D-OptoLogger

Dissolved Oxygen Logger

Operation Manual

Software version 3.4

Contents

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1. Introduction

The D-OptoLogger is a fully self-contained dissolved oxygen logger incorporating a dissolved oxygen sensor, battery and low power data logger in a rugged compact underwater housing.

The D-OptoLogger uses a field-proven solid-state optical sensing system to measure dissolved oxygen. It is highly stable over long periods of time, even in harsh conditions. The data is stored onboard in non-volatile memory. The D-OptoLogger is setup and data offloaded using simple Windows based software supplied with the instrument.

Optical Sensor Technology

Unlike conventional dissolved oxygen sensors, the D-OptoLogger sensing element utilizes fluorescence to measure dissolved oxygen. The basic principle involves subjecting a fluorescing compound (ruthenium) to a fixed wavelength of light. When the light source is removed, the compound emits a fluorescence, the intensity of which is dependent on the oxygen levels present in the surrounding water. An extremely stable electronic circuit has been designed to firstly excite the ruthenium and then measure the intensity of the resulting fluorescence. Using this circuitry, the D-OptoLogger should provide accurate dissolved oxygen measurements over many months without re-calibration.

Unlike conventional polarographic dissolved oxygen sensors, the optical method does not consume oxygen. Consequently the measurement of dissolved oxygen by the D-OptoLogger is unaffected by water movement. Also the D-OptoLogger does not utilize a membrane or any other consumables, thus minimizing servicing requirements.

Features

Your D-OptoLogger offers the following features:

- **Accurate dissolved oxygen measurements over long periods without re-calibration**

- **Low power consumption data logger**

- **Windows based communication software**

- **Minimal servicing requirements**

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2. D-OptoLogger Specifications

Specifications

Physical Dimensions		200mm long x 50mm diameter
Accuracy	Temperature: DO:	+/- 0.1 degrees C 1% of reading or 0.02 PPM, whichever is greater
Resolution	Temperature: DO saturation: PPM	00.01 degrees C 000.01% 00.001 PPM
Sensor Drift		<1% per year (provided measurement interval ≥10 minutes)
Power Supply		1 x PP9-9 volt alkaline battery. Duracell or Energizer recommended
Power Consumption		12 mA during measurement, 0.03 mA between measurements
Memory Capacity		10080 data records. Each data record consists of date, time, battery voltage, temperature, dissolved oxygen % saturation, dissolved oxygen PPM
Depth Rating		Maximum 30m water depth
"O" Rings		2 of #128 (1½ x3/32")

TABLE 1: D-OPTOLOGGER SPECIFICATIONS

Communication Cable Wiring Scheme
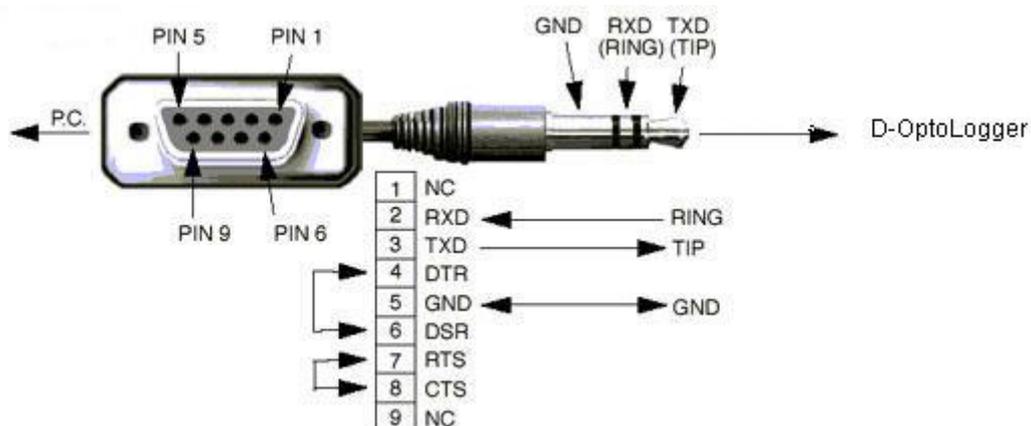
3. Software

