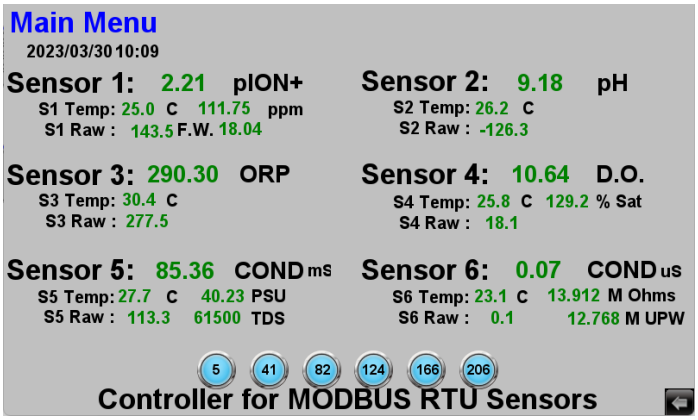
Installation Guide & User Manual RTU Style Six (6) Channel Touchscreen Controller for Smart Digital HiQDT pH, ORP, Dissolved Oxygen, Ion Selective & Conductivity Sensors

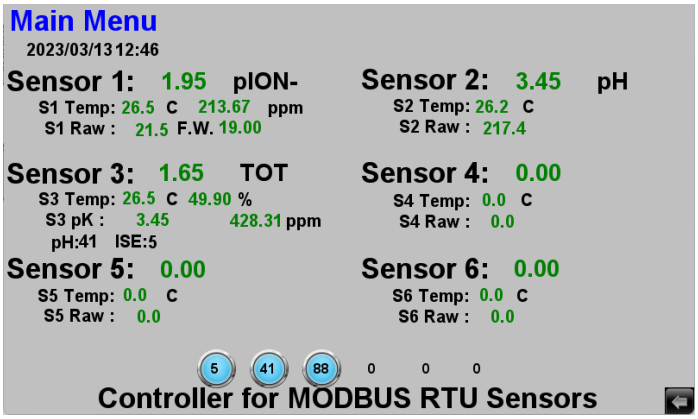
***Left**: Six (6) channel controller w/ 7.0" touchscreen & bottom input ports. **Right**: Controller shown with output ports on top view. Six (6) HiQ4FP panel connectors are waterproof input ports for sensors. Integral ½"NPT cable glands quantity one (1) on bottom input side & seven (7) on top output side for NEMA 4X wiring of power, analog outputs & remote access via ethernet port.*

INSTALLATION & USER GUIDE REV 1.2 – Build Date March 28, 2023

This controller offers turn-key plug & play solution to perform pH, ORP, dissolved oxygen (D.O), ion selective (ISE) and conductivity (EC) field measurements taking advantage of all features of the smart digital HiQDT MODBUS RTU sensors. The custom coded software allows for seamless integration on proven industrial HMI from Maple Systems with CE, CSA & UL approvals. This manual covers all aspects that are particular to this specific software implementation. For general aspects of the Maple Systems HMI hardware please refer back to the separate Maple Systems documentation.



Default main display window for the six-channel configuration. Access to all other screens is obtained through the main menu. Status updates, alarms & alerts are scrolled across top of screen. Isolation between analog output ground & sensor input ground points allow for six fully independent measurement channels.



Real-time pH compensated total ammonium, total fluoride and total cyanide determination is available with TOT configuration with two more channels still available for other measurements. Total ISE computed from free ISE & pH sensor inputs. Analog and digital outputs for all measured and computed values.

Six (6) CHANNEL ADVANCED TOUCHSCREEN CONTROLLER HARDWARE:

- Serpac I342HL,TCBG NEMA 4X Enclosure with Clear Hinged Latched Door ready for wall or pipe mounting *
- Serpac 7200HP Plastic Swivel Top Plate with Cutout for HMI5070/HMI5071L advanced touchscreen with pull handle
- Serpac 7200B Aluminum Bottom Plate for mounting of 35mm DIN-RAIL 3TX-RTU-D universal smart transmitters
- 1 each input side and 7 each output side ½" NPT cable glands factory installed into NEMA 4X enclosure assembly

* ***Larger I352HL,TCBG enclosure required for*** Phoenix Contact UNO-PS/1AC/24DC/30W 1.25A rated power supply.

Maple Systems Model HMI5070L or HMI5071L 7.0" Advanced Touchscreen HMI (Max 300mA / 450mA @ 24VDC)

https://www.maplesystems.com/product/modelname/hmi5070l

https://www.maplesystems.com/product/modelname/hmi5071l

ASTI 3TX-RTU-D Universal Transmitter for Smart Digital HiQDT MODBSU RTU Sensors (Max 60mA to 80mA @ 24VDC)

https://www.astisensor.com/3TX-RTU.pdf

ASTI 3TX-TOT-DT Total Fluoride, Total Ammonium and Total Cyanide pH Compensation Module for Smart Digital HiQDT MODBSU RTU Sensors connected with mating 3TX-RTU-D Transmitters (Max 60mA @ 24VDC)

https://astisensor.com/3TX-TOT-DT.pdf

- **Up to 6 each isolated analog outputs (scalable and selectable 0-20mA, 4-20mA, 20-0mA or 20-4mA)**
- **Up to 6 each smart digital HiQDT MODBUS RTU discrete sensor inputs (Prewired to HMI Serial Input Port)**
- **MODBUS MODBUS TCP Slave (a.k.a. MODBUS over Ethernet)**

ASSEMBLY SIZE: 11.8 inches (300mm) Width X 11.0 inches (280mm) Height X 5.5 Inches (140mm) Depth
NET WEIGHT: 8.0 Pounds (3.6 kilograms) SHIPPING BOX: 14 inches X 14 inches X 6 inches
SHIP WEIGHT: 9.0 pounds (4.1 kilograms)

POWER CONFIGURATIONS:
HiQDT-CTRL-6CH(S)-XEA-RTU-D-PS1 85 to 264 VAC - CUI PSK-S20C-24-DIN Max 0.833A @ 24VDC
HiQDT-CTRL-6CH(S)-XEA-RTU-D-PS1A * 85 to 264 VAC - Phoenix Contact UNO-PS/1AC/24DC/30W 1.25A @ 24VDC
HiQDT-CTRL-6CH(S)-XEA-RTU-D-PS4 9 to 36 VDC - CUI PYBE30-Q24-S24-DIN Max 1.25A @ 24VDC

*Where **"X"** in part number represents the number of 3TX-RTU-D modules which are factory installed at time of shipment which is the total number of channels available for the given configuration. The min value for **"X"** is 1 (single channel) and the max value for **"X"** is 6 (six channel). Purchase 3TX-0M-RTU-D transmitter to add additional channels after time of initial commissioning of unit.*

SUPPORTED AMBIENT OPERATING TEMPERATURES FOR ALL CONFIGURATIONS ARE 0 to 50° C

SOFTWARE:
Advanced menu-driven touchscreen interface for all features and functionality as detailed in this manual.

INDIVIDUAL COMPONENT MAX POWER CONSUMPTION @ 24VDC:
HMI5071L 450mA for HiQDT-CTRL-6CHS-… config HMI5070L 300mA for HiQDT-CTRL-6CH-… config
3TX-RTU-D 60mA with pH/ORP/ISE/DO sensors 3TX-RTU-D 80mA when used with Conductivity sensors
3TX-TOT-DT 60mA for all possible configurations

6 each All pH/ORP/ISE/DO HiQDT Sensors with 3TX-RTU-D 360mA Max
6 each All Conductivity HiQDT Sensors with 3TX-RTU-D 480mA Max

MAX TOTAL POWER CONSUMPTION @ 24VDC FOR VARIOUS CONTROLLER CONFIGURATIONS

HiQDT-CTRL-6CHS-6EA-RTU-D-PSX with HMI5071L using 6 each pH/ORP/ISE/DO Sensors 810mA
HiQDT-CTRL-6CHS-6EA-RTU-D-PSX with HMI5071L using 6 each Conductivity Sensors ** 930mA **

*** Contact factory if you plan to use conductivity sensors in this type of AC line powered configuration before ordering.***

HiQDT-CTRL-6CH-6EA-RTU-D-PSX with HMI5070L using 6 each pH/ORP/ISE/DO Sensors: 660mA
HiQDT-CTRL-6CH-6EA-RTU-D-PSX with HMI5070L using 6 each Conductivity Sensors: 780mA

INITIAL COMMISSIONING STEPS:

1. Provide power to touchscreen controller. Power options are 85-265 VAC (PS1) or 9 to 36 VDC (PS4) power type.
   a. **If unsure about correct location & power type to be provided to unit consult factory to avoid damage!!**
2. Determine desired configuration of sensor types to be used for each of the available six channels. It is not necessary to setup all sensor channels at time of commissioning. Channels may be added or removed over the course of time if desired. Note any such changes for any upstream connected PLC, DCS or SCADA.
3. Setup sensor with correct node & baudrate for channel on 3TX-RTU-D and 3TX-TOT-DT transmitters.
4. Plug in HiQDT sensors terminated with HiQ4M male snap connector (or extension cable terminating in the same) into one of the available HiQ4FP female panel mount connector.
5. Configure each sensor type from touchscreen controller for the channel to be used.
6. If commissioning was successful each channel will properly display the sensor type & live values in main screen.
7. Wire up analog outputs to be used after configuring them from the appropriate screens.
8. Setup secure remote access with EZAccess 2.0 software. One-time registration is required to Maple Systems.
9. Setup email notifications for trigger events to prompt when remote login might be advisable when not at site.

Default Home Screen & Main Menu

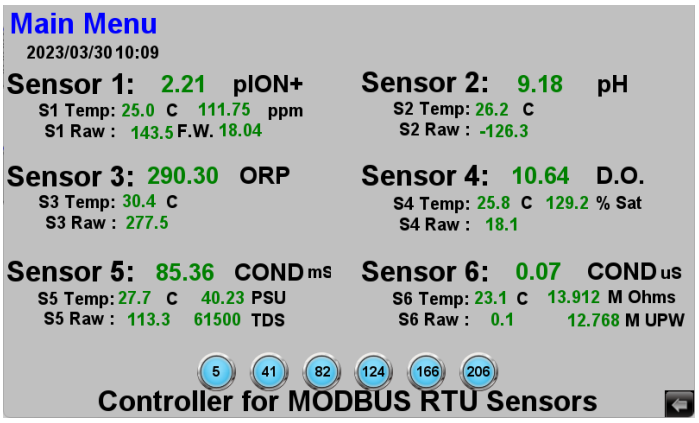
Default home screen shows live process & temperature values for all connected HiQDT sensors & raw absolute mV values for all channels in controller configuration. If the commissioning steps as detailed in page 4 of this manual were successful completed then sensors added will be shown in this home screen along together with corresponding node address in use for each channel.

