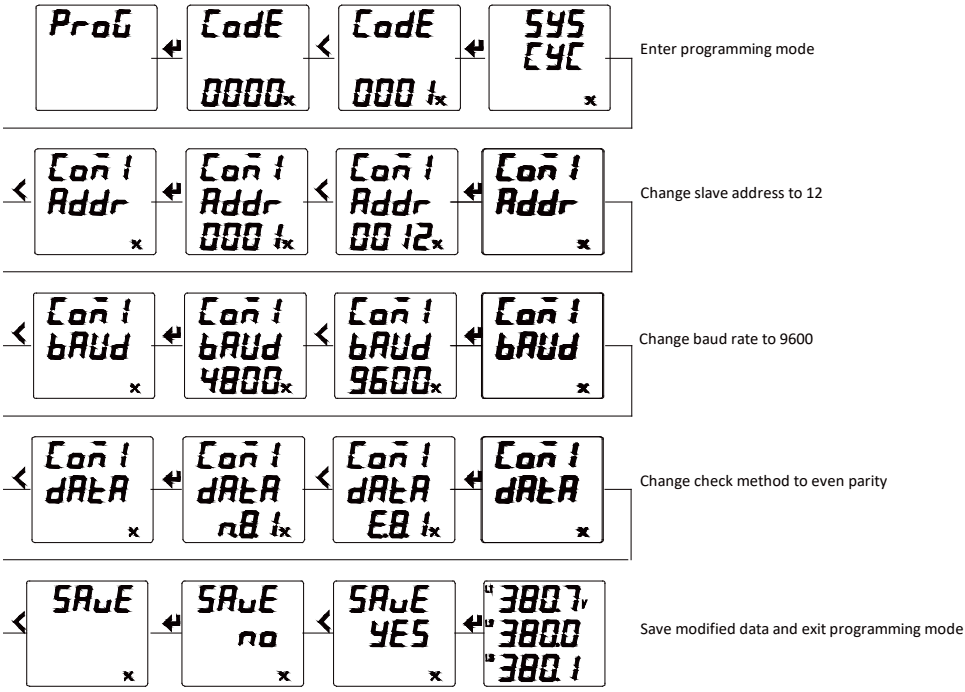
4.3.2 Signal input setting

If the signal of the meter is 10kV/100V, 2000A/5A, the menu operation steps are as follows:



4.3.3 Communication setting

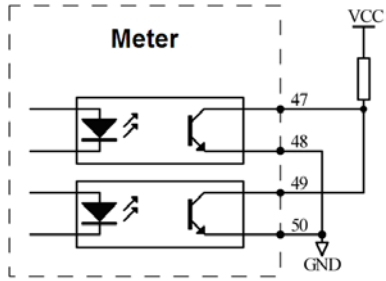
If the instrument communication address is set to 12, the baud rate is 9600, and the data format is E81 even parity mode, the menu operation steps are as follows:



5 Function

5.1 Energy pulse output

The meter provides active and reactive energy metering, and the power data can be transmitted and calibrated through 2 power pulse outputs.



Picture 5-3 Energy pulse output

(1) Pulse constant：5000 imp/kWh (all ranges), the meaning is when the meter accumulates 1kWh, the number of pulse output is 5000. It must be emphasized that 1kWh is secondary energy data. If the meter is connected with PT or CT, 5000 pulse corresponds to primary energy data 1kWh×voltage ratio PT × current ratio CT.

(2) Application example：the pulse counting device is used for PLC terminal. Supposing during the period with the length of t, the number of collected pulse is N; the input of meter is 10kV/100V, 400A/5A, thus the accumulated energy of meter during this period is N/5000×100×80 degrees of energy.

6. Communication

6.1 Physical layer

1) RS485 communication interface, asynchronous half-duplex mode;

2) Communication speed 2400 ~ 9600bps can be set, the factory default is 9600 bps;

3) Byte transfer format (N81, N82, E81, O81): 1 start bit, 8 data bits, (1 parity bit), 1/2 stop bit.

6.2 Communication protocol

The instrument supports the standard Modbus-RTU communication protocol.

The structure of the data frame: the message format.

address code	function code	Data code	Check code
1 byte	1 byte	N byte	2 byte

Address code: is the beginning of the frame, consisting of one byte (8-bit binary code), decimal 0 to 255, only 1~247 is used in our system, 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 will respond to the corresponding query. When the terminal sends back a response, the slave address data in the response tells the host which terminal is communicating with it.

Function code: Specify what function the terminal to be addressed performs. The following table lists the function codes supported by the meter and their meaning and function.

Function code	meaning
0x03/0x04	Read data register value
0x10	Write set register instruction

Data code: Contains the data required by the terminal to perform a specific function or the data collected by the terminal in response to a query. The contents of these data may be numeric values, reference addresses, or set values. For example, the function code tells the terminal to read a register, the data field needs to indicate which register to start and how many data to read, and the slave data code returns the data length and corresponding data.

Check Code: The Error Check (CRC16) 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.

