DRYDEN AQUA TECHNOLOGY
SUSTAINABLE WATER QUALITY

Oxygen Probe

Instructions for Use

OxyGen Probes

Robust, Accurate & Low Cost

Our oxygen probe is a very high performance and extremely robust oxygen probe manufactured by Dryden Aqua in Scotland for the measurement of oxygen in water and air. The probe provides for a low cost, easy to maintain sensor suitable for connection to Dryden Aqua monitors or your own instrumentation.

The probe has a high mv output for PLC based controllers, the high output increases accuracy and reduces electrical noise problems. The unique shape also provides a streamlined approach to insure minimal turbulence when suspended in the water.

Typical Applications

- Aquaculture
- Rivers and lakes
- Sewerage effluent
- Industrial waste water treatment systems
- Hydroponics
- Mining industry
- Air quality monitoring, environmental warehouses & storage

Benefits of Dryden Aqua probe

- Robust, reliable & accurate
- Very stable, no zero point error
- Galvanic cell for simplicity
- Kevlar reinforced urethane cable
- Fully epoxy filled for durability
- User serviceable (never needs to return to Dryden Aqua)
- Self-cleaning device available when used in polluted water.

1 year product guarantee against defects due to manufacture, however given the very robust design of our probes we normally expect them to last 5 to 10 years.

Technical Properties

Our oxygen probe is a galvanic cell, basically the probe acts like a battery in which there are two dissimilar metals in a conducting electrolyte solution. The anode is zinc and the cathode is silver, oxidation takes place on the surface of the anode to form a white deposit of zinc oxide. The rate of oxidation is a function of the diffusion of oxygen through a semi permeable Teflon membrane, which is in turn directly related to the partial pressure of oxygen in solution, or in the air. A potential difference is established in the probe, the millivolt output being approx. 8 to 16mv per 1 mg/l of dissolved oxygen. This gives the probe a reading of approximately 80mv when in air at 20 deg C.

Oxygen Probe Specifications:

- No zero point error
- Very accurate usually better than +/- 0.2mg/l
- Calibrate to 100% in air
- Self-temperature compensating from 5 to 40 deg C for 2 & 5 wire probes
- Connect with good quality four or five core cable *(5 core if an independent temperature readout is required)*.
- Very stable, usually 3 to 6 months between calibration checks
- Very easy to maintain, can be serviced in the field
- Strong Teflon membrane
- Very heavy duty sub-sea urethane cable, into epoxy sealed internals
- Diameter = 63 mm, length = 73 mm. Cable length = 5 m (standard)
- Weight 1000 g incl. cable 5m
- 6 to 12 mill volt per ppm (mg/l) (depends on temp)
- pressure to 10 atmospheres
- Water flow should be at least 4 cm/sec
- Response time, to change in, approximately 15 to 30 seconds
- Standard probe is a 2 wire, with temp sensor there are 5 wires
- Temperature sensor PT100 built in to probe is available as an option, alternative sensors can also be used.

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Any length of good quality two core (0.5mm^2, multi-strand) cable can be connected to the probe, technically there is no limit to the length of cable that you can attach, however we have only tested to 2000 meters. General maintenance is also very easy, all that you need to do is keep the probe membrane reasonably clean, this is achieved by giving the membrane a wipe with a cloth once a week.

Our probes are manufactured from acetyl plastic (POM) which is 10mm thick, the cable is hard wired into the probe and the probe is then filled with epoxy. The cable is a sub-sea cable, with a urethane sheath and Kevlar reinforcement. Our oxygen probe is a serious industrial quality product which you find hard to break and impossible to beat on price and performance.

Membrane Types

There are two types of membrane available for our Oxygen probe. The standard is a Teflon membrane which is temperature compensated in the probe to give very accurate measurements of oxygen in ppm or mg/l. The second type of membrane is made from Polythene and is designed for use with our probe when measuring oxygen in percentage saturation % sat. The Teflon membrane is slightly better than the polythene membrane and mg/l oxygen measurements are more meaningful than % saturation measurements. We always include Teflon membranes as standard unless requested to provide polythene membranes for % saturation.

