INSTRUCTION MANUAL

Campbell Scientific CS511-L Sensorex Dissolved Oxygen Probe

Revision: 6/12

WARRANTY AND ASSISTANCE

This equipment is warranted by CAMPBELL SCIENTIFIC (CANADA) CORP. (“CSC”) to be free from defects in materials and workmanship under normal use and service for **twelve (12) months** from date of shipment unless specified otherwise. ***** **Batteries are not warranted.** ***** CSC's obligation under this warranty is limited to repairing or replacing (at CSC's option) defective products. The customer shall assume all costs of removing, reinstalling, and shipping defective products to CSC. CSC will return such products by surface carrier prepaid. This warranty shall not apply to any CSC products which have been subjected to modification, misuse, neglect, accidents of nature, or shipping damage. This warranty is in lieu of all other warranties, expressed or implied, including warranties of merchantability or fitness for a particular purpose. CSC is not liable for special, indirect, incidental, or consequential damages.

Products may not be returned without prior authorization. To obtain a Return Merchandise Authorization (RMA), contact CAMPBELL SCIENTIFIC (CANADA) CORP., at (780) 454-2505. An RMA number will be issued in order to facilitate Repair Personnel in identifying an instrument upon arrival. Please write this number clearly on the outside of the shipping container. Include description of symptoms and all pertinent details.

CAMPBELL SCIENTIFIC (CANADA) CORP. does not accept collect calls.

Non-warranty products returned for repair should be accompanied by a purchase order to cover repair costs.

CAMPBELL® SCIENTIFIC

Campbell Scientific (Canada) Corp.
11564 149 Street | Edmonton AB T5M 1W7
780.454.2505 | fax 780.454.2655 | campbellsci.ca

PLEASE READ FIRST

About this manual

Please note that this manual was originally produced by Campbell Scientific Inc. (CSI) primarily for the US market. Some spellings, weights and measures may reflect this origin.

Some useful conversion factors:

Area:	1 in^2 (square inch) = 645 mm^2
Length:	1 in. (inch) = 25.4 mm 1 ft (foot) = 304.8 mm 1 yard = 0.914 m 1 mile = 1.609 km
Mass:	1 oz. (ounce) = 28.35 g 1 lb (pound weight) = 0.454 kg
Pressure:	1 psi (lb/in2) = 68.95 mb
Volume:	1 US gallon = 3.785 litres

In addition, part ordering numbers may vary. For example, the CABLE5CBL is a CSI part number and known as a FIN5COND at Campbell Scientific Canada (CSC). CSC Technical Support will be pleased to assist with any questions.

CS511-L Table of Contents

PDF viewers: These page numbers refer to the printed version of this document. Use the PDF reader bookmarks tab for links to specific sections.

Tables

Examples

Campbell Scientific CS511-L Sensorex Dissolved Oxygen Probe

An accurate and reliable sensor is a critical element in any measurement system. The CS511 meets these criteria for the measurement of dissolved oxygen. The CS511 is manufactured by Sensorex.

1. General Information

The CS511 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. The probe is shipped dry, but has a membrane installed in the cap. With the membrane in place, the cap must be filled with electrolyte solution before the cap is 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.

NOTE

Currently, the CS511 is Sensorex's Model DO6400/T. Prior to June 2008, the CS511 was Sensorex's Model DO6200/T. Programming, wiring, and most specifications are the same for these two sensors. However, they use different accessories and look different (see Figure 1). Refer to Appendix B if you have Sensorex's Model DO6200/T.

FIGURE 1-1. The CS511-L is currently Sensorex's DO6400/T (left). The DO6200/T (right) was shipped prior to June 2008 (refer to Appendix B).