6.3 Message format instruction

Read the data register value (function code is 0x03/0x04)

Request					
Frame structure	Address code	Function code	Data code		Check code
			Starting register address	Number of registers	
Occupied bytes	1 byte	1 byte	2 bytes	2 bytes	2 bytes
Data Range	1～247	0x03/0x04	0x0000～0xFFFF	Maximum 125	CRC16
Example of message	0x01	0x03	0x00 0x06	0x00 0x06	0x25C9
Response					
Frame structure	Address code	Function code	Data code		Check code
			Number of register bytes	Register value	
Occupied bytes	1 byte	1 byte	1 byte	12 bytes	2 bytes
Example of message	0x01	0x03	0x0C	12 bytes data	CRC16

Note:

The host request starting register address is the first data address of querying the primary grid or secondary grid; the number of registers is as the length of the query data. As shown in above example, the starting register address "0x00 0x06" indicates the three-phase phase voltage float data address and the number of register "0x00 0x06" indicates the data length 6 (3 float type data occupying six registers).

Write setting register (function code 0x10)

Request							
Frame structure	Address code	Function code	Data code				Check code
			Starting address of registers	Register length	Number of register bytes	Writing values	
Occupied bytes	1 byte	1 byte	2 bytes	2 bytes	1 byte	2N bytes	2 bytes
Data Range	1～247	0x10	0x080A	0x0001	N		CRC16
Example of message	0x01	0x10	0x08 0x0A	0x00 0x01	0x02	0x0064	0x2ED1
Response							
Frame structure	Address code	Function code	Data code				Check code
			Starting address of registers		Register length		
Occupied bytes	1 byte	1 byte	2 bytes		2 bytes		2 bytes
Example of message	0x01	0x10	0x08 0x0A		0x00 0x01		0x23AB

Note:

For the write setting register, please strictly comply with the meter setting information address table in the appendix. The wrong write setting register may cause the abnormal operation of meter, so be careful to do it.

Appendix Communication address information table

Primary grid data

Address (HEX)	Format	Data description	Unit	R/W
0006-0007	float	Voltage-L1	V	R
0008-0009	float	Voltage-L2	V	R
000A-000B	float	Voltage-L3	V	R
000C-000D	float	Voltage-L12	V	R
000E-000F	float	Voltage-L23	V	R
0010-0011	float	Voltage-L31	V	R
0012-0013	float	Current-L1	A	R
0014-0015	float	Current-L2	A	R
0016-0017	float	Current-L3	A	R
0018-0019	float	Active power-L1	kW	R
001A-001B	float	Active power-L2	kW	R
001C-001D	float	Active power-L3	kW	R
001E-001F	float	Total active power	kW	R
0020-0021	float	Reactive power-L1	kvar	R
0022-0023	float	Reactive power-L2	kvar	R
0024-0025	float	Reactive power-L3	kvar	R
0026-0027	float	Total reactive power	kvar	R
0028-0029	float	Total apparent power	kVA	R
002A-002B	float	Total power factor		R
002C-002D	float	Grid frequency	Hz	R
002E-002F	float	EP+	kWh	R
0030-0031	float	EP-	kWh	R
0032-0033	float	EQ+	kvarh	R
0034-0035	float	EQ-	kvarh	R
0036-0037	float	Neutral line current（3Phase 4 wire）	A	R
0038-0039	Long	Meter working time	s	R

Secondary grid data

Address (HEX)	Format	Data description	Unit	R/W
003A	int	Power factor-L1	0.001	R
003B	int	Power factor-L2	0.001	R
003C	int	Power factor-L3	0.001	R
003D	int	Voltage-L1	0.1V	R
003E	int	Voltage-L2	0.1V	R
003F	int	Voltage-L3	0.1V	R
0040	int	Voltage-L12	0.1V	R
0041	int	Voltage-L23	0.1V	R
0042	int	Voltage-L31	0.1V	R
0043	int	Current-L1	0.001A	R
0044	int	Current-L2	0.001A	R
0045	int	Current-L3	0.001A	R
0046	int	Active power-L1	1W	R
0047	int	Active power-L2	1W	R
0048	int	Active power-L3	1W	R
0049	int	Total active power	1W	R
004A	int	Reactive power-L1	1var	R
004B	int	Reactive power-L2	1var	R
004C	int	Reactive power-L3	1var	R
004D	int	Total reactive power	1var	R
004E	int	Apparent power-L1	1VA	R
004F	int	Apparent power-L2	1VA	R
0050	int	Apparent power-L3	1VA	R
0051	int	Total apparent power	1VA	R
0052	int	Total power factor	0.001	R
0053	int	Grid frequency	0.01Hz	R
0054-0055	long	EP+	1Wh	R
0056-0057	long	EP-	1Wh	R
0058-0059	long	Inductive reactive energy	1varh	R

005A-005B	long	Capacitive reactive energy	1varh	R
005C-005D	long	Apparent energy	1VAh	R
005E-005F	long	First-quadrant reactive energy	1varh	R
0060-0061	long	Second-quadrant reactive energy	1varh	R
0062-0063	long	Third-quadrant reactive energy	1varh	R
0064-0065	long	Fourth-quadrant reactive energy	1varh	R
0066	Int	Neutral line current	0.001A	R
0067	Int	Voltage phase sequence status（3phase 4 wire） 0：normal ； 1：abnormal		R

