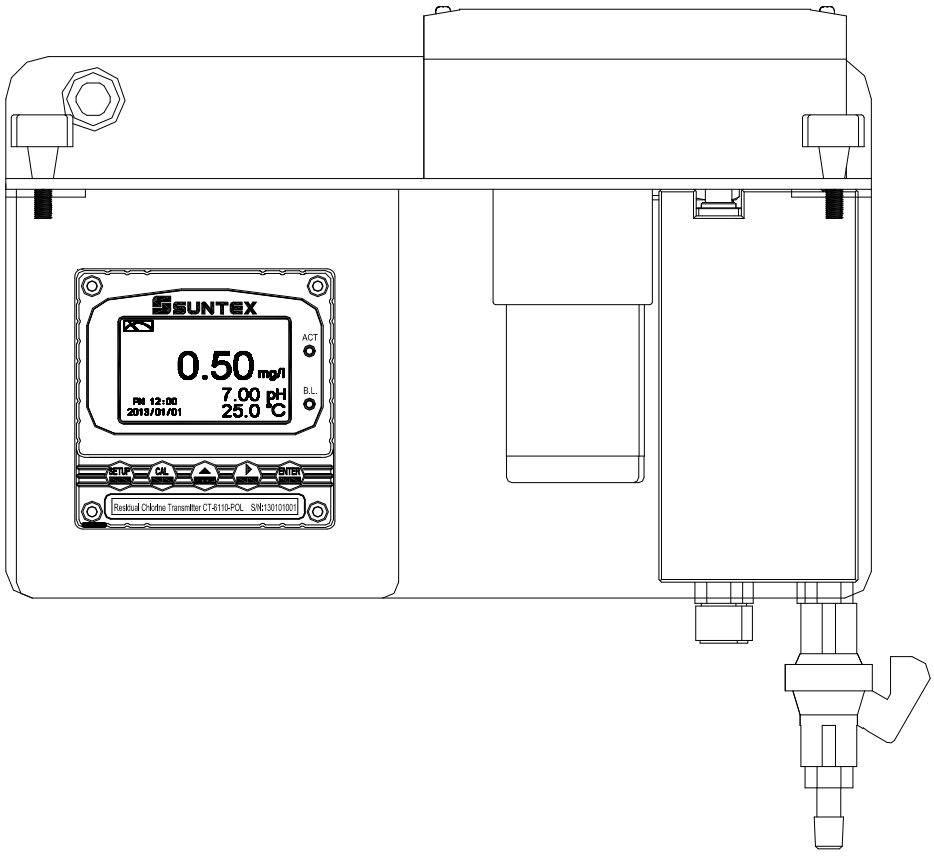
CT-6110-POL Intelligent Residual Chlorine Transmitter

Operation Manual



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Precautions for installation

Wrong wiring will lead to breakdown or electrical shock of the instrument, please read this operation manual clearly before installation.

- Make sure to remove AC power from the transmitter before wiring input, output connections, and remove it before opening the transmitter's housing.
- The installation site of the transmitter should be good in ventilation and avoid direct sunshine.
- The material of signal cable should be special coaxial cable. Strongly recommend using our coaxial cable. Do not use normal wires instead.
- Avoid electrical surge when using power. Especially when using three-phase power, use ground wire correctly. If the power surges interference occurs, separate the power supply of transmitter from the control device, such as: dosing machines, mixers, etc. to make individual power supply for the transmitter; or set surge absorber to reduce the power surges at all electromagnetic switches and power control device coils.
- The internal relay contact of the instruments is for alarm or control function. Due to safety, **please must connect to external relays which can stand enough ampere to make sure the safety operation of the instrument.**（Please refer to chapter 3.4 "Illustration of electrical connection"）
- The power voltage and the frequency for the power supply of transmitter are absolutely necessary to follow the designated power requirement of the order number model to avoid motor damage.
- There a manufacturer logo usually shows in the display of transmitter, and the illustration of each function in the manual is no longer expressed.

Brief Instruction

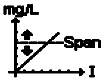
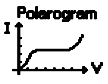
Description of set-up settings (see chapter 7 for details)

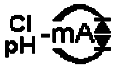
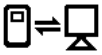
Press SETUP and MODE simultaneously to see the overview of the set-up settings now. Then press ENTER if you would like to modify set-up settings. Press keypad according to index of keypad on the screen.

Index of keypad

keypad	Accordingly item	Description
SETUP	SET:Back	Back to upper layer
MODE	▲: ◢	Choose leftward of change to left page
	▲: +	Increase digit
▶	▶: ◢	Choose rightward of change to right page
	▶: −	Decrease digit
ENTER	ENT: Enter	Confirm settings after modifications and then go through next step

Selection of set-up items

keypad	Accordingly item	Description
Mode		Measurement mode, select from normal(text) mode, real-time chart mode, trace mode display
Span Adj.		Span adjustment, allow directly measured value alignment from measurement status
Polar. Volt		Polarization voltage setting, to set the initial volt and gain
Polarogram		Apply polarization curve to record relationship between scanning voltage and current to help set the appropriate volume of polarization voltage
pH		pH function setting, to activate the pH measurement function and select pH compensation (for Free Cl_2) method
Temperature		Temperature measurement and compensation, including ATC and MTC mode. MTC---Manual temperature compensation, ATC--- auto temperature compensation

Motor		Motor setting, to activate the motor and water sample level detection function
Relay 1		First relay setting, to choose action off or Hi/Lo alarm
Relay 2		Second relay setting, to choose action off or Hi/Lo alarm
Cln/Auto Zero		Automatic wash/auto zero time setting, to set clean device or zero point filtered water device ON and OFF duration
Analog		Current output according to Free Cl_2 or pH setting range
Clock		Clock setting **(When out of power and reboot it, the instrument's time setting can maintain to the real time. If not, please replace the inner 3V CR2025 battery.)**
RS-485		RS485 serial interface (Modbus protocol)
Black-light		Backlight setting, to set Auto/ON/OFF backlight, brightness, and sensitivity
Contrast		Contrast of screen setting
Digital Filter		Take every serial 1~60 measurements, average them continuously, and make it as the readings
Logbook		Event recorder logbook (50 data)
Return		Setting of returning to the measurement mode
Code		Security code of set-up mode. The set-up code is precedential to calibration code, thus it can pass a different security code of calibration.
Language		Available for English, Traditional Chinese, Simplified Chinese

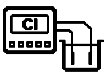
Description of calibration settings (see chapter 8 for details)

Press CAL and MODE simultaneously to see the last calibration information. Then press ENTER if you would like to make a new calibration or modify setting of calibration. Press keypad according to index of keypad on the screen.

Index of keypad:

keypad	Accordingly item	Description
CAL	CAL:Back	Back to upper layer
MODE	▲:◢	Choose leftward of change to left page
	▲: +	Increase digit
▶	▶:◢	Choose rightward of change to right page
	▶: −	Decrease digit
ENTER	ENT:Enter	Confirm settings after modifications and then go through next step

Selection of calibration items

keypad	Accordingly item	Description
Free Cl_2		Free Cl2 calibration, select from Zero or Span calibration
pH		pH calibration, select from TECH, NIST, and Any buffer calibration mode
Motor		Motor setting, to activate the motor and water sample level detection function
Return		Time interval setting of returning to the measurement mode
Code		Security code of calibration mode.

Note

Due to the need for continuous improvement of the transmitter function, we reserve the right to modify the content and the icon of the function. The actual icons and contents are subject to the instrument without notice.

1. Specifications

1.1 Specifications

Main specifications:

CT-6110-POL (Non-reagent type free chlorine transmitter)		
Measuring mode		Residual(Free) Chlorine & pH / Temperature, Simultaneous display
Measuring range	Free Cl_2	0.00~3.00mg/l (Free Cl_2 corresponding range adjustable for graphical display)
	pH	-2.00~16.00pH
	Temp	0.0~60.0°C
Resolution	Free Cl_2	0.01mg/l
	pH	0.01pH
	Temp	0.1°C
pH compensation/ accuracy		pH sensor auto compensation/ manual compensation/ OFF / ±0.01pH(±1 digit)
Temp. compensation/ accuracy		NTC-30K(compensation range: 0~45°C)/ ±0.2°C (±1 digit)
Display		Large LCM with sensitization sensor for auto/manual illumination function and contract function
Display mode		Text mode: Numerical display
		Chart mode: 3 mins real-time dynamic graph (Free Cl_2 corresponding range adjustable)
		Trace mode: Set up from 3 mins to 4 weeks duration of the measured value trend graph (Free Cl_2 corresponding range adjustable)
Analog output		Isolated DC 0/4~20mA corresponding to Free Cl_2 or pH, max. load 500Ω
Voltage output		DC ± 12V, 1W max. for PH-300T(Optional)
Logbook		50 event records
Serial interface		Isolated RS-485(Modbus RTU or ASCII)
Setting	Contact	240VAC, 0.5A Max. (recommended)
	Activate	Two individual Free Cl_2 or pH, Hi/Lo selectable, limited programmable
Clean/Auto Zero		240VAC, 0.5A Max. (recommended), ON:0~99 min. 59 sec. OFF:0~999 hours 59 min.
Cl_2 calibration	Zero point	Electrode open circuit or apply activated charcoal filtered water (residual chlorine free water) / pure water
	Span	Sampling DPD measurement input calibration or standard buffer calibration
pH calibration		Any, Tech & NIST buffer calibration
Diagnostic function		Temperature sensor, zero-point & slope diagnosis, water/power outage, logbook record or alarm symbol
Measurement system		
Measuring principle		Polarographic (No reagent needed for measurement)
Residual chlorine electrode		2 in 1 rotating electrode (Working electrode: gold, Counter electrode: silver) With relative slope index for electrode aging determination
Temperature probe		NTC-30K
pH electrode		Optional(No need for pH compensation when pH range within pH 6.5~7.5)
Cl_2 electrode cleaning		Ceramic beads auto cleaning
Motor protection		Auto over heat protection
Water outage/ Electrode open diagnosis		When water outage or electrode open, after auto diagnosis the motor auto shuts down

Performance	
Repeatability	±2% Full Scale
Linearity	±5% Full Scale
Accuracy	±2% Full Scale
Response time	<60 sec for 0~2mg/l, or < 90 sec for 2~3mg/l (90% response time)

Other specifications:

Piping connection size and flow-through chamber(Not including piping couplings)	
Flow-through chamber	Transparent, acrylic flow-through chamber
Inlet connection	1/4” NPT thread
Outlet connection	1/4” NPT thread
Spare connection	1/4” NPT thread
Sample conditions	
Sample temperature	0~50°C
Inlet pressure	0.01 ~ 2 kgf/cm^2 (as not overflow as the criteria)
Inlet flow	0.1~2 L/min (as not overflow as the criteria)
pH range	pH 5~9 (Optional pH sensor for auto compensation)
Environment	
Ambient temperature	0~50°C
Storage temperature	-10~70°C
Ambient humidity	5~95%RH
Power	
Power voltage/ Frequency	01: AC220V(-15~+10%) / 60Hz, 02: AC220V (-15~+10%)/ 50Hz 03: AC110V (-15~+10%)/ 60Hz, 04: AC110V (-15~+10%)/ 50Hz (Note: Single-phase electric power) (Designate the power voltage & frequency type when ordering)
Power consumption	Approx. 30W
Dimensions	
Installation	Wall mounting
System dimensions	~316 mm × 326 mm × 195 mm (H×W×D)
Weight	Approx. 4.5kg
Protection	Transmitter: IP 65 (NEMA 4X)

Note: The specifications are subject to change without notice.

1.2 Product model and spare part order number

Model	Sensor Code	Power Code
CT-6110	**-POL** **POL：Polarographic**	**-03** **01: Single-phase, AC 220V(-15~+10%)/60Hz** **02: Single-phase, AC 220V(-15~+10%)/50Hz** **03: Single-phase, AC 110V(-15~+10%)/60Hz** **04: Single-phase, AC 110V(-15~+10%)/50Hz**

Standard accessories:

1. Transmitter
2. Sensor assembly(Including Cl_2 electrode, temperature probe, motor & driving device)
3. Flow-through chamber
4. Measuring cup
5. Ceramic beads pack x 2
6. Inlet/Outlet couplings
7. Wall mounting frame
8. Transmitter mounting plate
9. Acrylic cover
10. Cable gland (If the original glands are not enough for wiring, the additional cable gland is available for installation at back cover)

If necessary, please order the spare parts as follows:

1. Free Cl_2 electrode: 8-CL-01
2. Ceramic beads: 8-40 (Weight about 40g)
3. pH electrode housing(Optional): 8-41
4. pH electrode(Optional): Select a suitable pH sensor. When installation, it is necessary to move the sensor assembly box to the clean position. Open the box upper cover, and install the pH electrode housing from the box bottom side up. Let the pH cable go through the pH cable gland of sensor assembly box. Finally, insert the pH electrode into the pH electrode housing. Please make sure that the pH electrode does exceed the tip of housing.(If the outer diameter of pH electrode head is too small, the electrode may exceed the tip of the housing. If so, it is suggested to apply O-ring at the bottom side of pH electrode head.) It will prevent the pH electrode from damaging by the bottom of the flow-through chamber.
5. pH buffers (Optional)

1.3 Measurement principle

The instrument applies polarogram principle to detect the free available chlorine which include chlorine($C1_2$) , hypochlorous acid(HOCl) and hypochlorite ion(OCl^-) in the water.

$$Cl_2 + H_20 \leftrightarrow HOCl + H^+ + Cl^-$$
$$HOCl \leftrightarrow H^+ + OCl^-$$

The CT-6110-POL utilizes the motor and timing belt to rotate the free chlorine sensor which dips into fresh water flow, and provides bias voltage between the working electrode(gold electrode) and the counter electrode(silver electrode) of the free chlorine sensor. Thus, the electrode will react to free chlorine in the water , and it results in an oxidation-reduction reaction(redox) and generates diffusion current. By measuring the current and combining the temperature measurement, the concentration of free chlorine in the water is determined.

There is a default setting for pre-set initial volt and volt adjustment gain. Normally, the pre-set initial volt and gain is applied for water sample measurement. When the concentration has changed, the instrument is able to search for the most suitable measurement volt to result in new concentration value. If the sample water is necessary to change the initial volt and gain, the polarogram function can be utilized to set the polarogram volt. (For diagram of scan volt/current, please refer to ch7.7 Polarogram.) Select the voltage of stable current range(which means voltage change but little change in current range), and then set the voltage as initial volt in the transmitter's polar. volt setting (Please refer to ch7.6 Polar. Volt.).

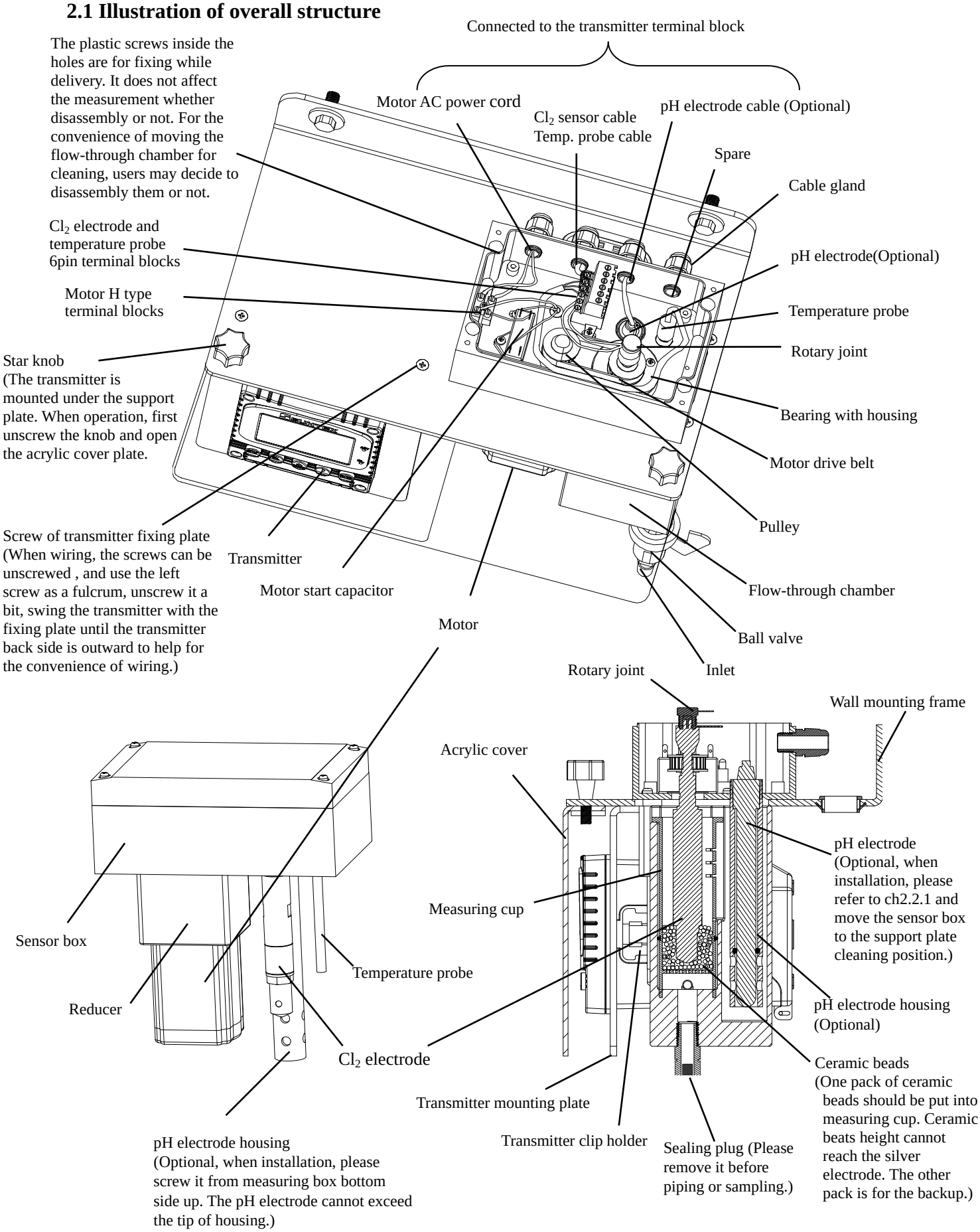
In most cases, it only needs to apply the pre-set initial volt and gain, and it is not necessary to proceed the polarogram scanning function as the previous description. When measurement under different conductivity range water sample, it will be necessary to set a suitable gain to prevent measurement error.(Please refer to ch7.6 Polar. Volt.)
While the free Cl_2 electrode is rotating, in order to maintain the measurement accuracy, it also applies ceramic beads to clean the electrode suffice simultaneously. For the first operation or for long stop duration of the motor, please let the electrode continuously operate at least one hour and then start the measurement work. The electrode is a consumable part, and it is necessary to be replaced after a period of use. Users may set the electrode at 100% relative slope while calibration(such as at the first calibration of the electrode). Then the relative slope value will show after every calibration is done. Apply the value for the determination index of electrode aging condition.

Temperature changes can affect the measured value of residual chlorine concentration. The instrument can apply the temperature value which is measured by a temperature probe for making a temperature compensation for residual chlorine concentration.

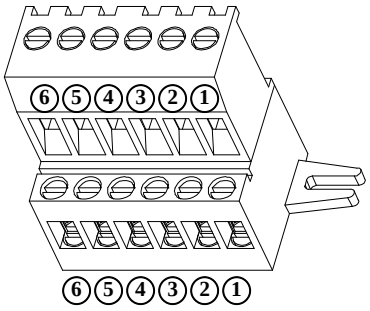
Changes in pH also affect the measured value of residual chlorine concentration. The standard measurement range for sample solution is pH 6.5~7.5. If the pH value of the sample solution exceeds the range, it is suggested to apply a pH electrode(optional), the instrument will automatically make a pH compensation for residual chlorine concentration.

2. Assembly and installation

2.1 Illustration of overall structure



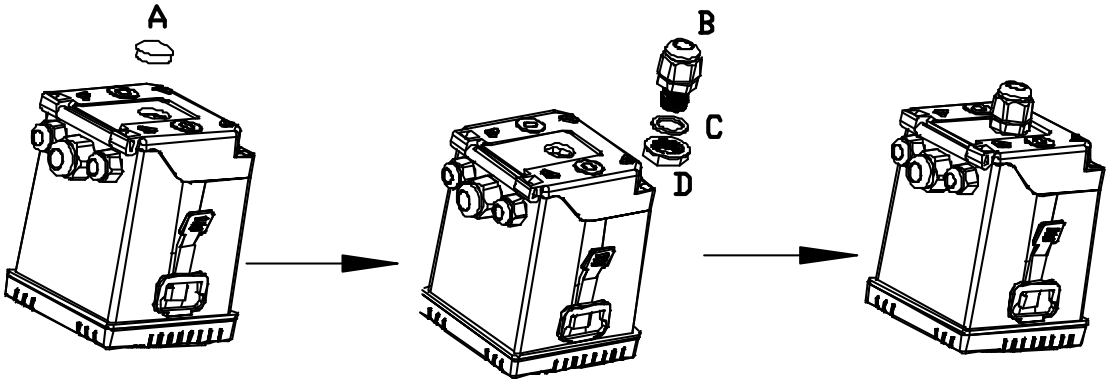
Wiring of residual chlorine electrode and temperature probe:



Sensor box			Transmitter
Cl_2 sensor wiring	Lower level of 6PIN terminal block for Cl_2 sensor and temperature probe	Upper level of 6PIN terminal block for signal cable to transmitter's terminal block	Rear terminal block
Lower end of rotary joint	① Brown(Thick wire)	① Brown	(11) CE (silver)
Upper end of rotary joint	② Red(Thick wire)	② Red	(12) WE(gold)
Temperature probe	③ Black	③ Black	(15) SG
	④ Red	④ Yellow	(16) T/P
	⑤ Green	⑤ Orange	(17) SG

Installation of cable gland:

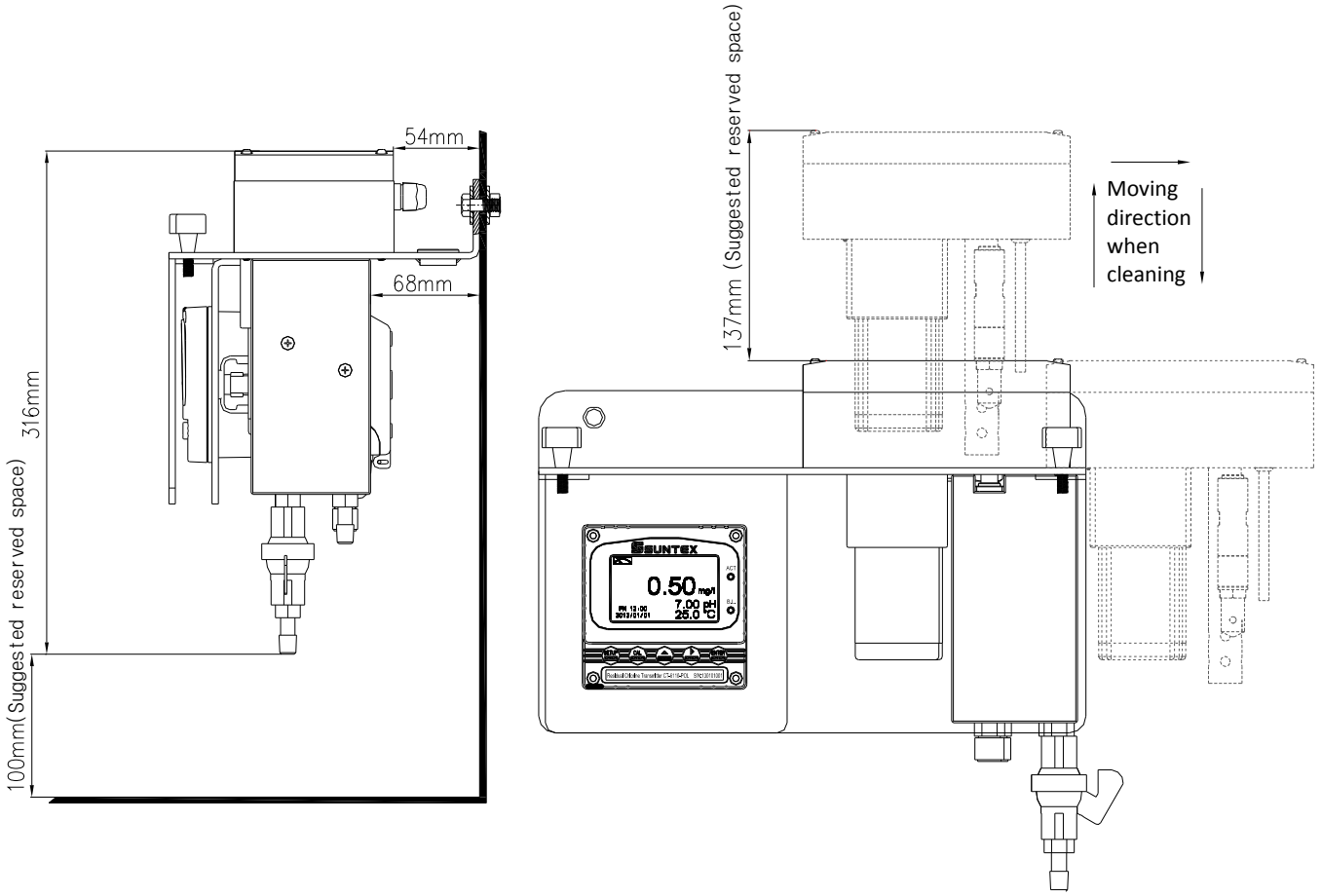
If the original glands are not enough for wiring, the additional cable gland is available for installation.

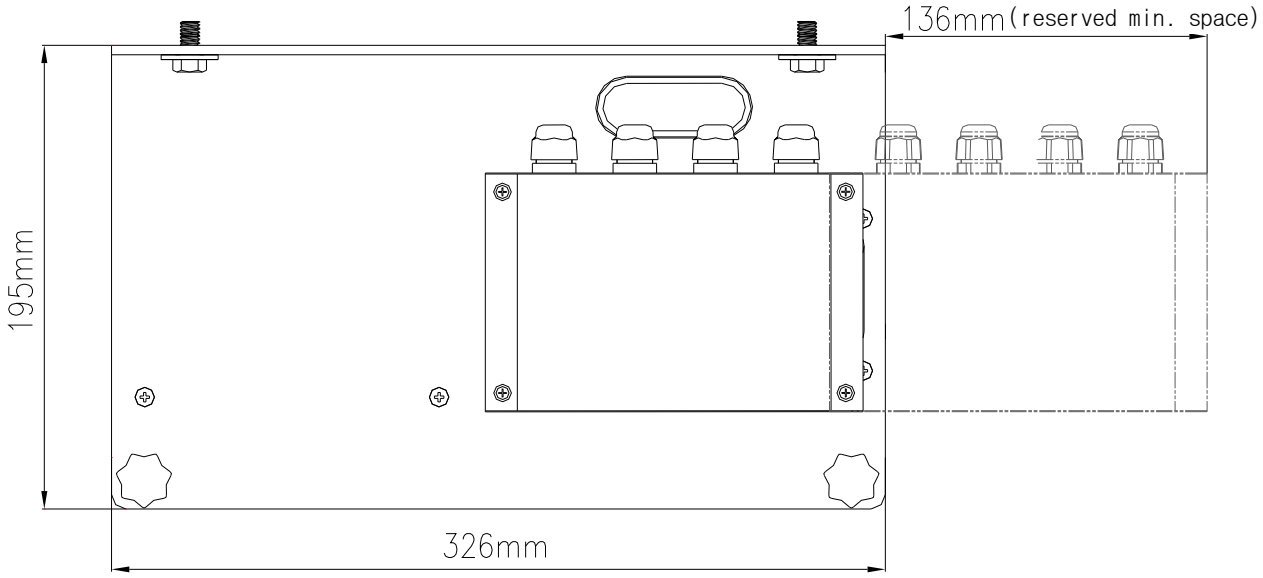


1. Remove the waterproof plug(A) from the back cover.
2. Set the rubber gasket(C) in the cable gland (B), and screw into the back cover.
3. Use a fixing nut(D) from the inside of the back cover to fix up the cable gland(B).