2. Specifications

Principle of Measurement:	Membrane covered galvanic oxygen probe
Output Signal:	33 mV ± 9 mV (100% saturation), < 2 mV (0% saturation)
Accuracy:	Better than ± 2% of reading ± 1 digit when calibration temperature equals measuring temperature ± 5°C
Response Time:	5 minutes from 100% to 0% oxygen
Materials of Construction:	
Body:	Noryl
Anode:	Silver
Cathode:	Zinc
Diameter	5.72 cm (2.25 in)
Height:	17.78 cm (7 in) from bottom of sensor to end of cable strain relief
Shipping Weight	0.8 kg (1.75 lb)
Cable:	no standard length—all custom made as requested, PVC jacketed

Operating Conditions:	
Temperature	0° to 50°C (32° to 122°F)
Pressure:	0 to 100 psig
Minimum Submersion Depth:	60 mm (2 ½ 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° to 40°C (40° to 104°F)
Range of Dissolved Oxygen:	0.5 to 50 ppm
Probe Electrolyte:	NaCl + glycerol (prevents freezing)

3. Shipping Kit and Accessories

NOTE Except for the agitator, these items are for Sensorex's DO6400/T. Refer to Appendix B if you have a DO6200/T.

3.1 Shipping Kit

(1) Membrane replacement tool
(1) Bottled DO electrolyte, 250 ml
(2) Teflon membranes
(2) Membrane o-rings
(2) Membrane spaces

3.2 Optional Probe Accessories

- PT4 Agitator for stagnant conditions
- 22261 Maintenance Kit containing (5) Teflon membranes, (5) membrane o-rings, (5) tensioning washers, and a 250-ml bottle of electrolyte
- 22262 Maintenance Kit containing (25) Teflon membranes, (25) membrane o-rings, (25) tensioning washers, and a 500-ml bottle of electrolyte
- 22263 Spare Parts Kit containing (2) membrane locks, (2) tensioning washers, (2) body o-rings, and (1) membrane replacement tool

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.

O_2 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.

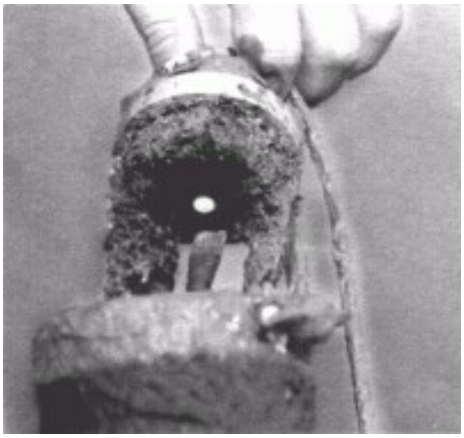

FIGURE 4-1. Preventing Bio-fouling of a DO Sensor

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.

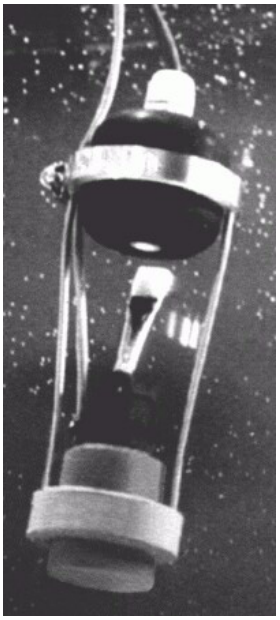

FIGURE 4-2. CS510-L with PT4 Agitator

5. Application Information

NOTE SCWin users: This manual was written primarily for those whose needs are not met by SCWin. 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 can use one differential channel or one single-ended channel. Differential wiring is better at rejecting electrical noise and ground loop error.

TABLE 6-1. Sensor Wiring

Color	Function	CR510, CR10X, CR800, CR850, CR23X, CR1000, CR3000, CR5000	CR200(X)-Series
White	Signal +	Differential High, or Single-Ended Channel	Single-Ended Channel
Black	Signal -	Differential Low or AG	Ground
Clear	Shield	Ground	Ground

7. Programming

The datalogger is programmed using either CRBasic or Edlog. Dataloggers that use CRBasic include our CR200(X)-series, CR800, CR850, CR1000, CR3000, and CR5000. Dataloggers that use Edlog include our CR510, CR10X, and CR23X. CRBasic and Edlog are included with LoggerNet and PC400 software.

