

Digital Conductivity / pH Meter

Model EC600



Introduction

Congratulations on your purchase of the Extech Conductivity / pH meter. The EC600 meter measures Conductivity, pH, and temperature parameters. Conductivity measurements also yield TDS (total dissolved solids), Salinity, and Resistivity readings. The built-in microprocessor provides automatic calibration, automatic temperature compensation, data storage, and self-diagnostics. The meter can recognize up to 13 types of pH standard buffer solutions and 8 types of Conductivity standards.

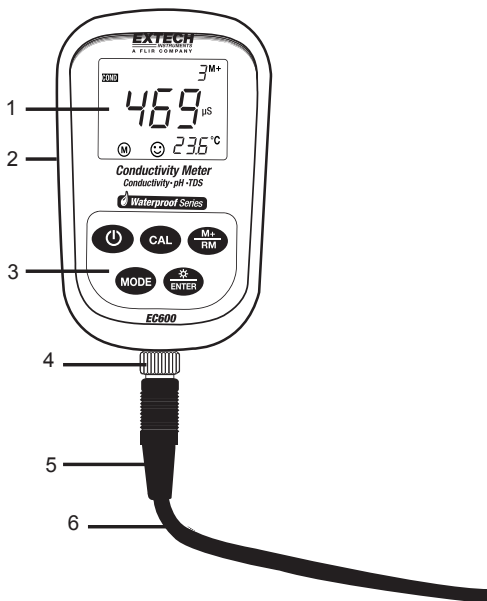
The meter's digital filter improves measurement speed and accuracy. Two special modes (for distilled water and distilled water mixed with ammonia) are provided. The meter offers a backlit LCD display and is dust-proof and water-proof, meeting the IP57 rating. This device is shipped fully tested and calibrated and, with proper use, will provide years of reliable service. Please visit our website (www.extech.com) to check for the latest version of this User Guide. The Extech Instruments brand, a wholly owned subsidiary of FLIR Systems, Inc., is ISO-9001 certified.

Supplied Equipment List

- EC6000 Meter
- Conductivity and pH Electrodes
- Standard pH buffer solutions (4.00pH, 7.00pH, and 10.01pH) / 50ml
- Standard Conductivity solution (1413 μ S/cm) / 50ml
- Screwdriver (for removing battery compartment)
- Batteries (2 x 'AA' 1.5V)
- User's Guide
- Carrying Case

Meter Description

1. LCD Display (detailed in section below)
2. Rubber protective jacket (remove to access the rear battery compartment)
3. Keypad (detailed in section below)
4. Electrode connection jack
5. Electrode plug
6. Electrode cable



Display Description

1. Measurement type icon
2. Measured reading
3. **888** (Stored data serial number), **M+** (measurement to be stored icon), **RM** (reading to be recalled icon)
4. Units of measure
5. Temperature reading
6. Stable measurement icon
7. Calibration icons
8. Low battery icon



Keypad Description

The meter has five (5) front panel function keys:



ON/OFF Power Key



Calibration Key:

- When taking a measurement, press this key to enter the calibration mode
- When in the programming mode, press this key to change the displayed number or the ON/OFF state



Function Key

- In pH measuring mode, one short press switches between pH and mV measuring modes. One long press (>2s) enters the parameter setting mode. Subsequent presses will scroll through the available parameters.
- In other measuring modes, press and hold to enter the parameter setting modes. The meter will scroll through the available parameters



Backlight and ENTER Key

- In the measurement mode, momentary presses toggle the backlight on and off
- When in the programming or calibration mode, press to ENTER data
- When in the pH mode, press and hold to change the resolution in the range of 0.01 to 0.1pH
- When in the Conductivity mode, press and hold to scroll through the TDS, Salinity, Resistivity, and Conductivity modes



MEMORY STORE and RECALL Key

- In the measurement mode, momentary presses store the displayed readings. Press and hold for at least 2 seconds to recall a saved reading
- In programming mode, press to change the displayed number or ON/OFF state

Store, Recall, and Clear Datalogger Memory

STORE Readings

The meter can store up to 100 pH, 100 mV, and 100 Conductivity readings for a total of 300 data points. To store a reading, wait until the reading stabilizes (the smiling face icon ☺ appears when the reading stabilizes). Press the **M+/RM** key momentarily to store a reading. The **M+** icon appears and the data point serial number increments.

