# HyQual - Water Quality Multi-Probe

**HyQuest Solutions / KISTERS Group**

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# Table of Contents

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## Glossary & Abbreviations

| Term | Explanation |
|---|---|
| SDI-12 | Serial Digital Interface at 1200 baud, an asynchronous serial communications protocol for smart sensors, SDI-12 sensors reply to commands send by the data logger, the standard also specifies supply voltage and current and including modes for low-power operation |
| USB | Universal Serial Bus, an asynchronous serial communication protocol for peripheral devices |
| EBP | External battery pack for HyQual 300 and HyQual 300 T |
| BP | Barometric Pressure |
| DO | Dissolved Oxygen |
| ODO | Optical Dissolved Oxygen |
| ORP | Oxidation-reduction potential |
| Redox | Reduction–oxidation, is a type of chemical reaction in which the oxidation states of substrate change. |
| SC | Specific Conductivity |
| C | Conductivity |
| Modbus | Modbus is a serial communication protocol. Method used for transmitting information over serial lines between electronic devices. There are two types of Modbus serial protocols, RS-232 and RS-485. Modbus RS-232 allows concurrent, full-duplex flow of data. Modbus RS-485 is half-duplex, and indicates values using differences in voltage. Modbus messages can also be sent over Ethernet or TCP/IP. |
| RS 485 | RS-485 is a serial interface, an industrial specification that defines the electrical interface and physical layer for point-to-point communication of electrical devices. The RS-485 standard allows for long cabling distances in electrically noisy environments and can support multiple devices on the same bus. RS485 has a data transmission speed of up to 10Mb/s for a distance of 15M. At the maximum of 1200M, RS485 transmits at 100Kb/s. |
| RS 232 | RS232 is a serial communication which is more than able to perform for a short distance and low data speed requirements. RS232 has a transmission speed of 1Mb/s up to 15M. Recommended Standard 232 is a standard originally introduced in 1960 for serial communication transmission of data. |
| SNAP-SHOT | Refers to manually capturing one line of readings, with the data stored in your Display |
| AU-TOSNAP | Refers to automatically capturing data, with the data stored in your Display. |
| Logging | Refers to unattended data capture, with the data stored in The HyQual probe |
| Telemetry Relay | It means that you have connected the HyQual probe to a telemetry device, deployed the HyQual probe in the proper location in the water, and left the site. |
| SN | Serial number (the sensors have the SN of the probe) |
| RV | Raw voltage |
| SRF | Sensor response factor. Figure of merit for the calibration based on 100 as reference value. Helps you know if calibration was properly done. |

# 1 Scope of Delivery

1x either HyQual 200 or HyQual 300 or HyQual 300T multi-probe
1x non-vented underwater cable (5, 10, 20, 30, 40 and 50 m)
Temperature sensor, dissolved oxygen sensor, specific conductivity sensor, pH sensor and ORP sensor
1x weighted sensor guard
1x kit: tool and maintenance
1x Internal memory
3-year warranty
Only for HyQual 300T: Turbidity sensor and its wiper
Interface RS-232
Soft carrying case
… and any option ordered with the multi-probe

## 1.1 Required Accessories

### Power supply

HyQual probes require a source of power.

Choices of power supply out of the water:

- For spot measurements, the optional external rechargeable Bluetooth® wireless technology battery enclosed in a waterproof (IP67) case connects to the probe via the HyQual probe‘s standard underwater cable running RS-232 or SDI-12. This battery operates only at the surface and its job is to power the multiprobe while you’re pairing the instrument with a data display via *Bluetooth*® wireless technology.

- A USB port on a PC is another way of suppling power to the multi-probes. For this case you would need to add the optional USB adapter.

- HyQual also connects to third-party devices (data loggers, samplers, telemetry, etc.) that supply power.

Choices of power supply that operate underwater:

- Instead of using power from the underwater cable you could use the optional EBP external rechargeable battery pack. This battery is ideal for HyQual 300 and 300 T due to its 75 mm (3 “) diameter. It also works fine with the 200 version, only it makes it look top heavy. Use the EBP external battery pack when you do not wish to have downtimes of charging the battery. The EPB is removable so you can replace it with a freshly charged battery right in the field. Please note that the use of EBP adds several millimeters to the length of the multiprobe.

### Communication and connection

Available for the HyQual probes is an optional SDI-12 and ModBus interface, with either an SDI-12 or MODBUS adapter cable.

### Connectivity and Visualization

When using a smartphone, tablet or other display device (Android™) you would need to add to your package the *Bluetooth*® wireless technology battery pack which allows to connect the external device with the probe via *Bluetooth*® wireless technology and additionally provides external power to the instrument.

HyQual also connects to a PC with the use of the optional USB Converter.

### Vented capacity

With the vented depth sensor, the multiprobe automatically corrects depth measurments for changes in Barometric Pressure.

Please note that vented capacity is optional, it requires to add an optional depth sensor, optional vented depth capacity, and an optional vented cable.

Additionally, this capacity is incorporated in the probe so you will add it when purchasing the probe. If you happen to have a probe and need to incorporate this capacity, you will have to send the probe back to us at your own expense.

### Additional sensors

Barometric pressure is calculated with the use of the depth sensor therefore, you will need to add an optional depth sensor to any of your probes HyQual 200, HyQual 300 and HyQual 300T.

When Absolute Pressure method is used (non-vented capacity) there are three ways of obtaining the value of Barometric Pressure:

a) With the use of a theorical Barometric Pressure
b) With the use of the depth sensor, by taking the probe out of the water and placing it at the water surface so that the probe only measures the Barometric Pressure
c) With a barometer (any brand)

Please note that barometric pressure value is needed for the calibration of the DO sensor.

# 2 Safety Instructions

## 2.1 General Safety Instructions

Read the user manual including all operating instructions prior to installing, connecting and powering up the HyQuest Solutions HyQual unit. The manual provides information on how to operate the product. The manual is intended to be used by qualified personnel, i.e. personnel that have been adequately trained, are sufficiently familiar with installation, mounting, wiring, powering up and operation of the product.

