SPM90 Single Phase DC Energy Meter

Installation & Operation Manual

V2.5

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.
- Use appropriate voltage tester to make sure the voltage has been cut-off.
- 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. Product Overview

SPM90 is designed for scenarios such as DC panel, charging pile and telecom base stations. This meter series can measure voltage, current, power and active energy in DC system. Not only can it be used as local display, but it can also be used in measuring system by connecting with industrial control equipment and computers. It is a high-performance automation meter that can work with modern DC power distribution system in industrial and mining industry, civil building and building automation.

Product performance fully meets the according technical requirements of Class 0.5 of GB/T 33708-2017 (Static meter for direct current energy).

Main function of this product:

- Real-time measurement of electrical parameters: voltage, current and power
- Measurement of bidirectional energy
- 1CH RS485 communication, 1CH electric pulse output optional.
- Supports MODBUS and DL/T645—2007 communication protocol.

2. Order Information

2.1 Order Information of SPM90 Main Unit

SPM90 - □ - □ - □ ① ② ③	
①: Energy pulse (Optional)	
P	Energy pulse
②: Working Power supply	
D	DC24V(9 ~ 72VDC)
③:Current specifications(Optional, default 100A)	
50	Connect 50A Shunt
100	Connect 100A Shunt
150	Connect 150A Shunt
200	Connect 200A Shunt
300	Connect 300A Shunt
400	Connect 400A Shunt
500	Connect 500A Shunt
600	Connect 600A Shunt
800	Connect 800A Shunt

2.2 Order Information of Current Shunt

Equip different specifications of Current Shunt according to the current size of the circuit to measure the current in the circuit.

Provide 9 specifications of Current Shunt for users.

Product name	Specification	Accuracy grade
Current Shunt	50A/75mV	0.2%
Current Shunt	100A/75mV	0.2%
Current Shunt	150A/75mV	0.2%
Current Shunt	200A/75mV	0.2%
Current Shunt	300A/75mV	0.2%
Current Shunt	400A/75mV	0.2%
Current Shunt	500A/75mV	0.2%
Current Shunt	600A/75mV	0.2%
Current Shunt	800A/75mV	0.2%

Note:

If Current Shunt in other specifications are needed, please contact us in advance.

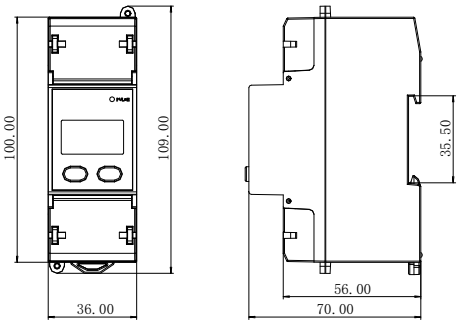
When selecting Current Shunt, make sure the the actual current is within 80% of scale span, preventing the influence on the accuracy on the Current Shunt caused by long-time large current.

The Current Shunt purchased by the user must ensure an accuracy $\leqslant$ 0.2% (output 75mV), otherwise it will affect the measurement accuracy.

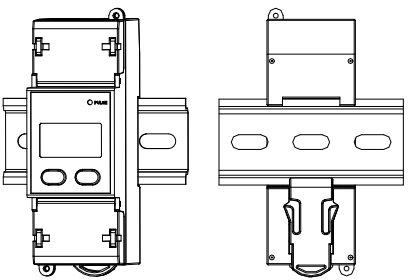
3. Appearance and Installation Dimension

3.1 Dimension and Installation of Main Unit

Unit：mm

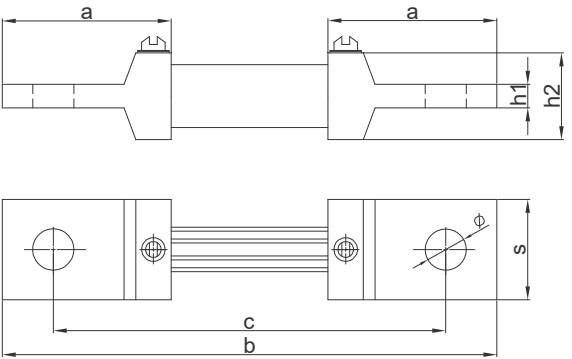


Pic. 3.1 DC meter dimensional drawing



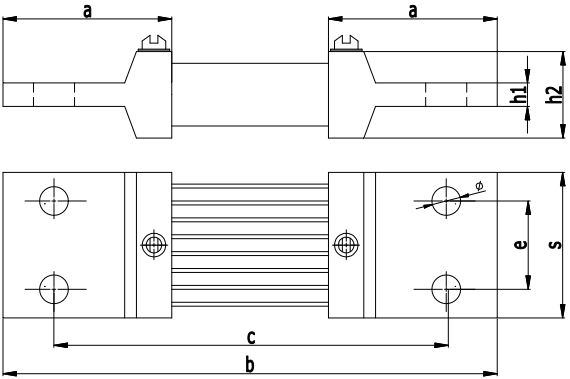
Pic. 3.2 DC meter installation drawing

3.2 Dimension and Installation of Current Shunt



Pic. 3.3 Dimensional diagram of Current Shunt(100A-600A)

