

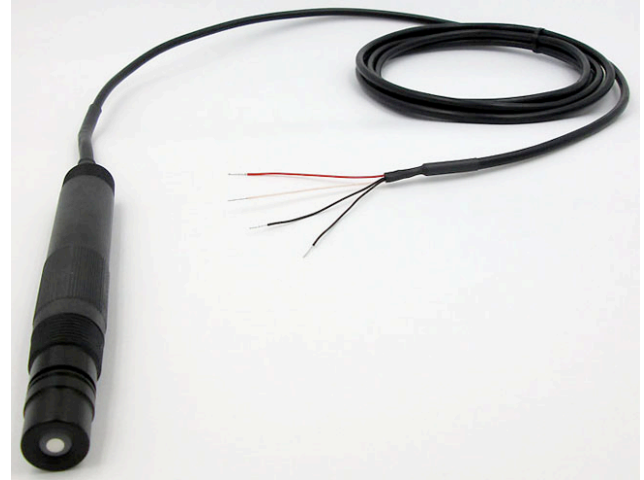
**AST-DO-UNIVERSAL Galvanic Dissolved Oxygen Sensors for
Inline, Immersion, Submersion, Sanitary & HOT-TAP Installations
Rugged Industrial High Stability Thick Membrane Ideal for Continuous
Measurement in Tough Applications like Abrasive Slurries & High Turbidity**



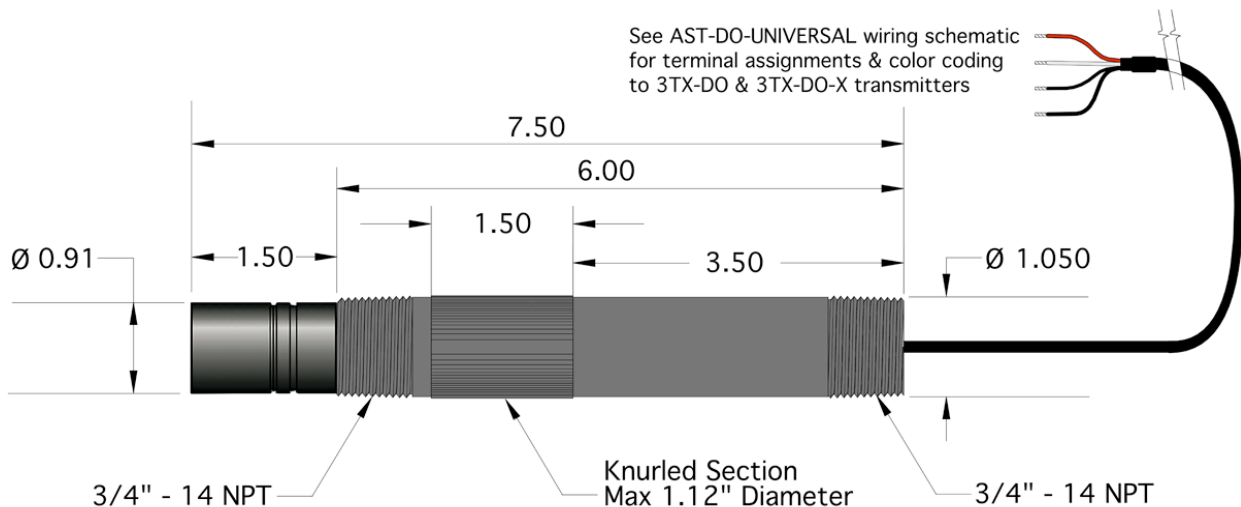
Close-Up on galvanic DO measuring cell of dissolved oxygen sensor in convertible configuration



Disassembled galvanic DO measuring cell ready for rebuilding. Cathode & anode on front tip of sensor are shown to the bottom right. High stability thick membrane installed into cap is shown immediately above. Membrane & electrolyte solution are easily replaced in just minutes when required. There is a virtually unlimited sensor lifetime achieved with this rebuildable type galvanic DO cell ensuring a very low total cost of ownership.



AST-DO-UNIVERSAL-CONVERTIBLE galvanic dissolved oxygen sensor shown in convertible without preamplifier with shielded black composite cable max 15 meters (50 feet) cable. With integral analog preamplifier configurations (not shown) can support up to 100 meters (330 feet) total cable length. Features available but not shown include waterproofing sealing for fully submersible installations without an immersion tube. The Q7M waterproof NEMA 6P rated quick disconnect snap connector is available for DO sensor in the with integral preamplifier configurations.



The AST-DO-UNIVERSAL is a robust thick high stability membrane covered galvanic cell that generates a mV signal proportional to the oxygen pressure. The probe is very rugged, easy to use proven solution for measurements from tough industrial, municipal, environmental and aquaculture as well as other difficult service condition applications. AST-DO-UNIVERSAL dissolved oxygen sensors also available in twist lock quick disconnect bayonet inline style for easy removal & insertion from process for service. Sanitary tri-clamp & HOT-TAP valve retractable installations use same 316SS sensor holder hardware as for the pH/ORP/ISE sensors.

Special Features and Unique Technical Advantages of AST-DO-UNIVERSAL Dissolved Oxygen Sensors

- Convertible configuration is suitable for inline, immersion or submersible use. Standard inline insertion depth 1.5 inches (max 3.5 inches as a special order).
- Thick-wall TEFLON™ (PTFE) membrane ensures very high stability as well as low-drift and high durability in aggressive industrial applications minimizing the frequency of membrane and electrolyte replacement.
- No special maintenance needed. Just wipe the membrane periodically.
- Galvanic dissolved oxygen cell with true zero means only a slope (span) calibration performed clean and dry in air is required. No wet solution calibration is needed and no solutions are ever required for calibration.
- No look-up tables are needed since the 3TX-DO transmitter computes the dissolved oxygen ppm value associated with the 100 percent saturation dry in air condition used for calibration at the current measured temperature (from integral Pt element) and the user entered atmospheric pressure. The automatic calibration mode autoreads the mV potential and then assigns the proper slope (span) mV per ppm response for the sensor. Manual calibration mode is also available if the fully automatic calibration mode is not desired.
- Membrane and electrolyte solution are simple to replace allowing for extremely low ongoing cost of ownership and a theoretically unlimited service lifetime
- The AST-DO-UNIVERSAL is not sensitive to hydrogen sulfide gas
- Temperature compensation is built-in & performed automatically inside sensor for reliable readings independent of the integral temperature sensor.
- Extremely high stability thick rugged TEFLON™ (PTFE) membranes mean calibration is seldom required and they can be repeated cleaned as needed. The required frequency of cleaning is low for most uses. If membrane is damaged, replacement cost is negligible and done in a few minutes from start to finish.
- Since the galvanic AST-DO-UNIVERSAL dissolved oxygen sensors generate their own mV potential, they do not suffer from cable sensitivity issues that many polarographic (amperometric) DO sensors can that are powered by the transmitter resulting in issues such as warm-up time, drift and related problems.
- AST-DO-UNIVERSAL dissolved oxygen sensors have very little sensitivity to environmental issues such as wind or electrostatics (in dry climates) as well as readily supporting long cable runs or deep submersion installations.
- Measure with flow as low as 1 cm/s making it suitable for most any installation
- Built-in integrated temperature compensation inside sensor means temperature sensor is only required for the percent (%) saturation to be computed to ensure accurate sensor dry in air span calibration and to display & output % saturation
- Spare membranes and internal electrolyte filling solution are available after the ample initial supplies are used at a nominal cost. Standard sensor package contains all parts to operate for a two to five year period for most applications.
- Custom configurations and options available (minimum order may apply).

Photos for Visualization of Installation Schemes



AST-DO-UNIVERSAL dissolved oxygen sensor in convertible configuration with thick, rugged, removable protective guard securely installed via 3/4" NPT threads for submersible probe installs in heavy abrasives or slurries to prevent damage from large particulates in solution



AST-DO-UNIVERSAL dissolved oxygen convertible style galvanic DO sensor shown threaded into tee with front 3/4" MNPT threads for inline use. Alternate inline installation uses 1" MNPT twist lock quick disconnect bayonet style sensor with mating receptacle to allow for fast and simple removal & installation from process without damaging the cable due to coiling from repeated use over time that can occur with screw-in type inline installations.



Core Features of Rugged AST-DO-UNIVERSAL Industrial Dissolved Oxygen Sensors in Convertible Configuration for Tough Inline, Immersion & Submersible Installations

- Inline Insertion depth from 1.5 inches (standard) to 3.5 inches (special order option)
- Ready for inline or immersion use standard, submersible with waterproofing option
- Waterproofing option for complete cable isolation in fully submersible field use and/or with washdowns & humid conditions
- Pt1000 temperature element used to compute the % saturation at the current temp
- Without preamplifier configuration 3 meters (10 feet) cable std, Max cable length 15 meters (50 feet) submersible to 25 feet
- With integral preamplifier configuration 3 meters (10 feet) cable std, Max 100 meters (330 feet) submersible up to 50 feet
- Thick rugged PVC jacket on sensor cable suitable for aggressive field use in both with & without preamplifier configurations