Keep the user manual on hand for later reference.

If you encounter problems understanding the information in the manual (or part thereof), please consult the manufacturer or its appointed reseller for further support. HyQuest Solutions HyQual is intended to be used in hydrometeorological or environmental monitoring applications.

Before starting to work, you have to check the functioning and integrity of the system.
Check for visible defects on the HyQual probe multi-probe, this may or may not include any or all of the following: mounting facilities, connectors and connections, mechanical parts, internal or external communication devices, power supplies or power supply lines, etc.

If defects are found that jeopardize the operational safety, work must be stopped. This applies for defects found before starting to work as well as for defects found while working.
Do not use any HyQuest Solutions HyQual probe in areas where there is a danger of explosion.
The present user manual specifies environmental/climatic operating conditions as well as mechanical and electrical conditions. Installation, wiring, powering up and operating any HyQuest Solutions HyQual probe must strictly comply with these specifications.

Perform maintenance only when tools or machinery are not in operation.
If guards are removed to perform maintenance, replace them immediately after servicing.
Never make any electrical or mechanical diagnostics, inspections or repairs under any circumstances.
Return the sensor to the manufacturer's named repair center. You can find information on how to return items for repair in the relevant section of the HyQuest Solutions website.

**Disposal instructions**: After taking any HyQuest Solutions HyQual probe out of service, it must be disposed of in compliance with local waste and environmental regulations. Any HyQuest Solutions HyQual probe is never to be disposed in household waste!

**Inputs and outputs of the device are protected against electric discharges and surges** (so-called ESD). Please do not touch any part of the electronic components! If you need to touch any part, please discharge yourself, i.e. by touching grounded metal parts.

## 2.2 Specific Safety Instructions

Handing of reagents needed for calibration purposes always requires special attention. Typically, the reagents used for calibration purposes of the multiprobe are considered to be non-hazardous.
Ensure that Safety Data Sheets (SDS) are available for all chemicals used.

In case of an incidents: consult these documents as they describe signs and symptoms of exposure, list first-aid procedures, and spill cleanups.
Secure all chemicals: store them out of reach of unauthorized personnel, ensure safety during transportation and provide containers that will contain and resist the chemical in case of a spillage.
Label all chemical containers clearly.

Keep a handheld eyewash bottle in a chemical-safety kit at hand and close to the location where the chemical reagents are used and stored.

If possible, use small dropper bottles or sample bottles prefilled with sufficient volume of preservative instead of transporting large containers of preservatives. Handling smaller volumes of chemicals lowers the risk and damage if a spill occurs.

Do not pipette by mouth. Always use mechanical pipettes or pipette bulbs.

# 3 Introduction

HyQual is a precision analytical measurement instrument. It integrates several sensors to determine a wide range of water quality parameters in a single housing. HyQual 200, HyQual 300 and HyQual 300T are individual complete solutions and depending on the chosen model and optional extensions, the multi-probes can determine a subset or all of the following parameters:

Temperature (standard), dissolved oxygen (standard), specific conductivity (standard), pH/ORP (standard), total dissolved solids (standard), salinity (standard) and turbidity (standard and only possible in HyQual 300T), depth/level (optional) and barometric pressure (optional).

# 4 Installation

The probes should be installed in a place where there is a sufficient water flow, that can be easily accessed for maintenance and protected from external elements such as animals and items such as stones or sticks that may damage the probe.

## 4.1 Protection for unattended logging

There are 4 pipe kits available:

- Pipe kit 2 ‘’ diameter: For protecting multiprobes, hinged locking cap
- Pipe kit 4’’ diameter: For protecting multiprobes, hinged locking cap

## 4.2 Operating limits

- Input voltage: 5 VDC to 15 VDC
- Storage temperature: 1 C to 50 C
- Max. depth:
  - 50 m
  - 10 m for ISE or TDG

# 5 Configuration

## 5.1 SNAPSHOT, AUTOSNAP, and LOGGING

“Logging” refers to unattended data capture, with the data stored in The HyQual probe. The data are tagged with time and date. Logging is useful if the HyQual probe needs to collect data for days or weeks at a remote location.

“Snapshot” refers to manually capturing one line of readings, with the data stored in your Display. If you wish to log specific readings, tap the Snapshot button to save that data in your Display. The data will be tagged with time and date, and you can add an annotation if you wish.

"AutoSnap" refers to automatically capturing data, with the data stored in your Display. If you are running a short-term experiment or are monitoring site for a few hours, AutoSnap will take a series of snapshots at the same interval as that you set for the interval between lines of rolling data.

### 5.1.1 Using Snapshot and AutoSnap

All of the user-interface versions have Hot Buttons for Snapshot and AutoSnap on the Home Screen. Simply press the button for the feature you wish.

You can change the file name you're using for Snapshots and AutoSnap (they're in the same file) any time you wish.

### 5.1.2 LOGGING

#### 5.1.2.1 Setting the Logging Interval

Go to the Logging section of your user-interface and follow the menu to set the Logging interval.

#### 5.1.2.2 Activating Logging

To initiate Logging, you must tell the HyQual probe that you want it to start logging. All of the user-interface versions have a Hot Button for turning Logging on, or off, on the Home Screen. Simply press the button to toggle between Logging ON and Logging OFF.

The Setup function for Logging lets you name your Logging file, and set the logging interval (time between logged lines of data).

