# SG-2110-RS Intelligent Specific Gravity Transmitter

1.200 SG

ACT

B.L.

PM 12:00
2011/12/01
MTC
25.0 ℃

SETUP    CAL    ▲ MODE    ▶    ENTER

Specific Gravity Transmitter SG-2110RS    S/N:111201001

**SUNTEX**
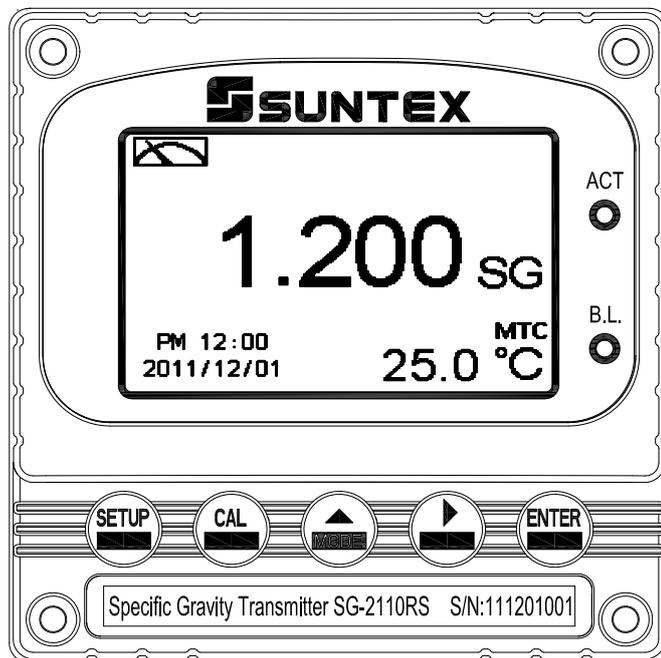
## Precautions for installation

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 controller before wiring input, output connections, and remove it before opening the controller housing.

● The installation site of the controller should be good in ventilation and avoid direct sunshine.

● The material of signal cable should be special coaxial cable. Strongly recommend using our coaxial cable. Do not use normal wires instead.

● Avoid electrical surge when using power. Especially when using three-phase power, use ground wire correctly.

● **The internal relay contact of the instruments is for alarm or control function. Due to safety, please must connect to external relay which can stand enough ampere to make sure the safety operation of the instruments.（Please refer to chapter 3.4 "Illustration of electrical connection"）**

# CONTENTS

# Brief Instruction

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

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

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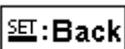
| Keypad | Accordingly item | Description |
|--------|------------------|-------------|
| ![SETUP] | SET:Back | Back to upper layer |
| ![MODE] | ▲:◣ | Choose leftward of change to left page |
| | ▲:+ | Increase digit |
| ![RIGHT] | ▶:◢ | Choose rightward of change to right page |
| | ▶:− | Decrease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

**Selection of set-up items**

| Function | Accordingly item | Description |
|----------|------------------|-------------|
| Mode | ⚙ | Measurement mode, to choose SG(Specific Gravity), °Bé(Baumé), Sal.(Salinity), Conc.(Concentration) measurement |
| Concentration | %\|SG 27.7\|1.200 28.3\|1.205 | Concentration/Specific Gravity Table, available for self-define concentration and SG relationship table for conveniently get concentration value in small range by linear regression calculation |
| Compensation | SG/℃ graph | SG temperature compensation coefficient, for sample solution temperature compensation coefficient input |
| Temperature | 🌡℃ | Temperature measurement and compensation, including MTC, PTC, NTC (3 types total). MTC---Manual temperature compensation, PTC/NTC--- auto temperature compensation |
| Relay 1 | ⌐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 | | Current output according to SG, °Bé, ppt, % setting range |
| Clock | | Clock setting **(When out of power and reboot it, the instrument's time setting can maintain to the real time. If not, please replace the inner 3V CR2025 battery.)** |
| RS-485 | | RS485 serial interface (Modbus protocol) |
| Black-light | | Backlight setting, to set Auto/ON/OFF backlight, brightness, and sensitivity |
| Contrast | | Contrast of screen setting |
| Digital Filter | | Take every serial 1~60 measurements, average them continuously, and make it as the readings |
| Logbook | | Event recorder logbook (50 data) |
| Return | | Setting of returning to the measurement mode |
| Language | | Available for English, Traditional Chinese, Simplified Chinese |
| Code | | Security code of set-up mode. The factory default is 1111, and a designated user can change the code. The set-up code is precedential to calibration code, thus it can pass a different security code of calibration. |
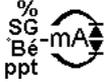
## Description of calibration settings (see chapter 8 for details)

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

**Index of keypad**:

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

**Selection of calibration items**

| Function | Accordingly item | Description |
|----------|------------------|-------------|
| Code | 🔒 | Security code of calibration mode. The factory default is 1100. |
| Return | ↻ | Time interval setting of returning to the measurement mode |
| Select Cal. | Select Cal. | To select calibration mode, offers Single Point, and Two Points, two kinds of calibration point modes |
| Single Point | Single Point | Single point, provides Span calibration mode |
| Two Points | Two Points | Two points, provides Zero point and Span calibration two kinds of calibration mode |
| Pure Water | Pure Water | Pure water calibration |
| CELL | CELL Const. | Plummet coefficient calibration |
| Known Sol. | Known Sol. | Use the known specific gravity solution to calibrate the system |

## 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 | | SG-2110-RS |
|---|---|---|
| Measuring modes | | Specific Gravity /Baumé/Salinity/ Concentration |
| Ranges | SG | 0.000~2.200SG (with Standard Plummet)<br>(The measuring range may depend on the density of chosen plummet) |
| | Temp. | -30.0~130.0˚C |
| Resolutions | SG | 0.001 |
| | Temp. | 0.1˚C |
| Accuracy | SG | ±0.002 (±1 Digit) |
| | Temp. | ±0.2°C(±1 Digit) with temperature error correction function |
| Unit conversion | | Built-in SG value converts to Baumé (˚Bé) or Salinity(ppt) or Concentration(%) value |
| Concentration table setting | | Changeable SG/Concentration table according to solutions<br>(Up to 10 points) |
| Temperature Compensation | | Manual or automatic temperature compensation,<br>SG value temperature compensation at 20˚C |
| SG temperature coefficient | | SG coefficient of linear temperature compensation |
| Calibration mode | | Zero point calibration and Span calibration<br>(For both volume and weight of plummet) |
| Plummet constant | | Settable plummet constant(1~99999), for calibrating both volume and weight of plummet |
| Ambient Temp. | | 0~50 ˚C |
| Storage Temp. | | -10~70 ˚C |
| 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,<br>max. load 500Ω |
| Serial interface | | RS-485 (Modbus RTU or ASCII) |
| Logbook | | 50 events records |
| Settings | Contact | RELAY contact，240VAC 0.5A Max.(recommend) |
| | Activate | Hi/Lo, Hi/Hi, Lo/Lo selectable two limited programmable |
| Wash | Contact | 240VAC, 0.5A Max. (recommend) |
| | Activate | ON:0~99 min. 59 sec.   OFF:0~999 hours 59 min. |
| Power Supply | | 100V~240VAC±10%，50/60Hz，5W max. |
| Installation | | Transmitter: Wall or Pipe or Panel mounting<br>SG Sensor: According to field conditions for user self-installation |
| Dimensions | | 96m × 96mm × 132mm (H×W×D) |
| Cut off Dimensions | | 93 mm × 93 mm (H×W) |
| Weight | | Transmitter: 0.5Kg, SG Sensor: 0.7kg |
| Protection | | Transmitter: IP 65 (NEMA 4X) |

**Note: The specifications are subject to change without notice.**

**1.2 Product components:**

    1.2.1 Standard components

        A. Intelligent specific gravity transmitter

        B. SG load cell sensor

        C. SG plummet

        D. Plummet tie line

        E. Sensor cable

    1.2.2 Optional accessories

        A. Temperature probe

        B. Load cell sensor rack: Can be added up to more than one rack for load cell protection to prevent from acid gas

        C. Sensor Cable: For other length requirement

        D. Chemical-resistant coating plummet

**Note:** (1) About the product external, installation method, and tie method please refer to appendix.

(2) If you would like to change the SG measurement range, you need to replace a different specific gravity plummet.

## 2. Assembly and installation

**2.1 Transmitter installation:** This Transmitter can be installed through panel mounting, wall mounting and 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 make it be fixed in to pickup groove.

### 2.2 Illustration of panel mounting



93 mm

93 mm

Hole size

Mounting bracket

112 mm

Illustration of panel mounting, fixed with mounting bracket

87 mm

87 mm

Hole distances on the panel box
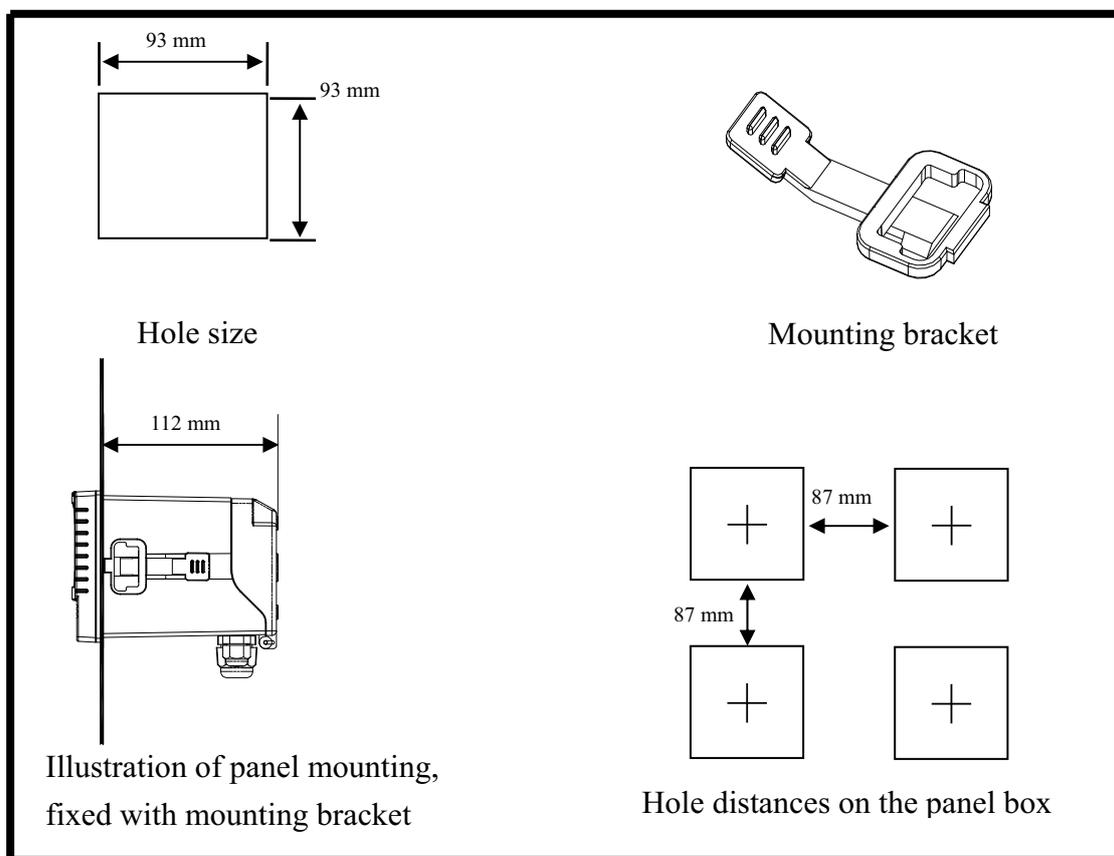
## 2.3 Illustration of Wall mounting and pipe mounting
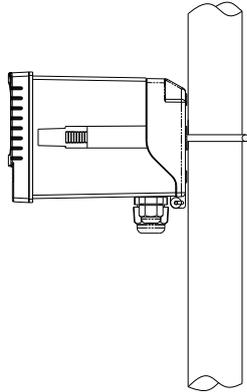


Installation of pipe mounting
Fixed with U-shaped pipe clip. The
distance between screw holes is 60mm
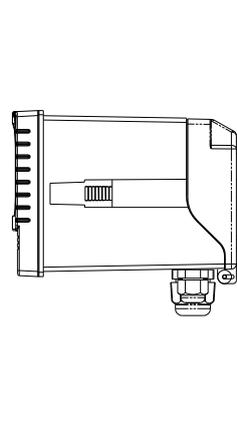
Installation of wall mounting
Fixed with 4 x M4 screws
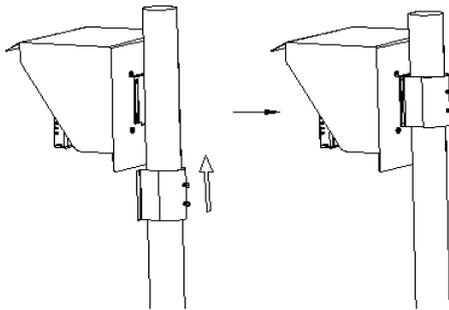
Sun Shield (Pipe mounting)
Order No.: 8-35 and 8-35-1
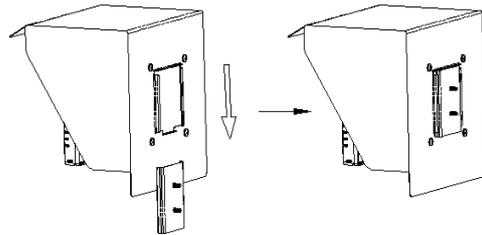
Sun Shield (Wall mounting)
Order No.: 8-35 and 8-35-2

# 3. Overview of Specific Gravity transmitter SG-2110-RS

## 3.1 Illustration of rear panel:
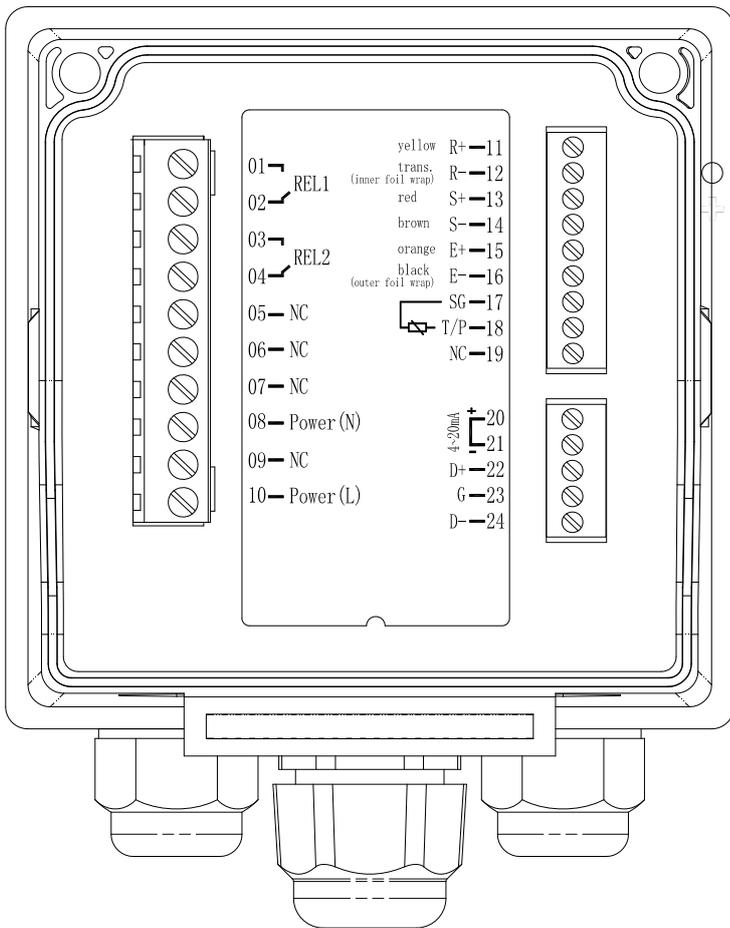


## 3.2 Illustration of terminal function
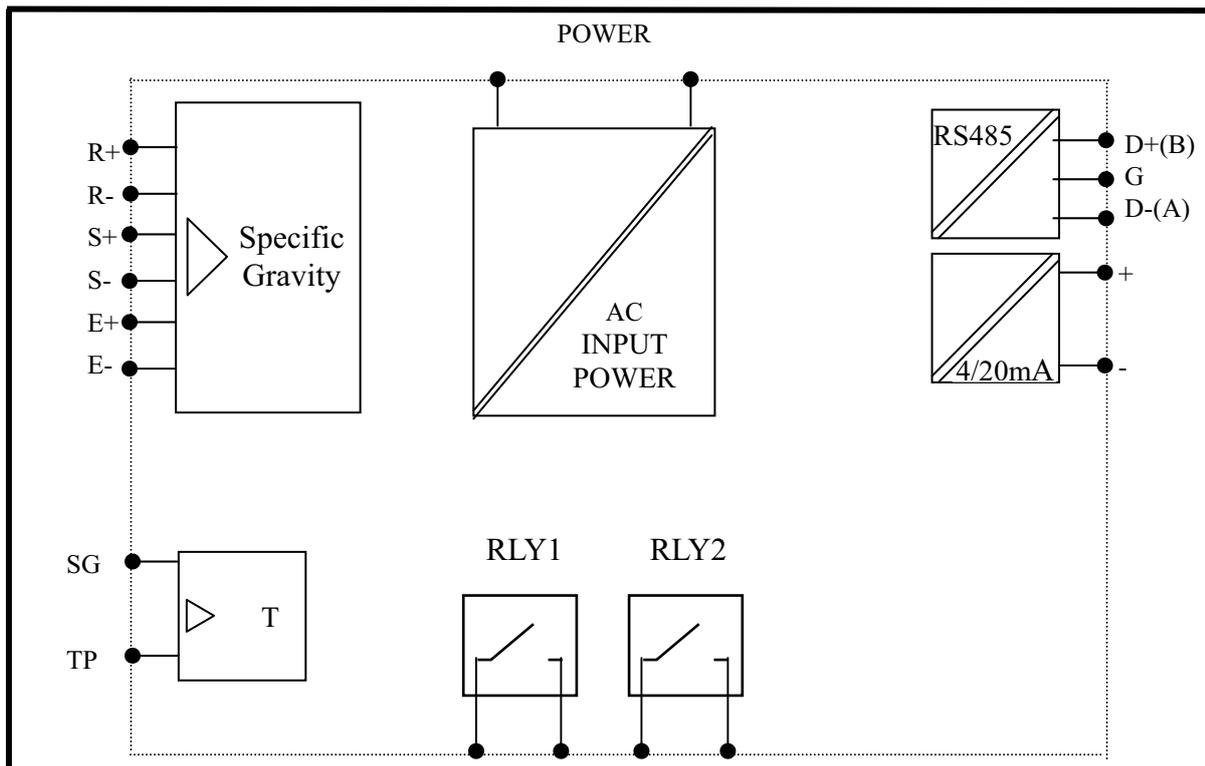
## 3.3 Description of terminal function