AST-DO-UNIVERSAL Galvanic Dissolved Oxygen Sensor Specifications

Measurement Range:	0-600 percent (%) saturation, 0-60 ppm range (Lowest Limit 0.1ppm) *
Operating Temperature:	-5 to +50 °C (+23 to +122 °F)
Convertible ¼”-¾” MNPT Installation Styles:	Inline, Immersion or Submersible w/ immersion tube or waterproofing installed
Twist Lock Configuration Installation Styles:	Inline with 1”MNPT Twist Lock Receptacle or Submersible w/ immersion tube or waterproofing installed on 1”MNPT threads
Sanitary/HOT-TAP Configuration Install Styles:	Inline with mating 316SS sanitary tri-clover sensor holder, Valve retractable when used with mating 316SS HOT-TAP hardware assembly Immersion or Submersible (w/ immersion tube or waterproofing installed)
Temperature Element:	Standard with Pt1000 temperature sensor
DO Measuring Cell Material of Construction:	DELFIN® (Polyoxymethylene, POM)
Sensor Body Material of Construction:	RYTON® R-4-230BL (Poly-Phenylene-Sulfone, PPS)
Cable Length Without Preamplifier:	Standard 10 feet (3 meters), Max is 50 feet (15 meters)
Cable Length With Integral Preamplifier:	Standard 10 feet (3 meters), Max is 330 feet (100 meters)
Measurement Principle:	Galvanic cell, self polarizing & internally self temperature compensating
Signal Response Wetted in Solution:	Slope (span) is 1mV to 5mV per DO ppm depending on exact conditions
Signal Response Dry in Air:	Typically 10mV to 40mV depending on exact conditions
Signal Response Time:	Typically 10 to 20 seconds near ambient (response time temperature dependent)
Signal Response Resolution:	1% saturation absolute
Signal Response Repeatability:	Typically ±1% of actual measurement under the exact same conditions
Calibration:	Slope from automatic dry in air calibration. No zero cal for galvanic DO cell.
Initial Impedance Without Preamplifier:	< 2 MegaOhms @ 25°C
Initial Impedance With Preamplifier:	< 2 KiloOhms @ 25°C
Flow Requirements, Water:	Minimum flow dependent on DO and temperature, typically 1 cm per second
Supplied With:	10 each spare thick high stability membranes with O-rings, 125 ml electrolyte filling solution, Tool for installation & removal of membranes from ring in cap

* Contact factory if you plan to measure dissolved oxygen levels above 400% saturation or 40ppm prior to purchase.

Quick Disconnect Snap Connector Option

AST-DO-UNIVERSAL dissolved oxygen sensors with integral preamplifier configuration can be supplied with the rugged field ready Q7M/Q7F NEMA 6P rated quick disconnect snap connector system. See pictures shown below for visualization of this option.



Q7M sensor end of cable snap connector detail close-up view



Q7M/Q7F snap connectors are NEMA 6P rated when interfaced.



Q7F-Xm-TL Female Q7F snap to tinned leads extension cable

Twist Lock Quick Disconnect Bayonet Inline Installation Style Option

The AST-DO-UNIVERSAL-TWISTLOCK configuration is available for use with the twist lock quick disconnect bayonet 1"MNPT fittings for inline installations that may require frequent removal from the process for cleaning. This installation hardware scheme can be visualized and the drawing downloaded from the [twist lock pH/ORP configurations webpage](#).

Sanitary Tri-Clover & HOT-TAP Valve Retractable Installation Style Options

The AST-DO-UNIVERSAL-SANITARY-HOT-TAP configuration is available for use with the 316SS installation hardware for sanitary tri-clover process connections or for valve retractable installations to remove the sensor while the process is still running. The installation hardware scheme for the sanitary tri-clover type processes can be visualized and the drawing downloaded from the [sanitary pH/ORP configurations webpage](#). The installation hardware scheme for the HOT-TAP valve retractable type processes can be visualized and the drawing downloaded from the [HOT-TAP valve retractable pH/ORP webpage](#) and the process connection itself can be viewed from the [HOT-TAP valve retractable hardware webpage](#).

Waterproofing Options for Fully Submersible Assemblies

All of the AST-DO-UNIVERSAL configurations (Convertible, Twist Lock & Sanitary/HOT-TAP) are available for fully submersible installations with the use of an immersion tube (a.k.a. standpipe or guiderod) when a suitable [waterproofing sealing option](#) is factory installed. The option must be installed at time of order for the AST-DO-UNIVERSAL sensor and cannot be installed subsequently. The recommended waterproofing options are the [WPIT sealing](#) which is quite sufficient for most such submersible installation uses or else the [WPB or WPH sealing](#) for an even more robust sealing assembly for the most aggressive service conditions.



3TX-DO & 3TX-DO-X Dissolved Oxygen (DO) Transmitter Specifications for AST-DO-UNIVERSAL Galvanic Dissolved Oxygen (DO) Sensors

See [main 3TX webpage](#) for all shared common transmitter specifications and documentation

Measurement Range:	0-400 percent (%) saturation, 0-40 ppm range *
Operating Temperature:	Usage -15 to +50 °C (Storage -35 to +75 °C)
Without Pre-amplifier Configurations:	Use 3TX-DO-A or 3TX-DO-D Model
With Pre-amplifier Configurations:	Use 3TX-DO-X-A or 3TX-DO-X-D Model
Installation Options for Transmitters:	35mm DIN-RAIL; Wall, Panel or Pipe with IP65 or NEMA 4X Rated Enclosures
Power Options:	3-wire 24VDC or 100-240 VAC 50/60 Hz Line Power Operation
Input Type:	AST-DO-UNIVERSAL Galvanic Dissolved Oxygen Sensor with or without preamplifier
DO Sensor Input Range:	1.00 to 6.00 mV per DO ppm slope (span) calibration limits; Max 240mV absolute
DO Resolution:	0.01mV and 0.01 DO ppm absolute anywhere in the range
Accuracy:	±1% Excluding Sensor (Ideal)
Temperature Elements Supported:	Pt100 or Pt1000 temperature sensor
Temp Range:	0 to +50 °C ± 0.2°C
Available Output:	Scalable Isolated Selectable 0-20mA or 4-20mA current loop (Max 500 Ohms load); Optional RS-485 MODBUS RTU
Values Output:	DO ppm or % saturation via analog output; DO ppm, % saturation and temperature all sent via RS-485 MODBUS RTU
Output Scaling Limits:	Min 0-4 DO ppm, 0-40 % saturation; Full Range 0-40 DO ppm or 0-400 % saturation *
Output Calibration:	Trim Offset and Span for analog 4-20mA analog current loop output

* Special order version of 3TX-DO is available for use up to 600% saturation or 60ppm.

Contact factory if you plan to measure dissolved oxygen levels above 400% saturation or 40ppm prior to purchase.

Calibration Performed:	Slope (span) obtained from galvanic DO cell clean and dry in air via fully automatic calibration. The dissolved oxygen ppm value of the 100% saturation dry in air condition automatically determined from values programmed into 3TX-DO transmitter using temperature value obtained from DO sensor and user entered atmospheric pressure. See 3TX-DO Dissolved Oxygen Product Brochure for a graphical visualization of feature.
Display Features:	Absolute mV of sensor, DO ppm for 100% saturation at current temp, salinity & pressure
Salinity Correction:	User entered PSU (PPT) salinity along with temp & air pressure computes % saturation. See 3TX-DO Dissolved Oxygen Product Brochure for graphical visualization of feature.

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.

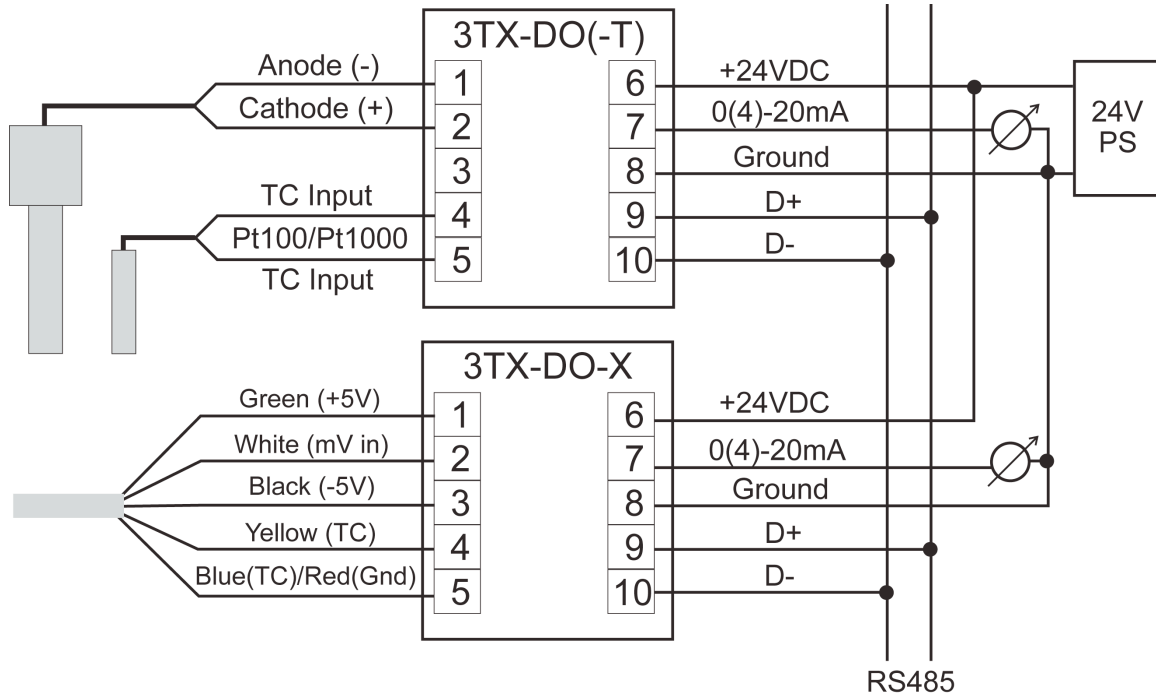
Deposits develop on all surfaces in biologically active system and various slurry and high viscosity solutions. Deposits that builds up on the membrane of an oxygen probe will change the sensitivity of that probe. The AST-DO-UNIVERSAL probes are designed so that deposits have little influence, but for 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 criterions 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 3/4" MNPT threads of convertible sensor

Last Revised July 15, 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.