How to identify the membranes

Teflon membranes will sink when placed in freshwater, polythene membranes will float. If you use the wrong membrane the temperature compensation will not work properly, especially if the water temperature is very different from the air temperature.

Calibration

Calibration of the oxygen probe is very easy, just follow the steps below;

Standard calibration mg/l

1. Remove probe from water, dry and clean the probe and membrane with a soft clean cloth.
2. Using a pin, clear the breather hole on top of the probe
3. Suspend the probe in the air above the surface of the water, try to keep the probe out of the wind and direct sunlight. The probe should be left for a period of at least 30 minutes or until you are sure that the temperature of the probe is the same as the air temperature. The best time to perform this task is early in the morning or late evening. If the water and air temperature differ by more than 5 deg C give the probe 1 to 2 hours for the temperature to fully stabilise. We need to be accurate to better than 0.1 deg C for the best possible calibration.
4. The probes will now be reading the equivalent of 100% saturation. Take an accurate reading of the air temperature by the probes. Use the table below to establish the concentration in mg/l for the probe, and use this figure with your oxygen monitoring equipment.
5. Example. if the air temp is 20.5 deg C and the probe is at the same temperature as the air, the probe should be reading 8.99mg/l. Set the display to give this reading

Quick calibration mg/l

Sometimes you do not have time to wait 30 minutes or more to perform a calibration, we therefore have a quick calibration technique that often proves more accurate than the standard technique.

1. Remove the probe (or probes from the water) dry the probes with a soft cloth or tissue, suspended in air out of direct sunlight
2. Clear the breather hole with a pin and wipe the membrane with a soft cloth
3. Measure the temperature of the water (if more than one probe is being calibrated, the water temperature should be known for each probe)
4. Calibrate the probes using the water temperature. The probes must be calibrated within 2 minutes of removing from the water, otherwise the temperature of the probe may have changed too much from the temperature of the water

Calibration for %sat

Our oxygen probes with Teflon membrane are intended to be used for the measure of oxygen concentration in air or water expressed as a temperature compensated value expressed as ppm or mg/l. If the probe is connected to a plc based system then the value may also be expressed as percentage saturation. If however you do not have a plc system, or if you just want to use the probes for percentage saturation readings, then they can be provided with a Polythene membrane as opposed to a Teflon membrane.

When a polythene membrane used the diffusion coefficient of oxygen through the membrane is very high so it functions as a measure of the partial pressure of oxygen. The probe is now calibrated in air to 100% saturation in air or water.

Using the probe with a Millivolt meter

The Dryden Aqua oxygen probe is a galvanic cell. The probe will generate a DC mv signal that is directly proportional to the oxygen content of the water. To calibrate the probe, remove the probe from the water and suspend in air out of direct sunlight for at least 30 minutes. Note the air temperature, and then look up the oxygen solubility table. If air temp is 20.2 deg C this equates to 9.05 mg/l oxygen. If the mv reading on the probe is 92mv, then this voltage corresponds to 9.05mg/l oxygen. 9.05/92 = 0.1. To use the probe in this case, drop the probe into the water and multiply the reading on the multi-meter dc mv scale by 0.1. For example, if the reading is 75mv, the oxygen content is 7.5 mg/l

Probe maintenance

The oxygen probe requires very little attention; the degree of attention will depend upon the water type in which the probe is immersed. For most applications, we recommend that the probe is removed from the water once a week and the membrane cleaned with a soft clean cloth. The breather hole on top of the probe should also be cleaned using a pin. This is all that you need do with the probe on a regular basis.

If the membrane is damaged, the readings will become very erratic. Under these conditions the membrane should be replaced. Do not replace or clean the white oxide deposit on the metal zinc anode. There is no need to replace the anode for many years unless there is less than 10% of the metal surface left. If the anode is changed do not over tighten the nut. This could cause damage to the internal epoxy fill and cause water ingress.

After one or more years, carbonate or metal oxide deposits can accumulate on the silver cathode disc. The deposits may be cleaned off with three wipes of the cathode with a 700-grade abrasion paper. The probes should then be washed. Under no circumstances should the silver cathode be scraped or polished, this would destroy the probe

Membrane Replacement

The following procedure describes membrane replacement.

