


# User instructions

## Luminescent Dissolved Oxygen Probe: Model LDO10101, LDO10103, LDO10105, LDO10110, LDO10115 or LDO10130

### Safety Information

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.

	<p>Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user.</p> <p><b>Note:</b> For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.</p>
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### Overview

Figure 1 on page 2 shows the LDO101 series probe, a luminescent dissolved oxygen (LDO<sup>®</sup>) probe. The LDO10105, LDO10110, LDO10115 or LDO10130 rugged probe is available with a 5, 10, 15, or 30 meter cable. The LDO10101 or LDO10103 standard probe is available with a 1 or 3 meter cable. The probe provides measurement of the dissolved oxygen concentration in wastewater, drinking water and general applications. For BOD applications, use the LBOD10101 probe equipped with LDO technology and an incorporated stirrer.

### Specifications

Specifications are subject to change without notice.

Specification	Details
Dissolved oxygen range	0.1 to 20.0 mg/L (ppm) 1 to 200% saturation
Dissolved oxygen accuracy	± 0.1 mg/L for 0 to 8 mg/L ± 0.2 mg/L for greater than 8 mg/L
% saturation resolution	0.1%
Temperature range	0 to 50 °C (122 °F)
Storage temperature	0 to 40 °C (104 °F)
Response time	T90% at 10 sec (when stirred)
Temperature resolution	0.1 °C (32.18 °F)
Temperature accuracy	± 0.3 °C (32.54 °F)
Pressure resolution	1 hPa
Pressure accuracy	± 0.8%
Minimum sample depth	25 mm (0.984 in.)
Dimensions	Standard diameter: 15 mm (0.59 in.), Length: 103 mm (4.1 in.), Total length (standard): 200 mm (7.9 in.), Total length (rugged): 220 mm (8.7 in.), Cable length: 1 or 3 meter (3.3 or 9.8 ft.). Rugged diameter: 15 mm (0.6 in.), Length: 16 mm (0.63 in.), Cable length: 5, 10 15 or 30 meter (16.4, 32.8, 49.2, or 98.4 ft.)
Cable connection	Digital output and connector compatible with HQd meters
Warranty	Probe is covered by a 3 year warranty. Sensor cap is covered by a 1 year warranty.

