Operation Manual

BMET-303

Conductivity Meter

Thank you for Choosing Biolab products. Please read the “Operating Instructions” and “Warranty” before operating this unit to assure proper operation.

INDEX

01 Introduction

1.1 Introduction

BMET-303 Conductivity Meter can measure conductivity and TDS in water solution, and can be widely used in universities, environmental protection, medicine, food, sanitation, geological prospecting, metallurgy, ocean exploration.

General Features

- Color high resolution LCD display , 5.7 inches.
- Multi reading feature allows auto read, timed read and continuous read.
- Automatic/Manual temperature compensation ensures accurate results.
- Auto-hold feature senses and locks the measurement endpoint.
- Data storage 500 sets (GLP compliant).
- Support for USB or RS 232 communication.
- Reset feature automatically resumes all settings back to factory default options.
- IP 54 waterproof
- 1-3 point s calibration automatically recognizes the standard solutions, including 12.88mS/cm, 1413µS/cm and 84µS/cm.
- Settable parameters, including cell constant, temperature compensation coefficient and TDS factor.
- Temperature compensation type none, linear, pure water)

1.2 Technical Specification

Table 1-1 Instrument Specifications

Model		BMET-303
Conductivity	Range	0.000 µS/cm~1000mS/cm
	Resolution	0.001 µS/cm, automatic switching according to the range
	Accuracy	±0.5% (FS)
	Repeatability	0.17%(FS)
	Measurement Accuracy	±0.80% (FS)
	Measurement Repeatability	0.40% (FS)
Resistivity	Range	5.00Ω·cm~100.0MΩ·cm
	Resolution	0.01Ω·cm, automatic switching according to the range
	Accuracy	±0.5% (FS)
TDS	Range	0.000 ppm~1000ppt
	Resolution	0.001ppm, automatic switching according to the range
	Accuracy	±0.5% (FS)
Salinity	Range	0.0~80.0 ppt
	Resolution	0.1 ppt
	Accuracy	±1 ppt
	Measurement Accuracy	±2 ppt
Temperature	Range	(-10.0~135.0) °C
	Resolution	0.1 °C

Temperature	Accuracy	±0.1 °C
	Instrument indication error	±0.3°C(0.0°C~60.0°C), ±1.0°C(Else)
Work environment		Ambient temperature: (0~40) °C Relative humidity: not more than 85%
Dimensions (L×B×H), weight (kg).		242mm×195mm×68mm, 0.9kg
Power supply		AC Adapter,100-240V AC input, DC 9V output

1.3 Function Introduction

Table 1-2 Functions Specification

Features		Explanation
Basic Function	Backlight adjustment	●
	Automatic diagnostics	●
	Factory reset	●
	Default parameter	●
	Prompt Sound	●
	Time settings	●
	Power failure protection	●
	Firmware upgrade	●
	Anti-interference automatic recovery	●
	Automatic shutdown	●
	Protection	IP54
Reading Function	Reading stability settings	●
	Auto-lock reading	●
	Reading Mode	●
	Sample ID	●
	Storage	500 sets of measurement parameters each

Data Management	View	●
	Delete	●
	GLP	●
Communications and external devices	Printer	RS232 Serial Printer
	Content and format customization	●
	PC	●
Conductivity Measurement	Conductivity	●
	Resistivity	●
	TDS	●
	Salinity	●
	Conductivity-ash	●
	Reference temperature	20.0°C, 25.0°C
	Multi-point calibration	3 points
	Automatic standard solutions recognition	12.88mS/cm, 1413μS/cm and 84μS/cm
	Cell constant set	●
	Temperature compensation coefficient set	●
Conductivity Measurement	Salinity compensation coefficient set	●
	Compensation mode	Non-compensatory, linear, pure water
	Automatic temperature compensation	●
	Manual temperature compensation	●
Temperature Measurement	Temperature units	℃, ℉

● Equipped

02 Safety Notices

Please read the entire contents of this manual carefully before use, and please 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.
- Please 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.

【TIPS】
TIPS help users to use the meter.

03 Terms Explanation

- Cell Constant: Also known as the conductivity cell constant. The ratio of the distance to the area of the electrode sheet, expressed in cm^{-1} . Usually, there are conductance electrodes with several cell constants such as 0.01, 0.1, 1.0, 10, etc. The conductance electrode with a cell constant of 1.0 is the most used one and has a wide measurement range.

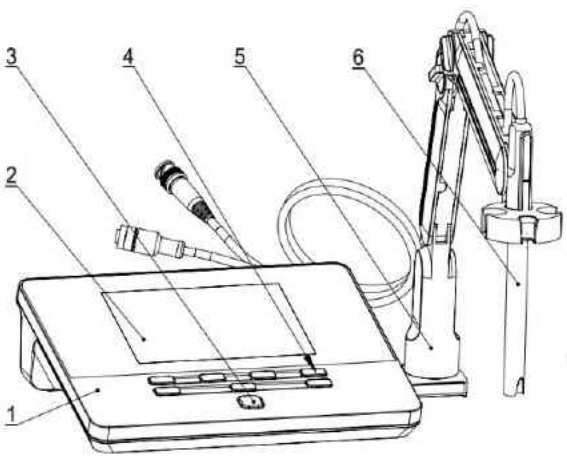
- Temperature Coefficient: The change in conductivity caused by a 1°C change in temperature is usually expressed in %/°C, and the default is 0.02, which is 2.00%/°C.

