

**CAMPBELL SCIENTIFIC CS511-L
SENSOREX DISSOLVED OXYGEN PROBE
INSTRUCTION MANUAL**

01/2001

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Campbell Scientific CS511-L Sensorex Dissolved Oxygen Probe

An accurate and reliable sensor is a critical element in any measurement system. The Sensorex Stationary Probe meets these criteria for the measurement of dissolved oxygen.

1. General Information

The Sensorex Stationary Probe is a galvanic probe which produces a millivolt signal proportional to the amount of oxygen present in the measured medium. Oxygen diffuses through the membrane onto the cathode, reacts chemically, and combines with the anode. An electrical current is produced by this chemical reaction which is converted from microamps to millivolts by an in-line resistor. An in-line thermistor also conditions the signal providing automatic temperature compensation. With these features, the probe produces a millivolt output proportional to the oxygen present in the medium in which it is placed. The probe consists of two parts, an upper part with cathode, anode and cable, and a lower part comprising a screw on membrane cap with fitted membrane. The cap is filled with electrolyte and simply screwed onto the top component.

The probe is self-polarizing and requires no external power source. There are three wires to connect. The shield wire generally should be used.

Because the probe's output is linear, it is possible to connect it directly to a data acquisition system capable of handling the small millivolt signal.

The probe's robust construction and simple design make maintenance and servicing it straightforward. There is no need to send the probe back to the factory for servicing. It utilizes a strong, easy-to-clean and easy-to-change membrane in a screw-on membrane cap. Regular servicing is not required. When necessary the probe can be fully overhauled in five minutes.



FIGURE 1-1. CS511-L

2. Specifications

| | |
|----------------------------|--|
| Principle of Measurement: | Membrane covered galvanic oxygen probe |
| Output Signal: | 1.65 mV \pm .45 mV per mg/l |
| Accuracy: | Better than \pm 2 % of reading \pm 1 digit when calibration temperature equals measuring temperature \pm 5 C |
| Output Impedance: | 10 k Ohms nominal |
| Response Time: | After equilibration, 1 minute for 95% of final value |
| Materials of Construction: | |
| Probe body: | Delrin |
| O-rings: | Membrane O-ring = Buna N Body Seal O-ring = Viton |
| Membrane: | 0.05 mm (2 mil) Teflon |
| Dimensions and Weight: | 3.5" height x 2.2" diameter 1.1 lbs |
| Cable: | standard length 3 m (10 ft); other lengths available upon request 5-wire 22 awg shielded, PVC jacketed |
| Operating Conditions: | |
| Temperature | 0 to 50 C (32 to 122 F) |
| Pressure: | Maximum 10 atmospheres (147 psig) |
| Minimum Submersion Depth: | 60 mm (2 1/2 in) |
| Minimum Water Flow: | 5 cm/s (2 in/sec) across membrane |
| Calibration: | In air or in air saturated water |
| Temperature Compensation: | Automatic from 4 - 40 C (40 - 104 F) |
| Range of Dissolved Oxygen: | 0-20 mg/l, 0-200 % Sat |
| Electrode Materials: | Ag cathode/Zn anode |
| Probe Electrolyte: | NaCl |

3. Optional Probe Accessories

Agitator for stagnant conditions.
Membrane replacement tool.
DO electrolyte, 500 ml.
Teflon membranes, 5 pack.
Teflon membranes, 25 pack.

4. Optional Agitator

The PT4 Agitator is a reliable and robust agitator for use in conjunction with probes subjected to bio-fouling in ponds and stagnant water conditions.

O₂ probes require a minimum water velocity across their membranes to function properly. Therefore, to measure DO in stagnant water conditions, it is necessary to move the water past the membrane to get accurate and reliable DO measurements. In many instances the water also has a high bio-loading and the probes become fouled resulting in inaccurate DO measurements.



FIGURE 4-1. Preventing Bio-fouling of the CS510-L

The PT4 Agitator overcomes these problems. The device is designed so that a soft bristle brush sweeps across the probe membrane or sensor tip. This sweeping action of the brush provides the required water velocity as well as prevents the membrane from becoming bio-fouled.

The optimum sweeping frequency depends upon the design of probe and type of membrane used and water conditions. An ON-time of 0.25 seconds and OFF-time of 5 seconds is suitable in most circumstances.

Agitator's overall size: 7-1/8" x 3-1/4" diameter, 1-1/4 lb. (180mm x 83mm, 0.6 kg)
Supplied with 10 ft. (3 meters) cable.
Power required: 10.5 to 18 VDC at the agitator, 1.1 amps. Maximum ON-time is 3 seconds.



FIGURE 4-2. CS510-L with PT4 Agitator

Optional Repeat Cycle Timer for Agitators: Reciprocating action may be controlled by the optional solid state Repeat Cycle Timer. It sends 12 VDC pulses to the agitator coil. The ON-time is 0.25 sec. The OFF-time is adjustable from 3 to 12 sec.; requires supply voltage 10 to 17 VDC; housed in watertight cylinder 6.6" x 2" diameter (170 mm X 50 mm).

5. Application Information

NOTE

Short Cut users: This manual was written primarily for those whose needs are not met by Short Cut. Your procedure is much simpler: just add the Sensorex probe (it's in the water folder), save your program, and follow the wiring shown in Step 2 of SCWIN.

