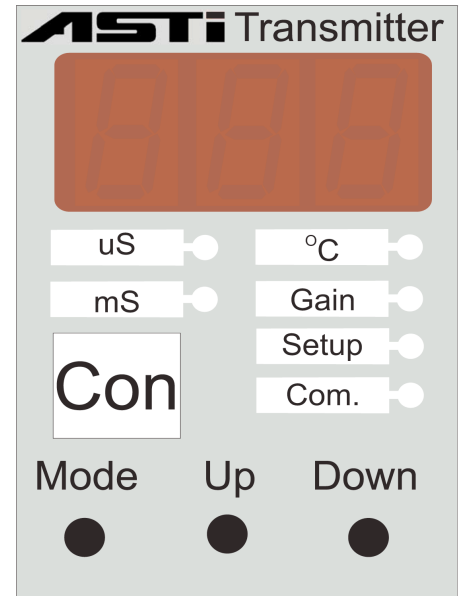# *3TX–CON 3-Wire Contacting Conductivity Transmitter*

- 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 condutance 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 <u>ANY</u> 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 input 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

√RoHS COMPLIANT

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
Output Hold: Automatic when in calibration mode

PARAMETERS

Function and Programming

The 23 progammable 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 *(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 define low 0/4mA setpoint in conductivity units.
Par. no. 12 define high 20mA setpoint 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/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 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.
Par. no. 26 resets back to factory default the P14 zero dry in air calibration as well as the wet P15 gain slope/span calibration.

* 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	Select Analog Output Type	Input for the analog output	Conductivity (S) or Temp °C	Con (S)
10	Analog Output	Type of output	0-20mA or 4-20mA	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 (0.5%)
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	Set Analog Output Mode	Set polarity of analog output	noninverted, inverted	n.inv
26	Reset Cals Only	Reset both the P14 & P15 cals	Def=Reset, Par=NoReset	Par

Calibration

Use 'Mode' to select 'Gain', then 'Up' or 'Down' to adjust the readout corresponding to the expected value. The adjustment may be ±50% or ±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.

Typical Installation

NOTES: The temperature can be calibrated by pushing the "Up" or "Down" buttons when in the temperature display (°C) mode. The raw (uncompensated) conductivity can be viewed by pushing the 'Down' button in the main measure display mode. The mA output for the current configuration is displayed by pressing the "Up" key in the main conductivity display mode.
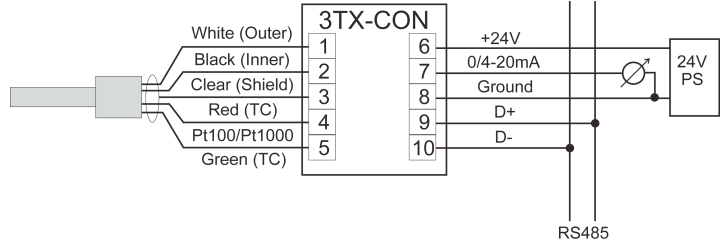
Cell Constant	Full Scale Maximum Conductivity Range (Nominal)	Minimum Range at 10% of Maximum Full Range
20.0 *(6.0-34.0)*	0 to 1,000,000 microSiemens(μS)/cm	0-1,000 mS/cm	0 to 100,000 microSiemens(μS)/cm	0-100 mS/cm
10.0 *(3.0-17.0)*	0 to 500,000 microSiemens(μS)/cm	0-500 mS/cm	0 to 50,000 microSiemens(μS)/cm	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/cm extended range is 0-200mS (min scale 0-20mS); K=0.2/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 ±50% to ±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. Refer to the separate specifications for the high resolution 3TX-CON-E unit.

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-CON 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).

The 3TX-CON contains 2 measurements (Conductivity and temperature). Access to these both of these measurements is 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 sent as 0-1000 corresponding to the effective range, but the temperature has an offset of 1024; i.e. the conductivity range as set by P11 & P12 is transmitted as 0-1000 while the 0-210°C temperature is then 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

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

Contact the factory for specific recommendations & ALL ISE inqueries. 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 (NH_3) 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 (NH_3) with Analog & MODbus Outputs; 1 each ISE Nitrite Ion with Analog Output Only; 1 each ORP Measurement Module and 1 each DO transmitter for galvanic active self-polarizing type sensors both with Scalable Analog & MODbus Outputs; With 115/230 Power Supply

Model: **3TX-6M-ISE-X-F-D-REL-pH-X-D-REL-CON-10.0/500-D-DAT-PS**
Description: Triple Channel Transmitter Assembly with Weatherproof Enclosure (for 6 Total Modules Max); 1 each Preamp Style Fluoride ISE Measurement Module & 1 each Preamp Style pH Measurement Module with Alarm/Relay Controller for both Fluoride ISE & pH; 1 each Contacting Conductivity Measurement with K=10.0/cm & Full Range 0-500mS; Analog & MODbus Outputs for All Measurements; DAT Datalogger/MODbusmaster Module to record all parameters; Universal 115/230 Power Supply

Model: **3TX-7MF-ISE-NH4-D-ISE-NO3-D-ISE-NO2-D-pH-D-CON-1.0/50-D-DO-D-DAT**
Description: Six Channel Measuring Transmitter Assembly Optimized for Low-Power Battery Operation; with NEMA 4X CSA/UL rated Enclosure (7 Module Max); 1 each ISE Ammonium Ion, 1 each ISE Nitrate Ion and 1 each ISE Nitrite Ion Module; 1 each pH module; 1 each Contacting Conductivity K= 1.0/cm & Full Range 0-50mS; 1 each Dissolved Oxygen module; Analog & MODbus Outputs for all Measurements & Temp; DAT Datalogger/MODbusmaster for continuous datalogging of all parameters

** For sensors with integral **preamplifiers**, order the pH/ORP transmitters as **–pH-X** and the ion selective (ISE) transmitters as **–ISE-X** and dissolved oxygen (DO) transmitters as **–DO-X**
*** For 2" NPT pipe mounting installations, an additional adapter plate must also be ordered for the 6M, 7MF & 9MF enclosures (inquire to factory for details).