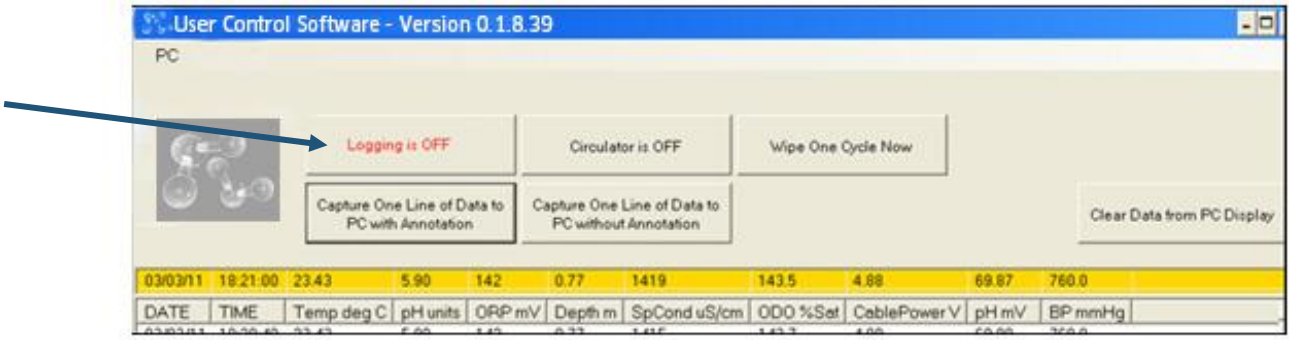


**Figure 1 – Switch Logging ON or OFF**

Once Logging is ON, supply the HyQual probe with power to start Logging. For convenience, you may wish to take a Display to the field so that you can activate Logging right before you place the HyQual probe in the water.

Please be aware that the blinking green LED communicates that you have adequate voltage to begin logging, and the blinking red LED (once you power up) that Logging is properly enabled.

## 5.2 Set Barometric Pressure

The HyQual probe needs to have information about the local Barometric Pressure (BP) when calibrating DO. To calibrate BP, open the Calibration menu, select "Set BP", and type in the correct value (in mm Hg) in the first box on the screen.

If you do not have information about the BP, you can set the approximate BP by typing your altitude (in feet) in the second box. Please notice that if you type in BP, altitude is automatically calculated, and vice-versa. The third method for setting BP is asking the HyQual probe the value (if the HyQual probe is equipped with a non-vented Depth sensor). If you choose this method, the correct values will automatically appear in the BP and altitude boxes.

## 5.3 Set Time and Date

To calibrate Time and Date, open the Calibration menu, select “Set Time and Date” to see the HyQual probe’s current time and date. If you wish to change any of those values, just type the new value in the appropriate box or click the box at the bottom of the screen. If you wish to synchronize the HyQual probe time and date with that of your Display, click the “synchronize” box.

# 6 Operation

## 6.1 Sensor Warm Up

The HyQual probe knows the warm-up times required for all the sensors you have enabled. It figures out exactly when to turn the various sensors on so that a frame of data can be taken exactly at the correct time. For instance, the DO sensor takes 20 seconds to warm up and the turbidity sensor takes 25 seconds to warm up. So, if you have only a DO sensor, the warm-up time will be 20 seconds. If you have DO and turbidity sensors, the warm-up time will be 25 seconds.

## 6.2 Four Basic Deployment Methods

There are four basic deployment methods for The HyQual probe.

### 6.2.1 Manual Data Collection

Manual Collection is also known as profiling, surveying, spot measurement, site-to-site measurements, etc., means you are present at the monitoring site and using a Display for observing measurements. This allows you to make data-based decisions in the field in real-time at multiple monitoring sites in one day. The Display can be a laptop, or almost any tablet or smart phone. You can record measurements using the HyQual probe’s Snapshot or Automatic Snapshot features. You might “snapshot” a series of measurements in one or more lakes or streams during the day, and then download your data to your desktop PC that evening. If your Display has email, you can email the data to anyone you wish, including yourself.

#### 6.2.1.1 Uploading Snapshot and AutoSnap Data

If you are using a phone or tablet as your display, Snapshot and AutoSnap data are stored in your Display. If you wish to upload that data to a PC, simply follow the same procedure you would use to synchronize your PC and phone or tablet to transfer pictures, contact lists, etc.

You can also email data files from your phone or tablet if they have Web access.

### 6.2.2 Unattended Logging

Unattended Logging means that you have set the HyQual probe into its Logging mode, deployed the HyQual probe in the proper location in the water, and left the site. The HyQual probe can run for weeks at a time with cable-supplied power or an optional HyQual Internal Lithium Battery Pack. You can, for instance, set the instrument to take a set of readings every half-hour, anchor it in an estuary, and return after two weeks to retrieve the instrument and download the data to a PC, laptop, tablet, or phone.

#### 6.2.2.1 Log Start on Power Up

HyQual starts logging when the user activates logging (see 5.1), and then provides power.

When power is first provided, the red LED will blink five times to confirm that Logging is activated, and the green LED will blink briefly to confirm that the HyQual probe is receiving adequate voltage to start Logging.

#### 6.2.2.2 HyQual Logging: time uniformity.

For instance, if your logging interval is 15 minutes and you turn Logging on at five minutes past 10 AM, your first data will be logged at exactly 10:15, and then every 15 minutes thereafter. If your logging interval is one hour and you turn Logging on at five minutes past 10 AM, your first data will be logged exactly at exactly 11 AM, and then every hour thereafter. Your data is cleaner, and it's easier to match times if you wish to merge data sets.

#### 6.2.2.3 Managing Log Files and Uploading Logging Data

Go to the Logging section of your user-interface and follow the menu to name Logging files, change Logging files, erase Logging files, or upload Logging Data to a PC.

#### 6.2.2.4 Powering the HyQual probe in Logging Mode

You can log data using an External Battery Pack (EBP) which is plugged to the probe or power from a secondary power source (such as a solar-recharged storage battery located above the water surface) via the Underwater Cable.

If you have an EBP and a secondary power source attached, the HyQual probe will use power coming from the secondary power source if its voltage is sufficient. If the HyQual probe cannot find adequate voltage in the Underwater Cable, it will use its EBP. This process preserves The HyQual probe batteries when possible. Other manufacturers, for reasons unknown, use the power source with the highest voltage, meaning that their batteries may be consumed quickly.