The D-OptoLogger is supplied with the custom designed Windows based communication software program "D-OptoLog". This software:

- Enables the user to communicate with the D-OptoLogger via a computer

- Is used to setup the D-OptoLogger prior to deployment

- Is used to download data from the D-OptoLogger to the PC after retrieval

Installation

The D-OptoLogger is supplied with a software CD that contains the file 'Install D-OptoLogX.exe' (X = version number). Double clicking the file from Windows Explorer will initiate installation onto the PC.
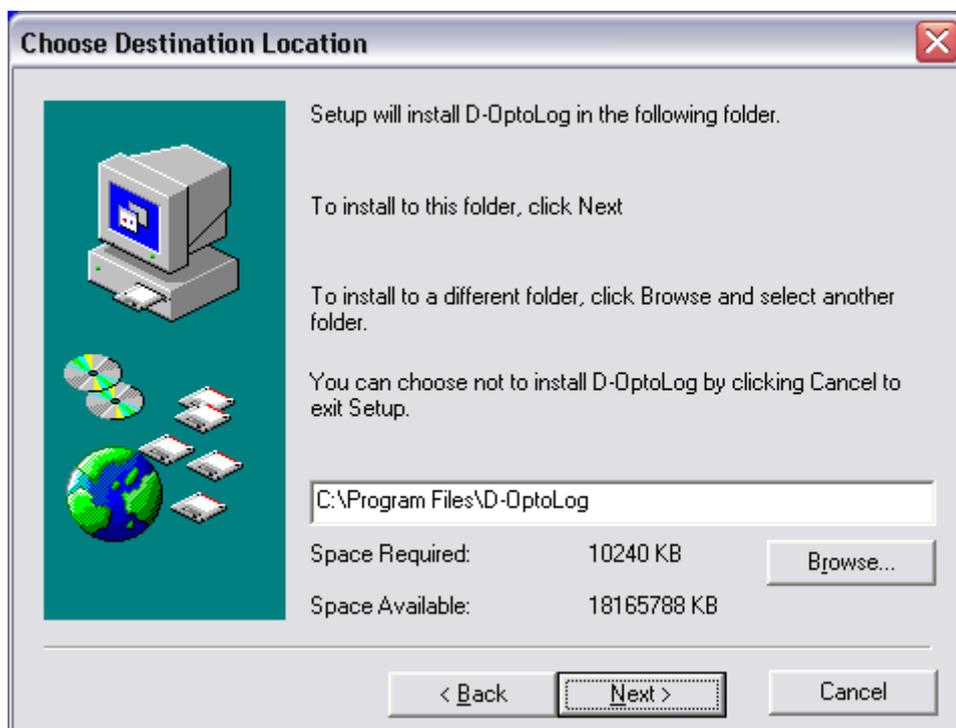
The default installation destination is C:\Program Files\D-OptoLog. It is recommended that this destination is accepted. This will result in the correct installation into the appropriate folders for either XP or Vista operating systems.

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Operation

The D-OptoLogger is supplied with a communication cable. This cable has a 9-pin serial plug on one end and a 3.5mm jack plug on the other end.

The 9-pin plug is plugged into the serial port on the PC. If the PC does not have a serial port, a USB to serial adaptor can be used. This adaptor plugs into the USB port on the PC and has a serial port that the communication cable 9-pin plug can be plugged into.

The jack plug on the communication cable is plugged into the communication socket located inside the D-OptoLogger housing. This is accessed by removing the D-OptoLogger end cap.

When D-OptoLog is started and the current port is unavailable, a port selection window opens (Figure 1).

FIGURE 1: D-OPTOLOG SERIAL PORT SELECTION WINDOW

If the computer has a hardware serial port, it will typically be 'Com 1'. If a USB to serial converter is being used, the com port number will most likely be another number.

