User   Manual

Revision   2.002

English

Smart energy meter

103EM series

Benefits and Features

● Three phase meter, 7 DIN modules, Standard DIN rail Format (DIN43880)

● IEC62053-21/22 Class 1.0,0.5S

● Record bi-directional active energy and 4-quadrant reactive energy for the last 12 months

● Records MD and its occurrence time for the last 12 months

● Instant Volt, Amp, Power factor, Frequency, Active power, Reactive power, Apparent power

● TOU of 4 tariffs, up to 12 time periods per day

● Summer time switch

● load profile(option)

● Optional miniature load control relay for remote disconnect/reconnect

● Tamper-proof with terminal cover open detection (option)

● Direct metering up to 100A. CT version is available

● Clock time verification function

● Isolate pulse output (DIN43864)

● LCD display, 6 integer 2 decimal, meter display when power fails

● Large clear backlight display

● Optional single-phase model

● IR port and RS485 communication port, support Modbus protocol

● RF radio interface, 433MHz/868MHz (optional)

● Program by pressing button on the front panel

● Memory back-up (EEPROM)

● CE approval

Index:

1. Safety notice

The 103EM series smart energy meter does not require special mechanical or electrical tools for the installation. Mounting position (with any angle of tilt) has no effect on the measurement functions of the meter.

Please note that meter wiring must be made according to applicable wiring diagram. Incorrect connection of the meter to the electricity network could cause major display problem and serious damage to the meter. Before starting the meter operation, it must be ensured that the local conditions of the energy system are consistent with the data shown on the nameplate of the meter. For the communication cables, it is preferred to use shielded ones. Make sure that the cables are not damaged and free of non-mechanical stress when installing. Also make sure that the meter is not energized during meter installation.

Repairs or removing the meter cover can be made only by a qualified electrician who is familiar with the associated risks. Capacitors in the meter may still be charged even if the meter is disconnected from all energy sources

2. Content of delivery

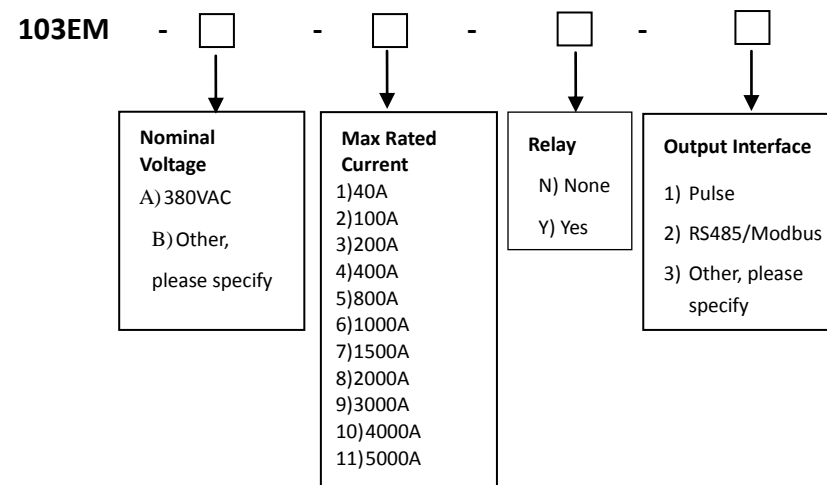Three phase electronic energy meter, instructions for assembly

ID setting

Baud rate setting

CT rate setting

Password setting

3. Technical description

3.1 Identify model number and type

The model number of the 103EM series is defined as following:

103EM - ☐ - ☐ - ☐ - ☐

Nominal Voltage	Max Rated Current	Relay	Output Interface
A) 380VAC B) Other, please specify	1) 40A 2) 100A 3) 200A 4) 400A 5) 800A 6) 1000A 7) 1500A 8) 2000A 9) 3000A 10) 4000A 11) 5000A	N) None Y) Yes	1) Pulse 2) RS485/Modbus 3) Other, please specify

103EM comes with two connection types: direct connection type and transformer connection type. Please check the firmware version number (refer to section 7.2) and use the following table to figure out which type your meter is.

