

# SIEMENS

SICAM P20

SICAM P21

SICAM P22

3-phase Current Power  
Meter

V1.40

Manual

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Preface

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**NOTE**

For your own safety, observe the warnings and safety instructions contained in this document, if available.

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# Preface

## Purpose of this manual

This manual describes the functions, operation, installation, and commissioning of devices 3-phase Current Power Meter-> In particular, one will find:

- Information regarding the configuration of the scope of the device and a description of the device functions > Chapter 3;
- Instructions for Operation and Display > Chapter 4;
- Technical Data > Chapter 2;

## Target Audience

Protection engineers, commissioning engineers, personnel concerned with adjustment, checking, and service of selective protective equipment, automatic and control facilities, and personnel of electrical facilities and power plants.

## Additional Support

Should further information on the System SICAM be desired or should particular problems arise which are not covered sufficiently for the purchaser's purpose, the matter should be referred to the local Siemens representative.

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## Notes on Safety

This document is not a complete index of all safety measures required for operation of the equipment (module or device). However, it comprises important information that must be followed for personal safety, as well as to avoid material damage. Information is highlighted and illustrated as follows according to the degree of danger:



### **DANGER**

**DANGER** means that death or severe injury will result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid death or severe injuries.



### **WARNING**

**WARNING** means that death or severe injury may result if the measures specified are not taken.

✧ Comply with all instructions, in order to avoid death or severe injuries.

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### **CAUTION**

**CAUTION** means that medium-severe or slight injuries can occur if the specified measures are not taken.

✦ Comply with all instructions, in order to avoid moderate or minor injuries.

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### **NOTICE**

**NOTICE** means that property damage can result if the measures specified are not taken.

✦ Comply with all instructions, in order to avoid property damage.

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### **NOTE**

Important information about the product, product handling or a certain section of the documentation which must be given particular attention.

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## **Qualified Electrical Engineering Personnel**

Only qualified electrical engineering personnel may commission and operate the equipment (module, device) described in this document. Qualified electrical engineering personnel in the sense of this manual are people who can demonstrate technical qualifications as electrical technicians. These persons may commission, isolate, ground and label devices, systems and circuits according to the standards of safety engineering.

## **Proper Use**

The equipment (device, module) may be used only for such applications as set out in the catalogs and the technical description, and only in combination with third-party equipment recommended and approved by Siemens.

Problem-free and safe operation of the product depends on the following:

- Proper transport
- Proper storage, setup and installation
- Proper operation and maintenance

When electrical equipment is operated, hazardous voltages are inevitably present in certain parts. If proper action is not taken, death, severe injury or property damage can result:

- The equipment must be grounded at the grounding terminal before any connections are made.
  - All circuit components connected to the power supply may be subject to dangerous voltage.
  - Hazardous voltages may be present in equipment even after the supply voltage has been disconnected (capacitors can still be charged).
  - Operation of equipment with exposed current-transformer circuits is prohibited. Before disconnecting the equipment, ensure that the current-transformer circuits are short-circuited.
  - The limiting values stated in the document must not be exceeded. This must also be considered during testing and commissioning.
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# Overview

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## 1.1 Introduction

SICAM P20, P21 and P22 3-phase electronic current monitoring instruments are designed for measuring 3-phase current of power grid. LCD screen is used. Data acquisition through RS485 is available. RS485 communication supports MODBUS-RTU protocol.

This product is extensively applicable to power substation and distribution automation system, industrial control and industrial automation system, energy management system and community power monitoring, etc.

This 3-phase electronic multi-function power meter meets following standards:

- IEC 62052-11:2003 (Electricity metering equipment (a.c.) General requirements, tests and test conditions-Part 11: Metering equipment) standard
- Modbus-RTU

## 1.2 Features

This project uses high-precision sampling and metering unit and high-speed MCU data processing unit, supporting high-precision, wide-range and accurate measurement and quick data analysis; segmented multi-line WVA LCD, realizing various and abundant display; white backlight for LCD, satisfying the need for viewing data in dark environment; NVRAM, supporting long-time data storage without data loss even in the event of power failure; RS485 communication port and industrial standard communication protocols, realizing flexible and reliable communication.



# Technical Data

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## 2.1 Technical Data

Item		Technical Data
Product standard		IEC61557-12:2007
Input connection		3 phase, single phase
Measurement	Current	Rated current $I_n$ : 1 A, 5 A
		Measuring range: 0.015 A ... 6 A Maximum measuring range: 9 A Power consumption: < 0.3 VA (single phase @5A) Accuracy: RMS 0.2 % Resolution: 0.001 A
Digital signal	Binary output (optional)	1 electromagnetic relay output Normal Open Contact Contact capacity: AC 250 V /3 A, DC 30 V /3 A
	Binary input (optional)	2 dry contact inputs Opto-coupler isolation, 4,000 V <sub>RMS</sub>
Communication	RS-485 port	Interface type: Twisted Pair, Half Duplex Transmission Communication rate: 600 bps ... 38,400 bps Protocol: Modbus-RTU
Environment	Operating temp.	-25 °C ... +60 °C
	Operating temp. limit	-35 °C ... +70 °C
	Relative humidity	≤ 95 % (condensation free)
Others	Operating power supply	AC or DC power supply Max. input range: 40 V ... 420 V Power consumption: ≤ 1.5 W, 2.5 VA
	Dimension	Overall dimension (mm): 72×72×85 Panel cut out size (mm): 67×67 IP53
	Weight	Approx. 300 g



# Functions

# 3

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### 3.1 Measurements

This product can be used to measure current of each phase, average current and Neutral current.