0 1 ─┐
0 2 ─┘ **REL1**：External relay terminal first control

0 3 ─┐
0 4 ─┘ **REL2**：External relay terminal second control

0 5 ─┐
0 6 ─┘ **NC**：None contact

0 7 ──── **NC**：None contact
0 8 ──── **100~240AC**：Power supply terminal
0 9 ──── **NC**：None contact
1 0 ──── **100~240AC**：Power supply terminal
1 1 ──── **R+**：The cell connection line: (yellow)。
1 2 ──── **R-**：The cell connection line: (transparent, inner foil wrap)。
1 3 ──── **S+**：The cell connection line: (red)。
1 4 ──── **S-**：The cell connection line: (brown)。
1 5 ──── **E+**：The cell connection line: (orange)。
1 6 ──── **E-**：The cell connection line: (black, outer foil wrap)。
1 7 ──── **SG**：Connect the cell connection line of temperature probe
1 8 ──── **T/P**：Connect the other cell connection line of temperature probe
1 9 ──── **NC**：None contact
2 0 ──── **4~20mA + terminal**：Master measurement current output terminal +, for external recorder or PLC control
2 1 ──── **4~20mA - terminal**：Master measurement current output terminal-, for external recorder or PLC control
2 2 ──── **D+（B）**：D+(B) of RS-485 output
2 3 ──── **G**：GND of RS-485 output
2 4 ──── **D-（A）**：D-(A) of RS-485 output。

| | |
|---|---|
| 01 ─┐ REL1 | yellow R+ ─11 |
| 02 ─┘ | trans.(inner foil wrap) R- ─12 |
| 03 ─┐ REL2 | red S+ ─13 |
| 04 ─┘ | brown S- ─14 |
| 05 ─ NC | orange E+ ─15 |
| 06 ─ NC | black(outer foil wrap) E- ─16 |
| 07 ─ NC | SG ─17 |
| 08 ─ Power(N) | T/P ─18 |
| 09 ─ NC | NC ─19 |
| 10 ─ Power(L) | 4~20mA + ─20 / ─21 |
| | D+ ─22 |
| | G ─23 |
| | D- ─24 |
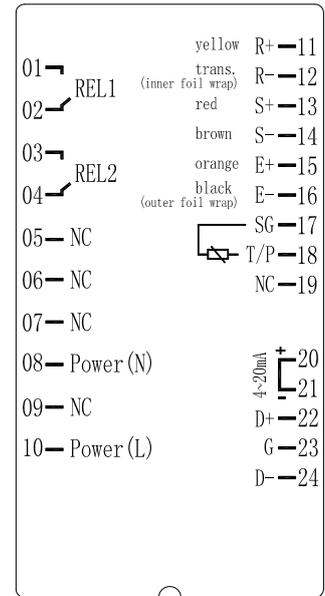
## 3.4 Illustration of electrical connection
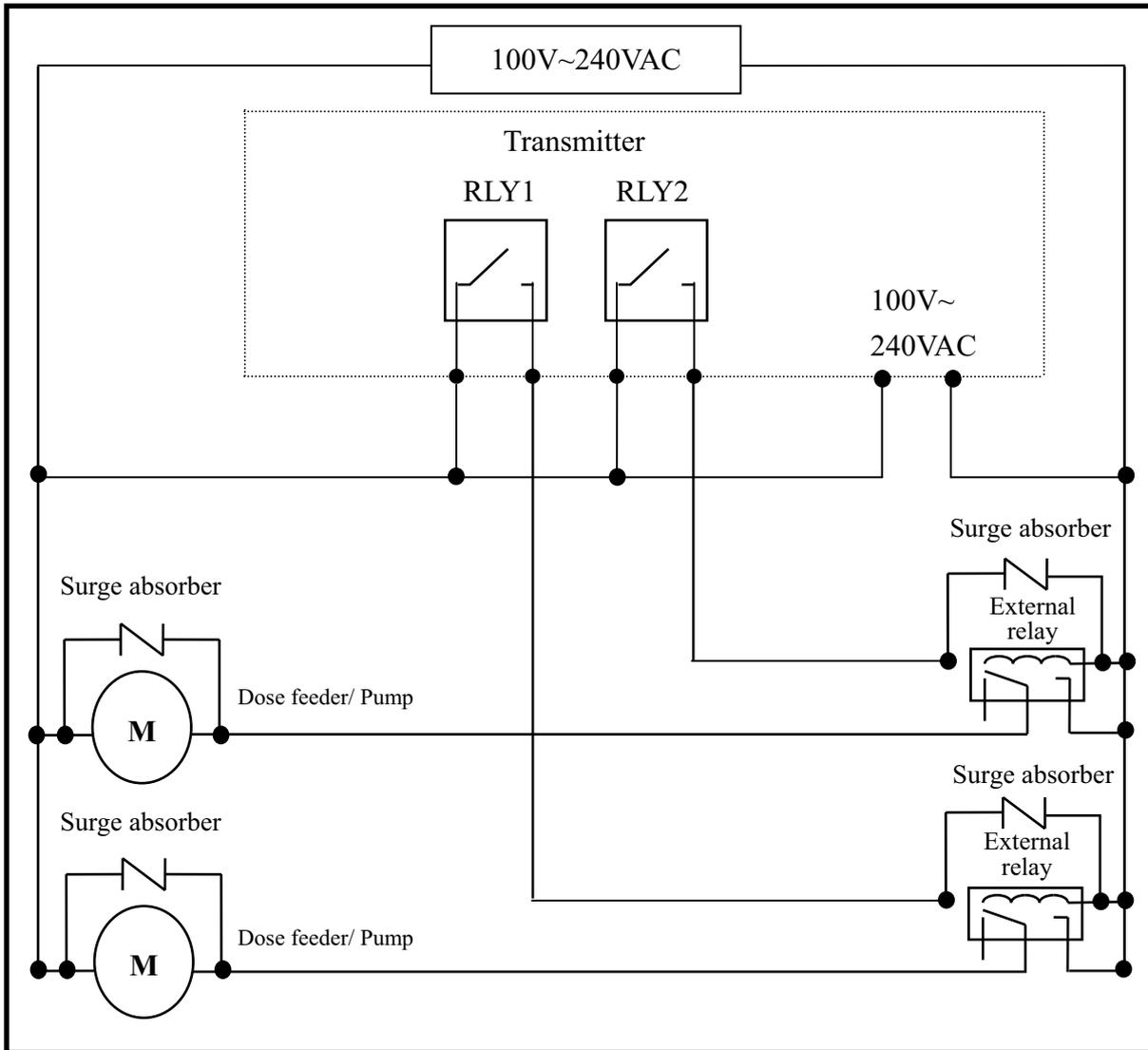


## 3.5 SG load cell wiring
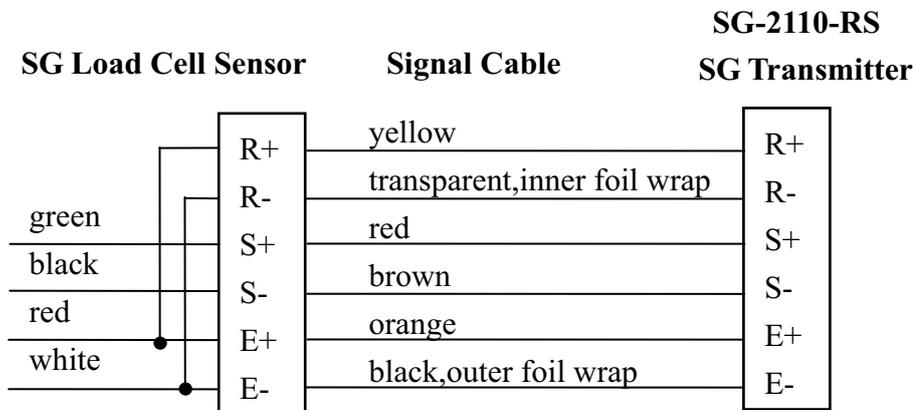
# 4. Configuration:

## 4.1 Illustration of front panel:
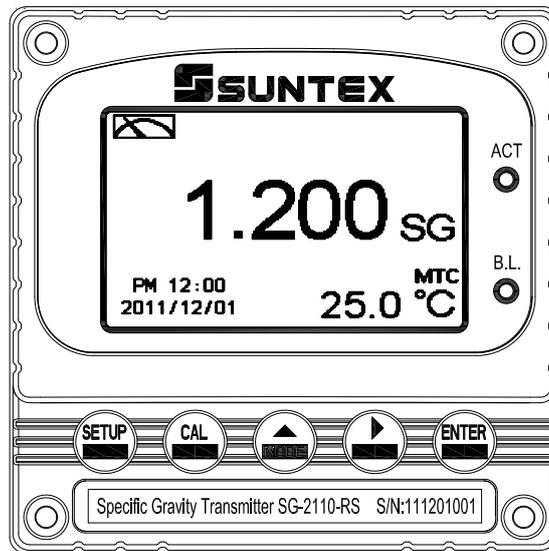


## 4.2 Keypad:

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

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

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

**MODE** ：1.　In the parameter set-up mode and Calibration mode, pressing this key to select leftward or change to another page.
2.　When adjusting value, press this key to increase the value.

▶ ：1.　In the parameter set-up mode and Calibration mode, pressing this key to select rightward or change to another page.
2.　When adjusting value, press this key to decrease the value.

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

## 4.3 LED indicators:

**ACT**：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 go out as the change of environmental brightness.

# 5. Operation

### 5.1 Measurement mode:

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

### 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 press to 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. In the measurement mode, press 🔘 continuously for 2 seconds to check Event Logbook, press 🔘 again to back to measurement mode.
3. In the measurement mode, press 🔘 continuously for 2 seconds to switch display mode from normal display to real-time chart mode or to trace mode.

### 5.5 Reset:

#### 5.5.1 Master reset:

Measurement mode: SG
SG temperature compensation: OFF
SG temperature compensation coefficient: 8.0/10000
Temperature compensation: MTC 25°C
Relay 1：High point alarm: AUTO, SP1= 1.300 SG, Hys= 0.010 SG
Relay 2：Low point alarm: AUTO, SP2 = 1.100 SG, Hys= 0.010 SG
Analog current output (SG/°Bé/ppt/%): 4~20 mA, 1.100~1.300 SG
Date & Time：2011/1/1    00:00:00
RS-485： RTU, Even, 19200, ID:001
Digital Filter: 5
Display backlit: OFF
Code: OFF
Contrast: 0
Auto back: Auto, 3 minutes

#### 5.5.2 Calibration reset:

Cal Time: 2011/01/01
Cal point: Zero
Cal Type: No Cal
Calibration value: Cell Constant, 11383
Auto back: Auto, 3 minutes

Note: The factory default of calibration presetting is "No Cal". It means that the user has not calibrated the SG sensor with the transmitter yet. After every calibration, the transmitter shows the plummet calibration point, calibration mode and calibration value. If have not done the calibration, the transmitter will apply preset plummet cell factor as the calculation reference.

# 6. Measurement display mode

### 6.1 Normal mode

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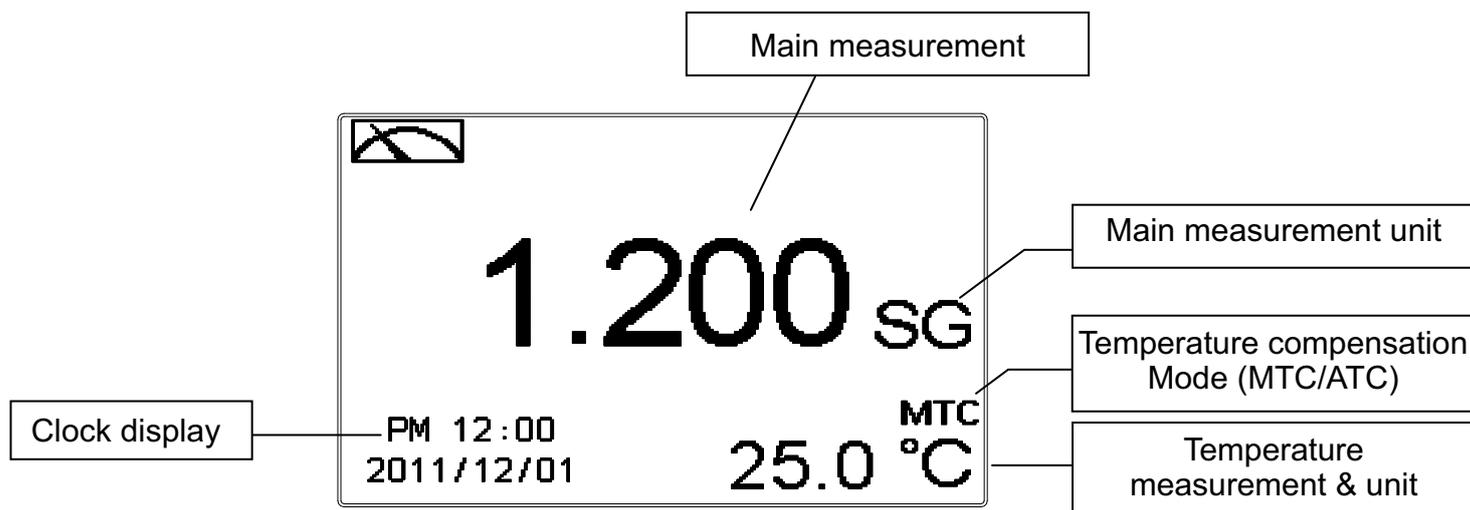
## 6.2 Real-Time Chart mode

Real-time chart mode is for dynamic display of real-time graphics. The duration is about three minutes of the recent changes in measured values of the curve. Users can set the mode to its corresponding SG, °Bé, Sal., and Conc. 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).
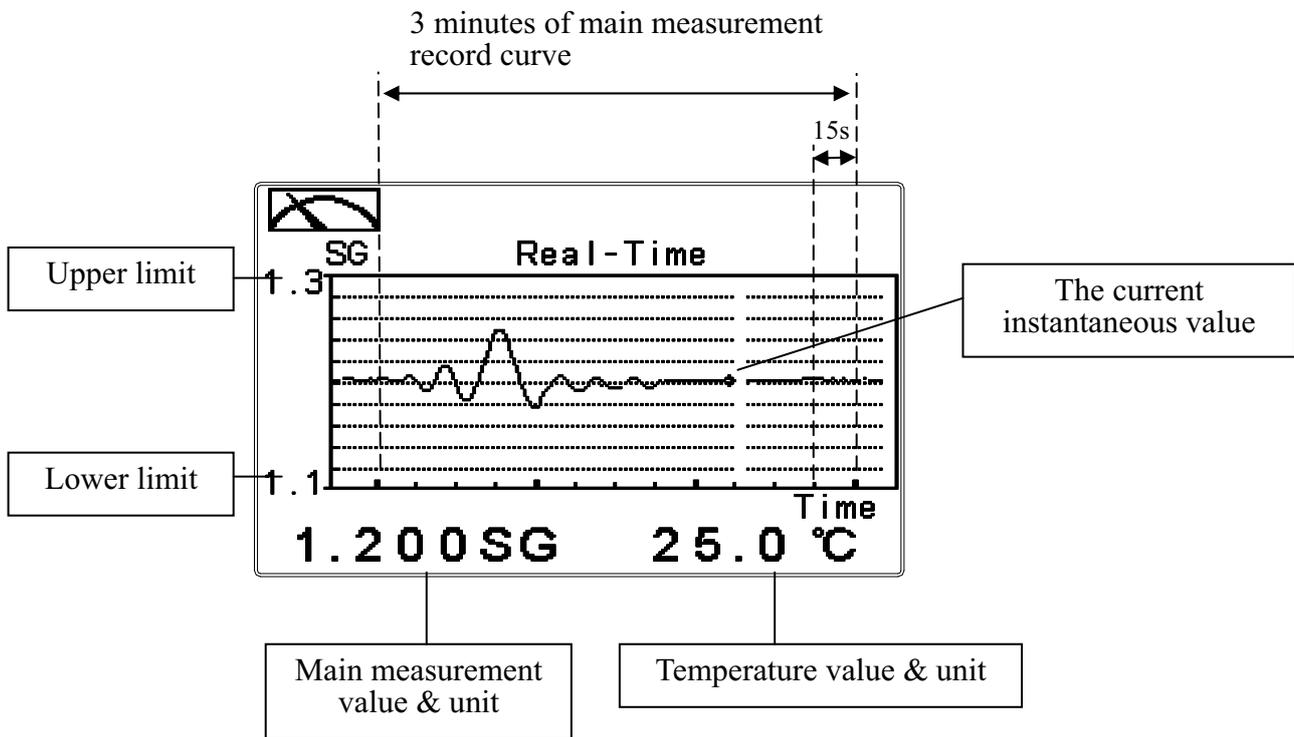
## 6.3 Trace mode

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 SG, °Bé, Sal., and Conc. 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).