735.1.1	Directly connect
735.2.1	Transformer connect

3.2 Performance criteria

|	
Operating humidity	≤ 75%
Storage humidity	≤ 95%
Operating temperature	-5°C - +45°C(3K5)
Storage temperature	-25°C - +55°C(3K6)
Humanity	75% yearly average,95% on 30 days/year
International standard	EN50470-3&IEC62053-21
Accuracy class	CI.1
Protection against penetration of dust and waterIP51	
Insulating encased meter protective class	Ⅱ
Connection area main terminals	
Current terminals flexible 1×mm^2 0-16mm^2	
another terminal flexible 1×mm^{2}0-2.5mm^2	

3.3 Meter specification

	Direct connected meters	Transformer connected meter
Voltage(v)	3×57.7/100V	3×57.7/100V
	3×220/380V	3×220/380V
	3×230/400V	3×230/400V
Operational voltage	±70%Un	±70%Un
Current(A)		
- Iref	10A	1.5
-Itr	1A	0.15A
-Imax	100A	6A
-Imin	0.5A	0.015A
-Ist	40mA	3mA
Power consumption of current circuits(VA)	< 0.01	< 0.01
Power consumption of voltage circuits(W)	< 1.3W	< 1.3W
General data		
Frequency (Hz)	50/60	50/60
	Direct connection type	**Transformer connection type**
Memory back-up	EEPROM	EEPROM
Environment resistance to heat and fire	Terminal 960℃ Cover 650℃	Terminal 960℃ Cover 650℃
Internal real-time clock with battery		
Time-keeping accuracy	<0.5s/day	
Clock operating with battery	>15 years	
Power off clock running time	>5 years	
Enclosure material		
upper	ABS+PC	ABS+PC
lower	ABS+PC	ABS+PC
Pulse output		
Pulse width(ms)	80	80
Pulse constant(imp/kWh)	400	1600
LED		
LED constant	400	1600

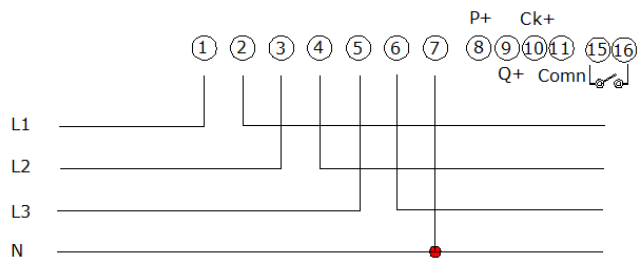| Relay		
Max junction voltage	AC250V DC30V	
Max junction current	3A	
Battery		
Battery volume	1200mAh	
Battery life	≥3years	
Width (mm)	126	126
Height (mm)	104.5	104.5
Depth (mm)	60	60

4. **Dimensions and sealing points**
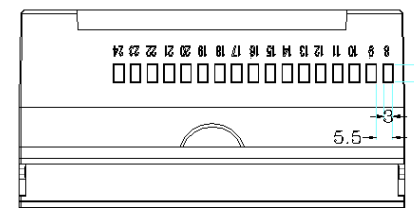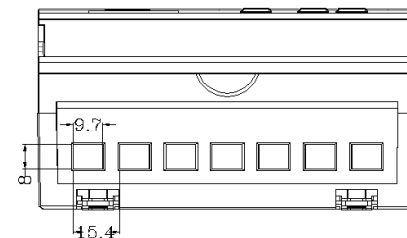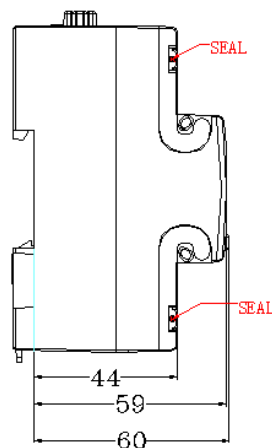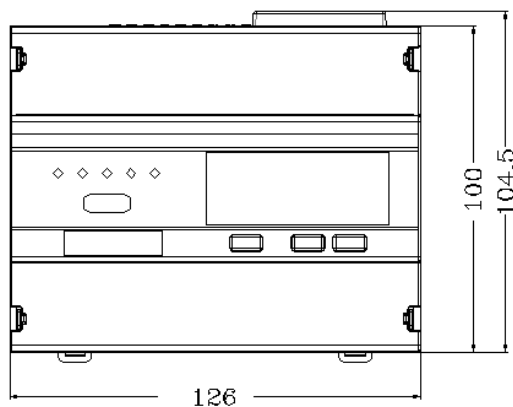
5. **Wiring diagrams**

