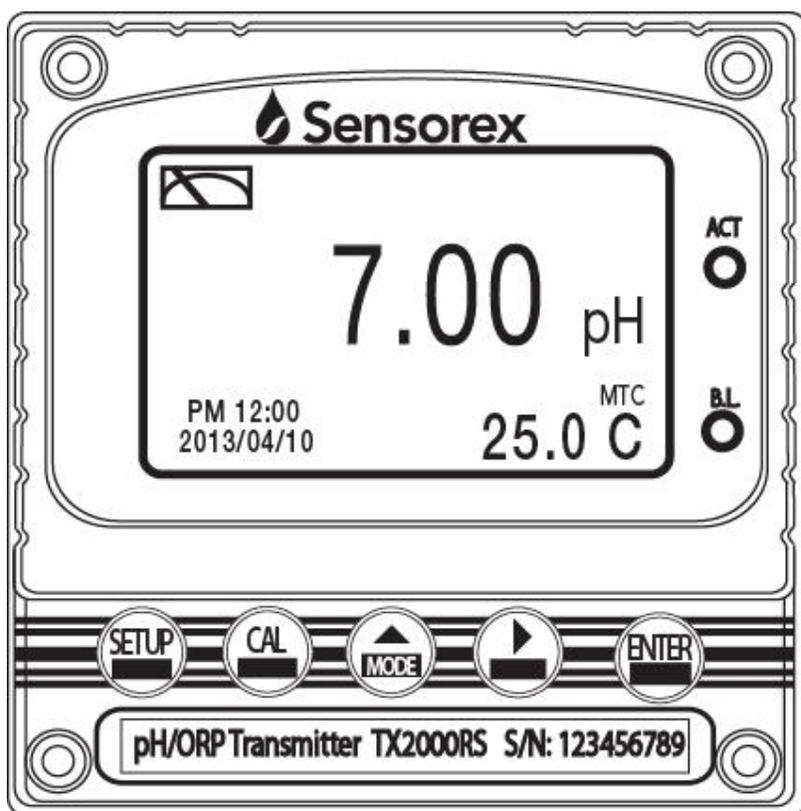


TX2000RS

Intelligent Conductivity Transmitter

Operation Manual



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Thank you for purchasing Suntex products. In order to continually improve and enhance the transmitter's function, Suntex reserves the right to modify the content and icon display of the product. The actual situation is subject to the instrument without notice. The operation manual is only provided for function and installation description, Suntex Instruments Co., Ltd. is not liable for any person or entity for any direct or indirect loss or damage due to improper usage of this product. If you have any questions or find omission, negligence or mistakes of the operation manual, please contact our staff. Thank you.

Precautions for Installation

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

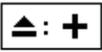
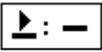
- Make sure to remove AC power from the transmitter before wiring input or output connections. Remove it before opening the transmitter's housing.
- The installation site of the transmitter should have good ventilation and avoid direct sunshine.
- The material of signal cable should be special coaxial cable. We strongly recommend using our coaxial cable. Do not use normal wires.
- Avoid electrical surge when using power, especially when using three-phase power. Use ground wire correctly.
- The internal relay contact of the instruments is for alarm or control function. Due to safety, **please connect to external relays which can stand enough ampere to ensure the safety operation of the instrument.** (Refer to chapter 3.7 "Illustration of electrical connection".)

Brief Instruction

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

Press  and  simultaneously to see the overview of the set-up settings now. Then press  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
		Back to upper layer
		Choose leftward of change to left page
		Increase digit
		Choose rightward of change to right page
		Decrease digit
		Confirm settings after modifications and then go through next step

Selection of Set-up Items

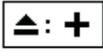
Keypad	Accordingly Item	Description
Mode		Measurement mode, to choose pH or ORP measurement
Multi-Cal.		Multi-point calibration, to choose 1~5 points calibration
Product Adj.		Sample readings adjust settings—Users may make a correction without removing the electrode out of installation site. Adjust the on-site measurements until the reading is the same as the reading from the lab measurement to eliminate the doubt of measurement error.
Temperature		Temperature measurement and compensation, including MTC, PTC, NTC (3 types total). MTC—Manual temperature compensation, PTC/NTC— auto temperature compensation.
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
Clean		Automatic wash time setting, to choose electrode clean equipment's ON and OFF duration
Analog 1		Current output according to pH or ORP setting range
Clock		Clock setting (When out of power, reboot it. The instrument's time setting can maintain to real time. If not, please replace the inner 3V CR2025 battery.)
RS-485		RS485 serial interface (Modbus protocol)
Digital Filter		Take every serial 1~60 measurements, average them continuously, and make it like the readings
Black-light		Backlight setting, to set Auto/ON/OFF backlight, brightness, and sensitivity
Contrast		Contrast of screen setting
Logbook		Event recorder logbook (50 data)
Return		Setting to return 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  and  simultaneously to see the last calibration information. Then press  if you would like to make a new calibration or modify the setting of calibration. Press keypad according to index of keypad on the screen.

Index of Keypad:

Keypad	Accordingly Item	Description
		Back to upper layer
		Choose leftward of change to left page
		Increase digit
		Choose rightward of change to right page
		Decrease digit
		Confirm settings after modifications and then go through next step

Selection of Calibration Items (Up to five-point calibration)

Keypad	Accordingly Item	Description
Code		Security code of calibration mode
Return		Time interval setting of returning to the measurement mode
TECH	TECH	Use tech buffer as standard solution for calibration
NIST	NIST	Use NIST standard buffers (DIN 19266) as standard solution for calibration
Any	Any	Use any buffer solution by users' definition for calibration
Define	DEF	There are five default standard buffer sets. The user can change the default as well as create and save the appropriate standard buffer pH/temperature relation curve to do calibration (memory up to five).

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

Model		TX2000RS
Measuring modes		pH / ORP / Temp.
Ranges	pH	-2.00~16.00 pH
	ORP	-1999~1999 mV
	Temp.	-30.0~130.0 °C
Resolutions	pH	0.01 pH
	ORP	1 mV
	Temp.	0.1 °C
Accuracy	pH	±0.01 pH ± 1 Digit
	ORP	±0.1% ± 1 Digit
	Temp.	±0.2°C (± 1 Digit), equipped with temperature error modification function
Temperature Compensation		NTC30K/ PT 1000 auto temperature compensation
		Manual adjustment temperature compensation
Calibration mode		TECH, NIST, Any Buffers, up to five point calibration
Ambient Temp.		0~50°C
Storage Temp.		-20~70°C
Input Impedance		> 10 ¹² Ω
Display		Large LCM with sensitization sensor for auto/manual illumination function and contract function
		Text mode: Numerical display
		Chart mode: 3 mins real-time dynamic graph
		Trace mode: Set up from 3 mins to four weeks duration of the measured value trend graph
Analog output		Isolated DC 0/4~20mA corresponding to main measurement, max. load 500Ω
Serial interface		RS-485 (MODBUS RTU or ASCII)
Logbook		50 event records
Settings	Contact	RELAY contact , 240VAC 0.5A Max.(recommended)
	Activate	Hi/Lo. Hi/Hi. Lo/Lo selectable two limited programmable, ON/OFF
Wash		RELAY contact: ON 0~99min. 59sec. / OFF 0~999hr 59min.
Voltage Output		DC±12V , 1W max.
Power Supply		100V~240VAC±10% , 9W max. , 50/60Hz
Installation		Wall or Pipe or Panel Mounting
Dimensions		96m × 96mm × 132mm (H×W×D)
Cut off Dimensions		93 mm × 93 mm (H×W)
Weight		0.5Kg
Protection		IP65(NEMA 4X)

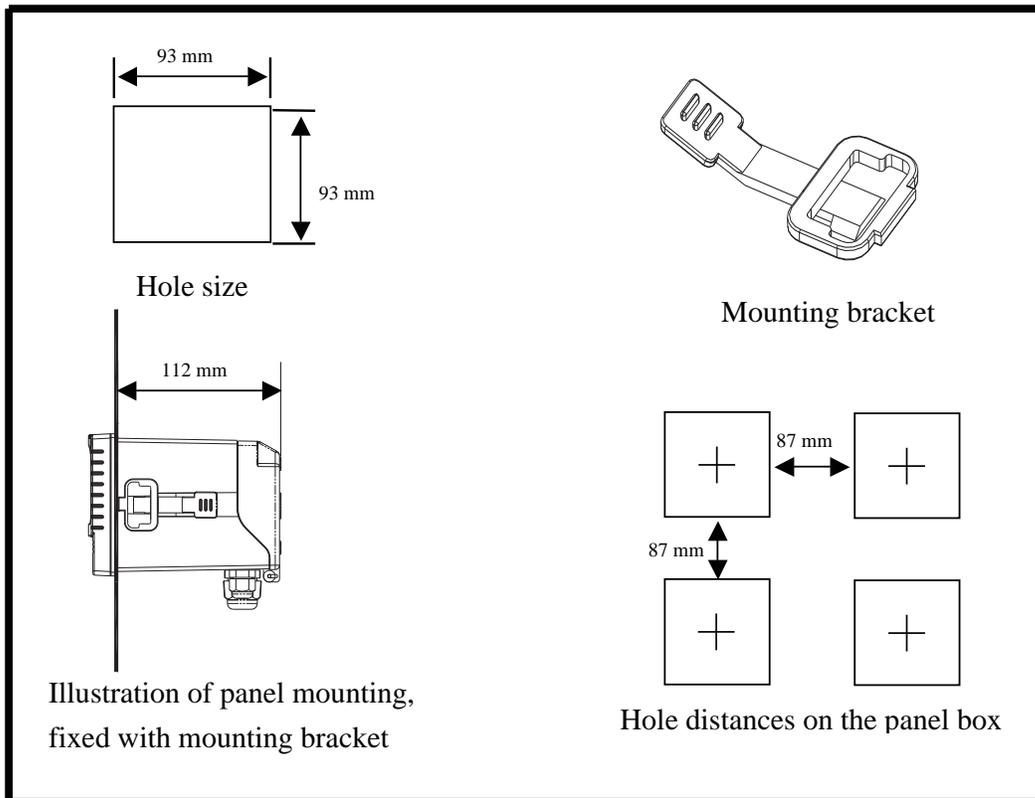
Note: The specifications are subject to change without notice.

2. Assembly and Installation

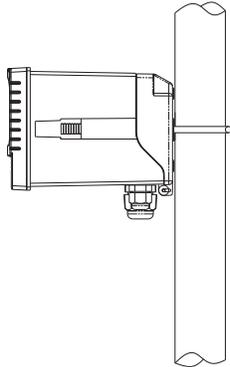
2.1 Transmitter Installation: This transmitter can be installed through panel mounting, wall mounting and 2" pipe mounting.

Installation of Panel Mounting: First, prepare a square hole of 93 x 93mm on the panel box, and then insert the controller directly into the panel box. Insert the accessorial mounting bracket from the rear and fix it into the pickup groove.

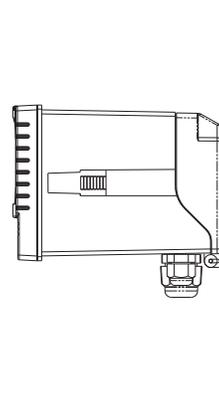
2.2 Illustration of Panel Mounting



2.3 Illustration of Wall Mounting and Pipe Mounting

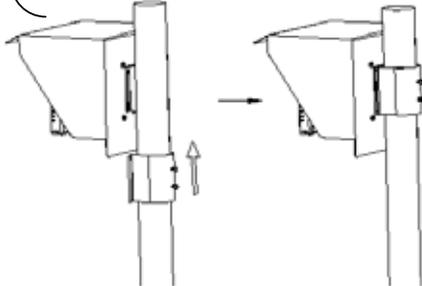


Installation of pipe mounting
fixed with U-shaped pipe clamp.
(Optional, Order Number: 5333027)

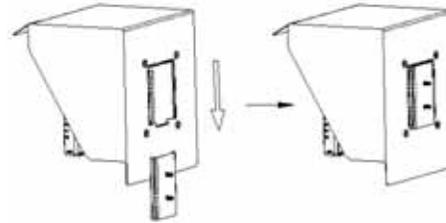


Installation of wall mounting
fixed with 4 x M4 screws

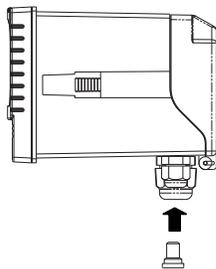
Penetrate the two prepared holes in the rear cover and fix the U-shaped pipe clip. Then, install two waterproof squeezed caps (the transmitter's standard accessory kit) into the holes from inner rear cover to prevent from water vapor.



Sun Shield (Pipe mounting, Optional)
(Order No.: 8-35 + 8-35-3 + 8-35-1)



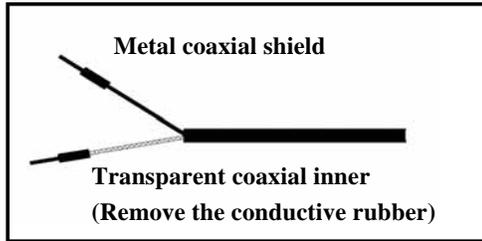
Sun Shield (Wall mounting, Optional)
(Order No.: 8-35 + 8-35-3 + 8-35-2)



Insert the single hole rubber plug into the unused cable gland. Tighten up the cable gland to prevent from the penetration of water vapor.

2.4 Assembly of Electrode and Housing

2.4.1 Cable Set-up



Set-up diagram of coaxial cable:

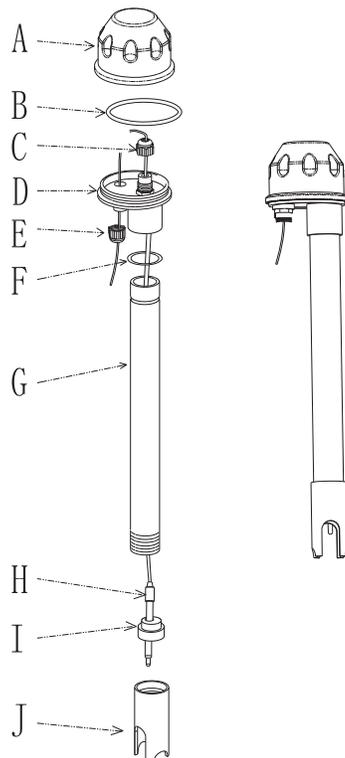
See the correct set-up method on the left:

Note: The black conductive rubber covering on the coaxial inner should be removed.

- Make sure to remove the conductive rubber or aluminum foil layer between the electrode signal wire and the coaxial shield.
- Extend the cable to the transmitter without any joint, except specific junction box. Connect the transparent coaxial inner directly to the glass terminal on the back of the transmitter and metal, connect coaxial shield to ref. terminal.

2.4.2 Assembly of Immersive Electrode Holder and Junction Box 8-09-5+ PP-100A

(Optional)



A----- Upper cover of round junction box

B----- O-ring

C----- Cable fixing gland MG16A

D----- Lower cover of round junction box

E----- Cable fixing point MG16A

F----- O-ring

G----- PP Electrode Protective Housing

H----- Electrode (Sensor)

I----- Rubber electrode holder

J----- PP pipe protective cover

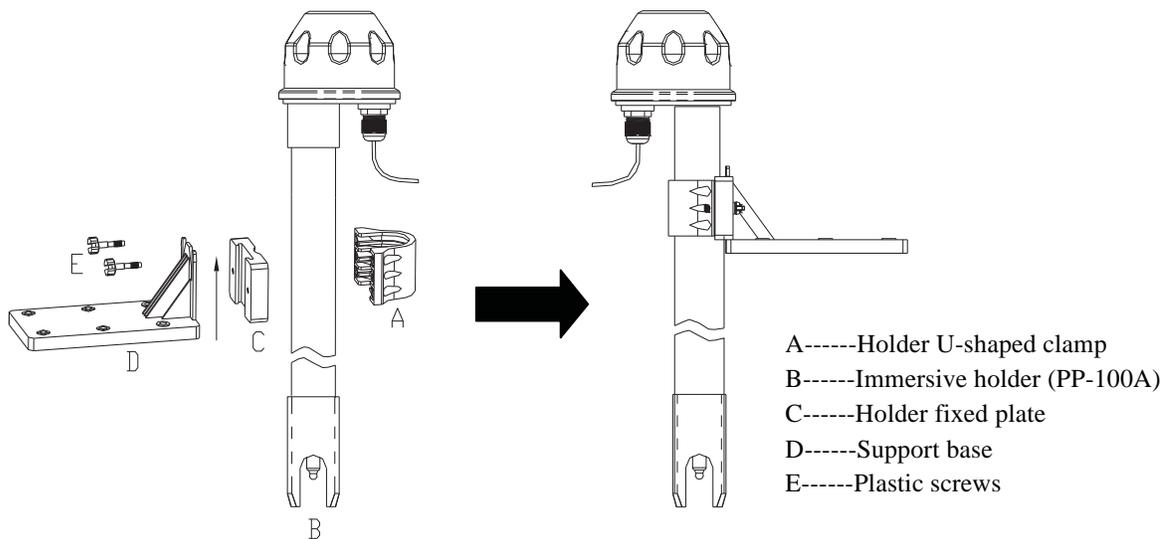
- Insert the electrode (**H**) through PP Electrode Protective Housing (**G**)
- Rinse the electrode (**H**) properly so that it can easily pass through the rubber electrode holder (**I**). Leave about 5cm below.
- Install the prepared rubber electrode holder (**I**) into PP Electrode Protective Holder (**G**) and

fix with PP pipe protective cover (**J**) tightly.

4. Insert the electrode cable (**H**) through lower cover of round junction box (**D**) and cable fixing gland (**C**). Use lower cover of round junction box (**D**) to fix PP Electrode Protective Housing (**G**) tightly.
5. Prepare 15cm cable in the PP pipe, and then fix cable fixing gland MG16A (**C**) tightly. Leave Electrode cable (**H**) for about 12-14cm. Then split it carefully.
6. Fix the terminal of electrode coaxial inner on terminal block 1 of round holder. Fix the terminal of electrode coaxial shield on terminal block 3. (See the instruction of junction box)
7. Extend the cable to pass through cable fixing gland (**E**) on lower cover of round junction box (**D**), and fix cable fixing gland MG16A (**E**) tightly, leaving 12-14cm in the box for split.
8. Extend the lead coaxial inner and electrode coaxial inner to connect them. Extend the lead coaxial shield to fix on the terminal block 3. Tighten up upper cover of round junction box (**A**) to finish the installation.

Installation of Holder Support Base

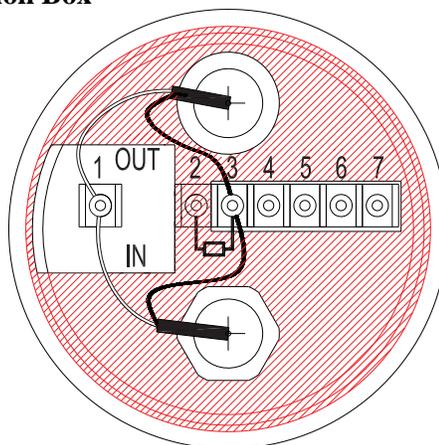
The L-shaped electrode holder support base is installed by finding an appropriate position in the edge of a pool according to the field's needs with nails or expansion screws.



1. Fix the holder fixed plate (C) into the support base (D)
2. Fix the U-shaped clamp (A) into immersive holder (B)
3. Combine the item 1 and item 2, tighten it up by the plastic screws (E)

2.5 Illustration and Description of Junction Box

(Two-wire distributing system
and three-wire distributing system)



(1) Two-wire distributing system			
INPUT Terminals	Terminal No.	OUTPUT Terminals	Terminals on Transmitter
Coaxial inner	1	Coaxial inner's extension wire for electrode	GLASS
Shield (forbidden)	2	Shield (forbidden)	-----
Coaxial shield	3	Coaxial shield's extension wire for electrode	REF
Temperature probe red wire	4	Red wire's extension wire for electrode	T/P
Temperature probe green wire	5	Green wire's extension wire for electrode	SG
Alternative	6, 7	Alternative	-----

Note: 1. Extension cable, Order number: 7202-F94009-BK or 7202-RG-58

1) If temperature probe is not used, the Order No. is 7202-RG-58.

2) If temperature probe is used, the Order No. is 7202-F94009-BK.

2. If temperatures probe 8-26-3 (NTC30K) or 8-26-8 (PT1000) is used for two-wire distribution, the black wire terminal should be forbidden.

