

AST-DO-UNIVERSAL Galvanic Dissolved Oxygen Sensors

The AST-DO-UNIVERSAL 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 dissolved oxygen probe is supplied standard with built-in Pt1000 temperature sensor in all configurations. The AST-DO-UNIVERSAL sensor is available in the convertible configuration suitable for use in inline, immersion and submersible installations. The AST-DO-UNIVERSAL sensor is also available in a twist lock configuration for quick disconnect bayonet style inline installation for application where frequent removal from service is needed for cleaning to avoid coiling of the cable from repeated insertion and removal from the inline 1"MNPT receptacle process fitting. In addition a sanitary & HOT-TAP configuration is available for use with the same 316SS sensor holder and other associated process mounting hardware as used for the pH, ORP & ISE sanitary & HOT-TAP valve retractable sensor assemblies.

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 internal electronics. The AST-DO-UNIVERSAL has built in temperature compensation for mg/l (ppm) units. The dissolved oxygen (DO) probe is designed for use at temperatures between -5 and 50 °C (+23 to +122 °F) with liquid movement down to approximately 1 cm/sec (minimum flow determined from measurement at 7 mg/l and 13 °C). The AST-DO-UNIVERSAL sensor can support cable lengths up to 100 meters (330 feet) in the with integral conventional analog preamplifier configuration. Special order versions of these DO probes for higher temperatures or greater depths are available on request.

AST-DO-UNIVERSAL probes do NOT need regular service; just keep the membrane reasonably clean.

If you can calibrate to the correct value you should not open the probe, even if it has been in use for a prolonged period of time (even years). If the membrane should be damaged membrane replacement will, of course, be necessary. The procedure to renovate the probe is easy and can be performed on-the-spot by anyone, as described later in this manual. Extra membranes are shipped new sensor orders and additional membranes are available as spares as are additional 125mL quantities of the internal electrolyte filling solution.

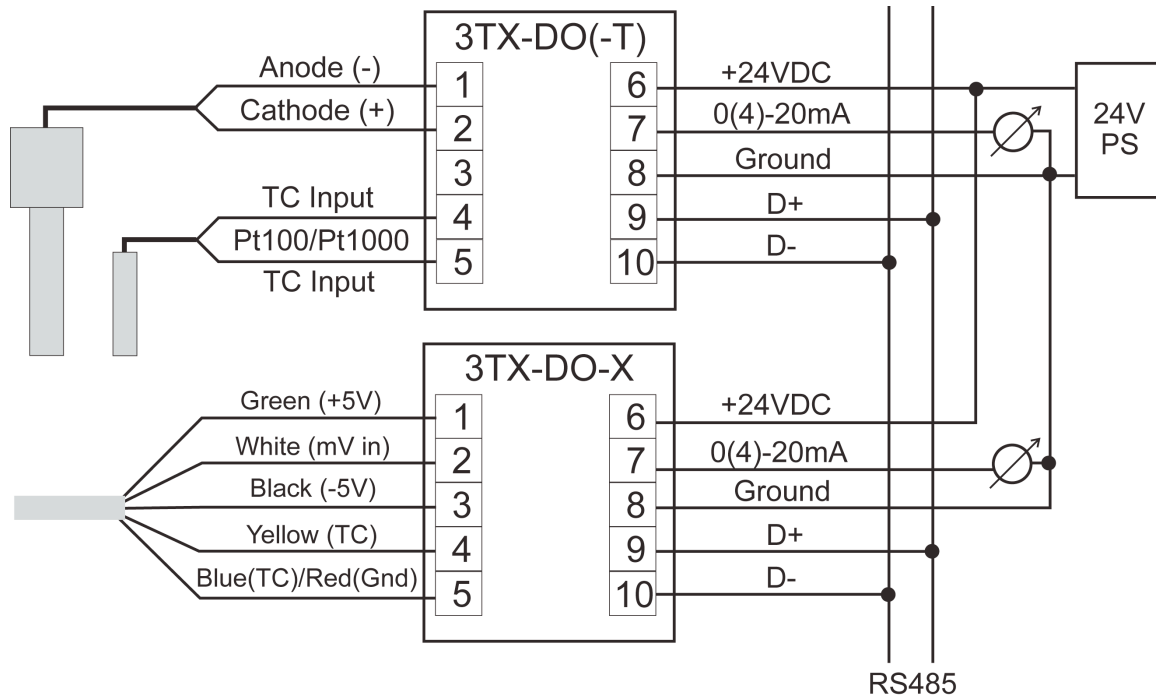
Deposits develop on all surfaces in biologically active system and various slurry and high viscosity solutions. Deposits that builds up on the membrane of an oxygen probe will change the sensitivity of that probe. The AST-DO-UNIVERSAL probes are designed so that deposits have little influence, but for the greatest accuracy you should keep the probe clean, just as it was when you calibrated it. Deposits should be wiped off the membrane with a soft cloth or paper. The cleaning frequency will depend on the accuracy desired, how fast deposits build up and on their exact nature of the build-up itself. An anti-fouling cap option is available where access to probe is difficult or deposits build-up so heavily & quickly that very frequent cleaning is necessary.

