

**CL-2059A**

**Industrial Residual Chlorine Analyzer**

# **User Manual**



**SHANGHAI BOQU INSTRUMENT CO.,LTD**

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## Chapter 1. Introduction

CL-2059A Industrial Online analyzer Which can measure residual chlorine and temperature simultaneously with high intelligence and sensitivity. It is widely used in such industries as thermal power plant, running water, pharmaceutical, chemistry, Food safety for residual chlorine continuous monitoring.

### Basic function

- Highly intelligent: The design project from concept of the industry one-up overall design which ensure imported core components high-quality.
- Free transform: You can choose temperature compensation between AUTO and hand operation thereby meet different requirement.
- Currents output: It's very strong anti-interference from isolation technology. Optional settings of the measurement parameters and high & low limit alarm.
- High & low alarm: Hardware isolation, each channel can be chosen measurement parameters arbitrarily, can be preset hysteresis.
- RS485 Communication: It will be monitor by computer for the convenience.
- Temperature compensation: AUTO at 0~50°C
- Waterproof and dust proof: good sealing instrument.

### Main feature:

- Menu: Design focus on object for easy operation.
- Multi-screen display : There are 3 display for the different requirement of user.
- Chlorine calibration : It provide chlorine zero and slope calibration with clear menu.
- Digital clock : Timer function
- Wide screen display: 12864 basic light soft and display clear of LED
- Meter stability : The function of E-DOG Make sure working persistent normally.

## Chapter 2 Working Principle

When it is gold one (Pt) of working electrode and counter electrode is

silver/silver chloride electrode (Ag/AgCl) reaction as blow:

Working electrode : WE:  $H^+ + 2e + OCl^- \rightarrow OH^- + Cl^-$

Counter electrode : CE:  $2Ag - 2e \rightarrow 2Ag^+$

According to Ilkovic equation : diffusion current  $I = nAFDc/\delta$

$n$  — the number of commutative electron per unit area

$A$  — surface area of working electrode

$F$  — Faraday constant

$D$  — diffusion coefficient of depolarizer

$c$  — concentration of depolarizer

$\delta$  — The thickness of diffusion layer between working electrode & solution

### Chapter 3 Technical Parameters

NAME	PARAMETER
Measurement range	Residual chlorine : 0~20.00mg/L, Resolution ratio: 0.01mg/L Temperature : 0~99.9℃, resolution ratio: 0.1℃
Measurement precision	Residual chlorine: better than $\pm 1\%$ OR $\pm 0.01\text{mg/L}$ take bigger one Temperature: better than $\pm 0.5^\circ\text{C}$ (0~50.0℃)
Lowest testing limit	0.01mg/L
Repeat-ability	Residual chlorine: $\pm 0.01\text{mg/L}$
Stability	Residual chlorine: $\pm 0.01 (\text{mg/L})/24\text{h}$
Output Current isolation	4~20 mA (load $< 750 \Omega$ ) output current ;optional measure parameter independently (FAC、T)
Output current error	$\leq \pm 1\% \text{FS}$
Low & high limit alarm	DC24V, 5A, each channel can choose it's measurement parameter independently (FAC、T) Retardation Alarm: choose parameter according your option
RS485 communication	Compatibility partly : MODBUS (Optional )
Working condition	ambient temperature 0~60℃ relative humidity $< 85\%$
Installing way	Rack
Overall size	96 (L) × 96 (W) × 118 (D) mm
Hole size	92×92 mm
Weight	0.5kg

## Chapter 4 Packing

The package of CL-2059A Industrial Online residual chlorine detector plastic for moisture proof inside , foam for quake proof middle ,packing for carton outside

Chat 3-1 Packing List

	NAME	QUALITY (PC)
1	Packing List	1
2	CL-2059A Industrial Online residual chlorine detector	1
3	Installing operation Menu	1
4	User Menu	1
5	Certificate of Quality	1

## Chapter5 Instrument Installation

Overall size : 96 (L) ×96 (W) ×118 (H) mm

Hole size : 92 (L) ×92 (W) mm



CL-2059A Industrial Online residual chlorine detector can opening type installation, fixing meter in the meter housing by open hole at 92x92mm with two pallet in package through two mounting hole

### ☆ Installing attention

1. Avoid serious moist and corrosion place for installing
2. Power must be switch off when installing
3. Make sure installing is solid and reliable

## Chapter 6 Wiring Diagram

Wiring terminal of meter and meaning of each one as blow chart 6-1

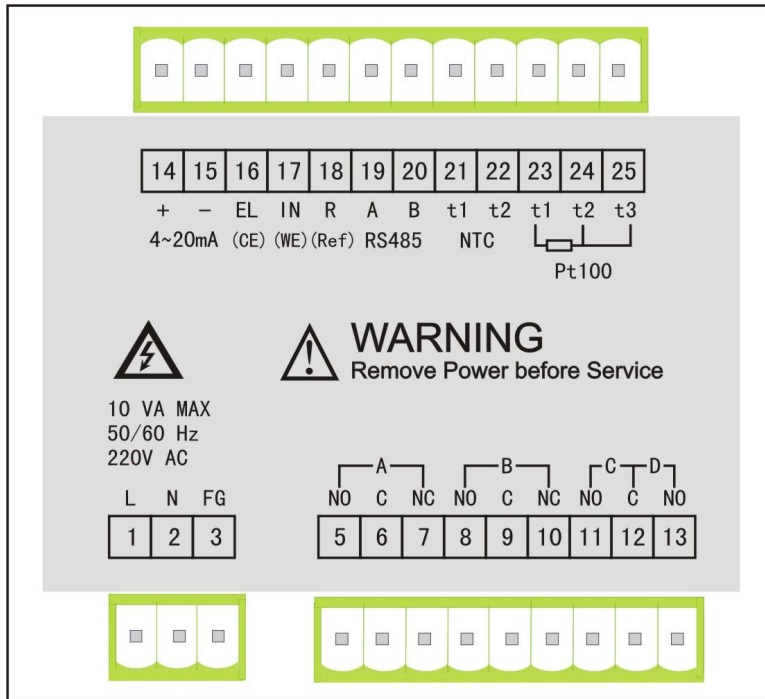


Chart6-1 Wiring terminal

Item	function	Terminal	Description	Remark
1	AC Power	L	Connect AC power phase line	Pls pay attention to safety when connection wer,person must have appropriate knowledge, comply with local regulation
		N	Connect AC power Zero Line	
		FG	Connect AC power Ground Line	
2	Relay A	NO	often open terminal of Relay A	
		C	public terminal of relay A	
		NC	often close terminal of relay A	
3	Relay B	NO	often open terminal of relay B	
		C	Relay B public terminal	
		NC	often close terminal of relay B	
4	Relay C	NO	often open terminal of relay C	
		C	public terminal of relay C,D	
5	Relay D	C	public terminal of relay C,D	
		NO	often open terminal of relay D	
6	Current output	+	4-20mA current output	
		—	4-20mA current ground	
7	FAC	CE	To probe terminal in connection to chlorine sensor	
		WE	Work probe terminal in connection to chlorine sensor	
		Ref	Ref.probe terminal in connection to chlorine sensor	
8	RS485	A	RS485 communication A	
		B	RS485 communication B	
9	Temperature	NTC T1	Terminal connection thermistor	Thermistor is NTC2252
		NTC T2	Other end connection thermistor	
		Pt100T1	Terminal connection resistance Pt100	Thermistor is Pt100