2.2 Installation dimensions and combinations

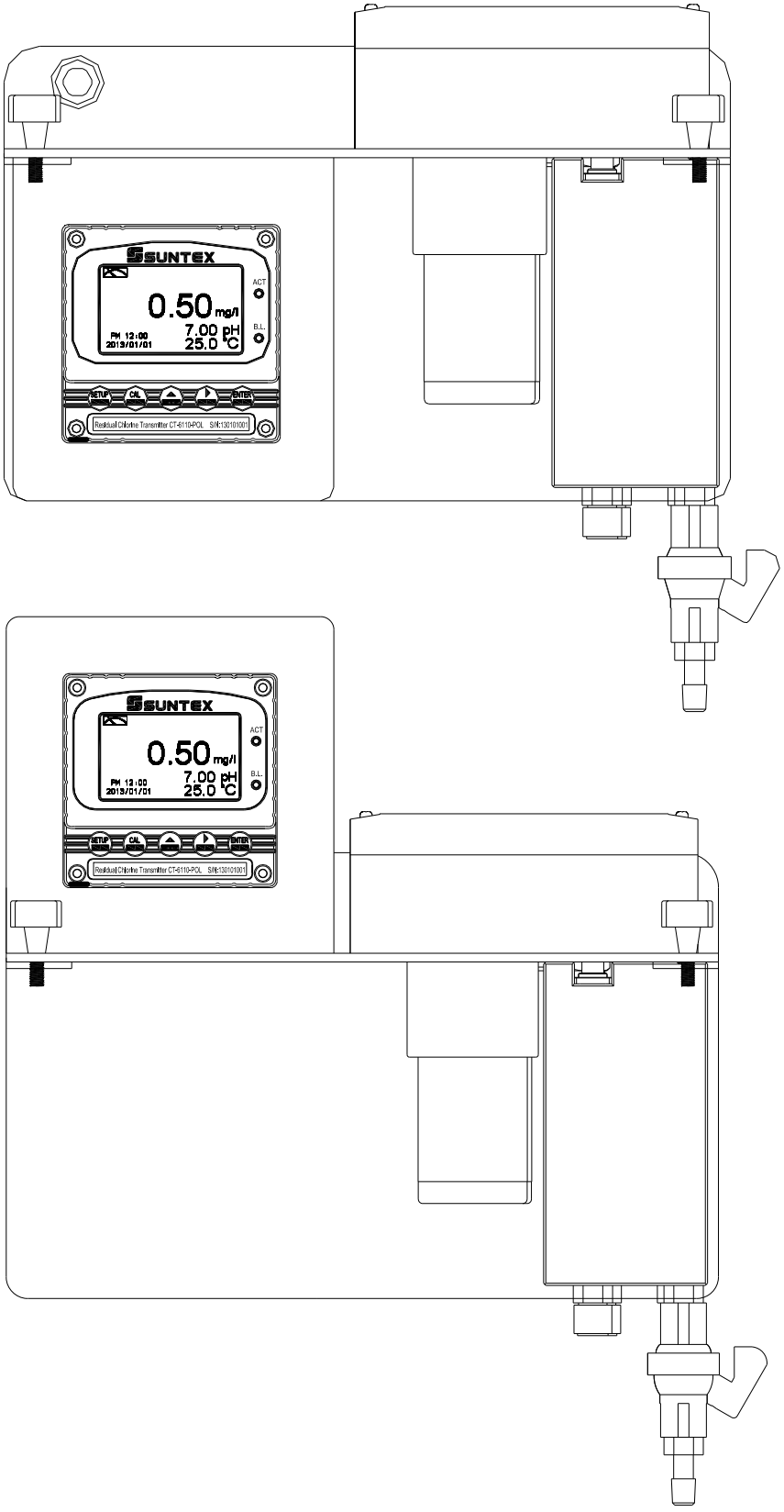
2.2.1 Installation dimensions





2.2.2 Combination types

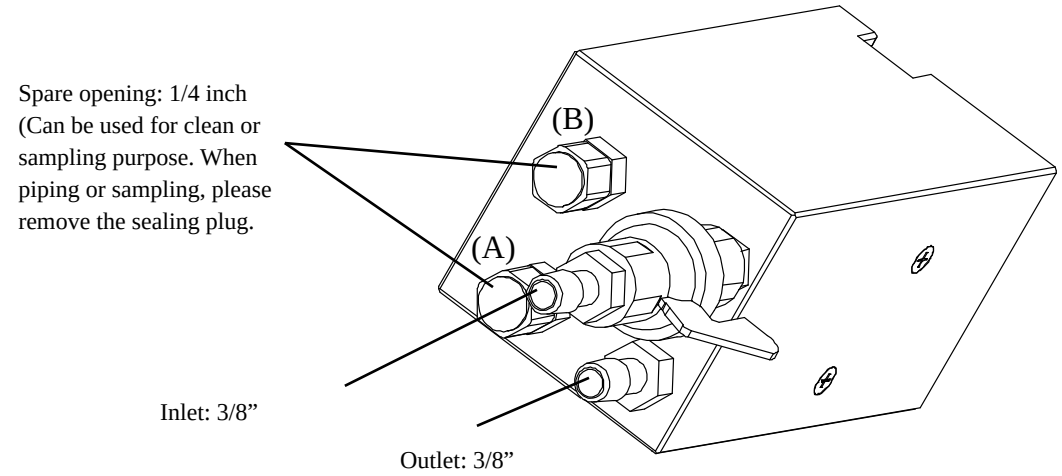
As shown below, the user can decide to configure the transmitter above or below the support plate.



2.3 Illustration of flow configuration

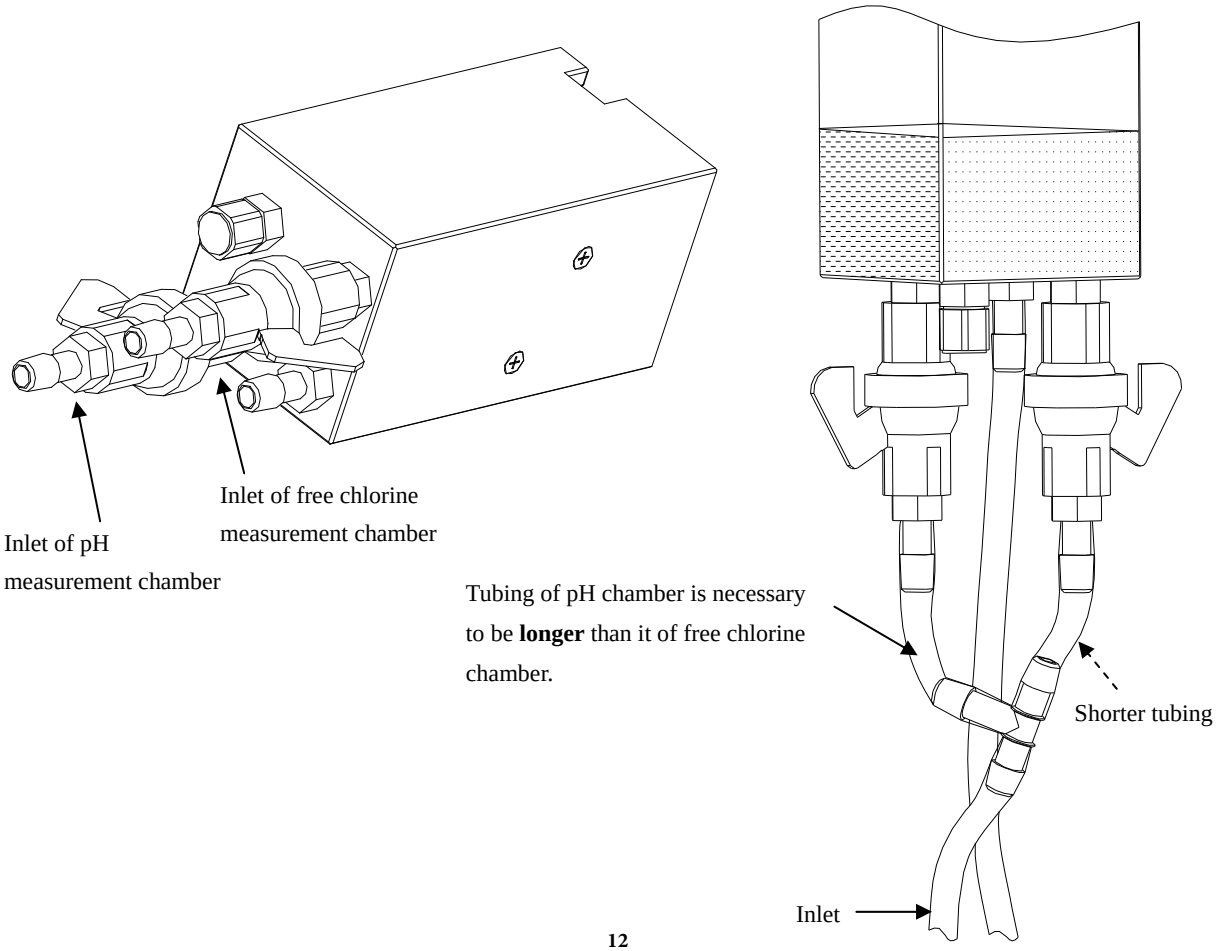
2.3.1 Piping of flow-through chamber

Assemble the couplings according to following illustration



2.3.2 Piping of flow-through chamber(When install with a pH sensor)

When the flow-through chamber is installed with a pH sensor, be sure to install a ball valve/connector which is included in the accessory part of 8-41 pH sensor housing at the spare opening port(A) as the inlet of pH measurement chamber. Use a T-connector and tubing to connect with the inlet piping and thus to make sure that both pH and free chlorine sensors measure fresh and moving sample solution. Meanwhile, use the ball valves to adjust suitable inlet flow to make inlet flow of pH measurement chamber less than inlet flow of free chlorine measurement chamber, and make sure the level of inlet sample solution is higher than both silver electrode of the free chlorine sensor and the front tip of the pH sensor.



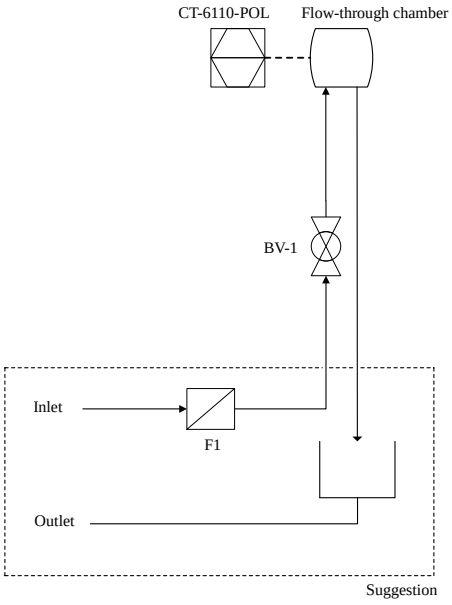
2.3.3 External piping configuration (Just for reference, not included in the standard & optional accessories list, users may select for installation according to the field conditions.)

BV-1: (Ball valve)

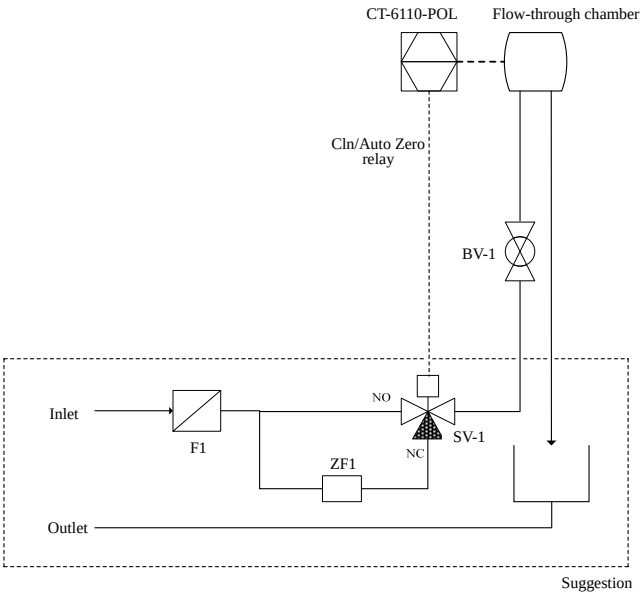
F1: (Filter)

ZF1: (Activated charcoal filter/Zero filter)

SV-1: (3-way solenoid valve)



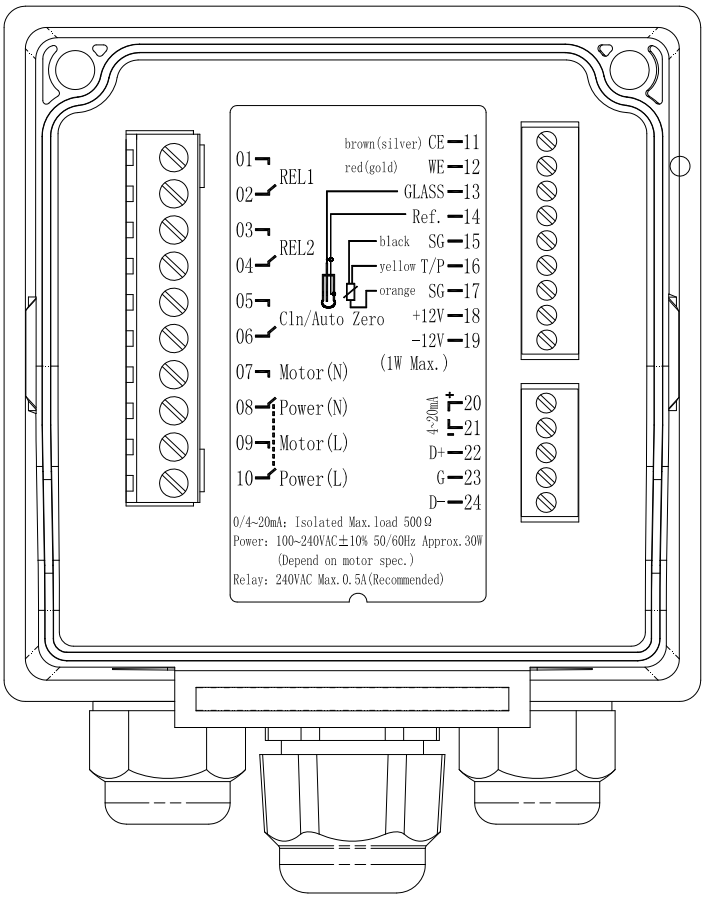
(A)General piping configuration



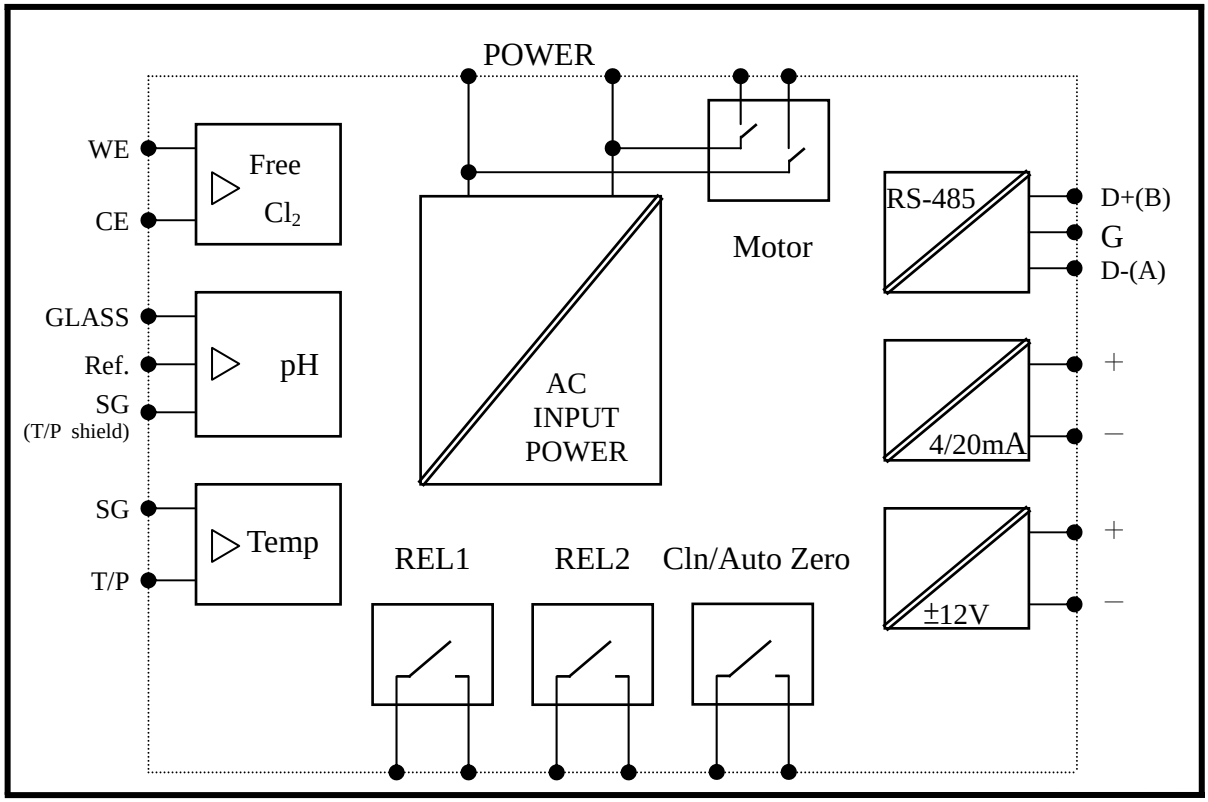
(B)Auto-Zero calibration piping configuration

3. Overview of Residual Chlorine transmitter CT-6110-POL

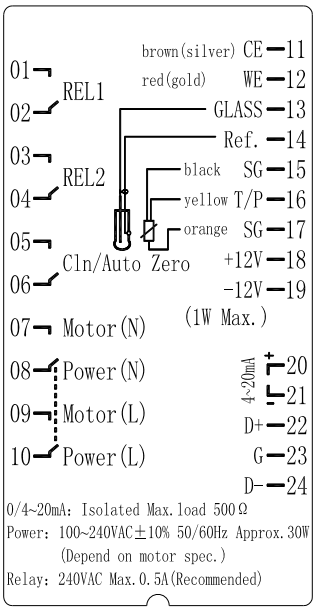
3.1 Illustration of rear panel



3.2 Illustration of terminal function



3.3 Description of terminal function



01, 02 — **REL1:** First alarm control, Free Cl_2/pH & Hi/Lo selectable, the contact for an external relay

03, 04 — **REL2:** Second alarm control, Free Cl_2/pH & Hi/Lo selectable, the contact for an external relay

05, 06 — **Cln/Auto Zero:** Wash/Auto zero relay contact for an external relay

07 — **Motor(N):** Connect with one end of the motor

08 — **Power(N):** **According to the designated power and frequency when ordering**

09 — **Motor(L):** Connect with the other end of the motor

10 — **Power(L):** **According to the designated power and frequency when ordering**

11 — **CE:** Connect with brown wire of free chlorine electrode(Silver, CE)

12 — **WE:** Connect with red wire of free chlorine electrode(Gold, WE)

13 — **GLASS:** Connect with coaxial inner of pH/ORP electrode signal wire

14 — **Ref. :** Connect with coaxial shield of pH/ORP electrode signal wire

15 — **SG:** Connect with black wire of temperature probe (When applying a pH electrode, the terminal is used as the solution ground)

16 — **T/P:** Connect with yellow wire of temperature probe

17 — **SG:** Connect with orange wire of temperature probe, or used as ±12V ground potential.

18, 19 — **DC±12V:** Output terminal of direct current voltage ±12V **(PH-300T only)**

20 — **4~20mA +terminal:** Master measurement(Free Cl_2/pH selectable) current output terminal +, for external recorder or PLC control

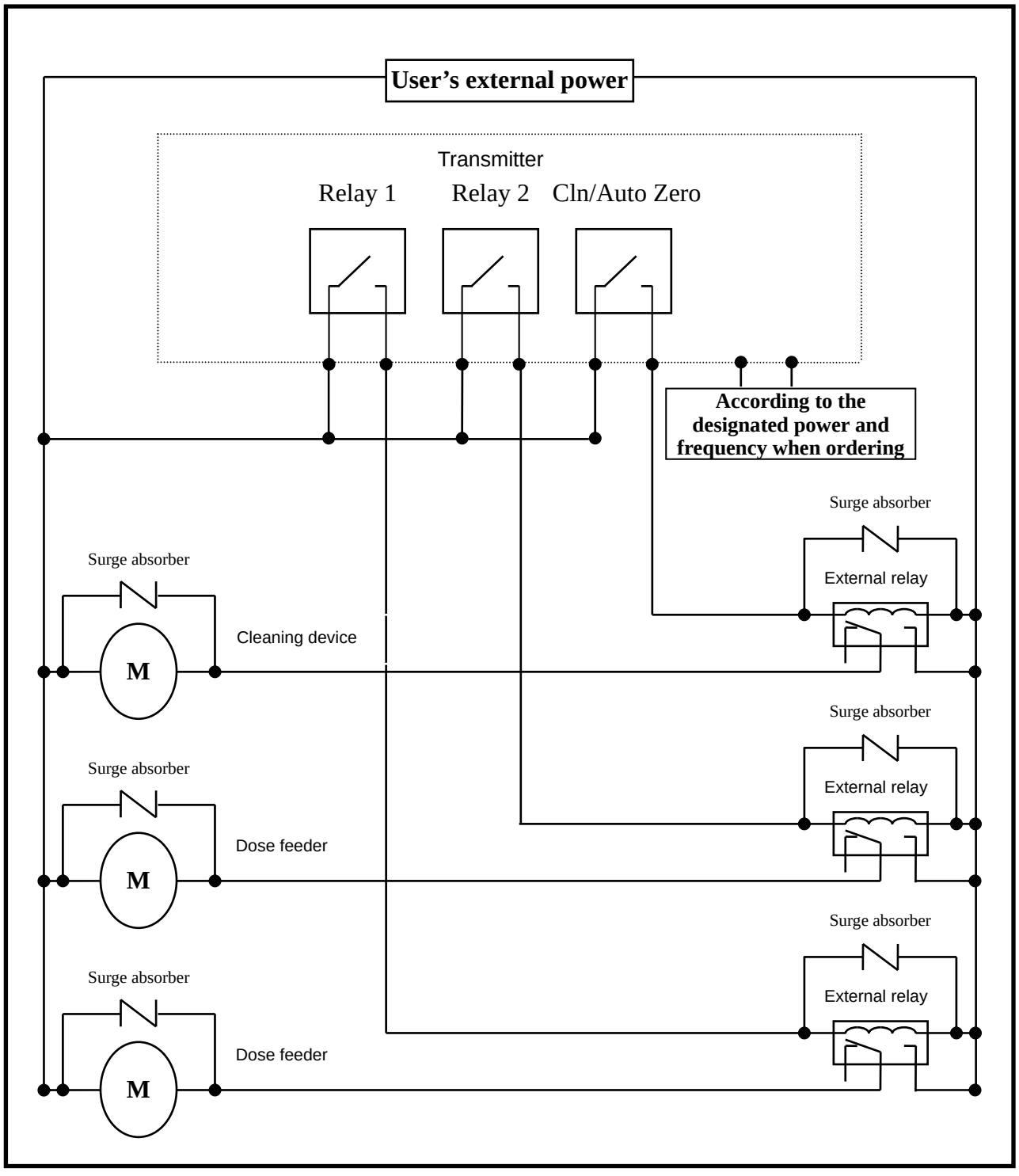
21 — **4~20mA – terminal:** Master measurement(Free Cl_2/pH selectable) current output terminal -, for external recorder or PLC control

22 — **D+(B):** RS-485 output D+(B)

23 — **G:** RS-485 output GND

24 — **D- (A) :** RS-485 output D-(A)

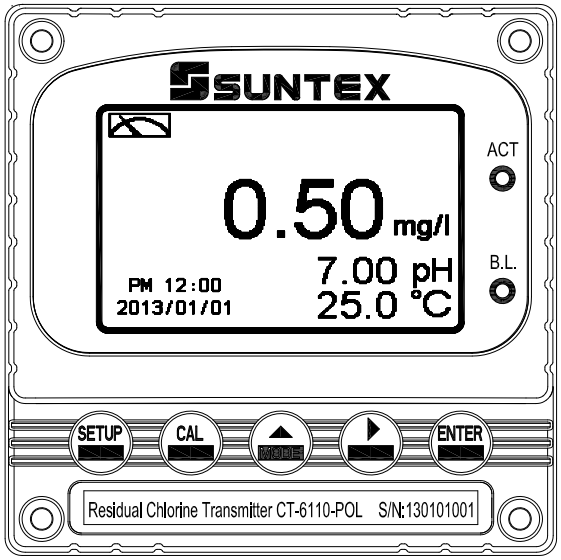
3.4 Illustration of electrical connection



Note: The transmitter built-in miniature relays is necessary to be repaired and replaced by professional technicians. It is recommended to use an external relay (Power Relay) to activate the external equipments.

4. Configuration

4.1 Illustration of front panel



4.2 Keypad

In order to prevent inappropriate operation by others, before the parameter setting and calibration, the operation applies multi-keys, and coding protection if necessary. Description of the key functions is in the following:

SETUP：In the parameter set-up mode, pressing this key allows you exit parameter set-up mode and back to Measurement mode.

CAL : In the Calibration mode, pressing this key allows you exit Calibration mode and back to Measurement mode.

MODE：1. In the parameter set-up mode and Calibration mode, pressing this key to select leftward or change to another page.

2. When adjusting value, press this key to increase the value.

：1. In the parameter set-up mode and Calibration mode, pressing this key to select rightward or change to another page.

2. When adjusting value, press this key to decrease the value.

ENTER：Key for confirmation; pressing this key is essential when modifying data value or selecting the parameter setting items in the window.

4.3 LED indicators:

ACT: Clean or auto zero device operation indicator and dosing control relay operation indicator (Relay 1, Relay 2)**.**

B.L. : Light sensor; in the automatic display backlit mode, the lamp will light or go out as the change of environmental brightness.

5. Operation

5.1 Measurement mode:

After all electrical connections are finished and tested, connect the instrument to the power supply and turn it on. The transmitter will automatically entering measurement mode with the factory default settings or the last settings from user.

For first operation or long period motor suspension, it is necessary to let the instrument continuously operate at least one hour before execution when powering on. It makes the electrode be fully polished by the ceramic beads to ensure the accuracy and stability of the residual chlorine measurement reading.

5.2 Set-up menu:

Please refer to the set-up instructions in Chapter 7. Press SETUP and MODE simultaneously to enter into set-up menu, and press SETUP to go press to back to measurement mode.

5.3 Calibration menu:

Please refer to the calibration instructions in Chapter 8. Press CAL and MODE simultaneously to enter into calibration menu, and press CAL to go back to measurement mode.

5.4 Shortcuts:

1. In the measurement mode, if selecting MTC for temperature compensation mode, you may press MODE and ▶ to adjust MTC temperature value.
2. Under measurement mode, press SETUP continuously for 2 seconds to see the Logbook function directly. Press SETUP key to back to measurement mode.
3. Under measurement mode, press ENTER continuously for 2 seconds to switch the display mode from text mode, trace mode, and real-time chart display mode.