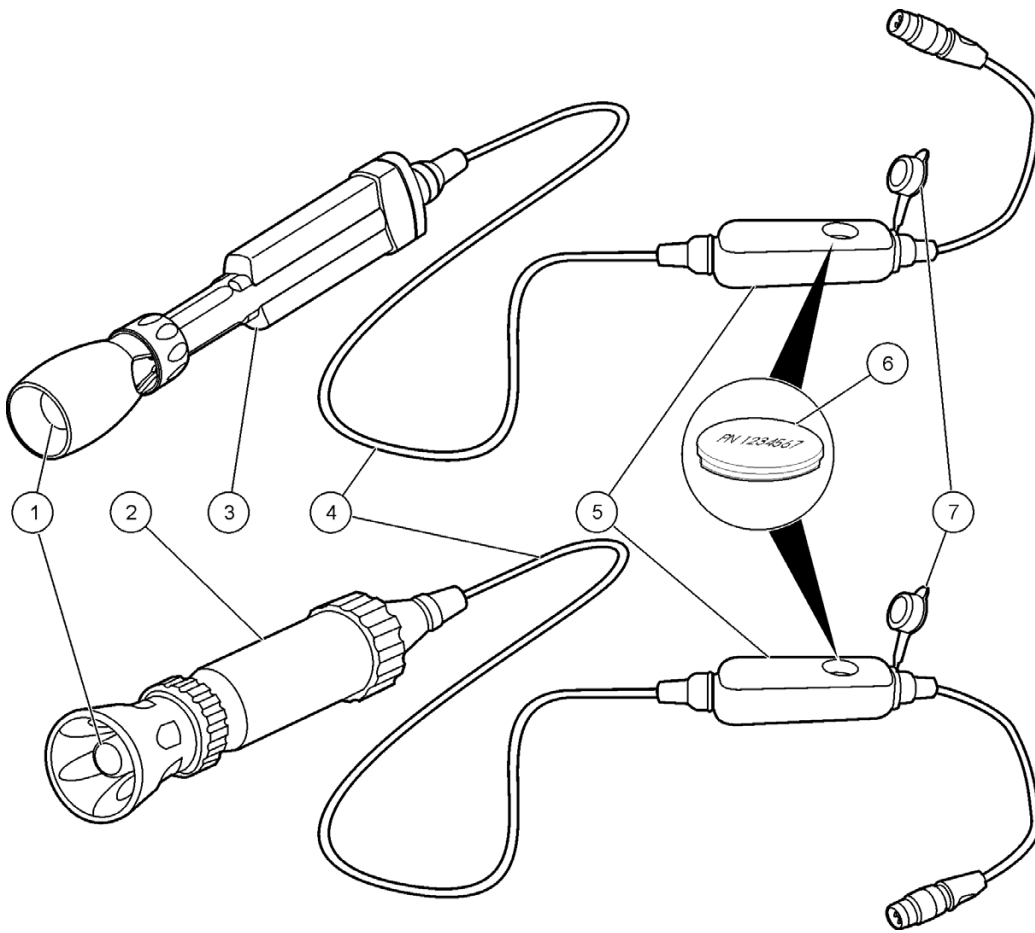


Figure 1 Probe overview

1	LDO sensor cap	5	Pressure sensor module
2	Rugged probe (5, 10, 15 or 30 meter cable)	6	iButton® (iButton is a registered trademark of Maxim Integrated Products, Inc.)
3	Standard probe (1 or 3 meter cable)	7	Pressure sensor module cap
4	Probe cable		

## Preparation for use

1. Verify that the LDO sensor cap and iButton are installed correctly. Avoid touching the sensor cap with a hand, fingers or any surface that may scratch the cap.

**Note:** Make sure the LDO sensor cap and iButton have the same lot code and the iButton label faces upward.

2. Rinse the sensor cap with deionized water and blot dry.

**Note:** The LDO sensor cap must be pre-conditioned if dissolved oxygen monitoring periods are longer than 6 hours. Refer to [Maintenance on page 6](#).

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# Calibration

## Before calibration:

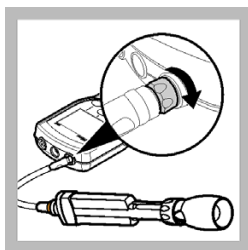
The probe must have the correct service-life time stamp. <b>Set the date and time in the meter before attaching the probe.</b>
The LDO101 probe is factory calibrated, ships with an iButton-provided calibration and is ready for use. The factory calibration will not allow a user calibration. To enable calibration, select User Cal as the Current Method in the LDO101 settings menu and follow the 100% (water-saturated air) procedures below.
It is not necessary to recalibrate when moving a calibrated probe from one HQd meter to another if the additional meter is configured to use the same calibration options. If the additional HQd meter uses different calibration options (e.g. calibration standards or acceptance criteria), calibrate the probe or change the method settings to select a different method. If using Factory Cal, a new method will need to be created.
To view the current calibration, select the <b>DATA LOG</b> key, <b>View Probe Data</b> , then <b>View Current Calibration</b>
Tighten the probe locking nut securely when connecting the probe to the meter.
For probes that are continuously immersed in aqueous solutions, condition the sensor cap for 72 hours. Refer to <a href="#">Maintenance on page 6</a> .
If any two probes are connected, Push the <b>UP</b> or <b>DOWN</b> arrow to change to the single display mode in order to show the <b>Calibrate</b> option.
A new method can be created if custom calibration or measurement settings are desired.
Refer to <a href="#">Troubleshooting on page 11</a> for calibration errors.
% saturation or mg/L calibration methods are available in the <b>Modify Current Settings</b> menu.

## Water-saturated air (100%) calibration

### Calibration notes

- Probes are initially calibrated at the factory. However, regular calibration by the user is recommended for the best measurement accuracy.
- To calibrate rugged probes, use a wide neck bottle or flask (such as a 250 mL Erlenmeyer flask).
- If the sensor cap is wet, carefully dry the cap with a nonabrasive cloth and put the probe back in the bottle.
- An additional zero point calibration can be added to the calibration routine. Refer to [Change calibration options on page 10](#).
- The slope value is the comparison between the latest calibration and the factory calibration expressed as a percentage. If the calibration slope does not meet the acceptance criteria, the display will show **Slope out of range**. Refer to [Troubleshooting on page 11](#).
- Data is stored automatically in the data log when **Press to Read** or **Interval** is selected while in Measurement Mode. When **Continuous** is selected, data is stored only when the **Store** key is pushed.
- The calibration is recorded in the probe and the data log. The calibration is also sent to a PC, printer or flash memory stick, if connected.

