FISON


# Benchtop pH Meter

# FM-BPM-A101

# Index

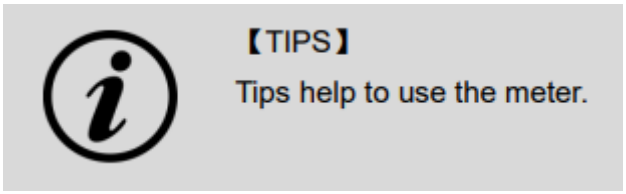
## 1. Safety Measures

Read the entire contents of this manual carefully before use, and keep this manual properly. The user "**MUST**" use the instrument following this manual to avoid damage to the user and equipment.

Before using the meter, "**READ**" the following notes:

- DO NOT DISASSEMBLE the device for inspection or repair.
- To prevent electric shock or damage to the device, DO NOT place
- cables and connectors in any liquid, wet, or corrosive environment.
- Use the defaulted power adapter, DO NOT use it if the power
- cord is damaged (the wire is exposed or broken).
- DO NOT use in flammable and explosive environments.
- DO NOT use if the user finds any abnormalities such as damage or deformation of the device.

The following identifier will be used in this manual.



## 2. Introduction

**Benchtop pH Meter FM-BPM-A101** is a multiple reading mode comprised unit comes with automatic and manual temperature compensation, has up to 6 calibration points with standard recognition. Features automatic electrode diagnosis with pH slope and offset display. With 7-inch color LCD display, provides easy data management and user-friendly interface. Equipped with large data storage and data analysis, it supports USB and RS232 interface for convenient data processing and analysis.

## 3. Features

- ✓ Benchtop pH meter with multiple reading modes: Auto read, Timed, Continuous
- ✓ Automatic and Manual temperature compensation to avoid fluctuations
- ✓ Up to 6 calibration points with standard recognition and calibration reminder
- ✓ Automatic electrode diagnosis with pH slope and offset display
- ✓ 7-inch LCD color display for easy data management and user-friendly interface
- ✓ Large data storage for up to 1000 group with data analysis function
- ✓ Supports USB and RS232 interface for convenient data processing and analysis

## 4. Specifications

| Model No. | FM-BPM-A101 |
|---|---|
| **pH** | Range: -2.00 to 20.00 pH<br>Resolution: 0.1, 0.01, 0.001 pH<br>Accuracy: ±0.002 pH<br>Calibration Points: Up to 6<br>Standard Recognition: NIST, GB, DIN, USA, MERK, JIS buffers |
| **mV** | Range: -2000 to 2000 mV<br>Resolution: 0.1, 0.01 mV<br>Accuracy: ±0.03%FS<br>Calibration Point: 1 custom point |
| **Temperature** | Range: -10 to 135 °C (14 to 275 °F)<br>Unit: °C, °F<br>Resolution: 0.1<br>Accuracy: ± 0.1 |
| **Measurement** | Reading Mode: Auto Read, Timed, Continuous<br>Reading Prompts: Reading, Stable, Locked<br>Temp. Compensation: ATC, MTC |
| **Data Storage** | 1000 groups |
| **pH Electrode** | BNC(Q9) |
| **Temp. Probe** | 4 pin aviation connectors |
| **Backlight** | Yes |
| **Auto Shutdown** | 1 to 60 min, off |
| **Display** | LCD |
| **Interface** | USB and RS232 |
| **IP Rating** | IP54 |
| **Power supply** | AC Adapter, 100 to 240 V AC input, DC 24V output |
| **Dimension** | 220 × 195 × 68 mm |
| **Weight** | 950 gm |

## 5. Applications

Benchtop pH Meter is widely used for determining pH of the solutions across academics, environmental protection, medicine, food, health, geological exploration, metallurgy, marine exploration, and other fields.

## 6. Instrument Introduction

### Overview

#### 1) Front View

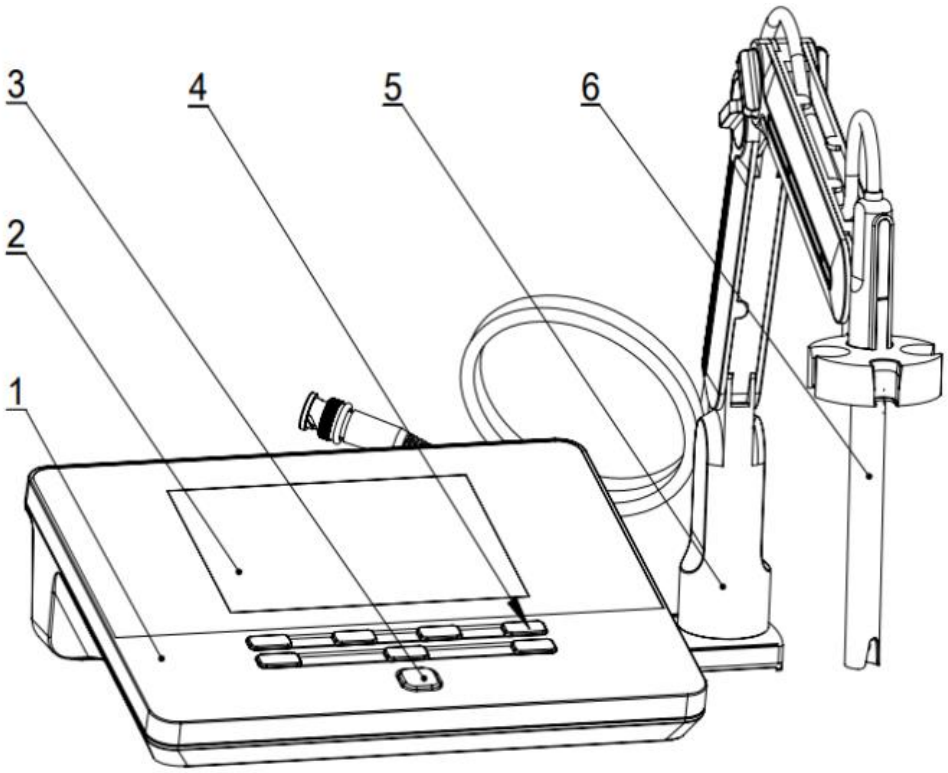



**Figure-1**

1. Meter Body
2. Display
3. Power key
4. Function Selection Key
5. Electrodes Stand
6. Ion Electrode

## 2) Back View

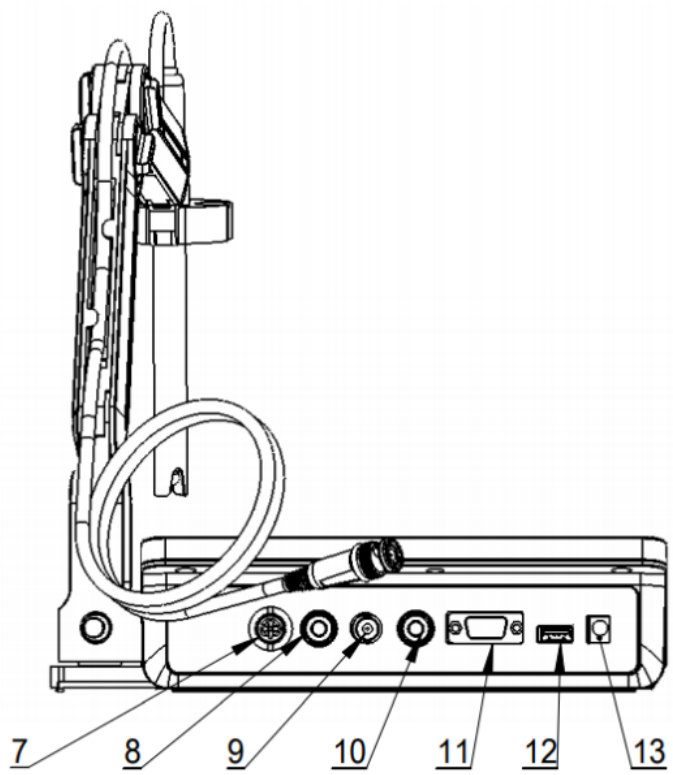



**Figure-2**

7. Temperature Electrode Socket
8. Ground Socket
9. Measurement Electrode Socket
10. Reference Electrode Socket
11. RS232 Socket
12. USB Socket
13. DC9V Power Socket

### 3) Electrodes and Connectors

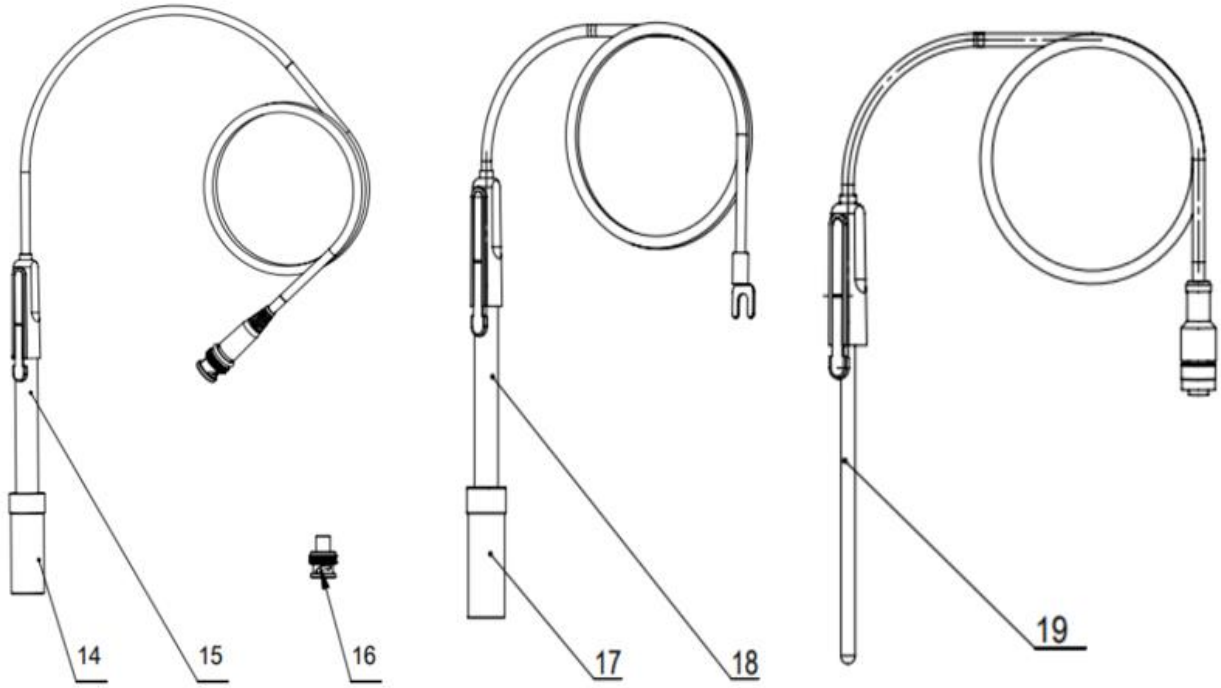



**Figure-3**

14. Ion Electrode Protection Cap
15. Fluoride Ion Electrode
16. Q9 Short Circuit Plug
17. Reference Electrode Protection Cap
18. Reference Electrode
19. Temperature Electrode