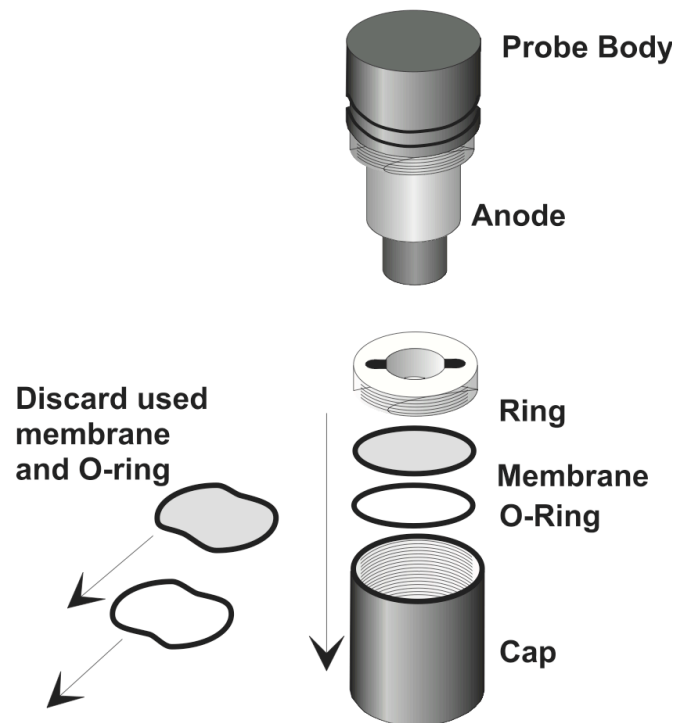
MEMBRANE REPLACEMENT PROCEDURE:

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.





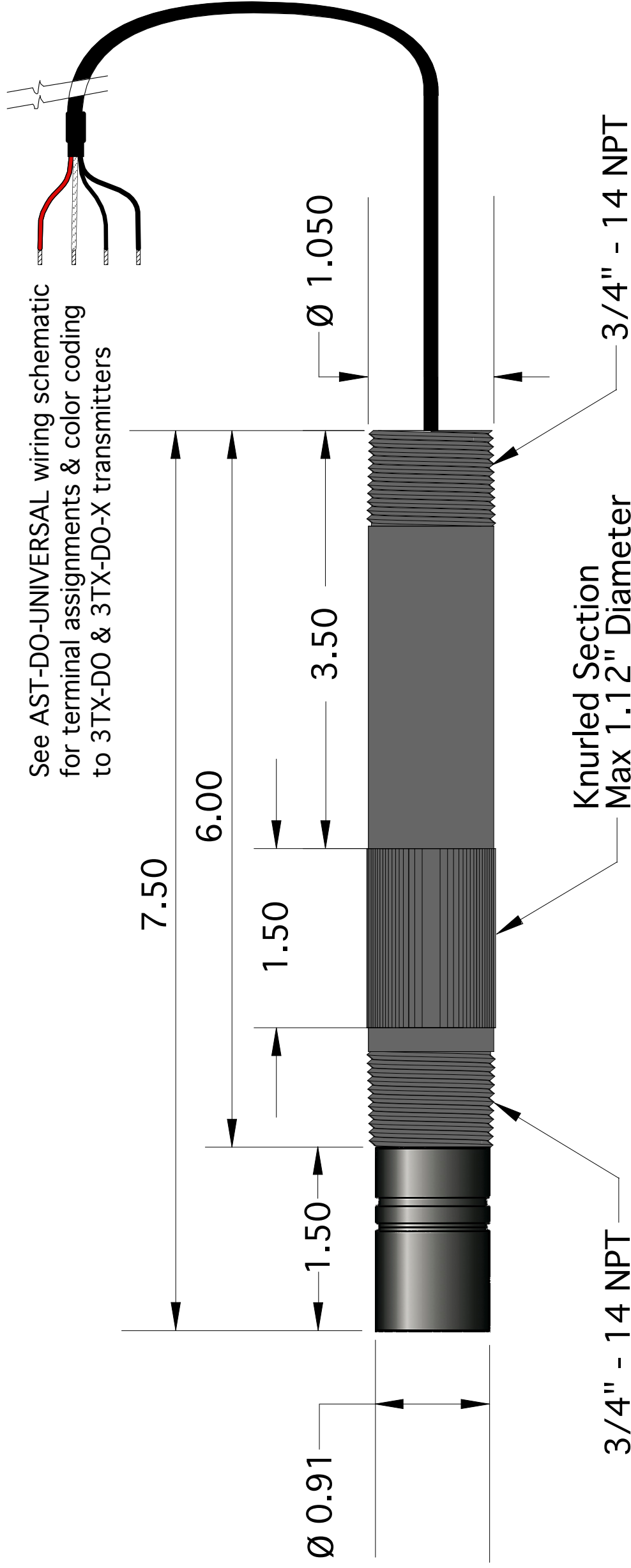
AST-DO-UNIVERSAL CONVERTIBLE INDUSTRIAL DISSOLVED OXYGEN SENSOR

<p>Special Features Highlighting Unique Technical Advantages:</p>	<p>Unique Features highlighting technical advantages for industrial application use</p> <ul style="list-style-type: none"> - Thick-wall TEFLON membrane ensures very high stability, low-drift and high durability in aggressive industrial applications & minimizes frequency of membrane replacement - No special maintenance needed. Just wipe the membrane periodically as required - Galvanic dissolved oxygen cell with true zero means only slope (span) calibration is performed dry in air. No wet solution calibration is ever needed to simple field operation - Membrane is easy to replace and electrolyte solution is simple to recharge allowing for extremely low ongoing cost of ownership and a theoretically unlimited service lifetime - The AST-DO-UNIVERSAL DO sensor is not sensitive to hydrogen sulfide gas - Temperature compensation is built-in & performed automatically for reliable readings
<p>Description of Most Important Common Core Features:</p>	<p>Rugged Industrial DO Sensor for Tough Inline, Immersion & Submersible Installs</p> <ul style="list-style-type: none"> - Inline Insertion depth from 1.5 inches (standard) to 3.5 inches (special order option) - Ready for inline or immersion use standard, submersible with waterproofing option - Waterproofing seal option is available for complete cable isolation for fully submersible installations & applications employing field washdowns and/or moist & humid conditions - Pt1000 temperature element used to compute the % saturation at the current temp - Without preamplifier configuration has 3 meters (10 feet) of cable standard, Maximum cable length in this configuration is 15 meters (50 feet) cable submersible to 25 feet - With integral conventional preamplifier configuration also has 3 meters (10 feet) of cable standard, Maximum 100 meters (330 feet) cable submersible up to 50 feet - Thick PVC jacket for aggressive use in both with & without preamp configurations
<p><i>Features for each configuration in addition to common core features itemized to differentiate models</i></p>	<p>AST-DO-UNIVERSAL-CONVERTIBLE WITHOUT PREAMP CONFIG</p> <ul style="list-style-type: none"> * Tinned lead terminations must be wired directly into transmitter terminals (max 50 feet) <p>AST-DO-UNIVERSAL-CONVERTIBLE WITH PREAMP CONFIGURATION</p> <ul style="list-style-type: none"> * Integral Analog Conventional Preamplifier for low-noise operation and long cable runs * Standard tinned leads end of cable can be bridged in NEMA 4X waterproof J-box Assy * Optional waterproof NEMA 6P quick disconnect Q7M Snap Connector for ease of use * Up to 100 meters (330 feet) low-noise preamplified signal using Q7F snap extensions
<p>Process Connections for Convertible Configuration:</p>	<p>¾" MNPT Front Threads for Screw-in Inline Installation (1.5" Std to 4.5" Max insertion) ¾" MNPT Rear Threads for Immersion Use or Submersible with Waterproofing Option</p>
<p><u>General Sensor Specifications:</u></p>	
<p>Operating Temperature Range:</p>	<p>-5 to +50 °C (+23 to +122 °F)</p>
<p>Operating Pressure Range:</p>	<p>Up to 200 bar submersion pressure; Inquire to factory for installation recommendations</p>
<p>Sensor Body Material:</p>	<p>RYTON® R-4-230BL (Poly-Phenylene-Sulfone, PPS)</p>
<p>DO Measuring Cell Material:</p>	<p>DELTRIN® (Polyoxymethylene, POM)</p>
<p>External Dimensional Details:</p>	<p>See AST-DO-UNIVERSAL ¾"-¾" MNPT Inline / Immersion / Submersible Drawing</p>
<p><u>Galvanic DO Sensor Specifications:</u></p>	
<p>Measurement DO Range:</p>	<p>0 to 600% saturated dissolved oxygen (Typically corresponds to about 0 to 60 ppm)</p>
<p>Response Time:</p>	<p>Typically 10 to 20 seconds near ambient (response time is temperature dependent)</p>
<p>Resolution:</p>	<p>1% saturation absolute</p>
<p>Repeatibility:</p>	<p>Typically ±1% of actual measurement under the exact same conditions</p>
<p>Initial Impedance:</p>	<p>< 2 MΩ @ 25 °C for AST-DO-UNIVERSAL WITHOUT PREAMP CONFIGURATION < 2 KΩ @ 25 °C for AST-DO-UNIVERSAL WITH PREAMPLIFIER CONFIGURATION</p>
<p>Typical Response & Characteristics:</p>	<p>Output is typically about 10mV to 40mV dry in air; Slope is 1mV to 5mV per DO ppm depending on exact conditions determined from dry in air slope (span) only calibration</p>
<p><u>Some Selected Examples of Recommended Applications:</u></p>	<p>Industrial & mining abrasive slurries as well as any solution with high turbidity. Ideal for high sulfide containing media since the AST-DO-UNIVERSAL sensor is insensitive to hydrogen sulfide gas. Any measurement where rugged process conditions may exist.</p>
<p><u>Storage and Shelf Life:</u></p>	<p>Two (2) years from date of dispatch from factory stored in dry state (without electrolyte)</p>

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NOTES

- All dimensions are in inches, unless otherwise indicated with tolerances as detailed below
- Material of construction for sensor body is RYTON & galvanic DO cell is Polyoxymethylene (POM)
- Drawing shown in the standard 1.50 inch insertion depth. At time of order insertion depth can be extended to a maximum of 3.50 inches upon request without incurring any additional charge. The overall sensor length would increase to 9.50 inches in this max insertion depth configuration.
- High stability thick-membrane dissolved oxygen (DO) galvanic cell is active sensing portion with response from ~1mV to ~5mV per ppm with a measurement range of 0-600% DO saturation.
- Max cable for sensors **WITHOUT** preamplifier is ~15 meters (50 feet) shielded composite black cable (as shown above) mating with 3TX-DO module. Max cable for sensors **WITH** integral preamplifier is 100 meters (330 feet) using multiconductor cable. **WITH** preamplifier DO sensors support quick disconnect snap termination & interface with 3TX-DO-X transmitter.
- Do not use any sensor beyond the factory defined maximum temperature, flow or pressure rating.