**Note:** Procedures also apply for rugged model probes.



1. Connect the probe to the meter. The LDO101 probe contains a factory calibration. Remove the shroud from the probe.



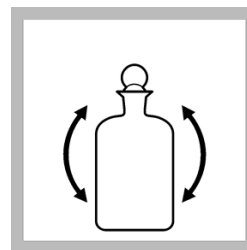
2. Push the **CALIBRATE** key to create a new method to enable user calibration.



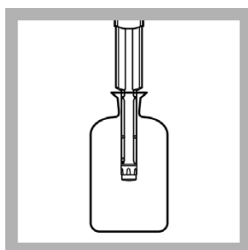
3. Push the **METHODS** key, and select User Cal - 100%. Push **OK**.



4. Add approximately  $\frac{1}{4}$  inch (6.4 mm) of reagent water to a narrow-neck bottle, such as a BOD bottle.



5. Insert a stopper and shake vigorously for approximately 30 seconds to saturate the entrapped air with water. Allow up to 30 minutes for contents to equilibrate to room temperature.



6. Remove the stopper. Carefully dry the cap with a non-abrasive cloth and place the probe in the bottle.



7. Select **Read**. The display will show **Stabilizing...** and a progress bar as the probe stabilizes. The display will highlight the standard value.



8. Select **Done** to view the calibration summary.



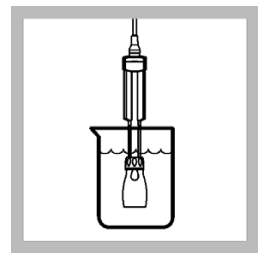
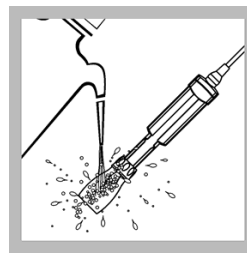
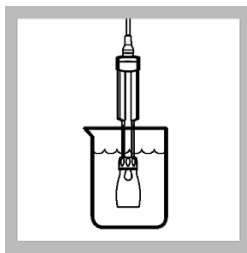
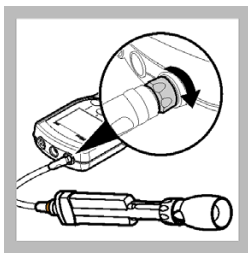
9. Select **Store** to accept the calibration and return to the measurement mode. Install the shroud on the probe body.

# Measurement

## Before measurement:

The probe must have the correct service-life time stamp. <b>Set the date and time in the meter before attaching the probe.</b>
The probe is factory calibrated and ready for use. For applications that require greater accuracy and precision, perform a user calibration ( <a href="#">Calibration on page 3</a> ).
When connecting the probe to the meter, make sure to securely tighten the probe locking nut.
If complete traceability is required, enter a sample ID and operator ID before measurement.
Refer to <a href="#">Troubleshooting on page 11</a> for measurement errors.
Optimal response time performance is achieved when sample is stirred or probe is placed in flowing conditions.
To deploy the rugged probe at a distance, toss the probe body with a gentle underhand throw. Do not swing the probe by the cable as this may cause injury to the user, will cause severe strain on the cable and will shorten the service life of the cell. Damage under these conditions is not covered by the product warranty.
Data is stored automatically in the data log when Press to Read or Interval is selected while in the measurement mode. When Continuous is selected, data will only be stored when Store is selected.
Salinity affects the concentration of dissolved oxygen in the sample. To correct for salinity effects, refer to <a href="#">Advanced operation on page 8</a> , or follow the <a href="#">Auto salinity correction (optional for HQ40d meter)</a> procedures.

**Note:** Procedures also apply for rugged model probes.



1. Connect the probe to the meter. Calibrate the probe if accuracy better than  $\pm 0.50$  mg/L is required for the application (refer to [Calibration on page 3](#)).
2. Place the probe in the sample and stir gently or add a stir bar. Move the probe up and down to remove any air bubbles from the sensor cap.
3. Select **Read**. The display will show **Stabilizing...** and a progress bar as the probe stabilizes in the sample. The display will then show the lock icon and the result will be automatically stored in the data log.
4. Rinse the probe with deionized water and blot dry with a laboratory wipe.
5. Repeat steps 2. to 4. for additional measurements.