### 4) Connector Specifications

| Connector | Electrode Type |
|---|---|
| BNC (Q9) | pH, ion-selective electrode |
| Banana | Reference electrode |

# 7. Installation

## 7.1 Electrodes Stand Installation

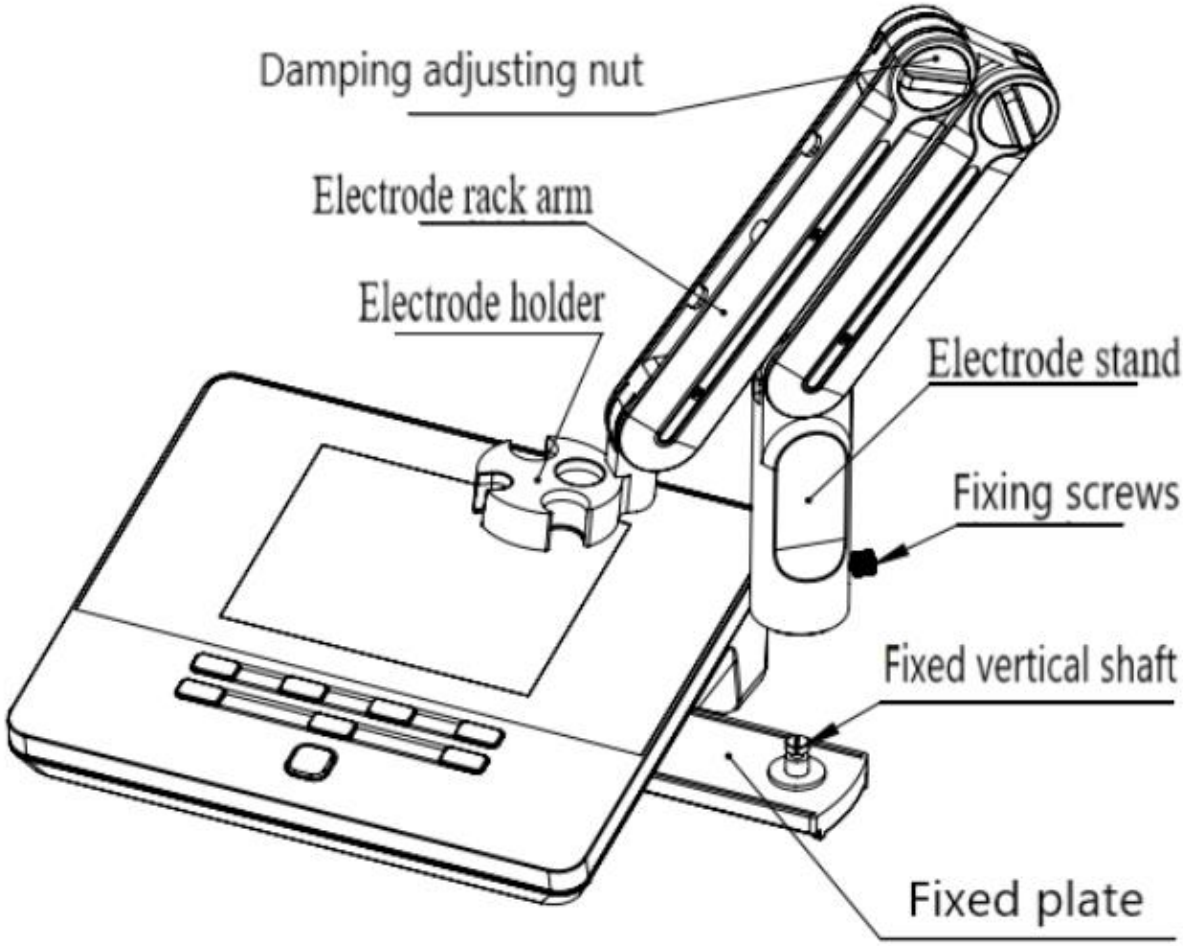



**Figure-4 (Electrode Stand Installation)**

1) Pull out the electrode holder fixing plate on the right side of the instrument.
2) Insert the center hole of the multifunctional electrode holder support (as in the above **Figure-4)** into the vertical shaft of the multifunctional electrode holder drawer.
3) Tighten the set screw on the lower part of the electrode holder's pole.

## 7.2 Electrodes Connection

1) Push the Fluoride ion electrode (**15**) (**Figure-3**) into the electrode holder (**5**). Find the measuring electrode socket (**9**) on the back of the instrument, and unplug the Q9 shorting circuit connector (**16**). Then, insert the fluoride ion electrode connector into the measuring electrode socket (**9**).
2) When other electrodes are used as required, Insert the electrode connector to the corresponding socket on the back of the instrument in the same way as above.
3) The pH meter adopted a pH combination electrode with a four-pin aviation connector. For replacement purchasing, choose electrodes with the proper connector.

# 8. Operations

## 8.1 Switch On/Off

1) After connecting the power adapter and installing the electrode stand and electrode, press ⏻ to switch on the meter.
2) The startup screen shows the software version and other related information. After the self-test program, the screen turns to the homepage and the meter is ready to measure.
3) The instrument uses touch keys as operation and control equipment and is equipped with 8 keys in total.
4) Users can complete the corresponding operations by pressing the corresponding function keys. Also, press ⏻ and hold the key for more than 3 seconds and release it to shut down.

## 8.2 Screen Icons

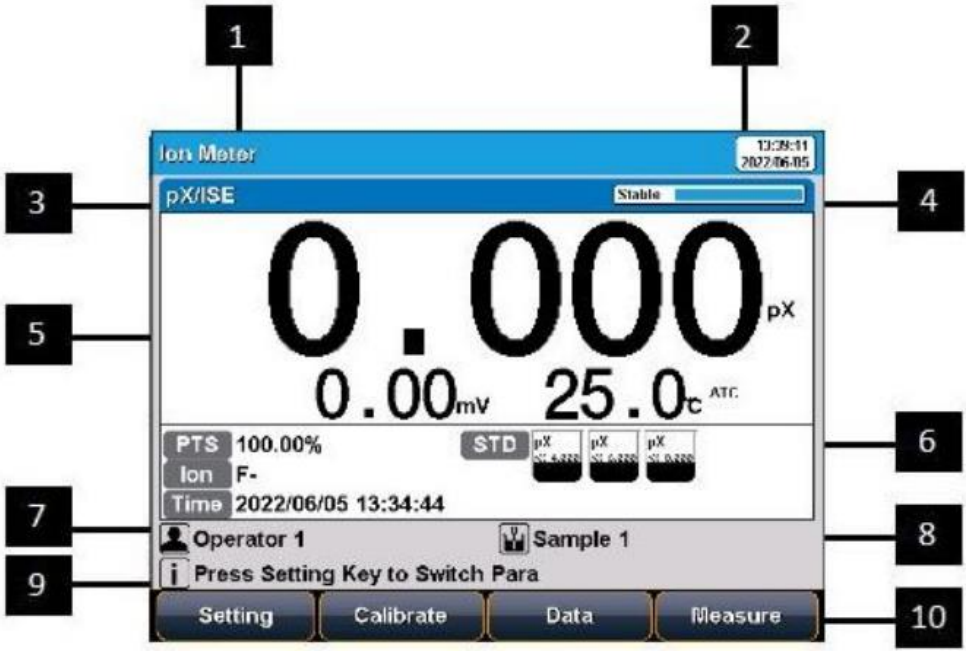



**Figure-5**

1. Instrument Model
2. System Time
3. Measurement Parameters
4. Reading Status
5. Measurement Information
6. Calibration Information
7. User ID
8. Sample
9. Operations Tips
10. Soft Function Keys

The instrument displays symbol identification that has the following functional implications:

| No. | Symbol | Explanation |
|---|---|---|
| 1. |   | Reading status, displays the measurement status of reading, stable, locked, each indicates that the processing, stable, and reading completed. |
| 2. |   | The percentage slope of the pH electrode calibration data. |
| 3. |   | The Standard buffer solution for calibration. |
| 4. |   | Standard solution. |
| 5. |   | Current measuring ions. |
| 6. |   | The time of calibration. |
| 7. |   | Standard solution for pH calibration. |
| 8. |   | Standard solution for ion calibration. |
| 9. | **ATC** | Automatic temperature compensation. |
| 10. | **MTC** | Manual temperature compensation. |
| 11. |  | User ID |
| 12. |  | Sample ID |
| 13. |  | Operation Tips. |
| 14. | **Auto Mode** | Auto-recognition of Standards. |
| 15. | **Manual Mode** | Manual recognition of Standards. |