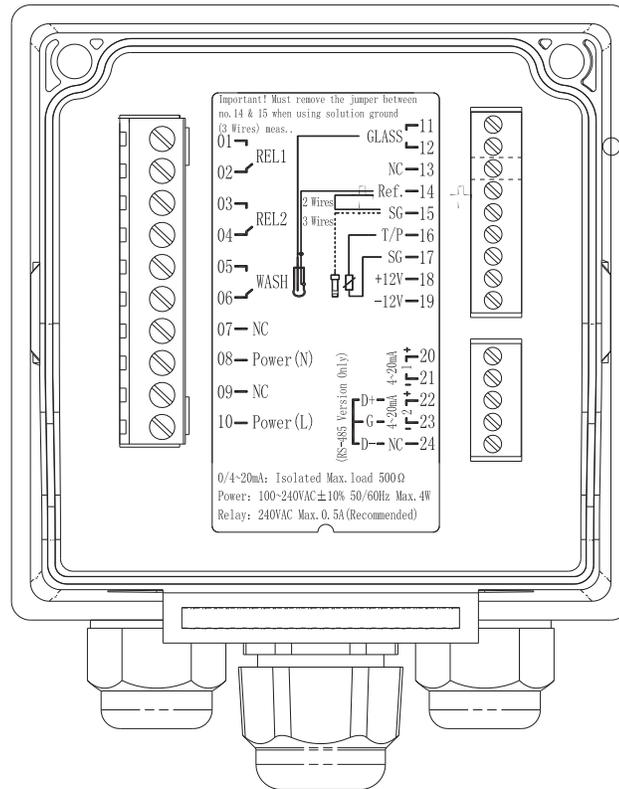
(2) Three-wire distributing system			
IN Terminals	Terminal No.	OUT Terminals	Terminals on Transmitter
Coaxial inner	1	Coaxial inner's extension wire for electrode	GLASS
Solution ground wire (Shield)	2	Solution ground wire	SG

Coaxial shield	3	Coaxial shield's extension wire for electrode	REF
Temperature probe red wire	4	Red wire's extension wire for electrode	T/P
Temperature probe green wire	5	Green wire's extension wire for electrode	SG
Alternative	6, 7	Alternative	----

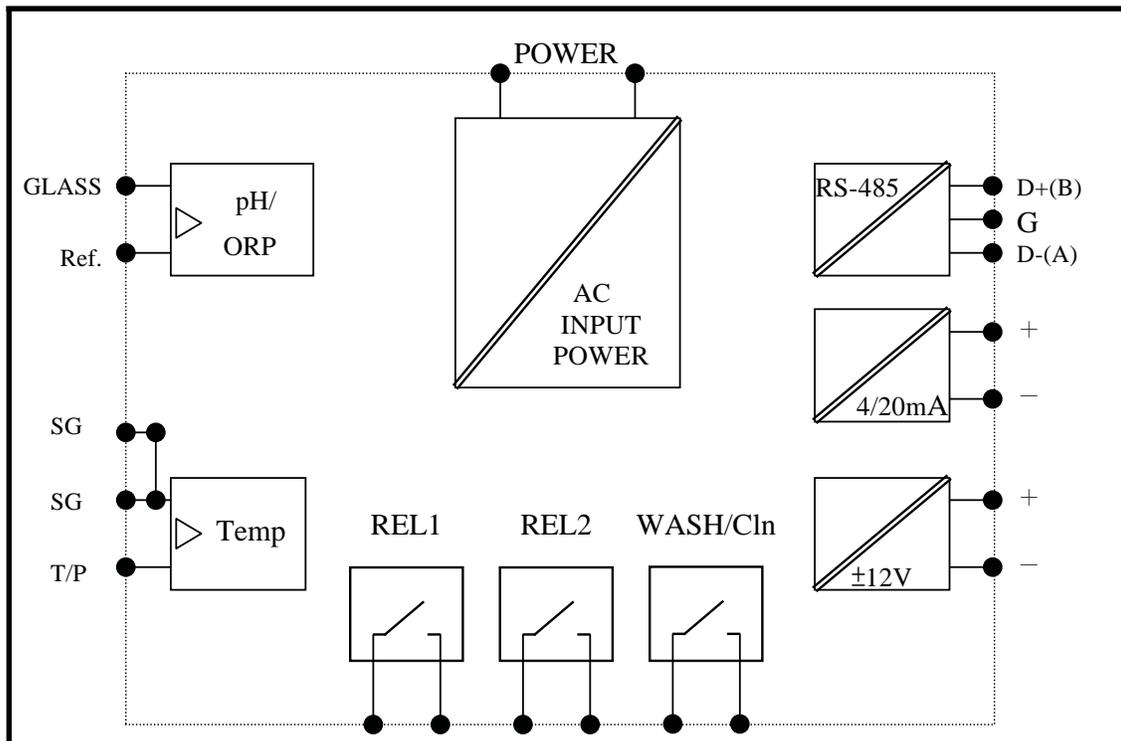
- Note: 1. The black wire on the temperature probes of 8-26-3 (NTC30K) or 8-26-8 (PT-1000) is used as special wire as solution ground rod which is to be connected at terminal 2.
2. The extension cable, Order Number: 7202-F94009-BK, is for system that apply a temperature probe or solution ground rod.

3. Overview of pH Transmitter TX2000RS

3.1 Illustration of Rear Panel

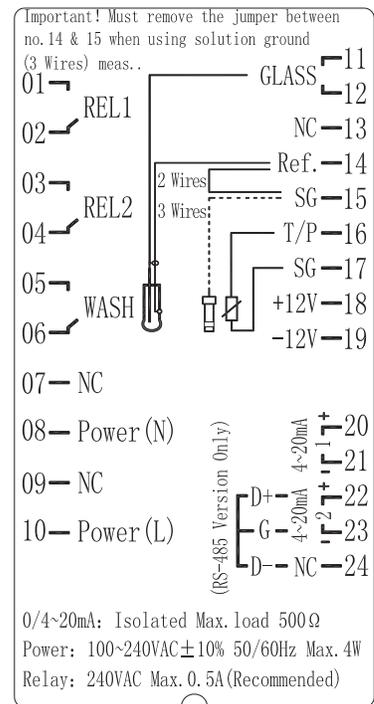


3.2 Illustration of Terminal Function



3.3 Description of Terminal Function:

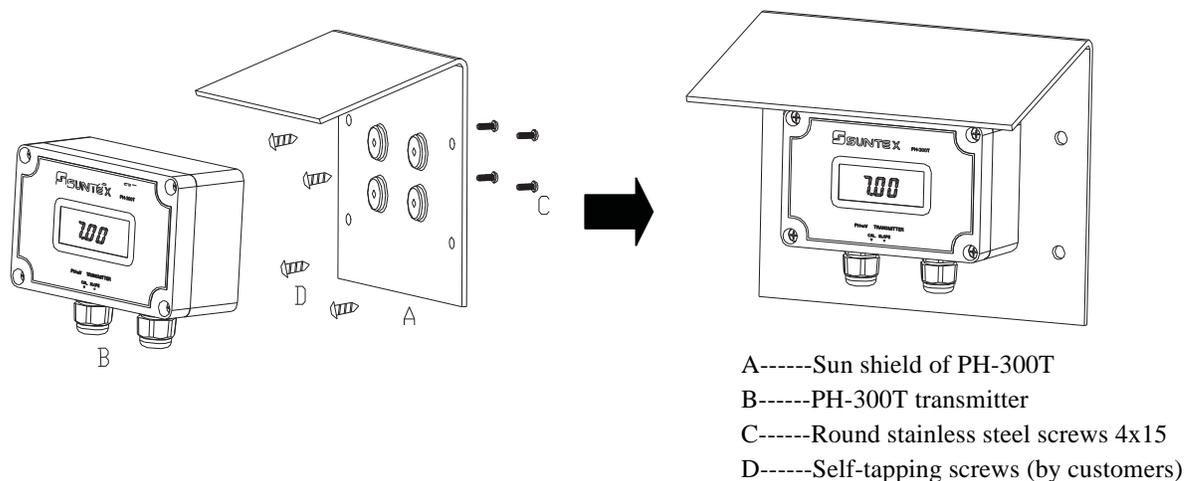
0 1	┌───┐	REL1: First alarm control, the contact for an external relay
0 2		
0 3	┌───┐	REL2: Second alarm control, the contact for an external relay
0 4		
0 5	┌───┐	WASH: Wash relay contact for an external relay
0 6		
0 7	───	NC: None contact
0 8	───	100~240VAC: Power supply terminal
0 9	───	NC : None contact
1 0	───	100~240VAC: Power supply terminal
1 1	┌───┐	GLASS: Coaxial inner of pH/ORP electrode signal wire
1 2		
1 3	───	NC: None contact
1 4	───	REF: Coaxial shield of pH/ORP electrode signal wire
1 5	───	SG: Solution ground wire. In two-wire distributing system, there should be a jumper between this terminal and REF (a short circuit slice is attached when going out the factory)
1 6	───	T/P: Connect with one cable end of temperature probe
1 7	───	SG: The other cable end of temperature probe, or used as ±12V ground potential.
1 8	┌───┐	DC±12V: Output terminal of direct current voltage ±12V (PH-300T only)
1 9		
2 0	───	4~20mA + terminal: Master measure current output terminal +, for external recorder or PLC control
2 1	───	4~20mA - terminal: Master measure current output terminal -, for external recorder or PLC control
2 2	───	4~20mA + terminal/ D+(B): Temperature current output terminal +, for external recorder or PLC control (only applicable for TX2000); or RS-485 output D+(B) (only applicable for TX2000RS)
2 3	───	4~20mA - terminal/ G: Temperature current output terminal -, for external recorder or PLC control (only applicable for TX2000); or RS-485 output GND (only applicable for TX2000RS)
2 4	───	NC / D-(A): NC or RS-485 output D-(A) (only applicable for TX2000RS) or RS-485 output D-(A) (only applicable for TX2000RS)



3.4 Installation of Accessorial Transmitter PH-300T (Optional)

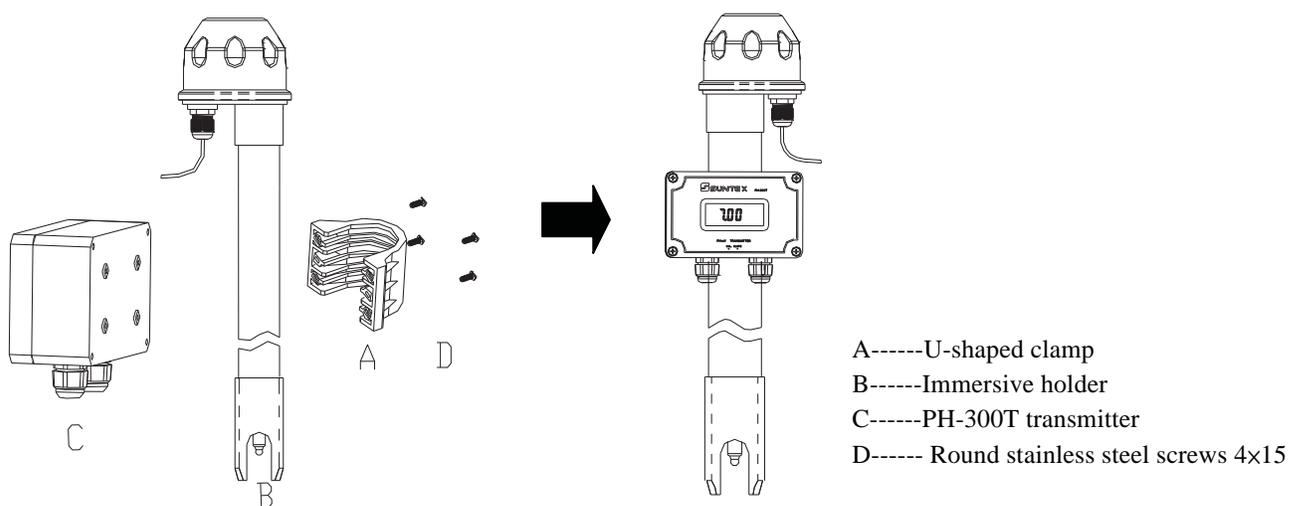
Accessorial pH/ORP transmitter, PH-300T, is mainly installed on the electrode protective pipe, but it can also apply to wall mounting and pipe mounting. For long distance transmission (100m), if TX2000RS is more than 30m far away from the electrode, PH-300T accessorial transmitter is recommended to avoid the attenuation of electrode signal and for the convenience of onsite observation, measurement, and calibration.

Illustration of Wall Mounting Type



1. Combine the sun shield and PH-300T transmitter by round stainless steel screws 4x15
2. Fix item 1 combination on wall by self-tapping screws

Illustration of Pipe Mounting Type



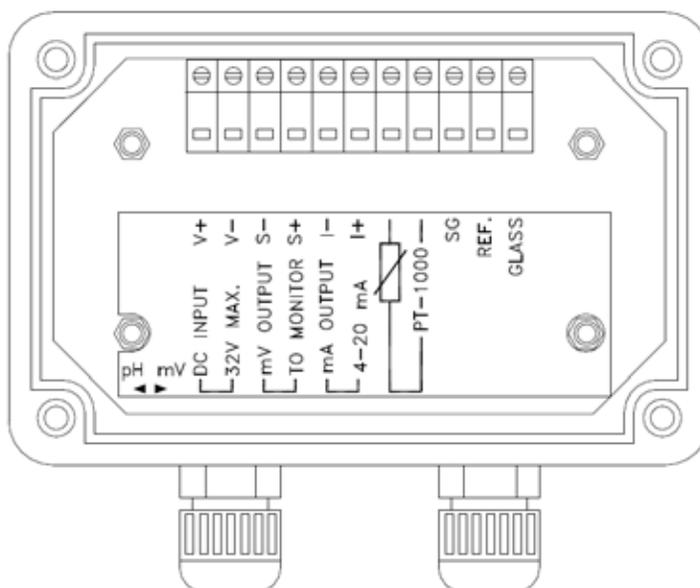
1. Fix immersive holder (B) into U-shaped clamp (A)
2. Combine the item 1 combination with PH-300T (C) by round stainless steel screws 4x15

3.5 Connection of Transmitter TX2000RS and accessorial transmitter PH-300T

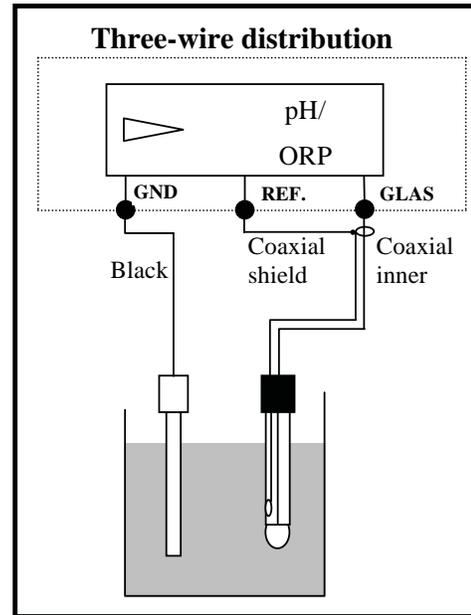
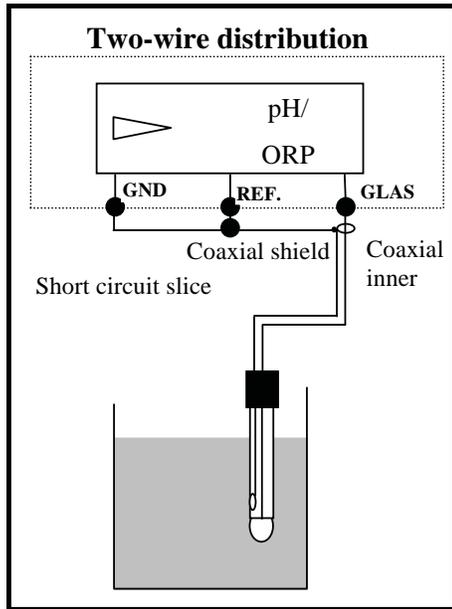
- A. Connect the GLASS point of transmitter PH-300T's terminal to the electrode coaxial inner (Note: Remove the black conductive rubber). Connect the REF point of transmitter PH-300T's terminal to the electrode coaxial shield.
- B. See the two-wire distributing system and three-wire distributing system in the following page.
- C. Sign "PT-1000" on transmitter. PH-300T's terminal is the connector for automatic temperature compensation probe, PT-1000, or applies a fixed temperature compensation resistance.
- D. The V+ and V- of transmitter PH-300T's terminal respectively connect to DC12V+ and - of the controller.
- E. The S+ and S- on transmitter PH-300T's terminal respectively connect to GLASS and REF of the controller.
- F. The I+ and I- on transmitter PH-300T's terminal are output (4-20mA), which can connect to devices that receive current signals. **(Note: The current output signal of this transmitter is not insulating, and thus do not directly connect with a PLC!)**

Note: Refer to the following table for proper fixed temperature compensation resistance

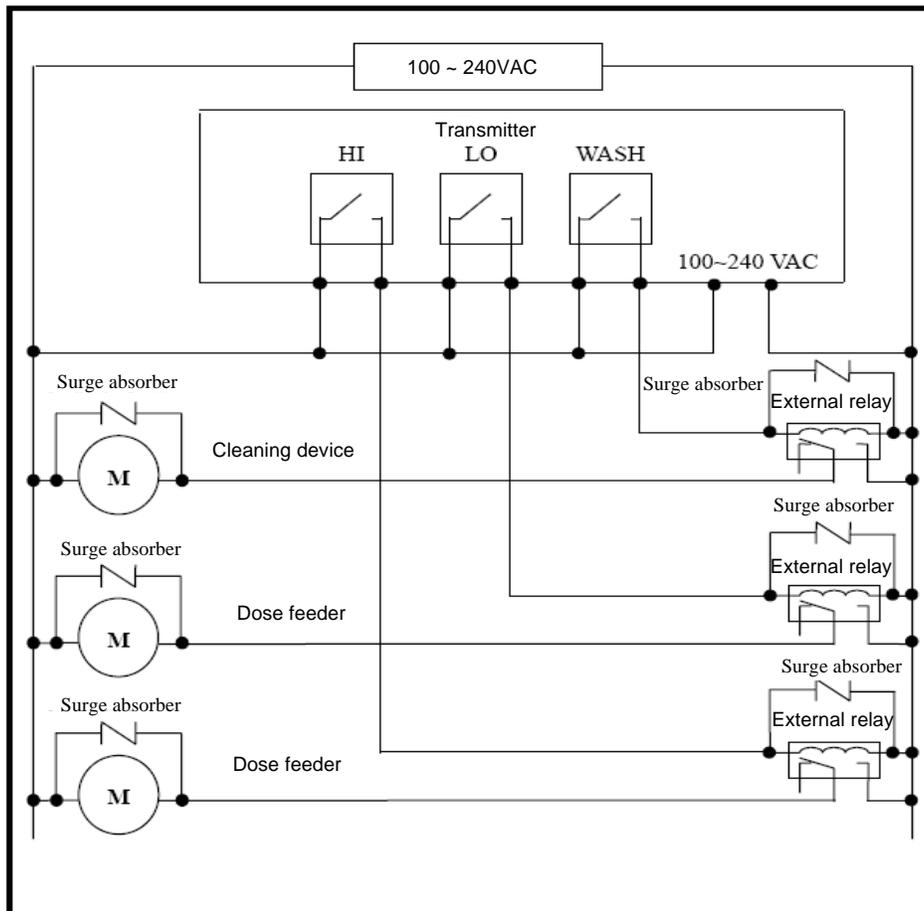
Temperature	0°C	5°C	10°C	15°C	20°C
R value	1000Ω	1019.25Ω	1038.5Ω	1057.75Ω	1077Ω
Temperature	25°C	30°C	35°C	40°C	45°C
R value	1096.25Ω	1115.5Ω	1134.75Ω	1154Ω	1173.25Ω
Temperature	50°C	55°C	60°C	65°C	70°C
R value	1192.5Ω	1211.75Ω	1231Ω	1250.25Ω	1269.5Ω
Temperature	75°C	80°C	85°C	90°C	100°C
R value	1288.75Ω	1308Ω	1327.25Ω	1346.5Ω	1385Ω



3.6 Typical Wirings



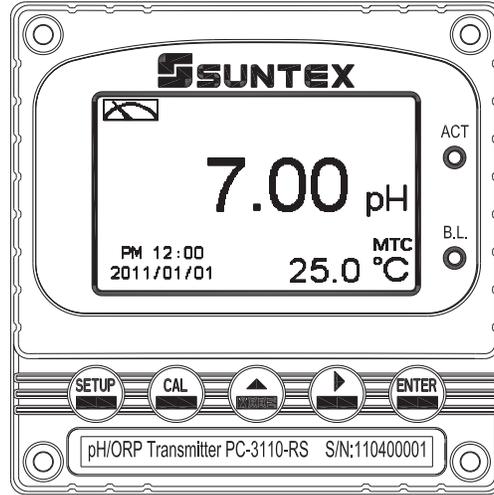
3.7 Illustration of Electrical Connection



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:

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

-  : In the parameter set-up mode, pressing this key allows you to exit parameter set-up mode and go back to measurement mode.
-  : In the calibration mode, pressing this key allows you to exit calibration mode and go back to measurement mode.
-  :
 1. In the parameter set-up mode and calibration mode, press this key to go left or to 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, press this key to go right or to change to another page.
 2. When adjusting value, press this key to decrease the value.
-  : 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: Washing device operation indicator and controlling operation indicator (Relay 1, Relay 2)

B.L.: Light sensor; in the automatic display backlit mode, the lamp will light or turn off depending on the 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 enter measurement mode with the factory default settings or the last settings from the user.