The mean value of the T/60 interval

The max. value of the T/60 interval

Trend recording interval
Whole Time(60 data record sets)

T/12

Upper limit

Lower limit

The min. value of the T/60 interval

The latest set of record shown on the right sector

Record duration(T), the negative sign is to mean the record time has past

Main measurement value & unit

Temperature value & unit
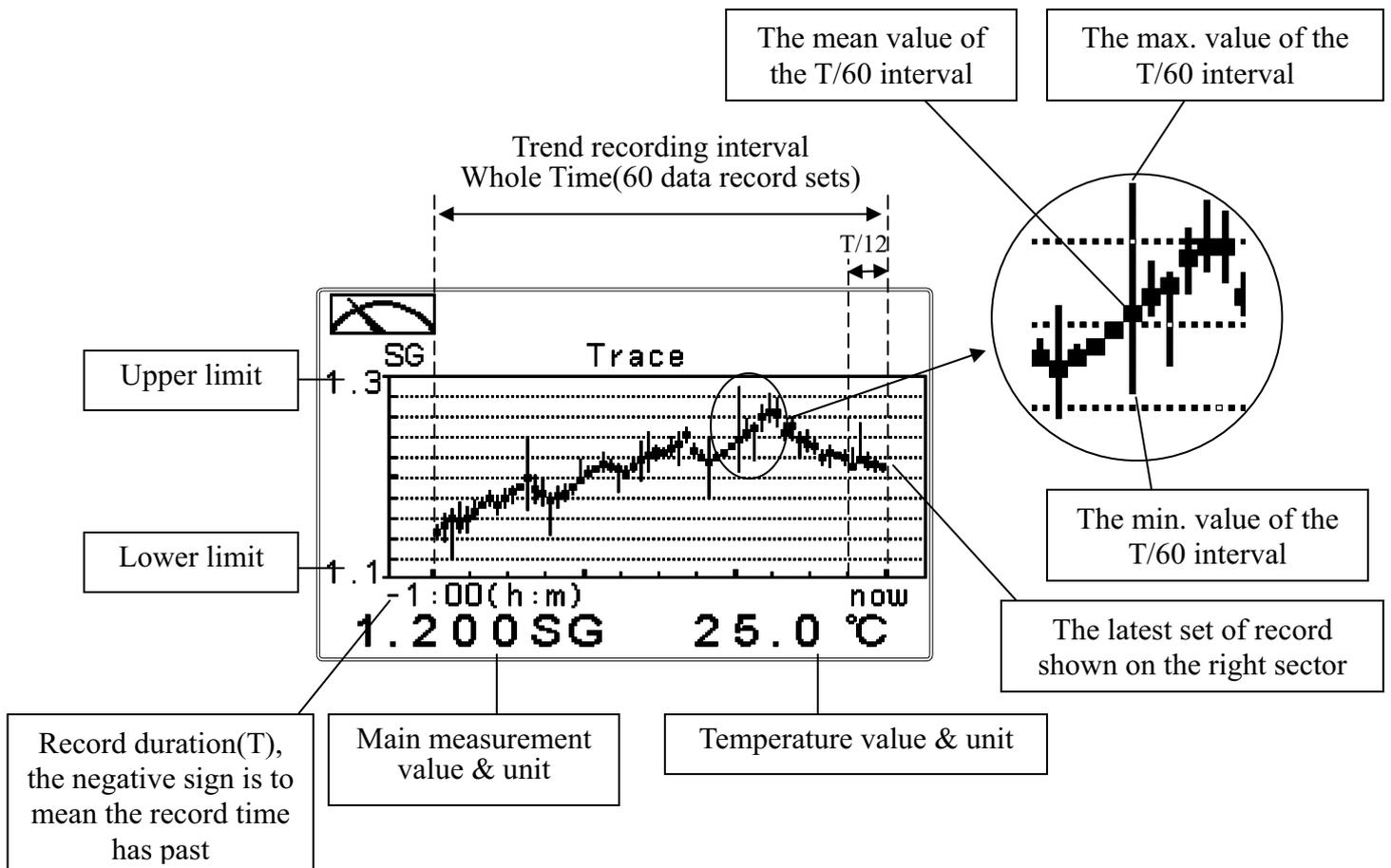
## 6.4 Warning symbols and text

1. When Relay 1 which is set in high setting point is in action, the display shows and twinkles the description, "REL 1_Hi", and ACT indicator LED lights up. When Relay 1 which is set in low setting point is in action, the display shows and twinkles the description, "REL 1_Lo", and ACT indicator LED lights up.

2. When Relay 2 which is set in high setting point is in action, the display shows and twinkles the description, "REL 2_Hi", and ACT indicator LED lights up. When Relay 2 which is set in low setting point is in action, the display shows and twinkles the description, "REL 2_Lo", and ACT indicator LED lights up.
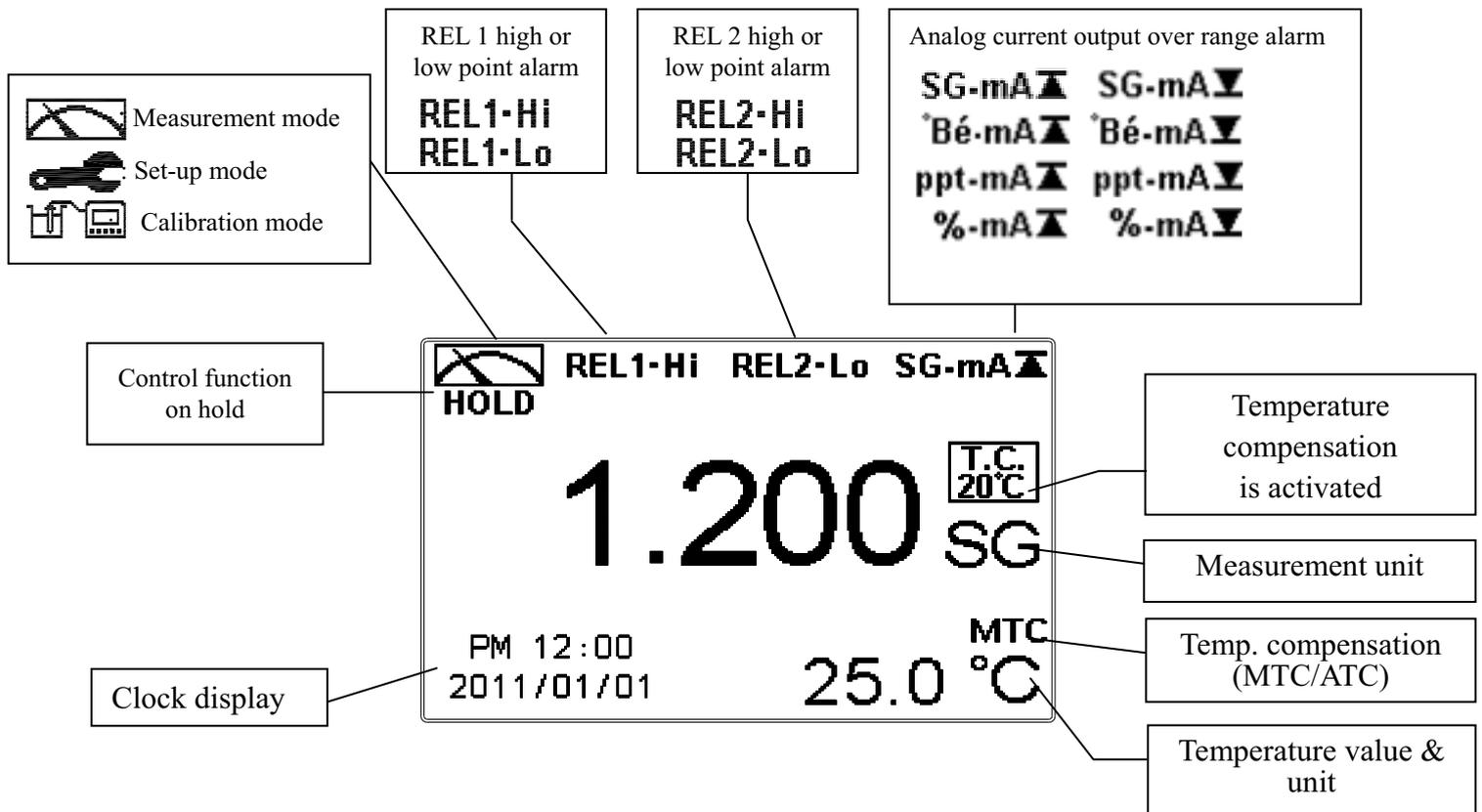


**Note: HOLD warning symbol appears in the cleaning status, set-up mode, and calibration mode. Under hold status, the relative display and output are as follows:**
1. Relay 1, 2 will cease from action. When it is form hold status of cleaning to enter into the set-up menu or calibration menu, the transmitter will cease the cleaning function.
2. The last signal output value of analog current output is kept in the reading before HOLD status.
3. The last signal output value of RS-485 interface is kept in the reading before HOLD status.

# 7. Settings

## Block diagram of settings-part 1

Overview

Setting Mode

Concentration Mode Only

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Auto Return Setting | Code Setting | Language Setting | Mode Setting | Concentration SG Convertion | Compensation SG temp. cell constant setting | Product Adj. Setting | Temperature Setting | Relay1 Setting | Relay2 Setting |

Input Code

English | Tradition al Chinese | Simplifie d Chinese

Select SG/Be/ppt/% Measurement

Point Setup | Table Table setup

OFF | ON

Modify reading

Select measuremen t method

Activate Relay 1 or not

OFF | ON

New Code

Digital Mode | Chart Mode | Trace Mode

Default Buit-In Table | Set Self-define Table

Set comp. value

MTC Manuual | ATC Auto

Select relay1 as Hi or Lo

Set Max Value | Set Max Value

Set temp. | Adjust temp.

Input Relay1 Set point

Set Min. Value | Set Min. Value

Input Relay1 Hys. Value遲

Set time Interval

Relay1 Test

←    :  MODE

→    :  ▶

↓    :  ENTER

Back to previous class/
action:          SETUP

# Block diagram of settings-part 2

Connected with previous page

Connected with previous page

| Relay1 Setting | Relay2 Setting | SG/Be/ppt/% Analog output | Clock Setting | RS-485 Setting | Digital Filter Setting | Backlight Setting | Contrast Setting | Logbook | Auto Return Setting | Code Setting |

Relay2 Setting:
- Activate Relay2 or not
- Select Relay2 as Hi or Lo
- Input Relay2 Setpoint
- Input Relay2 Hys. Value
- Relay2 Test

SG/Be/ppt/% Analog output:
- Select 0/20or 4/20mA analog output mode
- Input 0 or 4mA corresponding measurement value
- Input 20mA corresponding measurement value

Clock Setting:
- Set year
- Set date
- Set time

RS-485 Setting:
- Select RTU or ASCII
- Select parity
- Set baud rage
- Set ID

Digital Filter Setting:
- Input numbers of sample

Backlight Setting:
- Select backlight mode
  - Auto
    - Input brightness
    - Input Sensibi-lity
  - ON
    - Input brightness
  - OFF

Contrast Setting:
- Input display contrast level

Logbook:
- Review historical actions

Auto Return Setting:
- Select Auto-return mode
  - Auto Exit
    - Input auto return timer value
  - Manual Exit

Legend:
← : MODE
→ : (play button)
↓ : ENTER

Back to previous class/action : SETUP

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## 7.1 Entry of set-up menu

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

```
          ┌─────────────────────────────┐
          │     "Measurement (Mode)"     │◄──────────┐
          └─────────────────────────────┘           │
                        │      Press 🔘 or 🔘        │
                        ▼                             │
          ┌─────────────────────────────┐            │
          │          Overview            │            │
          │ 1.Mode:Specific Gravity      │            │
          │ 2.Compensation:OFF           │            │
          │ 3.Product Adjust:0.000SG     │            │
          │ 4.Temp:MTC,Setting:25.0℃     │            │
          │ 5.Rel1:Hi,SP:1.300,Hys:0.010SG│           │
          │ 6.Rel2:Lo,SP:1.100,Hys:0.010SG│           │
          │ 7.SG_mA:4-20mA,1.100-1.300SG │            │
          │ [SET:Back][▲:▲][▶:▲][ENT:Enter]│          │
          └─────────────────────────────┘            │
                        │      Press 🔘 or 🔘        │
                        ▼                             │
          ┌─────────────────────────────┐            │
          │          Overview            │            │
          │ 8.RS485:RTU,Even,19200,1     │            │
          │ 9.Digital Filter:5           │            │
          │ 10.BL:OFF                    │            │
          │ 11.Contrast:0                │            │
          │ 12.Return:Auto,03m:00s       │            │
          │                              │            │
          │ [SET:Back][▲:▲][▶:▲][ENT:Enter]│          │
          └─────────────────────────────┘            │
                        │   Press 🔘 to confirm it    │
                        ▼                             │
          ┌─────────────────────────────┐            │
          │      Enter set-up menu       │────────────┘
          └─────────────────────────────┘
```

Press ⬤(ENTER) for confirmation

Press 🔘 or 🔘

Press ⬤(SETUP)

## 7.2 Security code of settings

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

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



Press ⊙ to confirm it.

When a wrong password is keyed in, the display shows "Error 5", press ⊙ to re-key in it, or press ⊙ to exit.

The first '0' of digits '0000' start to twinkle. Press ⊙ or ⊙ to adjust the value, and then press ⊙ to confirm it and continually key in the next digit, and so on.

Press ⊙ to confirm it.

Press ⊙ or ⊙

(Select to turn on or turn off code protection function. If you select turn on, please key in a new code. There will be a code requirement showing in display when you re-enter to the setup mode. Key in the correct password to enter into setup mode.)

Press ⊙ to confirm it.

Key in new password

Press ⊙ to confirm it.

Enter "Language" Setup

## 7.3 Language

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



Press (ENTER) to confirm it.



Press (MODE) or (▲) to select language type



Press (MODE) or (▲) to select language type



Press (ENTER) to confirm it.

Enter "Measurement Mode" Setup

## 7.4 Mode

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



Press ⏎ to confirm it.



Press ⏏ or ⏺ to select SG measurement mode.

Press ⏎ to confirm it.



Select no to maintain the original setting and save the record. Press ⏎ to confirm it.



Press ⏎ to confirm it.

Select YES, press ⏎

Press ⏏ or ⏺ to input the upper limit.

Press ⏎ to confirm it.

Press ⏎ to confirm it.

Press ⏏ or ⏺ to input the lower limit.

Press ⏎ to confirm it.

To set record duration T, press ⏺ or ⏏ to adjust the hour value, press ⏎ to confirm and move to minute adjustment.

Press ⏎ to confirm it.

Enter "Temperature Compensation" Setup

## 7.4.2 Enter setup of "Mode", select °Bé measurement mode and select the display mode.



**Note:** Relation of Baume and Specific Gravity at 20°C under temperature compensation:

(1) When the SG of sample solution is higher than it of water:
$$°Bé = 145.0 - (145.0/SG)$$

(2) When the SG of sample solution is higher than it of water:
$$°Bé = (140.0/SG) - 130.0$$
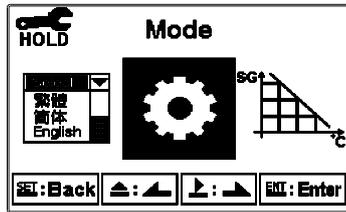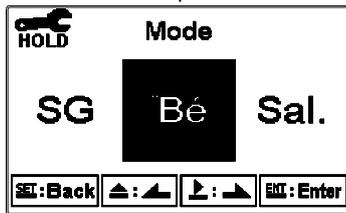
Press **ENTER** to confirm it.

Press ⬇ or **MODE** to select °Bé measurement mode.

Press **ENTER** to confirm it.
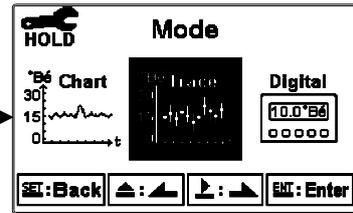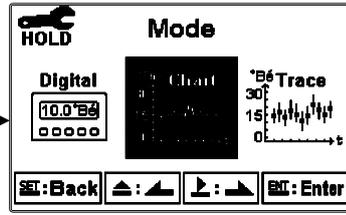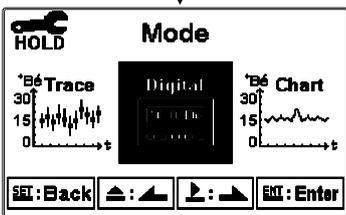
Select no to maintain the original setting and save the record. Press **ENTER** to confirm it.

Press **ENTER** to confirm it.

Select YES, press **ENTER**

Press ⬇ or **MODE** to input the upper limit.
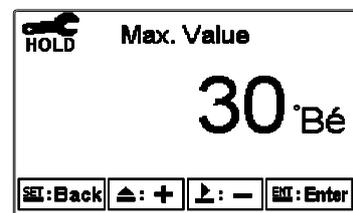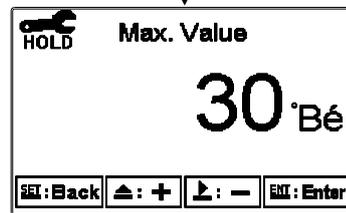
Press ⬇ or **MODE** to input the lower limit.

Press **ENTER** to confirm it.

Press **ENTER** to confirm it.

