HACH DOC023 Inductive Conductivity Sensors User Manual

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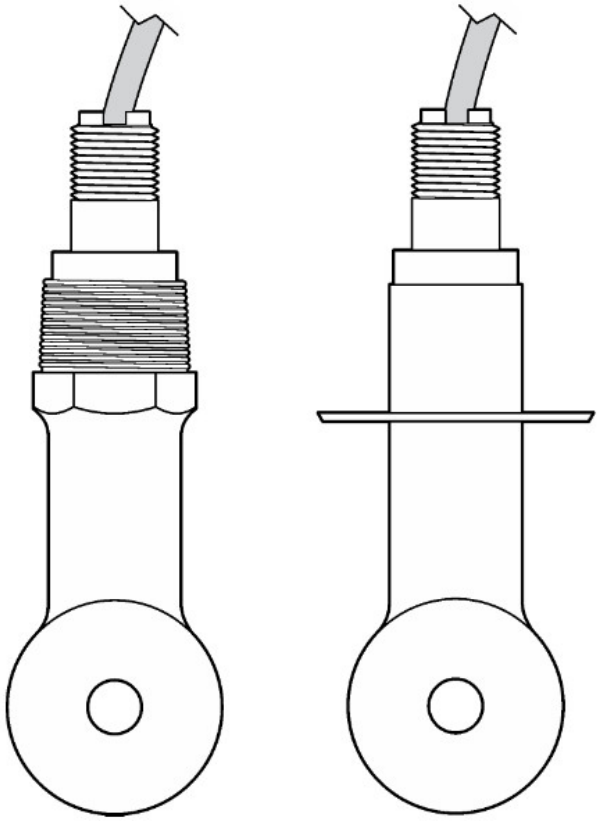
Inductive Conductivity Sensors
03/2023, Edition 9



Basic User Manual

Contents

Section 1 Online user manual

This Basic User Manual contains less information than the User Manual, which is available on the manufacturer's website.

Section 2 Specifications

Specifications are subject to change without notice.

Specification	Details
Dimensions	Refer to Figure 1 on page 5.
Pollution degree	2
Overvoltage category	I
Protection class	III
Altitude	2000 m (6562 ft) maximum
Operating temperature	-20 to 60 °C (-4 to 140 °F)
Storage temperature	-20 to 70 °C (-4 to 158 °F)
Weight	Approximately 1 kg (2.2 lbs)
Wetted materials	Polypropylene, PVDF, PEEK or PFA
Sensor cable	5-conductor (plus two isolated shields), 6 m (20 ft); rated at 150 °C (302 °F) — polypropylene
Conductivity range	0.0 to 200.0 µS/cm; 0 to 2,000,000 µS/cm
Accuracy	0.01 % of reading, all ranges
Repeatability/precision	> 500 µS/cm: ±0.5% of reading; < 500 µS/cm: ±5 µS/cm
Maximum flow rate	0–3 m/s (0–10 ft/s)
Temperature/pressure limit	Polypropylene: 100 °C at 6.9 bar (212 °F at 100 psi); PVDF: 120 °C at 6.9 bar (248 °F at 100 psi); PEEK and PFA: 200 °C at 13.8 bar (392 °F at 200 psi)
Transmission distance	200 to 2000 µS/cm: 61 m (200 ft); 2000 to 2,000,000 µS/cm: 91 m (300 ft)
Temperature measurement range	-10 to 135 °C (14 to 275 °F) limited by sensor body material
Temperature sensor	Pt 1000 RTD
Calibration methods	Zero calibration, 1-point conductivity calibration, 1-point temperature calibration
Sensor interface	Modbus
Certifications	Listed by ETL (US/Canada) for use in Class 1, Division 2, Groups A, B, C, D, Temperature Code T4 – Hazardous Locations with Hach SC Controller. Conforms to: CE, UKCA, FCC, ISED, ACMA, KC, CMIM. Sanitary sensors certified by 3A.
Warranty	1 year; 2 years (EU)

Section 3 General information

In no event will the manufacturer be liable for damages resulting from any improper use of product or failure to comply with the instructions in the manual. The manufacturer reserves the right to make changes in this manual and the products it describes at any time, without notice or obligation. Revised editions are found on the manufacturer's website.

3.1 Safety information

The manufacturer is not responsible for any damages due to misapplication or misuse of this product including, without limitation, direct, incidental and consequential damages, and disclaims such damages to the full extent permitted under applicable law. The user is soley responsible to identify critical application risks and install appropriate mechanisms to protect processes during a possible equipment malfunction.

Please read this entire manual before unpacking, setting up or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

Make sure that the protection provided by this equipment is not impaired. Do not use or install this equipment in any manner other than that specified in this manual.

3.1.1 Use of hazard information

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

3.1.2 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

This symbol, if noted on the instrument, references the instruction manual for operation and/or safety information.

Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

3.2 Product overview

DANGER

Chemical or biological hazards. If this instrument is used to monitor a treatment process and/or chemical feed system for which there are regulatory limits and monitoring requirements related to public health, public safety, food or beverage manufacture or processing, it is the responsibility of the user of this instrument to know and abide by any applicable regulation and to have sufficient and appropriate mechanisms in place for compliance with applicable regulations in the event of malfunction of the instrument.