1. Remove the oxygen probe from the water and clean with a cloth or paper towel
2. Unscrew the bottom end cap, please note that the electrolyte containing a white deposit of colloidal solution of zinc oxide may be captained in the cap. Discard this solution.
3. Using a coin, unscrew the threaded retaining ring in the membrane cap, remove and discard the membrane and small `O` ring located below the membrane
4. Clean the inside of the membrane cap thoroughly with a damp cloth, and finish off with a clean dry cloth.
5. Insert a new `O` ring, and then the membrane on top of the `O` ring. Screw down the threaded retaining ring until you feel tension, then give is a further 1/4 turn. If the membrane wrinkles, you will need to replace the `O` ring and membrane and try again.
6. Clean the inside of the probe top, you may clean the silver cathode with 1500 grade paper. Take care as damage to the silver cathode can affect probe readings. You can clean the angular zinc anode with rough abrasive paper to remove any oxidation layer. Clean the probe in freshwater to remove any of the fines.

7. Fill the membrane cap with electrolyte. Holding the probe vertically, screw the membrane cap on to the top of the probe, making sure that the large `O` ring is in place. Slowly screw up the cap, the excess electrolyte will escape though the breather hole. Take care that you do not screw the cap on too quickly since this will stretch the membrane. Screw up the cap until it seals on the large `O` ring a then give it a further 1/4 turn.
8. Immerse the probe into the water, after 24 hours perform a calibration as per the instructions above

Components supplied with the probe

The standard probe is supplied with the following components;

1. Oxygen probe fitted with 5 metres of heavy duty cable
2. 100ml bottle of electrolyte
3. 5 spare membranes and membrane 'O' rings

Note.

The probe is supplied dry without any electrolyte. On receipt of the probe, remove the end cap, fill the end cap with electrolyte and slowly screw the cap back up onto the probe. Screw the end cap up slowly to allow the excess electrolyte to squirt out of the top breather hole. You should then leave the probe for 30 minutes suspended in air before you perform a calibration. Once the probe is calibrated immerse the probe into the water for a period of at least 24 hours and then perform another calibration. Thereafter a calibration will be required at approximately 1 to 2 week intervals. After a period of approx. 4 weeks, the calibration frequency can be reduced to once every month to several months.

Low Temperature applications

If the oxygen probe is subjected to sub-zero temperatures, the electrolyte may freeze and cause damage to the probe. To avoid freezing down to temperatures of -25 deg C glycerine is added to the electrolyte at a level of 55% glycerine to 45% water by volume. The glycerine will reduce the millivolt output of the probe down to approximately 50mv.

Oxygen Probe wire colours

Integration with your own system

The probe can be considered a low impedance millivolt generator. It has built in temperature compensation for readings only in mg/l. The output is linearly proportional to the oxygen concentration, and it is about 120 mv in air at a temperature of 20 deg C. The output is approximately 10mv per mg/l of oxygen.

The output impedance is very low (< 1 kohm) so noise problems normally do not exist. However, it is important that the input impedance of the transmitter is at least 3 milliohms in order not to disturb the temperature compensation. It is also extremely important that inputs from probes are galvanically isolated from each other if more than one probe is connected to the same electronics.

The **oxygen** probe is easy to install. It should be placed where there is some movement in the water (2 cm/sec). Ensure that the probe cannot strike against the tank wall or similar, and don't mount it directly above air or oxygen diffusers etc.

Cable connections

Each probe is connected using ordinary 2-core cable and it is fitted with 5 metres of urethane cable unless otherwise specified. The red wire is positive and the blue is negative Use the junction box supplied with the probe when extending the cable.