Note: the following wiring diagram shows the energy meter with pulse output and the RS-485 interface. For other outputs, please contact support@spiremt.com for details.

Please note that the relay output is a miniature switch. It cannot be connected to power line directly. You must use an external smart switch and an external relay to provide remote connect/disconnect function.

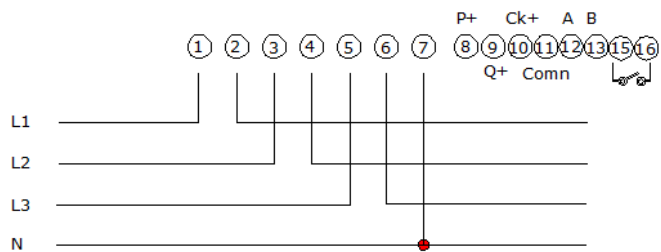5.1 **Direct connection type meter**

5.1.1 **Pulse output diagram**

1/2   L1 in & out

3/4   L2 in & out

5/6   L3 in & out

7   Neutral

8 &11   Active pulse output contact(11－,8+)

9&11   Reactive pulse output contact(11－,9+)

10&11   Clock test pulse output contact(11-,10+)

15&16   Relay output

5.1.2 Pulse plus serial communication outputs diagram

L1

L2

L3

N

1/2   L1 in & out

3/4 L2 in & out

5/6   L3 in & out

7   Neutral

8 &11   Active pulse output contact(11－,8+)

9&11   Reactive pulse output contact(11－,9+)

10&11   Clock test pulse output contact(11－,10+)

12&13   RS485 communication contact(13 TX/RX(-), 12 TX/RX(+))

15&16   Relay output

5.2 Transformer connection type meter

5.2.1   Pulse output diagram

1/2   L1 in & out

3/4   L2 in & out

5/6   L3 in & out

18/21/24/7   UL3,UL2,UL1,N

6

8 &11   Active pulse output contact(11—,8+)

9&11   Reactive pulse output contact(11—,9+)

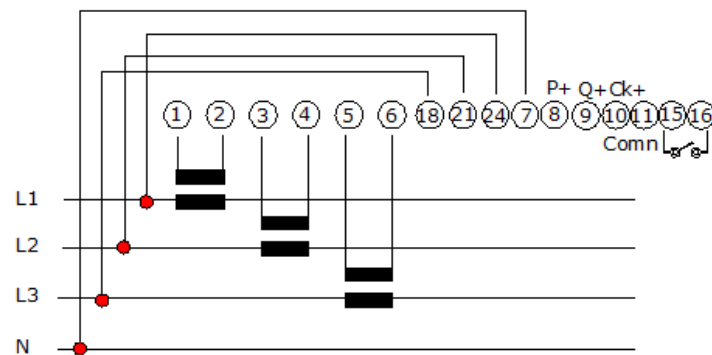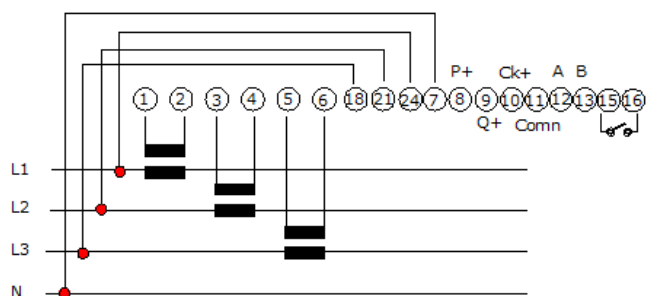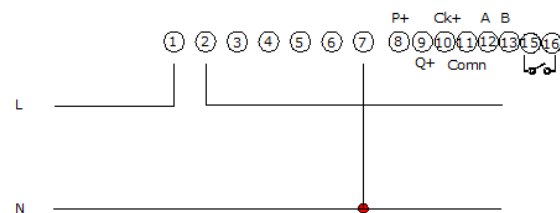10&11   Clock test pulse output contact(11—,10+)