### 3.2 Limit violation Alarm

1. This product is provided with Limit violation alarm function. User may select from current parameters at most 6 data groups at the same time as detection object and set upper and lower limits and judgment condition for them. Alarm will be activated when measured value is over the set limit. This product is provided with 1-way relay output. When alarm parameters are configured that output is made from certain relay which is at automatic mode (not manual), Limit violation alarm signal can be output through such relay (relay closing).
2. At most 6 Limit violation alarm parameters can be set at the same time within the product. Configuration flow of each Limit violation alarm parameter: select type of detected data-set threshold of detected data-set judgment condition-select output relay for alarm signal.
  - Code of various detected data: (hexadecimal number for Modbus-RTU code)

MODBUS code	Content of data
0F	Phase A current
10	Phase B current
11	Phase C current
12	Neutral current

When code of detected data is FF, Limit violation alarm function of such group is off.

- Threshold of detected data: threshold judging whether detected value is out of limit; different units for different types of data, such as current-A.
  - Judging condition: 0 means alarm activated when exceeding limit; 1 means alarm activated when falling below limit.
  - Alarm signal output relay: 0 means no output of alarm signal; 1 means alarm signal output from relay.
3. Example of alarm parameter setting. Set one Limit violation alarm parameter to automatic detection and alarm for "Phase A current", assuming that alarm threshold is 6 A, judging criterion is "over limit" and signal is outputted from relay 1.
 

Use MODBUS RTU protocol to set alarm parameter: set 0110 address to "0F", 0111 to "0000", 0112 to "0258" (multiply "6" by 100 to generate "600" and convert it into "00000258"), 0113 to "00" and 0114 to "01".

### 3.3 Display and Buttons

This product uses large-screen WVA multi-line LCD to provide visual and various display. The screen is provided with white backlight, enabling clear display in dark environment. Specific data information can be obtained through display with button operation. For details, see Chapter Operation and Display.

### 3.4 Communication

RS485 port is provided for parameter setting and reading of various data. For specific description, see Chapter Communication.

### 3.5 Permission and Security Management

1. This product is provided with programming permission management function.
  - L0 password: used for meter reset, setting all parameters and modifying L0, L2 and L4 passwords;
  - L2 password: used for meter reset, setting all parameters and modifying L2 and L4 passwords;
  - L4 password: used for parameter setting and modifying L4 password, not for meter reset, clearing extreme values and PT/CT ratio setting.
  - **All level default PASSWORD is "000000"**
2. Parameter setting is available only when this product is in programmable state. Steps for entering programming state: press " " and " " at the same time to enter "PASS" screen; input correct password and press " " to enter "SET" screen and enable programmable state. After entering programmable state, programmable state prompt appears on the bottom right corner of LCD. Programmable state will remain valid in 10 minutes after program button is pressed and become invalid after power down.
3. If incorrect password is used to set this product continuously (including communication setting and button programming) up to specific number of times (factory default 5 times), parameter setting function will be locked (factory default 60 minutes). Error count will be reset after setting once using correct password if such count is less than specific limit. Error count of password and lock time can be set (available in factory state).

### 3.6 Digital Input and Output Interface

#### Binary Input Interface

This product is provided with 2-digit binary inputs interface based on passive dry contact. Terminals are identified as DI1, DI2 and COM. COM is the common terminal.

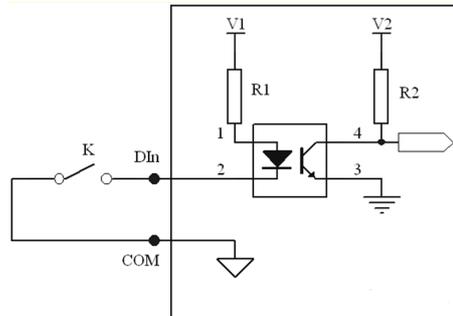


Figure 3-1 Circuit Diagram of Binary Input Interface

#### Relay Output Interface

This product is provided with one relay output interfaces for alarm indication or protection control output in many conditions. Electric parameter of internal relay: AC 250 V/DC30 V, 3 A.