## Auto salinity correction (optional for HQ40d meter)

Dissolved substances affect the amount of oxygen water can hold. Manually input salinity settings for the most accurate dissolved oxygen measurements or use the Auto Salinity Correction feature. The Auto Salinity Correction measures dissolved oxygen through the connection of one LDO101 probe and one CDC401 conductivity cell (set to Salinity parameter). The value obtained by the CDC401 conductivity cell automatically adjusts the salinity value for the LDO101 series probe. Auto Salinity Correction is recommended for dissolved oxygen measurements in samples where salinity varies. Salinity units are represented as parts per thousand (ppt) or ( $^{\circ}/_{\infty}$ ).

1. Connect the LDO101 probe and CDC401 conductivity cell to the HQd meter. Turn the meter on.

**Note:** Security options must be turned off to enable auto salinity correction.

2. Push **METER OPTIONS** and select the CDC401 Settings.

3. Select Current Method then Hach Salinity. Select **OK**.

**Note:** To change additional measurement options, choose *Modify Current Settings*, change the parameter to Salinity and any other desired settings.

4. Push **EXIT** until returned to the Full Access Options menu.

5. Select the **LDO101 Settings, Modify Current Settings, Measurement Options, Salinity Correction: Off**, then **Sal Correction Mode: Off**. Arrow down to Auto (\*) - Use CDC401 and select **OK**.

6. Push **EXIT** until the meter returns to the measurement mode. The HQ40d meter is now set up to automatically use the salinity values obtained by the CDC401 with the LDO101 probe. If the salinity value is out of range, the display will show \*S= ----. This will appear above the dissolved oxygen reading as shown in [Figure 2](#).

**Note:** The asterisk (\*) indicates that salinity is automatically correcting the dissolved oxygen value. No asterisk indicates that salinity is being manually corrected. Warning messages will override the asterisk (\*) priority.

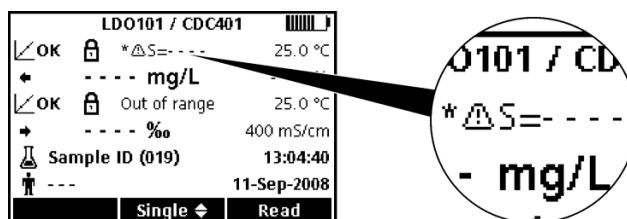


Figure 2 Salinity value out of range

## Maintenance

### Storage

Dry storage is recommended when the probe is used for measurements of short duration (less than 6 hours). Wet storage is required for monitoring periods longer than 6 hours. During the initial 72 hours of submersion in tap water, calibrate once every 8 hours. After 72 hours of storage in tap water, the sensor cap will reach a fully hydrated state. The need for recalibration is minimized if the sensor cap is kept wet. Rugged probes may be stored with the shroud installed if the storage container is sufficiently large.

### Sensor cap maintenance

Sensor cap replacement is required every 365 days or more often if the cap becomes damaged or fouled. The meter will display a reminder message when 30 days of sensor service life remain on the cap. For LDO sensor cap replacement instructions, refer to the instructions provided with the LDO sensor cap replacement kit.

### Rugged probe maintenance

The shroud protects the sensor elements during rugged applications. Damage to the sensing elements can occur if the shroud is not installed during field use. Damage under these conditions is not covered under warranty. Before a rugged probe can be cleaned, the shroud must be removed. Install the shroud after the probe is clean.

