SPM32 Multifunction Power Meter

Installation & Operation Manual
V1.0

ZHUHAI PILOT TECHNOLOGY CO., LTD.

Danger and warning!

This device can be installed only by professionals.

The manufacturer shall not be held responsible for any accident caused by the failure to comply with the instructions in this manual.

Risks of electric shocks, burning, or explosion

- This device can be installed and maintained only by qualified people.
- Before operating the device, isolate the voltage input and power supply and short-circuit the secondary windings of all current transformers.
- Put all mechanical parts, doors, or covers in their original positions before energizing the device.
- Always supply the device with the correct working voltage during its operation.

Failure to take these preventive measures could cause damage to equipment or injuries to people

CONTENTS

1. General Information

SPM32 Three Phase Multifunction Power Meter is designed for monitoring and displaying all kinds of electricity parameters in high/ low voltage system to 650kV. It has one RS485 port and support Modbus-RTU communication protocol. .

SPM32 provide the main function as below:

- Real-time measuring data, true RMS
  (Three phase voltage, current, active power, reactive power, apparent power, power factor, frequency, active energy, reactive energy)
- Demand calculation
  (Demand and peak demand for current, total active power)
- Optional 2 digital input
- Optional 2 relay output
- Alarm function
- 2~31th individual harmonic and THD
- One RS485, Modbus-RTU protocol

2. Order Information

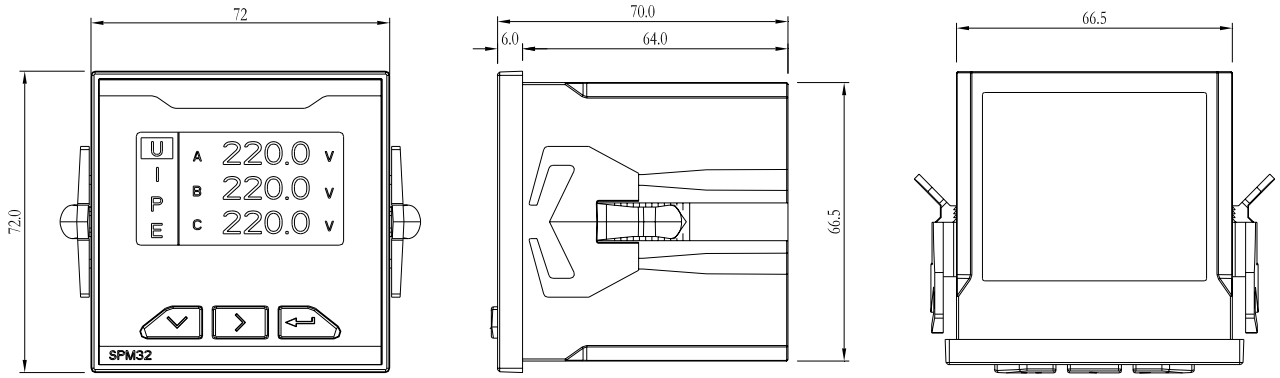
SPM32 - □ - □ ① ②	
①: Optional function	
R	Two relay output
S	Two status input
②: Rated input voltage/ current	
V1	5A
V2	1A

Example: SPM32-SR-V1, it means the device provides basic measuring function, one RS485 port, 2 digital input, 2 relay output. Rated input current 5A.

3. Dimension and Installation

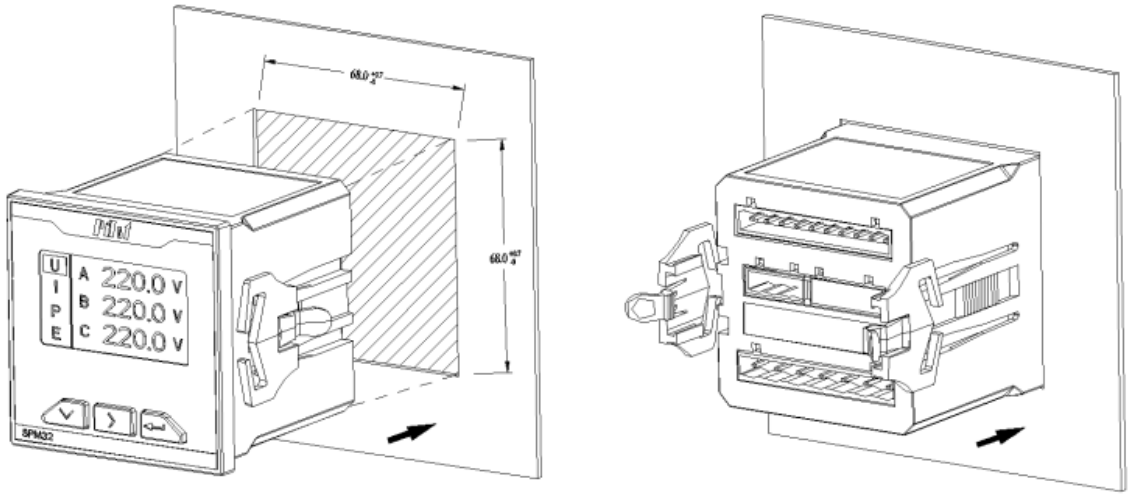
3.1 Dimension

unit : mm



3.2 Installation

unit : mm



4. Display and Keys-press Operation

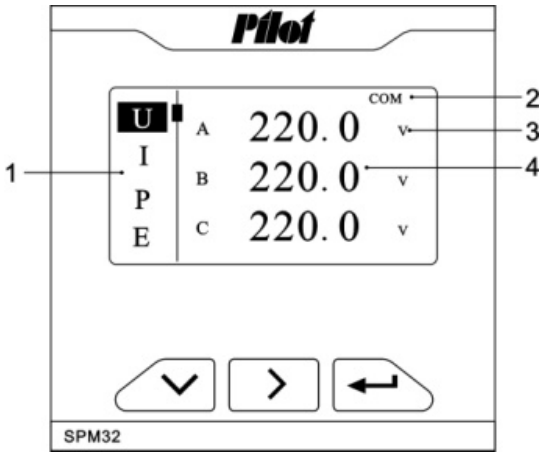
4.1 Display instruction

1: Main menu, the black flashing is the current menu.

2: Prompt of communication .

3: Unit of parameter.

4: Data display area.