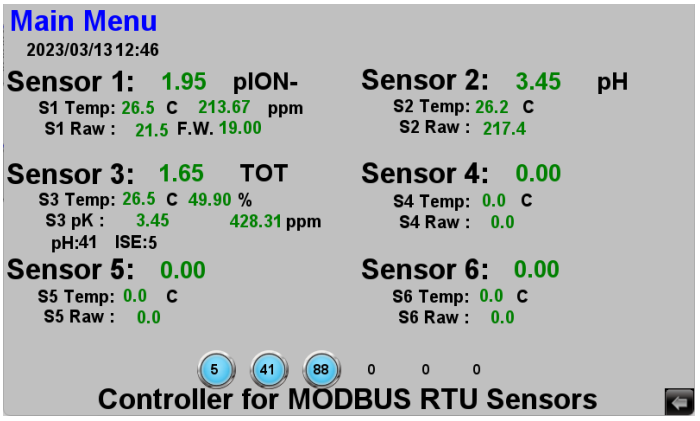
If for any reason any of the channels that was setup does not display correctly it is possible to use the "ASTI Windows Datalogging & Graphing Windows Software for 3TX Transmitters with MODBUS Output" to troubleshoot the HiQDT MODBUS sensor configuration. In this case you would temporarily disconnect the D+ & D- input leads to the HMI and temporarily redirect the output to this Windows software (contact factory for assistance). Please refer to the separate manual for this software for instructions on how to configure it for use with the HiQDT sensors for such a purpose.

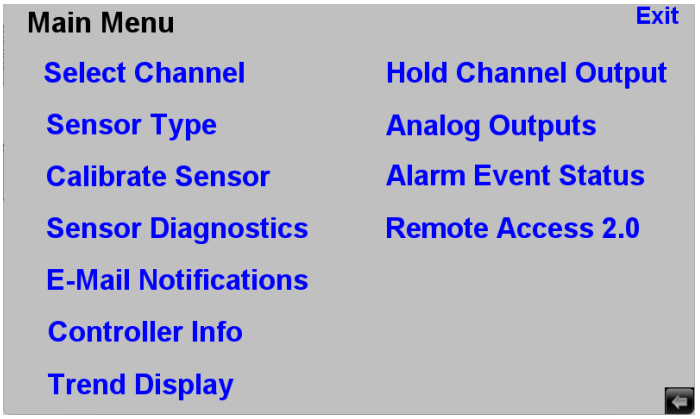
Main Menu is accessible from the home default display screen as shown on top to the right. Exiting from the main menu will load back the default display screen. After a period of inactivity, you will also get returned back to the home default display screen.

Subsequent portions of manual detail specific sub-menus or screens that are accessible starting from this main menu. If unsure where a specific menu is located, please refer to the table of contents on the previous page four (4).

The clickable items in any of the screens is indicated by being shown in **blue** and/or shown as a button.







INSTALLATION GUIDE

The software 6 channel touchscreen controller is specifically designed to be used with IOTRON™ & ZEUS™ series smart digital HiQDT MODBUS RTU HiQDT pH, ORP, D.O., ISE & EC sensors. All functionality detailed in this manual can also be performed by the ASTI supplied handheld battery powered communicator **(excluding only changing of the baudrate which is only possible using the Windows software)**. The Windows software can perform ALL possible operations on the smart digital sensors. The ASTI supplied HiQDT HMI+PLC touchscreen controller package that is a turn-key unit available for purchase ready for plug and play commissioning with a robust software suite.

The software contains the following **menus** and **fields**, all of which are accessible starting with the main menu.

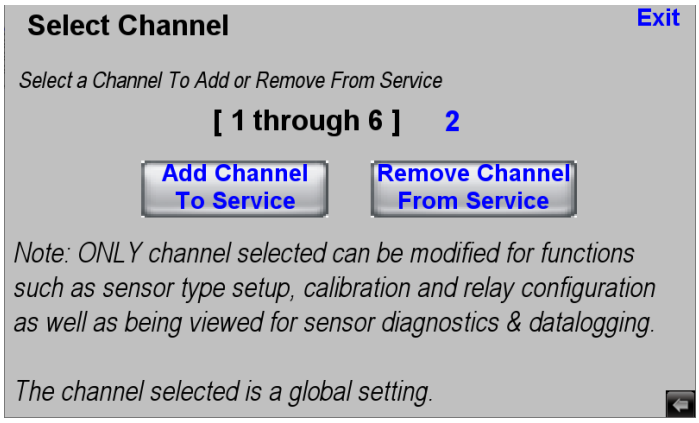
"Select Channel" Menu

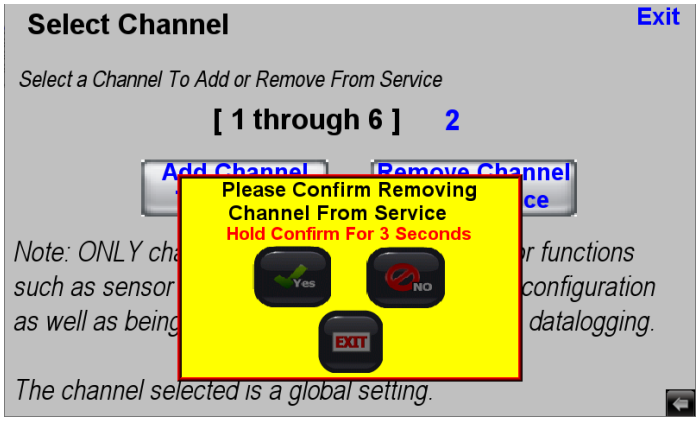
The select channel is a global setting. Most all tasks to be performed in the remainder of the menu such as sensor type & node address, sensor calibration, setup and scaling of analog output and relays use the channel that is set in this menu.

You must first designate whether you are adding or removing a channel from service. After selecting the channel, you can set the sensor type for that channel by clicking on the "Select Sensor Type" to navigate directly to this screen.

The working channel can be changed by clicking on the number shown in blue which will load a screen where a new channel can be entered. Valid choices are one to six (1 to 6). You will be asked to confirm each channel addition or removal.

If adding a new sensor after designating the channel to which it will be assigned you will then automatically proceed to "Sensor Type" screen for configuration. The channel number must be designated before the valid node address for the particular sensor type can be appropriately assigned.





IMPORTANT NOTE ABOUT BAUDRATE:

The default baudrate for all HiQDT sensors to be used with the six channel controller is 19,200 kbps. Default baudrate for the HiQDT sensors is 19,200 unless otherwise requested at time of purchase. If the baudrate is changed to 9,600 kbps on your HiQDT sensor it cannot be used with the ASTI HiQDT touchscreen controller.
ONLY the ASTI HiQDT Windows software can change the baudrate of the HiQDT smart digital RS-485 MODBUS RTU sensors (see manual for details).

IMPORTANT NOTE ABOUT NODE ADDRESS:

The default node address for HiQDT sensors will always be exactly the same as the sensor type. The parameter P02 will be set to the default node address for the sensor type that is to be connected to that channel. The value of parameter P21 will define the sensor type and channel number to the connected touchscreen.

For pH the sensor type and default node address is 1.
For standard range ORP the sensor type and default node address is 2.
For wide range ORP the sensor type and default node address is 3.
For dissolved oxygen (D.O.) the sensor type and default node address is 4.
For Ion Selective (ISE) the sensor type and default node address is 5.
For Conductivity (EC) the sensor type and default node address is 6.

When the sensors are purchased together with controller a logical preset node scheme will be installed for all 3TX-RTU-D transmitters such that so that all sensors will automatically show up in the home display screen in the requested channel configuration allowing for plug and play operation right out of the box. Contact factory for any special configuration requested at time of order.

Node Address for 3TX-RTU-D Transmitters with Six Channel Touchscreen Controllers

Channel Number	1	2	3	4	5	6
pH Sensor	P02=1 P21=1	P02=1 P21=41	P02=1 P21=81	P02=1 P21=121	P02=1 P21=161	P02=1 P21=201
Standard ORP Sensor	P02=2 P21=2	P02=2 P21=42	P02=2 P21=82	P02=2 P21=122	P02=2 P21=162	P02=2 P21=202
Wide Range ORP Sensor	P02=3 P21=3	P02=3 P21=43	P02=3 P21=83	P02=3 P21=123	P02=3 P21=163	P02=3 P21=203
Dissolved Oxygen Sensor **using ppm units**	P02=4 P10=ppm P21=4	P02=4 P10=ppm P21=44	P02=4 P10=ppm P21=84	P02=4 P10=ppm P21=124	P02=4 P10=ppm P21=164	P02=4 P10=ppm P21=204
Dissolved Oxygen Sensor **using % Saturation units**	P02=4 P10=%Sat P21=4	P02=4 P10=%Sat P21=44	P02=4 P10=%Sat P21=84	P02=4 P10=%Sat P21=124	P02=4 P10=%Sat P21=164	P02=4 P10=%Sat P21=204
Ion Selective (ISE) Sensor	P02=5 P21=5	P02=5 P21=45	P02=5 P21=85	P02=5 P21=125	P02=5 P21=165	P02=5 P21=205
Standard/High Range Conductivity Sensor P13 is 200 or 2000 **using EC units (uS or mS)**	P02=6 P11=Con P21=6	P02=6 P11=Con P21=46	P02=6 P11=Con P21=86	P02=6 P11=Con P21=126	P02=6 P11=Con P21=166	P02=6 P11=Con P21=206
Standard/High Range Conductivity Sensor P13 is 200 or 2000 **using PSU units**	P02=6 P11=PSU P21=6	P02=6 P11=PSU P21=46	P02=6 P11=PSU P21=86	P02=6 P11=PSU P21=126	P02=6 P11=PSU P21=166	P02=6 P11=PSU P21=206
Standard/High Range Conductivity Sensor P13 is 200 or 2000 **using TDS units**	P02=6 P11=tdS P21=6	P02=6 P11=tdS P21=46	P02=6 P11=tdS P21=86	P02=6 P11=tdS P21=126	P02=6 P11=tdS P21=166	P02=6 P11=tdS P21=206
Ultralow Range Conductivity Sensor P13 is 2 - **EC units (uS)**	P02=6 P11=Con P21=6	P02=6 P11=Con P21=46	P02=6 P11=Con P21=86	P02=6 P11=Con P21=126	P02=6 P11=Con P21=166	P02=6 P11=Con P21=206
Ultralow Range Conductivity Sensor P13 is 2 - **MΩ units**	P02=6 P11=rES P21=6	P02=6 P11=rES P21=46	P02=6 P11=rES P21=86	P02=6 P11=rES P21=126	P02=6 P11=rES P21=166	P02=6 P11=rES P21=206
Ultralow Range Conductivity Sensor P13 is 2 - **MΩ UPW units**	P02=6 P11=UP P21=6	P02=6 P11=UP P21=46	P02=6 P11=UP P21=86	P02=6 P11=UP P21=126	P02=6 P11=UP P21=166	P02=6 P11=UP P21=206