## 8.3 Function Key

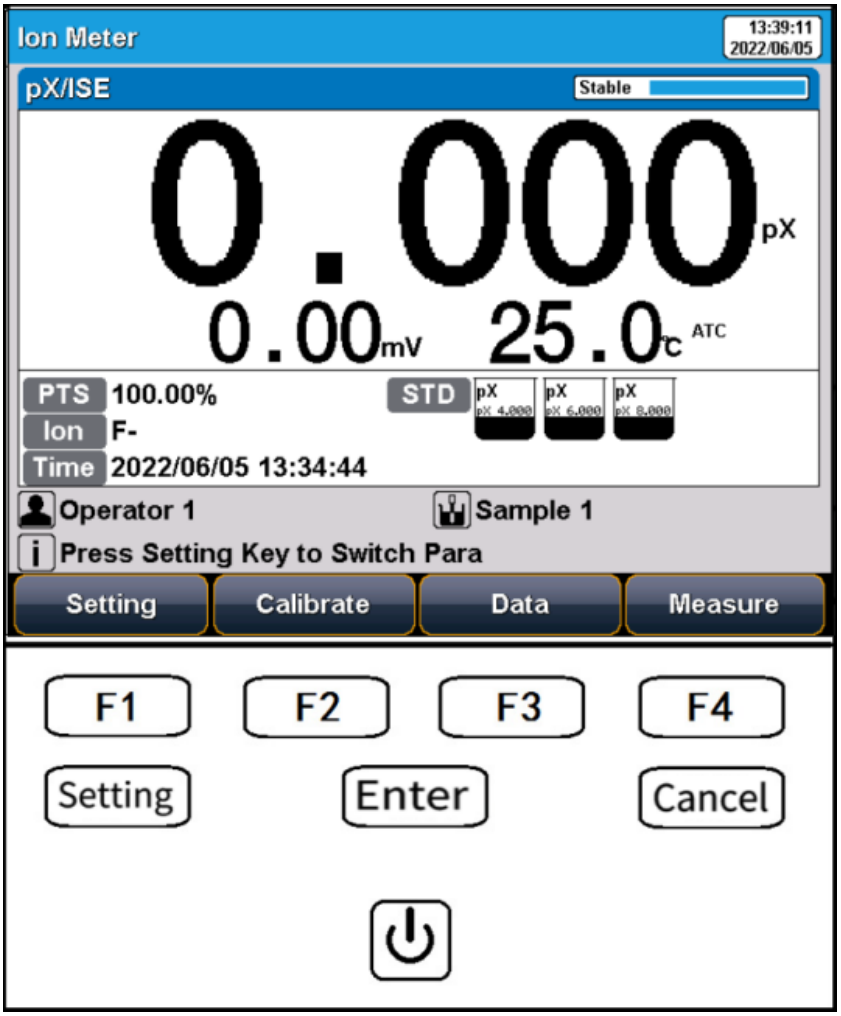



**Figure-6**

| No. | Key | Explanation | Note |
|---|---|---|---|
| **1.** | ⏻ | Power | Press to switch on/off. |
| **2.** | Setting | Setting | Set the parameters and settings. |
| **3.** | Cancel | Cancel | Cancel the operation. |
| **4.** | Enter | Enter | Confirm the option. |
| **5.** | F1 | F1 | Function key, Corresponds to the function options on the screen. |
| **6.** | F2 | F2 | Function key, Corresponds to the function options on the screen. |
| **7.** | F3 | F3 | Function key, Corresponds to the function options on the screen. |
| **8.** | F4 | F4 | Soft function keys, corresponding to the functions on the screen. |

## 8.4 Instrument Settings

In the measuring, users can set the instrument parameters by pressing "**Setting**" to set the measuring parameters.

### 8.4.1 Tutorial Setting

For the first use, please follow the guide to setting the measurement parameters. After all the settings, press "**Enter**" to return to the previous page.

### 8.4.2 Measurement Parameter Settings

It could select one measurement parameter from pH, pX/ISE, and Ion Concentration.

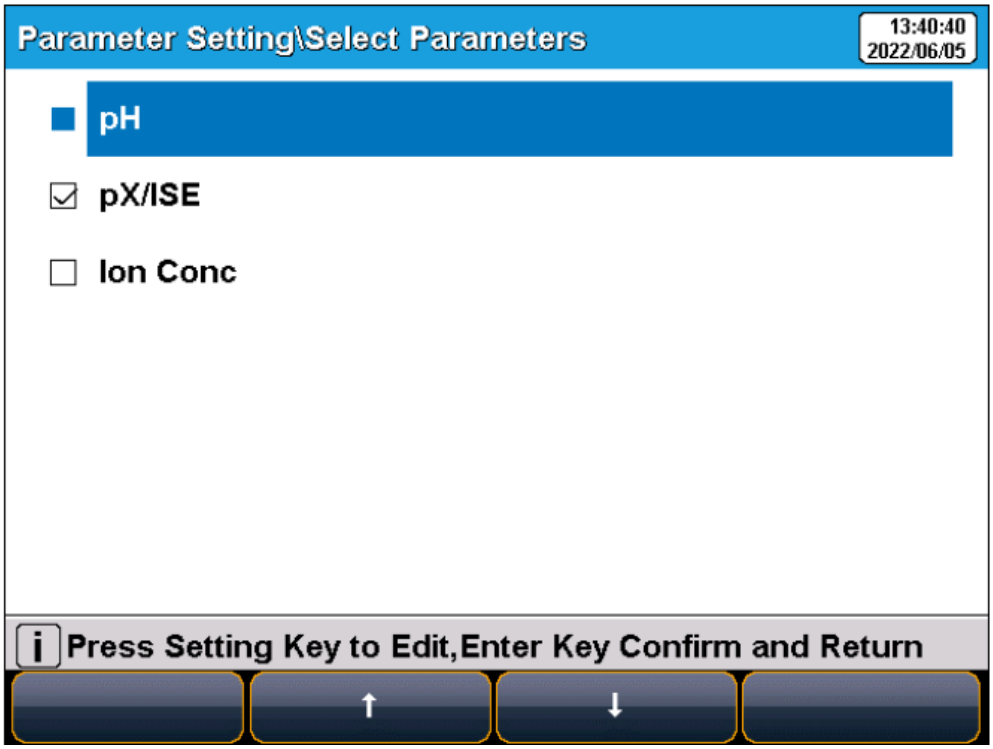



**Figure-7 (Instrument measurement parameter selection)**

### 8.4.3 Reading Mode Settings

The meter provides three reading modes, including continuous reading, auto reading, and timed reading.

1) **Continuous reading:** The instrument displays real-time measurement results. Users can end the measurement at any time and save the last result.
2) **Auto-reading:** The measurement reached the balance, and the meter locked the reading result. The meter offers "**Fast**", "**Medium**", "**Strict**" and "**Custom**" four options for endpoint detection conditions.
3) **Timed reading method:** Timed Reading contains two kinds of timed reading methods; "**Interval Measurement**" and "**Timed Measurement**". "**Interval Measurement**" provides measurement results at interval time and "**Timed Measurement**" provides measurement results after a set time.

| Stability Type | | pH | pX/Ion concentration |
|---|---|---|---|
| **Fast** | Stable time | 4s | 4s |
| | Fluctuation | 0.6mV | 0.3mV |
| **Medium** | Stable time | 6s | 8s |
| | Fluctuation | 0.1mV | 0.08mV |
| **Strict** | Stable time | 8s | 12s |
| | Fluctuation | 0.03mV | 0.03mV |
| **Custom (Recommended value)** | Stable time | 1 to 30s | 1 to 30s |
| | Fluctuation | 0.03~1mV | 0.03~1mV |

### 8.4.4 pH Parameter Setting

**1) pH standard solution group management**

The meter provides various Standards Groups including DIN, NIST, USA, and MERK. And allows the user to prepare customized Standard groups.

**Standard Solution Groups:**

| Groups | Contents |
|---|---|
| **DIN** | 1.680pH, 2.000pH, 3.557pH, 3.775pH, 4.008pH, 6.865pH, 7.000pH, 7.416pH , 9.184pH, 10.014pH, 12.454pH |
| **NIST** | 1.677pH, 4.008pH, 6.864pH, 7.000pH , 7.416pH, 10.014pH, 12.469pH |
| **USA** | 1.680pH, 4.010pH, 7.000pH, 10.010pH |
| **MERK** | 2.000pH, 4.000pH, 7.000pH, 9.000pH, 12.000pH |

- Usually, we use the pH value corresponding to 25.0°C to mark the pH standard buffer solution, such as NIST 7.00pH standard solution, which means the standard pH buffer solution is 7.00pH, and it is 7.00pH at 25.0°C.

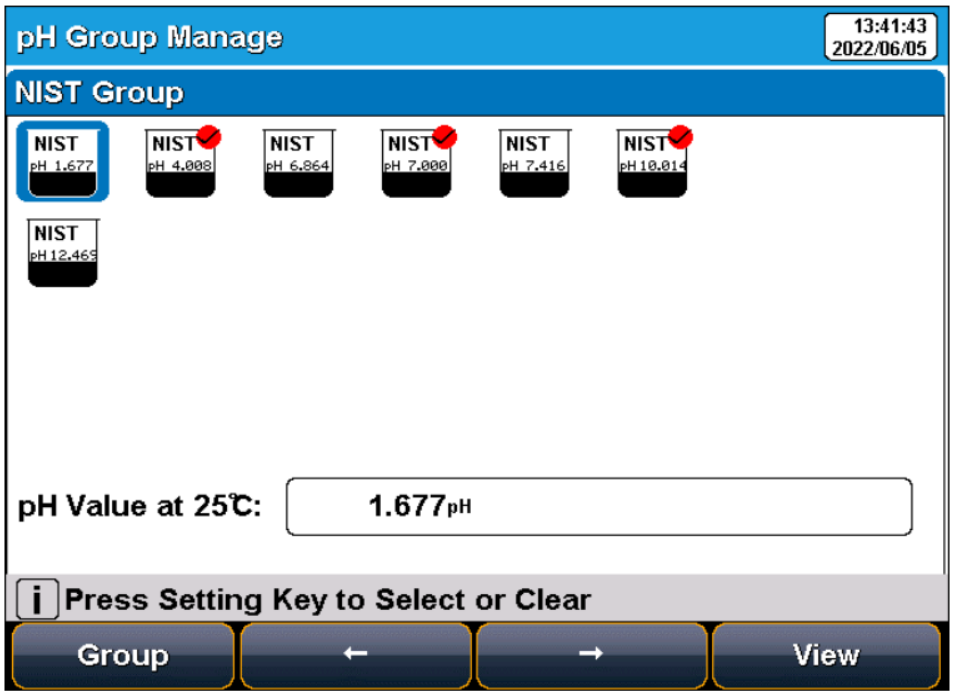



**Figure-8 (Selection of standard groups and standard solution)**

- After selecting the standard solution group, we need to select the standard buffer solution used for calibration from the standard solution group.
- The instrument supports up to 5-point calibration, that is, up to 5 standard solutions can be selected.
- Since the pH values of multiple standard buffer solutions in the standard solution group may be very close, ensuring that the instrument can correctly identify the standard buffer solution, will limit the selection of standard solutions with neighboring pH values.
- The check mark indicates the currently used standard solution group and the corresponding standard solution.

【TIPS】
If the selected standard solution group is different from the pH standard buffer solution used, it will lead to wrong calibration results.

**2) Manual standard solution identification**

In some special situations, it is necessary to use some non-standard pH buffer solutions or two very close pH standard buffer solutions for electrode calibration. In this case, the manual standard solution identification function can be used. When set to "**manual identification**", the pH value of the current standard solution can be input during and used for electrode calibration.

