

3TX Transmitters for Measurement, Control & Datalogging of Ion Selective, pH & ORP, Dissolved Oxygen & Conductivity



*Triple Channel Nitrate, pH & Conductivity Transmitter
3TX-3MF-ISE-NO3-D-pH-D-CON-1.0/50-D-PS*

The modular components of the 3TX series provide the flexibility to meet your application needs in a cost-effective way:

- **Custom configurations** means you only pay for the specific modules you need
- **Select any combination of measurements** that you need: pH, ORP, dissolved oxygen (DO), conductivity and ion selective (ISE)
- **Select the number of measurement channels** in the field assembly, from a single channel up to seven (7) channels
- Enjoy the flexibility to **add complementary modules either at initial installation or at a later time** without decommissioning the original analyzer assembly, including controllers (3TX-REL), dataloggers (3TX-DAT), pH compensation for ISE modules including MODbus converter for all inputs (3TX-TOT) and universal AC power supply

All modules in the 3TX series share these features and options:

- **Easy-to-read displays:** Bright three-digit LED displays are visible even in bright sunlight and do not suffer from the common problems associated with LCD displays, such as environmental fatigue and wear.
- **Easy to use:** Simple and intuitive three-button operation with no complex codes to memorize for most day-to-day tasks.
- **Easy installation:** Enclosures are customized for your modules and arrive ready for field mounting on any wall with no additional specialized hardware required. Modules are also available individually in a small, 35mm DIN-rail mountable form factor for direct integration into OEM equipment.
- **Weatherproof:** NEMA 4X CSA/UL rated & IP65 enclosures include high quality sealing cable glands (a.k.a. strain reliefs) that are ideal for weatherproof sealing on sensor, power, and output cables. Waterproof caps are also provided at no additional cost for all cable glands to seal and weatherproof any channels that will not be used.
- **Certifications:** CE approved for use in safe, non-hazardous areas (Class I, Division II or above - a.k.a. Zone 1 or above).
- **Security:** Optional lock available for all enclosure assemblies to restrict access to selected keyholders.
- **Power supply options:** Choose our CSA/UL/CE approved universal 100 to 240 VAC 50/60 Hz power supply module for line powered operation, or use any 3TX module with 3-wire 24VDC powered operation if you already have a dedicated 24VDC power supply (i.e. not shared with any other equipment) available onsite.



*Triple Channel Total Ammonia, pH & Conductivity Transmitter
3TX-4M-ISE-NH4-A-pH-A-TOT-CON-1.0/50-A*



*Single Channel pH Controller
 3TX-2M-pH-A-REL*

- **Option to customize default values:** Each module can be preset with your own preferred defaults for all user parameters at no additional cost (minimum order quantities apply for the feature)
- **½-DIN Panel & Pipe mounting option:** A universal two-inch (2") NPT pipe mounting kit is available for all 3TX enclosure options. The 3MP enclosure can be installed into any standard ½-DIN panel cutout. All enclosures are ready for wall mounting standard without any additional special hardware.

3TX Measurement Modules

- Measurement modules are available for pH, ORP, mV, temperature, ion selective (ISE), dissolved oxygen and conductivity.
- Scalable 4-20mA analog output is standard for all measurement modules, with optional MODbus digital output available at a nominal surcharge. Precise factory-calibrated linear analog output allows excellent use in control applications. All analog outputs have built-in trim calibration support, including both offset and span adjustments.
- Hold feature standard for all versions of the measurement modules for pH, ORP, ion selective (ISE), dissolved oxygen (DO) and conductivity parameters. When calibration mode is entered, the last value from measurement mode is held for both 4-20mA analog output as well as the MODbus output(s).
- Calibration of temperature is available for all measurement modules.



*Single Channel Contacting Conductivity
 Transmitter
 3TX-2M-CON-2.0/200-A-PS*

- Active 4-20mA can support remote external displays for viewing measured values in control panels, secondary field locations, or instrumentation shops.
- **ISE measurement module (3TX-ISE):**
 - 3TX-ISE displays, calibrates, and output in convenient ppm units.
 - Measures any ion, including Ammonium (NH₄⁺), Calcium (Ca⁺⁺), Fluoride (F⁻), Nitrate (NO₃⁻) and Nitrite (NO₂⁻) amongst many others. The type of ISE measurement must be preset at the factory. *
 - Simple offset adjustment allows easy field calibration of sensors while in service to agree with grab sample or laboratory analysis.
 - The standard 3TX-ISE transmitter supports and requires directly interfacing ion selective sensors without preamplifiers. In addition, the 3TX-ISE-X hardware version supports and requires ion selective sensors with preamplifiers to enable installations that require long cable lengths or to operate in very high interference areas. The software, features and functionality is perfectly identical for both hardware versions.
 - When the 3TX-ISE is combined with the 3TX-TOT and 3TX-pH modules, it can provide continuous inline field measurement of total ammonia (NH₃-N), total fluoride (HF), total cyanide (HCN) or total sulfide (H₂S) parameters without the use of any reagents within the permissible pH & temperature ranges.



*Six Channel pH/ORP/ISE/Conductivity Assembly
3TX-6MW-CON-ISE-REL-pH-ORP-ISE-PS*

- **Contacting Conductivity measurement module (3TX-CON):**
 - The 3TX-CON module supports most any cell constant (K), including 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, 5.0, 10.0 & 20.0. Effective calibrated cells anywhere from K=0.005/cm up to K=34.0/cm.
 - Support for low ranges down to 0-5 μ S and all the way up to 0-1,000 milliSiemens as required for the given application requirements.
 - Zero calibration for true 0.00 reading with your sensor dry in air.
 - Precise and wide-range gain calibration allows for effective (a.k.a. apparent) cell constant to be +/- 70% of the nominal sensor value.
 - Automatic correction for resistance and capacitance contribution of the cable length to the measurement for any sensor wire gauge and distance.
 - High resolution MODbus output available with 3TX-CON-E style unit.



*Seven Channel pH/ORP/ISE/Conductivity Assembly
3TX-7MF-ISE-CON-ISE-REL-pH-ORP-ISE-PS*

- **pH/ORP measurement module (3TX-pH):**
 - The 3TX-pH pH/ORP/mV/Temp transmitter allows for precise sensor calibration with support for two and three point slope calibrations. This means that a precise acid slope (pH below 7) and alkaline slope (pH above 7) is possible. One-point offset calibrations are possible at any pH value to allow for agreement with grab sample laboratory analysis.
 - The standard 3TX-pH transmitter supports and requires directly interfacing pH or ORP sensors without preamplifiers. In addition, the 3TX-pH-X hardware version supports and requires pH or ORP sensors with preamplifiers to enable installations that require long cable lengths or to operate in very high interference areas.
- **Dissolved Oxygen (DO) measurement module (3TX-DO):**
 - 3TX-DO module displays and outputs the concentration of dissolved oxygen in ppm, % saturation units, as well as the process temperature
 - Automatic correction for temperature, pressure and salinity for calibration and % saturation measurement modes
 - A simple gain calibration with sensor dry in air. The automatic gain calibration adjusts the sensor slope (mV per ppm DO) based upon pre-programmed 100% DO saturation at the temperature & pressure. No look-up tables are ever needed to calibrate the galvanic DO sensor.
 - No "Zero" calibration is ever needed for galvanic type dissolved oxygen (DO) sensors as they have a true zero potential.
 - The 3TX-DO module supports most any galvanic dissolved oxygen type sensor that is self temperature compensating (internal without integrated TC element required for this correction).



Temperature Module (3TX-TEM)

- 3TX-TEM is a module to add a scalable analog output for Temperature to any 3TX-pH, 3TX-ISE, 3TX-CON or 3TX-DO measurement module. This optional module can be used to add a temperature output at any time before or after commissioning.
- Input for temperature measurement can be Pt100 or Pt1000 type TC element integrated inside the sensor or else a separate temperature probe.
- Special hardware & software allows a single Pt100/Pt1000 element to be used both as input for a 3TX measurement module and a 3TX-TEM temperature transmitter. This configuration is referred to as “spliced” input mode and is the default.
- Any pH, ORP, ISE, conductivity or DO sensor with integral Pt100 or Pt1000 TC when in “splice” input mode will be used both for temperature compensation on the measurement module and to send a scalable output for temperature from the 3TX-TEM temperature module
- Direct wiring from separate (rather than shared) Pt100 or Pt1000 temperature elements is also supported. This configuration is referred to as “raw” input mode. In “raw” mode automatic correction for the resistance due to the cable is performed from user entered values for the wire gauge and cable length.
- Displays Temperature (°C) and raw Ohms from connected Pt100/Pt1000 element.
- Offset and gain (span) calibration types supported in both “splice” and “raw” modes for precise temperature measurement.
- Full range 0-210°C with a resolution of 0.2°C, Scalable 0-20mA or 4-20mA analog output type is selectable.

Control Module (3TX-REL)

- Each 3TX-REL module has 2 each independent Single-Pole Single-Throw (SPST) 5 Amp contact relays.
- Each relay is fully configurable by the user as to control mode and variables for each control algorithm.
- Tight integration between 3TX alarm & relay controller and 3TX measurement modules software makes configuration and scaling simple & easy for any local control requirements of the pH, ORP, ion selective (ISE), dissolved oxygen (DO) or conductivity parameters.
- The 3TX-REL alarm and relay controller module includes both basic and more sophisticated controlling options, including all of the following modes:
 - 1) A simple supervision option for alarm functionality only;
 - 2) An On/Off control with a user-configurable deadband (a.k.a. hysteresis);
 - 3) Time proportional control (TPC); and,
 - 4) Proportional frequency control (PFC, a.k.a. variable pulse controller).

It is possible to wire the analog 0/4-20mA output from 3TX-pH, 3TX-ISE, 3TX-DO or 3TX-CON measurement transmitter to other data acquisition or control device prior to connection with 3TX-REL alarm/relay module using the appropriate wiring scheme (see alternate wiring schematic for details).



Datalogging Module (3TX-DAT) and MODbus Options

- **MODbus:** If you would like to have MODbus digital output, there are two different approaches available:
 - 1: **Order measurement modules with MODbus option included.** Please note that adding the MODbus output is not an option after the module leaves the factory without MODbus.
 - 2: **Add a 3TX-TOT module to convert from analog to MODbus output.** Unlike the first approach, this flexible option may be selected either at the time of initial installation or at any time thereafter. The 3TX-TOT module also has additional functionality, as detailed in the section below.
- **Datalogging:** For datalogging functionality, there are also two different approaches:
 - 1: If you have opted for MODbus output using either of the approaches described above, you may **use a free of charge optional Windows PC software interface kit to the MODbus digital output.** This allows for real time display of all values for all transmitters that are wired to that MODbus line. In addition, the software kit allows for datalogging for all transmitters connected on the line, including both the scaled output value and temperature for each measurement module. Up to 247 devices can be supported on a single MODbus digital line (2-wire cable), and long cable length can be supported for field installations up to 6500 feet (1.23 miles or 1.98 kilometers) to make viewing in the instrument shop practical and easy.
 - A **free of charge Windows PC datalogging and graphing software** is provided for use with 3TX transmitters with the optional MODbus RS-485 digital output:
 - 2: A **3TX-DAT module** can be added to perform MODbus datalogging. The 3TX-DAT module allows for datalogging up to 63 each MODbus digital inputs from any mix of 3TX-pH, 3TX-ISE, 3TX-CON, 3TX-DO and 3TX-TOT modules. The sampling rate is configurable from once per second to once per hour. The 16MB onboard flash memory allows extensive datalogging capacity. Configuration of the 3TX-DAT is accomplished via the free of charge Windows datalogging and graphing software for 3TX transmitters with MODbus and uploaded & downloaded the separate ASTI Windows software for 3TX-DAT. The 3TX-DAT can be pre-configured upon request without additional charge. The logged data is downloaded to a Windows PC or tablet for further workup, graphing and analysis via the ASTI Windows software. The 3TX-DAT can be added at any time after commissioning if the mating 3TX measurement module(s) have the MODbus output option.
 - 3: Datalogging can also be accomplished by connecting (either directly or in series) the standard scalable 4-20mA analog output from the 3TX transmitters to any commercial PLC, SCADA or other data acquisition device that can be suitable configured to log engineered units for all measurements.

3TX-TOT pH Compensation Module to Compute Total ISE

- The 3TX-TOT module computes the total ISE. This module can compute total ammonia, total cyanide, total fluoride and total sulfide.
- The module computes the total ISE using three inputs: 1) the free ion activity; 2) the pH; and, 3) the temperature. These three input parameters are provided by the analog output from the respective measurement modules.
- A scalable 4-20mA analog signal is available to output the computed total ISE to PLC or other data acquisition equipment.
- MODbus included: All input and output data sent via MODbus standard with the 3TX-TOT module.

3TX Product Specification Sheet and Manual Links

<p>3TX-pH pH/ORP Transmitter</p>	<p>3TX-ISE Ion Selective Transmitter</p>	<p>3TX-CON Conductivity Transmitter</p>	<p>3TX-DO Dissolved Oxygen Transmitter</p>
<p>3TX-REL Alarm & Relay Controller</p>	<p>3TX-TOT Total ISE pH Compensation Module</p>	<p>3TX-DAT MODbus Datalogger</p>	<p>3TX-TEM Temperature Transmitter</p>

Common Special Features for All Measurement Modules (See Next Page)

- * Support for Custom OEM Configuration upon Request to define all setup parameter to a value of your choosing
- * Optional RS-485 MODbus digital output for all measurement modules (standard on 3TX-TOT module)
- * Low Cost datalogging and real-time monitoring with Windows PC software & MODbus digital output combination
- * 3TX-DAT MODbus datalogger interfaces with 3TX-pH, 3TX-ISE, 3TX-DO, 3TX-CON & 3TX-TOT modules with MODbus option



Key Features of 3TX Measuring Modules

Measurement	Input	Measurement Range	Outputs	Calibration Points	Compatible Sensor(s)	Special Features
Ion Selective (ISE) (3TX-ISE) *	- Any Combination Ion Selective Solid State & Organic Membrane *	Low (0.00 to 9.99), Mid (00.0 to 99.9), High (000 to 999) <i>All units for ranges are in ppm (mg/L)</i>	- Scalable Analog 0/4-20 mA for ISE or Temperature - Scaling Minimum 20% of selected range for Analog & MODbus outputs	- 2 point user defined to determine ISE slope - 1 point user defined for ISE standardize to correct for offset (drift)	- Any Suitable ASTI Ion Selective (ISE) Sensor with Pt100 or Pt1000 TC * <i>or</i> - Any Suitable ASTI Ion Selective (ISE) Sensor with Pt100 or Pt1000 TC and compatible preamp *	- Simplest field ISE instrument available on the market for easy commissioning and maintenance
pH or ORP (3TX-pH)	- Any Combination pH or ORP Sensor	- 0 to 14 for pH Standard (-2 to +16 with 3TX-pHE) -1000 to +1000 mV for ORP	- Scalable Analog 0/4-20 mA for pH, ORP (mV) or Temperature - Minimum 3 pH for Analog & MODbus outputs	- 2 point or 3 point calibration for determination of acid and alkaline slopes - 1 point user defined pH standardize calibration to correct for offset (drift)	- Any Suitable ASTI pH/ORP Sensor with Pt100 or Pt1000 TC <i>or</i> - Any Suitable ASTI pH/ORP Sensor with Pt100 or Pt1000 TC and compatible preamp	- Support for 1-point, 2-point, 3-point and arbitrary field offsets for optimal calibrations
Contacting Conductivity (3TX-CON)	- Any Contacting Conductivity Sensor with supported Cell Constant (K)	<u>Cell Constants Supported:</u> 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1.0, 2.0, 3.0, 5.0, 10.0 & 20.0 <u>Ranges:</u> 0-5uS up to 0-1,000 mS as per mating cell/configuration	- Scalable Analog 0/4-20 mA for Conductivity or Temperature - Minimum 10% of full scale range for Analog & MODbus outputs	- Gain adjustment to calibrate to effective (a.k.a. "apparent") cell constant - User configurable corrections for sensor cable length	- Any Suitable ASTI Contacting Conductivity Sensor with supported cell constant and integrated 100 or 1000 Ohm Platinum TC	- Correction for resistance and capacitance of sensor cable for both TC input and conductivity measurement itself
Dissolved Oxygen (DO) (3TX-DO)	- Most galvanic dissolved oxygen sensors that are self temperature compensating	<u>Minimum</u> 0.00 to 4.00 ppm (0-40% Saturation) <u>Maximum</u> 00.0 to 40.0 ppm (0-400% Saturation)	- Scalable Analog 0/4-20 mA output for DO readings in ppm or % Saturation - Minimum 10% of full scale range for Analog & MODbus outputs	- Gain calibration with sensor dry in air using either automatic or manual mode - No "zero" calibration for galvanic type DO sensors	- AST-DO or equivalent active self-polarizing galvanic DO cell that is self temperature compensating (without need of integrated TC element for this correction)	- Calibration and % saturation is automatically corrected for temperature, pressure and salinity for accurate measurements

* Ion selective measurement type must be set at time of purchase at ASTI factory. 3TX-ISE transmitters are not sold separately but rather only as part of complete ISE system including both the ISE transmitter AND ISE sensor supplied complete from ASTI factory. ISE measurement must be validated for feasibility by ASTI prior to sale.



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
-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 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 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
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33W) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

** To obtain a 3TX that supports and requires sensors with preamplifiers, order the pH/ORP transmitters as -pH-X and the ion selective (ISE) transmitters as -ISE-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).

3TX pH & ORP Controller, Transmitter & Datalogger Family



- The 3TX pH/ORP analyzer is available with sensors engineered for applications ranging from general purpose drinking water to harsh chemical conditions including low or high temperatures & high pressures
- Modular electronics gives flexibility to specify a single channel transmitter or else an analyzer with alarms, relay contacts for control as well as remote datalogging
- You may select multi-parameter analyzer with any combination up to 8 each pH, ORP, conductivity, dissolved oxygen (DO) or ion selective (ISE) sensors
- Sensors are rugged industrial grade with components and options optimized for your application use with mating instrument designed for accuracy & longevity
- 3TX transmitters are available for wall, pipe or panel mounting enclosure styles for 2, 3, 4, 6 or 8 modules; Supports 24VDC or 115/230 VAC power operation

Application Engineered pH Sensors:

- **Municipal Drinking Water:** General purpose pH measurement for compliance and process control.
- **Wastewater:** Systems specifically for municipal and food processing waste streams featuring break resistance and harsh chemical resistance material of construction.
- **Food, Beverage and Dairy processing:** Solid state sensors for sanitary CIP applications and temperatures from -30°C to 150°C, with dehydration resistant reference and heavy wall crack resistant pH glass.
- **Tough Applications:** Temperatures to 150°C, pressure to 150 PSIG, resistance to chlorine & chlorine dioxide gas, acid/fluoride, saturated sodium, sulfide, cyanide & a variety of solvents and hydrocarbons
- **Replacement pH Sensors:** Compatible with almost every brand of pH transmitter or controller are available, including the 5-wire differential type pH sensors found in many drinking water plants.
- **Sensor Body Materials:** CPVC, RYTON® (PPS), ULTEM™ (PEI), PEEK

Standard Features:

- ✓ Fully scalable analog output 4-20mA or 0-20mA for pH/mV, ORP or temperature. Active 4-20mA can support external displays in control panels or secondary locations.
- ✓ Supports 2-point and 3-point slope calibration to provide a precise acid slope and a precise alkaline slope. One-point offset calibration done with the sensor in service quickly synchronizes the unit with grab sample or laboratory determined measurements.
- ✓ Galvanic isolation between sensor input, power & analog output (3000V rating)
- ✓ Optional external preamplifier makes it unnecessary to open the analyzer for sensor replacement and optimizes performance for long cable runs or electrically noisy environments.
- ✓ Combination solid state, double & triple- junction pH sensors in various mounting styles and thread sizes, including inline pipe tee, twist lock quick disconnect, immersion, submersible, valve retractable. Sensor life is often two to ten times (2X to 10X) that of competitor's sensors.



GENERAL SPECIFICATIONS: 3TX-pH pH/ORP Transmitter / Analyzer / Controller

Measurement Type:	Single or multi-channel inline pH / ORP / mV / Temperature
Application :	Drinking water through wastewater, chemical processes, pollution control, long service life with low maintenance applications, support for remote installation locations; can be powered on and off at will
Transmitter pH / mV Range & Accuracy:	0-14 pH (-2 to +16 pH with 3TX-pHE version), ±1000mV, 0-210 °C. Accuracy ±0.2%
Sample Temperature Range:	CPVC: +5 to 60 °C; RYTON: -5 to +70 °C; ULTEM™: -5 to +105 °C; PEEK: -30 to +150 °C
Pressure Range:	CPVC: 1- 50 PSIG; RYTON & ULTEM™: 1-100 PSIG; PEEK: 1 to 150 PSIG; Twist Lock: 1-100 PSIG
Sensor Body:	CPVC, Ryton®, Ultem™, PEEK
Measuring glass types:	Most applications use most universal green glass, high HF resistant, and saturated sodium resistant
Glass configuration:	Hemispherical and Flat
Sensor Installation options:	1.05" or 1.31" diameter, screw-in inline 3/4" and 1" MNPT, immersion & submersion, valve retractable, 1" NPT twist lock quick disconnect inline
Reference System:	Double junction, Ag/AgCl, cross linked polymer is resistant to heat, solvents, and most chemicals. Sensor holds an excess of KCl, assuring saturation at all temperatures and extending sensor life. Solid-state conductive polymer minimizes effects of contaminants and permits sensor to be left dry for extended periods. Special order "Extreme" Dehydration resistant option available upon request.
Reference System - Primary Junction:	Porous Ceramic, Saturated KCl in cross linked polymer
Secondary Junction:	High Density Porous Polyethylene (HDPE) or porous KYNAR (PVDF), Sat. KCl in cross linked polymer
Display:	Bright 3-digit red LED display visible in sunlight of pH/mv or temperature with 6 LED indicators
Power Supply:	CSA/UL/CE approved universal 115/230 VAC power supply, consumption 60mA max per module
Signal Output:	Scalable 0-20mA or 4-20 mA DC 500 Ω max, Additional RS-485 Modbus digital output optional
Enclosures & Mounting Supported:	Wall, Pipe or Panel Mounting for 2, 3, 4, 6 or 8 modules per enclosure (NEMA 4X Rated & UL Listed)
ORP Sensors:	Platinum Low-Profile Slurry & High-Pressure & High-Flow Resistant Ball Style ORP Sensing Element -1000 to +1000 mV for various pressures, temperatures & chemical resistance

Module Description & Available Options:

Transmitter Modules: Precise sensor calibration support both 2-point & 3-point slope calibrations for a precise acid slope (pH below 7) and a precise alkaline slope (pH above 7) for optimal measurement accuracy. Grab sample 1-point offset calibration means that you can standardize to any buffer or sample of known pH to allow for precise agreement with any reference method. In addition to pH, ORP, mV and temperature, measurement modules are available for conductivity, dissolved oxygen (DO) and ions including fluoride, ammonia, nitrate, nitrite and calcium (and others). Each module includes 3-digit LED display and scalable 4-20mA output. Analog outputs have built-in trim offset and span calibration adjustments. Calibration of temperature is available for all measurement modules via 1-point offset adjustment. User selectable auto or manual temperature compensation modes.

Preamplifier Support: Unlike many low cost systems, the 3TX-pH and 3TX-ISE transmitter series supports optional external preamplifiers for noisy environments or to avoid opening the analyzer enclosure for sensor service, and to minimize sensor replacement costs (no long cables need be pulled).

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: Simultaneously datalogging from any 3TX module with MODbus output (3TX-pH, 3TX-ISE, 3TX-CON, 3TX-DO, 3TX-TOT) at frequency from every second to every hour. Configuration and downloading of data done via freely supply mating Windows PC software.

3TX-TOT Option: Computes the total concentration of ammonia, fluoride and cyanide using the free ion activity, pH, and temperature inputs from the respective measurement modules' bridged outputs. Provides scalable 4-20mA output for computed total ISE and Modbus output for all used inputs.

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 and 3TX-TOT.

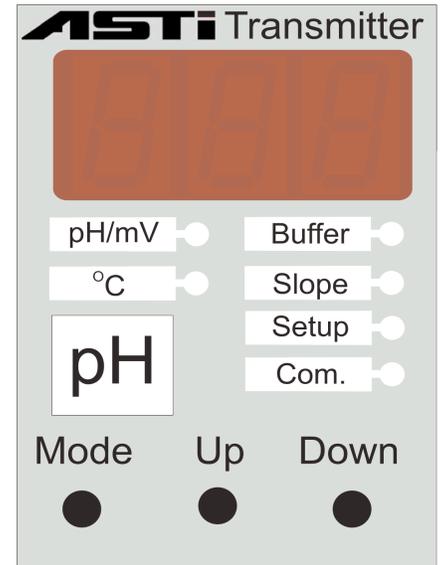
Enclosure Options: NEMA 4X Enclosures (UL Listed) for 2, 3, 4, 6, or 8 modules for Wall, Panel or Pipe Field Mounting or 35mm Din-Rail Only

Power Options: Universal 115/230 VAC power supply, or 3-wire 24VDC operation if you have a power supply onsite (not 2-wire loop powered).

Last Revised November 27, 2012

Model 3TX-pH 3-Wire pH/ORP/mV/Temp Transmitter

- 3TX-pH is a transmitter for pH, ORP, mV and Temperature Measurement
- Data Ranges: 0-14pH, ±1000mV, 0-210 °C (-2 to +16 pH with 3TX-pHE unit)
- pH/ORP sensor with & without preamplifier supported (300 feet max w/preamp)
- 2-Point Slope calibrations use the same slope in acidic and alkanline ranges
- When 3-Point Slope Calibration Configuration is enabled a separate slope can be established (calibrated) for acidic ranges (0-7 pH) and alkaline ranges (7-14 pH)
- Arbitrary Single (1-Point Offset) Calibration supported for quick calibration with single pH buffer or to allow for agreement between laboratory pH determinations
- Temperature compensation via Platinum 100 or 1000 Ohm element
- Display pH/mV or Temperature
- Fully Scalable Analog Output 0-20 mA or 4-20 mA for pH/mV or Temperature
- Galvanic isolation between sensor input, power & analog output (3000V rating)
- Optional: Serial communication via RS-485 MODbus Digital Output
- Field installations using weatherproof NEMA 4X & IP65 enclosures for up to 7 ea pH/ORP/ISE/DO or conductivity transmitters in single enclosure assembly



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 "lock" must be set to 'Off' to change ANY parameter, including the temperature, buffer and slope 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

The pH/ORP sensor without a preamplifier is connected directly to 3TX-pH transmitter. The mV signal from these sensors are processed by an integrated high impedance amplifier before entering the microprocessor. Alternatively, the 3TX-pH-X hardware version can support external preamplifiers to enable installations that require long cable lengths or to operate in very high interference areas. Temperature measurement is accomplished with a 2-wire Pt100/Pt1000 temperature sensor and then temperature compensation performed by the built-in microprocessor.

Analog Output

The 3TX-pH transmitter (module) has a scalable analog output of either 0-20 mA or 4-20 mA (selectable). The minimum pH range between the low (0mA or 4mA) and high (20mA) output is 1 pH unit with the default as 0 pH at 0mA or 4mA and 14pH at 20 mA. The output is proportional to pH/mV or Temperature and is galvanic insulated from the inputs.

MODbus (Optional)

Aquired data is transferred using MODbus standard for multidrop communication and are connected using RS485 system. The Modbus-master may be the 3TX-DAT module or any SCADA system. When units are ordered with MODbus option, the free of charge Windows datalogging and graphing software and be used to monitor & record all process and temperature values from up to 247 transmitter simultaneously at distances up to 6500 feet (2 kilometers).



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
Sensor: Combination Sensor
pH/mV Range: 0-14 pH, ±1000mV
pH input: < 1pA, >10GΩ
Accuracy: ±0.2% Excluding Sensor (Ideal)
Temp Sensor: Pt100, Pt1000
Temp Range: 0-210°C ± 0.3°C
Temperature: Fixed (Manual) or Automatic using
Compensation: Temperature (TC) Measurement
Analog Output: 0-20mA or 4-20mA, max. 500Ω

PARAMETERS

Function and Programming

The 23 programmable parameters are shown to the right. For access see the paragraph about programming on page 1.
If the softwarelock (Par. no. 1) is "On" the parameter can only be read. Set Software Lock to "Off" to change values.
Par. no. 2 sets the module's address for MODbus communication.
Par. no. 3 indicates the type of input for the pH/mV input.
Par. no. 4 indicates the type of input for the temperature input.
Par. no. 5 If Par. no. 3 is set to pH, the signal is temperature compensated. Par. no. 5 sets the temperature compensation to either set (manual) or based on the measured temperature.
Par. no. 6 sets the temperature for when temperature compensation of the pH measurement is in set (manual mode).
Par. no. 7 If a long cable is used for the Pt100 sensor the cable impedance should be entered and compensated for this offset.
Par. no. 8 is used to set how the pH sensor slope is calibrated. If 3-Point Slope Option is (On), the sensor is calibrated to have two different slope for the acidic pH range (i.e. between 6.86/7.00 and 4.01 buffers) and the alkaline pH range (i.e. between 6.86/7.00 and 9.18/10.00). If 3-Point Slope Option is (Off), the slope from a single slope calibration will be used in all pH ranges (0-14).
Par. no. 9 If Par.no. 3 is set to mV, the range is set using this parameter. It is possible to select the whole range (±1000mV), the negative range (-1000-0mV) or the positive range (0-1000mV). This setting impacts the analog output and transferred data.
Par. no. 10 is used to set the analog output proportional to either the pH/mV signal or the temperature signal.
Par. no. 11 sets the analog output to either 0-20 mA or 4-20 mA.
Par. no. 12 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. 13 & 14 are used to set the pH value that corresponds to 0/4mA output setpoint (**Par no. 13**) and sets the pH value that corresponds to 20mA output setpoint (**Par no. 14**). The minimum difference between Par no. 13 and 14 must be at least 1.0 pH unit although it is fully scalable without the ranges specified.
Par. no. 15 Variable to define the mV change for each "Up" or "Down" button depression when calibration is performed.
Par. no. 16 View & edit working sensor offset (Abs mV at pH 7)
Par. no. 17 View & edit working sensor slope 1. If P08 is OFF (default) then slope for full 0-14 range. If P08 is ON (3-Point Cal

List of Parameters

No	Parameter	Description	Range	Default
01	Lock	Software Lock	On / Off	On
02	Address	MODbus	Off, 1...247	Off
03	pH/mV	Type of Input	pH, mV	pH
04	Temperature	Type of Input	Pt100, Pt1000	Pt1000
05	Compensation	Temp. Comp.	Auto, Set	Auto
06	Manual Temp	Fixed Temp	0...210	25
07	Cable Impedance	Impedance of Pt100 Cable	0.0 .. 9.9 Ohm	0.0
08	3-Point Slope Option	Calibration of Sensor Slope	Off (2-Point) On (3-Point)	Off
09	Range mV	Range for mV	±1000, -1000 to 0 0 to +1000	±1000
10	Input for lout	Input used for output	pH or Temperature	pH
11	lout	Type of output	4-20mA, 0-20mA	4-20
12	lout mode	lout mode	noninverted, inverted	n.inv
13	0/4mA Set	Low Setpoint	0.0-13.0 pH	0.0
14	20mA Set	High Setpoint	1.0-14.0 pH	14.0
15	Step Change	mV Increment for Calibration	0=0.2, 1=0.5, 2=1.0, 3=2.0	1 (0.5mV)
16	Offset	mV @ pH 7	±250 mV	0
17	Slope 1	mV per pH	30 to 90	59.2
18	Slope 2	mV per pH	30 to 90	---
19	0/4mA Offset	Trim Low	±9.99%	0.00
20	20mA Gain	Trim High	±9.99%	0.00
21	Energy Save	Energy Save	On / Off	On
22	Baudrate	MODbus	9,600/19,200	19,200
23	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par

/ Dual Slope mode) then this is the slope for 0-7 pH range.
Par. no. 18 View & edit working sensor slope 2 for 7-14 pH range. This is valid only if P08 is ON, or else just blank "----" no value.
Par. no. 19 Offset adjustment for 0/4mA low analog output trim.
Par. no. 20 Gain adjustment for 20mA high analog output trim.
Par. no. 21 If no keys are pressed for 10 minutes the display will show a flashing bar (Energy Save). Pressing any key to return.
Par. no. 22 The MODbus standard requires a baudrate of 9,600 or 19,200 set in accordance with the MODbus-master.
Par no. 23 Feature to reset the analyzer back to factory default.

Buffer / Slope Adjustment

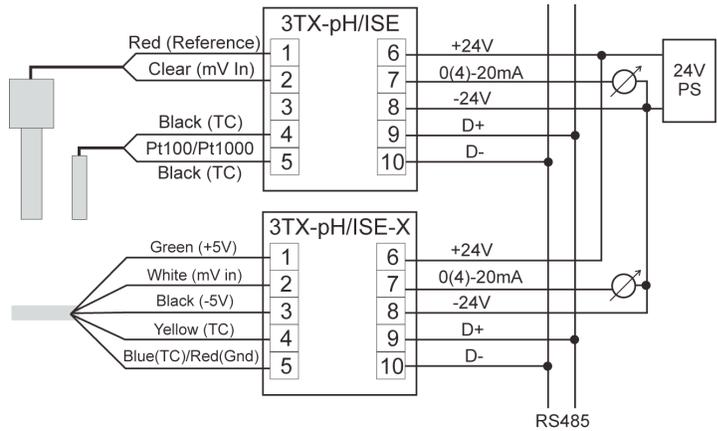
Using 'Mode' select 'Buffer' and calibrate to first desired value using Up/Down keys (typically pH buffer 6.86 or 7.00). Next using 'Mode' select 'Slope' and use Up/Down keys until display reads the second desired value (typically pH buffer 4.00 for low pH use and 9.18 or 10.00 for high range pH use). Dual slope mode is recommended when the process media frequently crosses pH 7 boundary (P08 set to 'On'). For dual slope, sensor is calibrated at three points: one near pH 7 (in 'Buffer' mode) then in a pH buffer below pH7 (in 'Slope' mode) and then in a pH buffer above pH7 (in 'Slope' mode). You must exit the 'Slope' mode after completing the acidic slope (below pH7) calibration before entering the alkaline slope (above pH7) calibration.

The 'Buffer' calibration can achieve a process offset whereby the online reading can be made to agree with any grab sample analysis. A two (2) second dampener exists for both calibrate modes and a ten (10) second dampener for the measure mode.

The sensor offset and slope values can be manually entered using **P16, P17 & P18**. All settings are stored in EEPROM so unit can be powered down without loss of configuration or calibration.

NOTE: The raw uncompensated (a.k.a. "absolute") mV potential of the pH sensor is displayed by pressing the "Down" key in the main pH/mV display mode. The display now changes from pH to absolute mV units. Negative values will be displayed flashing. The temperature can be calibrated pushing the "Up" or "Down" buttons when in the temperature display (°C) mode.

Typical Installation



The wiring for sensors with and without preamplifiers are detailed above. Note that these two wiring details represent interface with two altogether different hardware versions which must be selected at time of purchase.

MODBUS

In order to utilize the MODbus interface the 3TX-pH must be ordered with MODbus. 3TX-pH may be used as a slave for the 3TX-DAT or as a slave in a SCADA data acquisition. The setup and communication for each case will be explained below.

With 3TX-DAT

If 3TX-pH is used with 3TX-DAT, the baud rate on the MODbus as well as the address of the 3TX-pH should be noted. **The baud rate (P14)** must be set to the baud rate of the 3TX-DAT. Whether a baud rate of 19,200 or 9,600 is used is of no importance, as long as all units on the MODbus are set to the same baud rate.

The address (P02) must be unique in the network; Two units cannot have the same address. In a network with 3TX-DAT as the master, all addresses must be assigned in series; i.e. if 3 units are connected to 3TX-DAT, the addresses 1, 2 & 3 must be assigned to the three units. The order of the addresses is of no importance. In a network with a 3TX-DAT, up to 63 slaves may be connected.

In a SCADA system

The baud rate (P14) must be set to the baud rate of the SCADA system. **The address (P02)** must be unique in the network and Up to 247 3TX transmitters may be connected on a single network.

MODbus Scaling

The 3TX-pH in pH mode has the full 0-14 pH range or else in ORP mode will be as set in P09 (mV range). The 3TX-pHE in pH mode has the full -2 to +16 pH range or else while in ORP mode has the -1000 to +1000 mV range (both full scale). Note that the MODbus scaling may differ from 0/4-20 mA analog scaling for both units.

The 3TX-pH contains 2 measurements (pH/mV and temperature). Access to these are gained through the function code *Read_Input_Registers (04)*. The 3TX-pH gives access to different diagnostic values via *Diagnostics (08)*, as shown in the following.

Read_Input_Registers

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

Value 1 is pH/mV and value 2 is temperature. The measurements are transmitted in sequence; If 2 values are chosen both pH/mV and temperature are transmitted. If the value for temperature is wanted, 2 values must be requested. Both values are rated 0-1000 corresponding to the range, but the temperature has an offset of 1024; i.e. 0-14pH is transmitted as 0-1000 and 0-210°C as 1024-2024. Inquire to factory about scaling for special 3TX-pHE units.

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 Communication 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

<i>ENCLOSURE TYPE</i>	
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)
<i>MEASUREMENT MODULES ONE (1) THROUGH SEVEN (7)</i>	
CODE	DESCRIPTION
-pH **	pH/ORP/mV/Temp Measurement Module / Transmitter
-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
<i>OUTPUT OPTIONS FOR MEASUREMENT MODULES (ONE OPTION MUST BE SELECTED FOR EACH MODULE)</i>	
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 AND RS-485 MODbus Digital Output
<i>ADD-ON MODULES FOR MEASUREMENT MODULE ENCLOSURE ASSEMBLIES</i>	
CODE	DESCRIPTION
-PS	100 to 240 VAC 50/60 Hz Universal Power Supply Adapter for Line Powered Operation
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33Wh) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

** To obtain a 3TX that supports and requires sensors with **preamplifiers**, order the pH/ORP transmitters as **-pH-X** and the ion selective (ISE) transmitters as **-ISE-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).



General Installation & Calibration Guide to Installation & Calibration of ASTI pH Sensors with the 3TX-pH Transmitter

Power Wiring

Before energizing any 3TX transmitter, please read the relevant recommendations and warnings on page 1 & 2 of the 3TX FAQ write-up (see link below):

http://www.astisensor.com/3TX-FAQ-pH_ORP_Ion_Selective_ISE_Conductivity_Transmitter_Controller_Application_Notes.pdf

Before starting, if you are concerned that any setting have been inappropriately or accidentally modified you can reset the unit back to the factory defaults by turning P01 to 'Off' (this disables the software lock) and then toggle over to P23 and invoke a reset (set value to 'Def' and then press the mode key to accomplish this).

The general stepwise checklist for installation and calibration of ASTI pH sensors on the 3TX-pH transmitter is as follows:

Sensor Wiring

Confirm that the wiring is correct. There exists two basic categories of pH sensor that can be interfaced with the 3TX-pH transmitters. The first is a pH sensor without any integral preamplifier. This type of pH sensor is connected to the model 3TX-pH-A or 3TX-pH-D type transmitters. The second is an installation that either has an integral preamplifier inside the sensor or else an external preamplifier installed between the sensor and the transmitter. This type of pH sensor/installation is connected to the model 3TX-pH-X-A or 3TX-pH-X-D type transmitters. In either case, an integral Pt100 or P1000 element is required to have automatic temperature compensation with the 3TX-pH transmitter.

Wiring for pH Sensor to 3TX-pH without preamplifier

http://www.astisensor.com/ASTI_3TX-pH_3TX-ISE_Sensor_Wiring_Schematic.pdf

Wiring for pH sensor with integral preamplifier to 3TX-pH-X with tinned lead wire terminations

http://www.astisensor.com/ASTI_3TX-pH-X_3TX-ISE-X_Sensor_Preamp_Wiring_Schematic.pdf

Wiring for pH sensor with integral preamplifier to 3TX-pH-X with quick disconnect Q5M/Q5F terminations employed

http://www.astisensor.com/ASTI_3TX-pH-X_3TX-ISE-X_Sensor_Q5M_Q5F_Quick_Disconnect_Preamp_Wiring_Schematic.pdf

Wiring for pH sensor without integral preamplifier to 3TX-pH-X when external preamplifier is employed

http://www.astisensor.com/ASTI_3TX-pH-X_3TX-ISE-X_with_Mini_External_Preamp_Hookup.pdf

3TX-pH Documentation

The calibration instructions for the pH sensors with the 3TX-pH transmitters can be found at the top of page 3 of the document linked below:

<http://www.astisensor.com/3TX-pH.pdf>

Additional information and details regarding performing pH sensor calibration with the 3TX-pH transmitters is provided in the following pages. **As always, please note that to make ANY changes at all on ANY 3TX transmitter, the parameter P01 software lock needs to be toggled from the default 'On' to the 'Off' setting. This P01 software lock will reset after a period of inactivity back to the default 'On' state and must then be disabled again to make any setting or calibration changes.**



Buffer / Slope Adjustment Typical Installation:

Using 'Mode' select 'Buffer' and calibrate to first desired value using Up/Down keys. The recommend pH buffer for calibration in the 'Buffer' mode is 6.86 (preferred) or 7.00. Next using 'Mode' select 'Slope' and use Up/Down keys until display reads the second desired value which is typically pH buffer 4.01 when the measured pH will be normally below 7 and typically 9.18 (preferred) or 10.00 when the measured pH will be normally above 7. Enabling dual slope mode is recommended when the process media frequently crosses pH 7 boundary. The dual slope mode is disabled ('Off') by default, but can be enabled by setting the parameter P08 to the 'On' state. When dual slope is enabled, the pH sensor is calibrated at three points: one near pH 7 (in 'Buffer' mode), then in a pH buffer below pH7 (in 'Slope' mode) and then in a pH buffer above pH7 (in 'Slope' mode). **You must exit the 'Slope' mode by using the mode key after completing the acidic slope (below pH7) calibration before entering the alkaline slope (above pH7) calibration.** The 'Buffer' calibration can achieve a process offset whereby the online reading can be made to agree with any grab sample analysis. All calibrations are saved instantaneously as they are performed so there is no "save" or "enter" operation required. Note that a two (2) second dampener exists for both calibrate modes and a ten (10) second dampener for the measure mode.

