

EC-4110-I

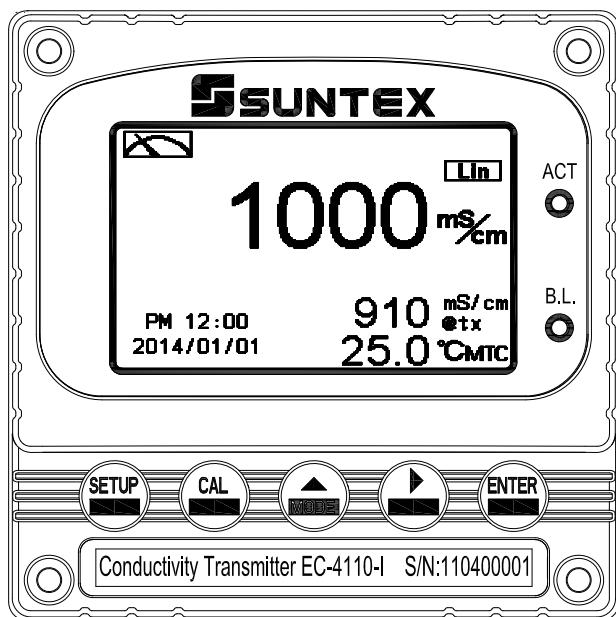
EC-4110-ICON

Inductive

Conductivity

Transmitter

Operation
Manual



SUNTEX

Thank you for purchasing Suntex products. To continuously improve and enhance the transmitter's function and capabilities, Suntex reserves the right to modify the content and icon display of the product without notice. When using this transmitter, please follow all instructions on installation and operation as described within this manual. Suntex Instruments Co., Ltd. is not liable for any direct or indirect loss or damage caused by improper usage of this product.

Precautions for Installation

Please read this operation manual thoroughly before installation to prevent incorrect wiring, which may lead to instrument damage and safety issues.

- All cable wirings must be correctly connected and inspected before connecting to the power supply to avoid electrical hazards.
- Ventilate meter installation site and keep away from direct sunlight.
- The signal cable requires a special coaxial cable material. Cables sold by Suntex are strongly recommended. Please do not use normal electric wires.
- Prevent power surge interference to the transmitter. Especially when using a three-phase power system, make sure the device is properly grounded. If power surge interference occurs, separate the power supply of the transmitter from that of the controlled device (i.e., dosing machines, mixers, etc.), or install surge absorber to reduce power surges from all electromagnetic switches and power control device coils.
- The internal relays must be connected to **external power relays with sufficient ampere capacity** before connecting to external alarms or devices to protect the instrument. (Please see to section 3.6, “Electrical Connection Illustration”)
- The Suntex logo is shown on the top right corner of the display during all operations. For function illustration purposes, the logo is not shown in the figures presented in this operation manual.

Disposal

When wishing to dispose of an obsolete instrument or any parts of an instrument, please observe local and national regulations and requirements for the disposal of electrical and electronic equipment.



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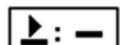
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Brief Instructions

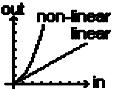
Settings Menu Description (See Chapter 6 for Details)

Press  and  simultaneously to view settings information overview. Press  to proceed into settings menu. Press keypad according to the index bar at the bottom of the screen.

Keypad Index

Keypad	Index Bar	Description
		Return to previous level or action
		Left or left page
		Increase digit
		Right or right page
		Decrease digit
		Confirm and proceed

Settings Items

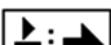
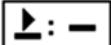
Function	Icon	Description
Mode		Select conductivity measurement mode with temperature compensation (Cond.@tref), concentration, TDS, salinity or absolute conductivity (Cond.@tx). Measurement can be displayed in text mode, real-time mode, or trace mode.
Product Adj.		Adjust measurement for process calibration
Temperature		Select temperature measurement and compensation mode, MTC - Manual temperature compensation PTC/NTC - Auto temperature compensation
Compensation		Select temperature compensation mode, linear (Lin.), non-linear (Non-Lin.), or no compensation (Lin., 0.0%)
Relay 1		Adjust first relay settings, select Hi/Lo alarm or OFF
Relay 2		Adjust second relay settings, select Hi/Lo alarm or OFF

Clean		Adjust automatic wash time settings Adjust cleaning relay ON/OFF duration
Current Output		Adjust current output corresponding to Cond.@tref, concentration, TDS, salinity, or Cond.@tx range
RS-485		Setup RS-485 serial interface (MODBUS protocol)
Clock		Adjust system time and date
Digital Filter		Adjust digital filter settings, number of samples to be averaged for each reading
Back Light		Adjust backlight settings, Auto/ON/OFF, brightness, and light sensor sensitivity
Contrast		Adjust screen contrast settings
Logbook		View event record logbook (50 data sets)
Return		Adjust measurement mode return settings
Code		Set settings passcode, this passcode is at a higher security level than the calibration passcode and can be used to bypass calibration lock.
Language		Select system language, English, Traditional Chinese, or Simplified Chinese

Calibration Menu Description (See Chapter 7 for Details)

Press  and  simultaneously to view calibration information overview. Press  to proceed into calibration menu. Press keypad according to the index bar at the bottom of the screen.

Keypad Index

Keypad	Index Bar	Description
		Return to previous level or action
		Left or left page
		Increase digit
		Right or right page
		Decrease digit
		Confirm and proceed to next step

Calibration Items

Function	Icon	Description
Cell Constant		Adjust the transmitter cell constant to match the sensor cell constant
Std. Solution		Calibrate using standard solution
Zero		Calibrate zero-point
Return		Adjust calibration mode return settings
Code		Set calibration passcode

Note

Due to the need for continuous enhancement of the transmitter functions, Suntex reserves the right to modify the icons and the contents. The icons and contents of the instrument are subject to change without notice.

1. Specifications

1.1 Specifications

Model	EC-4110-I	EC-4110-ICON
Measuring Modes	Conductivity/TDS/Salinity/Temp.	Conductivity/TDS/Salinity/Temp./Concentration
Range	Conductivity	000.0 µS/cm ~ 2,000 mS/cm, Auto or Fixed range
	Salinity	0.0 ppt ~ 70.0 ppt
	TDS	0 ~ 19,999 ppm; 0.00 ~ 199.9 ppt
	Temp.	PT-1000: -30.0 ~ 200.0°C, NTC-30K: -30.0 ~ 130.0°C
	Concentration	(Range varies depending on temperature) NaCl_28%: 0-28 % HCl_18%: 0-18 % HCl_39%: 22-39 % HNO ₃ _30%: 0-30 % HNO ₃ _96%: 35-96 % NaOH_24%: 0-24 % NaOH_50%: 15-50 % H ₂ SO ₄ _37%: 0-37 % H ₂ SO ₄ _88%: 28-88 % H ₂ SO ₄ _99%: 89-99 % H ₃ PO ₄ _35%: 0-35 % The boundaries of each conc. conversion range varies with temperature change. When over range, a warning will show on the display.
		—
		Self-Defined Table (Up to 9 temperature data points and 9 corresponding cond. vs conc. values at each temperature point; 9 x 9 matrix)
	Conductivity	0.1 µS/cm, 0.001 mS/cm, 0.01 mS/cm, 0.1 mS/cm, 1 mS/cm
	Temp.	0.1 °C
	Concentration	—
Accuracy	Conductivity	≥ 1 mS/cm: ±1% (±1 digit); < 1 mS/cm: ±10 µS/cm
	Temp.	±0.2°C (±1 digit) with temperature error correction
Temperature Compensation	Automatic with PT-1000 / NTC-30K	
	Manual adjustment temp. compensation, can display non-compensated conductivity value	
Calibration Modes		(1) Manual cell constant adjustment (2) Conductivity standard solution calibration (3) Zero-point calibration
Product Adjustment	Factor: 0.7000 ~ 1.3000	
Ambient Temperature	0 ~ 50°C	
Storage Temperature	-20 ~ 70°C	

Cell Constant	Adjustable: 0.008 ~ 9.9999 cm ⁻¹
Temperature Coefficient	Linear temperature compensation 0.00% ~ 40.00%, Non-Linear compensation, or No compensation
Compensated Temperature	Adjustable reference temperature: 0~200°C
Display Screen	Large LCM with contrast adjustment and sensor for auto/manual illumination
Display	Text mode: Numerical display
	Chart mode: 3 min real-time dynamic graph, range adjustable (Conductivity and Concentration only)
	Trace mode: 3 min to 4 week trend graph, range adjustable (Conductivity and Concentration only)
Analog Output	Isolated DC 0/4~20mA corresponding to main measurement, max. load 500Ω
Logbook	50 event records
Serial Interface	Isolated RS-485 (MODBUS RTU or ASCII)
Modbus Communication	Measuring value, calibration data, product adjustment, event logbook, control parameter, parameter readout and selection
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 ~ 99 min 59 sec / OFF 0 ~ 999 hr 59 min
Protection	IP65 (NEMA 4X)
Power Supply	100V~240VAC ±10%, 7W max., 50/60Hz
Installation	Wall or Pipe or Panel Mounting
Dimensions	96 mm × 96 mm × 132 mm (H×W×D)
Cut off Dimensions	93 mm × 93 mm (H×W)
Weight	0.5 kg

Note: The specifications are subject to change without notice.

1.2 Measurement Principle

1. EC-4110-I / EC-4110-ICON utilizes electro and magnetic field conversion principle to measure the conductivity of a sample. The electrodeless inductive sensor is composed of a drive coil and a receive coil that are not in direct contact with the solution. The material (i.e. PFA) used for the sensor is chemically resistant, and is applicable for acidic, alkaline, salt, effluent and other similar industrial online monitoring environments.
2. EC-4110-I/EC-4110-ICON induces alternating signals of electric field to activate the drive coil to produce a magnetic field. The sampling solution (containing ions of varying conc.) turns into a conductive circuit which transmits the signal to the receive cell, and is converted into a current that is measured as conductivity.
3. The temperature probe is equipped with a three-wire type PTC1000 and a two-wire type NTC30K sensor for temperature compensation. Users are able to select the temperature reference during sensor assembly. “Cond.@tx” represents conductivity measured under the current temperature of the sample. When operating under temperature compensation mode (linear, non-linear, or off) and reference temperature, “Cond.@tref” represents compensated conductivity value corresponding to the user-set reference temperature.
4. EC-4110-I and EC-4110-ICON models are both equipped with salinity and TDS measurement function.
5. EC-4110-ICON has a built-in conductivity and concentration conversion function for NaCl, HCl, HNO₃, H₂SO₄, H₃PO₄, and other chemical solutions. Users can select the chemical solution and its measurement concentration range. When the converted concentration is out of range, an error message will flash to notify the user. The measured absolute conductivity “Cond.@tx” can be converted to solution concentration and reference temperature-compensated conductivity value “Cond.@tref”.
6. EC-4110-ICON has a user-defined conductivity and concentration conversion table available for additional input. The units: %, ppm, and ppt are also selectable for displaying the concentration.
7. The user-defined concentration table (max. up to 9 data sets) allows input of absolute conductivity value and its corresponding concentration value under each temperature value. Users may input up to 9 temperature values with 9 pairs of conductivity and concentration values (9x9 matrix). Each temperature, conductivity, and concentration values must be entered in increasing or decreasing order; incorrectly ordered values will be identified and

displayed. If only one data set is available, use linear temperature compensation mode to input temperature compensation value.

8. The inductive conductivity sensor uses non-contact, electromagnetic field conversion to measure the conductivity value of the solution, therefore the cell constant of sensor represents the sensor's driving coil and receiving coil geometric structure. A label indicating the sensor's cell constant is attached on its cable. The sensor's electromagnetic signals may be affected by the installation environment, such as the Wall Effect, the piping material, or the sensor's proximity to the pipe wall, and therefore influencing the sensor's cell constant during installation. To compensate for any unnecessary effects, the sensor should be calibrated in air (zero-point calibration) or the cell constant should be adjusted accordingly. The user may also directly adjust the measured value via product adjustment.
9. Following installation or repair, zero-point calibration in the air is mandatory. The surface of the sensor should be cleansed with cleaning solution to remove all residues and kept dry for cell constant calibration or product adjustment.
10. The following display resolutions and units are available for selection: 2,000mS/cm, 999.9mS/cm, 99.99mS/cm, 9.999mS/cm, 999.9 μ S/cm, and AUTO (Automatic Switch Unit); 2,000mS/cm is set as default.
11. MODBUS transmits measurement value, calibration data, sample adjustment, event log, control parameter, primary measurement selection, parameter output, and meter settings. The settings are also able to be changed via MODBUS from a PLC.

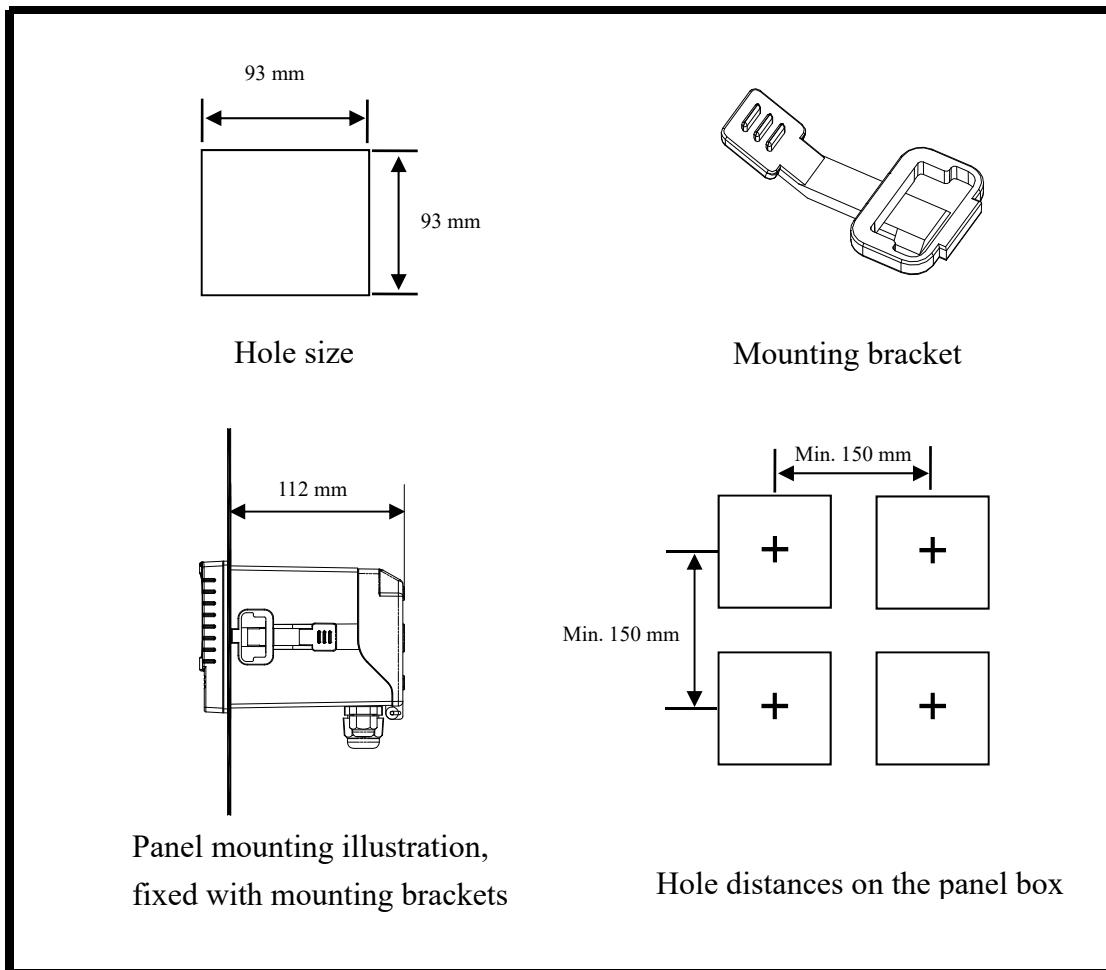
2. Assembly and Installation

2.1 Transmitter Installation:

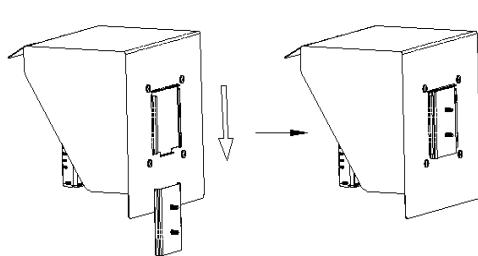
This transmitter can be installed by panel mounting, wall mounting, or 2" pipe mounting.

2.2 Panel Mounting Illustration:

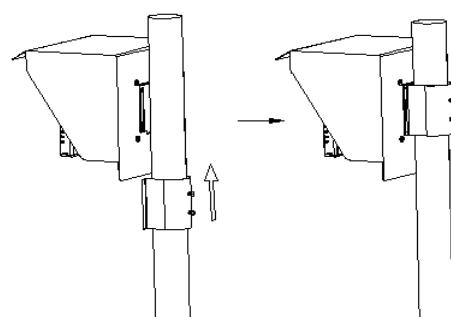
Prepare a square hole of 93 mm x 93 mm on the panel box, then insert the controller directly into the space. Insert the accessorial mounting bracket from the rear, and fix into the pickup groove.



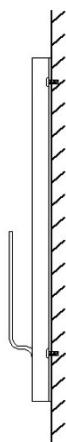
2.3 Wall Mounting and Pipe Mounting Illustration:



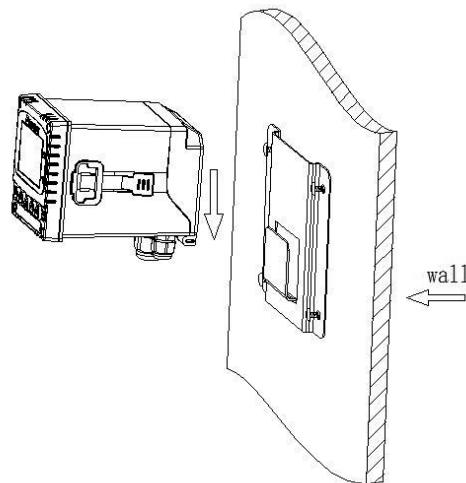
Sun Shield (wall mounting)
Order no. 8-35 + 8-35-2 + 8-35-3



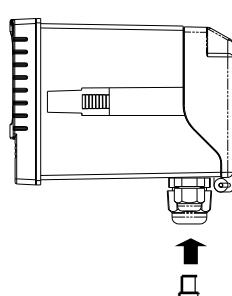
Sun Shield (pipe mounting)
Order no. 8-35 + 8-35-1 + 8-35-3



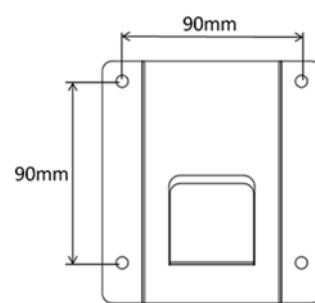
Wall mounting, use 4x M5
screws to secure 8-35-3



Follow the direction of the
arrow to install onto 8-35-3



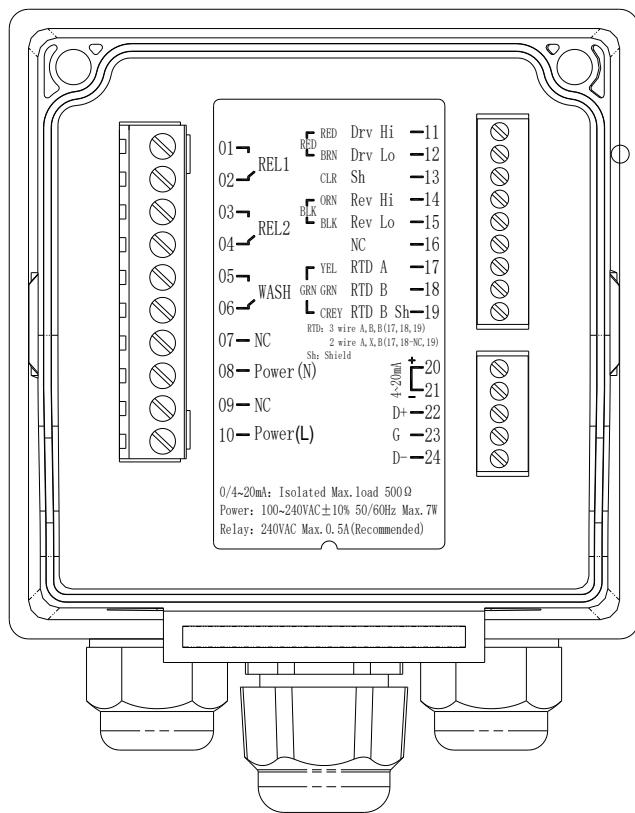
Insert rubber plug into the unused
cable gland. Tighten up cable gland to
prevent water vapor infiltration.



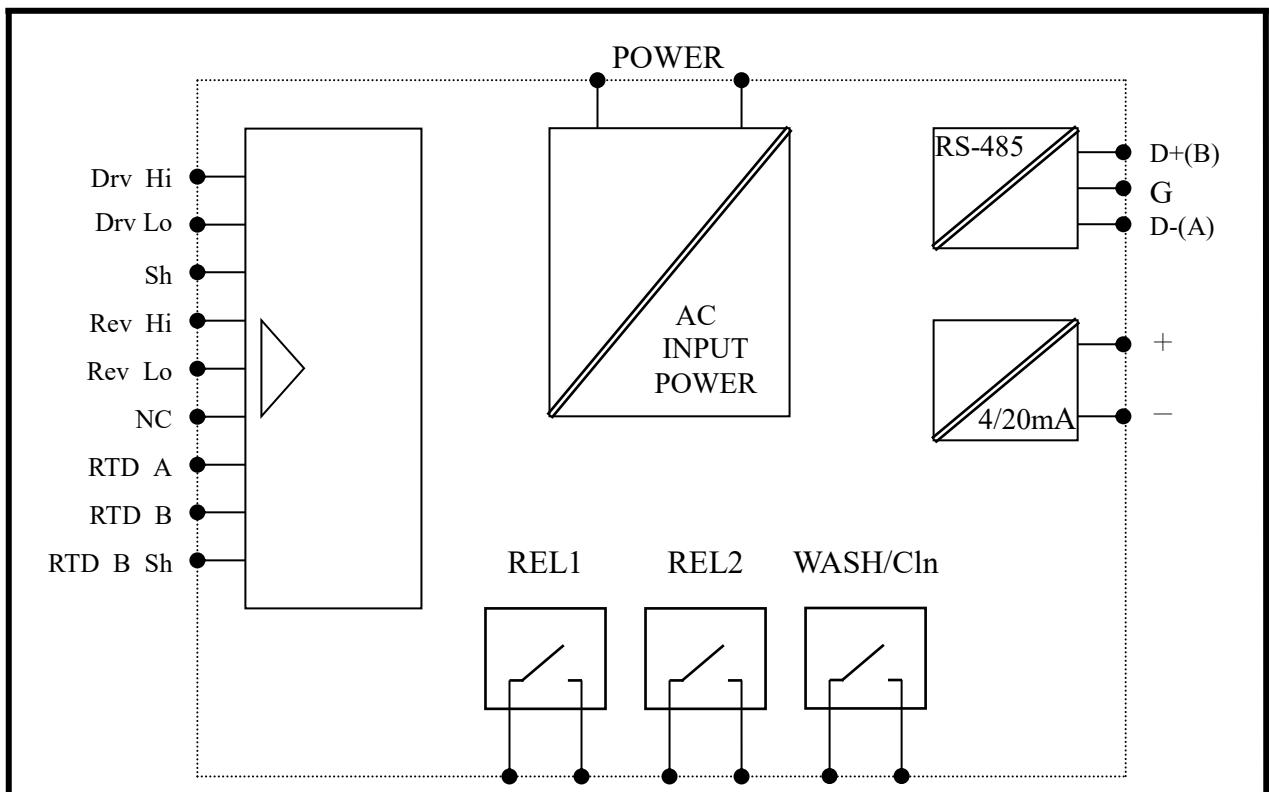
8-35-3 dimensions

3. Overview of Inductive Conductivity transmitter EC-4110-I / EC-4110-ICON

3.1 Rear Panel Illustration



3.2 Terminal Function Illustration



3.3 Terminal Function Description

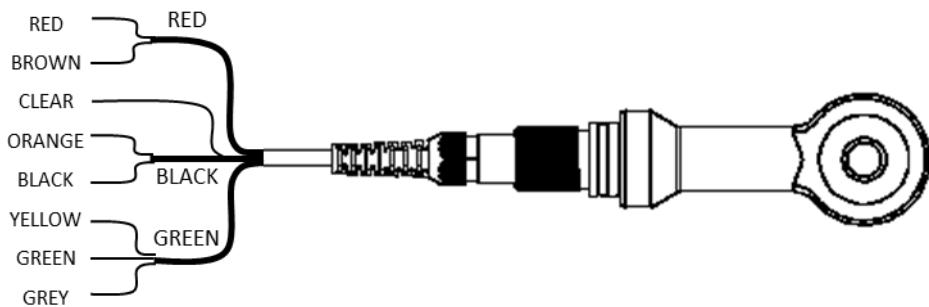
0 1		REL1: First alarm control, contact for an external relay
0 2		REL2: Second alarm control, contact for an external relay
0 3		WASH: Wash relay contact for an external relay
0 4		
0 5		
0 6		
0 7		NC: No contact
0 8		Power (N): 100~240VAC Power supply terminal
0 9		NC: No contact
1 0		Power (L) : 100~240VAC Power supply terminal
1 1		Drv Hi: Sensor drive coil terminal, High
1 2		Drv Lo: Sensor drive coil terminal, Low
1 3		Sh: Shield
1 4		Rev Hi: Sensor receive coil terminal, High
1 5		Rev Lo: Sensor receive coil terminal, Low
1 6		NC: No contact
1 7		RTD A: Three-wires temp. probe terminal A
1 8		RTD B: Three-wires temp. probe terminal B
1 9		RTD B Sh: Three-wires temp. probe terminal B Shield
2 0		4~20mA + terminal: Master measure current output terminal +, for an external recorder or PLC control
2 1		4~20mA - terminal: Master measure current output terminal -, for an external recorder or PLC control
2 2		D+(B): RS-485 output D+(B)
2 3		G: RS-485 output GND
2 4		D-(A): RS-485 output D-(A)

01	REL1	RED	Drv Hi	—11
02		BRN	Drv Lo	—12
03	REL2	BLK	CLR Sh	—13
04		BLK	Rev Hi	—14
05		YEL	Rev Lo	—15
06	WASH	GRN	RTD A	—17
		GRN	RTD B	—18
07		CREY	RTD B Sh	—19
08	Power (N)			—20
09	NC			—21
10	Power (L)		D+	—22
			G	—23
			D-	—24
0/4~20mA: Isolated Max. load 500Ω				
Power: 100~240VAC ±10% 50/60Hz Max. 7W				
Relay: 240VAC Max. 0.5A (Recommended)				

Instructions for temperature probe wiring on specific temperature system:

- PTC1000 (Three-wires): Connects No. 17 RTD A, No. 18 RTD B, and No. 19 RTD B Sh.
- PTC1000 (**Two-wires**): **electrical short-circuit with No.18 RTD B and No.19 RTD B Sh.**
- NTC30K (Two-wires): Only connects No.17 RTD A and No.19 RTD B Sh.
- 8-201-PFA-10 Inductive conductivity sensor's temperature system is with three wires PT-1000.