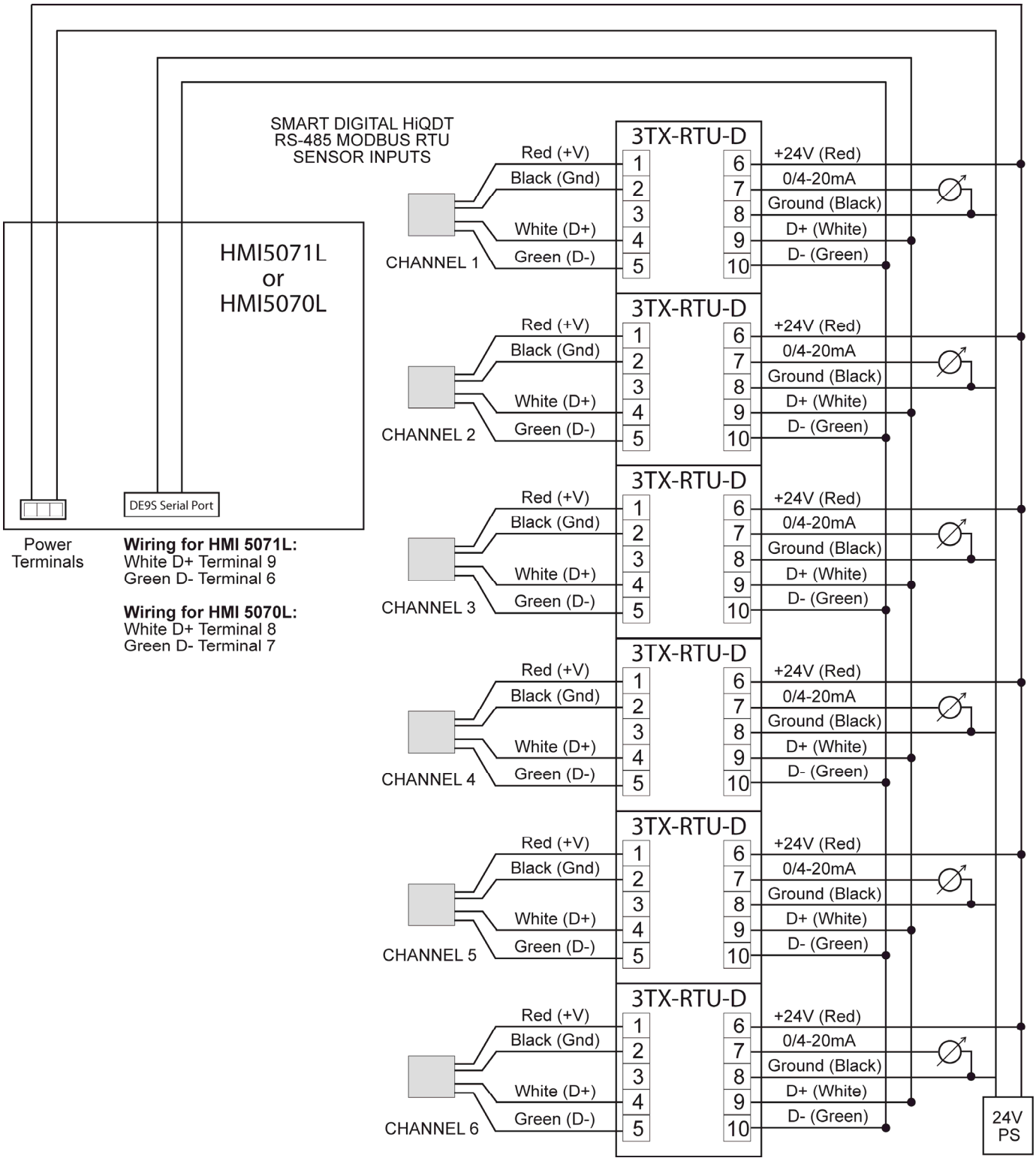
!! Important Special Note !!

The node address for parameter P21 on each 3TX-RTU-D transmitters MUST be unique at all times in order to ensure proper function. If the P21 node address is the same for any two transmitters then normal communications with the toucshcreen controller will not be possible!

COMMISSIONING AND SETUP:

ONLY the ASTI HiQDT Windows software or ASTI Handheld Communicator (HHC) can change the node address of the HiQDT smart digital RS-485 MODBUS RTU sensors (see respective manuals for details).

Wiring Schematic of 3TX-RTU-D with Six (6) Channel Touchscreen Controllers



SPECIAL CHANNEL COMMISSIONING NOTES ON 3TX-RTU-D TRANSMITTERS:

1. Parameter P02 on 3TX-RTU-D transmitter is always set to default node for sensor type used. This presumes that the sensor has not been changed from the factory standard factory default node address at time of dispatch.
2. Set Parameter P24 must to "ALL" to ensure that all capabilities from touchscreen controllers are enabled.

Wiring of 3TX-RTU-D Terminal 9 White D+ & Terminal 10 Green D- leads from Slave Port to HMI5070 or HMI5071L on DE9S COM3 (RS-485 2-wire MODBUS RTU communications)

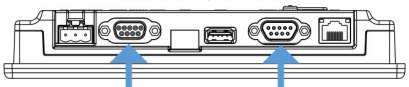
DE9S

Pin#	COM2 [RS-485 2 wire]	COM2 [RS-485 4 wire]	COM3 [RS-485 2 wire]	CAN Bus (XL/DXL only)
1	DATA-	RX-		
2	DATA+	RX+		
3		TX-		
4		TX+		
5	GND			
6			DATA-	
7				CAN_L
8				CAN_H
9			DATA+	

DE9P

Pin#	COM1 [RS-232]	COM3 [RS-232] (DL/DXL only)
1		
2	RXD	
3	TXD	
4		
5	GND	
6		
7	RTS	TXD
8	CTS	RXD
9	GND	

HMI5070NL, HMI5071L



When interfacing the HMI5071L the white lead from 3TX-RTU-D transmitter(s) are connected to terminal 9 (D+) and green lead from 3TX-RTU-D transmitter(s) are connected to terminal 6 (D-).

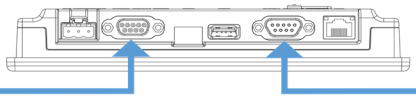
DE9S

Pin#	COM1 [RS-485 2 wire]	COM1 [RS-485 4 wire]	COM3 [RS-485 2 wire]
1	DATA-	RX-	
2	DATA+	RX+	
3		TX-	
4		TX+	
5	GND (COM1)		
6			
7			DATA-
8			DATA+
9			GND (COM3)

DE9P

Pin#	COM1 [RS-232]
1	
2	RXD
3	TXD
4	
5	GND
6	
7	RTS
8	CTS
9	

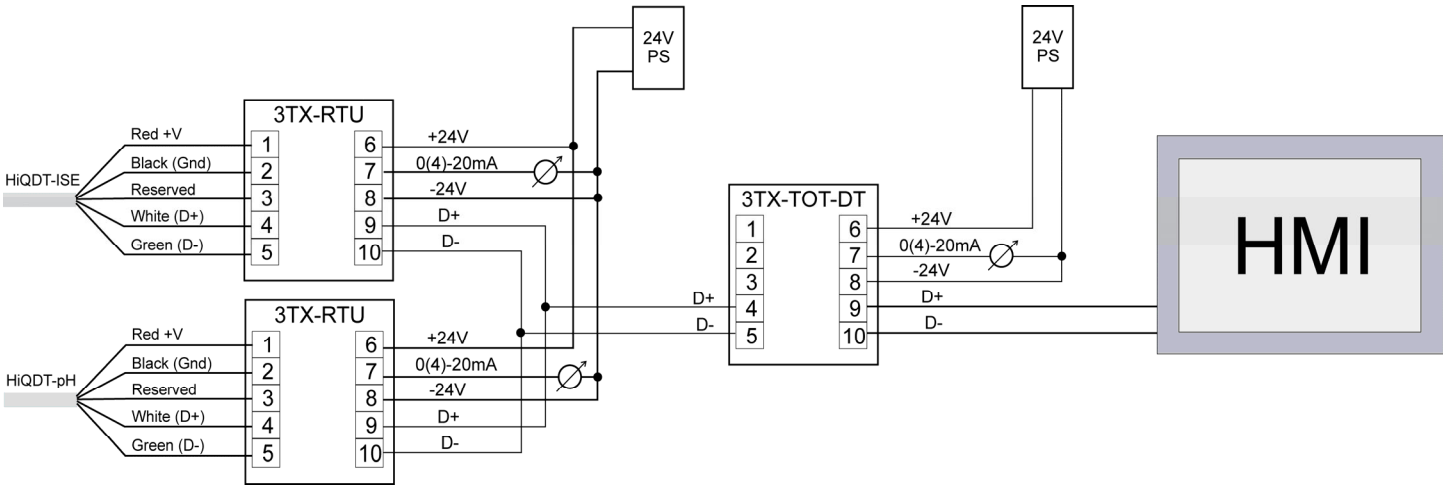
HMI5070L, HMI5070LB



When interfacing the HMI5070L the white lead from 3TX-RTU-D transmitter(s) are connected to terminal 8 (D+) and green lead from 3TX-RTU-D transmitter(s) are connected to terminal 7 (D-).

Wiring for Total ISE Measurement System in Base Configuration

1 each 3TX-TOT-DT pH Compensation Module & 2 each 3TX-RTU-D Transmitters for Free ISE and pH Sensor Inputs



Node Address for 3TX-RTU-D Transmitters with Six Channel Touchscreen Controllers (Channels 4, 5 & 6 are not used in this configuration but can be added at a later time)

Channel Number	1	2	3
pH Sensor		P02=1 P21=41	
Ion Selective (ISE) Sensor	P02=5 P21=5		

Node Address for 3TX-TOT-DT Transmitters with Six Channel Touchscreen Controllers (Channels 4, 5 & 6 are not used in this configuration but can be added at a later time)

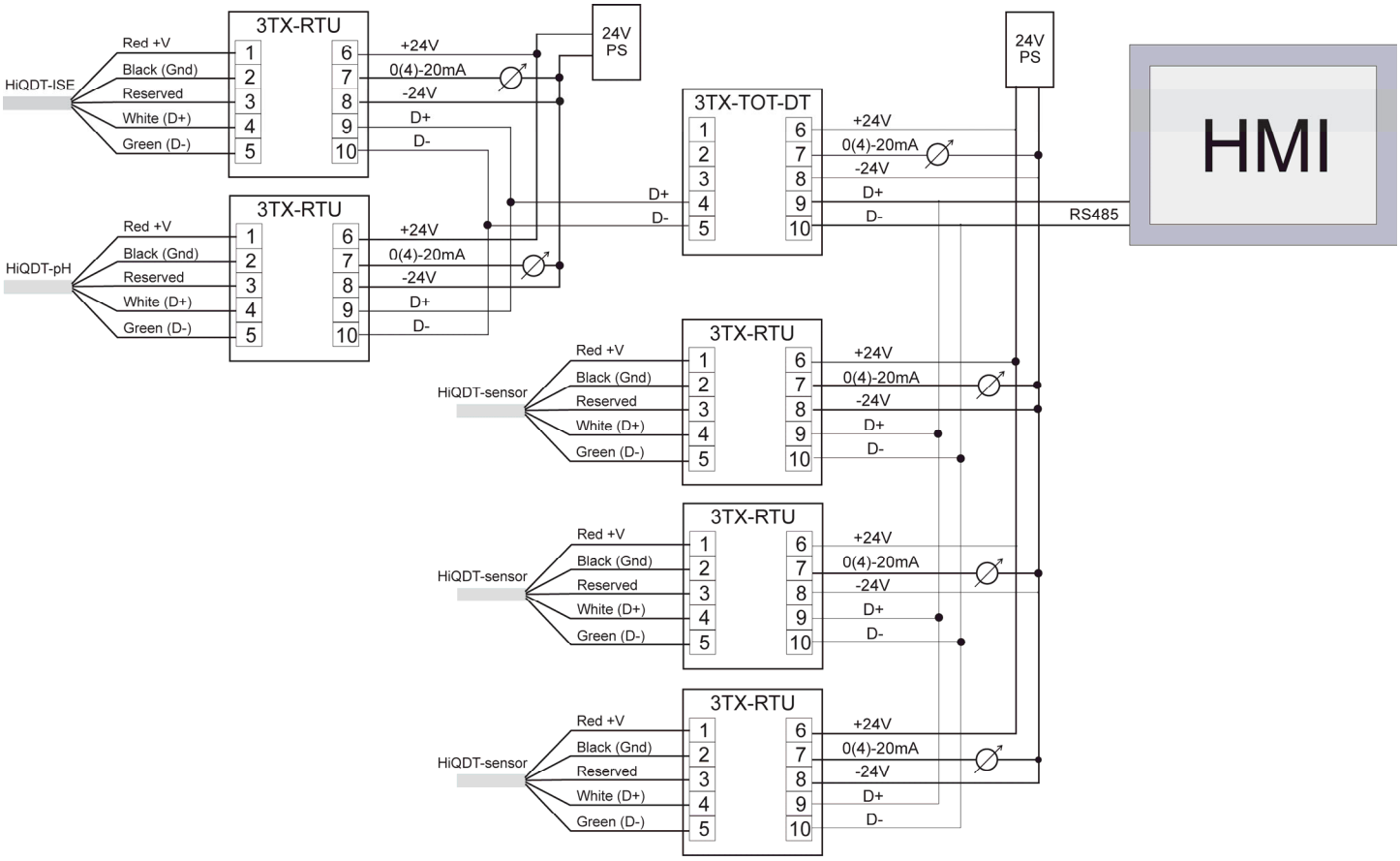
Channel Number	1	2	3
Total ISE pH Compensation Module			P03=5, P04=41 P21=88

