



Environmental Water Quality Electrochemical Measurement Package

The need to measure various parameters that are characteristic of the water quality in natural water sources such as lakes, rivers, streams, wells, estuaries and groundwater tables on a continuous or intermittent basis over long periods of time is often of great interest but can be quite cost prohibitive leading to just periodic grab sample analysis being performed instead. The ASTI unique product combination of low-maintenance rugged industrial service electrochemical sensors combined with the low-cost, modular and easy-to-use 3TX transmitter series allows for these measurement to be performed in a very cost effective manner and so offer a viable alternate to grab sampling only methodology for very many applications. Although the exact measurement needs and water chemistry for any given site may vary, the modular and customizable nature of both the sensors and transmitters offered allows for most any configuration or installation need to be addressed. This flexibility in product design allows ASTI to create a highly individualized and optimized measurement systems suitable for the customer and site needs at the lowest possible cost.

The measurement of pH, conductivity and dissolved oxygen (DO) constitute some of the most common parameters for water quality being very low maintenance and offered at a very attractive price point. In addition, the measurement of dissolved ammonia and nitrate ions is increasing of interest to detect discharge from overuse of fertilizer, industrial wastewater or municipal wastewater or else just natural or seasonal variation in these nutrient levels for other reasons. The ammonium and nitrate ion selective sensors are designed to operate in fresh (potable type) water and are suitable to detect both common lower levels of the ammonium and nitrate ions as well as higher levels from spiking due to the possible agriculture, industrial or municipal sources. If the measurements are to be performed for brackish type water the ion selective sensors readings will not be valid until such periods of intrusion of salt water intrusion. During period of brackish water intrusion as may occur and be of interest for areas such as estuaries, only the pH, conductivity and dissolved oxygen readings will be meaningful. Once the water returns to fresh water conditions the ammonium and nitrate readings will once again be meaningful after a suitable grab sample offset calibration at the site. Since in the typical case above the conductivity range can spike from the normal fresh water low condition which is typically always less than 2,000 microSiemens/cm to the high brackish condition which can be as much as about 50,000 microSiemens/cm it will be desirable to be able to catch the extent of brackish water intrusions into the natural water source based upon looking at the salinity corresponding to these higher conductivity conditions. Selection of the conductivity cell constants and transmitter range will be based upon the specific normal and excursion conditions at the given site. The AST50 contacting conductivity sensors offer a very low fouling design and wide range of cell constants and materials of construction making it ideal for such uses providing both accuracy and flexibility. The unique 3TX-CON conductivity transmitter circuitry offers scaling ranges such that a $K=0.1/cm$ version can measure as low as 0-50uS and as high as 0-20,000uS and $K=1.0/cm$ version can measure as low as 0-500uS and as high as 0-200,000uS.

Outlined in the following pages are several common approaches for such measurement systems. As quoted, the package is designed for 24VDC power operation from a solar rechargeable battery pack. These solar power sources are readily from multiple commercial sources for a modest cost and the ASTI factory can offer suitable recommendations. The longevity of the given battery power source is extended by use of an ultralow power timer switch which can offer intermittent operation with integral datalogging at up to 10 times the normal rated operating time for the given battery power source. This setup is ideal for completely off the grid remote installation sites. Recording of the measured value can be achieved by means of the low-power DAT MODbus datalogger (max 60mA power consumption like all of the 3TX modules). If line power is available or else a larger solar rechargeable battery pack system is in place, it is also possible to have the datalogging performed including remote access via ethernet or GSM wireless protocols.



TRANSMITTER OPTIONS FOR ENVIRONMENTAL MEASUREMENT SYSTEMS

All of the typical part numbers listed presume that the analytical measurement requirement is for pH, dissolved oxygen, conductivity, ammonia, nitrate and temperature. The part numbers and options will vary if other parameters are also required (or else should be omitted). Presented here are two typical approaches: analog only and dual analog/MODbus versions.