- TDS Conversion Factor: The conversion factor between conductivit y and TDS, which defaults to 0. 71.

- Unit conversion 1 ppt=10^3 ppm=1g/L , 1ppm=10^3 ppb=1mg/L 1ppb=10^{-3} ppm =1μg/L

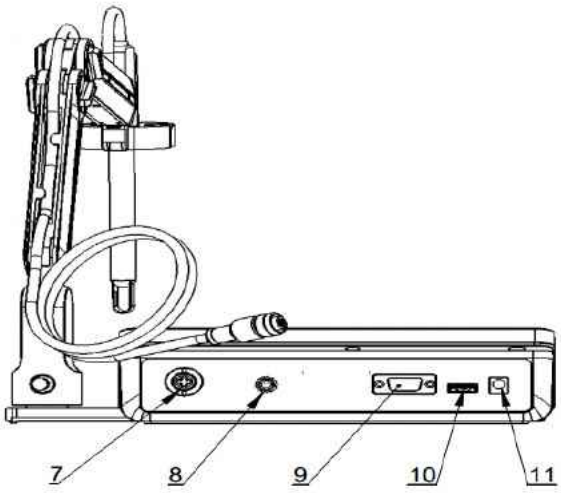
04 Overview and Installation

4.1 Overview



1 Meter Body
2 Display
3 Power Key
4 Function selection keys
5 Electrodes Stand
6 pH Electrode

Figure 4-1 Overview-Front View



7 EC Socket
8Ground Terminal
9 RS232
10 USB
11 DC/9V

Figure 4-2 Overview- Back View

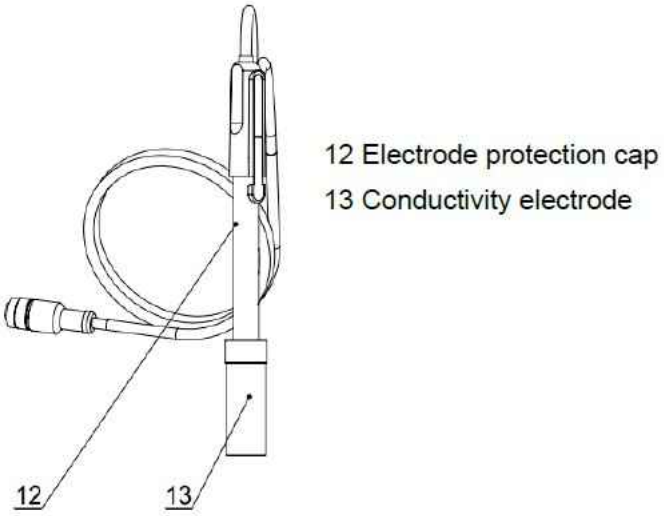


Figure 4-3 Electrodes and connectors

Table 4-1 Connector Specifications

Electrode type	Connector specifications
Conductivity electrode	5-pin aviation

4.2 Instrument Installation

4.2.1 Electrodes Stand Installation

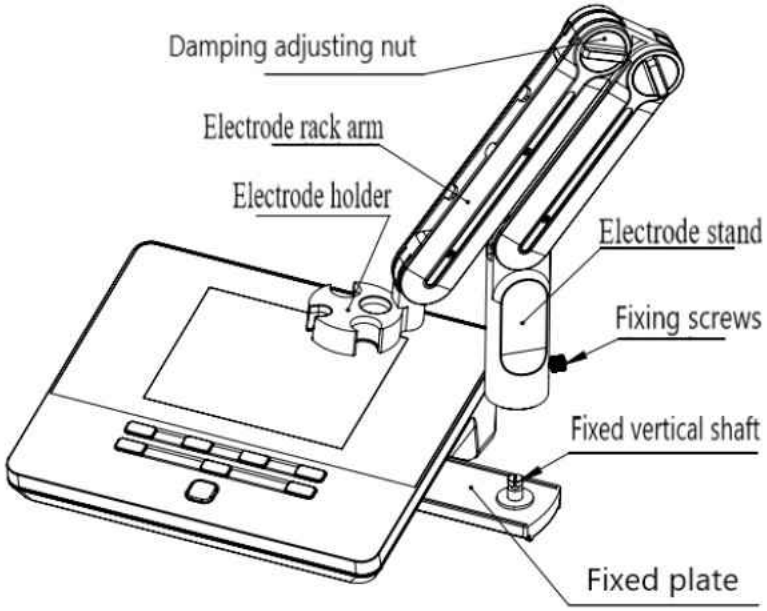


Figure 4-4 Electrode Stand Installation

1) Pull out the electrode holder fixing plate on the right side of the instrument,
2) Insert the multifunctional electrode holder support into the vertical shaft of the multifunctional electrode holder drawer,
3) Tighten the set screw on the lower part of the pole of the electrode holder.

4.2.2 Electrodes Connection

Push the conductivity electrode into the electrode holder. Remove the protector cap of the conductivi ty electrode. Connect the conductivity electrode into the right socket. Combination conductivity probes integrated with ATC probe. If the separate ATC probe is applied, please connect the ATC probe onto the DO/T electrode socket. At the measurement, please choose the right input of ATC in the meter when you applied a separate ATC probe.

【TIPS】
The 400F Series adopted a Conductivity Electrode with a five-pin aviation connector.

05 Instrument Operation

5.1 Switch On/Off

Press and release to switch on the meter. 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.

The meter equipped with 8 function keys. Users press and hold the key for more than 3 seconds and release to shut down.