B

B



Advanced Sensor Technologies U.S.A.
Website: <http://www.astisensor.com>

TITLE		3/4"-3/4" MNPT Inline / Immersion / Submersible	
SIZE	PROJECT	DRAWING NO.	REV
B	CONVERTIBLE	AST-DO-UNIVERSAL	/
SCALE	Not to Scale	MODEL	AST-DO-UNIVERSAL
		SHEET	1 OF 1

1

2

3



Wiring of AST-DO-UNIVERSAL Galvanic Dissolved Oxygen (DO) Sensors for Inline, Immersion, Submersible & Sanitary Installation Schemes to ASTI 3TX-DO & 3TX-DO-X Dissolved Oxygen (DO) Transmitters

AST-DO-UNIVERSAL DISSOLVED OXYGEN SENSOR WITHOUT PREAMPLIFIER

ASTI Cable Color Coding	Instrument Terminal Value	3TX-DO Terminal Number
Red	(-) mV Signal Anode	1
Clear	(+) mV Signal Cathode	2
N/A	No Connection	3
Black	Pt100 / Pt1000	4
Black	Pt100 / Pt1000	5

AST-DO-UNIVERSAL DISSOLVED OXYGEN SENSOR WITH PREAMPLIFIER

ASTI Cable Color Coding	Instrument Terminal Value	3TX-DO-X Terminal Number
Green	+5V Power (Green)	1
White	Dissolved Oxygen Sensor <i>mV Signal</i>	2
Black	-5V Power (Black)	3
Yellow	TC (Yellow)	4
Blue & Red	TC (Blue) & Common (Red)	5

Note 1: Depending upon the TC ordered it may be necessary to change the parameter 03 from Pt100 (default) to Pt1000 (selectable). The wiring is identical whether Pt100/Pt1000 are used.

Note 2: Mating galvanic dissolved oxygen sensor connected to the 3TX-DO transmitter must have internal temperature compensation. The temperature procured from the Pt100/Pt1000 element is only used for measurement of temperature, calibration of the sensor dry in air to 100% saturation condition and computation of the percent (%) saturation from DO ppm values.

Note 3: For the AST-DO-UNIVERSAL dissolved oxygen sensors with integral preamplifier for use with the 3TX-DO-X transmitters the cable can be bridged across any ordinary suitable terminal strip in a NEMA 4X enclosure and proper sealing cable glands (max 330 feet). The AST-DO-UNIVERSAL dissolved oxygen (DO) sensors without an integral preamplifiers must be connected directly to 3TX-DO transmitter input terminals (max 15 meters / 50 feet cable).

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.

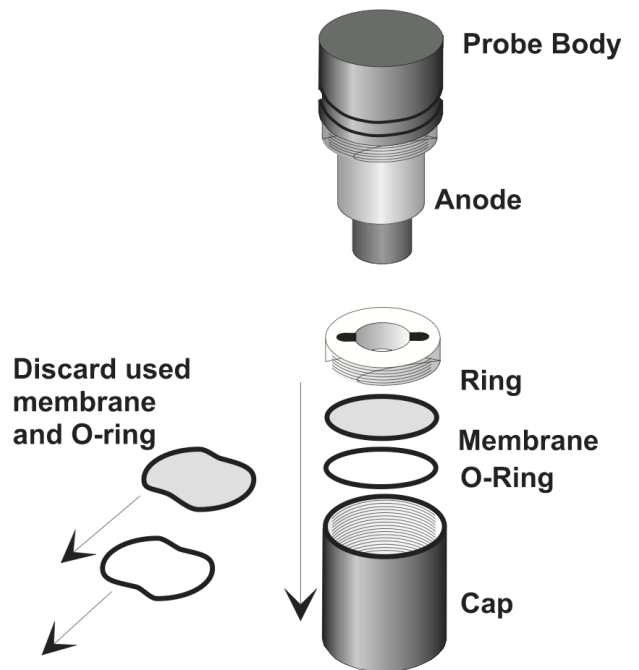
MEMBRANE REPLACEMENT PROCEDURE:

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 and tighten it firmly with the supplied tool.

Precautions and Caveats:

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

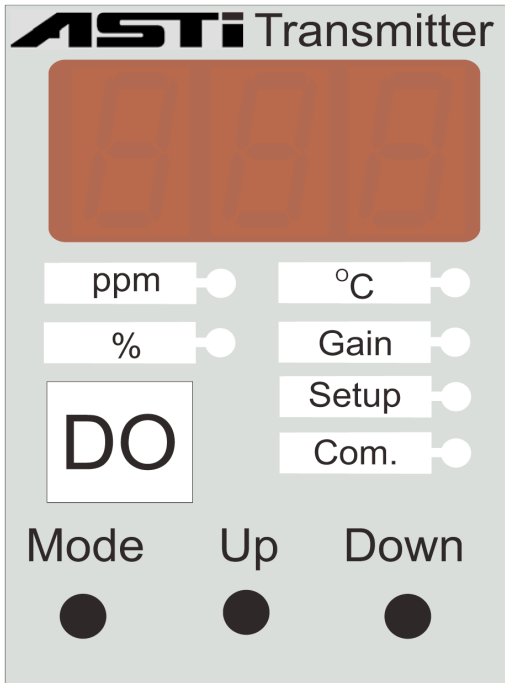
125ml Electrolyte (Internal Filling Solution to recharge sensor).

UNIVERSAL-DO-GUARD:

Protective guard threads onto 3/4"MNPT threads of convertible sensor

Last Revised June 28, 2016

3TX-DO Dissolved Oxygen Controller, Transmitter & Datalogger



- Rugged & cost-effective solution for continuous measurement of dissolved oxygen in tough process applications such as abrasive slurries, high levels of organic & biological content, high turbidity likely to foul luminescent type DO sensors
- Simple, easy to use 3TX-DO & 3TX-DO-X transmitters have all critical features for continuous field measurement such as:
 - Display and output dissolved oxygen levels in ppm and percent (%) saturation units plus temperature in °C via both analog 4-20mA and optional RS485 MODbus RTU
 - Calibrations and process readings are automatically corrected for temperature, air pressure and salinity
- Measure from 0-4 to 0-40.0ppm (0-40% to 0-400% saturation) or 0-6 to 0-60.0ppm (0-60% to 0-600% saturation) as special order
- Fixed 0.01 mV & 0.01ppm resolution anywhere in the range
- For galvanic dissolved oxygen sensors with true zero and mV per DO ppm response with internal temperature compensation For measurements operating from 0 to +50 °C (+32 to +122 °F)
- Modular 3TX series allows any mix of modules for pH, ORP, ISE, DO & conductivity measurement and/or control field use

KEY FEATURES & BENEFITS

Wide range of installation schemes to interface your process:

- ¾" NPT inline use with convertible type configuration
1" NPT inline with twist lock quick disconnect bayonet style
- ¾" & 1" NPT immersion use standard or else fully submersible when used with immersion tube and/or waterproofing option
- Sanitary tri-clover for food, dairy, beverage & pharmaceutical
- HOT-TAP valve retractable assemblies for locations where a slip stream bypass or submersible installation is not possible
- Galvanic DO sensor require **no zero adjustment of any kind**
- Gain calibration performed with sensor dry in air; 3TX-DO has correct calibration value stored at any temperature & pressure
 - Adjustment for gain is completely automatic so that **no look-up tables and no solutions are required to calibrate galvanic DO sensors with the 3TX-DO!**
- Due to unique electrolyte chemistry and design combined with rugged high stability thick membrane technology for minimal calibration, cleaning & rebuilding of the industrial DO cell.
- Available for DO sensors without preamplifiers (3TX-DO) as well as DO sensors with integral preamplifiers (3TX-DO-X)



AST-DO-UNIVERSAL dissolved oxygen sensor in convertible configuration; Close-up on DO cell