Display Features:

NOTE: The raw uncompensated (a.k.a. "absolute") mV potential of the pH sensor is displayed by pressing the "Down" key in the main pH/mV display mode. The display now changes from pH to absolute mV units. Negative values will be displayed as flashing. **The temperature can be calibrated by pushing the "Up" or "Down" buttons when in the temperature display (°C) mode.**

There are very many potential issues that are involved in the uncertainty of an online pH measurement. Some of the most common possible issues are summarized below and may be applicable to your particular installation.

Common Thermal Related Issues

Make sure that the online industrial sensor is in thermal and chemical equilibrium with the process before making any one-point offset calibration. Please note that sensors that run in hot processes should be allowed to cool down to room temperature before performing a 2-point calibration. The temperature indicated on the sensor can be used as a gauge of when it is ready to proceed with a calibration having reached a thermal equilibrium with ambient conditions. Calibrating a pH sensor when it is not at thermal equilibrium is a very common cause of calibration error and uncertainty that is altogether avoidable. If you are interested in performing reproducible online pH measurements, you may want to review our technical article on this subject which is accessible from the link below:

http://www.astisensor.com/minimizing_user_errors_ph.pdf

Common Offset Type Issues

If the displayed by the online sensor diverges from the lab expected reference value it is possible to force agree between these two reading with the 3TX-pH transmitter even after a calibration has been performed with pH buffers. Such a one-point grab sample type offset calibration is performed when in the 'Buffer' LED mode. Navigate with the 'Mode' key to the 'Buffer' mode while the pH sensor is installed into the process and the reading is quite stable and use the 'Up' and 'Down' keys to adjust the displayed value to agree with the laboratory determined reference value if desired. Such a grab sample offset type calibration should only be performed after all pH buffer calibrations have been completed.

pH Buffer Accuracy & Stability Issues

It is important to consider that some pH buffers degrade in quality much more quickly than others when left open to air, or else with exposure to heat and/or light. In particular, both commonly used pH buffer 7.00 and 10.00 are notorious about losing the accuracy of their values when exposed to the air, sunlight or just simply degrade with time. In contrast, the 4.01 pH buffer is a well known VERY stable pH buffer and so is the industry default standard for both conditioning and spot 1-point tests for pH sensors. One important step to ensure accurate calibrations with pH buffers is to be sure to check whether your buffers employed are still within the expiry period and the make sure that they were stored in a cool dry storage location away from sunlight.



In addition to the 4.01pH sensor, the 6.86 and 9.18 pH buffers are amongst the most stable pH buffers available. It is strongly recommend purchase colorless pH buffers rather than the more common colored pH buffers. If colored pH buffers are used for calibrations, it is important that they are NOT also used as the conditioning solution in which pH sensors are stored (this should be reserved for colorless type pH buffers). For higher value pH buffers (10+) it is recommended to purchase only smaller amounts (to ensure that they stay in code) and keeping them stored in a sealed container (make sure that they cap is on tight) in a cool, dry place to minimize the absorption of carbon dioxide from the air that can alter the value of these high pH buffers. In general, the higher value pH buffers are notorious very unstable, much as the very low pH buffers also tend to be rather more unstable. The best available option for calibration of pH above 10 is the 12.45 type pH buffer. The best available option for calibration of pH below 4 is the 1.68 type pH buffer. For general purpose calibrations, the MOST stable pH buffers are 4.01 and 6.86 and to a lesser degree 9.18. If the preferred 6.86 or 9.18 buffers are not available, the 7.00 and 10.00 buffers can be substituted with some slight loss of precision due to the differences in relative pH buffer stabilities.

pH BUFFER DURING CALIBRATION NOTE:: Since the 3TX-pH transmitter does not automatically correct for the temperature effects on your particular pH buffer, you will need to manually enter the correct buffer pH value at your particular temperature manually to ensure optimum accuracy during the calibration step. Each pH buffer solution is always labeled with the pH value at various temperatures so that you can adjust the pH to the appropriate number. Temperature compensation on the 3TX-pH does NOT account for the change in the pH buffer values due to temperature and so this correction must be done manually.

Temperature effects on pH Reading

More generally, note that temperature compensation for pH mode ONLY accounts for the change in potential of the pH sensor itself due to temperature. Any other temperature induced changes to the pH of any given solution (such as changing the effective mean activity coefficient or equilibrium of the process media or pH buffer) are NOT accounted by temperature compensation and thus must all be considered separately. Lastly, for ORP measurements there exists no temperature compensation at all meaning that temperature displayed is simply for reference purposes.

Dual Slope / Three-Point Calibration Feature of 3TX-pH Transmitters

Most transmitters will only use a single slope for the pH sensor response. In this way, the user should select the pH buffers to most resemble their typical pH value in the process. For acidic type applications, the pH buffers of 4.01 and 6.86 are best (or 7.00 if the better 6.86 is not available). For alkaline applications, the pH buffers of 6.86 and 9.18 are best (or 7.00 & 10 if the better 6.86 & 9.18 are not available). The cumulative uncertainty from using two poor buffers (such as 7.00 & 10.00) is not negligible. In the acidic case if at least the good 4.01 pH buffer is used then the uncertainty due to using the more poor 7.00 is somewhat muted (obviously 4.01 and 6.86 would better pairing). For calibration of applications consistently below pH4, the 1.68pH buffer is employed to obtain better slope values in the lower pH range. Calibration for applications consistently above pH10, the 12.45pH buffer is employed to obtain better slope values in the higher pH range. For inquiries about the best choice of pH buffers, please submit a support ticket about such questions.

While most continuous multi-stage processes do not tend to cross the neutral pH7 threshold, this CAN occur much more commonly for batch type applications. In this case, it is best practice to have both an acidic and alkaline slope calibrated separately. Unfortunately, most modern pH transmitter do not offer this option. Thankfully, the 3TX-pH transmitter DOES offer such as dual slope option (a.k.a. three point calibration). This is enabled by changing the parameter P08 from the default "Off" to "On" state. When this 3-point calibration (dual slope) now enabled you will have:

- P16 - Display and/or adjust AP (mV offset @ pH7)
- P17 - Display and/or adjust acidic slope (mV per decade response below 7)
- P18 - Display and/or adjust alkaline slope (mV per decade response above 7)

When P08 is "Off" then the mV per decade response shown in P17 is used in both the acidic and alkaline range.

Last Revised November 22, 2014



IOTRON™
pH / ORP / ISE / DO / Conductivity Measurement Products Lines

3TX-ISE Ammonia, Nitrate, Nitrite Transmitter, Controller & Datalogger



A typical system is shown above with free ammonia (ISE) and pH as inputs for the TOT to compute total ammonia. The 3TX-CON conductivity is the third optional input above but could be a DO, ORP or ISE measurement.

- The 3TX-ISE online analyzer with ion selective electrodes for Ammonia Nitrogen (NH₃-N), Nitrate (NO₃-N), and Nitrite (NO₂-N), can be reliably used as a monitor and method of control in the nitrification and nitrogen removal process, or to monitor drinking water chloramination.
- The 3TX-ISE is a simpler, lower cost alternative to many sample conditioning analyzers while providing reliable real time measurements in the conditions commonly found in most municipal wastewater and potable water applications.
- The modular design allows you to select a single channel or multi-channel transmitter, analyzer, or controller for any combination of available measurement parameters.
- Standard 4-20mA analog output and optional MODbus digital output for full integration with your existing SCADA or process control system

3TX-ISE Features & Benefits

- Unique membrane technology results in a rugged sensor that does not need rebuilding or maintenance. **You can typically expect twice the sensor life compared to competitive sensors for most applications.**
- Flexibility to configure the 3TX as a simple transmitter or a controller *for any combination of measurements and functions* to suit your needs. You can configure one system to monitor ammonia nitrogen, nitrite & ORP and another nitrate with alarm functions, and monitor pH with alarm and control functions.
- Nitrate/nitrite sensors don't suffer interference from turbidity or COD unlike optical ISE sensors
- Minimize maintenance and ownership costs due to rugged ISE sensors that require no reagents, no sample preparation & no rebuilding. Standard weekly sensor cleaning is sufficient for secondary WWTP use.
- 1-point grab sample offset calibration quickly standardizes the inline ISE instrument with your lab's analysis used for reporting WITHOUT removing the sensor from service.

Unique Membrane Technology

Engineered from the ground up and extensively field tested, unique proprietary membrane technology provides significantly improved sensor life and selectivity of ammonia over potassium; and nitrate over chloride ions, versus traditional ion selective electrode (ISE) membranes while offering substantial improvements in service longevity. Industry leading solid-state conductive polymer industrial reference system completes the ISE design to ensure low-maintenance and cleaning frequency.



Typical Applications

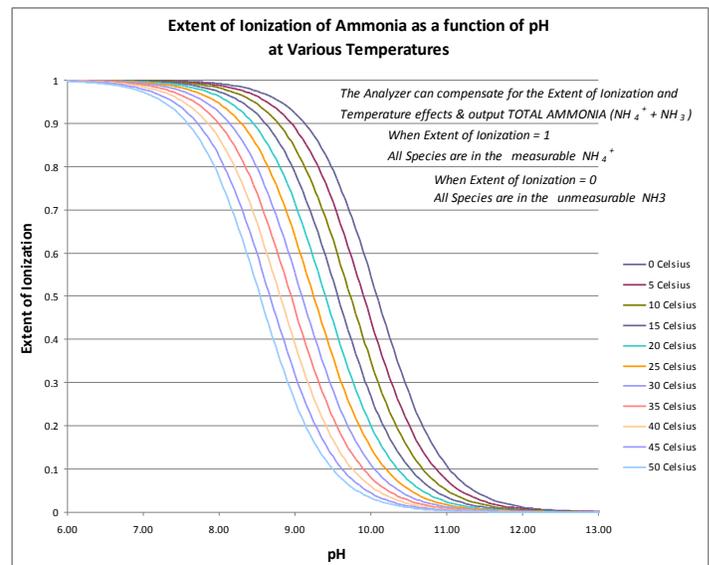
- Single channel Ammonia Nitrogen (NH₃-N), pH, nitrate (NO₃-N), nitrite (NO₂-N), conductivity or ORP for secondary or tertiary wastewater treatment monitoring and process control.
- Potable water nitrate reduction – 3-channel nitrate, pH, conductivity monitoring,
- Wastewater influent monitoring – dual channel ammonia nitrogen, pH.
- Wastewater nitrification & denitrification – 3 or 4-channel ammonia nitrogen, pH, nitrate, nitrite monitoring to assure full nitrification and prevent excessive chlorine consumption due to high nitrite.
- Wastewater final effluent – 3-channel monitoring of nitrate, pH, conductivity.
- Drinking water distribution systems– low level ammonia & nitrate monitoring.
- Industrial wastewater treatment including ammonia sparging and air scrubber applications.

Available Parameters & Measuring Ranges

3TX-ISE for NH₃-N: Ammonium ion concentration in clean potable water to wastewater & industrial use.
 Ammonia as nitrogen NH₃-N: Municipal & Industrial wastewater range: 1 ppm to 999 ppm
 Municipal drinking water range: 0.2 ppm to 999 ppm

Ammonium (NH₄⁺) free ion activity units for ranges detailed above (for NH₃-N units divide by 1.29). It is readily possible to measure down to 1ppm of ammonium even in the presence of 20 to 30 ppm of potassium ions, which is a common sample composition for many second wastewater effluent streams.

The graphs to the right show the impact of pH and temperature on the extent of ionization of ammonia gas to ammonium ion. The extent of ionization defines the percent of the weak base ammonia that the ion selective sensor can detect. On the vertical axes if the extent of ionization is 0.00 then none of the species is in the measurable form while if 1.00 then all is in the measurable form. The multiple shifted extent of ionization colored lines demonstrate the impact of temperature on this equilibrium physical chemistry process. The portion which is in the measurable form at that given pH and temperature (the extent of ionization) is called the “Free ISE”. The “Total ISE” computed by the TOT module (in this case total ammonia) is the value as though all 100% of ammonia were in the measurable form for the sensor.



3TX-ISE for NO₃-N: Nitrate ion concentration in clean potable water through wastewater & industrial use. Nitrate as nitrogen, range 0.62 ppm to 999 ppm units in nitrate ion, (for NO₃-N units divide ion units by 4.43). It is possible to measure down to 1ppm nitrate ion in 400ppm chloride ions. Nitrite is not a significant interference for the measurement of nitrate ions in typical municipal wastewater conditions.

3TX-ISE for NO₂-N: Nitrite ion concentration in drinking water through wastewater and industrial processes. Nitrite as nitrogen, range 0.46 ppm to 999 ppm units in nitrite ion, (for NO₂-N units divide ion units by 3.29). Nitrate is not a significant interference for measurement of nitrite in typical municipal wastewater conditions

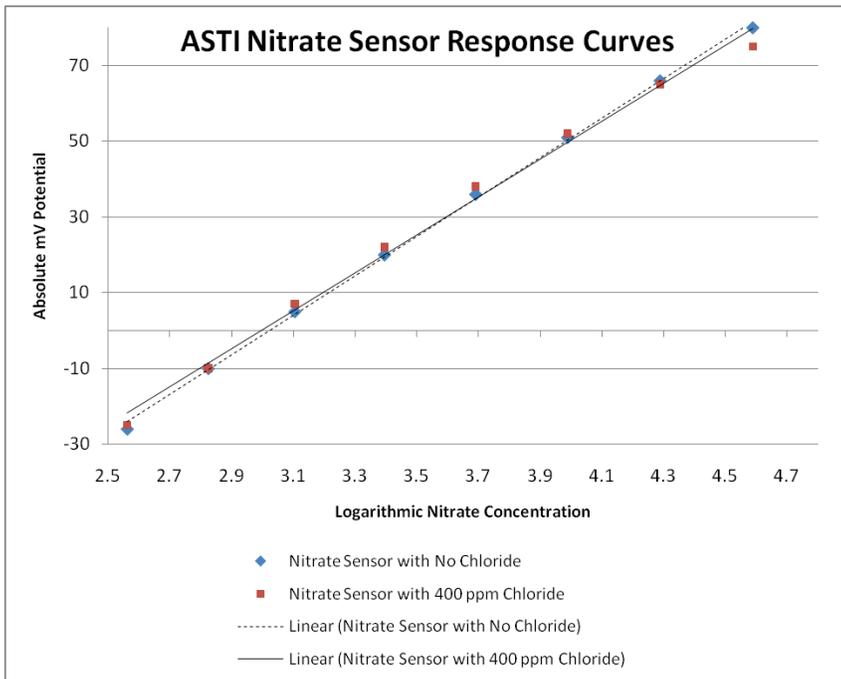


Interfering Ion Compensation For ISE Electrodes Is Not a Valid Solution

Measuring ammonium and nitrate ions using traditional older ISE membrane technology has been problematic due to interfering potassium and chloride ions that are present in concentrations typically found in processes outside of the laboratory. Often the “solution” has been to measure the interfering ion with a second electrode and “compensate” for the effect of the error on the primary measurement. This is altogether unlike pH compensation described on the previous page that details a well grounded pH compensation due to the change in the extent of ionization equilibrium for ammonia converting to the ammonium ion which is purely due to a physical chemistry issue (and not related to any issues of the ISE sensor itself).

However, there is no widely accepted scientific consensus that an ion selective sensor can be compensated for interferences with a second ISE sensor in continuous field applications. Interference is a degenerative process, exposure to levels outside the range of the sensor gradually degrades the sensor to the point it becomes unresponsive. Online process streams can have varying analyte and interfering ion levels, temperature, and sample background. Such continuous change in the sensor characteristics and sample, combined with potential uncertainty of a second “compensation” electrode, is a complex process to measure properly even in lab conditions. This just can’t be corrected in the field with a simple mathematical factor.

Sensors used with the 3TX-ISE do not require compensation, and are capable of measuring ammonia down to 1ppm in the presence of 20 to 30 ppm potassium ions, or nitrate as low as 1 ppm in the presence of up to 400 pm chloride ions, while maintaining linearity and stability. Such high selectivity over chloride is necessary in many secondary municipal wastewater applications to make nitrate measurement useful.



Conversion Table for Logarithmic pNO₃
Nitrate to ppm Nitrate

2.5	196.1 ppm
2.7	123.7 ppm
2.9	78.05 ppm
3.1	49.25 ppm
3.3	31.07 ppm
3.5	19.61 ppm
3.7	12.37 ppm
3.9	7.805 ppm
4.1	4.925 ppm
4.3	3.107 ppm
4.5	1.961 ppm
4.7	1.237 ppm

The linear response plot of our nitrate sensors in the presence of chloride at such concentrations and in the complete absence of chloride at such concentrations is statistically identical in terms of absolute response and slope (sensitivity). This means that chloride ion interference can be ignored when measuring nitrate under the most common conditions found in nitrification and denitrification monitoring processes. By contrast, there are known problems with optical nitrate and nitrite sensors experiencing very significant interference from both ions being present in the same process media whereas the novel ASTI ISE membranes do not have this issue.



Description & Options:

The ion selective modules in the 3TX-ISE include measurement and temperature transmission, integral temperature compensation, LED display of ppm or temperature, and configurable 0-20mA or 4-20mA output of ppm or temperature. Sensors are supplied as standard with a 10-ft cable with tinned lead ends, and feature industrial grade construction with the best reference lifetime in process industry through nonporous cross linked conductive polymer. Sensors are available with a protective guard and can be mounted inline in a pipe tee, immersion mounted in a tank, or submerged in a basin. A variety of waterproofing options are available to suit almost any application. Waterproof NEMA 4X Enclosures (UL Listed) supporting 2, 3, 4, 6, or 8 modules for Wall, Panel or Pipe Field Mounting are available in any mix of configurations and options for both 24VDC and 115/230VAC power operation installations.

Measurement / Transmitter Modules: Modules are available to measure pH, ORP, mV, Temperature, Conductivity, Dissolved Oxygen (DO), Ammonium ion (NH_4^+), Ammonia Nitrogen ($\text{NH}_3\text{-N}$), Nitrate ($\text{NO}_3\text{-N}$), and Nitrite ($\text{NO}_2\text{-N}$), Calcium (used as a proxy for water hardness), Potassium, Perchlorate, Chloride, and Sodium among other ion selective parameters. Includes a 3-digit display and (6) LED's for setup and value display. Includes scalable 0-20mA or 4-20mA output. 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.

Preamplifier Support: Unlike many low cost systems, the 3TX-ISE series supports optional external sensor preamplifiers for operation in noisy environments and eliminates the need to open the analyzer enclosure for sensor service, thus preventing accidental damage to the analyzer. Sensors with preamp can be located up to a maximum 300 feet away. The option to use either an integral or external preamplifier is only at time of order.

3TX-REL Option: Alarm and relay controller module with two independent configurable limits. One module required for each measurement module. Providing (2) each 250VAC / 5 amp dry contact relays with hold function for sensor calibration, and control functions that are fully configurable 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; 4) Proportional frequency control (variable pulse controller). Alarms include configurable startup timer and reaction timer to avoid alarming if limits are exceeded for a short time.

3TX-DAT Data Logging Option: MODbus 3TX-DAT field datalogger module can support simultaneously datalogging from any 3TX module with MODbus output option (3TX-pH, 3TX-ISE, 3TX-CON, 3TX-DO, 3TX-TOT) at frequencies from every second to every hour. 3TX-DAT can be turned on and off at will allowing for intermittent battery powered use with a timer switch. Configuration of 3TX-DAT datalogger and downloading of data done via freely supply mating Windows PC software.

3TX-TOT Option: Computes total ammonia $\text{NH}_3\text{-N}$ using an algorithm with the NH_4^+ free ion activity, pH and temperature as inputs and sends the computed total ammonia value by 4-20mA output. All of the inputs used as well as the computed total ammonia value are sent by RS-485 Modbus digital output protocol.

Modbus Option: Available by ordering the measurement module to include Modbus (only at time of initial order) or by adding the separate 3TX-TOT module anytime. The 3TX-TOT module can support a maximum of three measurement module inputs with the first two always being free ISE and pH. The third input can be any other module (3TX-pH, 3TX-ISE, 3TX-CON, 3TX-DO) not involved with the determination of total ISE.

Power: Universal 115/230 VAC power supply or a dedicated 24VDC power supply (not 2-wire loop power).



General Ion Selective Sensor Specifications

Integrated Ammonium (NH₄⁺) Ion Selective Sensor:

Concentration Range: * 1 to 5 X 10⁻⁶ Molar, (18,000 to 0.090 ppm)

Lowest Limit of Detection: 2X10⁻⁷ Molar, .004 ppm

pH Range: 2.5 to 9.0 pH (Max 11.0 pH when used with 3TX-TOT module)

Temperature Range: 5 to 40 °C

Pressure Range: 1 to 10 psig

Body Materials: CPVC, Ultem

Junction: HDPE

Reference System: Double junction, Porous Ceramic & Porous HDPE, Saturated KCl in cross-linked polymer

Configurations: 3/4" - 3/4" MNPT, 3/4" - 1" MNPT, 1" MNPT Twistlock

Installations: Indoor or Outdoor; Inline, Immersion or Submersible (Specify required style when ordering)

Interfering Ion Ratio Limits: ** Na⁺ (5X10³), K⁺ (10), H⁺ (1X10⁵)

Integrated Nitrate (NO₃⁻) Ion Selective Sensor:

Concentration Range: * 1 to 5 X 10⁻⁵ Molar, (62,000 to 0.620 ppm)

Lowest Limit of Detection: 0.080 ppm (80 ppb)

pH Range: 4 to 9.0 pH

Temperature Range: 5 to 40 °C

Pressure Range: 1 to 10 psig

Body Materials: CPVC, Ultem

Junction: HDPE

Reference System: Double junction, Porous Ceramic & Porous HDPE, Saturated KCl in cross-linked polymer

Configurations: 3/4" - 3/4" MNPT, 3/4" - 1" MNPT, 1" MNPT Twistlock

Installations: Indoor or Outdoor; Inline, Immersion or Submersible (Specify required style when ordering)

Interfering Ion Ratio Limits: ** ClO₄⁻ (0.006), I⁻ (0.42), Br⁻ (74), NO₂⁻ (219), Cl⁻ (2,754)

Integrated Nitrite (NO₂⁻) Ion Selective Sensor:

Concentration Range: * 1 to 5 X 10⁻⁵ Molar, (46,000 to 0.460 ppm)

Lowest Limit of Detection: 0.276 ppm (276 ppb)

pH Range: 4 to 9.0 pH

Temperature Range: 5 to 40 °C

Pressure Range: 1 to 10 psig

Body Materials: CPVC, Ultem

Junction: HDPE

Reference System: Double junction, Porous Ceramic & Porous HDPE, Saturated KCl in cross-linked polymer

Configurations: 3/4" - 3/4" MNPT, 3/4" - 1" MNPT, 1" MNPT Twistlock

Installations: Indoor or Outdoor; Inline, Immersion or Submersible (Specify required style when ordering)

Interfering Ion Ratio Limits: ** SCN⁻ (5), ClO₄⁻ (25), Br⁻ (230), NO₃⁻ (760), Cl⁻ (6,400)

* All linear measurement ranges for ISE sensors are given in the absence of any interfering ions. For any given specific measurement of interest for a given background of interfering ions, you should consult the factory for recommendations.

** Interfering ion ratio limits given in permissible ratios of Molar excess of interfering ion to the analyte (measured) ion.

The 3TX-ISE max range of 999 will limit the useable upper bound range of any of the given ISE sensor specified above. For measurement above 999 ppm range please inquire to factory for assistance. Although support for installations beyond 10 psig is not possible, it is possible to support installations above 40 degrees Celsius although the sensor lifetime will suffer somewhat accordingly. You can inquire to the factory for any such special installation or application requirements.

Last Revised November 27, 2012



IOTRON™
pH / ORP / ISE / DO / Conductivity Measurement Products Lines

3TX-ISE for Fluoride Ion Controller, Transmitter & Datalogger



- Many drinking water facilities and fluoride waste treatment plants are devoting more money, effort and maintenance than necessary to measure and maintain fluoride for compliance & monitoring
- Analyzers designed for the most demanding wastewater and industrial applications are overkill for the typical process conditions found in most municipal drinking water plants and discharge compliance of fluoride treatment systems
- The **Model 3TX-ISE Fluoride ion analyzer** reduces the cost of ownership and simplify continuous online monitoring and process control of fluoride levels in drinking water systems and waste treatment systems both batch and continuous type
- Leading solid-state fluoride ion selective (ISE) sensors engineered for water and wastewater applications suitable for service from pH 0 to 11 and anywhere in between; sensor construction optimized as dictated by installation and site need

KEY FEATURES & BENEFITS

- **No Reagents of Any Kind** - are required for monitoring and process control of your system. You need only to perform grab sample analysis to standardize the inline sensor with the results of your tests used for reporting and compliance. The inline sensor will trend and track in agreement with this reference method.
- **Simplified Operation** - Easy 1-point offset calibration synchronizes the instrument with your lab's results used for reporting WITHOUT removing sensor from service. Online tracking in agreement with your periodic grab sample analysis can substantially minimize the frequency with which such sampling is done.
- **Reduced Maintenance** - Eliminate the cost of online reagents, sensor service (contracts) and tip replacement. It's perfect for limited staff facilities as well as those who operate multiple water plants, or those who just want to save time and money for their inline ISE measurements.
- **Flexibility** - Base system includes measurement module (3TX-ISE) with 3-digit display as well as 4-20mA output, waterproof enclosure, and solid-state integrated fluoride ISE sensor with temperature compensation element. Available with or without pH compensation (3TX-TOT module) as dictated by the intended installation site. Sensor options include: severe duty temperature and chemical resistance, immersion or submersion types, screw in pipe tee or quick disconnect mounting and integrated or external preamplifiers. You can even add additional measurement modules to create a multi-channel analyzer.
- **You Buy Only the Technology You Need** - in terms of instrumentation, water chemistry and budget.
- **Systems Are Preconfigured, Pre-calibrated** - Ready for service after just a simple 1-point offset calibration!

Versions of the 3TX-ISE system available to measure Total Fluoride (HF) in wastewater & etching media with low or high pH applications using optional modules and sensors. Please contact factory for more information.



SPECIFICATIONS: 3TX-ISE Fluoride Ion Analyzer / Transmitter / Controller

Measurement Type and Purpose:	Ion Selective Electrode (ISE) to monitor fluoride levels in real time and control chemical feed process
Application Range (Sensor 6100-A):	Fluoride ion concentration in drinking water through wastewater, pH range 5.5 – 9.5 continuous. Processes with pH below 5.5 require different specialized acid service sensors – Inquire to ASTI factory
Displayed Concentration Range:	999 to 0.02 ppm; Output Range Full Scale Selectable: High 0-999, Mid 0-100.0, Low 0-10.00 Output scalable down to 20% of selected full scale range with arbitrary setpoints for 4mA & 20mA
Lowest Displayed Limit of Detection:	0.01 ppm
Sample pH Range:	5.5 to 9.5 pH continuous (Max 11pH); Low pH service version available for 0-6 pH range up to 160 °F
Sample Temperature Range:	CPVC: +5 to 60°C; Ultem™: -5 to + 105°C; PEEK: -30 to +150°C
Pressure Range:	Typical installations 10 psig or less
Sample Flow Requirements:	Slipstream installation, continuous flow, max 10 GPM in 2" pipe / 1 foot per second max or submersible
Ion Sensor Specifications:	Solid state selective fluoride sensitive membrane, combination sensor completely sealed both ends
Sensor Body:	CPVC or Ultem™
Reference Half Cell:	Ag/AgCl, Saturated KCl, in excess to assure saturation at all temperatures & extend sensor life
Reference System: Primary Junction:	Porous Ceramic, Saturated KCl in cross linked polymer, resistant to heat, solvents, most chemicals
Secondary Junction:	Solid-State Cross-Linked Conductive Polymer with HDPE porous matrix support, Saturated KCl salt system in cross linked polymer, resistant to heat, solvents & most chemicals
Display:	Bright 3-digit red LED display visible in sunlight
Power Supply:	CSA/UL/CE approved universal 115/230 VAC power supply, consumption 60mA max per module
Signal Output:	Scalable 0-20mA or 4-20 mA DC 250 Ω max, Additional RS-485 Modbus output available as option
Instrument Mounting & Dimensions:	Wall, Pipe or Panel Mounting for 2, 3, 4, 6 or 8 modules per enclosure (NEMA 4X Rated & UL Listed)

Module Description & Options:

Transmitter Modules: In addition to Fluoride, modules are available for pH, ORP, mV, Temperature, Conductivity, Dissolved Oxygen (DO), and other Ion Selective (ISE) measurement including Ammonia, Nitrite & Nitrate 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 low cost systems, the 3TX-pH and 3TX-ISE transmitter series supports optional external preamplifiers for noisy environments or to avoid opening the analyzer enclosure for sensor service, and to minimize sensor replacement costs (no long cables need be pulled).

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 supply mating Windows PC software.

3TX-TOT Option: pH compensation module computes total fluoride (Free Fluoride + HF) using the free fluoride ion activity, pH, and temperature from the respective measurement modules' bridged outputs. The 3TX-TOT module includes a scalable 4-20mA output for total fluoride 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 MODULE IS REQUIRED FOR pH BELOW 5.5 pH TO PROPERLY PERFORM FLUORIDE ISE MEASUREMENTS.**

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 modules purchased with MODbus output option or 3TX-TOT.

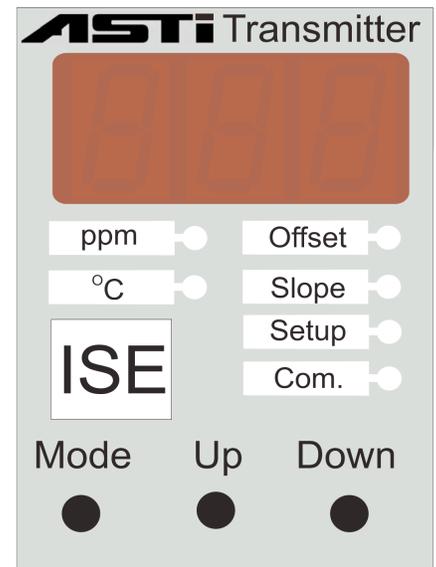
Enclosure Options: NEMA 4X Enclosures (UL Listed) for 2, 3, 4, 6, or 8 modules for Wall, Panel or Pipe Field Mounting or 35mm Din-Rail Only

Power Options: Universal 115/230 VAC power supply or 3-wire 24VDC operation (not 2-wire loop power) if you have a power supply onsite.

Last Revised November 27, 2012

Model 3TX-ISE 3-Wire Ion Selective Transmitter

- 3TX-ISE is a transmitter for Ion Selective (ISE) and Temperature Measurement
- Data Ranges: 0-10, 0-100 or 0-999 ppm (user selectable); 0-150 °C
- ISE sensors with and without preamplifier supported (max 300 feet with preamp)
- Single Point (1-Point Offset) calibrations are supported to allow for agreement between laboratory and portable grab sample ion determinations using photometric, colorimetric and other complementary technologies for field offsetting
- Slope of Ion Selective (ISE) Sensors can be determined with 2-Point calibrations
- Temperature compensation via Platinum 100 or 1000 Ohm element
- Display ion activity in ppm units (auto-scaling between ranges) or Temperature
- Scalable Analog Output 0/4-20 mA for ion activity in ppm units or Temperature
- Galvanic isolation between sensor input, power & analog output (3000V rating)
- Optional: Serial communication via RS-485 MODbus Digital Output
- Support for measurement of any ion is possible
- Field installations using weatherproof NEMA 4X & IP65 enclosures for up to 7 ea pH/ORP/ISE/DO or conductivity transmitters in single enclosure assembly



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 "lock" must be set to 'Off' to change ANY parameter, including the temperature, offset and slope 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

The ion selective sensor without preamplifier is connected directly to 3TX-ISE. The mV signal from these sensors are processed by an integrated high impedance amplifier. The 3TX-ISE-X hardware version can support external preamps (in sensor or J-Box) to enable installations that require long cable lengths or to operate in high interference areas. Temperature measurement with a Pt100/Pt1000 allows automatic temperature compensation to be performed.

Analog Output

The 3TX-ISE transmitter has a scalable analog output of either 0-20 or 4-20 mA (selectable). The difference required between the minimum (0/4mA) and maximum (20mA) output is 20% of the selected range (low 0-10, mid 0-100 or high 0-1000 ppm). For example, if the low range (0-10) is selected then the output could be as narrow as 0-2 ppm for the 0/4-20 mA scaling. The output is proportional to ISE ppm or temperature and galvanic insulated from the input.

MODbus (Optional)

Acquired data is transferred using MODbus standard for multidrop communication and connected using RS485. The Modbus-master may be the 3TX-DAT module or any SCADA system. When units are ordered with MODbus option, the free of charge Windows datalogging and graphing software and be used to monitor and record all process and temperature values from up to 247 transmitter simultaneously at distances up to 6500 feet (2 kilometers).



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
Sensor: Combination Sensor
ISE/mV Range: 0-10, 0-100, 0-999 ppm; ±1000mV
ISE input: < 1pA, >10GΩ
Accuracy: ±0.2% Excluding Sensor (Ideal)
Temp Sensor: Pt100, Pt1000
Temp Range: 0-150°C ± 0.3°C
Temperature: Fixed (Manual) or Automatic using
Compensation: Temperature (TC) Measurement
Analog Output: 0-20mA or 4-20mA, max. 500Ω

PARAMETERS

Function and Programming

The 20 programmable parameters are shown to the right. For access see the paragraph about programming on page 1.
If the softwarelock (Par. no. 1) is "On" the parameter 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 indicates the type of sensor for the temperature input.
Par. no. 4 If Par. no. 7 is set to ISE, the signal is temperature compensated. Par. no. 4 sets the temperature compensation to either set (manual) or based on the measured temperature.
Par. no. 5 sets the temperature for when temperature compensation of the pH is in fixed (manual) mode.
Par. no. 6 If a long cable is used for the Pt100 sensor the cable impedance should be entered and compensated for this offset.
Par. no. 7 Selects the output to be either ISE or temperature.
Par. no. 8 sets the analog output to either 0-20 mA or 4-20 mA.
Par. no. 9 sets the analog output scaling to either low (0.00-9.99 ppm), mid (00.0-99.9 ppm) or high (000-999 ppm) range.
Par. no. 10 & 11 are used to set the ppm value that corresponds to 0/4mA output setpoint (**Par no. 10**) and sets the ppm value that corresponds to 20mA output setpoint (**Par no. 11**). The difference between Par no. 10 and 11 must be at least 20% of the working output range selected (either low, mid or high range). The display and output ranges are altogether decoupled.
Par. no. 12 Variable to define the mV change for each "Up" or "Down" button depression when calibration is performed.
Par. no. 13 Displays formula weight of measured ion (next page details how to determine which ion correspond to this value)
Par. no. 14 View and edit the working (effective) sensor offset
Par. no. 15 View and edit the working (effective) sensor slope
Par. no. 16 Offset adjustment for low 0/4mA analog output trim.
Par. no. 17 Gain adjustment for 20mA high analog output trim.
Par. no. 18 If no keys are pressed for 10 min the display will show flashing bar (Energy Save). Press any key to return.
Par. no. 19 The MODbus standard requires a baudrate of 9,600 or 19,200 set in accordance with the MODbus-master.
Par no. 20 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	Address on MODbus	Off, 1...247	Off
03	Temperature	Type of Input	Pt100, Pt1000	Pt1000
04	Compensation	Temp. Comp. of pH	Auto, Set (Manual)	Auto
05	Comp. Temp.	Compensating Temperature	0..150	25
06	Cable Impedance	Impedance of Pt100 Cable	0.0 .. 9.9 Ohm	0.0
07	Output Variable	ISE or Temperature	ISE, °C	ISE
08	Analog Output Range	ISE Output Range	0-20, 4-20	4-20
09	ISE ppm Output Range	Low (0-10.0), Mid (0-100) & High (0-999)	10.0, 100, 999	10.0
10	0/4mA Set	Low ppm Setpoint	0.00..999	0.00
11	20mA Set	High ppm Setpoint	0.00..999	10.0
12	Step Change	mV Increment per 'Up' or 'Down' Button Depression	0=0.02, 1=0.05, 2=0.10, 3=0.20, 4=0.50, 5=1.0, 6=2.0	2 (0.10mV)
13	View Formula Weight of Ion	Grams per Mol of Ion	XX.XX per Ion Weight	N/A
14	View Current Sensor Offset	mV at Isoconcentration	Per ISE Sensor	N/A
15	View Current Sensor Slope	mV per Decade Response	Per ISE Sensor	N/A
16	0/4mA Offset	Trim Low	±9.99%	0.00
17	20mA Gain	Trim High	±9.99%	0.00
18	Energy Save	Energy Save	On / Off	On
19	Baudrate	MODbus	9,600 / 19,200	19,200
20	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par

Offset / Slope Adjustment

Calibration of the ion selective sensor is done with Up/Down keys. To perform a 2-point slope calibration use 'Mode' key select 'Offset' and adjust the reading until the display shows the correct value for the first ISE standard. Next select 'Slope' and use the Up/Down keys until the display reads the second desired value for the second ISE standard. A production 'Offset' calibration (for agreement with grab sample analysis) is done without performing slope calibration. **The ISE sensor should be left in service for the production 1-point 'Offset' calibration.** All settings are stored in EEPROM so unit can be powered down without loss of configuration or calibration.

The wiring for ISE sensors with and without preamplifiers are detailed to the right. These two wiring details represent interface with two altogether different hardware versions which must be selected at time of purchase.

Typical Installation

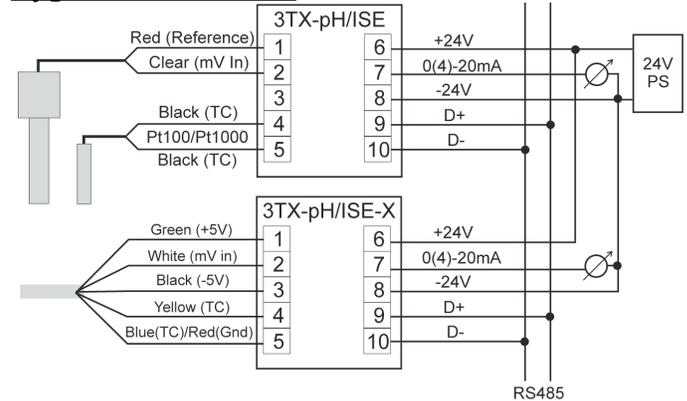


TABLE TO DETERMINE SELECTED ISE TRANSMITTER TYPES

Value of Parameter 13 (Formula Weight of Ion)	Corresponding Ion Selective Analyzer Type (Fixed)	Value of Parameter 13 (Formula Weight of Ion)	Corresponding Ion Selective Analyzer Type (Fixed)
18.0	NH ₄ ⁺ (Ammonium)	19.0	F ⁻ (Fluoride)
40.1	Ca ⁺⁺ (Calcium)	46.0	NO ₂ ⁻ (Nitrite)
23.0	Na ⁺ (Sodium)	62.0	NO ₃ ⁻ (Nitrate)
6.94	Li ⁺ (Lithium)	26.0	CN ⁻ (Cyanide)

Sign of sensor slope is fixed based upon ion type (anion or cation). Configuration of 3TX-ISE modules is done at ASTI factory and cannot be modified in the field. Contact ASTI factory for any values not listed above to determine the measurement type from the parameter 13 (Formula Weight of Ion).

NOTE: The raw uncompensated (a.k.a. "absolute") mV potential of the ISE sensor is displayed by pressing the "Down" key in the main ppm display mode. The display now changes from ppm to absolute mV units. Negative values will be displayed flashing. The temperature can be calibrated pushing the "Up" or "Down" buttons when in the temperature display (°C) mode.