The HyQual 300 and HyQual 300 T probes can be ordered with an optional External Battery Pack (EBP), a lithium rechargeable battery that you fix to the probe by plugging it, this means that you can purchase this battery after as it is not integrated to the probe. Please note that this battery ads several inches to the length of the probe and that it can also be used with the HyQual 200 only that its diameter would be larger than the HyQual 200's diameter which will make the probe look top heavy but it will work properly.

With an EBP, Logging starts when you use the Hot Button on the Home Screen to toggle from Logging OFF to Logging ON.

The EBP is a rechargeable, "smart" Lithium battery that operates underwater and it avoids downtime for charging the battery as you can replace it in the field with freshly recharged batteries without having to take the probe out of water.

The EBP will power the HyQual probe for roughly 40 days with a logging interval of 15 minutes in 25C water.

### 6.2.3 Telemetry Relay

Telemetry Relay means that you have connected the HyQual probe to a telemetry device, deployed the HyQual probe in the proper location in the water, and left the site. An Underwater Cable connects the HyQual probe to the telemetry system. The telemetry device uses satellite or cell-phone communication to periodically report HyQual data to your office PC or to a proprietary Web page. In many telemetry systems, you can also contact the HyQual probe and request transmission of the most recent data. Telemetry Relay lets you collect data all night and all day for weeks without being present at the monitoring site and allows you remote access to collected data at any time. Telemetry is helpful in optimizing trips to the field for HyQual calibration or maintenance. Telemetry is also ideal in locations for which access is dangerous or expensive.

#### 6.2.3.1 Logging Redundantly with Telemetry

If you wish to add redundancy to your data collection, you can connect a HyQual to a third-party data logger, telemetry device, etc. to store data in the HyQual probe (using its standard Logging function) and in the third-party device (according to its manufacturer's instructions).

If you will be using an Underwater Cable, you can run power to the HyQual probe from a surface power supply to provide power to HyQual – you don't need a HyQual Battery Pack.

Or, the surface power supply can power HyQual with the optional internal lithium battery pack, thus saving your batteries for emergencies such as the failure of the surface power supply.

Either way, you will end up with data records in both the HyQual probe and the third-party device.

### 6.2.4 On-Line Monitoring

On-Line Monitoring, also known as process-control monitoring, means that the HyQual probe is connected to a PLC, SCADA system, etc. An example is monitoring the input to a water-treatment plant for salinity or chlorophyll. On-Line Monitoring allows you to make water-quality-based decisions in real-time. The HyQual probe is particularly effective in this application when more than one parameter is needed in the control loop or decision-making process.

# 7 Maintenance

## 7.1 When to proceed to maintenance?

Judgment gained from observing your field conditions and data requirements provides information about when to maintain sensors. If you are logging data over long periods, the time when you collect your data from the HyQual probe is a good time for maintenance and calibration.

## 7.2 Maintenance – 1: Keep your device clean

Clean your instrument periodically with warm soapy water - liquid dishwashing soap is fine. Do not use abrasives or strong solvents (such as acetone). Do not clean with gasoline, kerosene, or industrial cleaners. Mild household cleaners work well. You can clean sensor stems with a soft brush, but use only a rag or paper towel when cleaning the sensor's actual measurement surface.

**Figure 2 – Rinsing a HyQual multiprobe**

Rinse the HyQual probe well with tap water after cleaning, and store sensors with a few ounces of tap water in the Storage/Calibration Cup.

If you take the HyQual probe apart and expose O-rings, keep them, and their mating surfaces, greased with silicon grease (found in your Maintenance Kit). The same applies to your Underwater or Data Cable's lower connector. Replace any O-rings with visible cracks.


**Figure 3 – Getting access to O-Rings**

Always remove batteries (if any) and clean The HyQual probe prior to storing it for prolonged periods. Always refill the reference electrode and recalibrate after long storage periods.

## 7.3 Maintenance – 1: Calibration

### 7.3.1 Basics of Parameter Calibration

The procedure for operating a HyQual, including making calibrations, varies with the type of Display used because the user-interface software can be different (mostly because of the differences in Display screen sizes). You could also study the highly detailed Appendices to familiarize yourself with the various procedures. Otherwise, you should be able to walk through the software once you have established communication between your Display and the HyQual probe. You can become a minor expert in just a few minutes.

The HyQual probe never guesses parameter values, so you must calibrate it from time to time by simply telling the instrument what it should read in a calibration situation for which the correct parameter value is known. Here's the general procedure:

1. Clean the sensor and perform any necessary sensor-specific maintenance.
2. Select a calibration standard whose value is close to the values you expect to see in the field. For best results, use fresh calibration solutions, and discard them once they have been used. But generally, you can reuse most calibration standards a few times if you are careful to avoid contamination.
3. With the HyQual probe's Storage/Calibration Cup screwed onto the HyQual probe housing, rinse the sensors three times with a small quantity of your calibration standard by pouring the standard into the Storage/Calibration Cup, positioning the "stopper" side of the lid (the side with the O-ring) on top of the Storage/Calibration Cup, and shaking the HyQual probe vigorously to remove traces of old calibration solutions. Discard the used calibration standard between rinses.
4. Next secure The HyQual probe with the sensors pointing up and fill the calibration cup with your calibration standard. Make sure the standard covers the sensor entirely, and that it also covers the thermistor for those parameters that are temperature-compensated. For turbidity sensors and other fluorometers fill the cup to at least 1 ½ inches above the sensor's lens surface.

5. Access your app's calibration function by navigating from the Home Screen to the calibration section. Select the parameter to be calibrated, and then enter the calibration value in the type-in box, and press enter. When the reading has stabilized, press enter to calibrate. The HyQual probe will report the resulting Sensor Response Factor (SRF; see below). For most apps, you then press Y to accept the calibration, N to back up one step, or Exit to leave the sensor uncalibrated.