SPECS	a	b	c	s	h1	h2	φ
50A	43±1	116±2	85±1	22±0.5	5.5±0.2	21±0.5	8.5±0.2
100A	43±1	116±2	85±1	22±0.5	5.5±0.2	21±0.5	8.5±0.2
150A	43±1	116±2	85±1	22±0.5	5.5±0.2	21±0.5	8.5±0.2
200A	43±1	116±2	85±1	22±0.5	5.5±0.2	21±0.5	8.5±0.2
300A	43±1	126±2	100±1	26±0.5	5.5±0.2	21±0.5	10.5±0.2
400A	43±1	126±2	100±1	38±0.5	5.5±0.2	21±0.5	10.5±0.2
500A	43±1	126±2	100±1	45±0.5	5.5±0.2	21±0.5	10.5±0.2
600A	43±1	126±2	100±1	62±0.5	5.5±0.2	21±0.5	10.5±0.2



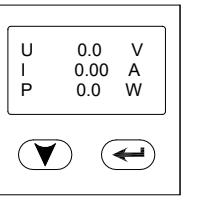
Pic. 3.4 Dimensional diagram of Current Shunt(800A)

SPECS	a	b	c	s	h1	h2	φ
800A	43±1	126±2	100±1	76±1	5.5±0.5	21±1	10.5±0.5

4. Display and Keyboard Instructions

4.1 Full Display

There is a one-inch dot matrix LCD with backlight on SPM 90, whose resolution is 128*64. With 2 keys and menu prompt, switching among different functions can be realized.



Note: Backlight turns off if the meter is left with no operation for 60s. Backlight will not turn on unless there is operation again.

4.2 Statue Inquiry

Indicator	Color	Indicating	Indicated message
PULSE	Red	Flash	Electric energy pulse

4.3 Keyboard Instructions

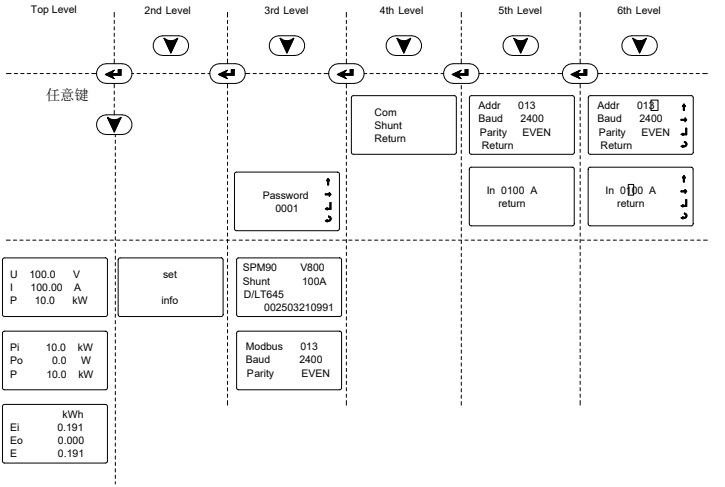
Note: Same keys play different functions if different interfaces.

Page down among equive menu

Next menu/confirm button

4.4 Real-time Data Display Procedure

Menu tree diagram:



Pic.4.1 Operation Menu Tree Diagram

Editing Instruction:

digit/option plus
digit/option shift
Confirm
Cancel

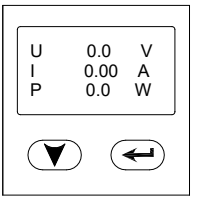
Editing options switching Editing option execution.

4.5 Power On Display Interface

Data display

1, Startup interface:

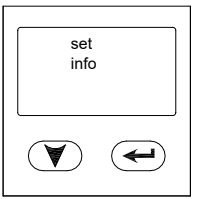
The meter self-examines with power on, LCD lights up, dot matrix fully displays, entering into startup interface 3s later



Note: Press confirm button to enter main menu and view the page.