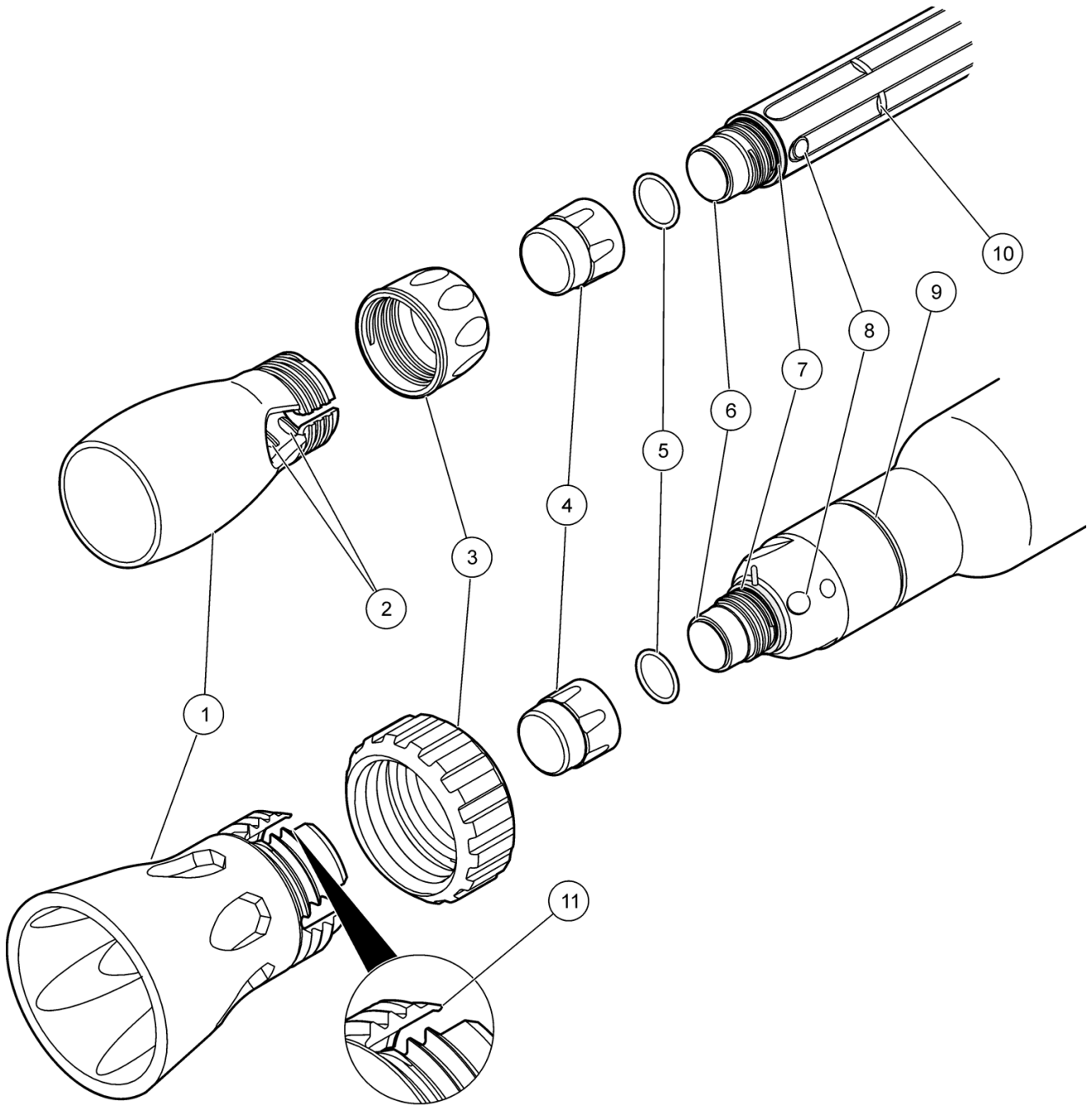


Figure 3 Sensor exploded view

1	Shroud	7	Cap seal
2	Locking ridges (8x)	8	Temperature sensor
3	Locking ring	9	Locking groove
4	Sensor cap	10	Locking ribs (4x)
5	O-ring	11	Locking rib
6	Sensor lens		

### To remove the shroud

1. Unscrew the locking ring.
2. Slide the shroud and locking ring off the probe.

### To install the shroud

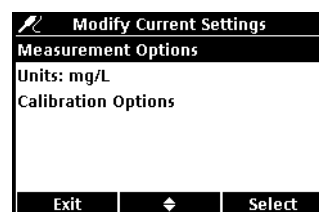
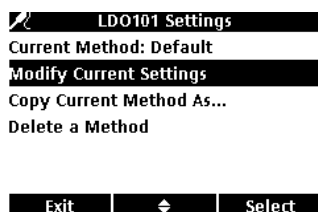
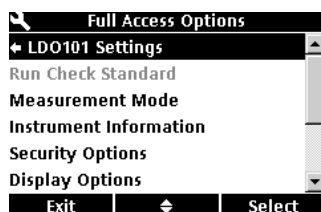
1. Place the locking ring on the probe body with the threads toward the sensor cap.
2. Slide the shroud on the probe until it is seated in the locking groove (rugged) or ribs (standard). Slide the standard probe shroud on the standard probe until the inside locking ridges align halfway between the ribs on the probe. Rotate slightly until the shroud is seated (Figure 3).
3. Firmly tighten the locking ring onto the shroud.