## Chapter 7 Interface Display





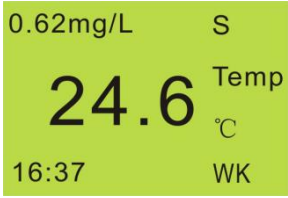
On the board , press “”key and “”key can check parameters in 3 display ways for discretion of operator 。  
5 display interface 7-1

Chart 7-1 display interface explain





No.	DISPLAY INTERFACE	EXPLAIN	REMARKS
1		<p>Enlarge display chlorine acid value, unit is mg/L</p> <p>Left is temperature</p> <p>WK is working state</p> <p>S is temperature gain from sensor sampling (M is manual compensation )</p> <p>R1 is relay 1 action</p> <p>R2 is relay2action</p> <p>RC is relay3action</p>	This is the interface when you power on
2		<p>Enlarge display residual chlorine current value unit is uA</p> <p>Left is temperature value</p> <p>Others as above</p>	
3		<p>Enlarge display temperature value unit is °C</p> <p>Left is temperature</p> <p>Others as above</p> <p>Left is residual chlorine value</p> <p>Others as above</p>	



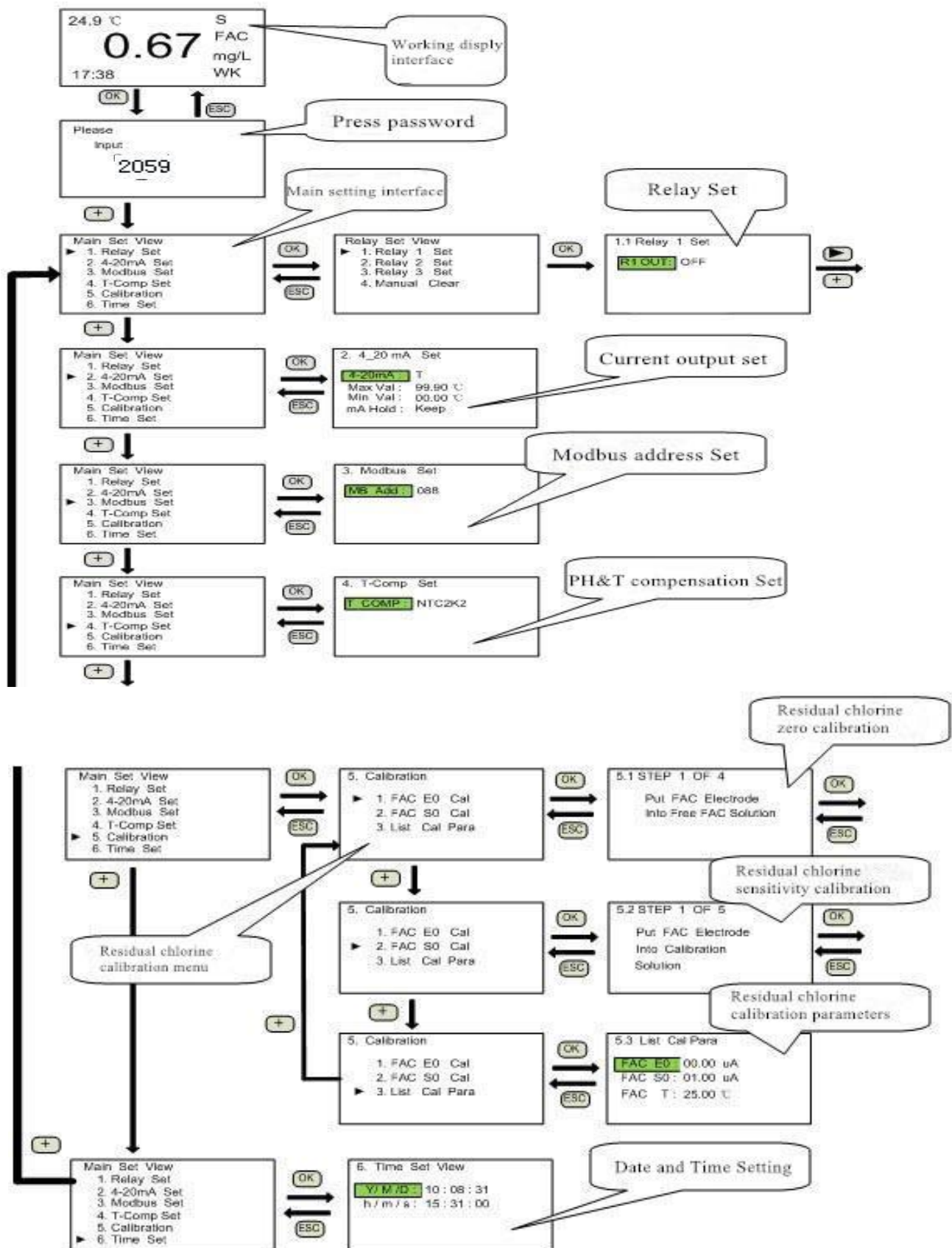
## Chapter 8 Parameter Setting

### 8.1 Button Introduction

CL-2059A industrial residual chlorine analyzer has 5 buttons, respectively is MENU key, ESC key, circulation plus key, circulation right key and Enter key.

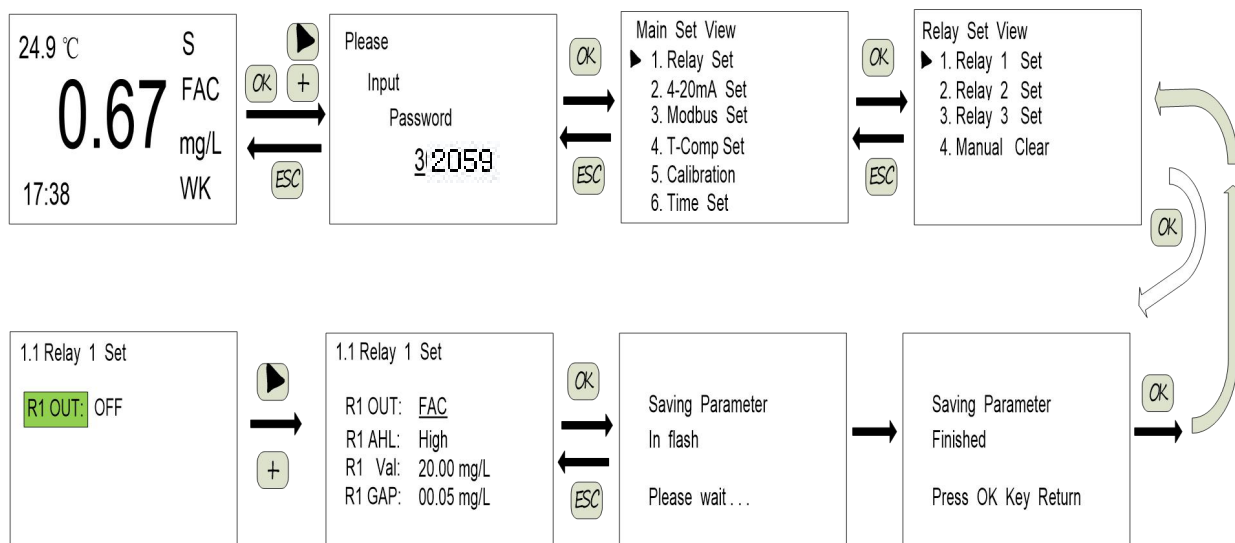
Button	Introduction
	In the working status, press Menu key, enter the password 2059 can enter setup. Under the setting mode, press the Menu key, returns the set menu or back to work.
	Cancel / back button: this button can be achieved to cancel the current operation, return to the previous menu function.
	Circulation Plus key: 1. Circulated select different parameter 2. Parameter modification at the cursor, circulation increased from 0 to 9.
	Circulation Right key: 1.The cursor can be circular right shifted, select different parameter. 2.Circulation right key can realize the selection of parameter and parameter position.
<b>Enter</b>	OK key: 1.The function of entering from previous menu to next menu can be achieved through this key. 2.When finish modify the parameters, press this key can realized the storage of modified parameters, and return to previous menu. 3. In the calibration operation, the key can complete the calibration process.