7.1 CRBasic

In the CR800, CR850, CR1000, CR3000, and CR5000, the **VoltDiff()** or **VoltSE()** can be used to measure the CS511. In the CR200(X)-series dataloggers, only the **VoltSE()** instruction can be used since these dataloggers do not support differential measurements. Example program 1 is a CR1000 program that uses the **VoltDiff()** instruction. Example Program 2 is a CR200(X) program.

EXAMPLE 1. Sample CR1000 Program using VoltDiff

This example is a CR1000 program but programming for the CR800, CR850, CR3000, and CR5000 is similar. Table 7-1 shows the wiring for the example.

TABLE 7-1. Wiring for Example 1	
CR1000 Connection	Sensor Wire
1H	White
1L	Black
Ground	Clear

```
'CR1000

'Declare Variables and Units
Public Batt_Volt
Public DOmV
Public DOppm

Units Batt_Volt=Volts
Units DOmV=mV
Units DOppm=ppm

'Define Data Tables
DataTable(Table1,True,-1)
    DataInterval(0,60,Min,10)
    Sample(1,DOmV,FP2)
    Sample(1,DOppm,FP2)
    Sample(1,Batt_Volt,FP2)
EndTable

DataTable(Table2,True,-1)
    DataInterval(0,1440,Min,10)
    Minimum(1,Batt_Volt,FP2,False,False)
EndTable

'Main Program
BeginProg
    Scan(5,Sec,1,0)
        'Default Datalogger Battery Voltage measurement Batt_Volt:
        Battery(Batt_Volt)
        'CS511 Dissolved Oxygen Probe measurements DOmV and DOppm:
        VoltDiff(DOmV,1,mV250,1,True,0,_60Hz,1,0)
        DOppm=DOmV*0.34
        'Call Data Tables and Store Data
        CallTable(Table1)
        CallTable(Table2)
    NextScan
EndProg
```

EXAMPLE 2. Sample CR200(X) Program

The CR200(X)-series must use the **VoltSE()** instruction since these dataloggers do not make differential measurements. If the other CRBasic dataloggers use the **VoltSE()** instruction instead of the **VoltDiff()** instruction, their programming will be similar to this example. Table 7-2 shows the wiring for the example.

TABLE 7-2. Wiring for Example 2

CR200(X) Connection	Sensor Wire
SE1	White
Ground	Black
Ground	Clear

```
'CR200(X) Series

'Declare Variables and Units
Public Batt_Volt
Public DOmV
Public DOppm

Units Batt_Volt=Volts
Units DOmV=mV
Units DOppm=ppm

'Define Data Tables
DataTable(Table1,True,-1)
    DataInterval(0,60,Min)
    Sample(1,DOmV)
EndTable

DataTable(Table2,True,-1)
    DataInterval(0,1440,Min)
    Minimum(1,Batt_Volt,False,False)
EndTable

'Main Program
BeginProg
    Scan(10,Sec)
        'Default Datalogger Battery Voltage measurement Batt_Volt:
        Battery(Batt_Volt)
        'CS511 Dissolved Oxygen Probe measurements DOmV and DOppm:
        VoltSE(DOmV,1,1,1,0)
        DOppm=DOmV*0.34
        'Call Data Tables and Store Data
        CallTable(Table1)
        CallTable(Table2)
    NextScan
EndProg
```

7.2 Edlog

Edlog Instruction 1 or 2 can be used. Example 1 shows the single-ended instruction for measuring the Sensorex probe; example 2 shows the differential instruction. 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.