### 7.3.2 Sensor Response Factor (SRF)

Near the end of the calibration routine, you will be asked to accept or decline the calibration based on the Sensor Response Factor (SRF). Suppose that a "typical" Conductivity sensor puts out 100 µA in a 1413 µS/cm standard. If your Conductivity sensor reports 100 µA in that same calibration solution, then your SRF is 100% (some parameters, such as pH, have a more complex SRF calculation, but the effect is the same). If your response is 80 µA, your SRF would be 80%. When you press the OK button to accept a calibration, the HyQual probe automatically accepts your calibration if the SRF is between 60% and 140%. If the SRF falls outside that range, you will be cautioned to check your standard value, make sure the sensor is clean, make sure the reading has stabilized, etc. But you can elect to accept any SRF.

### 7.3.3 Choosing Calibration Standards

For best results, choose a calibration standard whose value is close to what you expect to see in the field. For example, calibrate with a 1413 µS/cm Specific Conductance standard if you expect to see Specific Conductance readings between 500 and 1000 µS/cm in the field. Calibrating with a sea water standard or a very low standard would not be appropriate. Similarly, if your waters tend toward the acidic, calibrate with a 4-buffer instead of a 10-buffer.

If you are moving The HyQual probe across wide ranges of water conditions, you may wish to recalibrate to match the new situations. For instance, if you are measuring a clear lake during the morning and a high-sediment stream in the afternoon, you might consider recalibrating at noon with a high-value turbidity standard.

The table below shows common calibration practices.

**Table 1 – Common Calibration Practices**

| *Sensor* | *Standard Method of Calibration* | *Available Calibration Solutions* | *Comments* |
|---|---|---|---|
| *Temperature* | never requires calibrating | N/A | |
| *pH / pH reference* | 2 or 3 points | pH 4, pH 7, pH 10 | pH7, pH 10 most common |
| *ORP* | 1 point | ORP Standard 200 mV | |
| *Conductivity* | 1 point | CD Standard, 0.5 Molar, 58670 Micro S<br>CD Standard, 0.1 Molar, 12856 Micro S<br>CD Standard, 0.01 Molar, 1412 Micro S<br>CD Standard, 0.001 Molar,147 Micro S | brackish/saltwater<br>borderline brackish typical<br>freshwater very pure<br>fresh/glacial |
| *Reference Electrode* | calibration not required | N/A | replace pH electrolyte solution at routine calibration |
| *Depth* | adjust for barometric pressure | N/A | recalibrate at deployment site for best accuracy |

| | | | |
|---|---|---|---|
| *Turbidity* | 2 points | 0 NTU, 10 NTU, 100 NTU, 400 NTU | calibrate near expected value |
| *HDO (Optical DO)* | calibrate at 100% saturated water | DI water -shake vigorously to oxygenate | set BP before calibrating, recal at deployment site for best accuracy |
| *Chlorophyll* | 2 points | secondary solid or 40µg/L solution or lab sample | |
| *Rhodamine* | 2 points | secondary solid standard or rhodamine | |
| *Blue Green Algae* | 2 points | secondary solid standard or lab sample | |
| *Ammonium (NH4+)* | 2 points | Lo 4.63 mg/l; Hi 46.3 mg/l | |
| *Nitrate (NO3+)* | 2 points | Lo 4.62 mg/l; Hi 46.2 mg/l | |
| *Chloride (CL-)* | 2 points | CD Standard 147 Micro S<br>CD Standard 1412 Micro S | enter 34.3 mg/l for low cal<br>enter 319.3 mg/l for high ca |

### 7.3.4 Calibration Record (Cal Log)

Every HyQual probe has a dedicated data file called CAL.LOG. The CAL.LOG records every calibration made to your instrument, whether you accepted the calibration or not. This file shows the time and date of the calibration, the parameter calibrated, the reading before the calibration was accepted, the reading after the calibration was accepted, the "raw" sensor reading, the SRF, and a few other details. If you wish to know, for instance, the last time that DO was calibrated, the Calibration Record would tell you when the most recent DO calibration was made, the value of the calibration standard, and the instrument's reading in the standard before the calibration was made (to tell you exactly how much the instrument was changed during calibration). Please notice that this data cannot be altered within the HyQual probe!.


### 7.3.5 Temperature

The Temperature sensor is an electrical resistor (thermistor) whose resistance changes predictably with temperature. The sensor is protected by a stainless-steel tube. Thermistors are very stable with time, so are factory-calibrated and do not require recalibration.

### 7.3.6 Dissolved Oxygen

The optical dissolved-oxygen sensor is a blue-light source, a sensing surface, and a red-light receiver. The sensing surface is an oxygen-active compound stabilized in an oxygen-permeable polymer, usually silicone. When the sensing surface is exposed to oxygen (in water or air), oxygen diffuses into the sens-

ing surface according to the amount (partial pressure) of oxygen in the sample. The oxygen-active compound fluoresces by absorbing energy in the form of blue light and then emitting energy as red light. Oxygen "quenches" that fluorescence, so the more oxygen, the less fluorescence.

In each measurement cycle, the blue light is first turned on, and then turned off. The red-light receiver measures the time it takes, after the blue light is turned off, for the fluorescence to die off. This value is proportional to dissolved oxygen.

DO readings are corrected for the water sample's temperature and salinity (if you have a Conductivity sensor).

HyQuest Solutions recommends the "air-saturated water" DO calibration method, as opposed to the "water-saturated air" calibration commonly used in the past. Here are the steps to air-saturated water calibration:

1. Make sure your instrument's Barometric Pressure setting is accurate. (C.14)
2. Open the Calibration menu and select "ADO %sat" for HyQual
3. Put a half-liter of tap water in a liter jar, secure the lid, and shake the jar vigorously for one minute. Take the lid off the jar and let the water stand for about five minutes so air bubbles float out.
4. Screw your calibration cup onto the HyQual probe housing and remove the cup lid. With the sensors pointed upward, fill the calibration cup until your aerated water covers the DO sensor by a centimeter or so.
5. Wait a few minutes for the temperature to equilibrate and the sensor to arrive at a steady reading.
6. Now just follow the calibration instructions on the screen.