**8.2 The menu description** 8.1 gives the user set parameters, the relationship between before and after the menu. Press the Enter key to enter the password 2059



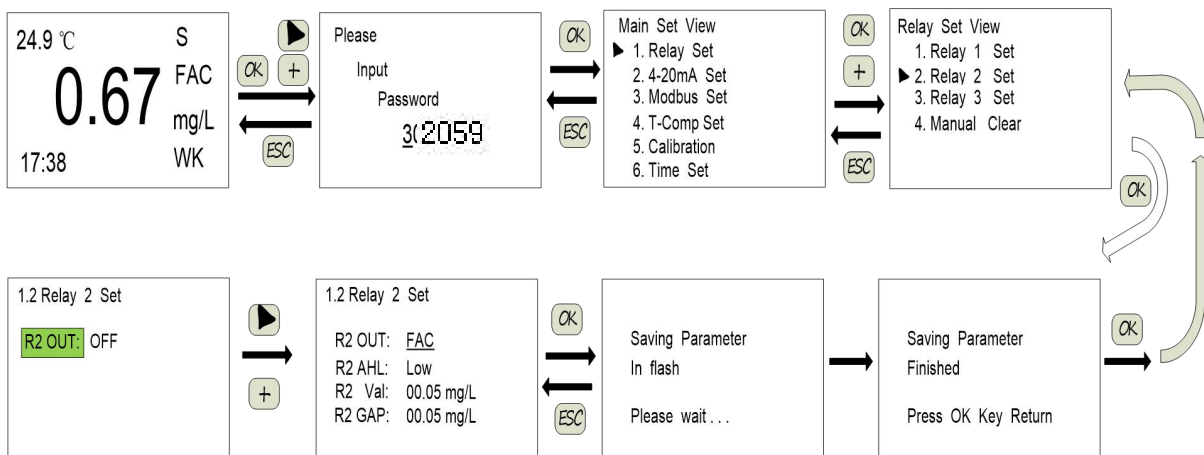
## 8.3 System Parameters Setting

### 8.3.1 Relay 1 Setting



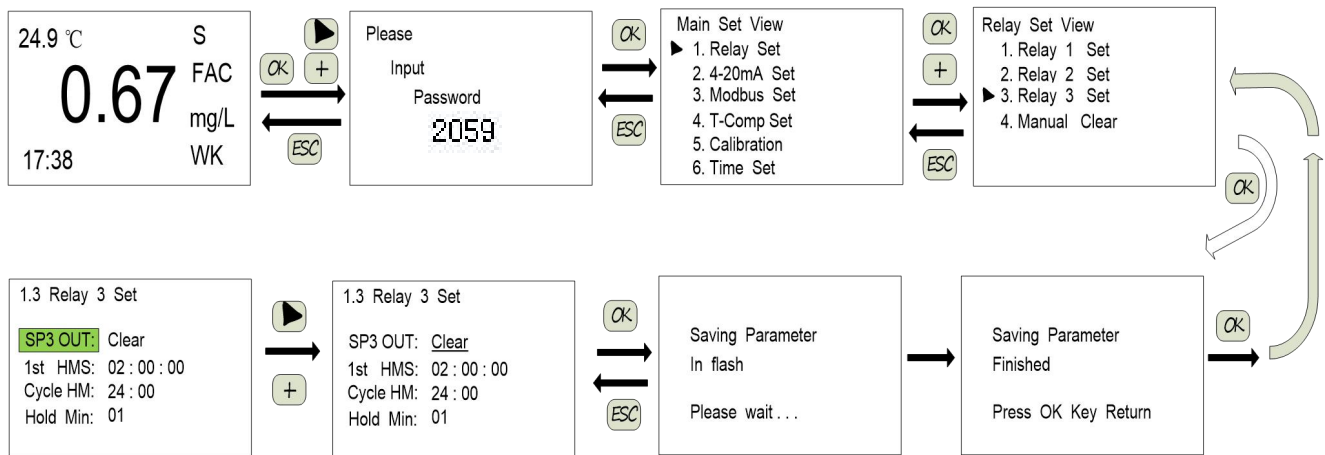
Component name	Figure	Button	Motion
Confirmation: Normal power supply			
Confirmation: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding.			
On the instrument		OK	Display 1. relay 1 set 2. relay 2 set 3. relay 3 set 4. manual cleaning operation
		▶ +	R1 Out: OFF/FAC/T Relay 1 output settings: off / chlorine / temperature
		▶ +	R1 AHL: Alarm type of relay 1 High/Low. R1 Val: Relay 1 alarm value. R1 Gap: Relay 1 alarm hysteresis value.  Explain. ★Select High alarm, alarm value is R1Val, the alarm stops value is (R1 ValR1 Gap). ★Select Low alarm, alarm value is R1 Val, the alarm stops value is (R1 Val+R1 Gap).
		OK	User press OK key, complete saved the new parameters, return to the previous menu.

### 8.3.2 Relay 2 Setting



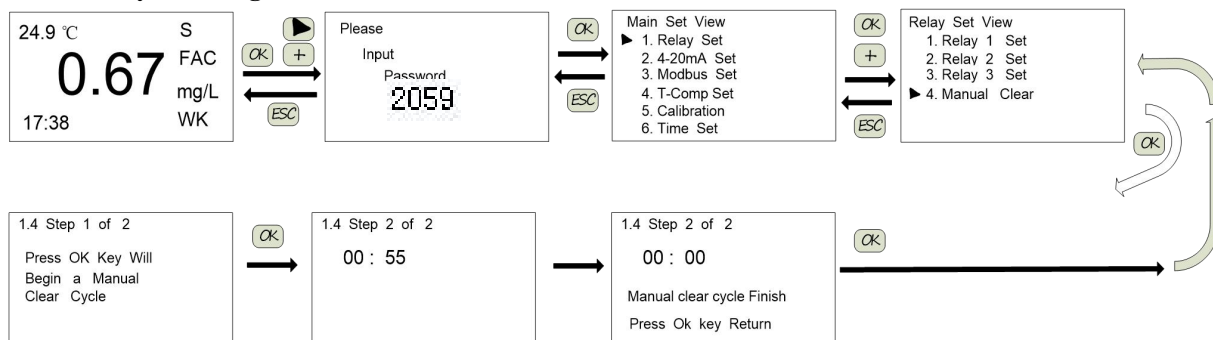
Component name	Picture	Button	Motion
Confirmation: Normal power supply			
Confirmation: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding			
On the instrument	<div>Relay Set View</div> <div>1. Relay 1 Set</div> <div>▶ 2. Relay 2 Set</div> <div>3. Relay 3 Set</div> <div>4. Manual Clear</div>	OK	Display :1. relay 1 set 2. relay 2 set 3. relay 3 set 4. manual cleaning operation
	<div>1.2 Relay 2 Set</div> <div>R2 OUT: FAC</div> <div>R2 AHL: High</div> <div>R2 Val: 20.00 mg/L</div> <div>R2 GAP: 00.05 mg/L</div>	▶ +	R2 Out: OFF/FAC/T Explain same With the relay 1