With regards to the temperature sensor (type pt100) the cable is numbered as follows;

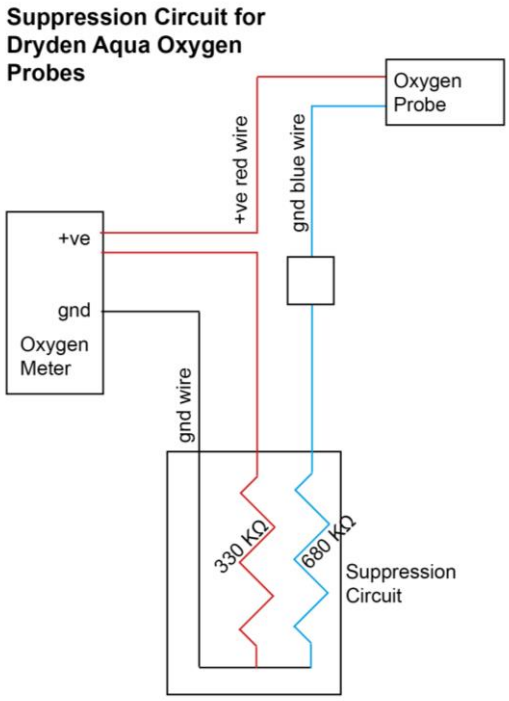
Standard Oxygen sensor

+ve oxygen wire	red
-ve oxygen wire	blue
PT 100 temp sensor	black
PT 100 temp sensor	white & yellow

All probes cables will have 5 x wires, for use with pT100 temp sensors. If a temp sensor is not required, the black, white and yellow core will not be used.

Suppression Circuit

The suppression circuit is used to drop the output of our oxygen probes by a factor of three times. If the probes are not being used with Dryden Aqua equipment, then in some cases you may need to drop the output voltage. Typical voltage is approximately 100mv, the suppression circuit drops it to 30mv



Solubility of Oxygen in water

The solubility of oxygen in water in equilibrium with air at 760mm Hg pressure and 100% relative humidity Units:mg/1 . The data gives the mg/l of oxygen in solution that is equivalent to 100% saturation at the specified temperature

T deg C	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	14.60	14.65	14.52	14.48	14.44	14.40	14.36	14.33	14.29	14.25
1	14.21	14.17	14.13	14.09	14.05	14.02	13.98	13.94	13.90	13.87
2	13.83	13.79	13.75	13.72	13.68	13.64	13.61	13.57	13.54	13.50
3	13.46	13.43	13.39	13.36	13.32	13.29	13.25	13.22	13.18	13.15
4	13.11	13.08	13.04	13.01	12.98	12.94	12.91	12.88	12.84	12.81
5	12.78	12.74	12.71	12.68	12.64	12.61	12.58	12.55	12.52	12.48
6	12.45	12.45	12.39	12.36	12.33	12.29	12.26	12.23	12.20	12.17
7	12.14	12.11	12.08	12.05	12.02	11.99	11.96	11.93	11.90	11.87
8	11.84	11.81	11.78	11.76	11.73	11.70	11.67	11.64	11.61	11.58
9	11.56	11.53	11.50	11.47	11.44	11.42	11.39	11.36	11.34	11.31
10	11.28	11.25	11.23	11.20	11.17	11.15	11.12	11.10	11.07	11.04
11	11.02	10.99	10.97	10.94	10.91	10.89	10.86	10.84	10.81	10.79
12	10.76	10.74	10.72	10.69	10.67	10.64	10.62	10.59	10.57	10.55
13	10.54	10.50	10.47	10.45	10.43	10.40	10.38	10.36	10.34	10.31
14	10.29	10.27	10.24	10.22	10.20	10.18	10.15	10.13	10.11	10.09
15	10.07	10.04	10.02	10.00	9.98	9.96	9.94	9.92	9.89	9.87
16	9.85	9.83	9.81	9.79	9.77	9.75	9.73	9.71	9.69	9.67
17	9.65	9.63	9.61	9.59	9.57	9.55	9.53	9.51	9.49	9.47
18	9.45	9.43	9.41	9.39	9.37	9.36	9.34	9.32	9.30	9.28
19	9.26	9.24	9.23	9.21	9.19	9.17	9.15	9.13	9.12	9.10
20	9.08	9.06	9.05	9.03	9.01	8.99	8.89	8.96	8.94	8.92
21	8.91	8.89	8.87	8.86	8.84	8.82	8.81	8.79	8.77	8.76
22	8.74	8.72	8.71	8.69	8.67	8.66	8.64	8.63	8.61	8.59
23	8.58	8.56	8.55	8.53	8.51	8.50	8.48	8.47	8.45	8.44
24	8.42	8.41	8.39	8.38	8.36	8.35	8.33	8.32	8.30	8.29
25	8.27	8.26	8.24	8.23	8.21	8.20	8.18	8.17	8.16	8.14
26	8.13	8.11	8.10	8.08	8.07	8.06	8.04	8.03	8.01	8.00
27	7.99	7.97	7.96	7.94	7.93	7.92	7.90	7.89	7.88	7.86
28	7.85	7.84	7.82	7.81	7.80	7.78	7.77	7.76	7.74	7.73
29	7.72	7.70	7.69	7.68	7.66	7.65	7.64	7.63	7.61	7.60
30	7.59	7.57	7.56	7.55	7.54	7.52	7.51	7.50	7.49	7.47