EXAMPLE 3. Portion of CR10X Sample Program using P1

```
1:  Volt (SE) (P1)
   1:   1              Reps
   2:   24             250 mV 60 Hz Rejection Range   ; code 23 used for CR23X
   3:   1              SE Channel
   4:   1              Loc [ DOmV     ]
   5:   1.0            Multiplier                    *See Calibration*
   6:   0.0            Offset
```

EXAMPLE 4. Portion of CR10X Sample Program using P2

```
1:  Volt (Diff) (P2)
   1:   1              Reps
   2:   24             250 mV 60 Hz Rejection Range   ; code 23 used for CR23X
   3:   1              DIFF Channel
   4:   1              Loc [ DOmV     ]
   5:   1.0            Multiplier                    *See Calibration*
   6:   0.0            Offset
```

8. Calibration

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

1) Program the datalogger 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 Appendix A, determine the oxygen concentration of the air.

5) Use the following equation to calculate the multiplier:
   M = P/R
   M = Multiplier
   P = Concentration in PPM of the air (from the calibration chart)
   R = The signal output of the OxyGuard probe when using a multiplier of one

6) Change the multiplier in the datalogger program from one to the calculated number.

A more common way to enter the multiplier is to insert a separate instruction in the program. This will allow a new multiplier to be added to the program without rewriting, compiling, and downloading the program to the datalogger.

CRBasic dataloggers can use an expression. The multiplier value is entered into the expression through the Public Table using the numeric display in PC200W, PC208W, LoggerNet, PC400, PConnect, or PConnectCE.

EXAMPLE 5. Sample Program using Expression

```
DOppm = DOMult * DOmV
```

Edlog dataloggers use Instruction 36. The multiplier is entered into an input location called DOmult using the numeric display in PC200W, PC208W, LoggerNet, PC400, PConnect, PConnectCE, or the datalogger keyboard display.

EXAMPLE 6. Sample Program using P36

```
57:  Z=X*Y (P36)
   1:   1              X Loc [ DOmV       ]
   2:   2              Y Loc [ DOmult     ]
   3:   3              Z Loc [ DOppm      ]
```

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.

Letting the CS511 dry up will shorten the life of the membrane and probe. If the CS511 needs to be stored out of water for extended periods of time, it should be drained of solution, and the membrane should be replaced when the probe's deployed. If the CS511 dries up while in the field, the probe should be recalibrated before using it again.

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:

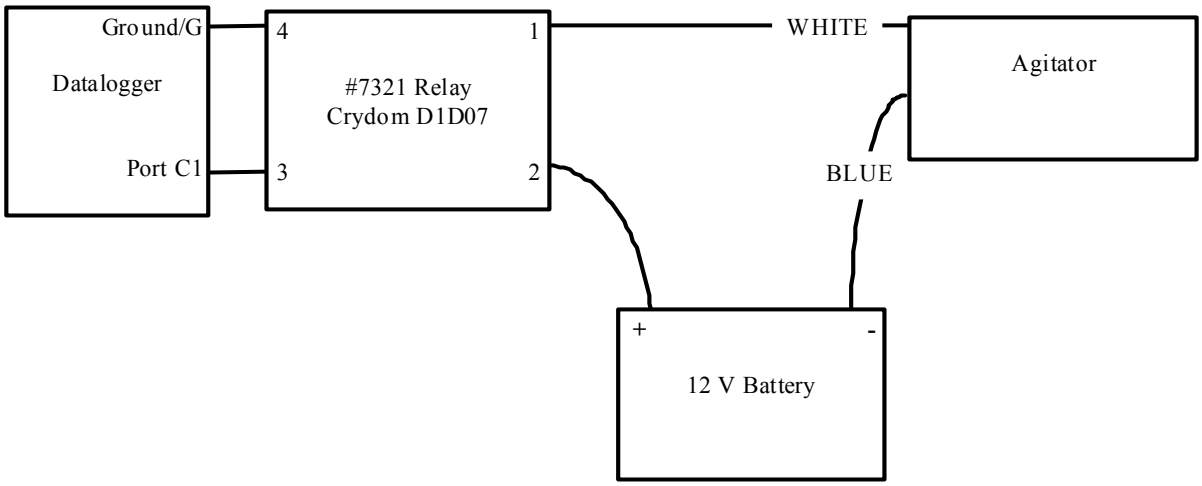

FIGURE 10-1. Agitator Wiring

The following instructions would trigger the agitator as discussed in the agitator manual.