15&16   Relay output

5.2.2   Pulse plus serial communication outputs diagram

1/2   L1 in & out

3/4   L2 in & out

5/6   L3 in & out

18/21/24/7   UL3,UL2,UL1,N

8 &11   Active pulse output contact(11—,8+)

9&11   Reactive pulse output contact(11—,9+)

10&11   Clock test pulse output contact(11—,10+)

12&13   RS485 communication contact(13 TX/RX(-), 12 TX/RX(+))

15&16   Relay output

5.3   single-phase model

5.3.1 direct connection type meter

1/2   Phase line IN/OUT

7   Neutral

8 &11   Active pulse output contact(11—,8+)

9&11   Reactive pulse output contact(11—,9+)

10&11   Clock test pulse output contact(11—,10+)

12&13   RS485 communication contact(13 TX/RX(-), 12 TX/RX(+))
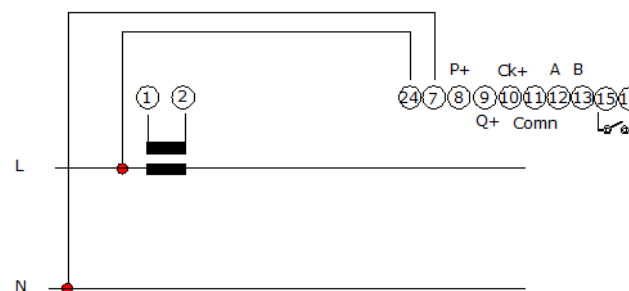
15&16   Relay output
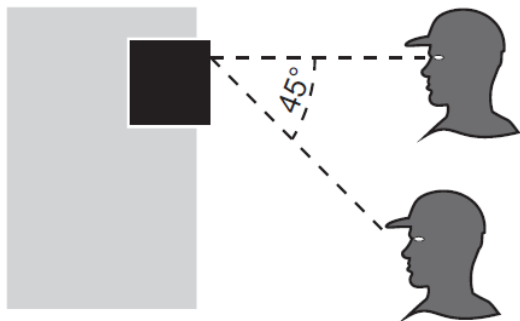
5.3.2 Transformer connection type meter

1/2   Phase line IN/OUT

7   Neutral

8 &11   Active output contact(11—,8+)

9&11	Reactive pulse output contact(11－,9+)
10&11	Clock test pulse output contact(11－,10+)
12&13	RS485 communication contact(13 TX/RX(-), 12 TX/RX(+))
15&16	Relay output

6. Meter reading

Recommend to install the meter with 1.8⁰ angle. The view angle can be as up to 45^0

7. Main function

7.1 Measuring Function

Meter can measure positive and reverse active energy, positive and reverse reactive energy.

With time-division measurement function, user can store or calculate active and reactive energy according to the time schedule of the 4 tariffs (Sharp, peak, Even, valley). You can have up to 12 time divisions, each division can correspond to one of the 4 tariffs.

On the 103EM front panel, there are three LED indicators for active/reactive energy pulse output and alarm indication.

7.2 Demand function

The meter can measure and record the forward and reverse active/reactive demand and the demand occurrence time. The demand period and sliding average time can be programmed in range 5-60mins and 1-5mins, respectively. Factory default: demand period (or interval) is 15mins, sliding average time is 1min.