Variation of mean atmospheric pressure with altitude

Once the probe has been calibrated at salinity correction factors applied, you may also set a correction factor for the barometric pressure. This aspect of probe calibration is usually ignored. If, however you are located at high altitude then it will be an important consideration. Divide by the correction factor because the oxygen content at altitude will be lower.

(m)height	Average Atmospheric Pressure (mmHg)	Correction Factor (division)
0	760	1.00
100	750	1.01
200	741	1.03
300	732	1.04
400	723	1.05
500	714	1.06

Correction factors for calibration

To calibrate the oxygen probe for use in seawater or higher salinity application, you need to compensate for the salinity of the water. Calibrate the probe as per normal according to the solubility tables (example, 20.5 deg C =8.99mg/l = 100% sat) . If the salinity is 30ppt, the correction factor is 83%, the reading on the oxygen meter should then be 8.99 x 0.83 = 7.46mg/l = 100% sat in seawater at 20.5 deg C and salinity of 30ppt.

Salinity ppt of the water in which the oxygen meter is to be used	Dissolved Oxygen setting, correction factor
0	100%
5	97%
10	94%
15	91%
20	88%
25	85%
30	83%
35	80%

PLC Integration

The following are the equations required to program a PLC for auto calibration of our dissolved oxygen probes.

Oxygen solubility against temperature

$y = a + bx + cx^2 + dx^3$

y = mg/l of oxygen

x = temperature in deg C

a = 1.4600935230797962E+01

b = -4.0140882958691904E-01

c = 7.6366209903493756E-03

d = -6.8203041414057321E-05

Salinity correction factor

f = g+ hs

f = application factor

s = salinity

g = 9.9750000000000005E-01

h = -5.7142857142857099E-03

Salinity compensated oxygen levels

Oxygen mg/l corrected for salinity = f y

Complete equation

$y = (a + bx + cx^2 + dx^3)(g + hs)$ = mg/l of oxygen corrected for salinity and temperature

% saturation

There is no equation for % sat, it is a direct linear relationship.

Dissolved Oxygen Meters

The Dryden Aqua Oxygen Probes are compatible with most DO meters on the market that accept a galvanic probe. For those requiring a 4 – 20 mA output or for panel mounted applications there are a range of transmitters available on the market. The instructions that follow relate to :

- the PR Electronics display programming front - model 4501

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- PR electronics universal transmitter – model 4116

The PR electronics transmitters are typical units available from electronics suppliers such as RS components. Similar units are also available from others. These are not a Dryden Aqua product and must be sourced elsewhere!

DIN rail Transmitters

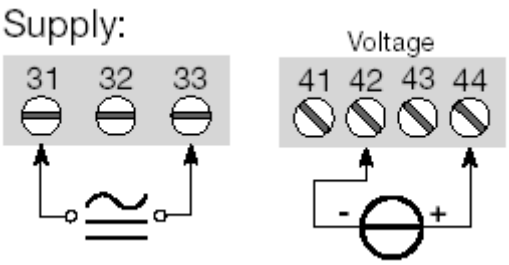
DIN rail mounted transmitters are available that display the output from the probe as raw data in millivolts or as an oxygen concentration as mg/l. The transmitters accept 12 to 24v dc/ac or up to 230v ac 50/60 Hz

Each transmitter can transmit the data in a multiple number of formats programmed from the unit; such as 0 to 20 or 4 to 20mA analogue. In addition, each transmitter is fitted with two relay outputs rated at 2 amps 230v act which may be used for the control of aeration or oxygen systems. The combination of Dryden Aqua probes and individual transmitters makes for a very simple, low cost and robust system.