**3) Resolution settings**

- The pH measurement resolution of the instrument is adjustable.
- **pH resolution:** 0.001pH, 0.01pH, and 0.1pH.
- **mV resolution:** 0.01mV, 0.1 mV, and 1 mV.

### 8.4.5 pX/ISE parameter settings

**1) Select ion mode**

The measurement ions are selected as follows:

- **The instrument has built-in:** F -, Cl-, Br-, I-, NO3 -, BF4 -, NH4 +, K+, Na+, Ca2+, Cu2+, Pb2+, Ag+, etc. Before measuring the corresponding ions, the user needs to select the corresponding ion mode and the corresponding measurement electrode.
- For an ion method not provided, a new method needs to be created. Press "**Create**", and fill in the information of the ion to finish the ion method customization.

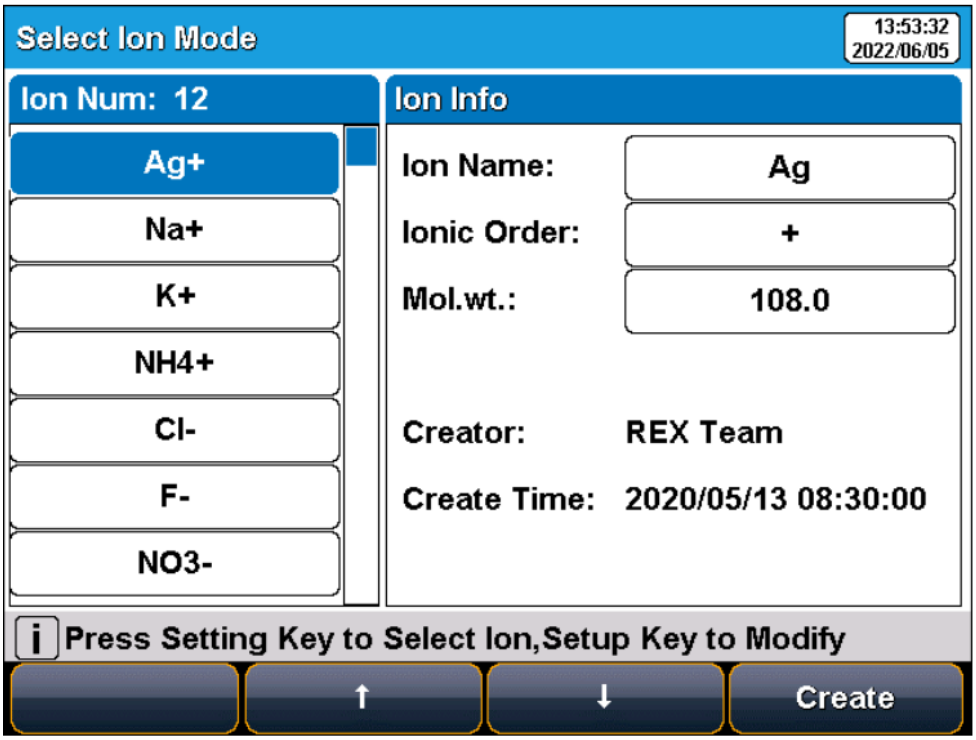



**Figure-9 (Manage and select ion modes)**

**2) Select measurement mode**

- Users can choose the following ion measurement methods according to their requirements. In general, when the ion measurement parameter selects pX or ion concentration measurement, it is recommended to use the direct reading concentration method for measurement, which has a fast measurement speed and is suitable for the measurement of batch samples. Standard addition, sample addition, and GRAN measurements are only valid when the measurement parameter selects ion concentration.
- When the measurement parameter selects "pX", the measurement mode is only valid for the direct reading concentration method; when the measurement parameter selects "ion concentration", the instrument supports 4 ion measurement modes: direct reading concentration method, standard addition method, sample addition method, GRAN Measurement method, users can choose according to actual requirements.

### 8.4.6 Temperature Parameter Settings

- The temperature unit of the meter is selectable in °C and °F.
- **Temperature compensation mode:** ATC and MTC. ATC means automatic compensation.
- **MTC** means manual compensation, it allows the user to input the temperature.

### 8.4.7 Data Management Settings

1) **Sample ID setting**
   The instrument supports three setting methods of Sample ID: Auto sample ID in number order, Auto sample ID in time order, and manual sample ID.
   - **ID in number order:** The sample ID No. is increasing with series number, allow to set ID digits (3 to 5 digits) and initial sample ID.
   - **ID in time order:** The sample ID No. is increasing with sample measuring time. Format, Year/Y, Month/M, Day/D, Hour/H, Minutes/M, Second/S.
   - **Manual sample ID:** Manually set the sample ID No when saving or printing data.

2) **Autosave setting**
   When this function is enabled, the meter saves the results when the reading is stable in the auto-reading and interval-timed reading mode**.**

3) **Overwrite setting**
   The meter provides 500 sets of measurement results storage space. When this function is enabled, the results data that exceeds capacity will overwrite the old results data.

### 8.4.8 Output option

The meter provides 500 sets of measurement results storage space. When this function is enabled, the results data that exceeds capacity will overwrite the old results data.

### 8.4.9 User ID Settings

Set the user ID.

### 8.4.10 System Parameter Settings

1) **System time settings**
   Settings of system time and data.
2) **Buzzer settings**
   Users can set the key sound by this setting.
3) **Backlight settings**
   Users can adjust the screen brightness by this setting.
4) **Automatic shutdown settings**
   The meter provides an auto shutdown function. When the meter is not using, the meter switches off automatically.
5) **Reset settings**
   When the meter is not working. Users can reset the meter from the default backup.
6) **Software version**
   Users can find the software version information on the general setting page.

## 8.5 pH Measurement

### 8.5.1 Calibration Preparation

1) The electrode slope and zero potential of pH electrodes drift slightly over time. To accurately measure pH, it is recommended to calibrate the pH electrode before use, the instrument supports 1-5 points of calibration.
2) **One-point calibration** is a calibration process with a single standard solution, commonly applied in a quick test. The calibration slope is 100% here. Two-point calibration uses two pH standard buffer solutions to calibrate the electrode and construct a linear calibration curve through two points.
3) **Two-point calibration** is the most commonly used calibration method, and it is usually recommended that the pH value of the solution to be measured lies between the two standard buffer solutions. Two-point calibration can improve pH measurement accuracy.
4) **Multi-point calibration** is a calibration process with more than one standard solution. It is recommended to calibrate between two standard buffer solutions at the pH of the solution to be tested. Multi-point calibration covers a wider measurement range for accurate pH measurement. Before starting calibration, prepare one or more pH standard buffer solutions.

### 8.5.2 Standards group selection

1) Before starting calibration, prepare one or more pH standard buffer solutions.
2) The meter has a standards recognition function; set the Standard Group before the measurement.
3) Users can also set the identification type to "**Manual Mode**" and manually enter the nominal value during the calibration process.

### 8.5.3 pH calibration

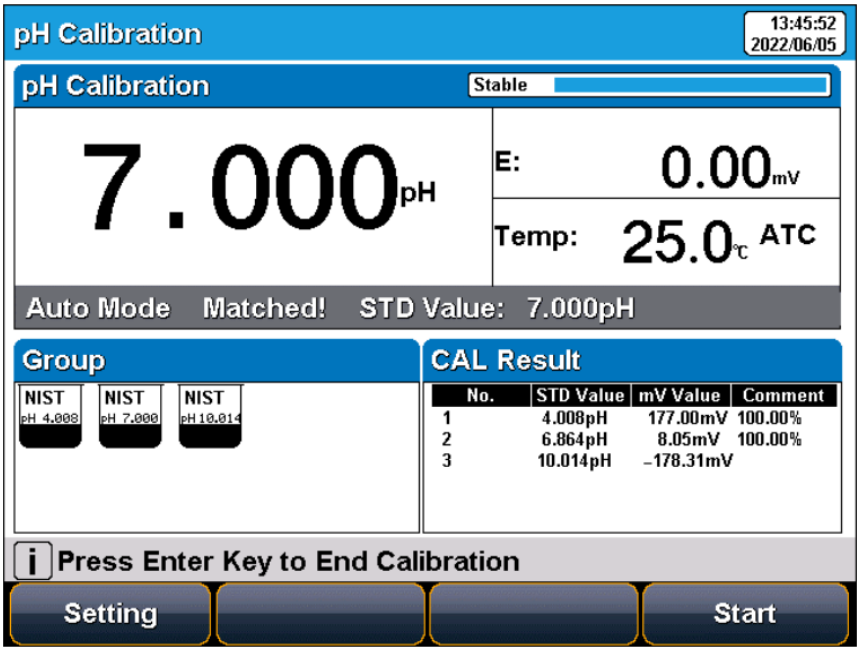



**Figure-10 (pH electrode calibration information)**

The calibration process is as follows:

1) Select a method. The method includes the parameter (e.g. pH), NIST standard solution group, pH 4.01, pH 7.00, and pH 10.01, auto Mode recognition.
2) Connect the ATC probe or enter the temperature manually.
3) Press the "**Calibrate**"-"**pH Calibration**".
4) Put the cleaned electrode into a pH 4.01 standard solution.
5) Wait for the instrument to display "**Auto Mode Matched**".
6) When the pH and temperature readings are stable, press the "**Start**".
7) If only 1-point calibration is required, after 1-point calibration is completed, press the "**End**" key to complete the calibration.
8) If multi-point calibration is required, please replace the pH7.00 and pH10.01 standard buffer solutions.
9) After cleaning the electrode, put the electrode into the standard solution. After the instrument recognizes it successfully, the instrument reads stably and presses the "**Next Point**" to complete the calibration.
10) After completing the calibration, press the "**End**" key to complete the calibration, save the calibration results, and end the calibration, directly entering the start interface. If the checked standard solution group is 5, automatically end the calibration after eight points of calibration.

【TIPS】

The meter will not save the date if the calibration results are not confirmed.

### 8.5.4 pH measurement

The measurement process is as follows:

1) Select a method. The method includes the parameter (e.g., pH), and reading mode (e.g., continuous reading, auto-reading, or time format).
2) Connect the ATC probe or enter the temperature manually.
3) Rinse the pH electrode with DI water, and dry it out.
4) Put the electrode into the test solution under test.
5) Put the measurement end of the electrode into the sample solution.
6) In the measurement status, press "**Start**" to enter into measurement status.
7) When the reading is stable, read the results.
8) Press the "**Save**" to save the measurement results and print the result.
9) Between measurements, store the pH electrode in distilled or deionized water.
10) After measurement, rinse the pH electrode with deionized water thoroughly.