Description:

(1) If there is no key operation within 60s, the backlight automatically turns off, when the backlight is lit until the button operation again.

4.2 Keys

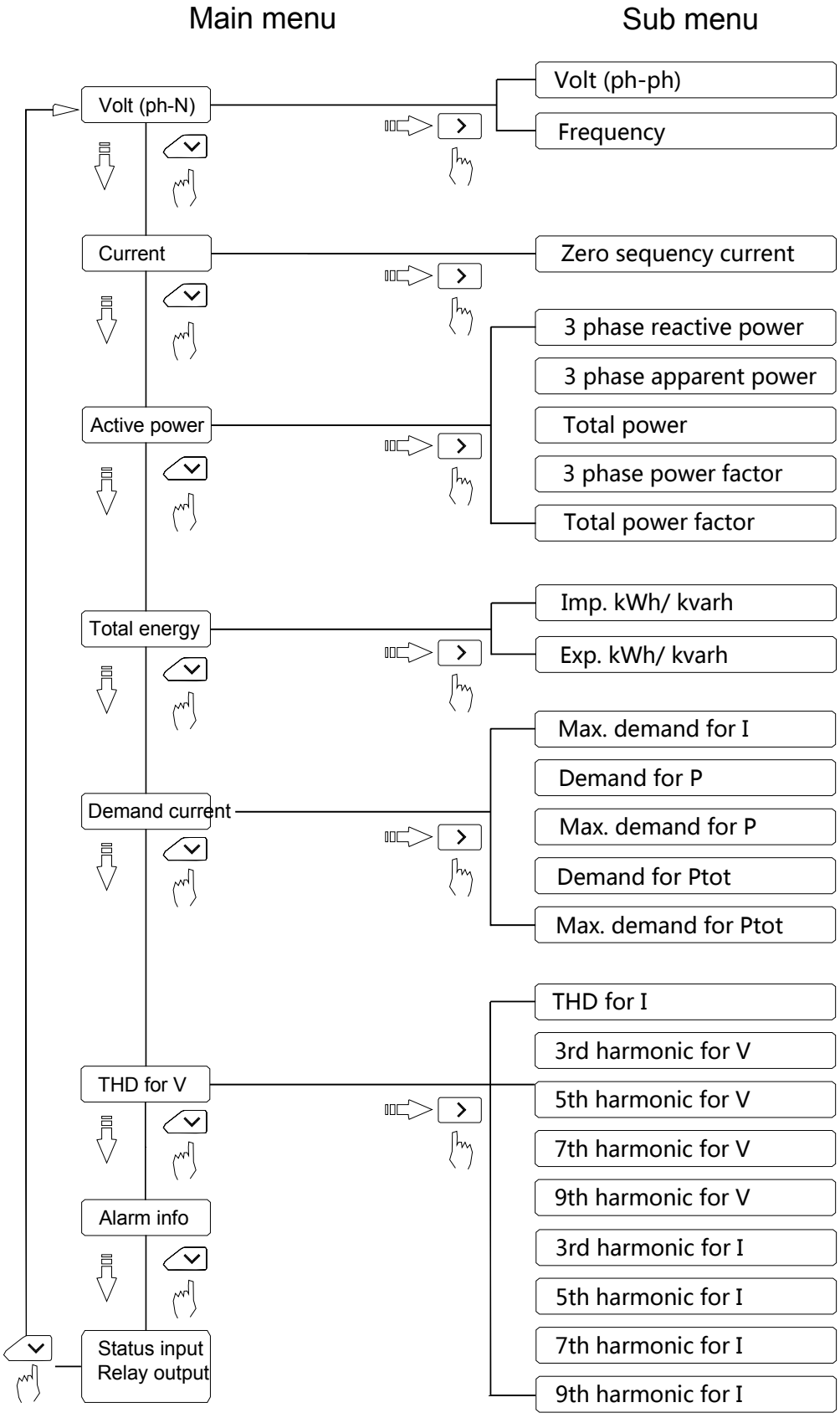
Note: In a different interface, the same keys have different functions.

 Sibling menu switch / decrease the value

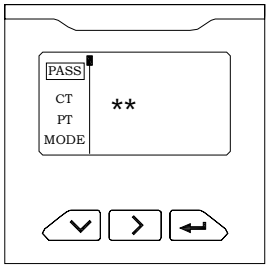
 Switching sibling menu to submenu / move the cursor to right

 Confirm/ Exit

4.3 Real-time data display procedure

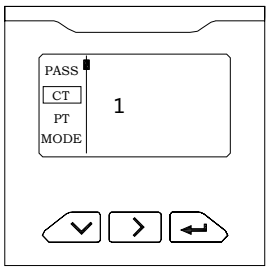


4.4 Setting menu and procedure



1. Password (PASS)

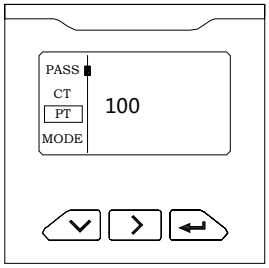
Default : 01
Range: 00-99



2. CT ratio (CT)

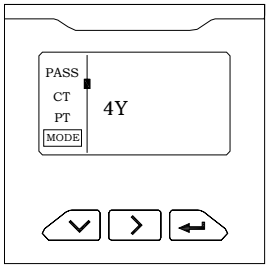
Range: 1 ~ 10000

e.g.
If CT spe. is 200A/5A,
set CT ratio = 40



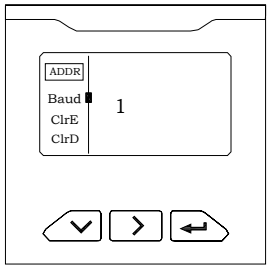
3. PT ratio (PT)
Range: 1~10000
(non decimal)
or 0.01 ~ 650.00
(two decimal)

e.g.
If PT spe. is 11kV/110V,
set PT ratio = 100



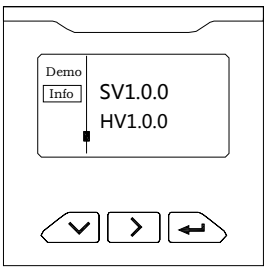
4. Wiring mode (MODE)

4Y: 3 phase 4 wire
3D: 3 phase 3 wire



5. Communication address (ADDR)

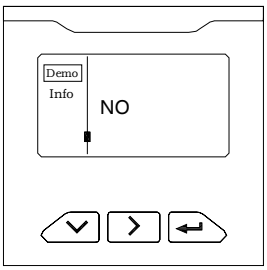
Range : 1~247



10. Version info (INFO)

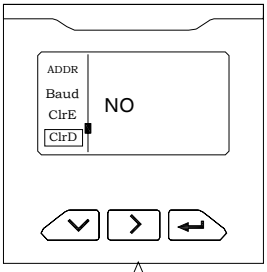
SV: Software version
HV: Hardware version

(can not set)



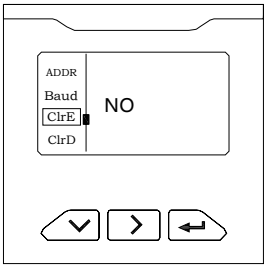
9. DEMO

"YES" to show dummy value
"NO" to show normal value.