3.4 Cable Wiring

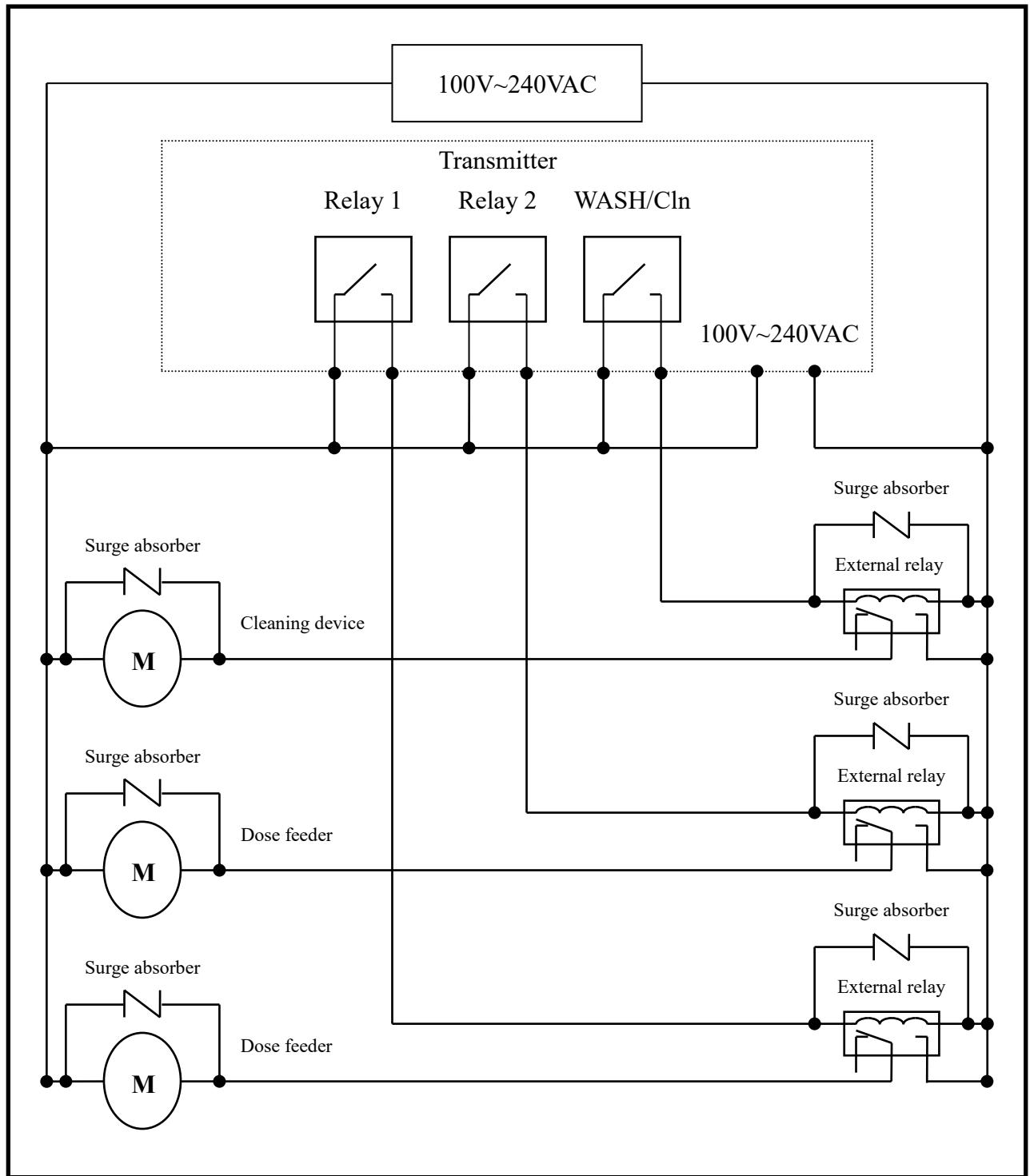


3.5 Cable Circuitry

Wiring instructions for 8-201-PFA-10 sensor:

Terminal	Heat Shrink Tube Color	Wire Color	Wire Description
Drv Hi	Red	Red	Drive Hi
Drv Lo		Brown	Drive Lo
Sh	Clear	Clear	SHIELD
Rev Hi	Black	Orange	Receive Hi
Rev Lo		Black	Receive Lo
RTD A	Green	Yellow	PTC1000 RTD-A
RTD B		Green	PTC1000 RTD-B
RTD B Sh		Grey	PTC1000 RTD-B Shield

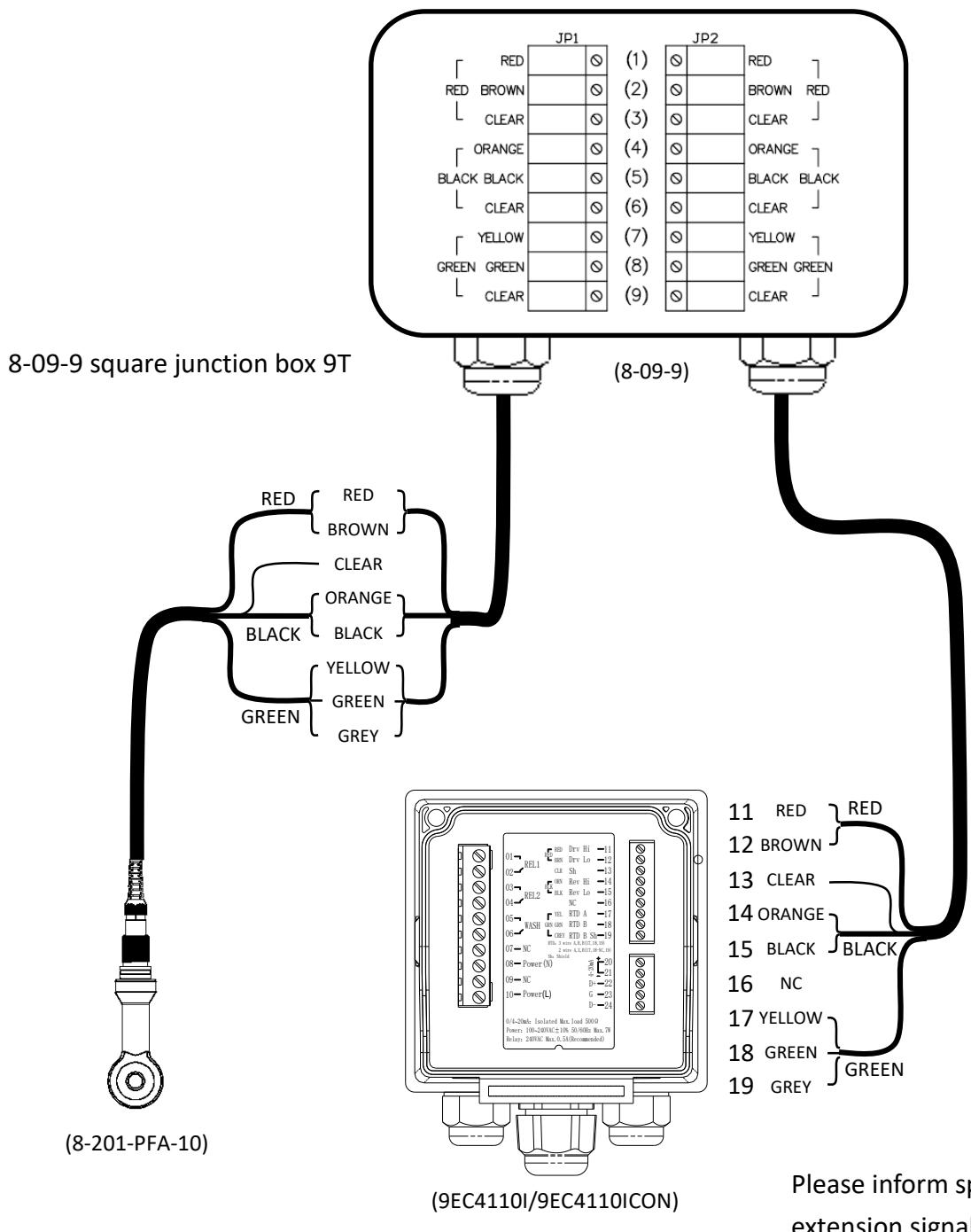
3.6 Electrical Connection Illustration



Note: The transmitter's built-in miniature relays are required to be repaired and replaced by professional technicians. **External relays** (Power Relay) must be connected to activate external devices.

3.7 Extension Cable Wiring Diagram

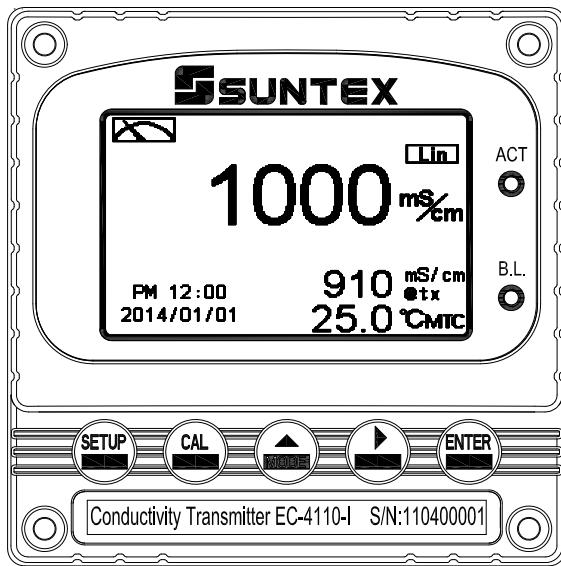
If the length of signal cable requires extension (max. up to 50m), the 8-09-9 rectangle junction box 9T (there are four M4 fixed screws on the rear) and extension signal cable can be used. After installation, the transmitter requires sensor zero-point and cell constant recalibration, or in-field product adjustment. Wiring diagram is as follows:



Please inform specific
extension signal cable
length when ordering

4. Configuration

4.1 Front Panel Illustration



4.2 Keypad

In order to prevent unauthorized operations, the transmitter utilizes multi-key and passcode functions to enter parameter and calibration setting modes. Description of the key functions are as follows:



: When in settings menu, press this key to exit and return to measurement mode.



: When in calibration menu, press this key to exit and return to measurement mode.



1. When in settings or calibration menu, press this key to move left or return to the previous page.

2. When adjusting values, press this key to increase the digit.



1. When in settings or calibration menu, press this key to move right or to advance to the next page.

2. When adjusting values, press this key to decrease the digit.



: Key for confirmation; press this key to confirm data values or select menu items.

4.3 LED Indicators

ACT: Washing operation relay (Clean) and dosing operation relay (Relay 1, Relay 2) indicator.

B.L.: Light sensor; under automatic display backlight mode, the backlight will automatically turn on or turn off depending on the surrounding brightness.

5. Operation

5.1 Measurement Mode

All electrical connections must be secured and tested before connecting the instrument to the power supply and turning it on. The transmitter will automatically enter measurement mode with the factory default settings or the previous user settings.

5.2 Settings Menu

Please refer to the settings instructions in Chapter 6. Press  and  simultaneously to enter settings menu, or press  to return to measurement mode.

5.3 Calibration Menu

Please refer to the calibration instructions in Chapter 7. Press  and  simultaneously to enter calibration menu, or press  to return to measurement mode.

5.4 Shortcuts

1. Under measurement mode, if MTC is selected for temperature compensation mode, press  or  to adjust the MTC temperature value.
2. Under measurement mode, press and hold  for 2 seconds to view Logbook. Press  again to return to measurement mode.
3. Under measurement mode, press and hold  for 2 seconds to switch the display mode to text mode, trace mode, or real-time chart mode.

5.5 Default Values

5.5.1 Settings Default Values

Measurement Mode: Conductivity@tref

Range: 2,000mS

Temperature Compensation: PT-1000

Temperature Coefficient: Lin, 2.00%

Relay 1: High point alarm: AUTO, SP1 = 1,000 mS/cm, Hys. = 10mS/cm

Relay 2: Low point alarm: AUTO, SP2 = 100 mS/cm, Hys. = 1.0 mS/cm

Wash Time: OFF

Analog current output (Conductivity): 4~20 mA, 0~1,000mS/cm

RS-485: MODBUS RTU, 19200, EVEN, 1, ID: 1

Digital Filter: 0 (Auto according to range)

Backlight: Off

Contrast: 0

Return: Auto, 3 minutes

Code: Off

5.5.2 Calibration Default Values

Calibration Type: No Cal

Calibration Temperature: None

Cell Constant: 2.700

Zero: 0.0 µS/cm

Return: Auto, 3 minutes

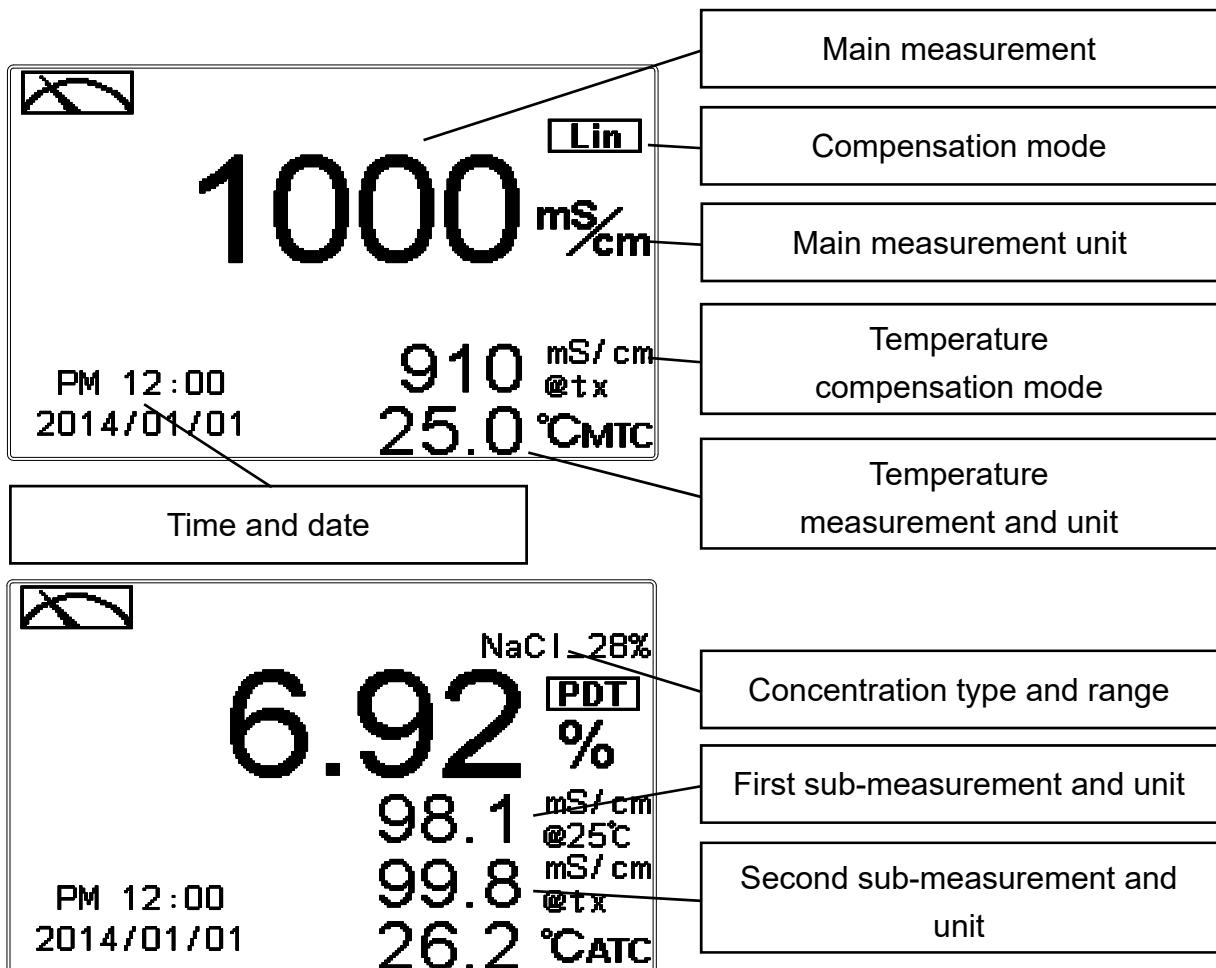
Code: Off

Note: If the calibration type is set at “No Cal” and the cell constant is “2.700”, the sensor has not been calibrated to the transmitter. When selecting standard solution or directly adjusting cell constant to complete calibration, the transmitter will display the cell constant of the cell. Before calibration, clean the sensor surface with cleaning solution to remove any debris or attached solids. Following installation or maintenance, zero-point calibration in air is necessary.

6. Measurement Display Mode

6.1 Text Mode

The text (general) mode is a digital display with contents as seen in the following illustration. Text mode mainly features the main measurement value and unit, temperature vale and unit, temperature compensation mode, and the time and date.



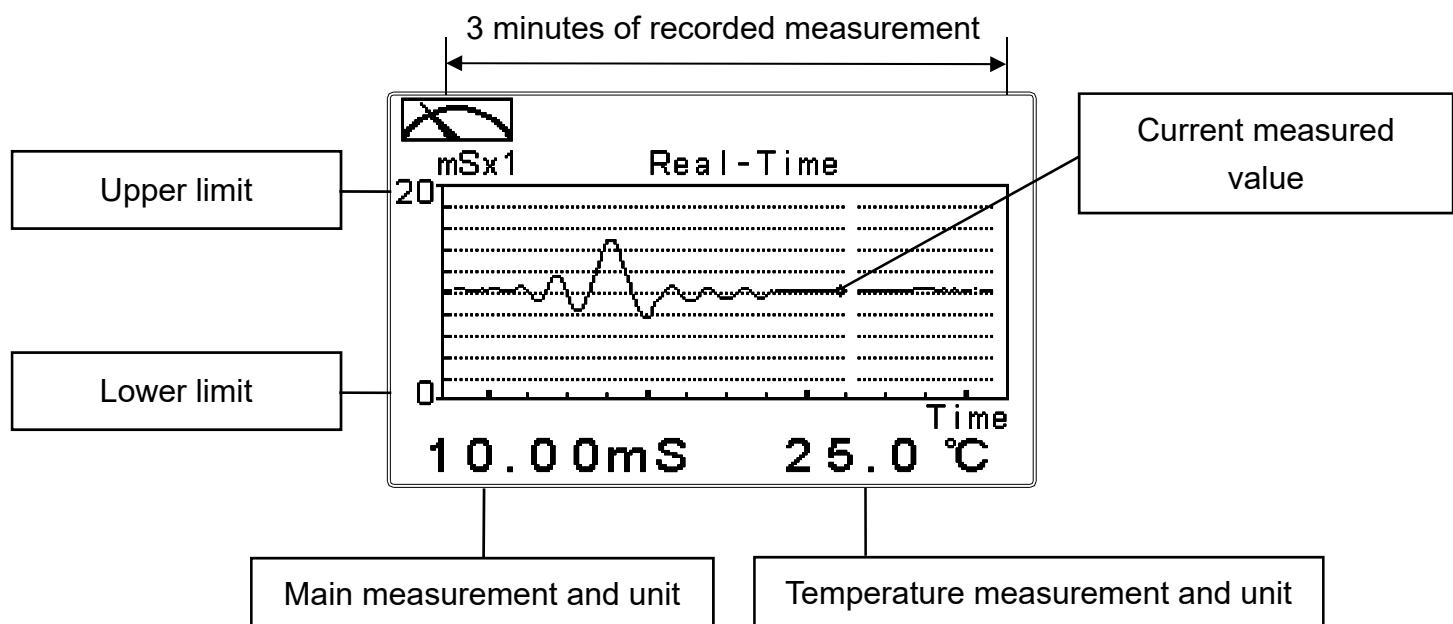
Note:

The main displaying measurement can be adjusted to display other testing subjects.

The first and second sub-measurements can be adjusted to display other measurements relative to the main measurement, or turned off.

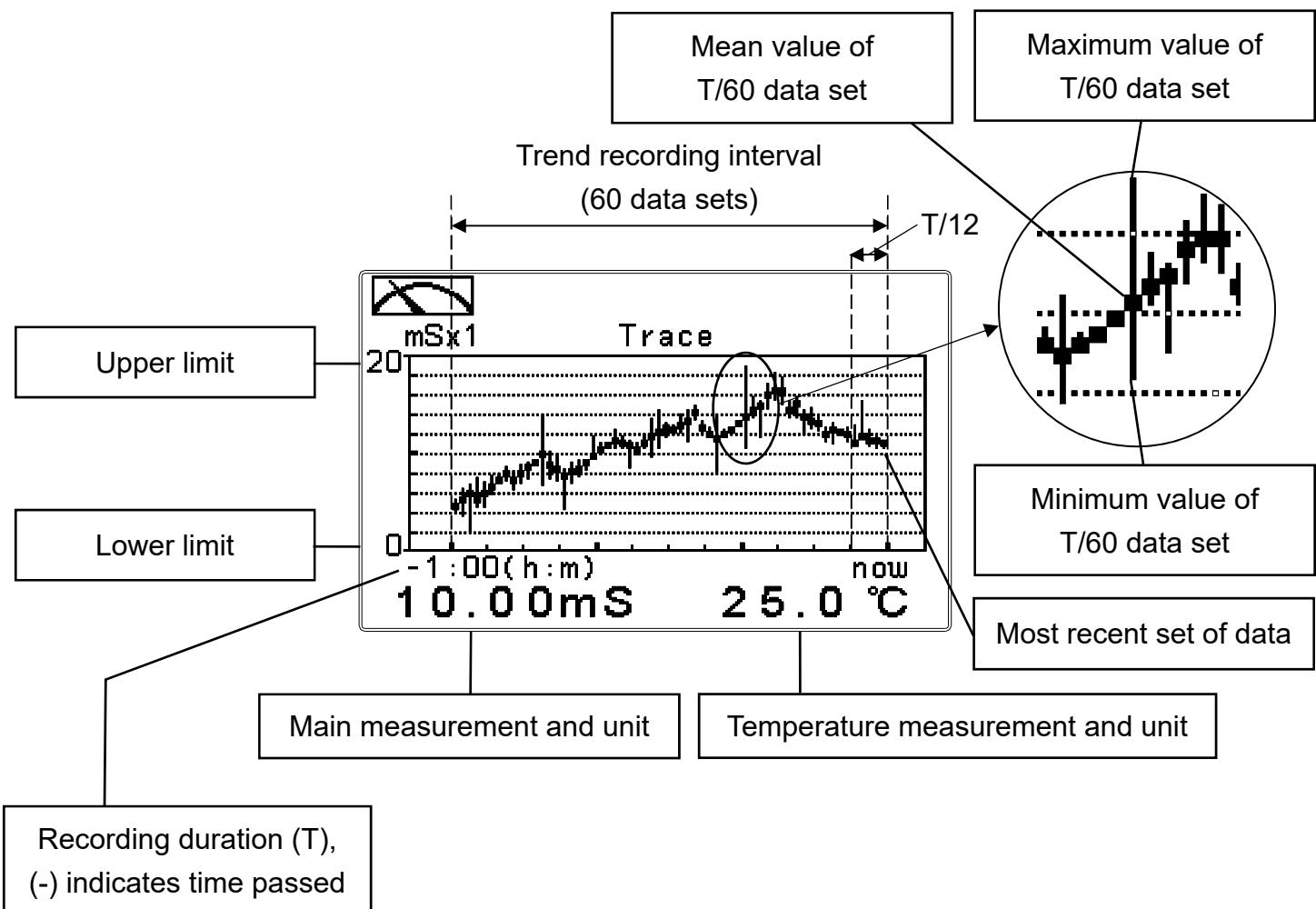
6.2 Real Time Chart Mode

Real-time chart mode displays a dynamic graph of the measured values over the last 3 minutes. Under settings, set the corresponding conductivity or concentration measuring range (see chapter 7.4, “Mode”) to adjust the resolution of the curve. The smaller the range, the higher the resolution. When entering settings or calibration mode then returning to measurement mode, the graph will be updated. If the measured value exceeds the set limits, the graph line will appear dotted. The timeline (x-axis) of the real-time graph is divided into 12 segments, each of which represents a quarter of a minute (15 seconds).



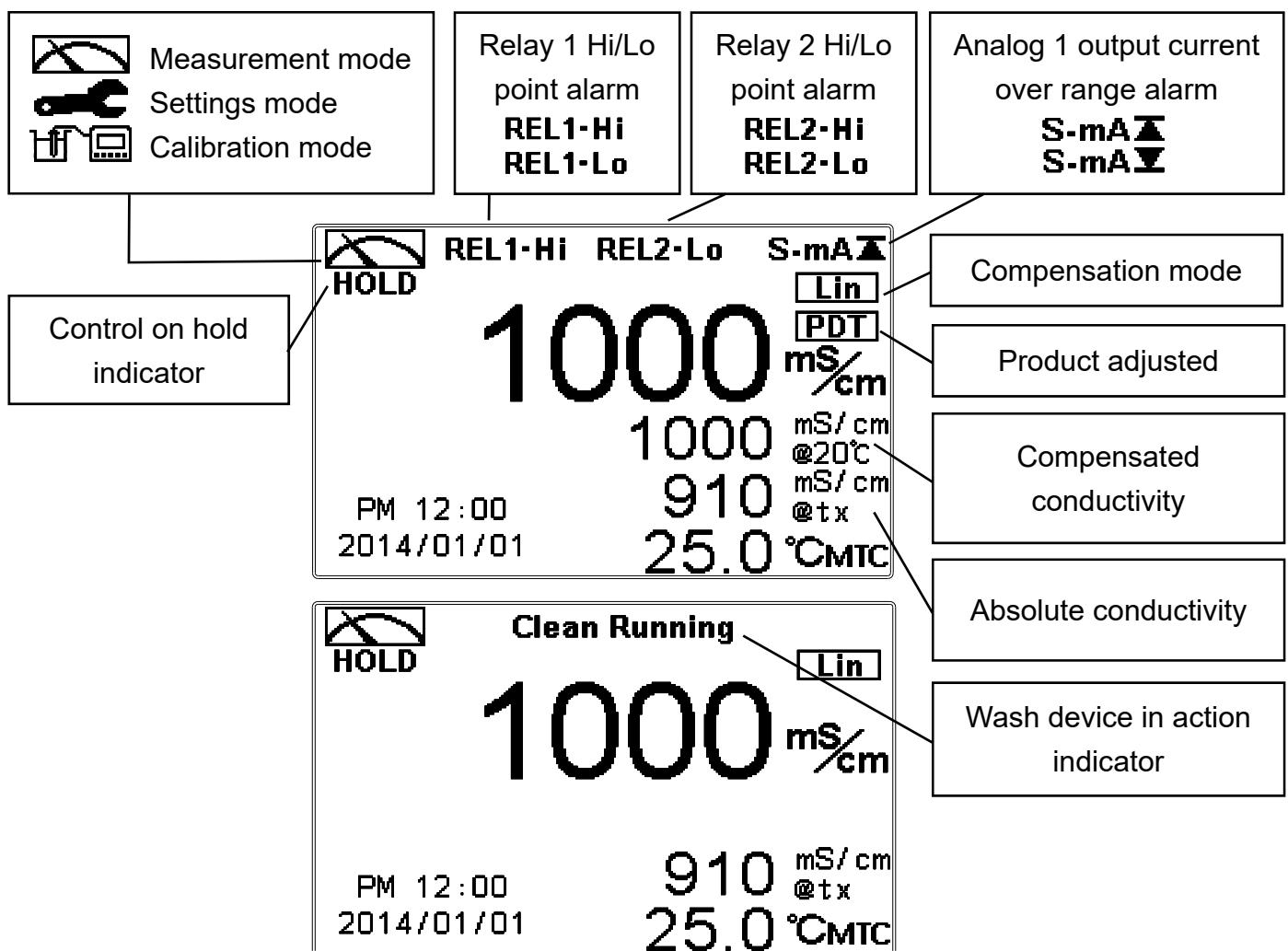
6.3 Trace Mode

Trace mode allows displays the previously measured values over the set time period “T” (min. 3 minutes, max. 4 weeks). The trend graph is composed of 60 data sets, with each set representing “T/60”. Each set of data (T/60) includes the mean, maximum, and minimum values, and is displayed as a vertical line. When a new set of data is generated to the right, the entire graph is shifted one unit to the left. E.g. “T” is set to 60 hours, each data set (T/60) thus represents 1 hour, and will record the mean, maximum, and minimum values within the hour. The timeline of the trace graph is divided into 12 segments, each of which represents T/12 and consists of 5 data sets. Under settings, set the corresponding conductivity or concentration measuring range (see chapter 7.4, “Mode”) to adjust the resolution of the curve. The smaller the range, the higher the resolution. If the measured value exceeds the set limits, only the mean value will be displayed above or below the limit.



6.4 Warning Symbols and Text

- When clean function is activated, the transmitter will display “HOLD” and flash “Clean Running”. At the same time, the WASH indicator LED will light up, and the transmitter will automatically turn off Relay 1 and Relay 2 function. Once cleaning is completed, both Relay 1 and Relay 2 will automatically resume.
- When Relay 1/Relay 2 Hi settings are activated, the transmitter will flash “REL1-HI/ REL2-HI”, and the RELAY1/RELAY2 indicator LED will light up. When Relay 1/Relay 2 Lo settings are activated, the display will flash “REL 1-Lo/ REL 2-Lo”, and the RELAY1/RELAY2 indicator LED will light up.
- When the Analog 1 current output exceeds the upper/lower limit, the display will flash “S-mA ▲ / S-mA ▼”.



Note:

The “HOLD” warning text appears when cleaning is in action, in settings menu, or in calibration menu. Under HOLD status, the display and output are as follows:

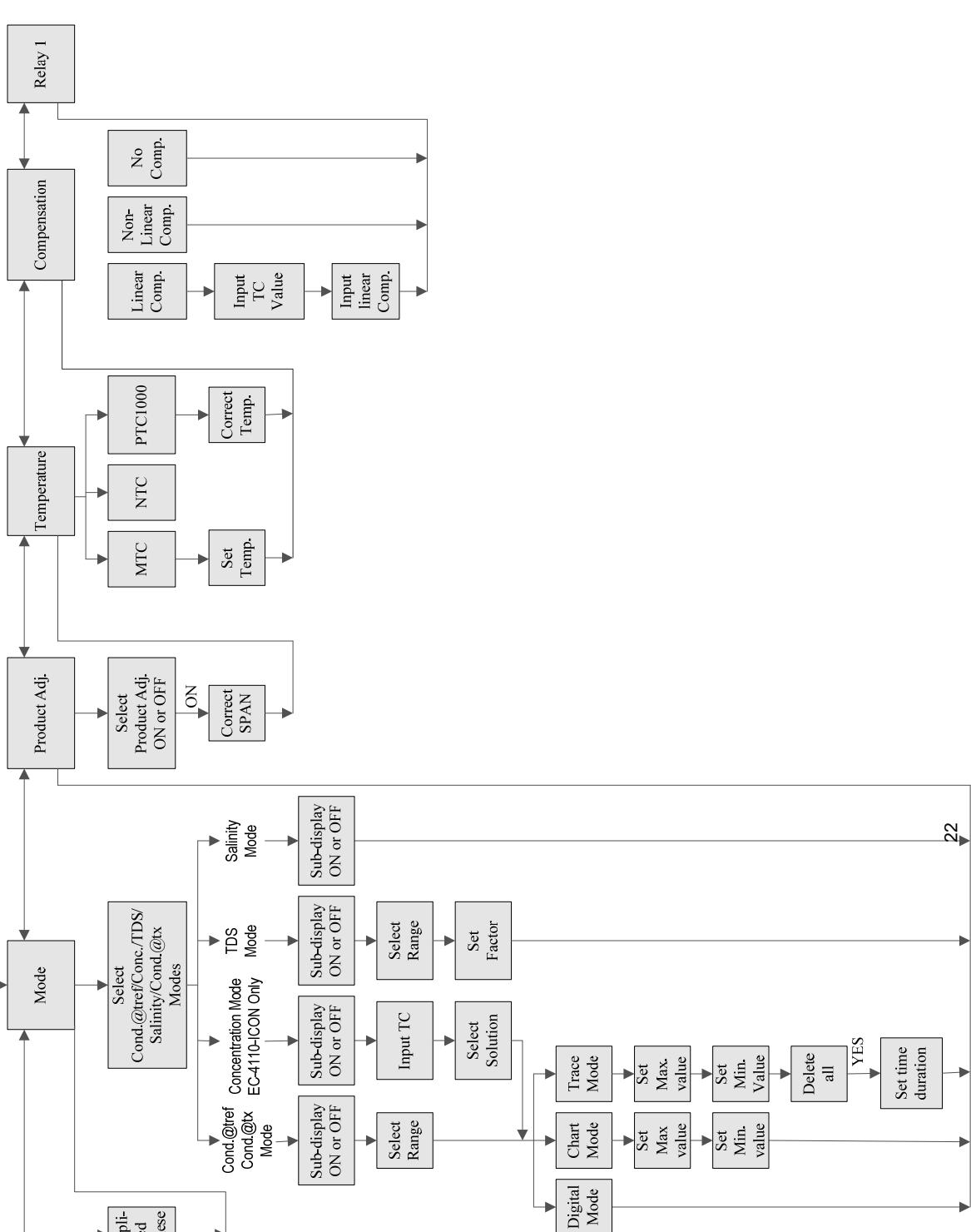
- Both Relay 1 and Relay 2 cease action. While cleaning, entering settings or calibration menu will terminate cleaning.
- The measurement value and RS-485 will remain at the most recent output before HOLD.