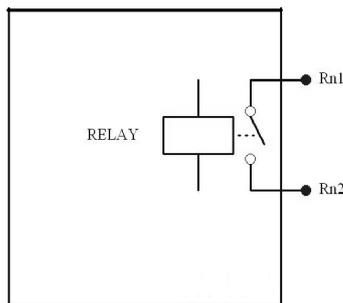


Figure 3-2 Circuit Diagram of Relay Output Interface



# Operation and Display

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### 4.1 Full-screen Display

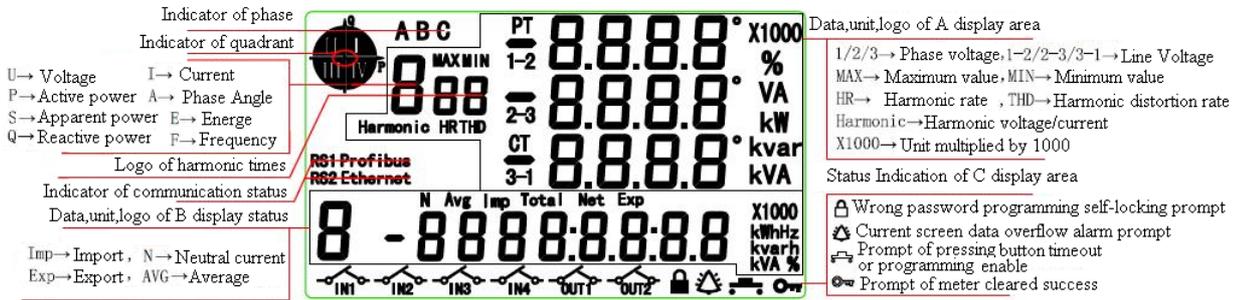


Figure 4-1 Description of LCD Indication

### 4.2 Cyclic Display

#### Key Functions at Cyclic Display Mode

Key symbol	▲	▼	←	↻
Function	Switching from cyclic display to button display		Lock/unlock blinking display	Switching between display areas A and B (blinking prompt)

#### Screen Lock in Cyclic Display State

Data in display area A or B can be locked in cyclic display state to enable long-time monitoring of data in certain area.

Steps: press "↻", select the desired display area (target data will blink thrice), and press "←" to lock, and vice versa for unlocking.

#### Cyclic Display Parameter

Duration: 1 to 99 sec., configurable;

Number of items: to be defined with one byte. 4 high 4 bits are number of items in display area A while 4 low 4 bits are number of items in display area B. 16 items are acceptable to each area. At any time, display area A and display area B should have at least one cyclic display item.

#### Cyclic Display State

Cyclic display data in areas A and B can be defined by user. User may develop cyclic display scheme previously through inquiring "Code list of optional settings in areas A and B".

Code list of optional settings in area A:

Data item	Data type (current value)		
	Transient	Maximun	Minimum
Current	6	7	8
Neutral current	9	10	11



**Note**

In flip-with-key state or parameter-set-with-key state, this product will automatically return to cyclic display state if no key operation within defined duration.

## 4.3 Key Definition

### Key Functions at Flip-With-Key Display Mode

Key symbol	▲	▼	↵	↶
Function	1) Switch from cyclic display state to key display state through pressing "▲" or "▼". 2) Flip over to previous screen with "▲" and to next screen with "▼".		Enter next menu	1) Switch between A (multi-line) and B (single line) display areas 2) Return to previous menu

### Data Item of Key Display

No.	Display content (1 <sup>st</sup> level)	Display content (2 <sup>nd</sup> level)
1	Current	Extreme value
2	Neutral current	Extreme value
3	CT ratio	/
4	Version	/
5	Device ID	/
6	Error code	/

### Examples for Flip-With-Key Operation

	<p>Example 1: This screen shows current items. At cyclic display mode, press "▲" or "▼" to enter key display mode. Press "▲" or "▼" again to switch to current items. In the figure, L1=1.000 A, L2=1.001 A, L3=1.002 A and 3-phase average current=1.001 A. "RS1" shows there is one RS485 port and flickering symbol means communication in progress.</p>
	<p>Example 2: This screen shows null line current items. At cyclic display mode, press "▲" or "▼" to enter key display mode. Press "▲" or "▼" again to switch to null line current items. In the figure, L1=0.940 A, L2=1.003 A, L3=1.006 A and null line current=0.079 A.</p>

	<p>Example 3:</p> <p>This screen shows maximum value display items of phase current.</p> <p>At cyclic display mode, press "▲" or "▼" to enter key display mode. Press "▲" or "▼" again to switch to phase current display items. Press "←" to enter maximum value display. In the figure, L1=1.020A, L2=1.031A, L3=1.032A and maximum value of average phase current =1.027A. Press "▲" or "▼" to switch to minimum value display of phase current and press "→" to return to previous display.</p>
	<p>Example 4:</p> <p>This screen shows CT ratio display items.</p> <p>At cyclic display mode, press "▲" or "▼" to enter key display mode. Press "▲" or "▼" again to switch to CT ratio display items.</p> <p>In the figure, CT ratio=5.</p> <p>(Note: decimals part of ratio are not displayed.)</p>
	<p>Example 5:</p> <p>This screen shows display items of software version number.</p> <p>At cyclic display mode, press "▲" or "▼" to enter key display mode. Press "▲" or "▼" again to switch to display items of software version number. In the figure, "Soft" means software version, "13" means product specification, "121121" means software version date and "00" means serial number of software production.</p>
	<p>Example 6:</p> <p>This screen shows Device ID display items.</p> <p>At cyclic display mode, press "▲" or "▼" to enter key display mode. Press "▲" or "▼" again to switch to Device ID display items. Device ID=000000000001.</p>
	<p>Example 7:</p> <p>This screen shows error code display items.</p> <p>At cyclic display mode, press "▲" or "▼" to enter key display mode. Press "▲" or "▼" again to switch to error code display items. "E" means error prompt, the 3 bits from right to left mean respectively phase C reverse, phase B reverse, and phase A reverse. Other 4 bits are meaningless. For example, "E0000001" means phase C reverse error occurs.</p>