The PR electronics model 4116 DIN rail mounted single oxygen transmitter will accept an input directly from our Oxygen Probes. If you want to display and alarm for both oxygen and temperature (PT100 sensors) then two transmitters will be required. The transmitter can then send the value back out as a voltage (e.g. 0 to 10v) or analogue output, (0 to 20mA, or 4 to 20mA). There are also two programmable relay outputs and a display.

The RS transmitters are provided with a clip on front display which is used to program the transmitter for different functions. The display gives the raw data output from the oxygen probe. It is useful to display the raw data, especially if you are using PLC based systems. The display can also be used to calibrate the unit to display the data as dissolved oxygen (units will be shown as mV). This makes for a very low cost multi-channel dissolved oxygen monitor.

Electrical connections



Transmitter connections

1. Check the mV output from the oxygen probe, with the probe in air the reading will be approx 80mV +/- 30mV
2. Connect the Dryden dissolved oxygen probe to terminals 42 (blue wire from oxygen probe) and 44 red wire from oxygen probe.
3. Connect the power supply to 31 and 33. The input power supply voltage is Universal, the transmitter will accept 20 to 240v ac or dc supply, 50 to 60 Hz. Insure that the power supply is isolated while you make the electrical connections, especially if a high voltage is used to power up the equipment. Once the electrically connections are in place, and electrically safe, you may turn on the power to the transmitter

Programming of the transmitter as an Oxygen meter and Alarm / Control system

Programming

You will need to set up each transmitter to read oxygen levels as follows;

1. Turn the power supply ON
2. The display will flash SE.BR
3. Press the OK button twice to display NO (Adv Set), press OK again followed by the UP arrow key until VOLT (In-type) is displayed. Press OK to accept.
4. Use the UP arrow key to scroll through the Volt in ranges, select Volt 0 to 1 and press OK
5. The unit will now ask you what units to display, press the down arrow key to select the unit type, select mV (millivolts) and press OK
6. Decimal point selection, the unit will display 111.1, press OK to accept the default value.
7. The display now reads DISP (lo) The display low value is zero by default, press OK to accept (see additional note (a) below) The Display high will be 100mv by default. Press the up-arrow key until it reads 200mv, then press OK to accept. The unit is now scaled between 0mv and 200mv. See note below about changing the units to display mg/l of Dissolved Oxygen, note (b) or %sat note (c)
8. The relay outputs R1 & R2 can now be set, set relays in DISP mode, if you have set the unit to display in mg/l, then the value displayed for the relay set points will relate to mg/l of dissolved oxygen or %sat.
9. The action of the relays is displayed in the third line of the transmitter. You can set the action of the relay on an increasing or decreasing value, you can set the hysteresis and the on off time in seconds. Once you have set the relays, your will then be asked to set the analogue out-put.
10. Select the output you want from the transmitter by pressing the UP arrow key. Normally it will be a CURR current analogue out-put between 0 and 20mV or 4 to 20mV. The transmitter also permits a voltage analogue output. Press OK to accept the analogue output.

Calibration

1. The unit now needs to be calibrated. You will need an accurate calibration source which gives 10mv to 200mv. However, if you do not have an accurate mv calibration source, you may use an accurate mV meter and measure the output from a Dryden Oxygen probe. The mV output from the probe will be around 90mv with the probe suspended in air at a temperature of 20 deg C. Do not move or touch the probe during a calibration, keep out of direct sunlight, see note (b) for additional information. Connect the probe the transmitter, and measure the mV across terminal 42 and 44. Press OK to show NO Adva Set and press the up arrow key to change to YES Adv Set then OK to accept.
2. Press the up arrow key to show Cal set-up and press OK
3. The display shows No Cal lo, press OK. The display now show No Cal Hi, press the up arrow key to change to YES Cal Hi and then OK to accept. Enter the mv value for the oxygen probe or the mg/l value for dissolved oxygen (see note (b)., press OK to accept.
4. No User Cal is now displayed, press the up arrow key to change to Yes User Cal and press OK to accept. The unit will now display the value from the probe, displayed as mV. If you want the value to be displayed at mg/l dissolved oxygen go to Note (b) below, or for percentage saturation go to note (c)