7. Settings

Settings Block Diagram – Part 1

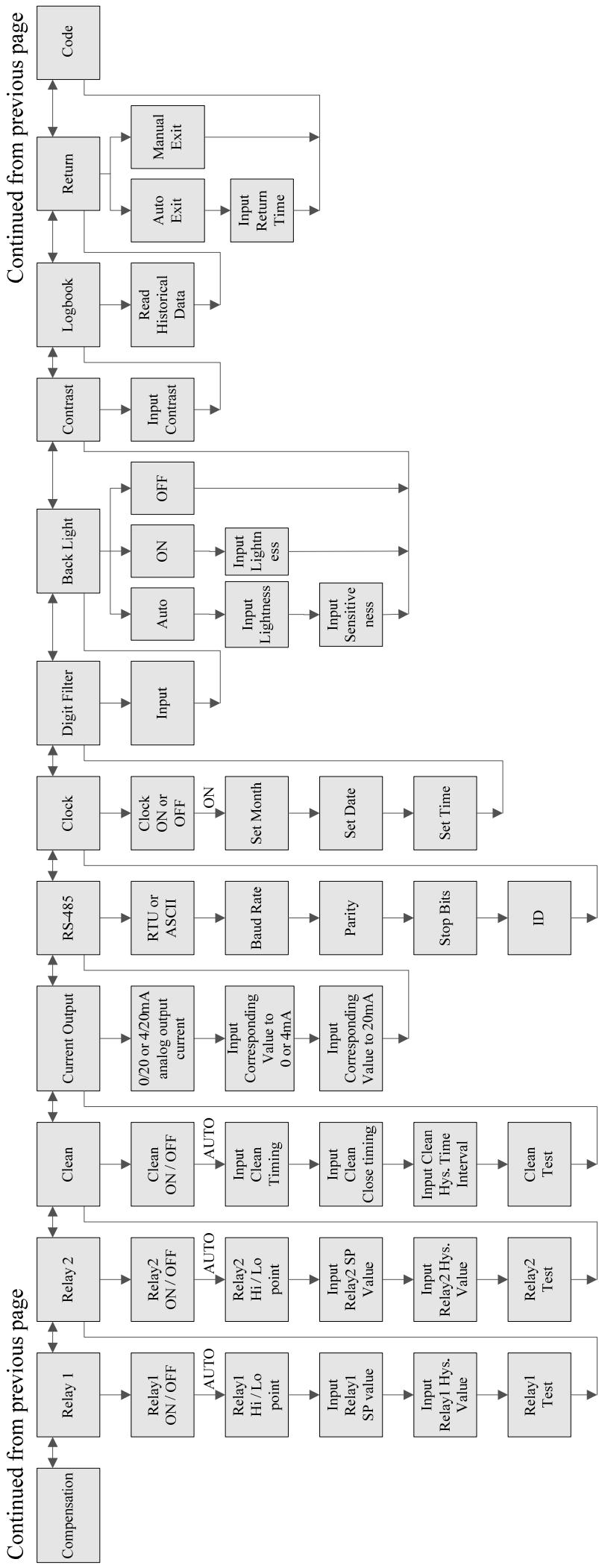
EC-4110-H
EC-4110-ICON
Overview

Continued on next page



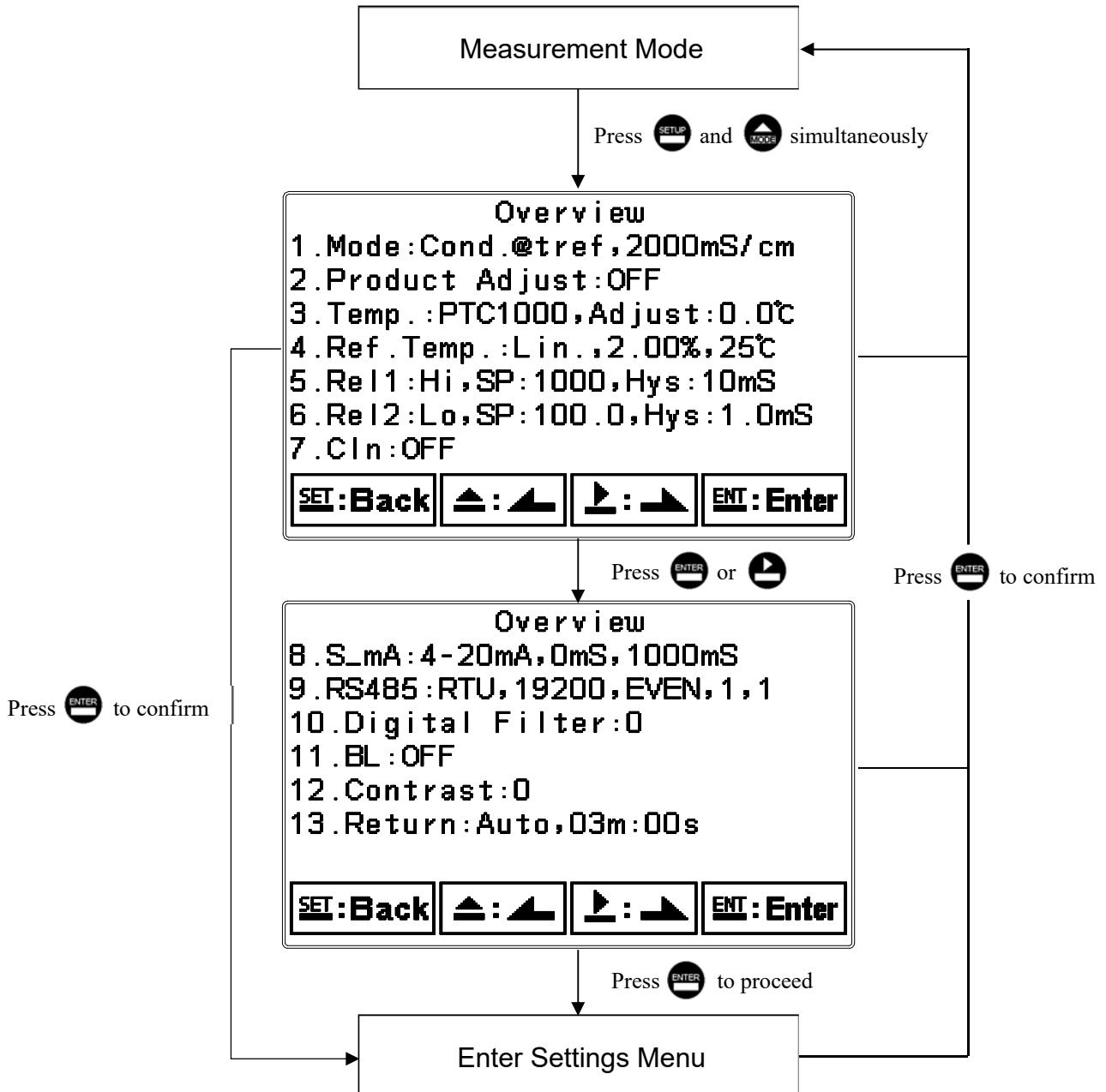
Return to previous :
level / action

Settings Block Diagram – Part 2



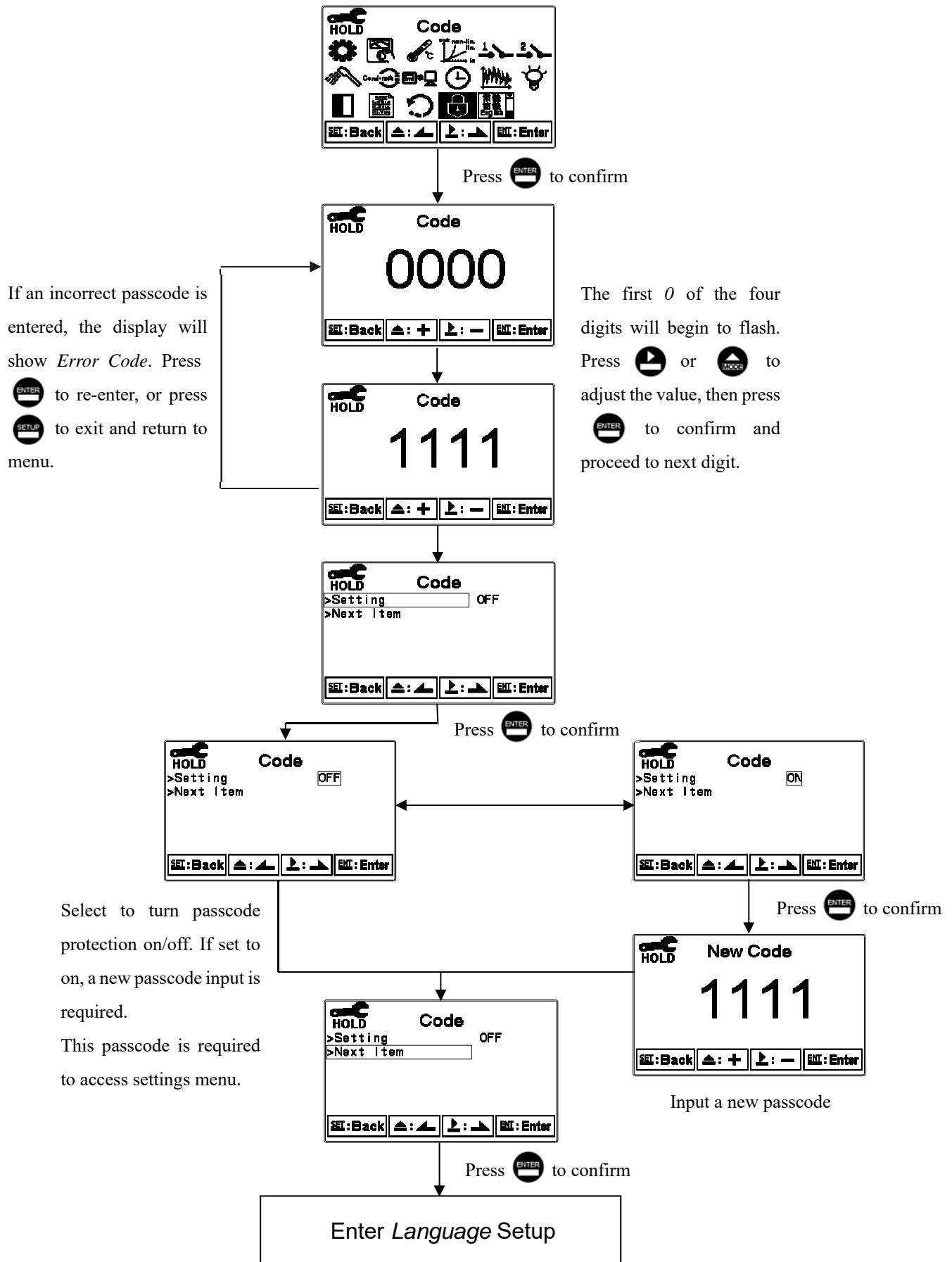
7.1 Settings Menu

Under measurement mode, press  and  simultaneously to view current settings overview. Press  to enter settings menu.



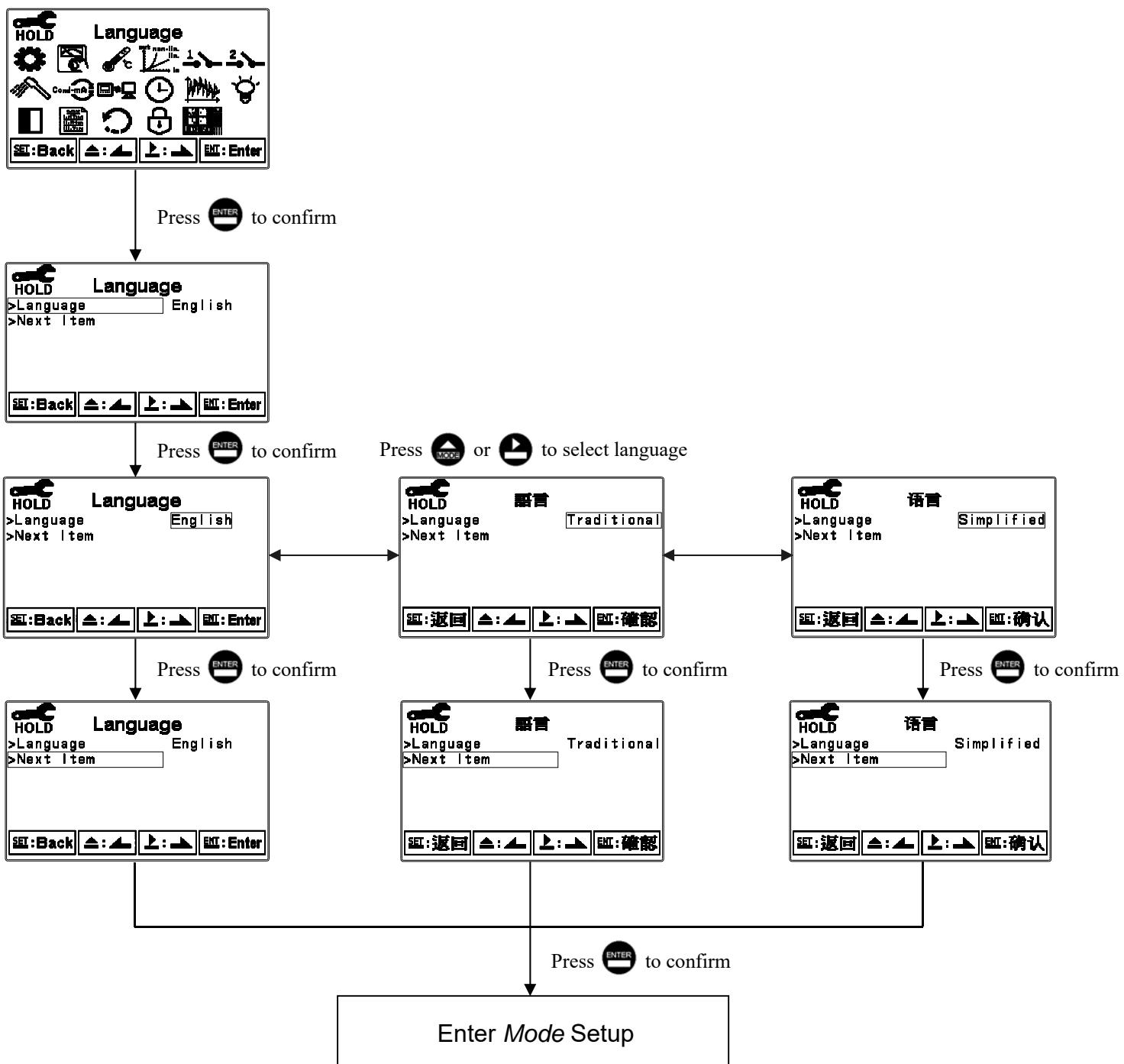
7.2 Settings Security Code

Under Settings selection menu, enter *Code* setup to proceed into passcode settings. The preset code is 1111. The passcode for settings mode is at a higher security level than the passcode for calibration mode, and can be used to access calibration code.



7.3 Language

Under Settings menu, enter *Language* setup to proceed into language selection settings. Select from English, Traditional Chinese, or Simplified Chinese.

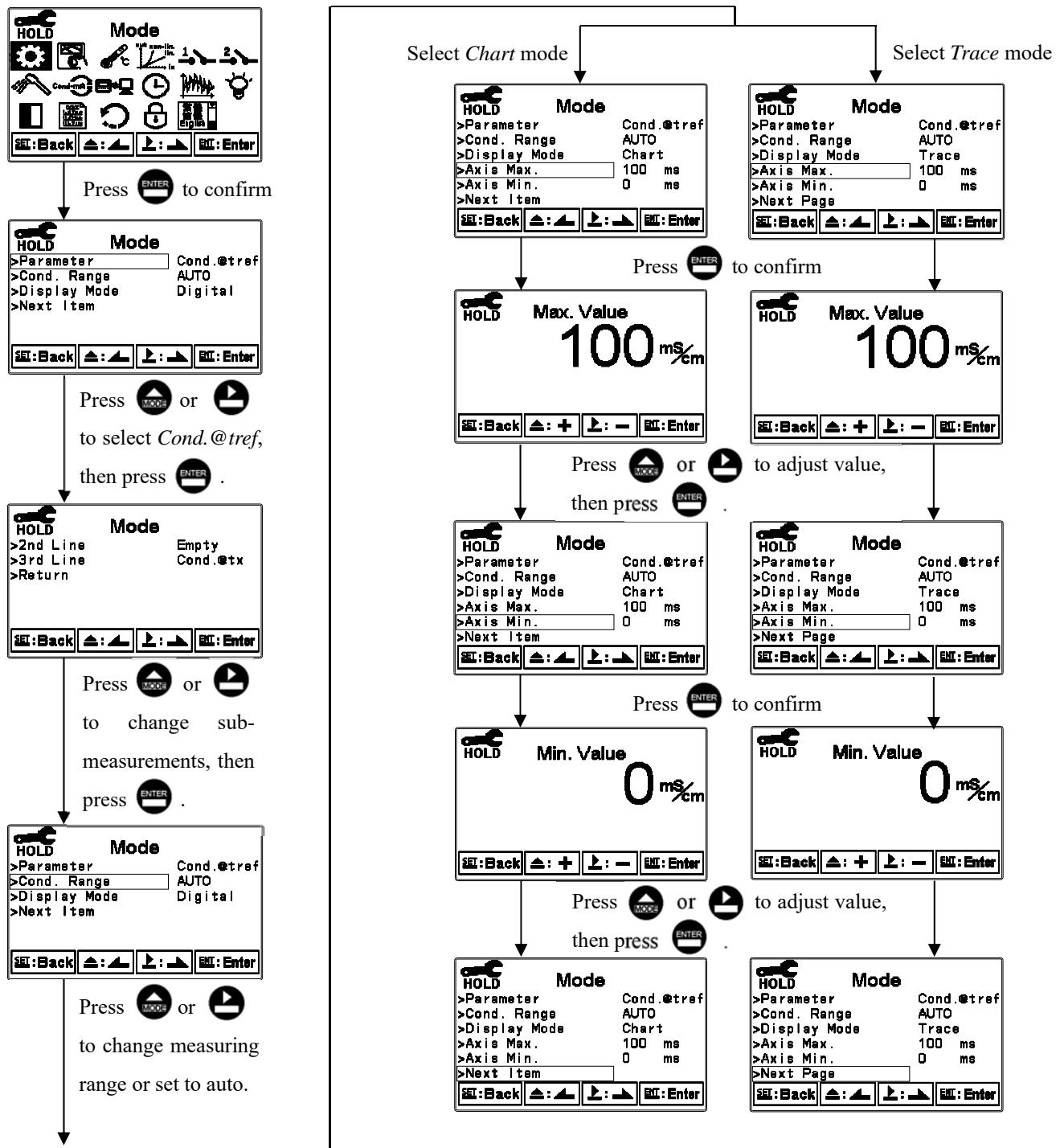


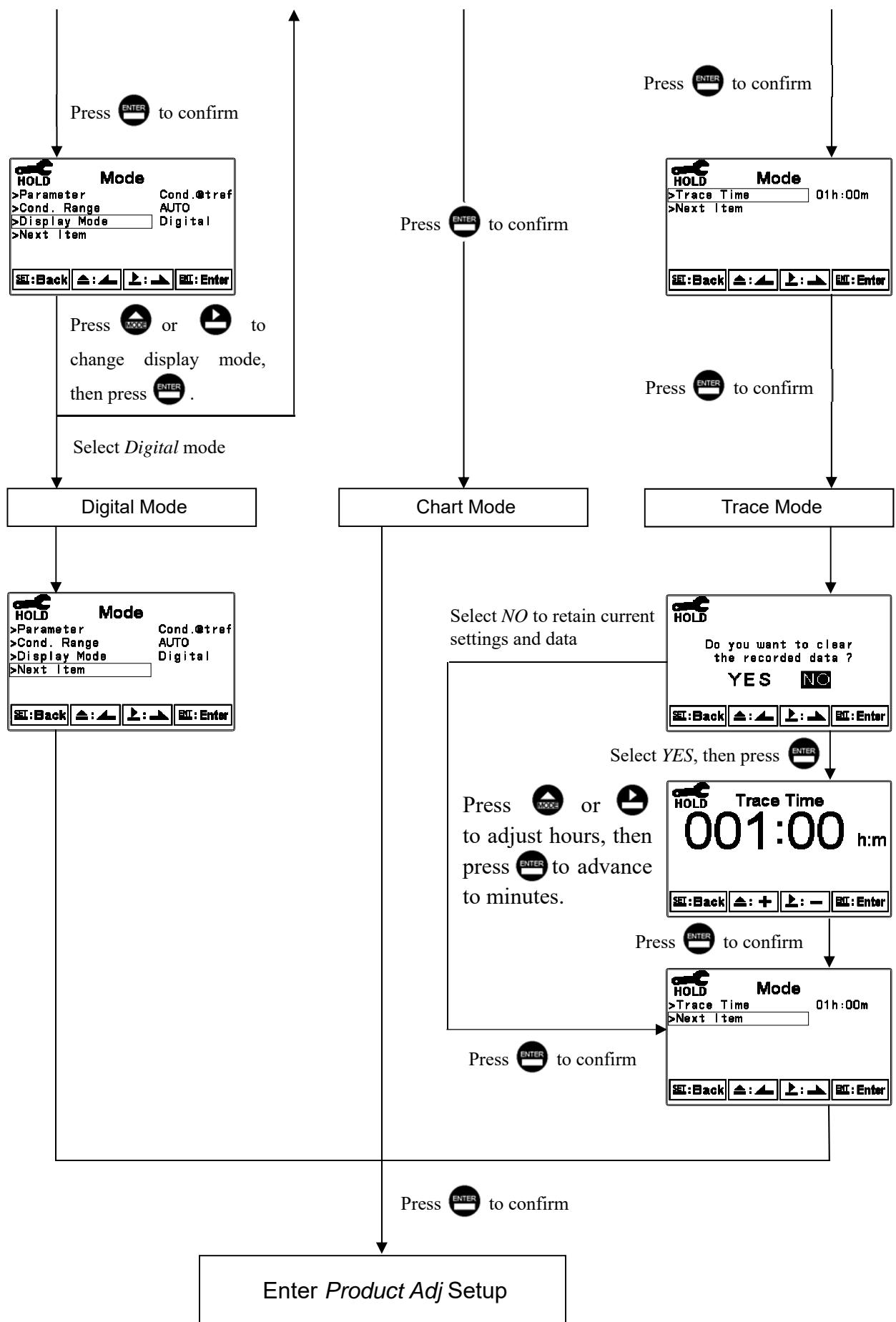
7.4 Measurement Parameter (Mode)

Under Settings menu, enter *Mode* setup to proceed into measurement mode configuration settings. The default measuring range is 2,000mS/cm. Select desired measuring range from 2,000mS/cm, 999.9mS/cm, 99.99mS/cm, 9.999mS/cm, 999.9μS/cm, or select auto range detection.

7.4.1 Conductivity with Temperature Compensation (Cond.@tref)

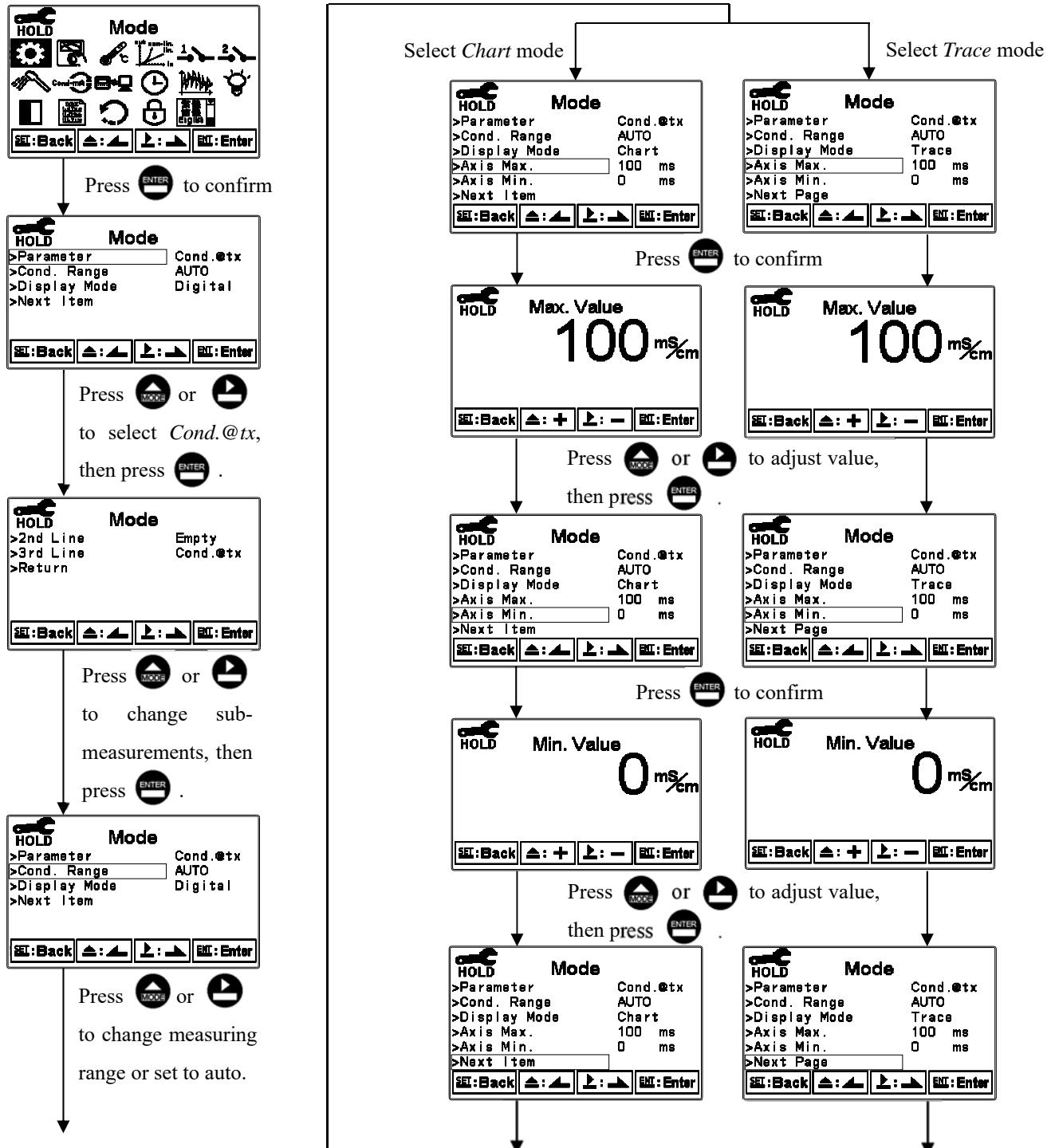
Conductivity can be measured with liner or non-linear temperature compensation. To adjust temperature compensation coefficient and reference temperature, see chapter 7.7, *Temperature Compensation Coefficient*. Under measurement parameter settings (Mode), select Cond.@tref for parameter, select conductivity measurement range or set to AUTO, then select display mode.