!! Important Special Note !!

The node address for parameter P21 on each 3TX-RTU-D transmitters MUST be unique at all times in order to ensure proper function. If the P21 node address is the same for any two transmitters then normal communications with the toucshcreen controller will not be possible!

Wiring for Total ISE Measurement System in Augmented Configuration (Part 1 of 2)

1 each 3TX-TOT-DT pH Compensation Module & 2 each 3TX-RTU-D Transmitters for Free ISE and pH Sensor Inputs + Up to 3 each 3TX-RTU-D Transmitters for measurement of additional parameters and/or locations



Node Address for 3TX-RTU-D Transmitters with Six Channel Touchscreen Controllers (See Following Page for Details about configuring Channels 4, 5 & 6)

Channel Number	1	2	3
pH Sensor		P02=1 P21=41	
Ion Selective (ISE) Sensor	P02=5 P21=5		

Node Address for 3TX-TOT-DT Transmitters with Six Channel Touchscreen Controllers (See Following Page for Details about configuring Channels 4, 5 & 6)

Channel Number	1	2	3
Total ISE pH Compensation Module			P03=5, P04=41 P21=88

!! Important Special Note !!

The node address for parameter P21 on each 3TX-RTU-D transmitters MUST be unique at all times in order to ensure proper function. If the P21 node address is the same for any two transmitters then normal communications with the toucshcreen controller will not be possible!

Wiring for Total ISE Measurement System in Augmented Configuration (Part 2 of 2)

Node Address for 3TX-RTU-D Transmitters with Six Channel Touchscreen Controllers

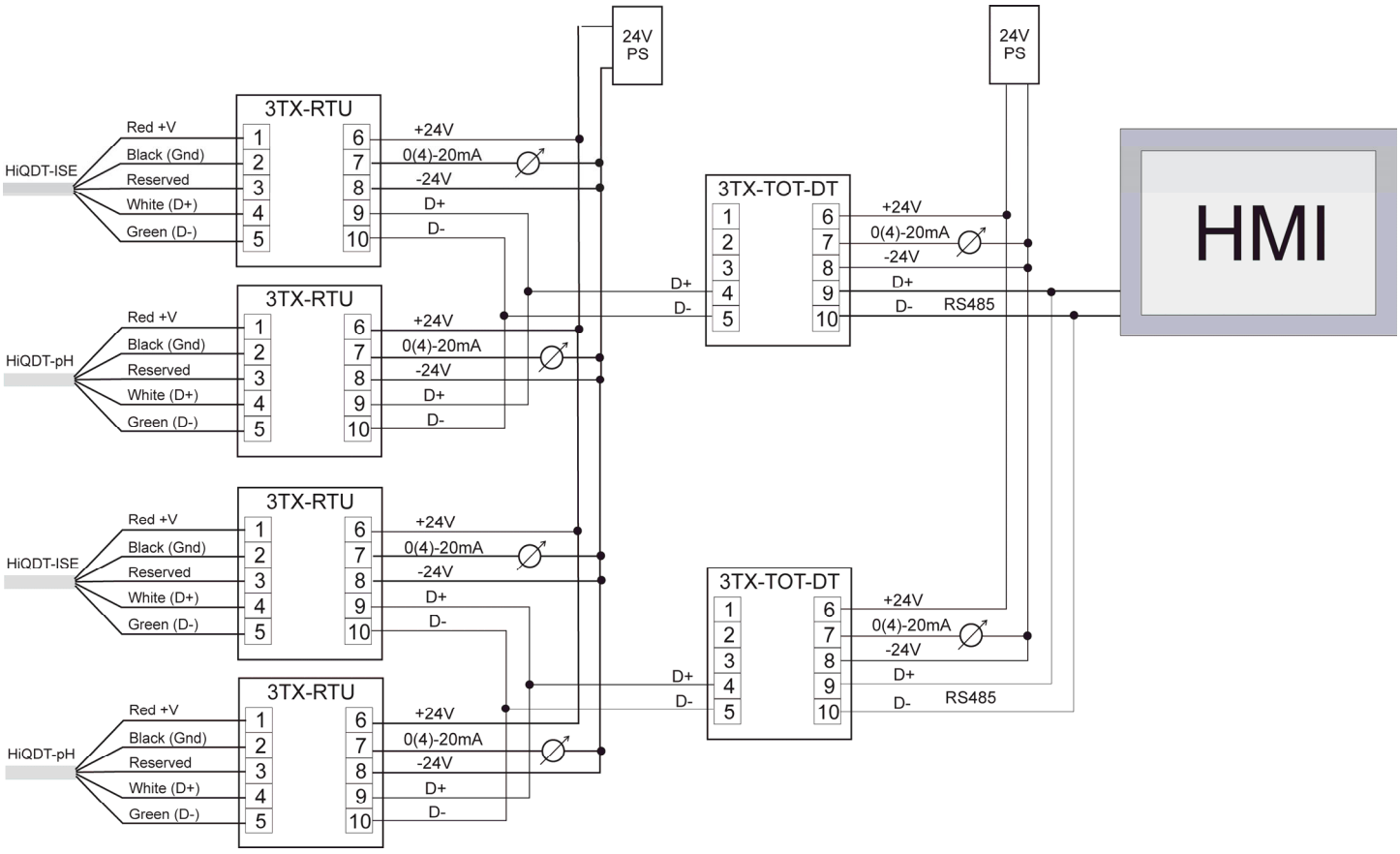
Channel Number	4	5	6
pH Sensor	P02=1 P21=121	P02=1 P21=161	P02=1 P21=201
Standard ORP Sensor	P02=2 P21=122	P02=2 P21=162	P02=2 P21=202
Wide Range ORP Sensor	P02=3 P21=123	P02=3 P21=163	P02=3 P21=203
Dissolved Oxygen Sensor **using ppm units**	P02=4 P10=ppm P21=124	P02=4 P10=ppm P21=164	P02=4 P10=ppm P21=204
Dissolved Oxygen Sensor **using % Saturation units**	P02=4 P10=%Sat P21=124	P02=4 P10=%Sat P21=164	P02=4 P10=%Sat P21=204
Ion Selective (ISE) Sensor	P02=5 P21=125	P02=5 P21=165	P02=5 P21=205
Standard/High Range Conductivity Sensor P13 is 200 or 2000 **using EC units (uS or mS)**	P02=6 P11=Con P21=126	P02=6 P11=Con P21=166	P02=6 P11=Con P21=206
Standard/High Range Conductivity Sensor P13 is 200 or 2000 **using PSU units**	P02=6 P11=PSU P21=126	P02=6 P11=PSU P21=166	P02=6 P11=PSU P21=206
Standard/High Range Conductivity Sensor P13 is 200 or 2000 **using TDS units**	P02=6 P11=tdS P21=126	P02=6 P11=tdS P21=166	P02=6 P11=tdS P21=206
Ultralow Range Conductivity Sensor P13 is 2 - **EC units (uS)**	P02=6 P11=Con P21=126	P02=6 P11=Con P21=166	P02=6 P11=Con P21=206
Ultralow Range Conductivity Sensor P13 is 2 - **MΩ units**	P02=6 P11=rES P21=126	P02=6 P11=rES P21=166	P02=6 P11=rES P21=206
Ultralow Range Conductivity Sensor P13 is 2 - **MΩ UPW units**	P02=6 P11=UP P21=126	P02=6 P11=UP P21=166	P02=6 P11=UP P21=206

!! Important Special Note !!

The node address for parameter P21 on each 3TX-RTU-D transmitters MUST be unique at all times in order to ensure proper function. If the P21 node address is the same for any two transmitters then normal communications with the toucshcreen controller will not be possible!

Wiring for Total ISE Measurement System for Two (2) Simultaneously Installations

1 each 3TX-TOT-DT pH Compensation Module & 2 each 3TX-RTU-D Transmitters for Free ISE and pH Sensor Inputs +
1 each 3TX-TOT-DT pH Compensation Module & 2 each 3TX-RTU-D Transmitters for Free ISE and pH Sensor Inputs



NOTE: The two total ISE installations measured in the configuration detailed in the wiring schematic above can be either redundant (two sets of ISE & pH sensors in the same tank or line) or from two separate installation points or locations as preferred.

Node Address for 3TX-RTU-D Transmitters with Six Channel Touchscreen Controllers

Channel Number	1	2	3	4	5	6
pH Sensor		P02=1 P21=41			P02=1 P21=161	
Ion Selective (ISE) Sensor	P02=5 P21=5			P02=5 P21=125		

Node Address for 3TX-TOT-DT Transmitters with Six Channel Touchscreen Controllers

Channel Number	1	2	3	4	5	6
Total ISE pH Compensation Module			P03=5, P04=41 P21=88			P03=125, P04=161 P21=208

!! Important Special Note !!
The node address for parameter P21 on each 3TX-RTU-D transmitters MUST be unique at all times in order to ensure proper function. If the P21 node address is the same for any two transmitters then normal communications with the toucshcreen controller will not be possible!