To determine the correct com port number when using a USB to serial converter it is necessary to open the Device Manager. In Vista, the device manager can be opened directly from the Control Panel. With XP, first open 'Control Panel', then open the 'System' folder, click on the 'Hardware' tab and then click on the 'Device Manager' button. Once you have opened 'Device Manager', click on 'Ports (COM & LPT)' to extend the tree. The com port number for the USB to serial converter will be displayed.

Control Panel → System → Hardware → Device Manager → Ports (COM & LPT)
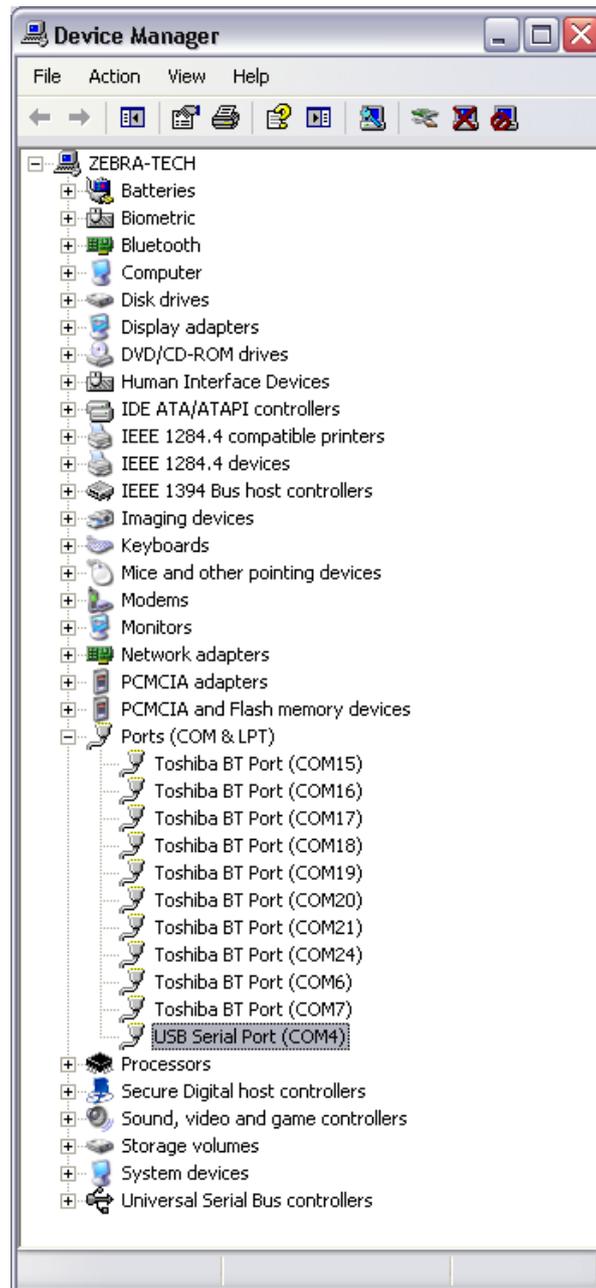
In the example in Figure 2, the com port is 'Com 4'.

FIGURE 2: DEVICE MANAGER

💡 **NOTE!**

The com port number assigned to the USB serial converter may change between computer re-starts.