3TX-DO(-X) Transmitters to interface with AST-DO-UNIVERSAL DO probes

The AST-DO-UNIVERSAL probe is a relatively high impedance (< 2 MegaOhms) millivolt generator in the without preamplifier configuration with an output dry in air about 10 to 40 mV. The mV output is internally temperature compensated and linearly proportional to oxygen concentration in mg/l. Without preamplifier configurations employs a well shielded cable to avoid noise in field use. The inputs from DO sensors are galvanically isolated from each other for multichannel 3TX transmitter assemblies ensuring accurate readings and stability. Similarly, DO sensors must be galvanically isolated from anything else that can have electrical contact with the water that is measured to prevent the possibility of ground loop problems. The 3TX-DO(-X) dissolved oxygen transmitter fulfills all of these criteria quite well including an outstanding 3000V galvanic isolation between the input and output of each module and a separate circuit and galvanic isolation for each mating sensor. The 3TX-DO(-X) transmitter is optimized, tested and supported for use with the AST-DO-UNIVERSAL sensors. Internal temperature compensation means the mV signal proportional to DO ppm does not need any adjustment to account for temperature effects to ensure reliable readings in any field install.

AST-DO-UNIVERSAL SENSOR INSTALLATION & MAINTENANCE GUIDE

Shown below is a wiring schematic of the AST-DO-UNIVERSAL sensor in the without preamplifier configuration mating with the 3TX-DO transmitter and AST-DO-UNIVERSAL sensor in with integral conventional analog preamplifier configuration mating with the 3TX-DO-X transmitter. Specifications and further details about the 3TX-DO(-X) transmitters are available on the main 3TX webpage.



Each AST-DO-UNIVERSAL probe active signal is connected as per the prescribed terminal assignments detailed above. In the without preamplifier configuration the red lead is the anode (-) signal connected to terminal 1, the clear lead is the cathode (+) signal connected to terminal 2 and the integral Pt1000 temperature sensor are the two black leads connected to terminals 4 & 5. The without preamplifier configurations are a high impedance signal (typically less than 2 MegaOhms) can support up to a maximum of 15 meters (50 feet) and the tinned lead wire terminations should be connected directly to the 3TX-DO transmitter. The with integral preamplifier configuration is a low impedance signal (typically less than 2 KiloOhms) supports up to a max of 100 meters (330 feet) with the tinned lead wire terminations either connected directly to the 3TX-DO-X transmitter or else bridged across a suitable terminal strip in a waterproof NEMA 4X J-box. The NEMA 6P rated Q7M/Q7F quick disconnect snap connectors option is available for the with preamplifier configurations.

The AST-DO-UNIVERSAL 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 for example). Ensure that the DO probe cannot strike against the tank wall and don't mount it directly above diffusers and other equipment that will give false readings. Several forms of mounting device are available for AST-DO-UNIVERSAL sensors. Inquire to the factory or your local distributor for assistance with your application. For applications where a submersible type installation approach is used either an immersion tube is used to seal the rear MNPT threads on the sensor or a suitable waterproofing option with tubing (such as WPIT or WPB/WPH) is employed for full cable isolation in which case the sensor can be suspended by just by the cable assembly alone (without a guiderod). For typical inline installation schemes a low-flow cell suitable for 3/4" NPT or 1" NPT process lines is employed.



DIRECTIONS FOR CALIBRATION OF AST-DO-UNIVERSAL DO SENSOR

Calibration

The calibration procedure below is when the AST-DO-UNIVERSAL sensor is mated with the 3TX-DO(-X) 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 with a high stability thick membrane design and construction such as the AST-DO-UNIVERSAL dissolved oxygen sensor can take up to an hour to respond to a 10 °C change in air, whereas in water sensing this same change would take just 10 minutes. This must be taken into consideration in deciding when the probe is ready for calibration. **Perform a precise temperature calibration before doing any gain calibration.**

The 3TX-DO(-X) transmitter defines from the temperature measured from the integral Pt1000 temperature sensor inside the AST-DO-UNIVERSAL probes together with the entered barometric pressure the theoretical 100% saturated DO ppm value to ensure proper calibration without the need for any charts, tables or solutions. The 3TX-DO(-X) transmitter has all other information stored in the software to complete a proper calibration of the AST-DO-UNIVERSAL sensor (probe) clean and dry in air. The gain (a.k.a. slope or span) calibration can be performed in either automatic or manual mode as may be preferred and is described in detail below:

Auto Calibration Routine: To initiate an auto-calibration, simultaneously hold the 'Up' & 'Down' keys for three to five (3-5) seconds and the display will flash "CAL". After eight seconds, the unit will either return a value of 'Go' to indicate successful gain calibration or a value of "Err" to indicate a failed gain calibration. Press the 'Mode' key to exit the automatic calibration mode to return back to the normal measure mode.