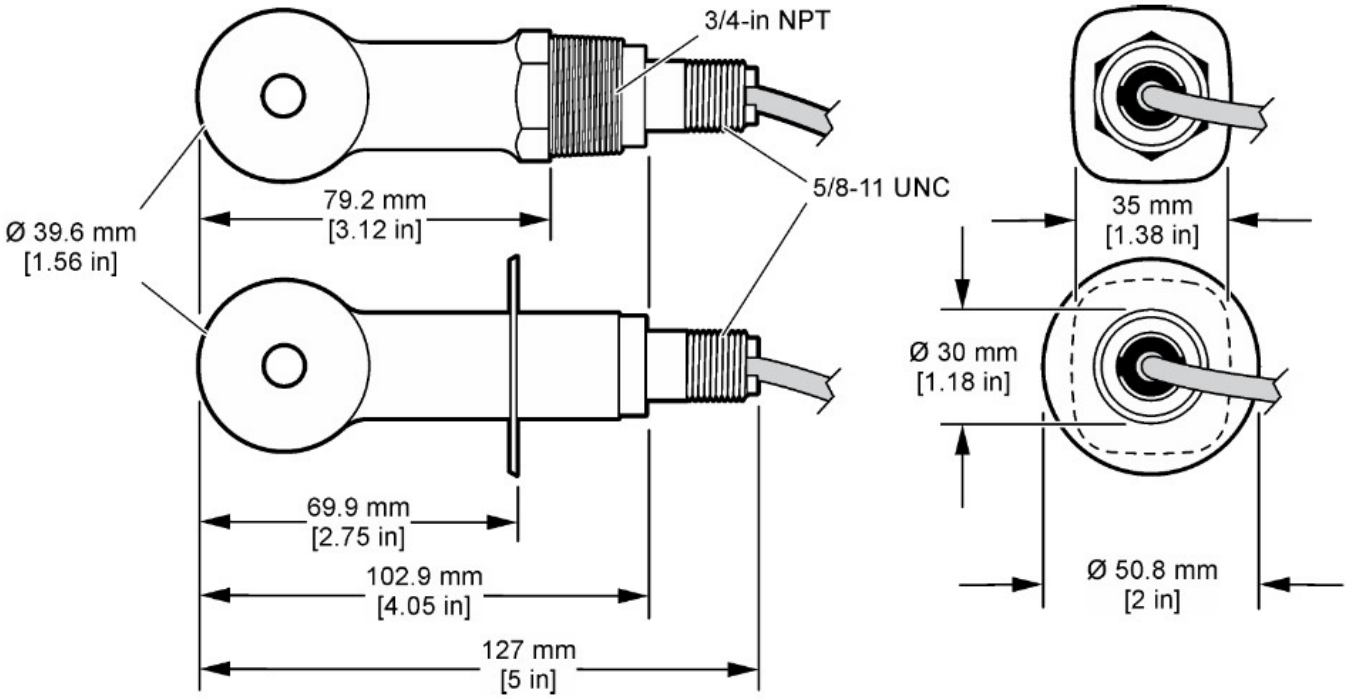
NOTICE

Use of this sensor may lead to fissures of the coating, exposing the underlying substrate to the environment in which the sensor is immersed. Therefore, this sensor has not been developed for, and is not meant for use in applications where the liquid is expected to conform to certain purity or cleanliness parameters and in which contamination could result in substantial damages. These applications typically include semiconductor manufacturing applications and may include other applications in which the user must assess risk of contamination and subsequent impact on product quality. The manufacturer advises against the use of the sensor in these applications and assumes no responsibility for any claims or damages arising as a result of the sensor being used in or in relation to these applications.

This sensor is designed to work with a controller for data collection and operation. Different controllers can be used with this sensor. This document assumes sensor installation and use with an SC4500 Controller. To use the sensor with other controllers, refer to the user manual for the controller that is used.

Refer to Figure 1 for the sensor dimensions.

Figure 1 Dimensions

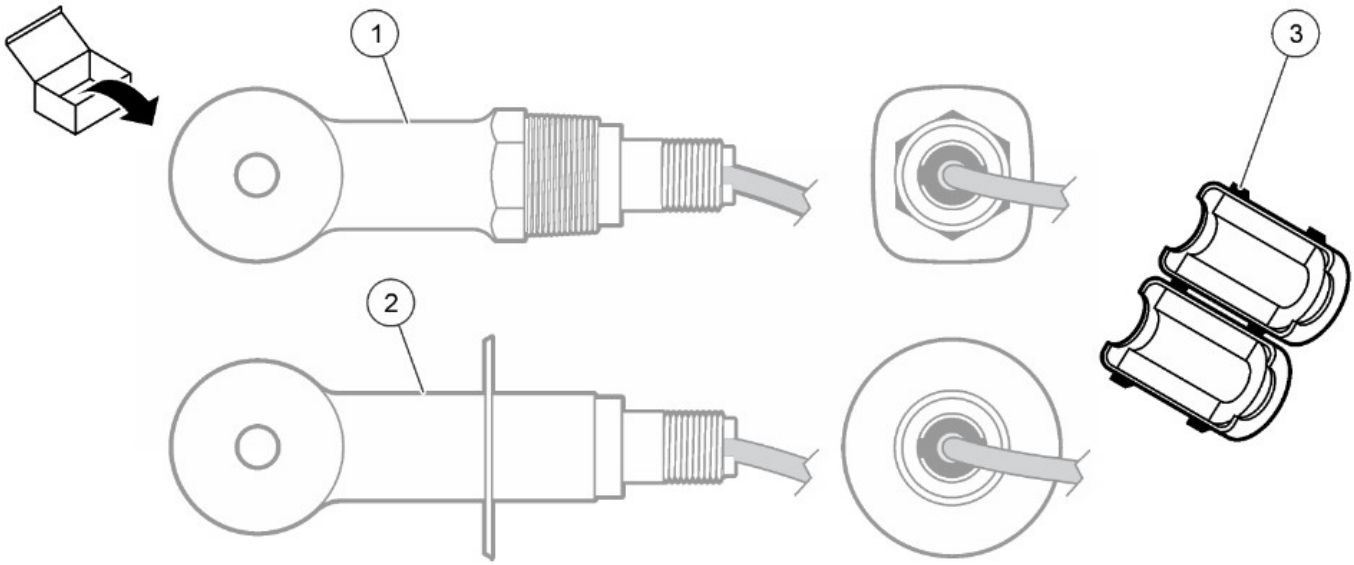


3.3 Product components

Make sure that all components have been received. Refer to Figure 2 and Figure 3. If any items are missing or damaged, contact the manufacturer or a sales representative immediately.