OPTION # 1 - ANALOG APPROACH

The analog approach is a good choice if an analog 4-20mA style datalogger has already been selected or is installed at the site. This is commonly employed for more permanent measurement locations be they 24VDC or line powered.

Model: 3TX-6M-ISE-NH4-A-ISE-NO3-A-pH-A-CON-CELL/RANGE-A-DO-A-TEM-TIM-SW

Short Description:

Six Channel Analog 4-20mA Electrochemical Transmitter with Local Indicator for all Parameters

Long Description:

- * Six Channel 3TX Analyzer & Transmitter Assembly (3TX-6M)
- * 24VDC 3-wire Power operation for all modules; Maximum power consumption is 360mA total (60mA max per module)
- * 1 each Ammonium Ion Measurement Module with scalable 4-20mA analog output only (ISE-NH4-A)
- * 1 each Nitrate Ion Measurement Module with scalable 4-20mA analog output only (ISE-NO3-A)
- * 1 each pH Measurement Module with scalable 4-20mA analog output only (pH-A)
- * 1 each Contacting Conductivity Measurement Module for cell constant K=CELL/cm and the corresponding full range and minimum scaling per that cell constant (see notes); scalable 4-20ma analog output only (CON-CELL/RANGE-A)
- * 1 each DO Measurement Module for self-polarizing galvanic DO sensor; scalable 4-20mA analog output only (-DO-A)
- * 1 each Temperature Output Module for any Pt100/Pt1000 TC element; scalable 4-20mA analog output only (-TEM)
- * 1 each ultralow power consumption timer switch for programmable intermittent operation (-TIM)
- * 1 each mechanical On/Off switch to ease of maintenance and to allow for user defined intermittent operation (-SW)
- * Weatherproof Enclosure supporting up to 6 modules max (for extra modules switch to 7MF enclosure assembly option)
- * Sealing Cable Glands for Sensor Input(s) and Transmitters Output(s) are Included Standard

NOTES ON ANALOG TRANSMITTER APPROACH:

* The contacting conductivity measurement module can be supplied to match any contacting conductivity cell constant of interest. The cell constant K=0.1/cm is suitable for most fresh water samples and the cell constant K=1.0/cm is suitable for for most brackish water sources. Conductivity measurement in highly saline water sources requires a cell constant of K=2.0/cm. Other common cell constants can also be supplied upon request if other ranges are preferred. Please see the 3TX-CON specification sheet for further details.

* All process parameters are temperature compensated using TC elements integrated into each respective sensor.

* Additional ion selective transmitters can be added for measurements such as calcium (as a proxy for water hardness) or any other parameters of interest. In such a case the larger 7MF enclosure should be used instead of the 6M enclosure.

* The transmitter assembly detailed above is for 3-wire 24VDC power operation. This means that a dedicated 24VDC power supply is to be employed (it is NOT 2-wire loop powered) with the analog 4-20mA output from each transmitter sent on two leads that are separate from the +24VDC power and the ground (DC common) terminal shared. This is the lowest cost transmitter power configuration available and a good choice if a dedicated 24VDC power supply (or power source such as battery pack) is available. Alternatively, a universal 100 to 240 VAC 50/60 Hz power supply module can be added for line powered operation if preferred. In this case this option is denoted by adding a "-PS" to end of the part number and applying the approach surcharge.



OPTION # 2 - DIGITAL MODBUS APPROACH WITH ONBOARD DATALOGGING

The MODbus approach is a very good choice if the pH is such that pH compensation is required to find the total ammonia levels and/or in the cases where a very tightly bundled and small form factor measurement system with onboard datalogging is required (turn-key and preconfigured). This is most commonly employed for either temporary or permanent battery powered locations.