5.2 Screen Icons

Figure 5-1 Screen icons explanation

1 Meter model's name. 2 System time.3 Parameter.4.Reading state.5Measurement box. 6Calibration information. 7User ID. 8Sample ID.9Operation explanation.10Function buttons.

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

Table 5-1 Symbol Explanation

No.	Symbol	Explanation
1		Reading status, display the measurement status of reading, stable, locked each indicates that the processing, stable, and reading completed.
2		Automatic temperature compensation
3		Manual temperature compensation
4		Standard solution for conductivity calibration
5		Cell constant
6		The reference temperature in EC measuring
7		Temperature ecoefficiency
8		Temperature compensation mode
9		Type of cell constant calibration
10		Calibration time
11		TDS factor
12		User ID
13		Sample ID
14		Operation notice

5.3 Function Key

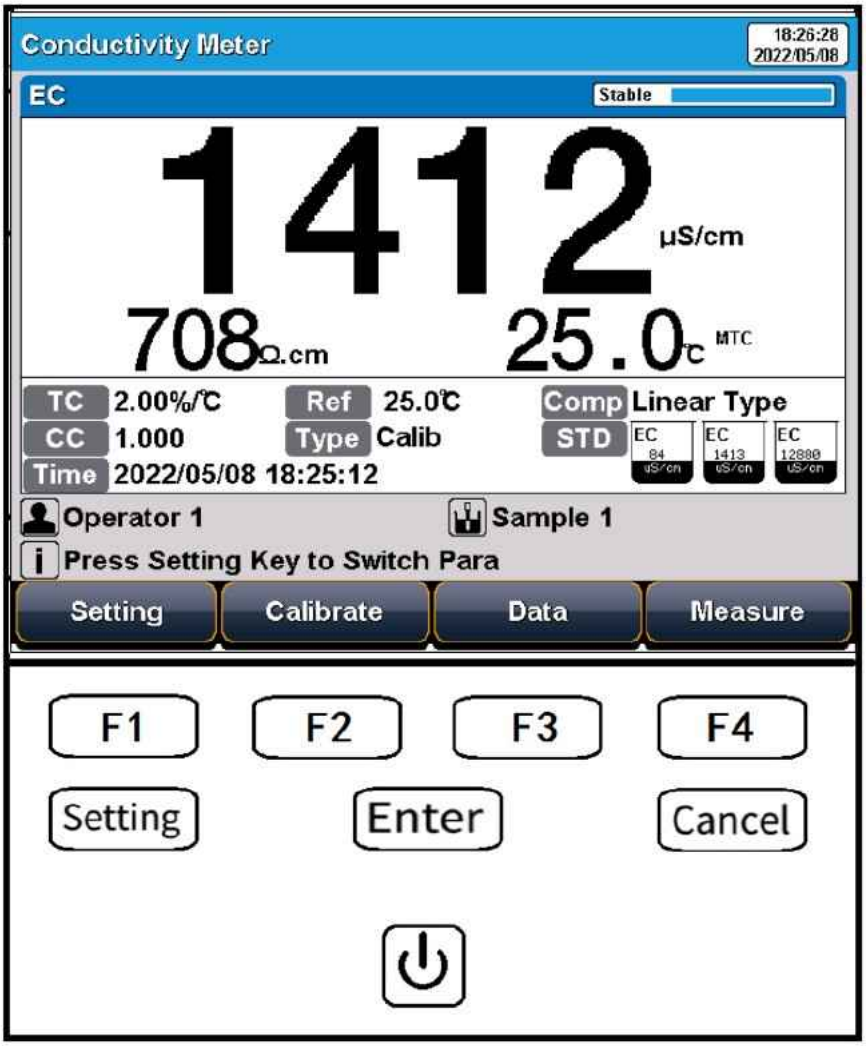


Figure 5-2 Function keys explanation

Table 5-2 Key Function Explanation

No.	Key	Explanation	Note
1	⏻	Power	Press to switch on/off
2	Setting	Setting	Set the parameters and settings

No.	Key	Explanation	Note
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

5.4 Parameter Settings

In the measuring, users can set the instrument parameters by pressing “Setting” to set the measuring parameters

5.4.1 Tutorial settings

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

5.4.2 Select parameters

It could select one measurement parameter from conductivity, TDS, salinity and resistivity every test.