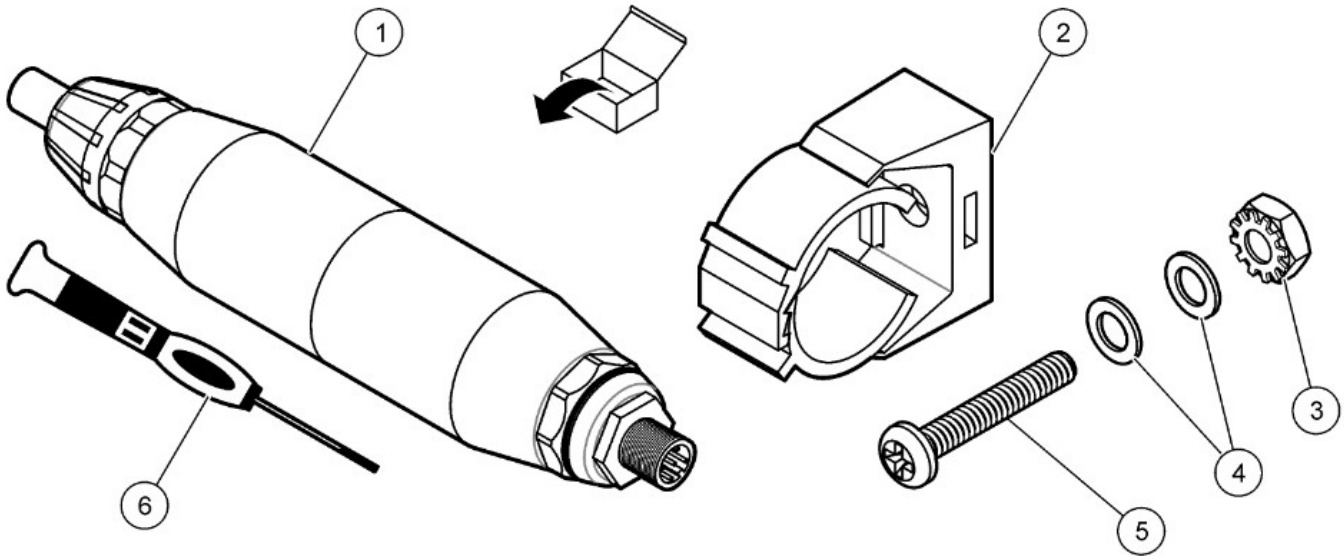
Note: The sensor can be ordered without the digital gateway that is shown in Figure 3.

Figure 2 Sensor components



1. Convertible-style sensor—for installation in a pipe tee or an open vessel with applicable mounting hardware
2. Sanitary-style sensor—for installation in a 2-inch sanitary tee
3. Ferrite

Figure 3 Digital gateway components



1. Digital gateway
2. Mounting bracket
3. Nut with lock washer, #8-32
4. Flat washer, #8 (2x)
5. Screw, cross-slot, #8-32 x 1.25 in.
6. Screwdriver (for the terminal block)

Section 4 Installation

WARNING

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

4.1 Install the sensor in the sample stream

WARNING

Explosion hazard. For installation in hazardous (classified) locations, refer to the instructions and control drawings in the controller Class 1, Division 2 documentation. Install the sensor according to local, regional and national codes. Do not connect or disconnect the instrument unless the environment is known to be non-hazardous.

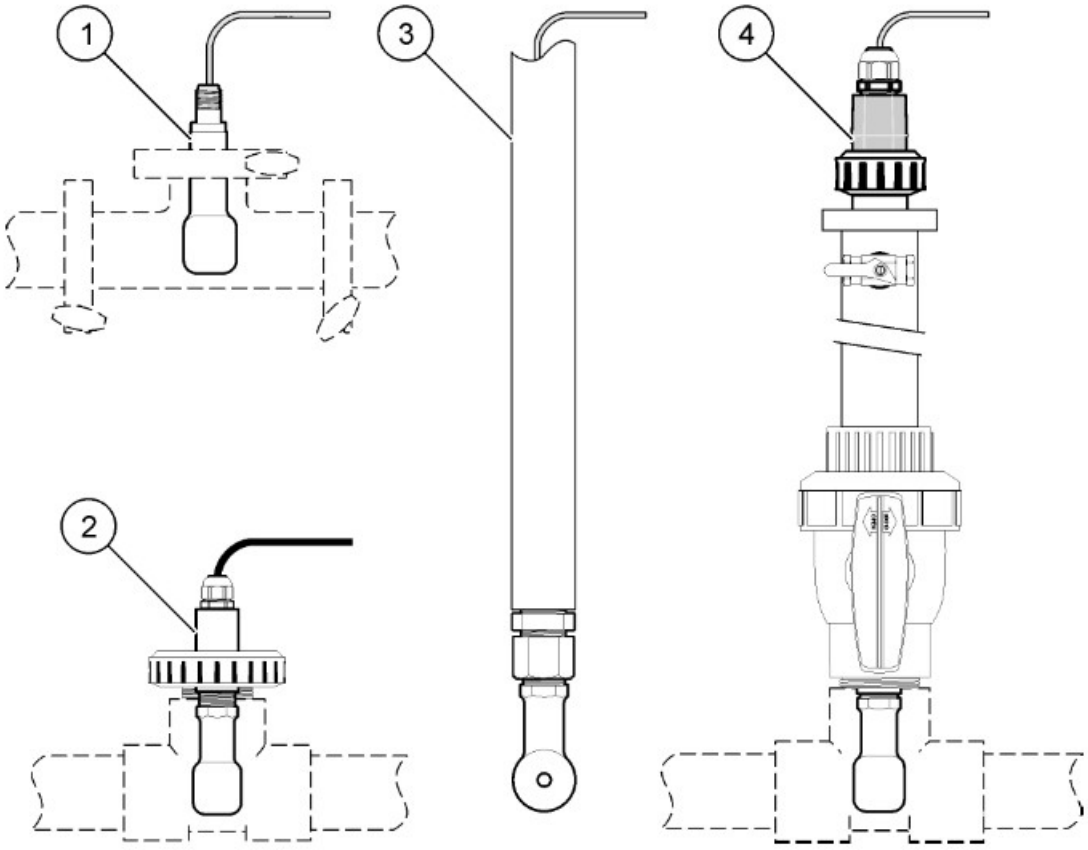
WARNING

Explosion hazard. Make sure that the mounting hardware for the sensor has a temperature and pressure rating sufficient for the mounting location.

Refer to Figure 4 for installation of the sensor in different applications. The sensor must be calibrated before use. Refer to Calibrate the sensor on page 12.

Make sure that the routing of the sensor cable prevents exposure to high electromagnetic fields (e.g., transmitters, motors and switching equipment). Exposure to these fields can cause inaccurate results.