MODBUS

In order to utilize the MODbus interface the 3TX-ISE must be ordered with MODbus. 3TX-ISE may be used as a slave for the 3TX-DAT or as a slave in a SCADA data acquisition. The setup and communication for each case will be explained below.

With 3TX-DAT

If 3TX-ISE is used with 3TX-DAT, the baud rate on the MODbus as well as the address of the 3TX-pH should be noted. **The baud rate (P14)** must be set to the baud rate of the 3TX-DAT. Whether a baud rate of 19,200 or 9,600 is used is of no importance, as long as all units on the MODbus are set to the same baud rate.

The address (P02) must be unique in the network; Two units cannot have the same address. In a network with 3TX-DAT as the master, all addresses must be assigned in series; i.e. if 3 units are connected to 3TX-DAT, the addresses 1, 2 & 3 must be assigned to the three units. The order of the addresses is of no importance. In a network with a 3TX-DAT, up to 63 slaves may be connected.

In a SCADA system or with Windows software

Since different SCADA systems may have different restrictions only the general are mentioned here: **The baud rate (P19)** must be set to the baud rate of the SCADA system. **The address (P02)** must be unique in the network. Up to 247 3TX transmitters may be connected on a single network; repeaters may be required if more than 32 nodes are used and/or for long cable distances.

MODbus Scaling

The MODbus scaling is defined only by P09 (low, mid or high) & this may differ from 0/4-20 mA analog scaling from P10 & P11.

The 3TX-ISE contains 2 measurements (ISE and temperature). Access to these are gained through the function code *Read_Input_Registers (04)*. The 3TX-ISE gives access to different diagnostic values via *Diagnostics (08)*, as shown below.

Read_Input_Registers

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

Value 1 is ISE ppm and value 2 is temperature. The measurements are transmitted in sequence; If 2 values are chosen both ISE ppm and temperature are transmitted. If the value for temperature is wanted, 2 values must be requested. Both values are rated to 0-1000 corresponding to the range, but the temperature has an offset of 1024; i.e. 0-999 ppm is transmitted as 0-1000 and 0-150°C as 1024- 2024.

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 Communication 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

<i>ENCLOSURE TYPE</i>	
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)
<i>MEASUREMENT MODULES ONE (1) THROUGH SEVEN (7)</i>	
CODE	DESCRIPTION
-pH **	pH/ORP/mV/Temp Measurement Module / Transmitter
-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
<i>OUTPUT OPTIONS FOR MEASUREMENT MODULES (ONE OPTION MUST BE SELECTED FOR EACH MODULE)</i>	
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
<i>ADD-ON MODULES FOR MEASUREMENT MODULE ENCLOSURE ASSEMBLIES</i>	
CODE	DESCRIPTION
-PS	100 to 240 VAC 50/60 Hz Universal Power Supply Adapter for Line Powered Operation
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33Wh) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

** To obtain a 3TX that supports and requires sensors with **preamplifiers**, order the pH/ORP transmitters as **-pH-X** and the ion selective (ISE) transmitters as **-ISE-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).



Extended cable lengths for pH/ORP/ISE Sensors with 3TX-pH/ISE-X Transmitters

NO PREAMPLIFIER: Connecting directly to the 3TX-pH or 3TX-ISE using sensors without preamplifiers:

The pH, ORP & ISE sensors come with 10 feet (3 meters) of cable standard (without additional charge to base price). These sensors can be supplied with up to 20 feet (6 meters) of cable without adding an integral preamplifiers to wire directly into the 3TX-pH or 3TX-ISE analyzers by choosing the appropriate per foot cable adder at time of order:

http://www.astisensor.com/ASTI_3TX-pH_3TX-ISE_Sensor_Wiring_Schematic.pdf

The cables for the sensors without preamplifiers are fully integral and so they cannot be cut, adulterated or spliced in any way. Because of this, the exact total length of cable required should be specified at the time of order. In a few cases cable lengths longer than 20 feet have been employed without an integral preamplifier, but it is best practice to restrict the cable length for sensors without preamplifier to 20 feet and to employ some form of preamplifier thereafter for any longer runs.

If a cable length longer than 20 feet is required, there are a number of options employing a preamplifier are available:

EXTERNAL PREAMPLIFIER: Connecting to the 3TX-pH/ISE-X using sensors without preamplifiers & external preamp

You can use the existing pH/OR/ISE sensor (whatever the cable length) and simply add an external preamplifier in a NEMA 4X J-Box assembly. Find below a link to download photos of the mini external preamplifier installed into the 1MF NEMA 4X J-Box complete with extension cable for visualization purposes:

http://www.astisensor.com/Mini_External_Preamp_NEMA4X.zip

This mini external preamplifier approach can minimize the long term residual cost of ownership for the sensor replacement aspect as well as simplifying maintenance. The wiring detail is linked below:

http://www.astisensor.com/ASTI_3TX-pH-X_3TX-ISE-X_with_Mini_External_Preamp_Hookup.pdf

Specification sheet for for interfacing with the 3TX-pH-X and 3TX-ISE-X preamplifier style transmitters is linked below:

http://www.astisensor.com/Mini_External_Preamplifiers.pdf

INTEGRAL PREAMPLIFIER: Connecting to the 3TX-pH/ISE-X using sensors with integral preamplifiers

In the alternative, if a preamplifier is integrated inside of the ISE sensor, then these terminations can be bridged across any ordinary suitable terminal strip so long as it is installed into a NEMA 4X waterproof J-box enclosure. The wiring schematic for when a 3TX compatible preamplifier is provided below:

http://www.astisensor.com/ASTI_3TX-pH-X_3TX-ISE-X_Sensor_Preamp_Wiring_Schematic.pdf

Either the external preamplifier or integral preamplifier approach will yield a setup that can support up to 300 feet total distance between the sensor and transmitter installation locations.

QUICK DISCONNECT OPTION: For fast & easy of commissioning for insertion and removal of sensor from service

The quick disconnect option **MUST** be specified at the time of order and is **ONLY** available if a preamp is integrated into the pH/ORP/ISE sensor. A quick start guide (see link below) shows a twist lock sensor with an integral preamplifier, the WPIT sealing option and the Q5M/Q5F quick disconnect system installed in a NEMA 4X field J-Box for visualization.

http://www.astisensor.com/Simplified_Q5M_Q5F_3TX_Quick_Disconnect_Guide.pdf

Please inquire to the ASTI factory for the costs associated with the various options outlined above. Please be sure to inquire about these extended cable length options before the purchase of any equipment to ensure that the most optimal configuration for the desired installation scheme is employed.



**Connection Diagram of Iotron™ pH, ORP and Ion Selective (ISE) Sensors without Preamplifiers
(Tinned Leads Only) to 3TX-pH pH/ORP Transmitters and 3TX-ISE Ion Selective Transmitters**

ASTI Cable Color Coding	Instrument Terminal Value	3TX-pH/ISE Terminal Number
Red	pH/ISE Sensor (-) <i>a.k.a Reference</i>	1
Clear	pH/ISE Sensor (+) <i>a.k.a mV Signal</i>	2
Black	Pt100 or Pt1000	4
Black	Pt100 or Pt1000	5

Note 1: The 3TX-pH transmitter can be used for either pH or ORP measurement and wiring connections are the same for both pH and ORP sensors (only the Parameter No. 03 needs to be changed/toggled to select between the two input types). For ORP sensors select mV as the input type in P03.

Note 2: For 3TX-ISE the ion measurement type (ammonium, fluoride, nitrate, calcium..etc) must be defined at time of purchase and cannot be changed after receipt of transmitter (see label on 3TX-ISE for which ion measurement type is supported for that given unit).

Note 3: Depending upon the TC ordered it may be necessary to change the parameter 04 from PT1000 (default) to PT100 (selectable).



**Connection Diagram of Iotron™ pH, ORP and Ion Selective (ISE) Sensors WITH Preamplifiers
to 3TX-pH-X pH/ORP Transmitters and 3TX-ISE-X Ion Selective Transmitters**

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

Note 1: The 3TX-pH transmitter can be used for either pH or ORP measurement and wiring connections are the same for both pH and ORP sensors (only the Parameter No. 03 needs to be changed/toggled to select between the two input types). For ORP sensors select mV as the input type in P03.

Note 2: For 3TX-ISE the ion measurement type (ammonium, fluoride, nitrate, calcium..etc) must be defined at time of purchase and cannot be changed after receipt of transmitter (see label on 3TX-ISE for which ion measurement type is supported for that given unit).

Note 3: Depending upon the TC ordered it may be necessary to change the parameter 04 from Pt1000 (default) to Pt100 (selectable). The wiring is identical whether Pt100/Pt1000 are used.

Note 4: Mating pH/ORP/ISE sensor must have the appropriate type of preamplifier integrated inside the sensor or using an external preamplifier in a waterproof J-Box to interface with the 3TX-pH-X or 3TX-ISE-X transmitter. These 3TX-pH-X & 3TX-ISE-X are different hardware from the 3TX-pH and 3TX-ISE transmitter that can directly interface pH/ORP/ISE sensors WITHOUT preamplifiers. The software and functionality is identical for both types of 3TX transmitter; the only difference is whether the sensor to interface must or must not have a preamplifier. The maximum recommended cable length for sensors with preamplifiers is 300 feet (in conduit).



Connection Diagram of Iotron™ pH, ORP and Ion Selective (ISE) Sensors WITH Preamplifiers AND Quick Disconnect Q5M Termination on Sensor mated with Q5F Quick Disconnect Extension Cable Wired to 3TX-pH-X pH/ORP Transmitters and 3TX-ISE-X Ion Selective Transmitters

<u>ASTI Cable Color Coding</u>	<u>Instrument Terminal Value</u>	<u>3TX-pH/ISE Terminal Number</u>
Green	+5V Power	1
White	pH/ORP/ISE Sensor mV Signal	2
Black	-5V Power	3
Yellow	TC	4
Red	TC * & Common–Ground–Reference	5

* The second side of TC is tied together with the common/reference signal inside the sensor when the Q5M & Q5F connector are used and so only the red wire need to wired to terminal 5.

Note 1: The 3TX-pH-X transmitter can be used for pH or ORP (simply toggle P03 between pH & mV modes). The wiring connections are exactly the same for both pH and ORP sensors.

Note 2: For 3TX-ISE-X the ion measurement type (ammonium, fluoride, nitrate, calcium..etc) must be defined at time of purchase an cannot be changed after receipt of transmitter (see label on 3TX-ISE-X for which ion measurement type is supported for that given unit).

Note 3: Depending upon the TC ordered it may be necessary to change the parameter 04 from Pt1000 (default) to Pt100 (selectable). The wiring is identical whether Pt100/Pt1000 are used.

Note 4: Mating pH/ORP/ISE sensor must have the appropriate type of preamplifier integrated inside sensor and Q5M/Q5F quick disconnect terminations to interface with the 3TX-pH-X or 3TX-ISE-X transmitter with the wiring prescibed above. The preamplifier compatible 3TX-pH-X & 3TX-ISE-X type transmitters are different hardware from the 3TX-pH and 3TX-ISE transmitter that can rather only interface pH/ORP/ISE sensors WITHOUT preamplifiers. The software and functionality is identical for both types of 3TX transmitters with the only difference being whether the sensor to interface must or must not have an integral preamplifier. The maximum recommended cable length for sensors with preamplifiers is 300 feet (in conduit).

Simplified Startup Guide & Selected Photos for Q5M / Q5F Quick Disconnect System for 3TX Transmitters

The Q5M (male) quick disconnect terminations from the sensors are mated to the Q5F quick disconnect terminations for the cable extensions inside the 1MF NEMA 4X waterproof J-Box. The sealing cable glands must be well secured to both the 1MF enclosure as well as onto the cables, and the lid must be fastened shut, to preserve the NEMA 4X rating.

CONNECTIONS

The photo below shows an example of the 3TX transmitter assembly installed into a 3MF NEMA 4X rated enclosure as well as the smaller 1MF NEMA 4X J-box for the bridging of the Q5F quick disconnect extension cable with the sensor with the Q5M connector, all wired together for visualization of the complete system.



The Q5M (male) quick disconnect termination from the sensor are mated to the Q5F (female) quick disconnect termination for the cable extension inside the 1MF NEMA 4X waterproof J-Box. The sealing cable glands must be well secured to both the 1MF enclosure as well as onto the cables, and the lid must be fastened shut to preserve the NEMA 4X rating.



IOTRON™

pH / ORP / ISE / DO / Conductivity Measurement Products Lines

Be sure to remove the gray sealing nut from the sealing gland assembly on the sensor and use it to securely fasten the ½" MNPT sealing cable gland into the inside of the 1MF enclosure (exactly as is done for the Q5F female cable extension). Some photos are below for visualization purposes.



Some close-ups of the female Q5F cable extension quick disconnect (in 1MF NEMA J-box) and the male Q5M sensor quick disconnect termination are below for visualization purposes.



A close-up of the male Q5M sensor quick disconnect termination and 1/2" MNPT sealing cable gland is below for visualization purposes.



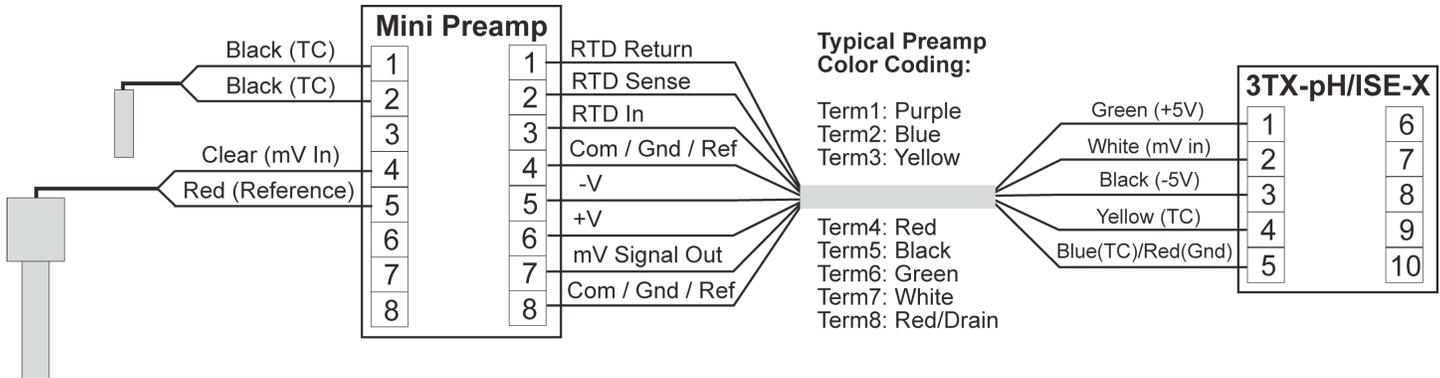
A complete 8X31 series type sensor complete with WPIT sealing, cable gland assembly (for use with 1MF box) and Q5M termination is shown below for visualization purposes.



Connection Diagram of ASTI Sensors WITHOUT PREAMPLIFIERS (Input) to External “Mini” Conventional Preamp (Output) to ASTI 3TX-pH-X and 3TX-ISE-X Preamp Style Transmitters

**Input from ASTI pH / ORP / ISE Sensors
Without Preamp
(Inside J-Box Connections)**

**Output from ASTI “Mini”
Conventional External Preamp
(Inside Transmitter Assembly Connections)**



Connection from ASTI “Mini” External Conventional Preamp Output (Schematic on Left) to Input Terminal Block on ASTI 3TX Transmitter (Schematic on Right)

Note 1:

The temperature compensation element input shown on the far left as the input side to the “Mini” external preamp terminal 1 & 2 can be 100 or 1000 Ohm Platinum (selectable in 3TX-pH-X or 3TX-ISE-X transmitter).

Note 2:

When using the “Mini” external conventional preamplifier with the 3TX-pH-X and 3TX-ISE-X it is not necessary to interface with the output side terminal 1 (RTD Return). This is not required because the 3TX transmitters do not support 3-wire TC inputs. As such the blue terminal 2 and yellow terminal 3 output connections provide the 2-wire Pt100 or Pt1000 TC inputs.

Note 3:

When using the “Mini” external conventional preamplifier with the 3TX-pH-X and 3TX-ISE-X it is not necessary to interface with the output side terminal 8 (duplicate common/ground/reference). This is because the 3TX transmitters do not require two common input leads (as some transmitter do) but rather just a single common/ground/reference connection from terminal 4 (red color coded lead).

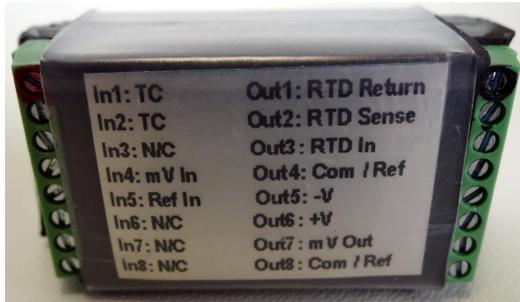
Note 4:

This “Mini” external conventional preamplifier can interface quite a number of additional transmitters besides the 3TX-pH-X and 3TX-ISE-X units. Please inquire to ASTI factory for wiring schematics to other transmitter types.

Note 5:

It is possible to power this “Mini” external preamplifier from a two-sided battery pack power source if it is to be mated with a pH/ORP transmitter that does not support preamplifiers. Inquire to ASTI factory this type of alternate wiring schematic.

Mini External Preamplifiers for pH, ORP & ISE Sensors



Dimensions: 47mm Width X 23mm Height X 19mm Depth (1.85" X 0.90" X 0.75" Inches)
Weight: 26 grams (0.92 ounces)
Power Consumption: Less than 1mA @ ±5V
Mating Cable: Standard CSA/UL Approved Multiconductor, 18 to 24 AWG (PVC or TEFLON Jacketed)
Maximum Cable: From 50 meters (165 feet) to 150 meters (495 feet) *

Mating Transmitters (Partial List):

- ASTI: 3TX-pH-X & 3TX-ISE-X Models, All 2TX & 4TX pH/ORP Transmitters
- Rosemount: 1055, 1056, 1057, 56, 3081, 4081, 5081, 6081, XMT, 1066, 54epH,... and many more
- Signet: 8710, 8750... and many more
- Contact ASTI factory for specific wiring diagrams and to see if your particular transmitter is supported

Configurations Available:

- ✓ Bare (No J-Box ** & No Cable) – Ideal for OEM partners that supply their own enclosures & cabling
- ✓ Installed into waterproof J-Box ** only (No Cable) – For customers that wish to supply their own cabling
- ✓ Assembly including both waterproof J-Box ** and preinstalled cable complete – Turn-key ready to install

Applications:

- ✓ Extend cable length of pH, ORP and Ion Selective (ISE) sensors
- ✓ To ensure quiet, low-noise operation in high noise areas (RF rejection)
- ✓ Easy sensor replacement by not opening transmitter enclosure (only J-Box with mini external preamplifier is opened)

Special Features:

- ✓ Operates on a wide range of supply voltage from ±3V (6V Total) to Max ±8V (16V Total)
- ✓ Creates 3-wire TC output from 2-wire TC input for automatic cable length correction on temperature sensor ***
- ✓ Can be powered from a pair of 3V or 6V lithium ion batteries wired with a midpoint (common) ****

* Total supported cable length depends upon drive voltage of mating transmitter and wire gauge on cable used.

** 3/4" NPT waterproof J-Box assembly is standard (when supplied). Optional Killark explosion proof version available.

*** Only valid when mating with transmitters that support 3-wire TC inputs.

**** For transmitters that do not support external preamplifiers. Inquire to factory for details and options about this approach.

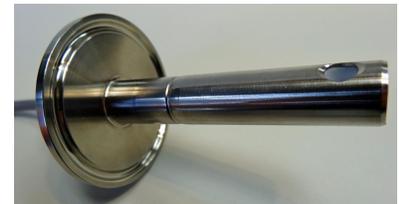
Last Revised January 27, 2013

3TX Conductivity Controller, Transmitter & Datalogger Family



- Ranges: Conductivity 0.05 – 1,000,000 μS , Temperature 0-210 $^{\circ}\text{C}$
- Cell Constants: From 0.01–20.0 (Custom cell constants are available)
- Low conductivity versions for $K=0.01/\text{cm}$ (min 0-5 μS , max 0-20 μS) and $K=0.1/\text{cm}$ (min 0-50 μS , max 0-200 μS)
- 1-Point Gain calibration for agreement with lab analysis or standard solution to set effective cell constant, Max $\pm 70\%$ from nominal cell
- Offset calibration for a true zero reading for sensor dry in air
- Integrated temperature compensation via Pt 100/1000 Ohm element
- Display & Output Conductivity (in μS or mS) or Temperature
- Scalable Analog Output 0-20 mA or 4-20 mA for Conductivity or Temperature, optional RS-485 Modbus Digital Output
- Automatic correction for resistance and capacitance of sensor cable
- Galvanic isolation between sensor input and analog output (3000V)
- 4mA offset & 20mA gain trim calibrations for accurate 4-20mA output
- Standard or custom designed industrial grade sensors engineered and built to order for superior performance and lifetime with configuration and materials of construction specifically suited for intended field use

- AST10 is available cell constants 0.01 to 10.0 & AST51 is available in cell constants 0.1 to 1.0, compact sensors for general purpose use and mounting into 3/4" or 1" pipe fittings to avoid the use of special flow cells. With polypropylene, stainless steel, or KYNAR (PVDF) fittings. Special short style $K=0.01/\text{cm}$ cell to support smaller lines for inline low conductivity use.
- AST52 High 10.0 cell constant in compact size for a variety of applications including skid mounted R.O. systems, water treatment, chemical dilution.
- ASTXX-TRI small size sensor available with optional TRI sanitary clean in place (CIP) flange. FDA compliant food grade materials. Flange sizes 1/2", 1", 1.5", 2" and 2.5". Rated for use up to 150 psig at 130 degree Celsius. Cell Constants from 0.01 to 10.0. Special $K=2.0/\text{cm}$, $3.0/\text{cm}$ and $5.0/\text{cm}$ style are ideal for chemical CIP inline installations to directly replace existing toroidal installation schemes.
- AST41 High temperature & pressure boiler condensate and blow down control. Double seal design extends sensor life over twice that of single or epoxy sealed units. Cell constants: 2.0, 1.0, 0.2, 0.1, 0.05. Temperatures to 205 $^{\circ}\text{C}$ and pressures up to 500 psig with PEEK insulator & 316SS electrodes standard.
- AST40 (not shown) is a sensor for cell constant range of 0.01 to 20.0 and various mountings, including insertion, submersible or valve retractable assemblies for insertion/removal under line pressure. Wetted materials 316 SS & PEEK, with double O-ring seals for high chemical concentrations of acid, bases and salts.
- AST50 & AST60 (not shown) compact double threaded 1" -1" MNPT bodied sensors for cell constants 0.1 to 2.0 offer fouling resistance & low maintenance for RO, drinking water inline quality measurements to wastewater submersion installations from low 50 μS all the way up to high 200,000 μS samples.



CUSTOM SENSOR DESIGN & FABRICATION AVAILABLE UPON REQUEST



GENERAL SPECIFICATIONS: 3TX-CON Conductivity Transmitter & Controller

Measurement Type:	Single or multi-channel inline Contacting Conductivity and Temperature		
Applications:	Drinking water through wastewater, chemical processes, pollution control, long service life with low maintenance applications, support for remote installation locations; can be powered on and off at will		
Conductivity & Temperature Ranges:	Conductivity Ranges for each Cell Shown Below, Temperature Range 0-210 °C, Accuracy ±0.2%		
Pressure Ranges:	Standard 100 psig @ 150°C, High Pressure 250 psig @ 205°C, Both Versions Max 500 psig @ 100°C		
<u>Wetted Materials of Construction</u>			
Sensing Electrodes	316 Stainless Steel (316SS), Titanium, Monel, Hastelloy C, Nickel, Zirconium and others upon request		
Insulators	CPVC, TEFLON (PTFE), KYNAR (PVDF), PEEK and others upon request		
"O"-Rings	EPDM, EPR & Viton-75 and others upon request		
Sealing Fittings	316SS, Monel, Propylene, KYNAR (PVDF) and others upon request		
Supported Measuring Ranges & Cells:	<u>Cell Constant</u>	<u>Full Scale Maximum Range</u>	<u>Minimum Scaling Available</u>
	20.0 (6.0-34.0)	0 to 1,000,000 microSiemens(μS)/cm	0 to 100,000 microSiemens(μS)/cm
	10.0 (3.0-17.0)	0 to 500,000 microSiemens(μS)/cm	0 to 50,000 microSiemens(μS)/cm
	2.0 (0.6-3.4) *	0 to 100,000 microSiemens(μS)/cm *	0 to 10,000 microSiemens(μS)/cm *
	1.0 (0.3-1.7)	0 to 50,000 microSiemens(μS)/cm	0 to 5,000 microSiemens(μS)/cm
	0.2 (0.06-0.34) *	0 to 10,000 microSiemens(μS)/cm *	0 to 1,000 microSiemens(μS)/cm *
	0.1 (0.03-0.17)	0 to 5,000 microSiemens(μS)/cm	0 to 500 microSiemens(μS)/cm
	0.1L (0.05-0.15)	0 to 200 microSiemens(μS)/cm	0 to 50 microSiemens(μS)/cm
	0.01 (0.005-0.015)	0 to 500 microSiemens(μS)/cm	0 to 50 microSiemens(μS)/cm
	0.01L (0.005-0.015)	0 to 20 microSiemens(μS)/cm	0 to 5 microSiemens(μS)/cm
	* Extended Ranges: K=2.0/cm 0-200mS (min 0-20mS); K=0.2/cm 0-20mS (min 0-2mS)		
	NOTES: Alternate cell constants/ranges upon request. Full scale range/cell must be defined at the time of order and cannot be changed after dispatch. See 3TX-CON-E high resolution MODbus supplement for cells and ranges.		
Sensor Installation options:	Inline ½" & ¾" MNPT, Immersion, Submersible, Valve Retractable (HOT-TAP) and Sanitary Tri-Clover		
Display:	Bright 3-digit red LED display visible in sunlight of Conductivity or Temperature with 6 LED indicators		
Power Supply:	CSA/UL/CE approved universal 100-240 VAC power supply, consumption 60mA max per module		
Signal Output:	Scalable 0-20mA or 4-20 mA DC 500 Ω max, Additional RS-485 Modbus digital output optional		
Enclosures & Mounting Supported:	Wall, Pipe or Panel Mounting for 2, 3, 4, 6 or 7 modules per enclosure (NEMA 4X Rated & UL Listed)		

Module Description & Available Options:

Transmitter Modules: In addition to conductivity, measurement modules are available for pH, ORP, dissolved oxygen (DO) and ions including fluoride, ammonia, nitrate, nitrite and calcium (and others). Each module includes 3-digit LED display and scalable 4-20mA output. Analog outputs have trim offset and span adjustment. Calibration of temperature via 1-point offset. User selectable auto or manual temperature compensation modes.

Preamplifier Support: Unlike many low cost systems, the 3TX-pH and 3TX-ISE transmitter series supports optional external preamplifiers for noisy environments or to avoid opening the analyzer enclosure for sensor service, and to minimize sensor replacement costs (no long cables need be pulled).

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: Simultaneously datalogging from any 3TX module with MODbus output (3TX-pH, 3TX-ISE, 3TX-CON, 3TX-DO, 3TX-TOT) at frequency from every second to every hour. Configuration and downloading of data done via free mating ASTI Windows PC software.

3TX-TOT Option: Computes the total concentration of ammonia, fluoride and cyanide using the free ion activity, pH, and temperature inputs from the respective measurement modules' bridged outputs. Provides scalable 4-20mA & MODbus output for computed total ISE and all used inputs.

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 and 3TX-TOT.

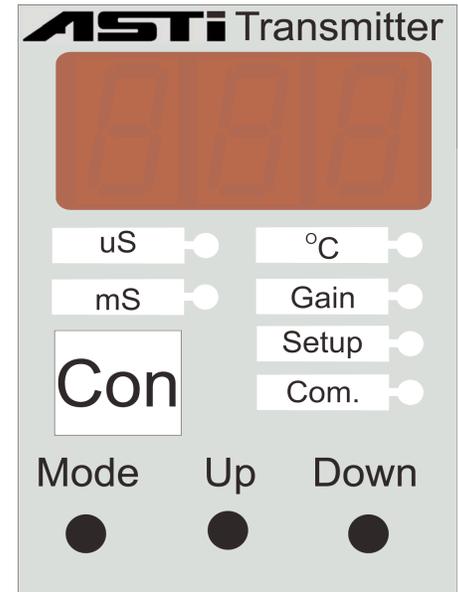
Enclosure Options: NEMA 4X Enclosures (UL Listed) for 2, 3, 4, 6, or 7 modules for Wall, Panel or Pipe Field Mounting or 35mm Din-Rail Only

Power Options: Universal 100-240 VAC with power supply or 3-wire 24VDC use with dedicated power supply (not a 2-wire loop powered device).

Last Revised January 2, 2015

3TX-CON 3-Wire Contacting Conductivity Transmitter

- 3TX-CON is a transmitter for Conductivity & Temperature Measurement
- Measurement Ranges: 0.05–1,000,000 μS | 0.00005–1,000 mS (*par no. 21*), 0–210 °C
- Cell Constants Supported: 0.01–20.0 (*par no. 22*) - custom cell constants available
- The full scale measurement range and nominal cell constant must be defined at the time of order and cannot be changed after dispatch from factory
- Production Calibration a.k.a. Single (1-Point Offset) Calibration supported for quick calibration to allow for agreement with laboratory conductance analysis
- Temperature compensation via Platinum 100 or 1000 Ohm element
- Display Conductivity (in μS or mS) or Temperature
- Scalable Analog Output 0–20 mA or 4–20 mA for Conductivity or Temperature
- Galvanic isolation between sensor input and analog output (3000V rating)
- Automatic correction for resistance and capacitance of sensor cable
- Optional: RS-485 MODbus Output; High Resolution 3TX-CON-E style available
- Field installations supported using weatherproof NEMA 4X & IP65 enclosures
- Up to 7 measurement modules can be used in a single enclosure assembly
- Optional 115/230 VAC power supply, relay/controller & datalogger modules



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

The conductivity cell outer and inner electrodes are connected to terminals 1 and 2, respectively. The current through the cell is proportional to the conductivity of the solution and measurement of the current is the basis of the readout, the analog output as well as the value sent over the MODbus. The Pt100/Pt1000 temperature sensor is connected to terminals 4 and 5 and the measured value is the basis of the temperature correction, which is performed by the built-in microprocessor. Terminal 3 is the ground terminal and should be connected to sensor wire shield.

Analog Output (Standard)

The 3TX-CON transmitter (module) has a scalable analog output of either 0–20 mA or 4–20 mA (selectable) and can be standard or inverted. The conductivity scaling between the minimum (0mA or 4mA) and maximum (20mA) output is 10% to 100% of the full range scale specified where the low and high outputs can be otherwise arbitrarily defined in conductivity units. The output is galvanically isolated from inputs and proportional to conductivity or temperature.

MODbus (Optional)

Data is transferred using MODbus standard for multidrop communication and connected 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 that can be used to monitor and record all process and temperature values from up to 247 transmitters simultaneously at distances to 6500 feet (2 km).



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
Sensor: 2-Wire Contacting Cell
Measuring Range: See Par. 21 for Max Full Range
Cell Constant: See Par. 22 (Nominal) & 15 (Gain)
Accuracy: ±1% Excluding Sensor (Ideal)
Temp Sensor: Pt100, Pt1000
Temp Range: 0-210°C ± 0.3°C
Temperature: Fixed (Manual) or Automatic using
Compensation: Temperature (TC) Measurement
Analog Output: 0-20mA or 4-20mA, max. 500Ω

PARAMETERS

Function and Programming

The 23 programmable parameters are shown to the right. For access see the paragraph about programming on page 1.
If the softwarelock (Par. no. 1) is "On" the parameter 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 indicates the type temperature input (Pt100 or Pt1000).
Par. no. 4 sets the temperature compensation to be either fixed (manual/set) or automatic from measured temperature.
Par. no. 5 sets the value for when temperature compensation of the conductivity measurement is in fixed (manual/set mode).
Par. no. 6 is the temperature compensation coefficient used, expressed in %/°C units (valid for auto or manual TC mode)
Par. no. 7 the wire gauge (AWG) for the sensor cable used
Par. no. 8 the length of sensor cable in units of feet.
Par. no. 9 select the conductivity measurement (S) or temperature measurement (°C) signal used for the analog output.
Par. no. 10 sets the analog output to either 0-20 mA or 4-20 mA.
Par. no. 11 sets low 0/4mA output scaling (in conductivity units).
Par. no. 12 sets high 20mA output scaling (in conductivity units). The difference between low & high output setpoints (P11 & P12) must be at least 10% of full range scaling per parameter P21.
Par. no. 13 Step change for up or down button during calibration.
Par. no. 14 Zero offset calibration done when sensor is dry in air.
Par. no. 15 Set/display the gain on cell constant. The effective cell constant is the product of P15 (gain) and P22 (nominal cell).
Par. no. 16 Offset adjustment for 0/4mA low analog output trim.
Par. no. 17 Gain adjustment for 20mA high analog output trim.
Par. no. 18 If no keys are pressed for 10 minutes, display will show flashing bar (Energy Save Mode). Pressing any key to exit
Par. no. 19 sets baudrate of 9,600 or 19,200 per MODbus master.
Par. no. 20 Feature to reset the analyzer back to factory default.
Par. no. 21 is the full range of the particular 3TX-CON module/transmitter. This is a display (read-only) parameter.
Par. no. 22 is the nominal conductivity cell constant. This is a display (read-only) parameter. Both P21 and P22 are set at the factory prior to dispatch and cannot be changed in the field.
Par. no. 23 allows setting the output to be inverted (i.e. for use in control) with the output corresponding to 20-0mA or 20-4mA.

* Negative trim adjustments will be shown as flashing numbers.

List of Parameters

No	Parameter	Description	Range	Default
01	Lock	Software Lock	On / Off	On
02	Address	Address on MODbus	Off, 1...247	Off
03	Temperature	Type of Input	Pt100, Pt1000	Pt1000
04	Compensation	Temp. Comp. Conductivity	Auto, Fixed (Manual / Set)	Auto
05	Comp. Temp.	Compensating Temperature	0..210	25
06	Temp. Comp. Factor	Compensation Factor	0.50 - 5.00 %/°C	2.10
07	Wire Gauge	Sensor AWG	20, 22, 24	22
08	Cable Length	Length in feet	1...999 feet	10
09	Input for lout	Input for the analog output	Conductivity Con or Temp °C	Con
10	lout	Type of output	4-20mA, 0-20mA	4-20
11	0/4mA Low Output Scale	Low Output (Cond Units)	0%-90% of Full Range	0%
12	20mA High Output Scale	High Output (Cond Units)	10%-100% of Full Range	100%
13	Step Change	Increments for Calibration	0=0.1%, 1 =0.2%, 2=0.5%, 3=1.0%	2
14	Offset Adjustment	Zero Calibration	Increments per P13	N/A
15	Working Gain (Slope)	Gain on Cell Constant	±50% or ±70%	1.00
16	0/4mA Offset	Trim Low	±9.99% *	Factory
17	20mA Gain	Trim High	±9.99% *	Factory
18	Energy Save	Energy Save	On / Off	On
19	Baudrate	MODbus	9,600 / 19,200	19,200
20	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par
21	Full Range	Max Range	Per Cell K	N/A
22	Nominal Cell Constant	Cell constant a.k.a. "K"	As defined on order	N/A
23	lout mode	lout mode	noninverted, inverted	n.inv

Calibration

Use 'Mode' to select 'Gain', then 'Up' or 'Down' to adjust the readout corresponding to the expected value. The adjustment may be $\pm 50\%$ or $\pm 70\%$ from nominal value depending upon model, and may be entered manually using Par no. 15. **The effective cell constant is found by multiplying the nominal cell constant (P22) with effective gain (P15).** A zero calibration is performed with sensor clean and dry and exposed to only air with Par no. 14, with the steps determined by Par no. 13.

NOTES: The temperature can be calibrated by pushing the "Up" or "Down" buttons when in the temperature display ($^{\circ}\text{C}$) mode. The raw (uncompensated) conductivity can be viewed by pushing the 'Down' button in the main measure display mode.

Cell Constant	Full Scale Maximum Conductivity Range (Nominal)	Minimum Range at 10% of Maximum Full Range
20.0 (6.0-34.0)	0 to 1,000,000 microSiemens(μS)/cm 0-1,000 mS/cm	0 to 100,000 microSiemens(μS)/cm 0-100 mS/cm
10.0 (3.0-17.0)	0 to 500,000 microSiemens(μS)/cm 0-500 mS/cm	0 to 50,000 microSiemens(μS)/cm 0-50 mS/cm
2.0 (0.6-3.4) *	0 to 100,000 microSiemens(μS)/cm 0-100 mS/cm *	0 to 10,000 microSiemens(μS)/cm 0-10 mS/cm *
1.0 (0.3-1.7)	0 to 50,000 microSiemens(μS)/cm 0-50 mS/cm	0 to 5,000 microSiemens(μS)/cm 0-5 mS/cm
0.2 (0.06-0.34) *	0 to 10,000 microSiemens(μS)/cm 0-10 mS/cm *	0 to 1,000 microSiemens(μS)/cm 0-1 mS/cm *
0.1 (0.03-0.17)	0 to 5,000 microSiemens(μS)/cm 0-5 mS/cm	0 to 500 microSiemens(μS)/cm 0-0.5 mS/cm
0.1L (0.05-0.15)	0 to 200 microSiemens(μS)/cm 0-0.2 mS/cm	0 to 50 microSiemens(μS)/cm 0-0.05 mS/cm
0.01 (0.005-0.015)	0 to 500 microSiemens(μS)/cm 0-0.5 mS/cm	0 to 50 microSiemens(μS)/cm 0-0.05 mS/cm
0.01L (0.005-0.015)	0 to 20 microSiemens(μS)/cm 0-0.02 mS/cm	0 to 5 microSiemens(μS)/cm 0-0.005 mS/cm

* $K=2.0/\text{cm}$ extended range is 0-200mS (min scale 0-20mS); $K=0.2/\text{cm}$ extended range is 0-20mS (min scale 0-2mS), both in analog & MODbus versions.

NOTES: Many alternate cell constants and ranges can be supported (inquire to factory). The full scale measurement range and nominal cell constant must be defined at the time of order and cannot be changed after dispatch. The effective cell constant can be modified with a gain calibration from $\pm 50\%$ to $\pm 70\%$ of the nominal cell constant (depending upon model). The possible effective cell constants after a gain adjustment is performed are shown to the right of the cell constant (in parentheses).

MODBUS

In order to utilize the MODbus interface the 3TX-CON must be ordered with MODbus. 3TX-CON may be used as a slave for the 3TX-DAT or as a slave in a SCADA data acquisition. Please refer to the separate specifications for the high resolution 3TX-CON-E.

With 3TX-DAT

If 3TX-CON is used with 3TX-DAT, the baud rate on the MODbus as well as the address of the 3TX-pH should be noted. **The baud rate (P19)** must be set to the baud rate of the 3TX-DAT. Whether a baud rate of 19,200 or 9,600 is used is of no importance, as long as all units on the MODbus are set to the same baud rate.

The address (P02) must be unique in the network; Two units cannot have the same address. In a network with 3TX-DAT as the master, all addresses must be assigned in series; i.e. if 3 units are connected to 3TX-DAT, the addresses 1, 2 & 3 must be assigned to the three units. The order of the addresses is of no importance. In a network with a 3TX-DAT, up to 63 slaves may be connected.

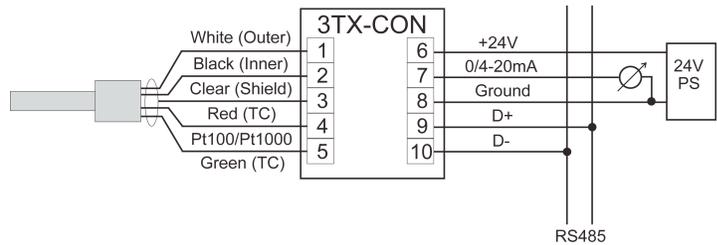
In a SCADA system or with Windows software

Since different SCADA systems may have different restrictions only the general are mentioned here: **The baud rate (P19)** must be set to the baud rate of the SCADA system. **The address (P02)** must be unique in the network; Two units are not allowed to have the same address. Up to 247 3TX transmitters may be connected on a single network, although repeaters may be required if more than 32 nodes are used and/or for long cable distances.

MODbus Scaling

The MODbus scaling for the conductivity process measurement output is the same as the analog output range as defined by P11 (low 0/4mA setpoint) and P12 (high 20mA setpoint).

Typical Installation



The 3TX-CON contains 2 measurements (Conductivity and temperature). Access to these measurements are gained through the function code *Read_Input_Registers (04)*.