### Key Setting Parameters

#### 1. Key functions at parameter setting mode

Key symbol	▲	▼	↵	↶
Function	a) "▲" to switch digit or flip over; b) "▼" to move cursor or flip over.		Enter next menu a) Press "↵" and "↶" at the same time to enter setting screen. b) Press "↵" to enter next menu or "confirm" parameter setting. c) Press "↶" to return to previous menu or "cancel" parameter setting <sup>1</sup> .	

1. Press "↵" once after adjusting parameters with "▲" and "▼" to display "Sure", and press "↶" once again to alter parameters. Pressing "↵" immediately after "Sure" appears will cancel current alteration.

#### 2. Data items configurable with key

NO.	1 <sup>st</sup> level menu		2 <sup>nd</sup> level menu			
	Symbol	Definition	Symbol	Definition	Range	Remarks
1	Conn	Communication setting	bPS	Baud rate	600 ... 38400	Default setting: 2400
			P <sub>r</sub> y	Parity	8E1/8o1/8n1/8n <sub>2</sub>	Default setting: 8E1
			nBUS	Modbus address	0 ... 247	Default setting: 0
			dLAY	Modbus sending delay	0 ... 2999	Default setting: 10
			645H	DL/T645 high 6 address	0 ... 999999	Default setting: 0
			645L	DL/T645 low 6 address	0 ... 999999	Default setting: Last 3 digital of S/N
2	PrCr	Ratio setting	Cr-A	Current conversion ratio integer part	0 ... 9999	Combination 0 ... 9999.9999
			Cr-b	Current conversion ratio decimal part	0 ... 9999	Default setting: 1
3	SYS	System setting	TYPE	Connection	3P4L 3P3L_2CT 3P3L_3CT AUto	3phase4wire 3phase3wire -2CT 3phase3wire -3CT Automatic
			PASS	Password		6 bits in total, altering L0-2 password Default setting: 000000

NO.	1 <sup>st</sup> level menu		2 <sup>nd</sup> level menu			
	Symbol	Definition	Symbol	Definition	Range	Remarks
4	CLR	Clearing extreme value	ETRE			
		Meter reset	ALL			
5	DISP	Display setting	PRES	Time of returning to cyclic display state when no operation	1 ... 99	Unit: min. Default setting: 10
			LIGH	Time of backlight on when no operation (normally on when set to 0)	0 ... 99	Unit: min. Default setting: 10
			CYCL	Interval of cyclic display	1 ... 99	Unit: sec Default setting: 5



**Note**

Password level (1 bit, 0 to 2) and password (6 bits) should be entered at first for key setting. Password level and permission:

- L0 password-all parameters above are configurable;
- L1 password-all parameters above are configurable;
- L2 password-all parameters except for meter reset, clearing extreme value and PT/CT ratio are configurable. All default password is 000000.



**Note**

The meter should be reset after altering conversion ratio to ensure reasonable correspondence between communication reading and displayed metering data.