In the CR800, CR850, CR1000, CR3000, and CR5000, use the Portset instruction.

EXAMPLE 7. Portion of CR1000 Program using Portset

```
Portset (1,1)
Delay (1,500,msec)
Portset (1,0)
```

In the CR200(X)-series, use the Portset instruction.

EXAMPLE 8. Portion of CR200(X) Program using Portset

```
Portset (1,1)
Delay(500,msec)
Portset(1,0)
```

In the CR510, CR10X, and CR23X, use instruction P86 and P22.

EXAMPLE 9. Portion of CR10X Program using P86 and P22 Instructions

```
45:  Do (P86)
   1:   41            Set Port 1 High

46:  Excitation with Delay (P22)
   1:   1             Ex Channel
   2:   20            Delay W/Ex (units = 0.01 sec)
   3:   0             Delay After Ex (units = 0.01 sec)
   4:   0             mV Excitation

47:  Do (P86)
   1:   51            Set Port 1 Low

48:  End (P95)
```

The above examples are 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.

Appendix A. Dissolved Oxygen Tables

Table I: Dissolved Oxygen in Fresh Water

Solubility of dissolved oxygen (mg/L) as a function of temperature and pressure for moist air, salinity = 0.0 ppt.

	ALTITUDE (Feet/Metres) and equivalent BAROMETRIC PRESSURE (mm Hg/mbar)												
	0	500	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	Feet
	0	152	305	457	610	762	914	1067	1219	1372	1524	1676	1829	Metres
TEMP.	760	747	733	721	708	695	683	671	659	648	636	625	614	mm Hg
°C °F	1013	995	978	961	944	927	911	895	879	863	848	833	819	mbar
0 32.0	14.60	14.34	14.09	13.84	13.60	13.36	13.12	12.89	12.67	12.44	12.22	12.01	11.80	
1 33.8	14.20	13.95	13.70	13.46	13.22	12.99	12.76	12.54	12.32	12.10	11.89	11.68	11.47	
2 35.6	13.81	13.57	13.33	13.10	12.87	12.64	12.42	12.20	11.98	11.77	11.56	11.36	11.16	
3 37.4	13.45	13.21	12.98	12.75	12.52	12.30	12.09	11.87	11.66	11.46	11.26	11.06	10.86	
4 39.2	13.09	12.86	12.64	12.41	12.20	11.98	11.77	11.56	11.36	11.16	10.96	10.77	10.58	
5 41.0	12.76	12.53	12.31	12.09	11.88	11.67	11.47	11.26	11.07	10.87	10.68	10.49	10.31	
6 42.8	12.44	12.22	12.00	11.79	11.58	11.38	11.18	10.98	10.79	10.60	10.41	10.23	10.05	
7 44.6	12.13	11.91	11.70	11.50	11.29	11.10	10.90	10.71	10.52	10.33	10.15	9.97	9.80	
8 46.4	11.83	11.62	11.42	11.22	11.02	10.83	10.63	10.45	10.26	10.08	9.91	9.73	9.56	
9 48.2	11.55	11.34	11.15	10.95	10.76	10.57	10.38	10.20	10.02	9.84	9.67	9.50	9.33	