The manufacturers of optical-DO sensors usually recommend that you not calibrate the zero-DO point because the zero-DO point drift is very low. However, The HyQual probe supports zero-DO calibration, should you wish to check your sensor's zero from time to time, using any of three methods:

1. Dissolve a few grams of sodium sulfite and a pinch of cobalt chloride in a half-liter of tap water. You can buy this solution ready-to-use but be careful not to aerate the solution by pouring it back and forth numerous times.
2. If you do not wish to use the sodium-sulfite method , you can prepare zero-oxygen water by bubbling nitrogen through water. Use bottled gas and an aquarium-type air stone. (If you're using a high-pressure gas bottle, please use a two-stage regulator to prevent unnecessary excitement.) After bubbling the gas through, say, a liter of water for, say, 10 minutes, you should have a good zero.
3. The simplest way to check zero response is with nitrogen gas. Wrap the sensor-end of The HyQual probe with a plastic bag, and feed nitrogen gas into the bag. Make sure there's another hole at the opposite end of the bag for the air to escape, otherwise you won't get a good zero and the exploding bag will cause unnecessary excitement. (If you're using a high-pressure gas bottle, please use a two-stage regulator.)

Optical dissolved-oxygen sensor maintenance is little more than occasionally cleaning the sensing surface (the dark material, about a centimeter diameter, at the tip of the sensor) with a cloth and soapy water.

Optical dissolved-oxygen sensors usually have very low drift rates . Practice will show you how often to calibrate DO, and you might find that one or the other of the calibration points (zero or 100% saturation) does not require calibration every time you set the other point.

### 7.3.7 Conductivity

HyQuest Solutions uses the four-electrode method to determine water conductivity. Two pairs of graphite electrodes are situated in a stable geometry (you can barely see the electrodes; they look like two bull's eyes inside the slot on the conductivity sensor).

A constant voltage is applied to one of each electrode pair, and the amount of current required to maintain that voltage is measured. As the conductivity of the water increases, the current increases predictably.

Conductivity sensor maintenance is nothing more than occasionally cleaning the measurement surface with a soft cloth or cotton swab and soapy water. Do not use anything abrasive.

The zero point for the sensor is set electronically, so you need only set the "slope" point:

1. Open the Calibration menu and select "SpCond µS/cm" or "SpCond mS/cm", depending on your preference of units.
2. Screw your calibration cup onto the HyQual probe housing and remove the cup lid. Rinse your sensors several times with the standard you'll use for calibration.
3. With the sensors pointed upward, fill the calibration cup until your solution covers the sensors by an inch or so.
4. Wait a few minutes for the temperature to equilibrate and the sensor to arrive at a steady reading.
5. Now just follow the calibration instructions on the screen.

The HyQual probe normally reports Specific Conductance – that's Conductivity that has been standardized to 25°C. Your reading is thus the conductivity of your water if that water was exactly 25°C. Conductivity has three other forms, Total Dissolved Solids (TDS), Salinity, and Resistivity (which we don't report because it has little meaning in natural waters). You can't calibrate TDS or salinity directly because they are calculated from Conductivity. You can, however, "calibrate" TDS with a TDS standard by adjusting the conductivity calibration point up or down until the TDS standard produces the desired TDS reading. The same is true for Salinity if you're using a standard quantified on the Practical Salinity Scale (PSS). "Enable" TDS and/or Salinity by checking the box next to those parameters in the "Sensors and Parameters" section.

### 7.3.8 pH

pH is measured as the voltage drop across the glass membrane of a pH electrode. A reference electrode is used to complete the voltage-measuring circuit. The pH glass is specially formulated to absorb water so that ions (particularly H+ and OH-) in the water are attracted to the glass to offset the ionic constituency of the pH electrode's internal electrolyte. As a result, there is a charge separation across the glass, and that's the voltage we measure. pH readings are automatically compensated for temperature.

pH electrode maintenance is nothing more than occasionally cleaning the glass surface with a soft cloth and soapy water. Do not use anything abrasive. The important part of pH maintenance is refilling the reference electrode. (D.10)

You can choose a two- or three-point pH calibration. The two-point calibration, a seven buffer and a second buffer whose value is near that of the waters you intend to monitor, is recommended. If you are measuring in waters whose pH might range significantly above and below seven, you may be able to increase your accuracy slightly by choosing a three-point calibration (seven buffers plus one basic buffer and one acidic buffer). pH calibration is simple:

1. Open the Calibration menu and select "pH".
2. Screw your calibration cup onto the HyQual probe housing and remove the cup lid. Rinse your sensors several times with the standard you'll use for calibration.

3. With the sensors pointed upward, fill the calibration cup until your solution covers the sensors by an inch or so.
4. Wait a few minutes for the temperature to equilibrate and the sensor to arrive at a steady reading.
5. Now just follow the calibration instructions on the screen.
6. Repeat steps 2 – 5, as directed by the software, if you wish to calibrate at a second or third pH value.

### 7.3.9 Reference Electrode

The key to reliable pH, ORP, and ISE measurements is a well-maintained reference electrode. Recall that a reference electrode is required to complete voltage measurement for pH readings.
Reference electrode maintenance is simple:

1. Remove the reference cap by unscrewing it from the reference sleeve and discard old reference electrolyte.
2. Fill the sleeve completely with fresh pH reference electrolyte (KCl saturated with silver chloride). Tap the HyQual probe a few times to dislodge any bubbles.
3. Screw the reference cap back on to the sleeve. As you screw the sleeve into place, air and excess electrolyte is forced out of the sleeve through the reference electrode junction (the white, porous circle at the end of the sleeve). This not only purges bubbles from the electrolyte, but also cleans nasty stuff out of the junction.

**Figure 4 – Filling in fresh pH reference electrolyte**

### 7.3.10 ORP

ORP is also known as Oxidation-Reduction Potential or Redox. The actual ORP sensor is the 1 mm platinum dot you can see when looking down at the pH sensor – if The HyQual probe has ORP. Because platinum does not react with ions in the water, it won't give or take any electrons from those ions unless they are very persuasive. The potential (voltage) created by this refusal is what you're actually measuring as ORP. As it is with pH measurement, the reference electrode completes the voltage-measuring circuit.