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Once the correct port has been selected and the 'OK' button pressed, the computer will start communicating with the D-OptoLogger. This may take up to 8 seconds. When communication has started the D-OptoLog main window will open (Figure 3).
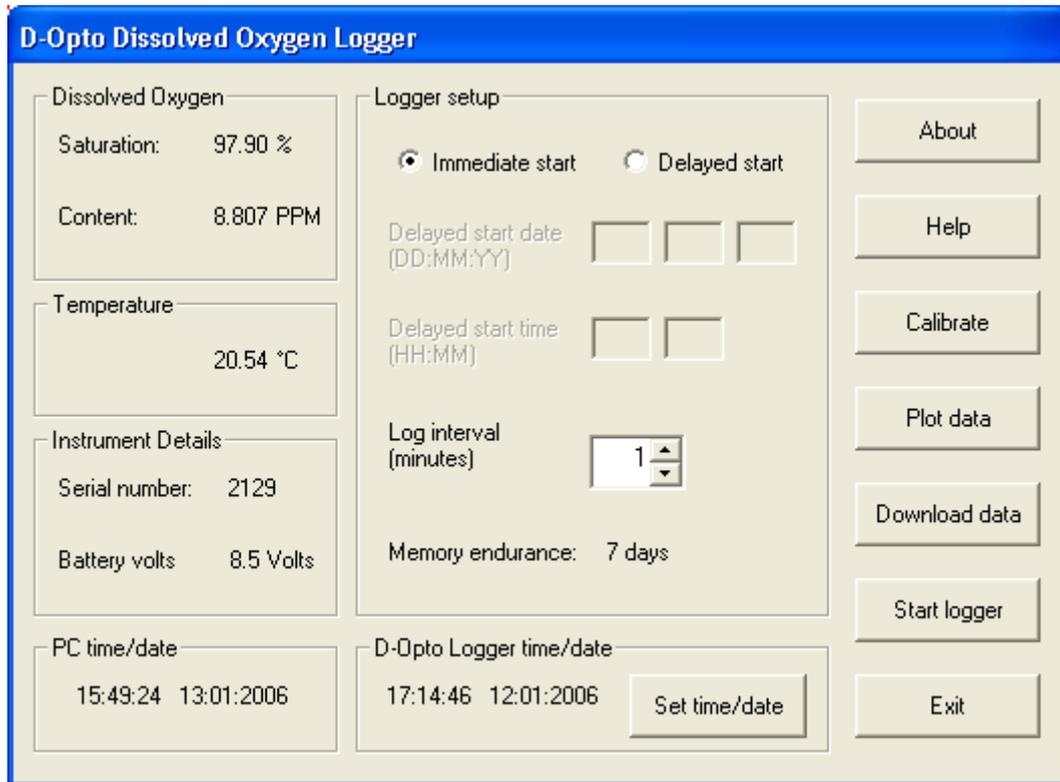

FIGURE 3: D-OPTOLOG MAIN WINDOW

The main window displays current dissolved oxygen (% saturation and PPM) and temperature (˚C) data and is updated approximately once every second.

The serial number displayed is factory set and is unique to each D-OptoLogger. It corresponds to the number displayed on the outside of the D-OptoLogger housing.

The logger setup section enables the operator to set the desired logger parameters.

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The 'Plot data' button enables a graphical plot of historic D-OptoLogger data to be displayed on screen (Figure 4).
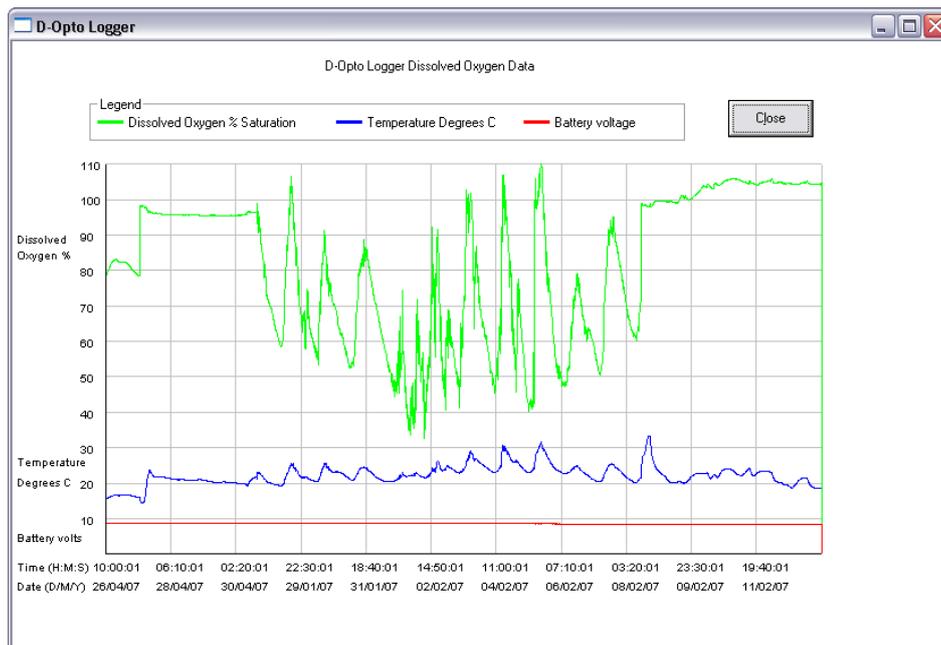