Model: **3TX-7MF-ISE-NH4-A-pH-A-TOT-ISE-NO3-A-CON-CELL/RANGE-D-DO-D-DAT-TIM-SW**

Short Description:

Five Channel Analog 4-20mA & MODbus Electrochemical Transmitter with Local Indicator for all Parameters

Long Description:

- * Seven Channel 3TX Analyzer & Transmitter Assembly (3TX-7MF)
- * 24VDC 3-wire Power operation for all modules; Maximum power consumption is 420mA total (60mA max per module)
- * 1 each Ammonium Ion Measurement Module with scalable 4-20mA analog output only (ISE-NH4-A)
- * 1 each pH Measurement Module with scalable 4-20mA analog output only (pH-A)
- * 1 each TOT pH compensation module to compute total ammonia from free ammonia input (3TX-ISE-NH4-A), pH levels from pH transmitter (3TX-pH-A) and bridged temperature input from TC on pH sensor; scalable 4-20mA analog output for computed total ammonia; MODbus RS485 outputs for all inputs and outputs (total ammonia, free ammonia, pH, temperature and 3rd transmitter input, in this case nitrate from the 3TX-ISE-NO3-A)
- * 1 each Nitrate Ion Measurement Module with scalable 4-20mA analog output only (ISE-NO3-A)
- * 1 each Contacting Conductivity Measurement Module for cell constant K=CELL/cm and the corresponding full RANGE and minimum scaling per that cell constant (see notes); 4-20ma analog & MODBUS output (CON-CELL/RANGE-D)
- * 1 each DO Measurement Module for self-polarizing galvanic DO sensor; 4-20mA analog & MODbus output (-DO-D)
- * 1 each MODbus Datalogger Module to record all process parameters and temperature from each sensor (-DAT)
- * 1 each ultralow power consumption timer switch for programmable intermittent operation (-TIM)
- * 1 each mechanical On/Off switch to ease of maintenance and to allow for user defined intermittent operation (-SW)
- * Weatherproof Enclosure supporting up to 7 modules max (for extra modules switch to 9MF enclosure assembly option)
- * Sealing Cable Glands for Sensor Input(s) and Transmitters Output(s) are Included Standard

NOTES ON DIGITAL MODBUS TRANSMITTER APPROACH:

- * The MODbus RS485 digital approach means that there exists BOTH a scalable 4-20mA analog output AND a RS485 MODbus digital communications for each process parameter of interest. The temperature from each sensor is also always sent via the MODbus protocol as well as the measured parameter.
- * Notes on contacting conductivity measurement ranges are the same as detailed in the analog approach notes.
- * All process parameters are temperature compensated using TC elements integrated into each respective sensor.
- * Additional ion selective transmitters can be added for measurements such as calcium (as a proxy for water hardness) or any other parameters of interest.
- * All transmitters can be powered on and off at will which is ideal for intermittent data sampling and recording. This is also ideal for intermittent battery powered operation be it from a smaller rechargeable portable setup or else a large permanent solar rechargeable station.
- * The 3TX-DAT datalogger module is tightly integrated with all of the measurement modules (3TX-pH, 3TX-ISE, 3TX-CON, 3TX-DO and 3TX-TOT). The 3TX-DAT is a small factor (same size as all of the measurement modules) and allows for datalogging of all mating measurement modules with configuration done by a free of charge Windows software that also allows for downloading of the recorded data as well as detailed visualization and data manipulation of the same. This DAT module is included in the system quoted above or can be removed if another datalogger is preferred.
- * Remote access options via ethernet or GSM wireless are available for both the analog and MODbus style approaches.



SENSOR OPTIONS FOR ENVIRONMENTAL MEASUREMENT SYSTEMS

All of the typical part numbers listed presume that the analytical measurement requirement is for pH, dissolved oxygen, conductivity, ammonia, nitrate and temperature. The part numbers and options will vary if other parameters are also required (or else should be omitted). Note that the sensors used are exactly the same no matter whether they are to be mated with the analog and MODbus transmitter approach.