### To clean the probe

- Gently clean the sensor cap with a mild detergent, water and a soft cloth or cotton swab. Do not remove the black colored substrate from the sensor cap.
- If water is present between the sensor cap and lens, remove the cap and blot dry the sensor cap and lens with a soft dry cloth. Install the sensor cap.

## Advanced operation

Parameter-specific settings can be changed through the Full Access Options menu. Details about menu navigation, available options and how to change them are given in the screens, tables and procedures throughout this section.



The settings that can be changed are shown in Table 1.

Table 1 Parameter-specific settings

Setting	Options	Description
Measurement options	<ul style="list-style-type: none"><li>• Resolution</li><li>• Measurement limits</li><li>• Salinity correction</li><li>• Pressure units</li><li>• Averaging interval</li></ul>	<ul style="list-style-type: none"><li>• Defines measurement resolution</li><li>• Upper and lower measurement limits</li><li>• Value for salinity correction</li><li>• Atmospheric pressure units</li><li>• How often the meter calculates an average readings</li></ul>
Units	<ul style="list-style-type: none"><li>• mg/L</li><li>• %</li></ul>	<ul style="list-style-type: none"><li>• Primary unit of measurement</li></ul>



**Table 1 Parameter-specific settings**

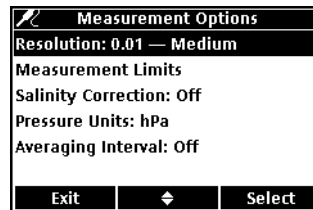
Setting	Options	Description
Calibration options	• Calibration	<ul style="list-style-type: none"> <li>• User 100%</li> <li>• User 100% with 0</li> <li>• User mg/L</li> <li>• User mg/L with 0</li> <li>• Factory</li> </ul>
	• Calibration reminder	<ul style="list-style-type: none"> <li>• Reminder repeat: Off, 8 h, 12 h, 1 d, 2 d, 5 d, 7 d</li> <li>• Calibration expires: Immediately,</li> <li>• Reminder + 30 m, Reminder + 1 h, Reminder + 2 h, Continue Reading</li> </ul>

**Change measurement options**

Methods are groups of default or user defined settings relevant to specific applications. If the meter is set to the default method and the Modify Current Settings option is chosen, a prompt will display to name the method after changes are entered. The settings are saved with this name to distinguish them from the default method settings, which cannot be changed. A saved method can be used instead of repeatedly adjusting individual settings. Changes made to a user defined method are automatically saved with the existing name. Multiple methods can be saved for the same probe.

There are three default methods provided for the LDO101 probe:

- Factory Cal (Calibration with default LDO calibration)
- User Calibration—100% (allows user calibration)
- Default



1. Make sure a probe is connected to the meter.
2. Push the **METER OPTIONS** key and select (Probe Model) Settings.
3. Select Modify Current Settings.
4. Select Units to change the units to mg/L (default) or to %.
5. Select Measurement Options.
6. Update the settings:

**Table 2 Measurement options settings**

Setting	Options	Description
Resolution	0.1—Fast (0.35 mg/L)/min 0.01—Fast (0.35 mg/L)/min 0.01—Medium (0.15 mg/L)/min (default) 0.01—Slow (0.05 mg/L)/min	The resolution affects the number of decimal places and the stabilization time. Higher resolution measurements take more time to stabilize.
Measurement limits	Lower limit (default: 0.0 mg/L; 0%) Upper limit (default: 20.0 mg/L; 200%)	The measurement limits can be set to match the acceptable values for the sample. When the measurement is above the upper limit setting or below the lower limit setting, the meter will show an "Out of limits" message. This message is an alert to a potential problem with process conditions.