SPECIFICATIONS: 3TX-DO(-X) Dissolved Oxygen Analyzer/Transmitter/Controller

Measurement Type and Purpose:	Galvanic (active self-polarizing) dissolved oxygen sensor to measure DO levels in aqueous media, internally self temperature compensating (even without integrated TC element)
Typical Applications for the AST-DO-UNIVERSAL Galvanic Dissolved Oxygen Sensors:	Industrial & mining abrasive slurries as well as any solution with high turbidity. Ideal for high sulfide containing media since the AST-DO-UNIVERSAL sensor is insensitive to hydrogen sulfide gas. Any measurement where rugged process conditions may exist.
Concentration Range Standard:	0.0 to 40.0 ppm or 0 to 400% saturation is the standard full range
Concentration Range Special:	0.0 to 60.0 ppm or 0 to 600% saturation ranges available as a special order option
Resolution:	0.01mV and 0.01 ppm absolute anywhere in the range
Output Scaling:	Minimum 10% of full range for both analog current loop & MODbus. The 4mA & 20mA setpoints can be arbitrarily defined and are fully reversible
Lowest Displayed Limit of Detection:	0.01 ppm (Recommended for applications that are typically 0.10ppm or higher)
Sample pH Range:	Typically 2 to 12 (Inquire for other pH levels outside of this range)
Sample Temperature Range:	0 to +50 °C (+32 to +122 °F)
Pressure Range:	Typical inline installations are 10 psig or less; Submersible to 50 meters (165 feet)
Sample Flow Requirements:	Continuous flow, Minimum 1cm per second for stable readings
AST-DO-UNIVERSAL Industrial Galvanic Dissolved Oxygen Sensor Specifications:	Membrane covered galvanic cell generates an internally temperature compensated mV signal linear to dissolved oxygen in air or liquid. Typical response is 1 to 5 mV per ppm as is determined from dry in air slope (span) calibration. Measurement range is 0-600% saturation.
Special Features:	3TX-DO(-X) corrects for temperature, pressure and salinity effects on % saturation in calibration and measurement modes; More details are provided on the following pages
Display:	Bright 3-digit red LED display visible in sunlight
Power Supply:	CSA/UL/CE Universal 100 to 240 VAC power supply, consumption 60mA max per module
Signal Output:	Scalable 4-20 mA; DO ppm, % Saturation & Temperature all sent on optional RS485 MODbus
Instrument Mounting & Dimensions:	Wall, Pipe or Panel Mounting for 2, 3, 4, 6 or 7 modules per enclosure (NEMA 4X CSA/UL)

Module Description & Options:

Transmitter Modules: In addition to dissolved oxygen, modules are available for pH, ORP, mV, Temperature, Conductivity and Ion Selective (ISE) measurements including Fluoride, Ammonia, Nitrite, Nitrate & Calcium among others. All analog outputs have built-in trim calibration support, including both offset and span adjustments. Calibration of temperature element is available for all measurement modules via 1-point offset adjustment.

Preamplifier Support: Unlike many galvanic dissolved oxygen measurement systems, the 3TX-DO-X transmitter model supports preamplifiers for use in particularly noisy environments or to avoid opening the analyzer enclosure. The 3TX-DO-X transmitters when used with the AST-DO-UNIVERSAL sensors in the with integral preamplifier configuration supports the Q7M/Q7F NEMA 6P rated quick disconnect snap connectors for ease of installation and maintenance at cable lengths up to 100 meters (330 feet). End of cable terminations can be bridged for with integral preamplifier configurations.

3TX-REL Option: Alarm and relay controller module provides (2) each 5 Amp contact relays and controller that is fully configurable by the user for control mode and variables for each control algorithm. Control modes include: 1) Alarm functions only; 2) On/Off control with a user-configurable dead band; 3) Time proportional control; and 4) Proportional frequency control (variable pulse controller).

3TX-DAT Data Logging Option: MODbus 3TX-DAT datalogger can support simultaneously datalogging from any 3TX module with MODbus output (3TX-pH, 3TX-ISE, 3TX-DO, 3TX-CON and 3TX-TOT) at frequencies from every second to every hour. Configuration of 3TX-DAT datalogger and downloading of data done via freely supplied mating Windows PC software which also allows for visualization and workup of the information.

3TX-TOT Option: pH compensation module computes total ammonia (NH₃ + NH₄⁺) using the free ammonium ion activity, pH, and temperature from the respective measurement modules' bridged outputs. The 3TX-TOT module includes a scalable 4-20mA output for total ammonia result and RS485 Modbus communications for all inputs and outputs. By using the bridged output for totalizing, you retain the use of free ion and pH 4-20mA outputs. **THE 3TX-TOT IS REQUIRED AT pH ABOVE 7.5 TO PROPERLY PERFORM AMMONIUM ISE MEASUREMENTS AT MOST TEMPERATURES.**

Modbus Option: Available as RS-485 output option for measurement module or by adding 3TX-TOT module at any time. Free of charge Windows Graphing & Datalogging software supplied with all 3TX measurement modules purchased with MODbus output option or 3TX-TOT.

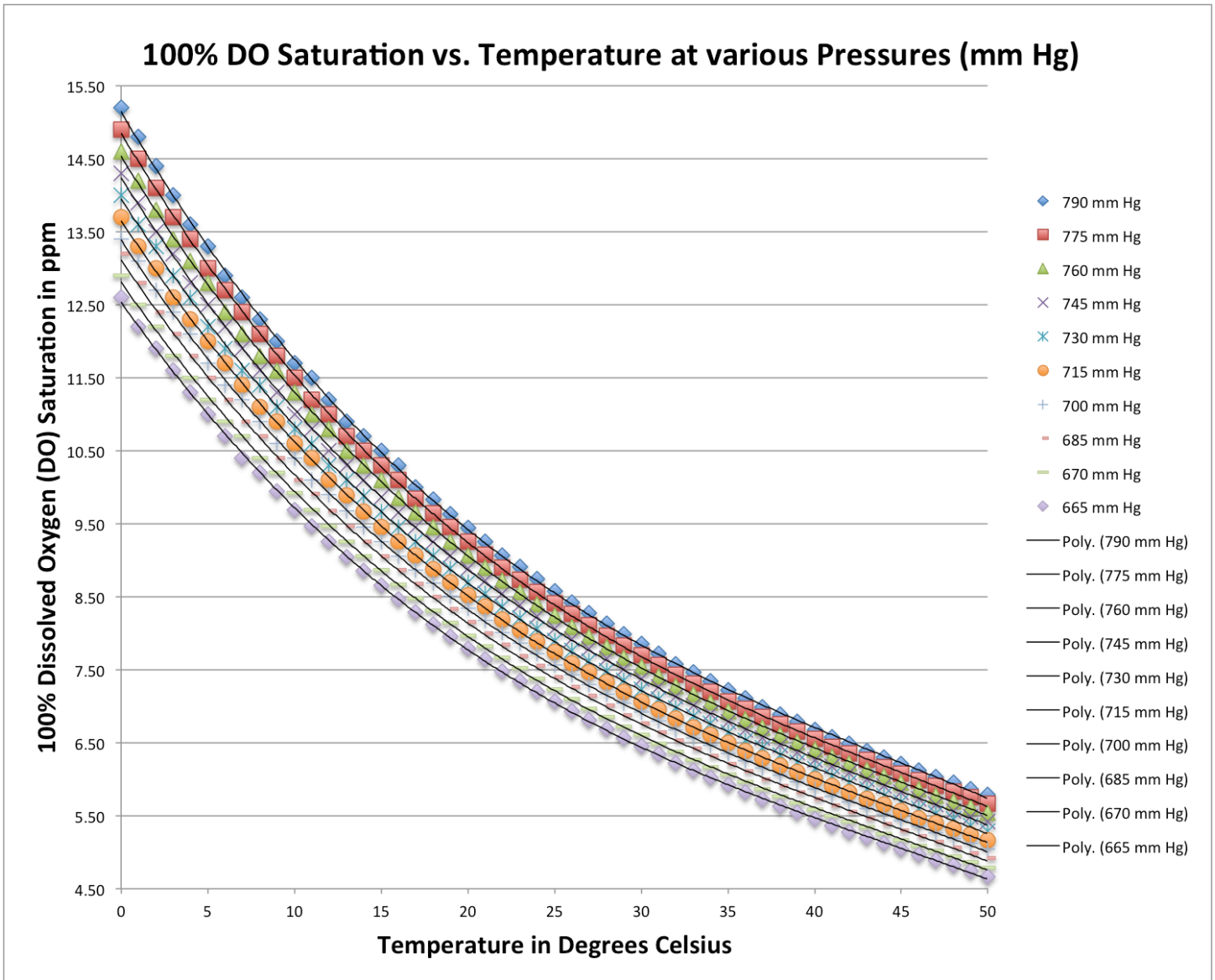
Enclosure Options: NEMA 4X Enclosures (CSA/UL Listed) for 2, 3, 4, 6, or 7 modules for Wall, Panel or Pipe Field Mounting or 35mm Din-Rail Only

Power Options: Universal 100 to 240 VAC 50/60 Hz power supply or 3-wire 24VDC operation (not 2-wire loop power) with a dedicated power supply.

Last Revised July 11, 2016

Automatic Calculation of Theoretical 100% Dissolved Oxygen Saturation at any Temperature & Pressure for Accurate Calibration & Measurement