5.5 Default value:

5.5.1 Setting default value:

Measurement display mode: Normal mode(Text & numeral display)
Span calibration: None
Polar. Volt: Initial volt = -100 mV, Gain= -10mV/μA
Polarogram: Starting volt = 0 mV, Finishing volt = -500 mV, Scanning speed = -50 mV/sec,
Max. current display value = 10μA, Min. current display value = -5μA
pH function: OFF
Temperature compensation: ATC
Motor: Auto, Detect ON
Relay 1: Free Cl_2, High point alarm: AUTO, SP1= 1.00 mg/l, Hys.=0.20 mg/l
Relay 2: Free Cl_2, Low point alarm: AUTO, SP2 = 0.30mg/l, Hys.= 0.20 mg/l
Cln/Auto Zero: Clean, OFF
Analog current output: Free Cl_2, 4~20 mA, 0.00~3.00mg/l
Date & Time: 2013/1/1 00:00:00
RS-485: RTU, 19200, Even, 1, ID: 001
Digital filter: 20
Backlight setting: OFF
Contrast: 0
Logbook: None
Auto return: Auto, 3 minutes
Code set-up: Off

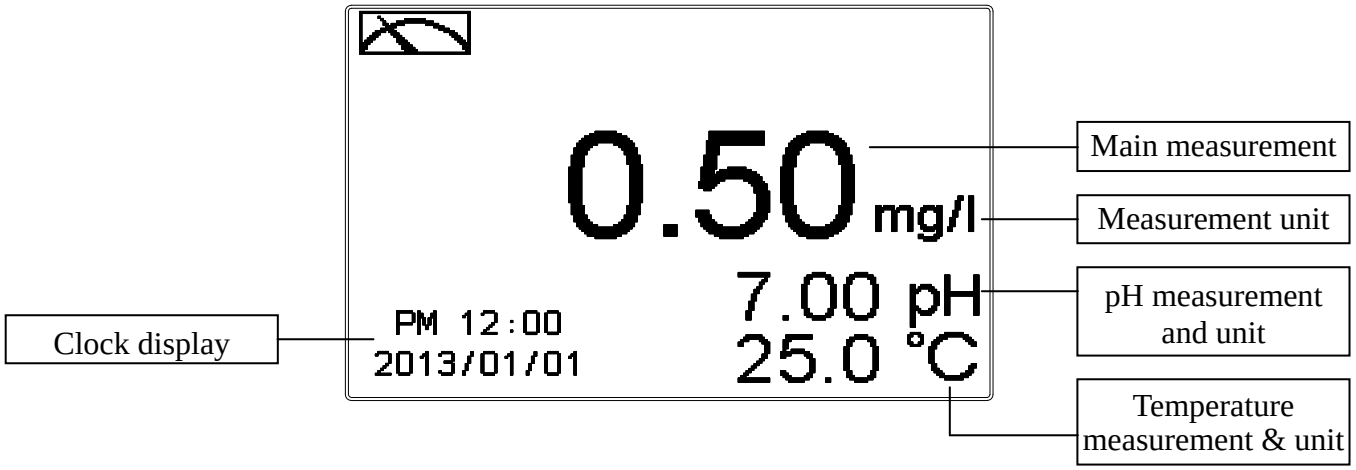
5.5.2 Calibration default value:

Free Cl_2 zero: Less than 0.1μA under normal condition
Free Cl_2 slope: 100%
Motor: Auto
pH Asy: 0mV
pH slope: -59.12 mV/pH @ 25.0˚C
Calibration mode: TECH-No Cal
Auto return: Auto, 3 minutes
Code set-up: Off

6. Measurement display mode

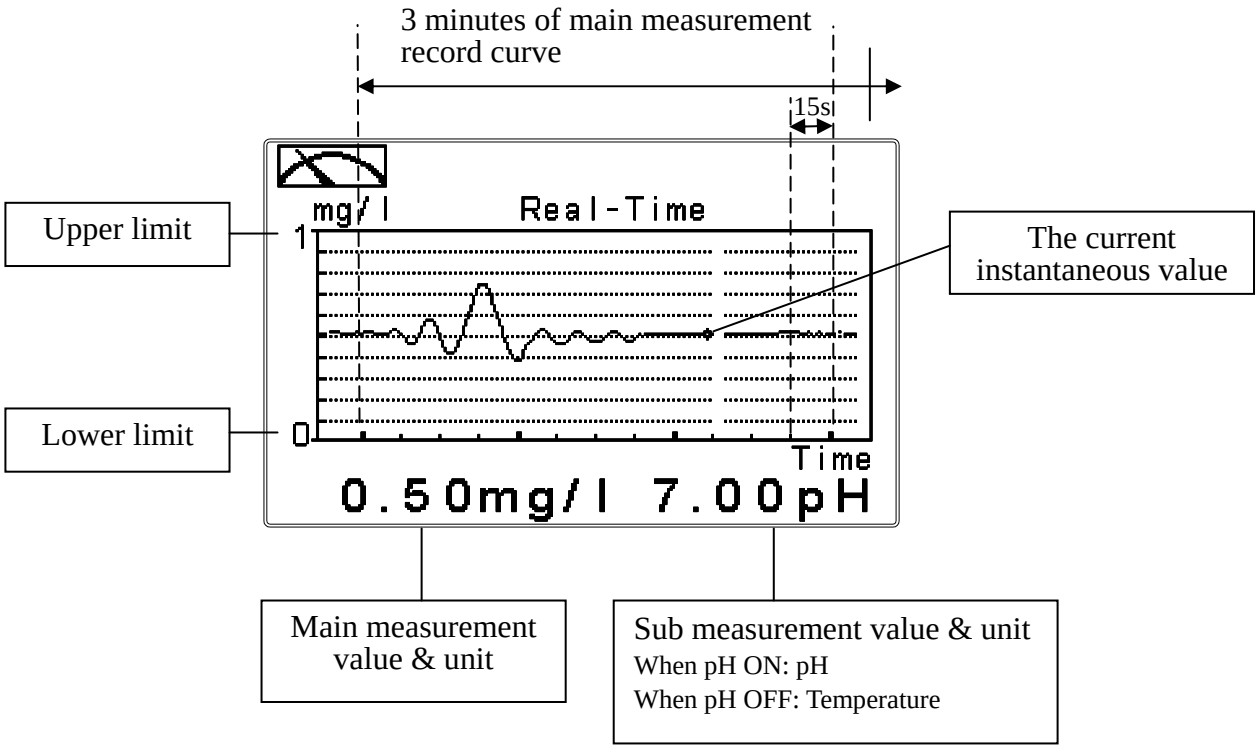
6.1 Text mode

The normal mode is for digit display, the content is as the following illustration. It mainly includes main measurement value and unit, temperature measurement value and unit, temperature compensation mode, and clock display.



6.2 Real-Time Chart mode

Real-time chart mode is for dynamic display of real-time graphics. The duration is about three minutes of the recent changes in measured values of the curve. Users can set the mode to its corresponding Free Cl_2 measuring range (see section 7.4). The smaller the range is set, the higher resolution of the display is. When entering setup or calibration mode and returning to measurement mode, the real-time graphic will be re-updated. When the measured value exceeds a set range of the upper and lower limit, the graphics will be presented in the upper and lower limits dotted line. Real-time chart mode display is shown as below. There are also real-time measurement value, & unit, and temperature value & unit which are displayed in the bottom of the screen. The timeline in real-time graphic is divided into 12 depict, which is describe the range of representatives of each of 1 / 4 minutes (15 seconds).

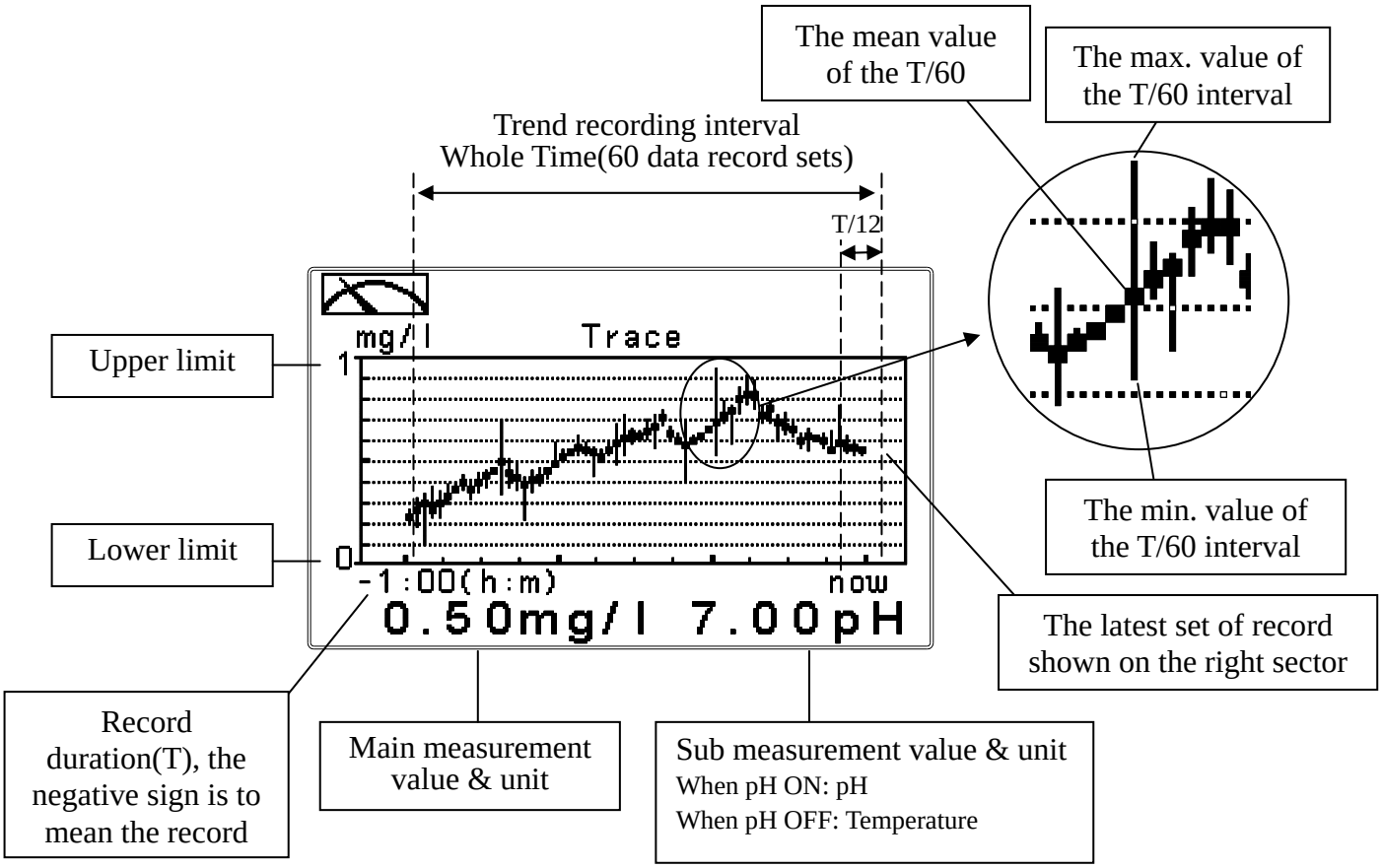


6.3 Trace mode

The feature of the trace mode is the record duration which can be set by the user (range from three minutes, up to four weeks). The trend graphic records the measurements in the past T time. The trend is recorded by the 60 group structure. Hence, each group of units is recorded in T/60 time interval. The trend line is constructed by all value data which is calculated to the average (Mean Value), maximum (Max Value) and minimum (Min Value) form. When the latest T/60 record shows in the rightmost of the trend graphic, all the previous record will be moved to the left side of the graphic. For example, T is set to 60 hours, then each set of records will be calculated to the average, the maximum, the minimum values after one hour(T/60 = 1), each time interval. Timeline of trends which is divided into 12 depictions showed on the horizontal axis of the display is on behalf of each characterization interval T/12. So, every depiction has 5 (T/60) sets of records. Users can set the corresponding Free Cl_2 measuring range in its set-up menu(see section 7.4). The smaller the range is set, the higher resolution of the display is. The trace mode is shown as below. There are also real-time measurement value, & unit, and temperature value & unit which are displayed in the bottom of the screen.

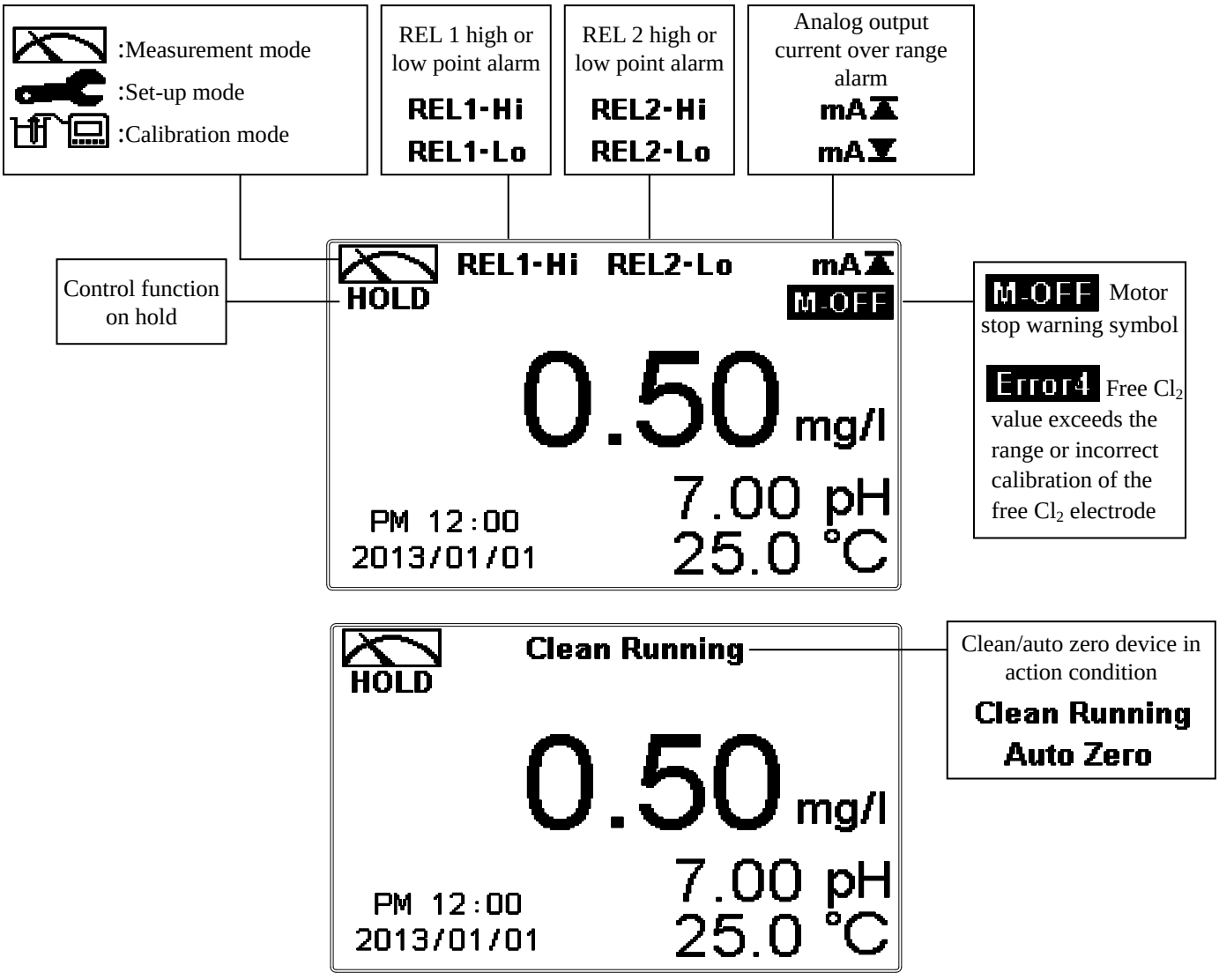
Attention: When the time interval has been reset, the trend in the data will not be retained, it will start a new trace record.

Note: The time display format (XX: XX) (hr: min), for example, appear as four weeks (672:00).



6.4 Warning symbols and text

1. When the clean/auto zero function is activated, the display shows and twinkles the description, “Clean Running/Auto Zero”. At the same time, the ACT indicator LED lights up, and the transmitter automatically turns off Relay 1 and Relay 2 function. After finishing cleaning/auto zero, the Relay 1 and Relay 2 will automatically back to normal status.
2. When Relay 1/Relay 2 which is set in high setting point is in action, the display shows and twinkles the description, “REL 1-HI/REL 2-HI”, and ACT indicator LED lights up. When Relay 1/Relay 2 which is set in low setting point is in action, the display shows and twinkles the description, “REL 1-Lo/ REL 2-Lo”, and ACT indicator LED lights up.
3. When the Analog current output exceeds the upper/lower limitation, the display twinkles ” mA▲/ mA▼.”
4. When the motor stops operation, the display will show and highlight “M-OFF” symbol.

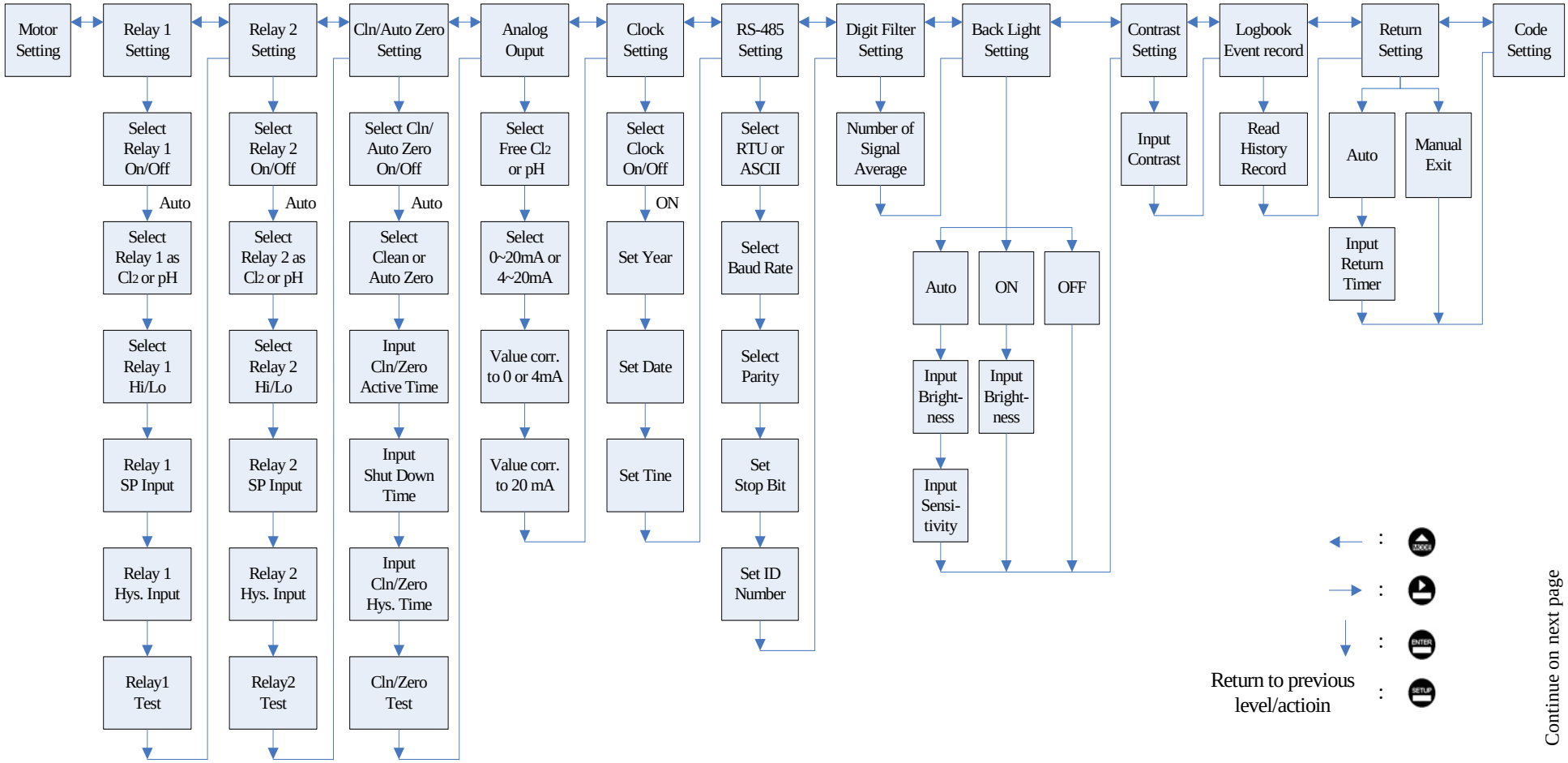


Note: The “HOLD” warning text appears when clean/auto zero function is activated, or when entering setup menu, or when entering calibration menu. Under HOLD status, the corresponding display and output as follows:

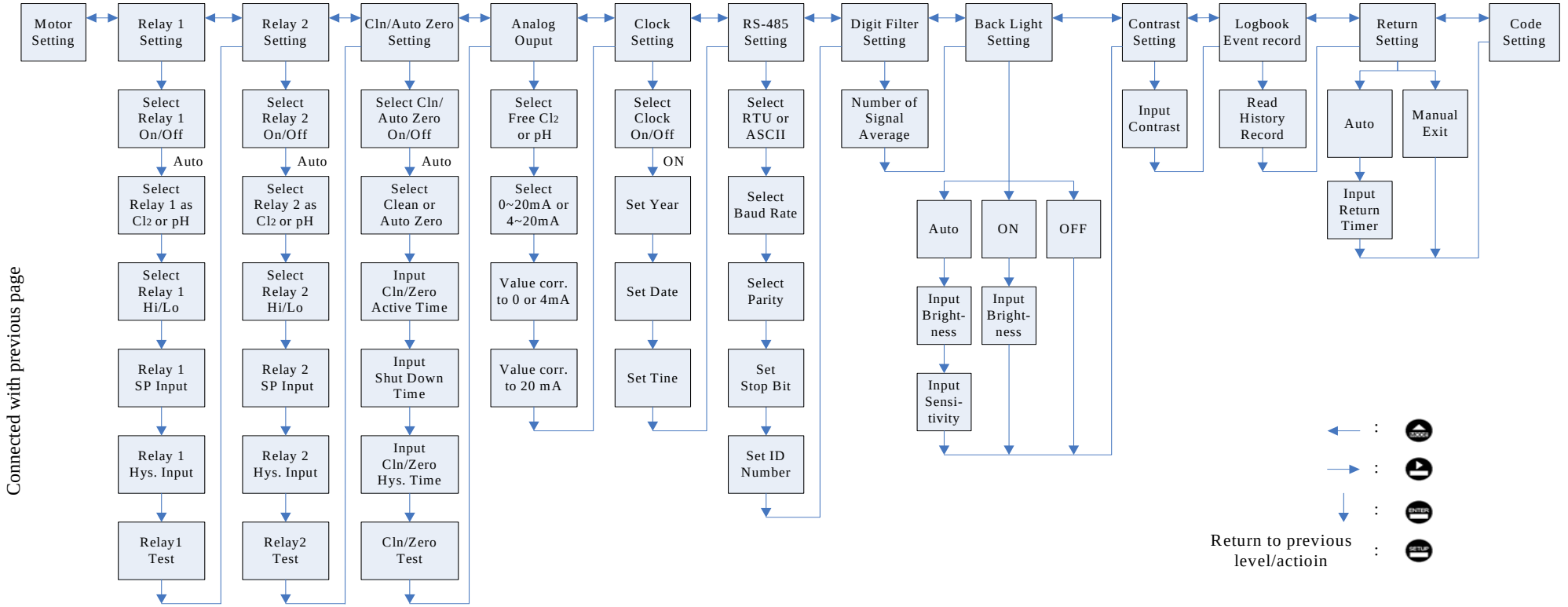
1. Both Relay 1 and Relay 2 cease from action. If enter setting menu or calibration menu under clean status, the instrument will stop clean status automatically.
2. The current output which is corresponding to measurement value remains at the last output value before HOLD status.

7. Settings

Block diagram of setting-part 1

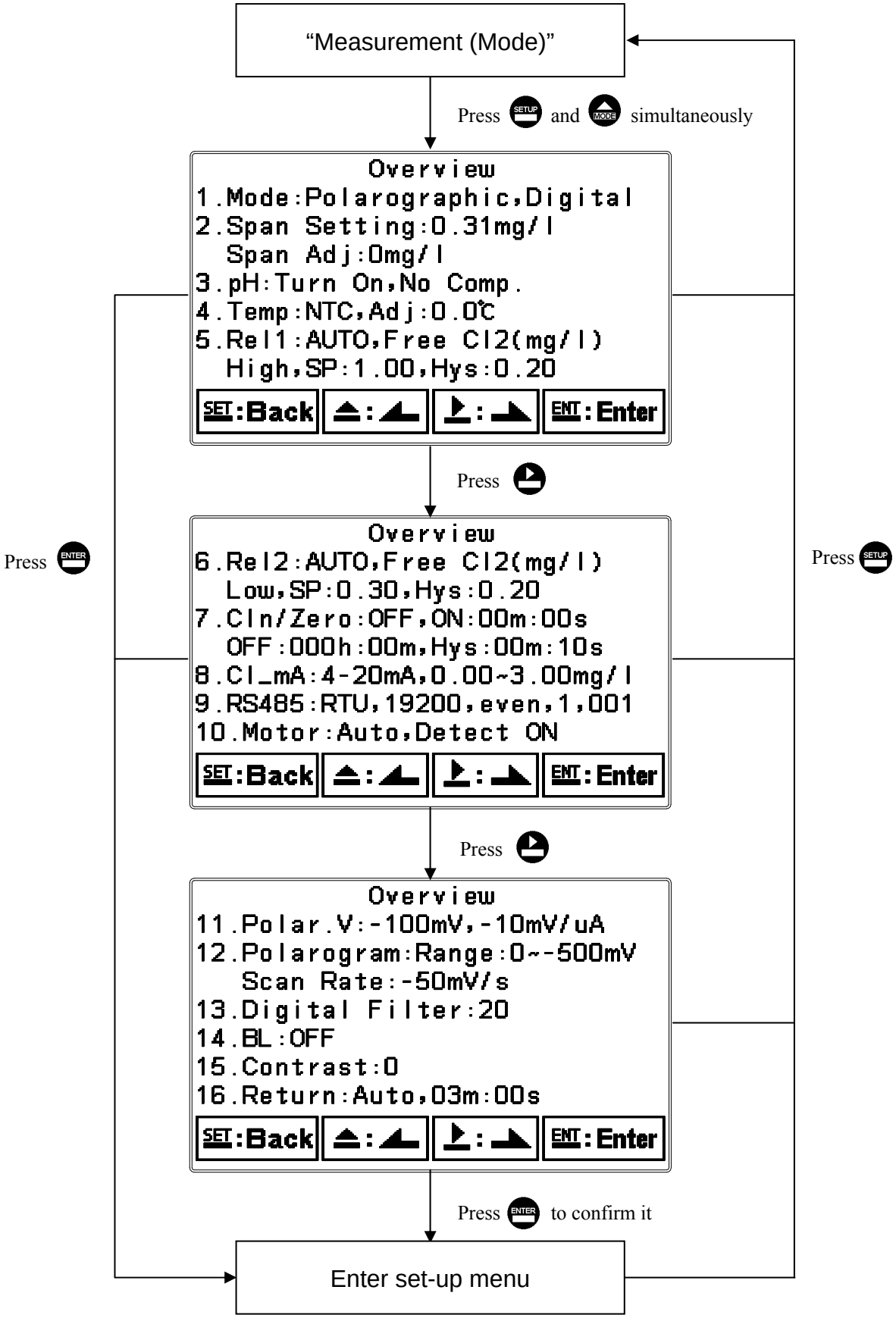


Block diagram of setting-part 2



7.1 Entry of set-up menu

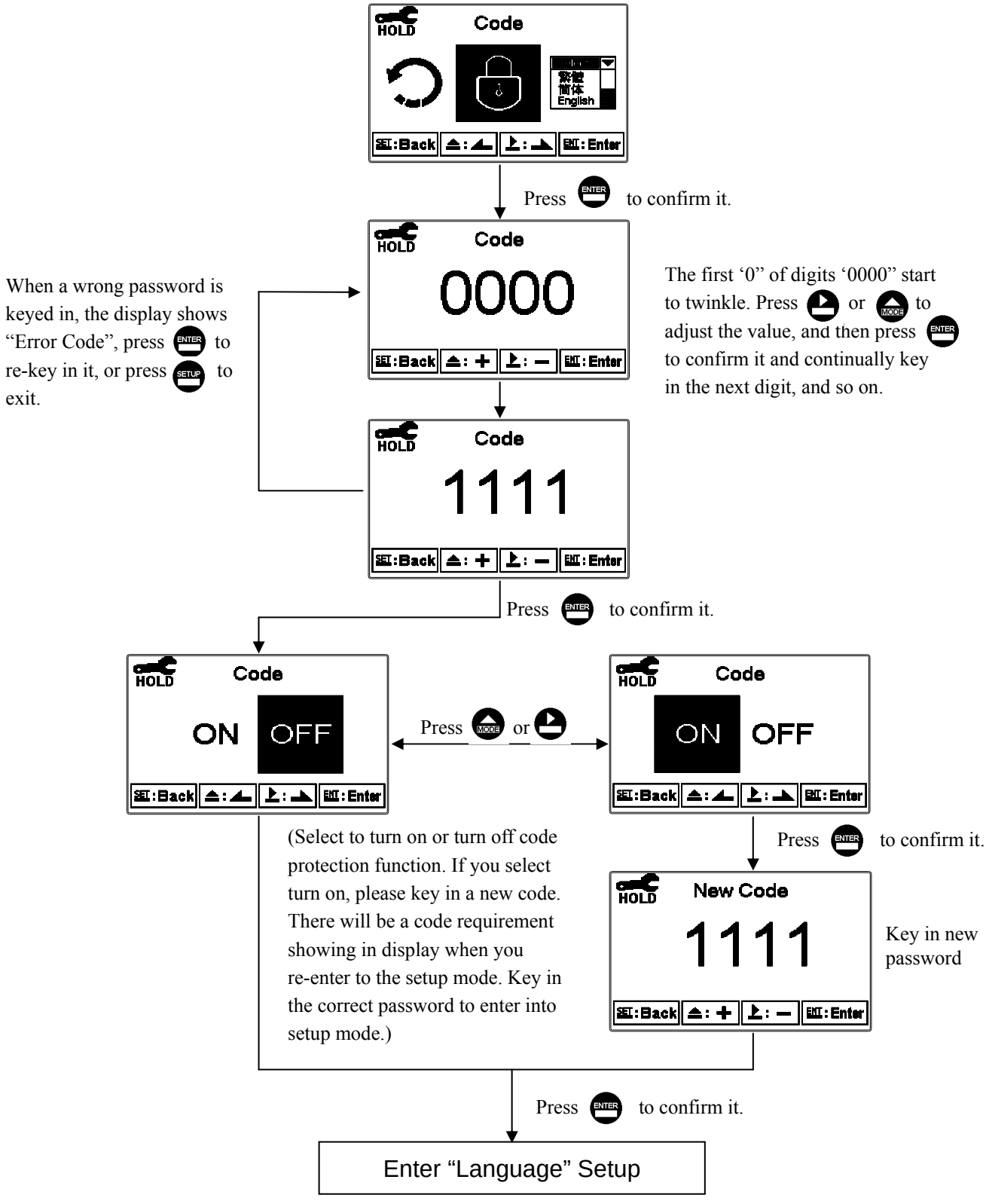
In the measurement mode, pressing the two keys SETUP and MODE simultaneously allows you enter the overview of current setting, and press ENTER to enter the set-up mode to modify the setting if necessary.