RECALL Readings

In the measurement mode, press the **M+/RM** key to recall the most recently stored reading. **RM** and the data point serial number for the displayed reading will appear on the LCD. The measurement information will appear on the lower right hand side of the LCD. Use the **CAL** or **M+/RM** buttons to scroll the remaining stored readings. Press the **ENTER** key to return to the normal measurement mode.

CLEAR Readings

From the RECALL mode, press and hold the **ENTER** key for at least five (5) seconds. The LCD display will show 'CLR' indicating that all of the stored readings have been erased. The unit will automatically return to the normal measurement mode after approximately 2 seconds.

pH Measurement Mode

Preparation for Measurement

1. Turn the meter ON using the power key
2. Connect the pH electrode to the meter and the pH mode will automatically be selected.
3. Unscrew the protective cap on the probe jack located on the bottom of the meter (store the protective cap in the carrying case for later use)
4. Carefully connect the pH probe to the meter's probe jack. The probe can only be inserted in one orientation. Once it is firmly connected, screw the probe collar onto the meter to secure the probe

3-Point Calibration (7.00pH, 4.00pH and 10.01pH)

1. Press the **CAL** key to enter the Calibration mode. The meter's display will show a blinking '**C1**'
2. Rinse the probe in distilled water, allow it to air dry, and submerge it into a pH 7.00 buffer solution. Stir the solution briefly and allow it to stay in the buffer solution until a stable reading is reached
3. Press **CAL** again and the display will show a blinking '**7.00**'
4. This portion of the calibration procedure is complete when the display stops blinking and shows the '**C2**' icon. The unit will automatically switch to the second point of the calibration
5. Rinse the probe in distilled water again, allow it to dry, and submerge it into a pH 4.00 buffer solution. Stir the solution briefly and allow it to stay in the buffer solution until a stable reading is reached
6. Press **CAL** again and the display will show a blinking '**4.00**'
7. This portion of the calibration procedure is complete when the display stops blinking and shows the '**C3**' icon. The unit will automatically switch to the third point of the calibration
8. Rinse the probe in distilled water again, allow it to dry, and submerge it into a pH 10.01 buffer solution. Stir the solution briefly and allow it to stay in the buffer solution until a stable reading is reached
9. Press **CAL** again and the display will show a blinking '**10.01**'
10. After the display stabilizes the 3-point calibration icon will appear **(L) (M) (H)**

1-Point and 2-Point Calibration

Note that the user can calibrate one or two points only, if the expected measurement is known.

For example, if the expected pH is 4pH, it is acceptable to perform only a 1-Point Calibration (4pH). If the expected measurement is between 4.00pH and 7.00pH, the user can perform a 2-Point Calibration (4.00 and 7.00pH), and so on.

For a 4pH calibration, only the circled **L** will appear on the LCD. For a 7.00pH, only the circled **M** will appear on the LCD. For a 10.01pH Calibration, only the circled **H** will appear (**L**ow, **M**edium, and **H**igh).

Note: Use the **ENTER** key to exit the Calibration mode and return to the normal measurement mode when performing 1 or 2 point calibrations.

For all other applications, a 3-Point Calibration is recommended. Always perform a 3-Point Calibration on new probes and probes that have been in use for long periods. This maximizes measurement slope linearity.

Testing the pH of a Sample

1. Perform the pH Calibration as described above
2. Rinse and dry the pH Probe and submerge it in a sample liquid
3. Stir the solution briefly with the probe and allow it to stand until the display stabilizes
4. Note that the closer the temperature of the sample solution to the calibration solution, the more accurate readings

pH Programming Parameters

The Table below shows the available programming menu items P1 ~ P7. Each parameter is explained in detail in the subsequent sections.

	Parameters	Code	Selections
P1	pH buffer solution series selection	SOL	USA (Europe & U.S.A) NIS (NIST) CH (China)
P2	Distilled water pH temperature compensation setting (see notes below this Table)	PU 1	OFF / ON
P3	Distilled water with Ammonia pH temperature compensation setting (see Notes below this Table)	PU 2	OFF / ON
P4	Temperature unit setting		°C / °F
P5	Back light display time setting	BL	0-1-3-6min
P6	Auto power off setting	AC	0-10-20min
P7	Restore to default factory settings		OFF / ON

Notes on P2 and P3 Parameters: Measurements of distilled water and distilled water mixed with ammonia affect the temperature compensation and the slope linearity of the pH probe. Such measurements are sometimes used in the electrical power and petrochemical industries. Set these parameters to ON only if necessary, otherwise leave these parameters in the OFF state.