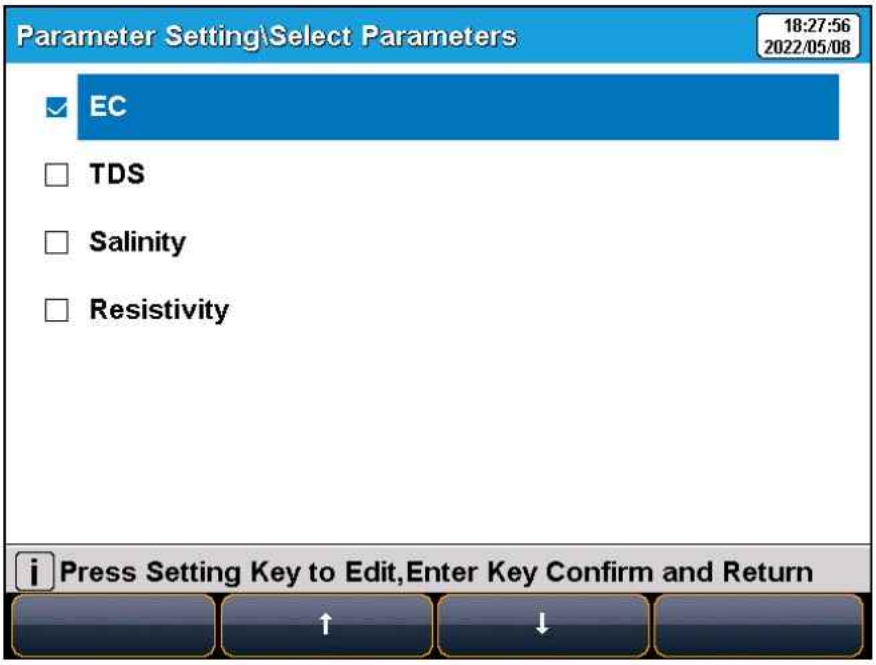


Figure 5-3 Select parameters

5.4.3 Reading Mode Settings

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

- Continuous reading: The instrument displays real time measurement results. User can end the measurement at any time and save the last result.
- 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.
- Time reading method: Timed Reading contains two kinds of timed reading methods: " Interval Measurement" and " Timed Measurement". Interval Measurement" provide measurement results at interval time and Timed Measurement" provide measurement result after a set time.

Table 5-3 Reading Parameters Settings

Stability Type		Conductivity
Fast	Stable time	5s
	Fluctuation	1.0%
Medium	Stable time	8s
	Fluctuation	0.4%
Strict	Stable time	15s
	Fluctuation	0.1%
Custom (Recommended value)	Stable time	1 to 30s
	Fluctuation	0.1~2%

5.4.4 Conductivity Parameter Settings

5.4.4.1 EC calibration type

EC calibration type: Cal by Standards and input manually.
Cal By Standards: Cell constant is calibrated with standard conductivity standard solution.
Input manually: It allows user to set the cell constant.

5.4.4.2 Manual standard recognition

For neighboring standards, please choose the customization to perform calibration.

5.4.4.3 Conductivity electrode type

Conductivity electrode: Four conductivity cell constant 0.01, 0.1, 1, 10. The defaulted conductivity cell constant is 1. Users need to enter the cell constant value on the label of conductivity electrode for accurate measurement.

5.4.4.4 EC Reference temperature

Conductivity reference temperature: The conductivity of the solution is greatly affected by temperature, to make the conductivity measurement results at different temperatures comparable, the conductivity and temperature values at the time of measurement are usually recorded and converted into the conductivity value at a certain temperature through temperature compensation, which is the reference temperature. The instrument allows settings of 20.0°C,25.0 °C 2reference temperatures, the default reference temperature is 25 °C.

5.4.4.5 EC Compensation

EC Compensation Mode: Three different compensation modes can be used for various applications. The meter supports Linear type, DI water type and non-comp type.

1) Lineartype: Linear compensation is usually used for the measurement of medium and high conductivity solutions. With linear compensation, you can set the temperature compensation coefficient, which defaults to 2.00%/°C (approximately the temperature compensation coefficient of a sodium chloride solution at 25°C). It allows user to set the temperature coefficient.

2) DIwater type: DI water compensation is usually used for the measurement of pure water and ultrapure hydro power conductivity below 5μS/cm. It allows user to set the temperature coefficient.

3) Non-comptype: Non compensation is usually used to obtain the true conductivity value at the measured temperature.

5.4.5 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 user to input the temperature.

5.4.6 Data Management Settings

5.4.6.1 Sample ID type

The instrument supports three setting methods of Sample ID: number order, time order, and manual.

- Number order: The sample ID No. is increasing with series number.
- 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: Manually set the sample ID No. It allows samples to manually enter the sample ID when saving or printing data.

5.4.6.2 Result Autosave

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

5.4.6.3 Data Overwrite

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.

5.4.7 Output option

The data format is GLP, STD Format, and Custom. It could select one data format to output the result.

5.4.8 User ID Settings

Set the user ID.

5.4.9 System Parameter Settings

5.4.9.1 System Date & Time

Settings of system date and time.

5.4.9.2 Buzzer setting

Users can set the key sound by this setting.

5.4.9.3 Brightness setting

Users can adjust the screen brightness by this setting.

5.4.9.4 Auto Power off

The meter provides auto shutdown function. When the meter is not using, the meter switches off automatically.

5.4.9.5 Restore Default

The meter supports "Restore Default" and "Restore Parameters". "Restoring Default"will restore all meter parameters to the factory state."Restoring parameters"will restore the measurement parameters to the factory state.

5.4.9.6 Software version

Users can find the software version information on the general setting page.

5.5 Conductivity Measurement

5.5.1 Cell Constant Input

Conductivity electrodes are precisely calibrated at the time of manufacture and marked with the exact cell constant. Before the measurement, by"Setting"-"EC Parameter" to enter the electrode cell constant.