Notes

(a) If you press yes for DISP (low) or YES for Cal lo, the transmitter will use the mv value of the source connected to the transmitter. If an oxygen probe is connected then the value set at Low will become the same as the probe output which will be around 90mv. This will not allow the transmitter to work. To calibrate to Low value, disconnect he oxygen probe and place a wire loop between inputs 42 & 44. On the transmitter go to Cal (low) select YES and press OK to calibrate the unit to 0mv input. Select No for Cal high value. Remove the wire between 42 & 44 and start again with the calibration.

(b) To display Dissolved Oxygen as mg/l on the transmitter, set the Display Scale from 0 to 20 (mv) as opposed to 0 to 200 (mv). Next enter the Adv Set-up and go to Cal (Hi) and enter the dissolved oxygen value at the Oxygen probe. You can obtain this value from the Tables by doing a standard calibration of our dissolved oxygen probe or you can use an accurate portable dissolved oxygen meter to measure the oxygen reading at the probe, and then simply enter this value in mg/l into the transmitter. Please note that the transmitter will display the reading in the units specified, e.g mv, The value will however equate to mg/l of oxygen. Then select YES for use CAL

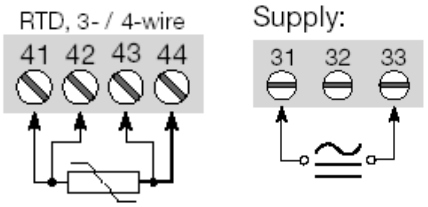
(c) To display the reading in percentage saturation %sat, please order %sat membranes for the probe. By default we will always supply mg/l membranes. Set the Display Scale to 0 to 200 (mv). Next enter the Adv Set-up and go to Cal (Hi) and enter the dissolved oxygen value at the Oxygen probe. If you are calibrating the probe in air, simply suspended the probe in air (out of direct sunlight) for at least 30 minutes, you can then assume that this value is equal to 100% sat, then simply enter this value into the transmitter. Alternatively, you may suspend the probe in a small tank of strongly aerated water. Again, you are making the assumption that the water is 100% saturated with oxygen.

Programming of the transmitter as a Temperature meter and Alarm / Control system

Electrical connections

Please note that the transmitter will only accept one input, if you are using a PT100 oxygen probe and you wish to monitor and display both oxygen and temperature, you will require two transmitters per probe.

Oxygen probe with pt100 sensor



1 +ve dissolved oxygen (red)

2 -ve dissolved oxygen connection (blue)

3 connected to the other side of the PT100 (black)

4 & 5 joined together on one side of the PT100 (green & yellow)

1. The Dryden Aqua oxygen probe with Temp sensors type PT100
2. Connect the Dryden dissolved oxygen probe to terminals 42 (blue wire from oxygen probe) and 44 (red wire from oxygen probe), on a second transmitter you can now connect the temperature sensor.
3. Connect PT 100 wire (wire 3 black onto 43), wire 4 white onto 41, wire 5 yellow onto 42.
4. Connect the power supply to 31 and 33. The input power supply voltage is Universal, the transmitter will accept 20v to 240v ac or dc supply, 50 to 60 Hz. Insure that the power supply is isolated while you make the electrical connections, especially if a high voltage is used to power up the equipment. Once the electrically connections are in place, and electrically safe, you may turn on the power to the transmitter

Programming

1. Turn the power supply ON
2. The transmitter will automatically detect the probe and display the temperature in Deg C. The alarm relay set points, hysteresis and analogue outputs cannot be set from the display module.

1. press OK "NOadv set" is now displayed, press OK to select

2. The input type is now displayed, press up arrow key to select temp then press OK

3. Press up arrow key to select type of temp sensor, select PT, then select PT100, then select 3 Wire, then select deg C or deg F

4. Setup R1 function, relay output 1, press OK to select, then use up arrow key to select normally open or normally closed action.