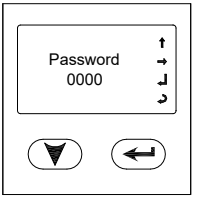
2, Main menu interface:

Press ▼ to select different submenu, press ↵ to enter submenu, as shown below:

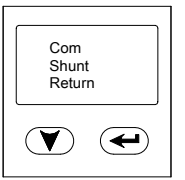


3, Set menu:

After entering the set menu, input the correct password to enter the Set menu display interface.



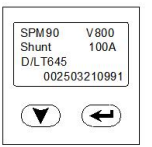
After inputting password 0001, entering submenu.

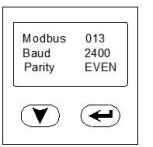


Detailed introduction of Set Menu will be shown in “4.6 Parameters Settings”.

4, Info Menu:

After entering the info menu, program version information, DL/T 645 address, shunt specifications, Modbus address, and communication parameters can be viewed.





4.6 Parameters Settings

■ **Meter Programming**

SPM90 can program the following setting parameters:

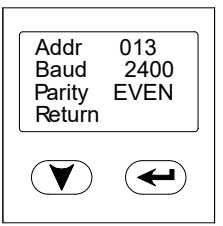
Programmable items
Communication Setting
Current grade

1, Communication Setting: Press ↵ to enter the communication interface:

Modbus address: can be set 1~247

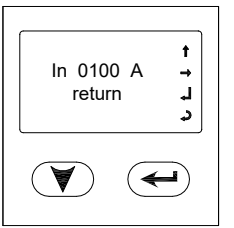
Baud: can be set 2400,4800,9500,19200

Parity bit: can be set None,EVEN,ODD



2, Current grade setting: Press ↵ to enter current grade interface, current grade can be set, as shown below.

Current grade can be set: 50A~2000A.



5. Measurement Capability

5.1 Real-time Basic Electrical Parameters

SPM90 can measure basic electrical parameters including voltage, current and power.

5.1.1 Voltage

Rated Voltage is 1000VDC, and allows for long-time overload of 1.5 times (1500VDC). Users should be noted this to prevent saturation of internal measurement circuit, which may cause inaccurate measurement.

5.1.2 Current

Current Shunt is needed when SPM90 measures the current. The Current Shunt is actually a resistor with very small resistance. Voltage appears when there is current running through, which can be shown on ampere meter.
Current range: 50A/75mV~2000A/75mV.

5.2 Energy Parameters

The maximum energy SPM90 can measure is 999999.999kWh, with three decimal places. When it reaches the maximum value, it automatically turns over to 0.

5.3 Electric Energy Pulse

5.3.1 Pulse width

Pulse width fixes at 30ms. (Pulse width means the duration of the high level).

5.3.2 Pulse constant

≤300A specifications, the pulse constant defaults to 100imp/kWh;

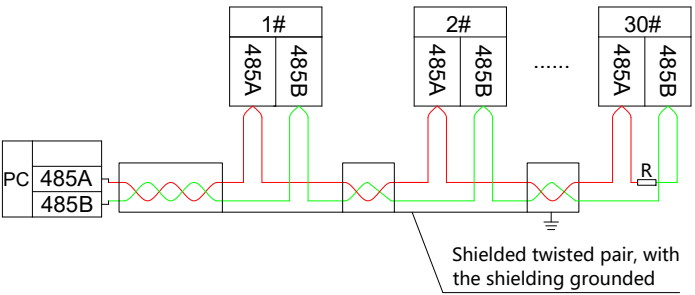
＞300A specifications,the pulse constant defaults to 50imp/kWh;

The pulse constant can be set from 1 to 1000 imp/kWh.

6. Communication

6.1 Overview

SPM90 get communicated with 1CH RS485. Please refer to picture shown below for wiring diagram. In real application, to prevent signal reflection, a resistor of about 120Ω will be connected at the end of RS485 bus for signal matching. Users should be noted this.



Pic.6.1 RS485 communication port wiring diagram on SPM90

6.2 Communication Media

32 pieces of SPM90 can work together in one network at most, which are wired via 18AWG shielded twisted pair. If no repeaters, then the longest distance of wire should be 1200 meters(Baud rate≤9600bps).

6.3 Communication Protocol

SPM90 is in accordance with the MODBUS-RTU and DL/T 645-2007 protocol, which can be set via the setting interface. For detailed information of protocol,

please refer to the manual of “SPM90_MODBUS Communication Protocol” and “SPM90_DL/T 645-2007 Communication Protocol”.

6.4 Communication Parameters

Whether the meter can communicate with the master station depends on whether the communication parameters are correct. Communication parameters include:

- Meter address ID: This is the identification of the meter on the network. It’s requested that the ID of every meter in the same network is the only one.
- Baud rate of communication: 2400, 4800, 9600, 19200 are optional.