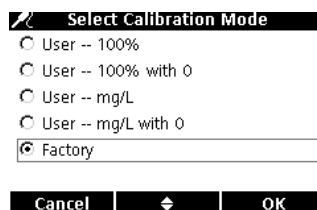
**Table 2 Measurement options settings (continued)**

Setting	Options	Description
Salinity correction	Off (default) Manual Auto (connect conductivity probe)	Salinity lowers the solubility of dissolved oxygen in water. To correct for salinity in the sample, set salinity correction to manual and then enter the salinity value. <b>Note:</b> When the HQ40d meter is used, a conductivity probe can also be connected for automatic salinity measurement and correction. The parameter setting for the conductivity probe must show salinity.
Salinity value	‰ (default: 35.0 ‰)	When salinity correction is set to manual, enter the salinity value of the sample. Salinity can be measured with a conductivity probe.
Pressure units	hPa mBar inHg mmHg	The meter shows the atmospheric pressure at the current elevation, which is necessary for accurate measurements. This pressure reading will not agree with readings from sources such as weather stations, which report atmospheric pressure at sea level.
Averaging interval	Off 30 seconds 60 seconds 90 seconds 3 minutes 5 minutes	The averaging interval is useful for samples that contain a lot of air bubbles, for example in an aeration basin. The air bubbles cause the dissolved oxygen readings to vary greatly from one reading to the next. To make the readings more consistent, increase the averaging interval. The meter will take measurements at the same frequency but show only the average over a longer interval.

**Note:** Labels and options may vary depending on the units selected.

7. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
8. Push **EXIT** until the meter returns to the measurement mode.

## Change calibration options



1. Make sure a probe is connected to the meter.
2. Push the **METER OPTIONS** key and select (Probe Model) Settings.
3. Select Modify Current Settings.
4. Select Calibration Options.
5. Update the settings:

**Table 3 Calibration option settings**

Setting	Option	Description
Calibration	User—100%	Water-saturated air (100%) calibration
	User—100% with 0	Water-saturated air (100%) calibration with 0 point
	User—mg/L	Allows calibration with specified dissolved oxygen concentration (mg/L) solution
	User—mg/L with 0	Allows calibration with specified dissolved oxygen concentration (m/L) solution with 0 point
	Factory	Calibration with default LDO calibration
Standard value	Adjustable	Use arrow keys to specify the concentration of the solution that will be used for calibration (if mg/L calibration mode is selected).
Calibration reminder	Reminder Repeat	Off, 8 h, 12 h, 1 d, 2 d, 5 d, 7 d
	Expires	Immediately, Reminder + 30 min, Reminder + 1 h, Reminder + 2 h, Continue Reading

6. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
7. Push **EXIT** until the meter returns to the measurement mode.

## Troubleshooting

Message or symptom	Possible cause	Action
Probe not supported	Software not updated	Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual.
	HQd meter does not support IntelliCAL probe	Contact a Hach Technical Support Representative.
Connect a probe or Probe requires service	Probe not connected properly	Disconnect, then connect the probe. Tighten the locking nut.
	Large number of methods stored on probe	Continue to let probe connect. Do not disconnect the probe. See the HQd Series meter manual.
	Software not updated	Update the HQd software to the newest revision at <a href="http://www.hach.com/SoftwareDownloads">www.hach.com/SoftwareDownloads</a> . Refer to the HQd Series meter manual.
	Damaged probe	Verify connectivity with another probe or meter to confirm isolated issue with probe. Contact a Hach Technical Representative.
Out of range	Sensor cap loose, scratched or damaged	Reposition or replace the LDO sensor cap
	Temperature and/or pressure sensor error	Verify that both temperature and pressure sensors are reading correctly <sup>1</sup>
	Damaged probe	Verify both blue and red LEDs are illuminated on the probe. If not, replace the probe or contact a Hach Technical Representative.
	Sample outside of specifications	Verify that the sample concentration, temperature and pressure are within the range of the LDO101 probe.
	iButton number does not match sensor cap lot number	Replace the iButton or sensor cap or perform a user calibration
	Sensor cap exposed to direct sunlight	Install the protective shroud