Press **ENTER** to confirm it.
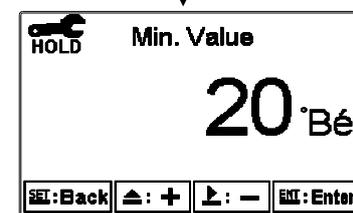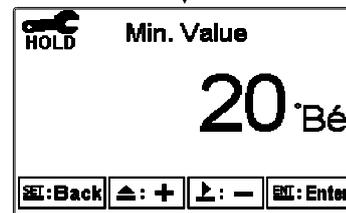
Press **ENTER** to confirm it.

To set record duration T, press **MODE** or ⬇ to adjust the hour value, press **ENTER** to confirm and move to minute adjustment.

Press **ENTER** to confirm it.

Enter "Temperature Compensation"

7.4.3 Enter setup of "Mode", select Sal.(Salinity) measurement mode and select the display mode.



Press ⏎ to confirm it.

Press 🔼 or MODE to select Sal. measurement mode.

Press ⏎ to confirm it.

Press ⏎ to confirm it.

Select no to maintain the original setting and save the record. Press ⏎ to confirm it.

Press 🔼 or MODE to input the upper limit.

Select YES, press ⏎

**Max. Value**

**90** ppt

Press ⏎ to confirm it.

Press ⏎ to confirm it.

**Max. Value**

**90** ppt

Press 🔼 or MODE to input the lower limit.

**Min. Value**

**30** ppt

**Min. Value**

**30** ppt

Press ⏎ to confirm it.

To set record duration T, press MODE or 🔼 to adjust the hour value, press ⏎ to confirm and move to minute adjustment.

**Trace Time**

**001:00** h:m

Press ⏎ to confirm it.

Enter "Temperature Compensation" Setup

7.4.4 Enter setup of "Mode", select Conc.(Concentration)measurement mode and select the display mode.



Press ⏎ to confirm it.

Press ▲ or 🔘 to select Conc. measurement mode.

Press ⏎ to confirm it.

Press ⏎ to confirm it.

Press ⏎ to confirm it.

Press ▲ or 🔘 to input the upper limit.

Press 🔘 or ▲ to select if you want to delete the previous trend record.

Press ▲ or 🔘 to input the lower limit.

Select YES, press ⏎

Press ⏎ to confirm it.

Press ⏎ to confirm it.

Press ⏎ to confirm it.

To set record duration T, press 🔘 or ▲ to adjust the hour value, press ⏎ to confirm and move to minute adjustment.

Press ⏎ to confirm it.

Enter "Temperature Compensation" Setup

25

## 7.5 Concentration/SG conversion table (Conc. mode only)

Enter setup of Concentration/SG conversion table function. Users can choose to set concentration of point(Point). The setting range is from 2 to 10 point(the default is 10 points). Or directly choose to enter the concentration/SG setting table, you may select built-in conversion table(Default Table) or select self-define concentration/SG table(Set Table) to create your own table. Both two tables can be modified and set concentration and specific gravity value. After any of the concentration/SG table is set, it will be saved as self-define table(Set Table), and the built-in table(Default Table) will not be changed. After the new table is done, the transmitter will calculate the slope and intercept through linear regression analysis, and it will also show the R2 determination coefficient value to provide users to estimate the suitability of the concentration/SG table. It is recommended to create a conversion table with small-scale range of concentration to make good linear relationship. Note: The built-in conversion table(Default Table) is for sulfuric acid under 27.7~33.2% at temperature 20°C.

Press **ENTER** to confirm it.

Press ⬇ or **MODE** to select "Point" or "Table".

Press **ENTER** to confirm it

Press ⬇ or **MODE** to set point of concentration.

Press **ENTER** to confirm it.

Press ⬇ or **MODE** to select "Default Table" or "Set Table".

Press **ENTER** to confirm it.

**Table Setting**

| % | SG | % | SG |
|------|-------|------|-------|
|  |  | 30.8 | 1.225 |
| 28.3 | 1.205 | 31.4 | 1.230 |
| 28.9 | 1.210 | 32.0 | 1.235 |
| 29.6 | 1.215 | 32.6 | 1.240 |
| 30.2 | 1.220 | 33.2 | 1.245 |

>Setting Completed

Press ⬇ or ⬆ to select one of concentration/SG, press **ENTER** to enter its parameter setting. Select "Setting Completed" to finish the setting.

Press **ENTER** to confirm it.

Do you want to change the data of Setting Table?

YES　NO

Press ⬇ or ⬆ to confirm if you want to modify the table.

Yes

No

**Overview**
1. Mode:Concentration
2. Slope:0.0081
3. Intercept:0.9763
4. Determination(R2):0.9999
5. Compensation:OFF
6. Product Adjust:0.0%
7. Temp:MTC,Setting:25.0°C

The display shows the result of linear regression analysis.

Enter "Temp. Compensation" Setup

## 7.6 Compensation

Enter setup of compensation mode, and select compensation ON or OFF. If select to activate the temperature compensation function, users may set compensation coefficient according to the character of sample solution. It compensates the measurement at 20°C. The same solution has different SG value under different concentration, and the different SG range has different compensation coefficient.

Ex: Certain solution's coefficient under different SG range showed as following table.

| SG range | Compensation coefficient | SG range | Compensation coefficient |
|---|---|---|---|
| 1.151~1.200 | 7.0/10000 | 1.561~1.700 | 10.0/10000 |
| 1.221~1.420 | 8.0/10000 | 1.701~1.770 | 11.0/10000 |
| 1.421~1.560 | 9.0/10000 | 1.771~1.840 | 12.0/10000 |

The formula of compensation coefficient is as follows:

| $SG_{20}$ | SG at 20°C | Formula 1: $SG_{20} = SG_T + [(T-20) \times C]$ |
|---|---|---|
| $SG_T$ | SG at T°C | |
| $T$ | Measured solution temperature | Formula 2: $C = (SG_{20} - SG_T)/(T-20)$ |
| $C$ | Temperature compensation | |

For example, if certain liquid's SG value is 1.300 at 20°C, and it's SG value is 1.292 at 30°C. Then, the compensation coefficient can be calculated as:

*C =(1.300-1.292)/(30-20). C = 8.0/10000*

**Note:** The default compensation coefficient is 8.0/10000.

The display shows $\boxed{\begin{smallmatrix}T.C.\\20°C\end{smallmatrix}}$ under measurement mode to represent the compensation function has been activated. (Please see ch6.4)
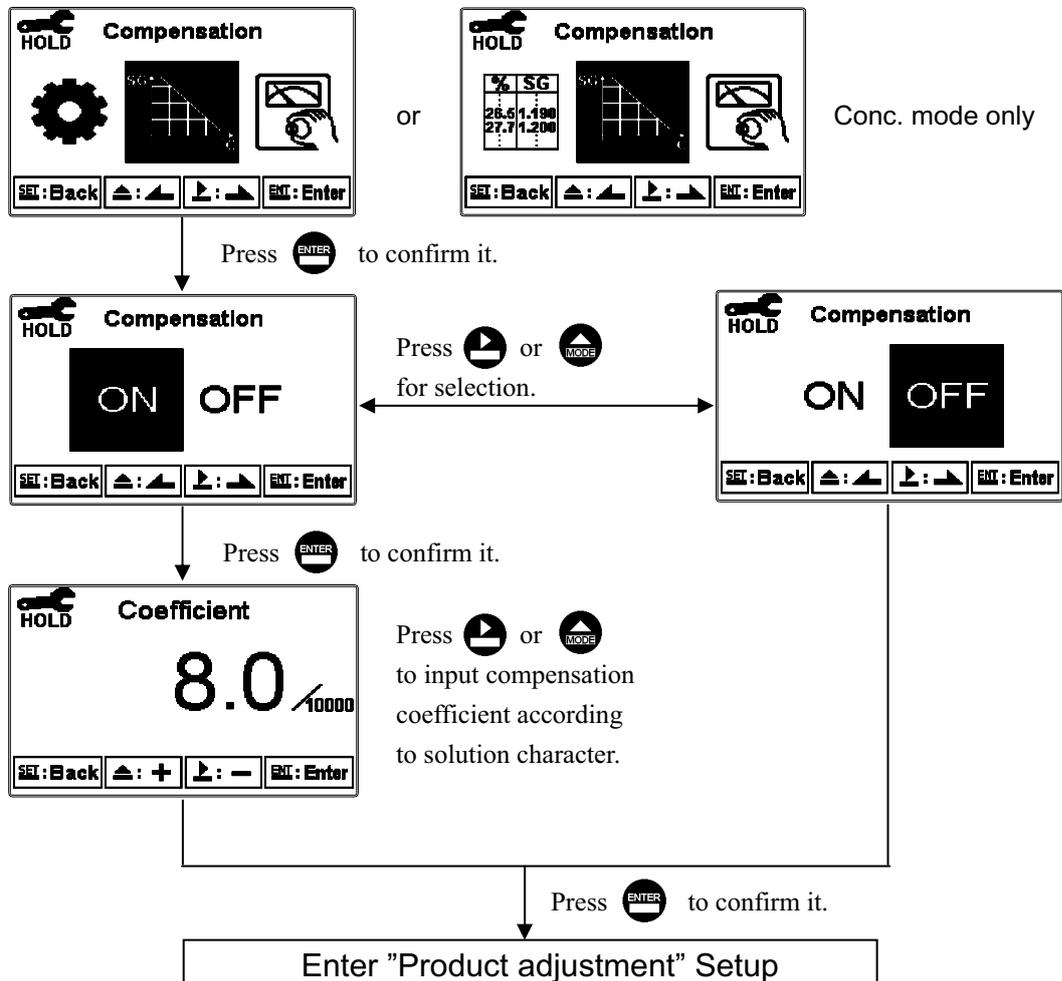
## 7.7 Product Adjustment

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 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 SG unit. (Please see Ch 6.4)

Press ENTER to confirm it

You may compare the SG reading with that of taking the sample out and testing in the lab. Press MODE or ▲ to adjust the SG value. You may also adjust measurement under other mode through the same procedure.

Press ENTER to confirm it.

Enter "Temperature" Setup
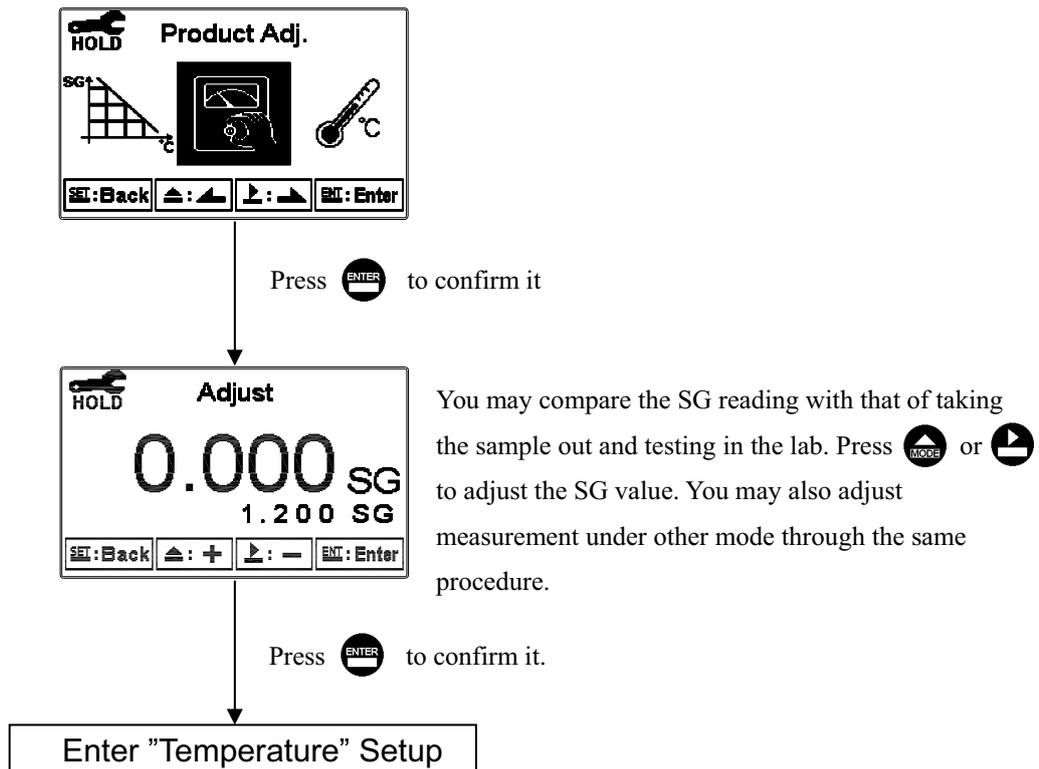
## 7.8 Temperature

Enter Temperature setup menu, select ATC for auto temperature compensation or select MTC for manual temperature compensation.



Press ENTER to confirm it.



Press MODE or ▲ for selection



Press ENTER to confirm it.



If necessary, compare with the actual temperature value tested by standard thermometer.
Press MODE or ▲ to input the modified value.



Use standard thermometer to test the actual temperature of the solution, and press MODE or ▲ to input the correct temperature value.
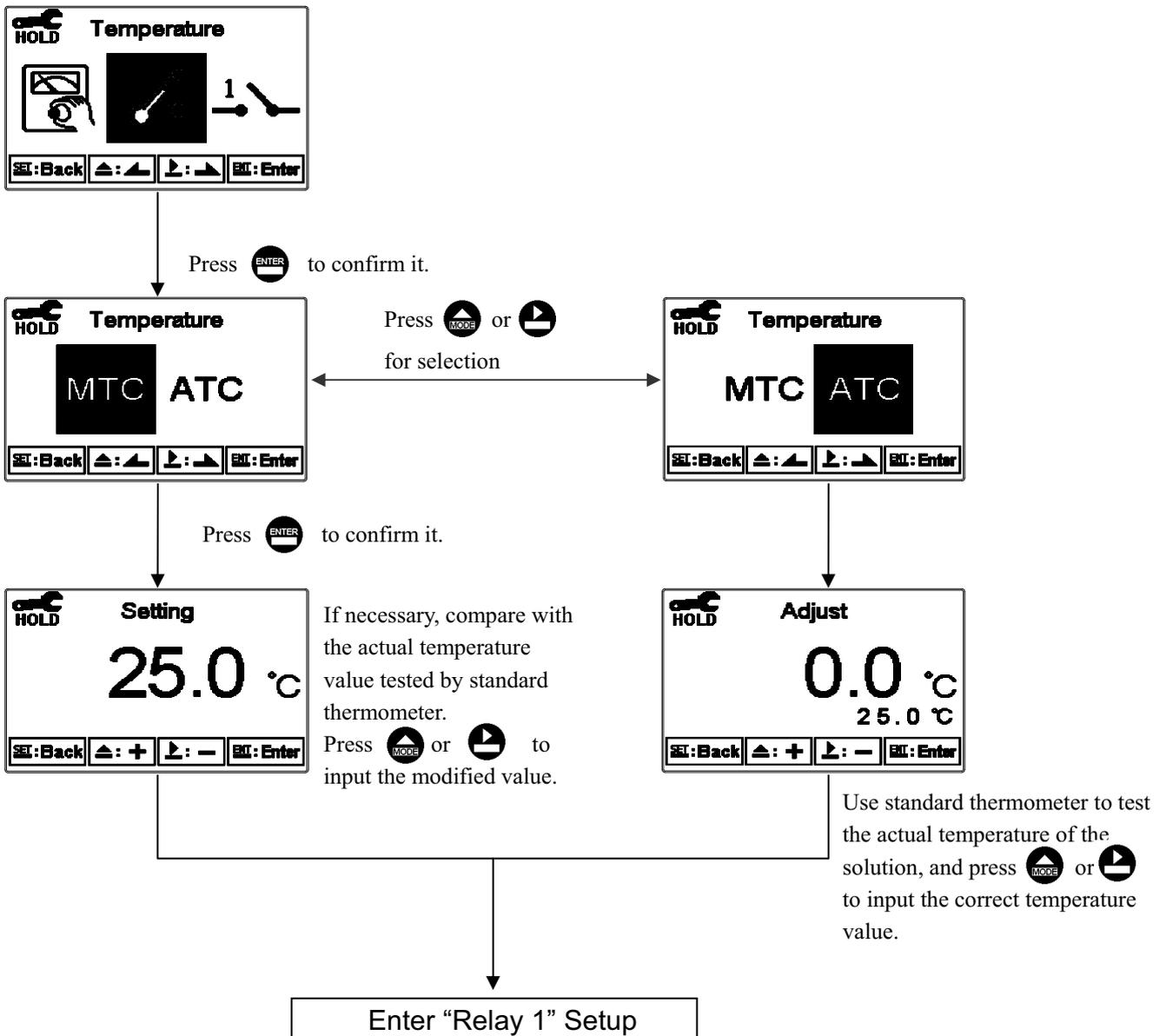
Enter "Relay 1" Setup

### 7.9 Relay 1

Enter setup of Relay 1. Select the item to turn on or turn of the relay 1 function. If you select to turn on the relay 1, then select for using relay 1 as "Hi set-point" alarm or "Low set-point" alarm. Set the value of set-point (SP) and hysteresis (Hys.). The meaning and relation of each parameter please refer to the right side illustration.(Hi point alarm setting)
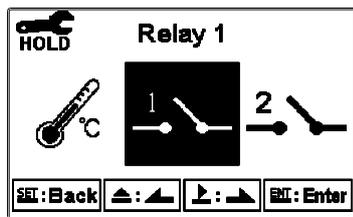


Press ENTER to confirm it.

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

Press ENTER to confirm it.
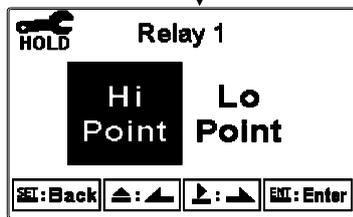
Press MODE or ▼ to select use REL1 as Hi point or Lo point alarm.