Parameter P1 (pH Buffer Solution Setting)

1. From the pH measurement mode, press and hold **MODE** for at least 2 seconds and then release, the 'P1' icon appears on the LCD
2. Use the **CAL** or the **M+/RM** keys to toggle through the three (3) selections: USA (for use in the USA or Europe, NIS (for NIST calibration purposes), and CH (for use in China)
3. Momentarily press **MODE** to move to the next parameter (P2), or press **ENTER** to return to the normal measurement mode

Parameter P2 (Distilled Water Temperature Compensation Setting)

1. From the P2 menu, use the **CAL** or the **M+/RM** keys to turn this feature ON or OFF
2. Momentarily press **MODE** to move to the next parameter (P3), or press **ENTER** to return to the normal measurement mode

Parameter P3 (Distilled Water with Ammonia Temperature Compensation Setting)

1. From the P3 menu, use the **CAL** or the **M+/RM** keys to turn this feature ON or OFF
2. Momentarily press **MODE** to move to the next parameter (P4) or press **ENTER** to return to the normal measurement mode

Parameter P4 (Temperature Measurement Units Setting)

1. From the P4 menu, use the **CAL** or the **M+/RM** keys to turn this feature ON or OFF
2. Momentarily press **MODE** to move to the next parameter (P5) or press **ENTER** to return to the normal measurement mode

Parameter P5 (Display Backlight Setting)

1. From the P5 menu, use the **CAL** or the **M+/RM** keys to select 0, 1, 3, or 6 minute default backlighting time
2. Momentarily press **MODE** to move to the next parameter (P6) or press **ENTER** to return to the normal measurement mode

Parameter P6 (Automatic Power OFF Setting)

1. From the P6 menu, use the **CAL** or the **M+/RM** keys to select a 0, 10, or 20 minute Auto Power OFF time
2. Momentarily press **MODE** to move to the next parameter (P7) or press **ENTER** to return to the normal measurement mode

Parameter P7 (Restore Factory Default Settings)

1. From the P7 menu, use the **CAL** or the **M+/RM** keys to select ON (reset the factory default settings) or OFF (cancel edit)
2. Momentarily press **MODE** to move to the first parameter (P1) or press **ENTER** to return to the normal measurement mode

pH Measurement, Calibration, and Electrode Considerations

- **Error messages** ERR-1: Electrode zero potential error and ERR-2: Electrode slope error; For either error, check the following:
 1. Air bubbles in the electrode bulb. Shake rigorously to remove air bubbles
 2. Accuracy of the pH buffers used in calibration. Replace buffers if necessary
 3. Set meter to its factory default state in Parameter P7 (previous section of manual)
- Calibration intervals depend on the sample, the electrode performance, and the required accuracy. For high accuracy measurements ($\leq \pm 0.02\text{pH}$), the meter should be calibrated immediately before taking a measurement. For general accuracy ($\geq \pm 0.1\text{pH}$), the meter can be calibrated and used for approximately one week before the next calibration.
- The meter must be recalibrated in the following situations:
 1. New probe, or probe that is unused for a long period of time
 2. After measuring acids ($\text{pH} < 2$) or alkaline solutions ($\text{pH} > 12$)
 3. After measuring a solution that contains fluoride or a concentrated organic solution
 4. If the solution's temperature differs widely from the calibration solution temperature
- The soaking solution contained in the supplied protective bottle is used to maintain activation in the glass bulb and junction. Loosen the capsule, remove the electrode and rinse in distilled water before taking a measurement. Insert the electrode and tighten the capsule after measurements to prevent the solution from leaking. If the soak solution is turbid or moldy, replace the solution.
- To prepare a soak solution: Use 25g pure KCL dissolved with purified water and diluted to 100mL. The electrode should not be soaked in a purified water protein solution or an acid fluoride solution for long periods of time. In addition, do not soak the electrode in organic silicon lipids.
- For calibration accuracy, the pH of the standard buffer solution must be reliable. The buffer solution should be refreshed often, especially after heavy use.
- For best accuracy, always keep the meter clean and dry, especially the meter's electrode and electrode jack. Clean with medical cotton and alcohol if necessary.
- The sensitive glass bulb at the front of the combination electrode should not come in contact with hard surfaces. Scratches or cracks on the electrode will cause inaccurate readings. Before and after each measurement, the electrode should be washed with distilled water and air dried. Do not clean the glass bulb with a tissue for it will affect the stability of the electrode potential and increase the response time. The electrode should be thoroughly cleaned if a sample sticks to the electrode. Use a solvent if the solution does not appear clean after washing.
- Electrodes that have been used over a long period of time, used in a strong solution that has damaged the sensitive bulb, or used with a substance resulting in a jam at the junction will become passivated; the sensitivity will decrease, its response will slow, and the readings will be inaccurate. Replace the electrode as soon as possible in these cases.
- For abnormal readings, try calibrating again; if the problem persists replace the Electrode. The user can also try resetting the meter to factory default conditions per Parameter P7 (detailed in an earlier section). Electrode life can be shortened by heavy use, extreme conditions, and improper maintenance.