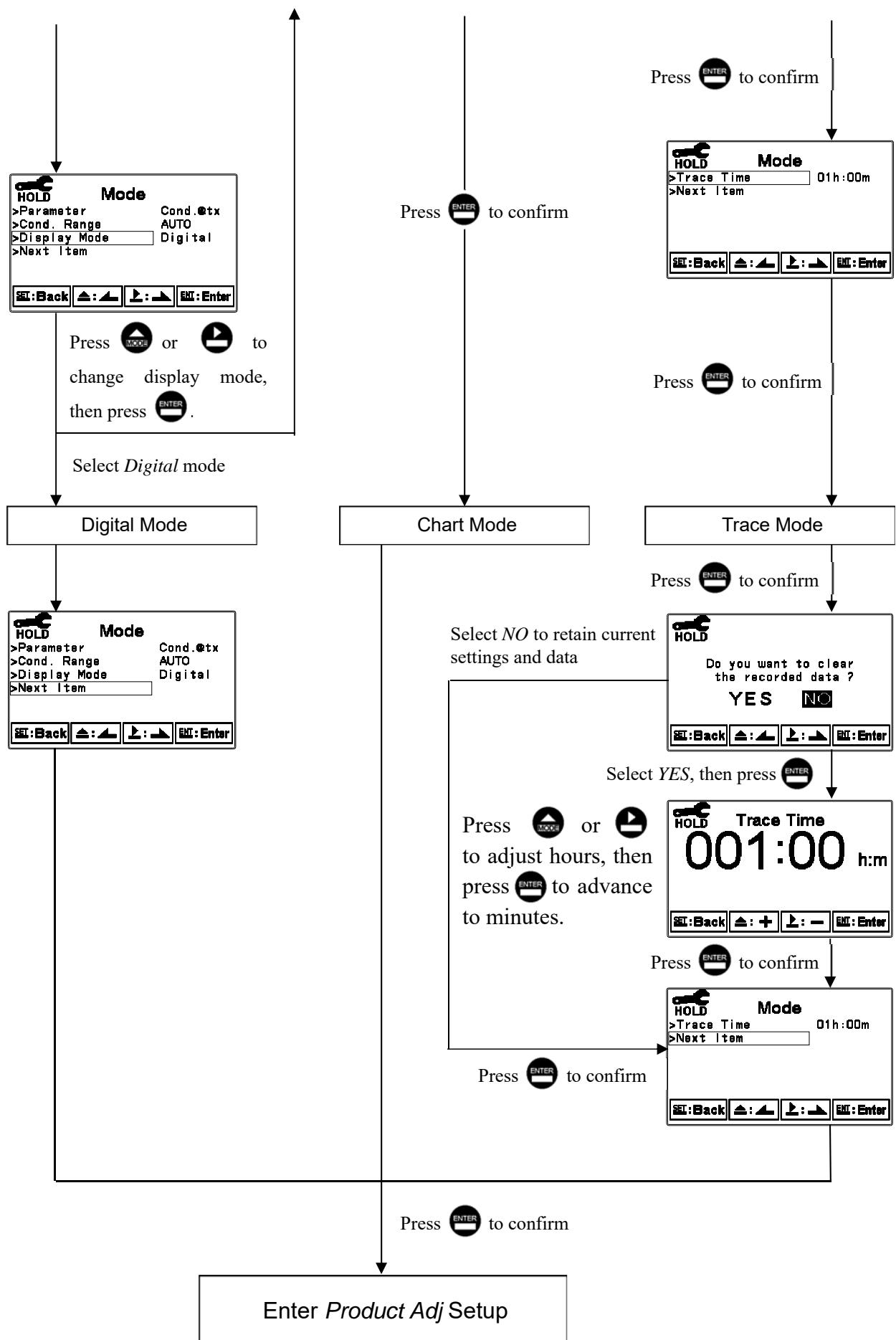




7.4.2 Absolute Conductivity (Cond.@tx)

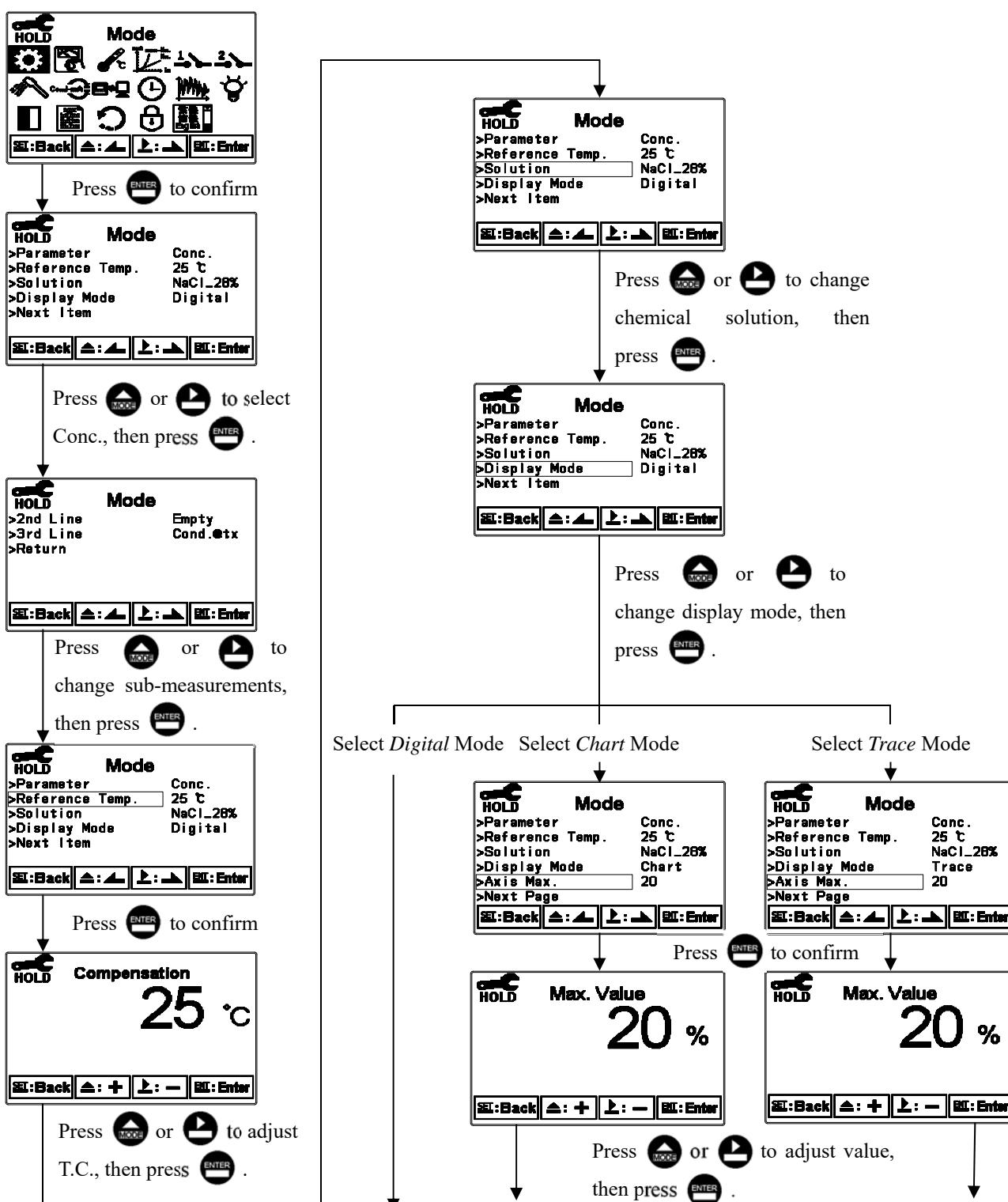
Absolute conductivity represents the conductivity measurement without temperature compensation. Under measurement parameter settings (Mode), select Cond.@tx for parameter, select conductivity measurement range or set to AUTO, then select display mode.

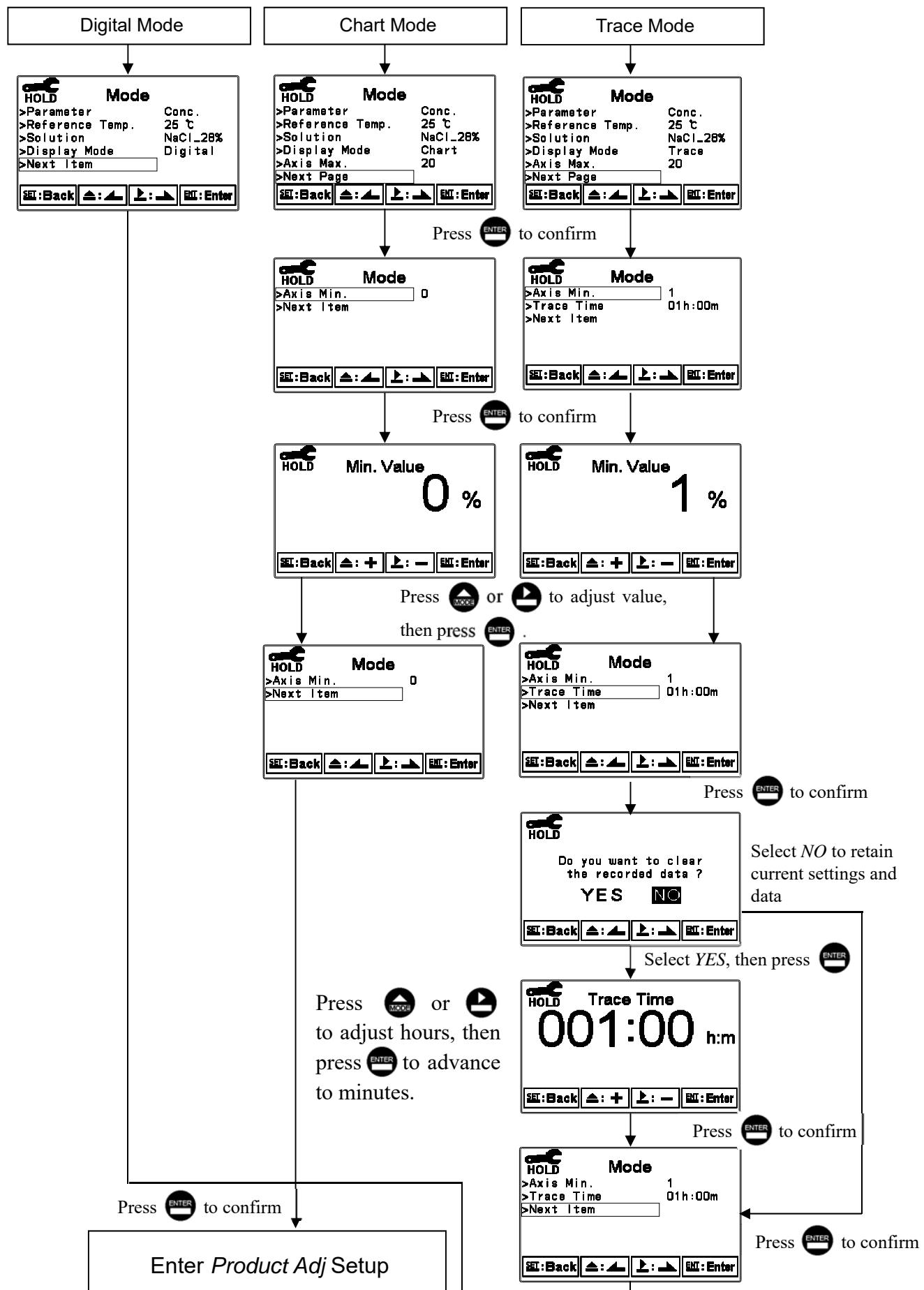




7.4.3. Concentration (EC-4110-ICON Only)

Under measurement parameter settings (Mode), select Conc. for parameter, select chemical solution type and concentration range, then select display mode. Built-in chemical measuring ranges are as follows: NaCl_28% (0-28%), HCl_18% (0-18%), HCl_39% (22-39%), HNO3_30% (0-30%), HNO3_96% (35-96%), NaOH_24% (0-24%), NaOH_50% (15-50%), H₂SO₄_37% (0-37%), H₂SO₄_88% (28-88%), H₂SO₄_99% (89-99%), H₃PO₄_35% (0-35%) or User-Defined. Concentration conversion limits of each solution vary with the change of temperature. When the conductivity or concentration value exceeds the measuring range, the value will flash to indicate error. For User-Defined concentration measurement, measurement range and error indicator does not apply.





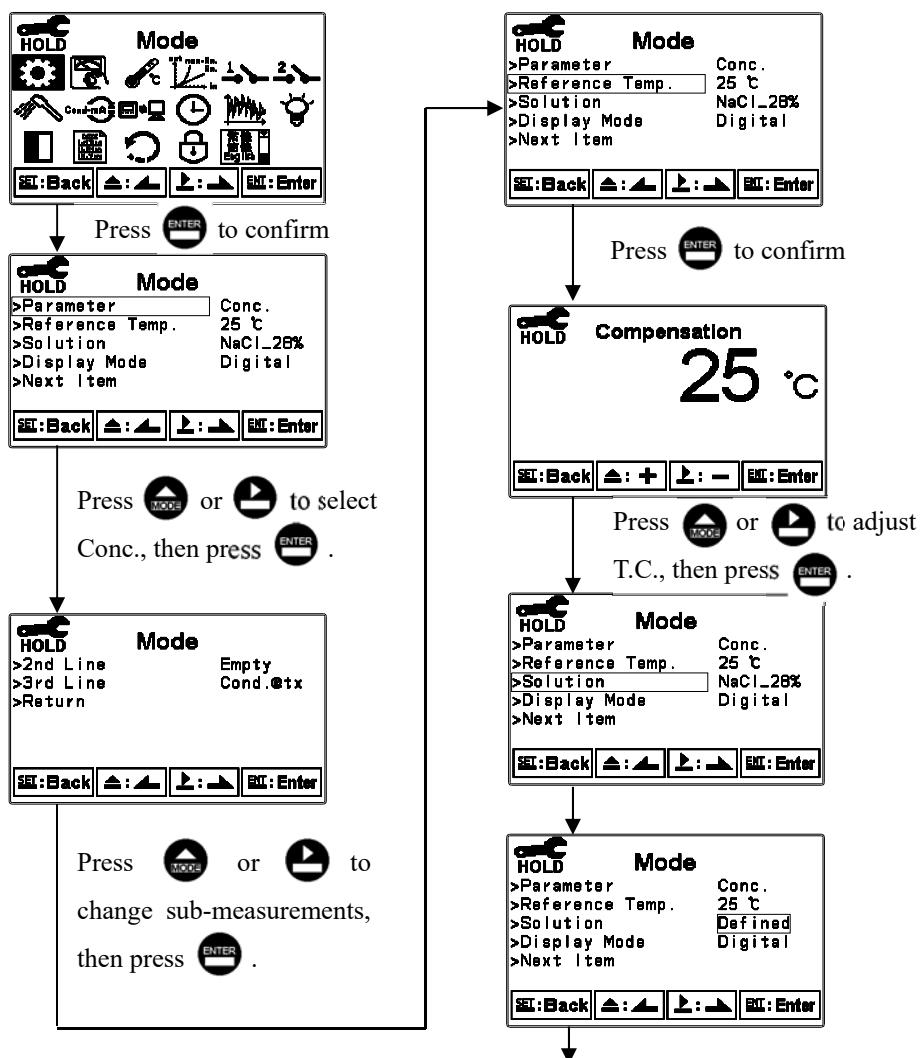
7.4.3.1. Concentration (EC-4110-ICON Only)

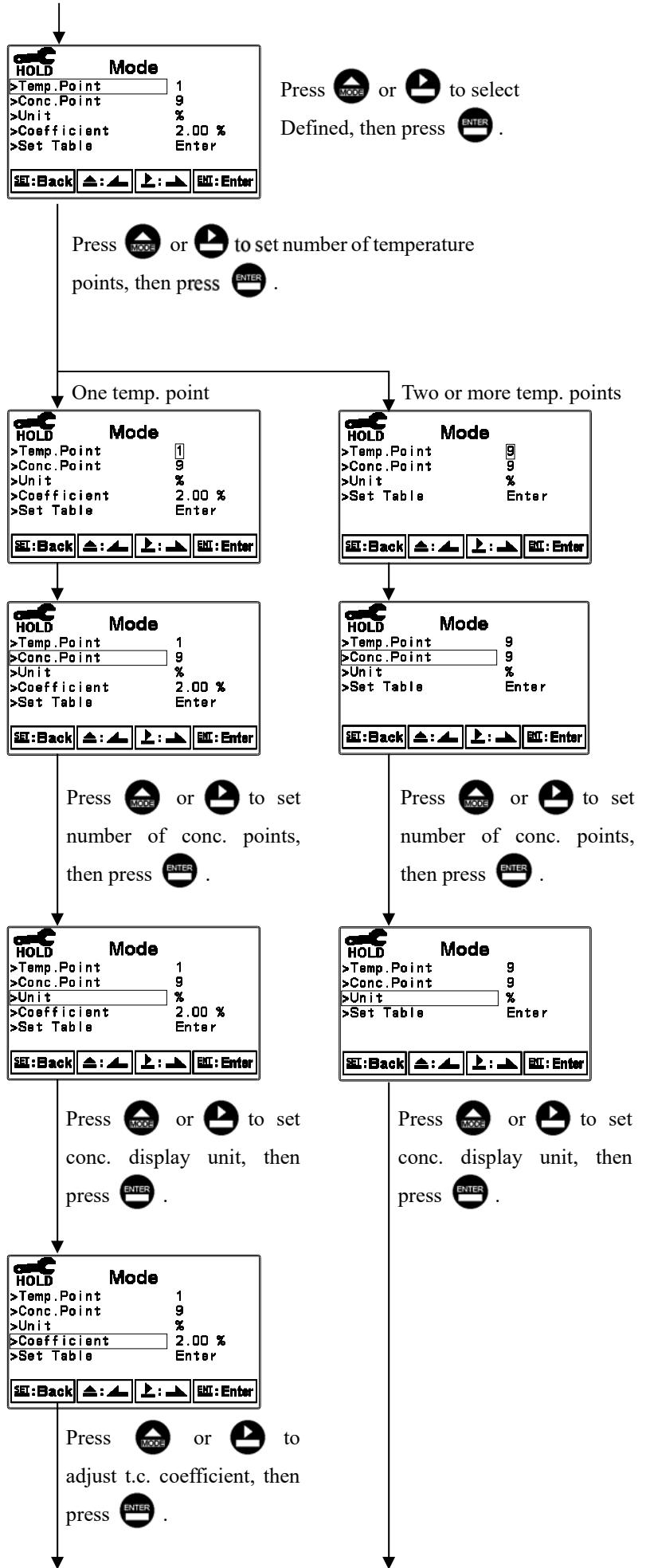
If a chemical solution and range is not available as an option, the user can input a self-defined chemical solution table for conversion. For a specific chemical solution, the transmitter allows up to 9 temperature tables. Each temperature table requires at least two and up to nine pairs of conductivity and its corresponding concentration value (the more data pairs are provided, the more accurate the conversion to concentration is). Each pair of conductivity and concentration value must be added in ascending or descending order. If a temperature table only has one data set, linear temperature compensation coefficient must be provided for temperature compensated concentration conversion. If only one temperature table is provided for a chemical solution, the temperature coefficient is also required. If two or more temperature tables are provided for a chemical solution, the temperature compensation coefficient is auto-calculated based on conversion data under different temperatures.

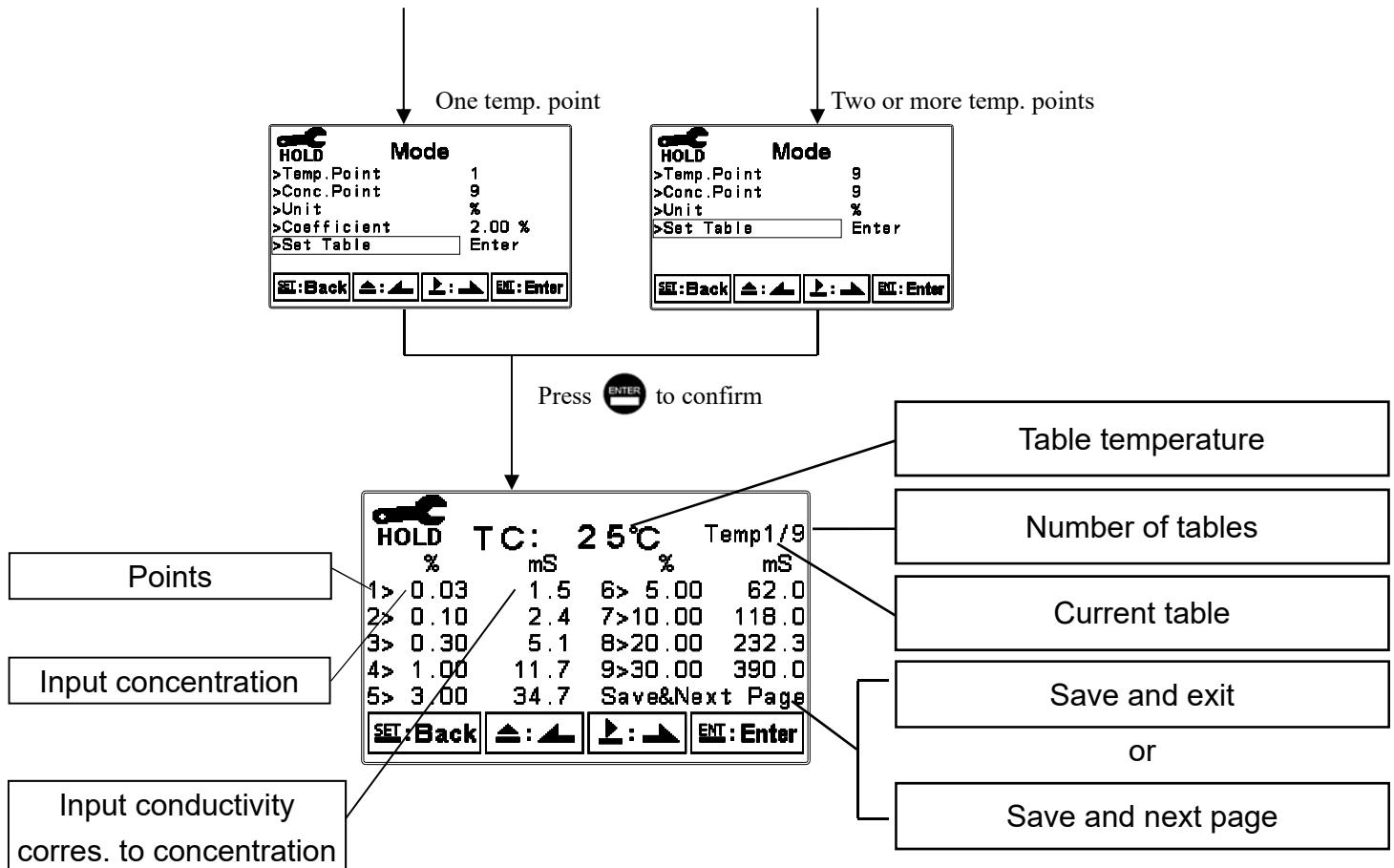
Additional temperature tables must also be added in ascending or descending order.

The default defined concentration data table is Hydrofluoric Acid (HF) at 25°C. This table and its temperature compensation coefficient may be revised accordingly, but will need to be manually re-input for HF measurement.

The more accurate the data provided (temperature, conductivity, and concentration) is to the tested chemical solution, the more accurate the conversion can be.







If the temperature tables are not input in ascending or descending order, a *Temp. Error* will display on the top of the screen.

Temp. Error			
HOLD TC: 15°C Temp3/9			
	%	mS	%
1>	0.03	1.5	6> 5.00 62.0
2>	0.10	2.4	7>10.00 118.0
3>	0.30	5.1	8>20.00 232.3
4>	1.00	11.7	9>30.00 390.0
5>	3.00	34.7	Save&Exit

If the concentration values are not input in ascending or descending order, a *Conc. Error* will display on the top of the screen.

Conc. Error			
HOLD TC: 25°C Temp1/1			
	%	mS	%
1>	0.03	1.5	6> 5.00 62.0
2>	0.10	2.4	7> 4.45 118.0
3>	0.30	5.1	8>20.00 232.3
4>	1.00	11.7	9>30.00 390.0
5>	3.00	34.7	Save&Exit

If the conductivity values are not input in ascending or descending order, a *Cond. Error* will display on the top of the screen.

Cond. Error			
HOLD TC: 25°C Temp1/1			
	%	mS	%
1>	0.03	1.5	6> 5.00 62.0
2>	0.10	2.4	7>10.00 118.0
3>	0.30	5.1	8>20.00 232.3
4>	1.00	11.7	9>30.00 390.0
5>	3.00	34.7	Save&Exit

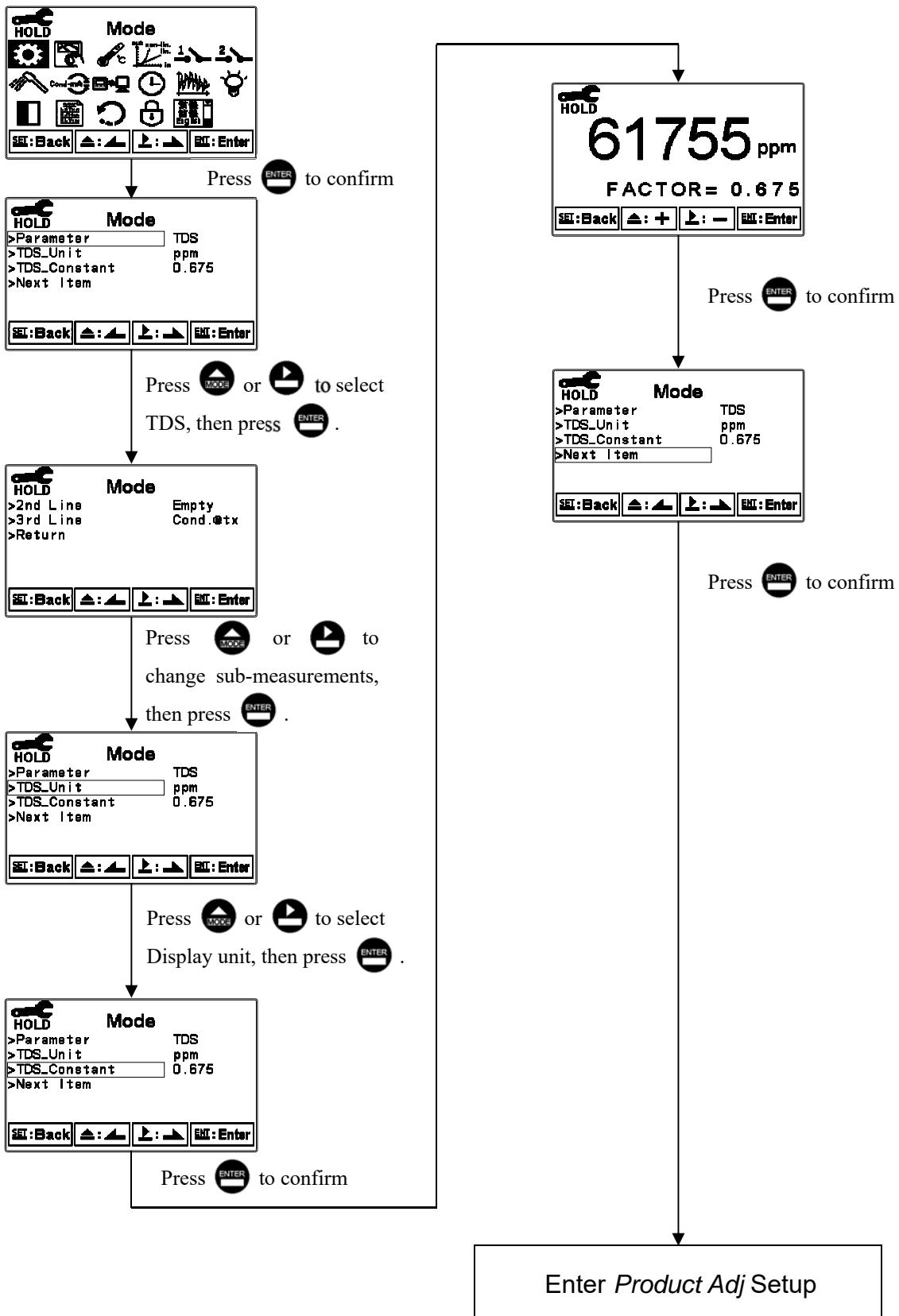
Hydrofluoric Acid (HF) Concentration/Conductivity Conversion Table
(for operation reference only, may need to be adjusted by user)

Concentration %	Hydrofluoric Acid HF Solution mS/cm at 25°C
0.0001	0.01
0.0003	0.03
0.001	0.099
0.003	0.290
0.01	0.630
0.03.	1.49
0.1	2.42
0.3	5.1
1.0	11.7
3.0	34.7
5.0	62.0
10.0	118.0
20.0	232.3
30.0	390.0

The temperature coefficient for standard solutions is 1.8~2% and may vary based on the concentration; users will need to adjust accordingly to measured values. E.g. 0.5% HF acid temperature coefficient is approx. 0.7%, 1.0% HF acid is approx. 0.73%, and 3.0% HF acid is approx. 0.74%.

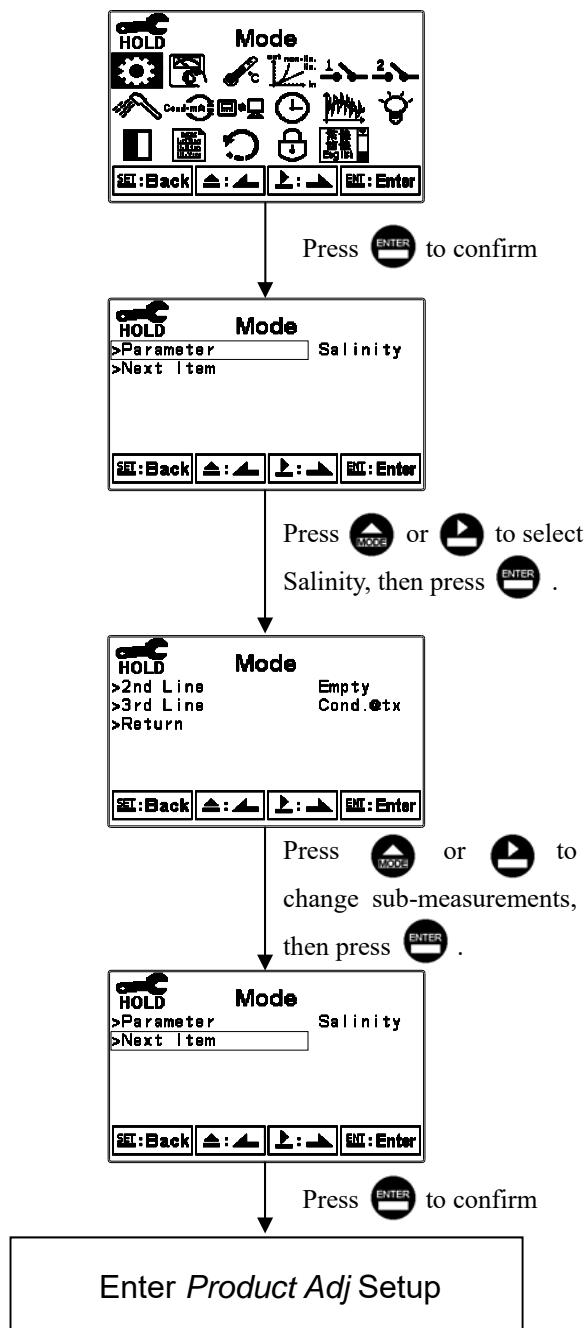
7.4.4. Total Dissolved Solids (TDS)

Under measurement parameter settings (Mode), select TDS for parameter, select display unit, then adjust TDS constant. The default TDS constant factor is 0.675/1 μ S/cm.