The meter can store the maximum forward/reverse active demand and the occurrence time in each month of the last 12 months.

7.3 Data store function

The meter can store total active energy, forward/reverse active total energy and time-sharing energy of the last 1-12 months. Also include the reactive forward/reverse total energy and time-sharing energy, four-quadrant reactive total energy and time-sharing energy.

Data storing time is at zero o'clock the end of a month or any day of a month from the first day to 28th day. Factory default is at 0'clock the end of a month.

When the meter lost no power, all configuration-related data will be save less than 10 years, other data preserve in less than 3 years.

7.4 TOU function

The internal clock circuit has a time automatic switching function.

Calendar, clock and billing rate can be set and adjusted through RS485 or infrared

interface.

   At least 4 tariffs and 12 time intervals can be set within a natural day, minimum time interval is 15 minutes. Time interval can be set cross zero o'clock.

   The meter accounts leap-years automatically.

7.5 Measurement and Monitoring Function

   Measure, record and display voltage, current, active power, reactive power, apparent power, power factors and frequency of each phase. Also able to display the direction of the current and power.

   The resolution of frequency is 0.01Hz. The accuracy of voltage, current, activepower, reactive power and apparent power is ±1％.

7.6 Display function

   The 103EM smart meter has two display methods: cycle display and button press display. With the button, the user can program the meter according his/her needs. The LCD backlight will be on when pressing the button. Display cycle can be set within 5~20 seconds. The default is 5 seconds. The user can also set up the display items through the meter's IR or RS485 interface. The display items are as following:

Code	Display item	Code	Display item
0010	UL1	0112	QL2
0012	UL2	0114	QL3
0014	UL3	0116	ΣQ

Code	Display item	Code	Display item
004E	Frequency	0150	PFL1
0050	IL1	0152	PFL2
0052	IL2	0154	PFL3
0054	IL3	0156	ΣPF
0056	In	000C	Battery Voltage
0090	PL1	0524	Modbus id
0092	PL2	0525	RS485 Baud rate
0094	PL3	0700	Current month total energy
0096	ΣP	0702	Current month T1 energy
00D0	SL1	0704	Current month T2 energy
00D2	SL2	0706	Current month T3 energy
00D4	SL3	0708	Current month T4 energy
00D6	ΣS	070A	Last1 month total energy
0110	QL1	070C	Last1 month T1 energy
Code	Display item	Code	Display item
070E	Last1 month T2 energy	0738	Last5 month T3 energy
0710	Last1 month T3 energy	073A	Last5 month T4 energy
0712	Last1 month T4 energy	073C	Last6 month total energy
0714	Last2 month total energy	073E	Last6 month T1 energy
0716	Last2 month T1 energy	0740	Last6 month T2 energy
0718	Last2 month T2 energy	0742	Last6 month T3 energy