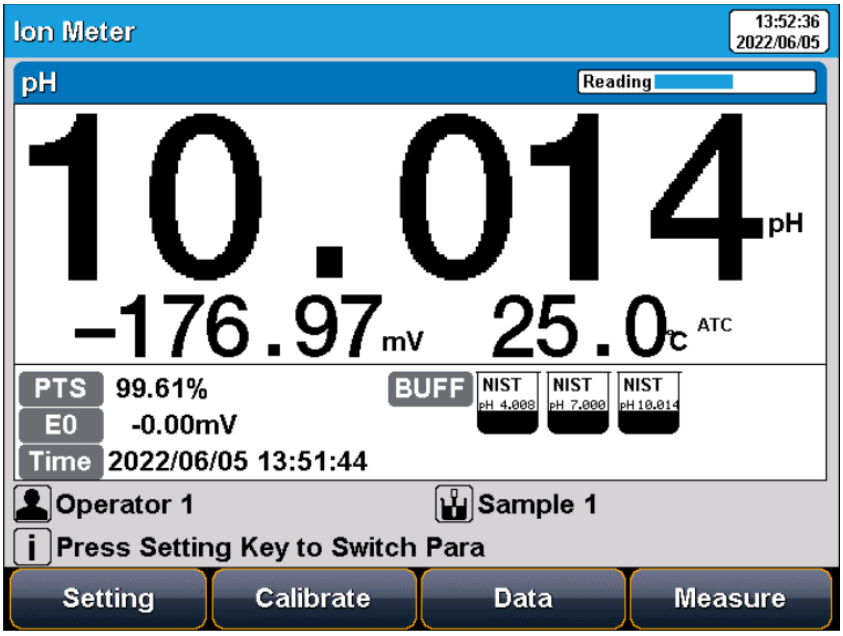



**Figure-11 (pH measurement information)**

【TIPS】

- The measurement end of the electrode should well be immersed into the sample solution.
- For high accuracy measurement, make sure the measurement is carried out at the lab with constant temperature and pressure.

## 8.6 Ion Measurement

### 8.6.1 Preparation

The slope and zero potential value of the ion electrode will change with time, so the ion electrode needs to be calibrated before use, and the instrument supports up to 5-point calibration. For the specific use of the electrode, please refer to the electrode manual.

**1) Ion-selective electrode**

The ion-selective electrode is based on the ion-selective membrane, which can be divided into a single crystal membrane, salt membrane, glass membrane, and PVC ion-selective membrane. Ion-selective electrodes usually have single electrodes and composite electrodes. Single electrodes can be used with different reference electrodes and have better measurement performance for some low-concentration ions. Composite electrodes are more convenient and simpler the operate. Users could be flexible to choose according to their requirements.

**2) Ionic strength adjustment buffer**

1) The use of ion electrodes to measure ion concentration requires the addition of an ionic strength adjustment buffer.
2) The ionic strength of a solution has an important influence on the measurement of ion concentration. On the one hand, the ion-selective electrode directly measures the activity of the ion, $\alpha = \gamma c$.
3) Wherein, $\alpha$ is the activity of the ion, $\gamma$ is the activity coefficient of the ion, and c is the ion concentration. Usually, the activity coefficient $\gamma$ is affected by the ionic strength in the solution.
4) By adding an ionic strength adjustment buffer to the standard solution and the test solution, the measured solution has a similar ionic strength to the standard solution, thereby having a similar activity coefficient $\gamma$.
5) On the other hand, in a solution with low ionic strength, the potential of the reference electrode will show instability. The addition of the ionic strength adjustment buffer can help stabilize the reference electrode.
6) Various ion measurement needs various ionic strength adjustment buffer. Common ionic strength adjustment buffers are recommended in the following table:

**Recommended ionic strength adjustment buffer:** The final concentration of the ionic strength modifier in the standard or sample.

| Ion category | Ionic strength adjustment buffer |
|---|---|
| $Na^+$ | 0.2 mol/L diisopropylamine |
| $F^-$ | 0.1 mol/L NaCl or TISAB |
| $Cl^-$ | 0.1 mol/L $KNO_3$ |
| $Br^-$ | 0.1 mol/L $KNO_3$ |
| $I^-$ | 0.1 mol/L $KNO_3$ |
| $Ag^+$ | 0.1 mol/L $NaNO_3$ |
| $Cu^{2+}$ | 0.1 mol/L $NaNO_3$ |
| $Pb^{2+}$ | 0.1 mol/L $KNO_3$ |
| $S^{2-}$ | 0.1 mol/L $KNO_3$ |
| $K^+$ | 0.05 mol/L $MgAc_2$ |
| $Ca^{2+}$ | 0.1 mol/L KCl |
| $NO3^-$ | 0.1 mol/L $NaH_2PO_4$ |
| $BF4^-$ | 0.1 mol/L $Na_2SO_4$ |
| $ClO4^-$ | 0.1 mol/L NaCl |

**3) Standard solutions preparation**

The best way to prepare standards is to use serial dilutions. Sequential dilution refers to diluting an initially prepared standard using a volumetric flask to obtain a second standard. Dilute the second standard to prepare a third standard. And so on until the required standard solution is obtained. In general, the concentration between two adjacent levels is a 10-fold relationship.

**4) Activation of the ISE electrodes**

When the electrode is used for the first time or has not been used for a long time, an activation is recommended. The electrode has better measurement performance after activation.

**Ion electrode activation solution and activation time recommendation**

| Ion category | Activation solution | Activation time |
|---|---|---|
| $Na^+$ | 10-3 mol/L NaCl | 2h |
| $F^-$ | 10-3mol/L NaF | 2h |
| $Cl^-$ | 10-3 mol/L KCl | 2h |
| $Br^-$ | 10-3mol/L NaBr | 2h |
| $I^-$ | 10-3 mol/L NaI | 2h |
| $Ag^+$ | 10-3mol/L AgNO3 | 2h |
| $Cu^{2+}$ | 10-3mol/L Cu(NO3 )2 | 2h |
| $Pb^{2+}$ | 10-3 mol/L Pb(NO3 )2 | 2h |
| $S^{2-}$ | 10-3 mol/L AgNO3 | 2h |
| $K^+$ | 10-3 mol/L KCl | 2h |
| $Ca^{2+}$ | 10-3 mol/L CaCl2 | 2h |
| $NO3^-$ | 10-3 mol/L NaNO3 | 2h |
| $BF4^-$ | 10-3 mol/L NaBF4 | 2h |
| $ClO4^-$ | 10-3mol/L NaClO4 | 2h |

【TIPS】

The activation time may variously be based on various activation solutions. See the ion-selective electrode manual for specifications.

**5) Stirrer setting**

The flow state of the solution influences the electrode potential of the ion-selective electrode. To improve the stability and repeatability of the measurement, it is recommended to use a stirrer to keep the flow rate of the solution stable during calibration and measurement.

### 8.6.2 Direct reading method

Direct Reading Measurement is a commonly used ion concentration measuring method. The Direct Reading mode uses the following Nernst formula to calculate the concentration:

$$E_x = E_0 + S \times \log(C_x + C_b)$$

**Wherein,**

**Ex**~ Equilibrium potential of the sample solution in mV.

**E0**~ zero potential value in mV.

**S** ~ Electrode slope (%).
**Cx**~ Concentration value of the sample solution, in mol/L.
**Cb**~ Blank concentration value in mol/L.
The electrode slope and zero potential value can be known from the calibration. When measuring the sample solution, the sample concentration result can be calculated from the formula. The direct-reading method is fast and suitable for quick test measurement of common samples.

### 1) Direct reading pX/ISC calibration

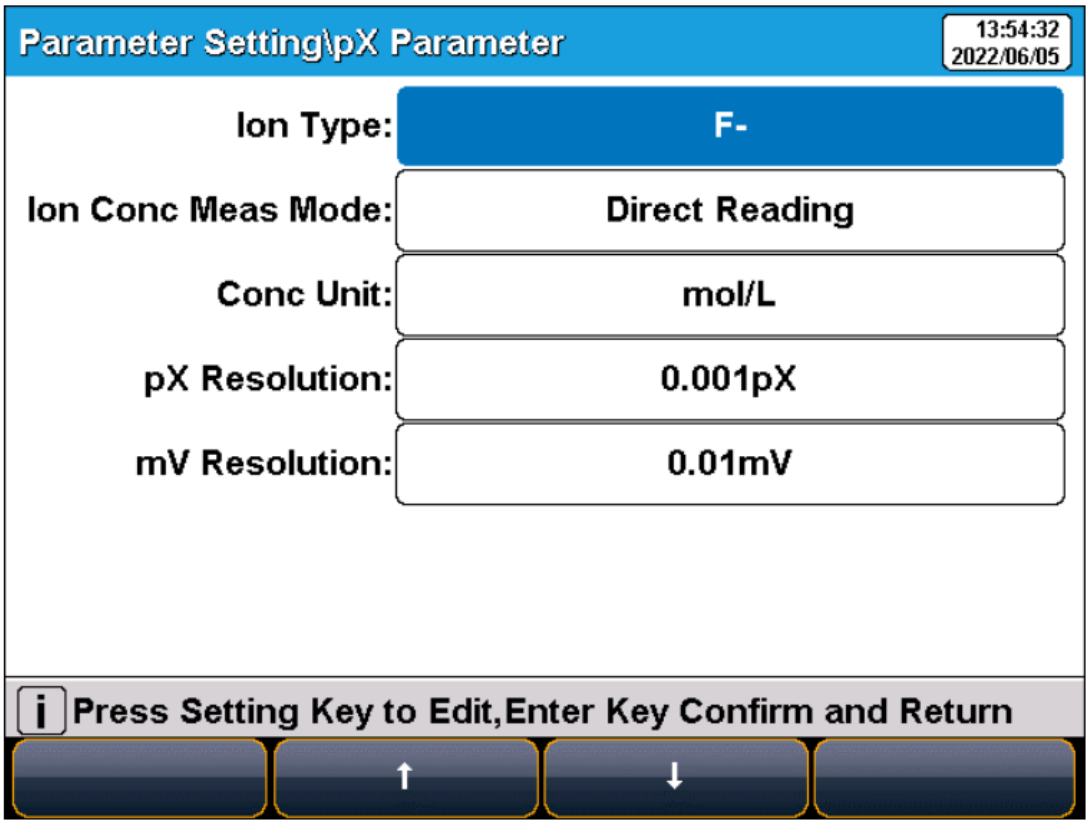



**Figure-12 (Direct reading concentration method measurement mode)**

The pX/ISE calibrations are suitable for the direct reading mode. The pX/ISE calibration process is as follows:

1. **Setting:**
   - Set the parameters (e.g., pX).
   - Set the ion mode (e.g. F-).
   - Set the Direct Reading as ion concentration measurement mode.
   - Set "Conc Unit", "pX Resolution" and "mV Resolution".
2. Add an appropriate amount of standard solution (usually 100 ml) to the beaker, then add an ionic strength adjustment buffer. Adjust the stirring speed of the solution for measurement.
3. Press the F2 "**Calibrate**"-"**pX Calibration**".
4. Put the cleaned electrode into the standard solution.