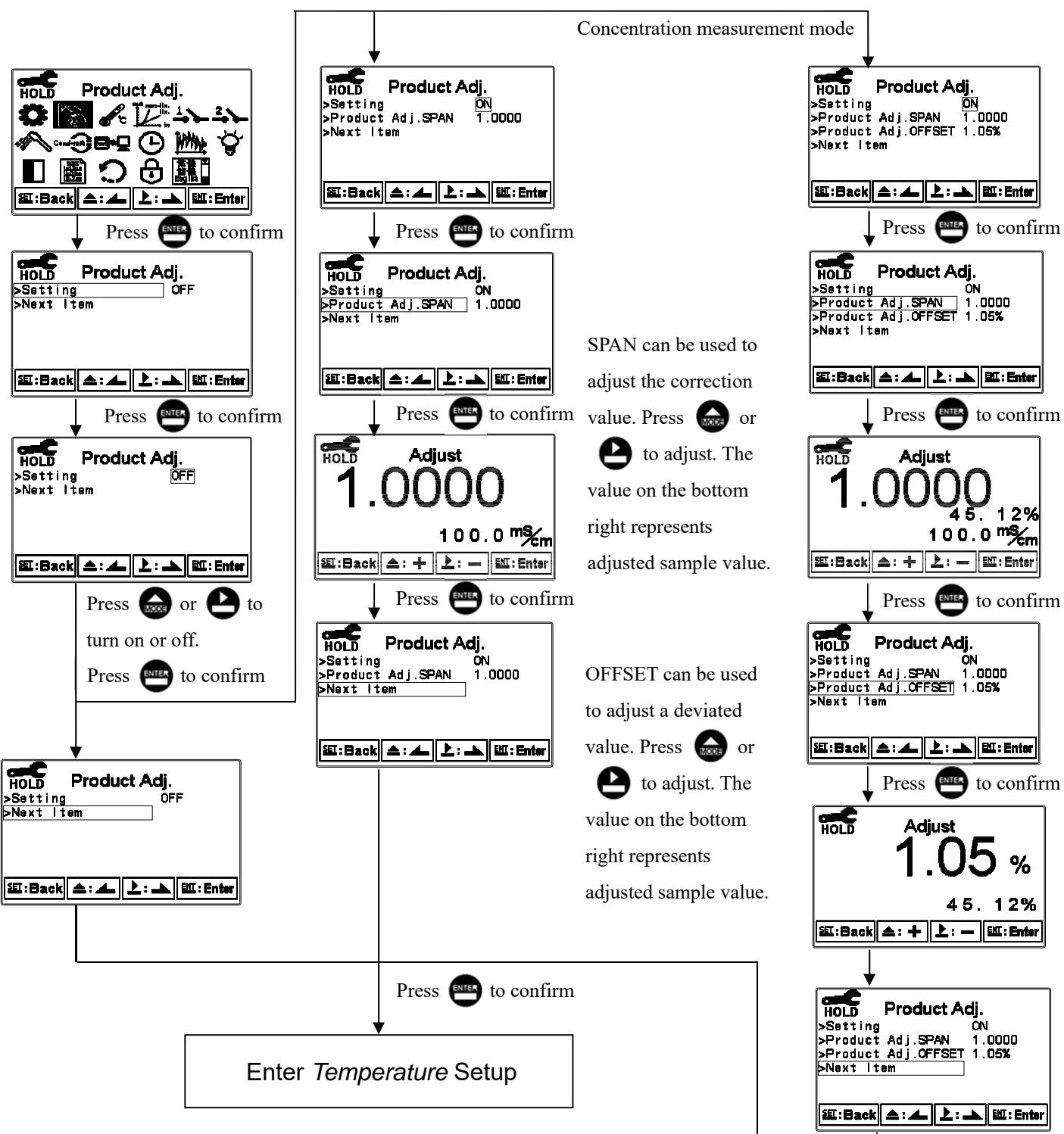
7.4.5. Salinity

Under measurement parameter settings (Mode), select Salinity for parameter.



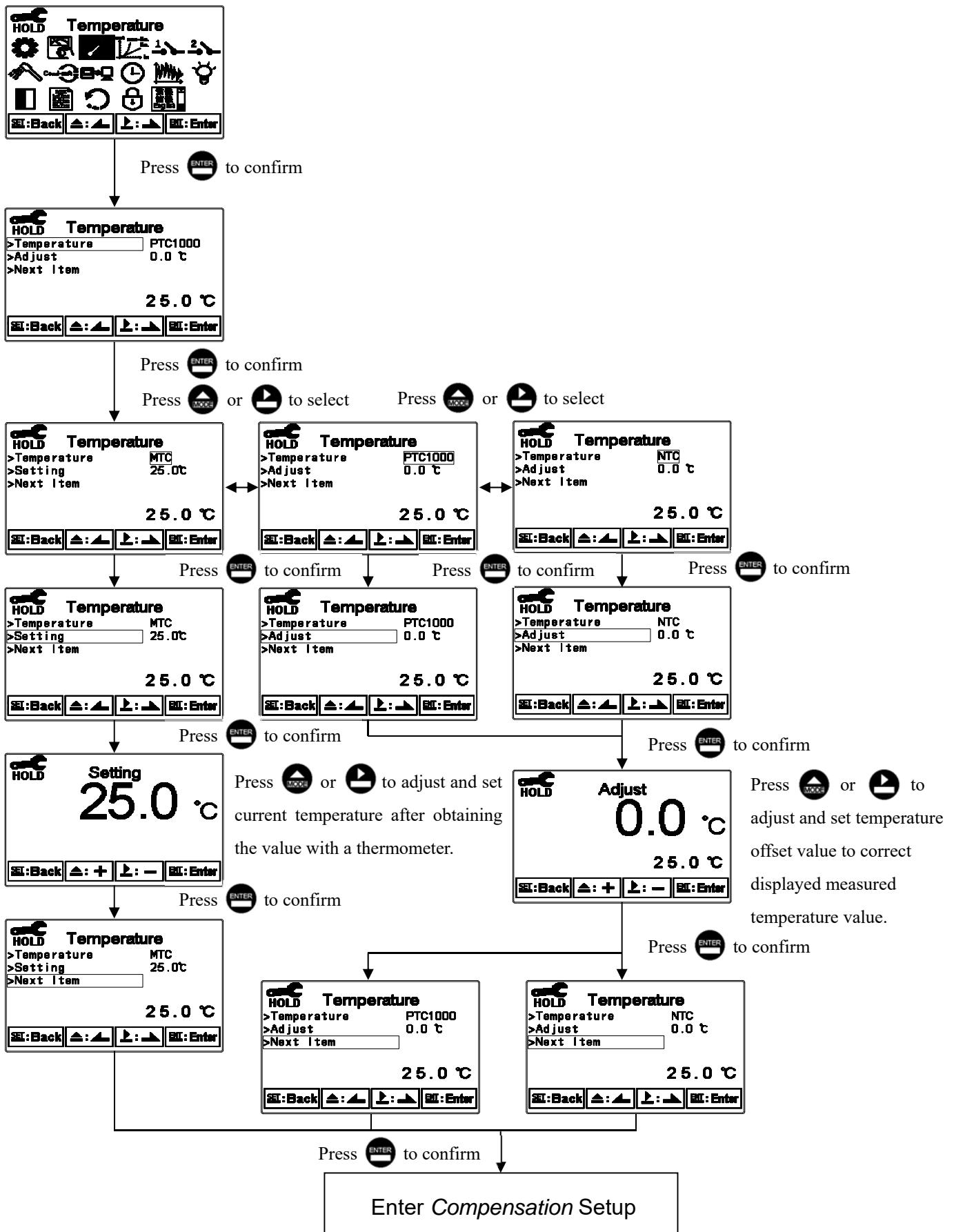
7.5. Product Adjustment

Under Settings selection menu, enter *Product Adj.* setup to proceed into measurement fine adjustment or as for online calibration purpose. Without needing to retrieve the electrode for calibration, product adjustment allows instantaneous manual value adjustment to a desired value. When the value is adjusted, the screen will display *PDT* (see chapter 6.4, "Warning Symbols and Text"). An inductive sensor measures conductivity via electromagnetic reactions, and thus the cell factor and measured value may therefore be affected by the length of signal cable and the distance between the sensor and the walls of the pipe. Using the SPAN function, product adjustment can be applied to adjust the conductivity value without adjusting the cell factor. When the measuring unit is set to concentration, the OFFSET function provides a third adjustment option to the measurement value for deviations caused by contamination or other reasons.



7.6. Temperature

Under Settings menu, enter *Temperature* setup. Select from PTC1000 (PT1K) or NTC (NTC30K) for automatic temperature compensation, or select MTC for manual compensation input.



7.7. Temperature Compensation Coefficient

The default temperature compensation reference temperature is 25°C, the default temperature compensation coefficient is 2.00%.

Under Settings selection menu, select *Compensation* and press to change compensation type. Depending on the measurement, select Linear, Non-Linear, or No for none; if unknown, select Linear for conductivity measurement.

Temperature Compensation Coefficient (T.C.):

The conductivity of a solution increases as the temperature rises. The relationship is as follows:

Note: Reference temperature t_{ref} is 25°C

C_{tref}	Cond. at reference temperature	$C_t = C_{tref} \{ 1 + \alpha (T - t_{ref}) \}$
C_{t1}	Cond. at T_1 °C	
T_1	Measured solution temperature	$A = (C_{t2} - C_{t1}) / \{ C_{t1}(T_2 - t_{ref}) - C_{t2}(T_1 - t_{ref}) \}$
C_{t2}	Cond. at T_2 °C	
T_2	Measured solution temperature	$\alpha = (C_{t2} - C_{t1}) / \{ C_{t1}(T_2 - t_{ref}) - C_{t2}(T_1 - t_{ref}) \}$
α	Temperature Compensation Coefficient	

To calculate solution TC:

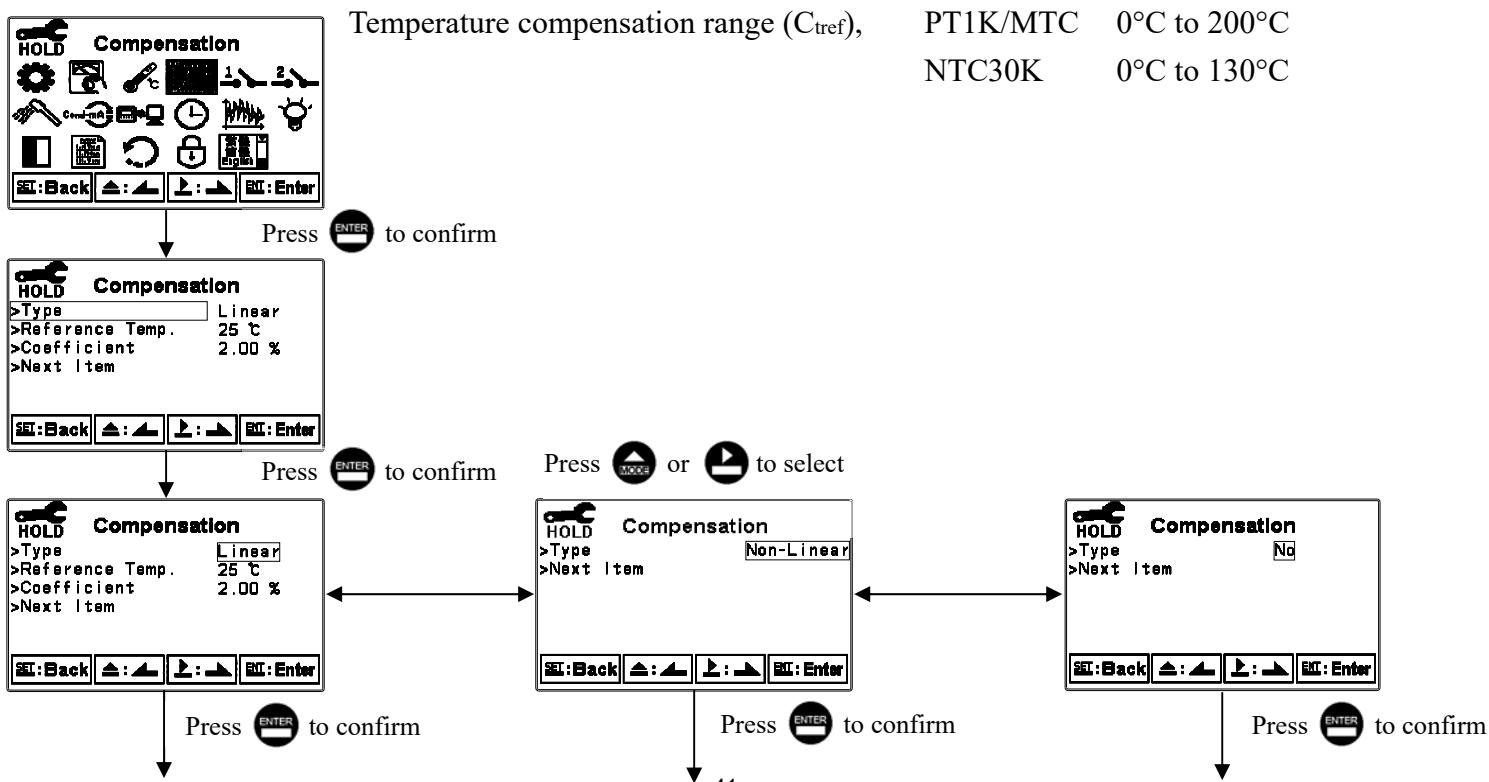
Using the formula above and 0.01M KCl as an example, set the T.C. to no compensation (Linear, 0.00%), and control the temperature between C_{t1} °C and C_{t2} °C. With the following values measured and given: @20°C, $C_{20} = 1278\mu\text{S}$; @30°C, $C_{30} = 1552\mu\text{S}$; α is calculated to be 1.94%.

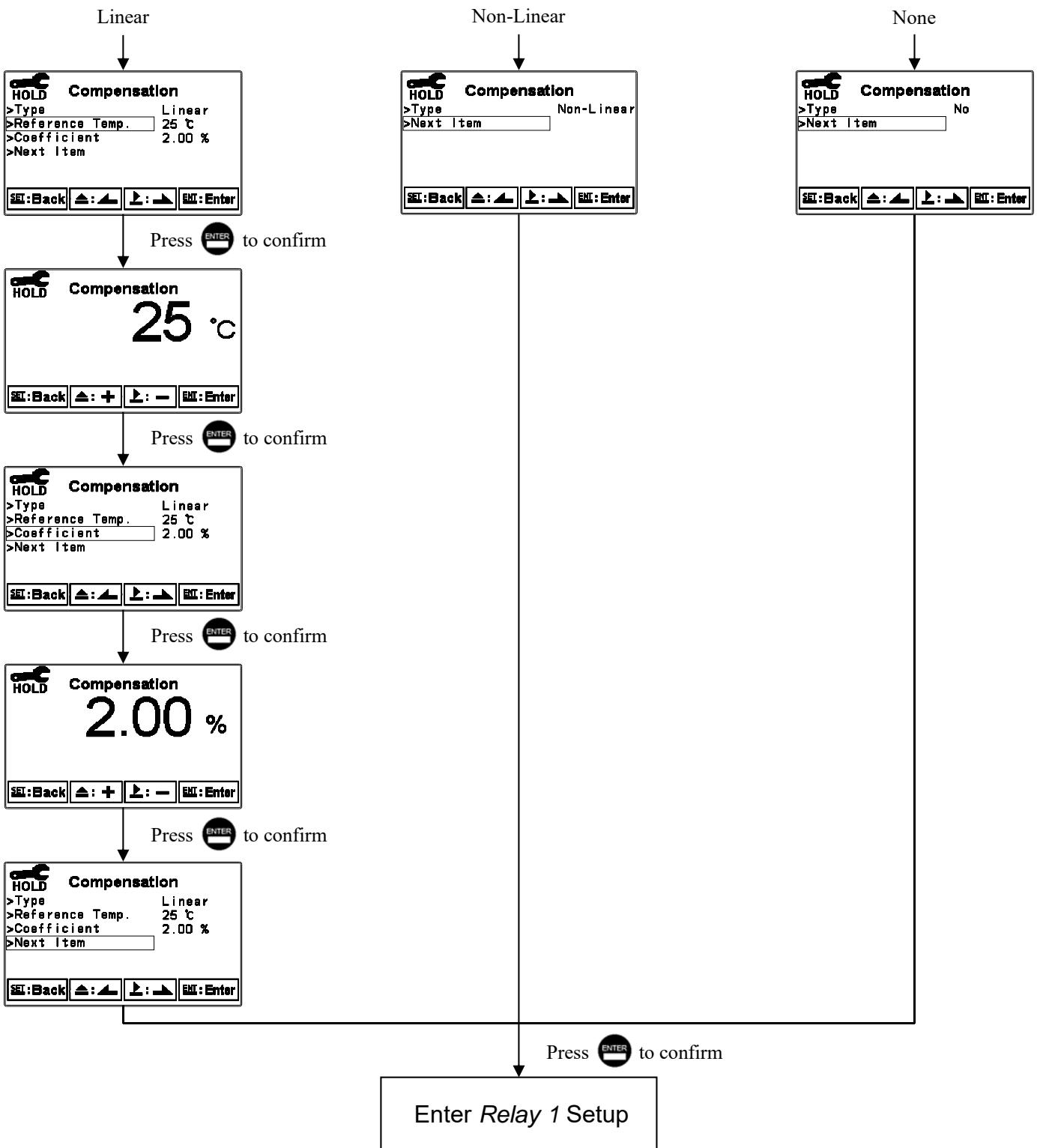
$$\alpha = \frac{1552 - 1278}{1278(30 - 25) - 1552(20 - 25)} \times 100 = 1.94$$

Of which, Linear compensation range: 0.00% to 40.00%,

Temperature compensation range (C_{tref}), PT1K/MTC 0°C to 200°C

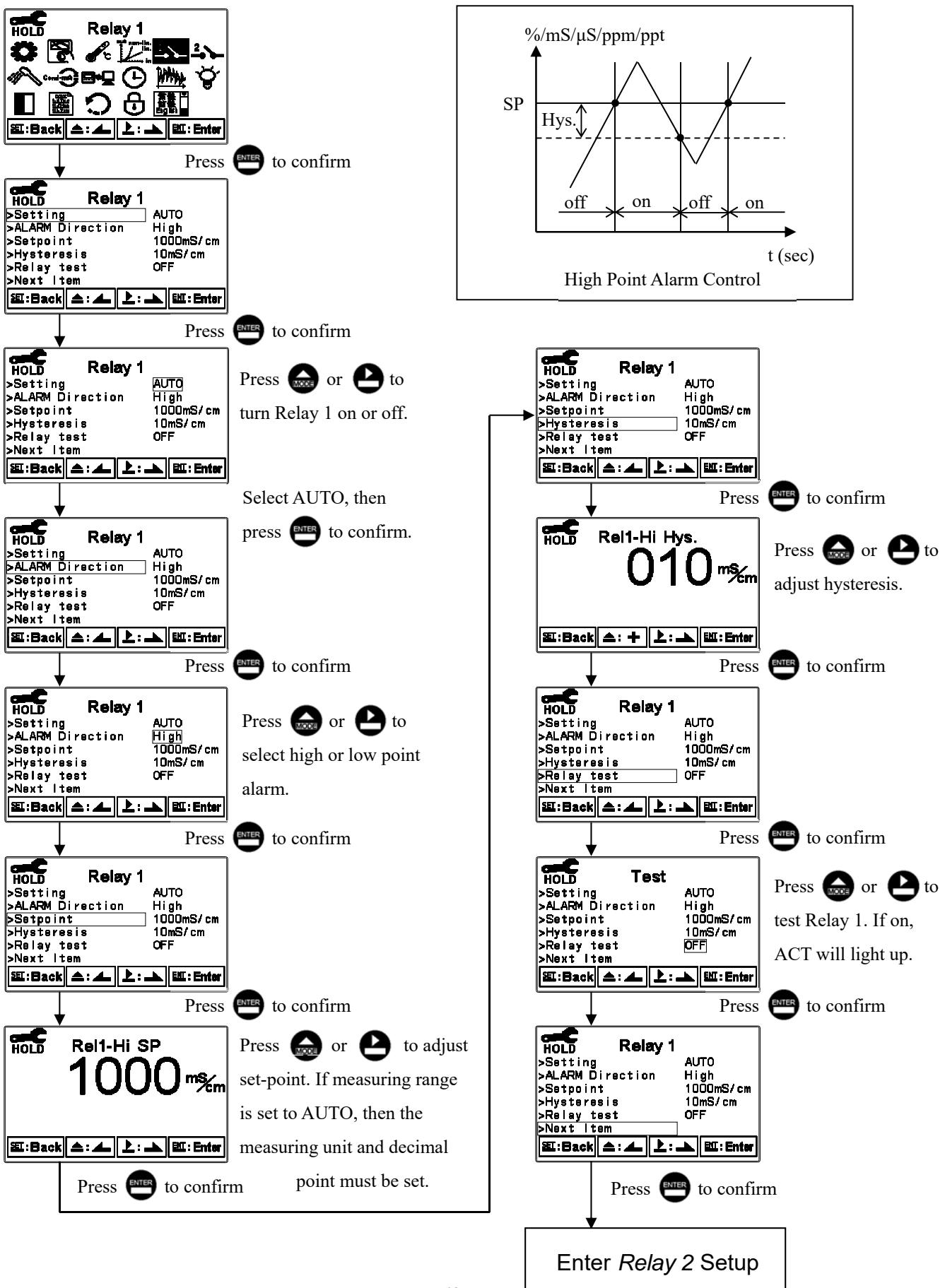
NTC30K 0°C to 130°C





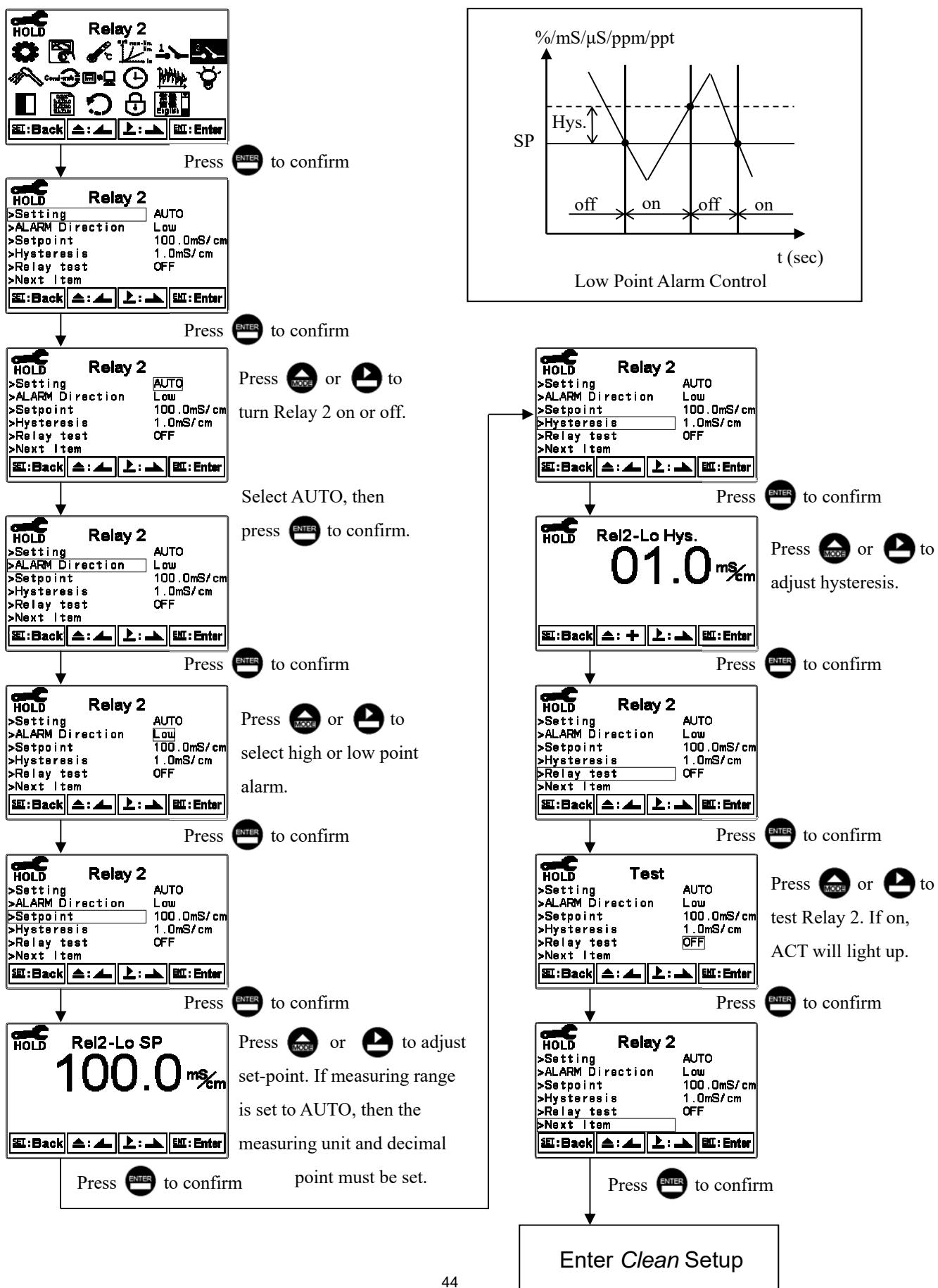
7.8. Relay 1

Under Settings menu, enter *Relay 1* setup to modify relay 1 settings, or turn off the function. When turned on, select high or low point alarm, then input set-point and hysteresis value. Refer to the graph for the relationship of the parameters (Hi-Point Alarm).



7.9. Relay 2

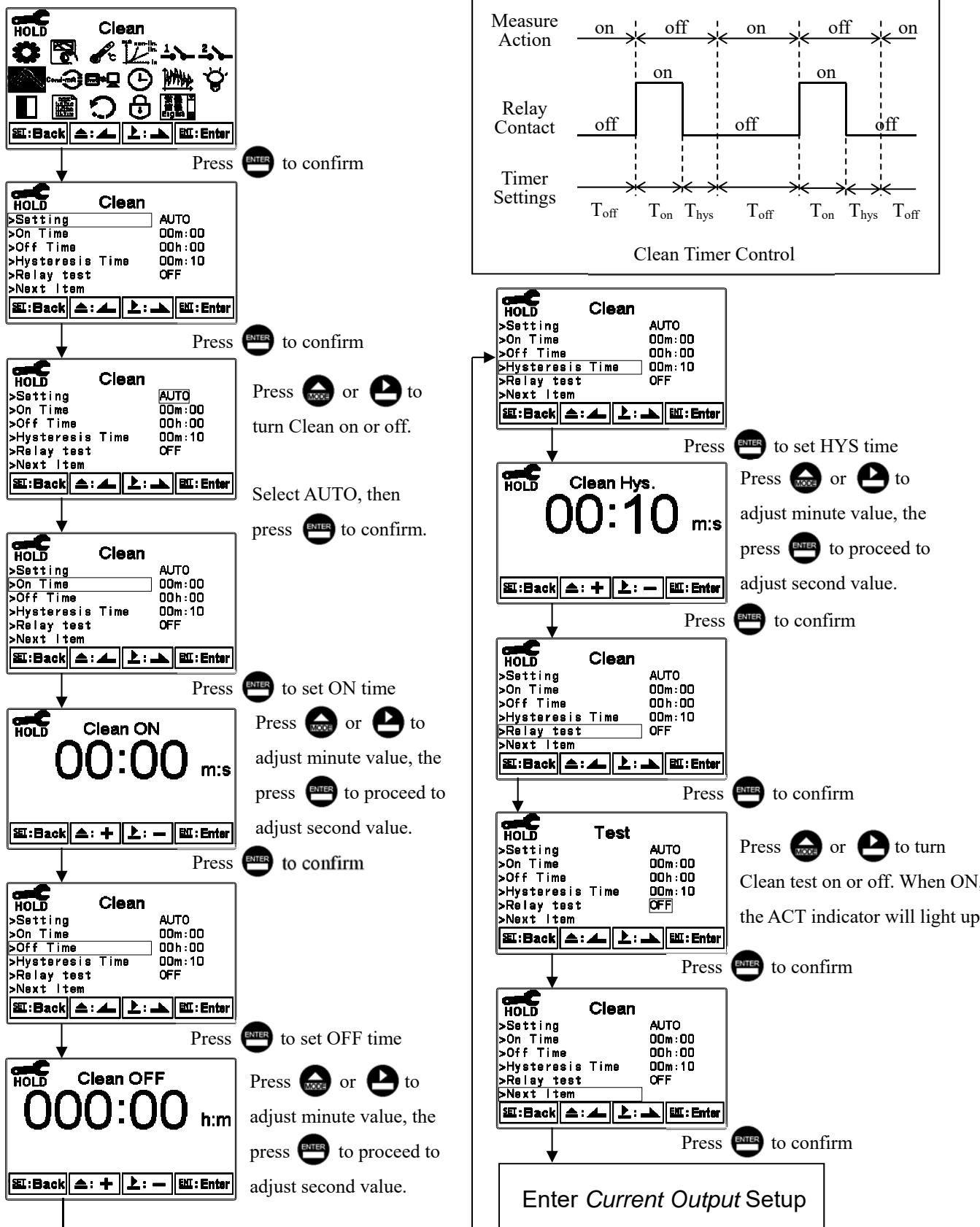
Under Settings menu, enter *Relay 2* setup to modify relay 2 settings, or turn off the function. When turned on, select high or low point alarm, then input set-point and hysteresis value. Refer to the graph for the relationship of the parameters (Lo-Point Alarm).