"Sensor Type" Menu

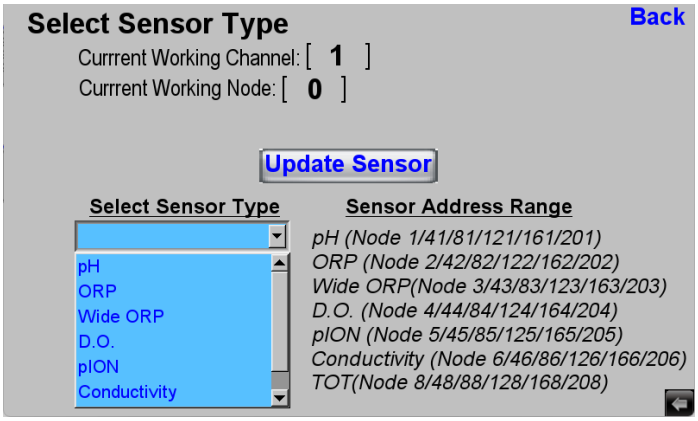
The table at the bottom of this page details the node address that should be assigned for each sensor type depending upon the channel to which it is to be commissioned (installed). This information is also shown in the "Sensor Type" screen as can be seen to the right. Clicking on the sensor type will assign the node address as appropriate for the current working channel that has been previously selected.

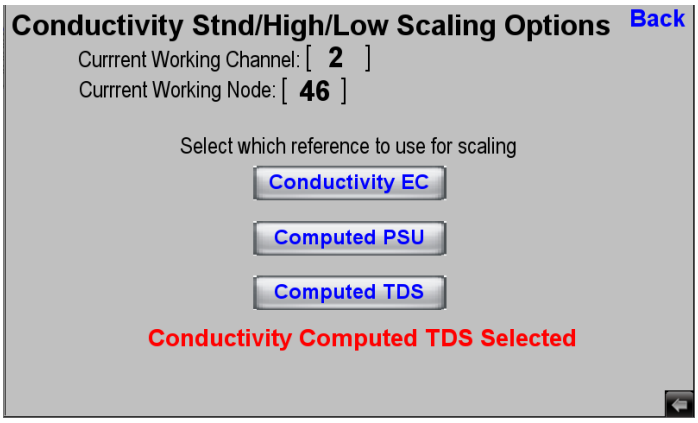
Sensor type ONLY configured for current channel!!

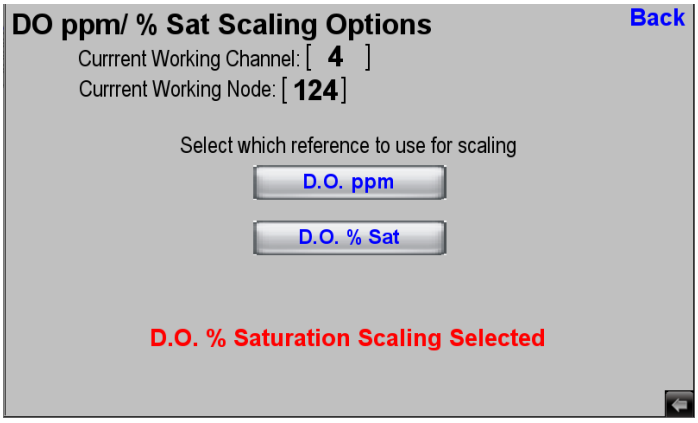
The sensor type for the current channel can be changed on the 3TX-RTU-D which is wired for that channel. Please see the manual for the 3TX-RTU-D transmitter for details on how to change the relevant parameters needed to properly configure for the desired channel to be added.

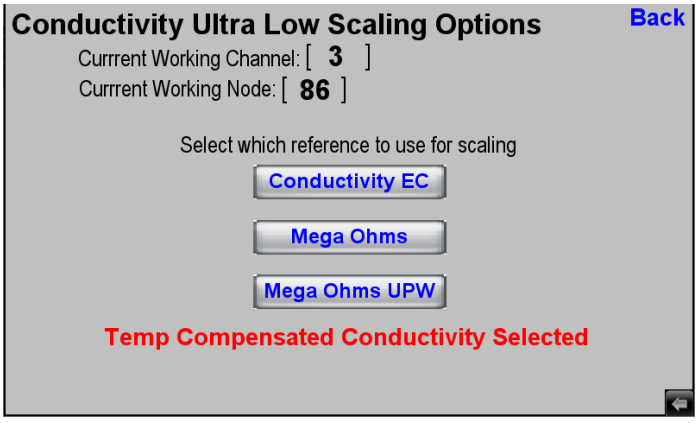
Current working node changes to selection after update sensor button is pushed and confirmed.

If selecting 3TX-TOT-DT transmitter with pH compensation for total fluoride, total ammonium or total cyanide you **MUST** have it fully configured before adding to touchscreen controller.









UNIT NOTE FOR DISSOLVED OXYGEN (DO) SENSORS:
The unit selected for the dissolved oxygen sensor at time channel is added to controller (ppm or % Saturation) will be the unit used for the analog output, contact relays and trend graph.

UNIT NOTES FOR CONDUCTIVITY (EC) SENSORS:
The unit selected for the dissolved oxygen sensor at time channel is added to controller (mS/PSU/TDS for standard/high range sensors and uS/MΩ/MΩ-UPW for the utlralow range sensors) will be the unit used for the analog output, contact relays and trend graph.

After unit selection after for conductivity or dissolved oxygen sensor the choice will be confirmed in red text below. Please see Appendix "G" for additional information about the various cell constants and range modes for the conductivity sensors before commissioning.

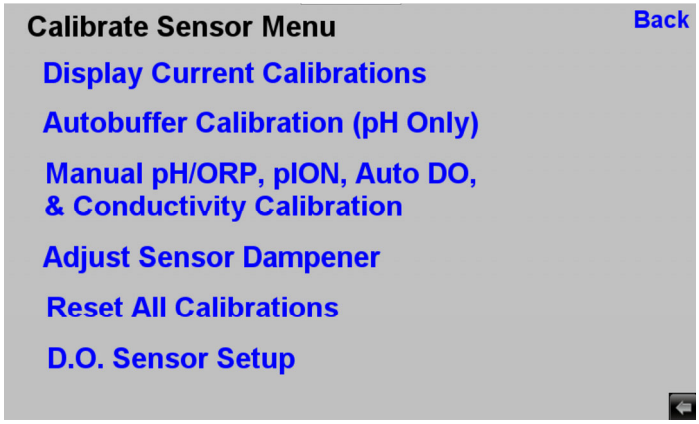
Conductivity sensor MUST be connected PRIOR to adding conductivity channel to the controller!!

SUMMARY OF CORRECT SEQUENCE FOR CALIBRATION OF HiQDT pH SENSOR WITH BUFFERS

1. Perform temperature calibration (manual mode only)
2. **Select the three pH buffers to be used to perform the calibration (See Appendix A, B & C)**
3. Perform **pH 'Offset'** Calibration (Autoread or Manual) a.k.a. Asymmetric Potential abbreviated as A.P.
4. Perform **pH 'Acid Slope'** Calibration (Autoread or Manual)
5. Perform **pH 'Alkaline Slope'** Calibration (Autoread or Manual) a.k.a. Base Slope
6. If desired, perform adjustment for agreement with laboratory reference value of process grab sample with pH 'Offset' mode. Account for all temperature induced effects if this last step is performed.

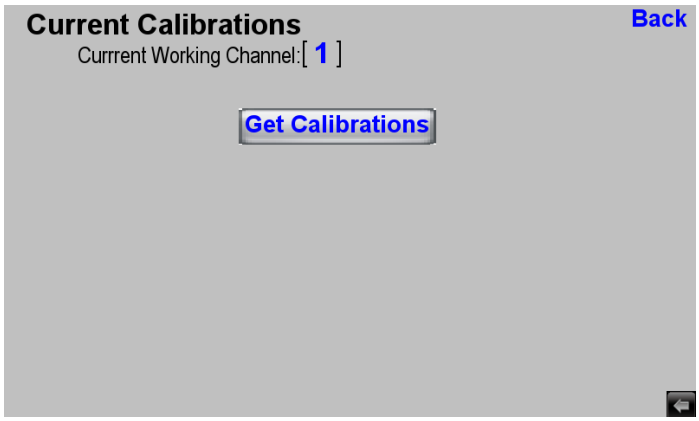
"Calibrate Sensor Menu"

All sensor calibrations can be shown from the "Display Current Calibrations" selection. The "Autobuffer Calibration" is only valid for pH sensors. The "Manual pH/ORP, pION, Auto DO & Conductivity Calibration" mode is valid for all sensors. "Adjust Sensor Dampener" and "Reset All Calibrations" tools are also valid for all sensor types. The "D.O. Sensor Setup" allows changing salinity and air pressure used to compute percent saturation. For faster calibration operation you can temporarily adjust the sensor dampener to a shorter time than when it is in field use for continuous measurements.

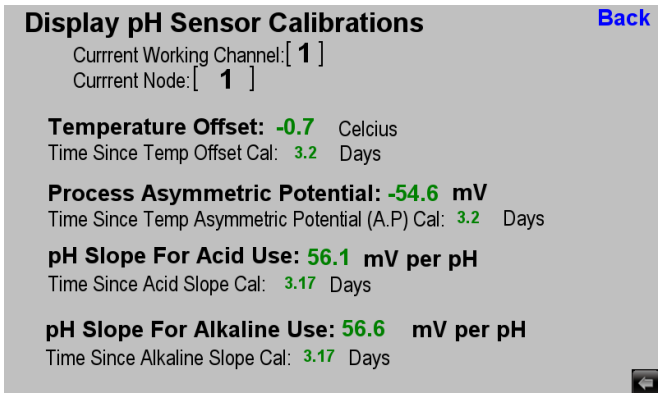


"Display Sensor Calibrations"

The calibration values for the sensor in the current working channel can be shown in this screen. Simply click on the Current Working Channel shown in blue and choice the channel that you wish to view if the desired selection is now what is shown. Finally to view the current calibrations then click "Get Calibrations" button and the values for the selected channel will be shown.

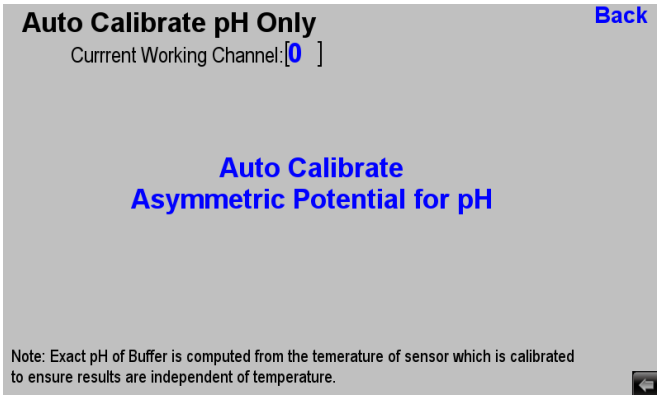


The calibrations will be loaded as appropriate for the given sensor type that is assigned to that channel. In the case shown to the right a calibration was very peformed fairly recently and so the time since calibration is shown as 3.17 days. If this display sensor calibrations screen is shown immediately after calibration then the time since calibration should show as 0.0 days instead.