mV Measurement Mode

1. Turn the meter ON using the power key
2. Momentarily press MODE to switch to the mV mode, if necessary
3. Connect the probe to the meter
4. Immerse the electrode in the sample solution, slowly stir the solution with the electrode and then allow it to rest in the solution
5. When the smile face icon appears on the LCD, the reading has stabilized

mV Programming Parameters

Prompt	Parameters	Code	Settings
P1	Back light display time	<i>bl</i>	0 -1-3-6 min
P2	Auto power off time	<i>AC</i>	0 -10-20 min

Parameter P1 (Display Backlight Setting)

1. Press MODE to access the P1 Parameter
2. Use the **CAL** or the **M+/RM** keys to select 0, 1, 3, or 6 minute default backlighting time
3. Momentarily press **MODE** to move to the next parameter (P2) or press **ENTER** to return to the normal measurement mode

Parameter P2 (Automatic Power OFF Setting)

1. From the P2 menu, use the **CAL** or the **M+/RM** keys to select a 0, 10, or 20 minute Auto Power OFF time
2. Momentarily press **MODE** to move back to Parameter P1, or press **ENTER** to return to the normal measurement mode

Conductivity Measurement Mode

Preparation for Measurement

1. Turn the meter ON using the power key
2. Press the MODE key momentarily to switch to the Conductivity mode, if necessary
3. Use the ENTER key to select TDS (Total Dissolved Solids), Salinity, Resistivity, and Conductivity
4. Unscrew the protective cap on the probe jack located on the bottom of the meter (store the protective cap in the carrying case for later use)
5. Carefully connect the electrode to the meter's input jack. The electrode can only be inserted in one orientation. Once it is firmly connected, screw the electrode collar onto the meter to secure it

Calibration

1. Press the CAL key and "CAL" will appear flashing on the LCD
2. Clean and air dry the conductivity electrode (use distilled water to clean)
3. Immerse the electrode in the 1413 μ S/cm calibration solution
4. Stir the solution with the electrode and then allow it to rest in the solution until the stabilized icon (smile face icon) appears
5. Press CAL again and the display will flash "1413 μ S/cm"; After several seconds the "END" icon will appear and the meter will return to the measuring mode
6. The LCD will display the stable measurement reading 1413 μ S/cm and the calibration icon "M", indicating that the calibration is complete.
7. If the measurement value is unstable, repeat the calibration until the measurement is stable. Replace the electrode if necessary.

Notes: The meter is calibrated before leaving the factory and can generally be used right out of the box. The meter can only be calibrated in the Conductivity mode and not from the TDS, Salinity, or Resistivity mode.

Measuring the Conductivity of a Sample

1. Clean and dry the conductivity electrode and immerse in the sample solution
2. Stir the solution and then allow the electrode to rest in the solution until the reading stabilizes (smile face icon appears)
3. Read the conductivity measurement on the meter's display
6. Use the ENTER key to select TDS (Total Dissolved Solids), Salinity, Resistivity, and Conductivity measurement modes

Calibration Considerations

This meter offers two calibration solution series (configured in Parameter P1).

(a) (Europe & U.S.A. series) — 84 μ S/cm, 1413 μ S/cm, 12.88 mS/cm and 111.9 mS/cm

(b) (China series) — 146.6 μ S/cm, 1408 μ S/cm, 12.85mS/cm and 111.3 mS/cm

The EC600 offers a unique one-point calibration feature. The user can select the calibration solution closest to the expected measurement value. In general the most common calibration solution is 1413 μ S/cm. Use the supplied conductivity electrode ($K = 1 \text{ cm}^{-1}$), and perform the calibration using the supplied 1413 μ S/cm calibration solution. The meter can then be used for measurements below 100 mS/cm. Please refer to the chart below.