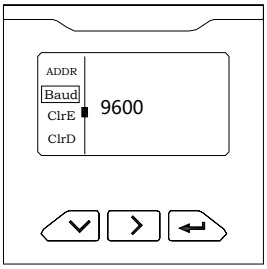
8. Clear demand (ClrD)

Select “YES” to clear demand



7. Clear energy (ClrE)

Select “YES” to clear energy



6. Baudrate (Baud)

Range: 4800, 9600 bps

Remark

1. Input super password “99”, the device will display the original password.

2. In 3-phase 3-wire mode, the device displays total power only (total P, total Q, total PF). Per phase power value will be 0.

3. The optional relay function only can be set via Modbus communication

4. In case the programmed data is invalid, the setting is not successful. The device restores the original parameters.

5. There is no description in this manual for other customized function.

5. Measuring Capability

5.1 Real-time basic electrical parameters

SPM32 measures basic parameters: voltage, current, power, and frequency etc.

Real-time metering	Measuring range
Current	
Single phase	0 ~ 65,000A
Zero sequence	0 ~ 65,000A
Unbalance (%)	0 ~ 100%
Voltage	
Line-line	0 ~ 650kV
Line-neutral	0 ~ 650kV
Active power/Reactive power /Apparent power	
Single phase	0 ~ ± 9999MW/var/VA
Total	0 ~ ± 9999MW/var/VA
Power factor	
Single phase	-1.000 ~ +1.000
Total	-1.000 ~ +1.000
Frequency	
35 ~ 65Hz	35 ~ 65Hz

5.1.1 Voltage

SPM32 maximum measurement for phase voltage is 400V (PT secondary). In 3-phase 3-wire system, maximum measurement for line voltage is 500V (PT secondary). Users should be noted this to prevent internal measuring circuit saturation, avoid inaccurate measurements.

The device support 3-phase 3-wire and 3-phase 4 mode. Users can set the Wiring Mode by keys or communication.

Note: After change the wiring mode, users must clear energy value to 0

5.1.2 Current

SPM32 must be connected by CT to measure current. CT secondary rated output required to meet the input requirements of SPM32 rated current (5A or 1A). When using an external CT, wiring should prevent open, otherwise it will generate a higher voltage in the secondary role. In the primary excitation effect, causing no casualties or damage to equipment.

Measuring range: 0 ~ 6.5 A (CT secondary).

CT ratio setting range: 1~10000

Users should be noted above range to prevent internal measuring circuit saturation, avoid inaccurate measurements.

5.1.3 Frequency

In different wiring mode, the device measures the frequency from different channel.

In 3-phase 3-wire, it measures frequency signal from Line 1-2

In 3-phase 4-wire, it measure frequency signal from Line 1 voltage input. In case Line 1 voltage loss, it measures from Line 3 voltage input. In case both Line 1 & 3 loss, it measures from Line 2 voltage input.

5.1.4 Power

SPM32 calculates per phase and total active power/ reactive power/ apparent power/ power factor.

Power measuring range: 0 ~ ± 9999MW/var/VA (per phase & total)

Power factor measuring range: -1.000 ~ +1.000 (per phase & total)

Note
1. The active power/ reactive power/ power factor is signed value 2. When wiring, users should pay attention to the phase sequence of voltage and current. Otherwise, it may cause wrong measuring data. Besides, it is necessary to connect the CTs terminals correctly; otherwise there will be negative power value.。

5.2 Demand value

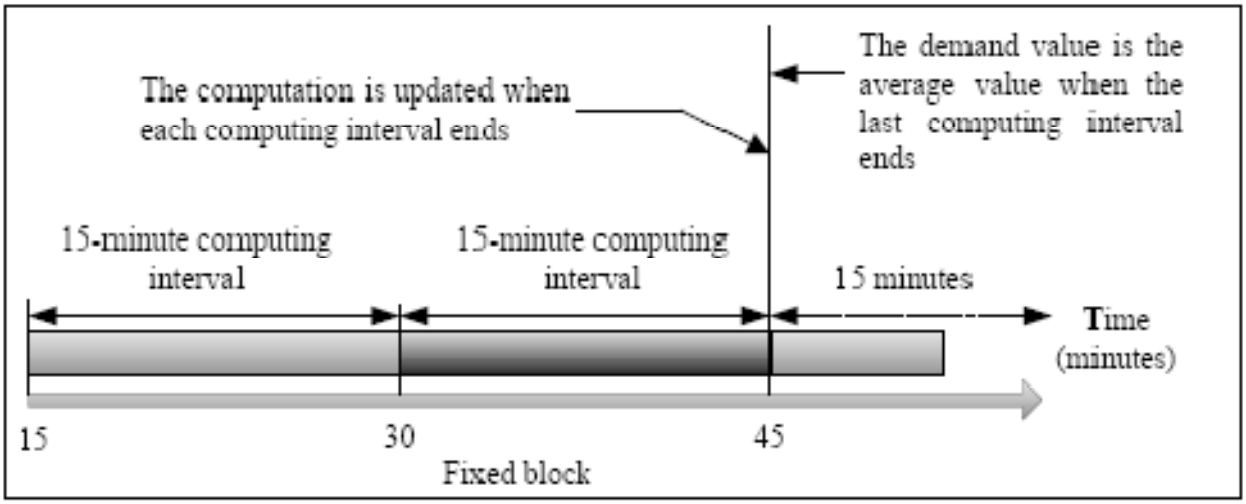
Demand value is accumulated value during a specified period divided by the length of that period. SPM32 adopts Fix Block to calculate the demand. Fix interval is 15 minutes.