Figure 4 Mounting examples



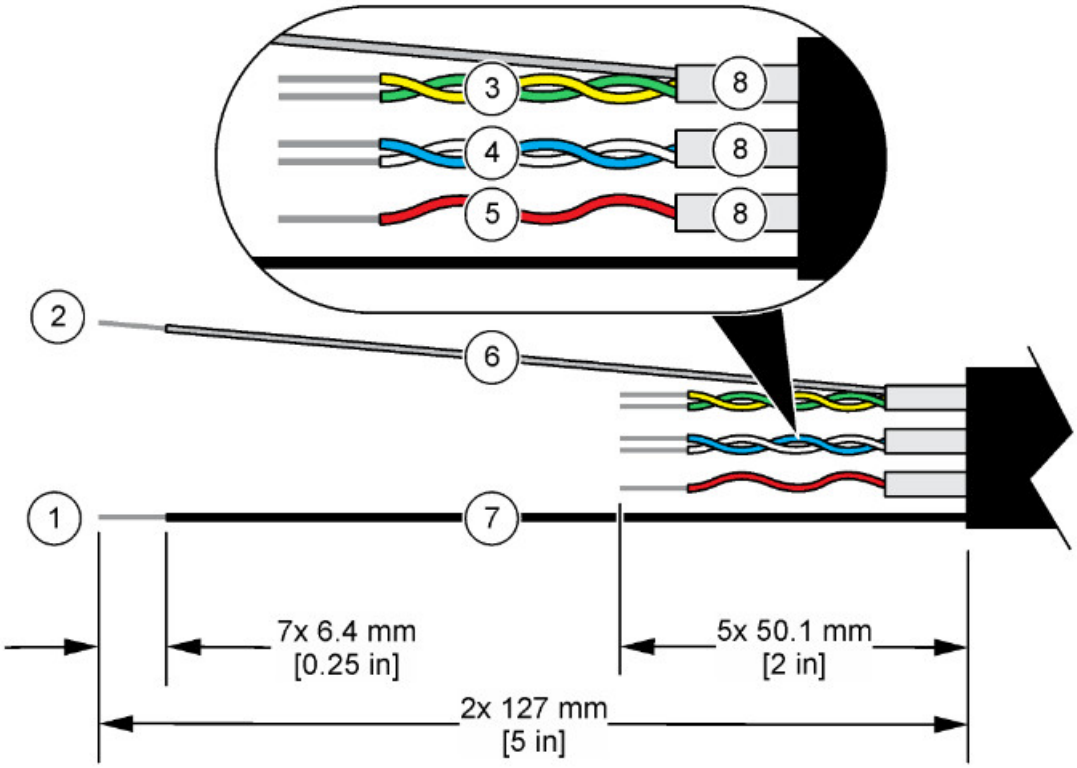
1. Sanitary (CIP) flange mount
2. Union T-mount
3. End of pipe immersion
4. Ball valve insertion

4.2 Electrical installation

4.2.1 Prepare the sensor wires

If the sensor cable length is changed, prepare the wires as shown in Figure 5.

Figure 5 Wire preparation



1 Outer shield wire1	**5** Red wire
2 Inner shield wire2	**6** Clear heat-shrink tubing3
3 Twisted pair, yellow wire and green wire	**7** Black heat-shrink tubing3
4 Twisted pair, white wire and blue wire	**8** Inner conductor shields4

4.2.2 Electrostatic discharge (ESD) considerations

NOTICE

Potential Instrument Damage. Delicate internal electronic components can be damaged by static electricity, resulting in degraded performance or eventual failure.
Refer to the steps in this procedure to prevent ESD damage to the instrument:

- Touch an earth-grounded metal surface such as the chassis of an instrument, a metal conduit or pipe to discharge static electricity from the body.
- Avoid excessive movement. Transport static-sensitive components in anti-static containers or packages.
- Wear a wrist strap connected by a wire to earth ground.
- Work in a static-safe area with anti-static floor pads and work bench pads.

4.2.3 Connect the sensor to an SC Controller

Use one of the options that follows to connect the sensor to an SC Controller:

- Install a sensor module in the SC Controller. Then, connect the bare wires of the sensor to the sensor module. The sensor module converts the analog signal from the sensor to a digital signal.
- Connect the bare wires of the sensor to an sc digital gateway, then connect the sc digital gateway to the SC Controller. The digital gateway converts the analog signal from the sensor to a digital signal.

1. The shield wire for the sensor cable
2. The shield wire for the green and yellow twisted pair
3. User supplied
4. The inner conductor shields are foil tubes with a conductive interior side and a nonconductive exterior side. Make sure to keep the electrical isolation between the interior side of the inner conductor shields. Make sure that the interior side of the inner conductive shields is not exposed.

Refer to the instructions supplied with the sensor module or sc digital gateway.

4.2.4 PRO-series Model E3 electrodeless conductivity transmitter

To connect the sensor to a PRO-series Model E3 electrodeless conductivity transmitter, remove power to the transmitter and refer to Figure 6 and Table 1.

Figure 6 Connect the sensor to the transmitter

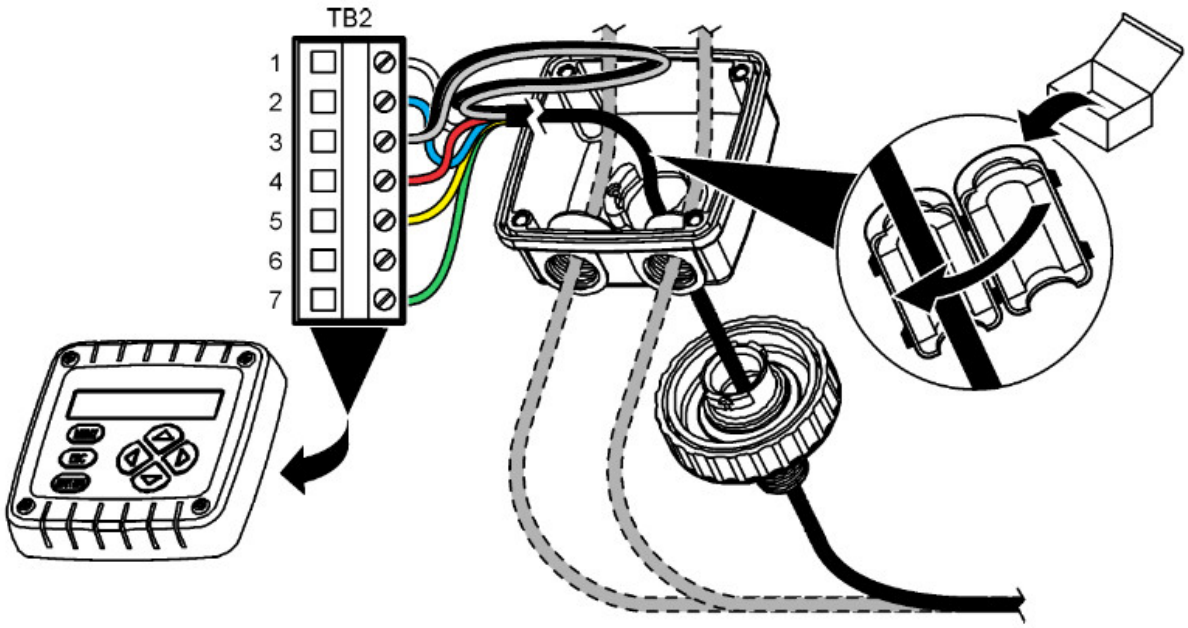


Table 1 Sensor wiring information

Terminal (TB2)	Wire	Terminal (TB2)	Wire
1	White	4	Red
2	Blue	5	Yellow
3	Clear (inner shield)5	6	—
3	Black (outer shield)5	7	Green

Section 5 Operation

WARNING

Fire hazard. This product is not designed for use with flammable liquids.