5. R1 set temperature is down displayed, the default is 50 degC, you can now change the value by using the up / down arrow key. Press OK to select the temp

6. You now have an option to set the relay to activate on an increasing INCR or decreasing DECR temperature, press OK to select

7. You now have the option to set the hysteresis or "dead band" around the switching point. the default is 1 deg C, it can be changed in 0.1 deg C increments.

8. You can now set the error action, the default condition is NONE

9. You can now select the on or off relay delay time in seconds, the default is zero seconds.

10 Relay 2, R2 is now displayed, repeat the above the set Relay No 2.

11. Analogue output is now displayed, you can now select a voltage or mv output, press OK to select.

12. The display will now program the transmitter, and then display the temp value. If you do not need to see the temperature, you can now remove the transmitter and use it the program the next unit.

Problem solving….Oxygen Probe

Problem	**Description**	**Action**

Possible errors with the reading.	Make sure you have the correct membrane fitted, Teflon for mg/l or Polythene for % sat	Check the membranes, Teflon sinks in freshwater, Polythene floats
	Proper calibration is very important, especially if there is a large temperature difference between the water and the air.	If water and air temperature differs by more than 5 deg C, give the probe 1 hour in air for the probe temperature to stabilize prior to calibration.
Zero or low reading	A zero reading means that there is no voltage being generated by the probe, or there is a break in the electrical circuit. The millivolt output from the probe should be between 60 and 120mv in most cases, with the probe in air at 20 deg C. The output is approx 10mv per mg of oxygen. If the reading is very low check the following.	
	Check that there is electrolyte in the probe	change the membrane and electrolyte
	Check that there is no cable damage	If there is cable damage then cut out or repair the damage. Check that there is no water or moisture in junction boxes or cable connections.
	biofouling of membrane can occur in biologically active water.	clean the membrane with a soft tissue once a week, or more frequently if required
High reading	The millivolt output from the probe should be between 60 and 120mv in most cases, with the probe in air at 20 deg C. The output is approx 10mv per mg of oxygen. If the reading is higher, check the following; There should only be one small `o` ring below the membrane, if there are two `o` rings, or if the `o` ring is above the membrane then this will give the wrong tension on the membrane.	change the membrane and electrolyte
	The large `O` ring between the top and bottom sections of the probe must be fitted. If it is missing then there will be too high a tension on the membrane.	change the membrane and electrolyte and fit a replacement large `O` ring
	Check the silver cathode for any damage. the cathode should be clean and smooth without any indentations. If the cathode has been damage, you will experience high erratic readings	If there is only minor damage then using wet/dry paper, 700 grade gently remove the indentations.
	If none of the above apply, remove the electrolyte from the probe, wash it electrode in fresh water and then thoroughly dry. The probe should now give a zero reading which will be less than 2 mv or 0.2mg/l of oxygen. If the probe gives a reading above 2 or 3mv, then it means that there is a short due to water ingress in the probe, cable or junction box.	If there is no damage to the probe cable, then the failure is internal. Return the probe to Dryden Aqua.
un-stable reading	New probes	It takes approximately 6 weeks for a new probe to

	fully condition stabilise.
Damaged cable, or water in junction box. Use ventilated field junction boxes for cable connections. Moisture in box will cause erratic readings from galvanic cells.	Any water, or even moisture in sealed junction boxes will cause erratic readings
Blocked breather hole. All probes have a small breather hole which should be kept clean. If the hole becomes blocked, gas inside the probe can inflate the membrane and push it off the cathode. This can give high and or unstable readings	clean the hole with a pin once a week.
If the probe is hitting the side of a tank, the readings can become erratic	position the probe such that it does not swing and hit the side of the tank.
Air or oxygen bubbles sitting below the membrane	Gas bubbles can sit on the underside of the membrane, this can lead to false readings. Position the probe in a strong current of water, or tilt the probe by 45 deg.
In hard water or seawater, or if there are high levels of carbonates or metal ions such as iron & manganese. They can form a coat on the silver cathode after one or more years. This needs to be removed to avoid erratic readings.	Remove end cap, use 800 grade abrasion paper, wipe the silver cathode three times to remove carbonates.