5. Press the F2 "**STD value**" to input the standard value of the standard solution.
6. Wait until the reading is stable, and press the F4 "**Start**".
7. If only 1-point calibration is required after 1-point calibration is completed, press the "**Enter**" key to complete the calibration.
8. If choosing multi-point calibration (up to 5), press "**Next Point**" to repeat the operation.
9. If the checked standard solution group is 5, automatically end the calibration after five points of calibration.

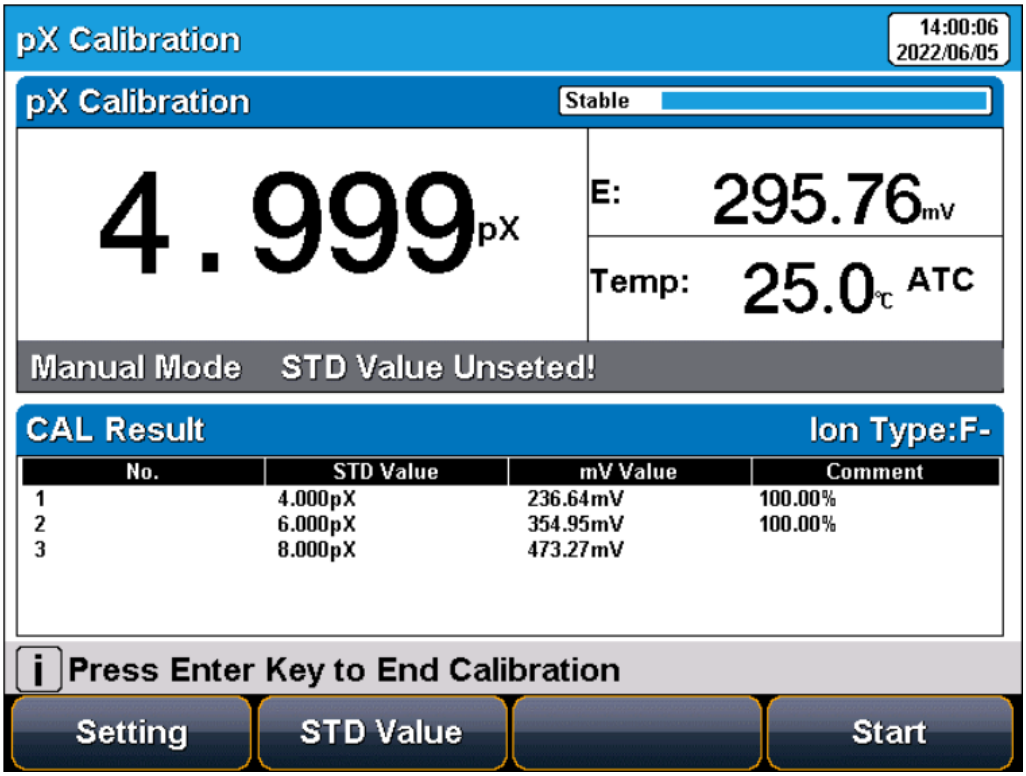



**Figure-13 (pX/ISE calibration information)**

【TIPS】

Please re-calibration for an unexpected measurement result.

A room temperature test solution is recommended.

It is recommended to calibrate from low concentration to high concentration standards.

**2) Direct reading measurement**

The measurement process is as follows:

1. **Setting:**
   - Set the parameters (e.g., pX).
   - Set the ion type (e.g. F-).
   - Set the direct Reading as ion concentration measurement mode.
   - Set the concentration unit (e.g. mol/L).
   - Set the reading mode (e.g. continuous reading, auto-reading, or timed
   - format).
2. Add an appropriate amount of standard solution (usually 100 ml) to the beaker, then add an ionic strength adjustment buffer. Adjust the stirring speed of the solution for measurement.
3. In the idle status, press F4"**Measure**" to enter into measurement status.
4. When the reading is stable, read the results.
5. Press the "**Save**" to save the measurement results.
6. Press the "**Output**" to print the measurement result when connected to the printer.
7. Between measurements, store the ISE electrode in distilled or deionized water.
8. After measurement, rinse the ISE electrode with deionized water thoroughly.

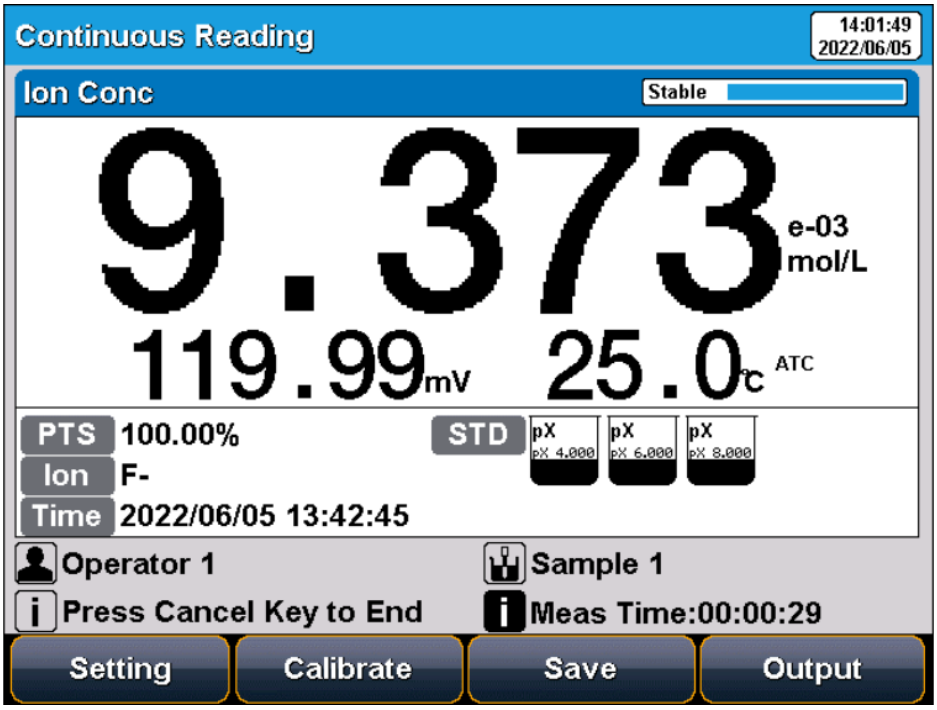



**Figure-14 (pX/ISE measurement information)**

【TIPS】

Different ISE probes have different potential values in a blank solution. If the blank potential is away from the reference value, the user can do an activation to improve the performance of electrodes. If the electrode still does not meet the requirements, a new electrode is quite considerable.

### 8.6.3 Standard addition method

Also known as the additive method, it is mainly used to measure samples with tiny content. First, the equilibrium potential value of the system is determined, then a standard solution of known concentration is added to the system and the equilibrium potential value of the system is determined. From the potential change, the sample concentration result can be calculated by the formula as follows:

$$C_x = \frac{\rho \times C_s}{(1+\rho) \times 10^{(E_2 - E_1)/S} - 1} + \frac{\rho \times C_b}{(1+\rho) \times 10^{(E_{b2} - E_{b1})/S} - 1}$$

**Wherein,**

**Cx** is the concentration value of the sample solution, in unit mol/L.
**Cs** is the concentration value of the standard (addition solution), in mol/ L.
**S** is the electrode slope (%).
**Cb** is a blank standard concentration value in mol/L.
**E1** is the potential value before the standard addition, in mV.
**E2** is the potential value after the standard addition, in mV.
**ρ** is the Standard add volume (Vs) / volume of sample to be tested (Vx).
**Eb1** is the potential value before the standard of calibration, in mV.
**Eb2** is the potential value after the standard of calibration, in mV.

【TIPS】
Before measuring, enter the related information of sample and standard, blank calibration can be also tested by this method.

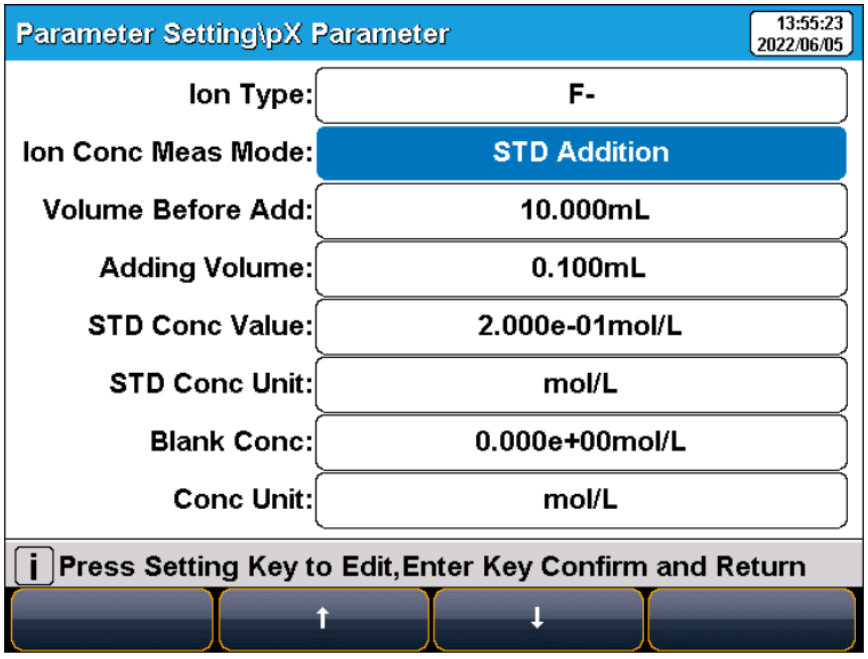



**Figure-15 (Standard addition method ion measurement mode)**

The standard addition measurement process is as follows:

1. **Setting:**
   - Set the parameters (e.g. Ion Conc).
   - Set the ion mode (e.g. F-).
   - Set the STD Addition as concentration measurement mode.
   - Set "**Volume Before Add**", "**Adding Volume**", "**STD Conc value**", "**STD Conc Unit**", "**Blank Conc**" and "**Conc Unit**".
   - Set the reading mode (e.g., continuous reading, auto-reading, or timed format).
2. Add an appropriate amount of sample solution (usually 100 ml) to the beaker, then add an ionic strength adjustment buffer. Adjust the stirring speed of the solution for measurement.
3. Put the cleaned electrode into the standard solution.
4. Press the F3"**Measure**".
5. Press "**Next**" after the reading is stable.
6. Follow the prompts to add the preset standard.
7. Press "**Next**" to measure the potential value of the solution.
8. After the reading is stable, press "**Next**" to end the measurement.
9. The results are shown by auto calculation.
10. Press the "**Save**" to save the measurement results.
11. Press the "**Output**" to print the measurement result when connected to the printer.