5.1 User navigation

Refer to the controller documentation for the touchscreen description and navigation information.

5.2 Configure the sensor

Use the Settings menu to enter identification information for the sensor and to change options for data handling

and storage.

1. Select the main menu icon, then select Devices. A list of all of the available devices shows.
2. Select the sensor and select Device menu > Settings.

   5 For the best immunity to electrical noise, connect the inner shield wire and the outer shield wire together with solder before they are put in the terminal block.
3. Select an option.
   - For sensors connected to a conductivity module, refer to Table 2.
   - For sensors connected to an sc digital gateway, refer to Table 3.

Table 2 Sensors connected to conductivity module

Option	Description
Name	Changes the name that corresponds to the sensor on the top of the measurement scree n. The name is limited to 16 characters in any combination of letters, numbers, spaces o r punctuation.
Sensor S/N	Lets the user enter the serial number of the sensor. The serial number is limited to 16 ch aracters in any combination of letters, numbers, spaces or punctuation.
Measurement type	Changes the measured parameter to Conductivity (default), Concentration, TDS (total di ssolved solids) or Salinity. When the parameter is changed, all other configured settings are reset to the default values.
Format	Changes the number of decimal places that are shown on the measurement screen to A uto, X.XXX, XX.XX or XXX.X. When Auto is selected, the decimal places automatically c hange. **Note:** The Auto option is only available when the Measurement type setting is set to Conductivity.
Conductivity unit	**Note:** The Conductivity unit setting is only available when the Measurement type setting is set to Conductivity or Concentration. Changes the conductivity units—Auto, µS/cm, mS/cm or S/cm.
Temperature	Sets the temperature units to °C (default) or °F.
T-compensation	Adds a temperature-dependent correction to the measured value—None, Linear (default : 2.0%/°C, 25 °C), Natural water or Temperature compensation table. When Temperature compensation table is selected, the user can enter x, y (°C, %/°C) points in ascending order. **Note:** The Natural water option is not available when the Measurement type setting is se t to TDS or Concentration.
Concentration mea surement	**Note:** The Concentration measurement setting is only available when the Measurement type setting is set to Concentration. Sets the type of concentration table to use—Built-in (default) or User compensation tabl e. When Built-in is selected, the user can select the chemical that is measured— H_3PO_4: 0 –40%; HCl: 0–18% or 22–36%; Na OH: 0–16%; $CaCl_2$ 0–22%; HNO_3: 0–28% or 36–96 %; H_2SO_4: 0–30%, 40–80% or 93–99%; HF: 0–30%; Na Cl: 0–25%; HBr, KOH, Seawate r When User compensation table is selected, the user can enter x, y (conductivity, %) poin ts in ascending order.

TDS (total dissolved solids)	**Note:** The TDS (total dissolved solids) setting is only available when the Measurement type setting is set to TDS. Sets the factor that is used to convert conductivity to TDS—NaCl (default) or Custom (enter a factor between 0.01 and 99.99 ppm/µS, default: 0.49 ppm/µS).
Temperature element	Sets the temperature element for automatic temperature compensation to PT100, PT1000 (default) or Manual. If no element is used, set to Manual and set a value for temperature compensation (default: 25 °C). When Temperature element is set to PT100 or PT1000, refer to Adjust the T-factor for non-standard cable lengths on page 12 to set the T factor setting. **Note:** If Temperature element is set to Manual and the sensor is replaced or the sensor days are reset, Temperature element automatically changes back to the default setting (PT1000).
Cell constant parameters	Changes the cell constant to the actual certified K value from the label on the sensor cable. When the certified K value is entered, the calibration curve is defined. Default: 4.70

Option	Description
Filter	Sets a time constant to increase signal stability. The time constant calculates the average value during a specified time—0 (no effect, default) to 200 seconds (average of signal value for 200 seconds). The filter increases the time for the sensor signal to respond to actual changes in the process.
Data logger interval	Sets the time interval for sensor and temperature measurement storage in the data log — 5, 30 seconds or 1, 2, 5, 10, 15 (default), 30, 60 minutes
Reset settings to default values	Sets the Settings menu to the factory default settings and resets the counters. All sensor information is lost.

Table 3 Sensors connected to SC digital gateway

Option	Description
Name	Changes the name that corresponds to the sensor on the top of the measurement screen. The name is limited to 16 characters in any combination of letters, numbers, spaces or punctuation.
Measurement type	Changes the measured parameter to Conductivity (default), Concentration, TDS (total dissolved solids) or Salinity. When the parameter is changed, all other configured settings are reset to the default values.
Conductivity unit	**Note:** The Conductivity unit setting is only available when the Measurement type setting is set to Conductivity, Concentration or Salinity. Changes the conductivity units—µS/cm (default), ms/cm or S/cm.
Cell constant parameters	**Note:** The Cell constant parameters setting is only available when the Measurement type setting is set to Conductivity or Salinity. Changes the cell constant to the actual certified K value from the label on the sensor cable. When the certified K value is entered, the calibration curve is defined. Default: 4.70
Concentration measurement	**Note:** The Concentration measurement setting is only available when the Measurement type setting is set to Concentration. Sets the type of concentration table to use—Built-in (default) or User defined. When Built-in is selected, the user can select the chemical that is measured— H_3PO_4: 0–40%; HCl: 0–18% or 22–36%; Na OH: 0–16%; $CaCl_2$ 0–22%; HNO_3: 0–28% or 36–96%; H_2SO_4: 0–30%, 40–80% or 93–99%; HF: 0–30% When User defined is selected, the user can enter x, y (conductivity, %) points in ascending order.
TDS (total dissolved solids)	**Note:** The TDS (total dissolved solids) setting is only available when the Measurement type setting is set to TDS. Sets the factor that is used to convert conductivity to TDS—Na Cl (default) or User defined (enter a factor between 0.01 and 99.99 ppm/µS, default: 0.49 ppm/µS).
Temperature	Sets the temperature units to °C (default) or °F.
T-compensation	Adds a temperature-dependent correction to the measured value—None, Linear (default: 2.0%/°C, 25 °C), Natural water or Temperature compensation table. When Temperature compensation table is selected, the user can enter x, y (°C, %/°C) points in ascending order. **Note:** The Natural water option is not available when the Measurement type setting is set to TDS. **Note:** The T-compensation setting is set to None when the Measurement type setting is set to Concentration.
Data logger interval	Sets the time interval for sensor and temperature measurement storage in the data log—Disabled (default), 5, 10, 15, 30 seconds, 1, 5, 10, 15, 30 minutes or 1, 2, 6, 12 hours
Alternating current frequency	Selects the power line frequency to get the best noise rejection. Options: 50 or 60 Hz (default).