5.2 Set-up Menu

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

5.3 Calibration Menu

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

5.4 Shortcuts:

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

5.5 Default Value:

5.4.1 Setting default value:

Measurement mode: pH
Multi-Cal: 2 points pre-setting
Temperature compensation: MTC 25°C
Relay 1: High point alarm: AUTO, SP1= 10.00 pH, Hys= 0.10 pH
Relay 2: Low point alarm: AUTO, SP2 =04.00 pH, Hys= 0.10 pH
Wash time: OFF
Analog 1 current output (pH/ORP): 4~20 mA, 0.00~14.00pH
RS-485: RTU, Even, 19200, ID: 01
Digital filter: 5
Backlight setting: Off
Code set-up: OFF
Date & Time: 2012/1/1 00:00:00
Contrast: 0
Logbook: None
Auto back: Auto, 3 minutes

5.4.2 Calibration default value:

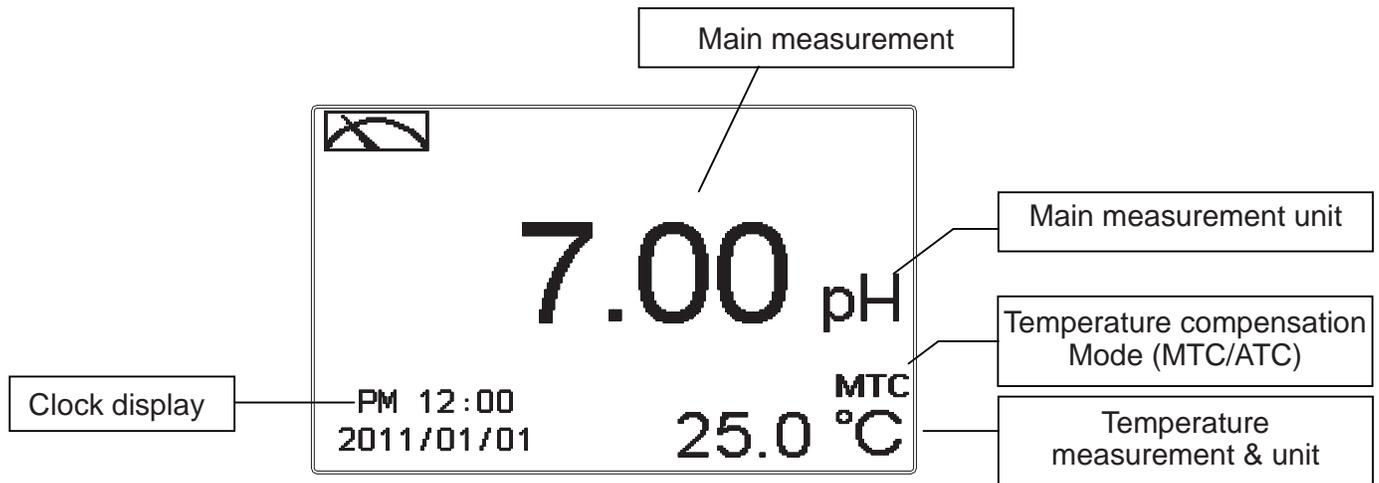
Asy: 0 mV
Slope: -59.15 mV/pH @ 25.0°C
Calibration type: TECH-No Cal
Calibration value: None data
Auto back: Auto, 3 minutes

Note: The factory default of calibration presetting is “No Cal”, and the calibration value is “None”. It means that the user has not calibrated the sensor with the transmitter yet. After finishing every calibration, the display shows the calibration type and the calibration value. If the equipments have not been calibrated yet, the measurement takes pre-set Asy and Slope into calculation. The factory default values are subject to change without notice.

6. Measurement display mode

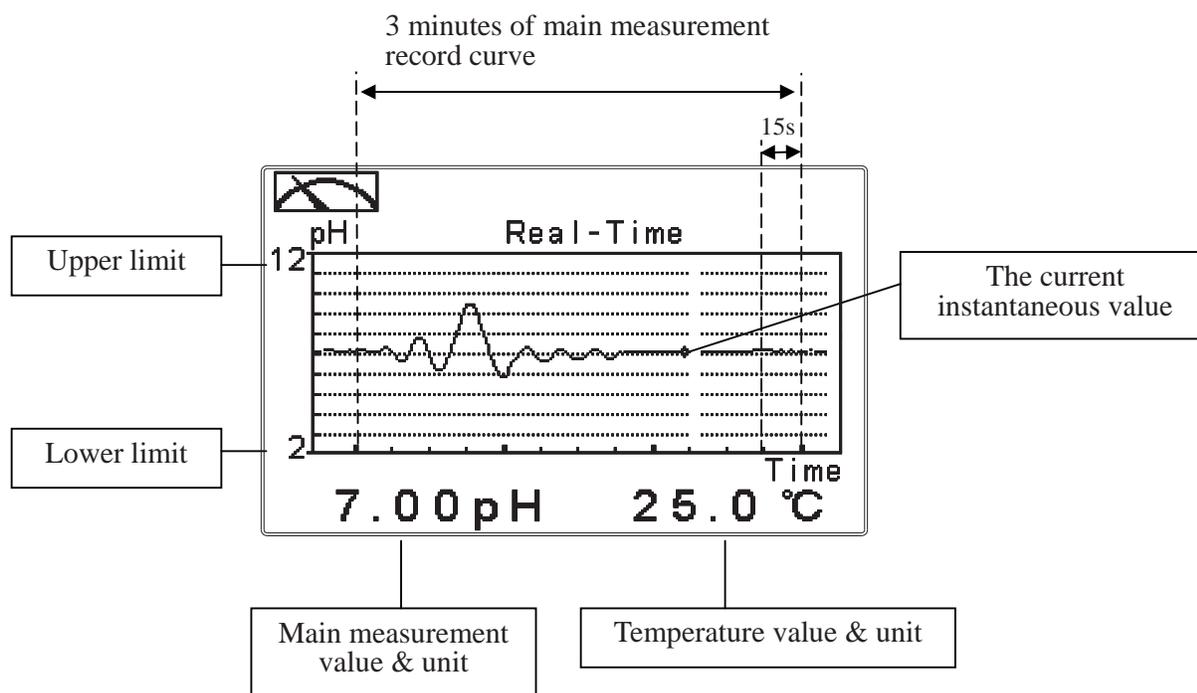
6.1 Text mode

The text 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 pH / ORP 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).

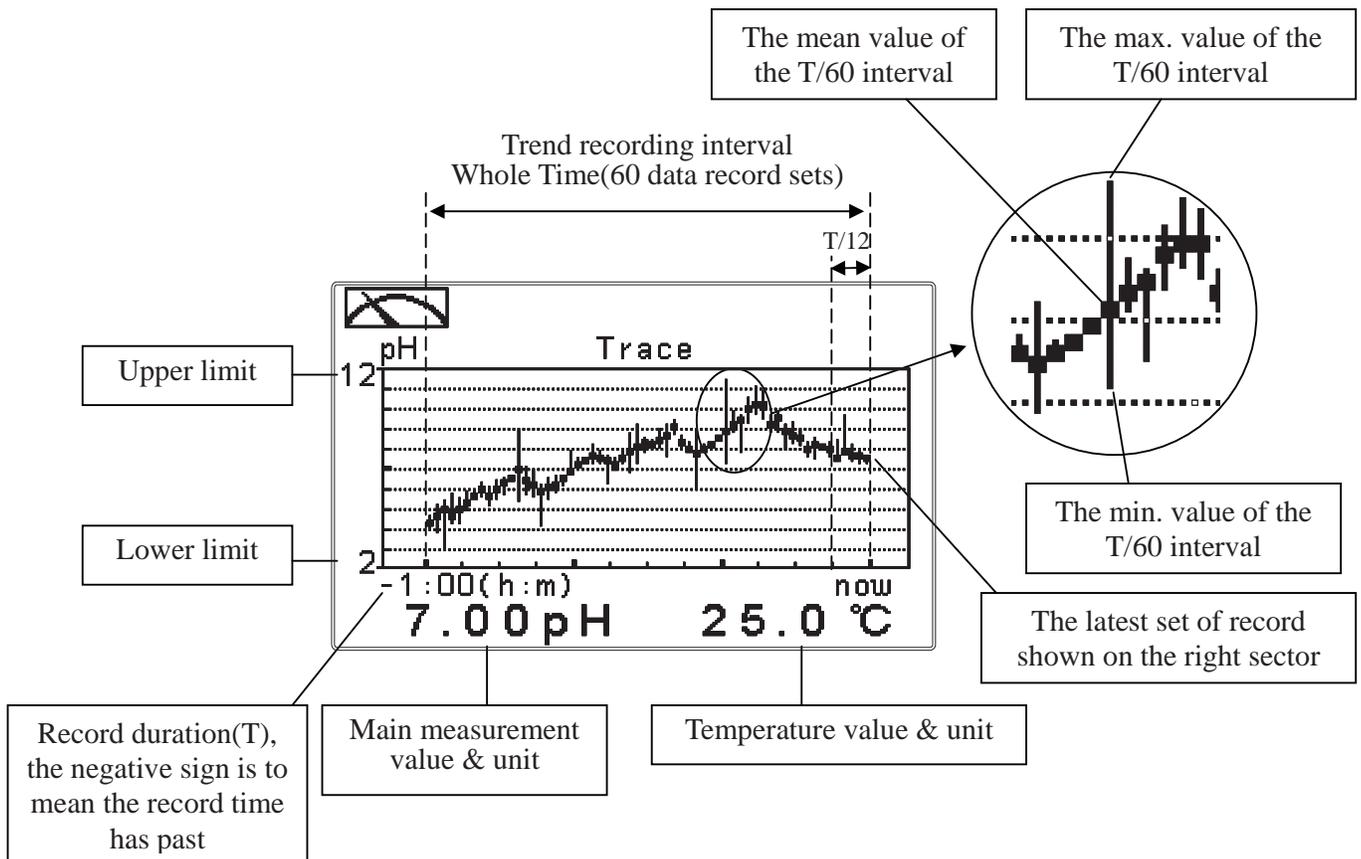


6.3 Trace mode

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 pH / ORP 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.

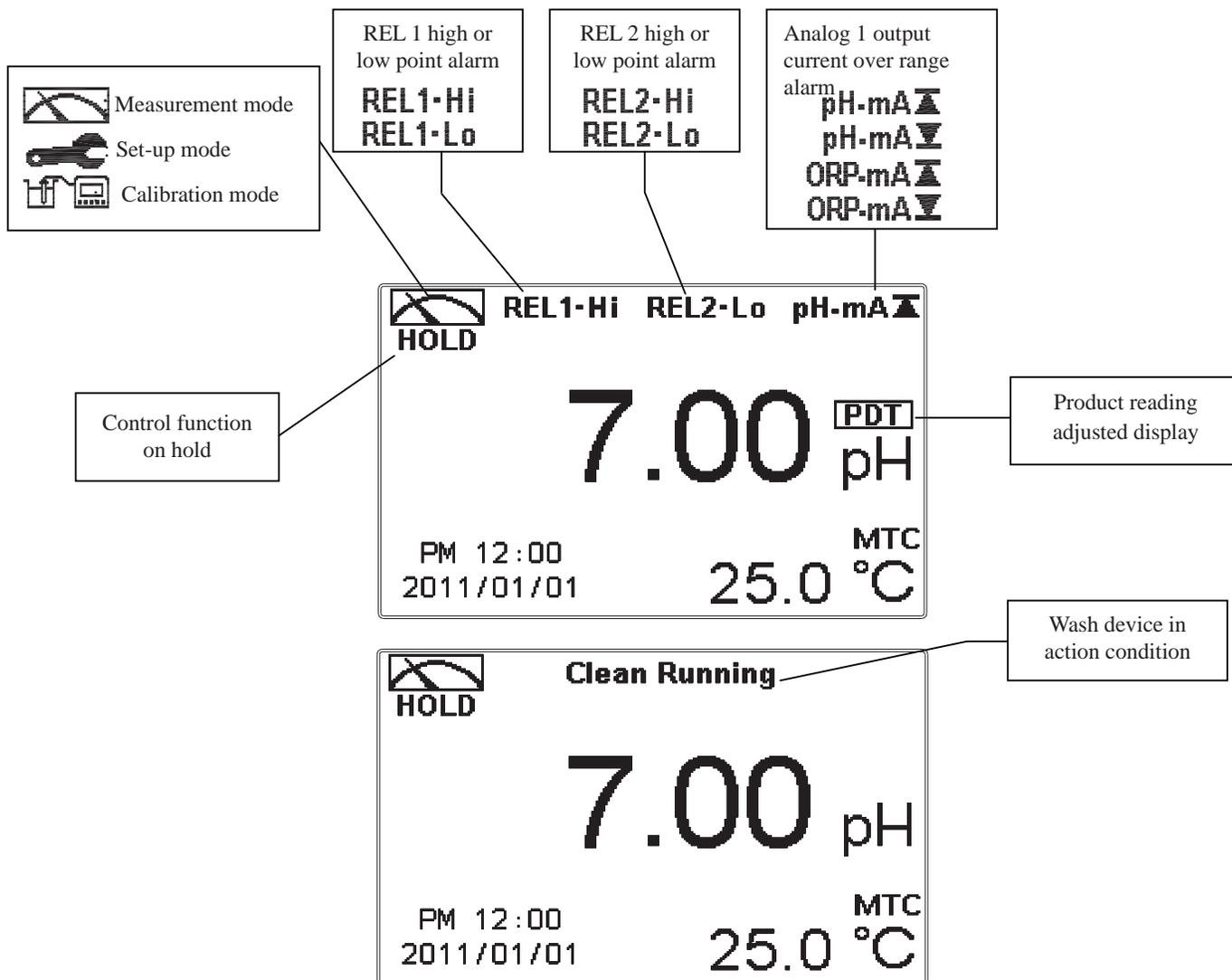
Attention: When the time interval has been reset, the trend in the data will not be retained, it will start a new trace record.

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 wash device is turned on, the display shows and twinkles the description, “Clean Running”. 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, 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 1 current output exceeds the upper/lower limitation, the display twinkles ”pH-mA▲ / pH-mA ▼” or ”ORP-mA▲ / ORP-mA▼“

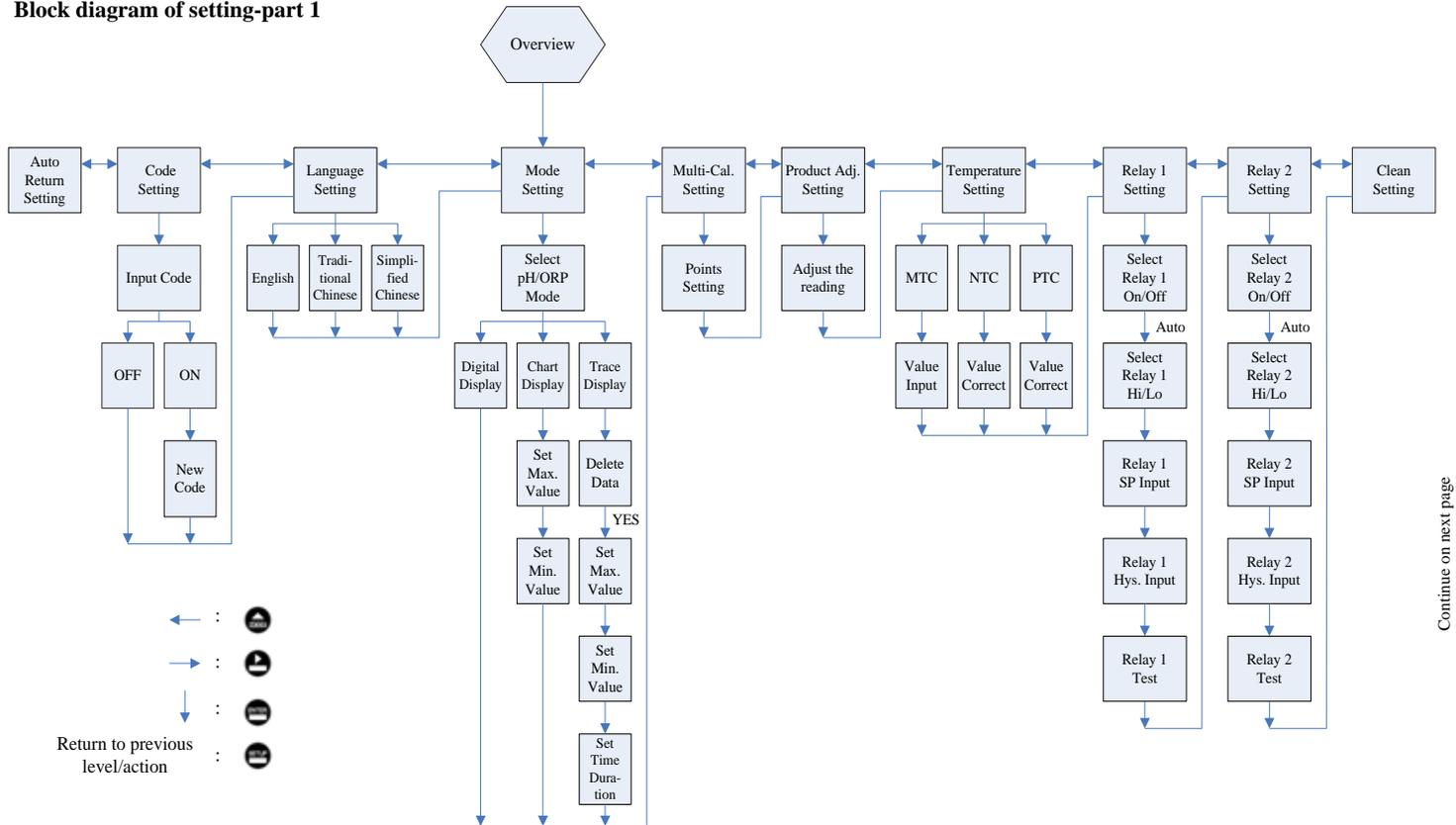


Note: The “HOLD” warning text appears when clean function is activated, or when entering setup menu, or when entering calibration menu. Under HOLD status, the corresponding display and output as follows:

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.
3. The last signal output value of RS-485 interface is kept at the last output value before HOLD status.