Press ENTER to confirm it.
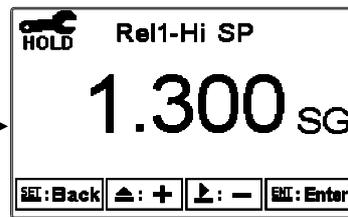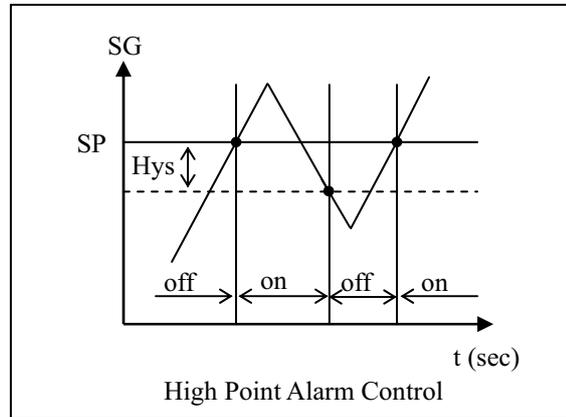
High Point Alarm Control

Press MODE or ▼ to adjust set-point(SP) value
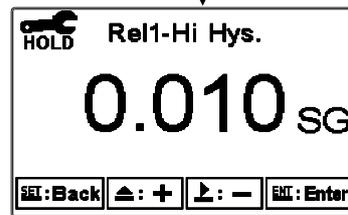
Press ENTER to confirm it.

Press MODE or ▼ to adjust Hysteresis value (Hys.).
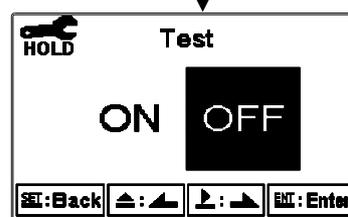
Press ENTER to confirm it.

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

Press ENTER to confirm it.

Enter "Relay 2" setup

## 7.10 Relay 2

Enter setup of Relay 2. Select the item to turn on or turn of the relay 2 function. If you select to turn on the relay 2, then select for using relay 2 as "Hi set-point" alarm or "Low set-point" alarm. Set the value of set-point (SP) and hysteresis (Hys.). The meaning and relation of each parameter please refer to the right side illustration.(Hi point alarm setting)



Press <kbd>ENTER</kbd> to confirm it.



Press <kbd>MODE</kbd> or <kbd>▲</kbd> to select to activate REL2 or not. If not, the guide menu goes to setup of Analog.



Low Point Alarm Control

Press <kbd>ENTER</kbd> to confirm it.



Press <kbd>MODE</kbd> or <kbd>▲</kbd> to select use REL2 as Lo point or Hi point alarm.

Press <kbd>ENTER</kbd> to confirm it.



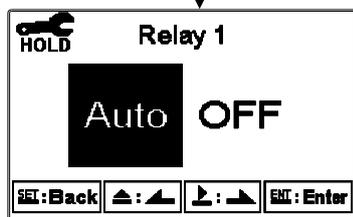Press <kbd>MODE</kbd> or <kbd>▲</kbd> to adjust set-point(SP) value

Press <kbd>ENTER</kbd> to confirm it.



Press <kbd>MODE</kbd> or <kbd>▲</kbd> to adjust Hysteresis value (Hys.).

Press <kbd>ENTER</kbd> to confirm it.



Press <kbd>MODE</kbd> or <kbd>▲</kbd> to select to activate a test of REL2 or not. If "ON", the relay 2 is in action, and the "ACT" indication light will light up.

Press <kbd>ENTER</kbd> to confirm it.

Enter "Analog output" setup

### 7.11 Analog output(SG)

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

Press ENTER to confirm it.

Press ▲ or MODE to select to current output range, 0-20mA or 4-20mA.

Press ENTER to confirm it.

Press ENTER to confirm it.

Press ▲ or MODE to set the lower limit of value relative to 4.0mA output signal. At the time the current output maintains at 4mA

Press ▲ or MODE to set the lower limit of value relative to 0.0mA output signal. At the time the current output maintains at 0mA

Press ENTER to confirm it.

Press ▲ or MODE to set the upper limit of value relative to 20.0mA output signal. At the time the current output maintains at 20mA

Press ENTER to confirm it.

Enter "Date/Clock" Setup

**7.12 Date/Time(Clock)**

Enter setup of Date/Time(Clock). Set the "Year", "Month", "Date", "Hour", and "Minute" time. Note: The transmitter may keep the clock in operation even when encountering power failure. Only when the inner battery is out of power, the clock may stop operation. Then, please replace the 3V CR2025 Li batter inside the transmitter.



Press ⏎ to confirm it.

Press 🔽 or 🔼 to set the year.

Press ⏎ to confirm it.

Press 🔽 or 🔼 to set the month part, and press ⏎ to adjust the date part.

Press ⏎ to confirm it.

Press 🔽 or 🔼 to set the hour part, and press ⏎ to adjust the minute part.

Press ⏎ to confirm it.

Enter " RS-485" Setup
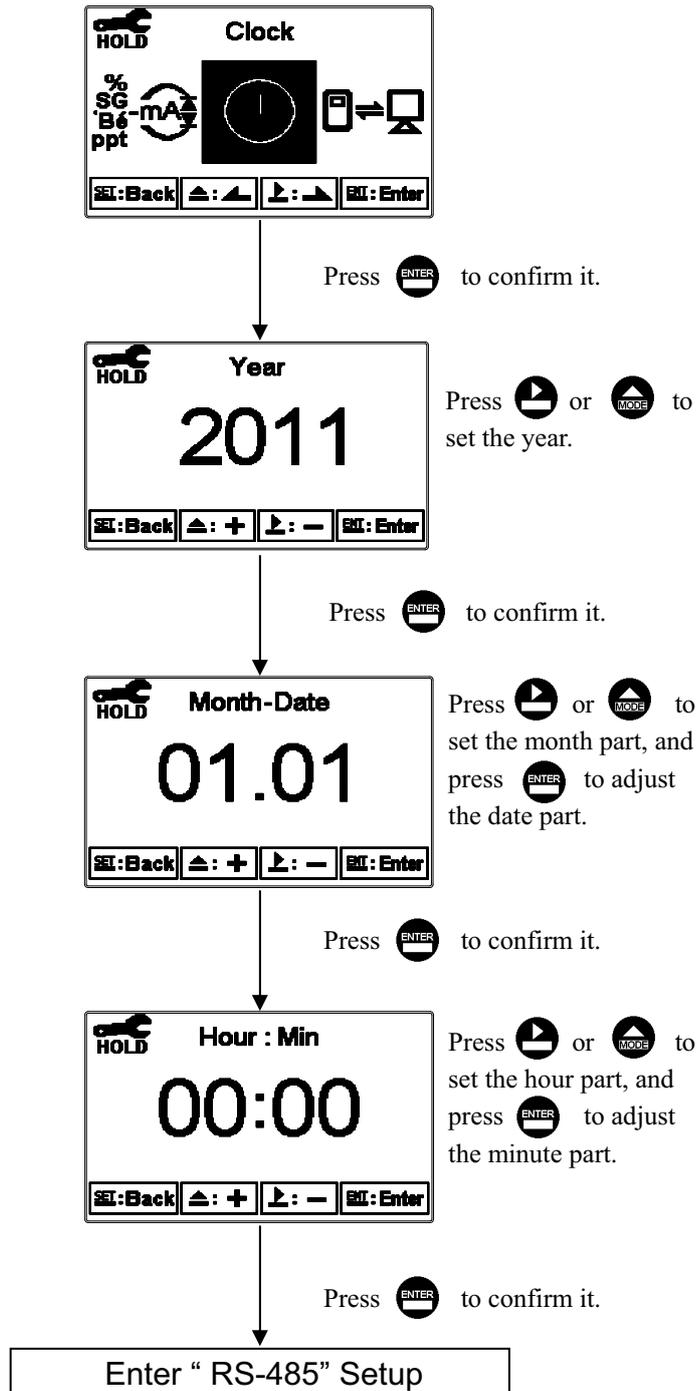
### 7.13 RS485 communication

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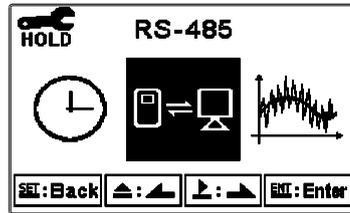


Press ⊙ to confirm it.
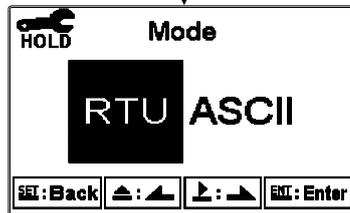


Press ⊿ or ⬛ to select RTU or ASCII mode.

Press ⊙ to confirm it.
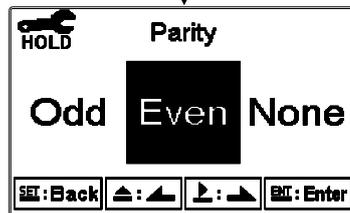


Press ⊿ or ⬛ to select Even, or Odd, or None for parity check.

Press ⊙ to confirm it.
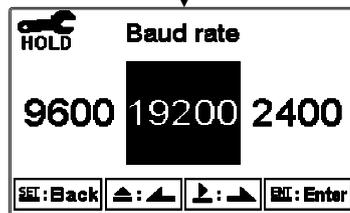


Press ⊿ or ⬛ to select 2400, or 4800, or 9600 for baud rate.

Press ⊙ to confirm it.
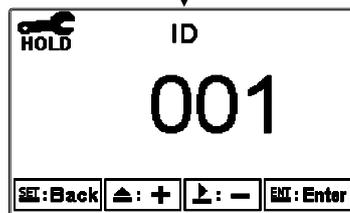


Press ⊿ or ⬛ to set the ID number of the transmitter. The valid value is from 1 to 247.

Press ⊙ to confirm it.

| 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 sample to be averaged each time to become a reading which is gradually counted in order to increase the stability of measurement.



Press [ENTER] to confirm it.

Press or [MODE] to set the number of sample to be averaged.

Press [ENTER] to confirm it.

Enter "Back Light" Setup
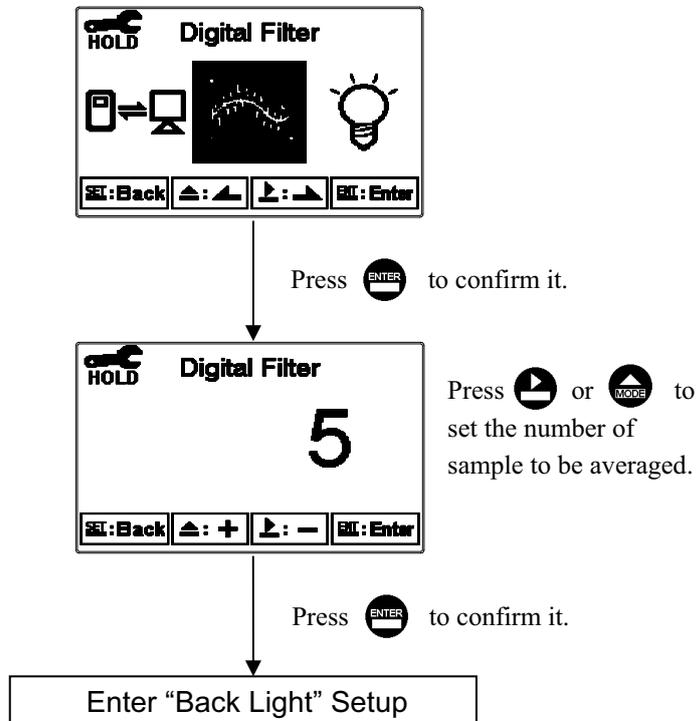
### 7.15 Backlight settings

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

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

Press ENTER to confirm it.

Press MODE or ▲ to select backlight mode

Press MODE or ▲ to select backlight mode

Press ENTER to confirm it.

Press ▲ or MODE to select -2, -1, 0, 1, 2, five Backlit Brightness levels

Press ▲ or MODE to select -2, -1, 0, 1, 2, five Backlit Brightness levels

Press ENTER to confirm it.

Press ENTER to confirm it.

Press ▲ or MODE to select -2, -1, 0, 1, 2, five Backlit sensitization levels.

Press ENTER to confirm it.

Press ENTER to confirm it.

Press ENTER to confirm it.

Enter "Contrast" Setup

## 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, low to high)

Press **ENTER** to confirm it.

Press or to select display contrast level.

Press **ENTER** to confirm it.

Enter "Logbook" Setup
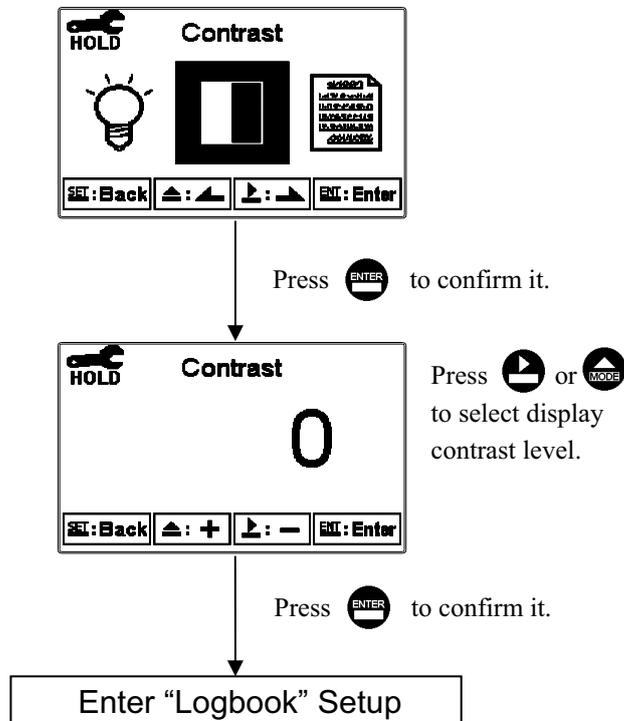
## 7.17 Logbook

Enter setup of Logbook. Users may look up the relative records of the transmitter. For example, Measurement, Setting, Calibration mode(Mea, Set, Cal mode), current output over setting range(SG_mA Over), power failure(Power On, Power Off), and other error message records (Error1, Error2…etc. The definition of error messages please refer to Ch10.)



Press ⊞ENTER to confirm it.



Press ⊡ or ◉MODE to select different page..

Press ⊞ENTER to confirm it.

Enter "Auto return (Return)"Setup
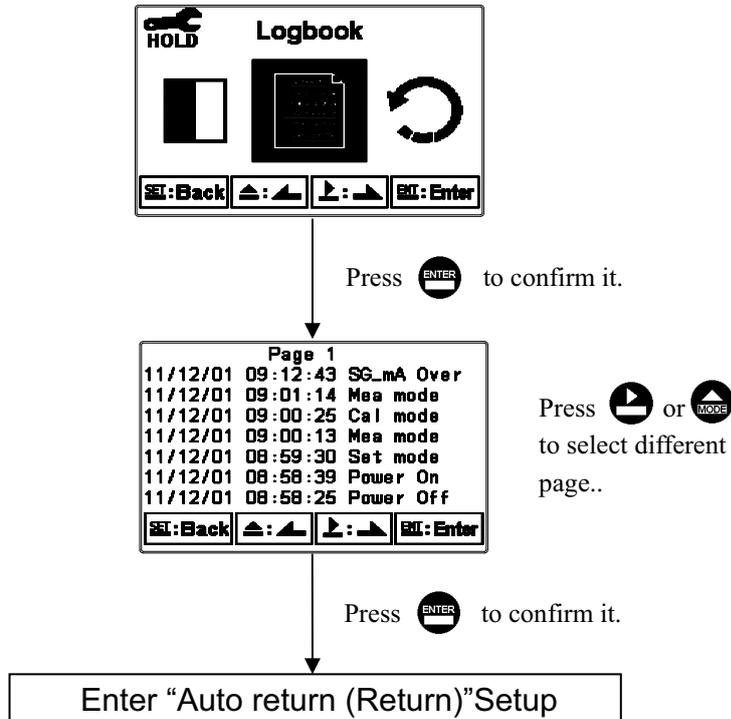
## 7.18 Return

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



Press **ENTER** to confirm it.



Press **MODE** or **⏷** to select Auto return or manual exit.



Press **ENTER** to confirm it.

Press **ENTER** to confirm it.



Press **⏷** or **MODE** to adjust "minute" part, and press **ENTER** to confirm it and move to" second" part.

Enter "Password (Code)"Setup

# 8. Calibration

## Block diagram of Calibration

Cal. Info

Cal. mode

Press [CAL] for doing zero point calibration only.

Return Setting

Code Setting

Select Cal. Type

Auto

Manual Exit

Code Input

Single Point Cal.

Two Point Cal.

Zero Point Cal.

Pure Water Cal.

Cell Const.

Known Sol. Cal.

Time Input

OFF

ON

Auto Cal. Judgement

ATC

MTC

Cell Const. Setting

Select presetting SG range

New Code Input

Zero Point SG value Display

Temp, Setting

Modify SG Value

Pure Water SG Display

Auto judge Cell Const.

Auto judge Cell Const.