Model: **AB 6410A-1000-10-TL Industrial Ammonium (NH₄⁺) ISE Sensor for Submersible or Inline Installations**

Description:

- 3/4"-3/4" MNPT Chemically Resistant CPVC Immersion Bodied Sensor WITH PROTECTIVE TINES
- Industrial Ammonium (NH₄⁺) Ion Selective Sensor with Solid-State Conductive Polymer Double Junction Reference System (AB 6410A-)
- Integrated Platinum 1000 Ohm Temperature Compensation Element to mate with 3TX-ISE ISE transmitter (-1000-)
- 10 feet (3 meters) cable with tinned lead wires to interface with 3TX-ISE per standard sensor wiring schematic (-TL)
- Waterproofing Seal "IT" for completely submersible installations (-WPIT)

Model: **AB 6810A-1000-10-TL Industrial Nitrate (NO₃⁻) ISE Sensor for Submersible or Inline Installations**

Description:

- 3/4"-3/4" MNPT Chemically Resistant CPVC Immersion Bodied Sensor WITH PROTECTIVE TINES
- Industrial Nitrate (NO₃⁻) Ion Selective Sensor with Solid-State Conductive Polymer Double Junction Reference System (AB 6810A-)
- Integrated Platinum 1000 Ohm Temperature Compensation Element to mate with 3TX-ISE ISE transmitter (-1000-)
- 10 feet (3 meters) cable with tinned lead wires to interface with 3TX-ISE per standard sensor wiring schematic (-TL)
- Waterproofing Seal "IT" for completely submersible installations (-WPIT)

Model: **PN 6013-1000-10-TL-WPIT Industrial pH Sensor for Submersible or Inline Installations**

Description:

- 3/4"-3/4" MNPT Chemically Resistant CPVC Immersion Bodied Sensor WITH PROTECTIVE TINES
- Rugged General Purpose Break-Resistant 8MM MUGG pH glass Element with Solid State Non-Porous Conductive Cross-Linked Polymer Double Junction System in HDPE Matrix (PN 6013-)
- Integrated Platinum 1000 Ohm Temperature Compensation Element to mate with 3TX-pH pH transmitter (-1000-)
- 10 feet (3 meters) cable with tinned lead wires to interface with 3TX-pH per standard sensor wiring schematic (-TL)
- Waterproofing Seal "IT" for completely submersible installations (-WPIT)

Model: **AST50-CELL-1000-10-TL-WPB 1"-1" MNPT Industrial Inline/Submersible Contacting Conductivity Sensor**

Description:

- AST50 1" MNPT Process Connection Suitable for Connection to 1" FNPT Conduit
- CPVC Material of Construction for sensor body, 316SS material of construction for electrodes (titanium optional)
- 100 psig @ 95 degree Celsius rating
- Overall Body Length of 3.5 Inches for AST50 Sensor, 1.0" Immersion depth past front threads
- Cell Constant "K" is given by "CELL", Maximum Range of 0 to 5,000 microSiemens for 3TX-CON contacting conductivity transmitter when CELL is **K=0.1/cm (Low Style)** Cell Constant, Maximum Range of 0 to 50,000 microSiemens for 3TX-CON contacting conductivity transmitter when CELL is **K=1.0/cm (High Style)** Cell Constant
- Integrated Platinum 1000 Ohm Temperature Compensation Element for 3TX-CON conductivity transmitter (-1000-)
- 10 feet (3 meters) cable with tinned lead wires to interface with 3TX-CON per standard sensor wiring schematic (-TL)
- Waterproofing Seal "B" for completely submersible installations (-WPB)



Model: **AST-DO-100-10-TL-NPT Submersible Galvanic Type Dissolved Oxygen (DO) Sensor**

Description:

- AST-DO Submersible Industrial Grade Active-Type Self-Polarizing Galvanic Dissolved Oxygen Sensor
- Absolute mV output self correcting for temperature (even without TC employed)
- Polyoxymethylene (POM) Material of Construction for Sensor Body, submersible to 100 meters (with extended cable)
- For use in 0-50 degrees Celsius Water Conditions
- Integrated Platinum 100 Ohm Temperature Compensation Element for 3TX-DO dissolved oxygen transmitter (-100-)
- 10 feet (3 meters) cable with tinned lead wires to interface with 3TX-DO per standard sensor wiring schematic (-10-TL)
- Includes 3/4" NPT adapter for standpipe submersible installations