### 8.6.4 Sample addition method

The method is similar to the standard addition method and is mainly used to measure samples with high-content sample solutions. The standard is replaced by samples to add to the sample solution. The calculation formula is as follows:

$$C_x = C_s \times [(1+\rho) \times 10^{(E_2 - E_1)/S} - \rho]$$

**Wherein,**

**Cx**~ the concentration value of the sample solution (addition solution), in mol/L.

**Cs**~ concentration value of the standard, in mol/L.

**ρ** ~Volume of the standard (Vs)/ Volume of the sample to be tested (Vx).

**E1**~ The potential value before the sample addition, in mV.

**E2**~ The potential value after the sample addition, in mV.

**S** ~ Electrode slope (%).

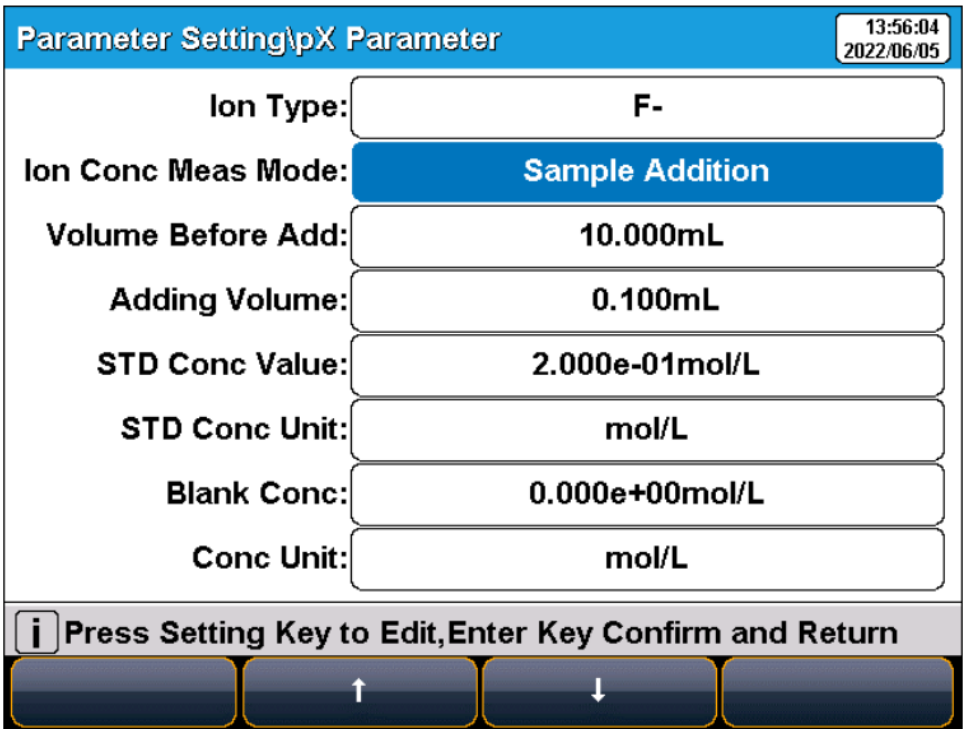



**Figure-16 (Sample addition method ion measurement mode)**

The sample addition measurement process is as follows:

1. **Setting:**
   - Set the parameters (e.g. Ion Conc).
   - Set the ion type (e.g. F-).
   - Set the sample addition as concentration measurement mode.
   - Set "**Volume before Add**", "**Adding Volume**", "**STD Conc value**", "**STD Conc Unit**", "**Blank Conc**" and "**Conc Unit**".
   - Set the concentration unit (e.g. mol/L).
   - Set the reading mode (e.g., continuous reading, auto-reading, or timed format).
2. Add an appropriate amount of standard solution (usually 100 ml) to the beaker, then add an ionic strength adjustment buffer. Adjust the stirring speed of the solution for measurement.
3. Put the cleaned electrode into the standard solution.
4. Press the F3"**Measure**".
5. Press "**Next**" after the reading is stable.
6. Follow the prompts to add the preset sample.
7. Press "**Next**" to measure the potential value of the solution.
8. After the reading is stable, press "**Next**" to end the measurement.
9. The results are shown by auto calculation.
10. Press the "**Save**" to save the measurement results.
11. Press the "**Output**" to print the measurement result when connected to the printer.

### 8.6.5 GRAN method

The measurement process is like the standard addition method, mainly for measuring samples with low content. According to the mathematical principle of GRAN mode, the ion concentration results of the sample can be calculated using the following equation:

$$(V_s + V_x) \times 10^{E/S} = 10^{E_0/S} \times (C_x V_x) + 10^{E_0/S} \times (C_s V_s)$$

**Wherein,**

**Cx**~ the concentration value of the sample solution (addition solution), in mol/L.
**Cs**~ concentration value of the standard, in mL.
**Vs**~ volume of standard, in mL.
**Vx**~ Volume of the sample to be tested in mol/L.
**E**~ The equilibrium potential of the sample solution (sample), in mV.
**E0**~ zero potential value, in mV.
**S** ~ electrode slope (%).

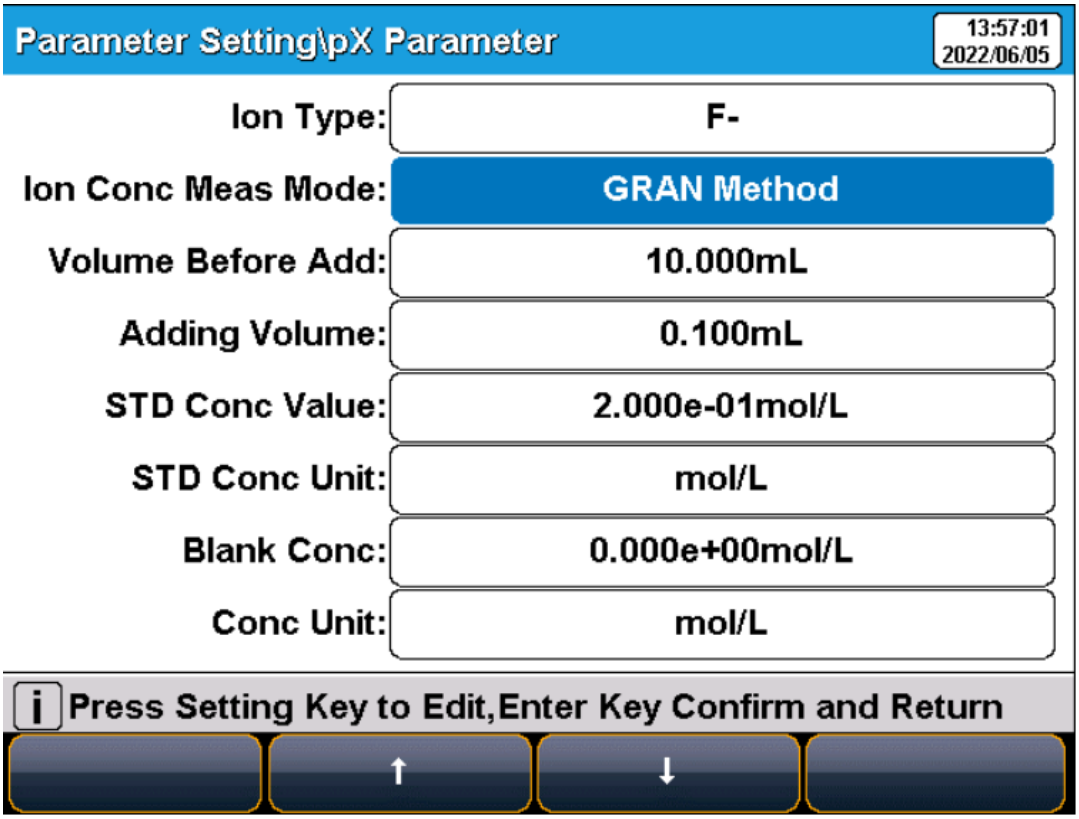
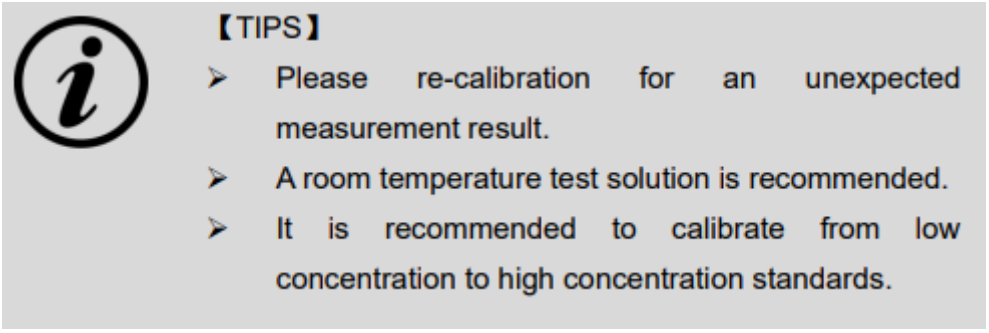



**Figure-17 (Ion measurement mode of GRAN measurement method)**

The GRAN measurement process is as follows:

1. **Setting:**
   - Set the parameters (e.g. Ion Conc).
   - Set the ion mode (e.g. F-).
   - Set the GRAN as concentration meas mode.
   - Set "**Volume before Add**", "**Adding Volume**", "**STD Conc Value**",
   - "**STD Conc Unit**", "**Blank Conc**" and "**Conc Unit**".
   - Set the reading mode (e.g., continuous reading, auto-reading, or timed format).
2. Add an appropriate amount of sample solution (usually 100 ml) to the beaker, then add an ionic strength adjustment buffer. Adjust the stirring speed of the solution for measurement.
3. Put the cleaned electrode into the standard solution.
4. Press the F3"**Measure**".
5. Press "**Next**" after the reading is stable.
6. Follow the prompts to add the preset standard.
7. Press "**Next**" to measure the potential value of the solution.
8. After the reading is stable, repeat the step 6 and step 7 for 3 or 8 times.
9. The results are shown by auto calculation.
10. Press the "**Save**" to save the measurement results.
11. Press the "**Output**" to print the measurement result when connected to the printer.