Calibrated Cell Const. Display

Calibrated Cell Const. Display

Calibrated Cell Const. Display

← : [MODE]

→ : [▶]

↓ : [ENTER]

Back to the previous class / action
or the end of the procedure: [CAL]

40

## 8.1 Enter calibration setup menu

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

```
┌─────────────────────────────┐
│       Measurement mode      │◄───────┐
└─────────────────────────────┘        │
              │                        │
              ▼   Press ⊙CAL or ⊙MODE  │
┌─────────────────────────────────┐    │
│        Calibration  Info.       │    │
│                                 │    │
│  1.Cal.Time:2011/01/01 09:00    │    │
│  2.Cal.Point:Zero               │    │
│  3.Cal.Mode:No Cal.             │────┘
│  4.Cell Constant:11383          │
│  5.Return:Auto,03m:00s          │    Press ⊙CAL to return to
│                                 │    measurement mode
│  CAL:Back          ENT:Enter    │
└─────────────────────────────────┘
              │
              ▼   Press ⊙ENTER to confirm it.
┌─────────────────────────────┐
│  Enter Calibration setup menu │
└─────────────────────────────┘
```
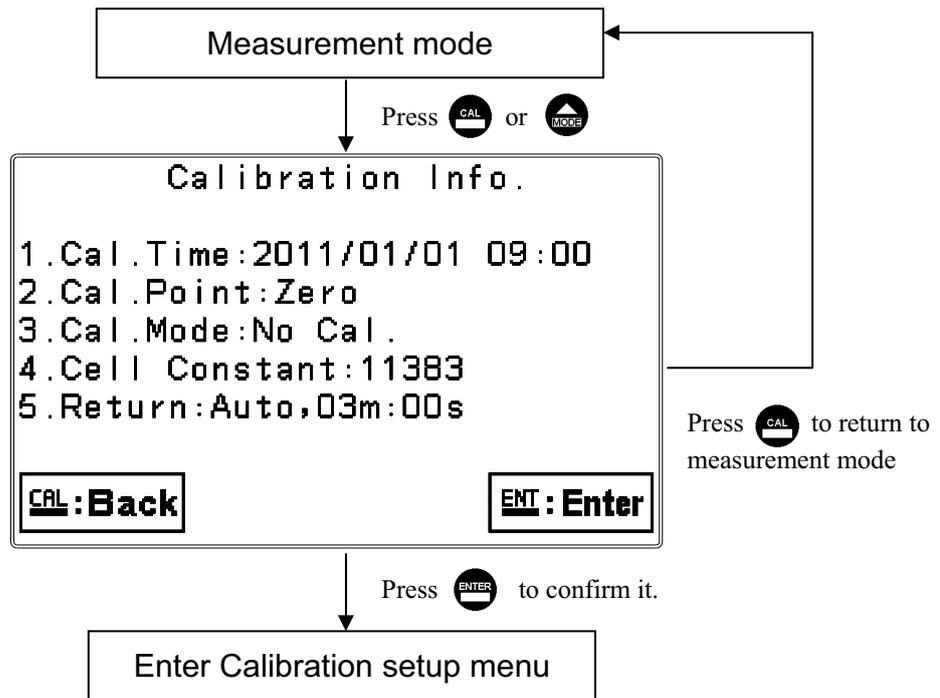
## 8.2 Security password of calibration (Code)

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



Press (ENTER) to confirm it.

If you input a wrong code, then the display shows a "Error 5" message. Press (ENTER) to restart inputting another code, or press (CAL) to exit the calibration menu.

The first '0" of digits '0000" start to twinkle. Press (MODE) or (⬇) to adjust the value, and then press (ENTER) to confirm it and continually key in the next digit, and so on.

If you input a wrong code, then the display shows a "Error 5" message. Press (ENTER) to restart inputting another code, or press (CAL) to exit the calibration menu.

Press (MODE) or (⬇)

(Select to turn on or turn off code protection function. If you select turn on, please key in a new code. There will be a code requirement showing in display when you re-enter to the setup mode. Key in the correct password to enter into calibration setup menu.)

Press (ENTER) to confirm it.

Input new code

Press (ENTER) to confirm it.

Enter "Select Cal." Setup

## 8.3 Specific Gravity Calibration

In order to maintain the accuracy of the instrument, it is necessary to make regular calibration to maintain the long term measurement reliability. The SG-2110-RS provides two types of calibration mode---"Single Point" and "Two Points". Users may select the single point calibration(span calibration) or two points calibration(Both span and zero-point calibration) by themselves.

Under "two points" calibration mode, it is possible to make zero-point calibration only(hang the plummet in the air) without making the span calibration(apply Archimedes buoyancy principle). There are tree types of span calibration for calibrating the cell constant of the plummet. The plummet cell constant is applied to calibrate the relation of plummet's volume and weight. User may select suitable type of span calibration according to the situation.

Whenever first time installation, plummet replacement, taking part of sensor, etc, it is necessary to select "Two points" calibration mode for making zero-point and span calibration to maintain the accuracy. The instrument provides calibration method by relation of plummet's volume and weight. It does not provide a pure weight correction for calibrating plummet's volume.

**Note:** The operation and installation of sensor and rack when calibration, please refer to the appendix part.

## 8.4 Select calibration mode(Select Cal.)

Single point calibration: Directly enter span calibration mode without making zero-point calibration, it is allowed to calibrate the relation of plummet's volume and weight to get plummet cell constant .

Two point calibration: Enter zero-point calibration. After finishing zero-point calibration, users may press 🔘 key to exit for making zero-point calibration. Or then enter span calibration mode for making span calibration.



Press 🔘 to confirm it.

Press 🔘 or 🔘 to select " Single Point" or "Two points" calibration.

Press 🔘 to confirm it.

Press 🔘 to confirm it.

Enter " Span Calibration" Mode

Enter " Zero-Point Calibration" Mode
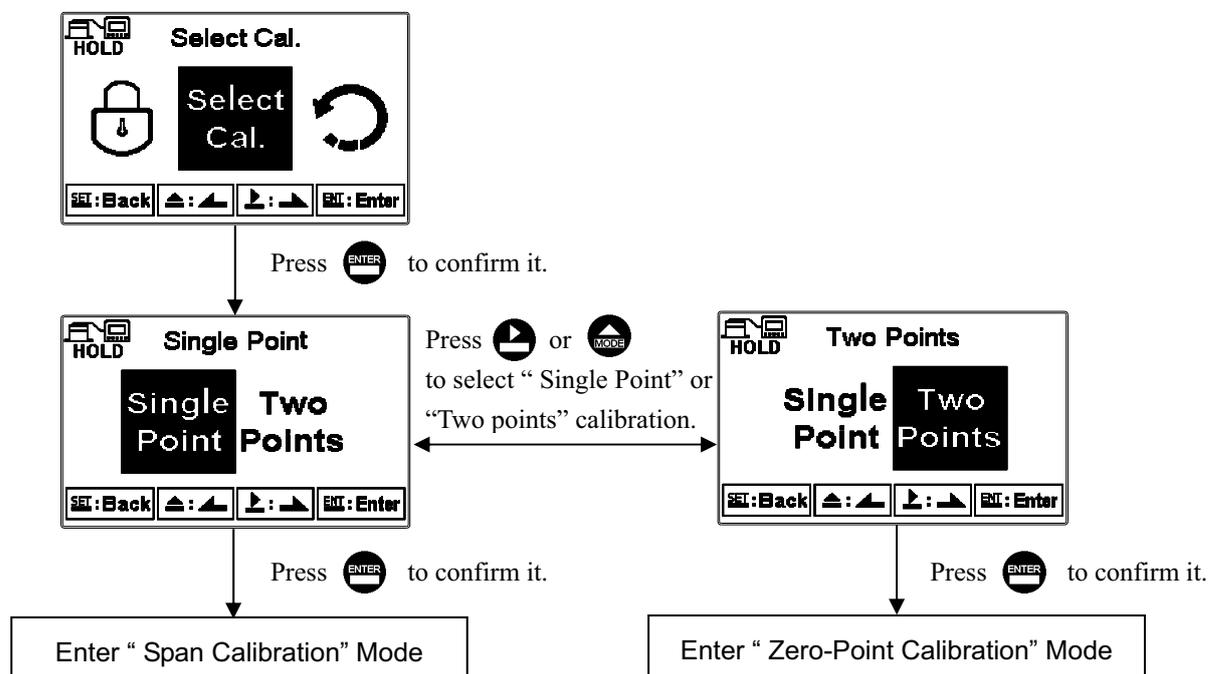
## 8.5 Zero-point calibration(Zero)

Enter two point calibration mode and then enter zero-point calibration. At the moment, the plummet needs to be clean and dry and to be placed in the air. Press ⊙ key to proceed calibration . When the ⧗ symbol shows in the display, the instrument starts the auto calibration. After calibration, the display automatically shows zero-point SG value. Press ⊙ key to finish zero-point calibration and enter span calibration procedure.



Press ⊙ to confirm it.



Press ⊙ to confirm it.



Press ⊙ to confirm it.



Press ⊙ to confirm it.

Enter " Span Calibration" Mode
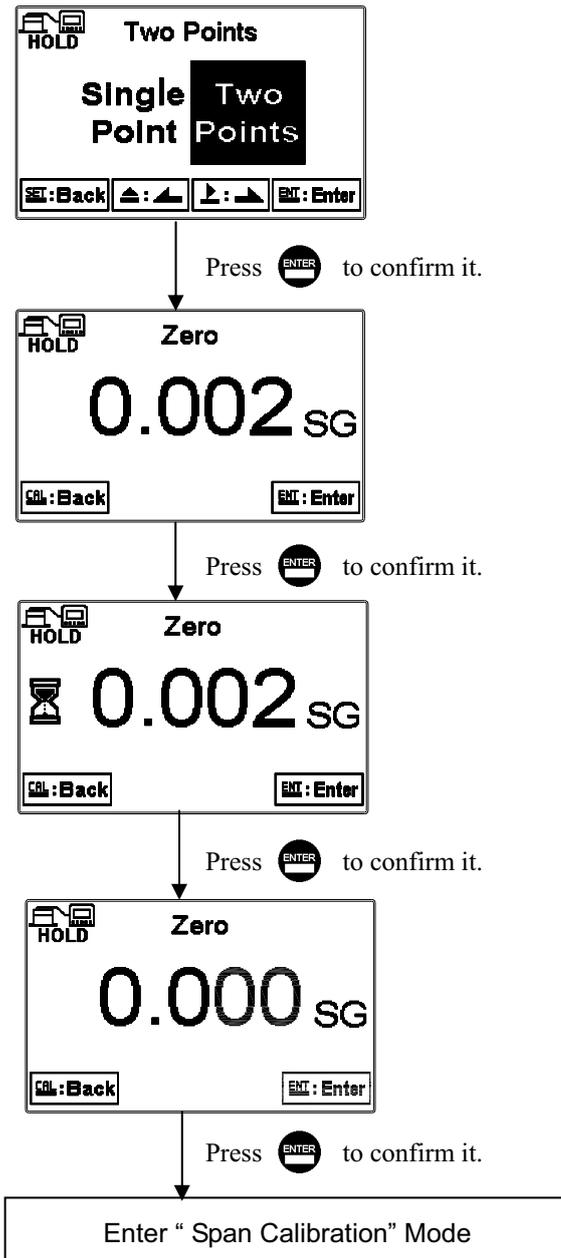
## 8.6 Span calibration

Enter span calibration mode. There are three method for selection to get the cell constant for calibrating the relation of plummet's volume and weight. If select Two Points calibration, users may press ⓒⒶⓁ key to exit for making zero-point calibration only.

### 8.6.1 Pure Water calibration

Enter pure water calibration menu display. Under MTC(Manual temperature compensation) mode, press ⓂⓄⒹⒺ or 🔼 key to input the temperature value of pure water, and then p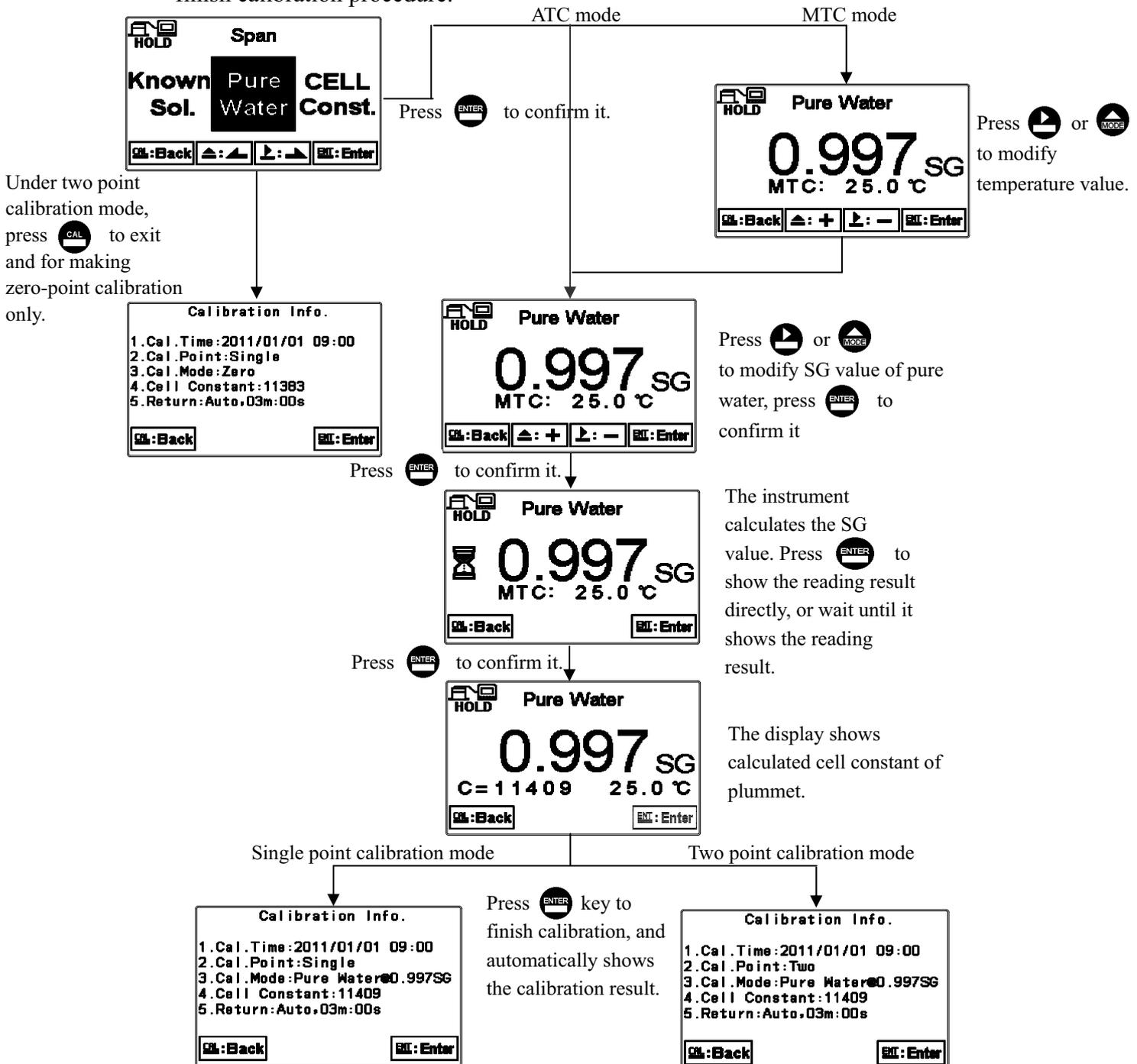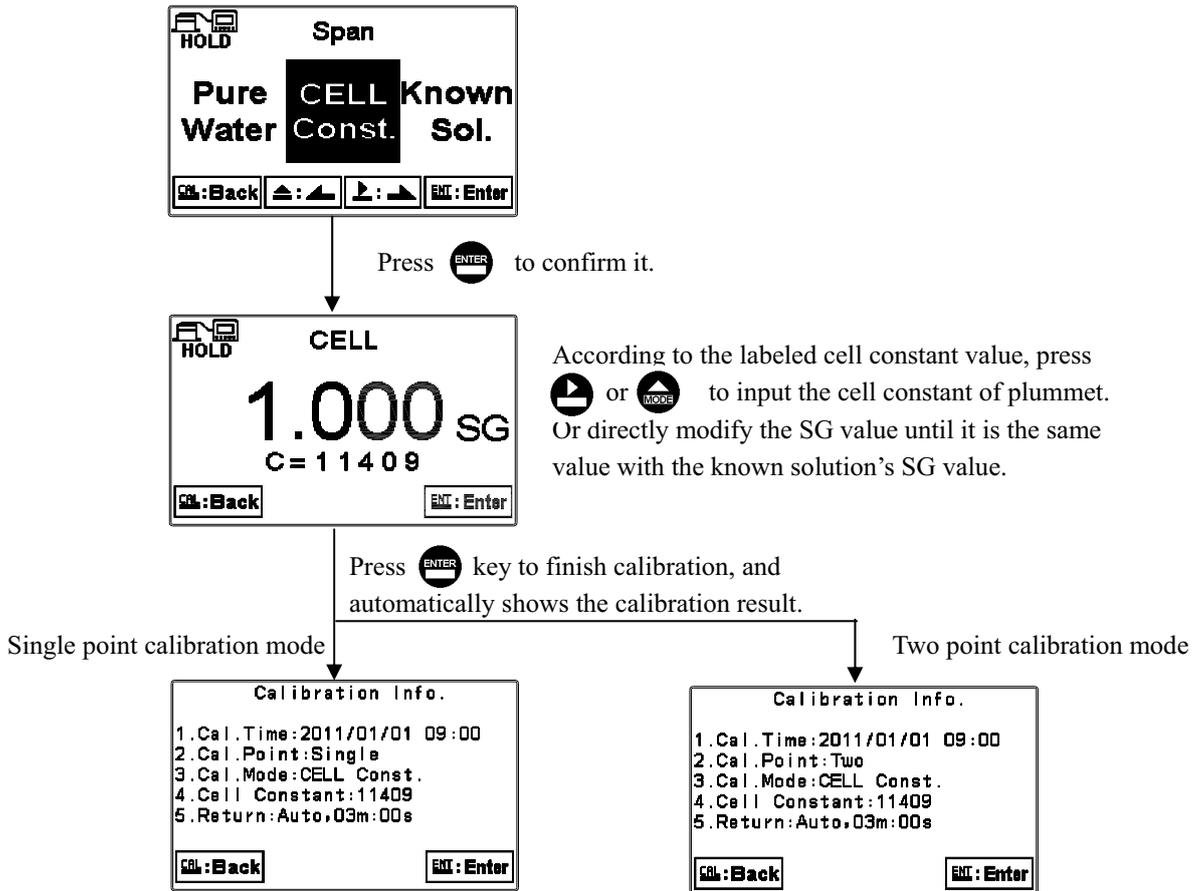ress ⒺⓃⓉⒺⓇ key to enter next menu display. At the moment, the SG value which related to pure water's temperature value starts to twinkles in the display.(Under ATC mode, it directly shows the pure water's SG value which related to the temperature.) Press ⓂⓄⒹⒺ or 🔼 to modify pure water's SG reading until it reaches the required value. Then, press ⒺⓃⓉⒺⓇ key to proceed calibration. When the ⌛ symbol shows in the display, the instrument starts the auto calibration. After calibration, the display automatically shows zero-point SG value. Press ⒺⓃⓉⒺⓇ key to finish calibration procedure.