Read_Input_Registers

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

Value 1 is Conductivity and value 2 is Temperature. If 2 values are chosen, both conductivity and temperature are transmitted. If, for instance, the value for temperature is wanted, 2 values must be requested. Both values are rated to 0-1000 corresponding to the effective range, but the temperature has an offset of 1024; i.e. the effective conductivity range is transmitted as 0-1000 and the full scale temperature range (0-210 $^{\circ}\text{C}$) is transmitted as 1024- 2024.

The 3TX-CON 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 Communication 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

<i>ENCLOSURE TYPE</i>	
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)
<i>MEASUREMENT MODULES ONE (1) THROUGH SEVEN (7)</i>	
CODE	DESCRIPTION
-pH **	pH/ORP/mV/Temp Measurement Module / Transmitter
-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
<i>OUTPUT OPTIONS FOR MEASUREMENT MODULES (ONE OPTION MUST BE SELECTED FOR EACH MODULE)</i>	
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
<i>ADD-ON MODULES FOR MEASUREMENT MODULE ENCLOSURE ASSEMBLIES</i>	
CODE	DESCRIPTION
-PS	100 to 240 VAC 50/60 Hz Universal Power Supply Adapter for Line Powered Operation
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33Wh) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

** To obtain a 3TX that supports and requires sensors with preamplifiers, order the pH/ORP transmitters as -pH-X and the ion selective (ISE) transmitters as -ISE-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).



3TX-CON-E HIGH RESOLUTION MODBUS CONDUCTIVITY TRANSMITTER SUPPLEMENT

The 3TX-CON-E series of contacting conductivity transmitters allows for high resolution MODbus output to take full advantage of the maximum internal resolution of the instrument for applications where this is advantageous. Please contact factory to determine if your application would benefit from use of the 3TX-CON-E version. All specifications not detailed below are identical to the standard 3TX-CON transmitter for the given cell constant and configuration.

Nominal Cell Constant	Calibrated Cell Range	Full Range with Temp. Comp.	Full Range Resolution MODBus Value 1 Scaling	Raw Conductivity Input Range	Raw Input Resolution MODBus Value 3 Scaling
K = 0.02/cm	0.006 to 0.034	0-2,000 µS (0-2mS)	0.1µS 0-20,000 Steps	0-5,000 µS (0-5mS)	0.1µS 0-50,000 Steps
K = 0.1/cm	0.03 to 0.17	0-5,000 µS (0-5mS)	0.5µS 0-10,000 Steps	0-25,000 µS (0-25mS)	0.5µS 0-50,000 Steps
K = 0.2/cm	0.06 to 0.34	0-20,000 µS (0-20mS)	1µS 0-20,000 Steps	0-50,000 µS (0-50mS)	1µS 0-50,000 Steps
K = 1.0/cm	0.30 to 1.70	0-50,000 µS (0-50mS)	5µS 0-10,000 Steps	0-250,000 µS (0-250mS)	5µS 0-50,000 Steps
K = 2.0/cm	0.60 to 3.40	0-200,000 µS (0-200mS)	10µS 0-20,000 Steps	0-500,000 µS (0-500mS)	10µS 0-50,000 Steps
K = 10.0/cm	3.00 to 17.0	0-500,000 µS (0-500mS)	50µS 0-10,000 Steps	0-2,500,000 µS (0-2,500mS)	50µS 0-50,000 Steps
K = 20.0/cm	6.00 to 34.0	0-1,000,000 µS (0-1,000mS)	100µS 0-10,000 Steps	0-5,000,000 µS (0-5,000mS)	100µS 0-50,000 Steps

Shared Modifications for all 3TX-CON-E series units from standard 3TX-CON transmitters:

- The second MODbus value is always the temperature. The scaling is 0-210 °C sent as 0-1,000 steps.
- Changing parameter P11 (low 0/4 mA setpoint) and/or the parameter P12 (high 20mS setpoint) will modify the scaling on the analog 0/4-20mA outputs only. The MODbus output ranges are fixed as defined above for the 3TX-CON-E version. In contrast, for the standard MODbus resolution CON-CELL/RANGE-D units, the MODbus scaling follows what is set for the analog 0/4-20mA outputs via parameters P11 & P12 and sent as 0-1000 steps.
- The MODbus output of any CON-E unit is incompatible with the DAT MODbus datalogger. To interface a 3TX conductivity transmitter with a DAT, use the standard MODbus resolution CON-CELL/RANGE-D units instead.
- The CON-E high resolution units are compatible with the “ASTI Windows Datalogging & Graphing Software for 3TX Conductivity Transmitters”, Version 2.3 or above.
- The CON-E high resolution units are compatible with any suitable standards compliant MODbus PLC, SCADA or data acquisition system. Please inquire to ASTI factory if you have any specific question regarding compatibility for your planned use and setup or the protocol employed.

To order the 3TX-CON-E style, simply include the desired nominal cell constant only when ordering. For example, the K=0.2/cm cell constant unit is simply ordered as 3TX-CON-E-0.2. Note that there is no need to indicate that the CON-E is a MODbus output style (typically denoted with a -D at the end of the typical 3TX transmitter part number) since this CON-E high resolution MODbus conductivity transmitter ONLY comes in the dual analog plus MODbus output configuration. There is no difference in price between the standard MODbus resolution CON-CELL/RANGE-D transmitters (and these are the DAT datalogger compatible units) and these high resolution MODbus CON-E-CELL transmitters (which are DAT incompatible). Please contact factory for assistance to ensure that you select the most appropriate unit for your desired application.

Last Modified August 11, 2014 - Revision 10



**Connection Diagram of ASTI Contacting Conductivity Sensors (Tinned Leads Only)
to 3TX-CON Contacting Conductivity Transmitters**

ASTI Cable Color Coding	Instrument Terminal Value	3TX-CON Terminal Number
White	Outer Electrode	1
Black	Inner Electrode	2
Clear (Optional)	Shield/Ground (Optional)	3
Red	Pt100 or Pt1000	4
Green	Pt100 or Pt1000	5

Note 1: Cell Constant and Range must be defined at time of purchase and cannot be changed after receipt of transmitter. See labels on 3TX-CON transmitter for details about cell constant and range and/or contact ASTI factory prior to purchase to ensure correct selection of cell constant and range.

Note 2: Depending upon the TC ordered it may be necessary to change the parameter 04 from PT1000 (default) to PT100 (selectable).



General Installation & Calibration Guide to Installation & Calibration of Conductivity Sensors with the 3TX-CON Transmitter

Before turning on the 3TX transmitter, please read the recommendations and warnings on page 1 & 2 of the 3TX FAQ write-up at the link below:

http://www.astisensor.com/3TX-FAQ-pH_ORP_Ion_Selective_ISE_Conductivity_Transmitter_Controller_Application_Notes.pdf

Before starting, if you suspect that any settings have been modified you can reset the unit back to factory default by turning P01 to 'Off' (disables the software lock) and toggle over to P20 to do a reset (set value to 'Def' and press Mode key to save the change).

A general checklist for installation and calibration of a contacting conductivity cell on the 3TX-CON follows:

1) Confirm correct wiring. When used with our own conductivity sensors this is indicated on the 3TX-CON instruction sheet and also with the supplied sensor. For third-party sensors you will need to confirm that the lead colors for the equivalent functions are wired to the corresponding terminals. There may be lead wires that are unused for some 3rd party sensors (simply push these back and tape-off each bare lead). This presumes that there exists no unusual bridged wiring schemes in the third party OEM sensor used. For example, the 3TX-CON transmitter expects a single value for each terminal lead (one color is inner electrode ONLY, another color is the outer electrode ONLY, yet another color is ONLY the shield,...and so forth). If multiple values have been tied together in some unusual or proprietary framework, we cannot supply such special end of cable terminations. The wiring details are provided on page 3 of the 3TX-CON document as well as the stand-alone wiring schematic at these links:

<http://www.astisensor.com/3TX-CON.pdf>

http://www.astisensor.com/ASTI_3TX-CON_Conductivity_Wiring_Schematic.pdf

2) Wait for the conductivity sensor to reach temperature equilibrium removed from the process, dry, and lying or suspended in air. Calibrate the temperature displayed on the transmitter. Verify that you have a reasonable reading displayed before proceeding. There are three settings related to the temperature value that will be displayed:

P03 - Sets TC element as either Pt100 (shows 100 in this case) or as Pt1000 (shows 999 in this case)

P07 - Selects the wire gauge of the leads

P08 - Set to match the actual cable length of the sensor in feet

Once these three setup parameters are correct you should get a temperature reading at least close to the actual value. The calibration of the temperature reading to be more precise can be done by turning off the P01 software lock and toggling to the temperature display LED mode. The 'Up' and 'Down' keys can be used to adjust the temperature reading until it exactly matches the desired value as measured with a good thermometer or other temperature reference device.

3) Zero the the connected conductivity sensor while it is dry and in air. This is done with setup parameter P14. Disable the P01 software lock and proceed to P14. Using the 'Up' and 'Down' keys, adjust the displayed value until it reads zero. This calibration should be done slowly as it is sensitive and rather difficult to redo if you allow the displayed value to drop below zero (going slowly avoids this issue). PLEASE SEE NOTE ABOUT STEP CHANGE SENSITIVITY NEAR THE END OF THIS GUIDE.



4) The conductivity sensor is now ready for wet calibration to determine the effective cell constant. This can be done by using a conductivity solution of an exact known conductivity value (a.k.a. conductivity standard). It is important to carefully note that the standard solution conductivity value varies with temperature and this must be accounted for during calibration. Contact the ASTI factory if you plan to use a conductivity standard solution to perform a wet Gain calibration to determine the effective (apparent) cell constant. Another option is to install the sensor into field service, allow it to equilibrate and to use the Gain calibration to adjust the displayed conductivity to the number determined from a grab sample reference determination. Both methods are commonly used for field calibration.

The Gain calibration on the 3TX-CON is accomplished by first disabling the P01 software lock and the toggling over to the 'Gain' LED mode. The display value can be adjusted using the 'Up' or 'Down' keys until the desired number is shown. There is some time averaging dampener running in both the calibration and measurement modes so adjust the displayed value slowly to avoid overshooting. The effective/apparent cell constant after calibration can be determined by multiplying the value displayed for parameter P15 (working gain) and parameter P22 (nominal cell constant). If you had a working gain of 0.95 and a nominal cell constant of 10.0 then your effective calibration cell constant is 9.50 (simply the product of these two values). In addition to showing the result of a wet gain calibration, parameter P15 also lets you adjust the working gain directly using the 'Up' and 'Down' keys (again, with P01 software lock disabled). PLEASE SEE NOTE ABOUT STEP CHANGE SENSITIVITY BELOW.

STEP CHANGE SENSITIVITY:

The sensitivity each time the 'Up' or 'Down' button (a.k.a. step change) is depressed is determined by parameter P13. The default is 0.5% (displays as "2"). This sensitivity can be modified if desired to be other values. Changing the setting to "0" makes the step change 0.1% (ultrafine), while changing the setting to "1" makes the step change 0.2% (fine). The default setting is "2" which is 0.5% (standard). In only a few cases will the step change need to be changed to the very coarse setting of "3" which is 1.0%.

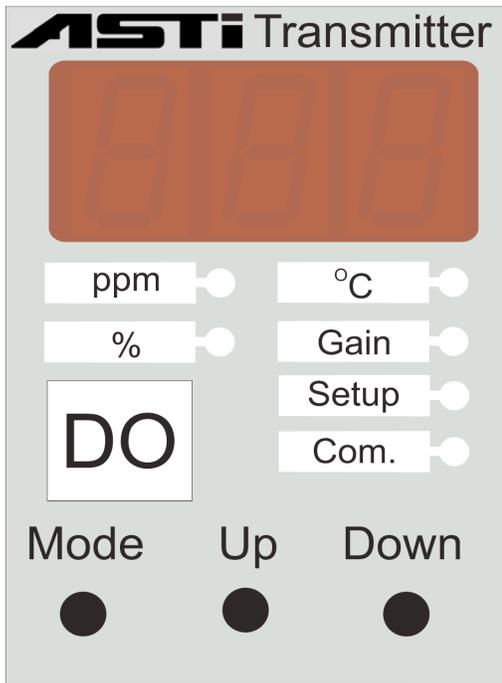
As always, the conductivity sensor should be cleaned prior to calibration and free from air bubbles inside the measuring cell to ensure proper results. The following cleaning procedure is for our AST10 and AST51 sensor but many of the concepts are generally applicable to a range of contacting cells:

http://www.astisensor.com/General_Cleaning_Instructions_for_Contacting_Conductivity_Sensors.pdf

Contact the ASTI factory if you have any difficulties pairing an OEM 3rd party conductivity sensor to the 3TX-CON after having gone through the procedures outlined in this document.

Last Revised December 22nd, 2014

3TX-DO Dissolved Oxygen Controller, Transmitter & Datalogger



- Many environmental monitoring & municipal and industrial wastewater treatment plants are devoting more money and time for the measurement dissolved oxygen than necessary due high costs of many competitors' transmitters and sensors.
- Simple, low-cost & easy to use 3TX-DO transmitter has all features that are needed such as:
 - Display and output dissolved oxygen levels in ppm and percent (%) saturation units plus temperature in °C via both analog 4-20mA and optionally RS485 MODbus
 - Calibrations and process readings corrected for temperature, air pressure and salinity
- Omitting expense features rarely if ever used saves substantial money on initial commissioning.
- Measure from 0-4 to 0-40.0ppm (0-40% to 0-400% saturation); Fixed 0.01ppm resolution anywhere in the range
- DO transmitter & sensor rated to 0-50°C (0-122°F)
- Modular 3TX series allows for any mix of 3TX modules for pH, ORP, ISE, DO & Conductivity for measurement or control

KEY FEATURES & BENEFITS

- AST-DO is a proven membrane covered self-polarizing active style galvanic cell that generates a low-impedance millivolt electrical signal proportional to the oxygen pressure it senses.
- **Extremely low initial commissioning cost and residual cost of ownership. For most applications included materials are sufficient to perform measurement for 3 to 5 years time.**
- Rugged submersible sensor suitable for most any municipal and industrial wastewater, aquaculture or environmental use
- Galvanic type DO sensor there is **a true zero and so no zero adjustment is ever needed**
- Gain calibration performed with sensor dry in air; 3TX-DO has correct calibration value stored at any temperature & pressure
 - Adjustment for gain via automatic or manual mode. **No look-up tables and no solutions required to calibrate your DO sensor with the 3TX-DO!**
- Due to unique electrolyte chemistry and design combined with rugged membrane technology, the calibration, cleaning and replacement needs are quite minimal and easy to perform



Close-Up of the fully submersible AST-DO-T Galvanic DO sensor with Pt100 TC is above.

Optional NPT submersible assembly option is installed in photo of the model shown above.

Inline Low-Flow Cell mounting adapters are also available (inquire to factory for details).



SPECIFICATIONS: 3TX-DO 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)
Application Range (AST-DO):	Environmental monitoring of water quality in rivers, lakes and well and other natural water sources, compliance for health and safety applications; municipal secondary and tertiary wastewater treatment; industrial wastewater treatment; aquaculture and fish applications
Displayed Concentration Range:	0.0 to 40.0 ppm or 0 to 400% Saturation
Resolution:	0.01 ppm anywhere in the range
Output Scaling:	Output scalable to 10% of full range (min 4ppm or 40% Saturation) for Analog & MODbus The 4mA & 20mA setpoints can be arbitrarily defined and are fully reversible
Lowest Displayed Limit of Detection:	0.01 ppm
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 installations 10 psig or less; Submersible to 50 meters (165 feet)
Sample Flow Requirements:	Continuous flow, Minimum 1cm per second for stable readings
DO Sensor Specifications:	Membrane Covered Galvanic Cell generates mV potential linear to the dissolved oxygen ppm in air or liquid; Internally temperature compensated; Response of 2mV to 6mV per ppm
Special Features:	3TX-DO automatically corrects for temperature, pressure and salinity effects on % saturation in calibration and measurement (both for display & output); More details on 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 low cost systems, the 3TX-pH and 3TX-ISE transmitter series supports optional external preamplifiers for noisy environments or to avoid opening the analyzer enclosure for sensor service, and to minimize sensor replacement costs (no long cables need be pulled).

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.

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 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

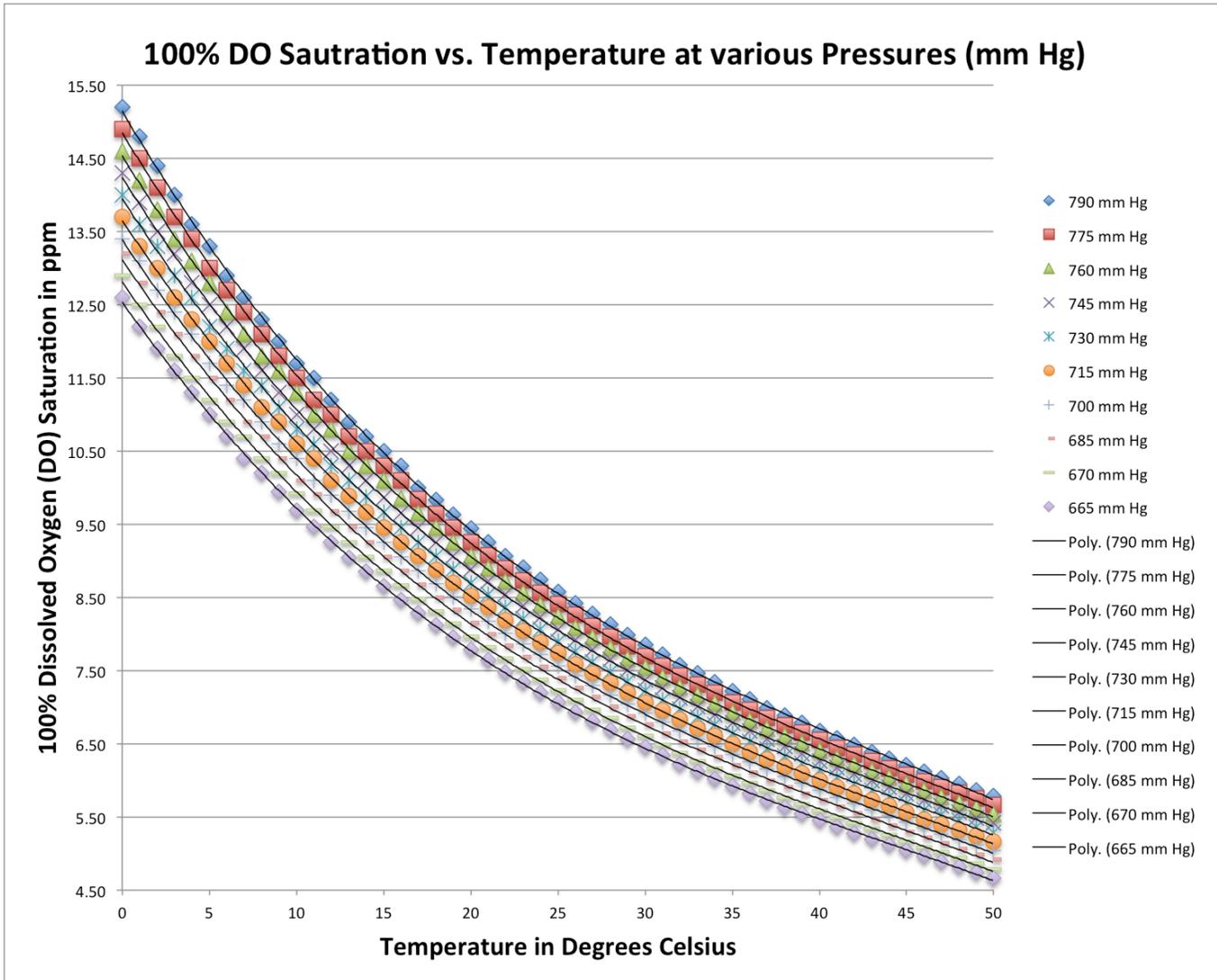
Power Options: Universal 100 to 240 VAC 50/60 Hz power supply or 3-wire 24VDC operation (not 2-wire loop power) with a dedicated power supply.

Last Revised June 17, 2014



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

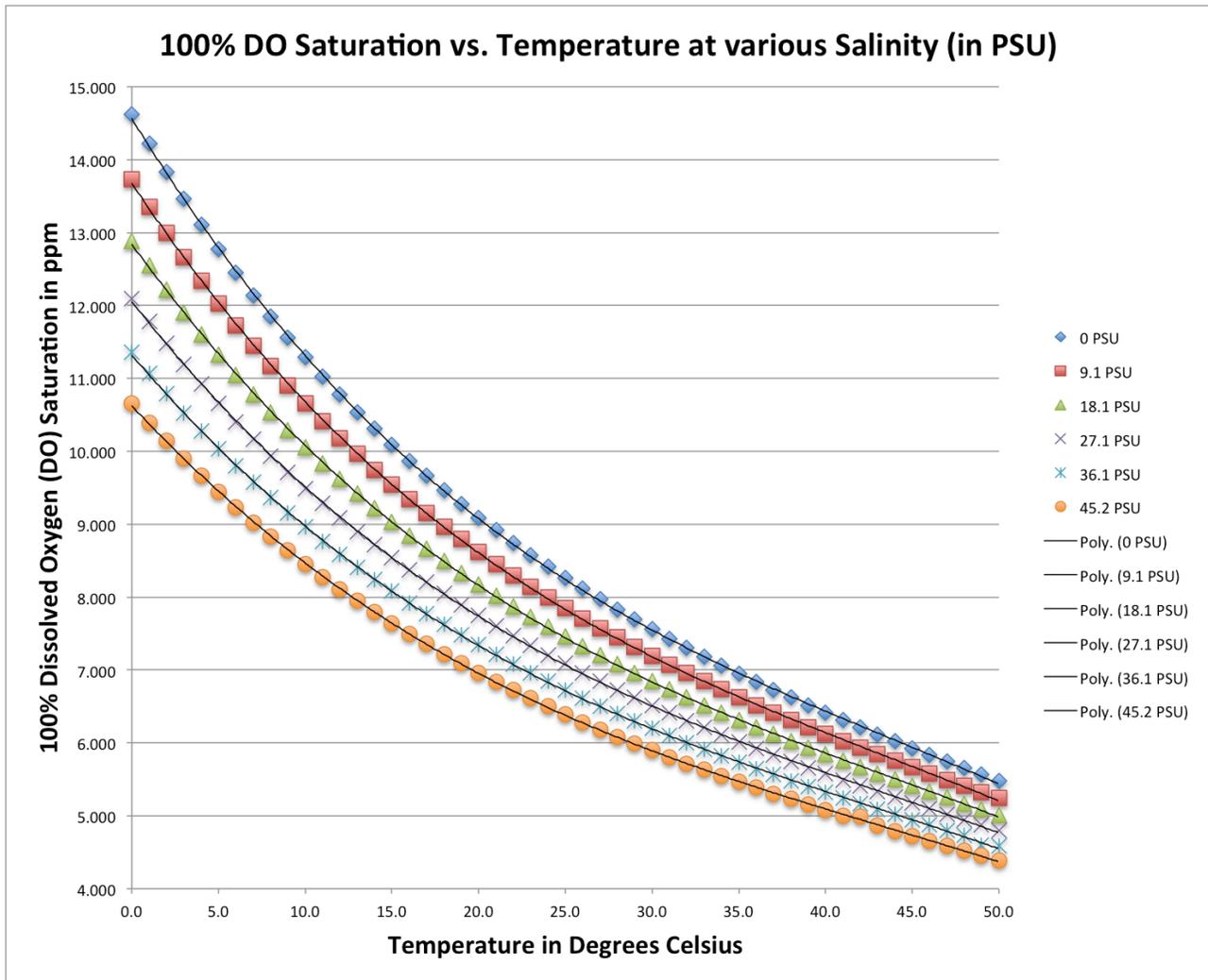
The 3TX-DO has preprogrammed the correct 100% dissolved oxygen saturation levels valid at any temperature and pressure. This is important for two main purposes: 1) to ensure accurate calibration of the sensor which is performed dry in air and 2) when the percent (%) saturation is displayed and output 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

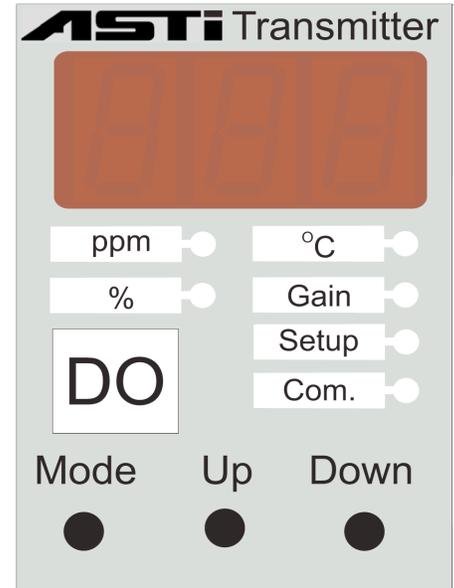
The 3TX-DO has preprogrammed the correct 100% dissolved oxygen saturation levels valid at not only any temperature and pressure but also corrected for salinity. This is important for applications where not only fresh water will be present but also for brackish and salt water sources in variable amounts. 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

The measuring sensor for oxygen must be connected to terminal 1 and 2. The DO sensors terminal 1 is +mV and 2 is -mV. The internally (self) temperature compensated absolute mV for galvanic type sensors is the basis for the display and outputs. The temperature sensor is connected to terminals 4 and 5 and the measured resistance is the basis of the temperature measurement which is used for setting the 100% saturation condition in the gain calibration and to compute the % saturation state in the process. The cable length contribution to resistance of the Pt100 is automatically corrected.

Analog Output (Standard)

The 3TX-DO transmitter (module) has a scalable analog output of either 0-20 mA or 4-20 mA (selectable) and can be standard or inverted. The output 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 output is galvanically isolated from input and proportional to DO ppm or DO % saturation.

MODbus (Optional)

Data is transferred using MODbus standard 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
Sensor: Self-Polarizing Galvanic DO Sensor
Measuring Range: 0-40 ppm full range scale
0-400% saturation full range scale
Resolution: 0.01 ppm anywhere in the range
Galvanic Range: From 2.0 to 6.0 mV per ppm DO
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

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 parameter 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 the temperature input to be manual (fixed/set) or automatic from connected Pt100 or Pt1000 temperature sensor.
Par. no. 4 sets the temperature value when temperature input is in fixed (manual/set) mode for P03.
Par no. 5 sets the ambient barometric air pressure in units of mm of Hg. 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 wire gauge (AWG) for the sensor cable used.
Par. no. 7 is the length of sensor cable in units of feet.
Par. no. 8 is the salinity of the process sample in units of PSU.
Par. no. 9 sets scheme used to compute % saturation. The default automatic mode takes the measured DO in ppm units and computes the % saturation against the stored theoretical value at the given temperature, ambient air pressure and salinity. Manual mode uses a fixed DO ppm value for this computation.
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 and 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. The difference between low & high output setpoints (P14 & P15) must be at least 10% of full range scaling in the chosen units.
Par. no. 16 displays the result of the gain calibration and also allows manual modification of same. Units are mV per ppm.
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.

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	Wire Gauge	Sensor AWG	20, 22, 24	20
07	Cable Length	Length in feet	1...999 feet	23
08	Salinity	PSU Units	0 to 50	0
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)	Gain/Cal on DO Cell	±50% from Nominal	3.75 mV
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.

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.

Calibration

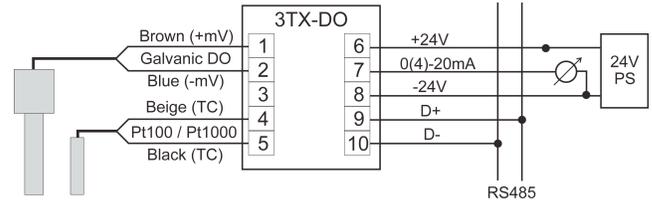
Use the 'Mode' key to select 'Gain'. Before removing the DO sensor from service, the 3TX-DO should be placed into the gain calibrate mode. The gain calibration is performed when the sensor is clean and dry and exposed to only air. In cases where the relative humidity is not 100%, the sensor should be suspended in air over a source of water for best results. Sufficient time must be allowed for the temperature and sensor reading to be fully stabilized in this condition to ensure a good calibration. The 3TX-DO transmitter defines from the

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: The temperature is calibrated with the "Up" or "Down" buttons in the temperature display (°C) mode. The result of the gain calibration can be viewed and modified in parameter P16 (units of mV per ppm DO). The raw mV potential is viewed by pressing the 'Down' button in the ppm or % display mode. The theoretical 100% saturation for the current temperature, pressure & salinity is viewed by pressing the 'Up' button in the ppm or % display mode.

Typical Installation



temperature (measured or entered) together with the entered barometric pressure the theoretical 100% saturated DO ppm value.

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 & 20mA setpoints is then 4ppm or 40% saturation absolute. The analog output is fully reversible. The analog & MODbus outputs can be scaled anywhere between the minimum 10% & 100% maximum limits. The MODbus output scaling will follow the analog setpoints (see more below).

MODBUS

In order to utilize the MODbus interface the 3TX-DO must be ordered with MODbus. 3TX-DO 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

The MODbus scaling for the DO process measurement output is the same as analog output set by P14 & P15. Since both the DO ppm and DO % saturation are sent via MODbus they are scaled together with a 10-fold factor and keyed upon the units selected in P11. If P11 is set to DO ppm and scaled as 2-10 ppm, the corresponding % saturation will be 20-100 %. If P11 is set to 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

<i>ENCLOSURE TYPE</i>	
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)
<i>MEASUREMENT MODULES ONE (1) THROUGH SEVEN (7)</i>	
CODE	DESCRIPTION
-pH **	pH/ORP/mV/Temp Measurement Module / Transmitter
-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
<i>OUTPUT OPTIONS FOR MEASUREMENT MODULES (ONE OPTION MUST BE SELECTED FOR EACH MODULE)</i>	
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 AND RS-485 MODbus Digital Output
<i>ADD-ON MODULES FOR MEASUREMENT MODULE ENCLOSURE ASSEMBLIES</i>	
CODE	DESCRIPTION
-PS	100 to 240 VAC 50/60 Hz Universal Power Supply Adapter for Line Powered Operation
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33W) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

** To obtain a 3TX that supports and requires sensors with preamplifiers, order the pH/ORP transmitters as -pH-X and the ion selective (ISE) transmitters as -ISE-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).

Last Modified April 16, 2013 Revision 7



**Connection Diagram of Submersible & Inline / Sanitary Galvanic
Dissolved Oxygen Sensors to ASTI 3TX-DO Dissolved Oxygen Transmitters**

SUBMERSIBLE SENSOR COLOR CODING

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

INLINE / SANITARY SENSOR COLOR CODING

ASTI Cable Color Coding	Instrument Terminal Value	3TX-DO Terminal Number
Blue	(-) mV Signal	1
Black	(+) mV Signal	2
N/A	No Connection	3
White	Pt100 / Pt1000	4
Brown	Pt100 / Pt1000	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 for measurement of temperature, calibration of the sensor and computation of the percent (%) saturation.

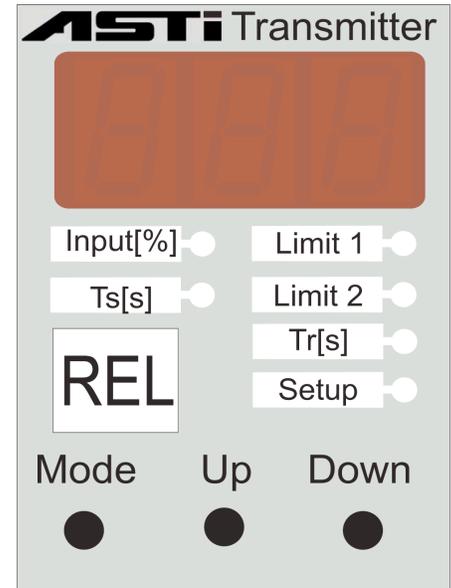
Note 3: Cable can be bridged across any ordinary suitable terminal strip in NEMA enclosure and sealing cable glands (max 330 feet). See relevant sensor manual and/or inquire to factory.



IOTRON™
pH / ORP / ISE / DO / Conductivity Measurement Products Lines

3TX-REL Alarm Relay and Controller Module

- 3TX-REL is a versatile controller and alarm module with 2 independent limits
- Performs alarm relay and/or controller functionality for 3TX-pH, 3TX-ISE, 3TX-DO or 3TX-CON measurement modules
- Offering Simple On/Off as well as more sophisticated Time Proportional Control (TPC) and Proportional Frequency Control (PFC) a.k.a. Variable Pulse
- One 3TX-REL module is required for control and/or alarm function for each 3TX measuring module (i.e., 1 each analog input per 3TX-REL module)
- Analog input: 0-20mA or 4-20mA
- Maximum or minimum limits can be configured for each of the 2 relays
- Configurable start timer and reaction timers
- 24VDC power operation, 5A max load/rating for each dry contact relay
- Hold function to disable relays during calibration and maintenance of measuring transmitters and sensors
- Scaling in native units (pH, ppm, $\mu\text{S}/\text{mS}$) for all input measurement modules
- DIN rail mountable; small form factor for tight space installations
- Field installations with weatherrpooof NEMA 4X & IP65 enclosures, supporting up to a total of 7 ea 3TX transmitter modules in a single enclosure



FEATURES

Application

3TX-REL modules are ideal for supervising mA signals. This unit is fully compatible with the output provided by all of our 3TX measuring transmitters (3TX-pH, 3TX-ISE, 3TX-DO and 3TX-CON). Simple On/Off as well as programmable control functionality is possible with the 3TX-REL module. For the purposes of the 3TX-REL, the 3TX-ISE and 3TX-DO modules are identical ppm units.

Analog Input

The analog input is a current input, and may be set up to either 0-20mA or 4-20mA. The 3XT-REL can be scaled so as to match exactly the 0-20mA or 4-20mA analog output from the 3TX-pH, 3TX-ISE & 3TX-CON measurement modules.

Digital Input

The 3TX-REL may be configured to both positive and negative logic on the digital inputs. Using parameter no. 21, the input may be set to either active high or active low. With positive logic, the accepted input voltage range is 5-30VDC. Negative logic is achieved by connecting the input to ground; for example by using a switch. The supervision may be blocked by activating the S2 input.

Relay Output

The unit contains two relays, one for each limit. The relays are both connection relays, but the polarity may be inverted independently using parameters no. 19 and 20 when in simple supervision and On/Off control mode.

Limits

The 3TX-REL integrates two limits. All settings for one limit may be altered independently of the other. Each limit may be set up as a Max. or Min. limit. All limits can be entered in the native unit of the measurement module to which it is connected (pH, ppm, $\mu\text{S}/\text{mS}$).

Start Timer (Ts)

The start timer may be used to avoid alarms during startup of an unstable process. It is activated when the input reaches 5%. If the timer is set to 0, supervision is performed without using the start timer.

Reaction Timers (Tr)

Each limit has a corresponding reaction timer used to avoid alarms if the limits are exceeded for short periods of time.

Control Modes

The 3TX-REL module can operate in four modes: 1) Simple supervision (alarm function only); 2) On/Off control with deadband; 3) Time Proportional Control (TPC) or 4) Proportional Frequency Control (PFC a.k.a. Variable Pulse).

Reset

During simple supervision (i.e. control mode is "Off") an alarm may be reset in two ways: 1) by activating the external reset input (S1 - terminal 3) or 2) by pressing the 'Mode' key in the "input" display mode. A reset requires the alarm condition to be cleared.



TECHNICAL SPECIFICATIONS

Mechanical

Housing: Lexan UL94V-0 (Upper part)
Noryl UL94V-0 (Lower part)
Mounting: IP M36 for 35 mm DIN rail
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: 200 grams (7.04 ounces)
Dimensions: D 58 x W 36 x H 86 mm (2.3" X 1.4" X 3.4")

Electrical

Power Supply: 24VDC ±10%
Consumption: 60 mA max
Input Current Range: (0)4-20mA, 70Ω
Digital input: Pos. logic: 5-30VDC; Neg. logic: 0V
Input S1: External reset
Input S2: Alarm block
Relay spec.: 250VAC / 5A
CE mark: EN61326A

PARAMETERS

Function and Settings

Parameter No. 01 is a "lock" which must 'Off' to change **ANY parameter**. To access parameters, press 'Mode' key until 'Setup' LED is lit and displays 'P00'. Use 'Up' and 'Down' keys to scroll through the parameters. Select parameter with 'Mode' key, and change value using 'Up' or 'Down' keys. To exit, select 'Par. no. 00' and press 'Mode' key.
Par. no. 2. Hold (Relay condition held - signaled by flashing input LED)
Par. no. 3. Type of input is selected - 0-20mA or 4-20mA.
Par. no. 4. Indicates the type of limit 1: Min. or Max.
Par. no. 5. Indicates the type of limit 2: Off, Min. or Max.
Par. no. 6. Select if display will show % (4mA=0%, 20mA=100%), pH units, Conductivity Units (either µS or mS), or ISE units (ppm)
Par. no. 7. When P05 is ISE, selects full scale range on 3TX-ISE module's 4-20mA output. 'Lo' is 0-10 ppm, 'Mi' is 0-100 ppm & 'Hi' is 0-999 ppm.
Par. no. 8. When P05 is set to CON, this selects the full scale range on the corresponding 3TX-CON measurement module 4-20mA. Each cell constant will define the full range scale. For K=0.01, Max=0.5mS; K=0.1, Max=5mS; K=1.0, Max=50mS; K=2.0, Max=100mS, K=10.0, Max=500mS
Par. no. 9. * This defines the value of the 4mA input. When P06 is % there are no adjustments possible. When P06 is ISE the value should match P10 on the 3TX-ISE module to which is it connected. When P06 is CON, then this will always be 0mS (no matter what the cell constant). When P06 is pH, the value should be match P13 on the 3TX-pH module.
Par. no. 10. * This defines the value of the 20mA input. When in P06 is % there are no adjustments possible. When P06 is ISE the value should be adjusted to match P11 on the 3TX-ISE to which is it connected. The difference between P09 and P10 when P06 is ISE must be at least 20% of the operating range (P09 on the 3TX-ISE). When P06 is CON then this will by default be the maximum full range scale associated with the conductivity cell constant selected. This value should match value of P12 on the 3TX-CON. The minimum value is 10% of full range. When P06 is pH, the value should match P14 on the 3TX-pH module. The minimum difference between P09 & P10 when P06 is pH is 3 pH units.
Par. no. 11 & 12. Off means simple supervision with alarm relays set to limits only. If 1, then On/Off Control is enabled. If 2, then time proportional control (TPC) is enabled. If 3, then proportional frequency control (PFC) is enabled (a.k.a. variable pulse control).
Par. no. 13. Sets basic time for limit 1 when in TPC mode (P11=2)
Par. no. 14. Sets basic time for limit 2 when in TPC mode (P12=2)
Par. no. 15. Sets basic pulse rate for limit 1 when in PFC mode (P11=3)
Par. no. 16. Sets basic pulse rate for limit 2 when in PFC mode (P12=3)
Par. no. 17. Common parameter - If On/Off mode (P11=1) then hysteresis (dead band) - If TPC or PFC (P11=2/3) then proportional band - For Limit 1
Par. no. 18. Common parameter - If On/Off mode (P12=1) then hysteresis (dead band) - If TPC or PFC (P12=2/3) then proportional band - For Limit 2
Par. no. 19. Polarity of relay 1: Non inverted/ Inverted ***
Par. no. 20. Polarity of relay 2: Non inverted/ Inverted ***

List of Parameters

No	Parameter	Description	Range	Default
01	Lock	Software Lock	On / Off	On
02	Hold	Relay on Hold	On / Off	Off
03	Input	Analog input	0-20mA, 4-20mA	0-20
04	Limit 1	Type of limit	Min (Lo), Max (Hi)	Hi
05	Limit 2	Type of limit	Off, Min (Lo), Max (Hi)	Lo
06	Display Mode	Type of Input Measurement	%, pH, CON, ISE	%
07	ISE Range	ISE Range Input	Lo, Mi, Hi	Lo
08	Con Range	Conductivity Cell Constant	0.01, 0.1, 1.0, 2.0, 10.0	1.0
09	4mA Scale	Reading @ 4mA	*	*
10	20mA Scale	Reading @ 20mA	*	*
11	Mode Lim1	Control mode Lim 1	Off, 1, 2, 3	Off
12	Mode Lim2	Control mode Lim 2	Off, 1, 2, 3	Off
13	Time Lim1	Time for Limit 1	1...250s	10
14	Time Lim2	Time for Limit 2	1...250s	10
15	Pulse Lim1	Pulse Rate Limit 1	1...250 pulse/min	60
16	Pulse Lim2	Pulse Rate Limit 2	1...250 pulse/min	60
17	Hysteresis 1	Dead Band Limit 1	1...50% **	10%
18	Hysteresis 2	Dead Band Limit 2	1...50% **	10%
19	Polarity 1	Polarity for relay 1 <i>Non-Inverted, Inverted</i>	n.inverted, inverted	n.inv
20	Polarity 2	Polarity for relay 2 <i>Non-Inverted, Inverted</i>	n.inverted, inverted	n.inv
21	Logic	Logic for digital inputs	Neg. (Lo), Pos. (Hi)	Lo
22	Trim Low	Calibrate 4mA Input	As Defined	-
23	Trim High	Calibrate 20mA Input	As Defined	-
24	% Trim Low	Display 4mA Offset	± 9.99%	****
25	% Trim High	Display 20mA Gain	± 9.99%	****
26	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par

Par. no. 21. Digital input configured to be active high (Hi) or low (Lo).
Par. no. 22. Allows calibration offset of 0mA or 4mA current signal input.
Par. no. 23. Allows calibration gain adjustment of 20mA current signal input.
Par. no. 24. Displays result of 0/4mA trim offset calibration (P22) in % units
Par. no. 25. Displays result of 20mA trim gain calibration (P23) in % units
Par. no. 26. Feature to reset the analyzer back to factory default.