10 50.0	11.28	11.08	10.88	10.69	10.50	10.32	10.14	9.96	9.78	9.61	9.44	9.27	9.11	
11 51.8	11.02	10.82	10.63	10.44	10.26	10.08	9.90	9.73	9.56	9.39	9.22	9.06	8.90	
12 53.6	10.77	10.58	10.39	10.21	10.03	9.85	9.68	9.51	9.34	9.17	9.01	8.85	8.70	
13 55.4	10.53	10.34	10.16	9.98	9.80	9.63	9.46	9.29	9.13	8.97	8.81	8.66	8.50	
14 57.2	10.29	10.11	9.93	9.76	9.59	9.42	9.25	9.09	8.93	8.77	8.62	8.47	8.32	
15 59.0	10.07	9.89	9.72	9.55	9.38	9.22	9.05	8.89	8.74	8.58	8.43	8.28	8.14	
16 60.8	9.86	9.68	9.51	9.35	9.18	9.02	8.86	8.70	8.55	8.40	8.25	8.11	7.96	
17 62.6	9.65	9.48	9.31	9.15	8.99	8.83	8.68	8.52	8.37	8.22	8.08	7.94	7.80	
18 64.4	9.45	9.29	9.12	8.96	8.80	8.65	8.50	8.35	8.20	8.06	7.91	7.77	7.64	
19 66.2	9.26	9.10	8.94	8.78	8.63	8.47	8.32	8.18	8.03	7.89	7.75	7.62	7.48	
20 68.0	9.08	8.92	8.76	8.61	8.45	8.30	8.16	8.01	7.87	7.73	7.60	7.46	7.33	
21 69.8	8.90	8.74	8.59	8.44	8.29	8.14	8.00	7.86	7.72	7.58	7.45	7.32	7.19	
22 71.6	8.73	8.57	8.42	8.27	8.13	7.98	7.84	7.71	7.57	7.44	7.31	7.18	7.05	
23 73.4	8.56	8.41	8.26	8.12	7.97	7.83	7.69	7.56	7.43	7.29	7.17	7.04	6.92	
24 75.2	8.40	8.25	8.11	7.96	7.82	7.69	7.55	7.42	7.29	7.16	7.03	6.91	6.79	
25 77.0	8.24	8.10	7.96	7.82	7.68	7.54	7.41	7.28	7.15	7.03	6.90	6.78	6.66	
26 78.8	8.09	7.95	7.81	7.67	7.54	7.41	7.28	7.15	7.02	6.90	6.78	6.66	6.54	
27 80.6	7.95	7.81	7.67	7.54	7.40	7.27	7.14	7.02	6.90	6.77	6.65	6.54	6.42	
28 82.4	7.81	7.67	7.53	7.40	7.27	7.14	7.02	6.89	6.77	6.65	6.54	6.42	6.31	
29 84.2	7.67	7.54	7.40	7.27	7.14	7.02	6.90	6.77	6.65	6.54	6.42	6.31	6.20	
30 86.0	7.54	7.41	7.28	7.15	7.02	6.90	6.78	6.66	6.54	6.42	6.31	6.20	6.09	
31 87.8	7.41	7.28	7.15	7.03	6.90	6.78	6.66	6.54	6.43	6.32	6.20	6.09	5.99	
32 89.6	7.29	7.16	7.03	6.91	6.79	6.67	6.55	6.43	6.32	6.21	6.10	5.99	5.89	
33 91.4	7.17	7.04	6.92	6.79	6.67	6.56	6.44	6.33	6.22	6.11	6.00	5.89	5.79	
34 93.2	7.05	6.92	6.80	6.68	6.56	6.45	6.34	6.22	6.11	6.01	5.90	5.80	5.69	
35 95.0	6.93	6.81	6.69	6.57	6.46	6.34	6.23	6.12	6.02	5.91	5.81	5.70	5.60	
36 96.8	6.82	6.70	6.59	6.47	6.36	6.24	6.13	6.03	5.92	5.82	5.71	5.61	5.51	
37 98.6	6.72	6.60	6.48	6.37	6.26	6.15	6.04	5.93	5.83	5.72	5.62	5.52	5.43	
38 100.4	6.61	6.49	6.38	6.27	6.16	6.05	5.94	5.84	5.74	5.63	5.53	5.44	5.34	
39 102.2	6.51	6.39	6.28	6.17	6.06	5.96	5.85	5.75	5.65	5.55	5.45	5.35	5.26	
40 104.0	6.41	6.30	6.19	6.08	5.97	5.86	5.76	5.66	5.56	5.46	5.37	5.27	5.18	