NOTES ON SENSORS:

* During the seemingly brief periods of brackish water due to the salt water intrusion into the river, the ammonium and nitrate ISE sensor readings will be skewed due to the very high level of sodium and chloride that will be present (the issue is exceeding the permissible level of interfering ion during these excursion conditions). Once this brackish water recedes, you will have these sensor reading return to normal after a suitable offset calibration correction. The pH, conductivity and dissolved oxygen reading will not be adversely effected by the presence of the brackish water.

* All sensors are quoted with the standard 10 feet (3 meters) of cable (this is the default). All sensors can be readily also supplied with up 20 feet (6 meters) of cable without the inclusion of any special options (just surcharge for the extra cable). For extended cable lengths beyond 20 feet for the pH, ORP of ion selective sensors an integral preamplifier is also required. Quick disconnect terminations are available for sensors. Optional features may incur a surcharge, if applicable.



Links to some technical data sheets of interest for the pH, dissolved oxygen, conductivity & ammonia and nitrate ion selective transmitters and sensors for use in such applications:

pH Measurement with 3TX-pH Transmitter & Mating 6013 pH Sensor

http://www.astisensor.com/3TX-pH_ORP_Sensors_Transmitters_Controllers_Dataloggers_Brochure.pdf

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

<http://www.astisensor.com/6013.pdf>

Dissolved Oxygen Measurement with 3TX-DO Transmitter & Mating AST-DO Dissolved Oxygen Sensor

http://www.astisensor.com/3TX-DO_Dissolved_Oxygen_Sensors_Transmitters_Controllers_Dataloggers_Brochure.pdf

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

http://www.astisensor.com/AST-DO-Dissolved_Oxygen_Sensor_Submersible.pdf

Conductivity Measurement with 3TX-CON Transmitter & Mating AST50 Conductivity Sensor

http://www.astisensor.com/3TX-Conductivity_Sensors_Transmitters_Controllers_Dataloggers_Brochure.pdf

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

http://www.astisensor.com/AST_Conductivity_Sensor_Specs_AST50-AST60.pdf

Ammonia & Nitrate Measurement with 3TX-ISE Transmitter & Mating AB 6410A & 6810A ISE Sensors

http://www.astisensor.com/3TX-ISE_Ammonia_Nitrate_Nitrite_Sensors_Transmitters_Controllers_Dataloggers_Brochure.pdf

http://www.astisensor.com/ASTI_Ammonium_Systems_3TX.pdf

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

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

<http://www.astisensor.com/6410A.pdf>

<http://www.astisensor.com/6810A.pdf>



Some Common Useful Links of Interest:

3TX Product Landing Webpage, Datalogger Module (DAT), Analog Temperature Output (TEM), Programmable Contact Relays for Alarm/Control & Overall FAQ for 3TX Series

<http://www.astisensor.com/3tx.htm>

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

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

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

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

Drawings of the enclosure assemblies (including the quoted 6M & 7MF option)

http://www.astisensor.com/3TX-2M_3TX-4M_Enclosure_2_Inch_Pipe_Mounting_Bracket_Details.pdf

http://www.astisensor.com/7MF_NEMA4X_Enclosure_Assembly_Drawing.pdf

Submersible options webpage and direct link to WPIT style quoted

<http://www.astisensor.com/prosub.htm>

<http://www.astisensor.com/prosubh2oIT.htm>

COMMON NOTES & COMMENTS:

* These environmental systems are sold and supported as complete packages. For example, piecemeal sale of ion selective sensors only is not possible. More generally, bundled system pricing is not usually valid if only selected portions are purchased. Please inquire to factory for details in this regard.

* Inquire to the ASTI factory for solar-cell rechargeable battery pack or portable rechargeable battery pack operation of these environmental systems. Some power configuration options are only available in selected enclosure assemblies.

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