Option	Description
Filter	Sets a time constant to increase signal stability. The time constant calculates the averag e value during a specified time—0 (no effect, default) to 60 seconds (average of signal v alue for 60 seconds). The filter increases the time for the sensor signal to respond to act ual changes in the process.
Temperature elem ent	Sets the temperature element for automatic temperature compensation to PT1000 (defa ult) or Manual. If no element is used, set to Manual and set a value for temperature comp ensation (default: 25 °C). When Temperature element is set to PT1000, refer to Adjust the T-factor for non-standar d cable lengths on page 12 to set the Factor setting. **Note:** If Temperature element is set to Manual and the sensor is replaced or the sensor d ays are reset, Temperature element automatically changes back to the default setting (P T1000).
Last calibration	Sets a reminder for the next calibration (default: 60 days). A reminder to calibrate the sen sor shows on the display after the selected interval from the date of the last calibration. F or example, if the date of the last calibration was June 15 and Last calibration is set to 60 days, a calibration reminder shows on the display on August 14. If the sensor is calibrate d before August 14, on July 15, a calibration reminder shows on the display on September 13.
Sensor days	Sets a reminder for sensor replacement (default: 365 days). A reminder to replace the se nsor shows on the display after the selected interval. The Sensor days counter shows on the Diagnostics/Test > Counter menu. When the sensor is replaced, reset the Sensor days counter on the Diagnostics/Test > C ounter menu.
Reset setup	Sets the Settings menu to the factory default settings and resets the counters. All sensor information is lost.

5.3 Adjust the T-factor for non-standard cable lengths

When the sensor cable is extended or shortened from the standard 6 m (20 ft), the resistance of the cable changes. This change reduces the accuracy of temperature measurements. To correct for this difference, calculate a new T-factor.

1. Measure the temperature of a solution with the sensor and with an independent, reliable instrument such as a thermometer.
2. Record the difference between the temperature measured from the sensor and from the independent source (actual).

   For example, if the actual temperature is 50 °C and the sensor reading is 53 °C, the difference is 3 °C.
3. Multiply this difference by 3.85 to get the adjustment value.

   Example: 3 x 3.85 = 11.55.
4. Calculate a new T-factor:

   • Sensor temperature > actual—add the adjustment value to the T-factor that is on the label on the sensor cable

   • Sensor temperature < actual—subtract the adjustment value from the T-factor that is on the label on the sensor cable
5. Select Settings > Temperature element > T factor (or Factor) and enter the new T-factor.

5.4 Calibrate the sensor

WARNING

 Fluid pressure hazard. Removal of a sensor from a pressurized vessel can be dangerous. Reduce the process pressure to below 7.25 psi (50 kPa) before removal. If this is not possible, use extreme caution. Refer to the documentation supplied with the mounting hardware for more information.;

 **WARNING**

 Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

 **CAUTION**

 Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

5.4.1 About sensor calibration

The wet cal method should be used to calibrate the conductivity sensor:

- Wet cal—use air (Zero Cal) and a reference solution or process sample of known value to define a calibration curve. A reference solution calibration is recommended for best accuracy. When the process sample is used, the reference value must be determined with a secondary verification instrument. Be sure to enter the T-factor in Temperature element of the Settings menu for accurate temperature compensation.

During calibration, data is not sent to the Datalog. Thus, the Datalog can have areas where the data is intermittent.

5.4.2 Change calibration options

For sensors connected to a conductivity module, the user can set a reminder or include an operator ID with calibration data from the Calibration options menu.

Note: This procedure is not applicable to sensors connected to an sc digital gateway.

1. Select the main menu icon, then select Devices. A list of all of the available devices shows.
2. Select the sensor and select Device menu > Calibration.
3. Select Calibration options.
4. Select an option.

Option	Description
Calibration reminder	Sets a reminder for the next calibration (default: Off). A reminder to calibrate the sensor shows on the display after the selected interval from the date of the last calibrati on. For example, if the date of the last calibration was June 15 and Last calibration is s et to 60 days, a calibration reminder shows on the display on August 14. If the sensor i s calibrated before August 14, on July 15, a calibration reminder shows on the display on September 13.
Operator ID for calibra tion	Includes an operator ID with calibration data—Yes or No (default). The ID is entered du ring the calibration.

5.4.3 Zero calibration procedure

Use the zero calibration procedure to define the unique zero point of the conductivity sensor. The zero point must be defined before the sensor is calibrated for the first time with a reference solution or process sample.

1. Remove the sensor from the process. Wipe the sensor with a clean towel or use compressed air to make sure the sensor is clean and dry.

2. Select the main menu icon, then select Devices. A list of all of the available devices shows.
3. Select the sensor and select Device menu > Calibration.
4. Select Zero calibration (or 0-point calibration).;
5. Select the option for the output signal during calibration:

Option	Description
Active	The instrument sends the current measured output value during the calibration proc edure.
Hold	The sensor output value is held at the current measured value during the calibration procedure.
Transfer	A preset output value is sent during calibration. Refer to the controller user manual t o change the preset value.

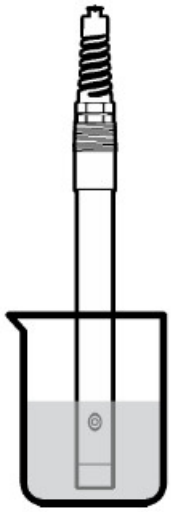
6. Hold the dry sensor in the air and push OK.
7. Do not push OK until the calibration result shows on the display.
8. Review the calibration result:
   • “The calibration was successfully completed.”—The sensor is calibrated and ready to measure samples. The slope and/or offset values are shown.
   • “The calibration failed.” —The calibration slope or offset is outside of accepted limits. Repeat the calibration with fresh reference solutions. Clean the sensor if necessary.
9. Push OK.
10. Proceed to the calibration with a reference solution or process sample.

5.4.4 Calibration with a reference solution

Calibration adjusts the sensor reading to match the value of a reference solution. Use a reference solution that is at the same value or higher than the expected measurement readings.
Note: If the sensor is being calibrated for the first time, be sure to complete the zero calibration first.