6. Wiring

The Sensorex probe uses one differential channel. Differential wiring is better at rejecting electrical noise and ground loop error.

Red ----- 1H
Black ----- 1L
Clear ----- G

7. Programming

Instruction 2, differential millivolt measurement is required for the Sensorex probe. The example measurement instructions that follow do not store data to

final storage. Additional instructions (Typically P92, P77 and output processing instructions such as P70) are required to store data permanently.

| | | |
|----------------------|-------------------------|-------------------|
| *1 Table 1 | | |
| 01: 15 | Sec. Execution Interval | |
| 01: Volt (Diff) (P2) | | |
| 01: 1 | Rep | |
| 02: 24 | 250 mV | |
| 03: 1 | Diff Chan | |
| 04: 1 | Loc: [DO] | |
| 05: 1 | Mult. | *See calibration* |
| 06: 0 | Offset | |

8. Calibration

The multiplier is used to calibrate the OxyGuard probe. To calculate the multiplier:

- 1) Program the CR10(X) using a multiplier of one.
- 2) Place the OxyGuard probe in the air, shaded from the sun. Wait for readings to stabilize. This may take 15 minutes or more.
- 3) Determine the air temperature and barometric pressure.
- 4) Using a calibration chart such as that provided in the probe's manual, determine the oxygen concentration of the air.
- 5) Use the following equation to calculate the multiplier:

$$M = P/R$$

$$M = \text{Multiplier}$$

$$P = \text{Concentration in PPM of the air (from the calibration chart)}$$

$$R = \text{The signal output of the OxyGuard probe when using a multiplier of one}$$
- 6) Change the multiplier in the CR10 program from one to the calculated number.

9. Maintenance

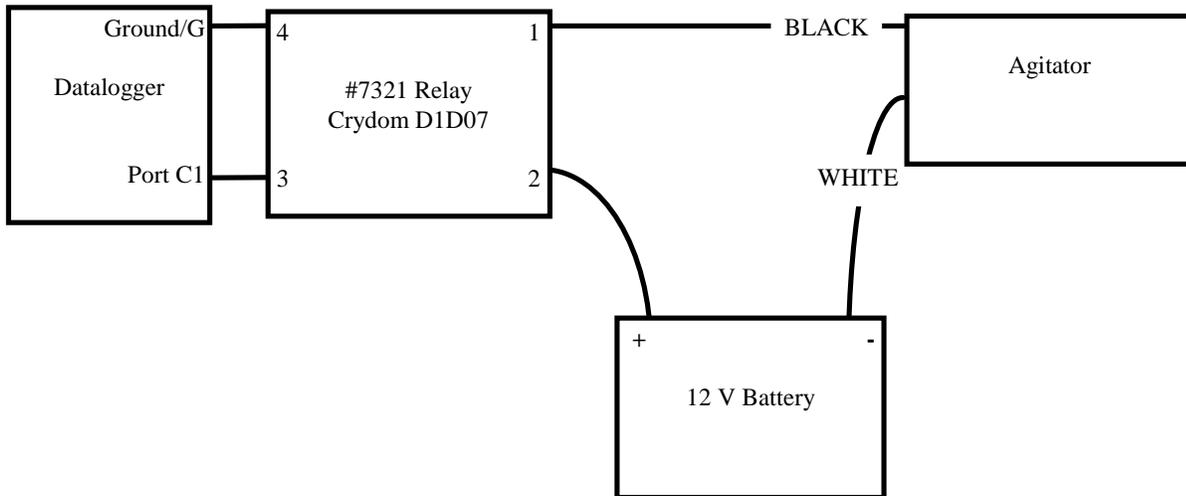
The Sensorex probe needs little maintenance. Regular cleaning of the membrane is all that is required. The membrane is very durable and can be cleaned with a cloth or soft paper. Do not scratch it clean with your fingernail.

10. Agitator Control

In low flow conditions (less than about 5 cm/sec), it may be necessary to add an agitator to the Sensorex probe. Campbell Scientific ships the agitator with a repeat cycle timer. Using the repeat cycle timer requires no datalogger programming. However, some users choose to use a solid state relay and have the datalogger agitate the water on the probe face either periodically

throughout the day or just before measurement. Agitating just before the measurement saves on power and causes less wear and tear on the agitator and probe membrane.

The wiring for the agitator as controlled by this example program would be as follows:



The following instructions in program table 2 would trigger the agitator as discussed in the agitator manual:

| *Table 2 Program | | | |
|--------------------------------|-----|-----------------------------------|----------------------------|
| 02: | 2.0 | Execution Interval (seconds) | |
| 1: Do (P86) | | | |
| 1: | 41 | Set Port 1 High | ; Use port number as wired |
| 2: Excitation with Delay (P22) | | | |
| 1: | 1 | Ex Channel | |
| 2: | 0 | Delay W/Ex (units = 0.01 sec) | |
| 3: | 25 | Delay After Ex (units = 0.01 sec) | |
| 4: | 0 | mV Excitation | |
| 3: Do (P86) | | | |
| 1: | 51 | Set Port 1 Low | |

The above example is not as power efficient as possible, and would require AC power to maintain a sufficient battery charge. If it is necessary to operate an agitator without AC power available, write the program so that the agitator is only operated for a short period of time just before the measurement is to be taken.