ATC mode          MTC mode

**Span**

Known | Pure | CELL
Sol. | Water | Const.

CAL:Back  ▲:▲  ▼:▲  ENT:Enter

Press ⒺⓃⓉⒺⓇ to confirm it.

**Pure Water**

0.997 SG

MTC: 25.0 ℃

CAL:Back  ▲:+  ▼:−  ENT:Enter

Press 🔼 or ⓂⓄⒹⒺ to modify temperature value.

Under two point calibration mode, press ⓒⒶⓁ to exit and for making zero-point calibration only.

**Calibration Info.**

1.Cal.Time:2011/01/01 09:00
2.Cal.Point:Single
3.Cal.Mode:Zero
4.Cell Constant:11383
5.Return:Auto,03m:00s

CAL:Back  ENT:Enter

**Pure Water**

0.997 SG

MTC: 25.0 ℃

CAL:Back  ▲:+  ▼:−  ENT:Enter

Press 🔼 or ⓂⓄⒹⒺ to modify SG value of pure water, press ⒺⓃⓉⒺⓇ to confirm it

Press ⒺⓃⓉⒺⓇ to confirm it.

**Pure Water**

⌛ 0.997 SG

MTC: 25.0 ℃

CAL:Back  ENT:Enter

The instrument calculates the SG value. Press ⒺⓃⓉⒺⓇ to show the reading result directly, or wait until it shows the reading result.

Press ⒺⓃⓉⒺⓇ to confirm it.

**Pure Water**

0.997 SG

C=11409  25.0 ℃

CAL:Back  ENT:Enter

The display shows calculated cell constant of plummet.

Single point calibration mode          Two point calibration mode

Press ⒺⓃⓉⒺⓇ key to finish calibration, and automatically shows the calibration result.

**Calibration Info.**

1.Cal.Time:2011/01/01 09:00
2.Cal.Point:Single
3.Cal.Mode:Pure Water@0.997SG
4.Cell Constant:11409
5.Return:Auto,03m:00s

CAL:Back  ENT:Enter

**Calibration Info.**

1.Cal.Time:2011/01/01 09:00
2.Cal.Point:Two
3.Cal.Mode:Pure Water@0.997SG
4.Cell Constant:11409
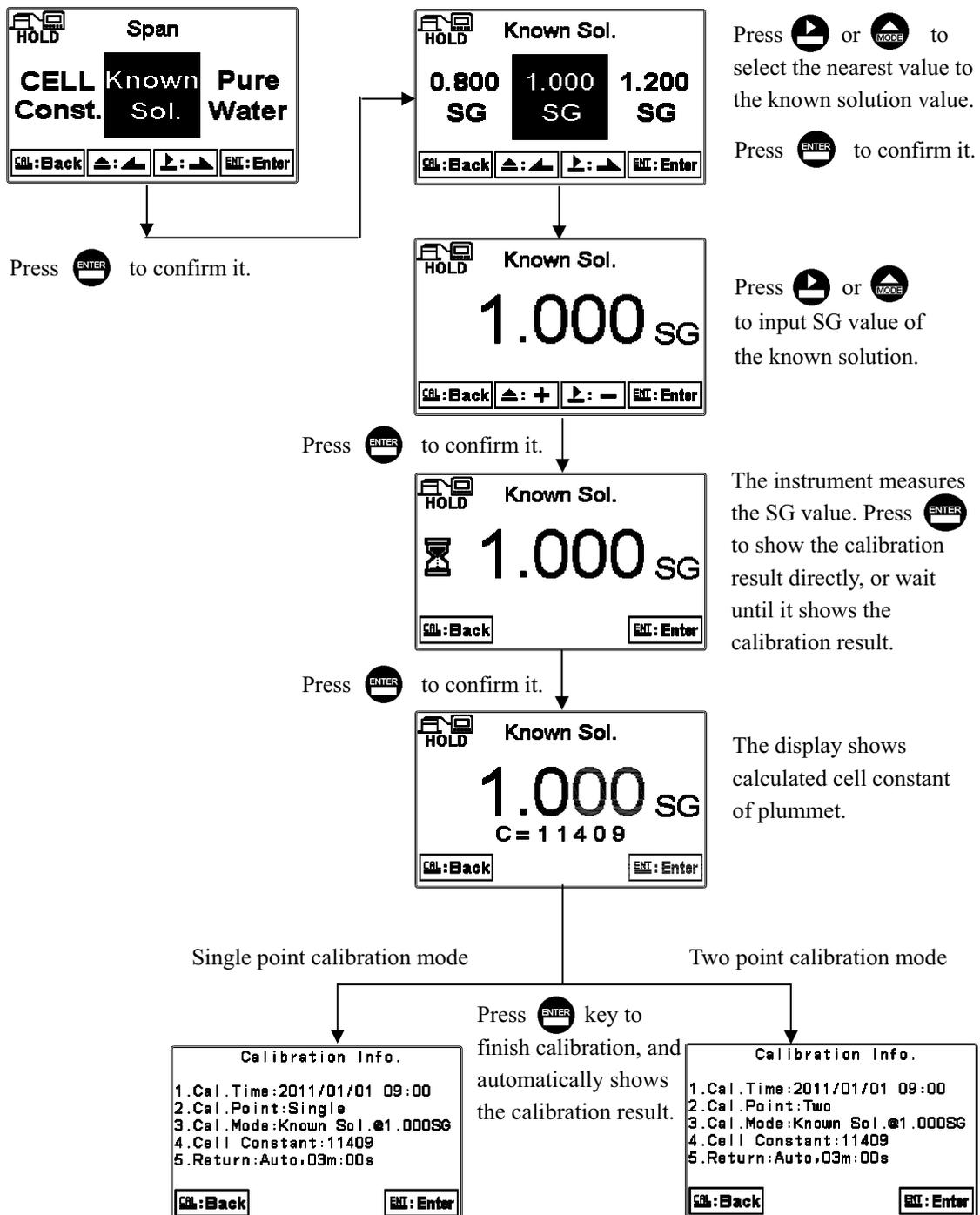5.Return:Auto,03m:00s

CAL:Back  ENT:Enter

### 8.6.2 Cell Constant calibration (CELL Const.)

Enter cell constant calibration menu display. At the moment, the cell constant value starts to twinkles in the display. Press ⬆ or ⬆ to modify the cell constant value of the plummet until the modified measurement value is the same with the SG value of known solution, or directly set the known cell constant value. Press ⏎ key to finish calibration procedure.

```
┌─────────────────────────┐
│ ▱▤       Span           │
│ HOLD                    │
│                         │
│ Pure  ▐CELL▌Known       │
│ Water ▐Const.▌ Sol.     │
│                         │
│ [▱:Back][⬆:▲][⬆:▲][⎘:Enter]│
└─────────────────────────┘
```

Press ⏎ to confirm it.

```
┌─────────────────────────┐
│ ▱▤       CELL           │
│ HOLD                    │
│  1.000 SG               │
│    C=11409              │
│                         │
│ [▱:Back]      [⎘:Enter] │
└─────────────────────────┘
```

According to the labeled cell constant value, press ⬆ or ⬆ to input the cell constant of plummet. Or directly modify the SG value until it is the same value with the known solution's SG value.

Press ⏎ key to finish calibration, and automatically shows the calibration result.

Single point calibration mode

```
┌─────────────────────────┐
│   Calibration Info.     │
│                         │
│ 1.Cal.Time:2011/01/01 09:00│
│ 2.Cal.Point:Single      │
│ 3.Cal.Mode:CELL Const.  │
│ 4.Cell Constant:11409   │
│ 5.Return:Auto,03m:00s   │
│                         │
│ [▱:Back]      [⎘:Enter] │
└─────────────────────────┘
```

Two point calibration mode

```
┌─────────────────────────┐
│   Calibration Info.     │
│                         │
│ 1.Cal.Time:2011/01/01 09:00│
│ 2.Cal.Point:Two         │
│ 3.Cal.Mode:CELL Const.  │
│ 4.Cell Constant:11409   │
│ 5.Return:Auto,03m:00s   │
│                         │
│ [▱:Back]      [⎘:Enter] │
└─────────────────────────┘
```

## 8.6.3 Known solution calibration (Known Sol.)

Enter known solution SG calibration menu display. Press ⬆ or ⬇ to select the nearest SG value to the known solution's SG value. There are 0.800SG, 1.000SG, 1.200SG and 1.600SG four sets for convenient selection. After select the most appropriate SG value, press ENTER to confirm it and enter to the next menu display. At the time, users may modify the SG value to become the known solution's SG value. Press ENTER to proceed the calibration. When the ⧖ symbol shows in the display, the instrument starts the auto calibration. After calibration, the display automatically shows the calibrated cell constant value. Press ENTER key to finish calibration procedure.



**Span** — CELL Const. | Known Sol. | Pure Water
CAL:Back | ⬆:⬆ | ⬇:⬆ | ENT:Enter

Press ⬇ or ⬆ to select the nearest value to the known solution value.

Press ENTER to confirm it.

**Known Sol.** — 0.800 SG | 1.000 SG | 1.200 SG
CAL:Back | ⬆:⬆ | ⬇:⬆ | ENT:Enter

Press ENTER to confirm it.

**Known Sol.**
1.000 SG
CAL:Back | ⬆:+ | ⬇:− | ENT:Enter

Press ⬇ or ⬆ to input SG value of the known solution.

Press ENTER to confirm it.

**Known Sol.**
⧖ 1.000 SG
CAL:Back | ENT:Enter

The instrument measures the SG value. Press ENTER to show the calibration result directly, or wait until it shows the calibration result.

Press ENTER to confirm it.

**Known Sol.**
1.000 SG
C = 11409
CAL:Back | ENT:Enter

The display shows calculated cell constant of plummet.

Single point calibration mode                    Two point calibration mode

Press ENTER key to finish calibration, and automatically shows the calibration result.

```
Calibration Info.
1.Cal.Time:2011/01/01 09:00
2.Cal.Point:Single
3.Cal.Mode:Known Sol.@1.000SG
4.Cell Constant:11409
5.Return:Auto,03m:00s
CAL:Back                ENT:Enter
```

```
Calibration Info.
1.Cal.Time:2011/01/01 09:00
2.Cal.Point:Two
3.Cal.Mode:Known Sol.@1.000SG
4.Cell Constant:11409
5.Return:Auto,03m:00s
CAL:Back                ENT:Enter
```

## 8.7 Return

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

Note: the return function of setup menu and calibration setup menu are independent settings.
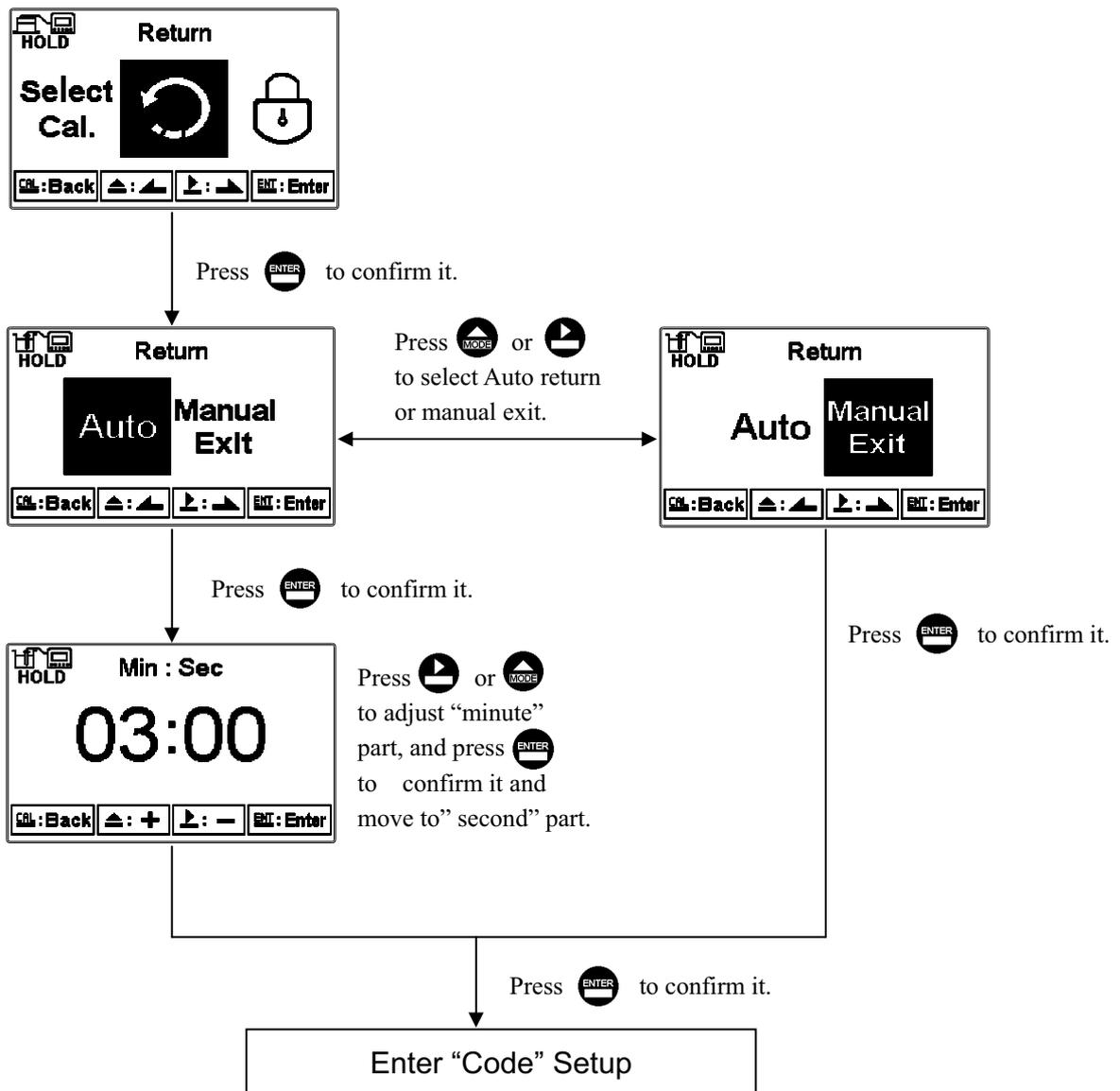
## 9. MODBUS protocol and instructions for SG-2110-RS

### 9.1 Communication connection

The RS-485 communication port of the transmitter features with electronic isolation protection, lightning protection, and to provide internal independent ground solution. It is allowed to use normal twisted-pair (segregation double-stranded twisted pair cable) 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 consider using the normal cable instead. However, there should be strictly in accordance with the requirements of industrial engineering construction. Wiring diagram is as follows:
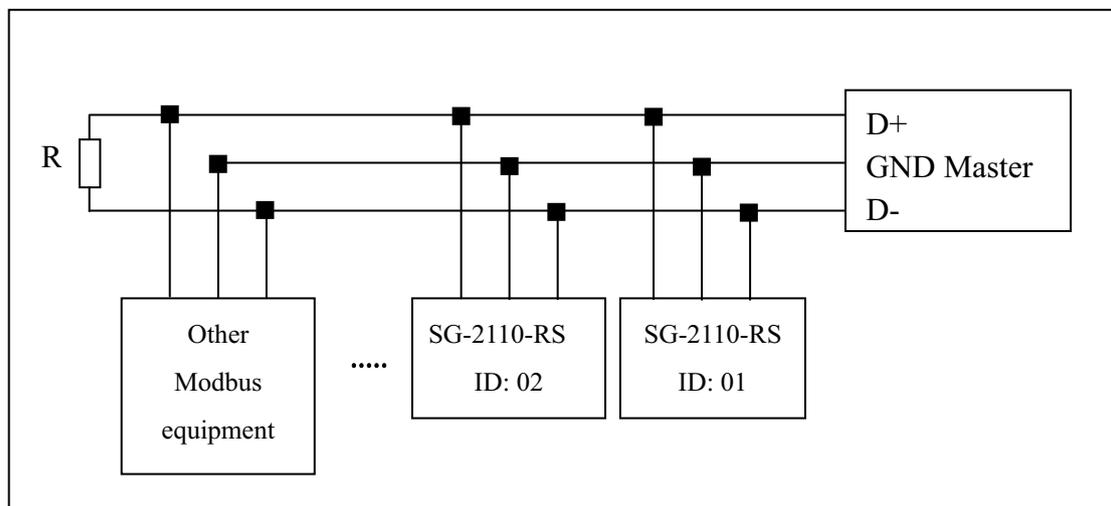


**Note:**

1. The RS-485 interface of SG-2110-RS transmitter has a protective earth terminal. When communicate with the RS-485, there should use with solution ground to eliminate risk of safety.
2. It is allowed to use an 120 ohm impedance matching resistors at terminal equipment in the transmission lines (D +, D-) ends across 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.
4. When communication, all the equipments of the network should be maintained in the same transfer mode, baud rate, parity consistent. And each of the device address can not be the same, so as not to conflict resulted in the normal network communications.
5. The Modbus command of the transmitter can only access 50 registers. If it exceeds the length, then it returns abnormal message.