SPM32 provides the following demand data and measuring ranges:

Demand reading	Measuring range
Demand current	
Per phase current	0 ~ 65,000A
Max. peak demand	0 ~ 65,000A

Demand active power	
Per phase power Total power	0 ~ ± 9999MW 0 ~ ± 9999MW
Max. peak of per phase Max. peak demand of total power	0 ~ ± 9999MW 0 ~ ± 9999MW

The figure below describes demand calculation:



5.3 Energy (kWh, kvarh)

SPM32 accumulates energy parameters: imp. kWh, exp. kWh, imp. kvarh, exp. kvarh and kVAh. If the value reaches to maximum (99,999,999.9 kWh), it will automatically turn over, and re-start accumulate from 0.

Note: the kVAh value only can be read via Modbus communication.

5.4 Harmonic parameters

SPM32 measures voltage and current harmonic up to 31st, and calculates THD,

The data of harmonics are given according to the percentage of fundamental

harmonics and have one digit after the decimal point. That is to say, when the value of the fundamental harmonic is fixed at 1000, it is 100.0% of the effective value of the fundamental harmonic; others are by analogy.

THD refers to the total of higher harmonics except fundamental harmonics, and it is calculated according to the following formula:

$$THD = \sqrt{\sum_{i=2}^{i=n} X_i^2}$$

i : Harmonic order.

X_i : Percentage of the effective value of each harmonic to that of the fundamental harmonic.

n : Highest harmonic order, which should be 31 here.

Note
SPM32 LCD display 3rd/ 5th / 7th / 9th harmonic and THD, other order harmonic can be read via Modbus communication.

5.5 Unbalance parameters

SPM32 can measure current unbalance, the unbalance is calculated:

$$\mathrm{Xunbal} = (\mathrm{Xmax} - \mathrm{Xmin}) / \mathrm{Xmax} \times 100\%$$

Xunbal — The unbalance of the voltage or current

Xmax — Maximum value of the three-phase voltage or current

Xmin — Minimum value of the three-phase voltage or current

5.6 Alarm setpoint

SPM32 with user definable valued system which can monitor the electrical parameters of the instrument and set the action.

5.6.1The alarm object and type

Object	Alarm triggered	remark
The upper limit of voltage	Max. primary voltage > Upper limit In 3P4W, the value is voltage ph-N In 3P3W, the values is voltage ph-ph (Setting range: 20.00V~650,000.00V)	Setting value to 0 means unable alarm.
The lower limit of voltage	Min. primary voltage < Lower limit In 3P4W, the value is voltage ph-N In 3P3W, the values is voltage ph-ph (Setting range: 20.00V~650,000.00V) If Secondary voltage <10V, the device will think it is phase loss alarm. It is not alarm for under voltage.	Setting value to 0 means unable alarm.
The upper limit of current	Max. primary current > Upper limit	Setting value to 0 means unable alarm.
The lower limit of current	Min. primary current (≠0) < Lower limit	
The upper limit of	Metering frequency >Upper limit	Setting value to

frequency		0 means unable alarm.
The lower limit of frequency	Metering frequency (≠0) < Lower limit	
The upper limit of power	Total active power (primary) > Upper limit	Setting value to 0 means unable alarm.
Voltage phase loss	Any one phase or 2 phase voltage (secondary) <10V	Select ON/OFF
DI 1 switch off	Digital input 1 channel switch position OFF	Select ON/OFF
The upper limit of demand power	Demand Ptot (primary) > Upper limit	Setting value to 0 means unable alarm.

5.6.2 Setpoint delay time

Alarm condition: When the monitoring object exceeds the limitation, the delay duration time also is required to active the alarm. Throughout the delay time, if the object is within the return limits, then the alarm setpoint is not activated.

The unit of delay time is seconds (s), setting range: 0~120 (s).

If the delay time is 0, it means that once the monitoring object exceeds the limit, the alarm setpoint generated immediately.

5.6.3 Alarm output

When the alarm occurs, the alarms type can also be read from LCD or via Modbus communication. If the alarm associated relays, the relay generates action. Once the alarm disappears, the ALARM light will be off, the relay will be reset.

5.6.4 Example

If user want to monitor over current and over voltage, suppose:

voltage exceeds 240V, delay time is 80s, or

current exceeds 200A, delay time is 10s, then the relay 1 alarm

The setting as below:

Parameter	Setting value
Voltage upper limit	240V
Voltage delay time	80s
Current upper limit	200A
Current delay time	10s
Relay 1 mode	Alarm
Relay 1 object	All

6. Input/output Characteristics

6.1 Relay output

SPM32 provides optional two relay output, relay specification is 250Vac/5A. It can be used with the instrument's alarm setpoint system, to monitor relative electrical parameters whether there is exceed limit, and thus output breaker reasonable action (Please refer to the chapter of the alarm setpoint for more details).

Or, the relay can be set to remote control mode. Users can remote control the relay according to project requirement.

SPM32 provides two relay operation modes. The action of relay is different in these two modes. The default control mode of this product is remote control. Users can modify to alarm control through panel relay setting or through communication.

- Remote control (external) - The relay is controlled by a PC or PLC by using commands through communication.
- Alarm Control (internal) - If there is an alarm generated, the relay on the action, you can refer to specific alarm setpoint alarm.
- When setting as Alarm mode, Alarm Subject including All, Voltage, Current, Frequency, Total active power, Voltage Phase lose, or DI 1 off, Demand power etc

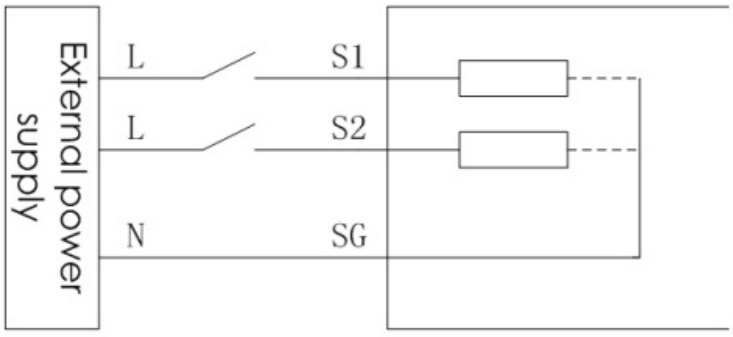
Once the relay has been in the remote control mode, even if the alarms generated, it will not act, the relay mode must be set to alarm mode, then can operate the alarm action.