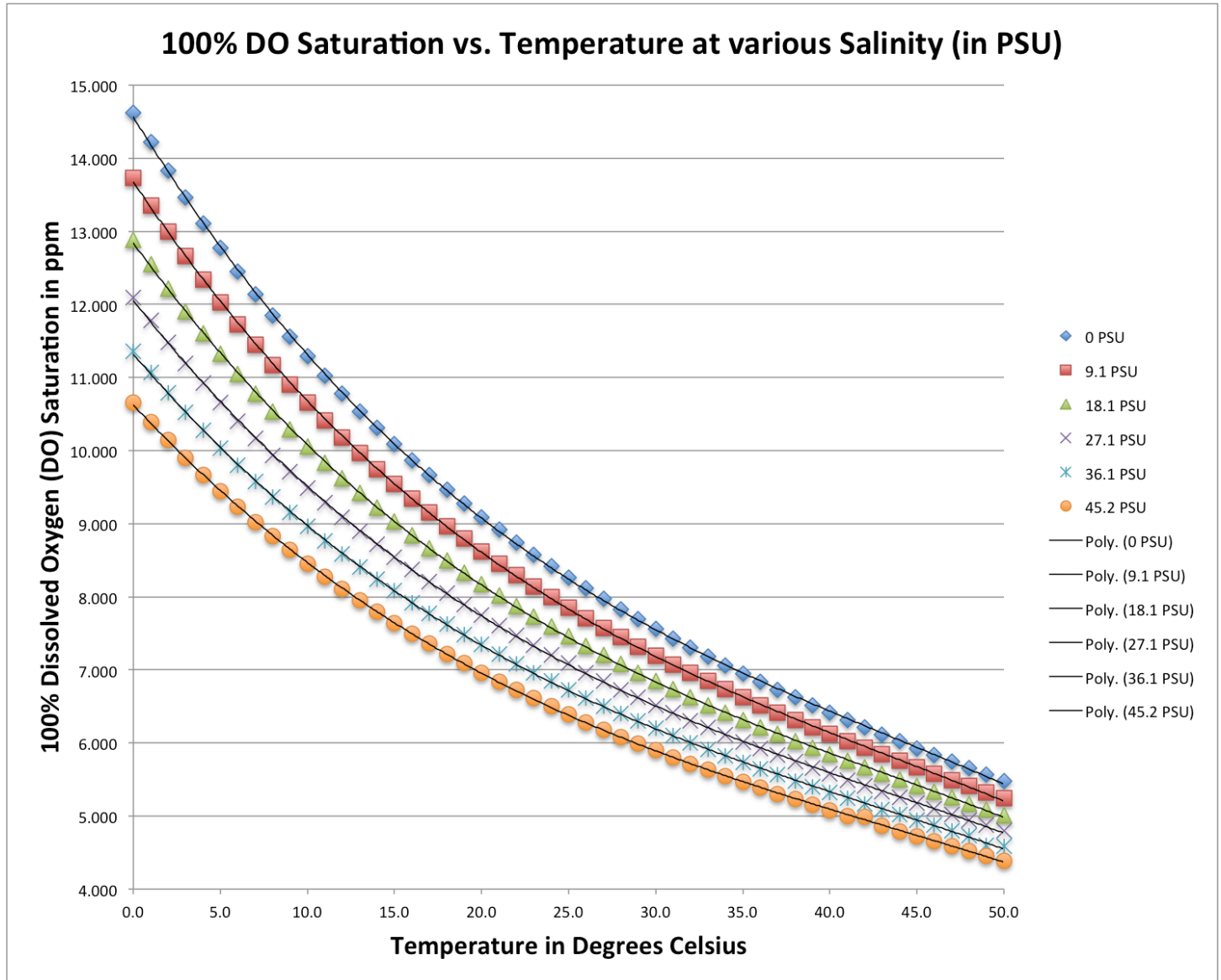
The 3TX-DO(-X) has preprogrammed the correct 100% dissolved oxygen saturation levels valid at any temperature and pressure. This is important for two main purposes: 1) to ensure accurate calibration of the sensor which is performed dry in air and 2) when the percent (%) saturation is displayed and output for purposes of monitoring and control. The graph below demonstrate the impact of both temperature and pressure on the dissolved oxygen (DO) ppm levels that constitute 100% saturation condition.



For the calibration function, either the field condition should be 100% relative humidity for best accuracy or else the sensor should be suspended dry in air but over a water source to simulate locally the 100% relative humidity condition. The water molecule in air (humidity) is then saturated with oxygen in manner that can be fully described by the ambient temperature and pressure as shown above. When placed into service, the galvanic DO sensor will measure the ppm levels at the installation depth. To convert this measured ppm value into percent (%) saturation the 3TX-DO transmitter uses the stored curve visualization above.

Automatic Calculation of Theoretical 100% Dissolved Oxygen Saturation at any Temperature & Pressure for Accurate Calibration & Measurement

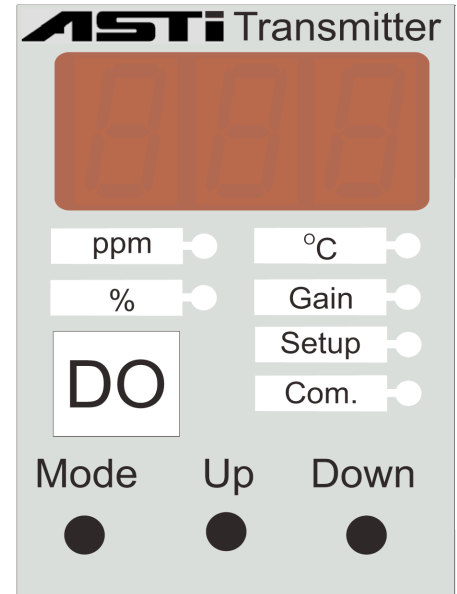
The 3TX-DO(-X) has preprogrammed the correct 100% dissolved oxygen saturation levels valid at not only any temperature and pressure but also corrected for salinity. This is important for applications where not only fresh water will be present but also for brackish and salt water sources in variable amounts. The graph below demonstrates the impact of salinity on the dissolved oxygen (DO) ppm levels that constitute 100% saturation condition at the nominal 760mm pressure condition. For simplicity of visualization just one set of curves is shown although the analyzer can perform this compensation any temperature, pressure or salinity.



This salinity correction is only required as a correction to the computation of the % saturation from the measured DO ppm levels for the inline measurement. Since the calibration is done dry in air, salinity correction is not required for this part of operation. Since the impact of salinity is considerable as shown in the graph above, it must be corrected carefully at any level of salinity and temperature. The salinity value in standard PSU (PPT) units can be entered into the 3TX-DO transmitter to perform this correction. The value of the salinity can be determined by a handheld salinity meter or else monitoring continuously using a 3TX-CON conductivity transmitter from which one can readily convert into common salinity units.

3TX-DO 3-Wire Dissolved Oxygen Transmitter

- 3TX-DO is a transmitter for Dissolved Oxygen (DO) & Temperature Measurement
- Measurement Ranges: Full Range 0-40ppm (0-400% saturation); Minimum Scaling 0-4ppm (0-40% saturation), 0-50 °C, 0.01 ppm resolution anywhere in range
- Most Galvanic (a.k.a. active self-polarizing) type DO sensors supported that have internal (automatic) temperature compensation of the mV potential per ppm unit
- Galvanic DO sensors have a true “zero” unlike polarographic (amperometric) DO sensors; no “zero” cal required but rather only a simple gain calibration in air
- Gain calibration is performed with sensor just dry in air; **Absolutely NO look-up tables or wet solutions required to calibrate your DO sensor with the 3TX-DO!**
- 3TX-DO has the preprogrammed the correct 100% saturation value for calibration at any temperature, elevation & pressure via automatic or manual gain cal mode
- % saturation computed with corrections for the temperature, pressure and salinity
- Display Dissolved Oxygen (DO) in ppm or % saturation units or Temperature in Celsius. Scalable analog output 0-20 or 4-20 mA for DO in ppm or % Saturation
- RS-485 MODbus Output sends DO ppm, % saturation as well as Temperature
- Galvanic isolation between sensor input and analog output (3000V rating)



FEATURES

The ASTI 3TX Family of Transmitters Consists Of:

3TX-pH: pH, ORP/mV and Temperature Transmitter with fully scalable 0/4-20mA output and MODbus (optional)

3TX-CON: Contacting Conductivity Transmitter with fully scalable 0/4-20mA output and MODbus (optional)

3TX-ISE: Ion Selective * Transmitter with fully scalable 0/4-20mA output and MODbus (optional)

3TX-DO: Dissolved Oxygen Transmitter with fully scalable 0/4-20mA output and MODbus (optional)

3TX-TEM: Adds scalable 0/4-20mA output of Temperature to 3TX-pH, 3TX-ISE, 3TX-CON or 3TX-DO transmitter.

3TX-REL: Alarm & relay controller (On/Off, TPC, PFC) for pH/ORP, ISE, DO & Conductivity measurement modules

3TX-TOT: Compute pH compensated “Total ISE” from ISE & pH analog inputs, 0/4-20mA analog & MODbus outputs

3TX-DAT: Datalogger & MODbus Master for up to 63 each 3TX transmitter modules with RS485 MODbus output

The 3TX family has a 3 digit display and 6 LEDs for setup and displaying values. The ‘Mode’ key is used to navigate.

Programming

The module is programmed by 3 keys on the front panel. The ‘Mode’ toggles and the ‘Up’ or ‘Down’ scroll through parameters. The parameter is altered via the ‘Mode’ and the value is changed using the ‘Up’ or ‘Down’. **Parameter P01 is a “lock” which must be set to ‘Off’ to change ANY parameter, including the temperature & gain calibrations.**

* Ion selective measurement must be validated by ASTI factory prior to order.
3TX-ISE sold only as part of complete ISE system with mating ISE sensor.

Input

Galvanic DO sensors have the Anode (-mV) connected to terminal 1 and Cathode (+mV) to terminal 2. The internally (self) temperature compensated mV potential is the basis for the DO ppm and % saturation display and output(s). Galvanic DO cells with mV response linear to DO ppm use 3TX-DO model whereas those with mV response linear to % saturation use 3TX-DO-T model. Galvanic DO cells with integral analog conventional preamplifiers use 3TX-DO-X model. The Pt100 or Pt1000 TC is connected to terminals 4 and 5 is the basis of the temperature measurement used to set the 100% saturation value for the gain calibration as well as to compute the % saturation state in the process.

Analog Output (Standard)

The 3TX-DO, 3TX-DO-T & 3TX-DO-X transmitters have a scalable & selectable analog 0-20 or 4-20 mA standard or inverted output. The scaling between the minimum (0mA or 4mA) and maximum (20mA) output is 10% to 100% of the 0-40 ppm or 0-400% saturation DO full range scale, where low and high outputs can be arbitrarily selected. The analog output is galvanically isolated from input and proportional to DO ppm or DO % saturation as configured.