7.2 Security code of settings

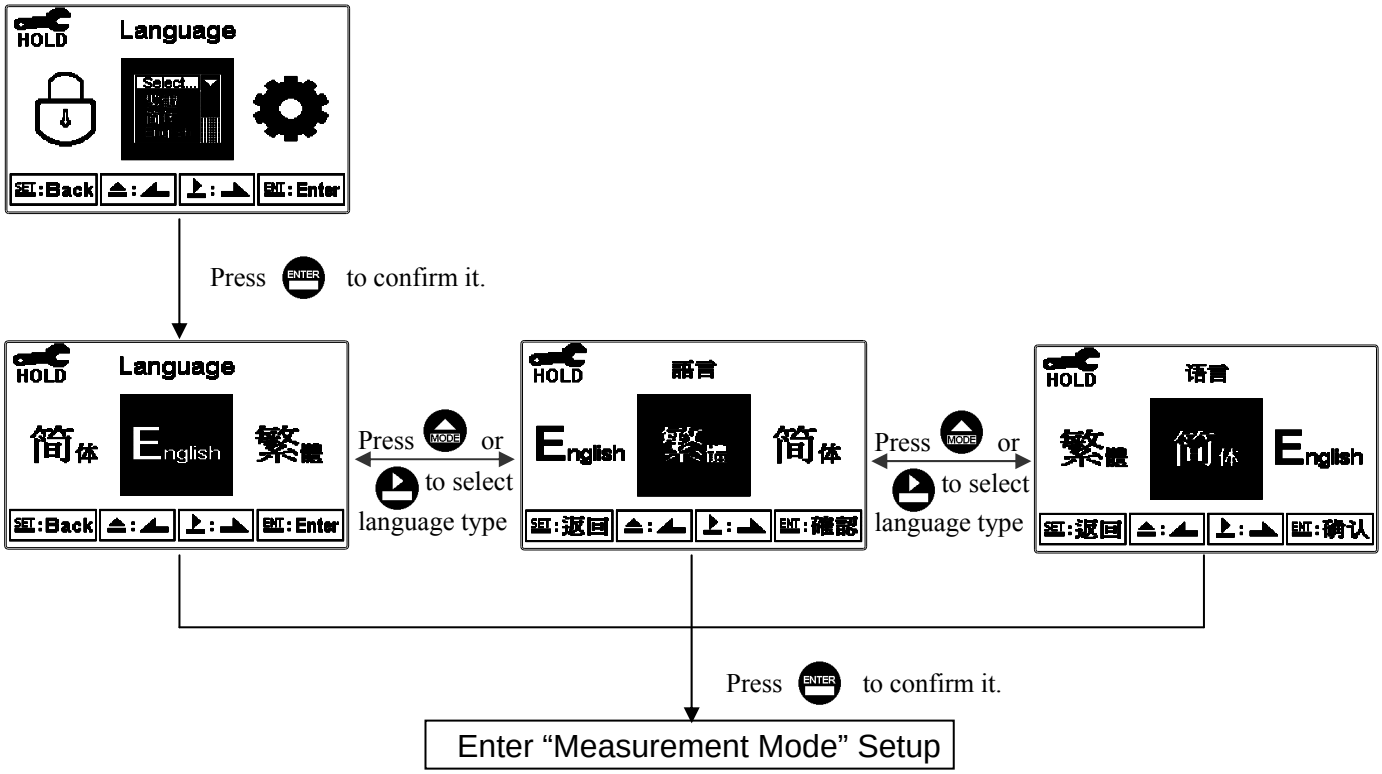
After entering set-up mode, select “code” item, press ENTER to enter into code procedure. **The code pre-setting is 1111.**

Note: The code of setting mode is prior to the code for calibration. That means that the code of setting mode can be used for the code of calibration mode.



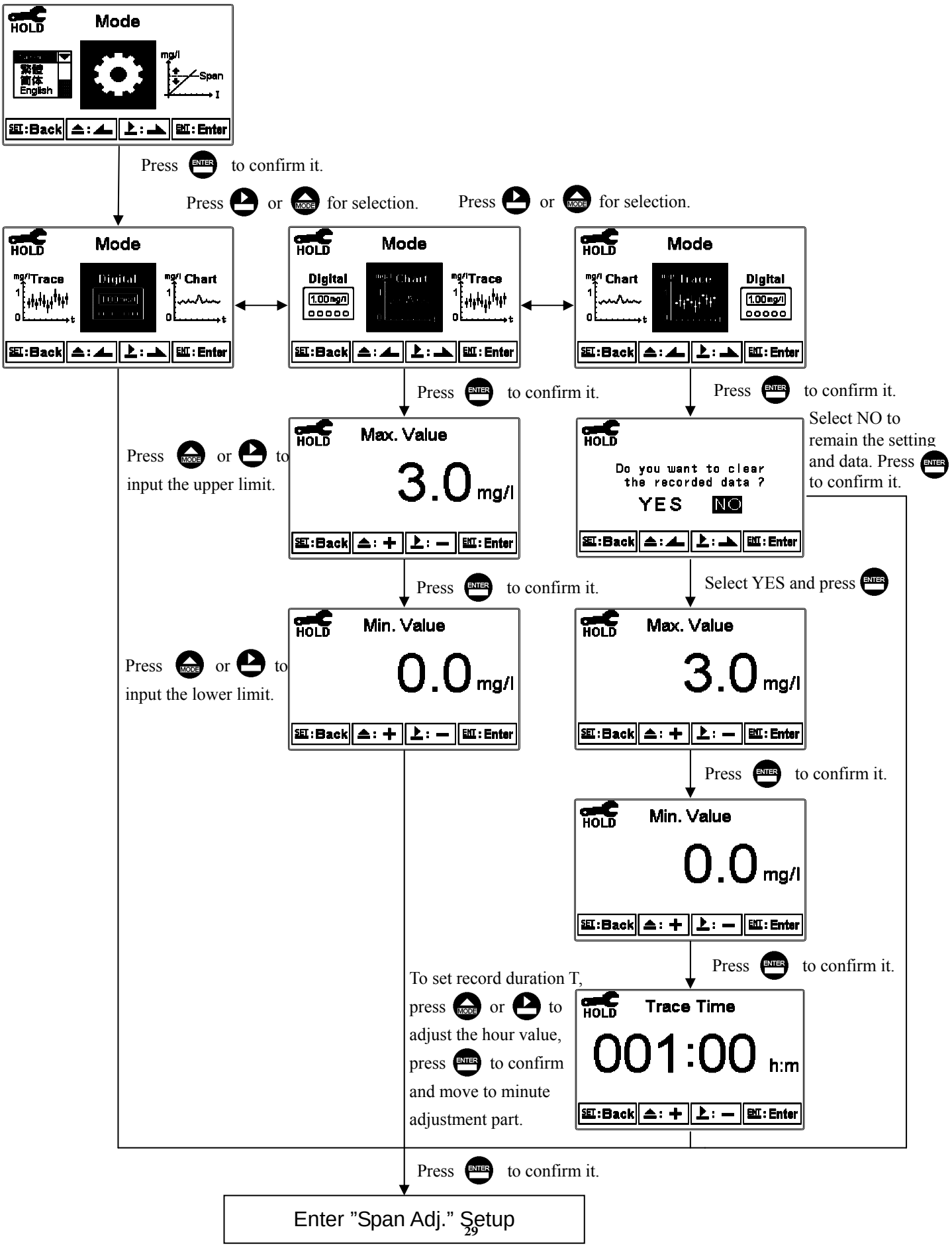
7.3 Language

Enter Language setup menu, select the system language from English, Traditional Chinese and Simplified Chinese.



7.4 Mode

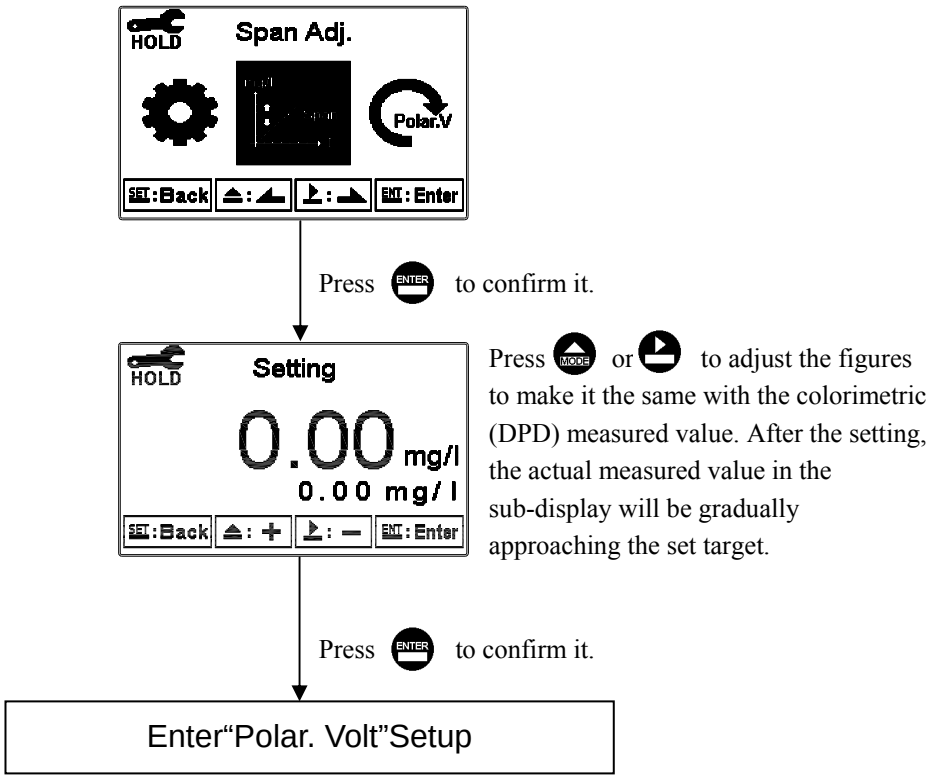
Enter setup of Mode, and select the display mode.



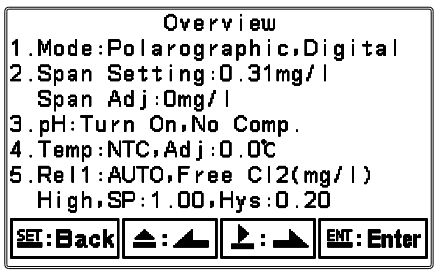
7.5 Span Adj.

Enter setup of span adjustment. Users can directly adjust span until the measurement value is the same with the colorimetric measurement value (DPD method). Span adjustment function and the span calibration in the calibration menu are the same function, but in the span adjustment function, the instrument will not make determination of both reading stability and electrode relative slope range.

Note: The concentration of sample for span adjustment is highly suggested greater than 0.2mg/l. (The span adjustment range has lower limit of 0.03mg/l.)



Note: After the span adjustment, the ”Overview of Setting” display will show the input value of span setting and the relative drifting(span adj.) of the last span calibration. It may help for electrode aging determination. See following illustration for an example.

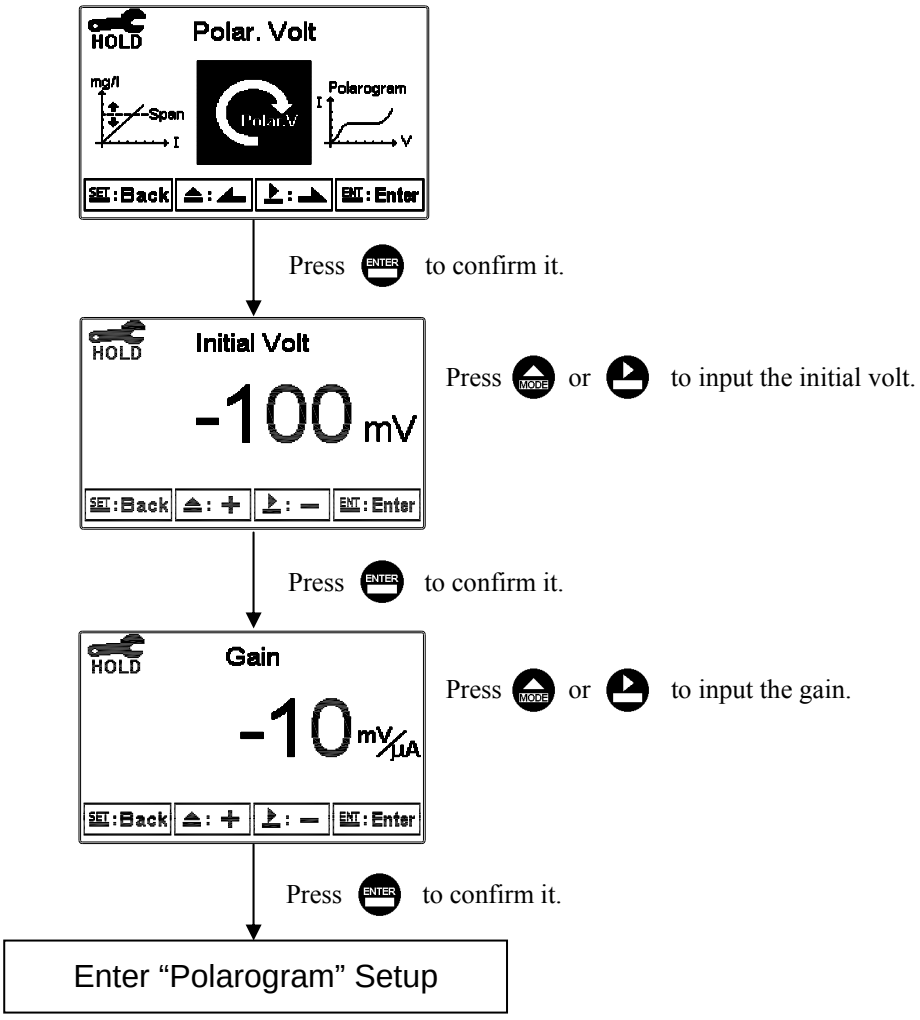


7.6 Polar. Volt

Enter setup of Polar. Volt. Set the initial volt and gain of polar. Volt. The initial volt setting can be referred to the polarogram setting(Please refer to ch7.7 Polarogram.) While the setting of a suitable gain value can compensate the initial volt. Normally, the pre-set initial volt and gain is applied for water sample measurement. When the concentration has changed, the instrument is able to search for the most suitable measurement volt to result in new concentration value.

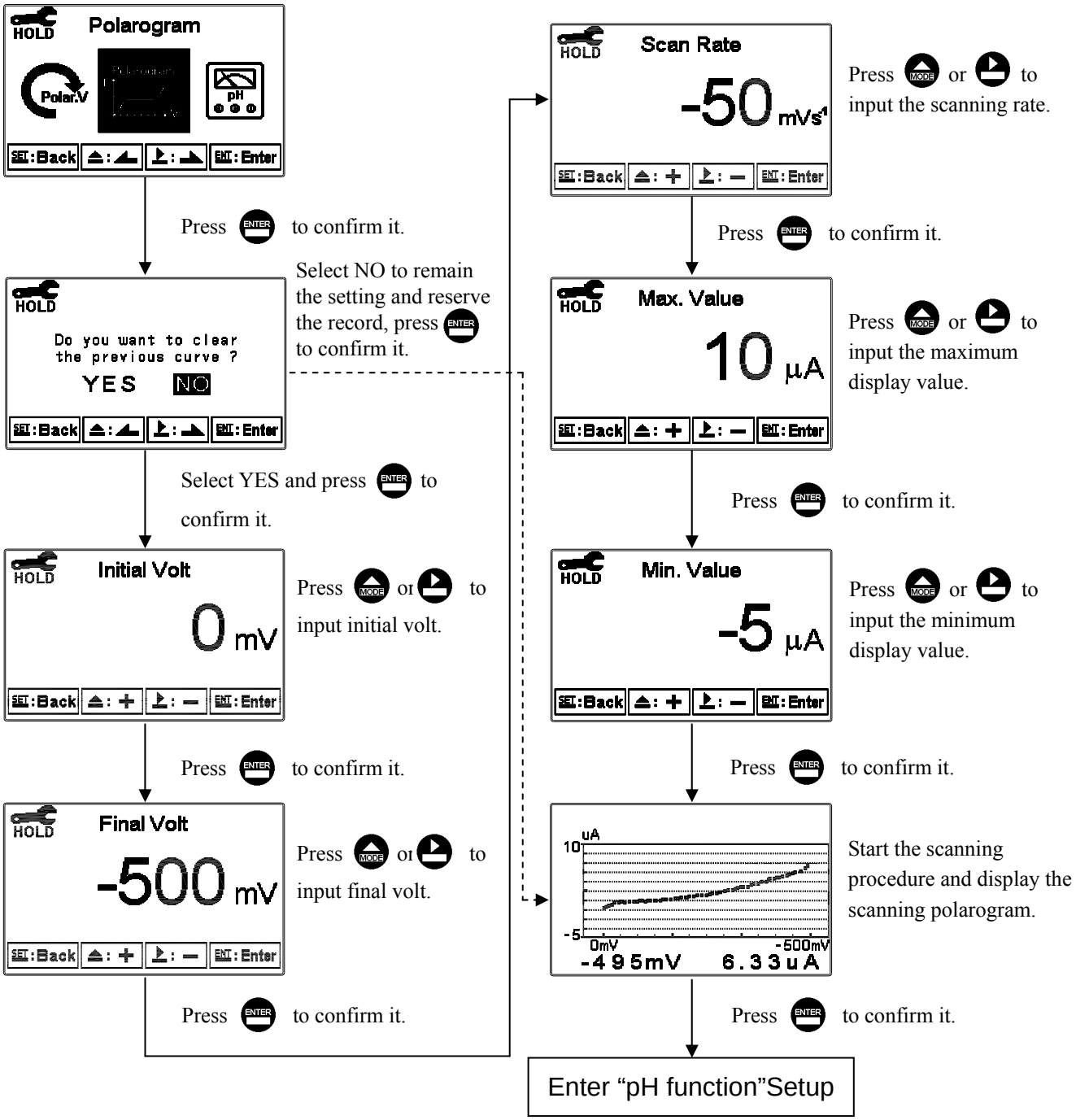
Note: The setting of gain is related to the conductivity of water sample. The following data is the suggesting setting value. When the gain is set as 0 mV/μA, it is suggested to apply polarogram function to determine the suitable polar. volt and to set the initial volt.

100~300 μS/cm： -20 mV/μA
300~500 μS/cm： -10 mV/μA (Pre-set value)
>500 μS/cm： 0 mV/μA



7.7 Polarogram

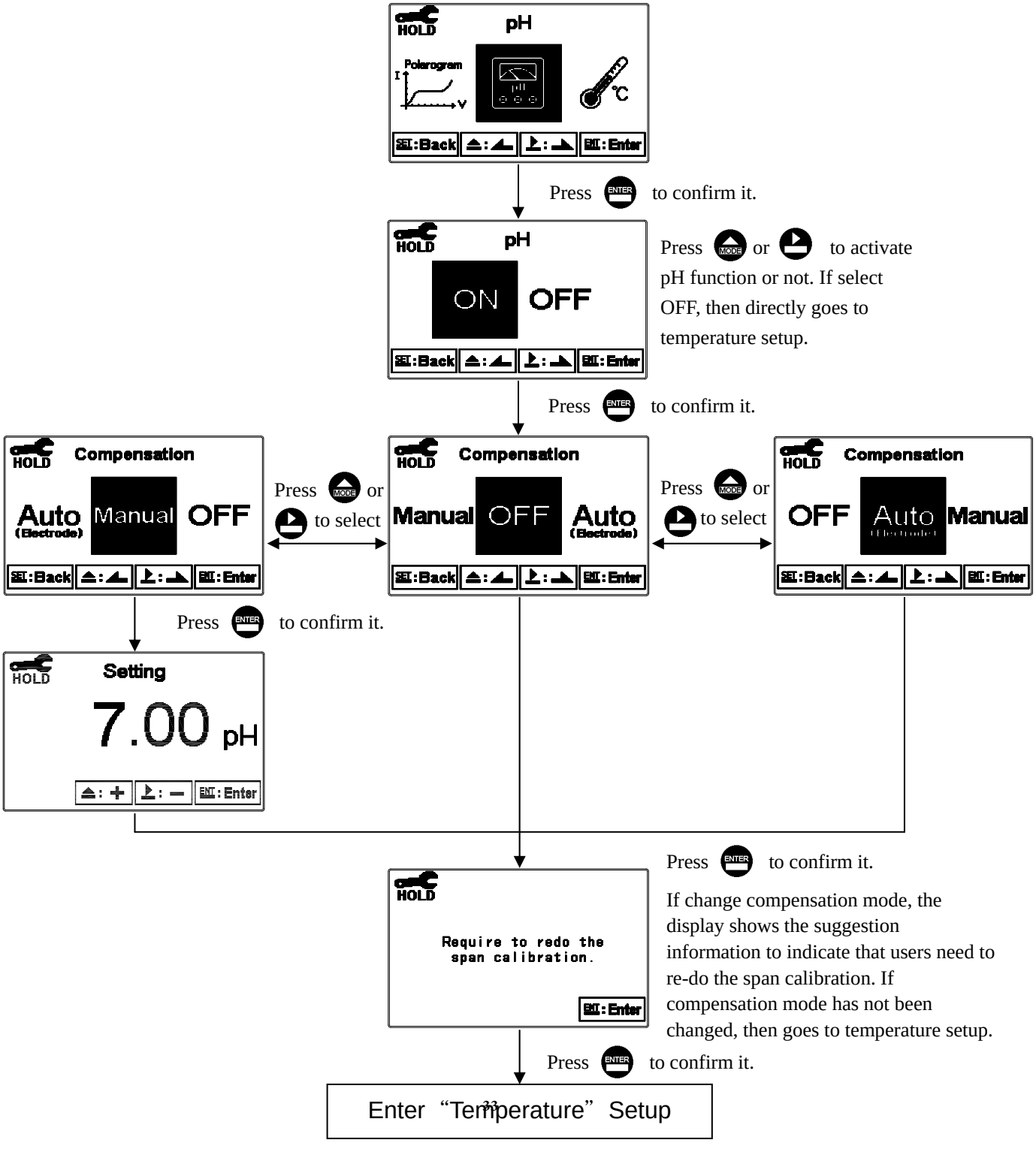
Enter setup of polarogram. Set the scan voltage of initial volt, final volt, scan rate, max. value and min. value of the diagram. After setting, it starts the scanning procedure and shows the scanning curve. Users may get the scanning voltage and current relationship from the polarogram. Select the voltage of stable current range(which means voltage change but little change in current range), and then set the voltage as initial volt in the transmitter's polar. volt setting (Please refer to ch7.6 Polar. Volt.).



7.8 pH function

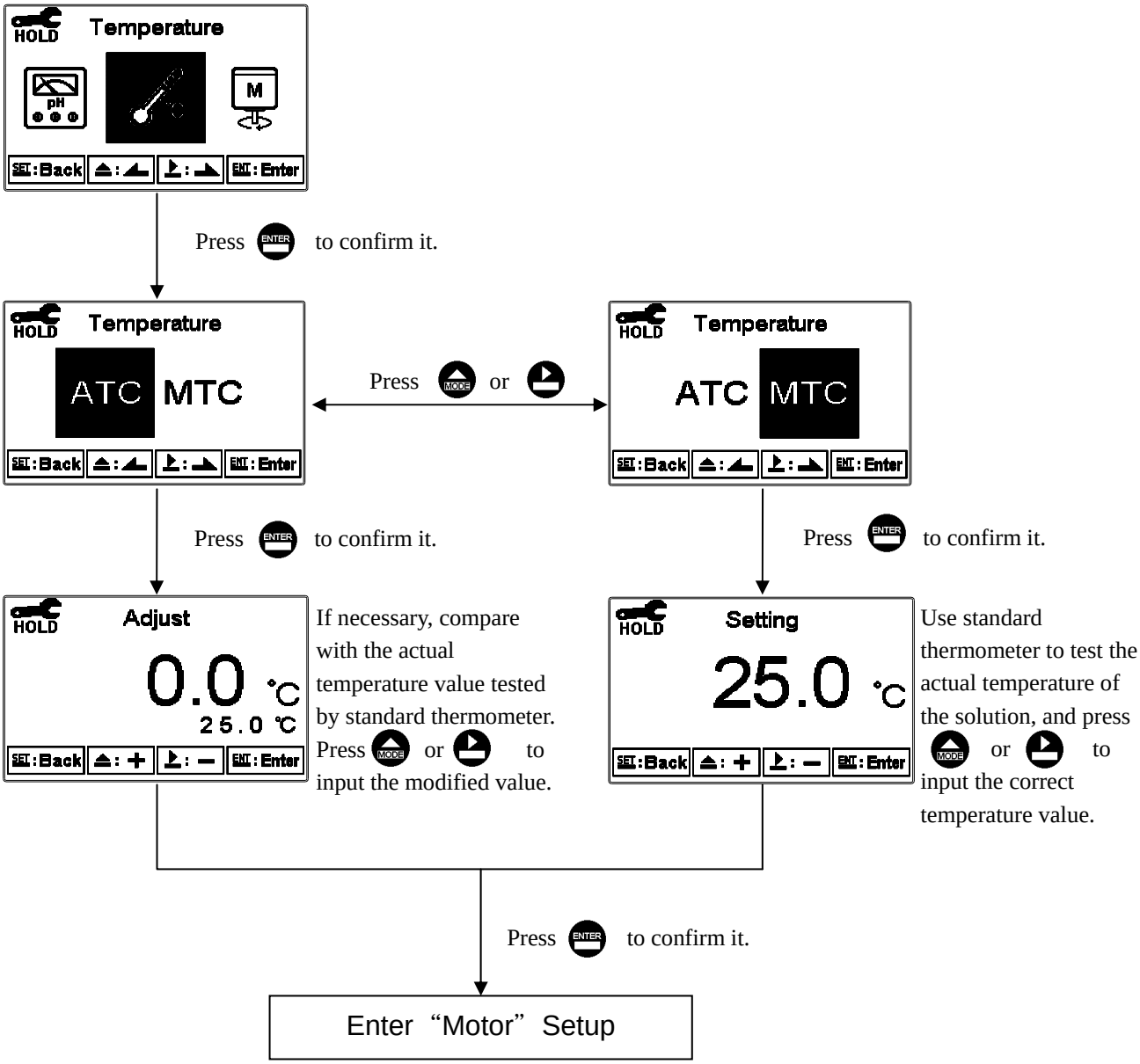
Enter setup of pH function. Select to turn on or turn off the pH function. If select turning on, then select the compensation mode of pH to residual chlorine measurement. Auto compensation mode(Auto) indicates that the instrument applying a pH electrode measuring the pH of the water and automatically compensates the impact of pH changes to the residual chlorine measurement. Manual compensation mode(Manual) indicates that the instrument does not apply a pH electrode's measurement but apply user setting pH value for compensating the impact of pH changes to the residual chlorine measurement. The "OFF" compensation mode indicates that although the instrument uses a pH electrode to measure the pH value of the water, the pH value only shows on the display yet not be applied to the compensation calculation of residual chlorine measurement. The pre-set pH function is OFF, and the pH compensation is turned off.

Note: When changing the compensation mode, it is necessary to re-do the electrode span calibration. When applying a pH electrode, the black wire of temperature probe must be connected to the rear terminal block no.15th (SG) of the transmitter, and thus to be as the Solution Ground function.



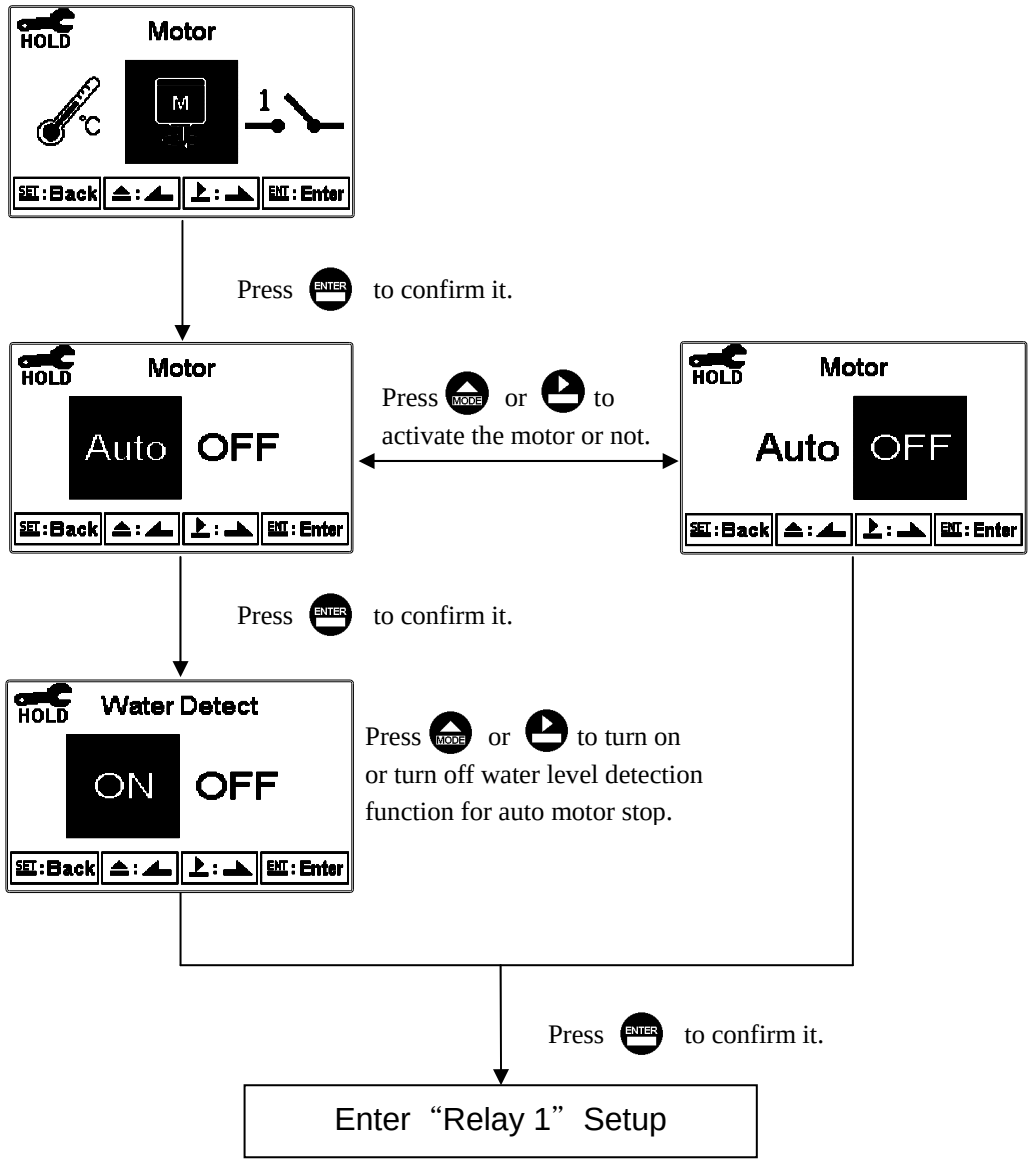
7.9 Temperature

Enter setup of “Temperature” to select temperature compensation mode. Select from ATC or MTC(Manual adjustment). The transmitter will automatically compensate the impact of temperature change for the residual chlorine measurement.