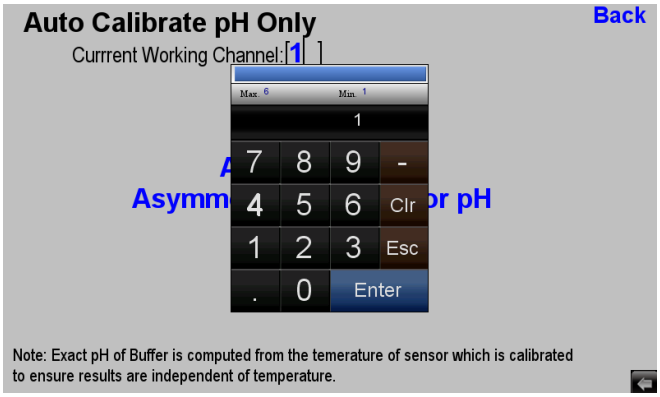


"Auto Calibrate pH Only" Menu

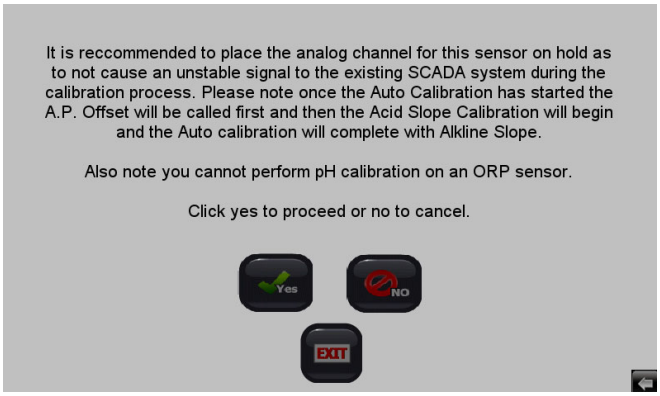
The autocalibration is only available if the sensor type is pH for the channel to be calibrated. You need only to select the channel for which you wish to perform autobuffer calibration on a pH sensor to begin the process.



You will always start by performing the asymmetric potential (offset) calibration for the pH sensor followed by the acid slope calibration and finally the alkaline slope calibration.



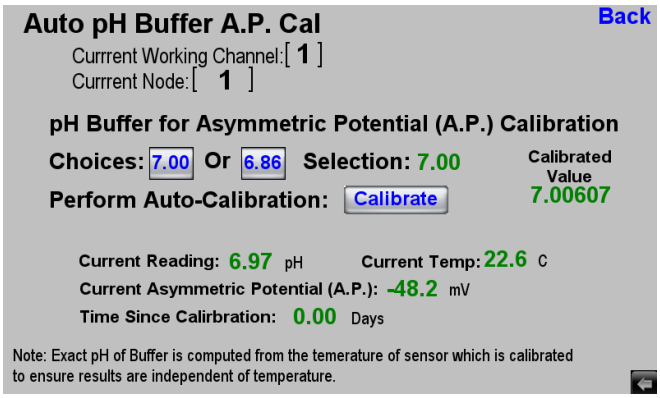
It is recommended to place the channel to be calibrated on output hold before proceeding with the calibration.



"Auto pH Buffer A.P. Cal"

The current pH and temperature are shown for selected channel in this screen along with the existing currently used asymmetric potential offset calibration as well as the time since this calibration was last performed.

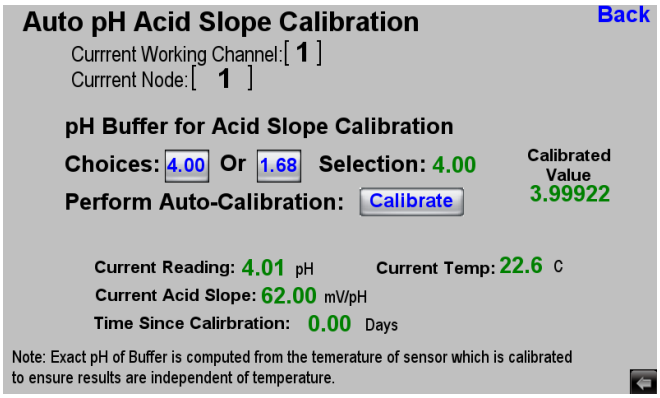
Choices of pH buffer for auto A.P. calibration are 7.00 or 6.86. After selecting buffer click on "Calibrate" button. If calibration is successful then "Calibration Complete" is shown. After dampener time expires the new calibration result will be shown and the time since calibration will show as 0.00 days. The exact value of pH buffer at cal temp shown as "Calibrated Value".



"Auto pH Acid Slope Calibration"

The current pH reading and temperature are shown for the selected channel in this screen along with the existing currently used acid slope calibration as well as the time since this calibration was last performed.

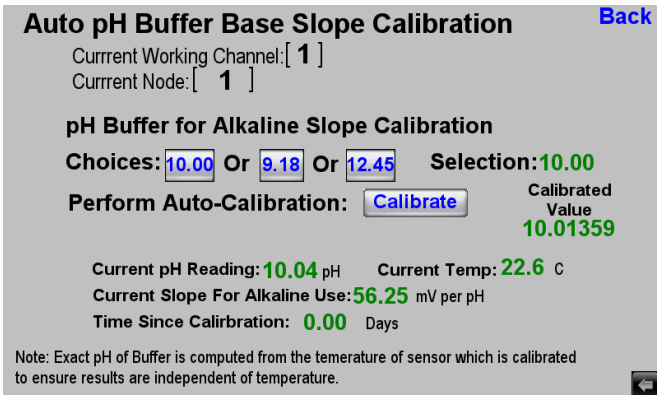
Choices of pH buffer for auto acid slope cal are 4.00 or 1.68. After selecting buffer click on "Calibrate" button. If calibration is successful then "Calibration Complete" is shown. After dampener time expires the new calibration result will be shown and the time since calibration will show as 0.00 days. The exact value of pH buffer at cal temp shown as "Calibrated Value".



"Auto pH Base Slope Calibration" Menu

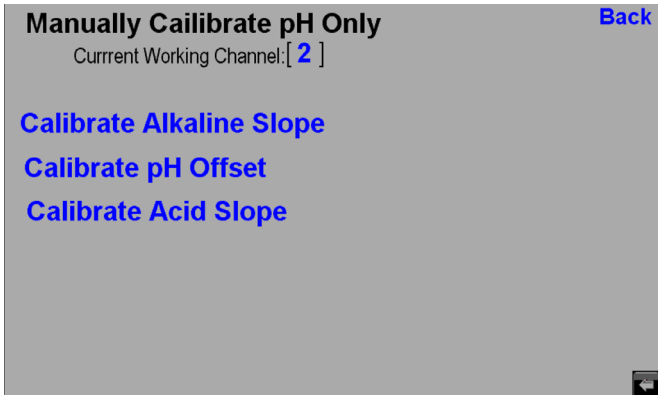
The current pH reading and temperature are shown for the selected channel in this screen along with the existing currently used alkaline slope calibration as well as the time since this calibration was last performed.

Choices of pH buffer for auto base slope cal are 10.00 or 9.18 or 12.45. After selecting buffer click on "Calibrate" button. If calibration is successful then "Calibration Complete" is shown. After dampener time expires the new calibration result will be shown and the time since calibration will show as 0.00 days. The exact value of pH buffer at cal temp shown as "Calibrated Value".

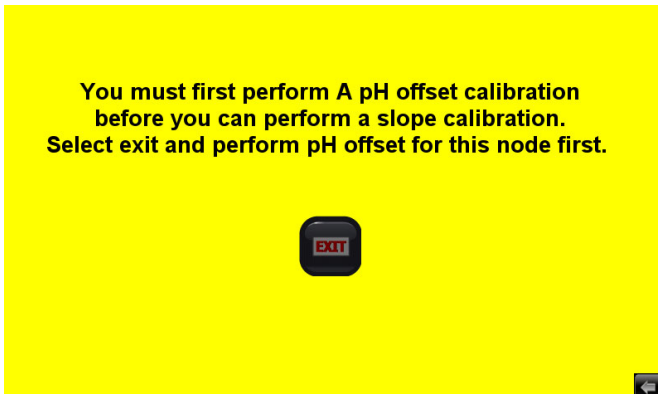


"Manual Calibrate" Menu

The available choices for manual calibration of a pH sensor are shown to the right.

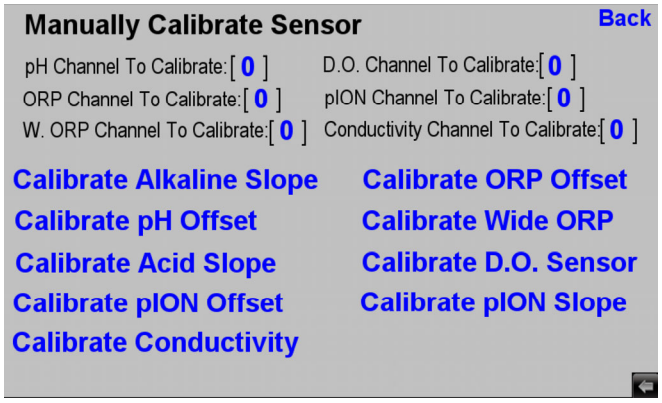


The slope calibration is only available when the sensor type is pH. In addition the pH offset calibration must always be performed before the slope calibrations can be performed.



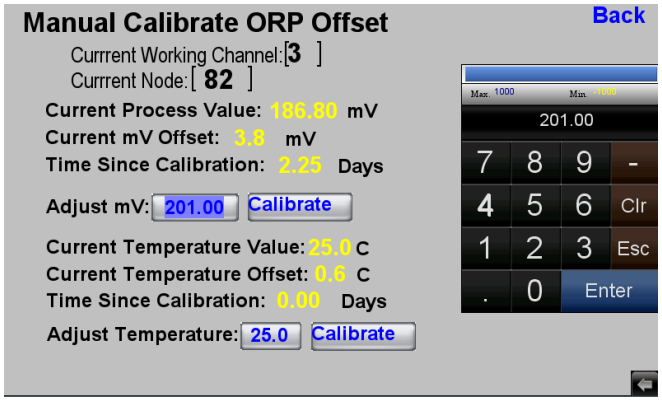
"Manual Calibrate ORP Offset"

The manual calibration menu options are shown to the right. The ORP offset can be performed with a ORP standard or else used to allow for agreement between the inline process reading and an offline grab sample determination.

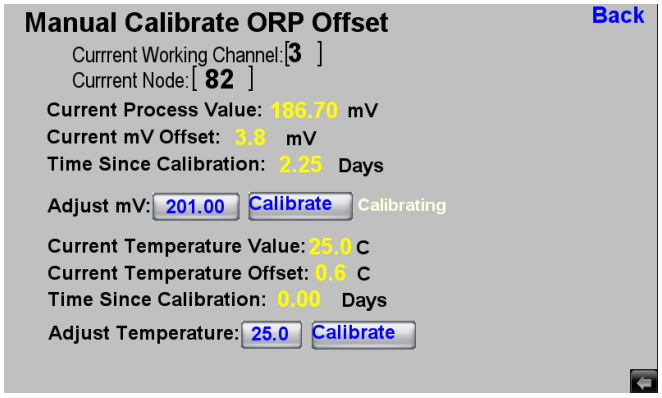


The current ORP reading and temperature are shown for the selected channel in this screen along with the existing current used offset calibration as well as the time since this calibration was last performed.