## 8.7 Data Management

1) Press "**Data**" to view the details of the results. The meter stores the measurement results independently according to the measured parameters.
2) The meter provides data Storage of 500 sets for each parameter (pH/mV/Temp). The user can press "**Delete**" in the delete menu.
3) It allows users to select the parameter data or all data to delete. The user can view the data filter by parameter, and locate No. or stored date. By the filter setting, press "**Start Search**" to look up the data.
4) The filter data is shown in a graph. Press "←" and"→" to choose data. Users can choose one and press the "**Enter**" key to see the detailed result.
5) Users can press "**Delete**" to delete the current result. Press "**Output**" to select the output data. The format supports the output of the current result, output matched result, and output of all results.

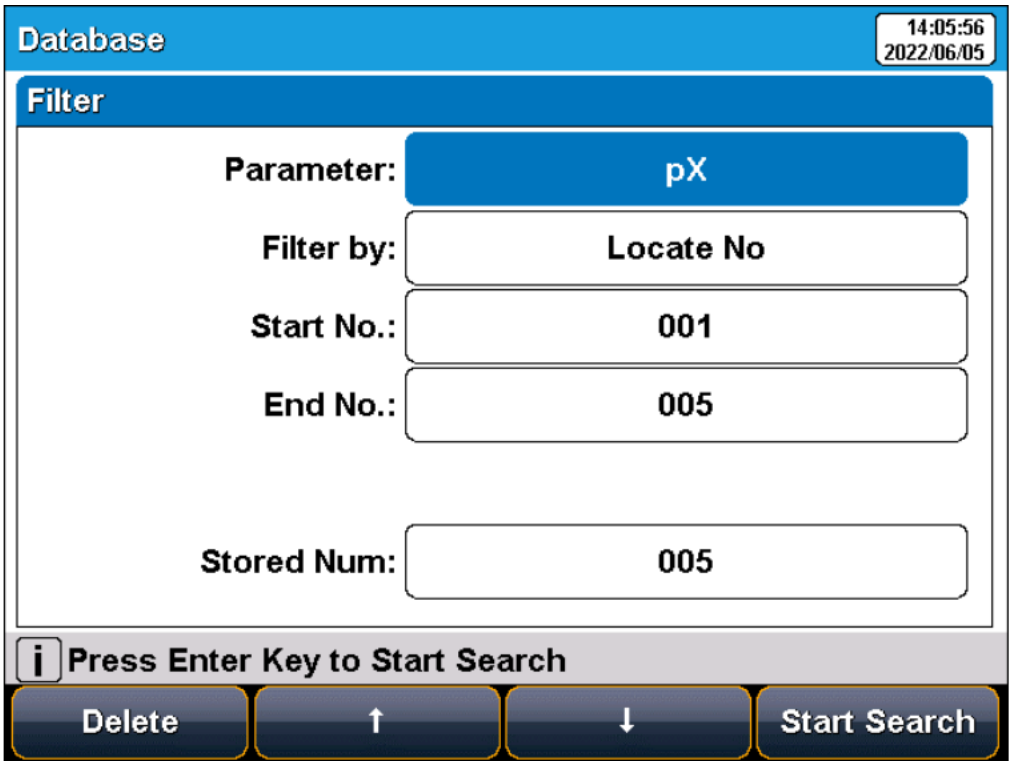



**Figure-18 (Results setting view)**

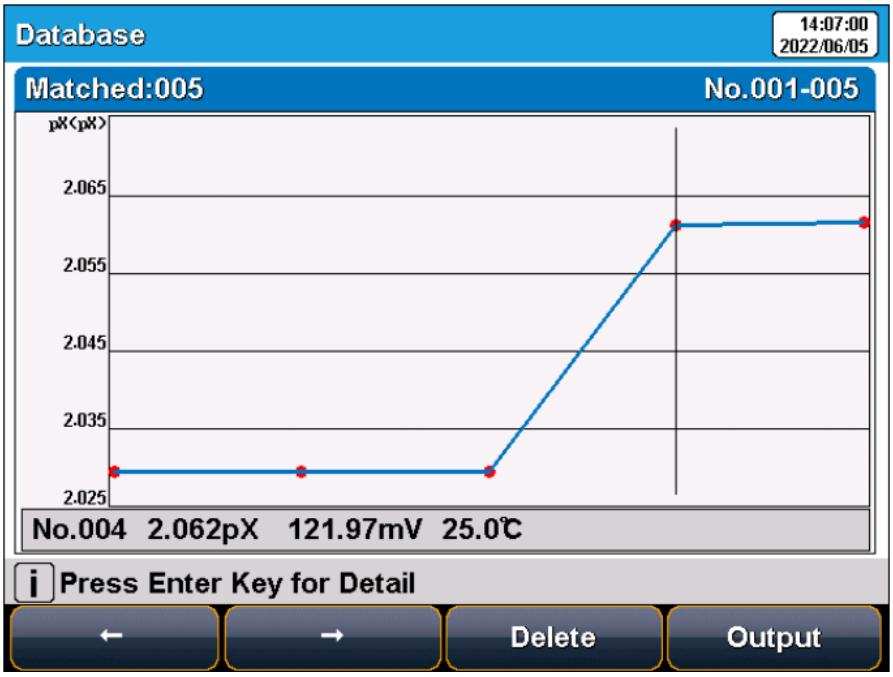



**Figure-19 (Review stored results)**

【TIPS】

- In order to ensure the correct use of the instrument and avoid burning the instrument and causing
- unnecessary losses to you, please turn off the power of the instrument and printer before connecting the printer.
- The communication baud rate of the meter is always 9600bps, the default setting is 8 data bits, one start bit, one stop bit, no parity.

The output format is approximately as follows:

```
**************************************
Report Title
--------------------------------------
Measure Time:2021/01/19 12:27:28
Operator: Operator 1
Model:  I400F pH/Ion Meter
Serial Number:
SW Version: Ver 1.00
--------------------------------------
.........................MATCHED INFO
Stored Num:                        28
Matched Num:                        1
Stored No.:                        15

.........................CALIB INFO
Calib Operator:                REX Team
Calib Time:          2020/05/13 08:30:00
Calib Num:                          3
.........................CALIB RESULT
STD 1:  4.003pH    177.3mV   25.0c
STD 2:  6.864pH      8.0mV   25.0c
STD 3:  9.182pH   -129.1mV   25.0c
pH Slope 1:                    100.00%
pH E0 1:                         0.0mV
pH Slope 2:                    100.00%
pH E0 2:                         0.0mV
.........................BRIEF INFO
Reading Mode:            Timed Reading
Stable Type:                    Medium
Temp Comp Type:                    ATC
.........................SAMPLE INFO
Sample ID:                    Sample 1
.........................RESULT
Result:                        7.000pH
Signal Value:                   -0.0mV
Temp Value:                      25.0c
--------------------------------------
--------------------------------------
                Signature:
```

# 9. Maintenance

**Meter Maintenance**

The correct use and maintenance of the instrument can ensure accurate and reliable performance. Additionally, exposure to chemicals or harsh use environments can affect performance.

The pH/pX electrode socket has a protective plug, when the meter is not in use, insert the protective plug into the pH/pX socket.

1) If the meter is not used long, disconnect the power supply.
2) The electrode socket of the instrument must be kept clean and dry, and should not be in contact with acid, alkali, and salt solutions.
3) Keep the meter and accessories clean and away from acids, alkalis, and any corrosive solutions/gases.
4) Users can clean the meter surface with clean water and detergent.
5) When the meter is transported, please follow the instructions:
   - Remove all connected cables.
   - Remove the electrode holder.
   - Use the original packaging in long-distance transport to avoid damage.

## 10. Troubleshooting

| Phenomenon | Possible Reasons | Solutions |
|---|---|---|
| No Display | It is not powered on. | Connect the adapter and press the power key to turn it on. |
| | Damage to the meter. | Replace or repair as required. |
| Incorrect mV measurement | The electrode is out of service life. | Replace the electrodes. |
| | The electrode plug is in poor contact. | Connect the protection plug, if the potential is not 0mV. |
| Incorrect pH measurement | The electrodes are not calibrated or they are calibrated incorrectly. | Recalibrate the electrode or replace the standard solution. |
| Incorrect pX/ISE measurement | The electrodes are not calibrated or they are calibrated incorrectly. | Recalibrate the electrode or replace the standard solution. |
| | Incorrect ISE probe. | Buy the correct ISE probe. Add ionic strength adjustment buffer. |

If the meter still does not work, contact your local technical support for further assistance.

# 11. Accessories

**Optional Accessories**
mV/ORP Electrode

## 12. Appendix

**pH/pX**

- **pH/pX Slope:** The amount of potential change generated by each 1 pH/pX change, expressed in mV/pH or by 100% Theoretical Slope (PTS). pX = - log[X], where [X] means molar concentration (mol/L) of X ions.
- **E0 of pH:** Also known as "**zero potential**", it usually refers to the potential value at a pH of 7.
- **One-point calibration:** Calibration with a standard solution.
- **Two-point calibration:** Calibration with two standard solutions.
- **Multi-point calibration:** Calibration with more than two standard solutions.

**pH-Temperature Relationship Table of pH Standard Solutions**

| Temperature( ℃) | 1.68 | 4.01 | 7.00 | 10.01 |
|---|---|---|---|---|
| 5 | 1.67 | 4.00 | 7.09 | 10.25 |
| 10 | 1.67 | 4.00 | 7.06 | 10.18 |
| 15 | 1.67 | 4.00 | 7.04 | 10.12 |
| 20 | 1.68 | 4.00 | 7.02 | 10.06 |
| 25 | 1.68 | 4.01 | 7.00 | 10.01 |
| 30 | 1.68 | 4.01 | 6.99 | 9.97 |
| 35 | 1.69 | 4.02 | 6.98 | 9.93 |
| 40 | 1.69 | 4.03 | 6.97 | 9.89 |
| 45 | 1.7 | 4.04 | 6.97 | 9.86 |
| 50 | 1.71 | 4.06 | 6.97 | 9.83 |