Code	Display item	Code	Display item	Code	Display item	Code	Display item
071A	Last2 month T3 energy	0744	Last6 month T4 energy	076C	Last10 month T4 energy	FC01	Time
071C	Last2 month T4 energy	0746	Last7 month total energy	076E	Last11 month total energy	FD00	Time of periode1
071E	Last3 month total energy	0748	Last7 month T1 energy	0770	Last11 month T1 energy	FD01	Time of periode2
0720	Last3 month T1 energy	074A	Last7 month T2 energy	0772	Last11 month T2 energy	FD02	Time of periode3
0722	Last3 month T2 energy	074C	Last7 month T3 energy	0774	Last11 month T3 energy	FD03	Time of periode4
0724	Last3 month T3 energy	074E	Last7 month T4 energy	0776	Last11 month T4 energy	FD04	Time of periode5
0726	Last3 month T4 energy	0750	Last8 month total energy	0778	Last12 month total energy	FD05	Time of periode6
0728	Last4 month total energy	0752	Last8 month T1 energy	077A	Last12 month T1 energy	FD06	Time of periode7
072A	Last4 month T1 energy	0754	Last7 month T2 energy	077C	Last12 month T2 energy	FD07	Time of periode8
072C	Last4 month T2 energy	0756	Last7 month T3 energy	077E	Last12 month T3 energy	FD08	Time of periode9
072E	Last4 month T3 energy	0758	Last7 month T4 energy	0780	Last12 month T4 energy	FD09	Time of periode10
0730	Last4 month T4 energy	075A	Last9 month total energy	0800	Postive Total Active energy	FD0A	Time of periode11
0732	Last5 month total energy	075C	Last9 month T1 energy	0900	Reverse Total Active energy	FD0B	Time of periode12
0734	Last5 month T1 energy	075E	Last9 month T2 energy	0A00	PosTotal reactive energy	FF00	High byte of serial number
0736	Last5 month T2 energy	0760	Last9 month T3 energy	0B00	Rev Total reactive energy	FF01	Low byte of serial number
Code	Display item	Code	Display item	0C00	Quadrant1 reactive energy	FF09	Meter's constant
0762	Last9 month T4 energy	0D00	Quadrant2 reactive energy	Code	Display item	Code	Display item
0764	Last10 month total energy	0E00	Quadrant3 reactive energy	FF18	CT ratio		
0766	Last10 month T1 energy	0F00	Quadrant4 reactive energy				
0768	Last10 month T2 energy	FB00	Terminal open number				
076A	Last10 month T3 energy	FC00	Date				

LCD content
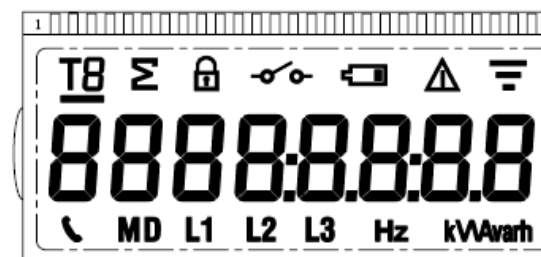
Description of LCD symbols

Symbol	Description
kVVArh	kWh—active energy kW—active power kvarh—reactive energy kvar—reactive power kVA—apparent power
Σ	Total
🔒	Unpermitted programming
⚠	LCD alarm indicator
📞	Communication symbols

7.7 Switching off display

When the power is off, user can read the meter by pressing button on the panel.

The meter can display the readings which were displayed before the power off.

The meter LCD will automatically shut off when no button pressing for 5s.

7.8 Load control

The meter has an internal relay output interface to control the Load. The meter can set up the power limit and the delay time of switch on/off when the power is over the limit. There is a symbol ─o╱o─ display on the LCD to remind user the relay is off .

Users can control the relay off and on remotely by serial interface, RS485, IR or RF.

7.9 Load record (option)

The meter can set up the "load curve" and "the start time of load curve" by serial interface.

Users can choose 6 types of data to record by timing in order to make the load curve.

Load record content can be any combination of "voltage, current, frequency", "active and reactive power", "power factor", "total power of active and reactive", "total reactive power of four-quadrant" and "current demand".

The load record interval can be set within 1~60min.

Load memory will also record the total forward and reverse active power, reactive power and four-quadrant power. If the recording interval is 5mins, the data memory space is enough for more than 40days.

7.10 Summer/winter time switch permit/prohibition

  The smart meter provides automatic summer/winter time switch at 02.00 on the last Sunday of March (forward 1 hour) and at 03:00 on the last Sunday of October (back 1 Hour).

   Summer/winter time switch can be enabled/disabled through RS485 or IR port.

7.11 Communication Function

The meter has an infrared port and a RS485 port which are independent with each other in physical layer. One communication channel will not be affected by the other one. The user can conduct data acquisition, broadcast time setting, reading, programming and management through hand-held terminals, data acquisition terminal, test equipments and computers. Communication protocol meets Modbus RTU standard.