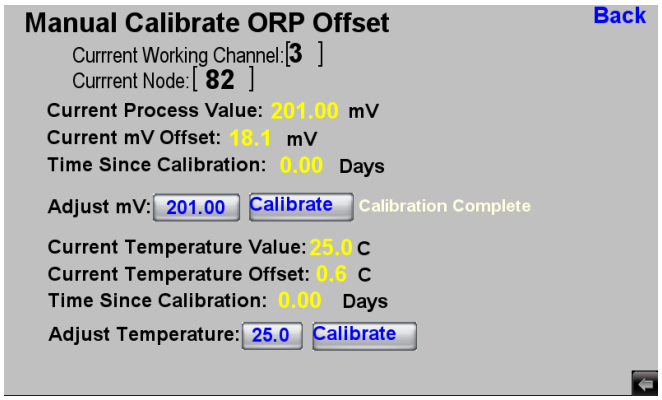
Enter the value to which you wish to adjust the reading of the ORP sensor. In the case that a ORP standard is used the exact value at the current temperature should be entered. Note that ORP measurements are not temperature compensated but are in fact highly temperature dependent. When calibrating this must be taken into take.



After pressing the "Calibrate" button the screen will display "Calibrating". If the calibration is successful it will show "Calibrationg Complete". The calibration might not be successful if the calibration limits are exceeded or else is a communication error occurs.

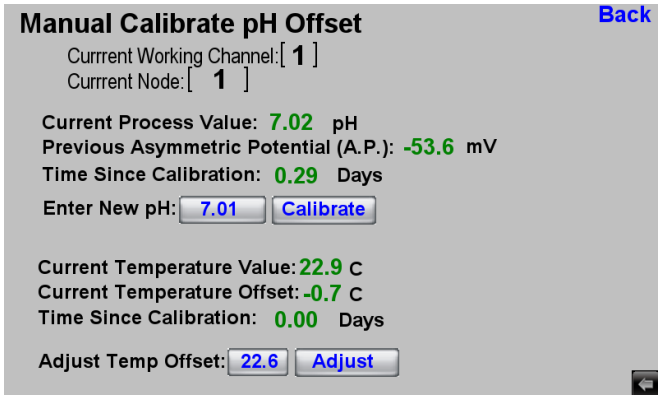


Finally after the dampener time is expired the new calibration results will be shown and the time since calibration will show as 0.00 days. The basic sequence of events after pressing the calibrate button also occurs for the temperature offset calibration as well.



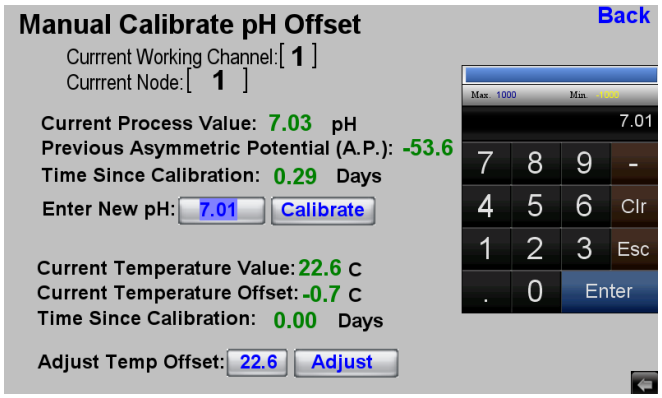
"Manual Calibrate pH Offset"

The manual calibration pH offset can be performed with a pH buffer or else used to allow for agreement between the inline process reading and an offline grab sample determination. **Such adjustments to a grab sample value should always be done in the 'Offset' mode after all pH buffer calibrations are performed.**



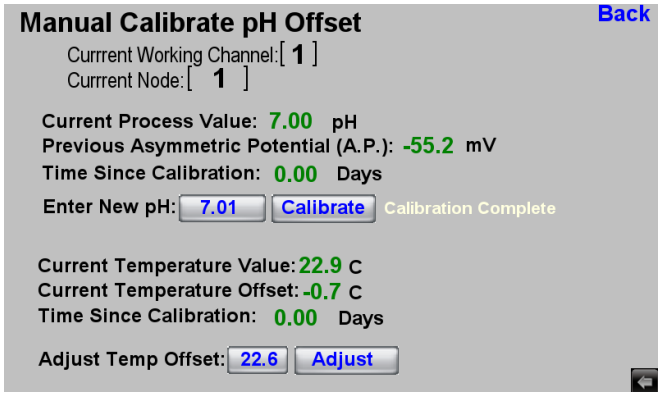
The current pH reading and temperature are shown for the selected channel in this screen along with the existing current used asymmetric potential offset calibration as well as the time since this calibration was last performed.

Enter the value to which you wish to adjust the reading of the pH sensor. In the case that a pH buffer is used the exact value at the current temperature should be entered (see appenix "A" and "B" for further details).

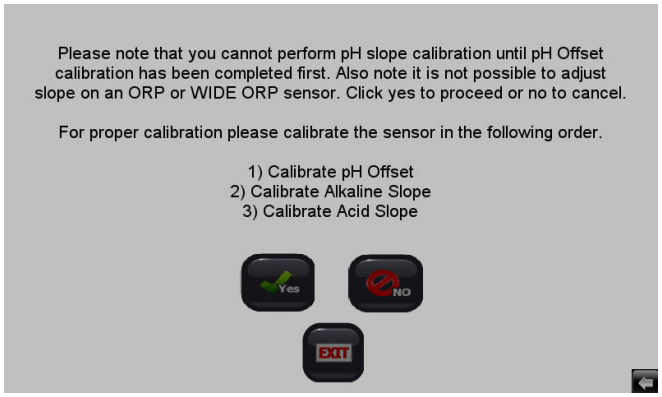


After pressing the "Calibrate" button the screen will display "Calibrating". If the calibration is successful it will show "Calibrationg Complete". The calibration might not be successful if the calibration limits are exceeded or else is a communication error occurs.

Finally after the dampener time is expired the new calibration results will be shown and the time since calibration will show as 0.00 days. The basic sequence of events after pressing the calibrate button also occurs for the autobuffer calibrations screens as well as the manual calibration screens.



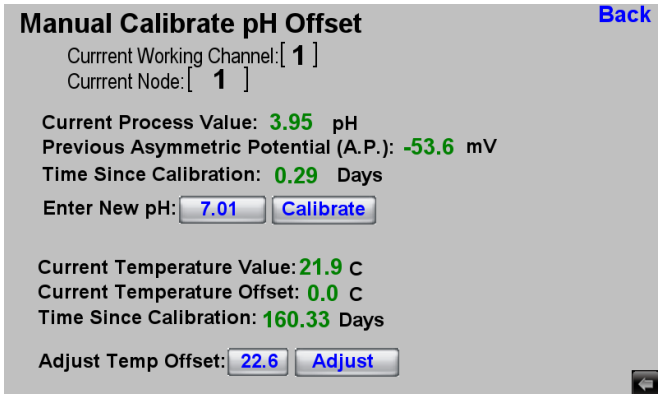
It is important to recall that the acid slope and base slope calibrations for pH sensors should always be done after performing the offset calibration first. For any type of calibrations to force agreement between the inline process reading and an offline determined value this should ALWAYS be done in the manual offset calibration mode and never in the manual slope calibration mode. Contact factory for assistance if the best practice calibration procedures are in doubt.



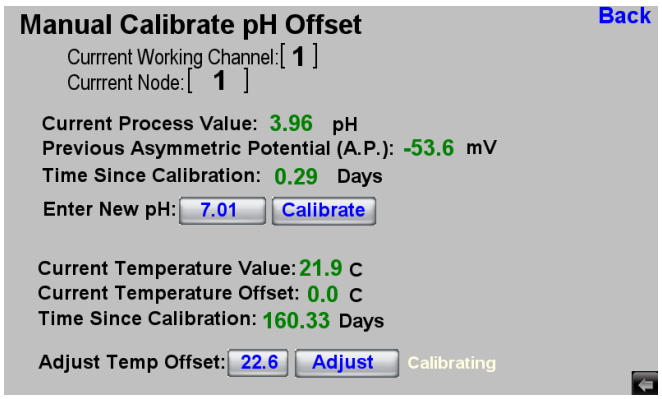
"Manual Calibrate Temp Offset"

The current pH reading and temperature are shown for the selected channel in this screen along with the existing current used temperature offset calibration as well as the time since this calibration was last performed.

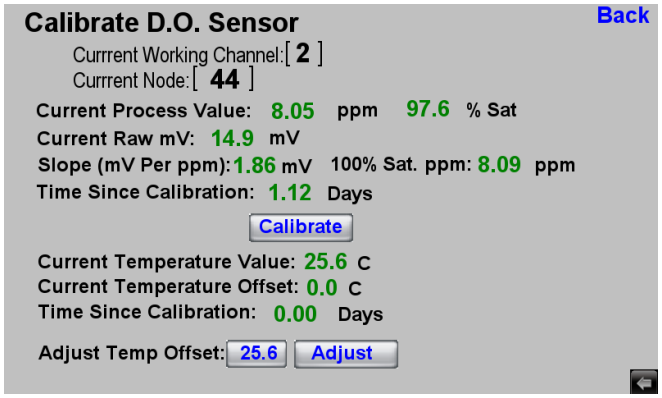
Enter the temperature value to which you wish to adjust the reading of the pH sensor. It is always best practice to calibrate the temperature BEFORE performing any process calibrations.



After pressing the "Calibrate" button the screen will display "Calibrating". If the calibration is successful it will show "Calibrationg Complete". The calibration might not be successful if the calibration limits are exceeded or else is a communication error occurs.

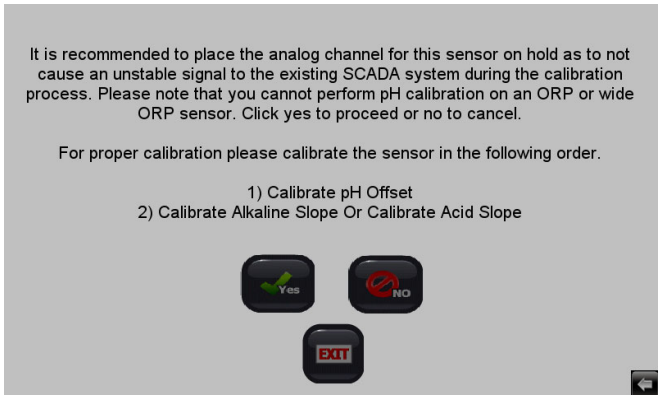


Finally after the dampener time is expired the new temperature calibration results will be shown and the time since calibration will show as 0.00 days. In the screenshot shown to the right the temperature calibration is shown being perform on a dissolved oxygen (D.O.) type sensor. The temperature calibration screen for the ORP sensor types will look largely similar to the pH offset screen in the screenshot above.



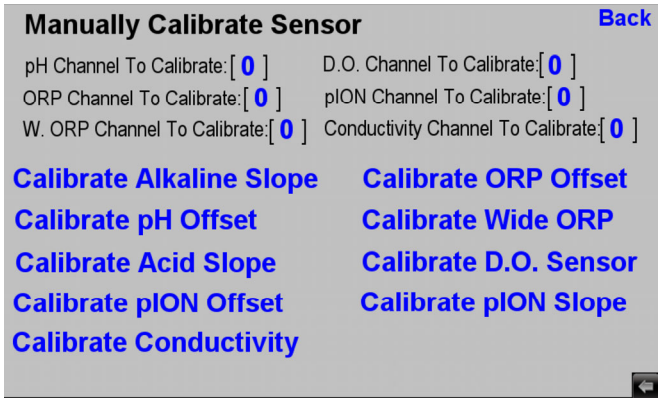
"Manual Calibrate pH Slope" Menu

Before proceeding to the manual pH slope calibration it is necessary to have previously performed the pH Asymmetric Potential (A.P.) offset calibration first.