### 8.3.3 Relay 3 Setting



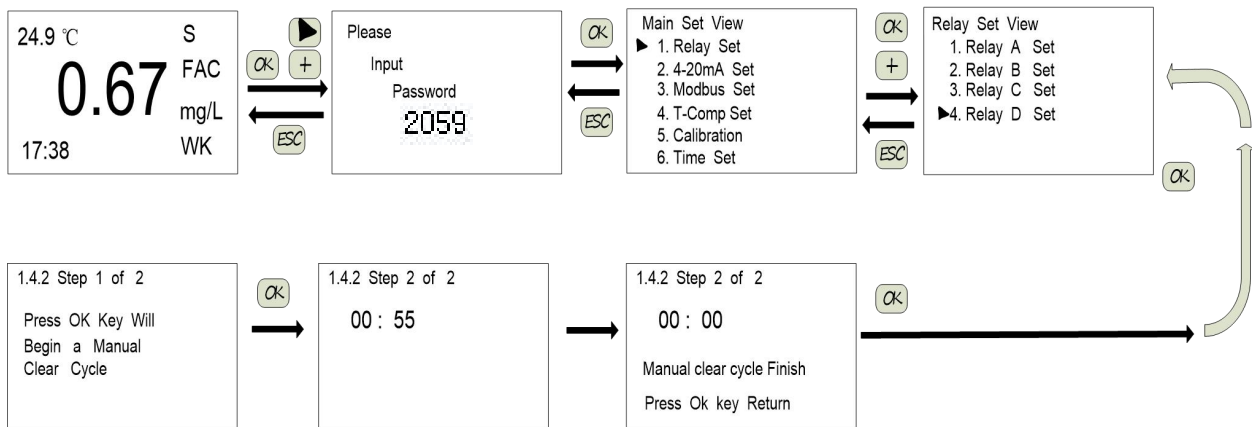
Component name	Picture	Button	Motion
Confirmation: Normal power supply Confirmation: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding			
On the instrument			Display :1. relay 1 set 2. relay 2 set 3. relay 3 set 4. relay 4 set
		 	R3 Out: OFF/FAC/T R3 High: high alarm value. R3 Low: low alarm value. R3 Dely: the alarm delay value. R3 Hold: alarm hold time value.

### 8.3.4 Relay 4 Setting



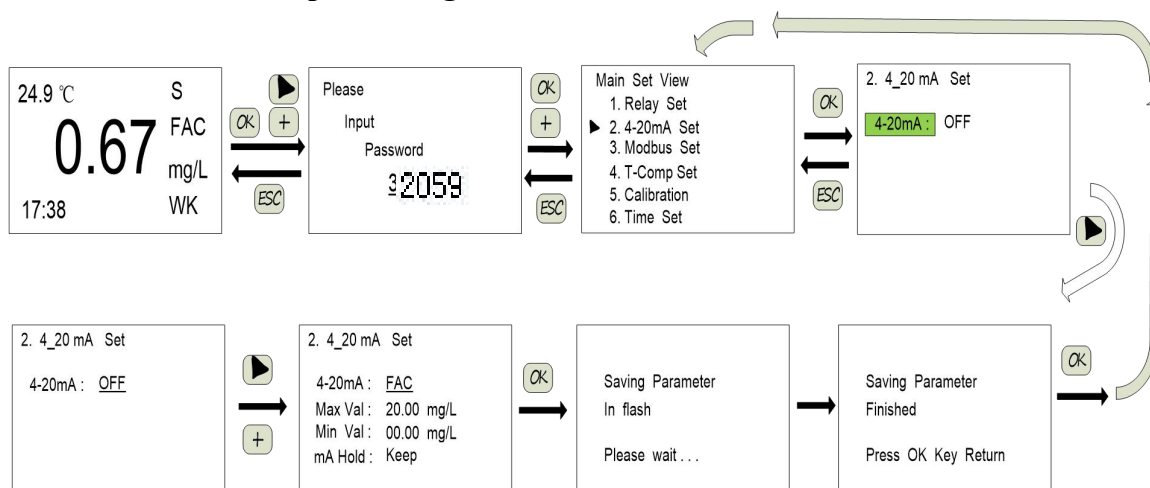
Part Name	Legend	Key-press	Action
Confirm: Normal power supply Confirm: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding.			
On the instrument	<div>Relay Set View</div> <div>1. Relay 1 Set</div> <div>2. Relay 2 Set</div> <div>▶ 3. Relay 3 Set</div> <div>4. Manual Clear</div>	OK	Display 1. Relay 1 Set 2. Relay 2 Set 3. Relay 3 Set 4. Manual Clear
<div>1.3 Relay 3 Set</div> <div>SP3 OUT: Clear</div> <div>1st HMS: 02 : 00 : 00</div> <div>Cycle HM: 24 : 00</div> <div>Hold Min: 01</div>		▶ +	SP3OUT: OFF/Clear/SP1&2/SP1/SP2 1 <sup>st</sup> HMS: 02:00:00 The first cleaning time hour / minute / second Cycle HM: 24:00 The cycle time of the cleaning hour / minute Hold Min: 01 Hold time minute Introduction: 1 <sup>st</sup> HMS Means from now on the first electrode cleaning time. After the first time when the cleaning is finished, the next cleaning time 1 <sup>st</sup> HMS + Cycle HM。 Hold Min to clean the hold time of relay. OFF: SP3 function off Clear: Cleaning relay SP1&2: Follow the action SP1 and SP2 SP1: Follow the action SP1 SP2: Follow the action SP2
<div>Saving Parameter Finished</div> <div>Press OK Key Return</div>		OK	User press OK key , finish to save the parameters, return to the previous menu

### 8.3.5 Manual Cleaning Operation



Part Name	Legend	Key-press	Action
Confirm: Normal power supply Confirm: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding.			
On the instrument	Relay Set View 1. Relay 1 Set 2. Relay 2 Set 3. Relay 3 Set ► 4. Manual Clear	OK	Display 1. Relay 1 Set 2. Relay 2 Set 3. Relay 3 Set 4. manual cleaning operation
	1.4 Step 1 of 2 Press OK Key Will Begin a Manual Clear Cycle	OK	Prompt press OK key, it will start a manual cycle
	1.4 Step 2 of 2 00 : 55		Manual cleaning countdown
	1.4 Step 2 of 2 00 : 00 Manual clear cycle Finish Press Ok key Return	OK	Manual cleaning finish. Press OK key to return to the previous menu.