3. Parameter setting with keys (take "Conn communication setting" for example)

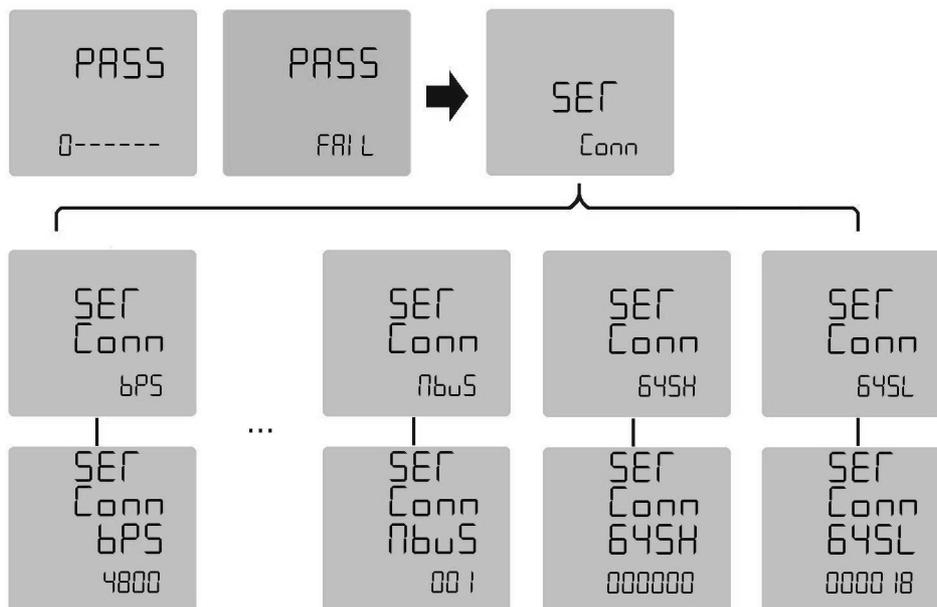


Figure 4-2 Parameter setting with keys

At any time, press "←" and "→" simultaneously to enter "PASS" screen. The first digit of displayed data means password level and the remaining 6 data make up the password (press "▲" to change digits and "▼" to move cursor). Press "←" to confirm. "FAIL" will appear if password level and password are wrong. To re-enter password, press "←". To quit and return to cyclic display state, enter "→" (if specified error count is reached, parameter setting function will be locked for certain period which is configurable in advance). If the password is validated, you may enter the first-level menu. The figure shows the read-write items under "Conn" menu: baud rate and communication address of RS485 port can be set.



**Note**

"SURE" screen appears after selecting or inputting parameter and pressing "←". Press "←" once again to activate new parameter. Pressing "→" at any time during parameter setting will cancel setting or return to previous menu.





# Installation and Wiring

# 5

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## 5.1 Overall Dimension

The figure below shows the overall dimension of this product. Panel cut out size: 67 mm×67 mm

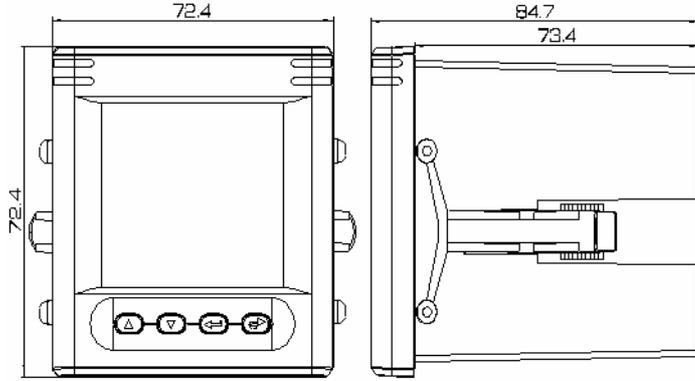


Figure 5-1 Overall Dimension of Instrument

## 5.2 Precautions of Installation

1. Dry and well ventilated environment far away from thermal source and strong electric (magnetic) field is recommended for installation of this product.
2. Ambient temperature:  $-25\text{ }^{\circ}\text{C}$  to  $+60\text{ }^{\circ}\text{C}$  , humidity:  $\leq 95\%$  (no condensation)
3. This product should be firmly mounted to avoid accident arising from vibration.
4. For the reason of convenient installation, maintenance and operation and safety, enough space around this product should be reserved during installation (especially when one panel for multiple meters).
5. Requirement for electric wiring: Stranded fire-retarded copper wire over  $2.5\text{ mm}^2$  should be used for current circuit,  $1.5\text{ mm}^2$  stranded fire-retarded copper wire should be used for voltage circuit and power supply circuit, and  $1.0\text{ mm}^2$  Shielded Twisted Pair should be used for RS485 communication.
6. Requirement for electric connection: In voltage input circuit and operating power supply circuit, appropriate fuses (such as 0.5 A fuse) should be connected and a CT short-circuit box should be provided to prevent open circuit of CT wiring.

## 5.3 Terminals and Wiring Diagram

### Definition of Terminals (viewed from rear to front and from left to right)

#### 1. Upper main terminals

V+	V-	NC	NC	NC	NC
Power supply		Reserved	Reserved	Reserved	Reserved



#### Note

NC means no connection, the same below.

#### 2. Lower main terminals

I11	I12	I21	I22	I31	I32
Phase A current input	Phase A current output	Phase B current input	Phase B current output	Phase C current input	Phase C current output



#### Note

Main terminals are barrier terminals which can be connected using fork or ring-type lug (no more than 6.5 mm wide). For cables to be connected to upper and lower main terminals, cold-pressed UT2.5-3 terminal is recommended before connection. The diagram of connection is below.

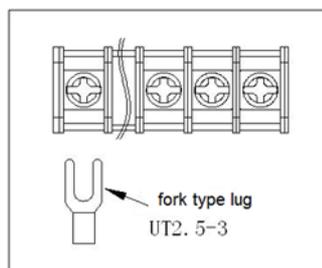


Figure 5-2 Connection Diagram of Main Terminal

3. Middle auxiliary terminal (common)

P+	P-	DI1	DI2	COM	A	B	NC	R11	R12
Reserved		Binary input 1	Binary input 2	Common binary input terminal	RS485 +	RS485 -	Reserved	Relay output	



**Note**

Auxiliary terminal is pluggable.