## 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 | SG2110 | |
| 0005H | Communication protocol | 2 | USHORT | 0: RTU<br>1: ASCII | 0 | |
| 0006H | Serial transmission speed (Baud rate) | 2 | USHORT | 0: 2400<br>1: 4800<br>2: 9600<br>3: 19200 | 3 | |
| 0007H | Parity | 2 | USHORT | 0: None<br>1: Even<br>2: Odd | 1 | |
| 0008H | Real-time clock* | 12 | USHORT | Second | 2011-01-01, 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<br>1: PTC<br>2: NTC | 0 | |
| 0010H ~0014H | Factory reserved | | | | | |
| 0015H | Relay 1 * | 2 | USHORT | 0: OFF<br>1: AUTO | 1 | |
| 0016H | | 2 | USHORT | 0：Hi<br>1：Lo | 0 | |
| 0017H | | 4 | FLOAT | SP1 | 1.300SG | Data affected by sign byte |
| 0019H | | 4 | FLOAT | Hys1 | 0.010SG | |
| 001BH | Relay 2 * | 2 | USHORT | 0: OFF<br>1: AUTO | 1 | |

| | | | | 0：Hi | | |
|---|---|---|---|---|---|---|
| 001CH | | 2 | USHORT | 1：Lo | 1 | |
| 001DH | | 4 | FLOAT | SP2 | 1.100SG | Data |
| 001FH | | 4 | FLOAT | Hys2 | 0.010SG | affected by sign byte |

| | | | | 0: AUTO | | |
|---|---|---|---|---|---|---|
| 0021H | | 2 | USHORT | 1: ON | 2 | |
| | | | | 2: OFF | | |
| 0022H | Backlight Brightness * | 2 | SHORT | 2: Highest bright | 0 | |
| | | | SHORT | 1: high bright | | |
| | | | SHORT | 0: Standard | | |
| | | | SHORT | -1: Low bright | | |
| | | | SHORT | -2: Lowest bright | | |
| 0023H | Backlight Sensitivity* | 2 | SHORT | 2: Highest Sensitivity | 0 | |
| | | | SHORT | 1: High Sensitivity | | |
| | | | SHORT | 0: Standard | | |
| | | | SHORT | -1: Low Sensitivity | | |
| | | | SHORT | -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 support 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$^{o}$C. The 16-bit of FLOAT data(Hexadecimal) will show 41 C8 CC CD. The transmission order is CC CD 41 C8. For detail description, please refer to ch 9.3 Modbus example description.

**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 | SG-2110-RS only has one channel | 1 | |
| 0032H | Sign byte | 6 | CHAR | % <br> ˚C <br> SG <br> Bé | | ASCII code |
| 0035H | SG/°Bé/ppt/% measurement | 4 | FLOAT | SG/°Bé/ppt/% measurement | | Data affected by sign byte |
| 0037H | Temperature measurement | 4 | FLOAT | Temperature measurement | | |
| 0039H-0050H | Factory reserved | | | | | |

Important: Usage address please refer to 03H Modbus response (measurement parameter)

**Function code: 01H 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 SG/°Bé/ppt/% 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 | Factory reserved | | | | |
| 0079H | Measurement status | 1 | Contact on | 1 (Contact on) | 0: Hold <br> 1: Measurement |
| 0080H-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$^{\circ}$C, and confirm that host and sub-machine communication format settings are correct. The host according to the following left table to send commands, and then to get the response from sub-machine according to following right table. This example shows the message transmission function code 03H data format. If under other function code, the logic mode is the same.

ASCII Mode:

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

RTU Mode:

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

**Note:** FLOAT is a 32-bit IEEE 754 format. The above table, for an example, is divided into two 16-bit register data transmission. The back 16-bit register(CC CD) will be transferred first, and then the first 16-bit register (41 C8) will be transferred later. Every 16-bit format is high-bit in the front and low-bit in the post. For example, the temperature now is 25.1$^{\circ}$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 |
|----------|--------|--------------|
| **Error2** | The cell constant of plummet is over range | 1.Please check whether the tie line is loosened or slipped<br><br>2.Please check whether the placement of plummet is correct or not |
| **Error3** | The reading is unstable while calibration | 1.Please check whether the tie line is loosened or slipped<br><br>2.Please check whether the placement of plummet is correct or not |
| **Error5** | Wrong password | Input the correct password |
| **Error9** | Serious error that does not permit any further measuring | Please call service engineer. |

## Appendix

**Installation suggestion of load cell sensor**

**Note:** The load cell sensor rack showed as illustration is an optional accessory. The rack can be overlapped for increasing the height. The flow-through chamber is an example to illustrate how to avoid the impact of water flow.
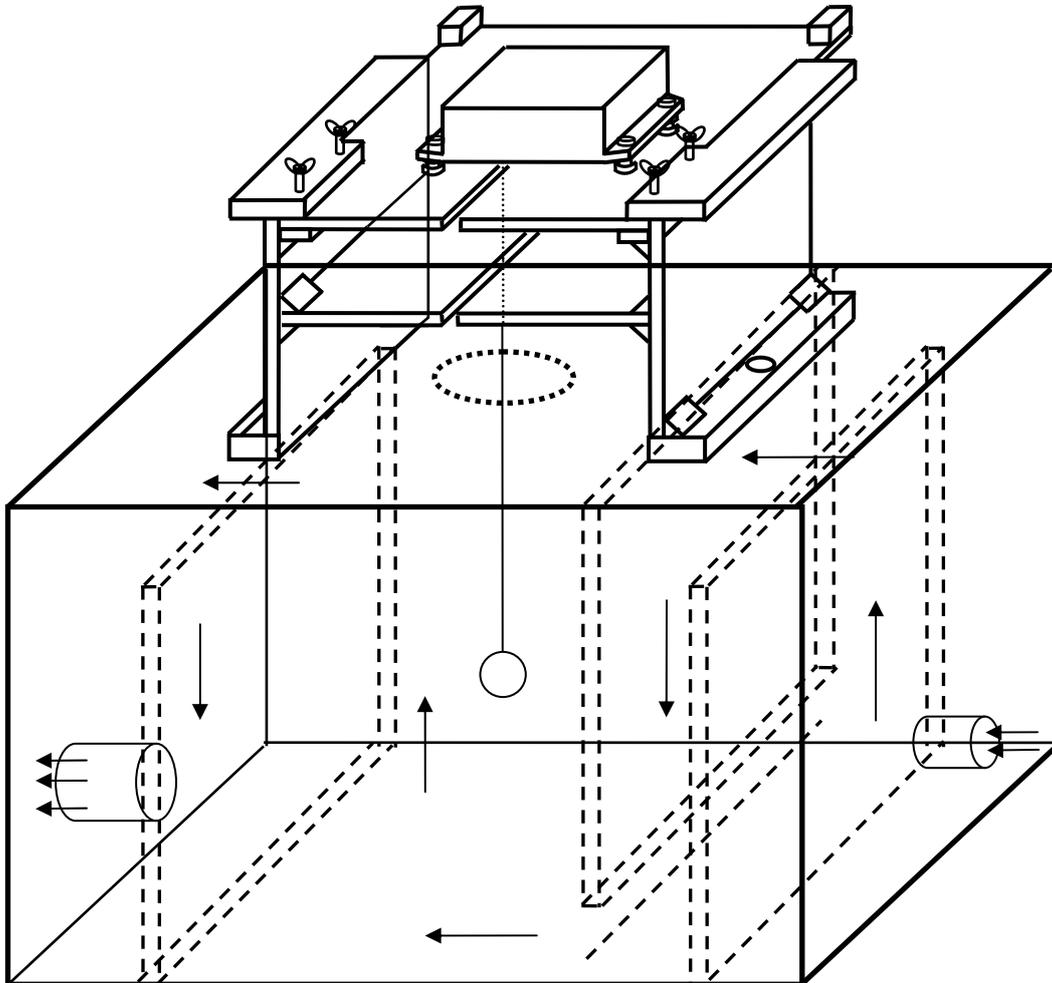


**Note:**

1. The sensor needs to be placed on the shock absorber o-ring set to reduce the impact of the external shock.

2. Each of the four corners of the load cell box has a screw to fix the sensor & shock absorber to the load cell platform which is capable to sliding forth and back on the sensor rack. It is also necessary to pay attention to maintain the horizontal level of the sensor.

3. When the upper platform needs to be pull out for processing the measurement or calibration, rotate to loosen the four screws on each of the platform corners by hand. After push it to the position you need, rotate to tighten up the screws and fix the upper platform.

4. The round hole at the middle part of lower right side of the rack is for temperature probe installation.

**Sensor and rack operation method during calibration:**
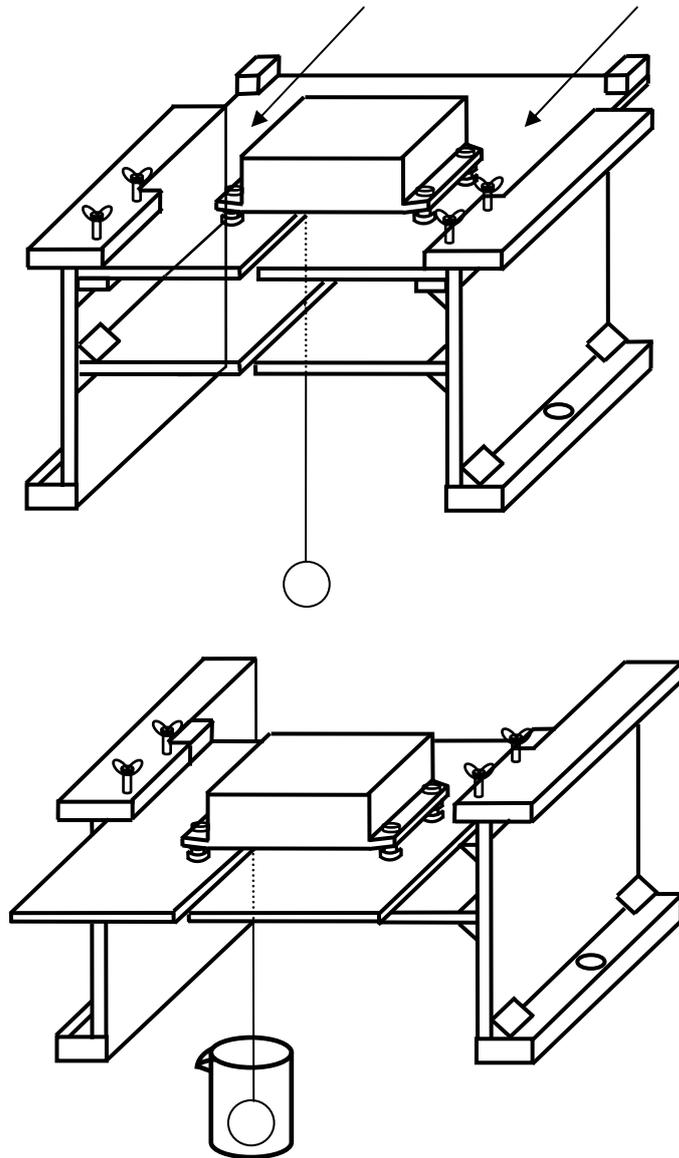


**Method 1:**

It may need to move upper board to proceed calibration where outside the measurement tank.

1. Remove the tie line with plummet along the rack slot from the measurement tank, and wipe the plummet clean.

2. Rotate to loosen the four screws around the corners by hand, and then you may push forward the upper board. After push it to the certain position, and rotate to tighten the screws by hand. At the time, you may proceed zero-point calibration in air.

3. Pour pure water or a known specific gravity solution into a cylinder, and then let plummet completely sink into the solution, and proceed the Span calibration.

4. After calibration, take out the plummet from the cylinder, wipe the plummet clean, and rotate to loosen the screws by hand.

5. Push back the upper board, put the plummet into measurement tank, and then rotate to tighten the screws to prevent sensor from moving.

**Method 2:**

Calibrating inside the measurement tank, no need to move the upper board

1. Drain all the solution inside the measurement tank.

2. Wipe the plummet clean, put the plummet hang on the air inside the tank, and make a zero point calibration.

3. Pour the solution back to the measurement tank until it is full within the auto-return function duration, use another specific gravity meter's measurement value as Span calibration for known solution.

**Suggestion of sensor and plummet's tie line terminal tying method:**

1. Fold the tie line inward
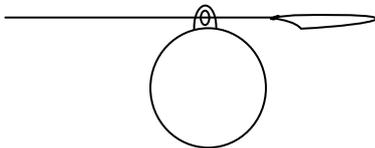
2. Wind around the fold tie line once.

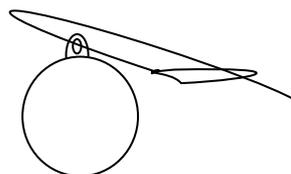3. Let the terminal of fold tie line go through back to the coil.

4. Tighten the knot and cut off redundant part.

**Suggestion of plummet and tie line wiring method:**

1. Let the terminal of tie line which is knotted after previous procedure go through the upper side hole of the plummet.
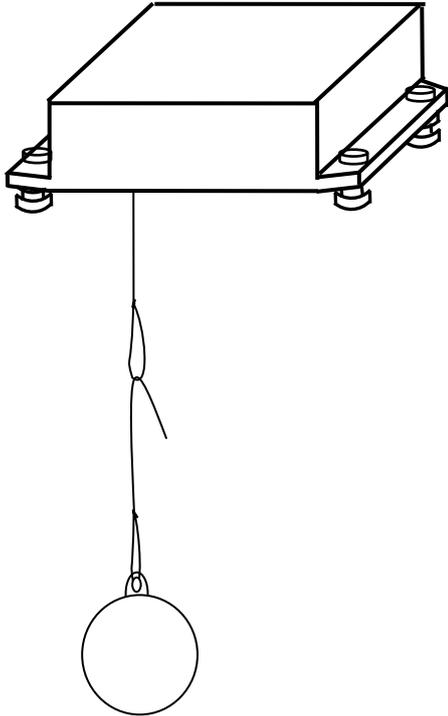
2. Let the other tie line terminal go through the knot.

3. Just tighten it up.

**Suggestion of sensor and plummet tie line method:**



1. Let the tie line terminal of plummet go through the coil of sensor tie line.

2. Knot the tie line terminal and sensor tie line coil. Cut off the redundant part.

**Sulfuric acid concentration/specific gravity table:**

The following table shows the concentration/specific gravity table of sulfuric acid at 20°C.

| Concentration (%) | Specific Gravity(SG) | Concentration (%) | Specific Gravity(SG) | Concentration (%) | Specific Gravity(SG) |
|---|---|---|---|---|---|
| 0.3 | 1.000 | 43.1 | 1.330 | 74.2 | 1.660 |
| 1.7 | 1.010 | 44.2 | 1.340 | 75.1 | 1.670 |
| 3.2 | 1.020 | 45.3 | 1.350 | 75.9 | 1.680 |
| 4.7 | 1.030 | 46.3 | 1.360 | 76.8 | 1.690 |
| 6.2 | 1.040 | 47.4 | 1.370 | 77.6 | 1.700 |
| 7.7 | 1.050 | 48.4 | 1.380 | 78.5 | 1.710 |
| 9.1 | 1.060 | 49.5 | 1.390 | 79.4 | 1.720 |
| 10.6 | 1.070 | 50.5 | 1.400 | 80.2 | 1.730 |
| 12.0 | 1.080 | 51.5 | 1.410 | 81.2 | 1.740 |
| 13.4 | 1.090 | 52.5 | 1.420 | 82.1 | 1.750 |
| 14.7 | 1.100 | 53.5 | 1.430 | 83.1 | 1.760 |
| 16.1 | 1.110 | 54.5 | 1.440 | 84.1 | 1.770 |
| 17.4 | 1.120 | 55.4 | 1.450 | 85.2 | 1.780 |
| 18.8 | 1.130 | 56.4 | 1.460 | 86.3 | 1.790 |
| 20.1 | 1.140 | 57.4 | 1.470 | 87.7 | 1.800 |
| 21.4 | 1.150 | 58.3 | 1.480 | 89.2 | 1.810 |
| 22.7 | 1.160 | 59.2 | 1.490 | 91.1 | 1.820 |
| 23.9 | 1.170 | 60.2 | 1.500 | 93.6 | 1.830 |
| 25.2 | 1.180 | 61.1 | 1.510 | 97.0 | 1.836 |
| 26.5 | 1.190 | 62.0 | 1.520 | | |
| 27.7 | 1.200 | 62.9 | 1.530 | | |
| 28.9 | 1.210 | 63.8 | 1.540 | | |
| 30.2 | 1.220 | 64.7 | 1.550 | | |
| 31.4 | 1.230 | 65.6 | 1.560 | | |
| 32.6 | 1.240 | 66.5 | 1.570 | | |
| 33.8 | 1.250 | 67.3 | 1.580 | | |
| 35.0 | 1.260 | 68.2 | 1.590 | | |
| 36.2 | 1.270 | 69.1 | 1.600 | | |
| 37.4 | 1.280 | 70.0 | 1.610 | | |
| 38.5 | 1.290 | 70.8 | 1.620 | | |
| 39.7 | 1.300 | 71.7 | 1.630 | | |
| 40.8 | 1.310 | 72.5 | 1.640 | | |
| 41.9 | 1.320 | 73.4 | 1.650 | | |

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