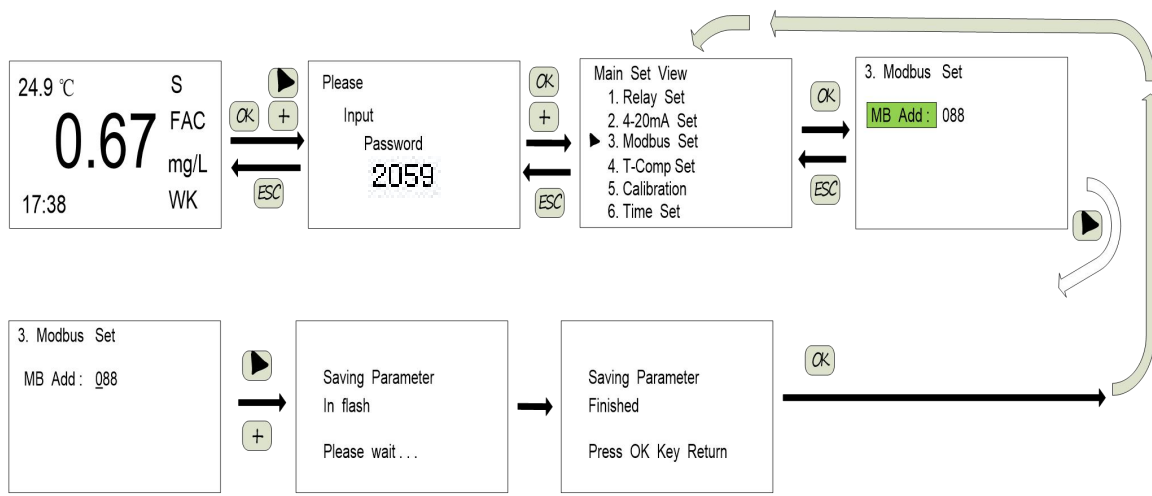
## 8.4 4-20 mA Current Output Setting



Part Name	Legend	Key-press	Action
Confirm: Normal power supply Confirm: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding.			
On the instrument	Main Set View 1. Relay Set 2. 4-20mA Set 3. Modbus Set 4. T-Comp Set 5. Calibration 6. Time Set	OK	Display 2. 4-20 mA current output setting The setting is complete the 4-20mA current output parameter selection and parameter setting.
	2. 4_20 mA Set 4-20mA: OFF	▶	Through ▶ key to enter the parameter selection, to determine the current output corresponding parameters of the project.
	2. 4_20 mA Set 4-20mA: FAC Max Val: 20.00 mg/L Min Val: 00.00 mg/L mA Hold: Keep	▶ +	4-20mA: OFF/FAC/T The default setting is 4-20mA current output off, users can through the cycle + key to choose the appropriate parameter. Meanwhile the activate parameter value setting of the parameter.
	2. 4_20 mA Set 4-20mA: FAC Max Val: 20.00 mg/L Min Val: 00.00 mg/L mA Hold: Keep	▶ +	Max Val: 20mA current corresponding the parameter value Min Val: 4mA current corresponding the parameter value mA Hold: Keep/Max In the installed state, the current output use keep/Max.

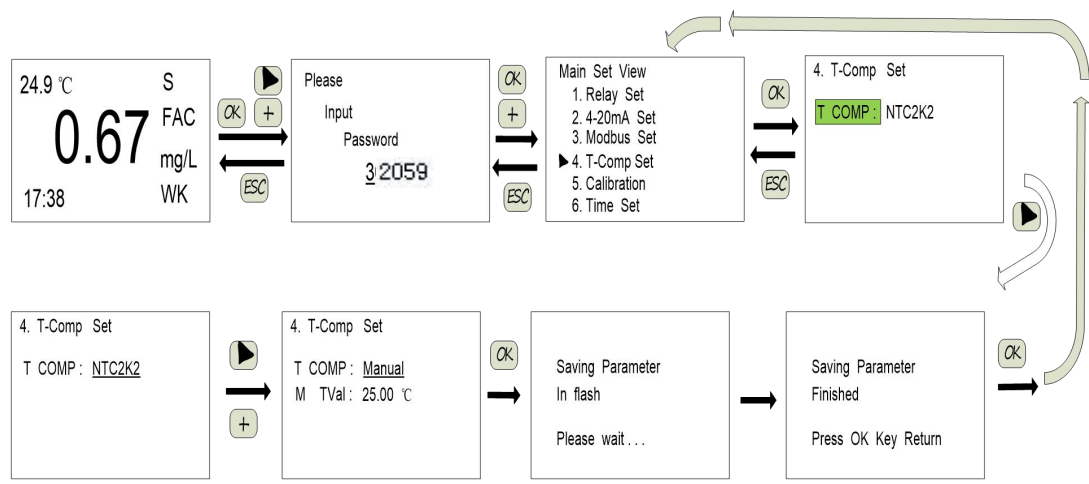


8.5 Modbus Address Setting



Part Name	Legend	Key-press	Action
Confirm: Normal power supply			
Confirm: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding.			
On the instrument	<div>3. Modbus Set MB Add : 088</div>	<div>▶ +</div>	The default setting Modbus address 088 , the user can use “+”key and “▶”key to complete the modification of the address。 Press OK key to complete the preservation of the new parameters, return to the previous menu