Table II: Dissolved Oxygen in Saline Water

Solubility of dissolved oxygen (mg/L) as a function of temperature and salinity for moist air at sea level

TEMP		SALINITY - Parts per Thousand								
°C	°F	0	5	10	15	20	25	30	35	40
0	32.0	14.60	14.11	13.64	13.18	12.74	12.31	11.90	11.50	11.11
1	33.8	14.20	13.73	13.27	12.83	12.40	11.98	11.58	11.20	10.83
2	35.6	13.81	13.36	12.91	12.49	12.07	11.67	11.29	10.91	10.55
3	37.4	13.45	13.00	12.58	12.16	11.76	11.38	11.00	10.64	10.29
4	39.2	13.09	12.67	12.25	11.85	11.47	11.09	10.73	10.38	10.04
5	41.0	12.76	12.34	11.94	11.56	11.18	10.82	10.47	10.13	9.80
6	42.8	12.44	12.04	11.65	11.27	10.91	10.56	10.22	9.89	9.57
7	44.6	12.13	11.74	11.37	11.00	10.65	10.31	9.98	9.66	9.35
8	46.4	11.83	11.46	11.09	10.74	10.40	10.07	9.75	9.44	9.14
9	48.2	11.55	11.19	10.83	10.49	10.16	9.84	9.53	9.23	8.94
10	50.0	11.28	10.92	10.58	10.25	9.93	9.62	9.32	9.03	8.75
11	51.8	11.02	10.67	10.34	10.02	9.71	9.41	9.12	8.83	8.56
12	53.6	10.77	10.43	10.11	9.80	9.50	9.21	8.92	8.65	8.38
13	55.4	10.53	10.20	9.89	9.59	9.30	9.01	8.74	8.47	8.21
14	57.2	10.29	9.98	9.68	9.38	9.10	8.82	8.55	8.30	8.04
15	59.0	10.07	9.77	9.47	9.19	8.91	8.64	8.38	8.13	7.88
16	60.8	9.86	9.56	9.28	9.00	8.73	8.47	8.21	7.97	7.73
17	62.6	9.65	9.36	9.09	8.82	8.55	8.30	8.05	7.81	7.58
18	64.4	9.45	9.17	8.90	8.64	8.39	8.14	7.90	7.66	7.44
19	66.2	9.26	8.99	8.73	8.47	8.22	7.98	7.75	7.52	7.30
20	68.0	9.08	8.81	8.56	8.31	8.07	7.83	7.60	7.38	7.17
21	69.8	8.90	8.64	8.39	8.15	7.91	7.69	7.46	7.25	7.04
22	71.6	8.73	8.48	8.23	8.00	7.77	7.54	7.33	7.12	6.91
23	73.4	8.56	8.32	8.08	7.85	7.63	7.41	7.20	6.99	6.79
24	75.2	8.40	8.16	7.93	7.71	7.49	7.28	7.07	6.87	6.68
25	77.0	8.24	8.01	7.79	7.57	7.36	7.15	6.95	6.75	6.56
26	78.8	8.09	7.87	7.65	7.44	7.23	7.03	6.83	6.64	6.46
27	80.6	7.95	7.73	7.51	7.31	7.10	6.91	6.72	6.53	6.35
28	82.4	7.81	7.59	7.38	7.18	6.98	6.79	6.61	6.42	6.25
29	84.2	7.67	7.46	7.26	7.06	6.87	6.68	6.50	6.32	6.15
30	86.0	7.54	7.33	7.14	6.94	6.75	6.57	6.39	6.22	6.05
31	87.8	7.41	7.21	7.02	6.83	6.65	6.47	6.29	6.12	5.96
32	89.6	7.29	7.09	6.90	6.72	6.54	6.36	6.19	6.03	5.87
33	91.4	7.17	6.98	6.79	6.61	6.44	6.26	6.10	5.94	5.78
34	93.2	7.05	6.86	6.68	6.51	6.33	6.17	6.01	5.85	5.69
35	95.0	6.93	6.75	6.58	6.40	6.24	6.07	5.92	5.76	5.61
36	96.8	6.82	6.65	6.47	6.31	6.14	5.98	5.83	5.68	5.53
37	98.6	6.72	6.54	6.37	6.21	6.05	5.89	5.74	5.59	5.45
38	100.4	6.61	6.44	6.28	6.12	5.96	5.81	5.66	5.51	5.37
39	102.2	6.51	6.34	6.18	6.03	5.87	5.72	5.58	5.44	5.30
40	104.0	6.41	6.25	6.09	5.94	5.79	5.64	5.50	5.36	5.22