1. Thoroughly rinse the clean sensor in deionized water.
2. Put the sensor in the reference solution. Support the sensor so that it does not touch the container. Make sure that the sensing area is fully immersed in the solution (Figure 7). Stir the sensor to remove bubbles.

Figure 7 Sensor in reference solution



3. Wait for the sensor and solution temperature to equalize. This can take 30 minutes or more if the temperature difference between the process and reference solution is significant.
4. Select the main menu icon, then select Devices. A list of all of the available devices shows.
5. Select the sensor and select Device menu > Calibration.
6. Select Conductivity solution (or Conductivity calibration if the sensor is connected to an sc digital gateway).
7. Select the option for the output signal during calibration:

Option	Description
Active	The instrument sends the current measured output value during the calibration procedure.
Hold	The sensor output value is held at the current measured value during the calibration procedure.
Transfer	A preset output value is sent during calibration. Refer to the controller user manual to change the preset value.

8. Enter the reference temperature of the reference solution and push OK.
9. Enter the slope of the reference solution and push OK.
10. With the sensor in the reference solution, push OK.
11. Wait for the value to stabilize and push OK.

    Note: The screen may advance to the next step automatically.
12. Enter the value of the reference solution and push OK.
13. Review the calibration result:

    • “The calibration was successfully completed.”—The sensor is calibrated and ready to measure samples. The slope and/or offset values are shown.

    • “The calibration failed.” —The calibration slope or offset is outside of accepted limits. Repeat the calibration with fresh reference solutions. Clean the sensor if necessary.
14. Push OK to continue.
15. Return the sensor to the process and push OK.

    The output signal returns to the active state and the measured sample value is shown on the measurement screen.

5.4.5 Calibration with the process sample

The sensor can remain in the process sample, or a portion of the process sample can be removed for calibration. The reference value must be determined with a secondary verification instrument.

Note: If the sensor is calibrated for the first time, be sure to complete the zero calibration first.

1. Select the main menu icon, then select Devices. A list of all of the available devices shows.
2. Select the sensor and select Device menu > Calibration.
3. Select Conductivity calibration, TDS calibration or Concentration calibration (or Calibration).

   Note: Use the Measurement type setting to change the parameter that is calibrated.
4. Select the option for the output signal during calibration:

Option	Description
Active	The instrument sends the current measured output value during the calibration procedure.
Hold	The sensor output value is held at the current measured value during the calibration procedure.
Transfer	A preset output value is sent during calibration. Refer to the controller user manual to change the preset value.

5. With the sensor in the process sample, push OK. The measured value is shown.
6. Wait for the value to stabilize and push OK.

   Note: The screen may advance to the next step automatically.
7. Measure the conductivity (or other parameter) value with a secondary verification instrument. Use the arrow keys to enter the measured value and push OK.
8. Review the calibration result:

   • “The calibration was successfully completed.”—The sensor is calibrated and ready to measure samples. The slope and/or offset values are shown.

   • “The calibration failed.” —The calibration slope or offset is outside of accepted limits. Repeat the calibration with fresh reference solutions. Clean the sensor if necessary.
9. Push OK to continue.
10. Return the sensor to the process and push OK.

    The output signal returns to the active state and the measured sample value is shown on the measurement screen.

5.4.6 Temperature calibration

The instrument is calibrated at the factory for accurate temperature measurement. The temperature can be calibrated to increase accuracy.

1. Put the sensor in a container of water.
2. Measure the temperature of the water with an accurate thermometer or independent instrument.
3. Select the main menu icon, then select Devices. A list of all of the available devices shows.
4. Select the sensor and select Device menu > Calibration.
5. Select 1-point temperature calibration (or Temperature adjustment).

6. Enter the exact temperature value and push OK.
7. Return the sensor to the process.

5.4.7 Exit calibration procedure

1. To exit a calibration, push the back icon.
2. Select an option, then push OK.

Option	Description
Quit calibration (or Cancel)	Stop the calibration. A new calibration must start from the beginning.
Return to calibration	Return to the calibration.
Leave calibration (or Exit)	Exit the calibration temporarily. Access to other menus is allowed. A calibration for a second sensor (if present) can be started.

5.4.8 Reset the calibration

The calibration can be reset to the factory default settings. All sensor information is lost.

1. Select the main menu icon, then select Devices. A list of all of the available devices shows.
2. Select the sensor and select Device menu > Calibration.
3. Select Reset to default calibration values or Reset to calibration defaults (or Reset setup), then push OK.
4. Push OK again.

5.5 Modbus registers

A list of Modbus registers is available for network communication. Refer to the manufacturer's website for more information.

Section 6 Maintenance

WARNING

Multiple hazards. Only qualified personnel must conduct the tasks described in this section of the document.

WARNING

Explosion hazard. Do not connect or disconnect the instrument unless the environment is known to be non-hazardous. Refer to the controller Class 1, Division 2 documentation for hazardous location instructions.

WARNING

Fluid pressure hazard. Removal of a sensor from a pressurized vessel can be dangerous. Reduce the process pressure to below 7.25 psi (50 kPa) before removal. If this is not possible, use extreme caution. Refer to the documentation supplied with the mounting hardware for more information.

WARNING

Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

CAUTION

Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

6.1 Clean the sensor

Pre-requisite: Prepare a mild soap solution with warm water and dishwashing detergent, Borax hand soap or a similar soap.

Examine the sensor periodically for debris and deposits. Clean the sensor when there is a buildup of deposits or when performance has degraded.

1. Use a clean, soft cloth to remove loose debris from the end of the sensor. Rinse the sensor with clean, warm water.
2. Soak the sensor for 2 to 3 minutes in the soap solution.
3. Use a soft bristle brush to scrub the entire measuring end of the sensor. Scrub the inside of the toroid.
4. If debris remains, soak the measuring end of the sensor in a dilute acid solution such as < 5% HCl for a maximum of 5 minutes.
5. Rinse the sensor with water and then return to the soap solution for 2 to 3 minutes.
6. Rinse the sensor with clean water.

Always calibrate the sensor after maintenance procedures are done.

Section 7 Troubleshooting

7.1 Intermittent data

During calibration, data is not sent to the Datalog. Thus, the Datalog can have areas where the data is intermittent.

7.2 Test the conductivity sensor

If a calibration fails, first complete the maintenance procedures in Maintenance on page 16.

1. Disconnect the sensor wires.
2. Use an ohmmeter to test the resistance between the sensor wires as shown in Table 4.

Note: Be sure that the ohmmeter is set to its highest range for all infinite (open circuit) resistance readings.