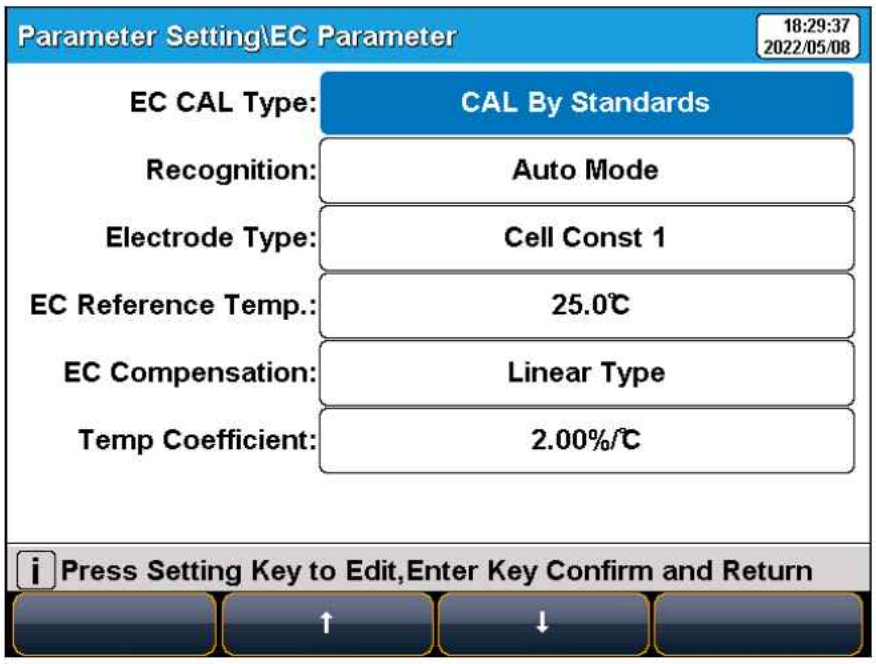


Figure 5-4 EC measurement information

5.5.2 Calibration Preparation

In general, conductivity electrodes need few calibrations. When the user gets an unexpected result, an electrode calibration is considerable.

Usually, single standard solution is required for calibration. For accurate measurement of sample conductivity above 50mS/cm, a two-point calibration is required. Two standards are required, a low conductivity standard and a conductivity standard close to the sample.

The meter provides universal standard groupto automatic recognition. And allows the user to prepare the customized Standard groups.

5.5.3 Conductivity Calibration

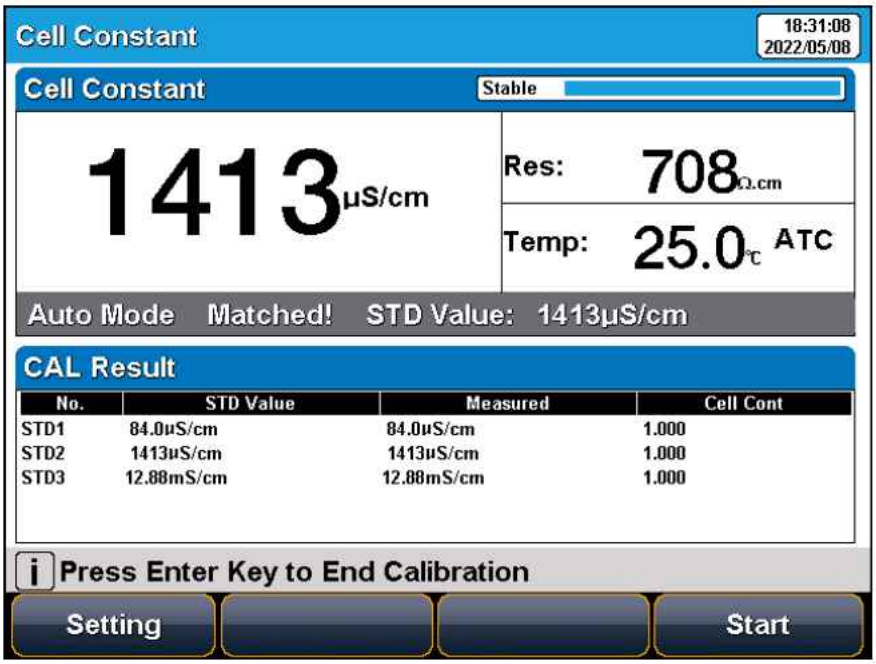


Figure 5-5 Electrode cell constant calibration information

For conductivity electrodes with different cell constants, it is recommended to use the following conductivity standard solutions for calibration.

Table 5-4 KCl standards to electrode cell constants

Cell constant (cm^{-1}).	0.1	1	10
KCl solution Concentration (mol/L).	0.001	0.01 or 0.1	0.1 or 1

The calibration process is as follows:

1. In the idle status, press soft button F1 "Setting" -"EC Parameter".
2. Press the "Constant type" to select the "1".
3. Press "Cal. Type" to select the "Cal by Standards".
4. Prepare one or more standard conductivity solution (e.g.,1413µS/cm conductivity solution).
5. Prepare a thermostatic bath, and set the temperature to (25.0±0.1) °C.

6. Place a standard conductivity solution in a thermostatic bath, and set the temperature to (25.0±0.1) °C.

7. Place the conductivity electrode into a standard solution.

8. When the conductivity and temperature reading (e.g.,1413μS/cm, 25.0°C) are stable, press the "Start".

9. If choosing one-point calibration, press "Enter" to end the calibration.

10. If choosing multi-points calibration (up to 3), press "Next Point" to repeat the operation.

11. The meter saves calibration data automatically and turn to idle status.

【TIPS】
If the standard is not recognized, please check the connection of the probe and the contamination of standards.

【TIPS】
The conductivity of the solution is greatly affected by temperature, it is recommended to use constant temperature water for calibration. Automatic or manual temperature compensation can also be optional when there is no water bath.