Manual Calibration Routine: For a manual 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. For positive values adjust with 'Down' key and for negative values adjust with 'Up' key. Press the 'Mode' key to exit the manual calibrate mode. There is no timeout in manual calibration routine so it will stay indefinitely until the 'Mode' key is entered to exit the gain LED mode and to return to the normal measure mode.

DISPLAY FEATURES & NOTES:

- The temperature is calibrated with "Up" or "Down" buttons in temperature display (°C) mode.
 - **Be sure to perform a precise temperature calibration before doing any gain calibration!**
- The result of gain calibration can be viewed and/or modified in parameter P16 (units are mV per ppm).
- The raw mV is viewed by pressing 'Down' button in the main ppm or % display mode.
- The ppm for 100% saturation at the current temperature, pressure & salinity is viewed by pressing the 'Up' button in the main ppm or % 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 AST-DO-UNIVERSAL 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. For greater accuracy, a correction for barometric air pressure can be entered in mmHg units using P05 in the setup menu. The salinity correction is recommended in salt water or brackish measured solutions to ensure that the computed % saturation is accurate. The salinity in PSU (ppt) units is entered using P06 in the setup menu. The salinity can be found from a handheld portable conductivity meter that can measure in salinity PSU/PPT units (ASTI can provide a conversion chart for mS conductivity to PSU units).

How often should calibration be performed?

Unfortunately, it is not possible to answer this question in a simple way. Under ideal conditions (in air) the probe can keep its calibration for many months. When used in water the actual conditions (e.g. the nature of deposit build-up) and desired accuracy will dictate calibration frequency. It is very important that calibrations are performed with care giving the probe time to stabilize and checking the barometer to enter the air pressure. Check salinity if you measure in salt or brackish type of solutions. It is important to remember that no continuous process measurement can ever be more accurate than the calibration performed before installation.

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. For industrial type process solution the most likely form of contamination and build-up will be particulates and solids from the solution if the media has high turbidity or viscosity or is an abrasive slurry in nature. 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 for membrane replacement and rebuilding of the DO cell unless the membrane is damaged or you cannot calibrate to the correct value after long use.

Other Points Worth Considering

Even though the AST-DO-UNIVERSAL dissolved oxygen probe is very robust, 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 then ask the ASTI factory or your local agent/distributor for assistance.

Best Practice Stocking

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 following page 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.

Spare Parts & Optional Fittings

UNIVERSAL-DO-HS-MB:	Set of 10 each thick high stability membrane with small O-rings
UNIVERSAL-DO-EL-125mL:	125ml Electrolyte (Internal Filling Solution to recharge sensor).
UNIVERSAL-DO-GUARD:	Protective guard threads onto ¼"MNPT threads of convertible sensor

Last Revised July 13, 2016

Membrane Replacement of AST-DO-UNIVERSAL Industrial Galvanic Dissolved Oxygen (DO) Sensor

IMPORTANT NOTE BEFORE CHANGING MEMBRANE!

The AST-DO-UNIVERSAL sensor should not be taken apart for service unless the membrane is damaged the response (slope) is significantly reduced by fouling or deposits on the membrane that cannot be cleaned off. This is typically only the case after some prolonged period of use or an exceedingly aggressive process condition during a shorter time.

PREPARATION FOR CHANGING MEMBRANE

Unscrew the cap, rinse with water and clean the anode ONLY with a PLASTIC scouring pad.

→ NEVER USE A METAL SCOURING PAD ON THE ANODE!

If the cathode is tarnished it can be cleaned with a 600 grade wet-or-dry paper. → DO NOT POLISH THE CATHODE!

QUICK TEST

After the anode and (if necessary the cathode) was cleaned it is possible to perform a simple test to ensure the integrity of the sensor. Dry the top part of the sensor quite thoroughly, especially the cathode and the area surrounding it. Measure the output of the sensor when connected to the mating 3TX-DO or 3TX-DO-X dissolved oxygen transmitter. It should show zero ppm on the display. If your display does not read zero (or very near zero) contact factory for assistance.

MEMBRANE REPLACEMENT PROCEDURE:

See drawing to right for all referenced components in instructions:

1. Use the tool provided to unscrew the ring the ring.
2. Remove the used membrane and O-ring.
3. Rinse the cap and ring. Dry both parts thoroughly.
4. Put a new O-ring in the bottom of the cap.
5. Put a membrane on top of the O-ring.
6. Replace ring & tighten it firmly with the supplied tool.

Precautions and Caveats:

- It is very important that all parts must be clean & dry before performing this procedure.
- Membrane must not be wrinkled before or after it is installed. If the membrane is wrinkled at any point in time it must be replaced with a new membrane immediately.
- Fill the cap to the brim with electrolyte. Hold probe upright & slowly screw on cap until it is completely flush. Some electrolyte solution may leak out during this step.
- Wait one hour before performing a calibration after changing the membrane. For best results calibrate once again approximately 24 hours after membrane is changed as the galvanic DO cell will have reached full equilibrium by this point in time.