** Value is 50% of range determined by Display mode (P06) and scale parameters P09 & P10

*** Relay polarity does not apply when in TPC mode (P11/P12=2) or PFC mode (P11/P12=3)

**** Default values will depend upon 4mA and 20mA calibration performed at ASTI factory.

Control Functions & Modes

On/Off control

When the measurement crosses the chosen setpoint, the relay will open and not close again until the measurement exceeds the hysteresis band.

Hysteresis Band

A hysteresis band (a.k.a. dead band) always lies above a Min & below a Max limit. This is P17 for Limit 1 & P18 for Limit 2 in On/Off mode.

Proportional Band

The proportional band is a range where a variable control is performed. A proportion band lies above a minimum and below a maximum limit. This is P17 for Limit 1 & P18 for Limit 2 in TPC control mode.

Basic Frequency

The basic frequencies for Limit 1 & 2 may be set from 1 to 250 pulse per minute (default 60). This is valid in the PFC control mode only.

Proportional Frequency Control (PFC a.k.a. Variable Pulse)

If the measurement lies outside the proportional band the relay will pulsate with the basic frequency. Inside the proportional band the frequency is changed linearly towards zero as the measurement approaches the setpoint.

Time Proportional Control (TPC)

The time is constant and equal to the basic time. Instead the duty cycle is changed according to the same principle as for PFC control. If the measurement lies outside the proportional band the relay is closed permanently and open permanently if limit is exceeded.

Control examples

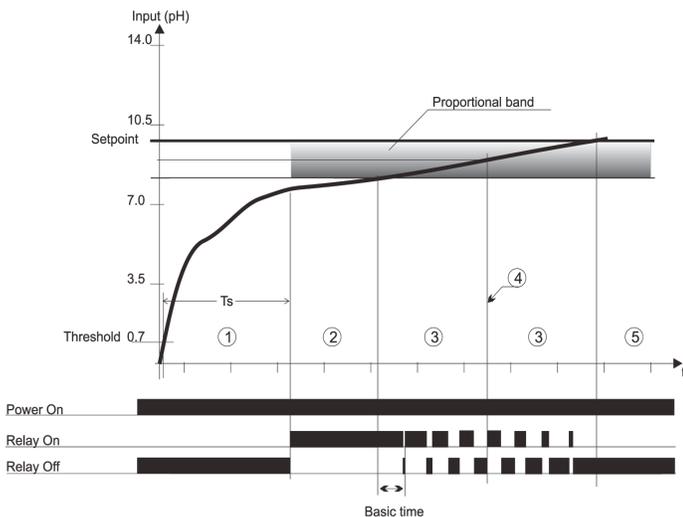
On/Off control may be used for alarms and simple control of pumps. Proportional frequency control is primarily designed for the control of dosing pumps. Proportional time control may be used for control where more fine approach is required than simple on/off control offers.

Parameters Accessible from LED Menu

In addition to the parameters in the setup menu, the 3TX-REL also features parameters directly accessible from the main LED menu (see next column top). The parameters are accessible by pressing the 'Mode' key until the LED for the parameter to be altered is lit. Use the 'Up' & 'Down' keys to alter the parameter. These parameters and their functions are shown in the table below.

Par No. 01 is a "lock" which must be 'Off' to change ANY parameter at all.

The figure below shows in principle how the TPC algorithm works. The curve depicts a process where a certain pH value (setpoint) is required. This example is taken from conditioning of heating water from a district heating plant, where the required pH value lies on 9.8 pH.



Parameter	Description	Range	Default
Ts [s]	Start up – timer	0.0 to 999s	10.0
Limit 1	Setpoint for limit 1 * Display mode % Display mode pH Display mode Con Display mode ISE	5.0– 99.9 % 0.1 – 14.0pH 1 – 500 ** 1 – 999 ***	80.0 11.2 400 ** 800 ***
Limit 2	Setpoint for limit 2 * Display mode % Display mode pH Display mode Con Display mode ISE	5.0– 99.9 % 0.1 – 14.0pH 1 – 500 ** 1 – 999 ***	20.0 2.8 100 ** 200 ***
Tr [s] (Limit 1)	Reaction time limit 1 ^	00.0 to 99.9s	10.0
Tr [s] (Limit 2)	Reaction time limit 2 ^	00.0 to 99.9s	10.0

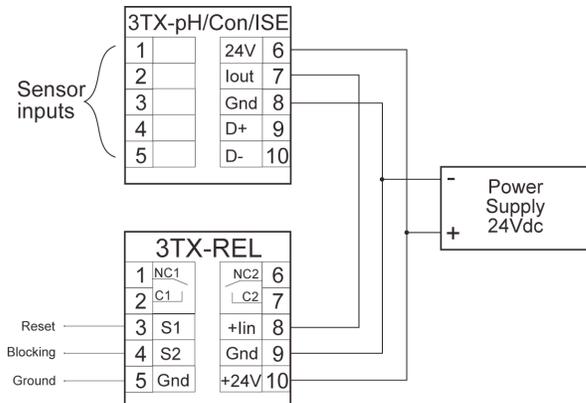
* Values depend on display mode and range selected with P06, P07 & P08

** Decimal point depends on selected range for conductivity

*** Decimal point depends on selected range for ISE

^ During this time period, no relay action will be undertaken when P06 is set to Off (supervision / alarm function only) or On/Off Relay control mode

Typical Installation



Note: An alternate wiring configuration is required if the 0/4-20mA transmitter output is to first (also) be sent to another data acquisition or control device. See website for alternate wiring.

Example of pH Control Application using TPC Mode

The required settings needed for this TPC implementation are:

- Limit: Hi (Max limit) or Lo (Min limit); Here a max limit is needed.
- Control mode: TPC
- Setpoint: Requested pH value; Here 9.8pH
- Proportional band: Band where the actual regulation is performed; Here 1 pH unit
- Basic time: "Cycle time" for the TPC algorithm; In the figure shown on the bottom left of this page, this is the time for the relay on + time for relay off
- Start timer: Startup time for the sensor to settle

When the measured value crosses 5% of the measuring range (here corresponding to 0.7pH) the startup timer is activated to avoid false readings during settling time of the sensor. This time should be selected large enough to give the sensor time to settle, but not much longer than this, since the supervision and control will be disabled in this period. The relay is off in this condition (see period 1 on figure).

After expiration of the startup timer the 3TX-REL starts to control. In the example, the measured value lies below the setpoint minus the proportional band (Period 2) and the relay will be continuously on to use maximum conditioning fluid.

When the measured value exceeds the setpoint minus the proportional band the values is said to lie within the proportional band (Period 3) and the on-time of the relay is regulated proportional to the distance up to the setpoint. This is illustrated with the two "bars" below the curve, where it is shown that the on-time drops as the value comes closer to the setpoint. At the point (4) the value is exactly in the middle of the proportional band where the on-time and off-time of the relay are equal (The relay is on half the time).

Finally when the setpoint is reached the relay is kept off and will not be set on again until the measured value drops below the setpoint. This is illustrated with period (5)



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
-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 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
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33W) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

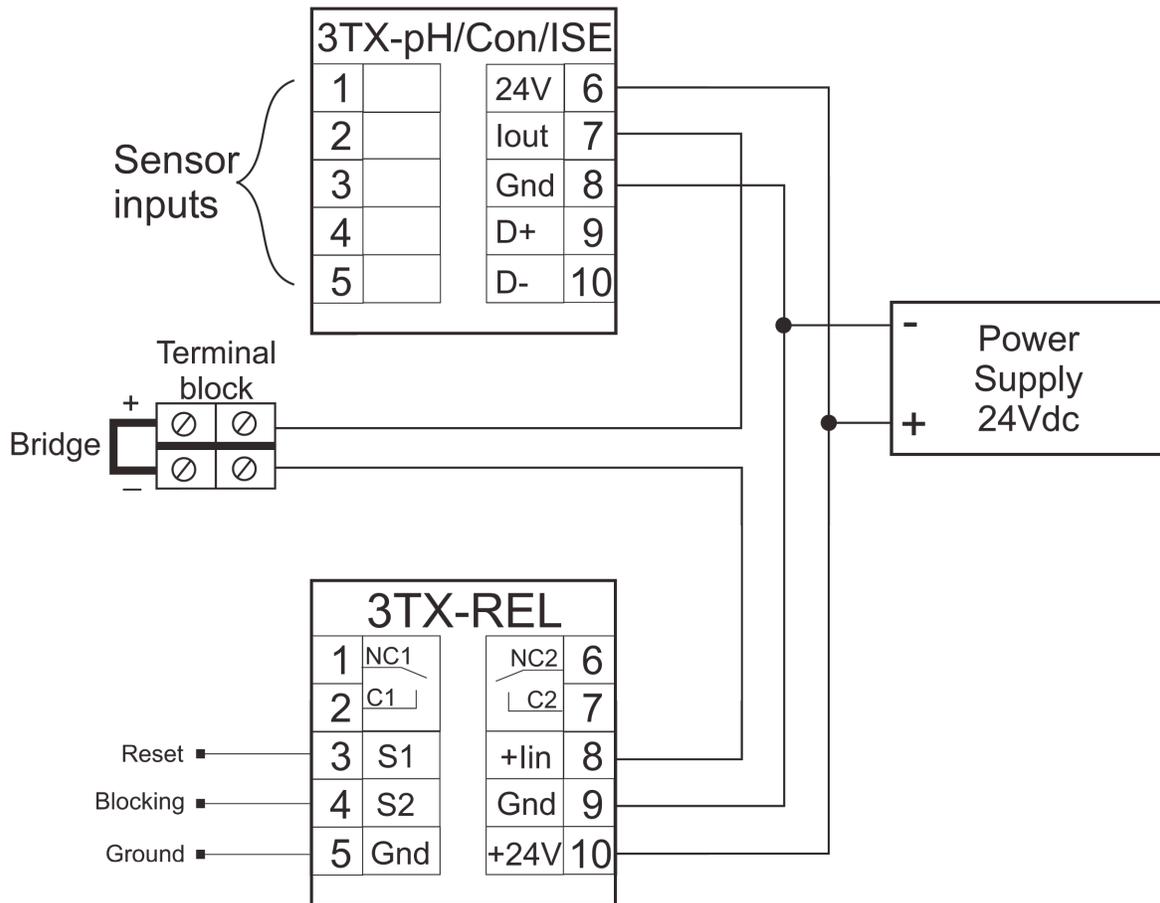
Model: 3TX-7MF-ISE-NH4-D-ISE-NO3-D-ISE-NO2-D-pH-D-CON-1.0/50-D-DO-D-DAT

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

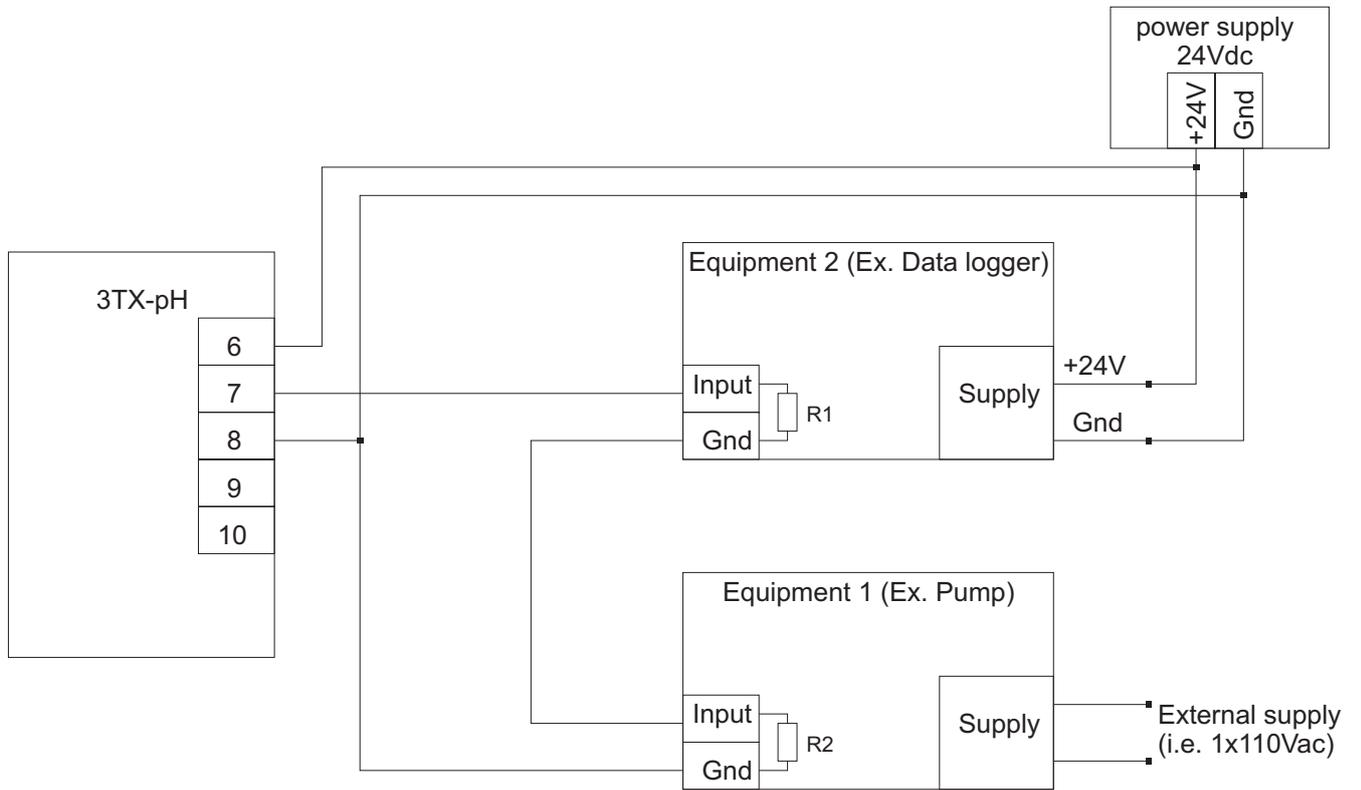
** To obtain a 3TX that supports and requires sensors with preamplifiers, order the pH/ORP transmitters as -pH-X and the ion selective (ISE) transmitters as -ISE-X

*** 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).

Wiring Schematic for 3TX Measurement Transmitters (3TX-pH, 3TX-CON or 3TX-ISE) when used together with 3TX-REL Relay Module and a 4-20mA Output is Required to connect with additional Data Acquisition or Control Devices



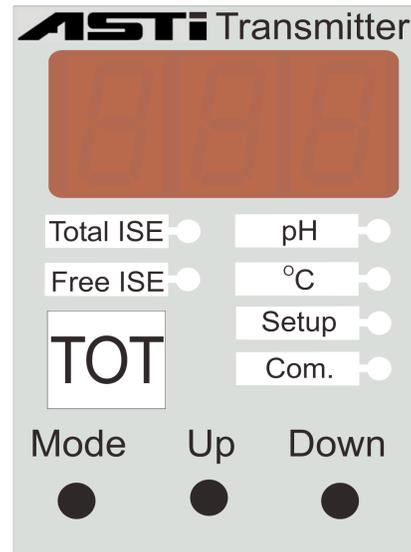
If you wish to “insert” an external device into the current loop, it can be done by removing the bridge jumper and connecting the two terminals to the external device (“+” to device input and “-” to device output, which may also be device ground). If no external device is to be connected, the bridge jumper must be in place to ensure normal operation of the 3TX-REL relay module.



Note:
 R1 and R2 are internal resistors.
 $R1 + R2 < 500\Omega$

3TX-TOT pH Compensation Module for Total ISE

- * The 3TX-TOT module determines Total ISE by using a compensation algorithm using Free ISE, pH and temperature as the primary process inputs
- * Total ISE can at present be found for Ammonia ($\text{NH}_3 + \text{NH}_4^+$), Fluoride ($\text{HF} + \text{F}^-$), Cyanide ($\text{HCN} + \text{CN}^-$) and Sulfide ($\text{HS}^- + \text{S}^{2-}$)
- * Total ISE computed is sent via 0/4-20mA analog output which is galvanically isolated from sensor inputs for use with mating data acquisition or controls
- * Input 1 is always Free ISE and Input 2 is always pH
- * Input 3 can be supported for any pH, ORP/mV, ISE, Conductivity measurement
- * All inputs and the computed total ISE are sent RS-485 MODbus digital outputs
- * The analog inputs can be sent on to other data acquisition and control devices
- * Highly configurable set of user parameters always almost any input configuration to be supported and the total ISE output to be highly customized
- * Temperature input can be obtained from splicing P100/Pt1000 TC input from ISE or pH sensor, from a separate Pt100/Pt1000 temperature sensor, or else from a scaled 4-20mA signal from a separate transmitter



FEATURES

The ASTI 3TX Family of Transmitters Consists Of:

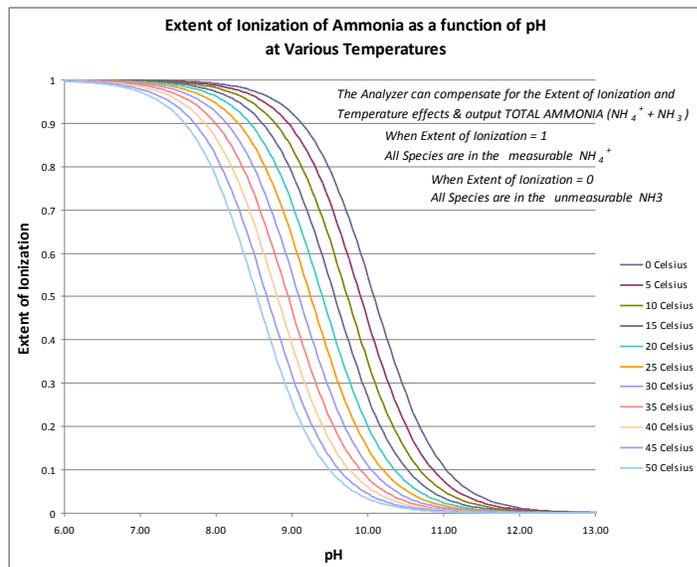
- 3TX-pH:** pH, ORP/mV and Temperature Transmitter with fully scalable 0/4-20mA output and MODbus (optional)
- 3TX-CON:** Contacting Conductivity Transmitter with fully scalable 0/4-20mA output and MODbus (optional)
- 3TX-ISE:** Ion Selective * Transmitter with fully scalable 0/4-20mA output and MODbus (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 calibration.**

* 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.



The graph above shows the effects of pH and temperature on the extent of ionization for the weak base, ammonia. The dissolved ammonia gas is converted into the ionized ammonium ion, which is measured by the ISE sensor. The extent of ionization reveals the percent of the weak base which can be measured. When the extent of ionization is 1.00, then 100% is in the measurable form. When the extent of ionization is 0.00, then 0% is in the measurable form. The 3TX-TOT module is able to compute, display and transmit what would be 100% of the weak acid or base activity, even if only a small fraction is actually in the measurable form. See the next page for more details.

TECHNICAL SPECIFICATIONS

Mechanical

Housing:	Lexan UL94V-0 (Upper part) Noryl UL94V-0 (Lower part)
Mounting: IP	M36 for 35 mm DIN rail
Class:	Housing IP40. Connector IP20
Connector:	Max 16A. Max 2.5 mm ² , Max torque 0,6 Nm
Temp.:	Usage -15 to +50 °C (Storage -35 to +75 °C)
Weight:	200 grams (7.05 ounces)
Dimensions:	D 58 x W 36 x H 86 mm (2.3" X 1.4" X 3 3/4")

Electrical

Power Supply:	24Vdc ±10%
Consumption:	60 mA max
Input Current:	0-20mA or 4-20mA, max. 250Ω
Accuracy:	Class 1%
Analog Output:	0-20mA or 4-20mA, max. 300Ω
Serial Port 1:	RS485, 9.6/19.2 K Baudrate
CE mark	EN61326A

The graphs to the right show the impact of pH on the extent of ionization of various weak acids as a function of pH. Unlike the graph on the first page for the conversion of the weak base ammonia to ammonium ion as function of pH shown at various temperatures, all of the graphs to the right are shown at a single temperature for a more simple visualization of these effects at the common 25 degrees Celsius condition. As short explanation of the chemistry behind the pH compensation to compute total ISE that the 3TX-TOT performs is below to understand the conditions under which this module should be used in conjunction with the 3TX-ISE and 3TX-pH transmitters.

The extent of ionization defines the percent of the species of interest for the weak base (typically ammonia) or the weak acid (typically HF, HCN or HS-) is converted into the form which the ion selective sensor can detect, which is the free ionized species. On the vertical axes this extent of ionization is 0.00 when none of the species is in the measurable form for the ion selective sensor. In such cases, it is not possible to use pH compensation is not possible since none of the species can be measured by the ISE sensor at all. When the extent of ionization is 1.00 then all of the weak base or weak acid is in the ionized form that can be detected by the ISE sensor and so not pH compensation is required. For example, all of the NH₃ gas is in the NH₄⁺ ion form all of the HF gas is in the F⁻ ion form, all of the HCN gas is in the CN⁻ ion form and all of the HS⁻ ions is in the measurable S²⁻ ion form. The portion which is in the measurable form at that given pH and temperature (the extent of ionization) is called the "Free ISE". The "Total ISE" computed by the 3TX-TOT module is the value computed as though all 100% were in the measurable form. An simple example is given below for the purposes of illustration:

Samples conditions are Temp: 25.0 °C, pH: 3.45

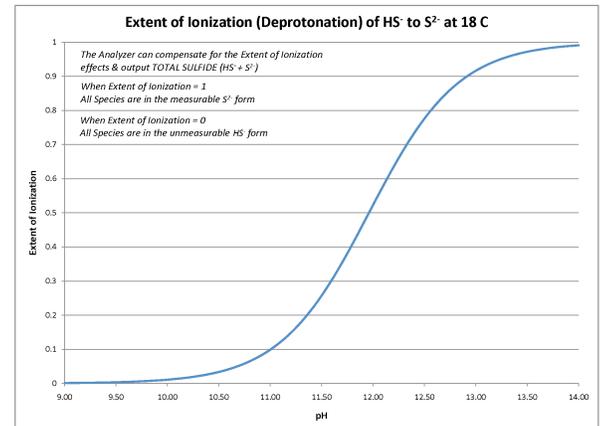
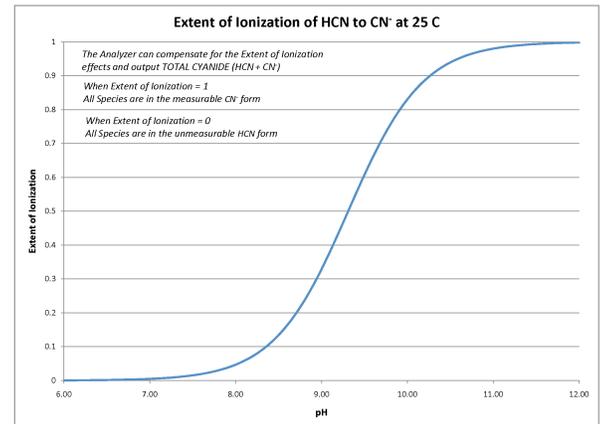
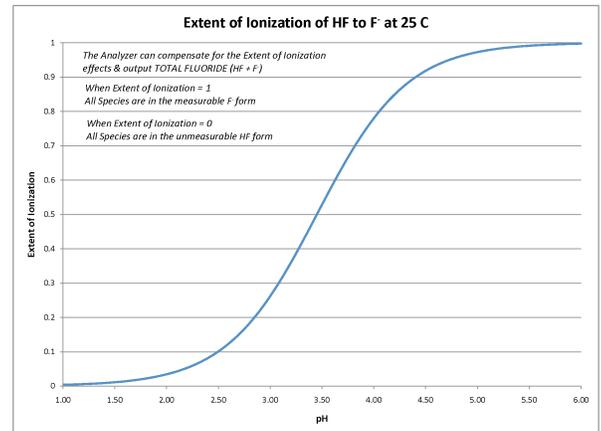
The extent of Ionization at this pH and temperature for the HF/F- system is 0.50

Free ISE: 35.0 ppm Fluoride (F-), Computed Total ISE: 70.0 ppm Fluoride (F-)

The 3TX-TOT module uses built-in algorithms to compute the extent of ionization for the system of interest (NH₃, HF, HF or HS) at the current pH and temperature. The Total ISE is found by simply taking the Free ISE and dividing it by this computed extent of ionization. The resulting Total ISE shows what would be the ion activity detected if all of the species were at a condition such that they were in the measurable form.

For the 3TX-TOT module, Input 1 shall always be the Free ISE and Input 2 shall always be the pH to be used for compensation (analog input from 3TX-pH transmitter). If the pH input is not available or constant, the pH value used can be entered manually in parameter P28, when P27 is set to manual (Set) pH mode. The temperature input used for the pH compensation algorithm can be obtained from a spliced Pt100 or Pt1000 TC element (obtained from the ISE or pH sensor), a separate Pt100/Pt1000 temp. probe, or else a 4-20mA signal from a temperature transmitter. In all cases the temperature input is always connected as Input 3. There is an optional support for a fourth input on the 3TX-TOT module. This is often an ion selective measurement that does not require pH compensation, an additional pH/ORP measurement, or else a conductivity measurement. All input measurements as well as the computed Total ISE value can be sent for further use in other data acquisition or control devices via analog 0/4-20mA outputs and MODbus RS-485 digital output. The wiring schematics on the fourth page detail all of the supported input configurations whereas the set of configurable parameters on page 3 details all of the supported modes and options available in the module.

If the 3TX-TOT module was purchased part of a complete 3TX field assembly, then the user parameters will have been preconfigured at the ASTI factory in the most suitable manner possible based upon the information provided. As such, quite often very few of the parameters may need to be modified to begin using your 3TX-TOT module.





List of Parameters for Function and Programming

No	Parameter	Description	Range	Default
P01	Lock	Software Lock	On / Off	On
P02	Address	Address on MODbus	Off, 1...247	Off
P03	Input 1 - Free ISE	Free ISE Analog Input	Off, 4-20mA, 0-20mA	4-20mA
P04	Free ISE Range	Select 3TX-ISE Free ISE Input	Lo (0-10), Mi (0-100), Hi (0-999)	Lo
P05	0/4mA Scale - Free ISE	Reading @ 0/4mA	-	-
P06	20mA Scale - Free ISE	Reading @ 20 mA	-	-
P07	Input 2 - pH	pH for compensation	Off, 4-20mA, 0-20mA	4-20mA
P08	0/4mA Scale - pH	Reading @ 0/4mA	-	-
P09	20mA Scale - pH	Reading @ 20 mA	-	-
P10	Input 3 - Temp	Temperature Mode	Manual (Set) or Automatic (Aut)	Set
P11	Manual Temp	Sets the Operating Temp if P10 is Set	0...105	25
P12	Temp Mode	Sets the temperature input mode	Splice, Raw, 4-20mA	Splice
P13	TC Input Select	Temp Input if P12 is Splice or Raw	Pt100 or Pt1000	Pt1000
P14	Input 3 - Configure	Select Analog Input 3	Off, 4-20mA, 0-20mA	Off
P15	Input 3 - Variable	Type of Input Measurement	Temp, pH, ORP/mV, CON, ISE	ISE
P16	Input 3 - ISE Range (If P15 is ISE)	Select Working Input Range on 3TX-ISE Input 3	Lo (0-10), Mi (0-100), Hi (0-999)	Lo
P17	Input 3 - Conductivity Cell Constant	Select Conductivity Cell Constant and Associated Full Scale Range	0.01, 0.1, 1.0, 2.0, 10.0 (If P15 is CON)	1.0
P18	Input 3 - ORP/mV	Set ORP/mV Scaling (If P15 is ORP)	±1000, -1000 to 0 or 0 to +1000	±1000
P19	Input 3 - 0/4mA Scale	Reading @ 0/4mA	-	-
P20	Input 3 - 20mA Scale	Reading @ 20mA	-	-
P21	Display Input 3	Displays Real-Time Input 3 Reading	Temp, pH, ORP/mV, CON or ISE	Off (None)
P22	Type of pH Compensation	Select the Type of pH compensation to be performed	Total Ammonia (nh3), Total Fluoride (hf), Total Cyanide (hcn) & Total Sulfide (hs)	Depends on Request at Time of Order
P23	Type of Total ISE Output	Select 0-20mA or 4-20mA Output	4-20mA, 0-20mA	4-20mA
P24	Scaling for 0/4-20mA Total ISE Output	Select Working Output Range on Computed Total ISE Output	Lo (0-10), Mi (0-100), Hi (0-999)	Hi
P25	0/4mA Scale-Total ISE	Reading @ 0/4mA	-	-
P26	20mA Scale-Total ISE	Reading @ 20 mA	-	-
P27	Set pH Compensation Mode	Set Automatic or Manual pH Input Mode	Automatic (Aut) or Manual (Set)	Automatic
P28	Manual pH Value	User entry of pH value in Manual Mode	0.00 to 14.00	7.00
P29	Trim Low Input 1	0/4mA Offset Calibration for Input 1	As Defined by Free ISE Measurement	-
P30	Trim High Input 1	20mA Gain Calibration for Input 1	As Defined by Free ISE Measurement	-
P31	Trim Low Input 2	0/4mA Offset Calibration for Input 2	As Defined by pH Measurement	-
P32	Trim High Input 2	20mA Gain Calibration for Input 2	As Defined by pH Measurement	-
P33	Trim Low Input 3	0/4mA Offset Calibration for Input 3	As Defined by Input 3 Configuration	-
P34	Trim High Input 3	20mA Gain Calibration for Input 3	As Defined by Input 3 Configuration	-
P35	Trim Low Output	0/4mA Offset Cal for Output (Total ISE)	As Defined by P23, P24, P25 & P26	-
P36	Trim High Output	20mA Gain Cal for Output (Total ISE)	As Defined by P23, P24, P25 & P26	-
P37	Baudrate	MODbus	9,600/19,200	19,200
P38	Back to Default	Reset to Default	Def=Reset, Par=No Reset	Par

Par. no. 1 is a "lock" which must 'Off' to change ANY parameter.

Par. no. 2 sets module's address for MODbus communication.

Par. no. 3 sets Free ISE input to be 0-20mA or 4-20mA (P08 on 3TX-ISE).

Par. no. 4 sets Free ISE input to low, mid or high. This should match P09 on the 3TX-ISE transmitter that is used for the Free ISE input.

Par. no. 5 defines value of 0/4mA input for free ISE. This value should be adjusted to match P10 on 3TX-ISE module to which is it connected.

Par. no. 6 defines value of 20mA input for free ISE. This should match P11 on 3TX-ISE. P05 & P06 must be at least 20% of the operating range (P09 on the 3TX-ISE).

Par. no. 7 sets pH input to be 0-20mA or 4-20mA (P11 on 3TX-pH).

Par. no. 8 defines the value of 0/4mA input for pH. This value should be adjusted to match P13 on 3TX-pH module to which is it connected.

Par. no. 9 defines the value of 20mA input for pH. This value should be adjusted to match P14 on 3TX-pH module to which is it connected. The minimum difference between P08 and P09 when is at least 3 pH units.

Par. no. 10 sets temperature for pH compensation in auto or manual mode.

Par. no. 11 defines temperature when P10 is set (in manual mode).

Par. no. 12 sets temperature input mode when P10 is Auto. When in Splice or Raw Pt100/Pt1000 mode, this signal is gained from Input 3/Ground. When in 0/4-20mA temperature input mode, this signal is gained from Input 3/Ground and P13 must be set to Temperature. If P10 is manual, all temperature inputs are ignored.

Par. no. 13 sets Pt100 or Pt1000 TC input (if P12 is Splice or Raw mode).

Par. no. 14 sets 0-20mA or 4-20mA mode for Input 3.

Par. no. 15 sets types of signal to be provided on Input 3 to Temp, pH, ORP/mV, CON, or ISE. If P12 is 4-20mA then this must be set to Temp.

Par. no. 16 selects ISE Input 3 to low, mid or high when P15 is set to ISE. This should match P09 on the 3TX-ISE transmitter that is used as Input 3.

Par. no. 17 selects cell constant used on sensor for 3TX-CON Input 3 when P15 is set to CON (Conductivity).

Par. no. 18 selects range for Input 3 when P15 is set to ORP/mV mode.

Par. no. 19 defines the value of the 4mA input. When P15 is ORP/mV the minimum value of P18 range selected is set. When P15 is ISE the value should be adjusted to match P10 on mating 3TX-ISE. When P12 is CON, then this will always be 0mS. When P13 is pH, the value should match P13 on the mating 3TX-pH.

Par. no. 20 value of the 20mA input. When P15 is ORP/mV the maximum value of P18 range selected is set. When P13 is ISE the value should match P11 on 3TX-ISE.

P19 and P20 when P15 is ISE must be at least 20% of the operating range (P09 on 3TX-ISE same as P16 on the 3TX-TOT). When P15 is CON should match P13 on 3TX-CON. When P15 is pH, the value should match P14 on the mating 3TX-pH.

Par. no. 21 displays the real time reading of Input 3.

Par. no. 22 selects the type of pH compensation being performed.

Par. no. 23 sets the Total ISE input to 0-20mA or 4-20mA.

Par. no. 24 sets Total ISE output to be low, mid or high.

Par. no. 25 sets Total ISE output at 0/4mA.

Par. no. 26 sets Total ISE output at 20mA. The difference between P25 and P26 should be at least 20% of the range selected by P24.

Par. no. 27 selects pH to be gained from Input 2 (Auto) or user defined (Manual)

Par. no. 28 sets the pH value when in P27 is in Manual mode

Par. no. 29 offset calibration of 0mA or 4mA current signal input 1 (Free ISE)

Par. no. 30 gain calibration adjustment of 20mA current signal input 1 (Free ISE)

Par. no. 31 offset calibration of 0mA or 4mA current signal input 2 (pH)

Par. no. 32 gain calibration adjustment of 20mA current signal input 2 (pH)

Par. no. 33 offset calibration of 0mA or 4mA current signal Input 3

Par. no. 34 gain calibration adjustment of 20mA current signal Input 3

Par. no. 35 offset calibration of 0mA or 4mA current signal Output (Total ISE)

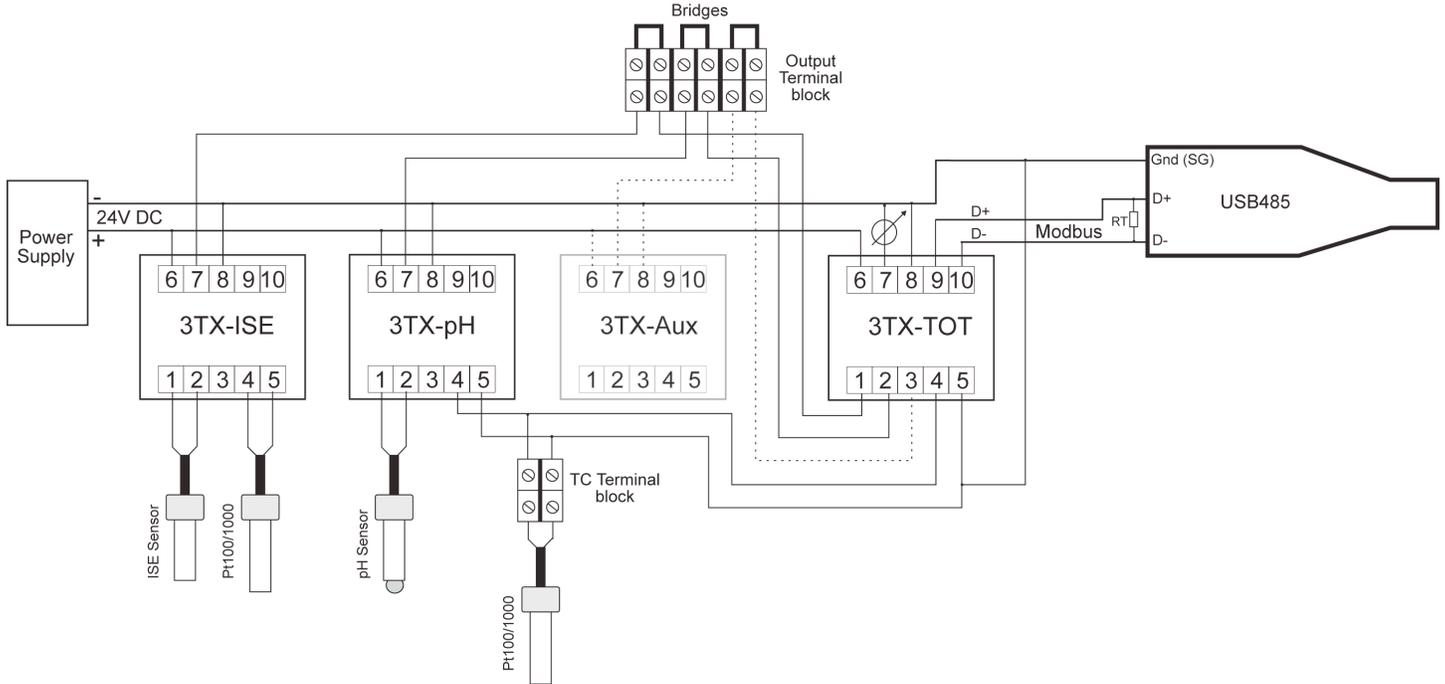
Par. no. 36 gain calibration adjustment of 20mA current signal Output (Total ISE)

Par. no. 37 sets the baudrate in accordance with the MODbus-master.

Par. no. 38 Feature to reset the analyzer back to factory default.



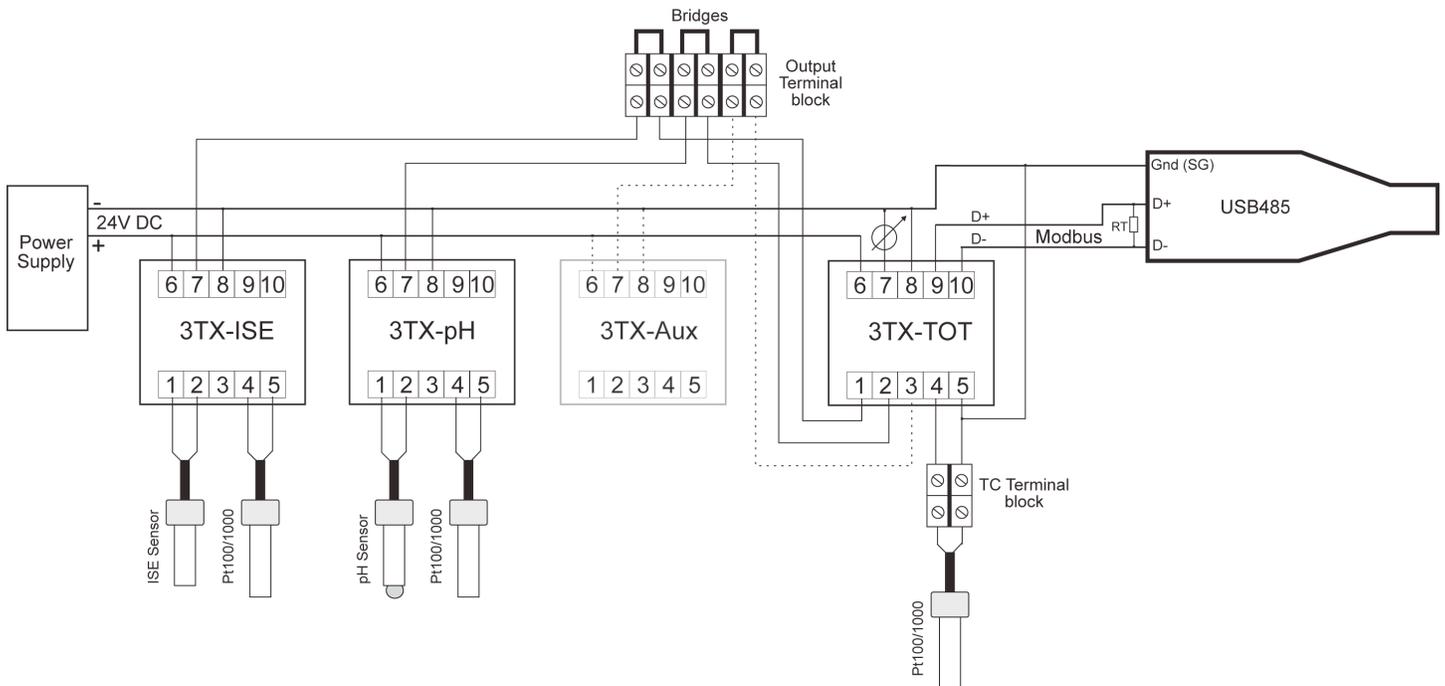
Wiring Approach 1: Spliced Pt100/Pt1000 Temperature Input to 3TX-TOT



Notes about wiring Approach 1:

- * The optional 3TX-Aux shown can be any additional measurement transmitter such as 3TX-pH, 3TX-ISE or 3TX-CON
- * The jumpers from the Output Terminal Block can be removed so that the current loop output can be sent to any data acquisition or control system.
- * When purchased as a complete assembly, specify your desired wiring approach and all units will be pre-wired at ASTI factory prior to dispatch.