Measuring range	0.05 to 20 μ S/cm	0.5 μ S/cm to 200mS/cm		
Electrode constant	K=0.1cm ⁻¹ (flow test)	K=1.0cm ⁻¹		
Calibration solution	84 μ S/cm	84 μ S/cm	1413 μ S/cm	12.88 mS/cm 111.9 mS/cm
Calibration indicator	Ⓕ	Ⓕ	Ⓜ	Ⓜ

There are two electrode calibration methods: *Standard Solution* calibration and *Constant* calibration. The calibration described above in the section **Calibration** refers to the Standard Solution method (the most accurate calibration method, assuming the calibration buffer standard is accurate and fresh).

To select the Constant calibration method use Parameter P5 described below in the **Programming Parameters – Conductivity** section.

The meter's temperature compensation coefficient is 2.0%. However, the conductivity temperature coefficient is different for solutions of a different variety and concentration. Use the chart below for common solution types (use Parameter P4 as described below in the **Programming Parameters – Conductivity** section).

The meter can perform an automatic non-linear temperature compensation in distilled water for measurements below 10 μ S/cm.

Note: When the coefficient for the temperature compensation is set to 0.00 (no compensation), the measurement value will be based on the current temperature.

Solution	Temperature compensation coefficient
NaCl salt solution	2.12%
5%NaOH solution	1.72%
Diluted ammonia solution	1.88%
10% hydrochloric acid solution	1.32%
5% sulfuric acid solution	0.96%

Important Note: When one or more of the programmable parameters is changed by the user from its original factory default condition, the parameter's code, shown below, is displayed in the upper right corner of the display as shown in diagram below (in this case, Parameter 'Tcc'). If more than one parameter is changed, only the code from the first parameter change is displayed.



Conductivity - Programming Parameters - Conductivity

The Table below shows the available programming menu items P1 ~ P7. Each parameter is explained in detail in the subsequent sections.

	Parameters	Code	Selections
P1	Standard solution series selection	SOL	USA (Europe & U.S.A) CH (China)
P2	Electrode Constant selection	Con	0.1, 1, or 10
P3	Reference Temperature selection	REF	77, 68, and 64 °F (25, 20, and 18 °C)
P4	Temperature compensation coefficient setting	TEC	0.00 to 9.99%
P5	Electrode Constant Calibration	CC	
P6	Temperature units		°C °F
P7	Back light display time setting	BL	0-1-3-6 minutes
P8	Auto power off setting	AC	0-10-20 minutes
P9	Restore to default factory settings		OFF / ON

Parameter P1 (pH Conductivity Buffer Solution Setting)

1. From the pH Conductivity measurement mode, press and hold **MODE** for at least 2 seconds and then release, the 'P1' icon appears on the LCD
2. Use the **CAL** or the **M+/RM** keys to toggle through the two (2) selections: USA (for use in the USA or Europe) and CH (for use in China)
3. Momentarily press **MODE** to move to the next parameter (P2), or press **ENTER** to return to the normal measurement mode

Parameter P2 (Electrode Constant 'K' Selection)

1. From the P2 menu, use the **CAL** or the **M+/RM** keys to select the desired electrode constant (0.1, 1.0, or 10). The default setting is K=1.0.
2. Momentarily press **MODE** to move to the next parameter (P3), or press **ENTER** to return to the normal measurement mode

Parameter P3 (Reference Temperature Selection)

1. From the P3 menu, use the **CAL** or the **M+/RM** keys to select the desired reference temperature (25, 20, or 18°C). The default setting is 25°C
2. Momentarily press **MODE** to move to the next parameter (P4) or press **ENTER** to return to the normal measurement mode

Parameter P4 (Temperature Coefficient Temperature Compensation Setting)

1. From the P4 menu, use the **CAL** or the **M+/RM** keys to select the coefficient in percent from 0.00 to 9.99. When set to zero, the temperature compensation is turned OFF. The default setting is 2.0%
2. Momentarily press **MODE** to move to the next parameter (P5) or press **ENTER** to return to the normal measurement mode

Parameter P5 (Electrode Constant calibration)

1. In the P5 window the user can see the existing constant in the main measurement area of the LCD in cm^{-1} units.
2. From the P5 menu, use the **CAL** or the **M+/RM** keys to change the K constant. Enter the K constant value from the label on the Conductivity probe cable.
3. Momentarily press **MODE** to move to the next parameter (P6) or press **ENTER** to return to the normal measurement mode