7.10 Motor

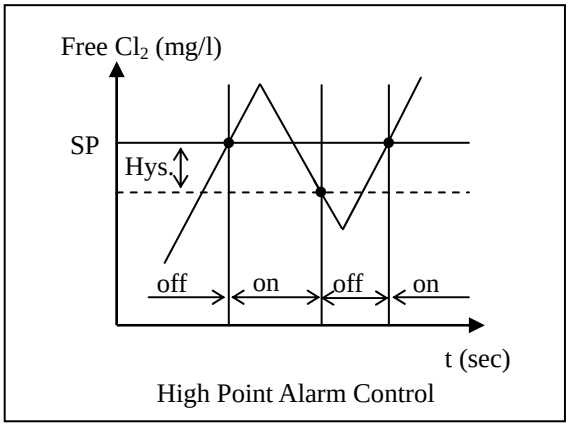
Enter setup of motor. Select to turn on or turn off the motor operation(can also be set in the calibration mode). Under measurement mode, the motor must be kept running. If the motor stop running, it will affect the correctness of chlorine measurement. At the time, there is a “M-OFF” warming symbol on the top right corner of the display. In addition, when the water level detection function is turned on, under measurement mode if electrode circuit open or water outage(the water level drop to the bottom of the silver electrode) happens, or if the measurement is kept constantly at near zero, then the instrument will judge it and stop the motor automatically after a certain of time. It prevents residual chlorine electrode continuously rub against without water sample and result to damage. It also shows “M-OFF” warning symbol on the top right corner of the display and goes into HOLD status. When turning off the water detection function, under measurement mode, regardless of the electrode circuit open, water outage, or constant zero measurement, the motor will keep running.



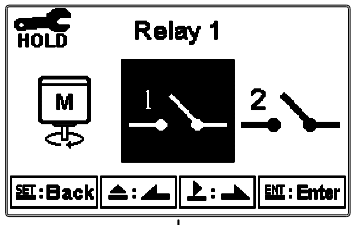
7.11 Relay 1

Enter setup of Relay 1. Select the item to turn on or turn off the relay 1 function. If you select to turn on the relay 1, then select for using relay 1 as Free Cl_2 or pH relay function, and then select “High set-point” alarm or “Low set-point” alarm. Set the value of set-point (SP) and Hysteresis (Hys.). The relationship between parameters can refer to an explanatory diagram of the box (as a high point alarm).

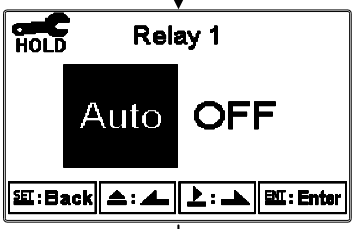
If select relay 1 as Free Cl_2 control, the procedure is as follow:



High Point Alarm Control

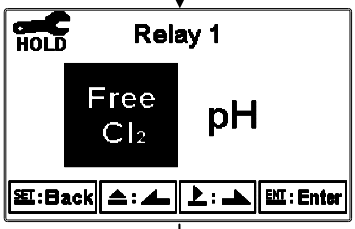


Press ENTER to confirm it.



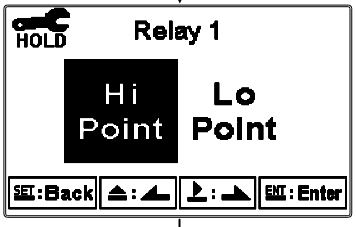
Press MODE or to select to activate REL1 or not. If not, the guide menu goes to setup of Relay 2.

Press ENTER to confirm it.



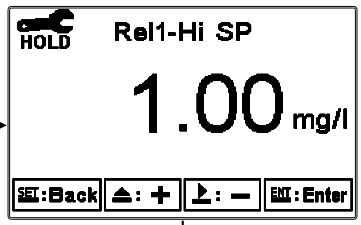
Press MODE or to select Relay 1 for Free Cl_2 measurement.

Press ENTER to confirm it.



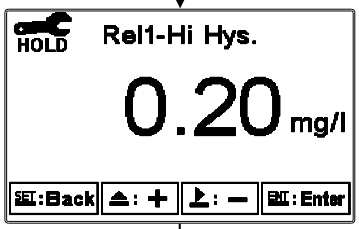
Press MODE or to select use REL1 as Hi point or Lo point alarm.

Press ENTER to confirm it.



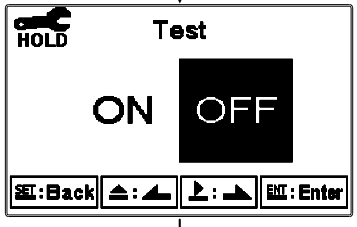
Press MODE or to adjust set-point (SP) value

Press ENTER to confirm it.



Press MODE or to adjust Hysteresis (Hys.) value

Press ENTER to confirm it.

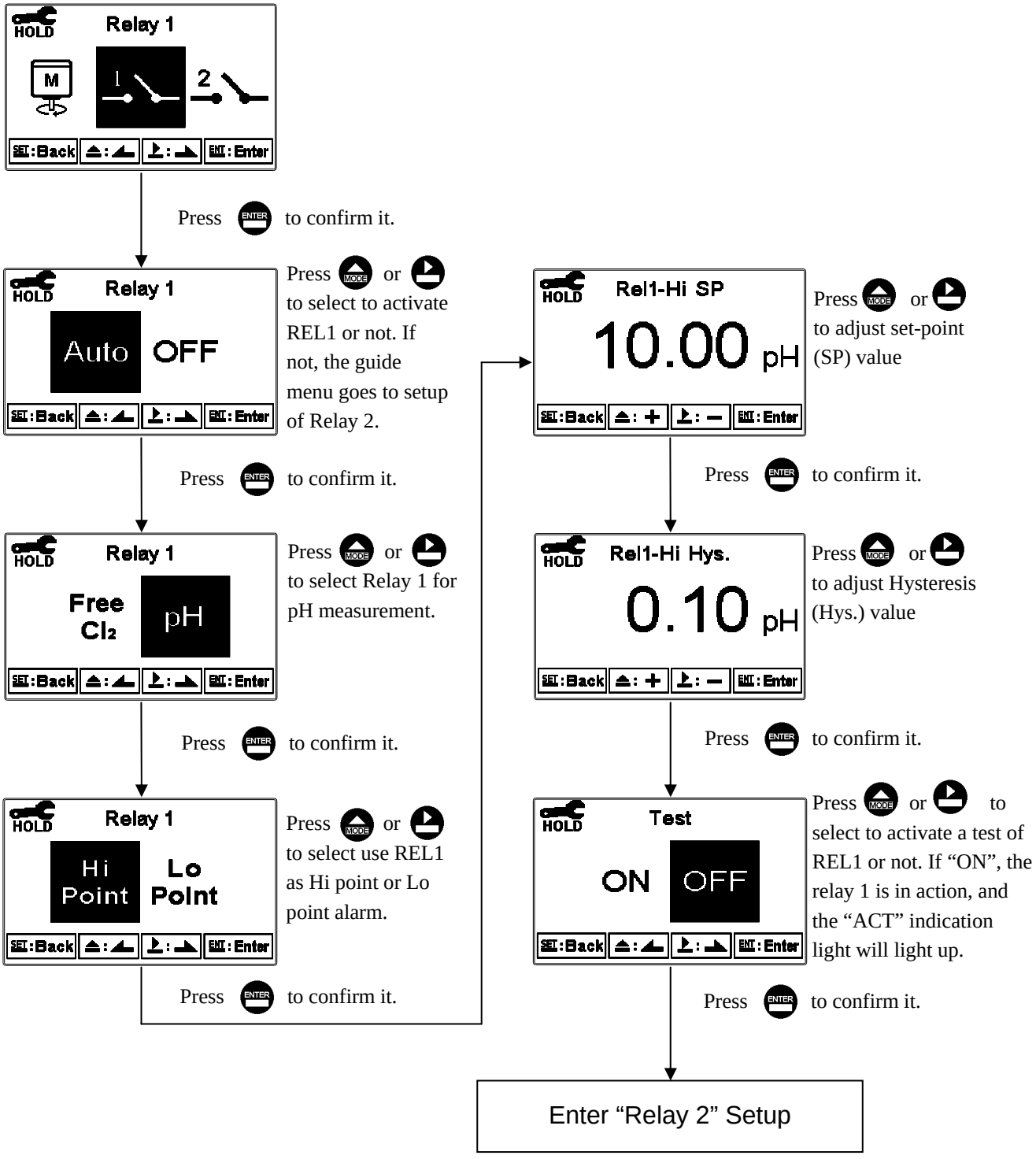


Press MODE or to select to activate a test of REL1 or not. If “ON”, the relay 1 is in action, and the “ACT” indication light will light up.

Press ENTER to confirm it.

Enter “Relay 2” Setup

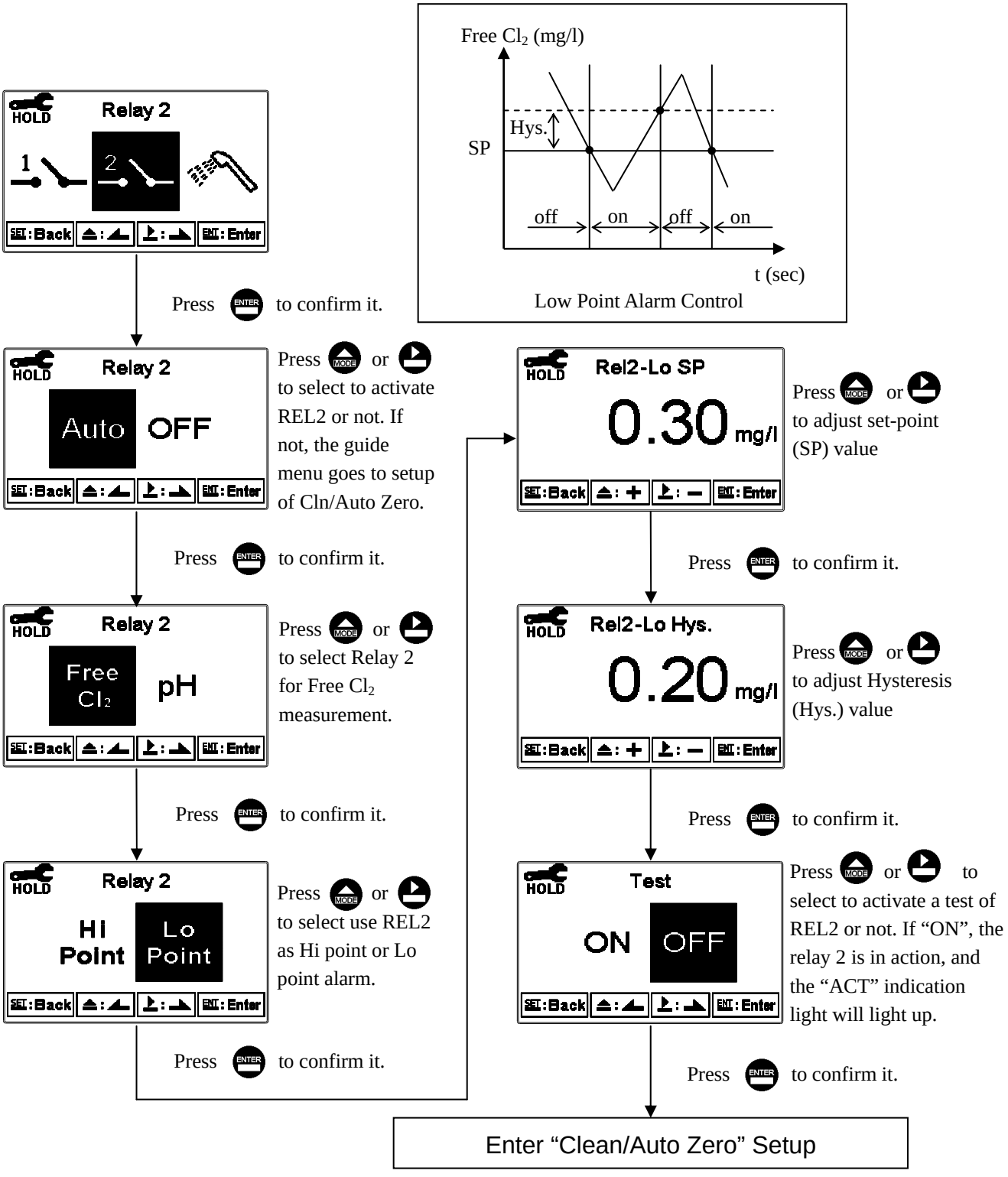
If select relay 1 as pH control, the procedure is as follow:



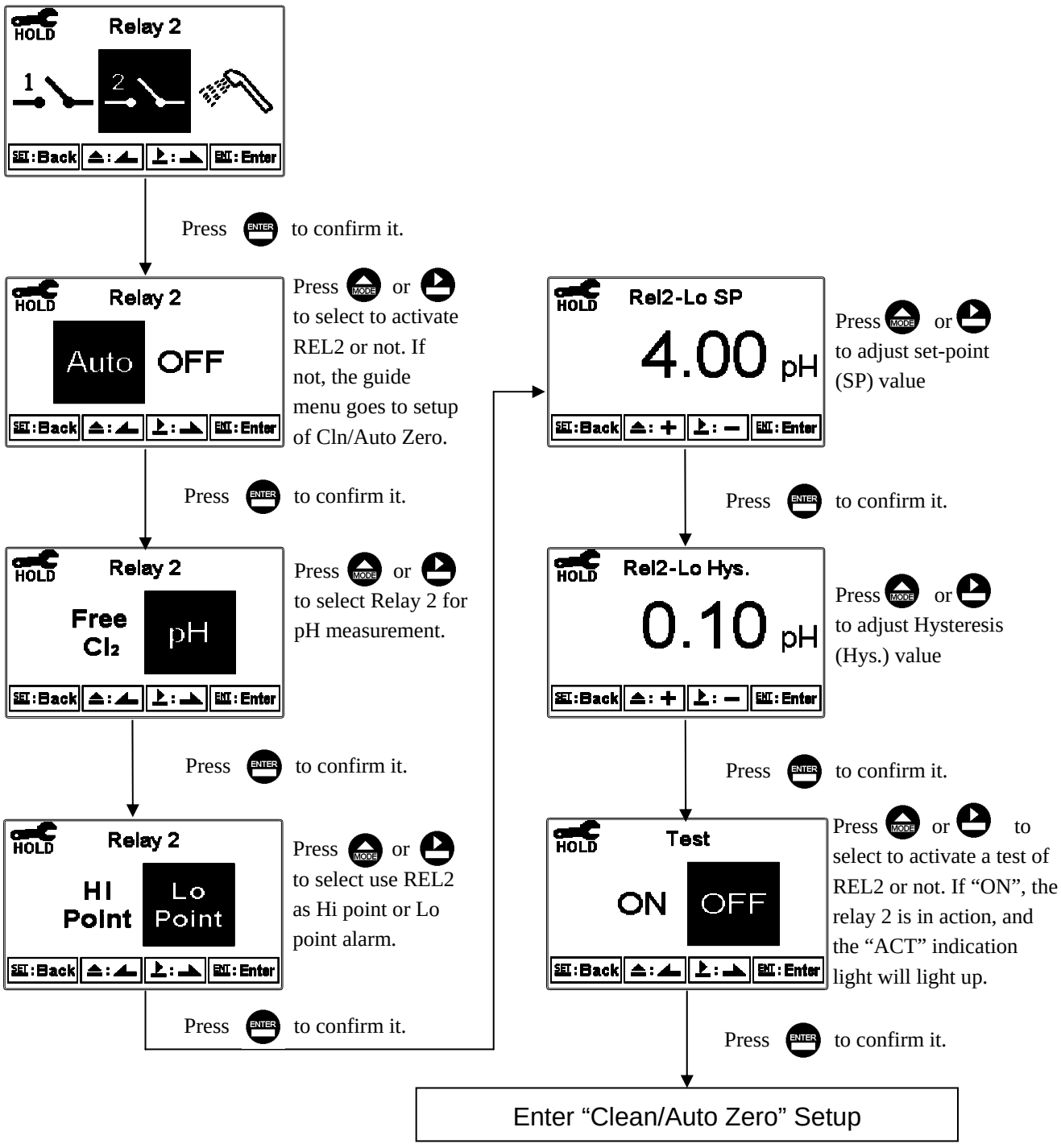
7.12 Relay 2

Enter setup of Relay 2. Select the item to turn on or turn off the relay 2 function. If you select to turn on the relay 1, then select for using relay 1 as Free Cl_2 or pH relay function, and then select “High set-point” alarm or “Low set-point” alarm. Set the value of set-point (SP) and Hysteresis (Hys.). The relationship between parameters can refer to an explanatory diagram of the box (as a high point alarm).

If select relay 2 as Free Cl_2 control, the procedure is as follow:



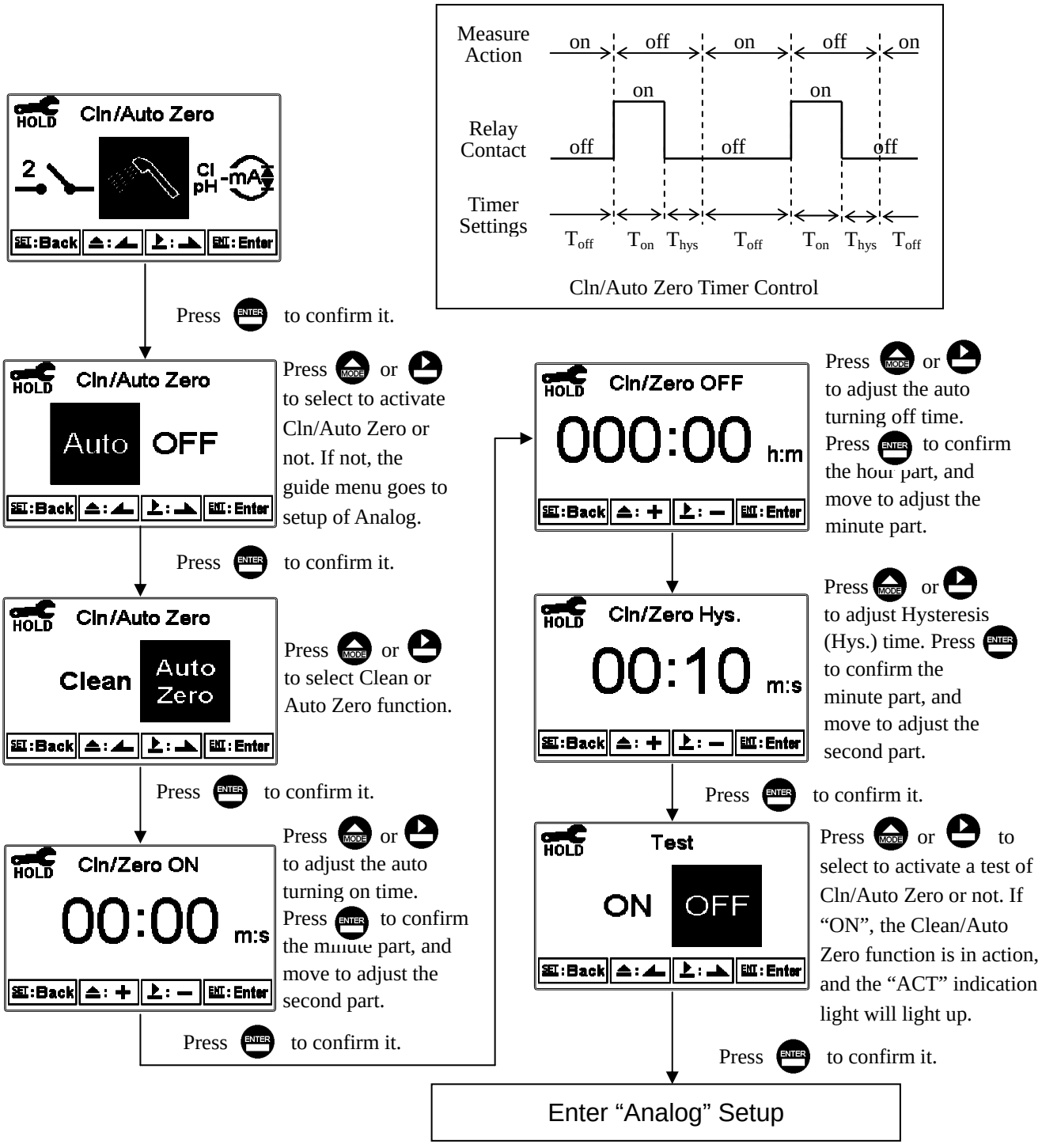
If select relay 2 as pH control, the procedure is as follow:



7.13 Clean/Auto Zero

Enter setup of “Clean/Auto Zero” function. Select the icon to turn on or turn off the clean function. If you select “Auto” turning on, then set as clean or auto zero function, and then set timer of the clean/auto zero function including automatically turning on timer and turning off timer, and set the Hysteresis timer(Hys.). (Please refer to ch2.3.2 for external piping configuration.)

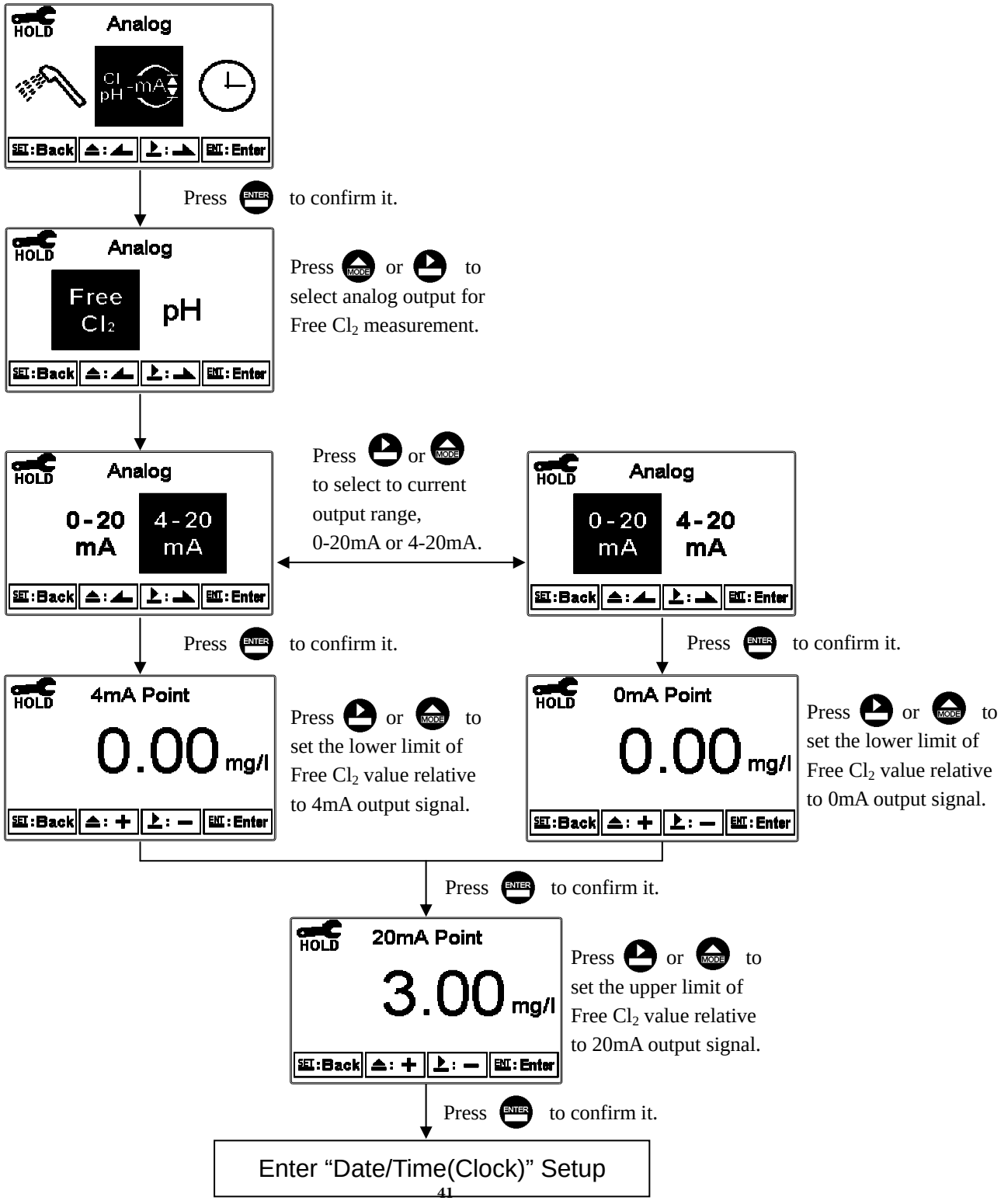
Note: When the clean/auto zero function is turned on, if any value is set to be 0, the instrument will automatically turn off this function. When the clean/auto zero function is activated under measurement mode, there is a “Clean Running” or “Auto Zero” message showing on top of the display. The measurement value will be remained at the last measured value before cleaning. If enter setting menu or calibration menu under clean status, the instrument will stop clean/auto zero procedure automatically.



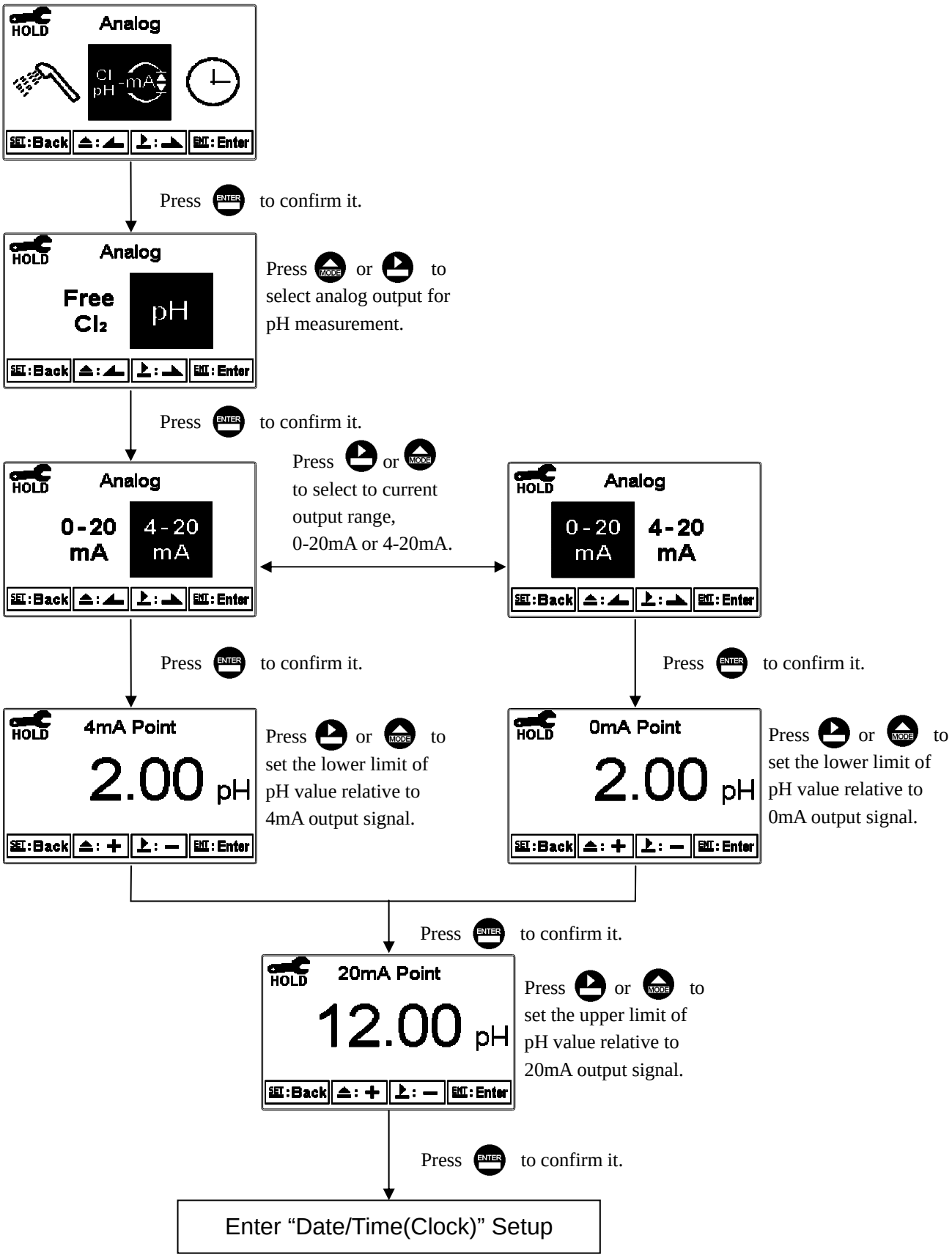
7.14 Analog

Enter setup of Analog. Select the function as for Free Cl_2 or pH, and then select as 0~20mA or 4~20mA current output. Set the related value to the range of Free Cl_2/ pH measurement. If the range of the measurement is to be set smaller, the resolution of current output is higher. When the measured value exceeds the higher range limit, the current will remain approximately 22mA output. When the measured value exceeds the lower range limit, under 0~20mA mode the current output will remain 0mA output; while under 4~20mA mode the current output will remain approximately 2mA output. The exceptional output value can be used as a basis for failure determination. Under HOLD(measurement) status, the current output maintain the last output value before HOLD status. However, in order for convenience of insuring the current setting of an external recorder or of a PLC controller, the current output will be 0/4mA or 20mA under the analog output setup menu.