Reset (effective only under remote mode): When receive a command from PC or PLC, the relay will act. The relay will keep on the position until to reset time. When reset time is 0, it means no reset.

6.2 Digital input

SPM32 provides 2-way nodes configurable input, applied to monitoring circuit breaker position signal, switch position signals and other status information. SPM32 provides active status node, which need an external power source (176V~300V). The following 2-way status input as example to introduce this wiring mode.

◇External active node wiring diagram is shown as below：



In general, when the external node is closed on, SPM32 LCD corresponding status input channel is ON (●), internal set to 1.

When the external node is turned off, SPM32 LCD corresponding status input channel is OFF (○), internal set to 0.

7. Technical Specification

Aux. power supply	AC 85~265V DC 100~300V
Rated input current	5A or 1A
Rated input voltage	57V ~300V(ph-N), 35Hz~65Hz
Status input	Rated voltage 220V, 2 channel active status input. Lower than 60V is open, higher than 178V is closed. Max. input is 300V.
Relay output	Rated contact capacity: AC 250V/5A or DC 30V/5A
Power Consumption	≤ 2W/4VA
Operating environment	Operating temperature: -10℃ ~ +55℃ Limit operating temperature: -25℃ ~ +55℃ Storage temperature: -40℃ ~ +70℃ Humidity: 5% ~ 95% RH, non-condensing
Power frequency withstand voltage	2KVAC
Insulation resistance	≥ 100MΩ
Impulse voltage	6KV
IP index	Front panel: IP52, case: IP20
Certificate	CE, Standard IEC61010-1: 2010

Parameter	Range	Accuracy
voltage	10V~500V	0.2%
current	5%~120% of rating	0.2%
Power factor	-1.000~1.000	0.5%
Active energy	0~99999999.9	1.0% or 0.5%
Reactive energy	0~99999999.9	2.0%
Active power	Per phase: 0 ~ ± 26MW Total: 0 ~ ± 78MW	0.5%
Reactive power Apparent power	Per phase: 0 ~ ± 26Mvar/VA Total: 0 ~ ± 78Mvar/VA	1.0%
Unbalance	0%~100%	1.0%
Harmonic	0%~100%	Class B
Standard		
Electrostatic Discharge Immunity Test	IEC61000-4-2:2001 (GB/T17626.2-2006)	Level 4
Radiated immunity test	IEC61000-4-3:2002 (GB/T17626.3-2006)	Level 4
Electrical fast transient/burst immunity test	IEC61000-4-4:2006 (GB/T17626.4-2008)	Level 4
Surge immunity test	IEC61000-4-5:2005 (GB/T17626.5-2008)	Level 4
RF field immunity induced mass	IEC61000-4-6:2006 (GB/T17626.6-2008)	Level 3
Radiated emissions limit	CISPR22: 2006 (GB 9254-2008)	Pass
Voltage dips, short interruptions immunity test	IEC61000-4-11:2004 (GB/T17626.11-2008)	Pass
Power frequency withstand voltage	GB/T 17215.211-2006	Rated insulation voltage≤300V，The

		test voltage 2000V。 Rated insulation voltage≤60V，The test voltage 1000V。 Leakage current ≦10mA。

8. Communication protocol

(Please refer to SPM32 Modbus Communication Protocol & Register List)

9. Maintenance and Trouble Shooting

Possible problem	Possible cause	Possible solution
There is no display on device after impose power supply.	The power supply fails to be imposed on the meter.	Check if the correct working voltage has been imposed on the L/+ and N/- terminals of the meter. Check if the fuse for the control power supply has been burnt down.
The measured value is not correct or does not conform to the expectation.	The voltage measurement is not correct.	Check if the neutral point has been connected reliably. Check if the measured voltage matches the rated parameter of the meter. Check if the PT ratio has been set correctly.
	The current measurement is not	Check if the measured current matches the rated parameter of

	correct.	the meter. Check if the CT ratio has been set correctly.
	The power measurement is not correct.	Check if the measurement mode has been set correctly. Check if the phase sequence corresponding to the voltage and the current is correct. Check if the current terminals of the same name are wrong.
The digital input status no changing.	The voltage relating to digital input is not correct.	Check if the types of external nodes match the rated parameters of the meter. Check if the external connection is correct.
The relay output status no changing.	The relay does not receive the control command.	Check if the communication link is correct.

	The control mode of relay is not correct.	Check if the current relay is under the correct mode.
There is no communication between the upper end device and the meter	The communication baud rate of the meter is not correct.	Check if the communication baud rate of the meter is consistent with its definition.
	The communication link has not been connected to the terminal resistor.	Check if the 120-Ohm resistor has been connected.
	The communication link suffers interference.	Check if the communication-shielding layer has been earthed effectively.
	The communication line is interrupted.	Check if the communication cable has been disconnected.
	The communication baud rate of the meter is not correct.	Check if the communication baud rate of the meter is consistent with its definition.

10. Terminals Definition

Terminals of basic unit

No.	Def.	Instruction	No.	Def.	Instruction
1	I3-	Phase C current outgoing line	**2**	I3+	Phase C current incoming line
3	I2-	Phase B current outgoing line	**4**	I2+	Phase B current incoming line
5	I1-	Phase A current outgoing line	**6**	I1+	Phase A current incoming line
7	NC	Null	**8**	SHLD	RS485 shield
9	485-	RS485 negative pole	**10**	485+	RS485 positive pole
11	NC	Null	**12**	V1	Phase A voltage
13	V2	Phase B voltage	**14**	V3	Phase C voltage
15	VN	Neutral line	**16**	N/-	Negative pole of power supply
17	L/+	Positive pole of power supply			

Terminals of 2DI+2DO module (Optional)

No.	Def.	Instruction	No.	Def.	Instruction
18	RL1	Relay 1 output 1	**19**	RLN1	Relay 1 Output 2
20	RL2	Relay 2 output 1	**21**	RLN2	Relay 2 Output 2
22	NC	Null	**23**	NC	Null
24	S2	Status input 2	**25**	S1	Status input 1
26	SG	Status input public GND			