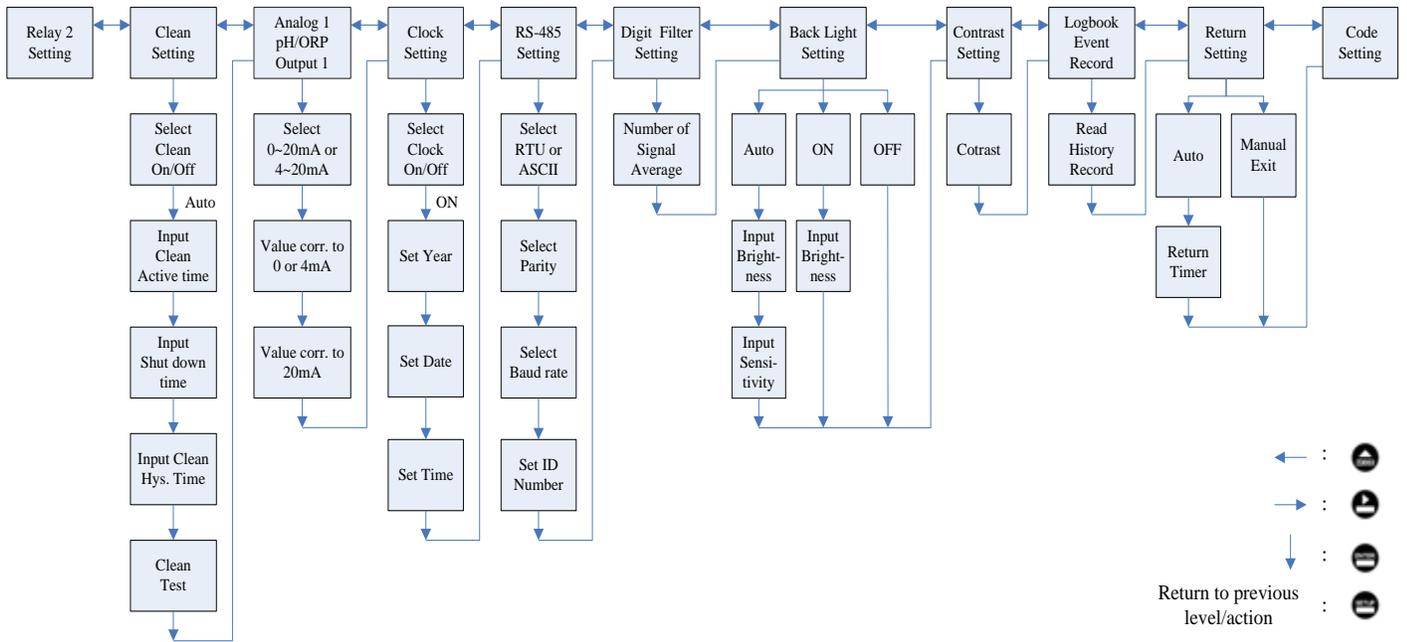
7. Settings

Block diagram of setting-part 1



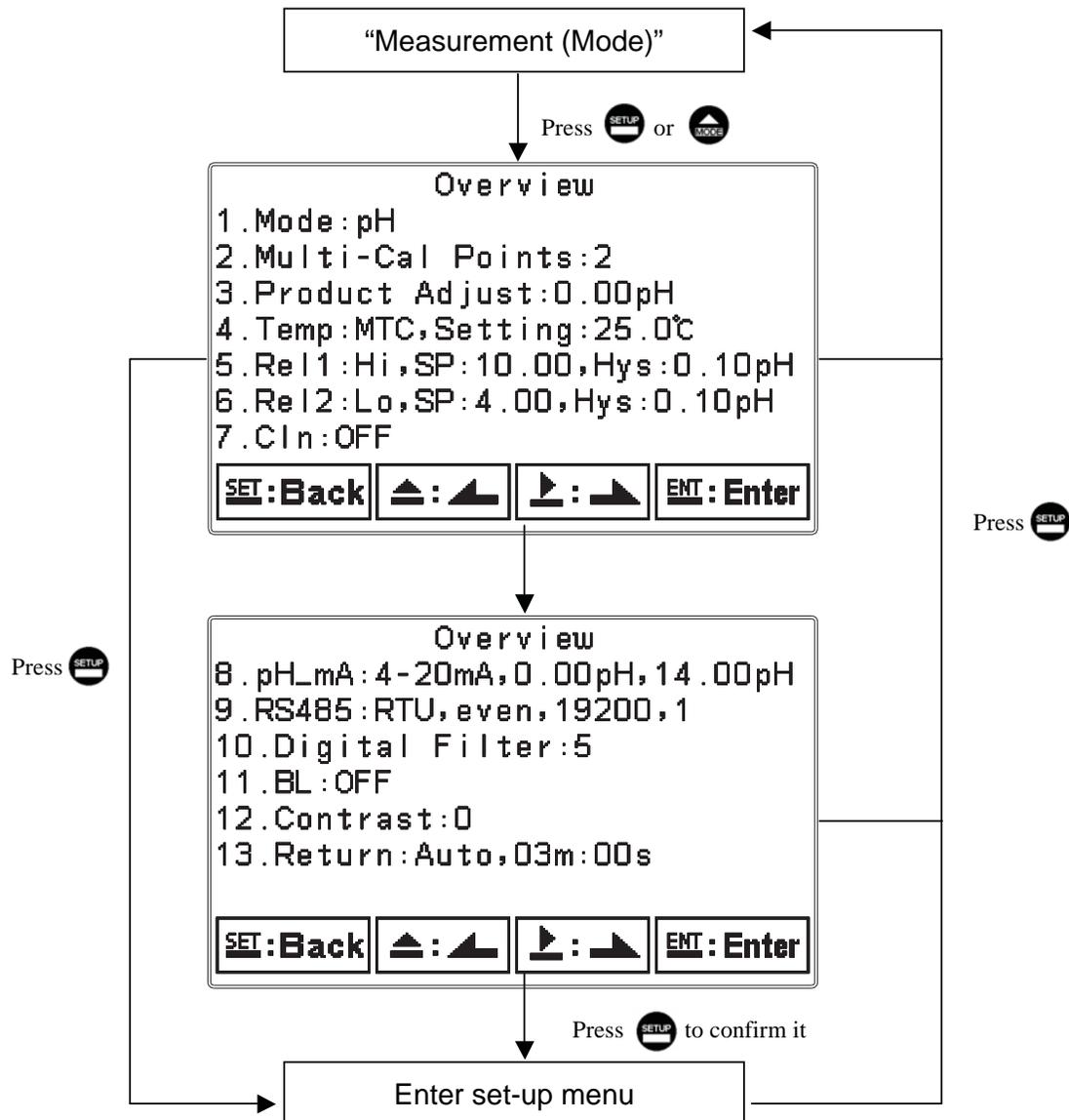
Block diagram of setting-part 2

Connected with previous page



7.1 Entry of Set-up Menu

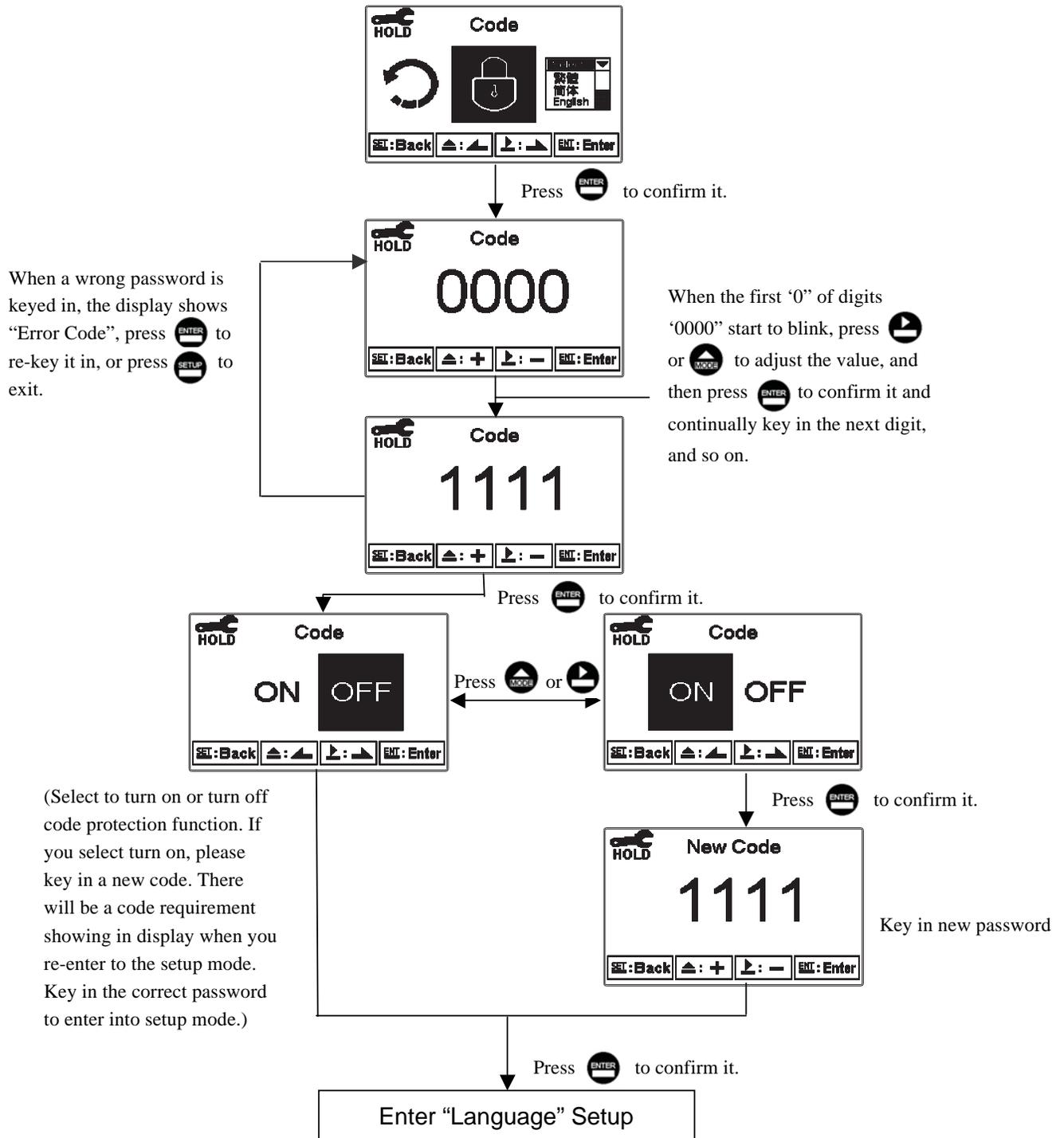
In the measurement mode, pressing the two keys  and  simultaneously allows you to view the current settings. Press  to enter the set-up mode and to modify the setting if necessary.



7.2 Security Code of Settings

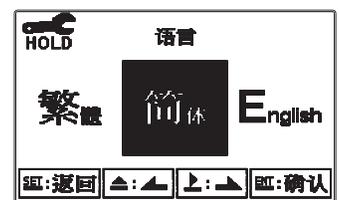
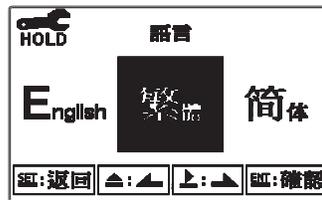
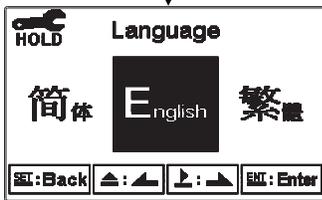
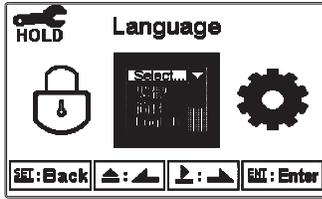
After entering set-up mode, select “code” item then press  to enter in the code procedure. **The code pre-setting is 1111.**

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.



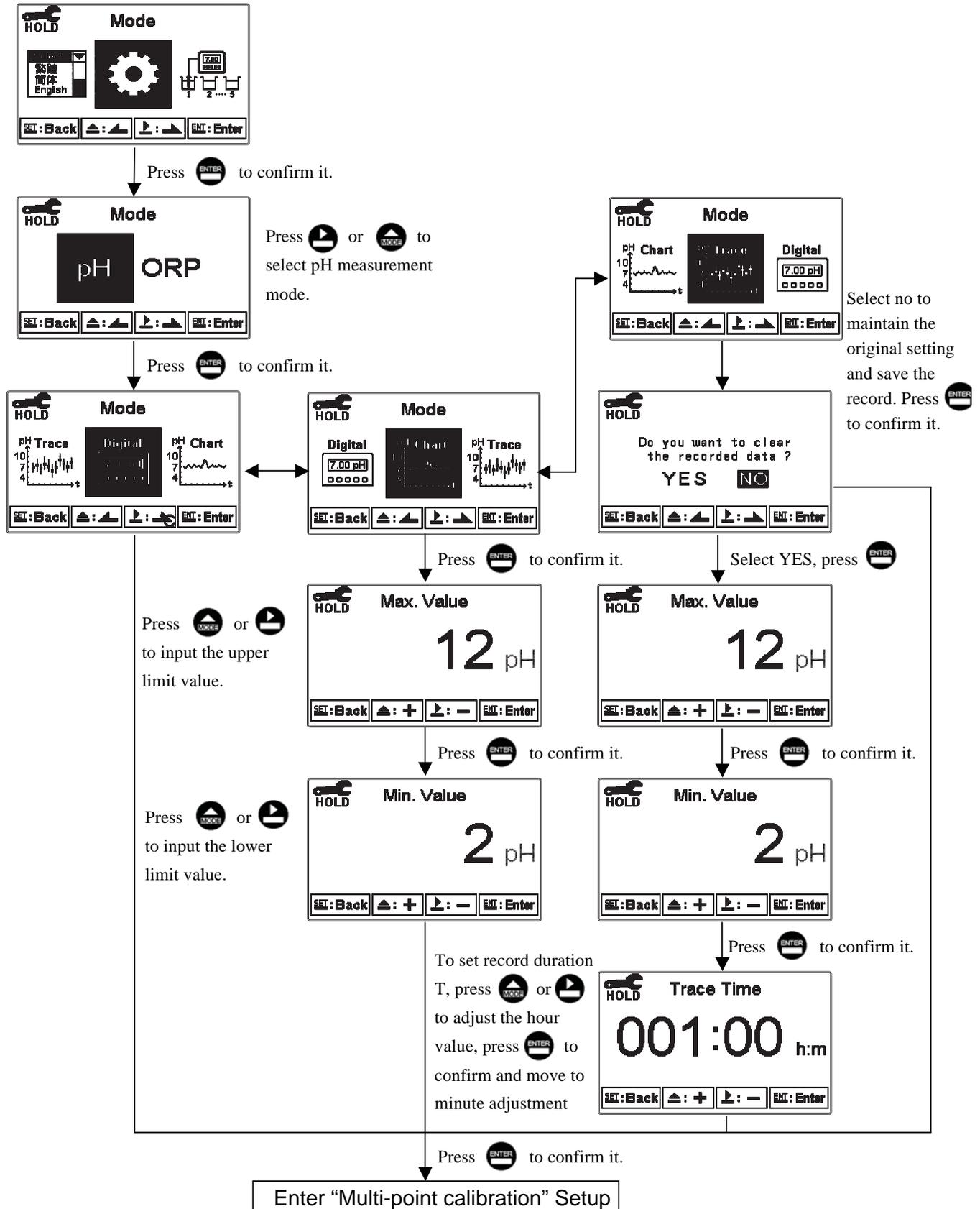
7.3 Language

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

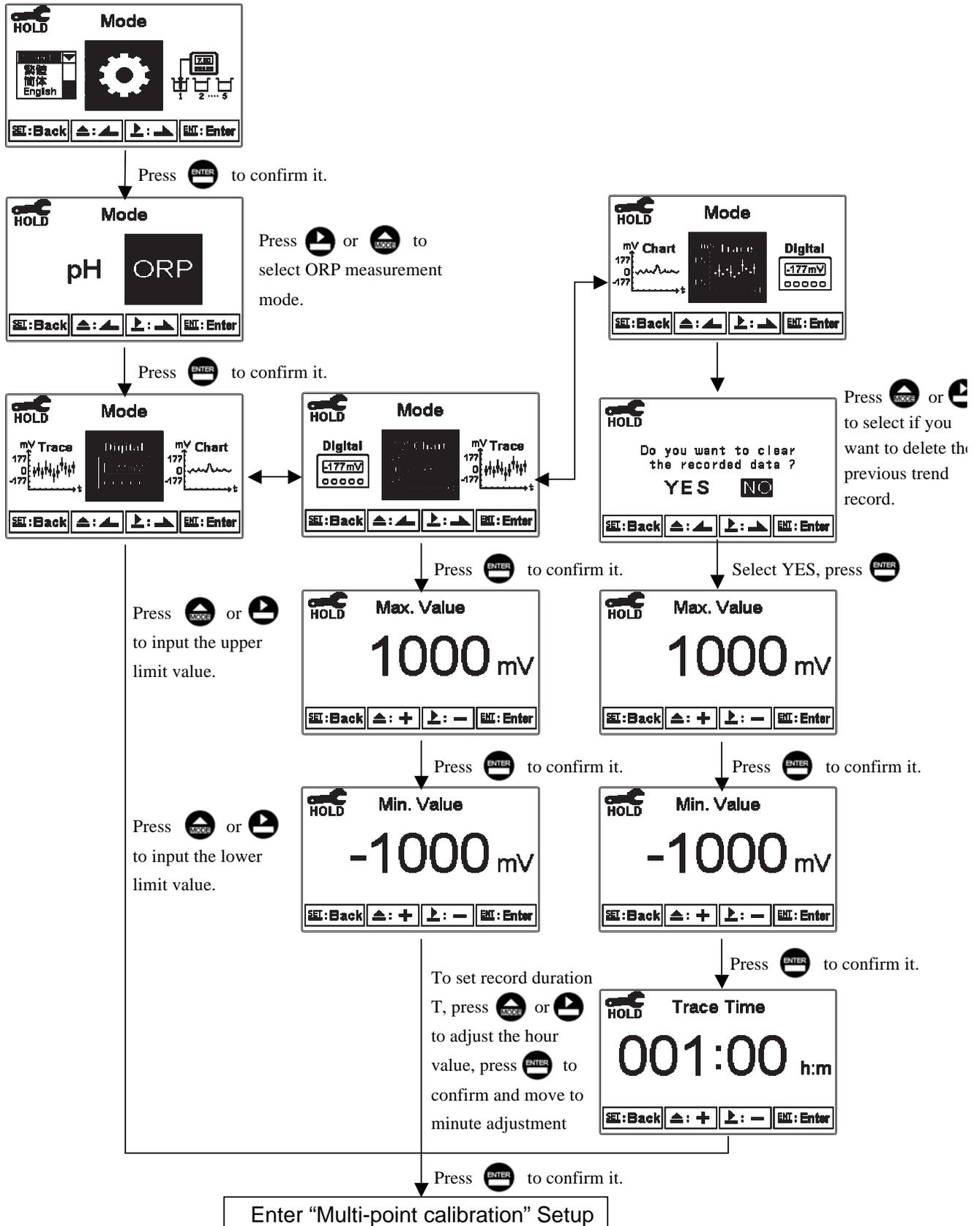


7.4 Mode

7.4.1 Enter setup of Mode, select pH measurement mode and select the display mode.

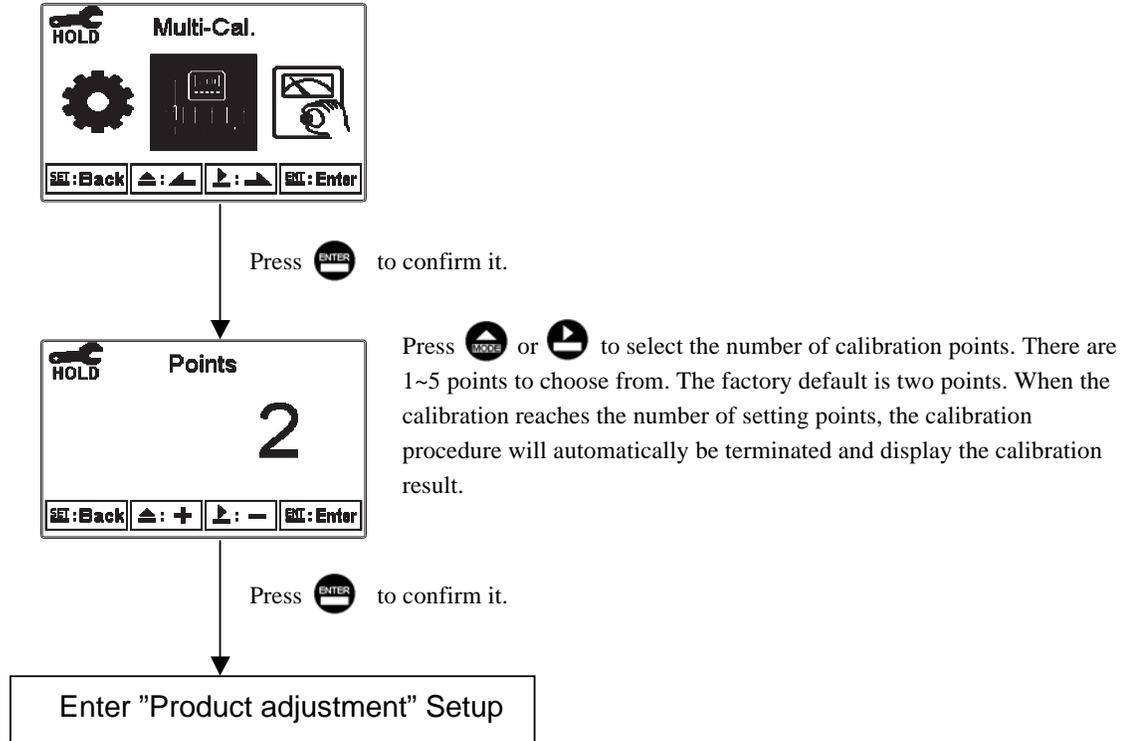


7.4.2 Enter setup of Mode, select ORP measurement mode and select the display mode.



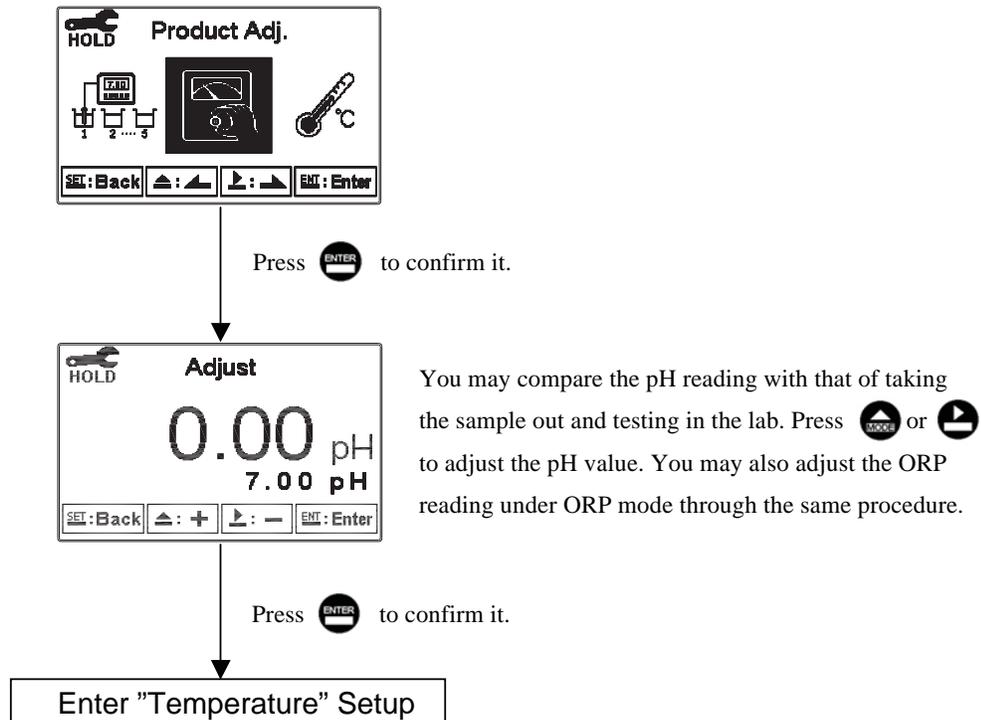
7.5 Multi-Cal

Enter setup of multi-points calibration to set the number of calibration points. The function is only for pH measurement.