If select analog output corresponding to Free Cl_2 measurement, the procedure is as follow:



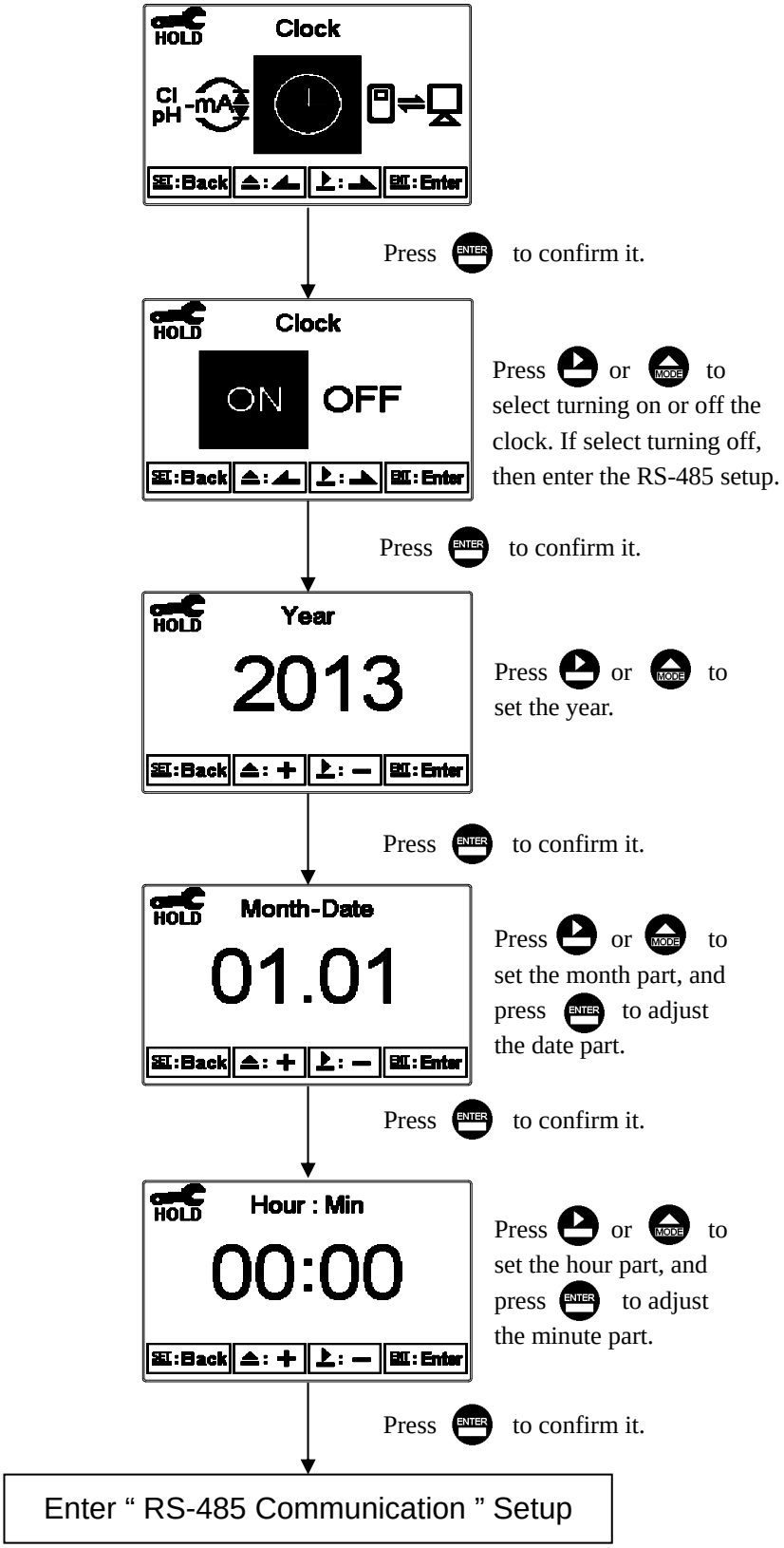
If select analog output corresponding to pH measurement, the procedure is as follow:



7.15 Date/Time(Clock)

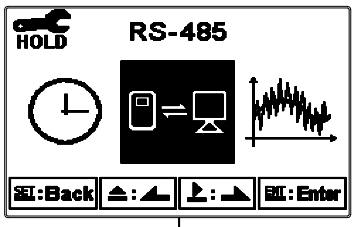
Enter setup of Date/Time(Clock). Set the “Year”, “Month”, “Date”, “Hour”, and “Minute” time. Note: If you select to turn off the clock function, there will not display clock under measurement mode. The calibration time of calibration record will also show ”OFF” under calibration overview display.

Note: Only when the inner battery is out of power, the clock may stop operation. Then, please replace the 3V CR2025 Li batter inside the transmitter.

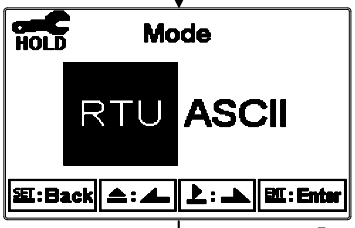


7.16 RS485 communication

Enter setup of RS485 communications. According to the Modbus protocol, set the transmitting mode, baud rate, parity, stop bit, and ID number. About the detail of Modbus protocol, please refer to Ch9. If under hold status, the measurement signal output maintains the last output value before hold status.

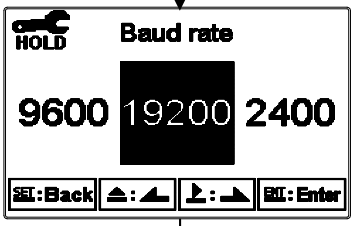


Press ENTER to confirm it.



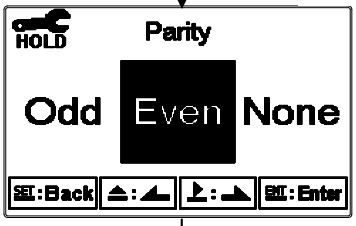
Press ▼ or MODE to select RTU or ASCII mode.

Press ENTER to confirm it.



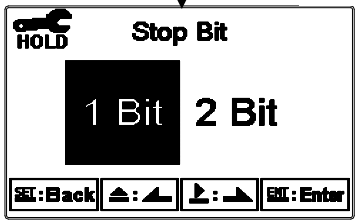
Press ▼ or MODE to select 2400, or 4800, or 9600 for baud rate.

Press ENTER to confirm it.



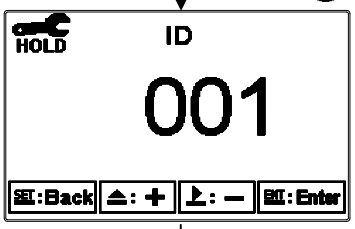
Press ▼ or MODE to select Even, or Odd, or None for parity check.

Press ENTER to confirm it.



Press ▼ or MODE to select stop bit as 1 bit or 2 bit.

Press ENTER to confirm it.



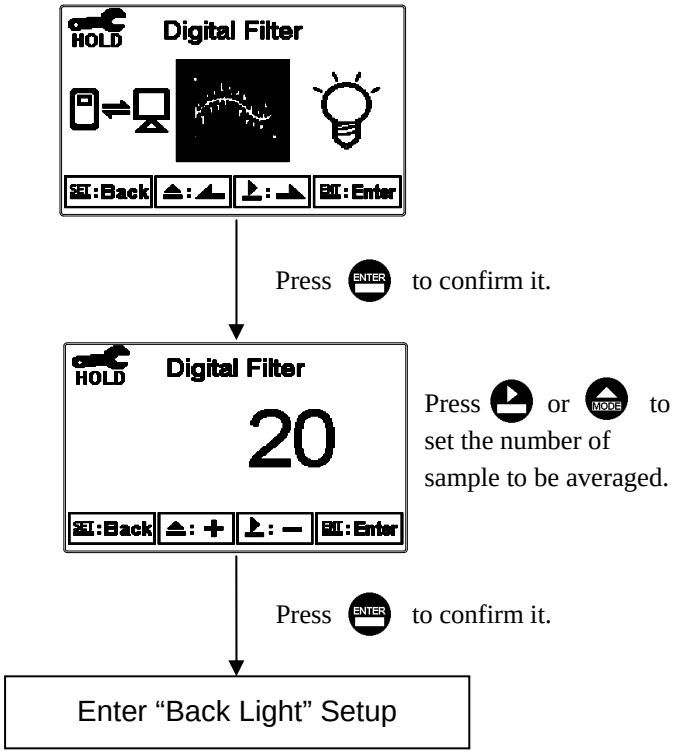
Press ▼ or MODE to set the ID number of the transmitter. The valid value is from 1 to 247.

Press ENTER to confirm it.

Enter " Sample average of measurements (Digital Filter) " Setup

7.17 Sample average of measurements (Digital Filter)

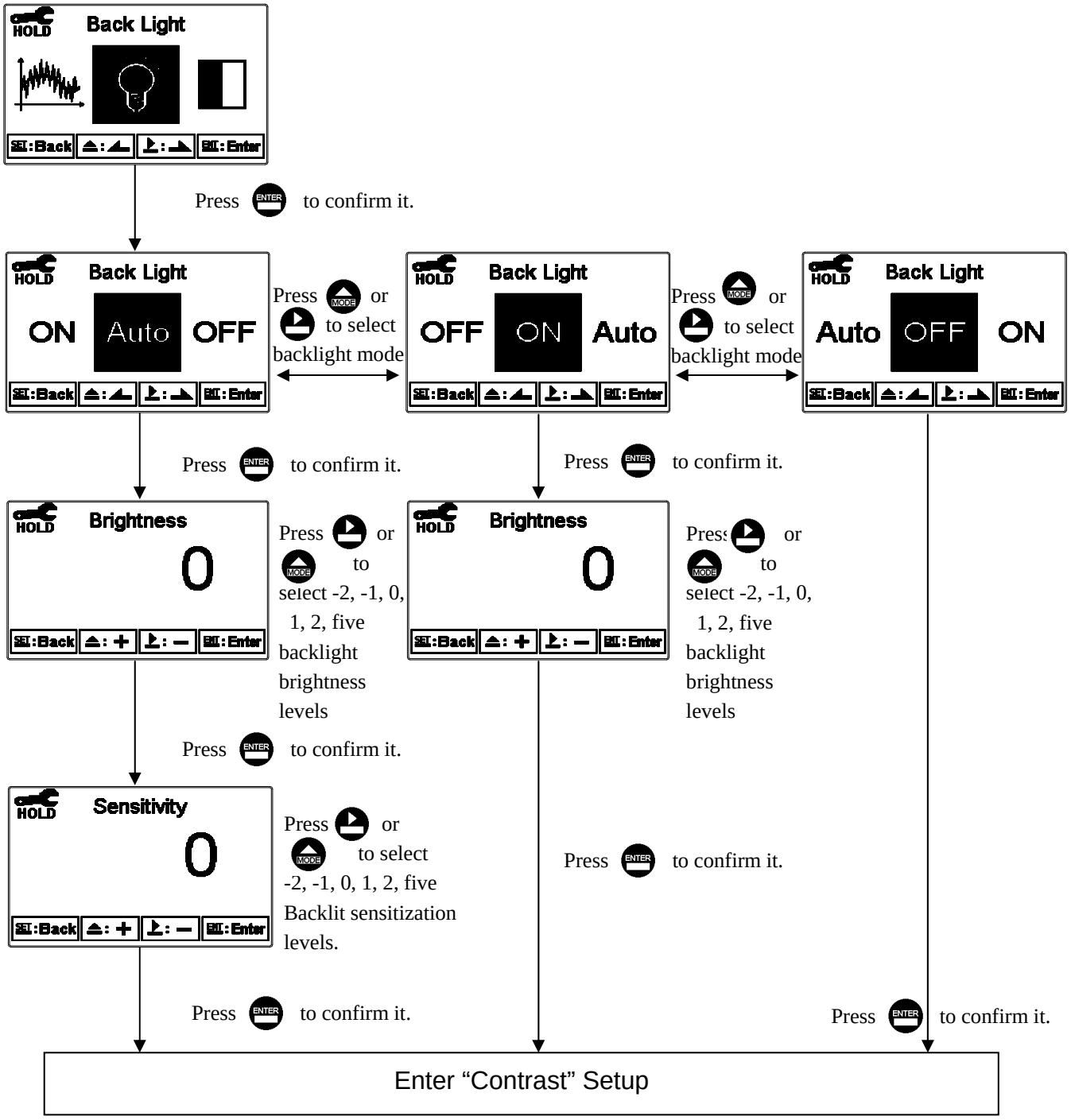
Enter the setup of Digital filter. You may select the number of sample to be averaged each time to become a reading which is gradually counted in order to increase the stability of measurement.



7.18 Backlight settings

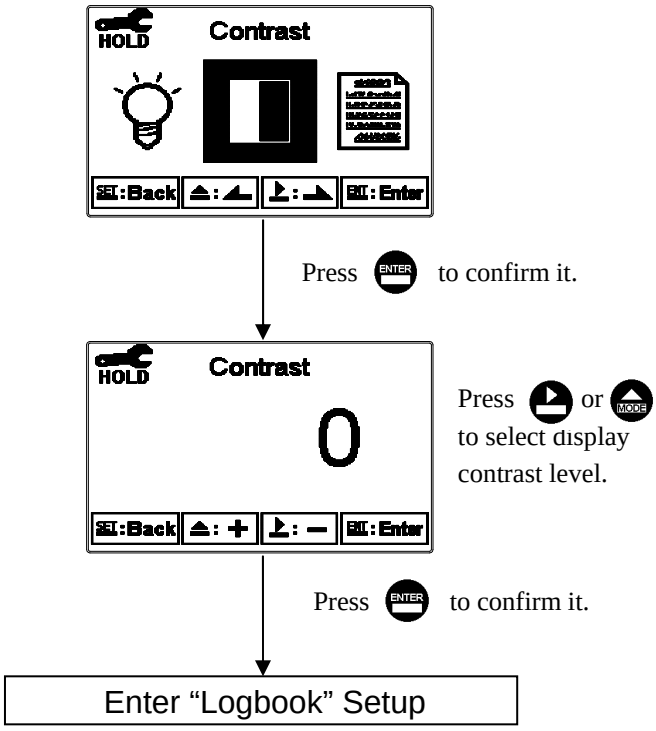
Enter setup of backlight display. According to your need, you can set the brightness of display(-2~2, dark~bright) and sensitivity of the sensitization sensor(-2~2, insensitive~sensitive). Where there is a keystroke, then activate the touch-on backlight function. Regardless of what kind of backlight mode, the touch-on function will activate the backlight. If there is no keystroke for 5 seconds, the display will back to the original backlight setting status.

ON setting: The backlight is always on.
OFF setting: The backlight is off. When there is a keystroke, it enters to the touch-on status.
Auto setting: According to the ambient light, activate or deactivate the backlight. When there is a keystroke, it enters to the touch-on status.



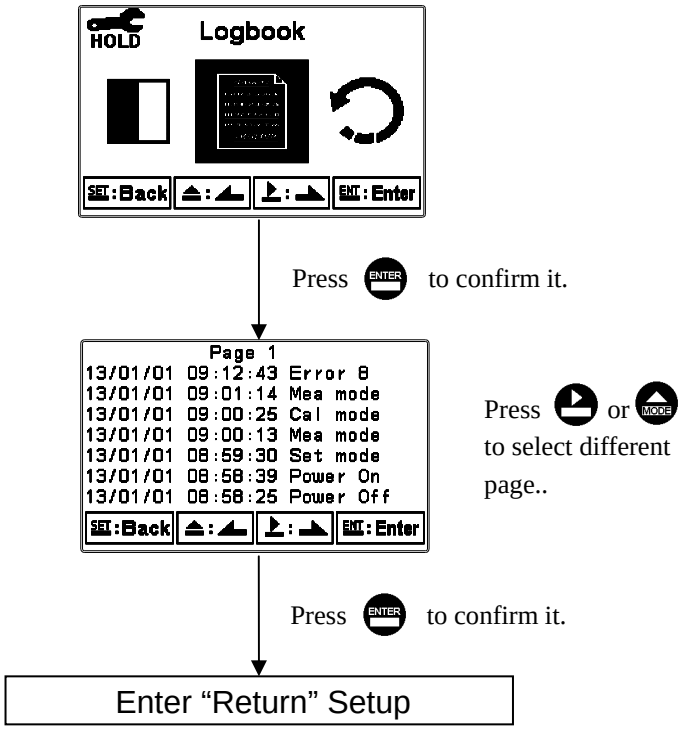
7.19 Contrast settings

Enter setup of display contrast. You can set the contrast of display according to your need. (-2, -1, 0, 1, 2, light to dark)



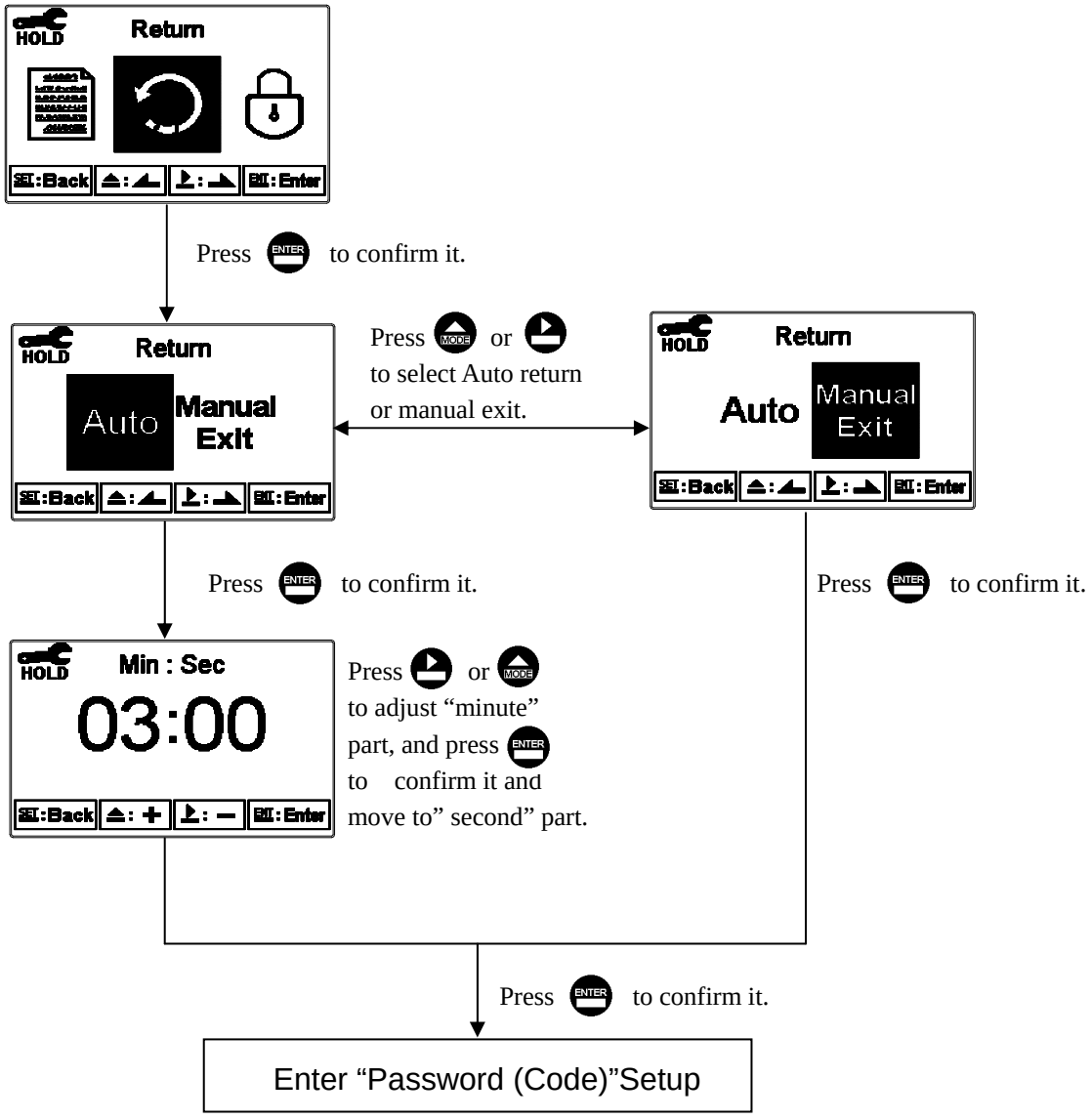
7.20 Logbook

Enter setup of Logbook. Users may look up the relative records of the transmitter. For example, Measurement, Setting, Calibration mode, current output over setting range, power failure(Power On, Power Off), and other error message records (Error1, Error2…etc. The definition of error messages please refer to Ch11.



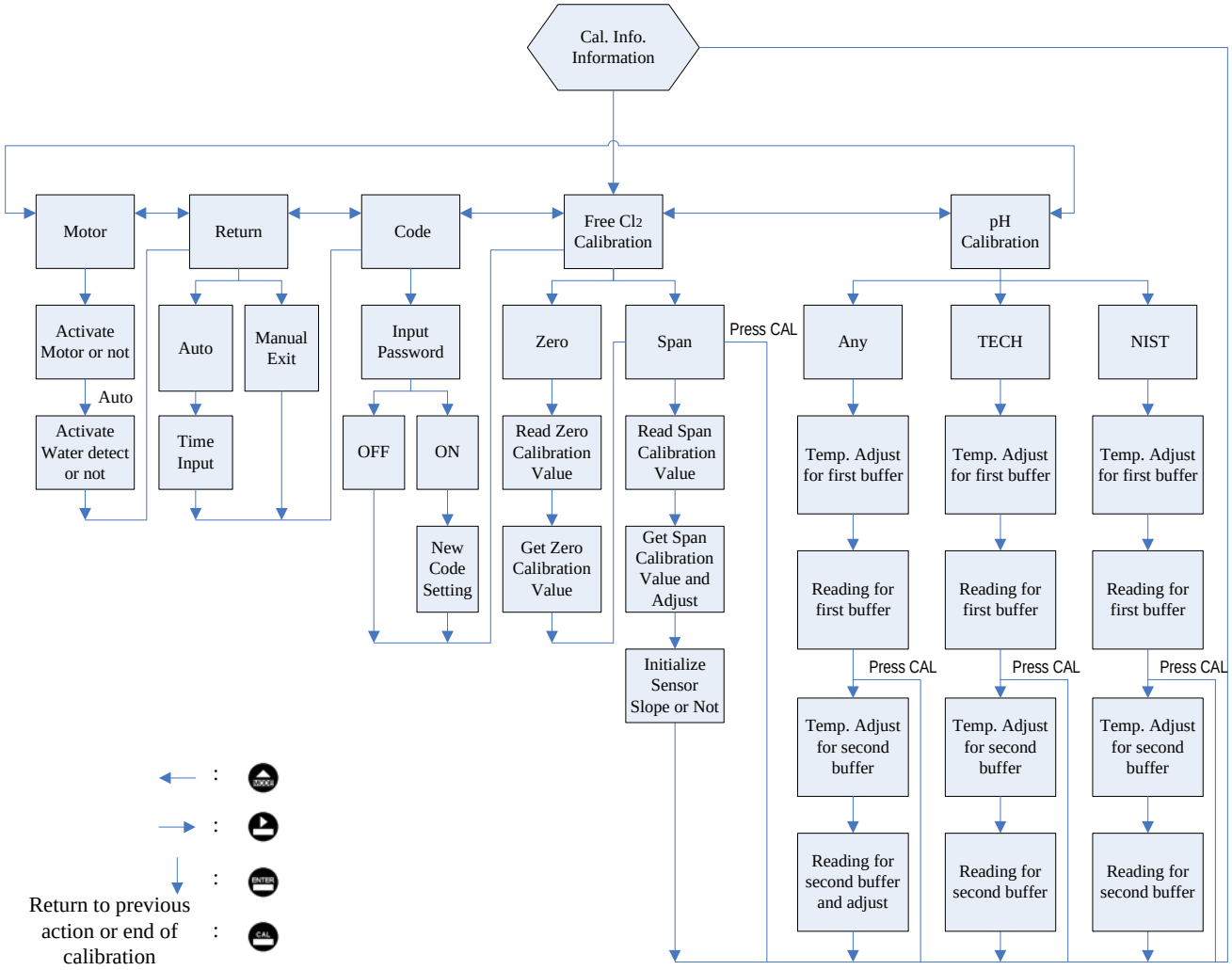
7.21 Return

Enter setup of auto return mode (Return) to set the function that the instrument automatically exit the setup menu after a period of time without pressing any key. The “Manual Exit” means that it needs to exit setup menu manually, while “Auto” means that the display automatically exit the setup menu and back to measurement mode after a period of time without pressing any key.