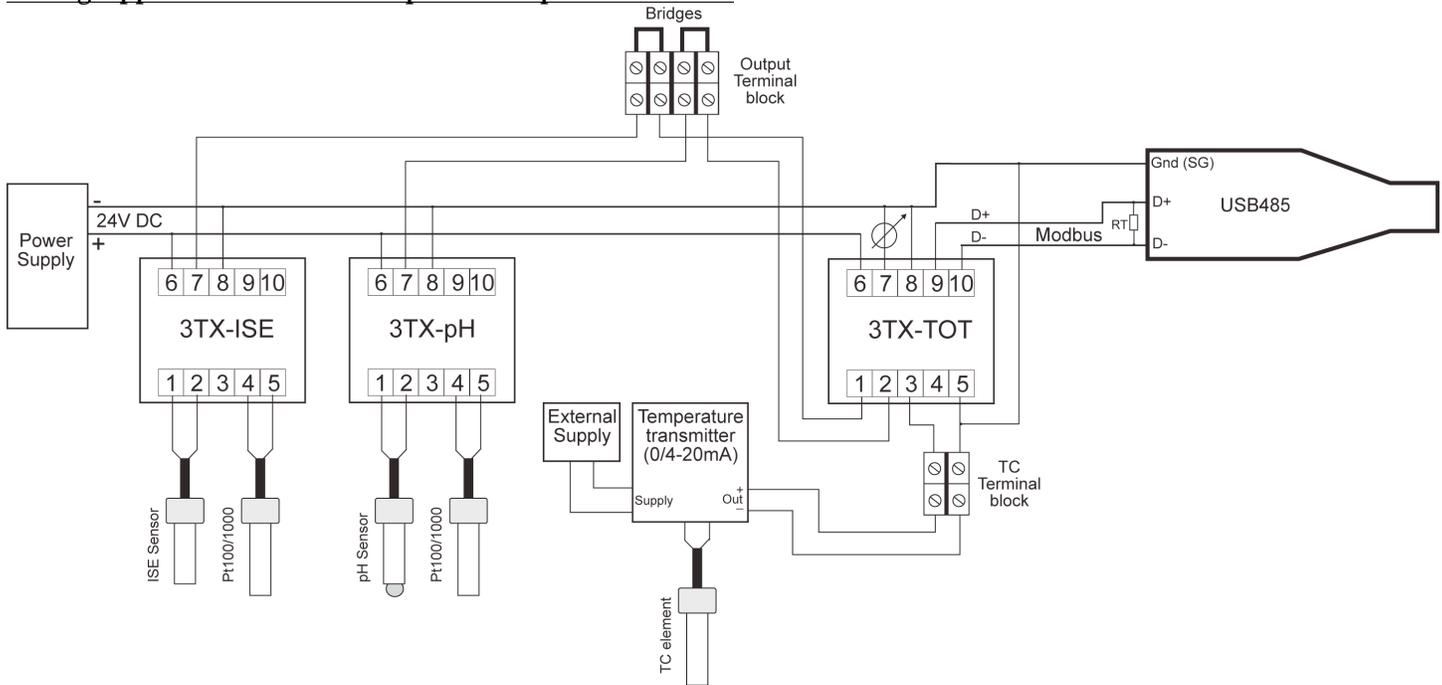
Wiring Approach 2: Raw Pt100/Pt1000 Temperature Input to 3TX-TOT



Notes about wiring Approach 2:

- * The optional 3TX-Aux shown can be any additional measurement transmitter such as 3TX-pH, 3TX-ISE or 3TX-CON
- * The jumpers from the Output Terminal Block can be removed so that the current loop outputs can be sent to any data acquisition or control system.
- * The TC terminal block shown is optional (can be wired directly into terminals 4 & 5 on 3TX-TOT module if desired)

Wiring Approach 3: 4-20mA Temperature Input to 3TX-TOT



Notes about wiring Approach 3:

- * In wiring Approach 3, it is not possible to have a third measurement transmitter (shown on Approach 1 & 2 as 3TX-Aux). The TC terminal block shown is optional.
- * The jumpers from the Output Terminal Block can be removed so that the current loop outputs can be sent to any data acquisition or control system.
- * When purchased as a complete assembly, specify your desired wiring approach and all units will be pre-wired at ASTI factory prior to dispatch.

NOTES ON DISPLAY OPTIONS AND TEMPERATURE CALIBRATION:

- The temperature is calibrated by pushing the “Up” or “Down” buttons when in the temperature display (°C) mode.
- The effective real-time pK (at the current tempature) is displayed by pressing the “Down”-key in main “TOTAL ISE” display mode.
- The effective real-time extent of ionization is displayed by pressing the “Up”-key in the main “TOTAL ISE” display mode.

MODBUS

The 3TX-TOT may be used as a slave for the 3TX-DAT or as a slave in a SCADA system. The setup and communication for each case will be explained in the following and is available as a standalone supplement entitled “3TX-TOT-MODbus-Protocol-Summary.pdf” with more details.

With 3TX-TOT

If 3TX-TOT is used together with the 3TX-DAT, the user must pay attention to two things: The baud rate on the MODbus as well as the address of the 3TX-TOT. **The baud rate (P37)** must be set to the baud rate of the 3TX-DAT. Whether a baud rate of 19,200 or 9,600 is used is of no importance, as long as all units on the MODbus are the same baud rate.

The address (P02) must be unique in the network; Two units are not allowed to have the same address. In a network with the 3TX-DAT as the master, all addresses must be assigned without leaving any address out; The order of the addresses is of no importance. In a network with a 3TX-DAT, up to 63 slaves may be connected with valid addresses from 1 to 247.

In a SCADA system

Since different SCADA systems may have different restrictions only the general are mentioned here: **The baud rate (P37)** must be set to the baud rate of the SCADA system. **The address (P02)** must be unique in the network; Two units are not allowed to have the same address.

MODbus Scaling

The scaling for the computed Total ISE output is defined by the range selected in P24 (low 0-10ppm, mid 0-100ppm or high 0-999ppm). This MODbus output for the computed Total ISE may differ from the analog 0/4-20mA scaling defined by P25 & P26.

The 3TX-TOT contains a maximum of 4 input measurements (Free ISE, pH, Temp and Auxiliary) and a fifth value for the computed Total ISE as the output. All five of these can be transmitted on the MODbus. Access to these are gained through the function code *Read_Input_Registers (04)*. The 3TX-TOT gives access via *Diagnostics (08)*, as shown in the following.

Read Input Registers

Function code	Start address	Number of values
04	1	1, 2, 3, 4 or 5

Measurements are transmitted in sequence; All values are rated to 0-1000 corresponding to the range, Output (Total ISE - 1st value) has no offset, Input 1 (Free ISE - 2nd value) an offset of 1024, Input 2 (pH - 3rd value) an offset of 2048, Input 3 (Temp - 4th value) an offset of 3072 and Auxiliary has no offset (5th value); Total ISE is sent as 0-1000, Free ISE as 1024-2024, pH as 2048-3048, Temp as 3072-4072, and Aux (when present) as 0-1000.

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 Communication 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

<i>ENCLOSURE TYPE</i>	
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)
<i>MEASUREMENT MODULES ONE (1) THROUGH SEVEN (7)</i>	
CODE	DESCRIPTION
-pH **	pH/ORP/mV/Temp Measurement Module / Transmitter
-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
<i>OUTPUT OPTIONS FOR MEASUREMENT MODULES (ONE OPTION MUST BE SELECTED FOR EACH MODULE)</i>	
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 AND RS-485 MODbus Digital Output
<i>ADD-ON MODULES FOR MEASUREMENT MODULE ENCLOSURE ASSEMBLIES</i>	
CODE	DESCRIPTION
-PS	100 to 240 VAC 50/60 Hz Universal Power Supply Adapter for Line Powered Operation
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33Wh) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

** To obtain a 3TX that supports and requires sensors with **preamplifiers**, order the pH/ORP transmitters as **-pH-X** and the ion selective (ISE) transmitters as **-ISE-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).

pH Compensation of Free ISE to Determine Total ISE

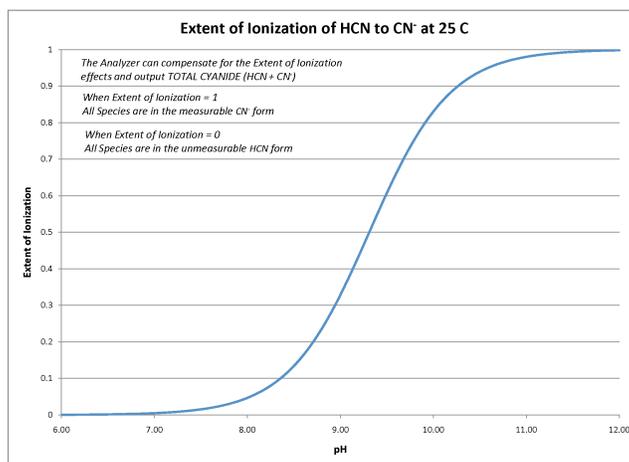
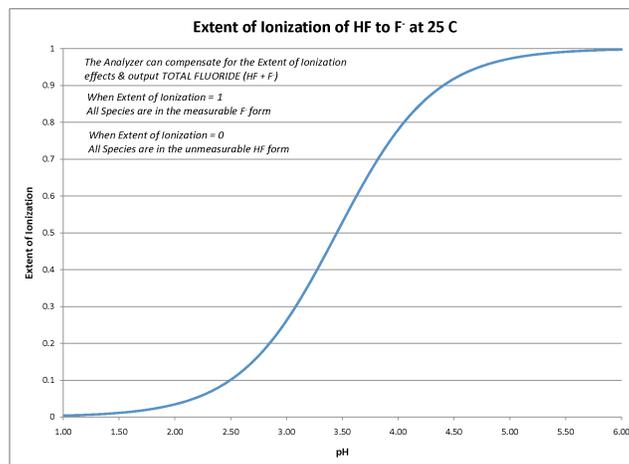
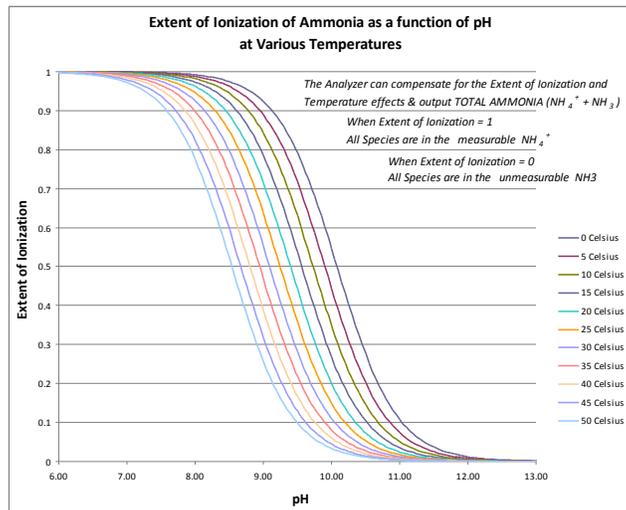
This document will detail the following frequently asked questions about pH compensation of free ISE (such as free ammonia, free fluoride, free cyanide and free sulfide) to find total ISE (total ammonia, total fluoride, total cyanide and total sulfide). The topics that will be discussed below are as follows:

- ❖ What is the difference between free ISE and total ISE?
- ❖ What exactly does pH compensation do?
- ❖ When do I need to perform pH compensation?

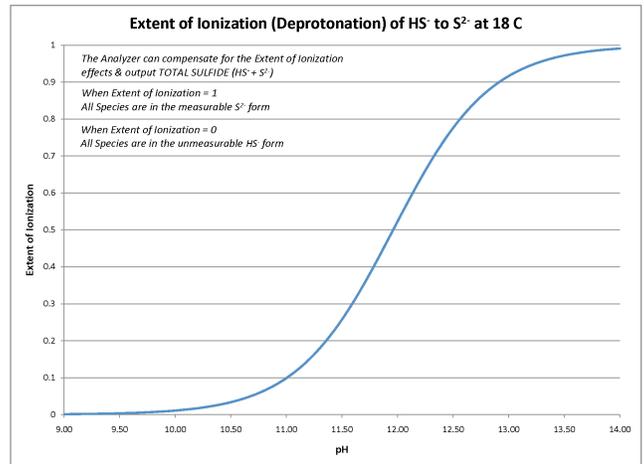
The top graph to the right shows the effects of pH and temperature on the extent of ionization for the weak base, ammonia. The dissolved ammonia gas is converted into the ionized ammonium ion, which is measured by the ISE sensor. The extent of ionization reveals the percent of the weak base which can be measured. When the extent of ionization is 1.00, then 100% is in the measurable form. When the extent of ionization is 0.00, then 0% is in the measurable form. The preconfigured easy to use 3TX-TOT module is able to compute, display and transmit what would be 100% of the weak acid or base activity, even if only a small fraction is actually in the measurable form.

The bottom graphs to the right show the impact of pH on the extent of ionization of various weak acids as a function of pH. Unlike the top graph on the right for the conversion of the weak base ammonia to ammonium ion as function of pH shown at various temperatures, the two bottom graphs to the right are shown at a single temperature for a more simple visualization of these effects at the common 25 degrees Celsius condition. As short explanation of the chemistry behind the pH compensation to compute total ISE is below to understand the conditions under which such pH compensation should be performed to obtain the total system ISE as a real-time process parameter.

The extent of ionization defines the percent of the species of interest for the weak base (typically ammonia) or the weak acid (typically HF, HCN or HS-) is converted into the form which the ion selective sensor can detect, which is the free ionized species. On the vertical axes this extent of ionization is 0.00 when none of the species is in the measurable form for the ion selective sensor. In cases where the extent of ionization is at or near 0.00, it is not possible to use pH compensation since none of the Free ISE species can be measured by the ISE sensor at all.



When the extent of ionization is 1.00 then all of the weak base or weak acid is in the ionized form that can be detected by the ISE sensor and so not pH compensation is required. For example, all of the NH_3 gas is in the NH_4^+ ion form, all of the HF gas is in the F^- ion form, all of the HCN gas is in the CN^- ion form and all of the HS^- ions is in the measurable S^{2-} ion form. The portion which is in the measurable form at that given pH and temperature (the extent of ionization) is called the "Free ISE". The "Total ISE" computed by pH compensation is the value computed as though all 100% of the species were in the measurable form. An pair of selected simple examples are given below for total ammonia and total fluoride the purposes of illustration of the concepts described above.



EXAMPLE 1: TOTAL AMMONIA: See Top Graph on Page 1

Samples conditions are Temp: 40.0 °C, pH: 8.50

The extent of Ionization at this pH and temperature for the $\text{NH}_3/\text{NH}_4^+$ system is 0.67

Free ISE: 1.25 ppm Ammonium (NH_4^+), Computed Total ISE: 1.89 ppm Ammonia/Ammonium ($\text{NH}_3/\text{NH}_4^+$)

EXAMPLE 2: TOTAL FLUORIDE: See Middle Graph on Page 1

Samples conditions are Temp: 25.0 °C, pH: 3.45

The extent of Ionization at this pH and temperature for the HF/ F^- system is 0.50

Free ISE: 35.0 ppm Fluoride (F^-), Computed Total ISE: 70.0 ppm HF/Fluoride (HF/ F^-)

The 3TX-TOT pH compensation module for Total ISE in conjunction with the 3TX-ISE and 3TX-pH measurement modules (which serve as the inputs for the 3TX-TOT module) use built-in ASTI programmed algorithms to compute the extent of ionization for the system of interest (NH_3 , HF, HF or HS) at the current pH and temperature. The Total ISE is then determined (computed) by the 3TX by simply taking the Free ISE and dividing it by this computed extent of ionization. The resulting Total ISE shows what would be the ion activity detected if all of the species were at a condition such that they were in the measurable form.

When the appropriate 3TX transmitter assembly is used (such as the model 3TX-4M-ISE-A-pH-A-TOT-PS for example), both the free ISE and total ISE can be output via a scalable 4-20mA analog outputs and MODbus digital outputs as well as the pH and temperature process parameters. A fourth input can also be accepted by the 3TX-TOT module and dispatched via both analog and digital outputs. This fourth input is commonly a related measurement such as ORP, conductivity or another ISE that does not require pH compensation.

If the 3TX dual ISE/pH with TOT pH compensation module transmitter assembly was purchased complete at time of commissioning including sufficient details about the total ISE requirements, then most all parameters will have been preconfigured at the ASTI factory in the most suitable manner possible based upon the information provided. As such, quite often very few of the parameters may need to be modified to begin viewing and sending the total ISE to SCADA or other data acquisition systems for further analysis or control. If no data acquisition system is in place for the installation location of interest, real-time monitoring, graphing and datalogging capabilities are possible via the free of charge Windows 3TX MODbus interface software.



MODBUS SUPPLEMENT FOR 3TX-TOT

MODBUS PROTOCOL SUMMARY

The basic communication information for the RS485 MODbus RTU protocol as implemented in the 3TX family of transmitters is as follows: 8-bit, even parity with 1 stop bit (all standards compliant). The MODbus standard includes a number of function codes giving the master of the network the ability of gathering or placing values and parameters in every slave connected to the network. The transmitters in the 3TX family have all the required function codes built-in as well as the relevant codes for each unit. The 3TX transmitters each contain a number of measurements (anywhere from 1 to 5 depending upon the module type), which may be collected via the MODbus protocol. Access to these measurements is common to all units in the 3TX family and is gained via the function code *Read_Input_Registers* (04). Furthermore the units give access to various diagnostics values via *Diagnostics Function Code* (08). The details of these function codes are described in the relevant sections of the given 3TX-pH, 3TX-ISE, 3TX-TOT, 3TX-CON and 3TX-DO transmitter specification sheets and manuals and the relevant portions are extracted reproduced below for summarization purposes. The summarized form below is not intended to be a replacement for the more detailed individual manual for each 3TX module but rather as a convenience supplement for just some of the more commonly used portions when configuring a system for MODbus data acquisition and/or control.

3TX-TOT MODBUS DETAILS

In order to utilize the MODbus interface the 3TX-TOT must be ordered with MODbus. 3TX-TOT may be used as a slave for the 'Dat' - unit 3TX-DAT or as a slave in a SCADA system. The setup / communication for each case will be explained in the following.

With 3TX-TOT

If 3TX-TOT is used together with the 3TX-DAT, the user must pay attention to two things: The baud rate on the MODbus as well as the address of the 3TX-TOT. **The baud rate (P27)** must be set to the baud rate of the 3TX-DAT. Whether a baud rate of 19,200 or 9,600 is used is of no importance, as long as all units on the MODbus are the same baud rate.

The address (P02) must be unique in the network; Two units are not allowed to have the same address. In a network with the 3TX-DAT as the master, all addresses must be assigned without leaving any address out; The order of the addresses is of no importance. In a network with an 3TX-DAT, up to 63 slaves may be connected with valid addresses from 1 to 247.

In a SCADA system

Since different SCADA systems may have different restrictions only the general are mentioned here: **The baud rate (P37)** must be set to the baud rate of the SCADA system. **The address (P02)** must be unique in the network; Two units are not allowed to have the same address.

MODbus Scaling

The scaling for the computed Total ISE output is defined by the range selected in P24 (low 0-10ppm, mid 0-100ppm or high 0-999ppm). Note that this MODbus output for the computed Total ISE may differ from the analog 0/4-20mA scaling defined by P25 & P26.

The 3TX-TOT contains a maximum of 4 input measurements (Free ISE, pH, Temp and Auxiliary) and a fifth value for the computed Total ISE as the output. All five of these can be transmitted on the MODbus. Access to these values are gained through the function code *Read_Input_Registers* (04). The 3TX-TOT gives access via *Diagnostics* (08).

Read_Input_Registers

Function code	Start address	Number of values
04	1	1, 2, 3, 4 or 5

Measurements are transmitted in sequence; All values are rated to 0-1000 corresponding to the range, Output (Total ISE - 1st value) has no offset, Input 1 (Free ISE - 2nd value) an offset of 1024, Input 2 (pH - 3rd value) an offset of 2048, Input 3 (Temp - 4th value) an offset of 3072 and Auxiliary has no offset (5th value); Total ISE is sent as 0-1000, Free ISE as 1024-2024, pH as 2048-3048, Temp as 3072-4072, and Aux (when present) as 0-1000.



Summary of TOT MODbus outputs

Value Number	Measurement	Sent as	Scaling
1	Total ISE (Output)	0-1000	As per P24 on TOT (Lo 0-10, Mi 0-100, or Hi 0-1000)
2	Free ISE (Input 1)	1024-2024	Range as per P04 on TOT (Lo 0-10, Mi 0-100, or Hi 0-1000) Low setpoint as per P05 on TOT High setpoint as per P06 on TOT
3	pH (Input 2)	2048-3048	Low setpoint as per P08 on TOT High setpoint as per P09 on TOT
4	Temp	3072-4072	0-105 °C (Default)
5	Aux (OPTIONAL) When used Input 3	0-1000	Aux Measurement as per P15 on TOT Low setpoint as per P18 on TOT High setpoint as per P19 on TOT

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 Communication Error count
	0D	Return Exception Error count
	0E	Return Slave Message count
	0F	Return Slave No Response count
	12	Return Bus Character Overrun count

NOTES:

The MODbus output from the 3TX-TOT module can be interfaced to any standard RS-485 RTU compliant MODbus data acquisition or control device. In addition, this MODbus output can be accepted by the ASTI 3TX-DAT MODbus datalogger as well as the ASTI Windows Datalogging software for 3TX Transmitters with MODbus outputs. Find below links to download the current manuals for the software of each these data acquisition options for the TOT.

ASTI Windows Datalogging Software for 3TX Transmitters with MODbus output

http://www.astisensor.com/ASTI_Datalogging_Graphing_Windows_Software_3TX_MODbus_Transmitters_pH_ORP_ISE_Dissolved_Oxygen_Conductivity_Version_2.2_Installation_User_Guide.pdf

ASTI 3TX-DAT MODbus Datalogger Download and Configuration Upload Windows Software

http://www.astisensor.com/ASTI_DAT_Configuration_Upload_Logged_Data_Download_Windows_Software_3TX_MODbus_Transmitters_pH_ORP_ISE_Dissolved_Oxygen_Conductivity_Version_1.5_Installation_User_Guide.pdf

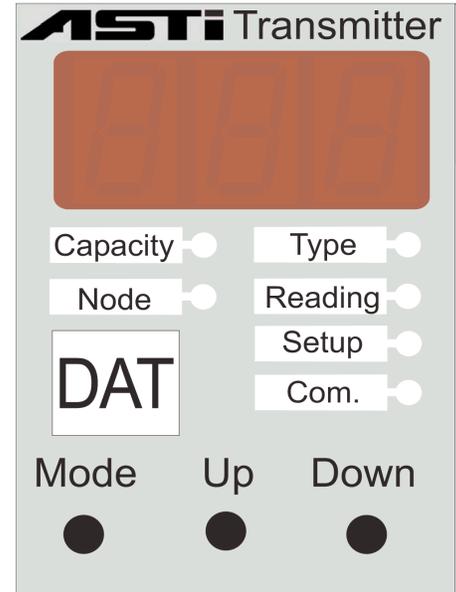
3TX-DAT MODbus Datalogger Module

<http://www.astisensor.com/3TX-DAT.pdf>

The software referenced above can be used to test the configuration of your TOT module prior to interfacing with your own MODbus data acquisition or control system or for diagnostic/testing purposes. All of the Windows software is supplied free of charge. ASTI factory supplied RS-485 to USB hardware converter and RS-232 to USB hardware converter can be purchased. The 3TX-DAT is sold separately and can be added at any time after commissioning so long as the modules to be interfaced have the MODbus output option.

3TX-DAT Datalogger and MODbusmaster

- Datalogger for 3TX transmitters with RS485 MODbus output option for pH, ORP, ion selective (ISE), conductivity, dissolved oxygen & temperature measurements
- Available prewired & preconfigured with mating transmitter(s) 3TX-pH, 3TX-ISE, 3TX-TOT, 3TX-DO & 3TX-CON as a complete turn-key measurement package
- Simultaneous datalogging of up to 63 each 3TX transmitter nodes at distances up to two (2) kilometers between measurement transmitter(s) and DAT datalogger
- Onboard 8MB serial flash memory allows for extensive datalogging capacity
- Total datalogging capacity for various node configurations and sampling rates in provided on page 4 as a guideline for best configurations and use in the field
- User field configurable sampling rates from once per second to once per hour
- Logged data downloaded via RS232 or USB with included Windows software for graphing & visualization of data; Export to Excel for reporting & compliance uses
- Built-in circuit for time and date (RTC) with 10 years battery backup on RTC
- Comes standard for use in 35mm DIN-RAIL mountable OEM systems OR
- Field installations using weatherproof NEMA 4X & IP65 enclosures for up to 8 ea pH/ORP/ISE/DO or conductivity measurements in single enclosure assembly



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 software "lock" which must be set to 'Off' to change ANY parameter or settings at all.**

* 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.

The 3TX-DAT Module Main Features

The 3TX-DAT primarily acts as a low-power, simple to use field MODbus datalogger for interfacing simultaneously with up to 63 each 3TX-pH, 3TX-ISE, 3TX-TOT, 3TX-DO & 3TX-CON transmitters with the RS485 MODbus output offering field configurable sampling rates anywhere from once per second to once per hour. The 3TX-DAT acts as the MODbusMaster on the RS485 network and so no other MODbusMaster may be present on the same network. As with all 3TX modules, the DAT may be powered on and off at will with a very short boot time (about 1 second) making it an ideal fit for remote battery powered installations that are only energized a portion of the time to conserve power.

MODbus & Configuration Setup

The 3TX-DAT acquires data from the 3TX nodes using the MODbus standard for multidrop communication. The units are connected using the RS485 system (see wiring scheme on page 2). Configuration of the nodes is performed via the included Windows software & (optionally) preconfigured at the ASTI factory. The DAT module has a built in clock and calendar circuit with a 10 year battery backup.

Transfer of Data to Windows Tablet or PC

The data accumulated in the 3TX-DAT may be transferred to a PC using the the RS232 (standard) or USB connection (see optional adapters/converters). The transferred data may be graphed & visualized or imported to Microsoft Excel for further data analysis using the included software packages.



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: 200 grams (7.06 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
Memory for datalogging: 8 Megabytes (8MB)
Number of Nodes / Points: Max 63 each 3TX Transmitters
Clock/Calendar: RTC with 10 year battery backup
Serial Port 1: RS485, 9.6/19.2 K Baudrate
Serial Port 2: RS232, 115 K Baudrate

PARAMETERS

Function and Programming

The 14 programmable parameters are shown to the right. For access see the paragraph about programming on page 1.

If the softwarelock (Par. no. 1) is "On" the parameter can only be read. Set Software Lock to "Off" to change values.

Par. no. 2 selects sampling rate to be in seconds or minutes units.

Par. no. 3 selects number of seconds or minutes (see P02) to be used for the sampling of all connected nodes.

Par. no. 4 sets the year, **Par. no. 5** sets of the month, **Par. no. 6** sets the date. Please note the formats for setting the RTC.

Par. no. 7 sets the hour and **Par. no. 8** sets the minutes.

Par. no. 9 sets number of seconds delay before datalogging starts. Contact ASTI to ensure optimal logged results after initial boot.

Par. no. 10 selects the baudrate as 9,600 or 19,200. All slaves as well as the DAT MODbusmaster must use the same baudrate.

Par. no. 11 displays the total number of nodes being datalogged in the current configuration (display only). Changes to the node configuration can only be made using the Windows software.

Par. no. 12 sets the action taken when the memory is full. If 'Old' is selected, datalogging will cease when memory is full. If 'dEL' is selected, datalogging will continue by erasing the oldest value.

Par. no. 13 sets the energy save mode mode. When enabled, the display will only periodically flash to conserve power to the LED.

Par. no. 14 erases all of the logged data. **Note that this action cannot be undone!** Care should be taken that the logged data is downloaded and checked for integrity prior to taking this action. To erase, select 'dEI' and press the 'Mode' key. See details in the summary of usage for situations when the data should first be downloaded prior to making changes & erasing the data.

List of Parameters

No	Parameter	Description	Range	Default
P01	Lock	Software Lock	On / Off	On
P02	Sample Rate Units	Selects Seconds or Minutes for the Units of the Sampling	Seconds or Minutes	Minutes
P03	Sample Rate	Data Acquisition Frequency in Seconds/Minutes	1, 2, 5, 10, 15, 30, 60	2
P04	RTC, Year	Set Date (Year)	00-99 (2000 - 2099)	2013
P05	Month	Set Date (Month)	01-12	01
P06	Date	Set Date (Date)	01-31	01
P07	Hour	Set Date (Hour)	00-23	00
P08	Minute	Set Date (Minute)	00-59	00
P09	Delay from Startup	# of seconds delay before datalogging	0, 2, 5, 10, 15, 30, 60, 120, 300	15
P10	Baudrate	MODbus baudrate	9,600 or 19,200	19,200
P11	Nodes	Total # of nodes datalogged	1 to 63	From Configuration
P12	Memory Full	Action taken when the memory is full	Old= Stop logging dEL= Keep logging	dEL
P13	Saver	Energy Save	On / Off	On
P14	Erase Flash	Erase all data (See Notes About When this is Required)	dAt= Keep dEI= Erase	dAt

DIGITAL COMMUNICATIONS

RS485 & RS232

The DAT module contains two modes of digital communications. Data is acquired via the RS485 network from terminals 9 & 10, with the DAT as MODbusmaster. Upload and download of node configuration and download of data is accomplished via RS232 (or USB connection with suitable converter) from singals on terminals on 1, 2 & 3. No special MODbus protocol specifications are required when the 3TX transmitters are paired with the DAT datalogging module since all communications are handled either entirely between the modules or else the Windows software.

Error Codes

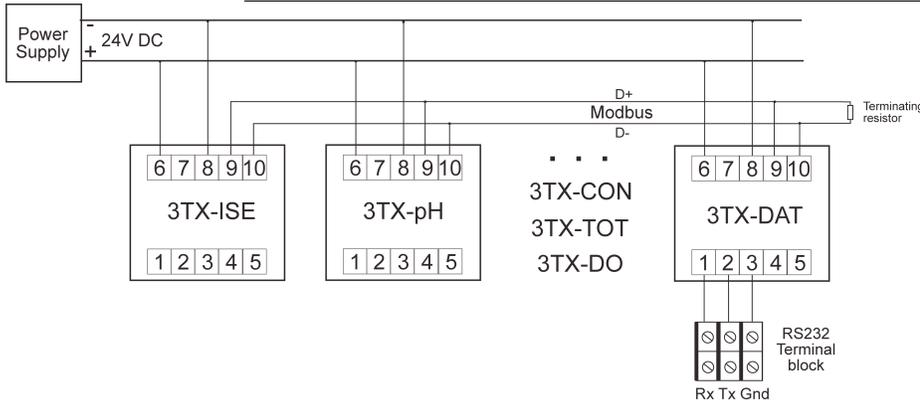
The 3TX-DAT module is equipped with diagnostics used to test if the network is operating as expected. If not, an error message is displayed; the format & type of error messages are listed below:

An error is displayed as E.AA, where E is the error code and AA is the node or the faulty input on the DAT:

Error code 2: Communication error, typically network problem.

Error code 3: Wrong setup of either master or node.

TYPICAL MODBUS WIRING INSTALLATION SCHEME



NOTES:

1. Up to 63 each of the 3TX-ISE, 3TX-pH, 3TX-CON, 3TX-TOT & 3TX-DO modules may be connected to a single 3TX-DAT, each 3TX transmitter with a unique valid node address from 1 to 247.
2. The value of the terminating resistor will vary based upon the number of connected nodes. Contact factory for assistance to choose the correct resistor.
3. The RS232 can be converted to a USB type interface with a suitable adapter (see page 5 for details on this option).

SUMMARY OF USAGE

- The following summary of usage assumes both the Windows datalogging & graphing software for 3TX transmitters with MODbus (and all necessary RS485 MODbus wiring connections for the same) and the separate Windows software for the DAT have been correctly installed in the default configuration and are working on a single PC/tablet.
- The user (or the ASTI factory) will create a configuration file using the 3TX Windows MODbus datalogging and graphing software. This configuration file shall contain all of the information necessary for the 3TX-DAT module to display and record all values from all of the connected 3TX modules in engineering units. Specifically this includes the node type (pH, ORP, ISE, CON, DO or TOT) and the scaling associated with the 0-1000 10-bit MODbus output for each value transmitted from each node. It is assumed that each pH, ORP, ISE, CON and DO node will send both the process parameter and temperature values. The DO will always send 3 values, namely the DO ppm, DO % saturation and temperature. The TOT can send as many as 5 values (Total ISE, Free ISE, pH, Temperature & Aux if present).
- Once a configuration file has been created and tested this program shall be closed and the RS485 connection removed. The 3TX-DAT Windows software will be opened which will search for the current 3TX MODbus datalogging configuration file. The Windows DAT software will automatically load the last used configuration file. An alternate configuration file can be selected if desired (or else if the last used file cannot be found the config file must be chosen).
- The appropriate COM port to which the 3TX-DAT must be selected before the configuration file can be loaded. This COM port either be a native RS232 connection using just the supplied DB9 (a.k.a. D-sub) terminal block adapter or else a USB connection using a RS232 to USB converter as detailed in page 5 section "Order Options & Accessories".
- Connect the 2-wire RS485 leads that were previously interfaced to the Windows datalogging & graphing software used to create the needed configuration file to terminal 9 & 10 on the 3TX-DAT module. If all units are energized, you should now be datalogging all connected modules at the sampling rate set forth in P02 & P03. Be sure to check that you have also properly set the year, month, date, hour and minutes before connecting the live RS485 MODbus leads.
- It is possible to validate that the uploaded configuration file is correctly working on the DAT module and that datalogging is commencing as expected by using the functionality as described in the "Display Features" section as detailed in page 4. If you want further validation of proper function, you can download an initial data set to confirm that all expected datalogging is occurring properly prior to completion of commissioning (see below & manual).
- The user will be able to download a data set from the 3TX-DAT module if it is correctly connected (either by RS232 or converted USB) and the corresponding COM port has been properly selected in the Windows DAT software. The configuration file active in the Windows 3TX-DAT module must match the configuration file of the 3TX-DAT that will be downloaded to ensure data integrity. The memory of the 3TX-DAT module must be manually erased from the module itself using P14. Erasing the stored logged data on the DAT module cannot be done from the Windows software as this can only upload and download a configuration or else download a set of logged data.
- After download, the data can be graphed and otherwise worked up and manipulated (e.g. export to Excel) by importing the downloaded *.db file into the same Datalogging & Graphing software for 3TX transmitters with MODbus that was used to create the configuration loaded onto the 3TX-DAT module. Be sure to note where you saved the downloaded DAT data set (*.db) and to give it a meaningful file name (e.g. "RemoteRiverSite42_2013-01-01_to_2013-05-01.log" or something similarly useful) so that you can make sense of the data in the future.



DATALOGGING CAPACITY IN DAYS OF 3TX-DAT FOR VARIOUS EXAMPLE NODE CONFIGURATIONS & SAMPLING RATES

Number of 3TX pH, ISE or CON Transmitters	SAMPLING RATE			Number of 3TX DO Transmitters	SAMPLING RATE		
	Every 30 Seconds	Every 5 Minutes	Every 15 Minutes		Every 30 Seconds	Every 5 Minutes	Every 15 Minutes
1	694	6,944	20,833	1	463	4,630	13,889
4	174	1,736	5,208	4	116	1,157	3,472
8	87	868	2,604	8	58	579	1,736
16	43	434	1,302	16	29	289	868
32	22	217	651	32	14	145	434
63	11	110	331	63	7	73	220

Number of 3TX TOT Transmitters	SAMPLING RATE			Number of 3TX TOT Transmitters	SAMPLING RATE		
	Every 30 Seconds	Every 5 Minutes	Every 15 Minutes		Every 30 Seconds	Every 5 Minutes	Every 15 Minutes
1	278	2,778	8,333	1	278	2,778	8,333
4	69	694	2,083	4	69	694	2,083
8	35	347	1,042	8	35	347	1,042
16	17	174	521	16	17	174	521
32	9	87	260	32	9	87	260
63	4	44	132	63	4	44	132

NOTES:

1. Times for datalogging capacity are shown in units of DAYS.
2. Datalogging capacity shown are approximate for reference purposes
3. 3TX-pH/ISE/CON send process parameter & temp for each node
4. 3TX-DO sends DO ppm, % Saturation & temp for each node
5. 3TX-TOT sends Total ISE, Free ISE, pH, Temp & Aux each node
6. Contact ASTI factory for specific sampling rate recommendations
7. DAT module comes standard with two (2) year warranty

DISPLAY FEATURES

CAPACITY

- The default main display mode shows the percent of the available 8MB memory that is used. This percent of memory used is shown in percentage units and is updated continuously (in real time).
- When in the "Capacity" mode, push the 'Down' button to show the number of days that datalogging can commence assuming the node configuration and sampling rate are unchanged. If you are getting close to full capacity and cannot download the data set, it is recommended to change the sampling rate with P02 & P03 (see page 2 & 3) and then go back to the capacity mode to see the new number of days that you can datalog with the revised sampling rate.
- When over 80% of capacity is exceeded, the capacity LED will flash continuously as a notification and warning.

NODE

- Push 'Up' or 'Down' key to find the node of interest. Press 'Mode' button to select the displayed node number.

TYPE

- The type of module for the selected "Node" is shown in the "Type" LED mode (pH, ORP, ISE, CON, DO or TOT).
- The temperature is shown in °C units by pushing the 'Down' button when in the "Type" mode of that selected node.

READING

- For the pH, ORP, ISE and conductivity module types, the value of the process parameter is displayed (in the native units for that type) in the "Reading" mode for the selected "Node". Negative values will show as flashing.
- For the DO module type, the ppm units are shown. To see the value in % saturation units, press the 'Down' key.
- For the TOT, the value in the main "Reading" mode shall be the Total ISE. Pushing the 'Up' button will show the Free ISE while pushing the 'Down' button will show the pH. Pushing the 'Up' & 'Down' keys together simultaneously in the "Reading" display mode for a TOT node type will show the Auxiliary value (if present).

NOTES

- The scaling details and user defined name of each node can be found on the original configuration file uploaded via RS232/USB to the DAT. This configuration file must be saved as it will be required to workup all downloaded data.
- Before adding or removing any nodes, the logged data from the DAT should be downloaded BEFORE creating and loading the new configuration file. This is critical to prevent loss of integrity to the logged data.
- Any change to the range and/or scaling of any connected 3TX modules will necessitate download of the data and creation of a new modified configuration file that must be reloaded onto the DAT. Recall that since many (most) of the 3TX modules have the MODbus output scaling follow the analog 4-20mA setpoints, in most cases if the 4-20mA scaling (or associated range) is changed then a new configuration file must be created to ensure proper datalogging operation of the mating DAT. The data should be downloaded BEFORE creating & loading a new configuration file.
- The sampling rate on the DAT module can be changed without compromising the integrity of the logged data set.



ORDERING OPTIONS & ACCESSORIES

The 3TX-DAT module comes standard with the 35mm DIN-RAIL mountable module itself (supplied either as just the standalone module itself, preinstalled onto a 35mm DIN-RAIL or else integrated into an enclosure assembly with mating transmitters as desired) as well as 2 meters (~6 feet) of multiconductor RS232 cable to mate with the included DB9 (a.k.a. D-sub) female terminal block adapter to interface with any standard RS232 port on a Windows PC. Some additional adapters and converters are available. These can be supplied either complete by ASTI as optional accessory items or else can be sourced separately from various commercial vendors:

OPTIONAL ACCESSORY # 1: RS232 to USB Adapter for DAT Module (when no RS232 port is available on the Windows PC)
OPTIONAL ACCESSORY # 2: RS485 to USB Converter for Windows Datalogging Software (for USB node configuration setup)
OPTIONAL ACCESSORY # 3: RS485 to RS232 Converter for Windows Datalogging Software (for RS232 node configuration setup)

BACKGROUND ON MODBUS & USE IN RS485 RTU NETWORKS WITH 3TX

A Brief History

MODbus is an industrial standard for serial communication introduced in 1979 by the company Modicon for use in client/server communication between units, which may be connected via different networks. MODbus is now a completely open standard available for all without the need for licenses or rights. MODbus has been called the “de facto standard in multi-vendor integration”.