Appendix B. Sensorex Model DO6200/T

Prior to June 2008, Campbell Scientific's CS511 was Sensorex's Model DO6200/T (see Figure B-1) instead of Sensorex's Model DO6400/T. Programming, wiring, and some specifications are the same for these two sensors. However, they look different and use different accessories.

FIGURE B-1. Sensorex's Model DO6200/T

B.1 DO6200/T Specifications

Principle of Measurement:	Membrane covered galvanic oxygen probe
Output Signal:	1.65 mV ± .45 mV per mg/l
Accuracy:	Better than ± 2 % of reading ± 1 digit when calibration temperature equals measuring temperature ± 5°C
Output Impedance:	10 k Ohms nominal
Response Time:	After equilibration, 2 minute for 90% 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:	8.9 cm (3.5 in) height, 5.6 cm (2.2 in) diameter, 0.5 kg (1.1 lb)

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 ½ 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° to 40°C (40° to 104°F)
Range of Dissolved Oxygen:	0-20 mg/l, 0-200 % Sat
Electrode Materials:	Ag cathode/Zn anode
Probe Electrolyte:	NaCl

B.2 Accessories for DO6200/T

14054 Teflon Membrane for DO6200/T (Qty 5)
14053 Teflon Membrane for DO6200/T (Qty 25)
14056 Membrane Replacement Tool for DO6200/T
14055 DO Electrolyte for DO6200/T, 500 ml

Campbell Scientific Companies

Campbell Scientific, Inc. (CSI)
815 West 1800 North
Logan, Utah 84321
UNITED STATES
www.campbellsci.com • info@campbellsci.com

Campbell Scientific Africa Pty. Ltd. (CSAf)
PO Box 2450
Somerset West 7129
SOUTH AFRICA
www.csafrica.co.za • cleroux@csafrica.co.za

Campbell Scientific Australia Pty. Ltd. (CSA)
PO Box 8108
Garbutt Post Shop QLD 4814
AUSTRALIA
www.campbellsci.com.au • info@campbellsci.com.au

Campbell Scientific do Brazil Ltda. (CSB)
Rua Luisa Crapsi Orsi, 15 Butantã
CEP: 005543-000 São Paulo SP BRAZIL
www.campbellsci.com.br • suporte@campbellsci.com.br

Campbell Scientific Canada Corp. (CSC)
11564 - 149th Street NW
Edmonton, Alberta T5M 1W7
CANADA
www.campbellsci.ca • dataloggers@campbellsci.ca

Campbell Scientific Centro Caribe S.A. (CSCC)
300 N Cementerio, Edificio Breller
Santo Domingo, Heredia 40305
COSTA RICA
www.campbellsci.cc • info@campbellsci.cc

Campbell Scientific Ltd. (CSL)
Campbell Park
80 Hathern Road
Shepshed, Loughborough LE12 9GX
UNITED KINGDOM
www.campbellsci.co.uk • sales@campbellsci.co.uk

Campbell Scientific Ltd. (France)
3 Avenue de la Division Leclerc
92160 ANTONY
FRANCE
www.campbellsci.fr • info@campbellsci.fr

Campbell Scientific Spain, S. L.
Avda. Pompeu Fabra 7-9, local 1
08024 Barcelona
SPAIN
www.campbellsci.es • info@campbellsci.es

Please visit www.campbellsci.com to obtain contact information for your local US or international representative.