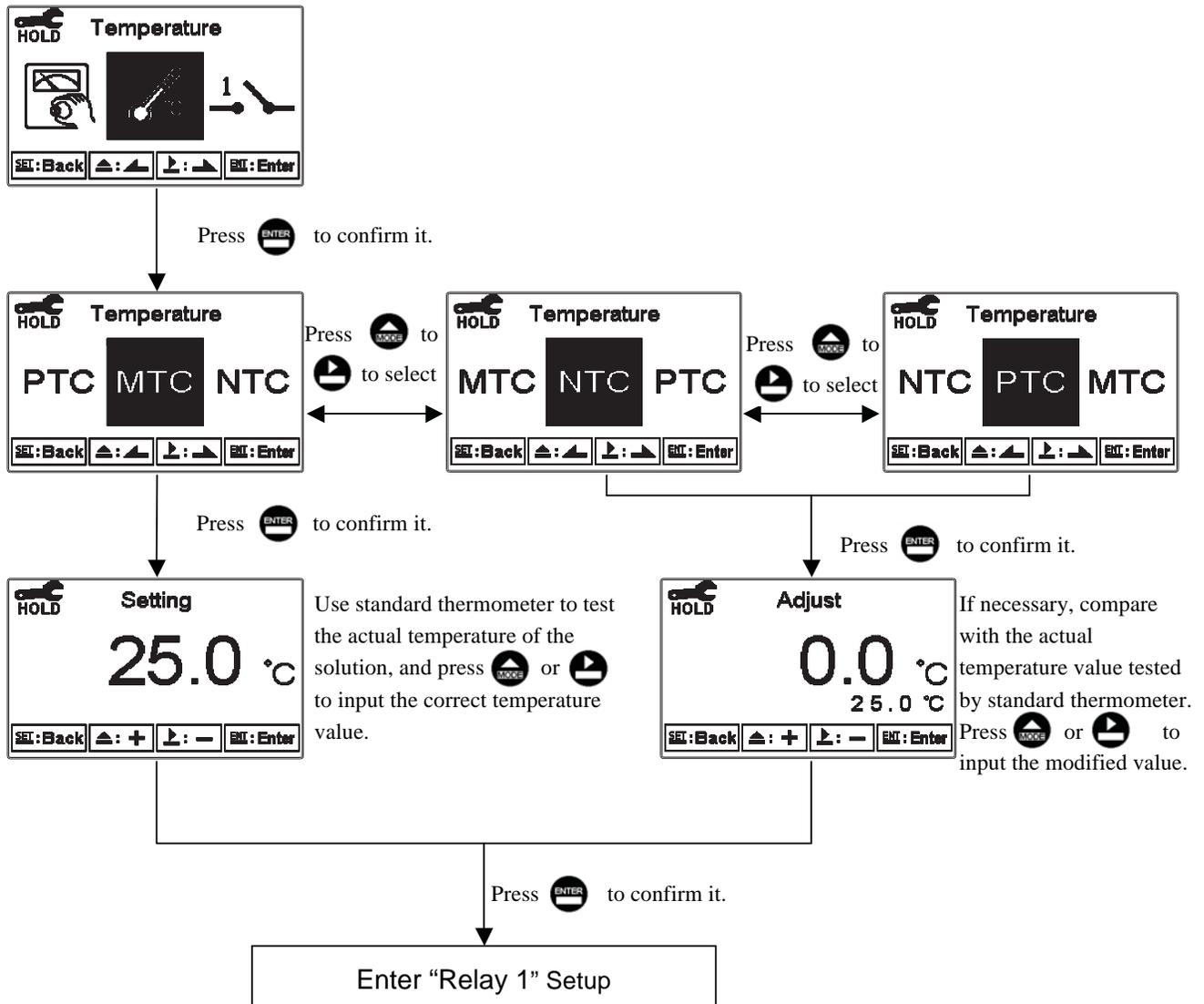
7.6 Product Adjustment

Enter setup of “Product Adj.”. Make the sample reading modifications. Users are allowed to make sample reading adjustment without taking out the sensor and making calibration. Utilize the function to adjust the field measurement as the same as the lab measurement to eliminate the doubt of measurement error. Under normal measurement display mode, there is a PDT sign on top of the pH unit. (Please see Ch 6.4)



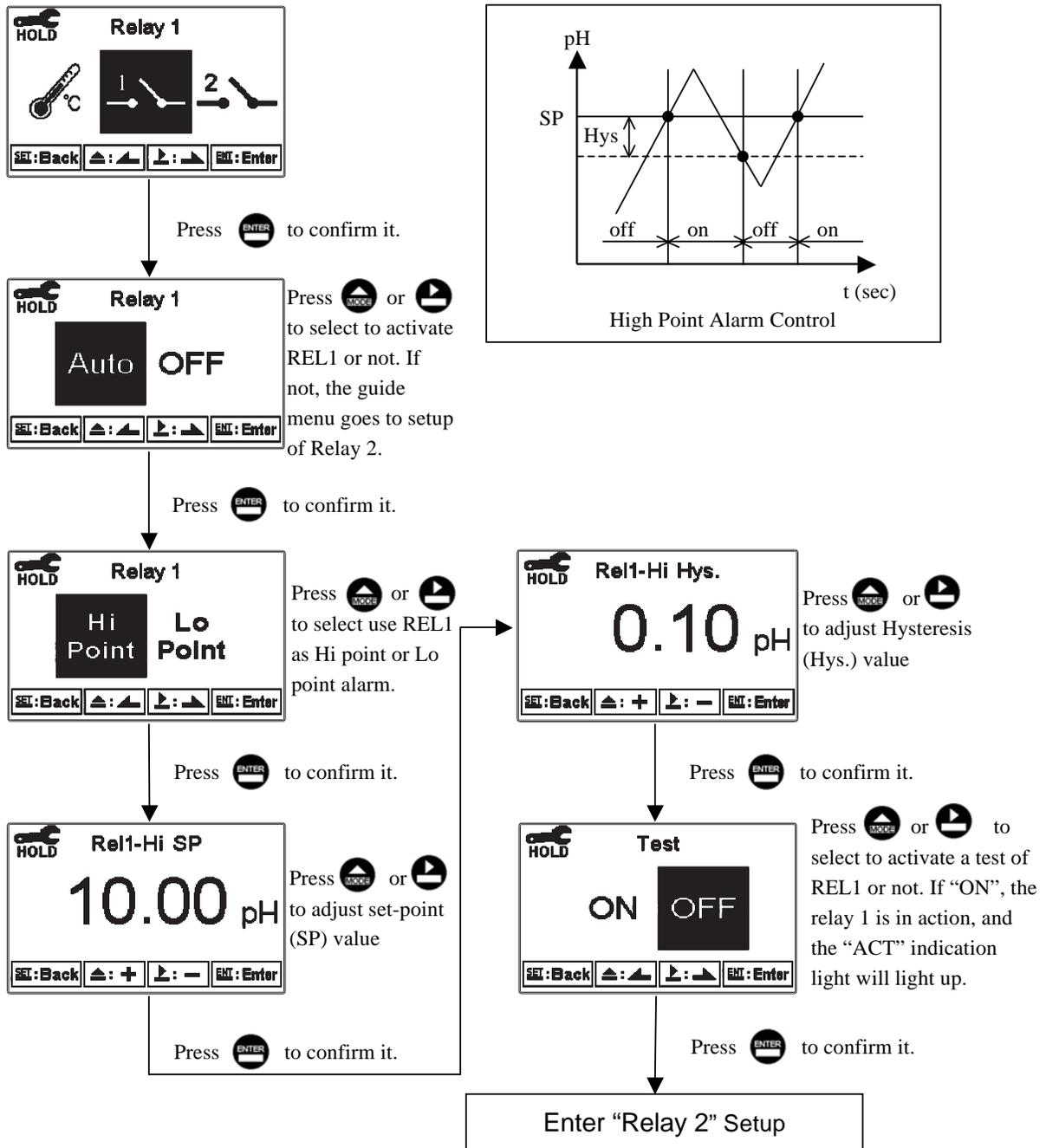
7.7 Temperature

Enter setup of “Temperature” to select temperature compensation mode. Select from NTC (NTC 30K), PTC (PT 1K), or MTC (Manual adjustment).



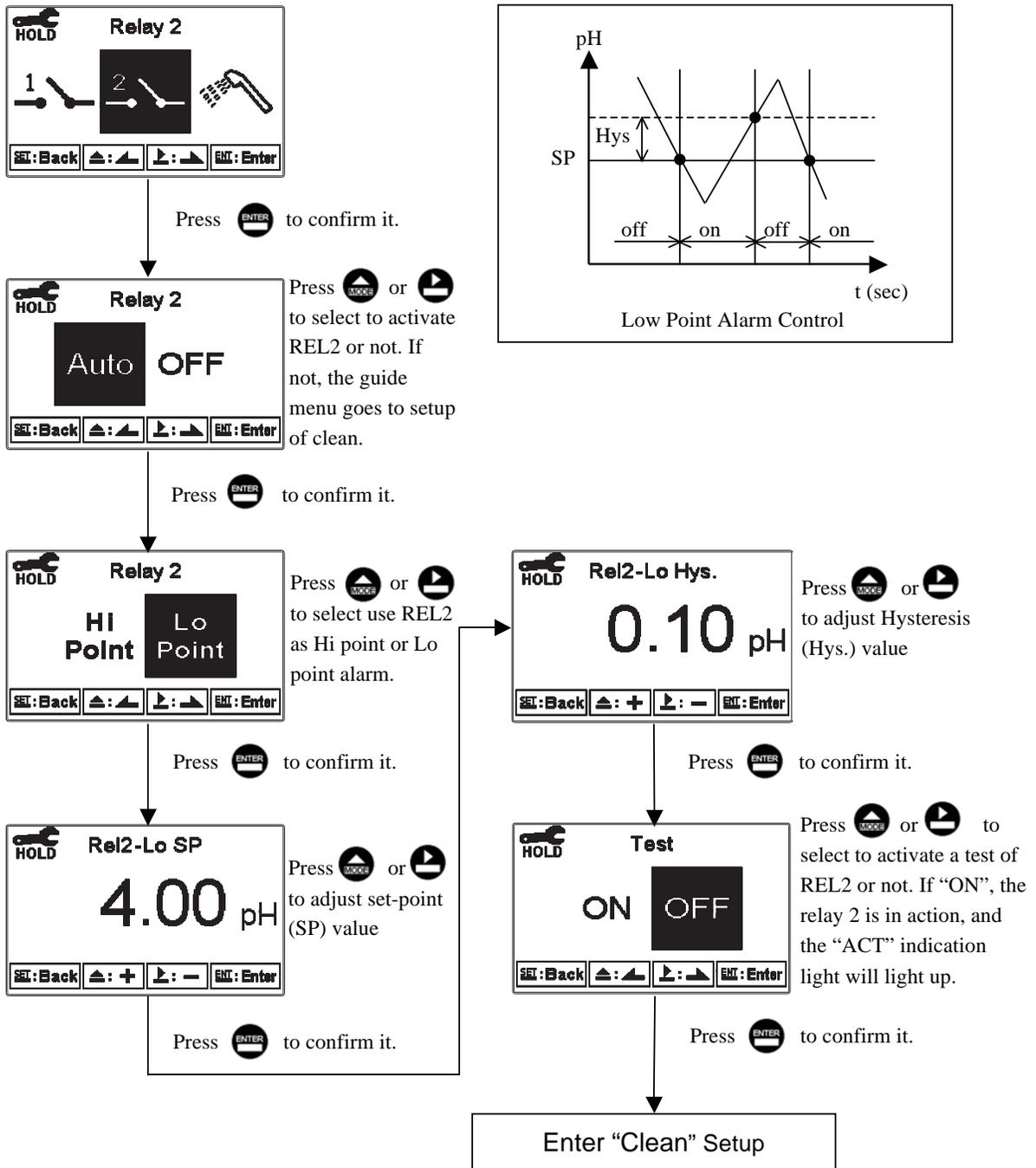
7.8 Relay 1

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



7.9 Relay 2

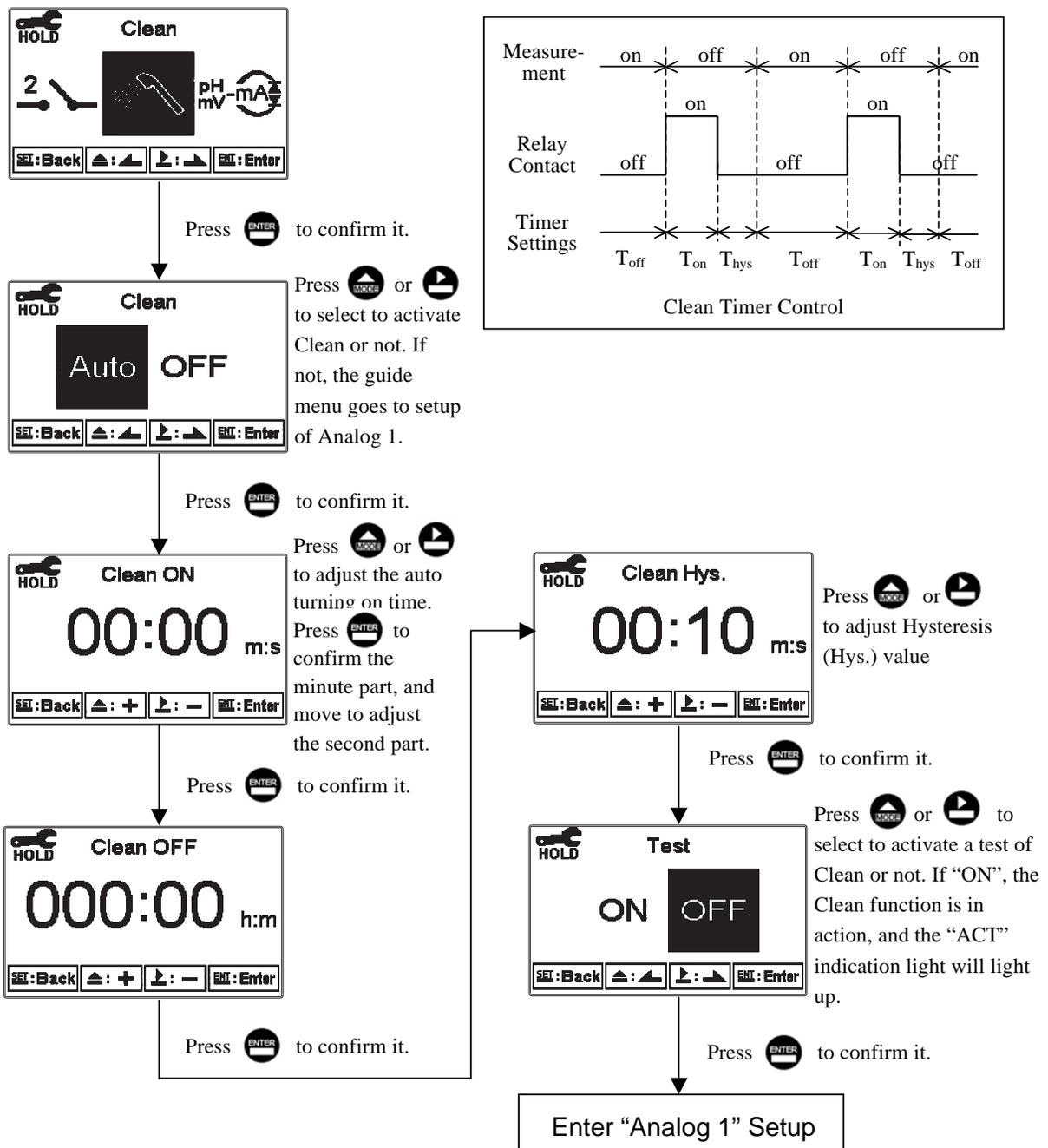
Enter setup of Relay 2. Select the item to turn on or to turn off the Relay 2 function. If you turn on Relay 2, then select “High set-point” alarm or “Low set-point” alarm. Set the value of set-point (SP) and Hysteresis (Hys.). The relationship between the parameters can be described in an explanatory diagram in the box (as a low point alarm).



7.10 Clean

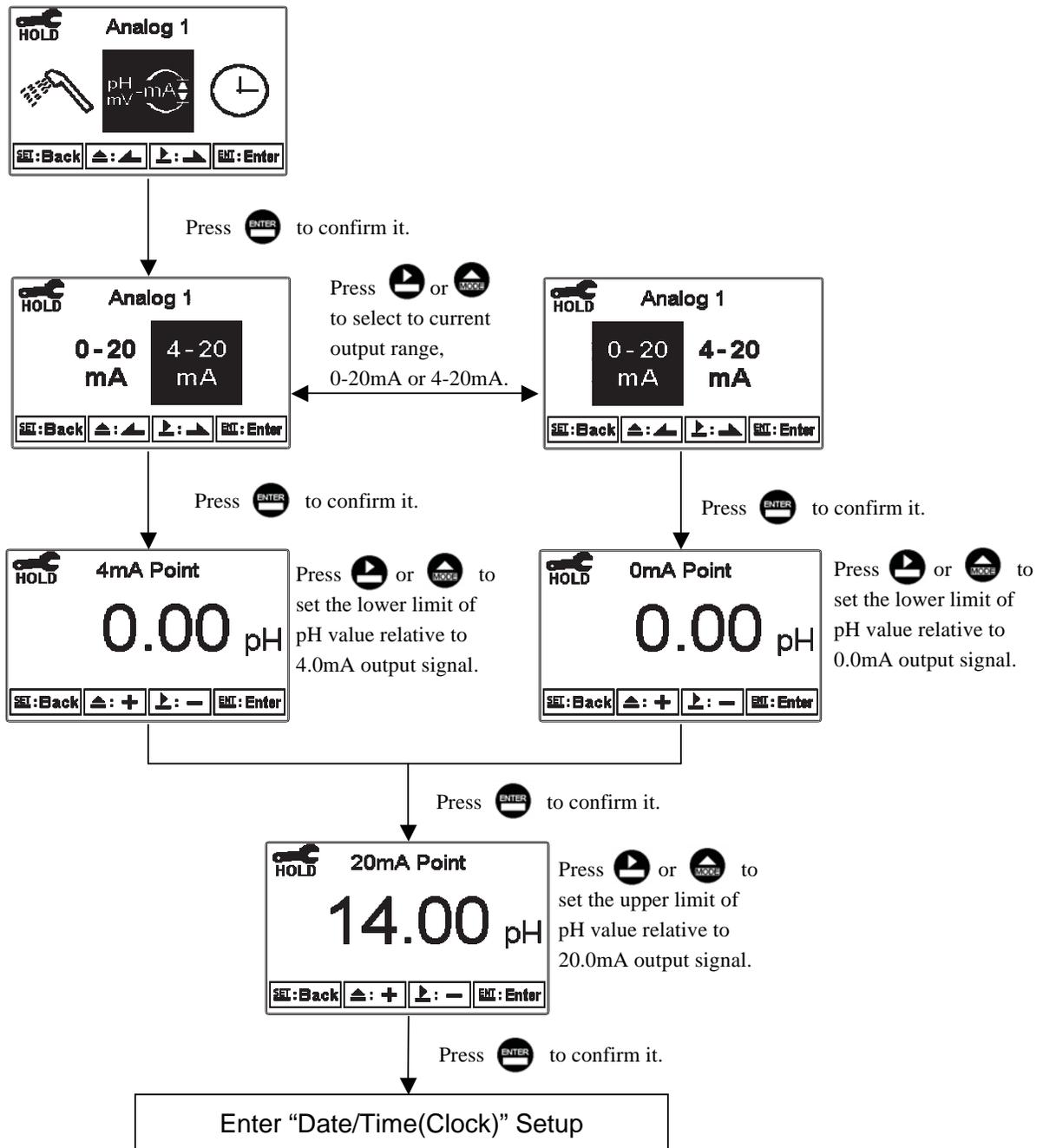
Enter setup of “Clean” function. Select the icon to turn on or turn off the clean function. If you select “Auto”, set the timer of the clean function including turning on time and turning off time. Set the Hysteresis value (Hys.).

Note: When the clean function is turned on, if any value is set to 0, the instrument will automatically turn off this function. When the clean function is activated under measurement mode, there will be a “Clean Running” message that will show on top of the display. The measurement value will remain at the last measured value before cleaning. If entering the setting menu or calibration menu under clean status, the instrument will stop clean status automatically.



7.11 Analog Output 1 (pH/ORP)

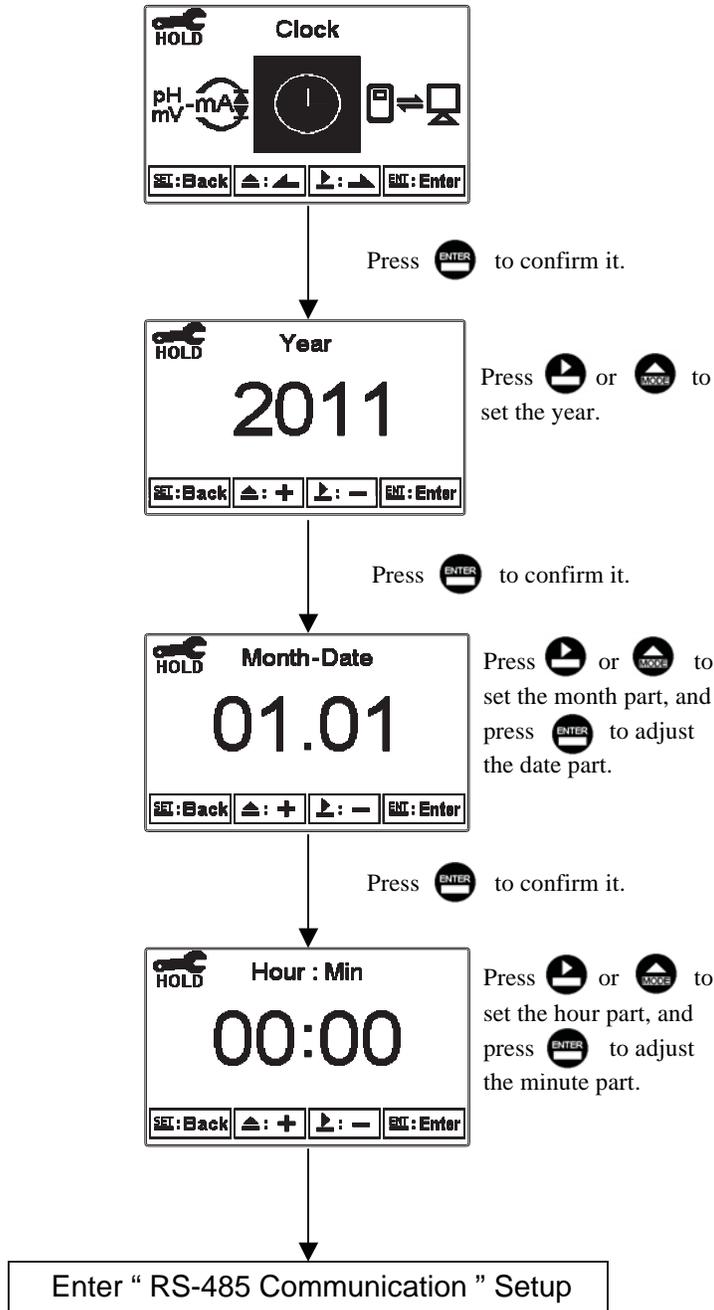
Enter setup of Analog 1. Select 0~20mA or 4~20mA current output. Set the related value to the range of pH/ORP measurement. If the range of the pH/ORP measurement is set to be smaller, the resolution of current output is higher. When the measured value exceeds the higher range limit, the current will 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 will 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.