## Troubleshooting (continued)

Message or symptom	Possible cause	Action
Slope out of range	Probe not prepared for sample	Allow probe to reach equilibrium in a water-saturated air environment and repeat calibration.
	Calibration method settings	Verify that the calibration standards in the method are correct.
	Sensor cap loose, scratched or damaged	Locate and install the iButton that matches the sensor cap and replace the sensor cap.
	Temperature and pressure errors	Verify temperature and pressure are reading accurately. Contact a Hach Technical Representative. <a href="#">1</a>
	LED lights do not function	Contact a Hach Technical Representative (800-227-4224)
LDO—calibration not supported (factory calibration)	LDO method calibration option is set to Factory.	If user calibration is desired, change settings in Cal options. Refer to <a href="#">Calibration on page 3</a> .
O <sub>2</sub> Sensor 0 days remaining	There are 0 days remaining in the life of the LDO sensor cap	Replace the LDO sensor cap. Calibration will be allowed, however the calibration icon and question mark will appear on the measurement screen even if the calibration has passed.
	Meter set to incorrect date and time	Disconnect the probe from the meter. Set the correct date and time in the Meter Options menu. Connect the probe and verify that the message has been removed.
	Software not updated	Update the HQd software to the latest version and test again.
O <sub>2</sub> Sensor ## of days remaining	There are 30 days or fewer remaining in the life of the LDO sensor cap.	Replace the LDO sensor cap soon.
Calibration failed: outside of acceptance criteria/Temperature out of range/Offset out of limits	Water Saturated air equilibration not reached	Allow longer equilibration time
	Sensor cap loose, scratched, or damaged	Reposition or replace the LDO sensor cap
	Temperature and/or pressure sensor error	Verify that both temperature and pressure sensors are reading correctly and within range. <a href="#">1</a>
	Damaged probe	Verify both blue and red LEDs are illuminated on the probe. If not, replace the probe or contact a Hach Technical Representative.

<sup>1</sup> The pressure as measured by the LBOD or LDO is what is referred to as **atmospheric pressure** and is not corrected to sea level. Weather station pressures are reported at sea level and commonly referred to as **mean sea level pressure**. As a result the LBOD or LDO will not read the same as most household or professional barometers or weather station reports (which are compensated) unless reported at sea level. In order to compare the pressure results obtained from the LBOD or LDO probe barometers and these compensated barometers, it is necessary to first compensate the pressure reported by the probes mathematically.

## Replacement parts

Description	Quantity	Item Number
IntelliCAL LDO probe, standard, with 1 m cable	1	LDO10101
IntelliCAL LDO probe, standard, with 3 m cable	1	LDO10103
IntelliCAL LDO probe, rugged, with 5 m cable	1	LDO10105
IntelliCAL LDO probe, rugged, with 10 m cable	1	LDO10110
IntelliCAL LDO probe, rugged, with 15 m cable	1	LDO10115
IntelliCAL LDO probe, rugged, with 30 m cable	1	LDO10130

## Accessories

Description	Quantity	Item Number
BOD bottle (300 mL)	1	62100
BOD bottle (300 mL)	6/pkg	62106
Citizen PD-24 USB handy printer, 120-220 VAC	1	2960100
Color coded probe clips (5 color coded sets)	10/pkg	5818400
Erlenmeyer flask	250 mL	2089846
Field kit (Includes glove kit, and five 120 mL sample cups)	1	5825800
Glove kit only for HQd meters	1	5828700
LDO sensor cap, replacement (includes iButton, cap seal and probe tip o-ring)	1	5811200
Meter stand	1	4754900
Printer paper for PD-24, thermal	5/pk	5836000
USB and AC power adapter for HQd meters (included with the HQ40d)	1	5826300
USB keyboard for HQd meters (must have 5826300)	1	LZV582
<b>Rugged probe accessories</b>		
Probe depth marker (rugged cable markers)	5/pk	5828610
Replacement shroud kit, rugged LDO probe	1	5825900
Rugged field case for 2 probes with up to 5 m cables (10 m total). Includes: Empty case and insert for meter and probe storage, (4) containers for sample collection	1	8505500
Rugged field case for three probes with up to 5 m cables (15 m total). Includes same accessories as case 8505500.	1	8505501
Rugged field case for probes with > 5 m cables (30 m total). Includes: Empty case and insert for meter and two probe storage cavities, space for storage of HQd meter with protective glove	1	8505600
<b>Standard probe accessories</b>		
IntelliCAL standard probe stand	1	8506600
Replacement shroud kit, standard LDO	each	5832500
Standard probe holder (use with protective glove)	1	5829400

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