Digital Communications for the 3TX family of Transmitters

Since the 3TX family of transmitters is modular concept, a multi-drop bus digital communication protocol is needed to handle an “arbitrary” number of modules dynamically such such that it always possible to always add or remove a unit. The license and royalty free MODbus standard was chosen as it fulfills all such requirements and is extensively supported by industry for mating with data acquisition and control equipment. All transmitters in the 3TX family are capable of communicating not only with the master 3TX-DAT but with any system as long as the system has a MODbus interface. This makes the 3TX transmitter family capable to interface most any SCADA system and gives the user the possibility of building a simple network and enhancing it later if the need arises.

Structure

The implementation of the MODbus in the 3TX family is based on an RS485 connection between the units. The driver circuit in each of the transmitters allows up to 32 units without the use of repeaters, while the address may be set within the whole address space of the MODbus standard (247). Using the 3TX-DAT as the master means that only a total of 63 addresses can be used at one time (although each 3TX can be assigned any node from 1 to 247). Naturally two units on the network are not allowed to share the same address.

3TX-DAT Wiring

The “typical modbus wiring installation scheme on page 3” shows 3TX transmitters connected to the master 3TX-DAT. The exact order is not of importance. The MODbus standard prescribes a terminating resistor (Rt) should be present at both ends of the network. The value of the terminating resistor(s) will vary based upon the number of connected nodes and for shorter distances may in fact be altogether unnecessary. Contact factory for assistance to choose the correct resistor(s) and arrangement for your specific installation.

SCADA system

The principle of a network with a SCADA system as the master is the same as prescribed in the Windows datalogging and graphing software for 3TX transmitters with MODbus. Here the MODbus standard sets the limit of the number of units, since the maximum valid address is 247. Up to 32 units may be connected without the use of a repeater. The same demands apply to the terminating resistor as described in the paragraph about the 3TX-DAT wiring.

Protocol

The basic communication information for the RS485 MODbus RTU protocol as implemented in the 3TX family of transmitters is as follows: 8-bit, even parity with 1 stop bit (all standards compliant). The MODbus standard includes a number of function codes giving the master of the network the ability of gathering or placing values and parameters in every slave connected to the network. The transmitters in the 3TX family have all the required function codes built-in as well as the relevant codes for each unit. The 3TX transmitters each contain a number of measurements (anywhere from 1 to 5 depending upon the module type), which may be collected via the MODbus protocol. Access to these measurements is common to all units in the 3TX family and is gained via the function code Read_Input_Registers (04). Furthermore the units give access to various diagnostics values via Diagnostics Function Code (08). The details of these function codes are described in the relevant sections of the given 3TX-pH, 3TX-ISE, 3TX-TOT, 3TX-CON and 3TX-DO transmitter specification sheets and manuals.

For a detailed description of the MODbus protocol please refer to the MODbus website: <http://www.modbus.org>



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
-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 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
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33W) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

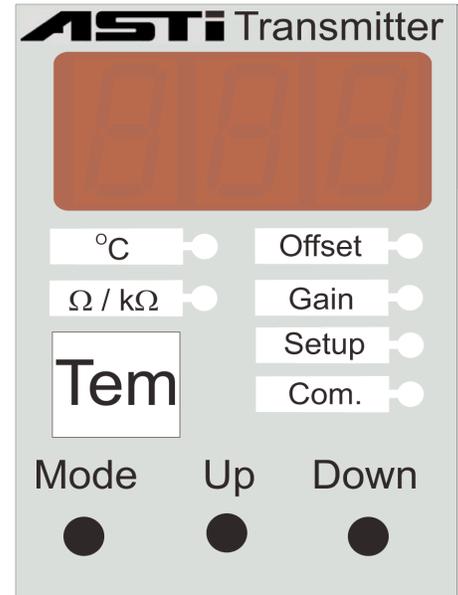
** To obtain a 3TX that supports and requires sensors with preamplifiers, order the pH/ORP transmitters as -pH-X and the ion selective (ISE) transmitters as -ISE-X

*** 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).

Last Modified September 12, 2013 Revision 3

Model 3TX-TEM 3-Wire Temperature Transmitter

- 3TX-TEM is a module to add a scalable analog output for Temperature to any 3TX-pH, 3TX-ISE, 3TX-CON or 3TX-DO measurement module
- Input for temperature measurement can be Pt100 or Pt1000 type element
- **Special hardware & software allows a single Pt100/Pt1000 to be used both as input for a 3TX measurement module and a 3TX-TEM temperature transmitter. This configuration is referred to as “spliced” input mode and is the default.**
- **Any pH, ORP, ISE, conductivity or DO sensor with Pt100/Pt1000 in “splice” mode will be used both for temperature compensation on the measurement module and to send a scalable output for temperature from the 3TX-TEM**
- Direct wiring from separate (rather than shared) Pt100 or Pt1000 temperature elements is also supported. This configuration is referred to as “raw” input mode.
- Displays Temperature (°C) and raw Ohms (Ω) from Pt100/Pt1000 element
- Scalable Analog Output 0-20 mA or 4-20 mA for Temperature
- Galvanic isolation between temp input, power & analog output (3000V rating)
- Field installations using weatherproof NEMA 4X & IP65 enclosures for up to 7 ea pH/ORP/ISE/DO or conductivity transmitters in single enclosure assembly



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 offset and 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

The Pt100 or Pt1000 temperature element can be connected either directly (“raw”) or else across a bridged terminal block (“splice”) to the 3TX-TEM transmitter. The measured resistance from these temperature sensors are processed by the microprocessor. Both offset and gain calibrations are supported for the temperature measurement for best accuracy in both raw and spliced wiring input modes. Correction for the resistance owing to the cable is automatically corrected via user entered wire gauge and cable length when in the raw input mode.

Analog Output

The 3TX-TEM transmitter (module) has a scalable analog output of either 0-20 mA or 4-20 mA (selectable). The minimum between the low (0mA or 4mA) and high (20mA) output is 100 °C. The output is proportional to the temperature and is galvanically insulated from the input. Trim calibrations for the 4mA (offset) and 20mA (gain) are available in the setup parameters to ensure accurate analog output anywhere within the scalable output range.

MODbus

No MODbus output is available for the 3TX-TEM transmitter. If MODbus is desired, it is recommended to get the temp measurement via the MODbus output of the pH, ORP, ISE, conductivity or DO measurement module directly. If you require a special version of the 3TX-TEM that supplies both an analog output and a MODbus RS485 output please contact factory for such special requests.



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: 200 grams (7.05 ounces)
Dimensions: D 58 x W 36 x H 86 mm (2.3" X 1.4" X 3.4")

Electrical

Power Supply: 24VDC ±10%
Consumption: 60 mA max
Accuracy: ±0.2% Excluding Sensor (Ideal)
Temp Sensor: Pt100, Pt1000
Temp Range: 0-210°C ± 0.2°C
Analog Output: 0-20mA or 4-20mA, max. 500Ω
CE mark: EN61326A

PARAMETERS

Function and Programming

The 13 programmable parameters are shown to the right. For access see the paragraph about programming on page 1.

If the softwarelock (Par. no. 1) is "On" the parameter can only be read. Set Software Lock to "Off" to change values.

- Par. no. 2** sets the type of wiring used as splice or raw (direct).
- Par. no. 3** sets the temperature element to be Pt100 or Pt1000 type.
- Par. no. 4** set the wire gauge (AWG) for the sensor cable used
- Par. no. 5** sets the length of sensor cable in units of feet.
- Par. no. 6** sets the analog output to either 0-20 mA or 4-20 mA.
- Par. no. 7** 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. 08 & 09** are used to set the temperature value that corresponds to 0/4mA output setpoint (**Par no. 08**) and sets the temperature value that corresponds to 20mA output setpoint (**Par no. 09**). The minimum difference between Par no. 08 and 09 must be at least 100 °C, although it is fully scalable within the range.
- Par. no. 10** Offset adjustment for 4mA low analog output trim.
- Par. no. 11** Gain adjustment for 20mA high analog output trim.
- Par. no. 12** If no keys are pressed for 10 minutes the display will show a flashing bar (Energy Save). Pressing any key to return.
- Par. no. 13** Feature to reset the analyzer back to factory default.

* Negative trim adjustments will be shown as flashing numbers.

List of Parameters

No	Parameter	Description	Range	Default
P01	Lock	Software Lock	On / Off	On
P02	Temp Mode	Wiring Type	Splice, Raw	Splice
P03	TC Input Select	Select the Pt Input Type	Pt100 or Pt1000	Pt1000
P04	Wire Gauge	Sensor Lead AWG	20, 22, 24	24
P05	Cable Length	Length of cable in feet	1...999 feet	10
P06	Type of Output	Select 0-20mA or 4-20mA	4-20mA, 0-20mA	4-20mA
P07	Output Mode	Analog Output Mode	Non-inverted, Inverted	n.inv
P08	0/4mA Low Output Setpoint	Reading @ 0/4mA	0 to 100 °C	0
P09	20mA High Output Setpoint	Reading @ 20 mA	100 to 210 °C	210
P10	Trim Low Output	4mA Offset Cal for Output	± 9.99% *	Factory Cal
P11	Trim High Output	20mA Gain Cal for Output	± 9.99% *	Factory Cal
P12	Energy Save	Energy Save	On / Off	On
P13	Back to Default	Reset to Default	Def=Reset, Par=No Reset	Par

CALIBRATION PROCEDURES

For Splice Type Wiring

Step 1:

Obtain a valid variable resistor potentiometer (a.k.a. "turn-pot") with a nominal value of 200 Ohms if a Pt100 element is used and a nominal value of 2000 Ohms if a Pt1000 element is used. Wire-up the turn-pot as "splice" type input as shown on page 3 to serve as a simulated temperature sensor.

Step 2:

Adjust the turn-pot so that the temperature reading on the measurement module (3TX-Aux) is very close to 0.0°C. Use the 'Offset' calibration mode to make the 3TX-TEM temperature (°C) reading agree with what is shown on the 3TX-Aux (measurement) module.

Step 3:

Adjust the turn-pot so that the temperature reading on the measurement module (3TX-Aux) is very close to 210°C. Use the 'Gain' calibration mode to make the 3TX-TEM temperature (°C) reading agree with what is shown on the 3TX-Aux (measurement) module.

For Raw (Direct) Type Wiring

Step 1:

Obtain a valid variable resistor potentiometer (a.k.a. "turn-pot") with a nominal value of 200 Ohms if a Pt100 element is used and a nominal value of 2000 Ohms if a Pt1000 element is used. Wire-up the turn-pot as "raw" type input as shown on page 3 to serve as a simulated temperature sensor.

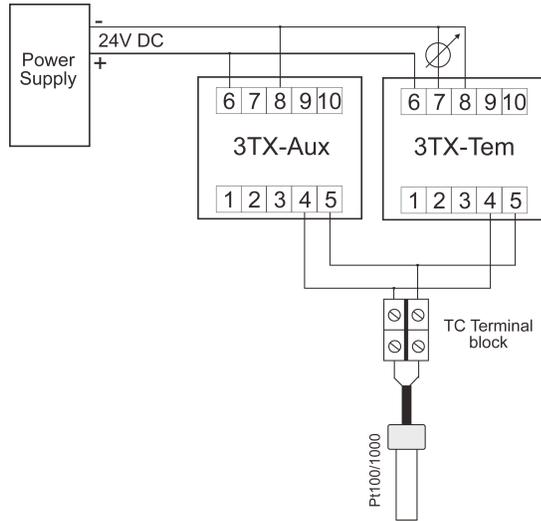
Step 2:

Adjust the turn-pot so that the temperature reading on 3TX-TEM is very close to 0.0°C. Use the 'Offset' calibration mode to make the 3TX-TEM reading agree with nominal temperature (°C) for that resistance. Adjust the turn-pot so that the temperature reading on 3TX-TEM is very close to 210°C. Use the 'Gain' calibration mode to make the 3TX-TEM reading agree with nominal temperature (°C) for that resistance.

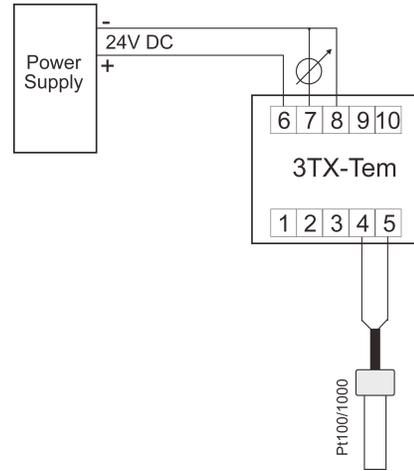
Step 3:

Determine the wire gauge and cable length of your Pt100 or Pt1000 temperature sensor and enter this into parameters P04 & P05, respectively. This corrects for any impact on temp due to resistance from cable length.

Typical Splice Type Wiring



Typical Raw (Direct) Type Wiring



SPLICE WIRING NOTES:

1. Wiring schematic valid when parameter P01 is splice.
2. The wiring schematic above is valid when the mating 3TX-Aux module is any 3TX-pH, 3TX-ISE, 3TX-CON or 3TX-DO measurement transmitter.
3. Be sure to select whether a Pt100 or Pt1000 is used in parameter P03. This will be the type of TC element in your pH/ORP/ISE/Conductivity or DO sensor. Only the temperature portion of the wiring is shown for simplicity.

RAW WIRING NOTES:

1. Wiring schematic valid when parameter P01 is raw (direct).
2. Be sure to correctly input the wire gauge (P04) and cable length (P05) when in this raw (direct) temperature input mode. Parameters P04 & P05 are used to compute the resistance due to the sensor cable length and automatically correct for this contribution. This correction is only active in raw input mode (and altogether disabled in splice mode).

Sample Nominal (Approximate) Pt100 & Pt1000 Resistance & Temperature Tables

°C	Ω	°C	Ω	°C	Ω	°C	Ω
0	100	38	115	76	129	114	144
2	101	40	116	78	130	116	145
4	102	42	116	80	131	118	145
6	102	44	117	82	132	120	146
8	103	46	118	84	132	122	147
10	104	48	119	86	133	124	148
12	105	50	119	88	134	126	148
14	105	52	120	90	135	128	149
16	106	54	121	92	135	130	150
18	107	56	122	94	136	132	151
20	108	58	122	96	137	134	151
22	109	60	123	98	138	136	152
24	109	62	124	100	139	138	153
26	110	64	125	102	139	140	154
28	111	66	126	104	140	142	154
30	112	68	126	106	141	144	155
32	112	70	127	108	142	146	156
34	113	72	128	110	142	148	157
36	114	74	129	112	143	150	157

°C	kΩ	°C	kΩ	°C	kΩ	°C	kΩ	°C	kΩ	°C	kΩ
0	1.00	38	1.15	76	1.29	114	1.44	152	1.58	190	1.72
2	1.01	40	1.16	78	1.30	116	1.45	154	1.59	192	1.73
4	1.02	42	1.16	80	1.31	118	1.45	156	1.60	194	1.74
6	1.02	44	1.17	82	1.32	120	1.46	158	1.60	196	1.74
8	1.03	46	1.18	84	1.32	122	1.47	160	1.61	198	1.75
10	1.04	48	1.19	86	1.33	124	1.48	162	1.62	200	1.76
12	1.05	50	1.19	88	1.34	126	1.48	164	1.63	202	1.77
14	1.05	52	1.20	90	1.35	128	1.49	166	1.63	204	1.77
16	1.06	54	1.21	92	1.35	130	1.50	168	1.64	206	1.78
18	1.07	56	1.22	94	1.36	132	1.51	170	1.65	208	1.79
20	1.08	58	1.22	96	1.37	134	1.51	172	1.66	210	1.80
22	1.09	60	1.23	98	1.38	136	1.52	174	1.66		
24	1.09	62	1.24	100	1.39	138	1.53	176	1.67		
26	1.10	64	1.25	102	1.39	140	1.54	178	1.68		
28	1.11	66	1.26	104	1.40	142	1.54	180	1.68		
30	1.12	68	1.26	106	1.41	144	1.55	182	1.69		
32	1.12	70	1.27	108	1.42	146	1.56	184	1.70		
34	1.13	72	1.28	110	1.42	148	1.57	186	1.71		
36	1.14	74	1.29	112	1.43	150	1.57	188	1.71		

NOTE: The raw (uncalibrated) resistance of the Pt100 or Pt1000 type temperature element can be viewed in the "Ω / kΩ" LED mode.



ORDERING INFORMATION FOR 3TX FAMILY OF TRANSMITTERS

<i>ENCLOSURE TYPE</i>	
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)
<i>MEASUREMENT MODULES ONE (1) THROUGH SEVEN (7)</i>	
CODE	DESCRIPTION
-pH **	pH/ORP/mV/Temp Measurement Module / Transmitter
-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
<i>OUTPUT OPTIONS FOR MEASUREMENT MODULES (ONE OPTION MUST BE SELECTED FOR EACH MODULE)</i>	
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 AND RS-485 MODbus Digital Output
<i>ADD-ON MODULES FOR MEASUREMENT MODULE ENCLOSURE ASSEMBLIES</i>	
CODE	DESCRIPTION
-PS	100 to 240 VAC 50/60 Hz Universal Power Supply Adapter for Line Powered Operation
-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
-TIM	Timer for Intermittent Operation with Battery Packs - Special Ultralow Power Consumption Style
-BAT	Universal Uninterruptible Power Supply with 1.4Ah (33W) LiPo Battery; For use with 7MF or 9MF Enclosures Only

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

** To obtain a 3TX that supports and requires sensors with preamplifiers, order the pH/ORP transmitters as -pH-X and the ion selective (ISE) transmitters as -ISE-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).

Last Modified May 18, 2013 Revision 2



Frequently Asked Questions (FAQ) for 3TX pH, ORP, Ion Selective (ISE), Dissolved Oxygen (DO) & Conductivity Transmitters & Controllers with Application Notes

Question:

Can I share the 24VDC power supply used to energize other instrumentation or equipment at the same installation site to also energize the 3TX transmitters?

Answer:

Absolutely not. **It is altogether critical that the 24VDC power supply used to power the 3TX transmitters is COMPLETELY separate from all other equipment.** This also includes all other instrumentation as well other heavier equipment such as pumps, motors and so forth. This is because the 3TX measurement module series is a 3-wire transmitter. The 3-wire aspect can be explained as follows: the 4-20mA analog current loop output sent from terminal 7 returns back to terminal 8; the +24VDC is connected to terminal 6 while the ground DC common from the power supply is shared with the return of the 4-20mA scalable current loop output on terminal 8. In this way all of the ground terminal are shared between the current loop output and the DC common amongst all 3TX measurement modules energized from a single 24VDC power supply source. There exists a 3000V opto-coupler isolation between the inputs and outputs of the 3TX transmitter no matter the particular measurement module. The outputs are not, however, isolated from each other as the ground terminal is shared in the manner described above. Because of these reasons whatever 24VDC power supply is used to energize the 3TX transmitters should be altogether dedicated to only power these modules only. This dedicated 24VDC power supply can either be customer supplied or using the ASTI supplied 3TX-PS module.

The 35mm DIN-RAIL mountable 3TX-PS power supply offer a very simple and low-cost solution for the 3TX transmitters to have their own dedicated 24VDC power supply as required. It is also quite compact being only half the width of a standard 3TX module and 35mm DIN-RAIL mountable and so readily fitting into any of the enclosure options. When purchased as part of a complete DIN-RAIL mounted or enclosure assembled configuration, the 3TX-PS module will be pre-wired to all of the 3TX transmitter(s) supplied so that only the AC power input for the 3TX-PS need to be added to have the unit(s) up and working (plus connecting the analog and MODbus outputs as well as the sensors for input as usual). The 3TX-PS is a well-tested proven power supply solution at very many customer installation sites. The issue of having a dedicated 24VDC power supply for the 3TX modules is important for both passive input measurement module types such the 3TX-pH, 3TX-ISE (mate with pH/ORP/ISE sensors without preamplifiers) and 3TX-DO (mate with galvanic DO cells) as well as active input measurement module types such as the 3TX-pH-X, 3TX-ISE-X (mate with pH/ORP/ISE sensors with preamplifiers) and 3TX-CON (all contacting conductivity cells). The isolation on the AC/DC transformer of the 3TX-PS acts to isolate the 24VDC power from the rest of the electrical devices at the installation site ensuring that no such potential ground issues occur to the modules themselves nor any devices powered from the 3TX measurement modules such as preamplifiers and contacting conductivity cells. This isolation in the 3TX-PS also serves to ensure that no issues prevent themselves regarding ground on the analog 4-20mA current loop output or RS485 MODbus outputs emanating from the power supply side of the system. It is still possible to have ground loop and electrical isolation issues that emanate from the process side of the system, but this is a much more complex question and larger in scope than just the 3TX instrumentation.

The 3TX-PS power supply has a 500mA max rating at 24VDC (12 Watts) and easily handles up to 8 each 3TX modules with 60mA as the absolute max power consumption per 3TX module unit. The 3TX-PS is a universal 100 to 240 VAC 50/60 Hz power supply module. The agency approvals for the 3TX-PS module includes CE, CSA & UL for use in safe areas. If you plan to install the 3TX transmitters into a hazardous area please inquire to the ASTI factory for special accommodations necessary to support these application and installation types.



Question:

How do you wire up the analog output from the 3TX transmitter to a data acquisition or control system?

Answer:

It is very important to ALWAYS keep in mind that all 3TX transmitters are 3-wire devices. This means that they have an ACTIVE 4-20mA analog current loop output just like any 4-wire device. The mating device to which this 4-20mA current loop output is connected (be it a control system or data acquisition equipment) should passively measure the current. Most PLC have a hardware or software toggle that allows you to select whether the 4-20mA received is from a 4-wire (or 3-wire) active type device or else if it is a 2-wire device which must be energized from the PLC power supply.

In particular that you should NEVER apply voltage across terminals 7 & 8 on any 3TX transmitter! This would happen if one erroneously wire up these 3-wire type 3TX transmitters as though they were a 2-wire type devices. The result of improperly applying a voltage across terminals 7 & 8 would be to destroy the output circuit altogether; such damage would be considered abuse and not covered under warranty.

The lead providing +24VDC power should always go to terminal 6 and the 4-20mA current loop output is always sent on a separate lead from terminal 7. The DC common (ground) is shared as terminal 8. In this way the current loop output is sent from terminal 7 and return to terminal 8 (ground / DC common). The 3TX transmitters are always energized on terminal 6 with the DC ground of the 24VDC power supply (a.k.a. rail) always being the (shared) terminal 8.

Question:

If I purchased a 3TX-REL alarm/relay controller together with any of the measurement modules such as the 3TX-pH, 3TX-ISE, 3TX-DO or 3TX-CON can I modify the 4-20mA output scaling set at the ASTI factory?

Answer:

Yes. You can modify the output scaling for each measurement module so long as it is within the proscribed limits for that transmitter type. In the case that you modify the output scaling from defaults for the measurement 3TX-pH, 3TX-ISE, 3TX-DO or 3TX-CON modules you will also need to modify the 4-20mA input scaling for the 3TX-REL controller and/or 3TX-TOT mating module accordingly. The 4-20mA output can be used both for connecting to the 3TX-REL alarm/relay controller and/or the 3TX-TOT pH compensation module as well as to other data acquisition or control devices using the bridge type wiring configuration:

<http://www.astisensor.com/3TX-REL-Bridge-Wiring.pdf>

If you ordered your system with both a measurement module and relay controller and/or TOT pH compensation module at the time of purchase from the ASTI factory, your system will be wired as shown on the above wiring schematic. To ensure optimal agreement between the measurement module (pH, ORP, ISE, Conductivity or Dissolved Oxygen) and the REL or TOT module to which the analog current loop output is bridged, it may be necessary to refine the trim calibrations. In this case it is recommended to perform the trim calibrations on the measurement module first with calibrated multimeter (see individual manuals for each 3TX transmitter to find the corresponding setup parameters to be adjusted). The trim calibration for receiving REL or TOT modules should be performed only after the output trim calibrations have been refined on the measurement modules. When performly paired, the reading should match closely between the units. Scaling the outputs more narrowly can make matching the values easier.



Question:

What does the 4mA +/- X.XX% and 20mA +/- X.XX% label on the 3TX transmitter mean?

Answer:

Prior to dispatch each 3TX transmitter has the 4mA trim offset and 20mA trim gain calibrated for optimal analog precision. These values may change slightly over time or due to environmental conditions. In such cases the analog trim can be further adjusted by modifying the appropriate parameter on the transmitter for the analog output or analog input of interest (see the relevant instructions in the manual for that particular transmitter). If the 3TX transmitter is reset in the field, the analog 4mA trim offset and 20mA trim gain calibration values shown on this label will be restored from the factory calibration and any modifications to this calibration made after dispatch from the factory will be lost.

Question:

Why is there a serial number for each transmitter? I ordered a complete dual or triple transmitter or controller assembly. Shouldn't there be just one serial number?

Answer:

Well actually not for how the modular and highly configurable 3TX system works. Each measurement module (3TX-pH, 3TX-ISE, 3TX-DO & 3TX-CON) or complementary module (3TX-REL, 3TX-TOT & 3TX-DAT) will have its own serial number. The complete assembly will be fabricated, prewired and calibrated as you have requested at the ASTI factory but each individual component will have its own unique traceable serial number. Unlike many other electrochemical measurement and control systems, component can be changed out, repaired or upgraded module by module and so our scheme (must) separately tracks each transmitter module. **Accordingly, removing or modifying the 3TX serial number will void your warranty on that particular module/transmitter.** If no serial number exists on a unit or a label indicating "DEMO ONLY" exists on the transmitter then assistance will be provided on a best faith basis but no specific warranty will apply.

Question:

What is the sampling rate of each of the measurement modules? Is there any time averaging for the view measurement during calibration & measure modes? Can any of these settings be modified in the field?

Answer:

The sampling rate for all of the measurement module is 4 Hz (4 data samples processed per second). There is time averaging (a.k.a. dampener) implemented as most appropriate for that measurement type for both the calibrate and measurement modes. The time averaging can be disabled at the ASTI factory for special order units when it is desirable to measure the raw 4 Hz measurement data sample rate. In most cases, a reasonable time averaging dampener yields the best results for calibration and control purposes. The time averaging settings (in terms of the number of seconds used) is set at the ASTI factory and cannot be modified in the field. Please inquire to the factory prior to purchase regarding any questions related to the dampener settings of your 3TX module since they can often be optimized for your use upon request at no additional charge but cannot be modified after dispatch to your location. For special applications, it is possible for ASTI to supply custom configuration of the 3TX transmitters without any dampener applied at all to see real time data at very high sampling frequency. This can be helpful for smaller pilot scale of benchtop use where these parameters can be change quite quickly as compared to larger production size systems.



Question:

Is there any good reason to modify the analog output scaling from the default values for the 3TX-pH, 3TX-ISE and 3TX-CON measurement transmitters?

Answer:

This will really depend upon your particular data acquisition and control setup. One thing to keep in mind is that the resolution of the 3TX analog output is fixed at 1000 steps completely independent of the scaling selected. This means that you have the same number of steps if you define your output to be the full range or a much more narrow portion of that range down to the minimum scaling allowed for that module. As an example if you have a 3TX-CON transmitter suitable for use with a 1.0/cm cell constant your maximum full scale range would be 0-50,000 microSiemens and the minimum scaling would be 0-5,000 microSiemens. Since the output resolution is fixed independent of scaling, choosing the minimum range would give you ten times (10X) better relative resolution in absolute microSiemens (5 μ S vs 50 μ S in this example). As another example the full range scaling for the 3TX-pH in the pH measurement mode is 0-14. If your application should truly only need to operate between the pH range of 4 to 11, then your relative output resolution would double by restricting it from the full range 0-14 to the more narrow 4-11 scaling since we have gone from a total of 14 pH units to only 7 pH units while the absolute output resolution is fixed. For most 3TX measurement modules the scaling can be reduced down as low as 10% or 20% of the full range. Check the relevant 3TX transmitter specification sheet and manual to find the specific limits of your module (be sure to check revision number).

Depending upon your needs it may then be advantageous to restrict the output scaling to the typical minimum and maximum operational range for that measurement point to have the highest possible resolution on the analog output of the corresponding 3TX module. As discussed in the previous Question & Answer above, if you change the output scaling (and thus the resolution) from the measurement transmitter you will also need to be sure to change the input scaling for any mating modules (such as the 3TX-REL or 3TX-TOT) that use the analog output from this measurement module. Most of the 3TX measurement modules with the MODbus output option will follow the analog 4-20mA scaling and the resolution is also fixed at 1000 steps by default. The MODbus protocol does allow for the possibility of much higher resolution output. One example is the 3TX-pHE module with 20,000 steps giving a resolution of 0.001 in pH mode and 0.1mV units in ORP mode. As another example, the 3TX-CON-E offers between 10,000 and 20,000 steps for the temperature compensated conductivity and 50,000 steps for the raw conductivity values giving the high possible resolution anywhere in the range for a given cell constant (see separate 3TX-CON-E cut sheet for details). Note that the temperature is always sent as 1,000 steps no matter the 3TX transmitter employed. Lastly, all of the measurement modules (3TX-pH, 3TX-ISE, 3TX-CON, 3TX-DO and 3TX-TOT) are compatible for use with the 3TX-DAT MODbus datalogger except for the special high resolution MODbus 3TX-pHE and 3TX-CON-E units, although these units ARE compatible with the free of charge Windows software and most any modern MODbus PLC system.

Question:

The 3TX-TOT wiring looks complicated. Will it be hard to use this total ISE measurement module?

Answer:

While the documentation on the 3TX-TOT module is exhaustive and thorough, this is primarily for the purpose to allow further customization by those that have very specific application needs. All of the wiring and configuration is performed at the ASTI factory when this module is fabricated as part of a complete total ISE measurement system. Bearing the ASTI factory preconfiguration in mind, there is typically very few parameters (if any) that need to be changed by the most users. Normally that needs to be done is to connect the sensor inputs as shown (all other module wiring will be completed prior to dispatch).



Question:

Can I add MODbus to the 3TX-pH, 3TX-ISE, 3TX-DO or 3TX-CON if purchased as analog output only units?

Answer:

No. The only option if you need MODbus output for module based as analog only units is to use a 3TX-TOT module which can convert the analog output to a MODbus output for selected configurations. The only other option is to purchase the identical measurement module(s) with the desired MODbus output and to change out the existing analog only units installed (be they in an enclosure assembly or on a DIN-RAIL). Since the 3TX-DAT datalogger only accepts MODbus input, if you believe that you may want to use this field datalogger it is recommended to purchase all of your measurement modules with the MODbus output in such cases.

Question:

Can the 3TX-pH and 3TX-ISE interface pH/ORP/ISE sensors with and without preamplifiers?

Answer:

Yes. More specifically the 3TX-pH can interface pH or ORP sensors ONLY WITHOUT PREAMPLIFIERS and the 3TX-ISE can interface ISE sensors ONLY WITHOUT PREAMPLIFIERS. Conversely, the 3TX-pH-X can interface pH and ORP sensors ONLY WITH PREAMPLIFIERS and the 3TX-ISE-X can interface ISE sensors ONLY WITH PREAMPLIFIERS. Note that by "ONLY WITH PREAMPLIFIERS" this can mean either that the sensor itself has an integral preamplifier or else that a sensor without an integral preamplifier is bridged across an external preamplifier (see separate documentation for mini external preamplifier option). Note that the two types of pH/ORP transmitters (3TX-pH & 3TX-pH-X) and ion selective transmitters (3TX-ISE & 3TX-ISE-X) are altogether different hardware versions and so are not interchangeable in the field. The decision regarding whether you plan to use a pH/ORP/ISE sensor with or without a preamplifier will need to be known prior to purchasing any pH/ORP or ISE measurement system using 3TX transmitters so that the suitable type of pH/ORP/ISE transmitter can be selected. In particular be sure to know the precise cable lengths needed prior to any commissioning for new installation sites and to double-check the required cable lengths for any existing locations. In the case that you wish to have the flexibility to support long cable runs and/or to the benefit or noise rejection from the process equipment by using an integral or external preamplifier, you can always choose to purchase the preamplifier style (3TX-pH-X & 3TX-ISE-X). The pricing is identical for both hardware versions as all software and functionality is also perfectly identical. Lastly, note that only pH/ORP/ISE sensors with integral preamplifiers can be supplied with quick disconnect terminations (see separate write-up on this option if this feature is desired). Note that the quick disconnect option must be chosen at time of order.

Question:

Can I change the ion to be measured on the 3TX-ISE or 3TX-ISE-X ion selective transmitter?

Answer:

In the field the answer is no. At the ASTI factory we can modify the programming so that your 3TX-ISE or 3TX-ISE-X can measure any ion that you wish. This modification of the ion configuration, however, cannot be performed in the field. This restriction is well considered trade-off. While some potential inconvenience exists from needing to send the 3TX-ISE or 3TX-ISE-X transmitter back to the ASTI to be reconfigured for another ion selective measurement, this limitation is far outweighed by making it such that the transmitter cannot be accidentally misconfigured in the field. In addition, custom OEM configurations allow for user defined default values for all parameters so that the software reset can yield exactly the desired configuration in the field (minimum order quantities apply to be eligible for the free of charge Custom OEM configuration feature).



Question:

Can I change the contacting conductivity cell constant for which the 3TX-CON is to be used?

Answer:

In the field the answer is no. Careful attention should be paid to the expected minimum, typical and maximum conductivity values for the planned measurement type. The most optimal cell constant to be employed and associated supported ranges are then defined in conjunction with the ASTI factory on the basis of this information. A cell constant and range selection guide is available upon request as a good initial guide. Prior to purchase and final specification of equipment, it is always best practice to contact the ASTI factory for an official recommendation. In many cases multiple transmitter configurations are available for the same cell constant or range and the best choice is often depend upon a variety of factors considered in totality.

Question:

How do you access the buttons & terminals when 3TX modules are installed in a 2M(W), 4M(W) or 6M(W) IP65 rated enclosures or else the 3MP, 3MF, 7MF & 9MF NEMA 4X rated enclosures?

Answer:

To access the three buttons for calibration and configuration of all 3TX transmitters with the 2M(W), 4M(W), 6M(W) enclosures only the clear window need be released (the top shell can stay in place). To access the terminals on the 2M(W), 4M(W) & 6M(W) type IP65 rated enclosures you must open the clear plastic window and also remove the four screws that hold the top shell of the enclosure assembly to the bottom shell. For the 3MP (NEMA 4X ½-DIN panel mount) and 3MF, 7MF & 9MF (NEMA 4X CSA/UL rated field mount style) enclosures only the latches need to be released to access all of the internal wiring as well as accessing the terminal buttons themselves. For all enclosure types the necessary cables should be securely installed through the cable gland sealing strain reliefs and secured tightly to prevent intrusion. Unused cable glands should have the factory supplied sealing caps secured to ensure weatherproof and waterproof operation. Enclosure ratings are only valid when the unit is completely closed and cables have been properly installed.

Question:

Can the 3TX systems be setup such that the top shell does not have to be removed when replacing sensors? Can sensors be changed out without having to pull the sensor cables into the enclosure each time?

Answer:

Yes. For the galvanic dissolved oxygen sensors that mate with the 3TX-DO and the contacting conductivity sensors that mate with the 3TX-CON the sensor terminations can be bridged across ordinary good-quality terminal strips provided that such bridging is done in a waterproof J-Box assembly. For the pH/ORP/ISE measurements the terminations can only be bridged when using the preamplifier style version of the pH & ISE transmitters (3TX-pH-X and 3TX-ISE-X) in combination with either an external preamplifier in a waterproof J-Box assembly (a.k.a. Mini External Preamplifier) or else a pH/ORP/ISE sensor with an integral preamplifier (optionally available with quick disconnect terminations). The preamplified extension cable from the waterproof J-Box bridge in such a pH/ORP/ISE measurement installation scheme is then permanently connected to the 3TX-pH-X or 3TX-ISE-X transmitters inside their separate enclosure assembly. All common functionality such as calibration, configuration and simply viewing the process parameters is possible without removing the top-shell of the IP65 rated enclosures.

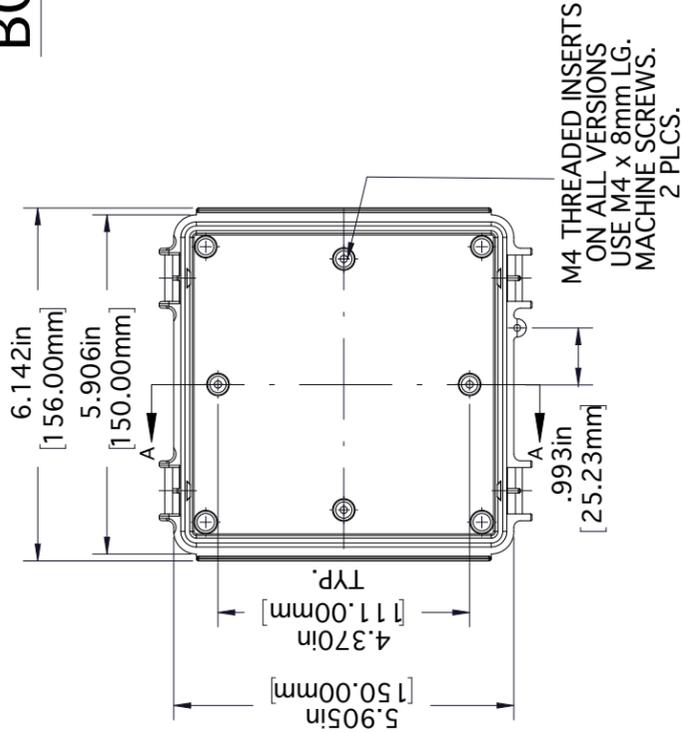
Last Revised October 18, 2014

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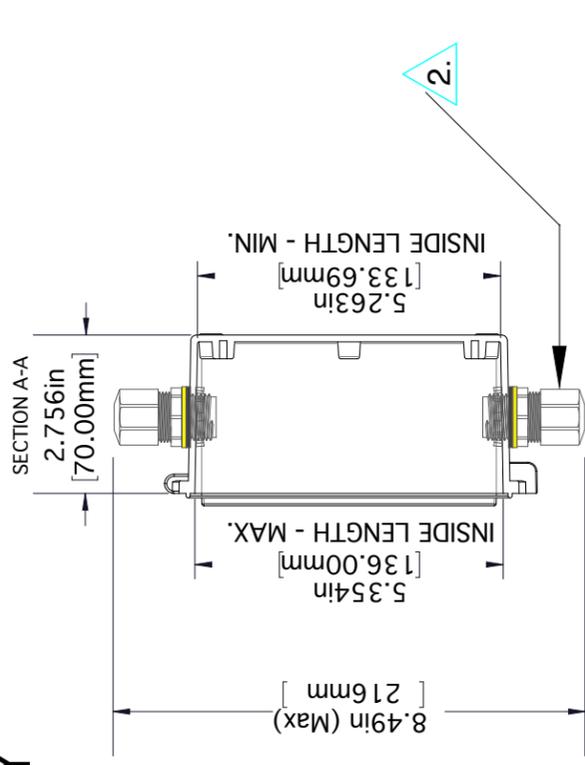
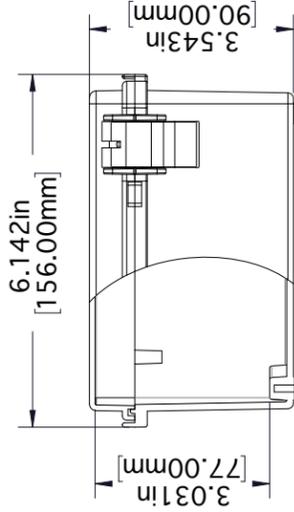
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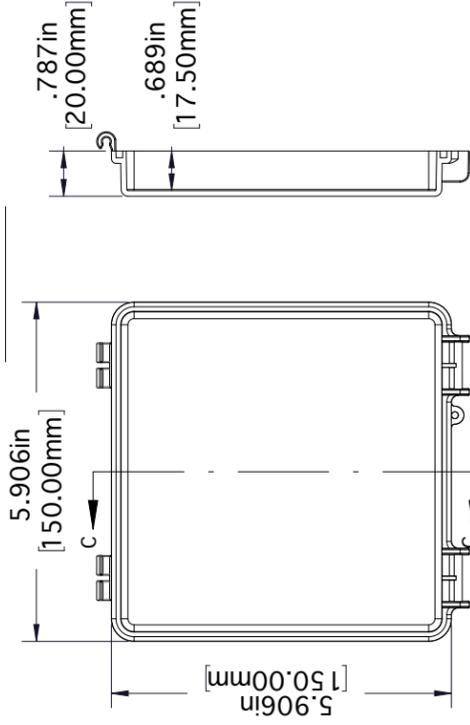
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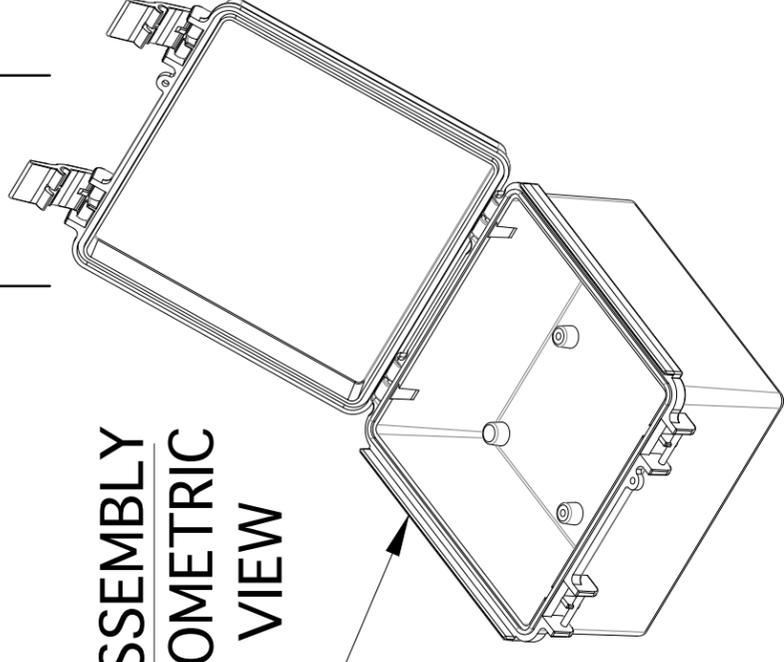
ASSEMBLY



COVER



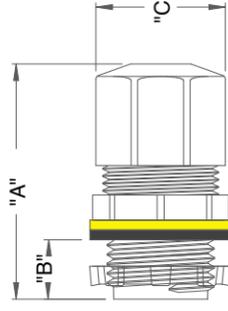
ASSEMBLY ISOMETRIC VIEW



1/2" MNPT Sealing Cable Gland Detail

- A = 1.792in (45.52mm)
- B = 0.502in (12.75mm)
- C = 0.978in (24.84mm)

Plastic Washer Shown in Yellow,
EPR Sealing Gasket Shown in Gray
0.093in (2.36mm) Thick



B NOTES.