**Wiring Diagram**

Wiring diagram of main terminal is showed below. "V+" and "V-" are power supply terminals. This product supports DC/AC input, with input voltage 40 V to 420 V.

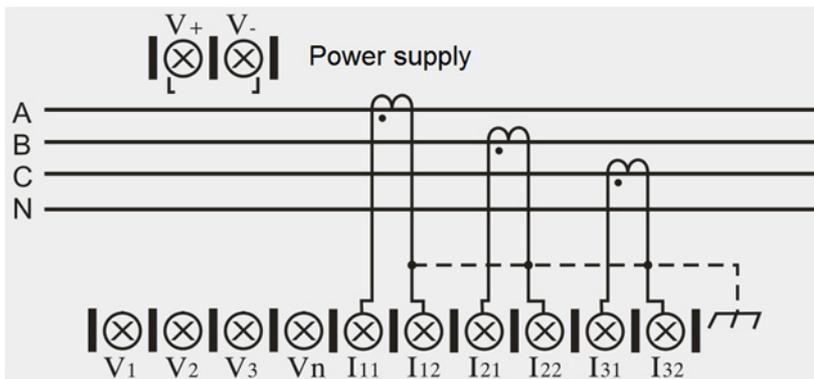


Figure 5-3 Wiring Diagram of 3-phase-4-wire (W/O PT)



# Communication

# 6

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## 6.1 Use of Communication

RS485 port of this product supports MODBUS-RTU communication protocol. Even parity check is the default setting for data byte check, namely 8E1 (8-digit data, even parity check, 1 stop bit) format. MODBUS-RTU communication protocol can also be configured to odd parity check or no verification, namely 8O1 (8-digit data, odd parity check, 1 stop bit), 8N1 (8-digit data, no parity check, 1 stop bit), or 8N2 (8-digit data, no parity check, 2 stop bits) format. Baud rate of communication port could any of 600 bps, 1,200 bps, 2,400 bps, 4,800 bps, 9,600 bps, 19,200 bps and 38,400 bps.

RS485 port of this product should be connected using Shield Twisted Pair. When wiring, layout of the entire network should be considered: length and orientation of communication cable, position of upper computer, matched resistance at network end-point, communication converter, network scalability, network coverage, EMI, etc.



### Note

1. Wiring should be conducted strictly in accordance with requirement.
  2. The power meter requiring no communication temporarily should be connected to RS485 network for easy diagnosis and test.
  3. The shielding layer side of cable connected with upper computer should be reliably earthed (PGND: ground, cubicle, cabinet, etc.) to avoid two-point or multi-point earthing.
  4. Shield Twisted Pair should be used for RS485 bus cable. For two twisted pairs, different colors are recommended, one color for "A" side and another color for "B" side of 485 communication port.
-

## 6.2 Introduction of MODBUS-RTU Communication Protocol

### 6.2.1 Overview

#### Type of Protocol

This is MODBUS RTU protocol applicable to real-time communication of embedded electric energy meter. This protocol defines the data exchange between terminal unit (slave) and Master, which is realized in the form of RTU (remote terminal unit) of MODBUS. Asynchronous master-slave half-duplex communication is used. Communication is initiated from master and slave responds after receiving request from master. Communication response time < 0.2 sec.

#### Physical Layer

- Transmission interface: RS-485
- Communication address: 0 to 247
- Communication baud rate: 600 bps to 38,400 bps
- Communication media: Shield Twisted Pair

#### Data Link Layer (DLL)

- Transmission manner: asynchronous master-slave half-duplex
- Data frame format: 1 start bit, 8-digit data, even parity check bit, 1 stop bit
- Data packet format:

Address	Function	Data	CRC
8 bits	8 bits	n*8 bits	16 bits

Data packet transmission sequence always uses identical address, function code, data and check code. Each data packet should be transmitted as a continuous bit stream. When data packet from the master reaches slave, slave matching the address field in data packet will receive and check the data. If no error, slave will execute the request in data packet and send the responsive data packet to the master. The data packet sent back by slave contains slave Address, Function executed, Data generated from function execution and CRC.

- Address

Address is at the beginning of data packet and consists of an 8-bit data which means slave address specified by the master. Each slave address in the bus is unique. Valid address range is from 0 to 247. After the master sends data packet, only slave matching the inquire address of the master will respond.

- Function

It describes which function is executed by slave. Meanings of all function codes are given below.

Code	Definition	Function
03 H	Read data	Read current binary value of one or more variables
10 H	Preset multiple registers	Overwrite values of several variables using specific binary value

- Data

It contains data required for executing specific function by slave or data acquired when slave responds inquiry of master. Content of these data may be address code or data.

- CRC

Check code is 16-bit check data formed in data transmission for CRC of master and slave. Various interferences exist in communication, so data transmitted during communication may change. CRC will avoid data distortion during responsive transmission of master and slave and improves security and efficiency of system. For formation rule of check code, see Annex 1.