6.5 Anti Strong Electricity Function of Com. Port

Communication Port on SPM90 supports Anti Strong Electricity Function. The meter won’t be burnt when wired into strong electricity (220VAC) for a short time. Communication function gets back to normal after the strong electricity is removed for 20 minutes.

7. Technical Parameters

Parameter		Range
Rated Parameter	Rated working voltage	DC24V (9-72VDC)
	Rated current	Can be set: 50A,100A,150A,200A,300A,400A,500A ,600A,800A,etc(The maximum measurement value is 2000A), use external 75mV Current Shunt input
	Rated voltage	1000VDC, and allows for long-term overload of 1.5 times (up to 1500VDC)
	Parameter	**Accuracy**
Electrical Parameter Accuracy	Voltage	0.2%
	Current	0.2%
	Energy	0.5S
	Power	0.5%
	Parameter	**Performance**
	Consumption	≤ 1W
Environment Temperature	Normal working temperature	-10℃ ~ +55℃
	Extreme working temperature	-25℃ ~ +70℃
	Storage temperature	-25℃ ~ +70℃
	Working humidity	Under 95%
Insulation performance	Power-frequency withstand voltage	4400VAC

	Insulation resistance	≥ 100MΩ	
	Impulse voltage	6000V	
IP Protection grade	Complete machine	IP20	
	Item	**Reference standard**	**Experiment grade**
Electromagnetic compatibility	Electrostatic Discharge	GB/T17626.2-2018 (IEC61000-4-2:2008)	Grade 4
	Radiated immunity of radiofrequency electromagnetic fields	GB/T17626.3-2016 (IEC61000-4-3:2020)	Grade 3
	Electrical fast transient burst immunity	GB/T17626.4-2018 (IEC61000-4-4:2012)	Grade 4
	Surge (impact) immunity	GB/T17626.5-2019 (IEC61000-4-5:2014)	Grade 4
	Conduction noise immunity of radio-frequency field induction	GB/T17626.6-2017 (IEC61000-4-6:2014)	Grade 3
	Electromagnetic emission limiting value	GB 4824-2019 (CISPR11:2016)	Grade B
	Voltage sag、shot-time interruption immunity	GB/T17626.11-2008 (IEC61000-4-11:2020)	Conformed

Note: The accuracy of electrical parameters is met within the normal operating temperature range.

8. 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 POW+ and POW- 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 voltage wiring is reliable. Check if the measured voltage matches the rated parameter of the meter. Check if the wiring of the positive and negative terminals of the voltage is incorrect.
	The current measurement is not correct.	Check if the measured current matches the rated parameters of the equipment
	The power measurement is not correct.	Check if the wiring of the positive and negative terminals of the voltage is incorrect
There is no communication between the upper end device and the meter.	The communication address of the meter is not correct.	Check if the communication address of the meter is consistent with its definition.
	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.

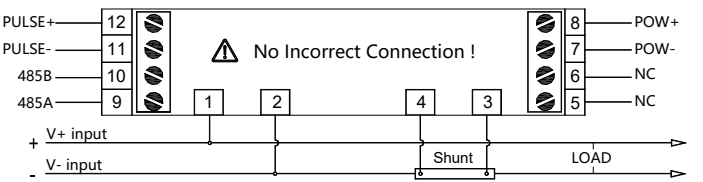
9. Appendix

9.1 Terminals Definition

No.	Definition	Description
1	V+	Positive polarity of voltage input
2	V-	Negative polarity of voltage input
3	I+	Positive polarity of voltage input
4	I-	Negative polarity of current input
5	NC	NULL
6	NC	NULL
7	POW-	Negative polarity of power input
8	POW+	Positive polarity of power input
9	485A	RS485 positive polarity
10	485B	RS485 negative polarity
11	Pulse-	Negative polarity of energy pulse
12	Pulse+	Positive polarity of energy pulse

9.2 Typical Wiring Diagram

Wiring of SPM90-1-P is as follows:



Note:

1) If -P is not included in order, then terminal 11, 12 are not added on the meter.

2) To ensure correct measurement, the shunt is connected in series with the

negative electrode close to the load end.

3) Attention for wiring of terminals 3 and 4: To ensure measurement accuracy, suggest using multi stranded copper cables with a wire diameter of $\geqslant$ 1.5mm2 (16AWG) and a wire length $\leqslant$ 1.5m. Recommended wire diameter is 2.5 mm2 (13AWG) and wire length is 1.5m.

Notice:

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

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