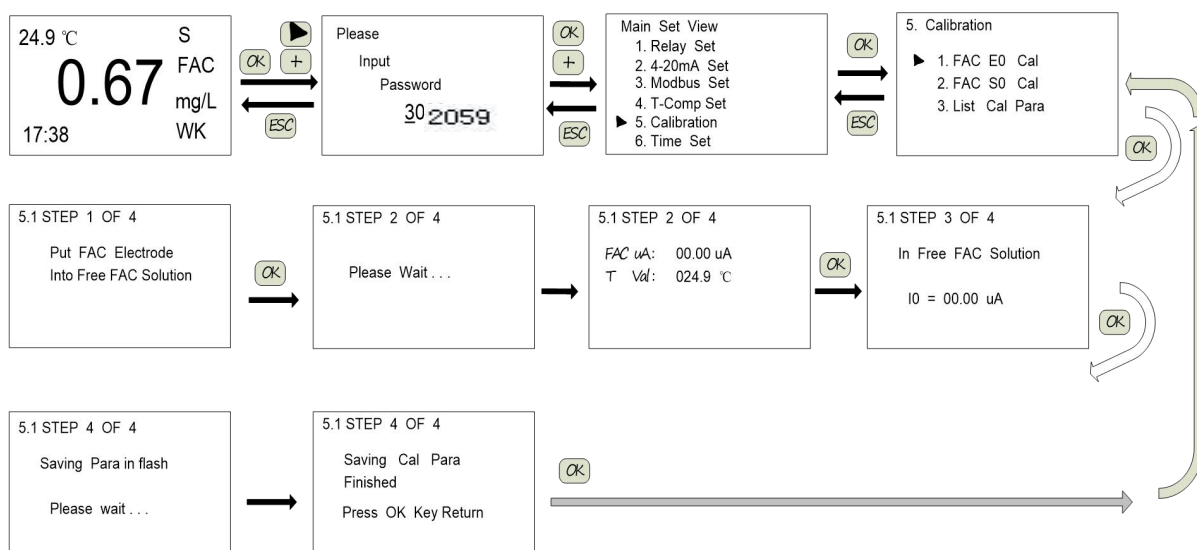
8.6 Temperature Compensation Setting



Part Name	Legend	Key-press	Action
Confirm: Normal power supply Confirm: The operator gave the corresponding authorization for security and a variety of potential hazards have a full understanding.			
On the instrument	Main Set View 1. Relay Set 2. 4-20mA Set 3. Modbus Set ► 4. T-Comp Set 5. Calibration 6. Time Set	OK	Display 4. Temperature compensation setting, the set is complete the temperature value of the acquisition mode setting is sampling by the electrodes, or manually set the value.
	4. T-Comp Set T COMP: NTC2K2	►	T Comp: OFF/Manual/NTC2K2。 Temperature compensation : Off/Manual/Thermistor2252
	4. T-Comp Set T COMP: Manual M TVal: 25.00 °C	► +	In manual mode , the user can use“+”key and“►”key, to complete the modification of the temperature value.
	Saving Parameter Finished Press OK Key Return	OK	The user press OK key to complete the preservation of the new parameters, return to the previous menu

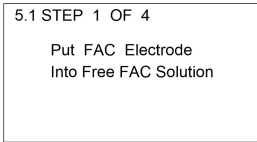

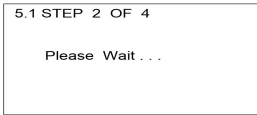
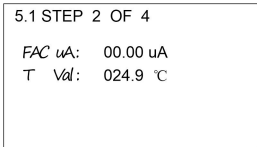

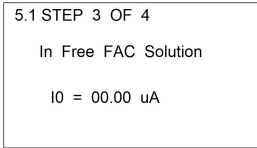

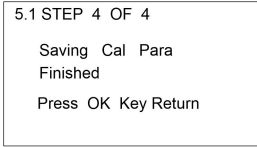

## 8.7 Chlorine Calibration Operation

### 8.7.1 Chlorine zero point calibration operation

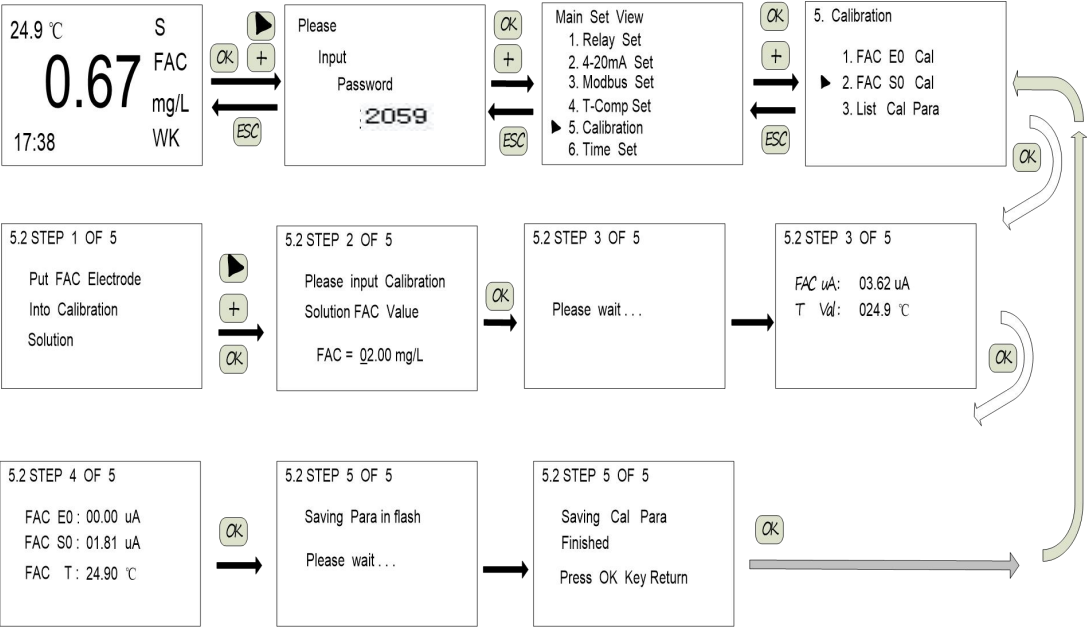


Chlorine zero point calibration procedure schematic

Zero point calibration specific steps are as follows:

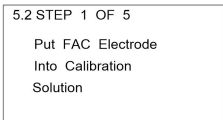

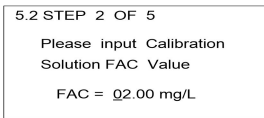

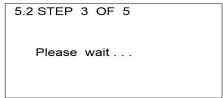
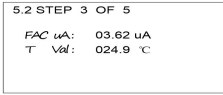

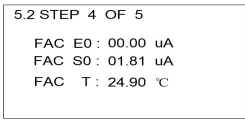

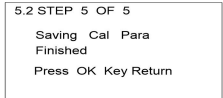

Parts name	Figure	Keys	Operation
Confirmation: NTC thermistor (temperature compensated using NTC2K2) and meter connection Confirmation: Normal supply Confirmation: the operator know the calibration principle well, given the corresponding authorization, know security and a variety of potential dangerous and well.			
On the meter			Tip: put the chlorine sensor into the non-chlorine calibration solution.
On the sensor			Put the chlorine sensor into the non-chlorine calibration solution, enter chlorine zero point calibration step 2 of 4.
On the meter			To begin the calibration sloution sampling, please wait.
			Display sampling current and temperature of calibration solution, the display value refreshes, when the display value volatility is very small, you can press "ok" key enter Step 3 of 4.
On the sensor			Display new calibration I <sub>0</sub> Display Press "ok" key, store new calibration data.
			After finish the parameter calibration, press "ok" to go back to the former step menu.