Terminals of 2DO module (Optional)

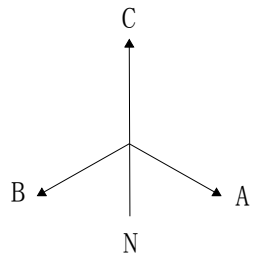
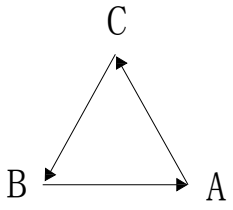
No.	Def.	Instruction	No.	Def.	Instruction
18	RL1	Relay 1 output 1	**19**	RLN1	Relay 1 Output 2
20	RL2	Relay 2 output 1	**21**	RLN2	Relay 2 Output 2

Terminals of 2DI module (Optional)

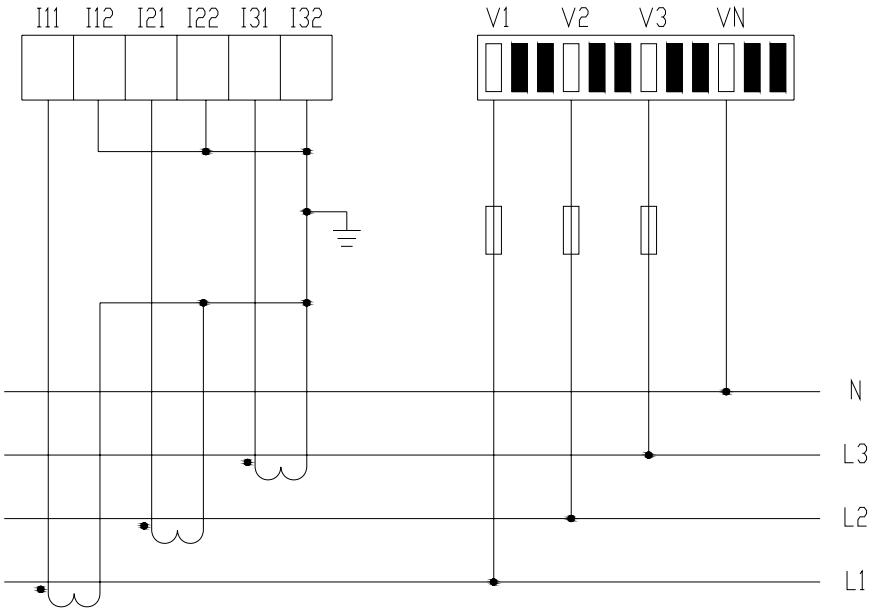
No.	Def.	Instruction	No.	Def.	Instruction
18	NC	Null	**19**	NC	Null
20	S2	Status input 2	**21**	S1	Status input 1
22	SG	Status input public GND			

11. Typical Connection

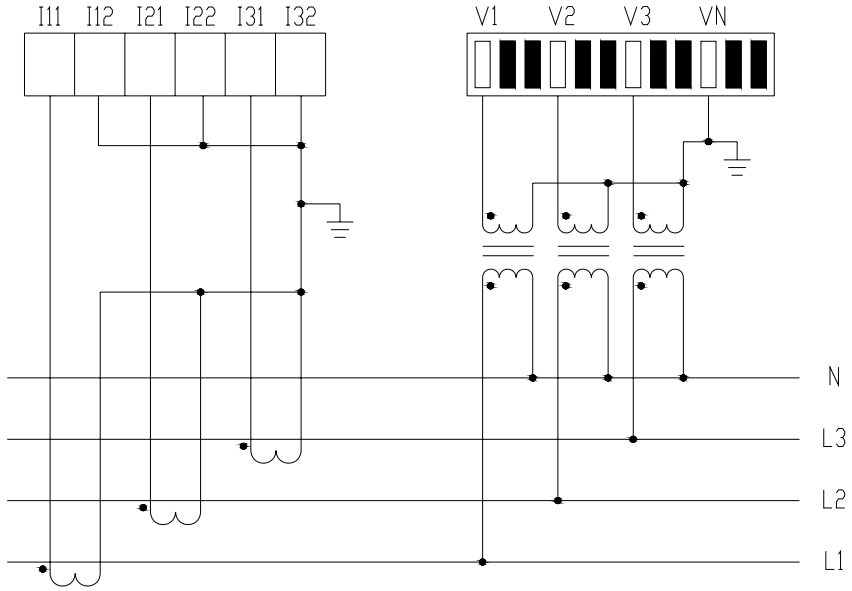
SPM32 supports multiple connection modes of measurement, the following methods were used icons explained.