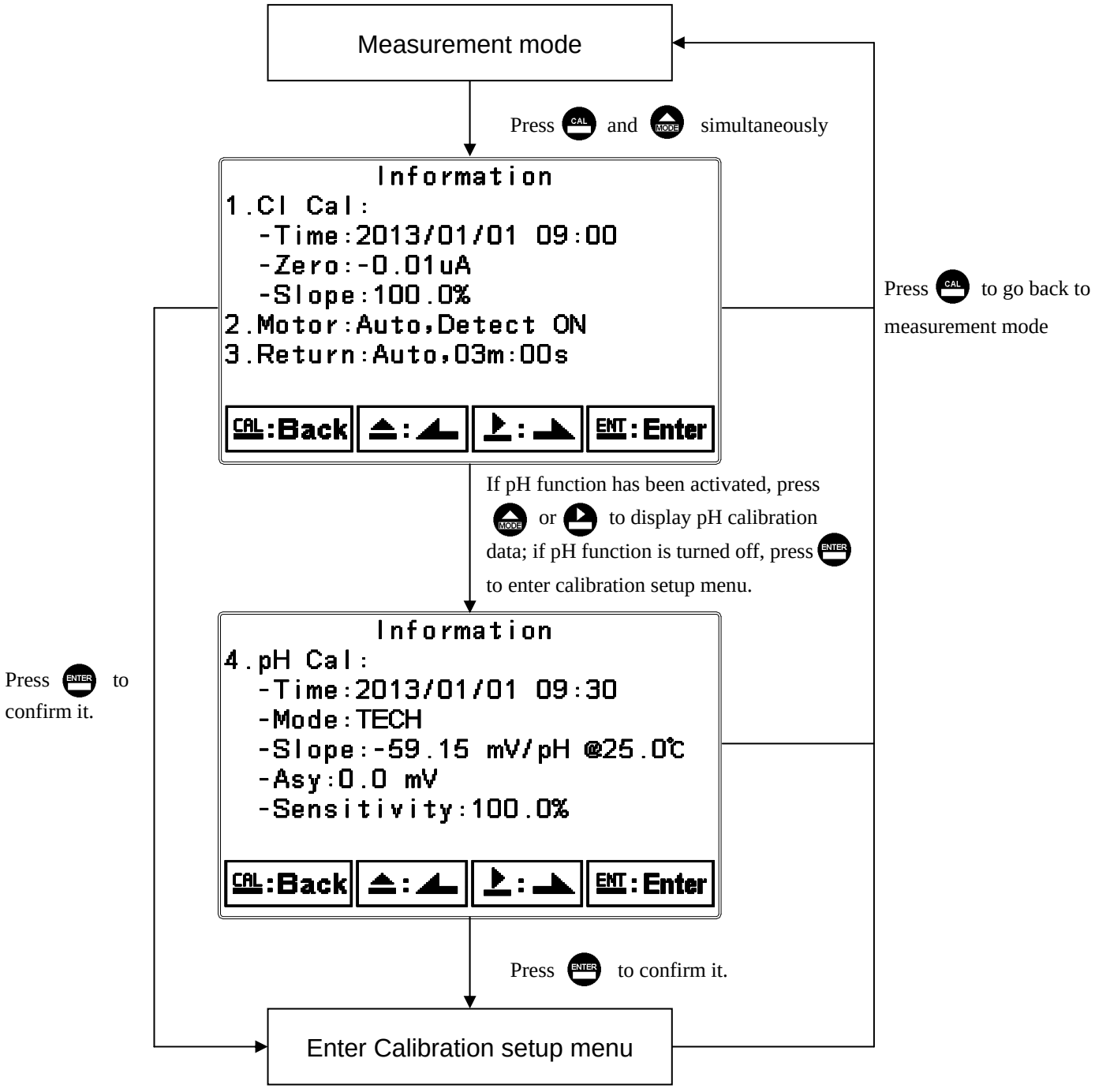
8. Calibration

Block diagram of Calibration



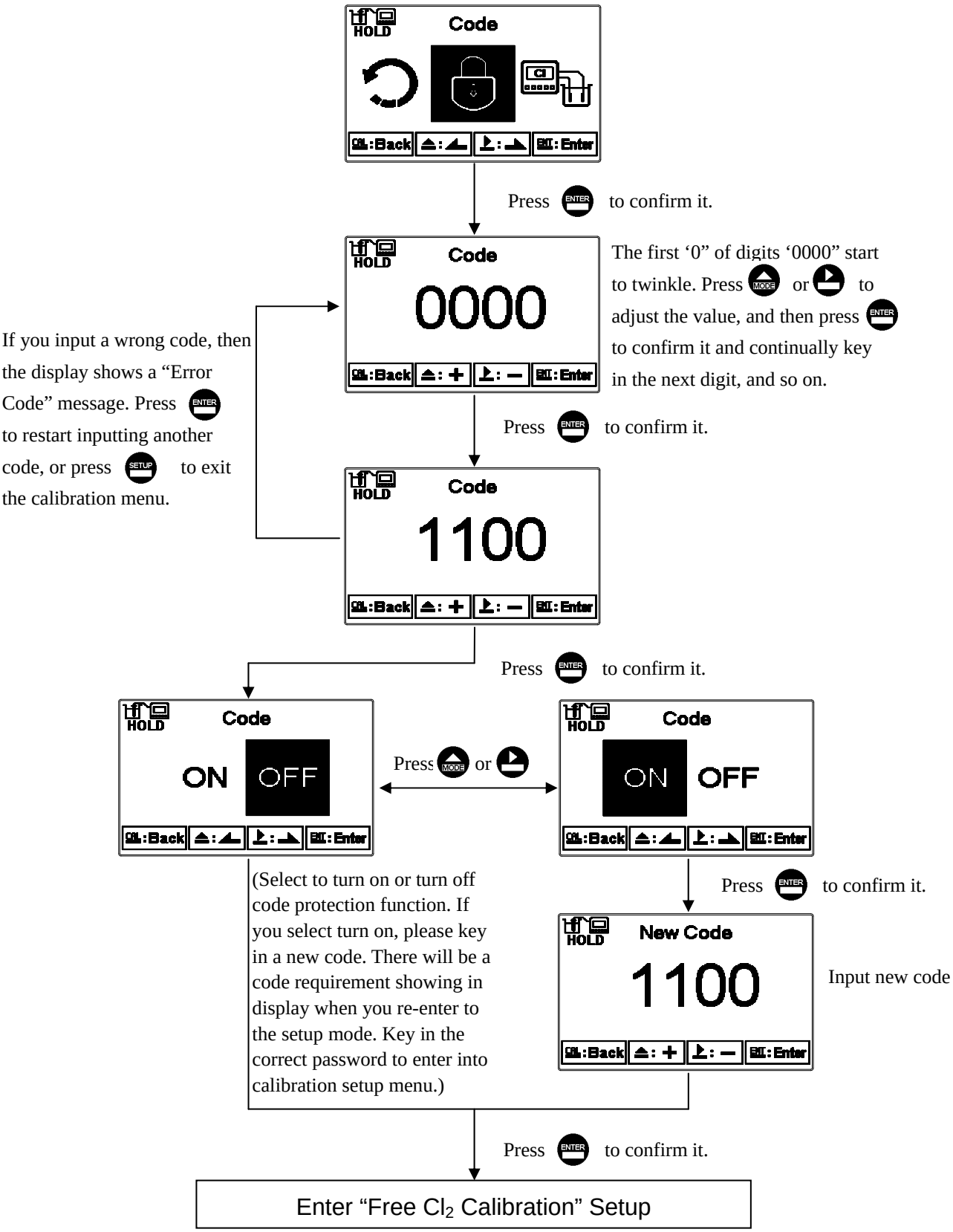
8.1 Enter calibration setup menu

In the measurement mode, pressing the two keys CAL and MODE simultaneously allows you enter the Calibration Information. If you do not need to re-calibrate the measurement system, press CAL to go back to measurement mode. If you need to re-calibrate the system, press ENTER to enter to the calibration setup menu. (If the calibration time shows "OFF", it represents that the clock function has been turned off.)



8.2 Security password of calibration (Code)

Select the Code (password) icon after entering calibration setup mode. Select to activate code function or not. **The default Calibration setting code is "1100".**



8.3 Free Cl_2 calibration

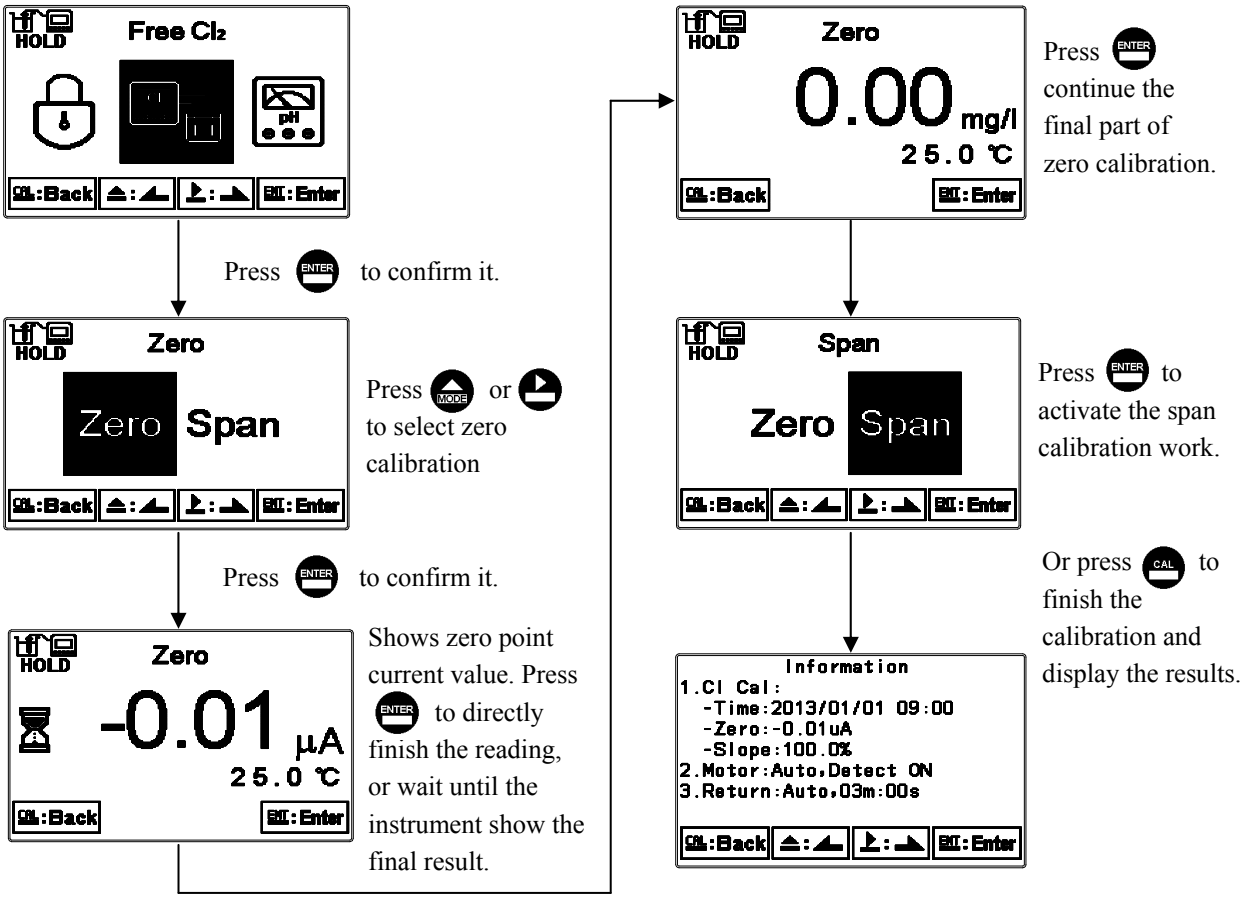
In order to maintain the correctness of chlorine reading, it is recommended to make electrode calibration regularly. In addition, when a new replacement chlorine electrode or a stop operation of motor happens, it is also recommended to re-make calibration work. Be noticed that it is necessary to power on in normal circumstances and run the instrument continuously at least one hour before starting calibration. It helps the electrode be fully polished by ceramic beads before calibration. (This step is required when first operation or when motor has been stopped.)

There are two types of chlorine electrode calibration: Zero point calibration and Span calibration. Zero calibration is to calibrate the current offset(μA) of the electrode. Span calibration is to calibrate the relative slope(%) of the electrode. Usually, it is not necessary to make zero calibration. The following chapter describes there two calibration works.

8.3.1 Zero point calibration

There are two ways of zero calibration: First way is to make electrode open of the working electrode(gold electrode) and counter electrode(silver electrode) by pull out the wiring from terminal 11th and terminal 12th and thus it becomes electrode open status, or by stopping the motor function and then move the sensor box to the clean position to let the free Cl_2 electrode hang in the air and dry. While the measurement value becomes stable, and then start the zero calibration. The other way is to apply active carbon filtered water(Residual chlorine has been removed from the water. For the piping configuration please refer to Ch 2.3.2, (illustration B, Auto-Zero calibration piping configuration.) or pure water. Turn off the original inlet valve and then turn on the active carbon filtered water or pure water inlet valve to input it into flow-through chamber. After the measurement value becomes stable, then start the zero calibration. This method can be executed by Auto Zero function(Cln/Auto Zero relay) to set the on and off duration for auto switching. The method and operation order of Auto Zero function is the same as above process but done by automatically instead of by manually. When applying auto zero calibration, the duration is recommended at least 24 hours or more.

The process of manual zero calibration work is as follows.

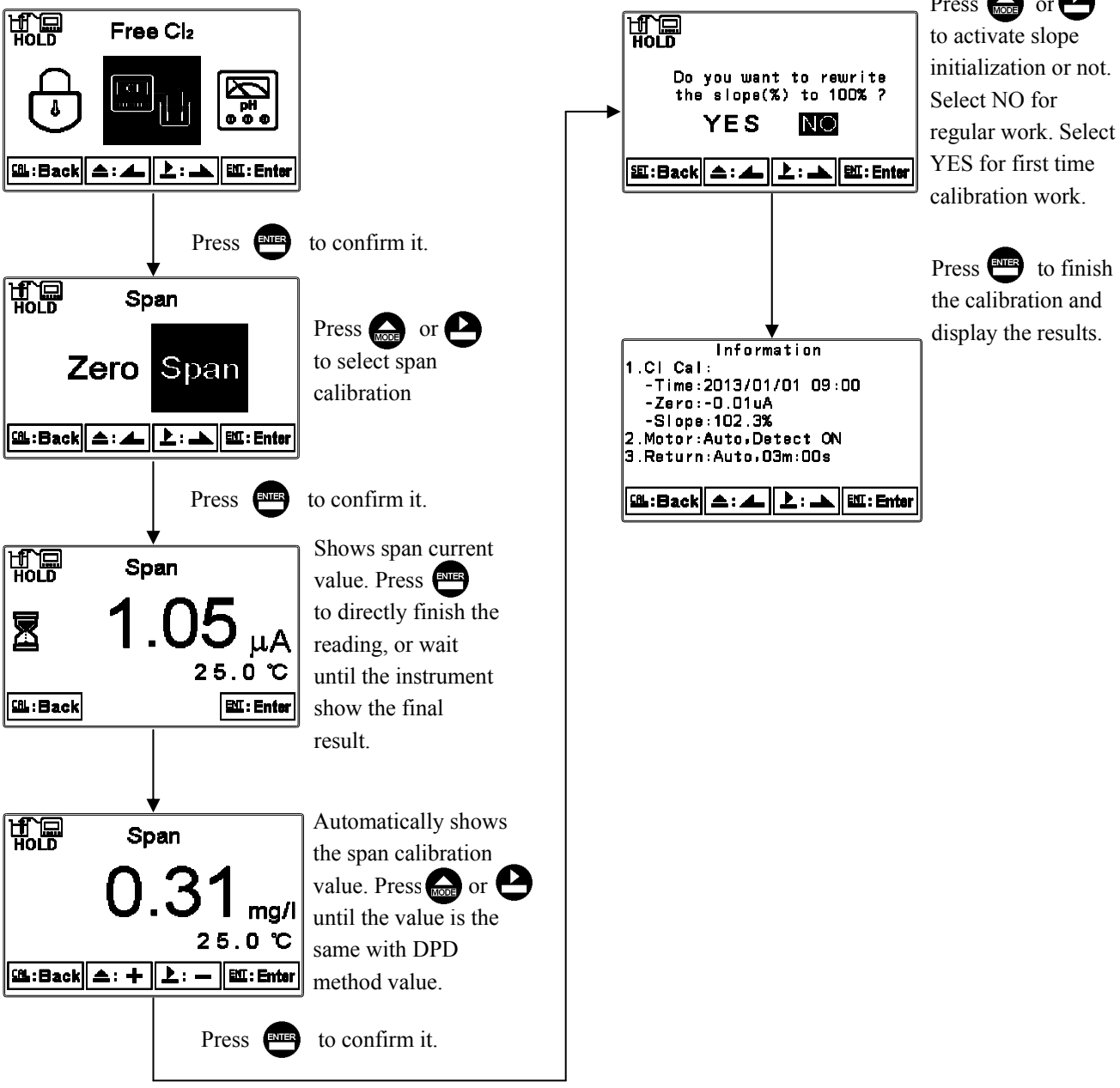


8.3.2 Span calibration

There are two ways of span calibration: The first one is to take some sample from the sample port of pipe line and apply DPD method to measure the sample. Then, start the span calibration process when the measurement value of the instrument is stable. Apply the DPD method value to adjust the span calibration value until they are the same; the other way is to apply known residual chlorine concentration reference solution. Firstly, turn off the original inlet valve and turn on the reference solution inlet valve to input the reference solution into flow-through chamber. Wait until the measurement value is stable and then start the span calibration. During the span calibration, input the known concentration value.

Then, select to start electrode's relative slope initialization or not. If yes, the slope will base the circumstance and set as 100% relative slope; if not, the slope will be determined base on the relationship which current circumstance slope divided theory basis slope. Hence, make slope initialization at the first calibration work of the sensor in order to make a judgment standard of future electrode aging or damaged. For example, when calibrated slope (%) has difference from the slope of the 100% too much, it means that the electrode has been aging or damaged phenomenon. **Note: The concentration of sample for span adjustment is highly suggested greater than 0.2mg/l. (The span adjustment range has lower limit of 0.03mg/l.)**

The process of span calibration work is as follows.



8.4 pH Calibration

The instrument provides two-point standard buffer solution calibration. By using 2 value standard buffers to calibrate the electrode's slope and zero point (Asy, Offset or Zero point). According to different combination of standard buffers, the TECH, NIST, Any buffer solution, totally three calibration modes are provided. When calibration of pH electrode, it is necessary to turn off the motor in the motor setup. Move the sensor assembly box to the clean position of supporting plate, and let the pH electrode dip into standard buffer. Please be noted that if motor is still in operation while calibration, the instrument will stop the motor automatically. After calibration is finished, please remove the sensor assembly box back to top of flow-through chamber

8.4.1 TECH mode

The electrode is automatically calibrated according to pH value and temperature of TECH standard buffers (pH4.01, pH7.00, pH10.00). The range of zero point and slope of the electrode is also determined. If one of them is over the range, the display shows error message of zero point and slope failure. (See appendix Table 1, pH/temperature table of TECH standard buffers)

8.4.2 NIST mode

The electrode is automatically calibrated according to pH value and temperature of NIST standard buffers.(pH1.68, pH4.01, pH6.86, pH9.18, pH 12.45). The range of zero point and slope of the electrode is also determined. If one of them is over the range, the display shows error message of zero point and slope failure. (See appendix Table 2, pH/temperature table of NIST standard buffers)

8.4.3 Any mode

The electrode measures mV value of known standard buffers. According to theoretic slope and the temperature of standard solutions, the display shows an approximate pH value. Then, you can calibrate the electrode by freely adjust the pH value as those of the standard solutions'. There is not a zero point range failure determination by the instrument but only the slope range determination. If the slope is over the range, the display shows error message of slope failure.

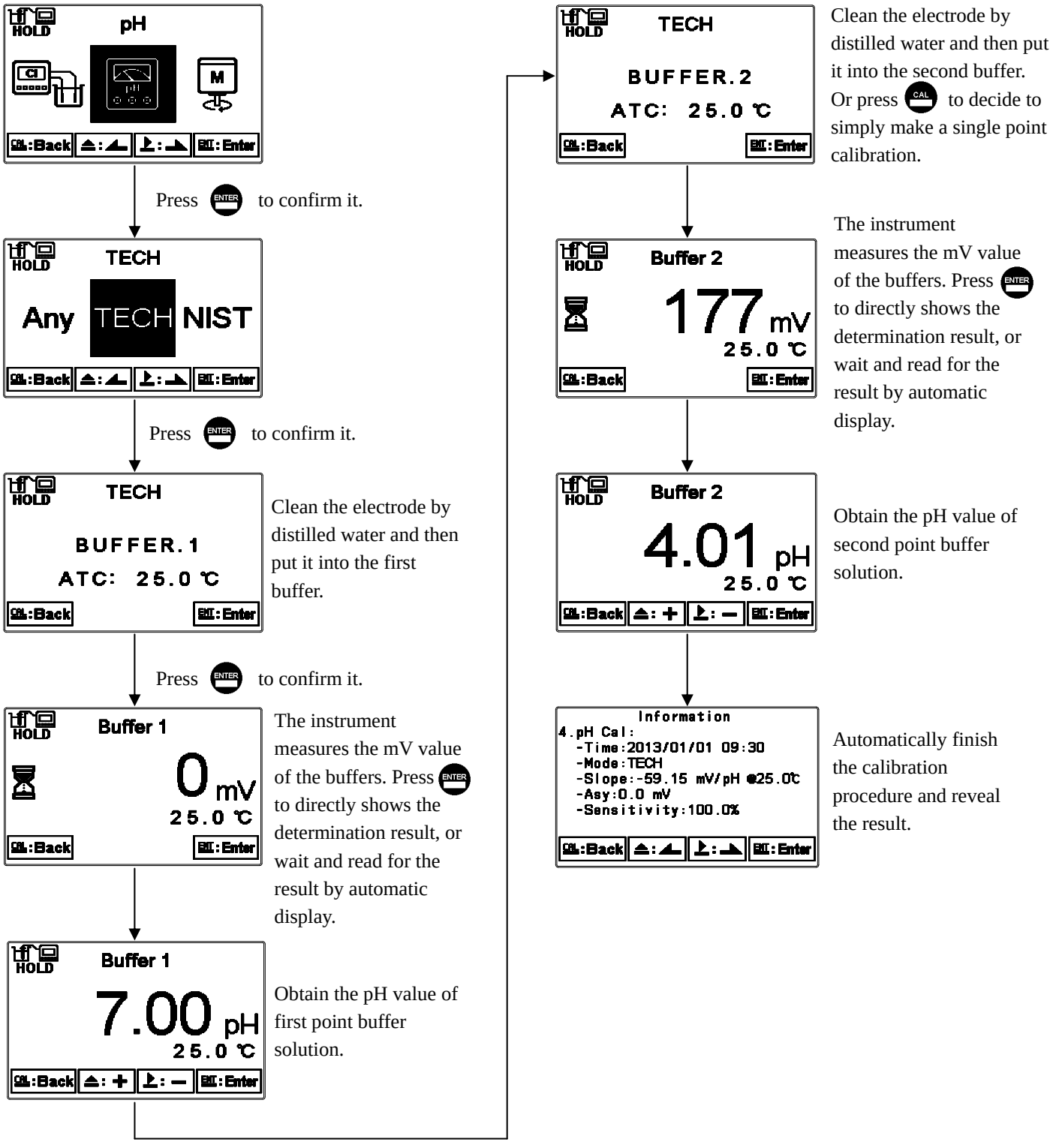
8.4.4 Definition of calibration parameter

You can calibrate the electrode by any sequence. As different calibration point method is applied, the definition of the zero point and slope different.

Calibration point	Determination	The showed calibration value
One point calibration	Asy	Zero point (Asy, offset or Zero point)= Asy 1.If not calibrated, Slope = Theoretical slope 2.If calibrated, Slope = Slope of last calibration
Two or three point calibration	Asy Slope	Zero point (Asy, offset or Zero point)= Asy Slope = Slope* Note: To obtain a new zero point(Asy) and Slope by applying linear regression.

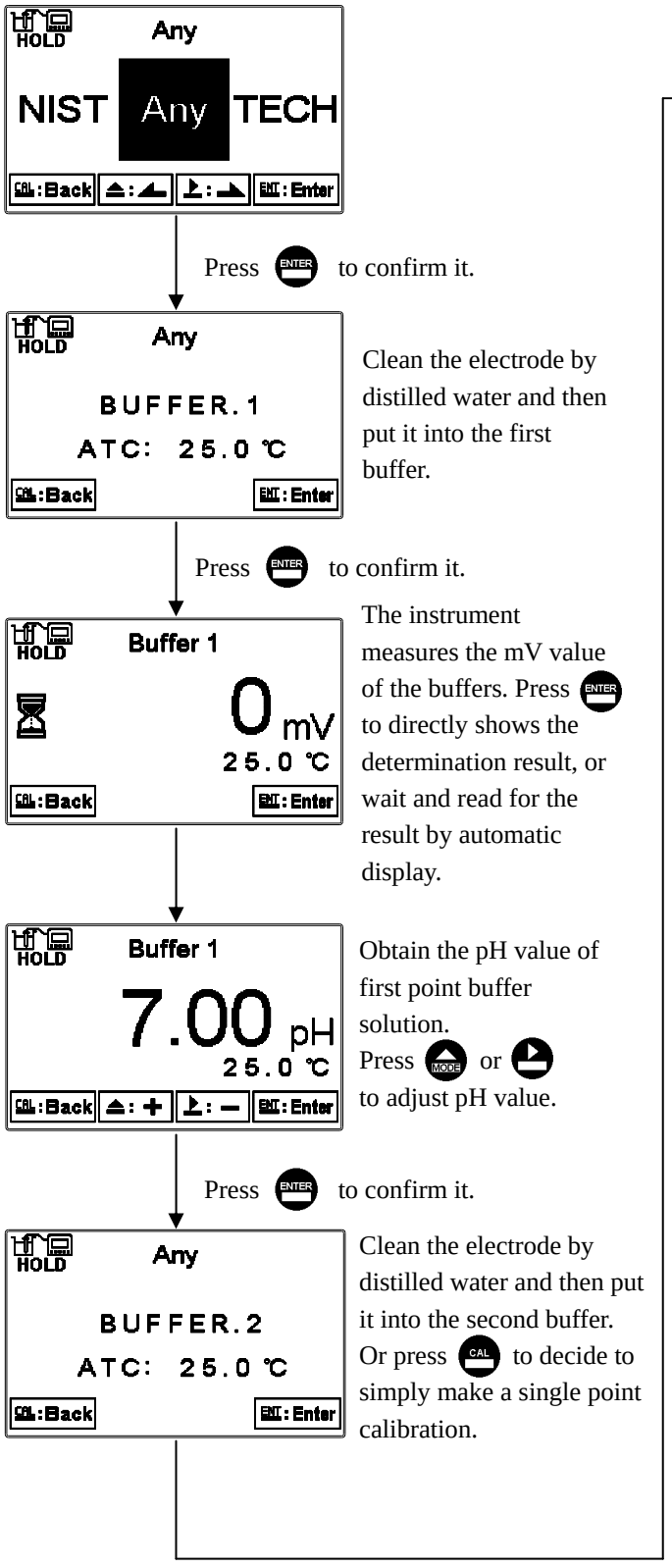
8.4.5 TECH, NIST buffer Calibration

The procedure below is two points calibration of TECH buffer. (The procedure is same as NIST buffer mode.) Select TECH mode in the pH calibration setup. Operate the instrument as follow procedure diagram.



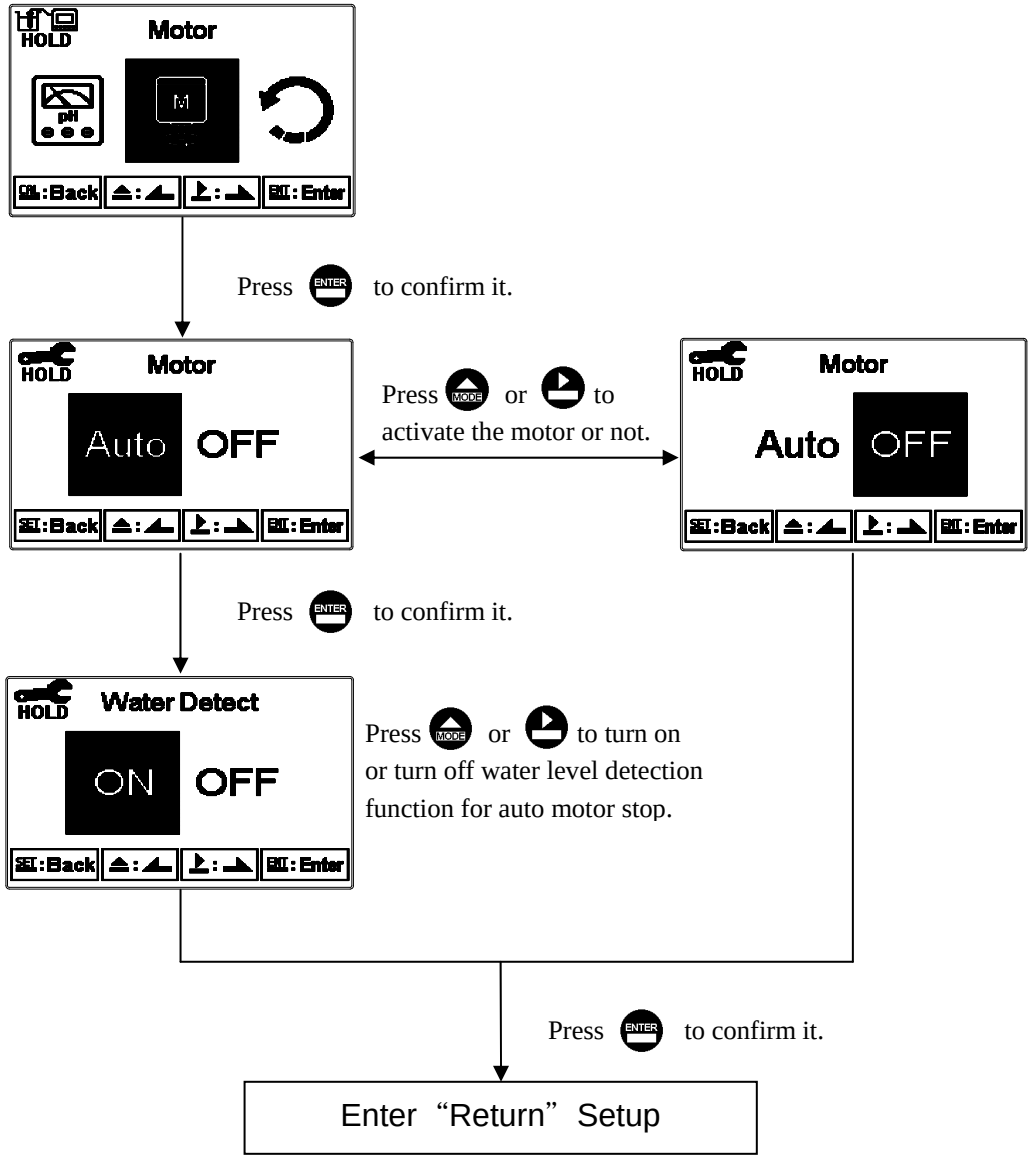
8.4.6 Any Calibration

The procedure below is two points calibration of Any mode. Select Any mode in the pH calibration setup. Operate the instrument as follow procedure diagram.