5.5.4 Conductivity Measurement

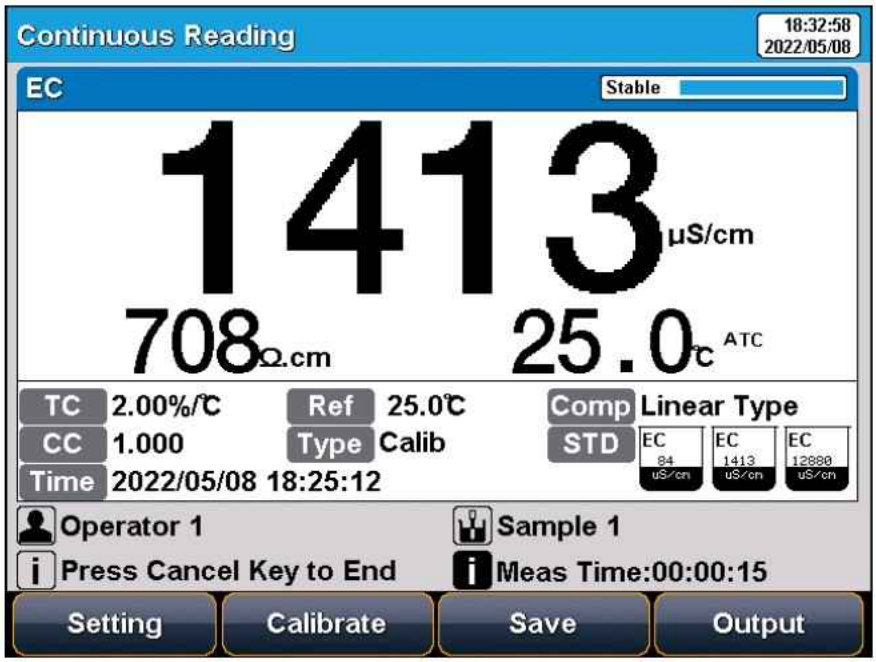


Figure 5-6 Conductivity measurement information

The measurement process is as follows:

1. Setting.

1) Set the parameters (e.g.,conductivity).

2) Set the reading mode (e.g.,continuous reading, auto-reading, or timed format).

3) Set the temperature compensation (e.g.,Linear compensation, temperature compensation coefficient 2.00%/°C).

4) Set the reference temperature (e.g.,25°C).

2. Rinse the conductivity electrode with DI water, dry out.

3. Put the measurement end of the electrode into the sample solution.

4. In the idle status, press the soft button F4 "Measure" to enter into measurement status.

5. When the reading is stable, read the results.

6. Press the "Save" to save the measurement results.

7. Press the "Output" to print the measurement result when connect to the printer.

8. Between measurements, stored EC electrode in distilled or deionized water.

9. After measurement, rinse the EC electrode with deionized water thoroughly and put on the electrode protection cap.

5.6 TDS Measurements

5.6.1 TDS conversion factor

5.6.1.1 Low Concentration TDS Sample

For samples with relatively simple composition and low concentration, TDS of solution can be estimated by conductivity. Compared with weighing method, TDS estimation by conductivity is relatively simple and convenient with quite good accuracy. The conversion factor between conductivity and TDS defaulting to 0.71, whichcan be used as the TDS coefficient for approximate estimation in most situations.

The conversion factor adjust process is as follows:

1. Press soft button F1 "Setting" -"TDS Parameter".

2. Select the TDSF CAL Type as the set TDS Factor.

3. Input the TDS factor as the desired TDS coefficient.

Table 5-5 Conductivity to TDS Standard Solution

Conductivity μS/cm	TDS standards		
	KCl(ppm)	NaCl(ppm)	442(ppm)
23	11.6	10.7	14.74
84	40.38	38.04	50.5
447	225.6	215.5	300
1413	744.7	702.1	1000
1500	757.1	737.1	1050
2070	1045	1041	1500
2764	1382	1414.8	2062.7
8974	5101	4487	7608

12880	7447	7230	11367
15000	8759	8532	13455
80000	52168	48384	79688

1. 442 indicated the solution contains 40%Na2SO4,40%NaHCO3,20%NaCl.
2. Thevalues listed in the table are values at 25°C.

5.6.1.2 High Concentrations TDS Sample Measurement

For samples with simple components and higher concentrations, such as high concentrations of NaCl solution, TDS factor re-calibration is needed.
For TDS measurements, the user may need to correct the TDS conversion factor by TDS standard.
The conversion factor calibration process is as follows:

1. Setting.

1) Set the parameters (e.g.,TDS).

2) Press soft button F1 "Setting" -"TDS Parameter".

3) Select the TDSF CAL Type as the set Cal by STD.

4) Set the reference temperature (e.g.,25°C).