	
3-phase 4-wire system	3-phase3-wire system

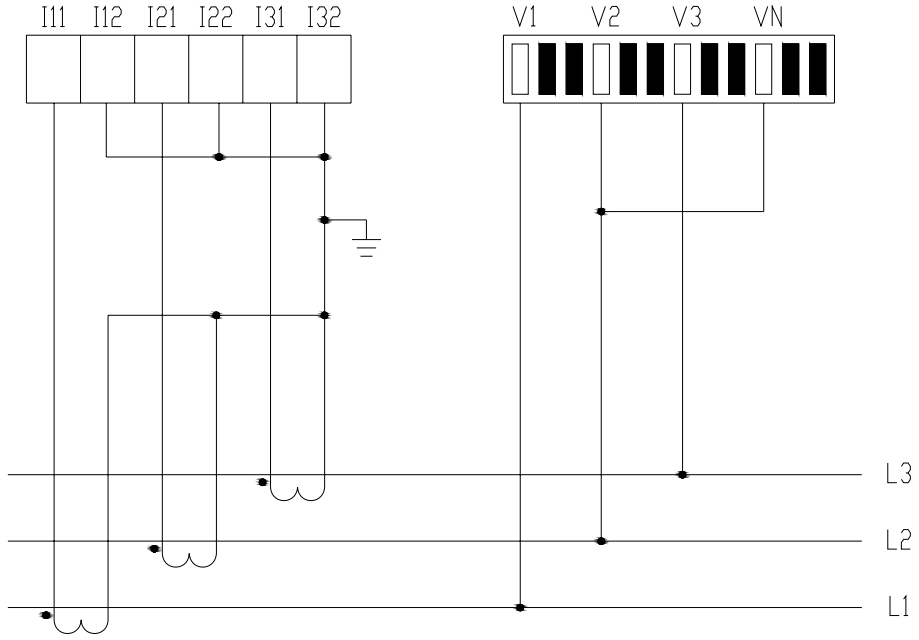
■ 3-phase 4-wire system, no PT, 3CT



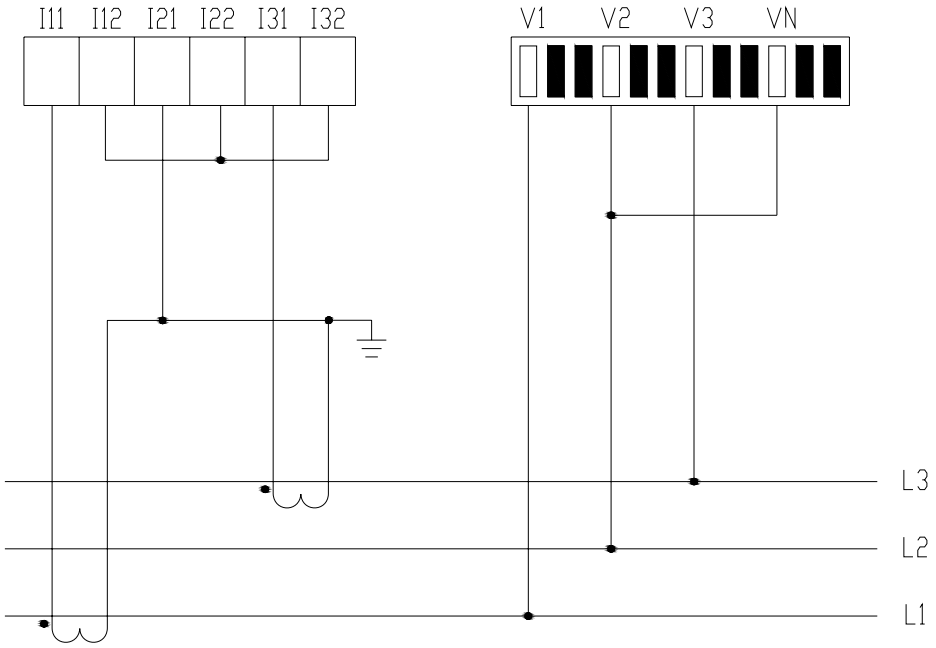
■ 3-phase 4-wire system, 3PT, 3CT



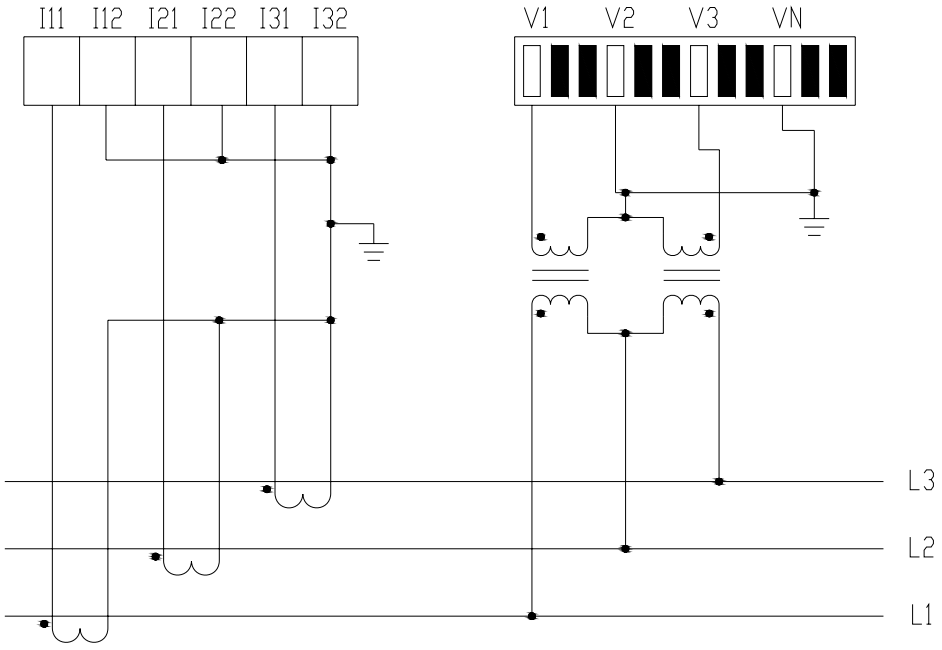
■ 3-phase 3-wire system, no PT, 3CT



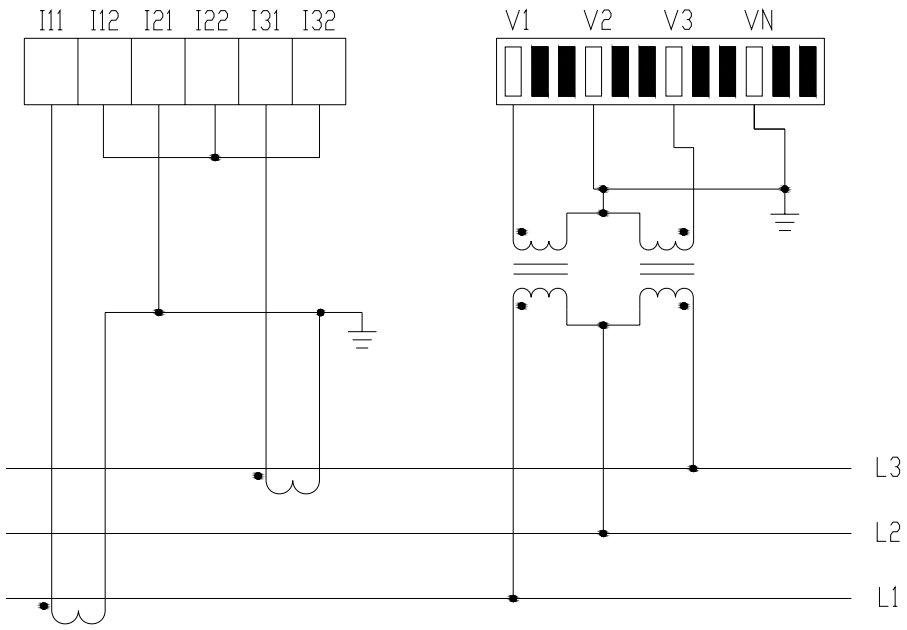
■ 3-phase 3-wire system, no PT, 2CT



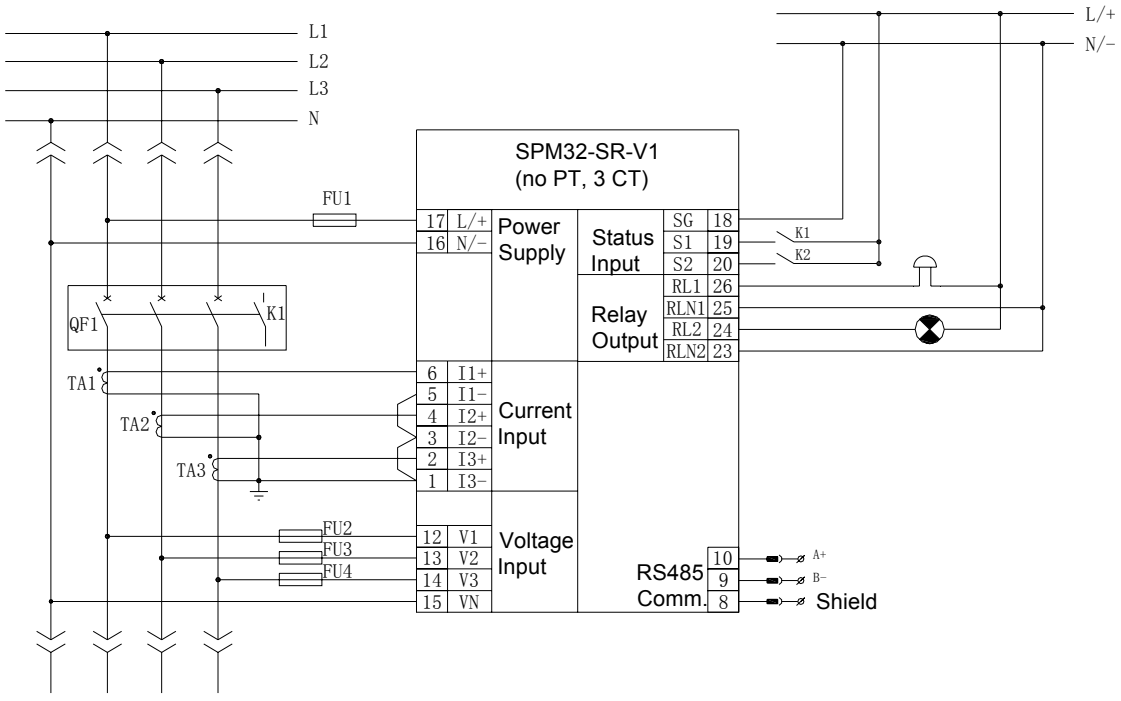
■ 3-phase 3-wire system, 2PT, 3CT