8.5 Motor

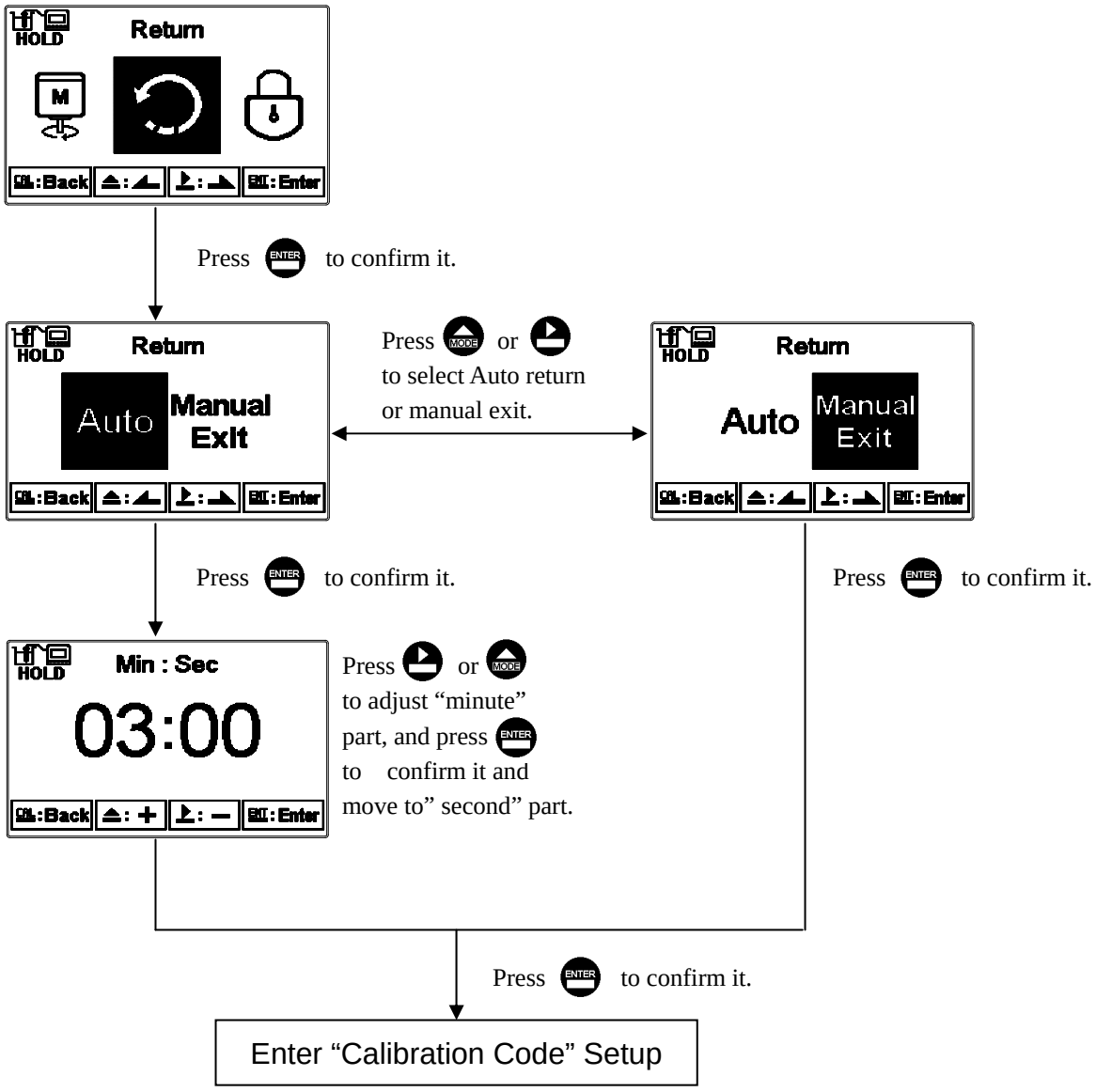
Enter setup of motor. Select to turn on or turn off the motor operation(can also be set in the setting mode). Under measurement mode, the motor must be kept running. If the motor stop running, it will affect the correctness of chlorine measurement. In addition, when the water level detection function is turned on, under measurement mode if electrode circuit open or water outage(the water level drop to the bottom of the silver electrode) happens, or if the measurement is kept constantly at near zero, then the instrument will judge it and stop the motor automatically after a certain of time. It prevents residual chlorine electrode continuously rub against without water sample and results in damage. It also shows “M-OFF” warning symbol on the top right corner of the display and goes into HOLD status. When turning off the water detection function, under measurement mode, regardless of the electrode circuit open, water outage, or constant zero measurement, the motor will keep running.



8.6 Return

Enter setup of auto return mode (Return) to set the function that the instrument automatically exit the setup menu after a period of time without pressing any key. The “Manual Exit” means that it needs to exit calibration setup menu manually, while “Auto” means that the display automatically exit the calibration setup menu and back to measurement mode after a period of time without pressing any key.

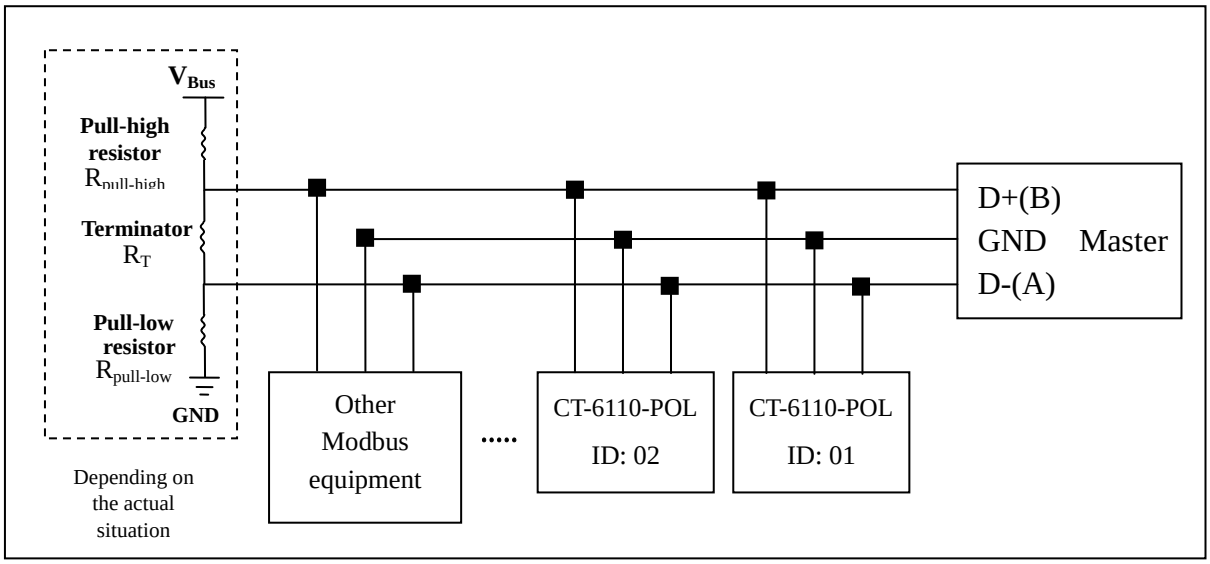
Note: The return function of setup menu and calibration setup menu are independent settings.



9. MODBUS protocol and instructions

9.1 Communication connection

The RS-485 communication port of the transmitter features electronic isolation protection and lightning protection, and it provides isolated ground solution. It is allowed to use normal twisted-pair (segregation double-stranded twisted pair cable) cable for connection. All devices are in contact with a positive connecting point D+(B) of the double-stranded twisted-pair cable all together, and another line will be connected with all the negative contacts D-(A), and the isolated shield wire must be connected to ground(GND). When we talk about communication in the laboratory, the stand-alone master-slave communication is relatively simple. Hence, it is allowed to consider using the normal cable instead. However, there should be strictly in accordance with the requirements of industrial engineering construction. Wiring diagram is as follows:



Note:

1. The RS-485 interface of the transmitter has a protective earth terminal. When communicate with the RS-485, there should use with solution ground to eliminate risk of safety.
2. It is allowed to use an 120 ohm impedance matching resistors at terminal equipment in the transmission lines (D +(B), D-(A)) ends across to effectively reduce or eliminate signal reflection.
3. Without repeaters, the RS-485 network cannot exceed a maximum of 32 nodes. The maximum communication transmission distance of RS-485 is up to 1200 meters. For long distance transmission, it is recommended to apply cables which are dedicatedly design for RS-485.
4. When communication, all the equipments of the network should be maintained in the same transfer mode, baud rate, parity consistent. And each of the device address cannot be the same, so as not to conflict resulted in the normal network communications.
5. The Modbus command of the transmitter can only access 50 registers. If it exceeds the length, then it returns abnormal message.
6. The waiting time which a slave instrument response to a master machine is different according to each model. Generally, it shall be longer than 0.5 second. (Some models may require a longer waiting-responding time, please note whether the operation manual specified.)

9.2 MODBUS address and command table

The following information is the Modbus address and command table. User who apply a PLC or HMI systems to communicate with this instrument need to pay particular attention to whether if the actual delivery address decrease 1 to deliver. If the above situation happens, it is necessary to add 1 to correspond to this table. For example, the temperature of the table address is 0037H (hexadecimal) or 55 (decimal), if the PLC or HMI system delivers the address which has been decreased 1 and then transmit, then the user must enter the 0038H (hexadecimal) or 56 (decimal) in order to correspond to the correct temperature address code which affected by the PLC or HMI system.

Function Code：03H, 06H, 10H Modbus response (setup parameter)

Logic address (Hex)	R/W	Item	Number of Byte	Information type	Description of data transmission	Default value	Note
0000	None						
0001	R	Equipment's ID	2	USHORT	1-247	1	
0002	R	Transmitter model	6	USHORT	ASCII Code	CT6110	
0005	R	Communication protocol	2	USHORT	0: RTU 1: ASCII	0	
0006	R	Serial transmission speed (Baud rate)	2	USHORT	0: 2400 1: 4800 2: 9600 3: 19200	3	
0007	R	Parity	2	USHORT	0: None 1: Even 2: Odd	1	
0008	R/W	Real-time clock*	12	USHORT	Second	2013-01-01, 00:00:00	
0009	R/W			USHORT	Minute		
000A	R/W			USHORT	Hour		
000B	R/W			USHORT	Day		
000C	R/W			USHORT	Month		
000D	R/W			USHORT	Year		
000E	R/W	Code setting*	2	USHORT	Code setting	1111	
000F	R/W	Temperature mode*	2	USHORT	0: MTC 1: ATC	1	

0010	R/W	Cln/Auto Zero relay*	2	USHORT	0: OFF	0	
				USHORT	1: AUTO		
0011	R/W		2	USHORT	ON.S: 0-5999	0	Second
0012	R/W		2	USHORT	OFF.H: 0-999	0	Hour
0013	R/W		2	USHORT	OFF.M: 0-59	0	Minute
0014	R/W		2	USHORT	Hys.S: 0-5999	0	Second
0015	R/W	Relay 1 *	2	USHORT	0: OFF	1	
					1: AUTO		
0016	R/W		2	USHORT	0: Hi	0	
					1: Lo		
0017	R/W		4	FLOAT	SP1	1 mg/l /10.00pH	Data affected by parameter unit
0019	R/W		4	FLOAT	Hys1	0.2 mg/l /0.1pH	
001B	R/W	Relay 2 *	2	USHORT	0: OFF	1	
					1: AUTO		
001C	R/W		2	USHORT	0: Hi	1	
					1: Lo		
001D	R/W		4	FLOAT	SP2	0.3 mg/l /4.00pH	Data affected by parameter unit
001F	R/W		4	FLOAT	Hys2	0.2 mg/l /0.1pH	
0021	R/W	Backlight Brightness*	2	USHORT	0: AUTO	2	
					1: ON		
					2: OFF		
0022	R/W		2	SHORT	2: Highest brightness	0	
				SHORT	1: high brightness		
				SHORT	0: Standard		
				SHORT	-1: Low brightness		
				SHORT	-2: Lowest brightness		
0023	R/W	Backlight Sensitivity*	2	SHORT	2: Highest Sensitivity	0	
				SHORT	1: High Sensitivity		
				SHORT	0: Standard		
				SHORT	-1: Low Sensitivity		
				SHORT	-2: Lowest Sensitivity		

0024	R/W	Sample average of measurements (Digital Filter)*	2	USHORT	1-60	20	
0025	R/W	Relay 1 type*	2	USHORT	0：Free Cl_2 1：pH	0	
0026	R/W	Relay 2 type*	2	USHORT	0：Free Cl_2 1：pH	0	
0027	R/W	Cln/Auto Zero type*	2	USHORT	0：Clean 1：Auto Zero	0	
0028	R/W	Initial Volt*	2	USHORT	0 ~1000 mV	100mV	Absolute value
0029	R/W	Gain*	2	USHORT	0 ~100mV/μA	10mV/μA	Absolute value
002A	R/W	Motor*	2	USHORT	0：OFF 1：ON	1	
002B	R/W	Water Detect*	2	USHORT	0：OFF 1：ON	1	
002C	R/W	Remote zero point*	2	USHORT	0：OFF 1：ON 2：Error	0	2:Error (Read Only)
002D	R/W	Remote Span calibration*	2	USHORT	0：OFF 1：ON 2：Error	0	2:Error (Read Only)
002E	R/W	Remote Span input*	4	FLOAT	Span adjustment	0~3 mg/l	
0030	Factory reserved						

Note 1 : The actions without * sign only support for function code 03H. The actions with * sign support function code 03H, 06H, 10H.

Note 2 :FLOAT is a 32-bit IEEE 754 format. The above table, for an example, is divided into two 16-bit register data transmission. The back 16-bit register(CC CD) will be transferred first, and then the first 16-bit register (41 C8) will be transferred later. Every 16-bit format is high-bit in the front and low-bit in the post. For example, the temperature now is 25.1^{o}C. The 16-bit of FLOAT data(Hexadecimal) will show 41 C8 CC CD. The transmission order is CC CD 41 C8. For detail description, please refer to Ch 9.3 Modbus example description.

Note3 : USHORT means unsigned short integer.

Function code: 03H Modbus response (measurement parameter)

Logic address (Hex)	R/W	Item	Number of Byte	Information type	Description of data transmission	Default value	Note
0031	R	Number of measurement channels	2	USHORT	0: Hold Status 1: Measurement	1	
0032	R	Parameter unit	6	CHAR	mg/l	mg/l	ASCII code
0035	R	Free Cl_2 measurement	4	FLOAT	Free Cl_2 measurement		Data affected by parameter unit
0037	R	Temperature measurement	4	FLOAT	Temperature measurement		
0039	R	pH measurement	4	FLOAT	pH measurement		
0041-0050	Factory reserved						

Function code: 01H Modbus response (dispersion parameter)

Logic address (Hex)	R/W	Item	BIT	Description	Default value	Note
0070	R	LO Alarm	1	Contact on	0 (Contact off)	
0071	R	HI Alarm	1	Contact on	0 (Contact off)	
0072	R	mA too high	1	Contact on	0 (Contact off)	
0073	R	mA too low	1	Contact on	0 (Contact off)	
0074	R	Exceed temp. range	1	Contact on	0 (Contact off)	
0075	R	Exceed pH range	1	Contact on	0 (Contact off)	
0076	R	RLY1 Action	1	Contact on	0 (Contact off)	
0077	R	RLY2 Action	1	Contact on	0 (Contact off)	
0078	R	Cln/Auto Zero Action	1	Contact on	0 (Contact off)	
0079	R	Measurement status	1	Contact on	1 (Contact on)	0: Hold 1: Measurement
007A	R	Exceed Free Cl_2 range	1	Contact on	0 (Contact off)	
007B	R	Free Cl_2 electrode open	1	Contact on	0 (Contact off)	
007C	R	Motor action	1	Contact on	1 (Contact on)	
007D-0090	Factory reserved					

9.3 Modbus example description(ex: function code 03H)

The following description takes the temperature reading(0037H) as an example. Set the temperature at the transmitter at MTC 25.1^{o}C, and confirm that host and sub-machine communication format settings are correct. The host according to the following left table to send commands, and then to get the response from sub-machine according to following right table. This example shows the message transmission function code 03H data format. If under other function code, the logic mode is the same.

ASCII Mode:

Request		**Response**	
Message Framing	Hex	Message Framing	Hex
ID, Address	01	ID, Address	01
Function code	03	Function code	03
Starting Address Hi	00	Byte Count	04
Starting Address Lo	37	Register value Hi	CC
No. of Registers Hi	00	Register value Lo	CD
No. of Registers Lo	02	Register value Hi	41
LRC	C3	Register value Lo	C8
		LRC	56

RTU Mode:

Request		**Response**	
Message Framing	Hex	Message Framing	Hex
ID, Address	01	ID, Address	01
Function code	03	Function code	03
Starting Address Hi	00	Byte Count	04
Starting Address Lo	37	Register value Hi	CC
No. of Registers Hi	00	Register value Lo	CD
No. of Registers Lo	02	Register value Hi	41
CRC Check Lo	75	Register value Lo	C8
CRC Check Hi	C5	CRC Check Lo	65
		CRC Check Hi	5A

Note: FLOAT is a 32-bit IEEE 754 format. The above table, for an example, is divided into two 16-bit register data transmission. The back 16-bit register(CC CD) will be transferred first, and then the first 16-bit register (41 C8) will be transferred later. Every 16-bit format is high-bit in the front and low-bit in the post. For example, the temperature now is 25.1^{o}C. The 16-bit of FLOAT data(Hexadecimal) will show 41 C8 CC CD. The transmission order is CC CD 41 C8.

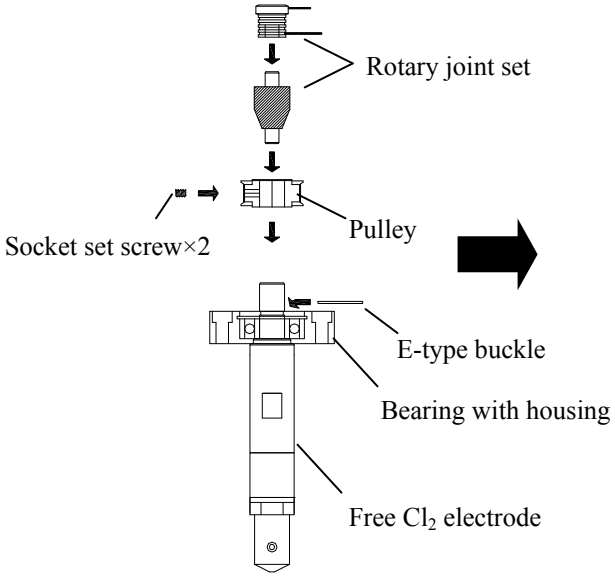
10. Maintenance

Under normal operation, the transmitter needs no maintenance expect regular cleaning and calibration of the electrode to ensure accurate and stable measurement and system operation.

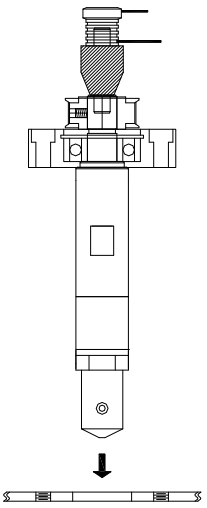
10.1 Electrode

10.1.1 Free Cl_2 electrode

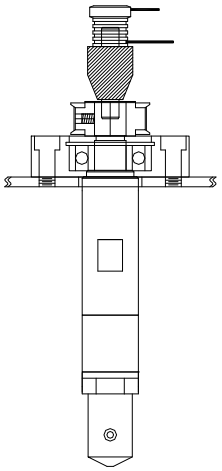
During the measurement, the gold electrode surface of free Cl_2 electrode is continuously grinded and polished by ceramic beads. Thus, this provides a self-cleaning effect in itself. However, under the continuous grinding, the gold electrode in the end will be damaged, and the electrode will need to be replaced. The following illustrations show the assembly steps of the electrode and sensor box. For disassembly, converse the steps to carry them out. If measures low concentration of water sample in long period, the silver electrode surface may become white. It is a normal phenomenon, and it does not affect the actual measurement. When replacing the free Cl_2 electrode, loosen the lower electrode wiring of 6PIN terminal block(①Brown thick wire and ②Red thick wire) first, and then remove the rotary joint. It is not necessary to loosen the screws of reducer/sensor box. Then, loosen the screws of bearing housing, take out the whole electrode with bearing housing, take apart between pulley and E-type buckle, and then take out the old electrode for replacement.



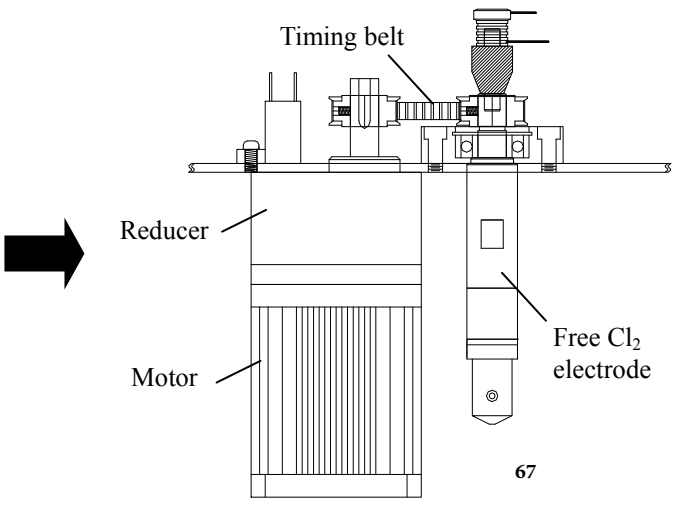
I1.Electrode and bearing assembly drawing



I2. Insert the completion of the electrode into the sensor box



I3.After inserting, screw up the bearing screws



I4. Loosen the screws of reducer/sensor box. Move the reducer closer to the free Cl_2 electrode, and mount the timing belt on two pulleys. Move the reducer to adjust for suitable tightness of the timing belt, and then screw up the screws of reducer/sensor box. Finally, screw up the free Cl_2 wiring.

10.1.2 pH electrode

The cleaning cycle for the pH electrode depends on the pollution degree of the measurement sample. Normally, it is recommended to make weekly cleaning. The following chart gives introductions of different cleaning methods according to different type of contaminations to provide the operators with reference for cleaning and maintenance.

Type of Contaminations	Cleaning methods
Measuring solutions containing proteins. (Contamination of the junction)	The electrode should be soaked in Pepsin/HCl for several hours. METTLER-TOLEDO 9891 Electrode Cleaner is recommended.
Measuring solution containing sulfides. (The junction becomes black)	The junction should be soaked in Thiourea/HCl solution until being bleached. METTLER-TOLEDO 9892 Electrode Cleaner is recommended.
Contamination by grease or organic substance	Short rinsing of the electrode with acetone and ethanol.
Acid and alkaline soluble contaminations	Rinsing the electrode with 0.1mol/l NaOH or 0.1mol/l HCl for a few minutes.
Apply clean water to flash the electrode after above cleaning steps and immerse theelectrode in 3M KCl solution for 15 minutes at least, and then calibrate the electrode.	
The electrode should only be rinsed and never rubbed or otherwise mechanicallycleaned, since this would lead to electrostatic charges. This could cause an increase in the response time.	
In cleaning the platinum electrode, the platinum ring of the electrode can be rubbed gently with a wet soft piece of cloth.	

※ The frequency of electrode cleaning depends on the type and degree of contamination. However it is recommended that the electrode be cleaned once a week.

10.2 Motor and drive mechanism

10.2.1 Motor and reducer

When the electrode rotation speed is abnormal , or when abnormal sound occurs during rotation, please check whether if the motor or reducer is working normally. If the abnormal situation results from the motor or reducer, please notify the local distributor for maintenance or parts replacement.

10.2.2 Timing belt and pulley

When the electrode rotation speed is abnormal , or when abnormal sound occurs during rotation, please check whether if the belt or any socket set screw which is to fixed the pulley is loose. If

the abnormal situation results from the timing belt or pulley, please notify the local distributor for maintenance or parts replacement.

10.2.3 Rotary joint

When measurement is abnormal, please turn off the power of the instrument, loosen the lower electrode wiring of 6PIN terminal block(①Brown thick wire and ②Red thick wire), and take apart upper plastic signal connector from the rotary joint set. Measure the plastic signal connector by a multimeter. Under normal circumstances, the two channels of the signal connector should be insulation, and the resistance of the same channel upper and lower connecting point should be less than 1Ω. If there is abnormality, please notify the local distributor for maintenance or parts replacement.

10.2.4 Bearing with housing

When the electrode rotation speed is abnormal , or when abnormal sound occurs during rotation, please check whether if the bearing of the bearing with housing works normally. If the abnormal situation results from the bearing with housing, please notify the local distributor for maintenance or parts replacement.

10.3 Flow-through chamber

It is recommended to clean the flow-through chamber regularly in order to prevent from dirt or other impurities from affecting the measurement results. When cleaning, please turn off the motor function from setting, and then lift up the sensor box, move it right, and put down to hang on the support columns of the supporting plate.(Please refer to Ch 2.2.1 for illustration of Installation dimensions.) This helps for clean the free Cl_2 electrode, pH electrode(optional), pH electrode housing(optional), and the surface of temperature probe. Then, take out the measuring cup, and pour out the ceramic beads in order to clean both of them. Users may consider to remove the four piping connectors which are under the flow-through chamber, and apply suitable size long brush to scrub the chamber. After cleaning, wrap some sealing tape around the connectors thread and screw up the connectors to the flow-through chamber. When the flow-through chamber is really necessary to be took apart from the supporting plate, be careful to control the force to avoid damaging the acrylic thread hole

11. Error messages (Error code)

Messages	Reason	Dispositions
Error1	Asy (Zero-point) of free Cl_2 measurement exceeds upper/lower limitation	Please check whether the free Cl_2 electrode is damaged or not.
Error2	Relative slope of free Cl_2 measurement exceeds upper/lower limitation	1. Please check whether the free Cl_2 electrode is damaged or not. 2. Re-initialize the free Cl_2 electrode slope.
Error3	The free Cl_2 readout is unstable while calibration	1. Please check whether the flow in the flow-through chamber is stable. 2. Please check whether the polarogram voltage and gain is suitable.
Error4	The free Cl_2 measurement is over range, or incorrect calibration	1. Please check whether the polarogram voltage and gain are suitable or not. 2. Please check whether the free Cl_2 electrode is damaged or not. 3. Re-calibrate the Cl_2 sensor
Error5	The polarogram voltage is over range	Re-arrange the suitable polarogram voltage and gain.
Error6	The temperature is over the measurement range.	Please check whether the temperature elect is damaged or not.
Error7	The temperature is over the compensation range.	Please check whether the water temperature is within the reasonable range or not.
Error8	The current output exceeds corresponding setting range	1. Please check whether the corresponding range to current ouput 0/4-20mA is suitably set or not. 2. Please check whether the measurement is over range.

Error9	Electrode open or damaged	1. Please check whether there is water outage or whether the inlet water quantity is too less. 2. Replace the free Cl_2 sensor.
Error10	Wrong password **ERROR CODE**	Re-enter the password
Error11	Asy (Zero-point) of pH measurement exceeds upper/lower limitation	1. Please replace by new buffers. 2. Maintain the electrode or change a new electrode, and make another calibration.
Error12	Slope of pH measurement exceeds upper/lower limitation	1. Please replace by new buffers. 1. Maintain the electrode or change a new electrode, and make another calibration.
Error13	The pH readout is unstable while calibration	1. Please check whether there is bubble or air in the glass end of the electrode. 2. Please maintain the electrode or change a new electrode, and make another calibration.
Error14	1. The temperature is over the range 0~50°C while pH calibration. 2. pH buffers cannot be recognized.	1. Please adjust the standard solution to the proper temperature range. 2. Please replace the pH buffers, or please maintain the electrode or change a new electrode, and make another calibration.

Appendix

Table 1 TECH Buffers

TECH buffers			
TEMP°C	Buffer 4.01	Buffer 7.00	Buffer 10.00
5	3.999	7.087	10.241
10	3.998	7.053	10.155
15	3.999	7.031	10.116
20	4.002	7.011	10.047
25	4.006	6.996	9.998
30	4.011	6.985	9.952
35	4.018	6.976	9.925
40	4.031	6.971	9.874
45	4.047	6.969	9.843
50	4.055	6.969	9.810

Table 2 NIST Standard buffers

NIST standard buffers(DIN 19266)					
TEMP°C	Buffer 1.68	Buffer 4.01	Buffer 6.86	Buffer 9.18	Buffer 12.45
5	1.668	4.004	6.951	9.395	13.207
10	1.670	4.000	6.923	9.332	13.003
15	1.672	3.999	6.900	9.276	12.810
20	1.675	4.001	6.881	9.225	12.627
25	1.679	4.006	6.865	9.180	12.454
30	1.683	4.012	6.853	9.139	12.289
35	1.688	4.021	6.844	9.102	12.133
40	1.694	4.031	6.838	9.068	11.984
45	1.700	4.043	6.834	9.038	11.410
50	1.707	4.057	6.833	9.011	11.705

SUNTEX

SUNTEX INSTRUMENTS CO., LTD.

13F, No. 31, Lane 169, Kangning St.,
Xizhi Dist., New Taipei City, Taiwan (R.O.C.)
Tel: 886-2-2695-9688
Fax: 886-2-2695-9693
e-mail: suntex@ms1.hinet.net

www.suntex.com.tw/en

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