Max./min value and demand data

Address	Format	Data description	Unit	R/W
0100	Int	Max. Voltage-L1	0.1V	R
0101	Int	Max. Voltage-L2	0.1V	R
0102	Int	Max. Voltage-L3	0.1V	R
0103	Int	Max. Voltage-L12	0.1V	R
0104	Int	Max. Voltage-L23	0.1V	R
0105	Int	Max. Voltage-L31	0.1V	R
0106	Int	Max. Current-L1	0.001A	R
0107	Int	Max. Current-L2	0.001A	R
0108	Int	Max. Current-L3	0.001A	R
0109	Reserved			
010A	Int	Max. active power-L1	1W	R
010B	Int	Max. active power-L2	1W	R
010C	Int	Max. active power-L3	1W	R
010D	Int	Max. total active power	1W	R
010E	Int	Max. total reactive power	1var	R
010F	Int	Max. total apparent power	1VA	R
0110	Int	Max. total power factor	0.001	R
0111	Int	Max. grid frequency	0.01Hz	R

0112-0117	Reserved			
0118	Int	Min. voltage-L1	0.1V	R
0119	Int	Min. voltage-L2	0.1V	R
011A	Int	Min. voltage-L3	0.1V	R
011B	Int	Min. voltage-L12	0.1V	R
011C	Int	Min. voltage-L23	0.1V	R
011D	Int	Min. voltage-L31	0.1V	R
011E	Int	Min. current-L1	0.001A	R
011F	Int	Min. current-L2	0.001A	R
0120	Int	Min. current-L3	0.001A	R
0121	Reserved	In(3 phase 4 wire)		
0122	Int	Min. active power-L1	1W	R
0123	Int	Min. active power-L2	1W	R
0124	Int	Min. active power-L3	1W	R
0125	Int	Min. total active power	1W	R
0126	Int	Min. total reactive power	1var	R
0127	Int	Min. total apparent power	1VA	R
0128	Int	Min. power factor	0.001	R
0129	Int	Min. grid frequency	0.01Hz	R
012A-01BF	Reserved			
01C0	Int	Present current demand-L1	0.001A	R
01C1	Int	Present current demand-L2	0.001A	R
01C2	Int	Present current demand-L3	0.001A	R
01C3	Int	Present total active power demand	1W	R
01C4	Int	Present total reactive power demand	1var	R
01C5	Int	Present total apparent power demand	1VA	R
01C6-01C7	Reserved			
01C8	Int	Current demand of last cycle-L1	0.001A	R
01C9	Int	Current demand of last cycle-L2	0.001A	R
01CA	Int	Current demand of last cycle-L3	0.001A	R
01CB	Int	Total active power demand of last cycle	1W	R
01CC	Int	Total reactive power demand of last cycle	1var	R

01CD	Int	Total apparent power demand of last cycle	1VA	R
01CE-01CF	Reserved			
01D0	Int	Max. current demand-L1	0.001A	R
01D1	Int	Max. current demand-L2	0.001A	R
01D2	Int	Max. current demand-L3	0.001A	R
01D3	Int	Max. total active power demand	1W	R
01D4	Int	Max. total reactive power demand	1var	R
01D5	Int	Max. total apparent power demand	1VA	R
01D6-01FF	Reserved			

Setting parameters

Address (HEX)	Format	Data content	Data description	R/W
0802	Int	High byte: cycle display	0x01: cycle display !(0x01): no cycle display	R/W
		Low byte: off-limit alarm threshold value	0：off 1-180%	
0803	Int	High byte: defaulted display interface	0: voltage 1: current 2: frequency 3: active power 4: power factor 5: active energy	R/W
		Low byte: backlight duration time setting	1-180s 0：constant on	R/W
0804	Int	High byte: communication address	1-247	R/W
		Low byte: communication baud rate	0：1200bps 1：2400bps 2：4800bps 3：9600bps	
0805	Int	High byte: data format	0：N,8,1 1：E,8,1	R/W

			2：O,8,1 3：N,8,2	
0806-0807	--	--		
0808	Int	High byte: wiring mode	0：3P4W 1：3P3W 2：1P2W	R/W
		Low byte: grid frequency	0：50Hz 1：60Hz	R/W
0809	Int	High byte: dispaly energy	0：close energy display 1：enable energy display	R/W
		Low byte:reserved		
080A	Int	PT secondary voltage rated value	1～660V	R/W
080B	Int	CT secondary current rated value	1～6A	R/W
080C-080D	Int	--		R/W
080E-080F	long	PT primary voltage rated value	1～999999V	R/W
0810-0811	long	CT primary current rated value	1～999999A	R/W
0812-0833	Int	--		R/W
0834	Int	Demand item	Ia/Ib/Ic/P/Q/S: 0(fixed)	R
0835	Int	Demand working mode	0：slip block mode 1：fixed block mode	R/W
0836	Int	Demand slip block time（t）	1～9999s	R/W
0837	Int	Demand period coefficient（n）	1～30 Demand calculation period T=n×t	R/W