RS485 circuit and energy meter internal circuit are featured with electrical isolation and failure protection.

RS485 communications transfer rates can be selected to be 1200bps, 2400bps, 4800 bps and 9600bps, default is 2400bps.

The max number of meters on a RS485 bus is 64 Units, the longest communication distance is 1.2Km.

7.12   Alarm function

When the meter is wired incorrectly, such as it makes current reversed, it will display ⚠ , and the ALARM led will be on.

7.13 Pulse output function

7.13.1 Active/reactive pulse output

103EM smart meter is equipped with two dedicated pulse outputs, one for active energy and one for reactive energy. Both outputs are optically isolated from the inside circuit. Each pulse represents a certain amount of active/reactive energy. The output terminals are pin 8 and pin 11 for P+ and P- and pin 9 and pin 11 for Q+ and Q-.

The pulse output is a polarity dependant, passive transistor output requiring an external voltage source for correct operation. The voltage (Ui) of the external source should be 5-27VDC, and the maximum input current (Imax) should be 27mA DC. Connect 5-27V DC to connector 8&9 (anode), and the signal wire (S) to connector 9 (cathode). A LED in the front panel will blink once per pulse output.

opto-coupler outpout into meter
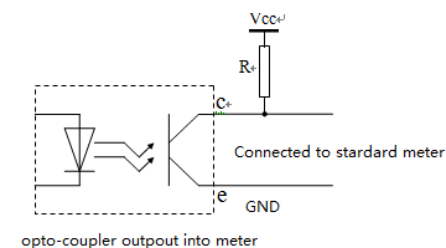
### 7.13.2 Multi-function signal output

Terminal 10 and 11 are for the Multi-function signal output. The output could be 1Hz clock which could be used to test internal clock accuracy (wiring diagram below).
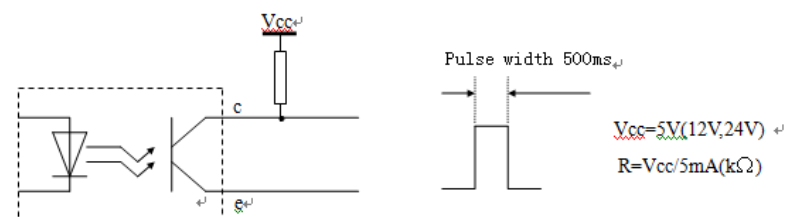
This output can be also programmed to represent the demand cycle signal or the switching signal of the time switching event. When the meter is power off it will switch to 1Hz clock output.

8 Programming

To start, you need to press and hold the "SET" key for about 3s. Then, you will see the below password verification menu:
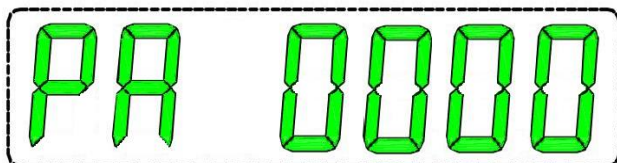
8.1 password verification

The password verification menu has "PA" followed by the currently memorized password value. "PA" means "Password", the following 4 digits value is the password, which is "0000" in this example. You can press "Page Down" button to decrease the input value and "Page Up" button to increase the input value. Press the "SET" button to move to the next digit. After you finish setting up the last digit, press the "SET" button again to confirm the password. If the Password is correct, the meter will move to the next step and display the "ID" programming menu.

Remarks:

Please note that the factory default password is 8888.

8.2 ID setting

After the Password authentication, the meter will display the "ID XX" setup interface. For example, "Id 00" means that the ID address is 00 (in hex).


You can press "Page Down" button to decrease the input value and "Page Up" button to increase the input value. Press the "SET" button to move to the next digit. After you finish setting up the last digit, press the "SET" button to save the setup. The LCD will move to Baud rate programming menu automatically.

Note: for meter with pulse output only, you may not see this menu.

8.3 Baud rate setting

Press "SET" button to enter next interface if you do not need to change the baud rate.