ORP electrode maintenance is nothing more than occasionally cleaning the platinum surface with a soft swab and soapy water. If the platinum is discoloured, you can polish the ORP electrode with very light abrasive, like 900-grit wet-and-dry sandpaper (please be careful not to polish the pH glass bulb). The important part of ORP maintenance is refilling the reference electrode. (D.9)

ORP uses a one-point calibration:

1. Open the Calibration menu and select "ORP".
2. Screw your calibration cup onto the HyQual probe housing and remove the cup lid. Rinse your sensors several times with the standard you'll use for calibration.
3. With the sensors pointed upward, fill the calibration cup until your solution covers the sensors by an inch or so.

4. Wait a few minutes for the temperature to equilibrate and the sensor to arrive at a steady reading.
5. Follow the calibration instructions on the screen.

### 7.3.11 Depth and Vented Depth

Depth is measured by a strain-gauge transducer as hydrostatic water pressure. The deeper you go in the water, the higher the pressure.

HyQuest Solutions' Depth sensors are usually buried inside the instrument, with a small pressure port that can be seen on the outside of the HyQual probe bottom cap. They require no regular maintenance, but you might check occasionally to make sure the pressure port is not clogged. If it is, use something soft, like a toothpick, to clear the port of obstruction.

Depth calibration is nothing more than "zeroing" the sensor in air, where one assumes the water depth to be zero:

1. Make sure the HyQual probe is not in the water.
2. Open the Calibration menu and select "Depth".
3. Now just follow the calibration instructions on the screen.

Please notice that the Depth sensor cannot distinguish between water pressure and the air pressure over that water (i.e., barometric pressure). After you have zeroed the sensor, any change in barometric pressure will be measured as a change in water pressure.

Another choice is using Vented Depth (Stage). Vented Depth uses the same transducer as does Depth, except that there's a small hole in the back of the transducer. There is a tube inside the cable (i.e., a Vented Cable) to connect the Stage sensor to the atmosphere so that changes in barometric pressure will not affect the Depth reading.

Vented-Depth cables have a desiccant-filled housing at their surface end. The desiccant keeps water from condensing in the vent tube by letting vapor escape through a small Gortex patch. Keep that housing clean and replace the desiccants every year.

### 7.3.12 Turbidity

Turbidity is measured as the fraction of an infrared light beam that is scattered at 90° to that beam. More particles in the water mean more of that light is scattered, so the Turbidity reading is higher.

Any material that accumulates on the optical surfaces of the Turbidity sensor is indistinguishable from material in the water, so most Turbidity sensors have little wipers to clean the window(s).

Turbidity sensors require no regular maintenance, but you might check occasionally to make sure the optical window (i.e. the little glass port on the front of the sensor) has not been damaged by overzealous wiping.

Turbidity uses a two-point calibration; one point is zero turbidity and the other point should be a standard approximating the turbidity of the water you intend to monitor.

Make sure you use enough calibration standard to cover the sensor's "optical volume" – imagine a golf ball stuck on the end of the sensor; make sure there are no objects in the volume represented by that ball. One common method is keeping calibration solutions in one-litre, dark, wide-neck bottles with a non-reflective finish (such as Nalgene 2106 bottles in amber).

For the zero calibration:

1. Open the Calibration menu and select “Turb NTU” of “Turb FNU” depending on your preference for measurement units.
2. Screw your calibration cup onto the HyQual probe housing and remove the cup lid. Rinse your sensors several times with the standard you’ll use for calibration.
3. With the sensors pointed upward, fill the calibration cup until your solution covers the sensors by at least an inch or so.
4. Wait a few minutes for the temperature to equilibrate and the sensor to arrive at a steady reading.
5. Follow the calibration instructions on the screen.

If you wish to calibrate at a second point, repeat steps 2 – 5 with a different turbidity standard.

A clean wiper means better measurements. If the wiper pad has deteriorated or is clogged with debris from your water (algae, silt, etc.), you should change it. For best results, you might consider changing the wiper pad prior to each long-term deployment. To change the wiper pad:

1. Make sure you have the 1.5mm hex key and a new pad for the wiper. Loosen the small set screw on the wiper arm.
2. Remove the wiper pad from the wiper arm and replace the pad.
3. Place a new wiper arm on the motor shaft so that the set screw faces the flat spot on the motor shaft.
4. Gently press the wiper pad against the face of the probe until the pad is compressed to roughly three quarters of its original thickness. It is important that the wiper arm does not contact the probe face – only the pad should be in contact. A gap of 0.5 mm between the wiper arm and the probe face is typical when a new pad has been installed. Another way of setting the pad gap is to place the pad such that you can slide a small piece of paper under the pad, but snug enough that the pad will hold the paper.
5. Tighten the set screw.

Do not over-tighten the set screw on the little rotating arm that holds the wiper pad as that will strip the threads. Do not rotate the wiper arm manually either as that will strip the gears.

# 8 Troubleshooting

We designed the HyQual probes so you do not be a specialized technician troubleshooting if something goes wrong.

## 8.1 Use Status LED for Troubleshooting

Any HyQual probe has three light-emitting diodes (LED’s) mounted on the circuit board and visible through the instrument housing, to help you understand what the HyQual probe is doing or not doing, and to provide information when troubleshooting.

The green light blinks every second when the HyQual probe is receiving adequate operating voltage via the cable; it does not blink when the HyQual probe operates under its own battery power.

The amber light blinks when the HyQual probe is receiving RS-232 communications from an external device (such as a PC or logger).

When you first power-up the HyQual probe, a sequence of red and amber light flashes provides information about the voltage of the External Battery Pack (if any) and whether or not Logging is activated or not. The red light will blink five times to indicate that Logging is activated and to indicate the first 3.5 volts of battery power. Then the amber light will blink once for each volt over 3.5 volts, and then the red may blink for additional half-volt.

For instance, five reds, five ambers, and a red means logging is enabled and the External Battery Pack is putting out 3.5 + 5 + 0.5 = 9 volts.