MODbus (Optional)

Data is transferred using MODbus RTU for multidrop communication using RS485. The Modbus master may be the 3TX-DAT or any SCADA system. When units are ordered with MODbus, a Windows datalogging software is freely provided. The MODbus option allows for the DO value in ppm and percent (%) saturation units to be sent simultaneously as well as the process temperature.

TECHNICAL SPECIFICATIONS

Mechanical

Housing: Lexan UL94V-0 (Upper part)
Noryl UL94V-0 (Lower part)
Mounting: M36 for 35 mm DIN rail
IP Class: Housing IP40. Connector IP20
Connector: Max 16A. Max 2.5 mm²
Max torque 0.6 Nm
Temp.: Usage -15 to +50 °C (Storage -35 to +75 °C)
Weight: 75 grams (2.64 ounces)
Dimensions: D 58 x W 36 x H 86 mm (2.3" X 1.4" X 3.4")
CE mark: EN61326A

Electrical

Power Supply: 24VDC ±10%
Consumption: 60 mA max
Resolution: 0.01 ppm anywhere in the range
Galvanic Sensor: 1.0-6.0 mV per ppm for 3TX-DO(-X)
Response Range: 0.25-2.50 mV per % saturation (-T)
Accuracy: ±1% Excluding Sensor (Ideal)
Temp Sensor: Pt100 or Pt1000
Temp Range: 0-50°C ± 0.2°C
DO Temp Comp: Automatic in all configurations
Analog Output: 0-20mA or 4-20mA, max. 500Ω

DO Sensor Type

Self-Polarizing Galvanic

Full Scale Maximum DO Range (Nominal)

0 to 40.0 ppm (0-400%)

Minimum Range at 10% of Maximum Full Range

0 to 4.00 ppm (0-40%)

OUTPUT SCALING NOTES: The 4-20mA scaling can be arbitrarily set provided the difference is at least 10% of the 0-40ppm or 0-400% saturation full range. The minimum difference between the 4mA (P14) & 20mA (P15) setpoints is 4ppm or 40% saturation. The analog output is fully reversible (see P13). Analog & MODbus outputs can be scaled anywhere between the minimum 10% & 100% maximum limits. The MODbus output scaling will follow the analog setpoints (see next page).

PARAMETERS

Function and Programming

The 21 parameters are shown to the right. For access, please see page 1. **If the softwarelock (Par. no. 1) is "On" the parameters can only be read. Set Software Lock to "Off" to change values.**
Par. no. 2 sets module's address for MODbus communication.
Par. no. 3 sets temp. to manual (set) or automatic from sensor.
Par. no. 4 sets the temp. value when in fixed (set) mode for P03.
Par. no. 5 sets the ambient barometric air pressure in units of mmHg. This value is used in the gain calibration and for calculating the % DO saturation. Any barometer at (or near) installation site can supply the pressure in these common units.
Par. no. 6 is the salinity of the process sample in units of PSU.
Par. no. 7 is the wire gauge (AWG) for the sensor cable used.
Par. no. 8 is the length of sensor cable in units of feet.
Par. no. 9 sets mode used to compute % saturation. The default automatic mode uses DO ppm and computes the % saturation based upon the given temperature, air pressure and salinity. Manual mode uses a fixed DO ppm to define 100% saturation.
Par. no. 10 defines the DO ppm that constitutes 100% saturation condition when P09 is set to manual mode.
Par. no. 11 selects the analog output (and MODbus output mode if present) of the dissolved oxygen (DO) transmitter in units of ppm or % saturation; these units are also used for P14 & P15.
Par. no. 12 sets the analog output to either 0-20 mA or 4-20 mA.
Par. no. 13 allows setting the output to be inverted (i.e. for use in control) with the output corresponding to 20-0mA or 20-4mA.
Par. no. 14 sets 0/4mA output scaling in DO ppm or % sat units.
Par. no. 15 sets 20mA output scaling in DO ppm or % sat units. See output scaling notes above for limits on P14 & P15 setpoints.
Par. no. 16 display/adjust gain value. Units are mV per ppm or mV per % saturation based upon which 3TX-DO model is used.
Par. no. 17 Offset adjustment for 0/4mA low analog output trim.
Par. no. 18 Gain adjustment for 20mA high analog output trim.
Par. no. 19 If no keys are pressed for 10 minutes, display will show flashing bar (Energy Save Mode). Pressing any key to exit.
Par. no. 20 sets baudrate of 9,600 or 19,200 per MODbus master.
Par. no. 21 Feature to reset the analyzer back to factory default.

List of Parameters

No	Parameter	Description	Range	Default
01	Lock	Software Lock	On / Off	On
02	Address	MODbus Node	Off, 1...247	Off
03	Temperature	Select Temp Input Mode	Set, Pt100 or Pt1000	Pt100
04	Manual Temp	Temp if P03 is Manual Mode	0...50	25
05	Barometric Air Pressure	pressure in mm Hg units	600 to 900	760
06	Salinity	PSU Units	0 to 50	0
07	Wire Gauge	Sensor AWG	20, 22, 24	22
08	Cable Length	Length in feet	1...999 feet	23
09	% Saturation Computation	Computation % Saturation	Automatic or Manual	Auto
10	Manual Saturation	ppm for 100% Saturation	4.00 to 40.0 ppm	10.0
11	Input for lout	Input for the analog output	DO ppm or % Saturation	DO ppm
12	Analog Output Type	Type of Output	4-20mA, 0-20mA	4-20
13	Output mode	Inversion Setting	noninverted, inverted	n.inv
14	0/4mA Low Output Scale	Low Output (DO Units)	0%-90% of Full Range	0%
15	20mA High Output Scale	High Output (DO Units)	10%-100% of Full Range	100%
16	Working Gain (Slope)	mV per DO ppm or % Sat	1.0-6.0 or 0.25-2.50 (-T)	3.75 or 1.10 (-T)
17	0/4mA Offset	Trim Low	±9.99% *	0.00
18	20mA Gain	Trim High	±9.99% *	0.00
19	Energy Save	Energy Save	On / Off	On
20	Baudrate	MODbus	9,600 / 19,200	19,200
21	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par

* Negative trim adjustments will be shown as flashing numbers.

Calibration

Use the 'Mode' key to select 'Gain' before removing the DO sensor from service. Perform gain calibration when the sensor is clean & dry and exposed to only air. If the relative humidity is not 100%, suspend sensor in air over a source of water for best results. Be sure to allow sufficient time for temperature & sensor reading to be quite stable to ensure a good gain calibration result.

Three type of different galvanic dissolved oxygen sensors are supported by three different types of 3TX-DO transmitters:

- 3TX-DO** - With mV response linear to DO ppm
- 3TX-DO-T** - With mV response linear to DO % Saturation
- 3TX-DO-X** - With mV response linear to DO ppm & integral conventional analog preamplifier

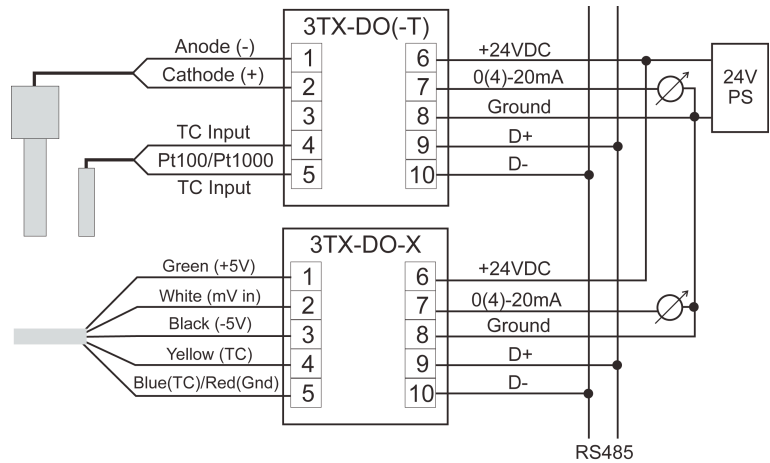
IMPORTANT: Be sure to perform a precise temperature calibration before performing any gain calibration.

Auto Calibration Routine: To initiate an automatic calibration, simultaneously hold the 'Up' & 'Down' keys for three to five (3-5) 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 the 'Mode' key to exit the manual calibrate mode.

DISPLAY FEATURES & NOTES: Temperature calibrated with "Up" or "Down" buttons in °C display mode. Result of gain calibration is viewed and/or modified in P16 (mV per ppm for 3TX-DO{-X}) & mV per % saturation for 3TX-DO-T). Raw mV viewed by pressing 'Down' button in ppm or % display mode. 100% saturation for the current temp, pressure & salinity is viewed by pressing the 'Up' button in the ppm or % display mode.

Typical Installation



MODBUS

In order to utilize the MODbus interface the 3TX-DO(-T) must be ordered with MODbus. 3TX-DO(-T) may be used as a slave for the 3TX-DAT or as a slave in a SCADA system or else with the free of charge Windows datalogging and graphing software.

With 3TX-DAT

If 3TX-DO is used together with 3TX-DAT the baud rate on the MODbus and address of 3TX-DO must be correctly set. **The baud rate (P20)** must be set to the baud rate of 3TX-DAT. The baud rate used being 19,200 or 9,600 is of no importance, as long as all units on the RS-485 MODbus network are set to the same baud rate.

The address (P02) must be unique in the network. In a network with the 3TX-DAT as master, all addresses must be assigned without omitting any address. The exact order is of no importance. In a network with a 3TX-DAT, up to 63 MODbus slaves may be connected, with valid addresses from 1 to 247.

In a SCADA system or with Windows software

Since different SCADA systems may have different restrictions. **The baud rate (P20)** must match that of the SCADA system. **The address (P02)** must be unique in the network. Max of 247 each 3TX units on one MODbus network, with repeaters after 32 units.