FIGURE 4: 'PLOT DATA' SCREEN

The 'Calibrate' button opens the D-OptoLogger Calibration window (Figure 5). All calibration values are calculated and stored internally by the D-OptoLogger. The 'Restore Defaults' button causes the D-OptoLogger to resort back to the original factory calibrations. A full description of the calibration procedure is outlined in the 'Operating the D-OptoLogger' section.

FIGURE 5: D-OPTOLOGGER CALIBRATION WINDOW

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The 'Altitude Correction' button opens up the Pressure Correction Calculator which provides a tool for pressure correcting the dissolved oxygen saturation content of fully aerated water (Figure 6). It will accept either altitude (m) or barometric pressure (mBar).

> NOTE!
>
> By pressing the 'Restore Defaults' button, the original factory calibration values are reinstated by the D-OptoLogger.
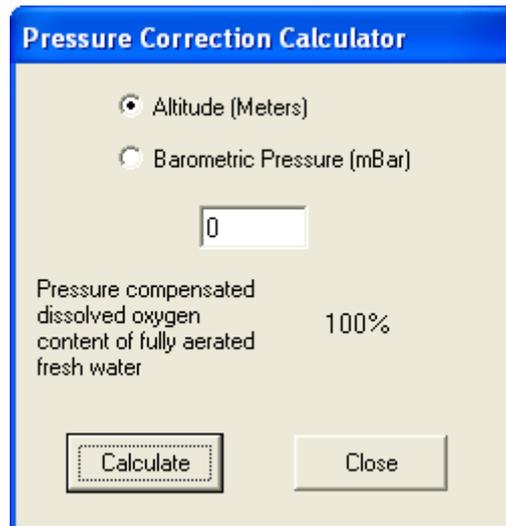

FIGURE 6: PRESSURE CORRECTION CALCULATOR

4. Operating the D-OptoLogger

Installation

The D-OptoLogger can be mounted in any orientation. The body can be clamped in position. Avoid using excessive force. A safety wire can be attached to the eyelet swivel on the top cap of the logger. It is not recommended that the D-OptoLogger is suspended solely from the eyelet swivel.

> **NOTE!**
> A new battery should always be used when starting a deployment. Use good quality alkaline batteries such as Duracell or Energizer.

Sealing the D-OptoLogger

The D-OptoLogger end cap features a dual 'O' ring sealing system. It is essential that these 'O' rings are properly serviced and maintained, otherwise moisture may penetrate the housing.

The 'O' rings must be cleaned and lubricated each time the end cap is replaced prior to underwater deployment.

1) Using the 'O' ring pick supplied, remove the 'O' rings from the inside of the end cap and the body of the D-OptoLogger.

2) Using a lint free tissue, clean the 'O' ring seats, the corresponding 'O' ring surfaces and both 'O' rings.

3) Lightly grease both 'O' rings with the grease supplied with your D-OptoLogger.

4) Replace the 'O' rings, ensuring no hairs or particles become trapped under them.

5) Screw the end cap onto the D-OptoLogger body. **Do not over tighten.**

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Logging Endurance

The D-OptoLogger can log 10,080 data records into non-volatile memory. Each data record consists of the time and date, battery voltage, dissolved oxygen percent saturation, PPM and temperature (See Table 2).