## 8.2 Check active Components

### 8.2.1 Check if the Motherboard of the Sensor is OK

If the HyQual probe turns on and reads any of its parameters correctly, then the basic communication circuitry is OK - if not, a new CPU board is needed.

### 8.2.2 Check if any given sensor needs replacement

If the HyQual probe reads temperature, but not, for example, conductivity, then a new conductivity sensor is needed. Contact HyQuest Solutions, we will send you the replacement component by your local courier service. You can install it on your own in a few minutes. There's no labor charge. 1-2 days downtime.

# 9 Repair

HyQuest Solutions precision instruments and data loggers are produced in quality-controlled processes. All HyQuest Solutions production and assembly sites in Australia, New Zealand and Europe are ISO 90001 certified. All equipment is factory tested and/or factory calibrated before it is shipped to the client. This ensures that HyQuest Solutions products perform to their fullest capacity when delivered. Despite HyQuest Solutions most rigorous quality assurance (QA), malfunction may occur within or outside of the warranty period. In rare cases, a product may not be delivered in accordance with your order.

In such cases HyQuest Solutions' return and repair policy applies. For you as a customer, this means the following:

(1) Contact HyQuest Solutions using the Repair Request Form made available online: https://www.hyquestsolutions.com.au/services/repairs-product-warranty/repairs
In response you will receive a reference number that must be referenced on all further correspondence and on the freight-documents accompanying your return shipment.
(2) Please provide as much information and/or clear instructions within the return paperwork. This will assist our test engineers with their diagnosis.
(3) Please do not ship the goods prior to obtaining the reference number. HyQuest Solutions will not reject any equipment that arrives without reference number; however, it may take us longer to process.

Custom requirements for items sent to HyQuest Solutions for warranty or non-warranty repairs: Check with your national customs/tax authorities for details, processes and paperwork regarding tax exempt return of products. Typically, special custom tariff codes are available (such as HS Code = 9802.00) that verify the item is being returned for repair and has no commercial value.

Please note that the customs invoice / dispatch documents should also clearly state: “Goods being returned to manufacturer for repair – No Commercial value”. It is mandatory to have any returned goods accompanied by a commercial invoice on headed paper. HyQuest Solutions reserves the right to charge the customer for time spent rectifying incorrect customs documents.

Note: Please ensure that your goods are packed carefully and securely. Damage that occurs during transit is not covered by our warranty and may be chargeable.

# 10 Technical Data

| Technical Specifications | | | |
|---|---|---|---|
| | HyQual 200 | HyQual 300 | HyQual 300T |
| **Diameter** | 50 mm (1.95”) | 75 mm (2.95”) | 75 mm (2.95”) |
| **Length** | 47.8 cm (18.8”) | 47.8 cm (18.8”) | 47.8 cm (18.8”) |
| **Mass** | 0.82 kg (1.8 lbs.) | 1.63 kg (3.6 lbs.) | 1.63 kg (3.6 lbs.) |
| **Standard** | Temperature sensor, dissolved oxygen sensor, specific conductivity sensor, pH sensor and ORP sensor, calculated total dissolved solids, calculated salinity, interface RS-232, weighted sensor guard, internal memory (months of datalogging), maintenance kit, carrying case, non-vented underwater cable (5, 10, 20, 30, 40 and 50 m) | | |
| | | | Turbidity sensor, wiper |
| **Options** | Depth (level) sensor, barometric pressure, vented capacity, data cable for display devices (not for field use), calibration solutions, copper anti-fouling kit, USB adapter (connect DB9 to USB), integrated SDI-12 and MODBUS output, SDI-12 adapter cable, MODBUS adapter cable and Android display | | |
| **Material** | Resistant materials like stainless steel 303 and 316, polyacetal (Delrin), PVC, Teflon, ABS, titanium, Viton, neoprene, silicone, glass | | |
| **Power Supply and Consumption** | -Supply: underwater cable (incl.), or *Bluetooth*® wireless technology battery pack (opt.), or External battery pack (opt.)<br>-Consumption: depends on the number of sensors, logging interval and site conditions.<br>Battery dimensioned to ensure long autonomy.<br>- Rechargeable External Lithium Battery choices (optional): Spot measurement: Bluetooth battery pack that operates at the surface. Continuous logging: Battery that operates underwater, with the same diameter as HyQual 300/300 T but it fits HyQual 200. | | |
| **Output Options (Interfaces)** | Standard: RS-232. Optional: *Bluetooth*® wireless technology, SDI-12, MODBUS) | | |
| **Certifications** | CE, RoHS (WEEE pending) | | |

# 11 Obligations of the Operator and Disposal

When disposing of the units and their accessories, the applicable local regulations regarding environment, disposal and occupational safety must be observed.

Before dismantling:

- Electrical Devices:
  - Switch off the units.
  - Disconnect electrical appliances from the power supply, regardless of whether the appliances are connected to the mains or to another power source.
- Mechanical devices:
  - Fix all loose components. Prevent the device from moving independently or unintentionally.

- Loosen mechanical fastenings: Please note that equipment can be heavy and that loosening the fastenings may cause them to become mechanically unstable.

*Disposal:*

Operators of old appliances must recycle them separately from unsorted municipal waste. This applies in particular to electrical waste and old electronic equipment.
Electrical waste and electronic equipment must not be disposed of as household waste!
Instead, these old appliances must be collected separately and disposed of via the local collection and return systems.
Integrated or provided batteries and accumulators must be separated from the appliances and disposed of at the designated collection point. At the end of its service life, the lithium-ion battery must be disposed of according to legal provisions

*EU WEEE Directive*

- As players in the environmental market, KISTERS AG and HyQuest Solutions are committed to supporting efforts to avoid and recycle waste. Please consider:
  - Avoidance before recycling!
  - Recycling before disposal!

- This symbol indicates that the scrapping of the unit must be carried out in accordance with Directive 2012/19/EU.
  - Please observe the local implementation of the directive and any accompanying or supplementary laws and regulations.

# 12 Contact Data

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