MODbus Scaling

MODbus scaling for DO process measurement is the same as analog output set by P14 & P15. The DO ppm and % saturation are sent via MODbus scaled together with a 10-fold factor, keyed by the units selected in P11. If P11 is DO ppm and scaled as 2-10 ppm, the corresponding % saturation will be 20-100 %. If P11 is DO % saturation and scaled as 50-200%, the corresponding DO ppm will be 5-20 ppm. Temperature is always scaled as 0-100 °C.

The 3TX-DO contains 2 measured values (Dissolved Oxygen ppm and temperature) and 1 computed value (% saturation). Access is gained through the function code *Read_Input_Registers (04)*.

Read_Input_Registers

Function code	Start address	Number of values
04	1	1, 2 or 3

Value 1 is DO in ppm units, value 2 is the DO in % saturation units and Value 3 is Temperature; all three values are transmitted in sequence; If 3 values are chosen then DO ppm, % saturation and temperature are transmitted. All values are rated to 0-1000 corresponding to the scaled range; the scaled DO ppm range is sent as 0-1000, the % saturation (always 10 times the DO ppm scaling) as 1024-2024 and finally the full scale temperature range (0-100 °C) is transmitted as 2048-3048.

The 3TX-DO gives access to different diagnostic values via *Diagnostics (08)*, as shown in the following.

Diagnostics

Function Code	Sub Code (HEX)	Description
08	00	Return Query Data
	0A	Clear counters and diagnostics register
	0B	Return Bus Message Count
	0C	Return Bus Com Error count
	0D	Return Exception Error count
	0E	Return Slave Message count
	0F	Return Slave No Response count
	12	Return Bus Character Overrun count



ORDERING INFORMATION FOR 3TX FAMILY OF TRANSMITTERS

ENCLOSURE TYPE	
CODE	DESCRIPTION
3TX-0M	3TX Transmitter with No Enclosure
3TX-DIN	3TX Transmitter with No Enclosure; Preinstalled onto 35mm DIN-Rail
3TX-2MW	3TX Transmitter(s) with IP65 WeatherProof Enclosure; Up to 2 Total Modules (Wall Installations Only)
3TX-2M	3TX Transmitter(s) with IP65 WeatherProof Enclosure; Up to 2 Total Modules (Wall or Pipe Installations)
3TX-3MP	3TX Transmitter(s) with NEMA 4X Enclosure for ½-DIN Panel Only ; Up to 3 Modules (with Panel Bracket Assembly)
3TX-3MF	3TX Transmitter(s) with NEMA 4X Enclosure; Up to 3 Total Modules (Wall or Pipe Installations)
3TX-4MW	3TX Transmitter(s) with IP65 WeatherProof Enclosure; Up to 4 Total Modules (Wall Installations Only)
3TX-4M	3TX Transmitter(s) with IP65 WeatherProof Enclosure; Up to 4 Total Modules (Wall or Pipe Installations)
3TX-6M ***	3TX Transmitter(s) with IP65 WeatherProof Enclosure; Up to 6 Total Modules (Wall or Pipe Installations)
3TX-7MF ***	3TX Transmitter(s) with NEMA 4X Enclosure; Up to 7 Total Modules (Wall or Pipe Installations)
3TX-9MF ***	3TX Transmitter(s) with NEMA 4X Enclosure; Up to 9 Total Modules (Wall or Pipe Installations)
MEASUREMENT MODULES ONE (1) THROUGH SEVEN (7)	
CODE	DESCRIPTION
-pH **	pH/ORP/mV/Temp Measurement Module / Transmitter
-HiQ-pH	Intelligent pH & ORP Transmitter for Smart Digital pH & ORP Sensors; Both 4-20mA & MODBUS outputs standard
-CON-CELL/RANGE	Contacting Conductivity Measurement Module / Transmitter (CELL Constant & RANGE in mS Defined at Time of Order)
-ISE-ION **	Ion Selective (ISE) Measurement Module / Transmitter (Ion Measurement Type ION Must be Defined at Time of Order) *
-DO **	Dissolved Oxygen Measurement Module / Transmitter For Galvanic Type DO sensors
OUTPUT OPTIONS FOR ANALOG MEASUREMENT MODULES (ONE OPTION MUST BE SELECTED FOR EACH MODULE)	
CODE	DESCRIPTION
-A	Single Fully Scalable Analog 0-20 or 4-20 mA Output Only
-D	Single Fully Scalable Analog 0-20 or 4-20 mA Output Only AND RS-485 MODbus Digital Output
ADD-ON MODULES FOR MEASUREMENT MODULE ENCLOSURE ASSEMBLIES	
CODE	DESCRIPTION
-PS	100 to 240 VAC 50/60 Hz Universal Power Supply Adapter for Line Powered Operation
-PS/BAT	Dual Isolated & Regulated 24VDC Power Supply Step-Up Converter for operation from 5V, 6V & 9V Batteries
-TEM	Scalable Analog 0-20 or 4-20mA Temperature Transmitter for Raw or Spliced Pt100/Pt1000 temperature element
-SW	On/Off Power Switch (½ Width of power supply module and ¼ width of standard 3TX transmitter)
-REL	Alarm and Relay Controller Module for 3TX-pH, 3TX-ISE, 3TX-CON and 3TX-DO measurement modules
-TOT	Compute pH compensated "Total ISE" from analog inputs for ISE & pH, 0/4-20mA analog & MODbus digital outputs
-DAT	Datalogger & MODbusmaster for 3TX Transmitters with RS485 MODbus; Download & Setup via RS232/USB on Windows

Contact the factory for specific recommendations & ALL ISE inquiries. Pipe mounting bracket kits supplied separately. For 3MP, 3MF, 6M & 7MF enclosures power supply is not counted as a module for space purposes.

Model: 3TX-2M-pH-A-CON-1.0/50-D

Description: Dual Channel Transmitter Assy w/ Weatherproof Enclosure (2 Total Modules); 1 each pH Measurement w/ Analog Output; 1 each Contacting Conductivity Measurement w/ Cell Constant 1.0/cm & Full Range 0-50mS/cm (Min Scaling 0.5-0mS/cm); with Analog and Digital MODbus RS-485 Outputs (No AC Power Supply)

Model: 3TX-3MP-ISE-F-A-pH-A-TOT-PS

Description: Dual Channel Total Fluoride Measurement Transmitter Assembly with NEMA 4X (UL) Enclosure for ½-DIN Panel Mounting Installations (for 3 Total Modules); 1 each ISE Fluoride Ion and 1 each pH Measurement Module with Analog Output Only; 1 each TOT module to compute total fluoride (HF + F⁻) with Analog & MODbus Outputs for all free fluoride, total fluoride, pH and temperature; With Universal 11 Power Supply Module

Model: 3TX-3MF-DO-D-TEM-SW-PS

Description: Dissolve Oxygen Transmitter Assembly with NEMA 4X CSA/UL rated Enclosure; Field or Wall Mounting Installations (3 Module Max); 1 each DO transmitter for galvanic type dissolved oxygen sensors; Scalable Analog & MODbus Output for DO ppm, saturation & Temperature; 115/230 Power Supply with On/Off Switch

Model: 3TX-4MW-ISE-NH4-A-pH-A-TOT-PS

Description: Dual Channel Total Ammonia Measurement Transmitter Assembly; Weatherproof Wall Mount Only Enclosure (4 Modules Max); 1 each ISE Ammonium Ion and 1 each pH Measurement Module with Analog Output Only; 1 each TOT to compute total ammonia (NH₃) with Analog & MODbus Outputs; With 115/230 Power Supply

Model: 3TX-6M-ISE-NH4-A-pH-A-TOT-ISE-NO2-A-pH-D-DO-D-PS

Description: Five Channel Transmitter Assembly with Weatherproof Enclosure (for 6 Total Modules); 1 each ISE Ammonium Ion and 1 each pH Measurement Module with Analog Output Only; 1 each TOT module to compute total ammonia (NH₃) with Analog & MODbus Outputs; 1 each ISE Nitrite Ion with Analog Output Only; 1 each ORP Measurement Module and 1 each DO transmitter for galvanic active self-polarizing type sensors both with Scalable Analog & MODbus Outputs; With 115/230 Power Supply

Model: 3TX-6M-ISE-X-F-D-REL-pH-X-D-REL-CON-10.0/500-D-DAT-PS

Description: Triple Channel Transmitter Assembly with Weatherproof Enclosure (for 6 Total Modules Max); 1 each Preamp Style Fluoride ISE Measurement Module & 1 each Preamp Style pH Measurement Module with Alarm/Relay Controller for both Fluoride ISE & pH; 1 each Contacting Conductivity Measurement with K=10.0/cm & Full Range 0-500mS; Analog & MODbus Outputs for All Measurements; DAT Datalogger/MODbusmaster Module to record all parameters; Universal 115/230 Power Supply

Model: 3TX-7MF-ISE-NH4-D-ISE-NO3-D-ISE-NO2-D-pH-D-CON-1.0/50-D-DO-D-DAT

Description: Six Channel Measuring Transmitter Assembly Optimized for Low-Power Battery Operation; with NEMA 4X CSA/UL rated Enclosure (7 Module Max); 1 each ISE Ammonium Ion, 1 each ISE Nitrate Ion and 1 each ISE Nitrite Ion Module; 1 each pH module; 1 each Contacting Conductivity K= 1.0/cm & Full Range 0-50mS; 1 each Dissolved Oxygen module; Analog & MODbus Outputs for all Measurements & Temp; DAT Datalogger/MODbusmaster for continuous datalogging of all parameters

** For sensors with integral preamplifiers, order the pH/ORP transmitters as -pH-X and the ion selective (ISE) transmitters as -ISE-X and dissolved oxygen (DO) transmitters as -DO-X

*** For 2" NPT pipe mounting installations, an additional adapter plate must also be ordered for the 6M, 7MF & 9MF enclosures (inquire to factory for details).