



FX300-DO-100 Submersible Galvanic Dissolved Oxygen Sensor for Low-Maintenance and Low-Cost Measurements



The FX-300 DO dissolved oxygen monitor with galvanic sensor is ideal for those who can't justify and afford the cost of optical DO measurement systems.

The FX300-DO100 probe is a membrane covered self-polarizing active style galvanic cell that generates a low-impedance millivolt electrical signal proportional to the oxygen pressure it senses.

It's robust, easy to use and a solution that's been proven over decades for DO measurement in municipal secondary and tertiary wastewater treatment as well as industrial, environmental and aquaculture applications.

The mating electronics are simple, easy to operate and modular, to provide a cost effective dissolved oxygen or multi-parameter measuring system.

Features & Advantages:

- Substantially lower total cost of ownership:
 - Commissioning costs are often less than 1/3 that of optical sensor systems
 - The cost of ownership for FX300-DO sensors is often less than 1/5 the cost of optical sensors
- No zero point calibration is ever required since galvanic sensor have a true zero point.
- Typical clean water use keeps calibration up to 1 year at a time with membrane lasting 3 to 5 years. Dirty water applications will need to have membrane replaced only annually and calibrate infrequently. Supplied materials are sufficient to perform measurements for 5 years.
- Extremely high stability such that calibration is seldom required. The 50 μ thick rugged membrane is easily cleaned although the required frequency for most application is low. The membrane can be replaced by anyone at very negligible cost in less than 10 minutes from start to finish.
- Calibrate in air over water, no solutions or look-up tables are required.
- Supplied as standard with 1-1/2 MNPT adapter and water proofing

DO probes do NOT need regular maintenance or service; just keep the membrane reasonably clean.



FX-300-DO100 Galvanic Dissolved Oxygen Sensor Specifications

Measure Range: 0-4 ppm up to 0-40 ppm (Lowest Limit 0.1ppm)

Operating Temperature: 0-50 °C (122 °F)

Installation Style: Submersible to 50 meters (165 feet) or Inline Flow

Temperature Element: Standard with Pt100 temperature sensor

Material of Construction: Sensor body is Polyoxymethylene (POM)

Dimensions: Dia & Length is 58 mm (2.30 inches) without assembly

Cable Length: Standard 23 feet (7 meters), Max is 330 feet (100m)

Weight: Approximately 1 pound including standard cable

Measurement Principle: Galvanic cell, self polarizing (a.k.a. active type) and self temperature compensating (without TC element)

Range and Output: Nominal 2-6 mV/ppm for standard membrane
Nominal 25-250 mV/%Sat for thick type membrane

Initial Impedance: Approximately 1 Kilohm

Flow Requirements, water: Minimum flow dependent on DO and temperature, typically 1 cm/sec, suitable for most submersible use

Supplied With: (5) membranes with O-rings, 50 ml electrolyte, and cathode cleaning pad. 1-1/2" MNPT adapter and cable waterproofing



Dissolved Oxygen Sensor Description

The FX-300-DO100 oxygen probe is a galvanic oxygen sensor that produces an electrical output proportional to the oxygen present in the medium it is placed in. It consists of an upper part with cathode, anode and cable, and a cap with membrane and electrolyte. The probe is supplied with a built-in Pt100 temperature sensor. It is available as standard with installation hardware for use with a NPT standpipe for submersible installations. Dissolved oxygen is either measured in % saturation or mg/l. The ppm units can be used interchangeably with mg/l.