2. Prepare TDS Standard.

3. Place a standard conductivity solution in a thermostatic bath, and set the temperature to (25.0±0.1) °C.

4. Rinse the conductivity electrode with DI water, dry out.

5. Put the measurement end of the electrode into the sample solution.

6. Press the F2 "Calibrate"-"TDS Calibration".

7. Set the STD value as the sample STD value.

8. When the TDS and temperature reading (708ppm, 25.0°C) are stable, press the "Start".

9. If choosing one-point calibration, press "Enter" to end the calibration.

10. If choosing multi-points calibration (up to 3), press "Next Point" to repeat the operation.

11. The meter saves calibration data automatically.

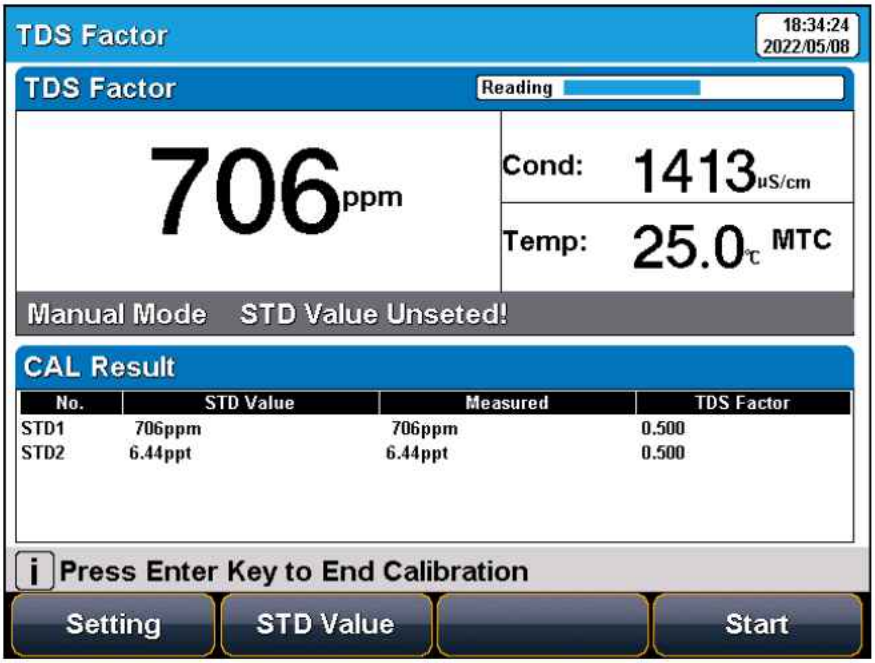


Figure 5-7 TDS coefficients calibration

5.6.1.3 Complex TDS Sample Measurement

For samples with complex compositions, the accuracy of TDS measurements can be improved by re-determination by laboratory methods and manual input of TDS coefficients. Whenthe composition or concentration of the sample to be measured changes significantly, it is recommended to recalibrate the TDS coefficient.

The conversion factor calibration process is as follows:

1. Rinse the electrode with DI water. Put the measurement end of the electrode into the sample solution and set the temperature at (25.0±0.1) °C.

2. Using weighing method to determine the TDS.

3. Calculate the TDS coefficient.

4. Press soft button F1 "Setting" -"TDS Parameter".

5. Select the TDSF CAL Type as the set TDS Factor.

6. Input the TDS factor as the desired TDS coefficient.

5.6.2 TDS Measurements

Users can switch the measurement parameter to TDS measurement by pressing Conductivity/TDS measurement box on the screen.

5.7 Salinity Measurement

The instrument can be used to determine the salinity of sodium chloride. The salinity of sodium chloride can be used to approximate the salinity of the solution being measured. By measuring the conductivity of the sample, the mass percentage of the corresponding sodium chloride solution can be calculated to convert the sodium chloride salinity.
Users can switch the measurement parameter to salinity measurement by pressing Conductivity/TDS measurement box on the screen. The detail refers to the measurement method of conductivity salinity measurement.

5.8 Resistivity Measurement

Resistivity and conductivity are reciprocal to each other, and conductivity can be measured at the same time when measuring resistivity.
Users can switch the measurement parameter to resistivity measurement by pressing Conductivity/TDS measurement box on the screen. The detail refers to the measurement method of conductivity measurement.

5.9 Data Management

Press "Data" to view the detail of results.
The meter stores the measurement results independently according to the measured parameters. The meter provides dataStorage 500 sets for each parameter (EC/Resistivity/TDS/Salinity).
The user can press "Delete" into the delete menu. It allows users to select the parameter data or all data to delete.

The user can view the data filter by parameter, locate No. or stored date. By the filter setting, press "Start Search"to look up the data. The filter data shows in a graph. Press "←" and"→"to choosedata. User can choose one and press "Enter"keytosee the detail result. Users can press "Delete"to delete thecurrentresult. Press "Output" to select the output data. The format supports output the current result, output matched resultand output all result.