Table 4 Conductivity resistance measurements

Measurement points	Resistance
Between red and yellow wires	1090–1105 ohms at 23–27 °C6
Between blue and white wires	Less than 5 ohms
Between green and yellow wires	Less than 5 ohms
Between white and shield wires	Infinite (open circuit)

If one or more of the measurements is incorrect, call technical support. Supply technical support with the serial number of the sensor and the resistance values measured.

7.3 Diagnostics/Test menu

The Diagnostics/Test menu shows current and historical information about the sensor. Refer to Table 5. Push the main menu icon, then select Devices. Select the device and select Device menu > Diagnostics/Test.

Table 5 Diagnostics/Test menu

Option	Description
Module information	For sensors connected to a conductivity module only—Shows the version and the serial number of the conductivity module.
Sensor information	For sensors connected to a conductivity module—Shows the sensor name and the serial number entered by the user. For sensors connected to an sc digital gateway—Shows the sensor model number and the sensor serial number. Shows the software version and driver version installed.
Last calibration	For sensors connected to a conductivity module only—Shows the number of days since the last calibration was done.
Calibration history	For sensors connected to a conductivity module—Shows the calibration slope and date of the previous calibrations. For sensors connected to an sc digital gateway—Shows the cell constant parameters, offset correction and date of the last calibration.
Reset calibration history	For sensors connected to a conductivity module only—For service use only
Sensor signals (or **Signals**)	For sensors connected to a conductivity module only—Shows the current conductivity and temperature reading. For sensors connected to an sc digital gateway—Shows the current temperature analog to digital converter counter. Select Sensor signal to show current measurement analog to digital converter counter or set the sensor range (default: 6). Select Sensor measurement to show the sensor reading.
Sensor days (or **Counter**)	Shows the number of days that the sensor has been in operation. For sensors connected to an sc digital gateway—Select **Counter** to show the number of days that the sensor has been in operation. To reset the counter to zero, select **Reset**. Reset the Sensor days counter when the sensor is replaced.
Reset	For sensors connected to a conductivity module only—Sets the Sensor days counter to zero. Reset the Sensor days counter when the sensor is replaced.
Factory calibration	For sensors connected to a conductivity module only—For service use only

6 An infinite value (open circuit) or 0 ohms (short circuit) identifies a failure.

7.4 Error list

When an error occurs, the reading on the measurement screen flashes and all outputs are held when specified in the Controller > Outputs menu. The screen changes to red. The diagnostics bar shows the error. Push on the diagnostic bar to show the errors and warnings. As an alternative, push the main menu icon, then select Notifications > Errors.

A list of possible errors is shown in Table 6.

Table 6 Error list

Error	Description	Resolution
Conductivity is too high.	The measured value is > 2 S/cm, 1,000,000 ppm, 200% or 20,000 ppt.	Make sure that the Conductivity unit setting is set for the correct measurement range.
Conductivity is too low.	The measured value is < 0 µS/cm, 0 ppm, 0% or 0 ppt or the sensor cell constant is not correct.	Make sure that the sensor is configured for the correct cell constant.
Zero is too high.	The zero calibration value is > 500,000 counts.	Make sure that the sensor is held in air during zero calibration and is not located near radio frequency or electromagnetic interference. Make sure that the cable is shielded by metal conduit.
Zero is too low.	The zero calibration value is < –500,000 counts.	
Temperature is too high.	The measured temperature is > 130 °C.	Make sure that the correct temperature element is selected. Refer to Configure the sensor on page 9.
Temperature is too low.	The measured temperature is < –10 °C.	
ADC failure	The analog to digital conversion failed.	Power off and power on the controller. Contact technical support.
Sensor is missing.	The sensor is missing or disconnected.	Examine the wiring and connections for the sensor and for the module (or digital gateway). Make sure that the terminal block is fully inserted into the module, if applicable.
Measurement value is out of range.	The sensor signal is outside of the accepted limits (2 S/cm).	Make sure that the Conductivity unit setting is set for the correct measurement range.

7.5 Warning list

A warning does not affect the operation of menus, relays and outputs. The screen changes to an amber color. The diagnostics bar shows the warning. Push on the diagnostic bar to show the errors and warnings. As an alternative, push the main menu icon, then select Notifications > Warnings. A list of possible warnings is shown in Table 7.

Table 7 Warning list

Warning	Description	Resolution
Zero is too high.	The zero calibration value is >300,000 counts.	Make sure that the sensor is held in air during zero calibration and is not located near radio frequency or electromagnetic interference. Make sure that the cable is shielded by metal conduit.
Zero is too low.	The zero calibration value is < –300,000 counts.	
Temperature is too high.	The measured temperature is > 100 °C.	Make sure that the sensor is configured for the correct temperature element.
Temperature is too low.	The measured temperature is < 0 °C.	
Calibration is overdue.	The Cal Reminder time has expired.	Calibrate the sensor.

Warning	Description	Resolution
The device is not calib rated.	The sensor has not been calibrated.	Calibrate the sensor.
Replace a sensor.	The Sensor days counter is more than the interval selected for sensor replac ement. Refer to Configure the sensor on page 9.	Replace the sensor. Reset the Sensor days counter on the Diagnostics/Test > Reset me nu (or Diagnostics/Test > Counter menu.
Calibration is in progre ss…	A calibration was started but not comp leted.	Return to calibration.
Outputs on hold	During calibration, the outputs were s et to hold for a selected time.	The outputs will become active after the sel ected time period. As an alternative, remove and then supply power to the controller.
Linear temperature co mpensation is out of ra nge.	The user-defined linear temperature c ompensation is out of range.	The value must be between 0 and 4%/°C; 0 to 200 °C.
Temperature compens ation table is out of ran ge.	The user-defined temperature compensation table is out of range.	The temperature is above or below the tem perature range defined by the table.
Incorrect user concent ration table.	The concentration measurement is ou tside of the range of the user table.	Make sure that the user table is set for the c orrect measurement range.
Incorrect built-in temp erature table.	The measured temperature is outside of the range of the built-in temperatur e compensation table.	Make sure that the temperature compensati on is configured correctly.
Incorrect built-in concentration table.	The concentration measurement is ou tside of the range of the built-in conce ntration table.	Make sure that the concentration measurement is configured for the correct c hemical and range.

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Documents / Resources

	HACH DOC023 Inductive Conductivity Sensors [pdf] User Manual DOC023 Inductive Conductivity Sensors, DOC023, Inductive Conductivity Sensors, Conductivity Sensors, Sensors

References

- Geräte und Reagenzien für die Wasserqualitätsanalyse | Hach
- Hach | Hach
- User Manual