8.7.2 Chlorine meter slope calibration operation

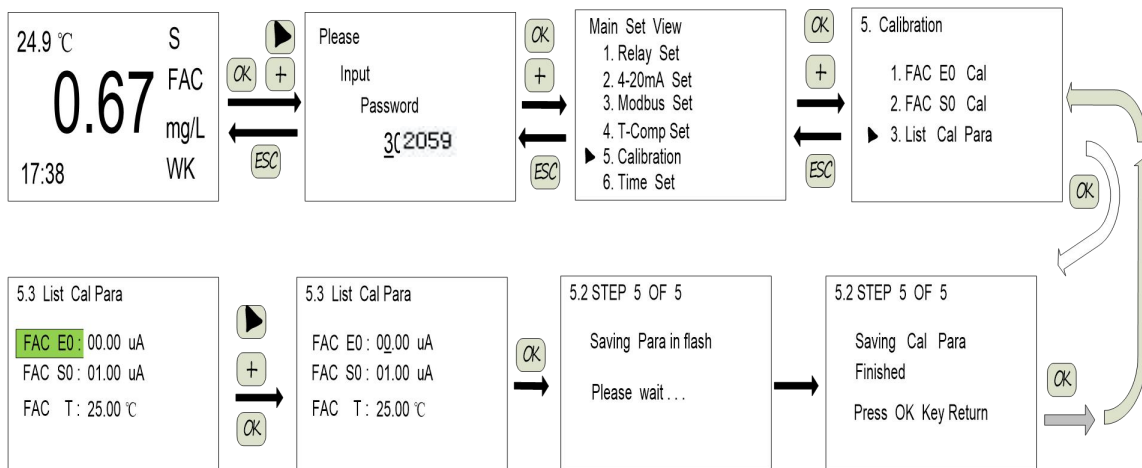


Chlorine meter slope calibration operation sketch map

### Specific slope calibration operation steps as flowing:

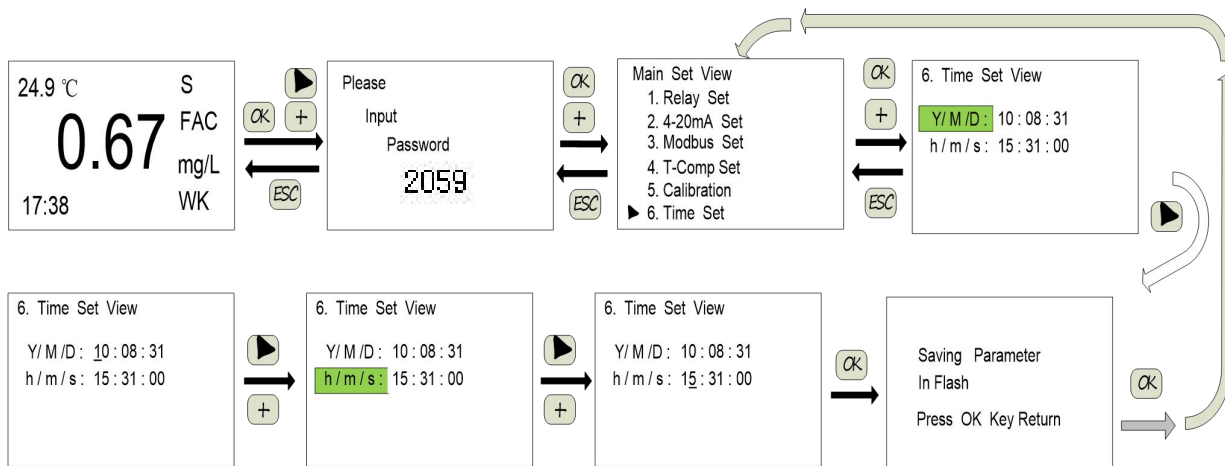
Parts name	Figure	Keys	Operation
<p>Confirmation: PH sensor and NTC thermistor (automatic temperature compensation mode) and connected to meter.</p> <p>Confirmation: Normal supply</p> <p>Confirmation: the operator know the calibration principle well, given the corresponding authorization, know security and a variety of potential dangerous and well.</p>			
On the meter			<p>Tip: put the chlorine sensor into the non-chlorine calibration solution.</p> <p>Press “ok” key to enter chlorine calibration step 2 of 5.</p>
			Users can use key “+” and “▶” to finish the chlorine calibration value.
On the sensor			<p>Put the chlorine sensor into relate calibration solution.</p> <p>Press “ok” key to enter zero point calibration step 3 of 5.</p>
On the meter			Start the calibration solution sampling, please wait.
			Display the calibration solution sampling electric current and temperature value, display value refresh, when the display value volatility is very small, press “ok” key to enter the parameter calibration step 4 of 5.
			<p>Display new calibration parameter <math>E_0</math>, <math>S_0</math>, <math>T_0</math>.</p> <p>Press “ok” key to save new calibration data.</p>
			After calibration parameter finished, press “ok” key to go back to the former step.

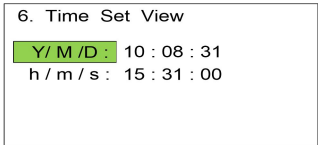

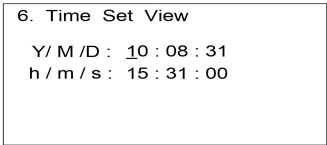


### 8.7.3 Chlorine calibration parameter check and modify



Part name	Figure	Key	Operation
On the meter	<div>5.3 List Cal Para</div> <div>FAC E0: 00.00 uA FAC S0: 01.00 uA FAC T: 25.00 °C</div>		<ol style="list-style-type: none"> <li>When the parameters was selected, it become black.</li> <li>Press “+” key to select different parameters.</li> <li>Press “▶” key to enter the parameter number setting.</li> </ol>
	<div>5.3 List Cal Para</div> <div>FAC E0: 00.00 uA FAC S0: 01.00 uA FAC T: 25.00 °C</div>		<ol style="list-style-type: none"> <li>When the parameter was selected, the parameter will display in down line mode.</li> <li>Press “+” key to add the parameter value.</li> <li>Press “▶” to select different parameters.</li> <li>Key “+” and key “▶” are circulating setting keys.</li> </ol>

## 8.8 Date and time setting



Part name	Figure	Key	operation
Confirmation: Power supply normal.			
Confirmation: the operator was given the corresponding authorization, know security and a variety of potential dangerous and well.			
On the meter			Display: Y/M/D h/m/s Display meter current date and time
		 	Users can use up, down, left and right key to finish the time modify, press “ok” key to finish the new parameter save, go back to the former step.

## Chapter 9 Communication Function

Instrumentation to provide half-duplex asynchronous RS485 serial communication, using MODBUS-RTU protocol, the measurement data can be read out, each meter mailing address can be set, communication links should use shielded double twisted with copper network, the diameter not less than 0.5mm square. Should make the communication line wiring away from strong power cables or other strong electric field environment, recommend use the T-type network connection, not recommended using star or other connections.

MODBUS\_RTU communication protocol: MODBUS protocol communication line adopt a master-slave response mode of communication connections. First, the signal addressed to the terminal of the host computer a unique address (slave) device, then the terminal response signal emitted transfer to the host in the opposite direction, that is, all communication data signal transfer in the opposite both directions in a single communication line (half duplex mode).

MODBUS protocol only allows communication between the host (PC, PLC, etc.) and terminal equipment, and does not allow the exchange of data between separate terminals, so that each terminal device does not occupy the communication line when they are initialized, and only limited to response check signal reaches the machine.

Host Query: query message frame includes device address, function code, data code, the calibration code.

Address code: indicate to the selected slave device;

Function code: indicates the function of selected slave device to perform.

Data segment: contains any additional information of the slave device function perform.

Check code: used to test the accuracy of the one frame information, using CRC16 calibration rules.

Slave response: If a normal response generated from the equipment, there are the slave address code, function code, data code and CRC16 checksum in the response message. Data code includes data collected from the device, such as parameter measurements.

Hardware connection: the signal line is connected to the A and B terminals of the meter.

Communication settings: Instrument requires a communication format is the 9600, N81 (1 start bit, 8 data bits, no parity, 1 stop bit), the response rate was 0.015S.



## Chapter 10 Communication Protocol

### MODBUS address information form:

Addresses	Parameter description	Byte	Instruction
00	FAC measurement value	float	
01			
02			
03			
04	T measurement value	float	
05			
06			
07			
08	FAC uA current measurement value	float	
09			
10			
11			
12	Year	char	
13	Mouth	char	
14	day	char	
15	Hour	char	
16	Min	char	
17	Sec	char	

Communication command: Function code 03—to read and display data.