7.10. Clean

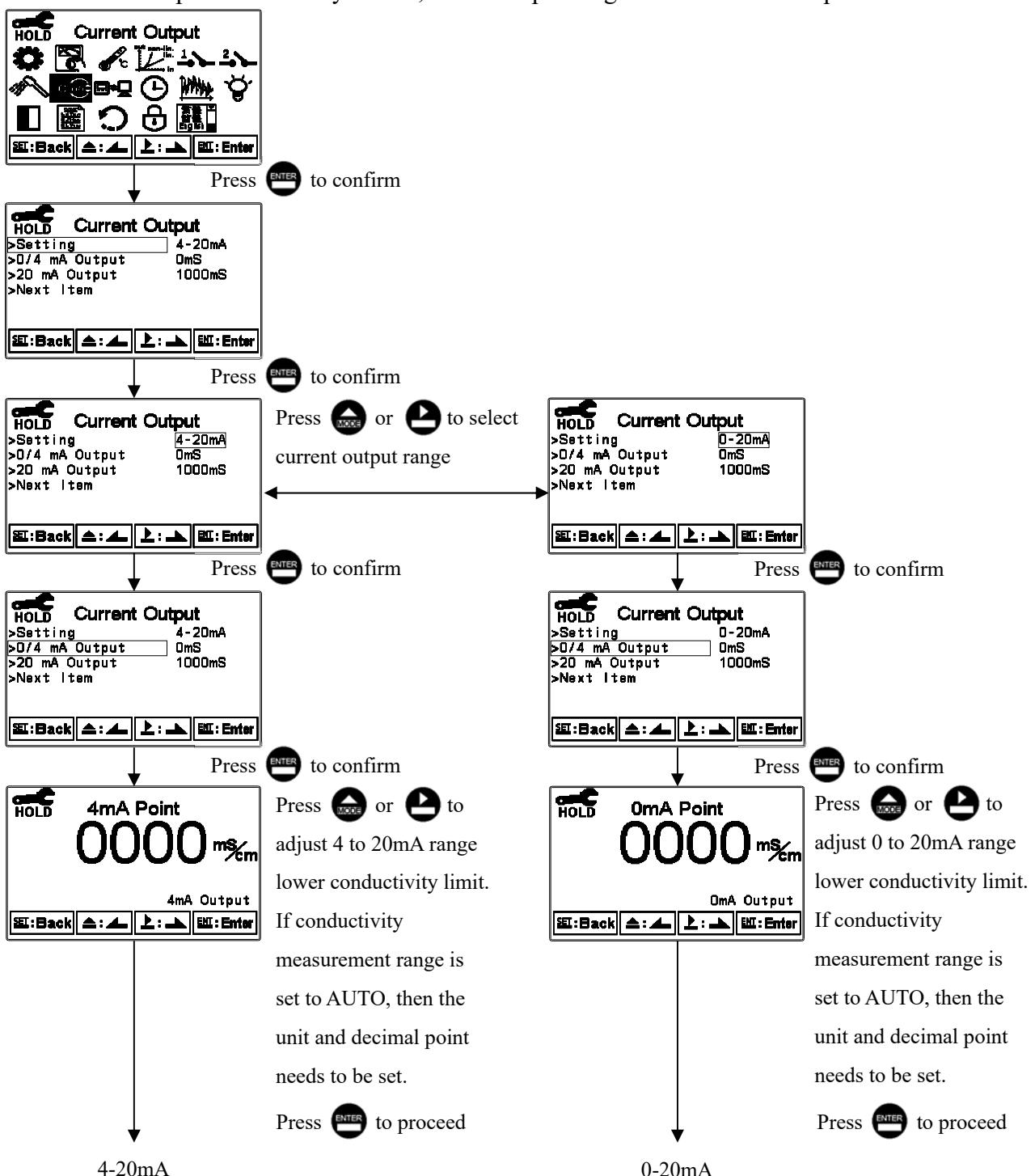
Under Settings menu, enter *Clean* setup to modify clean settings, or turn off the function. When turned on, set cleaning time, off time, and hysteresis time. Refer to the graph for the relationship of the parameters.

Note: When turned on, if either on or off time is set to 0, the function will turn off automatically. When cleaning under measurement mode, *Clean Running* will appear at the top of the screen, the last measured value before cleaning will be retained. When entering settings menu or calibration menu, cleaning will terminate automatically.

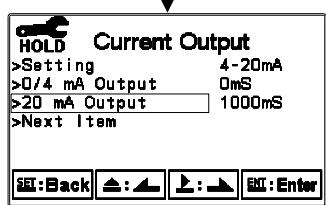


7.11. Current Output

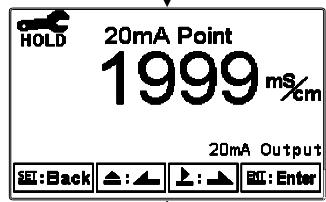
Under Settings menu, enter *Current Output* setup to modify output settings. Select 0 to 20mA or 4 to 20mA output range, then set the corresponding conductivity range limits. The smaller the set conductivity range, the greater the output current accuracy. If the measured value exceeds the upper range limit, the current will remain at approximately 22mA output. If the measured value exceeds lower range limit, under 0 to 20mA output mode, the current will remain at 0mA output; under 4 to 20mA output mode, the current will remain at 2mA output—used as measurement error indicator. When on *HOLD* status, the output current will remain at the last output value before *HOLD*. For the convenience of connecting to an exterior recorder or PLC, when setting 0/4 to 20mA output conductivity values, the corresponding currents will be output.



4-20mA

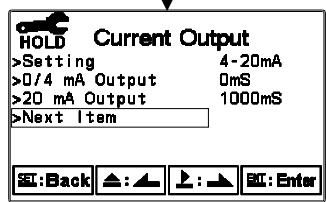


Press to confirm

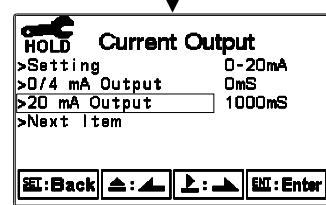


Press or to adjust 4 to 20mA range upper conductivity limit.

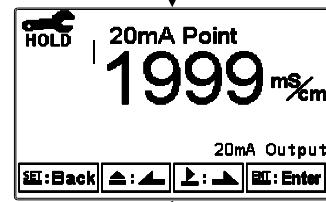
Press to confirm



0-20mA

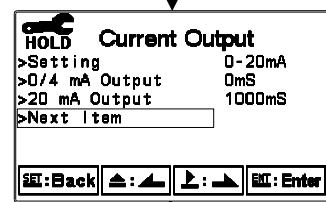


Press to confirm



Press or to adjust 0 to 20mA range upper conductivity limit.

Press to confirm

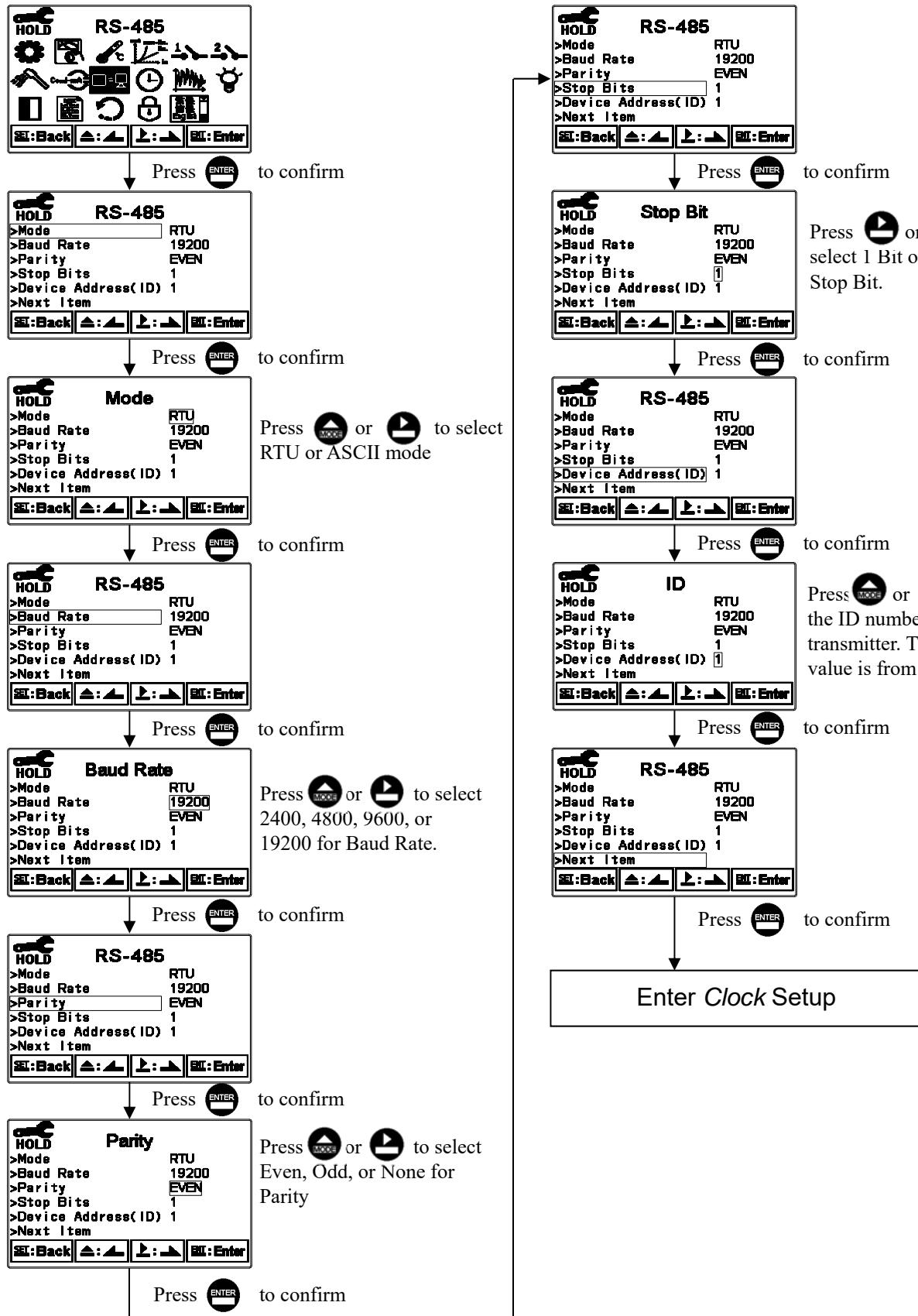


Press to confirm

Enter RS-485 Setup

7.12 RS-485 Communication

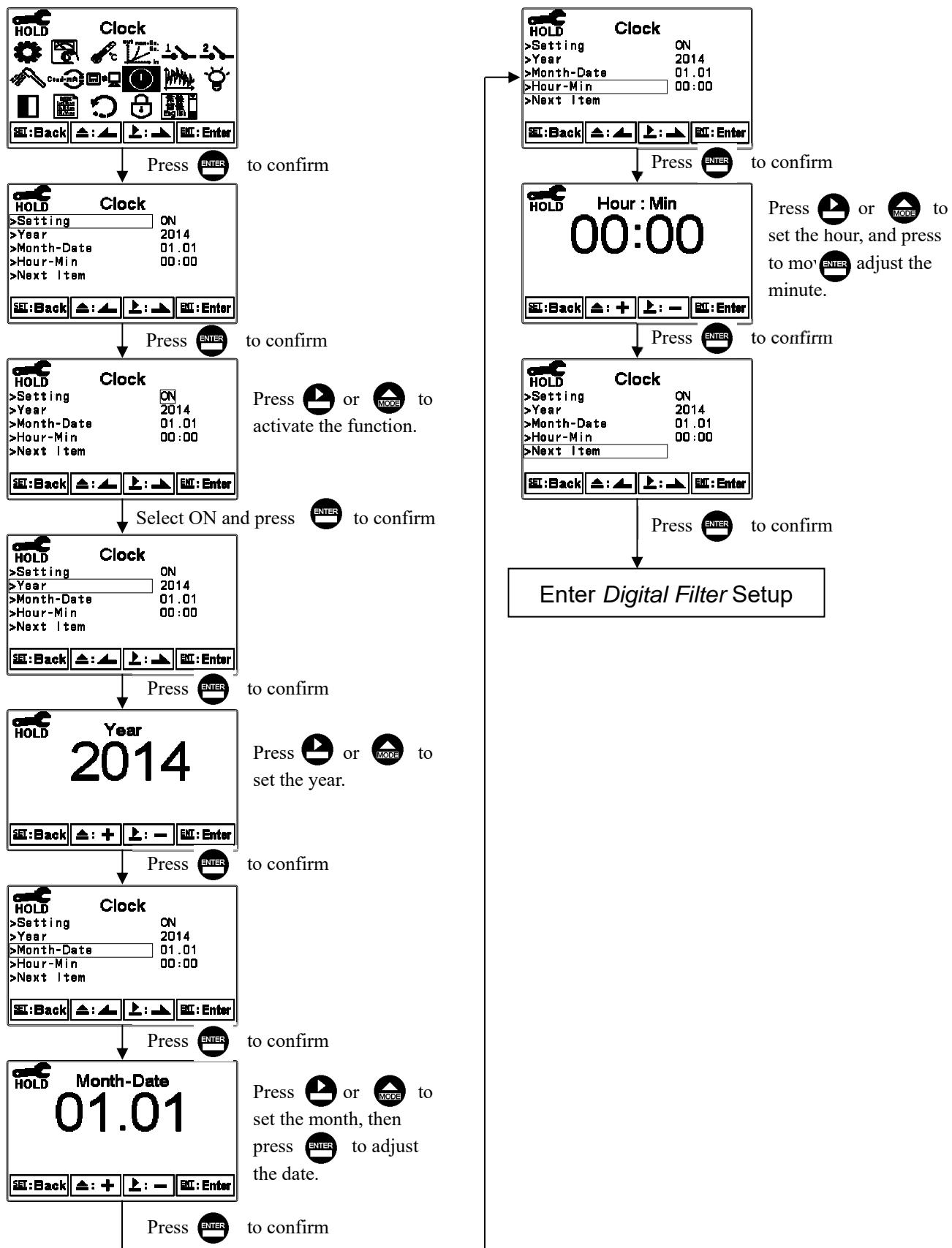
Enter setup of RS-485 communication. According to the Modbus protocol, set the Transmitting Mode, Baud Rate, Parity, Stop Bit, and ID number. About the detail of Modbus protocol, please refer to Ch9 Modbus Protocol. If under HOLD status, the measurement signal output maintains the last output value before HOLD status.



7.13 Clock

Enter setup of Date/Time (Clock). Set the “Year”, “Month”, “Date”, “Hour”, and “Minute” time. When the clock function if set to OFF, the time will not display under measurement mode. The calibration time of calibration record will also show “OFF” under calibration overview display.

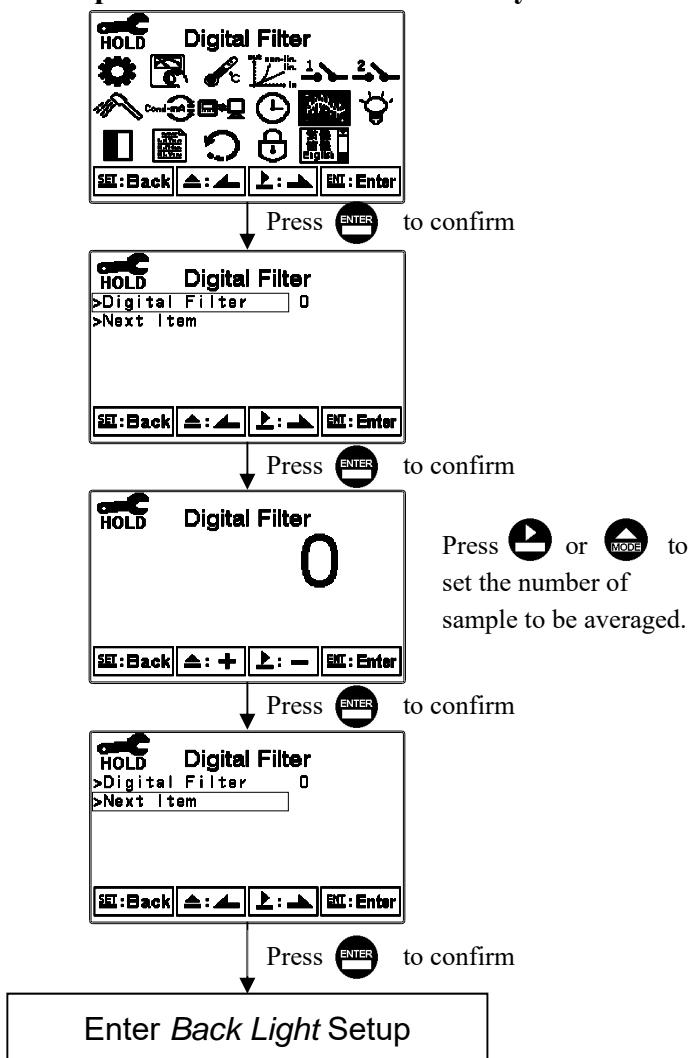
Note: The transmitter may keep the clock in operation even when encountering a power failure. Only when the inner battery is out of power, the clock may stop operation. If so, please replace the 3V CR2025/2032 Li batter inside the transmitter.



7.14 Digital Filter

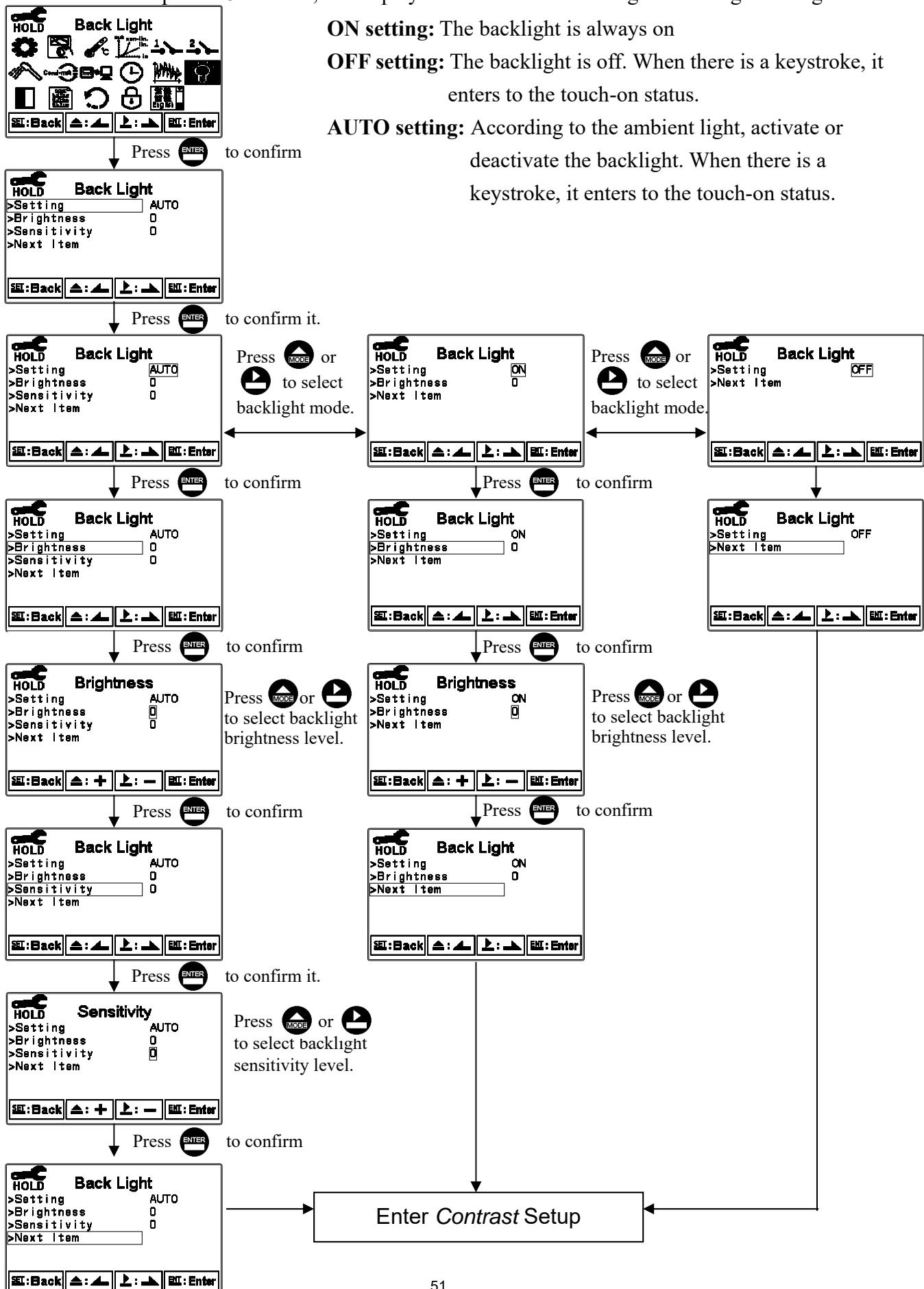
Enter the setup of Digital Filter. Select the number of samples to be averaged for each reading to increase the stability of measurement.

Note: 0 represents automatic conductivity measurement range setting.



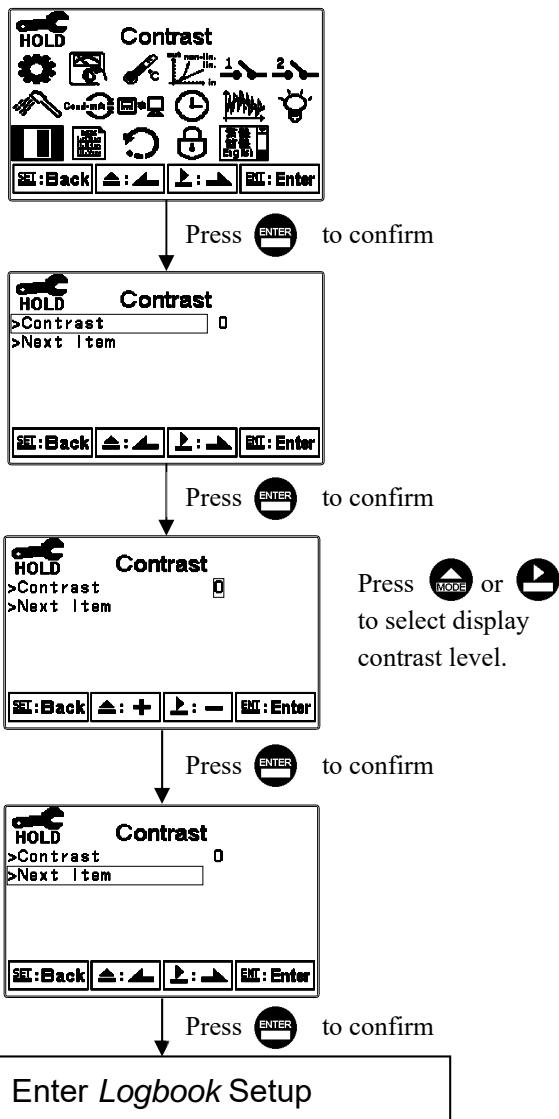
7.15 Back Light

Enter setup of backlight display. According to the user requirements, the brightness of display (-2~2, dark~bright) and sensitivity of the sensitization sensor(-2~2, insensitive~sensitive) can be adjusted. Under OFF or AUTO backlight mode, any key input will activate the backlight. If there is no input for 5 seconds, the display will be return to the original backlight setting.



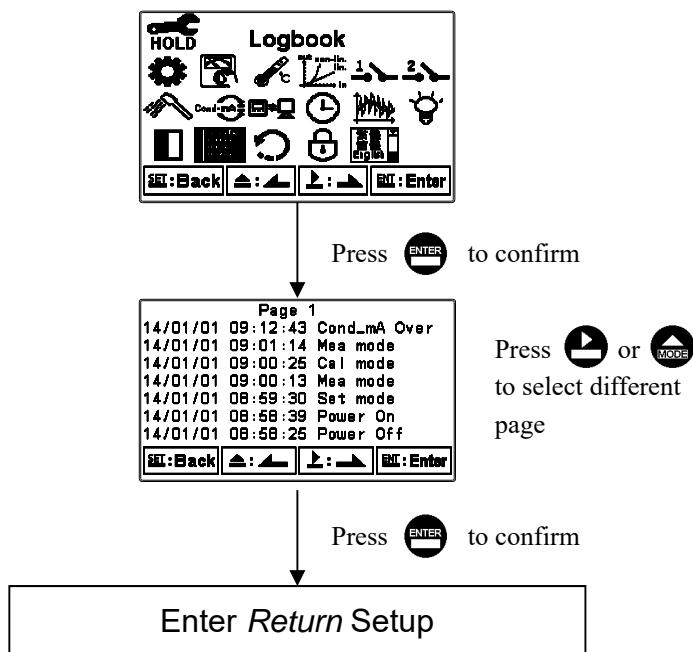
7.16 Contrast

Enter setup of Contrast. Set the contrast of display as required. (-2, -1, 0, 1, 2, low to high).



7.17 Logbook

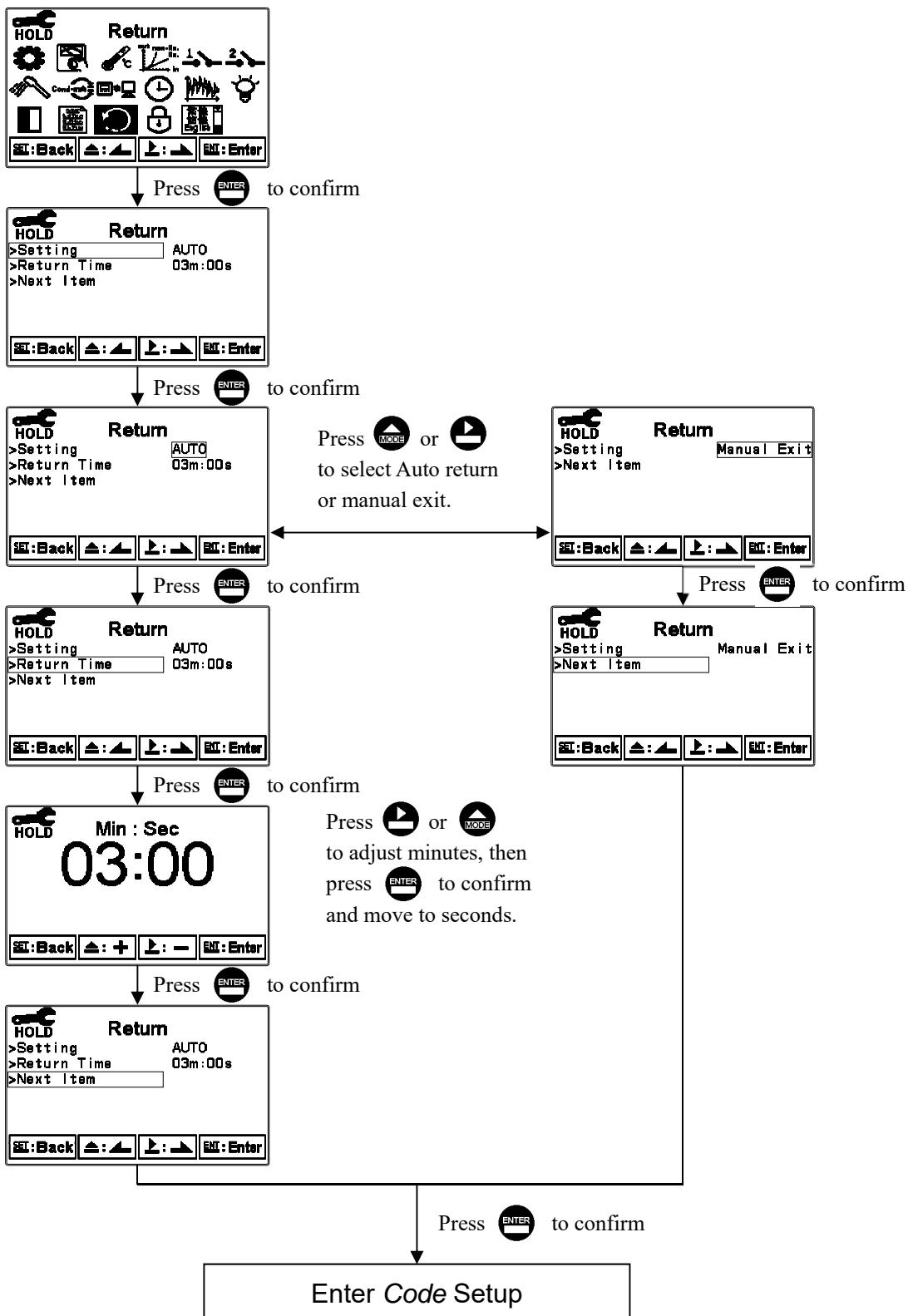
Enter setup of Logbook. The user may look up the relative 50 records of the transmitter shown on the display screen or read by Modbus. The event descriptions are as follows. To use Modbus to read event records, input the serial number 0028 first, then attain the corresponding event records from 0029H~002FH. Serial number 1 represents the latest event, serial number 2 represents the former event, and so on.



Event	Description	Modbus code
Mea mode	Measurement mode	00
Set mode	Setting mode	01
Cal mode	calibration mode	02
Power On	The unit is powered up	03
Power Off	The unit is out of power	04
Cond_mA Over	Current is over range (Conductivity mode)	05
Error 1	Unstable reading during calibration	06
Error 2	1. Cell factor exceeds the upper/lower limit 2. Temperature is over range	07
Error 3	Wrong password	08
Conc_mA Over	Current is over range (Concentration mode)	09
Error 9	The unit is broken	10
Modbus Write	Modbus input action	13

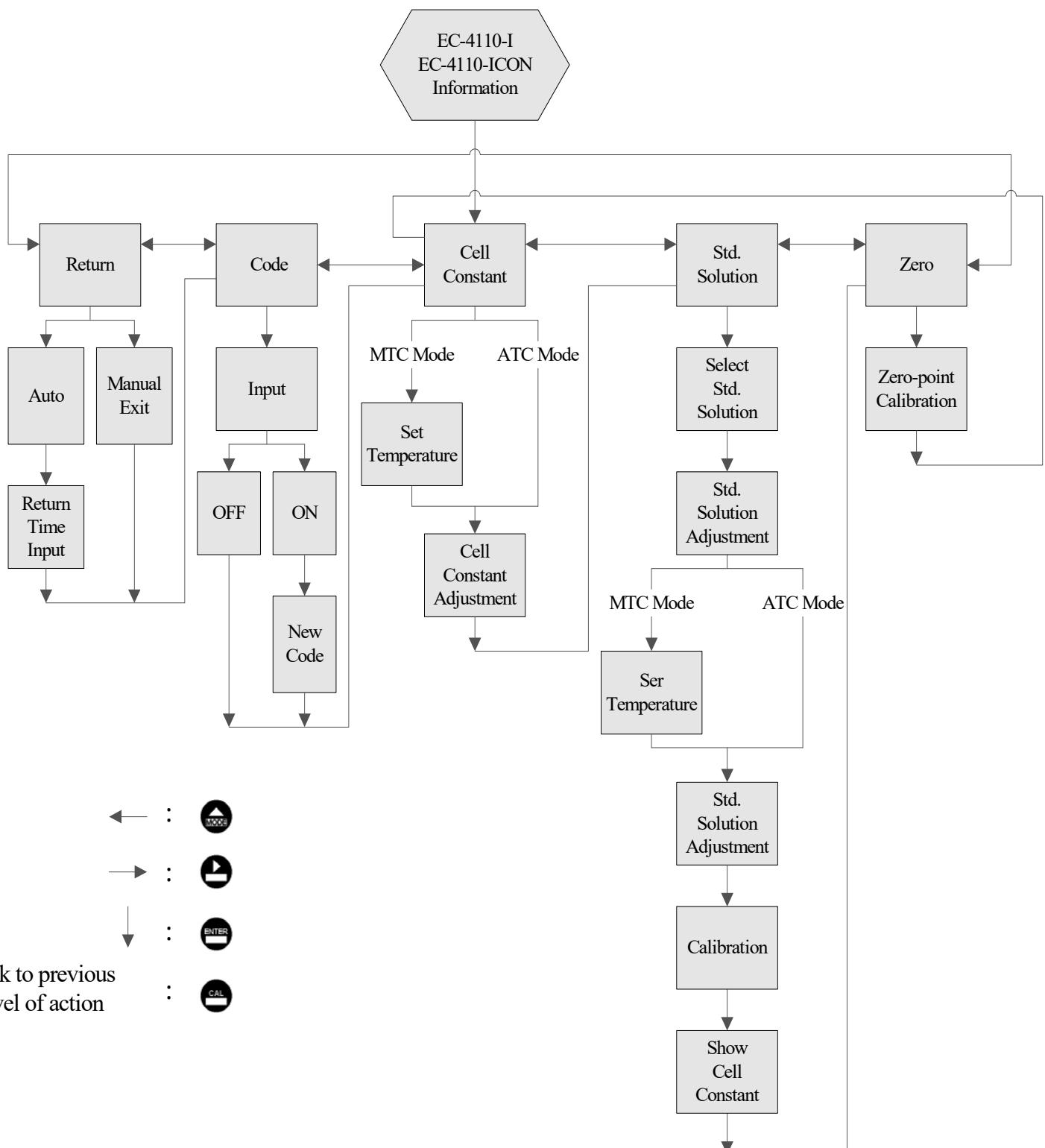
7.18 Return

Enter setup of auto return mode (Return) to set the transmitter to automatically exit the setup menu after a period of inactivity. “Manual Exit” requires that the user to exit setup menu manually, “Auto” allows the transmitter to automatically exit the setup menu and return to measurement mode after a period of inactivity.