## 6.2.2 Function of Application Layer

### Read Data Command (function code 03 H)

- Down frame format

Communication address (0-247)	Function code (03 H)	High byte of start address of data	Low byte of start address of data	High byte of length of data	Low byte of length of data	Low byte of CRC	High byte of CRC
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- Response frame format

Communication address (0-247)	Function code (03 H)	Number of bytes of data length	Content of data	Content of data	Content of data	Low byte of CRC	High byte of CRC
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- Example

- Down frame of 3-phase voltage data read

Device address	03 H	10 H	00 H	00 H	03 H	Low check	High check
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- Response frame

Device address	03 H	06 H	Data 1	Data 2	...	Low check	High check
----------------	------	------	--------	--------	-----	-----------	------------

### Preset Multi-Register Command (function code 10 H)

- Down frame format

Device address 0-247	Function code (10 H)	High byte of start address of variable	Low byte of start address of variable	High byte of variable number	Low byte of variable number	Byte n of data	Byte 1 of data	Byte of data	Byte n of data	Low byte of CRC	High byte of CRC
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- Response frame format

Device address 0-247	Function code (10 H)	High byte of start address of variable	Low byte of start address of variable	High byte of variable number	Low byte of variable number	Byte n of data	Byte 1 of data	Byte of data	Byte n of data	Low byte of CRC	High byte of CRC
----------------------	----------------------	--	---------------------------------------	------------------------------	-----------------------------	----------------	----------------	--------------	----------------	-----------------	------------------

- Example

- Down frame when CT conversion ratio is 1234.5678 (hexadecimal notation of 12345678: 00BC 614EH)

Device address	10 H	00 H	05 H	00 H	02 H	04 H	00 H	BCH	61 H	4EH	Low check	High check
----------------	------	------	------	------	------	------	------	-----	------	-----	-----------	------------

- Response frame

Device address	10 H	00 H	05 H	00 H	02 H	Low check	High check
----------------	------	------	------	------	------	-----------	------------

### Exception Response

- Exception response frame format

Communication address (0-247)	Function code (80 H+03 H) (80 H+10 H)	Exception code (XX H)	Low byte of CRC	High byte of CRC
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- Example

- Address data of illegal register read

Device address	03 H	XX H	XX H	00 H	01 H	04 H	Low check	High check
----------------	------	------	------	------	------	------	-----------	------------

- Response frame

Device address	83 H	02 H	Low check	High check
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- Exception code of MODBUS

Code	Meaning
02 H	illegal data address
03 H	illegal data
10 H	no permission
11 H	register length overflow

### 6.2.3 CRC Method

CRC contains 2 bytes, namely 16-bit binary system. CRC is calculated with transmitting device and placed at the tail of transmitted message. Receiving device recalculates CRC of message received and compares whether CRC derived matches the received one. If not, error may occur.

To calculate CRC, preset all 16-bit registers to 1. Then, process each 8-bit data message one by one. Only 8-bit data bit is used for CRC calculation and start bit and stop bit and parity check bit (if any) are not involved.

Steps of calculating CRC:

- Preset 16-bit register to hexadecimal FFFF (namely all to 1), and this register is called CRC register.
- Execute exclusive OR of low bytes of 1<sup>st</sup> 8-bit data and 16-bit CRC register and put the result in CRC register.
- Shift the content of register rightwards by one bit (towards lower bit) and fill the highest bit with 0. Check the lowest bit.
- If the lowest bit is 0, repeat step 3 (shift again); if it is 1, execute exclusive OR of CRC register and polynomial A001 (1010 0000 0000 0001).
- Repeat step 3 and step 4 until shift rightwards 8 times. Now, all 8-bit data are processed.
- Repeat step 2 to step 5 to process next 8-bit data.
- The CRC register derived finally is CRC.

## 6.2.4 Information mapping table

### Common Parameters

Parameter	Address	Data Type	Length	R/W	Data Range	Remark
Modbus address	0000 H	unsigned int	2 bytes	R/W	0...247	
Baud rate of communication	0001 H	unsigned int	2 bytes	R/W	0...6	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 19200 bps 4: 38400 bps 5: 600 bps 6: 1200 bps
High 16 bits of current ratio part	0004 H	unsigned long	4 bytes	R/W	0...99999999	CT ratio=set value/10,000, 10,000 as default when CT=0
Low 16 bits of current ratio part	0005 H					
Clearing extreme value	0006 H	unsigned int	2 bytes	W	Arbitrary value	
Parity	0020 H	unsigned int	2 bytes	R/W	0...3	0: 8E1 1: 8o1 2: 8n1 3: 8n2