Send				Response			
01	address			01	Address		
03	Function code			03	Function code		
00	register address			04	data bit		
	high						
01	register address			80	Data1		
	low						
00	register address			04	Data 2		
	number high						
04	register address			80	Data 3		
	number low						
CRCH	CRC check code			80	Data 4		
	high						
CRCL	CRC check code			CRCH	CRC check code		
	low				high		
				CRCL	CRC check code		
					low		

Example 1:Instrument Modbus communication address is 88; read FAC value, T value, FAC uA current value and time. Host equipment send to instrument 58 03 00 00 00 12 0E C9. Read all the data parameter value.

58	03	00	00	00	12	0E	C9
Address	Function code	Start address		Length		CRC low	CRC high

**Instrument send back to Host equipment:**

58 03 12 00 00 00 00 41 F0 83 38 3B B3 FE A0 10 09 02 15 22 25 9D 8C

Value	Instruction	Explanation	Note
58	Address	88	
03	Function Code		
12	length	18	
00 00 00 00	FACvalue	FAC=0.00	
41 F0 83 38	T value	T=30.06 ℃	
3B B3 FE A0	FAC current value	FAC uA=0.005	
10 09 02	Data	Y10M09D02	
15 22 25	Time	H15M22S25	
9D 8C	CRC		

## Chapter 11 Setting Examples

### Example 1

Users choose constant voltage chlorine electrode (with temperature compensation) measure residual chlorine in the water, need high and low limit alarm.

1.Constant voltage chlorine electrode has confirmed polarization.

2.Users first need to connect chlorine electrode (with temperature compensation) to the instrument, connecting solid and reliable, no grease, water and other pollution.

3. According to Section VIII

User needs to do

a. Prepare a standard solution: no chlorine solution, chlorine calibration solution (usually 1 ~ 2mg / L).

b.chlorine electrode zero point calibration .

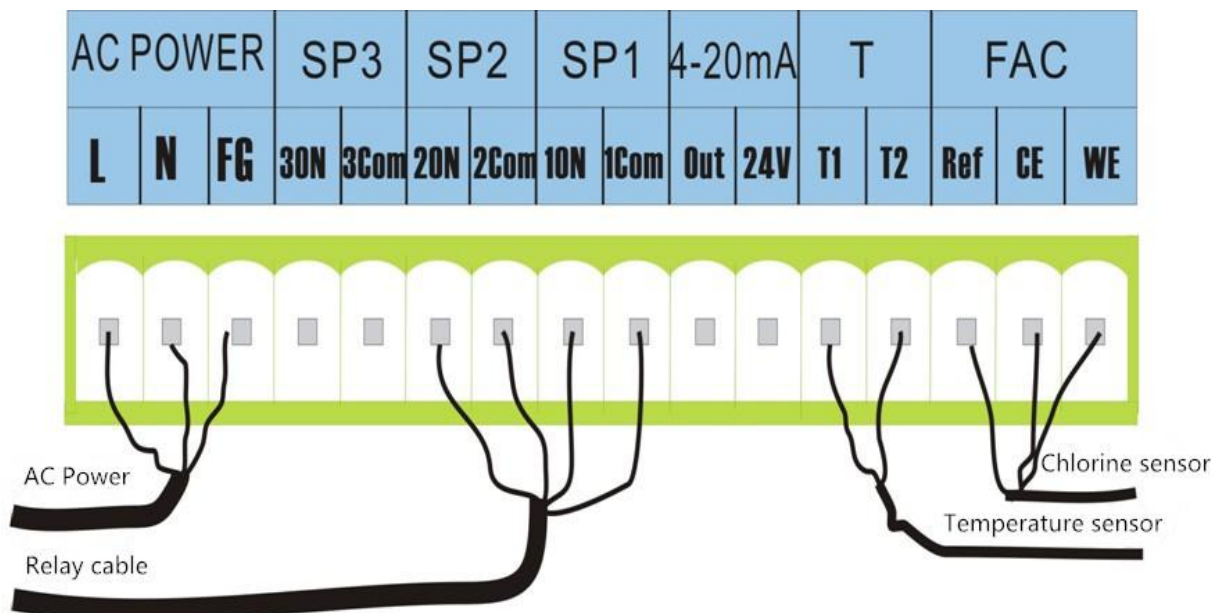
c. chlorine electrode slope calibration.

4. Instrument Set

Set relay 1 as high alarm, set alarm value and high alarm hysteresis.

Set Relay 2 as low alarm, set alarm value and low alarm hysteresis value.

5. Cable connecting.



### Example 2:

Users choose constant voltage chlorine electrode (with temperature compensation) measure residual chlorine in the water.

1. Users first need to connect chlorine electrode (with temperature compensation) to the instrument, connecting solid and reliable, no grease, water and other pollution.

2. According to Section VIII

3. User needs to do

a. Prepare a standard solution: no chlorine solution, chlorine calibration solution (usually 1 ~ 2mg / L).

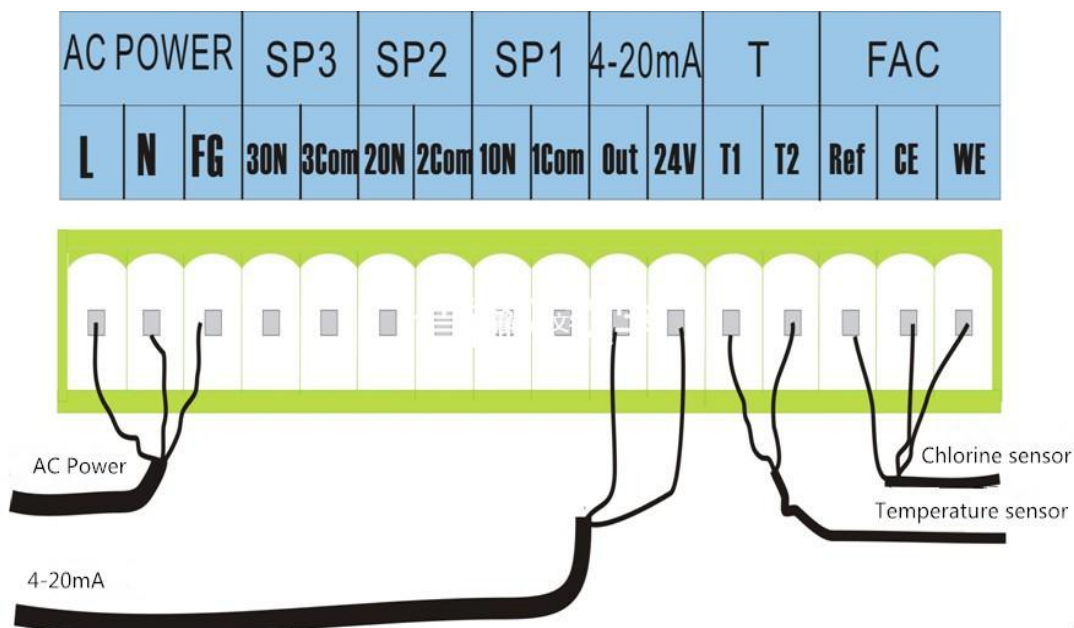
b. chlorine electrode zero point calibration .

c. chlorine electrode slope calibration.

4. Instrument set

Set 4-20mA current output parameter.

5. Wiring



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