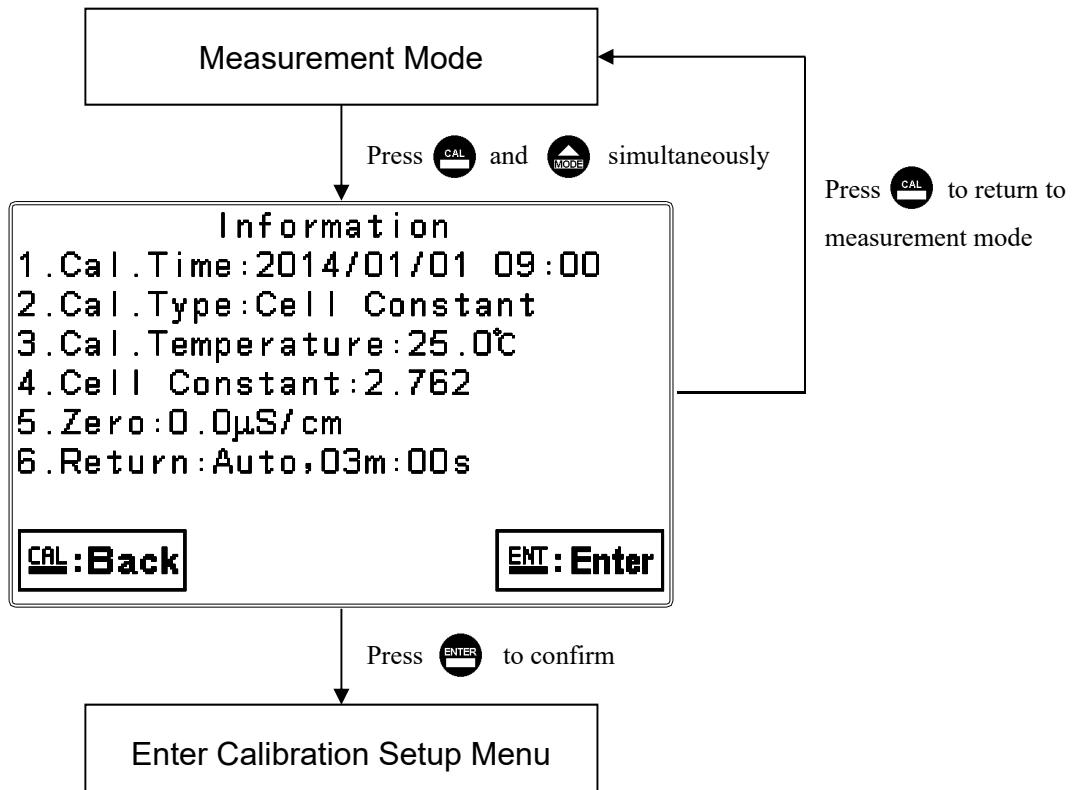
8. Calibration

Calibration Block Diagram



8.1 Calibration Menu

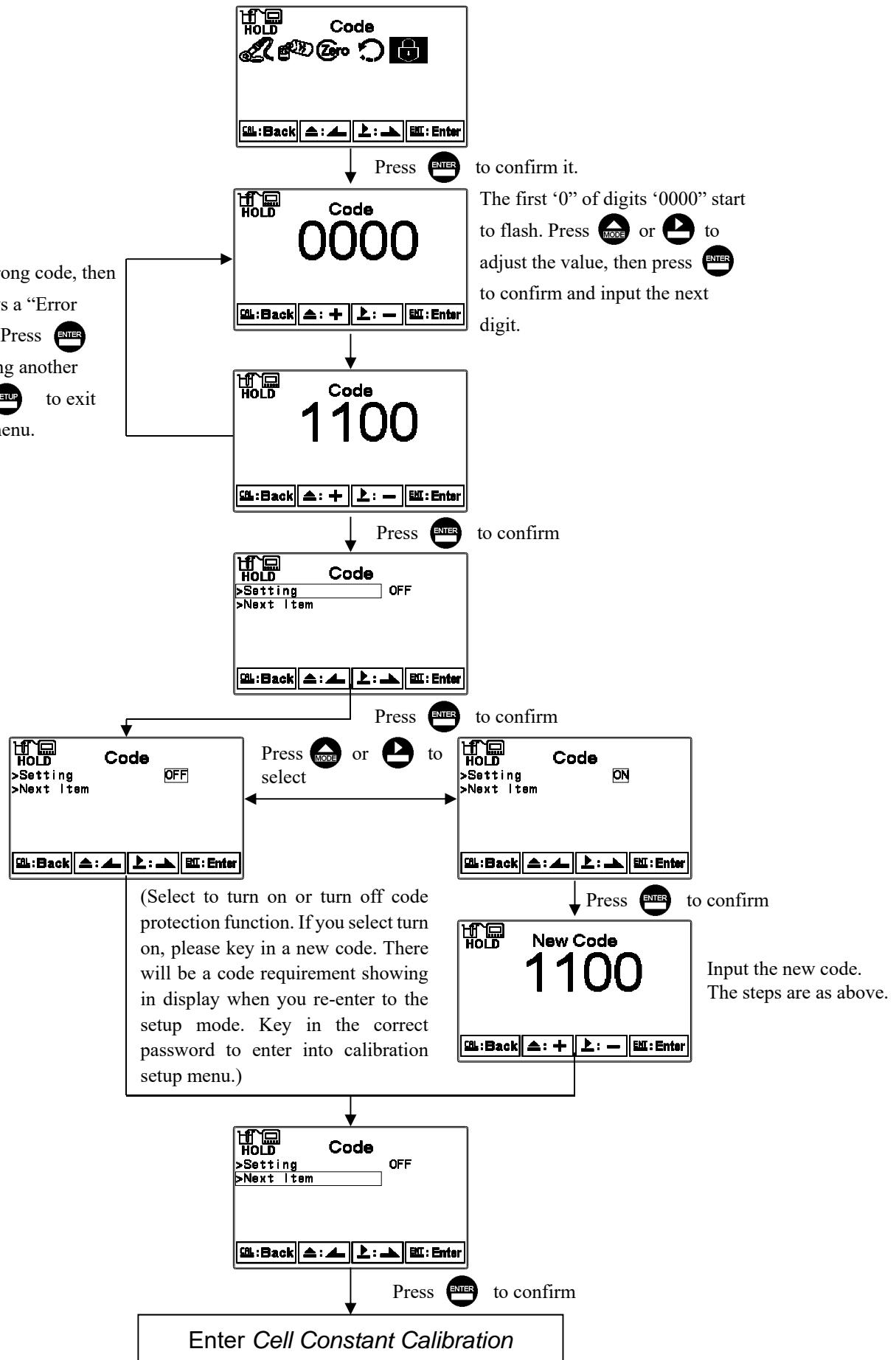
In measurement mode, press  and  simultaneously to enter the Calibration Information. If re-calibration is not necessary, press  to return to measurement mode. To re-calibrate the system, press  to enter to the calibration setup menu. (If the calibration time is “OFF”, the clock function has been turned off.)



8.2 Calibration Security Code (Code)

Select the Code (password) icon after entering calibration setup mode to activate code function
The default Calibration setting code is “1100”.

If you input a wrong code, then the display shows a “Error Code” message. Press  to restart inputting another code, or press  to exit the calibration menu.



8.3. Zero Point Calibration

Zero point calibration is necessary once the inductive sensor is connected to the transmitter. Calibration can be done in the air or with standard solution.

Zero Point Calibration in Air:

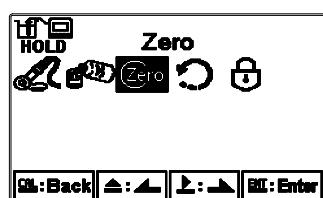
Make sure sensor surface is dry and clean, then hold sensor in the air.

Zero Point Calibration with Standard Solution:

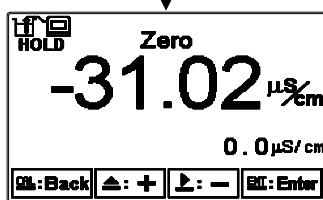
Place sensor into standard solution, then adjust zero point deviation value until the measurement value meets expected value.

Under Settings selection menu, select *Zero* and press  to begin zero point calibration.

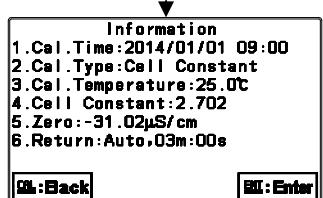
In the air



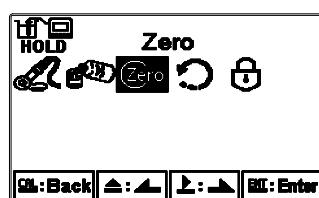
Press  to begin zero point calibration



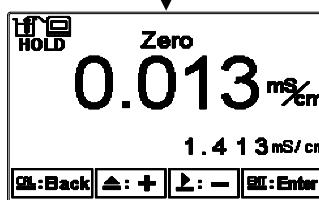
Press  or  to adjust zero point deviation. Calibration is complete when the sub value is zero. Press  to proceed.



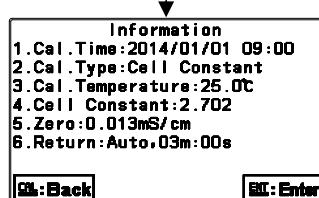
In standard solution



Press  to begin zero point calibration



Press  or  to adjust zero point deviation. Calibration is complete when the sub value stabilizes at standard solution value. Press  to proceed.

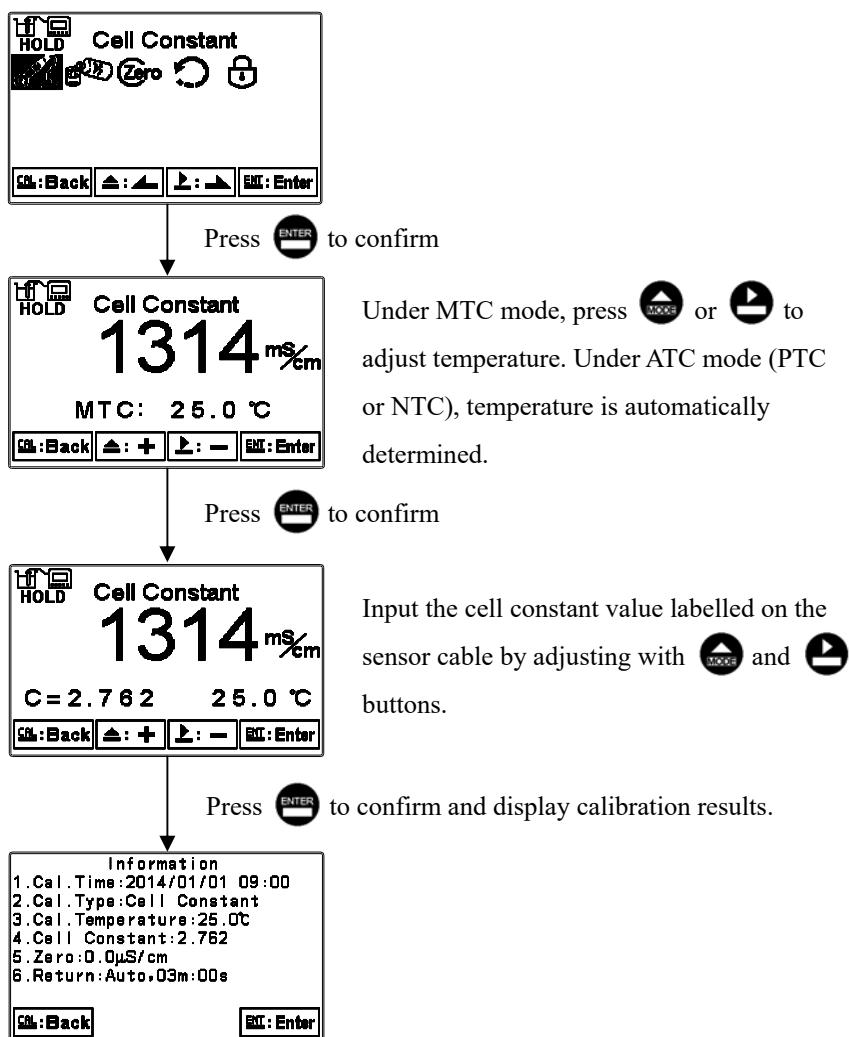


8.4. Cell Constant Calibration

Under Settings selection menu, select *Cell Constant* and press  to input pre-determined sensor cell constant. The factory provided cell constant value is labelled on the sensor cable and has been calibrated following production.

The inductive sensor utilizes electromagnetic induction principle to detect the conductivity of a sample solution and requires no direct electrode contact to the sample solution. However, electromagnetic signals may be affected by the environment due to wall-effect, metal (conductor) or plastic (insulation) pipeline, or distance between sensor and pipe shell, and therefore may slightly deviate from actual lab measured values.

If a standard conductivity solution or a lab measured sample solution is available, cell constant calibration can also be performed in the field with a pre-determined value.



8.5. Standard Solution Calibration

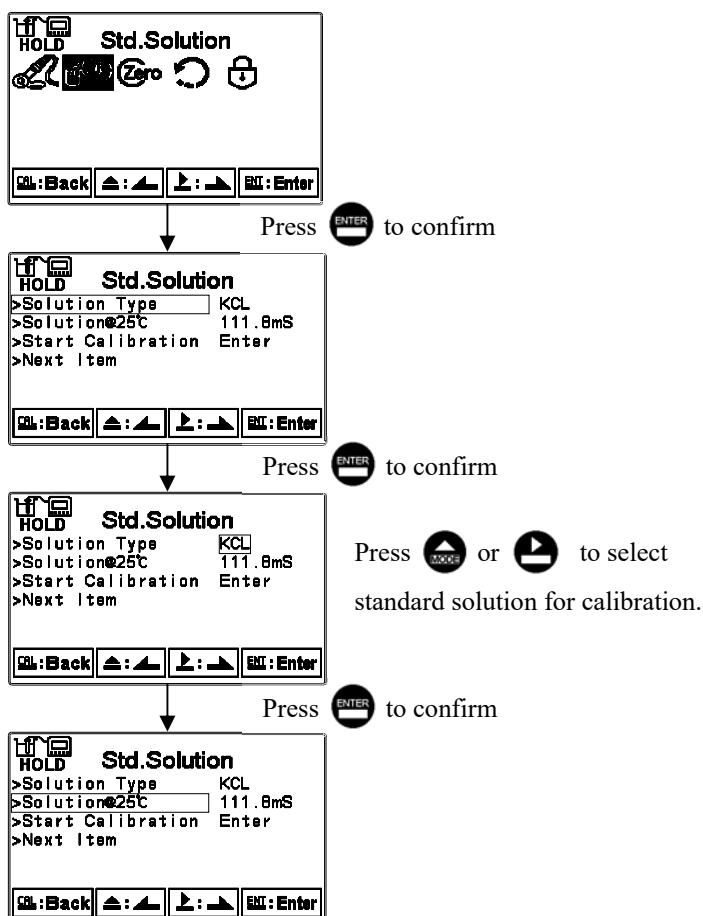
KCl-based or NaCl-based standard solution are available for selection.

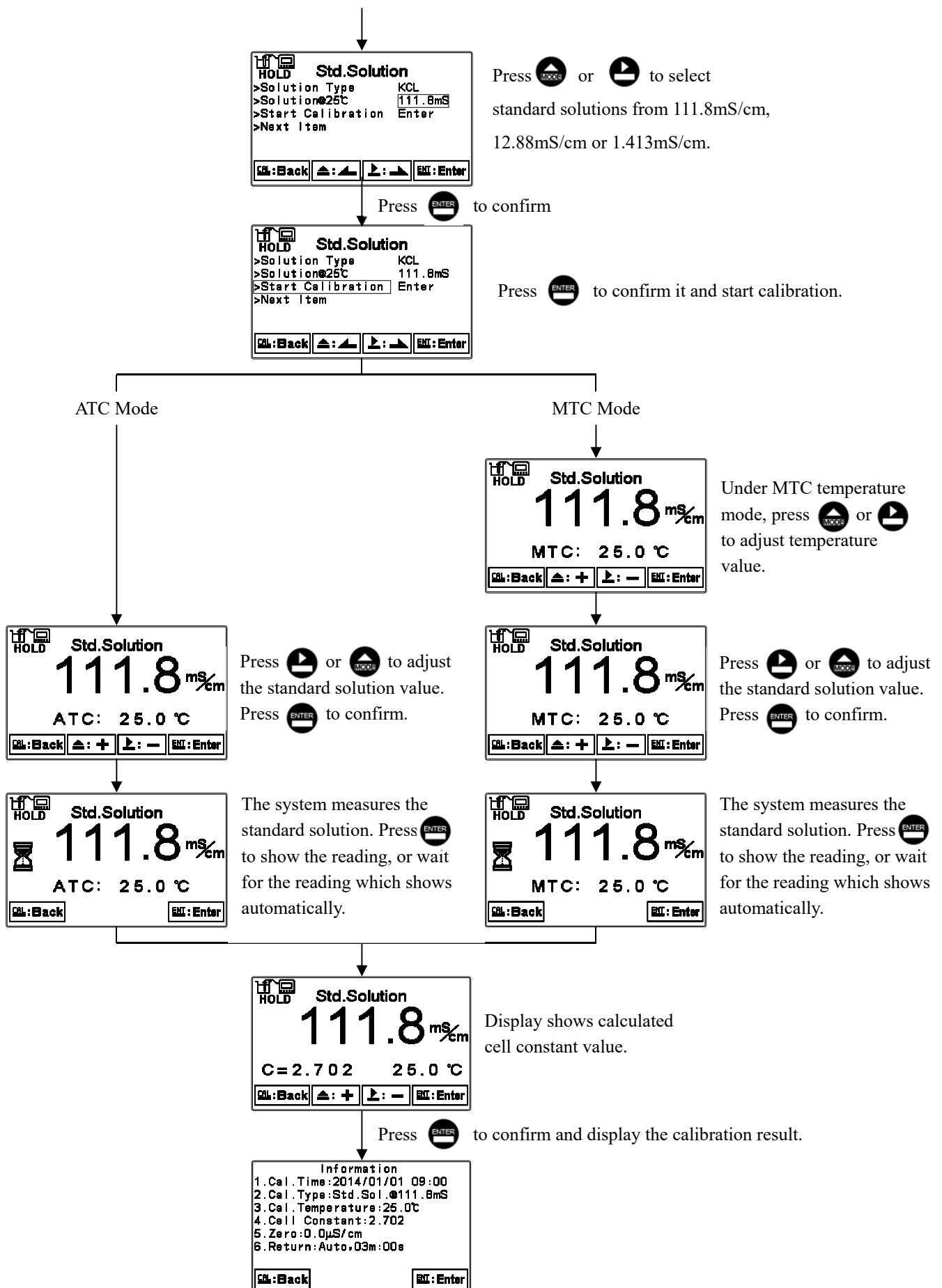
1. In a laboratory setting, immerse the sensor within the standard solution for more than 30 minutes, and keep at least 3cm distance from the container or vessel wall to avoid wall-effect influencing the measurement.
2. In a pipe-line installation setting, the standard solution is flowed to the inductive sensor. Calibrate with the wall effect considered to obtain the correct in-field cell constant.
3. Pre-determined cell constant labelled on the sensor is highly recommended to be used along with product adjustment to calibrate the inductive sensor. Refer to section 7.8 *Product Adjustment* for detailed instructions.
4. Before calibration, make sure that the temperature of the standard solution measured by the sensor is accurate to avoid incorrect temperature compensation.

Note: It is necessary to make a zero-point calibration before standard solution calibration when setting up the inductive sensor for the first time.

8.5.1. KCl Standard Solution

There are 3 KCl-based standard solutions available for selection: 111.8 mS (1mol/L), 12.88 mS (0.1mol/L), and 1.1413 mS (0.01 mil/L). Refer to the *Appendix Calibration Solution: Conductivity and Temperature Table* for conductivity and temperature reference.

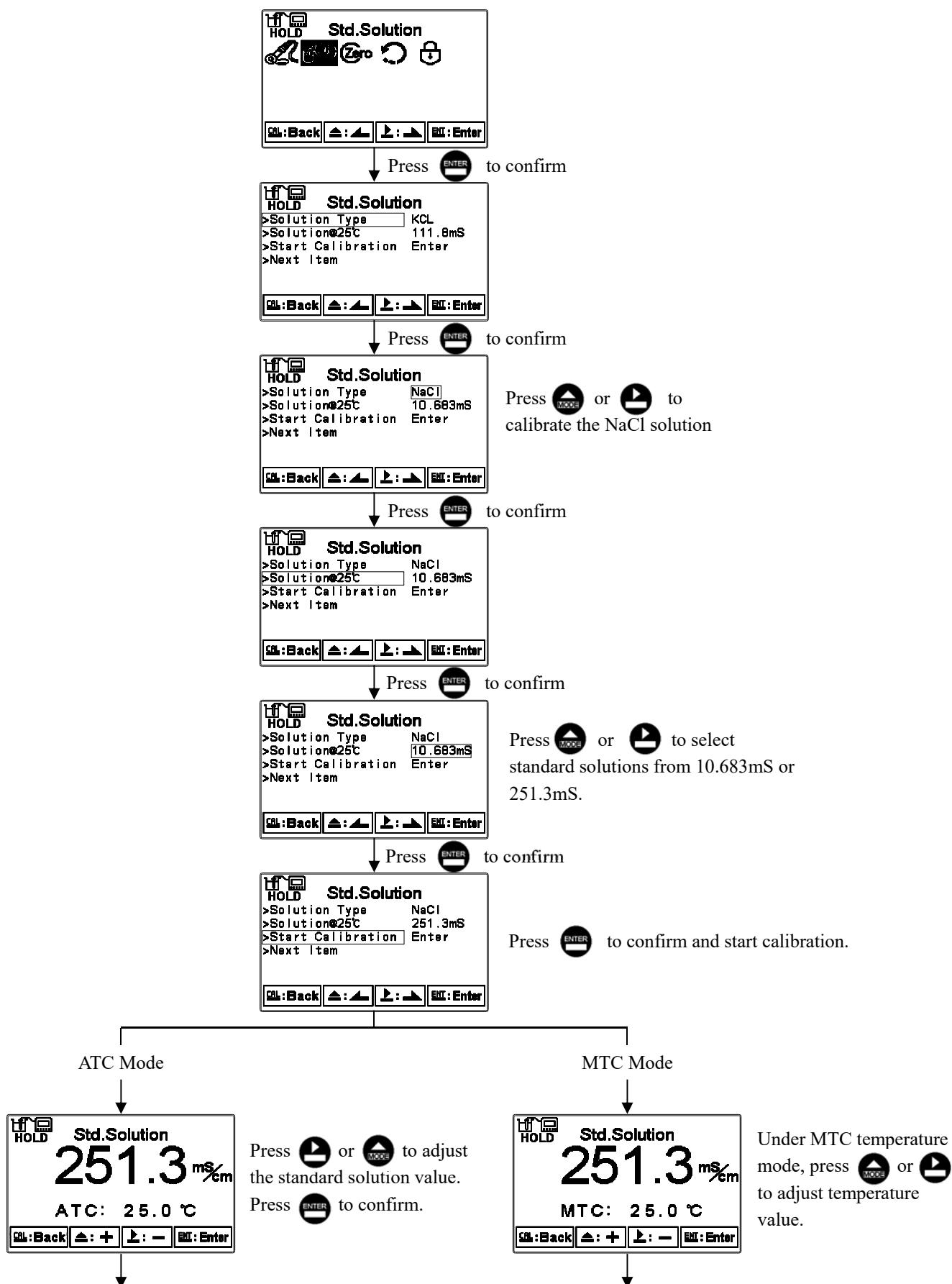




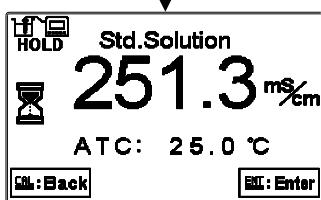
8.5.2 NaCl Standard Solution

Two standard solutions 10.683 mS/cm (0.1 mol/L) and 251.3 mS/cm (saturated) are available for selection.

Please refer to “Appendix Calibration Solution: Conductivity and Temperature Table” for additional information.

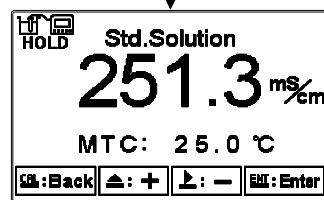


ATC Mode

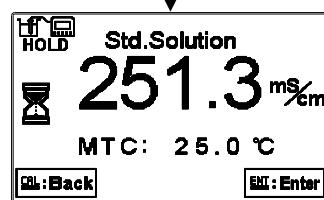


The system measures the standard solution. Press to show the reading, or wait for the reading which shows automatically.

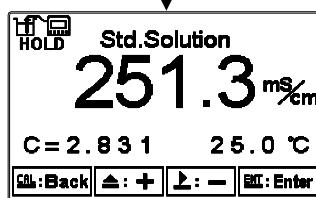
MTC Mode



Press or to adjust the standard solution value.
Press to confirm it.

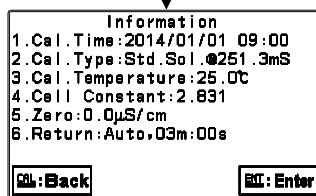


The system measures the standard solution. Press to show the reading, or wait for the reading which shows automatically.



Display shows calculated cell constant value.

Press

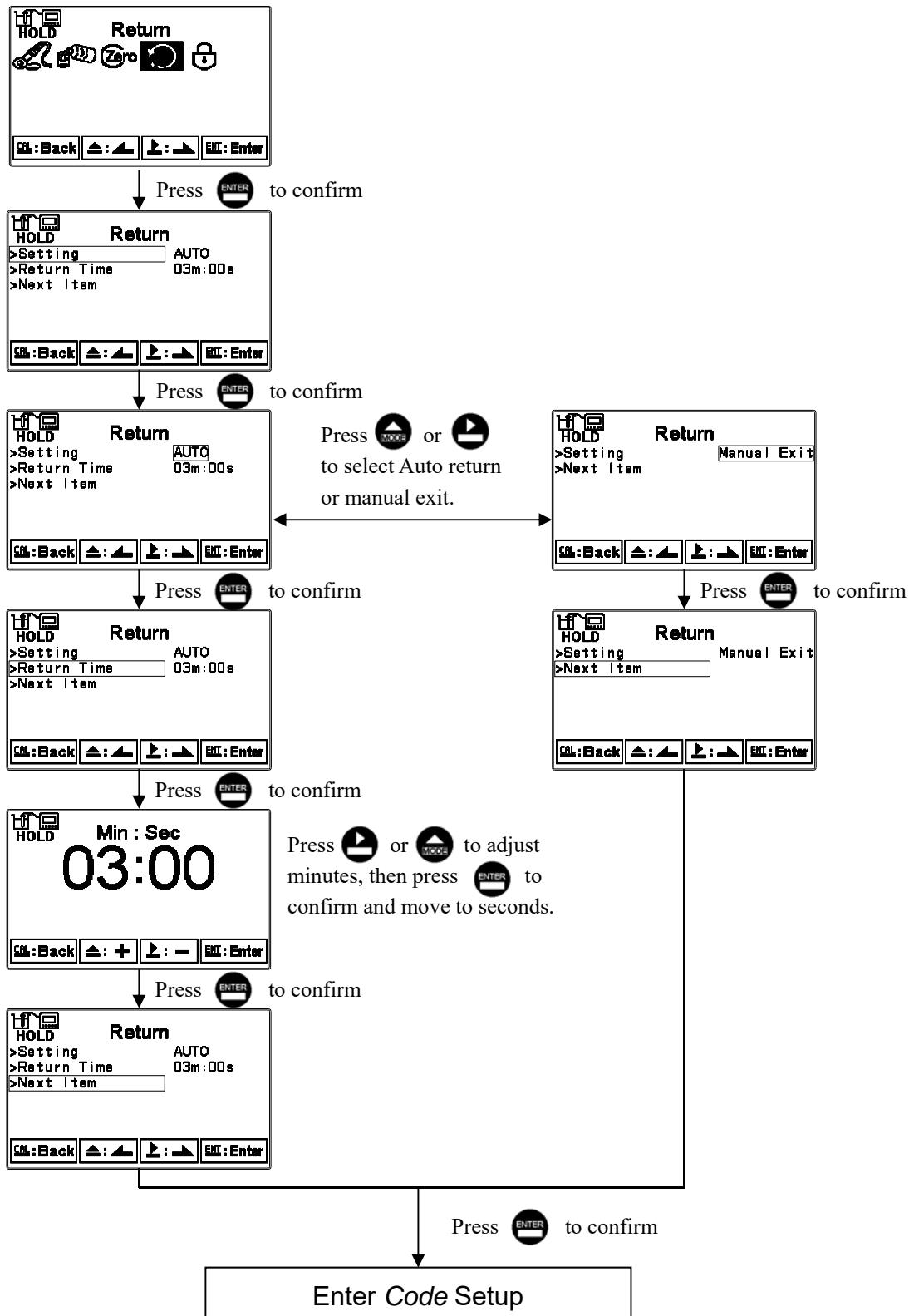


to confirm and display the calibration result.