7.12 Date/Time (Clock)

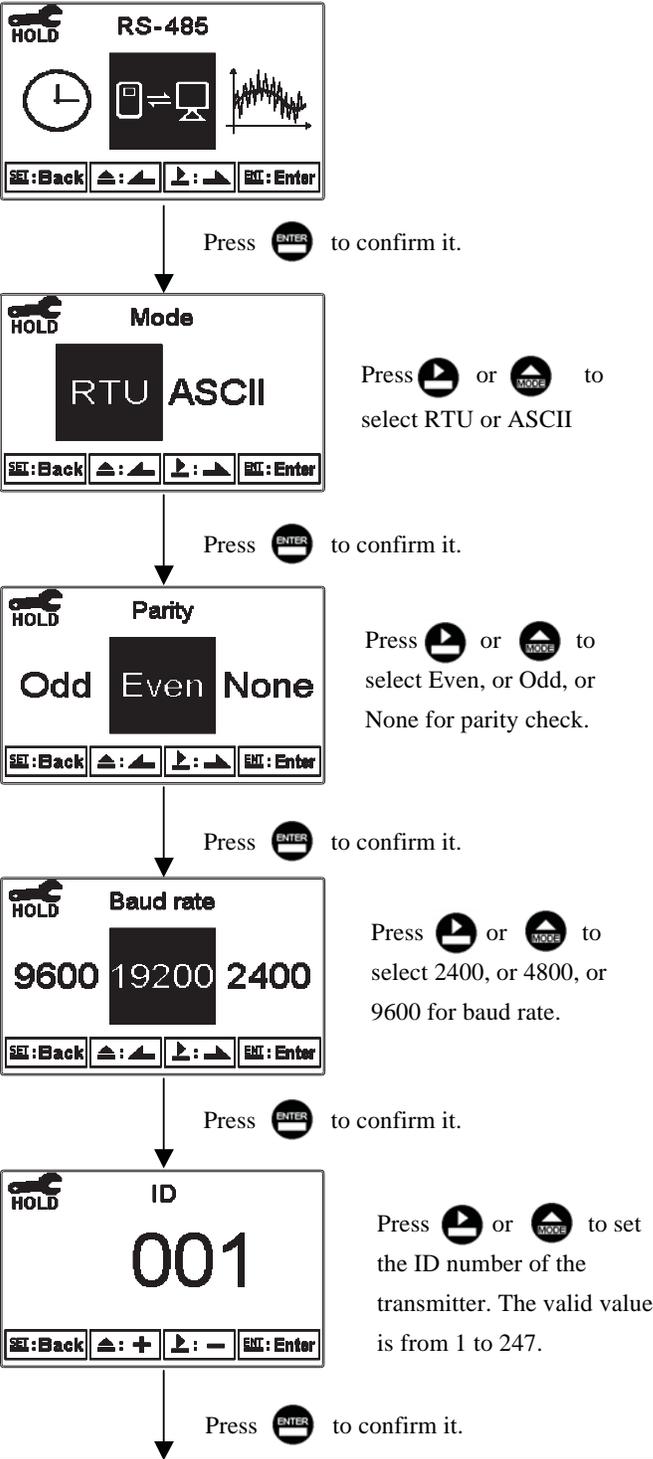
Enter setup of Date/Time (Clock). Set the “Year”, “Month”, “Date”, “Hour”, and “Minute” time.

Note: The clock needs to be reset once it encounters power failure with the TX2000RS model. With the TX2000RS model, the transmitter may keep the clock in operation even when encountering power failure. Only when the inner battery is out of power will the clock stop operation. When not operating, replace the 3V CR2025 Li battery inside the transmitter.



7.13 RS485 Communication

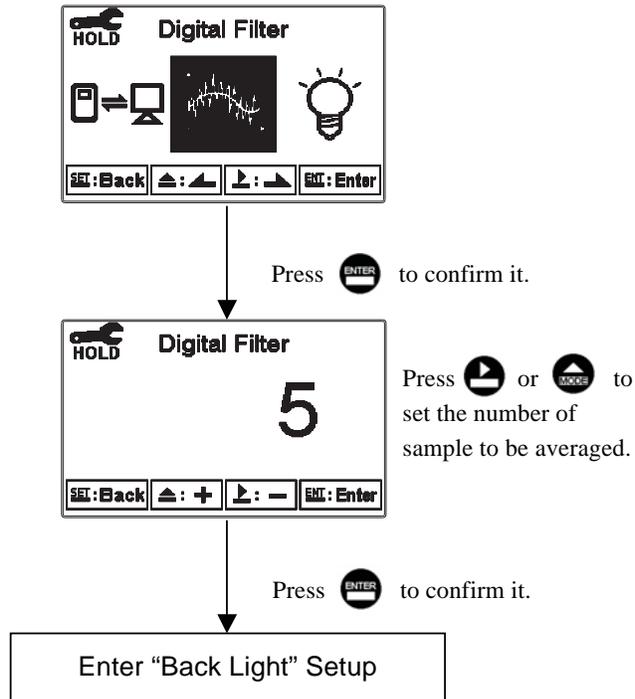
Enter setup of RS485 communications. According to the Modbus protocol, set the transmitting mode, parity, baud rate, and ID number. For details of the Modbus protocol, please refer to Ch. 9. If under hold status, the measurement signal output maintains the last output value before hold status.



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

7.14 Sample Average of Measurements (Digital Filter)

Enter the setup of digital filter. You may select the number of samples to be averaged each time to become a reading. The readings are gradually counted in order to increase the stability of measurement.



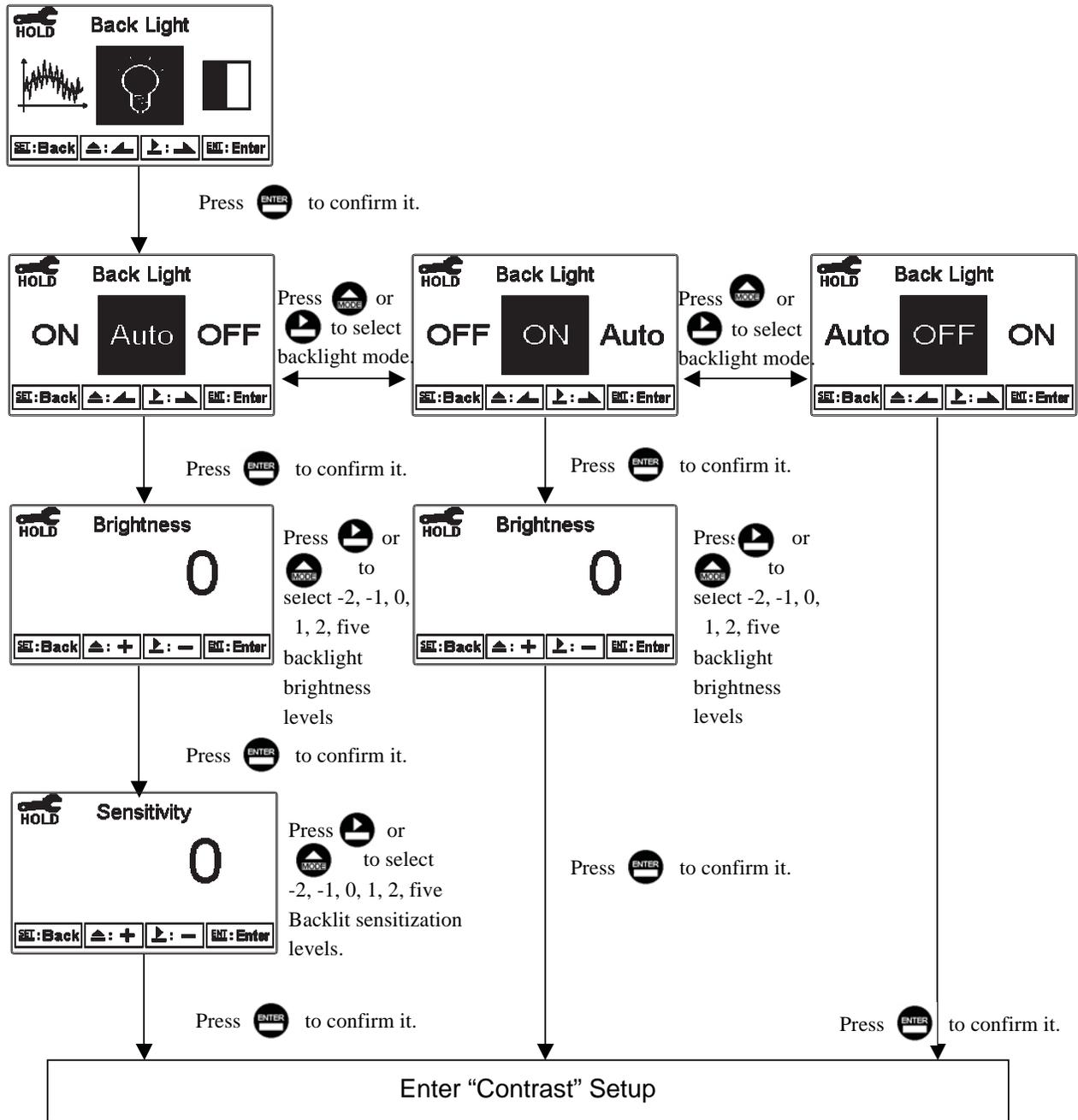
7.15 Backlight Settings

Enter setup of backlight display. According to your needs, 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, you can activate the touch-on backlight function. Regardless of the kind of the backlight mode, the touch-on function will activate the backlight. If there is no keystroke for five seconds, the display will go back to the original backlight setting status.

ON setting: The backlight is always on.

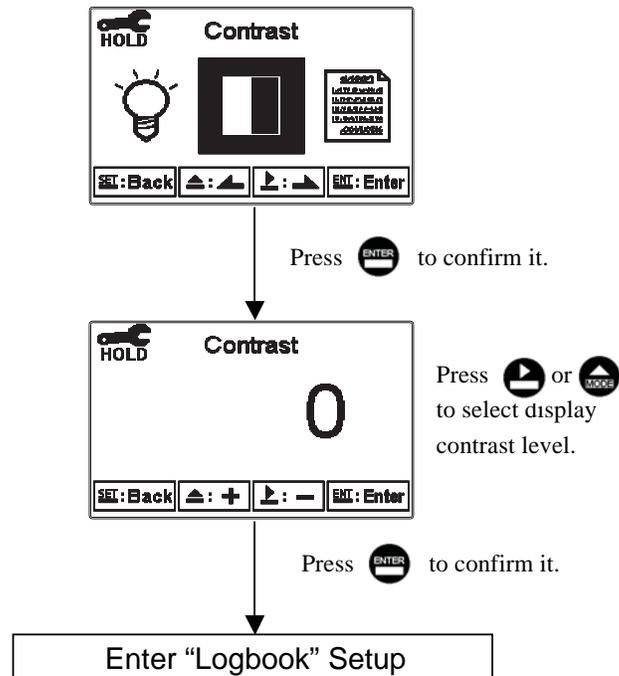
OFF setting: The backlight is off. When there is a keystroke, it enters into the touch-on status.

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



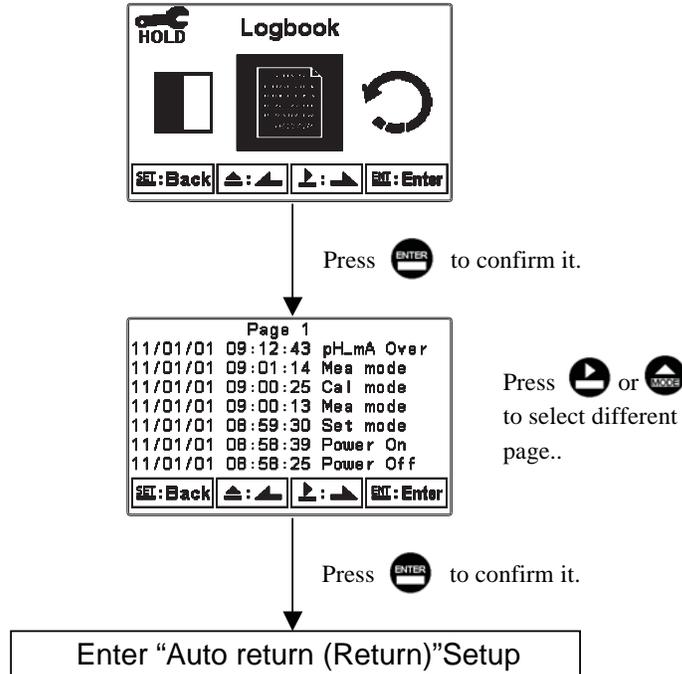
7.16 Contrast Settings

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



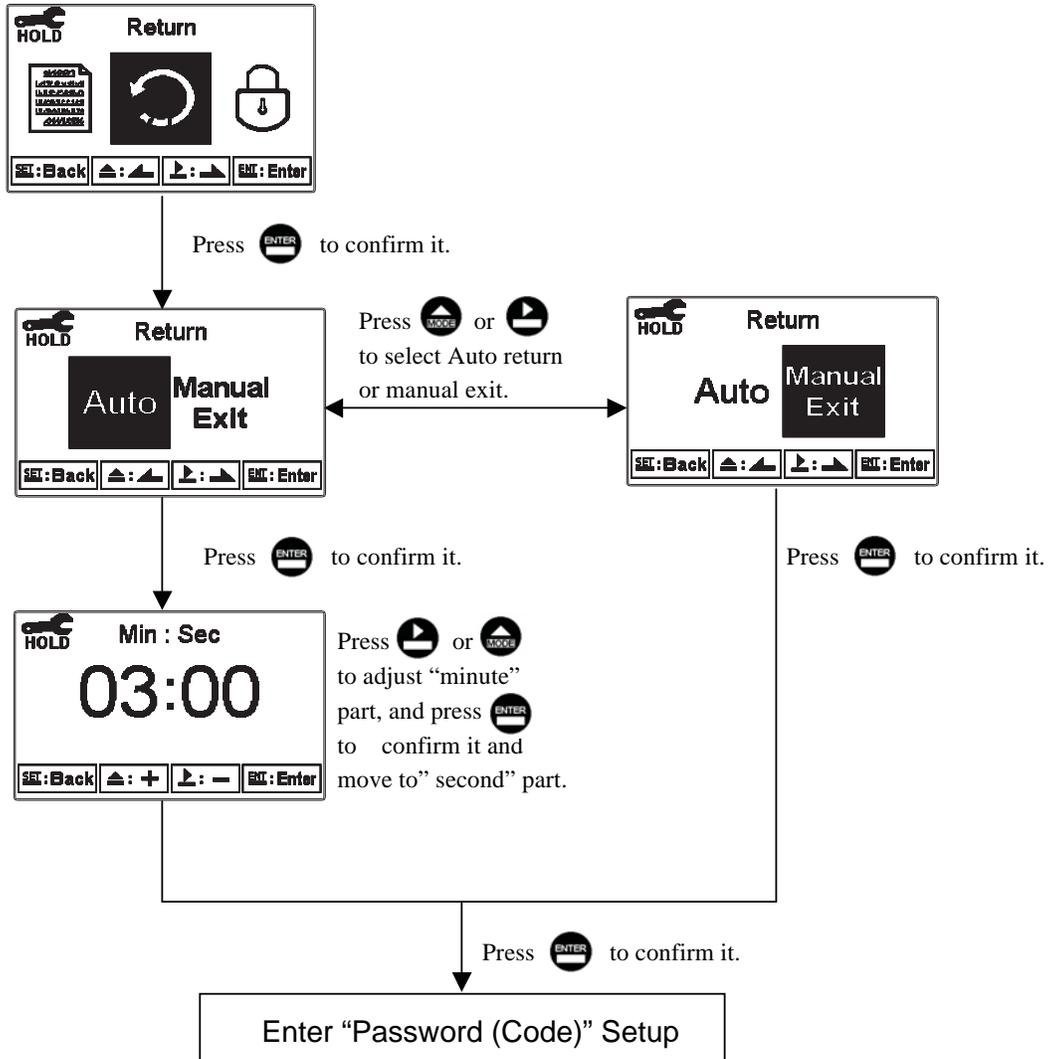
7.17 Logbook

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 (pH_mA Over), power failure (Power On, Power Off), and other error message records (Error1, Error2...etc.)



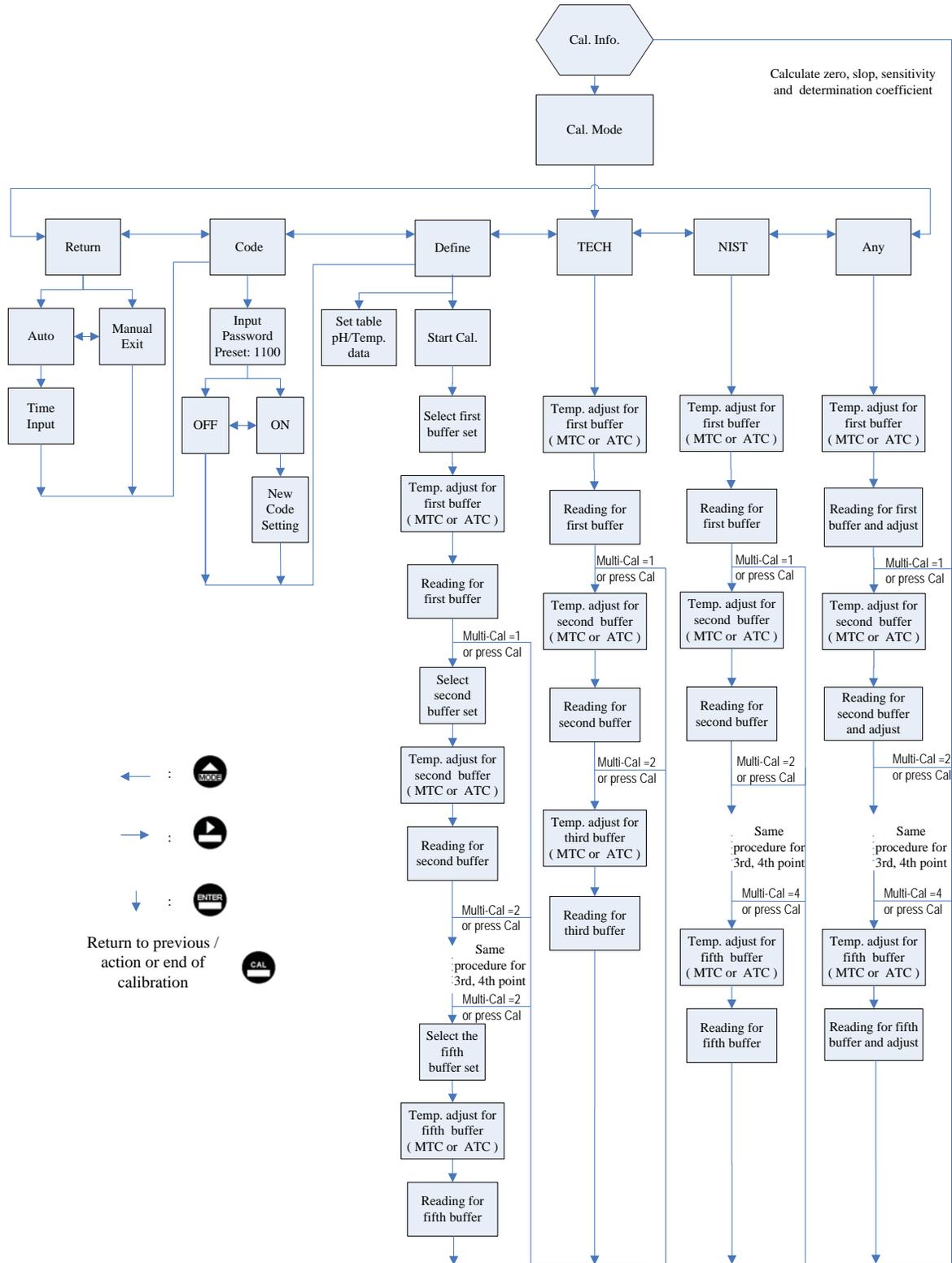
7.18 Return

Enter setup of auto return mode (Return) to set the function so that the instrument automatically exits 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 exits the setup menu and then goes back to measurement mode after a period of time without pressing any key.