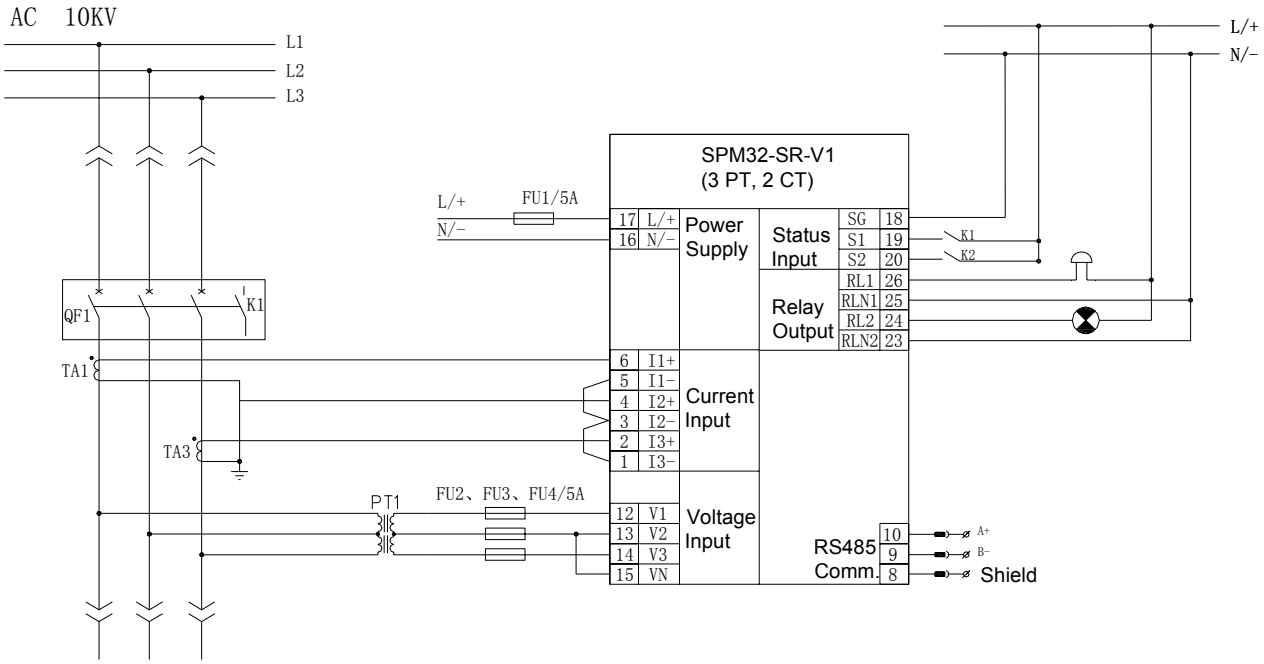
■ 3-phase 3-wire system, 2PT, 2CT



■ Typical wiring: 3-phase 4-wire system



■ Typical wiring: 3-phase 3-wire system



Notice:

PILOT reserves the right to modify this manual without prior notice in view of continued improvement

Zhuhai Pilot Technology Co., Ltd.

Add:No.15,keji6Road,Chuangxin Haian,Tangjia High-tech Zone,Zhuhai,Guangdong,519085 China

Tel: +86-756-3629687/3629688

Fax: +86-756-3629600/3629670

http://www.pmac.com.cn