### Alarm Parameters

Parameter	Address	Data Type	Length	R/W	Data Range	Remark
Relay output 1	0100 H	unsigned int	2 bytes	R/W	0...1	Write operation is valid when "alarm manner control byte" is 0 or 2
Binary inputs	0102 H	unsigned int	2 bytes	R		High byte: binary input status (note) Low byte: binary output status
Alarm manner control byte	0103 H	unsigned int	2 bytes	R/W	0...1	0: turn off alarm function 1: relay output 1 is used for alarm
Alarm status byte	0106 H	unsigned int	2 bytes	R	0...0x3F	From low to high, each bit means status of an alarm group: 0: no alarm activated 1: in alarm status
BO1 Relay operation time	0107 H	unsigned int	2 bytes	R/W	0 or 100...3000	Unit: ms. Value 0 is for latched output; value 100~3000 for pulse output

Parameter	Address	Data Type	Length	R/W	Data Range	Remark	
Alarm 1	Limit violation data type	0110 H	unsigned int	2 bytes	R/W	0...31	See alarm type table
	High 16 bits of Limit violation threshold	0111 H	unsigned long	4 bytes	R/W	Arbitrary value	Threshold=set value/100
	Low 16 bits of Limit violation threshold	0112 H					
	Limit violation detection type	0113 H	unsigned int	2 bytes	R/W	0...1	0: over, 1: below
	Alarm port	0114 H	unsigned int	2 bytes	R/W	0...1	0: off 1: alarm output to relay output 1
Alarm 2	0115 H ...0119 H		10 bytes	R/W		See Alarm 1	
Alarm 3	011A H ...011E H		10 bytes	R/W		See Alarm 1	
Alarm 4	011F H ...0123 H		10 bytes	R/W		See Alarm 1	
Alarm 5	0124 H ...0128 H		10 bytes	R/W		See Alarm 1	
Alarm 6	0129 H ...012D H		10 bytes	R/W		See Alarm 1	



**Note**

High bytes BIT0-BIT3 respectively mean status of binary input 1-2. Bit value 0 means input is open while 1 means input is closed.

Low bytes BIT0 and BIT1 respectively mean status of relay output 1. Bit value 0 means contact is open (relay no operation) while 1 means contact is closed (relay closed).

**Other Parameters**

Parameter	Address	Data Type	Length	R/W	Data Range	Remark
Cyclic display time	0132 H	unsigned int	2 bytes	R/W	1...99	Unit: sec
Number of cyclic display items	0133 H	unsigned int	2 bytes	R/W	0...0xFF	See description of cyclic display parameters
1 <sup>st</sup> screen of cyclic display item of screen A	0140 H	unsigned int	2 bytes	R/W	0...999	See cyclic display code table of area A
Number n screen of cyclic display item of screen A	...	unsigned int	2 bytes	R/W	0...999	
16 <sup>th</sup> screen of cyclic display item of screen A	014F H	unsigned int	2 bytes	R/W	0...999	

**Current Value**

Name	Address	Data Type	Length	R/W	Data Range	Unit
Phase A current	1008 H	unsigned int	2 bytes	R	0...65535	0.001 A
Phase B current	1009 H	unsigned int	2 bytes	R	0...65535	0.001 A
Phase C current	100A H	unsigned int	2 bytes	R	0...65535	0.001 A
Average current	100B H	unsigned int	2 bytes	R	0...65535	0.001 A
Neutral current	100C H	unsigned int	2 bytes	R	0...65535	0.001 A

**Extreme Value Parameters**

Name	Address	Data Type	Length	R/W	Data Range	Unit
Phase A current	4X2A	unsigned int			0...65535	0.001 A
Phase B current	4X31	unsigned int			0...65535	
Phase C current	4X38	unsigned int			0...65535	
Neutral current	4X3F	unsigned int			0...65535	

**Note**

X-0 means maximum value while X=1 means minimum value.

This manual applies to software version for 150113 and later released by the device.



# Maintenance

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## 7.1 Maintenance

- Voltage connection should be conducted strictly in accordance with voltage level marked on nameplate.
- Tighten the terminals and hang the meter securely to screen which is strong, refractory and vibration-free during installation. Upward view of the meter provides the best display effect, so it should be installed vertically.
- The meter should be stored in environment free of condensation at  $-35\text{ }^{\circ}\text{C}$  to  $70\text{ }^{\circ}\text{C}$  and  $\leq 95\%$  humidity in original package. At most 5 layers are allowable for stacking. The meter is inappropriate for storing after unpacking. The meter should be stored in clean location free of hazardous substances or gas which may cause corrosion in air.
- In the operating environment of the meter, lightning protection should be provided.



# Ordering Number

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## 8.1 Ordering Number

<b>Model:</b>	<b>SICAM</b>	—			
<b>Function</b>					
3I, w/o communication port		<b>P</b>	<b>2</b>	<b>0</b>	
3I, 1*RS485		<b>P</b>	<b>2</b>	<b>1</b>	
3I, 2BI 1BO, 1*RS485		<b>P</b>	<b>2</b>	<b>2</b>	

<b>Model</b>	<b>Order No.</b>
SICAM P20	7KG7321-0AA00
SICAM P21	7KG7321-0AA01
SICAM P22	7KG7321-0AA21