Data Field Number:	Description:
1	Year
2	Month
3	Day
4	Hour
5	Minute
6	Second
7	Battery voltage
8	Temperature (Degrees C)
9	Dissolved Oxygen (%)
10	Dissolved Oxygen (PPM)

TABLE 2: DATA FILE FORMAT

Data is retained in the non-volatile memory until a new logging session is started, at which point the memory is cleared of the previous data.

Memory logging endurance for different logging intervals are shown in Table 3.

Logging Interval (minutes):	Memory Endurance (Days):
1	7
5	35
10	70
15	105
30	210
60	420

TABLE 3: MEMORY ENDURANCE

NOTE!
In reality battery power may limit the deployment duration, not memory capacity.

The D-OptoLogger will operate until the battery voltage drops below around 7.0 volts. If this occurs while the D-OptoLogger is in logging mode, the last set of data values in the data file will be set to zero and the D-OptoLogger enters a low power sleep mode with no further data values being logged.

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Calibration

Under normal operating conditions the D-OptoLogger should require only infrequent calibration.

Calibration of the D-OptoLogger is a simple operation that can be performed in the field. Due to the measurement principle of the D-OptoLogger, performing air calibrations is not advisable.

> **NOTE!**
> When calibrating the D-OptoLogger, **do not** allow water to enter into the instrument.

The offset and gain of the D-OptoLogger are calibrated individually. Normally only the offset will need to be calibrated as the gain is more stable than the offset over time.

> **NOTE!**
> The gain should be calibrated only **AFTER** the offset has been calibrated.

FIGURE 7: D-OPTOLOGGER CALIBRATION WINDOW

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- **<u>Offset Calibration</u>**
  A reference solution of 0% dissolved oxygen is required for the offset calibration. This can be created by mixing a couple of teaspoons of sodium sulfite into 1 litre of distilled or fresh tap water.

  Procedure:
  1) Place the D-OptoLogger in the reference solution and allow it to equilibrate for at least 30 minutes.
  2) Power up the D-OptoLogger and start D-OptoLog. Once the measurements have stabilized, press the 'Calibrate' button in the main window.
  3) Enter 0 (zero) in the offset calibration edit box and press the 'Reset offset' button.
  4) The D-OptoLogger performs a calibration routine followed by a self-check; this can take up to 30 seconds. Do not remove the D-OptoLogger from the reference solution during this period. The operator will be notified when the process is complete.

- **<u>Gain Calibration</u>**
  A solution of known dissolved oxygen content, other than 0%, should be used for the gain calibration. The most practical method is to create a fully aerated solution. This can be done by bubbling air through a container of distilled or fresh tap water, stirring frequently. After around 30 minutes, the water can be assumed to be fully saturated.

  The actual dissolved oxygen saturation can be calculated by correcting for altitude, or preferably, the local barometric pressure if that is known. The 'Correction Calculator' can be used to calculate the corrected dissolved oxygen content of the fully aerated reference solution. As an example, if the D-OptoLogger is installed at a field site at 435 meters above sea level, and a fully aerated reference solution is prepared on site, the actual dissolved oxygen percent saturation is calculated at 95%. (See Appendix 1)

  Procedure:
  1) Place the D-OptoLogger in the reference solution and allow it to equilibrate for at least 30 minutes.
  2) Power up the D-OptoLogger and start D-OptoLog. Once the measurements have stabilized, press the 'Calibrate' button in the main window to open the Calibration window.
  3) Enter the pressure corrected dissolved oxygen percent saturation of the reference solution in the gain calibration edit box and press the 'Reset span' button.
  4) The D-Opto performs a calibration routine followed by a self-check; this can take up to 30 seconds. Do not remove the D-OptoLogger from the reference solution during this period. The operator will be notified when the process is complete.

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5. Maintenance

As with all instruments, it is good operating practice to make regular checks on the quality of data being generated by the D-OptoLogger. This can be carried out on site using one of the following two methods:

1) Place a recently calibrated transportable dissolved oxygen sensor next to the D-OptoLogger and compare the measurements. It is important to allow a sufficient period of time for temperature equilibration to occur.