Press "Page Down" button to decrease the input value, and press "Page Up" to increase the input value, press the "SET" button to move to the next input digit. When the baud rate is done, press the "SET" button to save the setup. The meter will enter into the "CT" programming menu.
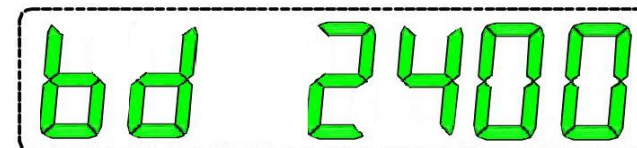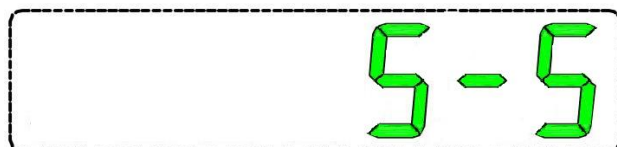

Remarks：

1. default baud rate will be 2400bps
2. 1200/2400bps /4800bps/9600bps can be programmed
3. For meter with pulse output only, you may not see this menu

Remarks：

1. if the meter is Direct connection type, it has no CT setup menu
2. after the CT ratio setup, the energy consumption display will be reset to 0

8.4 CT rate setting

Press "Page down" and "page up" buttons to select the CT transformation ratio press "SET" button to save the setup. The LCD will enter into Password setup menu.

|	5:5	5:50	5:60	5:75	5:10 0	5:125	5:150	5:160	5 ： 200
CT rate	5:25 0	5:30 0	5:40 0	5:50 0	5:60 0	5:750	5:800	5:100 0	5 ： 1200
	5 ： 1250	5 ： 1500	5 ： 2000	5 ： 2400	5 ： 2500	5:300 0	5:400 0	5:500 0	5 ： 6000
	5:75 00								
Rem ark	**When CT ratio is lower than 200, there is 1digit decimal. Otherwise, there is no decimal.**								

8.5 Password setting
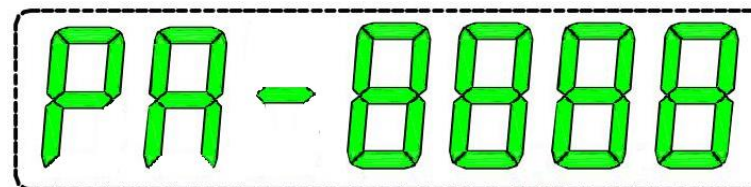
The LCD will display the current password after entering the password setup menu. You can press "Page Down" button to decrease the input value and "Page Up" button to increase the input value. Press the "SET" button to move to the next digit. After you finish setting up the last digit, press the "SET" button to save the password. You should see the "-" sign blink for about 30 seconds. **Please do not interrupt the meter while the "-" sign is blinking!** After 30 seconds the meter will save the password you changed.

Remarks:

1. Do not forget the password you entered. *Please write down your password in a secure place.*

2. After the programming, please review all the menus to make sure all the settings are correct.

9. Battery replacement.

When the battery symbol on the LCD blinks, it means the battery volume is

not enough. User can replace the battery according to the following instructions:

★ Turn off the power.

★ Open the meter terminal cover.

★ Open the battery cover.

★ Replace the battery with new ones（connect positive wire with the"+" terminal，connect negative wire with the "-" terminal. Tight the terminal screws.

★ close both battery cover and meter terminal cover.

10. Transportation and Storage

Be cautious when transporting and unpacking. Avoid impact shock.

When store, please make sure the air in the storage air is not corrosive, the temperature is 0°C~40°C and humidity is no more than 85%. Please do store the meters with original packing and put them on shelf above ground.

Please contact support@spiremt.com for technical support.

Spire Metering Technology LLC

Address: 249 Cedar Hill Street, Marlborough, MA 01752, USA

Tel.:   +1 978 263 7100   Fax: +1 978 478 9170

Email: support@spiremt.com   Website: www.SpireMT.com