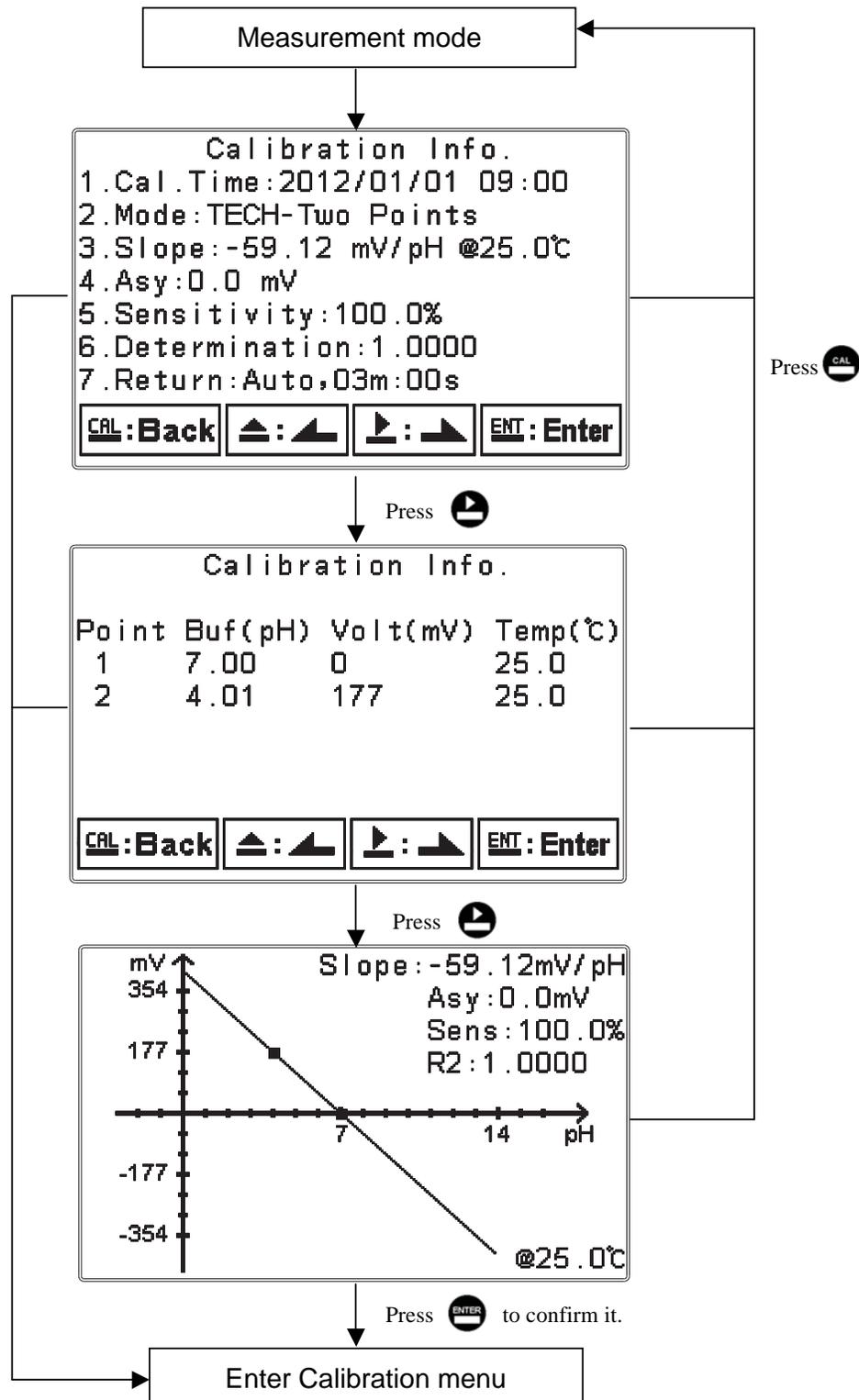
8. Calibration

Block diagram of calibration



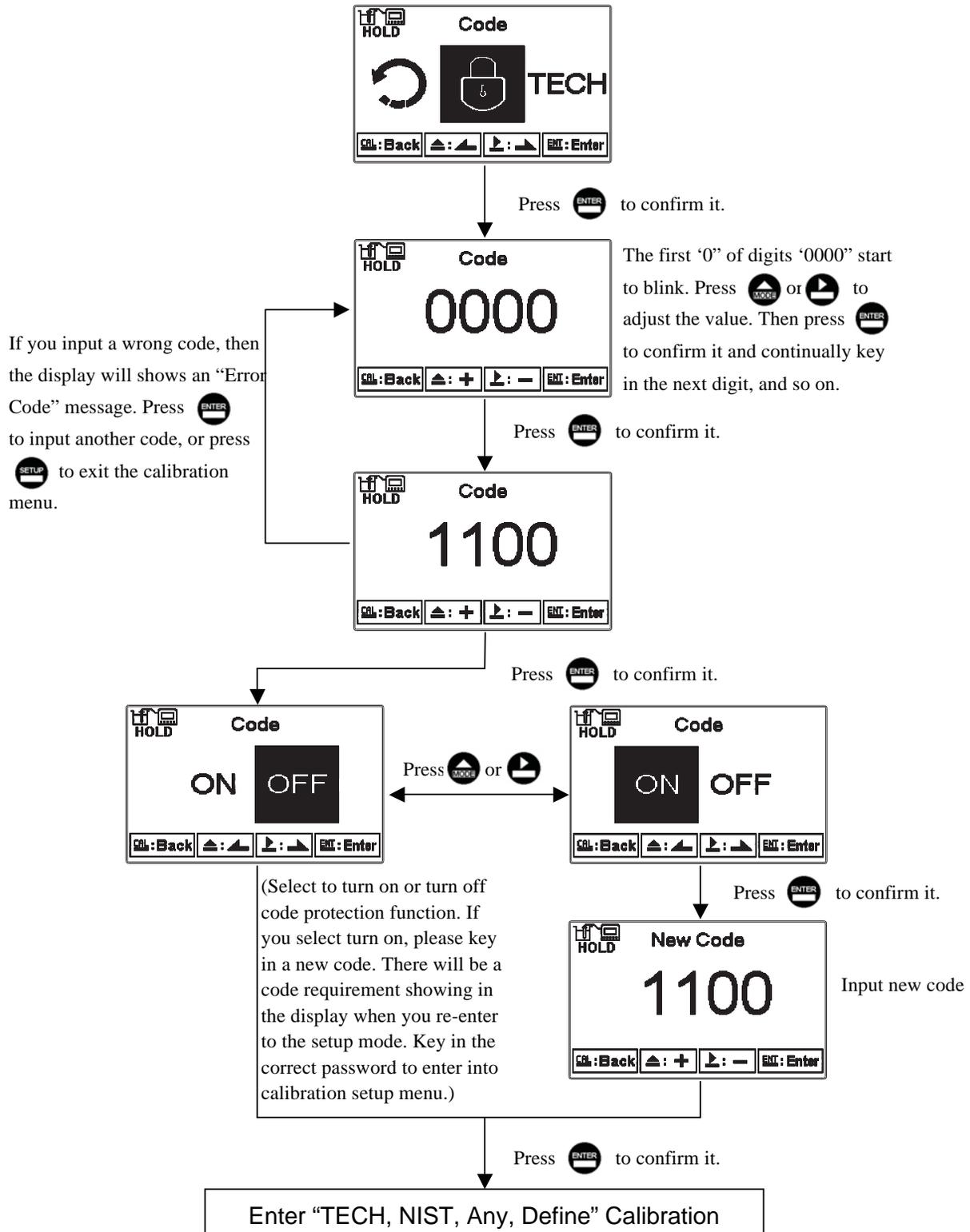
8.1 Enter Calibration Setup Menu

In the measurement mode, pressing the two keys  and  simultaneously will allow you to enter the Calibration Information. If you do not need to re-calibrate the measurement system, press  to go back to measurement mode. If you need to re-calibrate the system, press  to enter to the calibration setup menu.



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 pH Calibration

The instrument provides multi-point standard buffer solution calibration. You may decide how many points to calibrate the measurement system. (TX2000 model can go up to 3-point; TX2000RS can go up to 5-point.) The principle is according to “Method of Least Squares.” Apply linear regression to calibrate the electrode’s slope and zero point (Asy, Offset, or Zero point).

When calibrating an electrode, you may calibrate one to three point(s) by any sequence to provide linear regression for mV and pH multi-calibrations as well as to show the electrodes’ slope and zero point (Asy, offset, or Zero point) at 25°C. The electrode’s slope rate, which is the actual slope divided by theoretical slope, and the sensitivity shows in percentage in the display. In addition, the display shows the linear regression determination coefficient, R², of the electrode and buffer solution to provide you an estimation of an electrode’s regression suitability. According to different combinations of standard buffers, the TECH, NIST, and any buffer solution calibration modes are provided.

8.3.1 TECH Mode (up to 3-point calibration)

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 an error message of zero point and slope failure. (See appendix Table 1, pH/temperature table of TECH standard buffers)

8.3.2 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 an error message of zero point and slope failure. (See appendix Table 2, pH/temperature table of NIST standard buffers)

8.3.3 Any Mode

The electrode measures mV value of different standard solutions. 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 an error message of slope failure.

8.3.4 Define mode

There is a factory default of five buffer standard solutions' pH/temperature table which may be modified and saved by users. When users have their own buffer solutions, they may create or modify the data sheet and then save it in the memory of the transmitter. Under this calibration mode, the sensor does not do the zero-point calibration and slope range determination. (See appendix Table 3, pH/temperature table of define [built-in] standard buffers.)

8.3.5 Definition of Calibration Parameter

You can calibrate the electrode by one point or up to three points of standard solutions by any sequence. As different calibration point methods are applied, the definition of the zero point and slope differ.

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, apply linear regression.

8.3.6 TECH, NIST Buffer Calibration

The procedure below is two-points calibration of TECH buffer. (The procedure is the same as NIST buffer mode.) First, enter the setup of multi-points calibration and set the number of calibration point for two (See chapter 7.5 Multi-Cal). Then, go to calibration menu and select TECH mode. Operate the instrument as follows in the procedure diagram. For multi-points calibration, setting the number of points in the Multi-Cal setting in advance is also needed. The calibration procedure is the same.

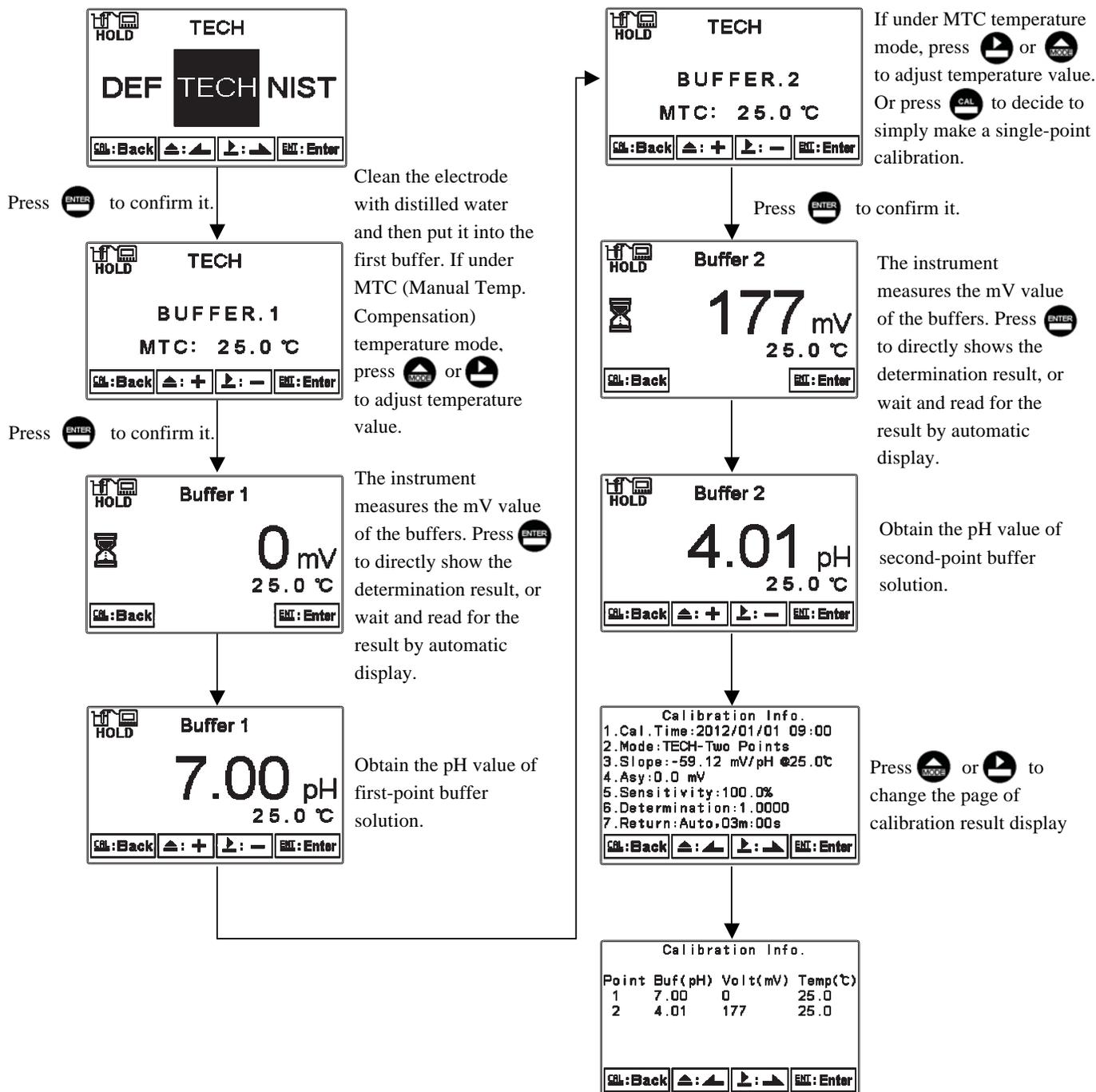
Clean the electrode with distilled water and then put it into the second buffer.

If under MTC temperature mode, press or to adjust temperature value. Or press to decide to simply make a single-point calibration.

The instrument measures the mV value of the buffers. Press to directly shows the determination result, or wait and read for the result by automatic display.

Obtain the pH value of second-point buffer solution.

Press or to change the page of calibration result display



Calibration Info.

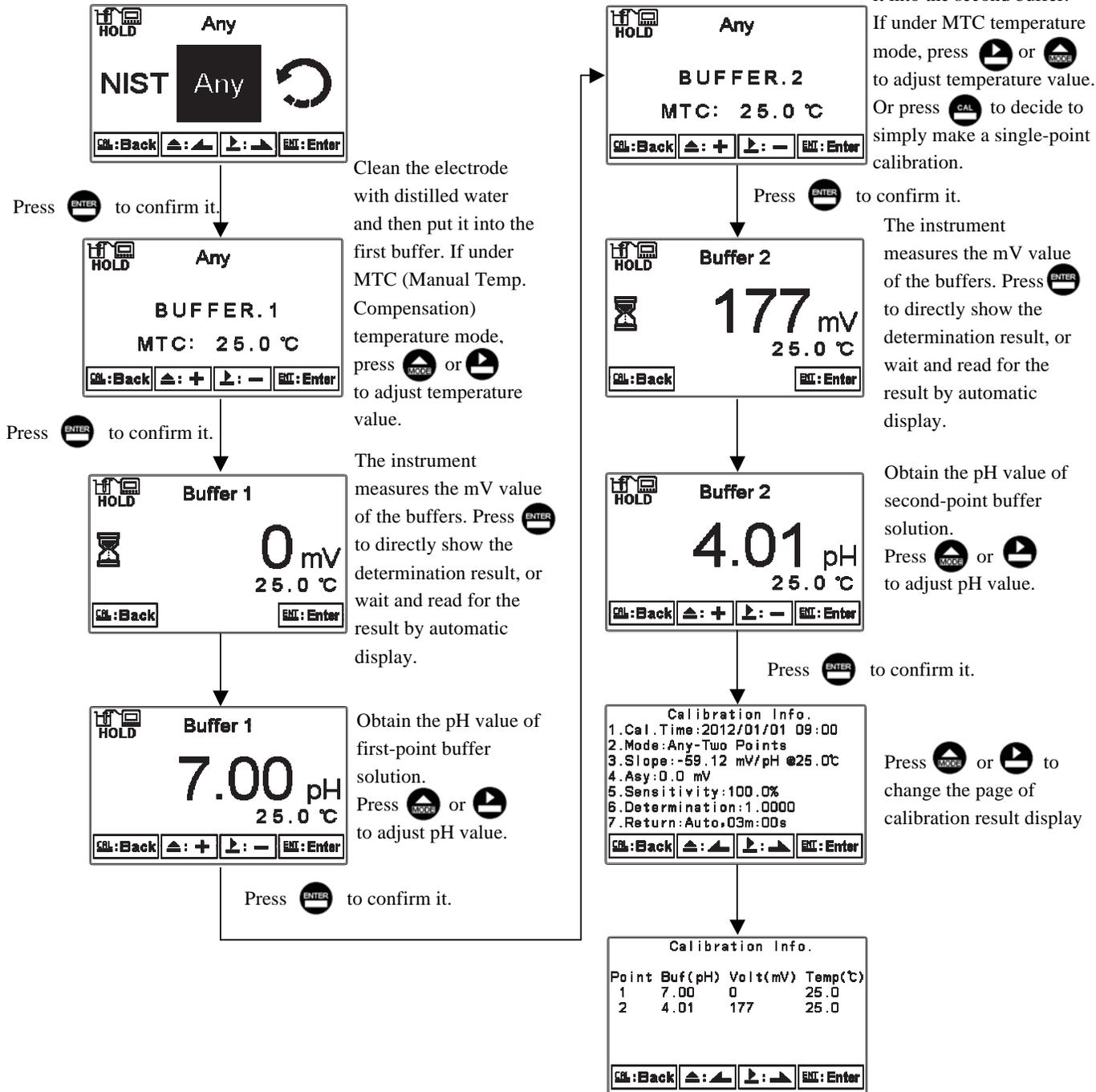
Point	Buf(pH)	Volt(mV)	Temp(°C)
1	7.00	0	25.0
2	4.01	177	25.0

8.3.7 Any Calibration

The procedure below is two-points calibration of any mode. First, enter the setup of multi-points calibration and set the number of calibration point for two (See chapter 7.5 Multi-Cal). Then, go to the calibration menu and select “Any” mode. Operate the instrument as follows in the procedure diagram. For multi-points calibration, you also need to set the number of points in the Multi-Cal setting in advance. The calibration procedure is the same.

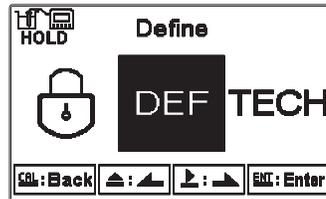
Clean the electrode with distilled water and then put it into the second buffer.

If under MTC temperature mode, press or to adjust temperature value. Or press to decide to simply make a single-point calibration.

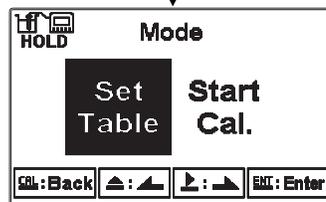


8.3.8 Define Calibration

Define mode has a pre-set of five buffer solutions' pH/Temperature table. Users may modify the data sheet according to the buffer solutions set they use. The table can be modified and saved in the memory of the transmitter.



Press to confirm it.



Press or to select table modification or execute preset calibration procedure.

Press to confirm it.

The screen displays 'Buffer 1' at the top, a 'HOLD' icon, and a table with two columns of TC and pH values. At the bottom are buttons for 'Back', left arrow, right arrow, and 'Enter'.

TC	pH	TC	pH
5	2.01	30	2.00
10	2.01	35	2.00
15	2.00	40	2.00
20	2.00	45	2.00
25	2.00	50	2.00

Press or to modify the pH value of buffer 2 data sheet under different temperature. Select "Next Page", and then press to go to next buffer data sheet.

Press to confirm it.

The screen displays 'Buffer 2' at the top, a 'HOLD' icon, and a table with two columns of TC and pH values. At the bottom are buttons for 'Back', left arrow, right arrow, and 'Enter'.

TC	pH	TC	pH
5	4.04	30	4.01
10	4.02	35	4.01
15	4.01	40	4.01
20	4.00	45	4.01
25	4.01	50	4.00

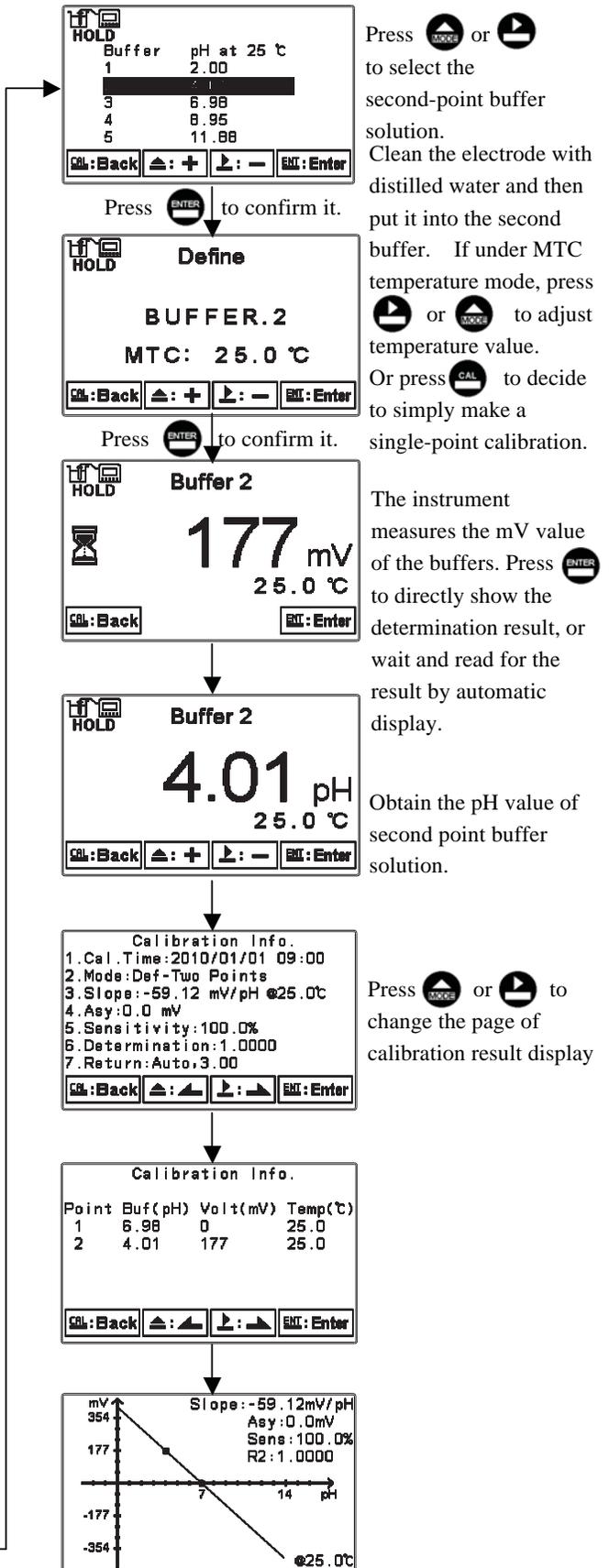
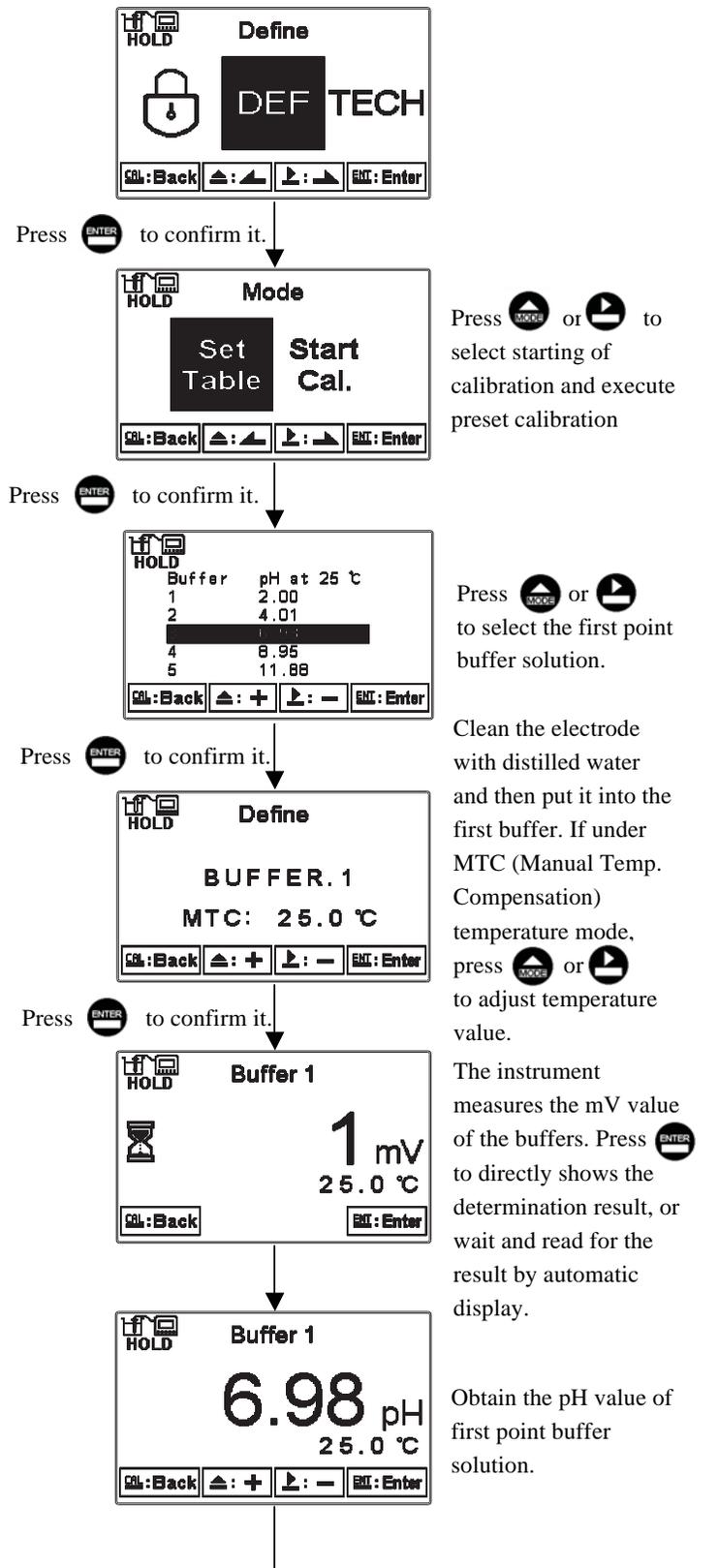
Press or to modify the pH value of buffer 2 data sheet under different temperature. Select "Next Page", and then press to go to next buffer data sheet.