1. NEMA 4X, CSA/UL Listed Enclosure, PBT/PC plastic for Body, Polycarbonate plastic for clear door cover UL94-HB for Body & UL94-V0 for Door Flammability Rating, UV Stabilized with Polyurethane Internal Gaskets
2. 1/2" MNPT sealing cable glands along with mating tapped and threaded holes (not shown on drawing) with EPR sealing gasket 3 each on top and 3 each on bottom standard
3. Wall mounting kit supplied standard (not shown on drawing). 2" NPT Pipe Mounting Kit Optional (supplied & ordered separately).

SECTION C-C

Use with cables with diameter from
0.100 to 0.300in (2.54 to 7.62mm)



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Orange, California USA
Toll-Free: 888-969-2784

TOLERANCES

1 Place: ± .1	3 Places: ± .005
2 Places: ± .01	4 Places: ± .0005
Angular: ± 0.25°	

TITLE
3MF NEMA 4X ENCLOSURE ASSEMBLY

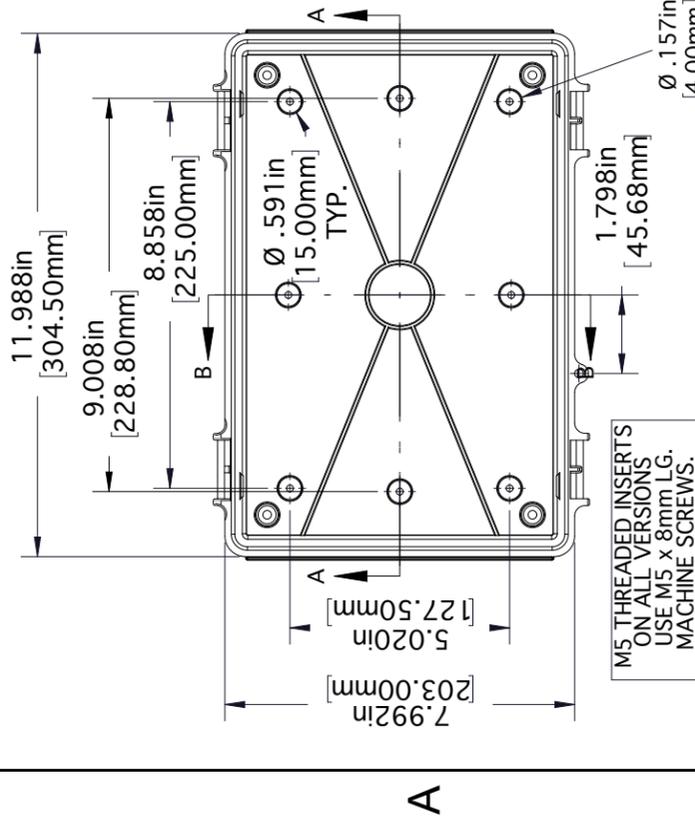
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SCALE Not to Scale	MODEL 3MF	SHEET 1	OF 1

2

1

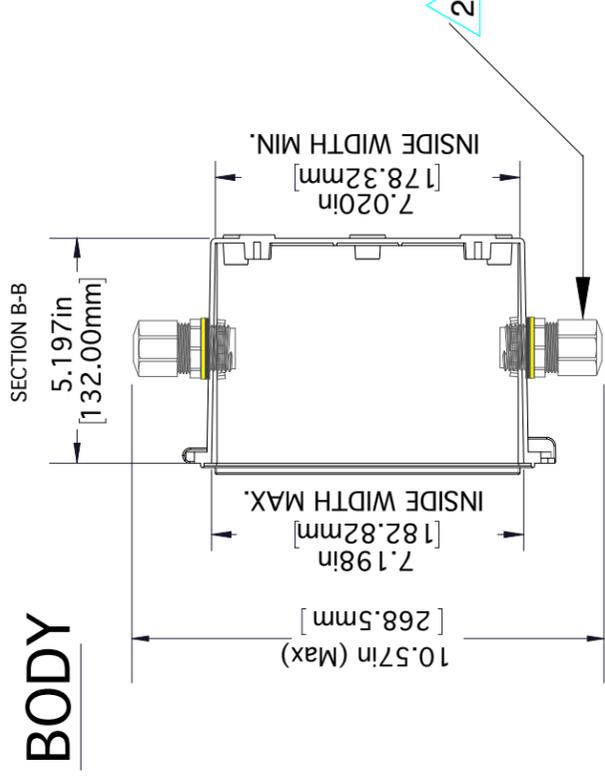
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1



A

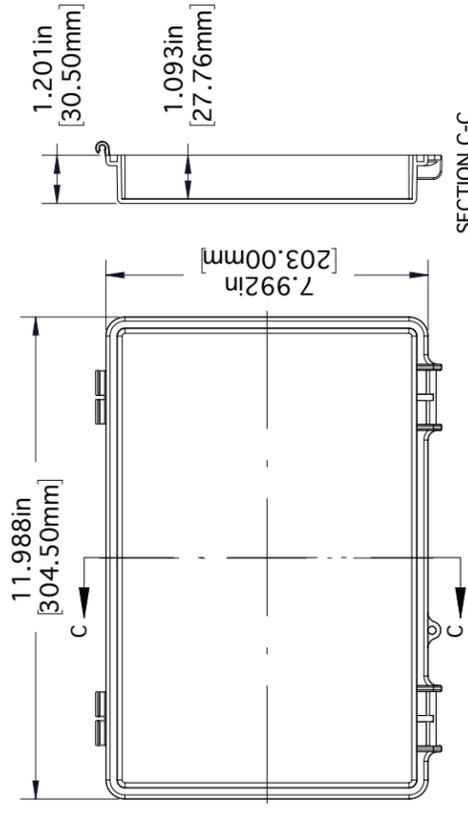
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BODY

SECTION B-B

COVER



SECTION C-C

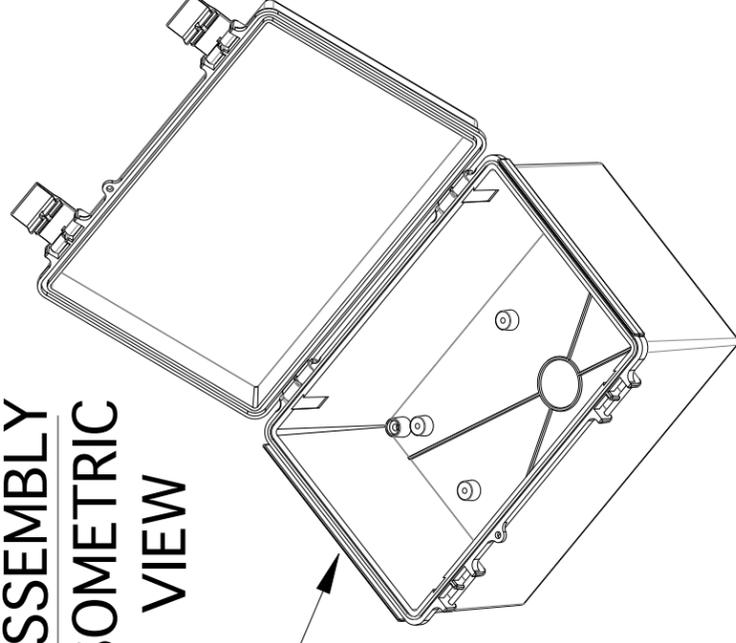
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REVISION HISTORY

DESCRIPTION

DATE

APPROVED

ASSEMBLY
ISOMETRIC
VIEW

A

B

NOTES.

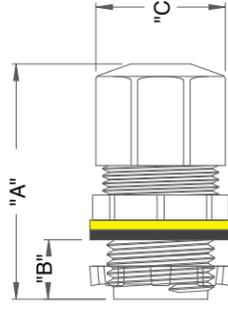
1. NEMA 4X, CSA/UL Listed Enclosure, PBT/PC plastic for Body, Polycarbonate plastic for clear door cover UL94-HB for Body & UL94-V0 for Door Flammability Rating, UV Stabilized with Polyurethane Internal Gaskets
2. 1/2" MNPT sealing cable glands along with mating tapped and threaded holes (not shown on drawing) with EPR sealing gasket 7 each on top and 7 each on bottom standard
3. Wall mounting kit supplied standard (not shown on drawing). 2" NPT Pipe Mounting Kit Optional (supplied & ordered separately).

1/2" MNPT Sealing Cable Gland Detail

- A = 1.792in (45.52mm)
B = 0.502in (12.75mm)
C = 0.978in (24.84mm)

Plastic Washer Shown in Yellow,
EPR Sealing Gasket Shown in Gray
0.093in (2.36mm) Thick

Use with cables with diameter from
0.100 to 0.300in (2.54 to 7.62mm)



2.



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TOLERANCES

1 Place: $\pm .1$	3 Places: $\pm .005$
2 Places: $\pm .01$	4 Places: $\pm .0005$

Angular: $\pm 0.25^\circ$

2

TITLE
7MF NEMA 4X ENCLOSURE ASSEMBLY

DRAWING NO.

7MF

REV

/

SCALE

Not to Scale

MODEL

7MF

SHEET

1

OF

1

3

1

2

3

Sealing EPR Gasket
0.093" (2.36mm) Thick
0.500" (12.7mm) Wide

1.

J=2.753" (70mm)

K=0.815" (21mm)

L=5.330" (135mm)

M=5.255" (133mm)

6.50" (165mm)

M

0.133" (3.4mm)

0.315" (8mm)

Q

Q=1.63" (41.4mm)

R

R=2.06" (52.3mm)

Panel Faceplate
5.40"X5.40"
(138mmX138mm)
Cutout for 1/2-DIN
3TX-3MP Assy

A

B

NOTES.

1. NEMA 4X, UL Listed Enclosure, ABS/PC plastic for Body, Polycarbonate plastic for clear door cover UL94-V0 for Body & UL94-V0 for Door Flammability Rating, UV Stabilized with Polyurethane Internal Gaskets
2. Panel Bracket Assembly, Material of Construction 16 Gauge Steel, Power Coated, 316SS Optional
3. #10-32 X 2" Panhead Phillips Screw (2.5" Optional), 4 places, 90 degrees apart (see subsequent drawings)
4. 1/2" MNPT sealing cable glands along with mating tapped and threaded holes not shown on drawing, 3 each on top and 3 each on bottom standard
5. NEMA 4X Enclosure & Panel Mounting Bracket are bound together with suitable silicone sealant for a fully waterproof 1/2-DIN panel mount enclosure assembly as shipped, ready for installation complete

REV	DESCRIPTION	DATE	APPROVED

REVISION HISTORY



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TITLE 3MP 1/2-DIN PANEL MOUNT ASSY SIDE VIEW			
SIZE B	PROJECT 3MP	DRAWING NO. 3MP - VIEW 1	REV /
SCALE Not to Scale	MODEL 3MP	SHEET 1	OF 1

TOLERANCES

1 Place: ± .1	3 Places: ± .005
2 Places: ± .01	4 Places: ± .0005
Angular: ± 0.25°	

2

3

1

1

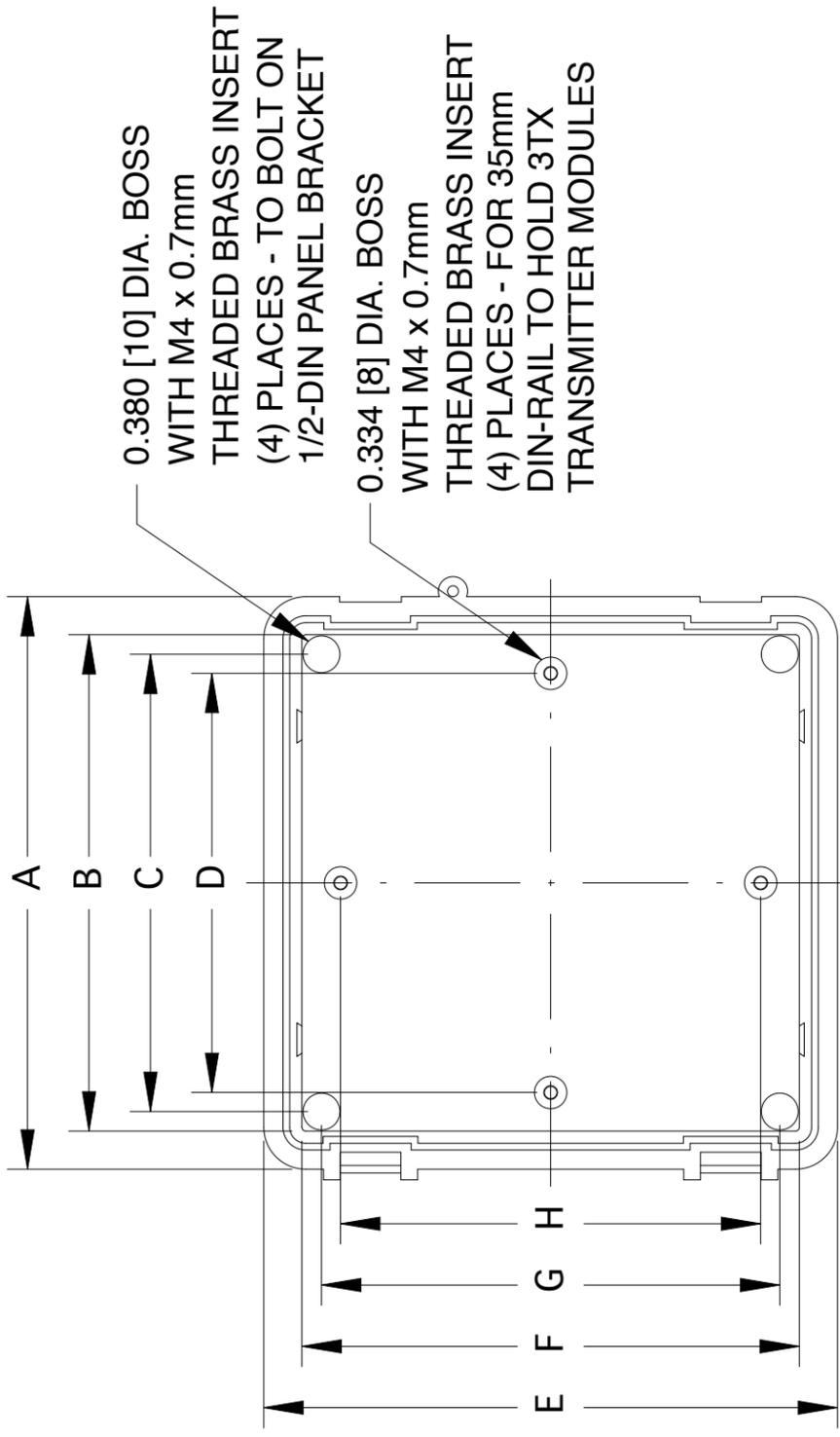
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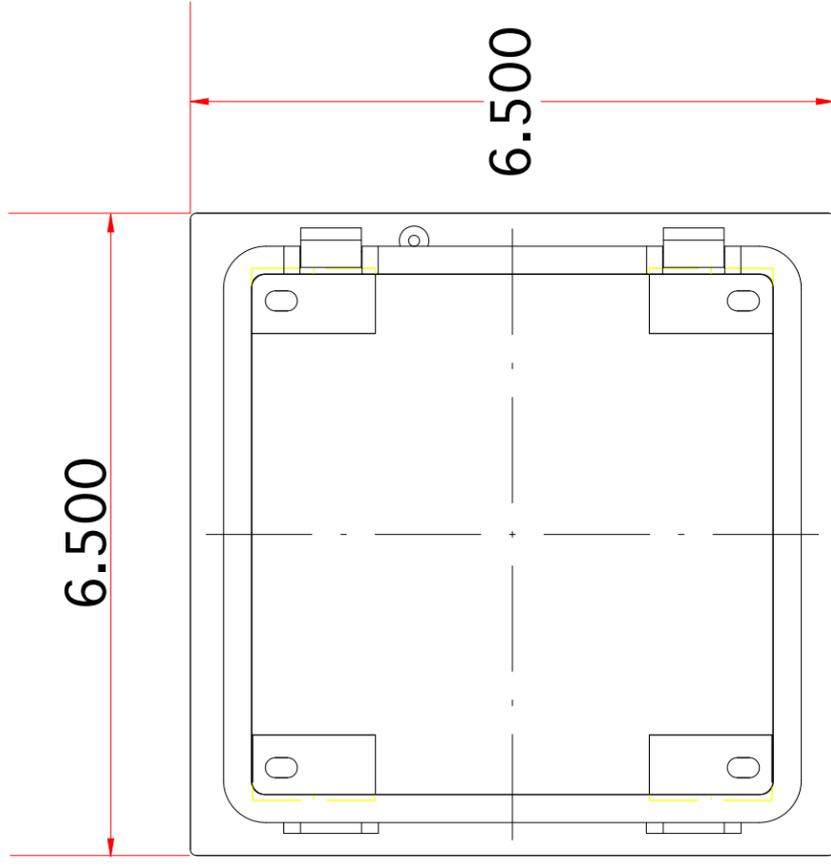
REVISION HISTORY

REV	DESCRIPTION	DATE	APPROVED

A, E=5.904" (150mm), B, F=5.040" (128mm), C, G=4.715" (120mm), D, H=4.322" (110mm)



VIEW LESS COVER



NOTE: CUTOUT FOR 1/2-DIN 3MP PANEL MOUNTING ENCLASURE ASSEMBLY IS STANDARD 5.40" X 5.40" (138mm X 138mm)



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TOLERANCES	
1 Place: ± .1	3 Places: ± .005
2 Places: ± .01	4 Places: ± .0005
Angular: ± 0.25°	

DRAWN BY TADP
CHECKED BY MJP
APPROVED BY MJP

TITLE 3MP 1/2-DIN Panel Mount for 3TX - FRONT			
SIZE B	PROJECT 3MP	DRAWING NO. 3MP - VIEW 2	REV /
SCALE Not to Scale	MODEL 3MP	SHEET 1	OF 1

1

2

3

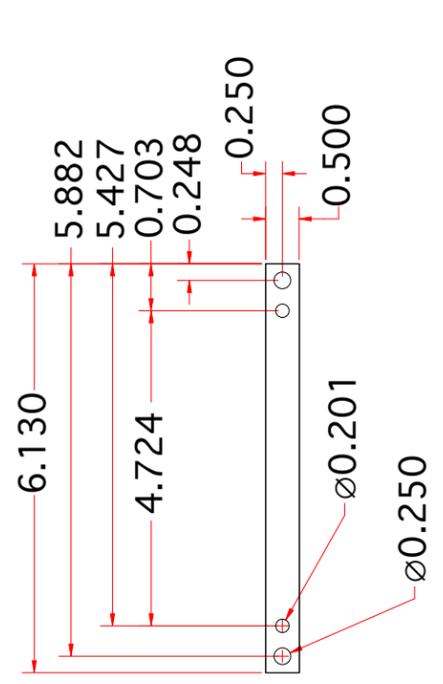
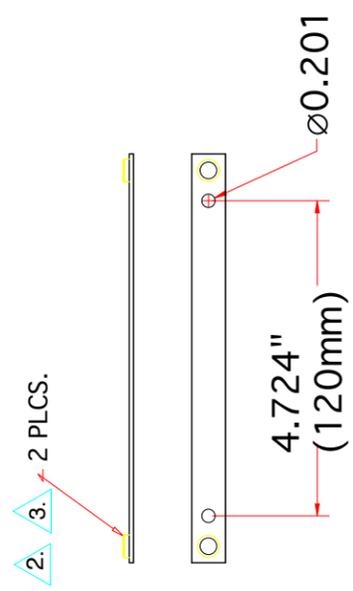
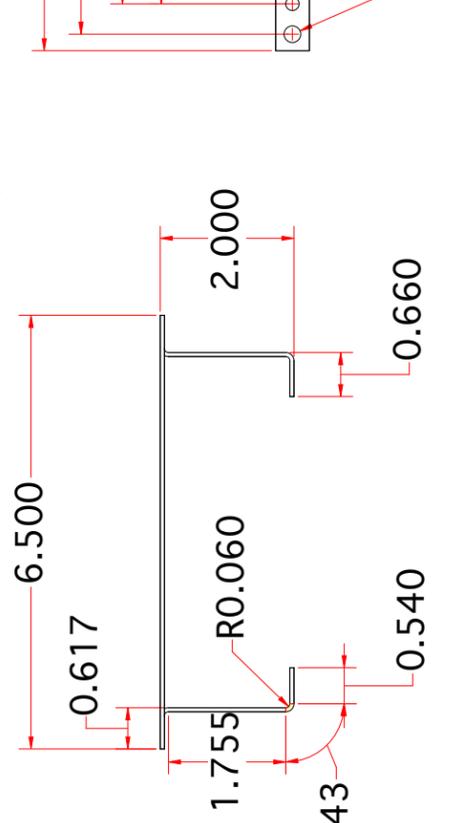
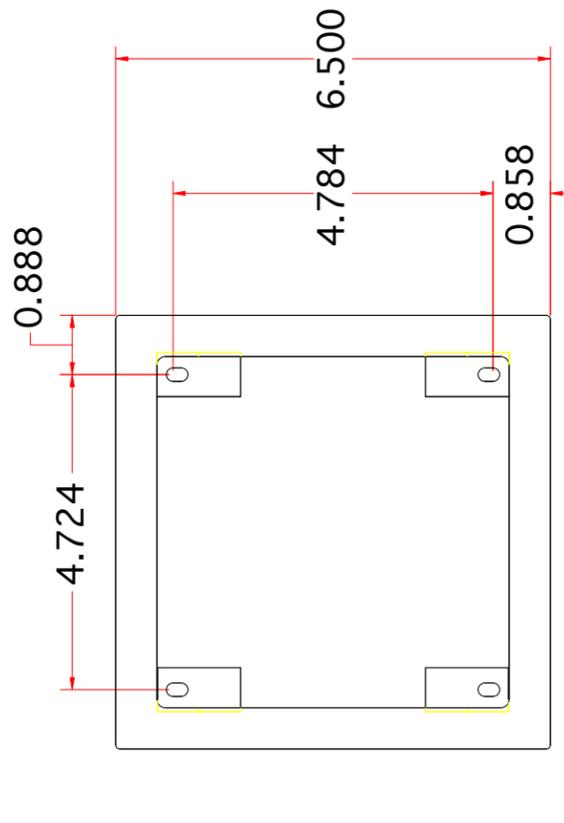
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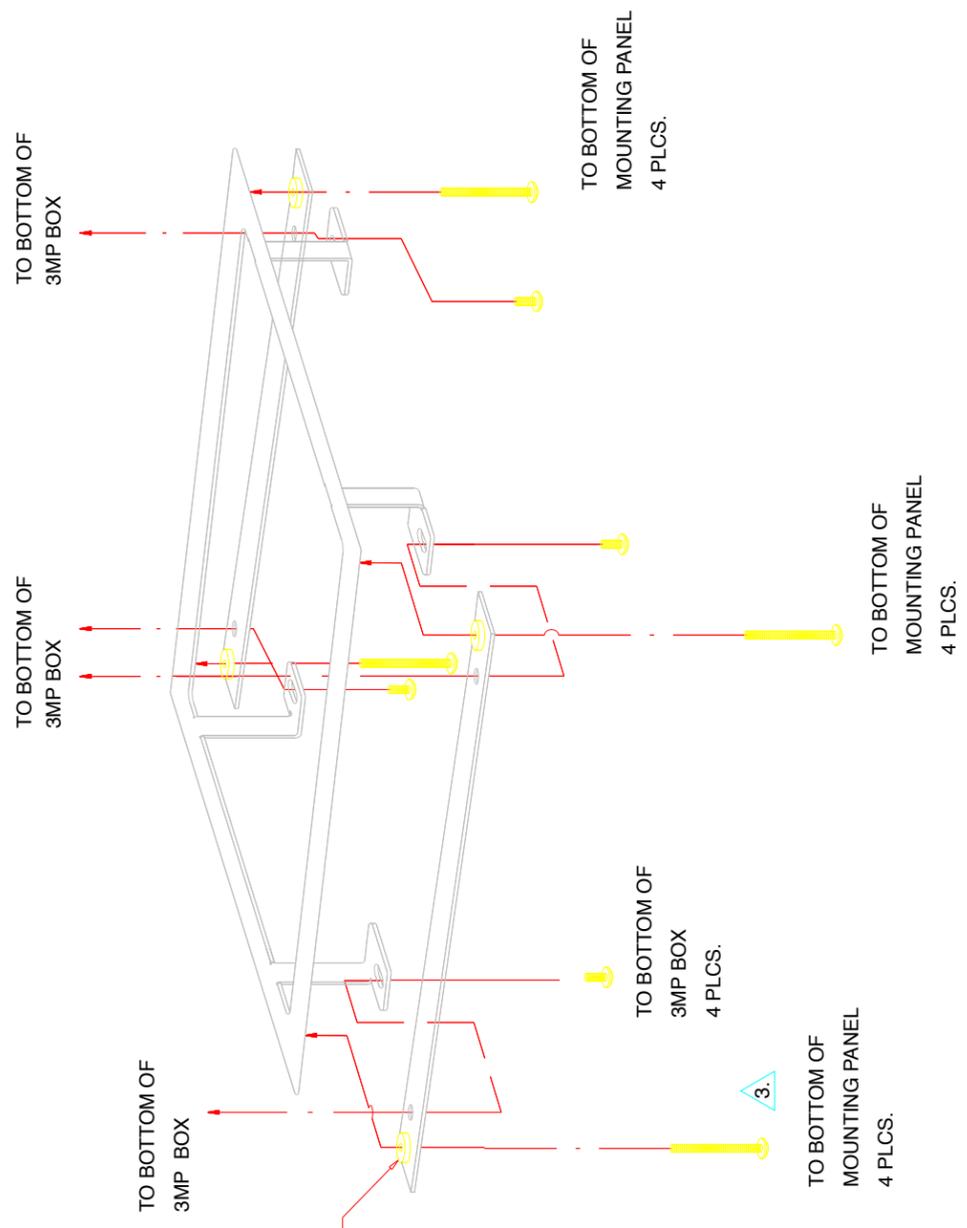
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REVISION HISTORY		
REV	DESCRIPTION	DATE

APPROVED



FLAT PATTERN



NOTES.

- 1. STEEL, 16 GAUGE, POWDER COATED, 316SS OPTIONAL
- 2. #10-32 CAPTIVE NUT
- 3. #10-32 x 2" PANHEAD PHILIPS

B

B



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DRAWN BY TADP		TITLE 3MP - BRACKET ASSEMBLY DETAIL	
CHECKED BY MJP		SIZE B	PROJECT 3MP
APPROVED BY MJP		SCALE Not to Scale	DRAWING NO. 3MP - VIEW 3
TOLERANCES		MODEL 3MP	REV /
1 Place: $\pm .1$	3 Places: $\pm .005$	SHEET 1	OF 1
2 Places: $\pm .01$	4 Places: $\pm .0005$	3	
Angular: $\pm 0.25^\circ$			

1

2

3

1

2

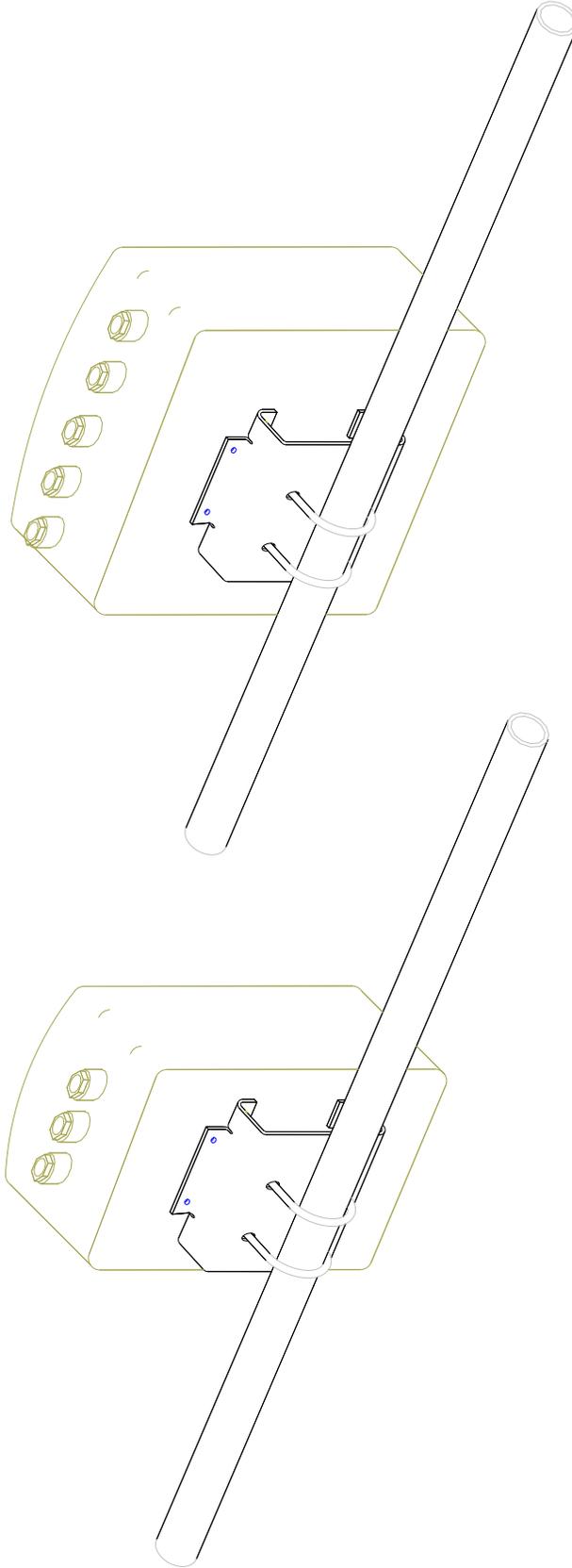
3

REV

DESCRIPTION

DATE

APPROVED



Mounting Bracket is Universal. Same bracket can be used for 3TX-2M and 3TX-4M enclosure assemblies. Mounting can be supported for both vertical (not shown here) and horizontal 2" pipe installation styles without modifying bracket position on enclosure.

NOTES.

1. Material, 1018 steel, 14 ga. Powder Coated
2. Internal Bend Radius = R.06
3. Bend allowance - .140 per 90°

ASTI
 Advanced Sensor Technologies, Inc.
 Orange, California USA
 Phone: 714-978-2837

DRAWN BY Thomas Patko		TITLE 3TX-2M & 3TX-4M Enclosure 2" Pipe Mounting Bracket - View 3	
CHECKED BY Martin Patko		SIZE A	DRAWING NO. 2" Pipe Mounting Bracket
APPROVED BY Martin Patko		SCALE x1	REV A
TOLERANCES		SHEET 1 OF 1	
1 Place: ± .1	3 Places: ± .005		
2 Places: ± .02	4 Places: ± .0005		
Angular: ± 0.25°			

1

2

3

1

2

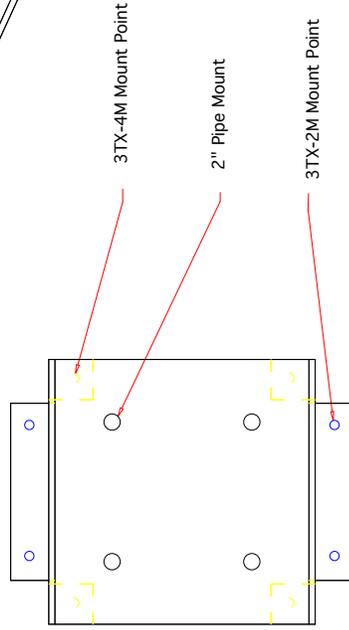
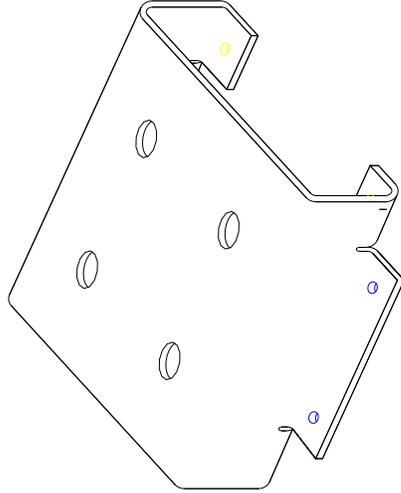
3

REV

DESCRIPTION

DATE

APPROVED



3TX-2M or 3TX-4M Enclosure

A

A

NOTES.

- 1. Material, 1018 steel, 14 ga. Powder Coated
- 2. Internal Bend Radius = R.06
- 3. Bend allowance - .140 per 90°

B

B

ASTI
 Advanced Sensor Technologies, Inc.
 Orange, California USA
 Phone: 714-978-2837

DRAWN BY Thomas Patko		TITLE 3TX-2M & 3TX-4M Enclosure 2" Pipe Mounting Bracket - View 2	
CHECKED BY Martin Patko		SIZE A	DRAWING NO. 2" Pipe Mounting Bracket
APPROVED BY Martin Patko		SCALE x1	REV A
TOLERANCES		SHEET 1 OF 1	
1 Place: ± .1	3 Places: ± .005		
2 Places: ± .02	4 Places: ± .0005		
Angular: ± 0.25°			

1

2

3

1

2

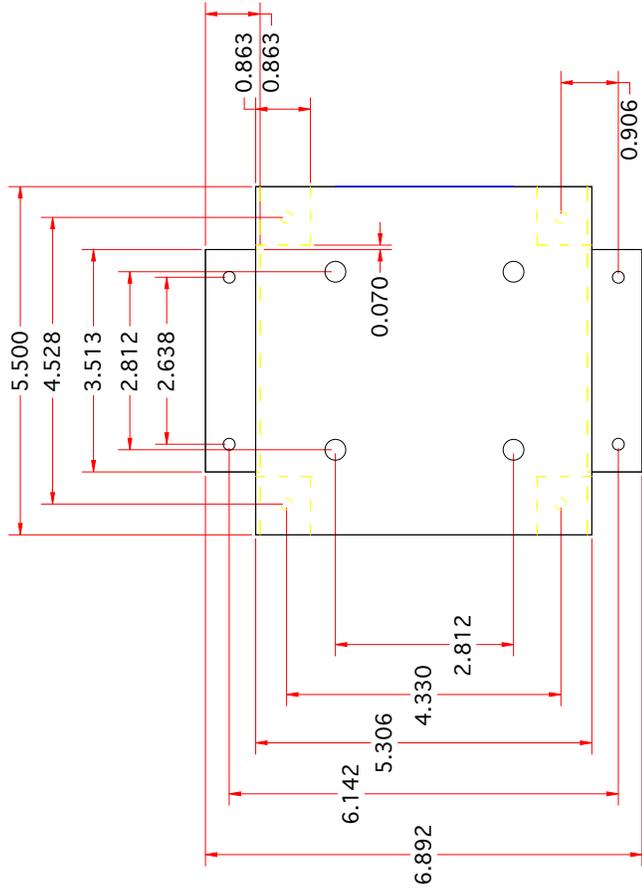
3

REV

DESCRIPTION

DATE

APPROVED



A

B

NOTES.

- 1. Material, 1018 steel, 14 ga. Powder Coated
- 2. Internal Bend Radius = R.06
- 3. Bend allowance - .140 per 90°



Advanced Sensor Technologies, Inc.
 Orange, California USA
 Phone: 714-978-2837

DRAWN BY Thomas Patko		TITLE 3TX-2M & 3TX-4M Enclosure 2" Pipe Mounting Bracket - View 1	
CHECKED BY Martin Patko		SIZE A	DRAWING NO. 2" Pipe Mounting Bracket
APPROVED BY Martin Patko		SCALE x1	REV A
TOLERANCES		SHEET 1 OF 1	
1 Place: ± .1	3 Places: ± .005		
2 Places: ± .02	4 Places: ± .0005		
Angular: ± 0.25°			

1

2

3

1

2

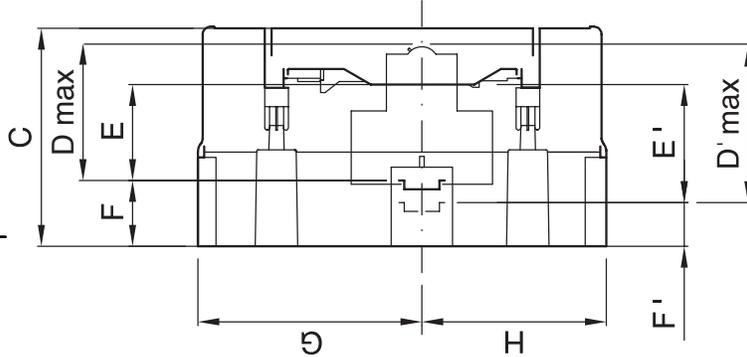
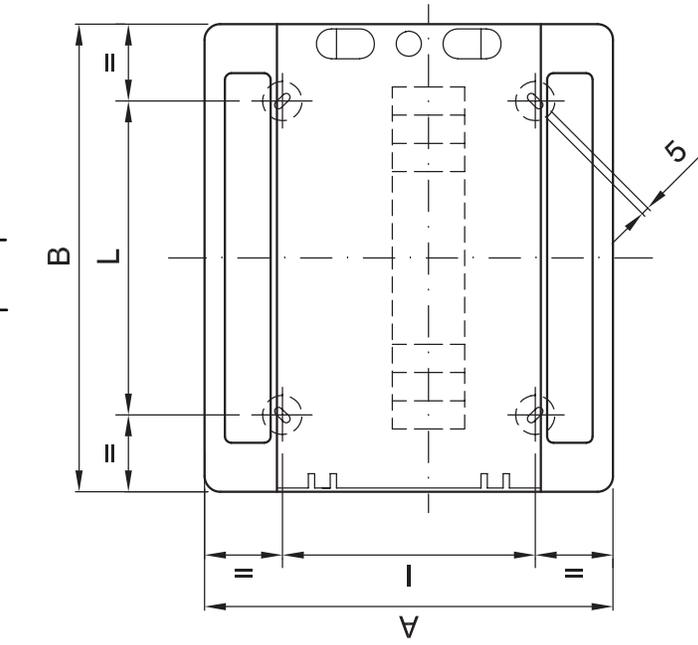
3

REV

DESCRIPTION

DATE

APPROVED



Enclosure	Modular mounting										Fixing				
	A	B	C	D max	E	F	G	H	I	D' max	E'	F'	NR	I	L
3TX-2M	210	143	100	75	48	15	105	105	105	-	-	-	3	156	67
3TX-4M	210	215	100	75	48	15	105	105	105	-	-	-	4	110	115
3TX-6M	260	298	140	75	48	48	117,5	142,5	102	75	21	4	4	161	200

Note: All dimensions are in millimeters

ASTI
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TOLERANCES

1 Place: ± .1

3 Places: ± .005

2 Places: ± .02

4 Places: ± .0005

Angular: ± 0.25°

DRAWN BY

Thomas Patko

CHECKED BY

Martin Patko

APPROVED BY

Martin Patko

TITLE

3TX-2M & 3TX-4M Enclosure Assembly Dimension Details

SIZE

A

PROJECT

3TX-2M & 3TX-4M Assy

DRAWING NO.

REV

A

SCALE

x1

SHEET 1 OF 1

1

2

3