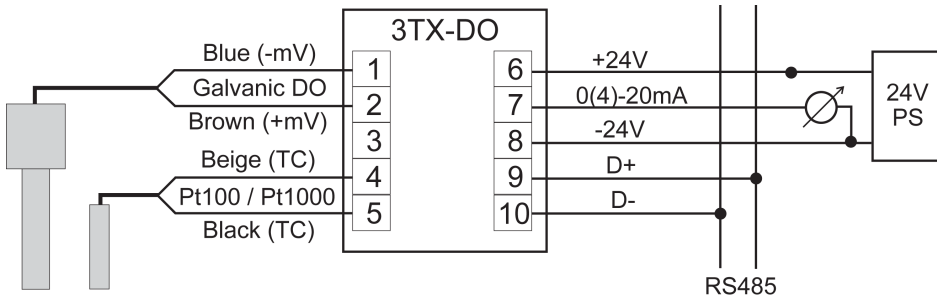
Oxygen diffuses through the membrane onto the cathode, where it reacts chemically and then combines with the anode. This chemical process develops an electrical current, which is converted into a millivolt output signal through a built-in resistor. The probe has built in temperature compensation for mg/l (ppm) units. The probe is designed for use at temperatures between 0 and 50 °C with liquid movement down to approximately 1 cm/sec (measured at 7 mg/l and 13 °C) and depths to 100 meters (330 feet). Special order versions of these DO probes for higher temperatures or greater depths are available on request.

Deposits develop on all surfaces in any biologically active system, and a deposit that builds up on the membrane of an oxygen probe will change the sensitivity of that probe. FX-300-DO probes are designed so that deposits have little influence, but for the greatest accuracy you should keep the probe clean. Deposits should be wiped off the membrane with a cloth or paper. The cleaning frequency will depend on the accuracy desired, how fast deposits build up and on their exact nature. An anti-fouling cap is available for situations where access to the probe is difficult or where deposits build-up so heavily and quickly that frequent cleaning is necessary.



SENSOR INSTALLATION

Shown below is a typical wiring scheme of the DO sensor mating with the FX-300-DO transmitter. Further details about the transmitter are available in the manual.



Each FX-300-DO probe active signal is connected using ordinary 2-core cable, and it is fitted with 3 meters of cable unless otherwise specified. With a built-in Pt100 TC element, the probe has a four-lead cable (temperature inputs coming on the Beige and Black leads).

If the sensor cable is to be extended, be sure to use a waterproof junction box assembly (inquire to factory for assistance or supply of such an enclosure type). There is practically no limit to cable length that can be supported with the proper installation scheme. The type of extension cable is not critical, but make sure that the cable selected can withstand sunlight and moisture if you run it outdoors.

The FX-300-DO probe is easy to install. It should be placed where there is some movement in the water; approximately 1 cm/sec is enough at 7 mg/l and 13°C. Ensure that the probe cannot strike against the tank wall or similar, and don't mount it directly above diffusers and other equipment that will give false readings.

Several forms of mounting devices are available. NPT probe adapter submersible assembly option is standard for use with an NPT standpipe for guided submersible installations. For some applications the probe can be fitted with a membrane protector and hung only by its cable. Lastly for typical inline installation schemes a low-flow cell suitable for 3/4" NPT process lines is available as well using the compact style sensor.

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Calibration

The calibration procedure below is used when the sensor is mated with the FX-300-DO transmitter. Use the 'Mode' key to select 'Gain'. The gain calibration is performed when the sensor is clean and dry and exposed to only air. In cases of calibrations performed in air where the relative humidity is not 100%, the sensor should be suspended in air over a source of water for best results.

It is necessary to wait for temperature and reading equalization (stabilization) before performing a calibration. Any robust long-life probe such as the FX-300-DO can take up to an hour to respond to a 10 degree temperature change in air, which only takes 10 minutes in water. This must be taken into consideration when deciding when the probe is ready for calibration.

The FX-300-DO transmitter defines the theoretical 100% saturated DO ppm value to ensure proper calibration without the need for any charts or tables; using the temperature (measured from the integrated temperature sensor) together with the entered barometric pressure. All you need is your FX-300-DO sensor and the FX-300-DO transmitter will have all other information stored in the software to complete a proper calibration of the probe in air. The gain calibration can be performed in either automatic or manual modes as may be preferred and is described below:

Auto Calibration Routine

To initiate an automatic calibration, simultaneously hold the 'Up' & 'Down' keys for 3 to 5 seconds continuously and the display will then flash "CAL". After eight seconds, the unit will either return a value of 'Go' to indicate success or else a value of "Err" to indicate a failed calibration. You must press the 'Mode' key to exit the automatic calibrate mode.