The screen displays 'Buffer 5' at the top, a 'HOLD' icon, and a table with two columns of TC and pH values. At the bottom are buttons for 'Back', left arrow, right arrow, and 'Enter'.

TC	pH	TC	pH
5	12.41	30	11.72
10	12.26	35	11.67
15	12.10	40	11.54
20	12.00	45	11.44
25	11.68	50	11.33

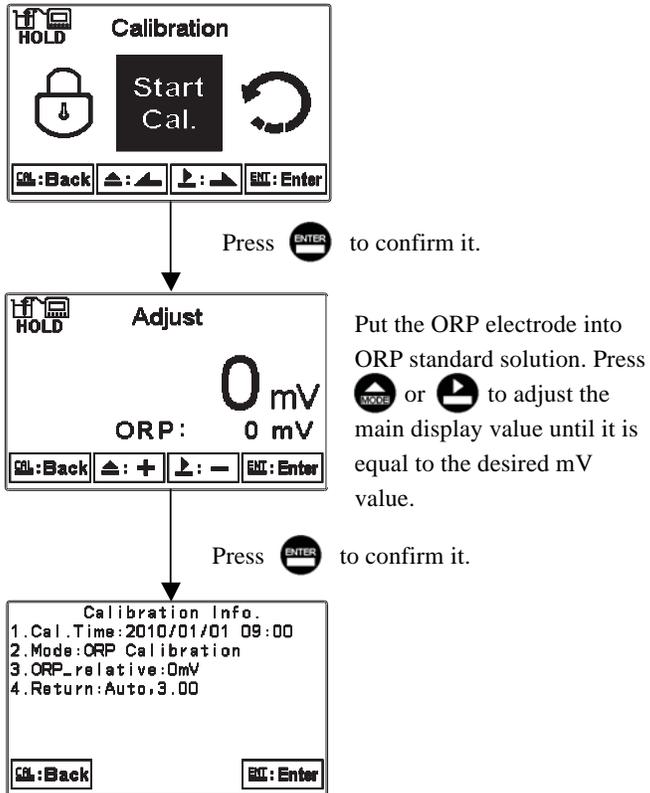
Press or to modify the pH value of buffer 5 data sheet under different temperature. Select "Exit", and then press to finish the setting.

The procedure below is two-points calibration of Define mode. First, enter the setup of Multi-points calibration and set the number of calibration point for two (See chapter 7.5 Multi-Cal). Then, go to calibration menu and select "Define" mode.



8.4 ORP Calibration

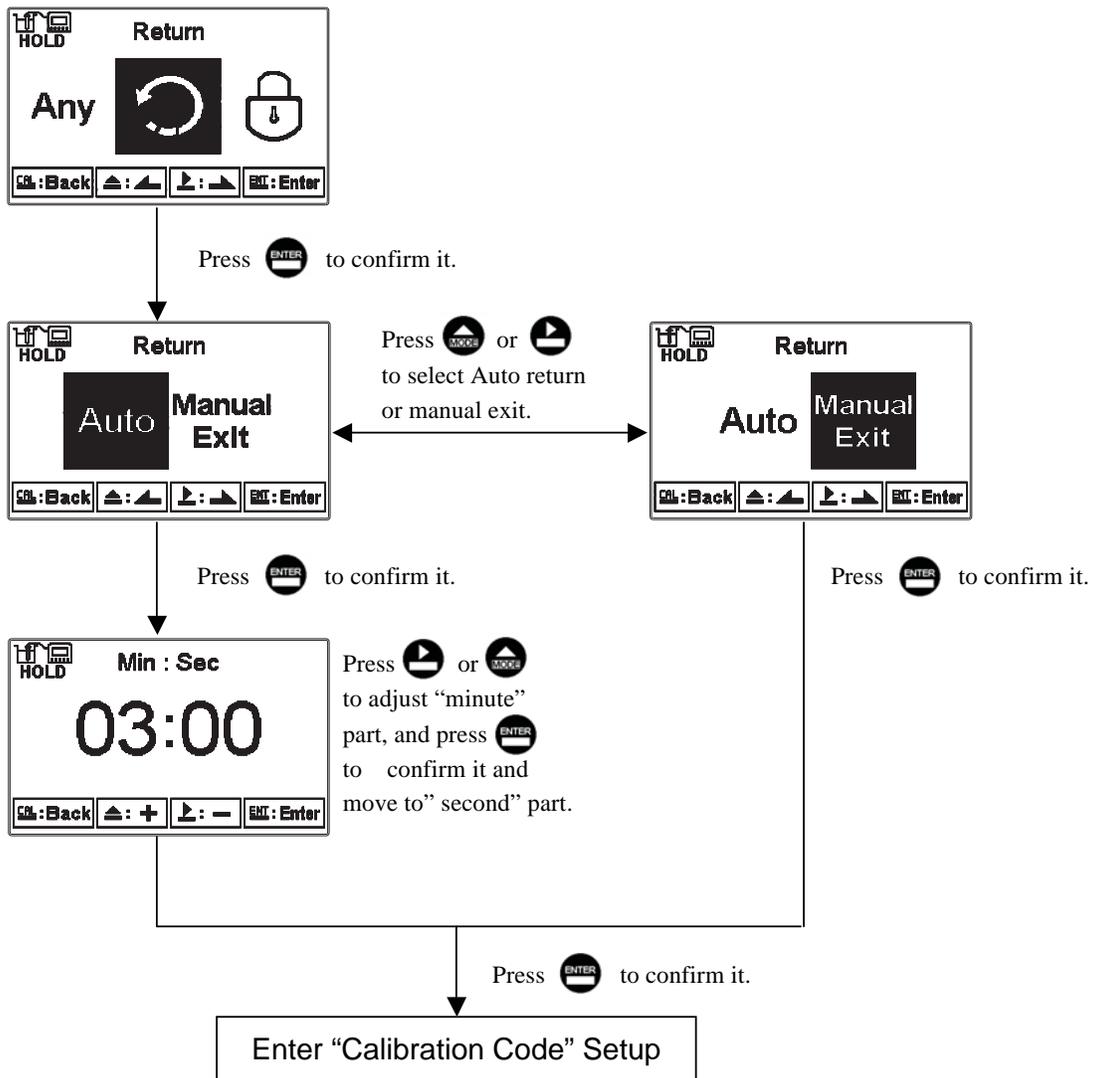
Under ORP measurement mode, enter calibration setup menu. Select the calibration icon, and adjust mV value. The adjustable range is from -300mV to 300mV.



8.5 Return

Enter setup of auto return mode (Return) to set the function so that the instrument automatically exits 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 exits the calibration setup menu and goes back to measurement mode after a period of time without pressing any key.

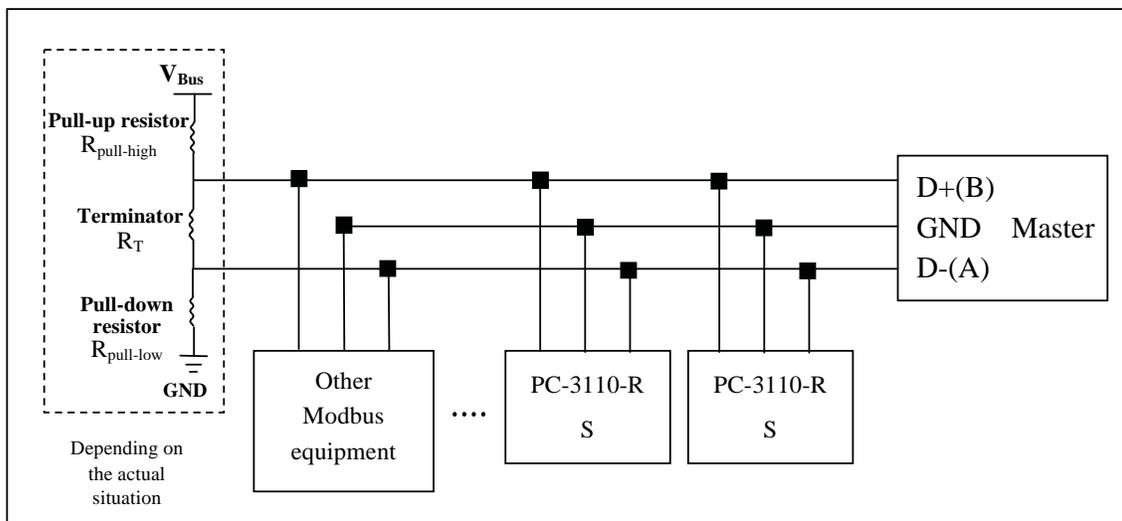
Note: The return function of setup menu and calibration setup menu are independent settings.



9. MODBUS Protocol and Instructions

9.1 Communication Connection

The RS-485 communication port of the transmitter features comes with electronic isolation protection, lightning protection, and provides internal independent ground solution. It is allowed to use normal twisted-pair (segregation double-stranded twisted pair) cable connections. All devices are in contact with a double-stranded, and then all together, and another line will be connected with all the negative contacts, and the isolated shield wire must be connected to GND. When we talk about communication in the laboratory, the stand-alone master-slave communication is relatively simple. Hence, it is allowed to be used with a normal cable instead. However, it 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 TX2000RS transmitter has a protective earth terminal. When communicating with the RS-485, solution ground should be used to eliminate risk of safety.
2. It is allowed to use an 120 ohm impedance matching resistors in the terminal equipment in the transmission lines (D +, D-) to effectively reduce or eliminate signal reflection.
3. Without repeaters, the RS-485 network can not 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 specifically designed for RS-485.
4. During communication, all the equipments of the network should be maintained in the same transfer mode, baud rate, and parity consistent. 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 to an abnormal message.
6. The waiting time which a slave instrument responds 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 Name and Address Table

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

Logic address	Item	Number of Byte	Information type	Description of data transmission	Default value	Note
0001H	Equipment's ID	2	USHORT	1-247	1	
0002H	Transmitter model	6	USHORT	ASCII Code	TX2000	
0005H	Communication protocol	2	USHORT	0: RTU 1: ASCII	0	
0006H	Serial transmission speed (Baud rate)	2	USHORT	0: 2400 1: 4800 2: 9600 3: 19200	3	
0007H	Parity	2	USHORT	0: None 1: Even 2: Odd	1	
0008H	Real-time clock*	12	USHORT	Second	2012-01-01, 00:00:00	
0009H			USHORT	Minute		
000AH			USHORT	Hour		
000BH			USHORT	Day		
000CH			USHORT	Month		
000DH			USHORT	Year		
000EH	Code setting*	2	USHORT	Code setting	1111	
000FH	Temperature mode*	2	USHORT	0: MTC 1: PTC 2: NTC	0	
0010H	Clean relay*	2	USHORT	0: OFF	0	
			USHORT	1: AUTO		
0011H		2	USHORT	ON.S: 0-5999	0	Second
0012H		2	USHORT	OFF.H: 0-999	0	Hour
0013H		2	USHORT	OFF.M: 0-59	0	Minute
0014H	2	USHORT	Hys.S: 0-9999	0	Second	
0015H	Relay 1 *	2	USHORT	0: OFF 1: AUTO	1	
			USHORT	0: AUTO 1: Lo		
0016H		2	USHORT	0: AUTO 1: Lo	0	
0017H		4	FLOAT	SP1	10.00pH/1000mV	Data

0019H		4	FLOAT	Hys1	0.1pH/10mV	affected by sign byte
001BH	Relay 2 *	2	USHORT	0: OFF	1	
				1: AUTO		
001CH		2	USHORT	0: Hi	1	
				1: Lo		
001DH		4	FLOAT	SP2	4.00pH/-1000mV	Data affected by sign byte
001FH	4	FLOAT	Hys2	0.1pH/10mV	affected by sign byte	

0021H	Backlight Brightness*	2	USHORT	0: AUTO	2		
				1: ON			
				2: OFF			
0022H		SHORT	2	SHORT	2: Highest brightness	0	
					1: high brightness		
	0: Standard						
	-1: Low brightness						
	-2: Lowest brightness						
0023H	Backlight Sensitivity*	2	SHORT	2: Highest Sensitivity	0		
				1: High Sensitivity			
				0: Standard			
				-1: Low Sensitivity			
				-2: Lowest Sensitivity			
0024H	Sample average of measurements (Digital Filter) *	2	USHORT	1-60	5		
0025H-0030H	Factory reserved						

Note 1: The actions without * sign only supportS for function code 03H. The actions with * sign support function code 03H, 06H, 10H. USHORT data range from 0 to 65535, SHORT data range from -32768 to 32767.

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°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.

Function code: 03H Modbus Response (measurement parameter)

Logic address	Item	Number of Byte	Information type	Description of data transmission	Default value	Note
0031H	Number of measurement channels	2	USHORT	TX2000RS only has one channel	1	
0032H	Sign byte	6	CHAR	pH	pH	ASCII code
				ORP(mV)		
0035H	pH/ORP measurement	4	FLOAT	pH/ORP measurement		Data affected by sign byte
0037H	Temperature measurement	4	FLOAT	Temperature measurement		
0039H-0050H	Factory reserved					

Function code: 01H,05H,0FH Modbus Response (dispersion parameter)

Logic address	Item	BIT	Description	Default value	Note
0070H	LO Alarm	1	Contact on	0 (Contact off)	
0071H	Hi Alarm	1	Contact on	0 (Contact off)	
0072H	MA too high	1	Contact on	0 (Contact off)	
0073H	MA too low	1	Contact on	0 (Contact off)	
0074H	Exceed temp. range	1	Contact on	0 (Contact off)	
0075H	Exceed pH/ORP range	1	Contact on	0 (Contact off)	
0076H	RLY1 Action *	1	Contact on	0 (Contact off)	
0077H	RLY2 Action*	1	Contact on	0 (Contact off)	
0078H	Clean Action*	1	Contact on	0 (Contact off)	
0079H	Measurement status	1	Contact on	1 (Contact on)	0: Hold 1: Measurement
007AH-0090H	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°C, and confirm that host and sub-machine communication format settings are correct. The host, according to the following left table, sends commands and then gets 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°C. The 16-bit of FLOAT data (Hexadecimal) will show 41 C8 CC CD. The transmission order is CC CD 41 C8.

10. Error Messages (Error Code)

Messages	Reason	Dispositions
Error1	Asy (zero-point) exceeds upper/lower limitation	<ol style="list-style-type: none"> 1. Please replace by new buffers. 2. Maintain the electrode or change a new electrode, and make another calibration.
Error2	Slope exceeds upper/lower limitation	<ol style="list-style-type: none"> 1. Please replace by new buffers. 2. Maintain the electrode or change a new electrode, and make another calibration.
Error3	The readout is unstable	<ol style="list-style-type: none"> 1. Please check whether there is bubble or air in the glass end of the electrode 2. Maintain the electrode or change a new electrode, and make another calibration.
Error4	<ol style="list-style-type: none"> 1. The temperature is over the range 0~50°C while calibration. 2. Buffer cannot be recognized 	<ol style="list-style-type: none"> 1. Please adjust the standard solution to the proper temperature range. 3. Please check whether there is bubble or air in the glass end of the electrode, or maintain the electrode or change a new electrode, and make another calibration.
Error5	Wrong password ERROR CODE	Re-enter a password
Error9	Serious error that does not permit any further measuring	Please call service engineer.

11. Maintenance

Generally speaking, under normal operation, the transmitter needs no maintenance except regular cleaning and calibration of the electrode to ensure accurate and stable measurement and system operation.

The cleaning cycle for the 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 types 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 the electrode 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 mechanically cleaned 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.**

Appendix

Table 1: **TECH** buffers

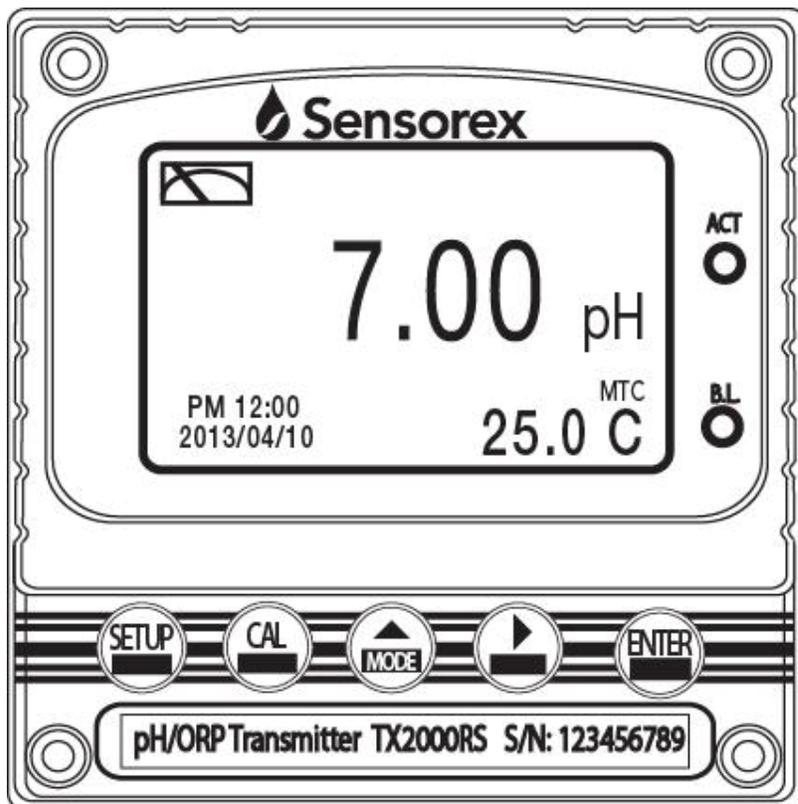
TECH buffers			
TEMP °C	Buffer 4.01	Buffer 7	Buffer 10
5	3.999	7.087	10.241
10	3.998	7.053	10.155
15	3.999	7.031	10.116
20	4.002	7.011	10.047
25	4.006	6.996	9.998
30	4.011	6.985	9.952
35	4.018	6.976	9.925
40	4.031	6.971	9.874
45	4.047	6.969	9.843
50	4.055	6.969	9.810

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

Table 3: **Define** (Built then in by end-user) standard buffers

Define standard buffers table					
TEMP °C	Buffer 1	Buffer 2	Buffer 3	Buffer 4	Buffer 5
5	2.010	4.040	7.070	9.160	12.410
10	2.010	4.020	7.050	9.110	12.260
15	2.000	4.010	7.020	9.050	12.100
20	2.000	4.000	7.000	9.000	12.000
25	2.000	4.010	6.980	8.950	11.880
30	2.000	4.010	6.980	8.910	11.720
35	2.000	4.010	6.960	8.880	11.670
40	2.000	4.010	6.950	8.850	11.540
45	2.000	4.010	6.950	8.820	11.440
50	2.000	4.000	6.950	8.790	11.330



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