Parameter P6 (Temperature units of measure)

1. From the P6 menu, use the **CAL** or the **M+/RM** keys to select the desired unit of measure (C or F)
2. Momentarily press **MODE** to move to the next parameter (P7) or press **ENTER** to return to the normal measurement mode

Parameter P7 (Display Backlight Setting)

1. From the P7 menu, use the **CAL** or the **M+/RM** keys to select 0, 1, 3, or 6 minute default backlighting time
2. Momentarily press **MODE** to move to the next parameter (P8) or press **ENTER** to return to the normal measurement mode

Parameter P8 (Automatic Power OFF Setting)

1. From the P8 menu, use the **CAL** or the **M+/RM** keys to select a 0, 10, or 20 minute Auto Power OFF time
2. Momentarily press **MODE** to move to the next parameter (P9) or press **ENTER** to return to the normal measurement mode

Parameter P9 (Restore Factory Default Settings)

1. From the P9 menu, use the **CAL** or the **M+/RM** keys to select ON (reset the factory default settings) or OFF (cancel edit); Note that by selecting ON the factory default settings will automatically switch ON, there is no confirmation step. The user should select ON only if absolutely certain that the default settings be accessed.
2. Momentarily press **MODE** to move to the first parameter (P1) or press **ENTER** to return to the normal measurement mode

Conductivity Measurement, Calibration, and Maintenance Considerations

- The meter and probe are calibrated before leaving the factory; the user can take measurements immediately upon receiving the unit
- The recommend calibration period is once per month under normal circumstances; It is necessary to calibrate a newly purchased conductivity electrode or one that has been in service for a long period of time
- Keep the conductivity electrode clean. It's best to rinse electrodes with distilled water and air dry
- The surface of the supplied conductivity electrode is plated with a layer of metal platinum (black) in order to lower the electrode polarization and increase the measuring range. Do not polish the black platinum surface; clean it by stirring in Distilled water. If excessive organic buildup appears on the black platinum coating clean with hot water and detergent or with alcohol
- Replace the electrode if the above cleaning methods are ineffective
- Reset the meter to its factory default settings (Parameter P9) if unusual operation is noticed. If the restore process does not solve the issue, return the unit for an evaluation

Specifications

pH Specifications

Measuring range	-2.00 to 19.99 pH
Resolution	0.1/0.01 pH
Accuracy	Meter only: ± 0.01 pH; with probe: ± 0.02 pH
Input current	$\leq 2 \times 10^{-12}$ Amperes
Input impedance	$\geq 1 \times 10^{12} \Omega$
Stability	± 0.01 pH / 3hours
Temp. Compensation range	0 to 100 °C (32 to 212 °F) automatic (ATC)

mV Specifications

	Range	Resolution
mV/E _H	-1999 mV to 0 to 1999mV	1 mV
Accuracy	Meter: $\pm 0.1\%$ FS	

Conductivity Specifications

	Range	Resolution
Conductivity	0.00 to 19.99 μ S/cm	0.01 μ S/cm
	20.0 to 199.9 μ S/cm	0.1 μ S/cm
	200 to 1999 μ S/cm	1 μ S/cm
	2.00 19.99 mS/cm	0.01 mS/cm
	20.0 to 199.9 mS/cm	0.1 mS/cm
TDS	0 to 100 g/L (Total Dissolved Solids)	1 g/L
Salinity	0 to 100 ppt	1 ppt
Resistivity	0 to 100 Mohms	1 Mohms
Accuracy	Meter only: $\pm 1\%$ F.S.; with probe: $\pm 2\%$ F.S.	
Electrode constant	0.1 / 1 / 10 cm ⁻¹	
Reference temperatures	25, 20, and 18°C (77, 68, and 64°F)	
Temp. Compensation	0 to 50°C (32 to 122°F) Automatic	

Other Technical Parameters

Data storage	300 data groups
Storage content	Data serial number, measurement value, unit of measure
Power	Two 'AA' batteries (1.5V x 2)
Size and weight	Meter: 65 × 120 × 31mm (2.6 x 4.7 x 1.2") / 180g (6.3 oz) Case: 360 x 270 x 76mm (14.1 x 10.6 x 3") / 1.7kg (3.57 lbs)
Quality/Safety certification	ISO-9001, CE and CMC

Working Conditions

Environment temperature	5 to 35 °C(41 to 95 °F)
Environmental humidity	≤ 85%
IP rating	IP57 Dustproof and waterproof

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