Manual Calibration Routine

For a manual gain calibration, adjust using 'Up' or 'Down' keys until the display reads exactly "0.0". Positive deviations are shown as X.X or XX. Negative deviations are shown as -X.X or -XX. If a positive value is shown adjust with 'Down' key and if a negative value is shown adjust with 'Up' key. You must press 'Mode' key to exit the manual calibrate mode.

The raw mV potential for the sensor can be viewed by pressing the 'Down' button in the main display mode. The theoretical 100% saturation for the current temperature, pressure and salinity is viewed by pressing the 'Up' button in the main display mode.

Calibration Tips

Take the probe up from the water process media, wipe the membrane dry, and hang the probe in free air, away from direct sunlight. If necessary, wrap aluminum foil around the sensor to avoid sunlight negatively impacting on the calibration. Be sure to wait for complete temperature equalization before performing the calibration described above.

Calibration against various "pocket" test kits cannot be recommended.

At high altitudes, or for greater accuracy, a correction must be made for pressure which can be entered in mm Hg units using parameter P05 in the setup menu.



Calibration Tips

The salinity correction is required in salt water or brackish solutions to ensure that the DO measurement (and in particular the computed % saturation) is accurate. The salinity in PSU (same as ppt) units can be entered using parameter P06 also in the setup menu. The salinity can readily be found from a hand-held portable conductivity meter that has the proper software to convert the measured conductivity in milliSiemens (mS) units into to salinity PSU/PPT units.

For DO sensors that have the integrated Pt100 temperature element, be sure that the wire gauge (parameter P07) and the cable length (parameter P08) are also properly entered.

How often should calibration be performed?

Unfortunately, it is not possible to answer this question. Under ideal conditions (in air) the probe can keep its calibration for many months. In use in water the actual conditions (e.g. the nature of deposit build-up) and the desired accuracy will dictate calibration frequency. It is very important that calibration is performed with care. Give the probe good time to stabilize, check the barometer and decide if correction is necessary. Check the salinity if you measure in salt water. Remember that no measurement is more accurate than the calibration.

Maintenance

The probe's membrane must be kept free from deposits. A film composed mostly of bacteria will cover ALL surfaces in a biologically active system. This bacteria film acts as a diffusion barrier for the oxygen that must diffuse through the membrane. The membrane must, therefore, be cleaned at regular intervals, the frequency depending on the actual conditions. Cleaning can be performed with a cloth or soft paper. The membrane is strong and not easily damaged, but do not try to scratch it clean with a fingernail! There is no need to exchange the electrolyte regularly, and there is no sensor element that will need replacing!

The probe should not be taken apart unless the membrane is damaged or you cannot calibrate to the correct value after long use.

Other Points Worth Considering

Even though the FX-300-DO probe is one of the most robust available, it should be treated carefully. It measures of few thousandths of a gram of oxygen, which it must "drag" out of the water around it. So, if in your opinion it performs mysteriously, ask the factory for assistance.



SERVICE PROCEDURE FOR DO PROBES

DO Probe membrane replacement and probe renovation

The probe's membrane should be wiped clean from time to time. **The probe should not be taken apart unless the membrane is damaged or unless, after long use (i.e. years), you cannot calibrate to the correct value.**

Please note the following points:

The electrolyte (filling solution) of an FX-300-DO probe is blue to start with, but soon becomes very dark, and deposits are found inside the probe.

To replace the membrane and renovate the probe proceed as follows:

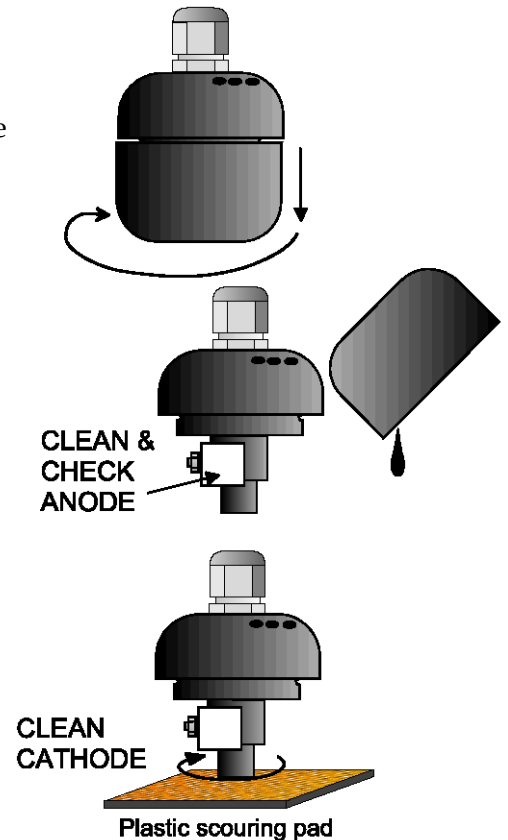
1) Remove the probe, rinse it and unscrew the cap. If it sticks, tap the side of the probe gently with a hammer then try again. Discard the very dark used electrolyte, rinse the cap and top part, clean off any dark colored oxide deposits.

2) Inspect the anode. If the probe was filled correctly when it was last renovated it will be easy to clean the dark deposits from the anode using a nailbrush or similar. If the probe was not filled completely the anode will be very corroded and must be replaced entirely. Check that the nut under the anode is tight before fitting a new anode. Wash the anode in soapy water before use to remove any protective oil.

3) Check the cathode and remove any deposits using the plastic abrasive pad supplied with the probe or a little wet or dry emery paper, grade 600. The cathode **MUST NOT BE POLISHED**.

4) Rinse and dry the top part.

5) You can at this stage perform an easy check on the probe. Dry the probe completely taking care especially at the cathode and area around it. You can then observe the output signal of the probe and it should be zero (less than 0.01 mV when measured at the probe). Contact the factory if this is not the case.





6) Fill a NEW OR RENOVATED CAP to the brim with electrolyte. The use of excess electrolyte helps to remove any entrenched air bubbles.

7) Locate the flat machined from the thread. Lower the upper part into the cap and turn the cap half a turn to engage the thread.

8) Tilt the probe 15° so that the flat is uppermost and screw the cap onto the top part. Excess electrolyte and air should dribble out at the flat.

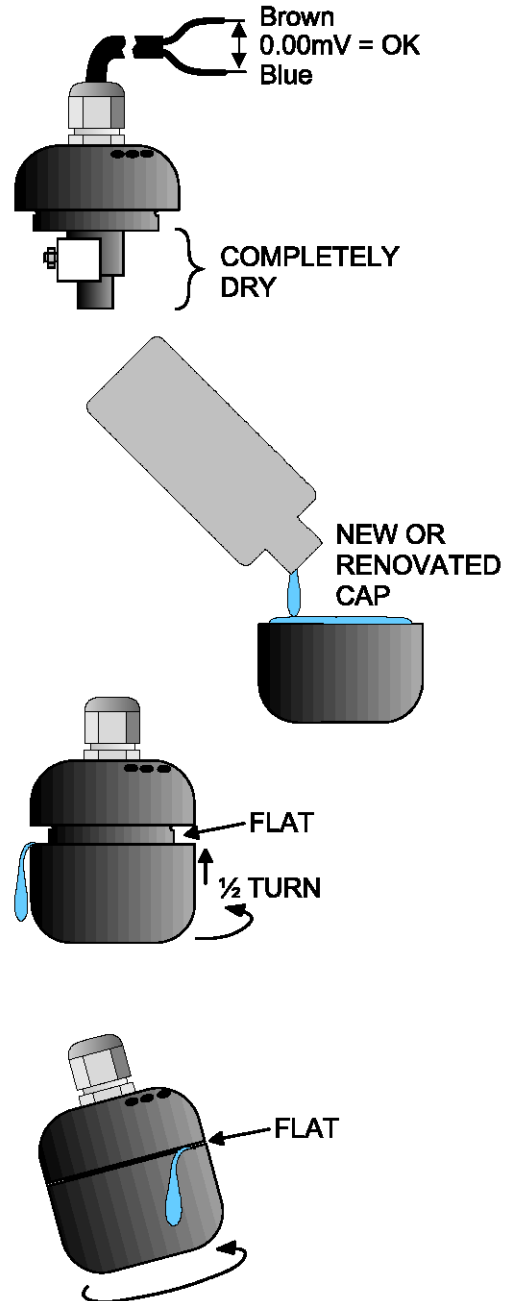
IT IS IMPORTANT THAT THE PROBE IS FILLED COMPLETELY.