2) Place the D-OptoLogger in a solution of known dissolved oxygen content. A solution of 0% dissolved oxygen saturation can be created by adding a few teaspoons of sodium sulfite to 1 litre of distilled or fresh tap water.

The D-OptoLogger can tolerate some biofouling, however steps should be taken to minimize this where possible. For example, covering the D-OptoLogger can reduce the amount of bio-growth by restricting available light. The copper biofouling control ring should reduce bio-growth in the area around the optical window; this ring is sacrificial and may require replacement on an occasional basis.

Periodically it may be necessary to clean the D-Opto optical window to remove bio-growth or other accumulated deposits. Use warm soapy water to clean the D-OptoLogger.

💡	NOTE! DO NOT use a hard object to clean the optical window as this may scratch or damage it. Only use the cleaning pads supplied with the D-Opto.

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6. Troubleshooting

Interpreting the LED indicator

The LED indicator inside the D-OptoLogger housing, next to the battery and communication socket, can be used to identify the D-OptoLogger's current status. The interval between the flashing sequences may be up to 8 seconds.

LED Blink Sequence:	Status Description:
One flash	Operational
Two flashes	Delayed start
Three flashes	Not operational, waiting for PC communications
Four flashes	Memory full
Five flashes	Low battery shut down

TABLE 4: LED FLASH SEQUENCE CODES

Loss of communication

If the PC starts to communicate with the D-OptoLogger, but then loses communication, replace the D-OptoLogger battery.

If the D-OptoLogger is not communicating with the PC:
- Check the battery voltage.
- Check the communications cable is plugged into the correct serial port on the PC.

Zero value data

If the last data record in the data file consists of zero values the D-OptoLogger battery dropped below around 7 volts and needs replacing.

Erratic dissolved oxygen readings

You may encounter occasions when the dissolved oxygen readings are highly erratic, but the temperature readings are stable. The D-OptoLogger incorporates a high gain amplification circuit to measure the fluorescence of the optical window. The instrument has been carefully designed to prevent electrical interference impacting on the operation. Under extreme conditions however, noise may become a problem.
- Track down the source of noise; this could be a nearby pump or other motor.
- If the D-OptoLogger is being bench tested in a small container of water, noise can be caused by a lack of suitable earthing. Place a grounding wire from the water to the D-OptoLogger power ground.
- The D-OptoLogger is supplied with built-in noise rejection specific for the country of supply. If the D-OptoLogger is being used in a country other than the country it was supplied to, contact your supplier or Zebra-Tech.

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7. Appendices

Appendix 1: Pressure Correction Chart

Altitude (m)	Altitude (feet)	Barometric pressure (mBar)	% Saturation
0	0	1013	100
85	278	1003	99
170	558	993	98
256	841	983	97
343	1126	973	96
431	1413	963	95
519	1703	952	94
608	1995	942	93
698	2290	932	92
789	2587	922	91
880	2887	912	90
972	3190	902	89
1066	3496	899	88
1160	3804	882	87
1254	4115	871	86
1350	4430	861	85
1447	4747	851	84
1544	5067	841	83
1643	5391	831	82
1743	5717	821	81
1843	6047	811	80
1945	6381	800	79
2047	6717	790	78
2151	7058	780	77
2256	7401	770	76
2362	7749	760	75
2469	8100	750	74
2577	8455	740	73
2687	8815	730	72
2797	9178	719	71
2909	9545	709	70
3023	9917	699	69
3137	10293	689	68

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Appendix 2: Useful Conversions

Convert from	To	Calculation
kPA	mBar	Multiply by 10
inHg	mBar	Multiply by 33.85
Feet	Meters	Multiply by 0.3048
˚Centigrade	Fahrenheit	(9/5 ˚C) +32

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8. Further Assistance

For further assistance with this or any other **Zebra-Tech** product, please contact:

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For up to date information about the D-OptoLogger and other Zebra-Tech products, please visit the **Zebra-Tech Ltd** website at:
http://www.zebra-tech.co.nz

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