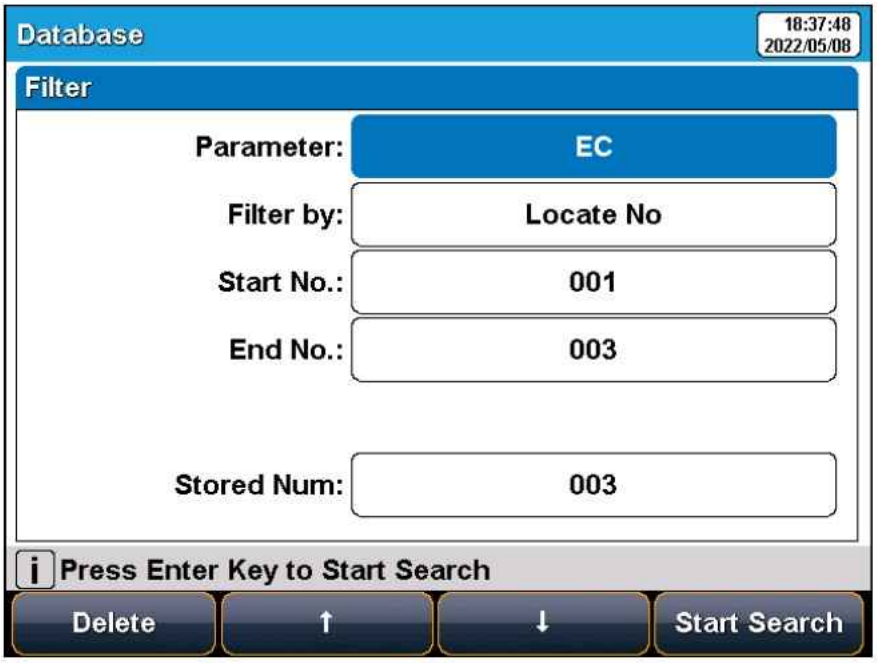


Figure 5-8 Results setting view

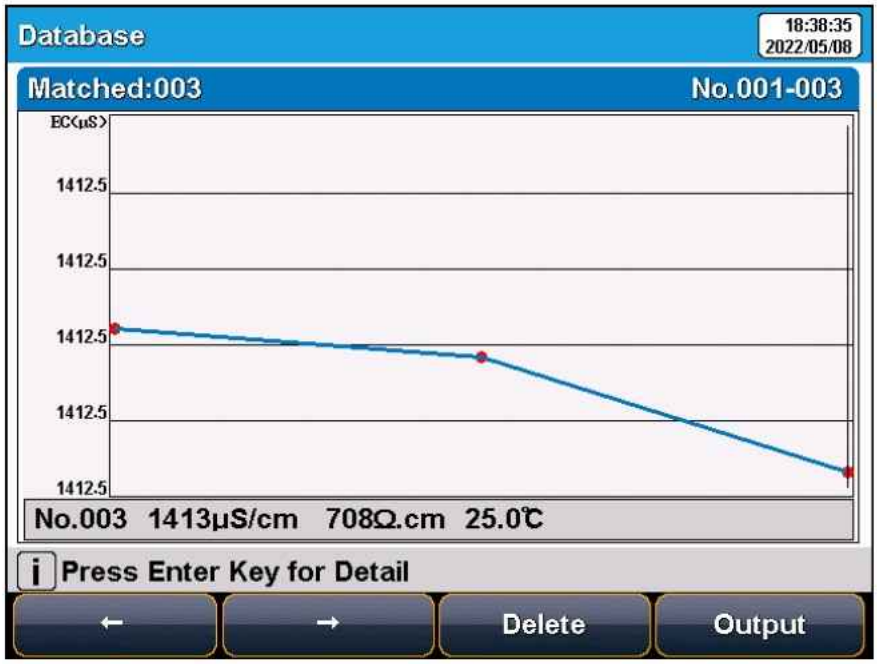


Figure 5-9 Results data graph

The output format is followed:

```
****************************************
Report Title
----------------------------------------
Measure Time:2021/01/19 12:27:28
Operator: Operator 1
Model:  EC400F Conductivity 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:  84uS/cm     84uS/cm      25.0c
STD 2: 1413uS/cm    1413uS/cm    25.0c
STD 3: 12.88mS/cm   12.88mS/cm   25.0c
Cell constant 1:                    1.000
Cell constant 2:                    1.000
Cell constant 3:                    1.000
..............................BRIEF INFO
Reading Mode:          Continuous Reading
Stable Type:                       Medium
Cond Comp type: Linear Mode
Temp Comp Type:                       ATC
..............................SAMPLE INFO
Sample ID:                      Sample 1
................................RESULT
Result:                          456ppm
Signal Value:                   912uS/cm
Temp Value:                       25.0c
----------------------------------------
----------------------------------------
                    Signature:
```

06 Maintenance/Troubleshooting

6.1 Meter Maintenance

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

- If the meter is not used for a long time, please disconnect the power supply.
- The electrode socket of the instrument must be kept clean and dry, and should not be in contact with acid, alkali, and salt solutions.
- Keep the meter and accessories clean and away from acids, alkalis, and any corrosive solutions/gases.
- Users can clean the meter surface with clean waters and detergent.
- When the meter is transported, please follow the instructions:

↙ please remove all connected cables.

↙ Please remove the electrode holder.

↙ Please use original packaging in the long-distance transport to avoid damage.

6.2 Electrodes Maintenance

For more detailed information, please refer to the electrode instruction manual.

6.3 Troubleshooting

Table 6-1 Troubleshooting

Phenomenon	Probable reasons	Solutions
1. No Display	Damage to the meter.	Replace or repair as required.
5. Incorrect conductivity measurement	1. The electrode is out of service life 2. The electrodes are not calibrated or are calibrated incorrectly	1. Replace the electrodes 2. Recalibrate the electrode or replace the standard solution

07 Technical Supports

Accessories

Please refer to the accessories table for purchasing recommendations.

Table 7-1 Meter accessories

Name	Description
DJS-1VTC conductivity electrode	Conductivity, TDS Measurement Probe
Conductivity solution 1413μs/cm	Standard solution

08 Appendixes

Appendix 1

Conductivity Standard Solution

Table 1 KCl standards to electrode cell constants

Cell constant (cm^{-1}).	0.1	1	10
KCl solution Concentration (mol/L).	0.001	0.01 or 0.1	0.1 or 1

Table 2 Approximate concentrations of KCl solutions and their conductivity values (μS/cm) relationship

T(°C)	84μS/cm	1413μS/cm	12.88mS/cm
5	53.02	896	8.22
10	60.34	1020	9.33
15	67.61	1147	10.48
20	75.80	1278	11.67
25	84.00	1413	12.88
30	92,19	1552	14.12
35	100.92	1696	15.39

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