9) WHEN YOU ARE CERTAIN THAT THE PROBE IS FILLED COMPLETELY TIGHTEN THE CAP **HARD**.

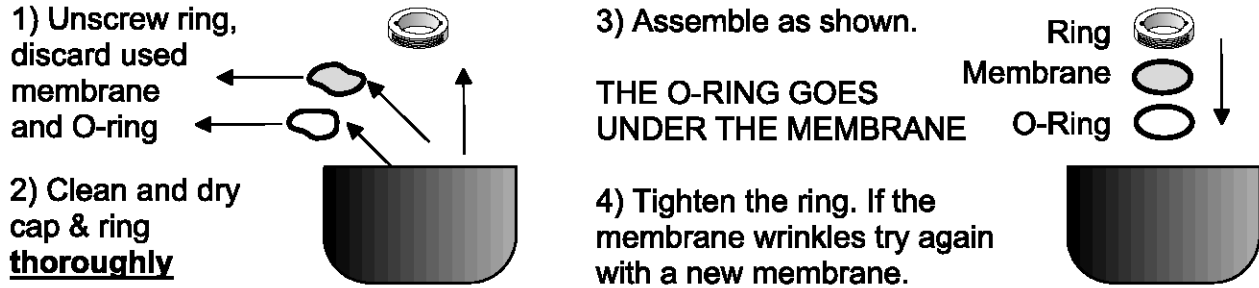
10) After renovation the probe can be regarded as new. It should be hung up in air to stabilize for at least an hour before calibration.

If possible re-calibrate after a day or two for best results. A new membrane can easily be fitted to the cap as described on the following page.

A cap must not be re-used without replacing the membrane, as the membrane stretches to fit the cathode, and will not fit perfectly a second time



The four step procedure for fitting a new membrane to the cap is as shown below. The membrane must be completely flat. If any wrinkles are present remove it and try again with a new one. It is important that all parts are clean and dry. Neither O-ring nor membrane can be used more than once.



Spare Parts

Spare membranes, O-rings and electrolyte for the first few years' use are shipped with the probe, after which you can purchase more. A stock of these parts will enable you to replace a damaged membrane in a few minutes. If desired you can also stock a spare probe in which case you will then be able to replace a probe that is accidentally mechanically destroyed, damaged or lost. A spare probe can be kept ready-to-use for years at a time if stored in the proper manner and conditions. Spare probes should be stored in a cool, dry place without any electrolyte (filling solution) in the cap (completely dry). When a dry, unfilled spare probe is taken from stock for use, follow the steps outlined on the previous pages to get it ready for installation.

A stock of one or more spare caps will make it easy to renovate probes with damaged or "old" membranes. You can fit new membranes to the "old" caps indoors in the dry conditions ready for next time. You can also keep one or more spare anodes that must be washed in soapy water to remove all protective oil before use.

Spare Part Numbers & Optional Installation Fittings

- DO-MPPM: Sets of 25 membranes with small O-rings
- DO-THICK: Set of 10 each thick-type membrane with small O-rings
- DO-AN3: Anode for FX-300-DO100 probes.
- DO-C3PPM: Cap with membrane.
- DO-PP: Membrane protector.
- DO-E30500: 500 ml Electrolyte (Filling Solution).
- DO-E31L: 1 Liter Electrolyte (Filling Solution).
- DO-NPT: NPT submersible assembly adapter option for standpipe installations
- DO-INLINE: Inline Low-Flow Cell Adapter compact sensors for 3/4" Process Lines
- DO-TOOL: Membrane ring removal tool.