8.6 Automatic Return (Return)

Enter setup of auto return mode (Return) to set the transmitter to automatically exit the calibration menu after a period of inactivity. “Manual Exit” requires that the user to exit calibration menu manually, “Auto” allows the transmitter to automatically exit the calibration menu and return to measurement mode after a period of inactivity.

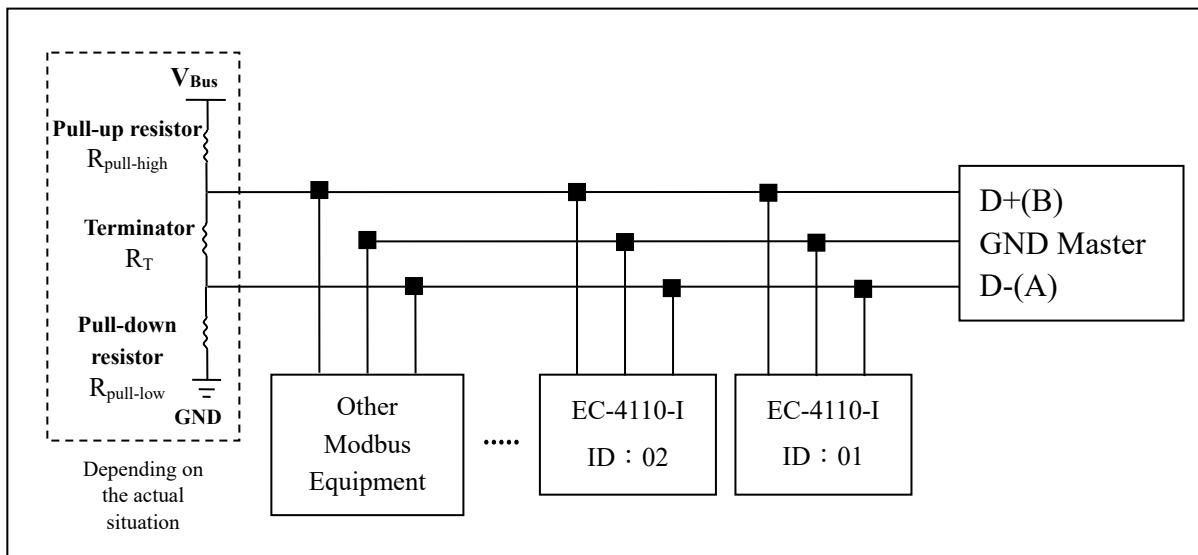
Note: The return functions of setup menu and calibration menu are independent settings.



9. Modbus Protocol and Instructions

9.1 Communication Connection

The transmitter's RS-485 communication port features electronic isolation protection, lightning protection, and provides an isolated ground terminal. It is able to connect using standard twisted pair (segregated, double-stranded) cables. The positive connection point D+(B) of all devices are connected together with one strand of the double-stranded twisted-pair cable, and all the negative contacts D-(A) with the other strand; the isolated wire shield must be connected to the ground terminal(GND). In the laboratory, a standalone master-slave communication is simple and therefore standard cables may be used. However, for industrial settings, strict engineering construction requirements must be taken into account for proper installation. The wiring diagram is as follows:



Note:

1. The transmitter's RS-485 interface is equipped with a protective ground terminal. When communicating with the RS-485, the ground terminal must be used to eliminate safety risks.
2. Use 120 ohm impedance matching resistors at the signal cable terminals (D+(B) and D-(A)) of the terminal devices to effectively reduce or eliminate signal reflection.

Note: Three common causes of connection failures:

- a. Open circuits: the signal cable has an open circuit.
- b. Short circuits: there is insufficient insulation between signal cables causing a short circuit.
- c. Idle-bus: there is no data transmission in the Controlbus.

The three conditions above can cause an unknown state of the Controlbus voltage, leading to the receiver receiving unexpected signals. Therefore, in complicated setups like multi-transmitter connections, the Controlbus requires a terminating resistor to avoid baud rate reflection, in addition to biasing circuits composed of pull-high and pull-low resistors, and voltage source (VBus). As seen in the diagram above, make sure the signal cable terminals D+(B) and D-(A) has free voltage in between to keep the signals complete. Some systems may not be suitable for a fixed resistor and VBus, therefore users will need to be more aware of the settings. Some equipment parts (RS-485 converters or modules) provide terminating, pull-high, pull-low resistors, and VBus settings. Please refer to the corresponding operation manuals before installation and connection. For VBus, the standard is 5 V, for pull-high and pull-low resistors, 1 KΩ, and for terminating resistors, 120 KΩ.

3. Without repeaters, the RS-485 network cannot exceed a maximum of 32 nodes. The maximum transmission

communication distance for RS-485 is up to 1200 meters. For long distance transmission, it is recommended to use cables that are specifically design for RS-485.

4. When communicating, all equipment within the network should be consistently kept in the same transfer mode, baud rate, and parity. All devices must be under different addresses to prevent conflicts within the network communications.
5. The transmitter's Modbus command can only access 50 registers. Abnormal information will be returned if the maximum length is exceeded.
6. The idle time in which a slave instrument responds to a master machine is different according to each model. Generally, the time needed should be longer than 0.5 seconds (some models may require a longer waiting-responding time, please note if the operation manual specifies).

9.2 Modbus Address and Command Table

Modbus response table is as follows. As users communicate with transmitters through PLC or Man-machine Interface, check to see if the transmission of address subtracts 1 by default. If so, add 1 onto each address to match the table; e.g. for logic address 0037H (16-bit) or 55 (10-bit), if there is a minus 1 output signal proceeded by PLC or Man-machine Interface, users must input 0038H (16-bit) or 56 (10-bit) to match the appropriate logic address 0037H (16-bit) or 55 (10-bit).

Function Code: 03H, 06, 10H Modbus Response (Setup Parameter)

Logic address	R/W	Item	Number of Byte	Information Type	Description of data transmission	Default Value	Note			
0000H				None						
0001H	R	Equipment's ID	2	USHORT	1-247	1				
0002H	R	Transmitter Model	6	USHORT	ASCII Code	EC4110				
0005H	R	Communication Protocol	2	USHORT	0 : RTU	0				
					1 : ASCII					
0006H	R	Serial Transmission Speed (Baud rate)	2	USHORT	0 : 2400	3				
					1 : 4800					
					2 : 9600					
					3 : 19200					
0007H	R	Parity	2	USHORT	0: None	1				
					1: Even					
					2: Odd					
0008H	R/W	Real-time Clock*	12	USHORT	Second	2014-01-01 00 : 00 : 00				
0009H	R/W			USHORT	Minute					
000AH	R/W			USHORT	Hour					
000BH	R/W			USHORT	Day					
000CH	R/W			USHORT	Month					
000DH	R/W			USHORT	Year					
000EH	R/W	Code Setting*	2	USHORT	Code setting	1111				
000FH	R/W	Temperature Mode*	2	USHORT	0 : MTC	1				
					1 : PTC1000					
					2 : NTC					
					3 : PTC100					
0010H	R/W	Clean Relay*	2	USHORT	0 : OFF	0				
					1 : AUTO					
					2 : ON.S : 0-5999					
					2 : OFF.H : 0-999					
					2 : OFF.M : 0-59					
0011H	R/W	Clean Relay*	2	USHORT	Hys.S : 0-5999	0	Second			
0012H	R/W					0	Hour			
0013H	R/W					0	Minute			
0014H	R/W					0	Second			

0015H	R/W	Relay 1*	2	USHORT	0 : OFF 1 : AUTO	1	
0016H	R/W		2		0 : Hi 1 : Lo		
0017H	R/W		4	FLOAT	SP1	1000mS/cm	Data affected by sign
0019H	R/W		4	FLOAT	Hys1	10mS/cm	
001BH	R/W		2	USHORT	0 : OFF 1 : AUTO	1	
001CH	R/W	Relay2*	2		0 : Hi 1 : Lo		
001DH	R/W		4	FLOAT	SP2	100.0mS/cm	Data affected by sign
001FH	R/W		4	FLOAT	Hys2	1.0mS/cm	
0021H	R/W		2	USHORT	0 : AUTO 1 : ON 2 : OFF	2	
0022H	R/W	Backlight Brightness*	2		2: Highest brightness 1: high brightness 0: Standard -1: Low brightness -2: Lowest brightness		0
0023H	R/W		2		2: Highest Sensitivity 1: High Sensitivity 0: Standard -1: Low Sensitivity -2: Lowest Sensitivity		
0024H	R/W	Sample Average of Measurements (Digital Filter) *	2	USHORT	0-60	0	
0025H	R/W	Product Adjustment*	2	USHORT	0 : OFF 1 : ON	0	
0026H			4		FLOAT 0.7000~1.3000	1.0000	
0028H	R/W	Event Serial Number	2	USHORT	1~50	1	
0029H	R	Event Time	12	USHORT	Second	2014-01-01 00 : 00 : 00	
002AH	R			USHORT	Minute		
002BH	R			USHORT	Hour		
002CH	R			USHORT	Day		
002DH	R			USHORT	Month		

002EH	R			USHORT	Year		
002FH	R	Event Code	2	USHORT	0~13	0	
0030H	R/W	Main Measurement*	2	USHORT	1~16	2	

Note 1: Actions without * only supports function code 03H. Actions with * supports function code 03H, 06H, 10H.

Note 2: FLOAT is a 32-bit IEEE 754 format. The above table, as an example, is divided into two 16-bit register data transmissions. The second 16-bit register (CC CD) will be transferred first, followed by the first 16-bit register (41 C8). Every 16-bit format is high-bit in the front and low-bit in the back. For example, if the temperature now is 25.1°C, the 16-bit of FLOAT data (hexadecimal) will be 41 C8 CC CD. The transmission order will be CC CD 41 C8. For detailed description, please refer to section 9.3, Modbus example description.

Note 3: USHORT represents unsigned short integer.

Note 4: Logbook Event Code

To read the data of the event log through Modbus, input the 0028H event number first, then read 0029H~002FH accordingly. Event no.1 indicates the latest record, no.2 indicates the previous record, and so on.

Event	Description	Modbus code
Mea mode	Measurement mode	00
Set mode	Setting mode	01
Cal mode	calibration mode	02
Power On	The unit is powered up	03
Power Off	The unit is out of power	04
Cond_mA Over	Current is over range (Conductivity mode)	05
Error 1	Unstable reading during calibration	06
Error 2	1. Cell factor exceeds the upper/lower limit 2. Temperature is over range	07
Error 3	Wrong password	08
Conc_mA Over	Current is over range (Concentration mode)	09
Error 9	The unit is broken	10
Modbus Write	Modbus input action	13

Note 5: Main Measurement Code

Main Item	Description	Modbus Code
Cond.@tx	Absolute conductivity measurement mode	01
Cond.@tref	Temperature compensated conductivity measurement mode	02
Salinity	Salinity measurement mode	03
TDS	Total dissolved solids measurement mode	04
NaCl_28%	Sodium chloride solution 0~28%	05
HCl_18%	Hydrochloric acid solution 0~18%	06
HCl_39%	Hydrochloric acid solution 22~39%	07
HNO ₃ _30%	Nitric acid 0~30%	08
HNO ₃ _96%	Nitric acid 35~96%	09
NaOH_24%	Sodium hydroxide solution 0~24%	10
NaOH_50%	Sodium hydroxide solution 15~50%	11
H ₂ SO ₄ _37%	Sulfuric acid 0~37%	12
H ₂ SO ₄ _88%	Sulfuric acid 28~88%	13
H ₂ SO ₄ _99%	Sulfuric acid 89~99%	14
H ₃ PO ₄ _35%	Phosphoric acid 0~35%	15
Defined	User defined concentration table	16

Function Code: 03H Modbus Response (Measurement Parameter)

Logic address	R/W	Item	Number of Byte	Information type	Description of data transmission	Default value	Note
0031H	R	Measurement Status	2	USHORT	0 : Hold	1	
					1 : Measurement		
0032H	R	Sign	6	CHAR	µS/cm	Cond.@tref 2000mS/cm	ASCII Code
					mS/cm		
					%		
					ppm		
					ppt		
0035H	R	Cond./Conc./TDS/Salinity Measurement	4	FLOAT	Cond./Conc./TDS/Salinity Measurement		
0037H	R	Temperature Measurement	4	FLOAT	Temperature Measurement		
0039H-003FH		Factory reserved					
0040H	R	Cell Constant	4	FLOAT	Cell Constant	2.700	

0042H	R	Calibration Time	2	USHORT	Minute	2014-01-01 00 : 00		
0043H	R		2	USHORT	Hour			
0044H	R		2	USHORT	Day			
0045H	R		2	USHORT	Month			
0046H	R		2	USHORT	Year			
0047H- 0050H			Factory reserved					

Function Code: 01H & 05H Modbus Response (Dispersion Parameter)

Logic address	R/W	Item	BIT	Description	Default value	Note		
0070H	R	LO Alarm	1	Contact on	0 (Contact off)			
0071H	R	Hi Alarm	1	Contact on	0 (Contact off)			
0072H	R	mA output Too High	1	Contact on	0 (Contact off)			
0073H	R	mA output too Low	1	Contact on	0 (Contact off)			
0074H	R	Exceed Temp. Range	1	Contact on	0 (Contact off)			
0075H	R	Exceed Measuring Range	1	Contact on	0 (Contact off)			
0076H	R	RLY1 Action	1	Contact on	0 (Contact off)			
0077H	R	RLY2 Action	1	Contact on	0 (Contact off)			
0078H	R	Clean Action	1	Contact on	0 (Contact off)			
0079H- 008FH			Factory reserved					

9.3 MODBUS Description Example (ex: function code 03H)

The following description uses temperature reading 0037H as an example. Set the temperature of the transmitter at MTC 25.1°C then confirm that the host and the sub-machine communication format settings are correct. The host sends request commands according to the left column of the table below, and then receives a corresponding response from the sub-machine according to the right column. This example shows the function code 03H as transmission data format; for other function codes, the same logic applies.

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

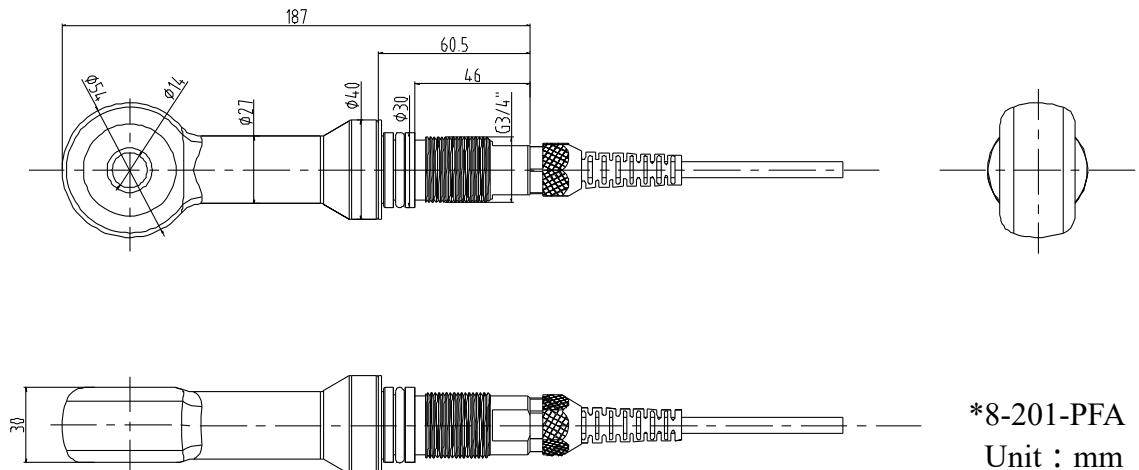
Note: FLOAT is a 32-bit IEEE 754 format. The above table is divided into two 16-bit register data transfers. The back 16-bit register (CC CD) is transferred first, followed by the front 16-bit register (41 C8). Every 16-bit format is high-bit in the front and low-bit in the post. For example, if the temperature now is 25.1°C, the 16-bit of FLOAT data (hexadecimal) is 41 C8 CC CD. However, the transmission order will be CC CD 41 C8.

10. Error Messages (Error Code)

Messages	Reason	Dispositions
Error1	Measurement is unstable during calibration	<ol style="list-style-type: none">1. Replace with new standard solution2. Maintain or replace electrode, and make another calibration.
Error2	<ol style="list-style-type: none">1. Cell constant of the electrode exceeds the upper or lower limit2. Exceeds temperature range	<ol style="list-style-type: none">1. Replace with new standard solution2. Maintain or replace electrode, and make another calibration.
Error3	Wrong password ERROR CODE	Re-enter passcode
Error5	Critical error that does not permit any further measuring	Contact service engineer.

11. Sensor Installation

11.1 Sensor Appearance

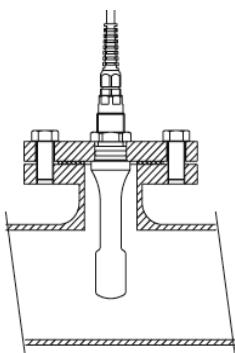
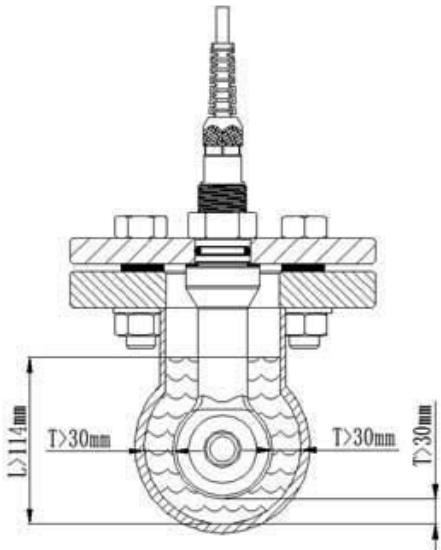


8-201-PFA Inductive Conductivity Sensor

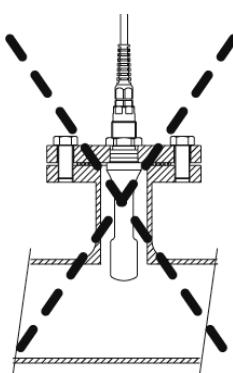
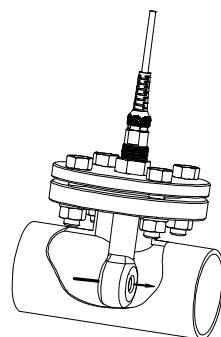
Includes: 1.Sensor 2. FEP O-ring 3. Teflon flat gasket 4. Hexagon nut

11.2 Installation Approach

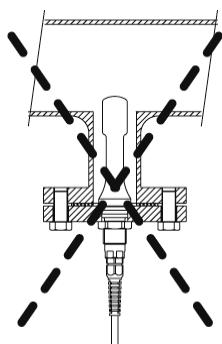
11.2.1 Flange Installation



Correct Installation



Incorrect Installation: insufficient immersion



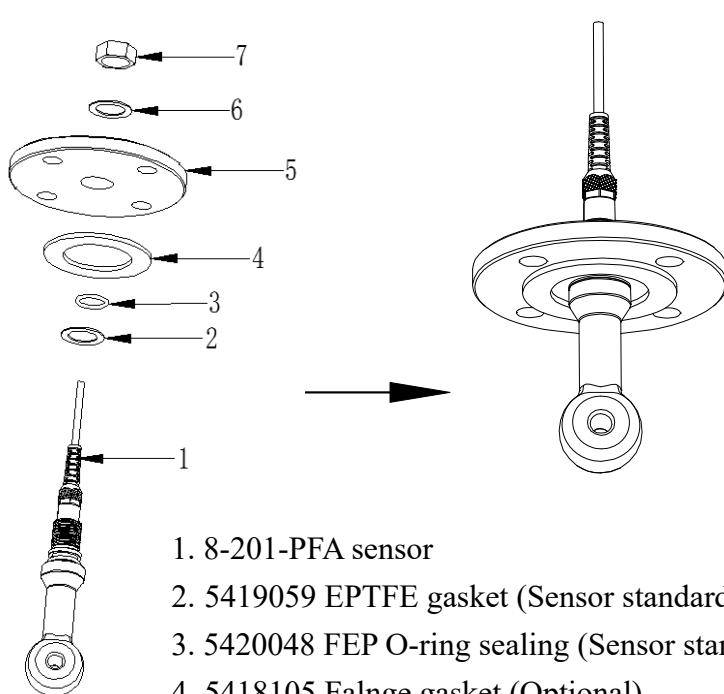
Incorrect Installation: solid impurities sediment influence measurement value

1. Keep the centric hole of the sensor in parallel with the direction of water flow, then allow water to flow through the hole. Suitable for pipeline installation (See left diagram).

2. The sensor should be immersed **at least 114mm**, and the distance T to the shell of pipe should be over 30mm. (Pipe inner diameter is recommended as 114mm, or at least 110mm; see left diagram)

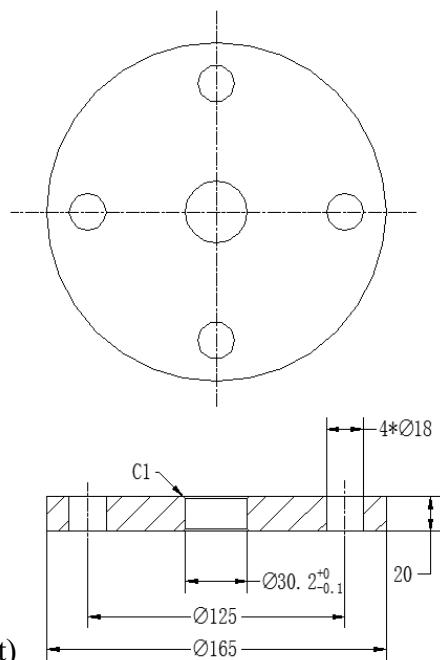
3. Flange spec: DN50 above (customer-made spec according to actual situation in field).

Flange Installation Steps

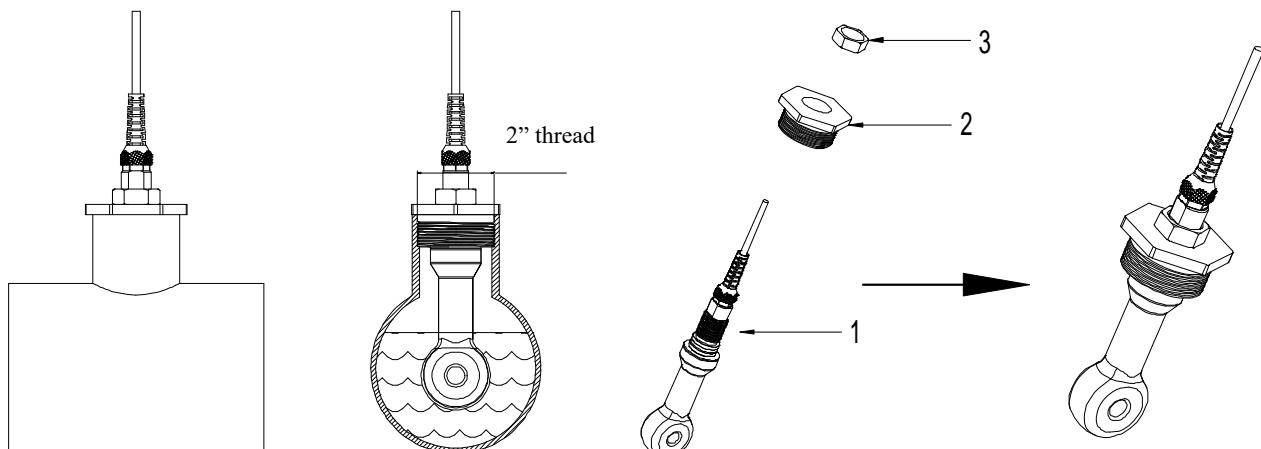


1. 8-201-PFA sensor
2. 5419059 EPTFE gasket (Sensor standard kit)
3. 5420048 FEP O-ring sealing (Sensor standard kit)
4. 5418105 Flange gasket (Optional)
5. 5710040 DN50 Flange (Optional)
6. 5333057 (Sensor standard kit)
7. 5329003 G3/4" hexagon nut (Sensor standard kit)

Flange Spec DN50 PL16



11.2.2 Tee Installation

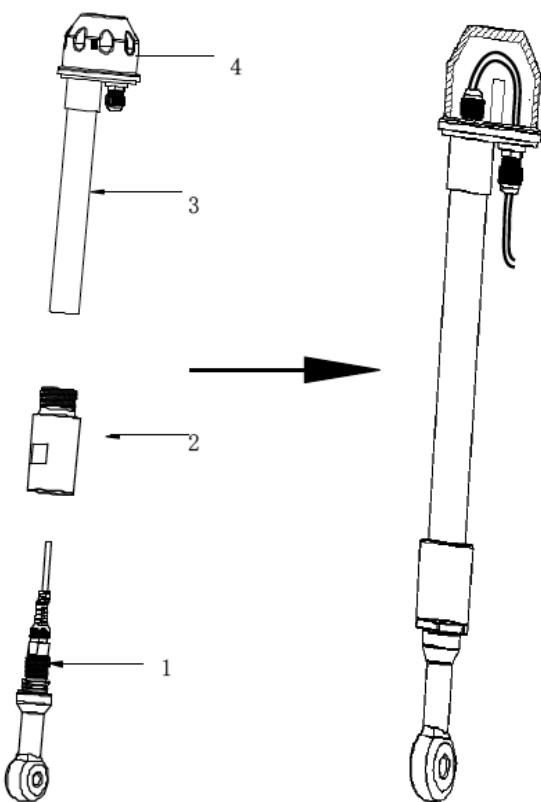


Directly install the sensor & bushing with fixed Thread (at least 2" thread) on a T-connector

Installation accessories:

1. 8-201-PFA sensor
2. 5419061 Bushing (2"-3/4") (Optional)
3. 5329003 G3/4" hexagon nut (Sensor standard kit)

11.2.3 Immersive Holder Installation



Installation accessories:

1. 8-201-PFA-10 Inductive conductivity sensor
2. 5419060 Holder adapter for 8-201-PFA sensor (1"-3/4") (Optional)
3. 7202-DO100C Immersive holder 1M with O-ring (Optional)
4. 8-09-4 Round waterproof cap (Optional)

Appendix: Calibration Solution

Potassium Chloride Solution

Conductivity in mS/cm

°C	Conductivity	1.413mS/cm@25°C	12.88mS/cm@25°C	111.8mS/cm@25°C
	Concentration	0.01mol/l	0.1mol/l	1mol/l
0	0.776	7.15	65.41	
5	0.896	8.22	74.14	
10	1.020	9.33	83.19	
15	1.147	10.48	95.52	
16	1.173	10.72	94.41	
17	1.199	10.95	96.31	
18	1.225	11.19	98.22	
19	1.251	11.43	100.14	
20	1.278	11.67	102.07	
21	1.305	11.91	104	
22	1.332	12.15	105.94	
23	1.359	12.39	107.89	
24	1.386	12.64	109.84	
25	1.413	12.88	111.8	
26	1.441	13.13	113.77	
27	1.468	13.37	115.74	
28	1.496	13.62		
29	1.524	13.87		
30	1.552	14.12		
31	1.581	14.37		
32	1.609	14.62		
33	1.638	14.88		
34	1.667	15.13		
35	1.696	15.39		
36		15.64		

Sodium Chloride Solution

Conductivity in mS/cm

°C	Conductivity	10.683mS/cm@25°C	251.3mS/cm@25°C
	Concentration	0.1mol/l	Saturated
0	5.786	134.5	
1	5.965	138.6	
2	6.145	142.7	
3	6.327	146.9	
4	6.510	151.2	
5	6.695	155.5	
6	6.881	159.9	
7	7.068	164.3	
8	7.257	168.8	
9	7.447	173.4	
10	7.638	177.9	
11	7.831	182.6	
12	8.025	187.2	
13	8.221	191.9	
14	8.418	196.7	
15	8.617	201.5	
16	8.816	206.3	
17	9.018	211.2	
18	9.221	216.1	
19	9.425	221.0	
20	9.631	226.0	
21	9.838	231.0	
22	10.047	236.1	
23	10.258	241.1	
24	10.469	246.2	
25	10.683	251.3	
26	10.898	256.5	
27	11.114	261.6	
28	11.332	266.9	
29	11.552	272.1	
30	11.773	277.4	

31	11.995	282.7
32	12.220	288
33	12.445	293.3
34	12.673	298.7
35	12.902	304.1
36	13.132	309.5

Optional Accessories

If necessary, please order the spare parts as follows:

1. Installation (please refer to chp.11 Installation of Sensor Assembly)
 - 1.1 Flange Mounting (for installations in pipelines)
 - a. 5419059 Teflon flat gasket (8-201-PFA sensor standard kit)
 - b. 5420048 FEP O-ring sealing (8-201-PFA sensor standard kit)
 - c. 5329003 G3/4" hexagon nut (8-201-PFA sensor standard kit)
 - 1.2 Bushing installation (for installations in pipelines)
 - a. 5419061 Bushing for tee installation (2"-3/4")
 - b. 5329003 G3/4" hexagon nut (8-201-PFA sensor standard kit)
 - 1.3 Immersion installation (for installations in open tanks)
 - a. 5419060 Holder adapter for 8-201-PFA sensor (1"-3/4")
 - b. 7202-DO100C Immsersive sensor protection holder, PP, 1M
 - c. 8-09-4 Round waterproof cap
 - d. 8-26-7 Plastic L-shaped electrode holder support base
2. Extension cable max. up to 50M (**zero-point calibration, cell constant calibration, and product adjustment are required after installation**)
 - a. 8-09-9 Rectangle junction box, 9 Terminals
 - b. 5251023 Extension cable, please advise specific length as ordered
3. KCl Conductivity standard solutions (optional)
 - a. 8-EC80000-2 80.0 mS/cm standard solution, 500ml
 - b. 8-EC12880-2 12.88 mS/cm standard solution, 500ml
 - c. 8-EC1413-2 1,413 μ S/cm standard solution, 500ml



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