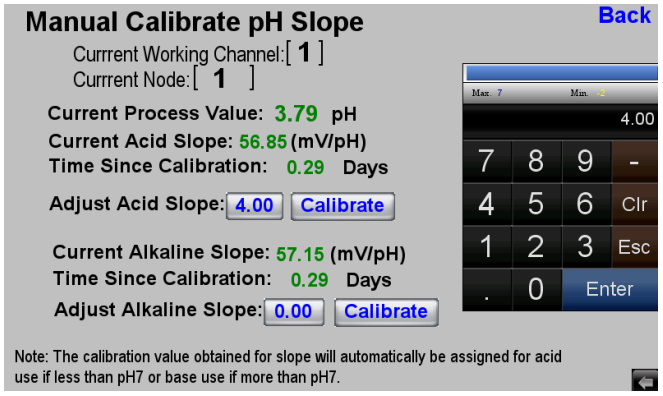
"Manual Calibrate pH Slope" Menu - ACID

Select the desired channel where you wish to perform the slope calibration.

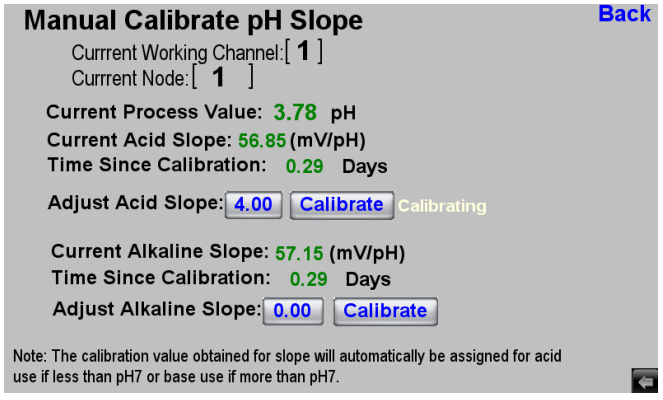


The current pH reading and temperature are shown for the selected channel in this screen along with the existing current used asymmetric potential offset calibration as well as the time since this calibration was last performed.

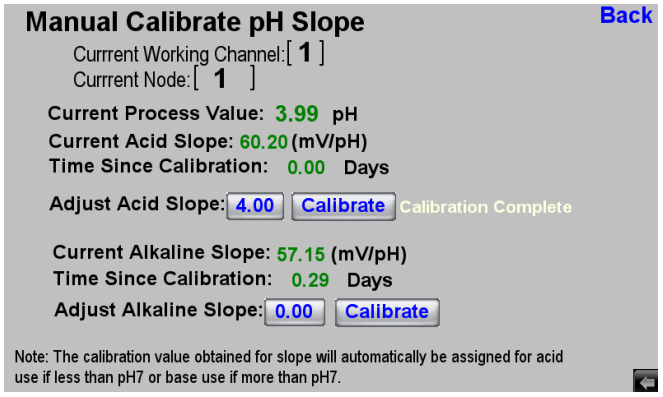
Enter the value to which you wish to adjust the reading of the pH sensor to perform the acid slope calibration. In the case that a pH buffer is used the exact value at the current temperature should be entered (see appenix "A" and "B" for further details).



After pressing the "Calibrate" button the screen will display "Calibrating". If the calibration is successful it will show "Calibrationg Complete". The calibration might not be successful if the calibration limits are exceeded or else is a communication error occurs.

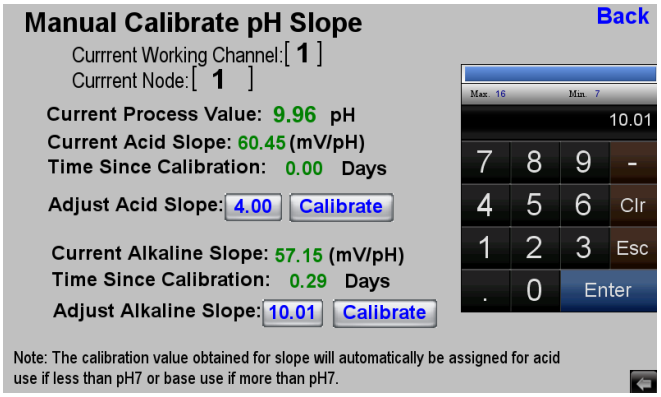


Finally after the dampener time is expired the new calibration results will be shown and the time since calibration will show as 0.00 days. The basic sequence of events after pressing the calibrate button also occurs for the autobuffer calibrations screens as well as the manual calibration screens.

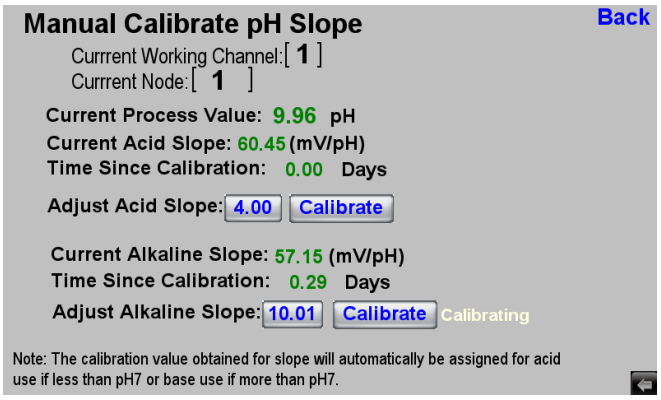


"Manual Calibrate pH Slope" Menu - BASE

The current pH reading and temperature are shown for the selected channel in this screen along with the existing current used asymmetric potential offset calibration as well as the time since this calibration was last performed.

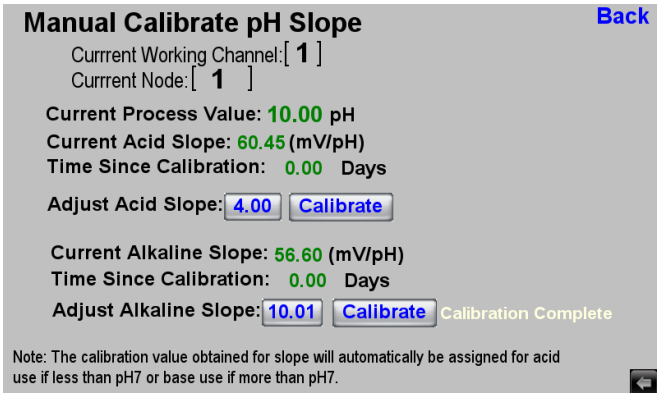


Enter the value to which you wish to adjust the reading of the pH sensor to perform the acid slope calibration. In the case that a pH buffer is used the exact value at the current temperature should be entered (see appenix "A" and "B" for further details).

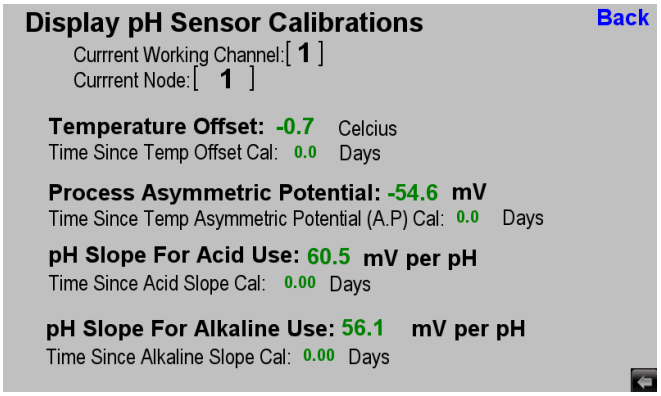


After pressing the "Calibrate" button the screen will display "Calibrating". If the calibration is successful it will show "Calibrationg Complete". The calibration might not be successful if the calibration limits are exceeded or else is a communication error occurs.

Finally after the dampener time is expired the new calibration results will be shown and the time since calibration will show as 0.00 days. The basic sequence of events after pressing the calibrate button also occurs for the autobuffer calibrations screens as well as the manual calibration screens.



It is best practice to view the result of your calibrations to ensure that everything is shown as expected. An example is shown to the right for bringing up the sensor calibration display screen for the channel which was just calibrated in the screenshots showing the various manual offset and slope modes.



"Manual Calibrate ISE Offset & Slope"

The manual calibration of the ion selective (ISE) offset can be performed to allow for agreement between the inline process reading and an offline grab sample determination. **Such adjustments to a grab sample value should always be done in the 'Offset' mode.**

The ppm reading and temperature shown for selected channel in this screen along with the existing current used asymmetric potential offset calibration as well as the time since this calibration was last performed.

Enter value to adjust the reading of the ISE sensor.

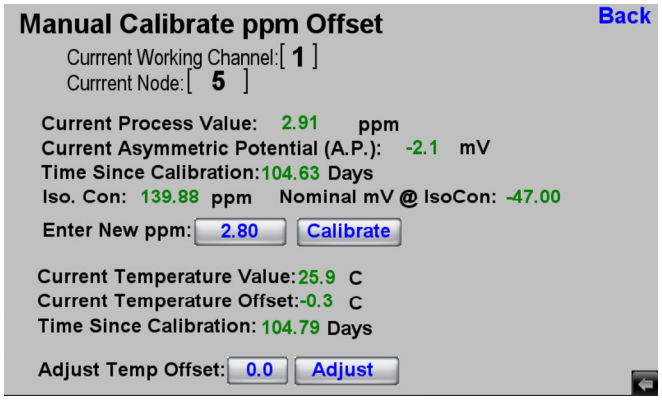
Press the "Calibrate" button. If calibration is successful it will show "Calibration Complete". After dampener time expires the new calibration result will then show and time since calibration will then show as 0.00 days.

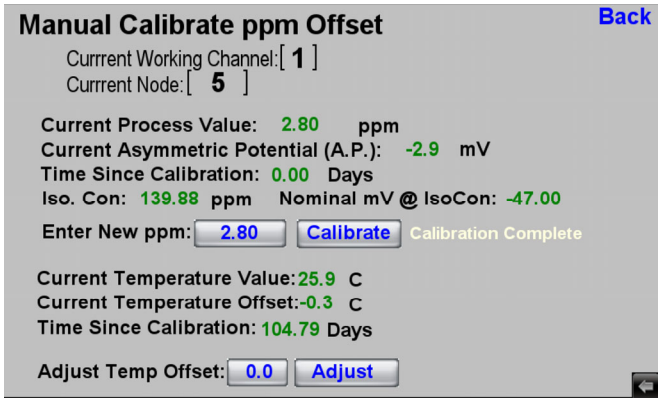
There must exist a timely method to perform a grab sample analysis of process media at installation. A grab sample must be taken and analyzed from the location near where sensor is installed, most typically done using a portable photometer for most ions. Contact the ASTI factory if suitable equipment is not available at the site.

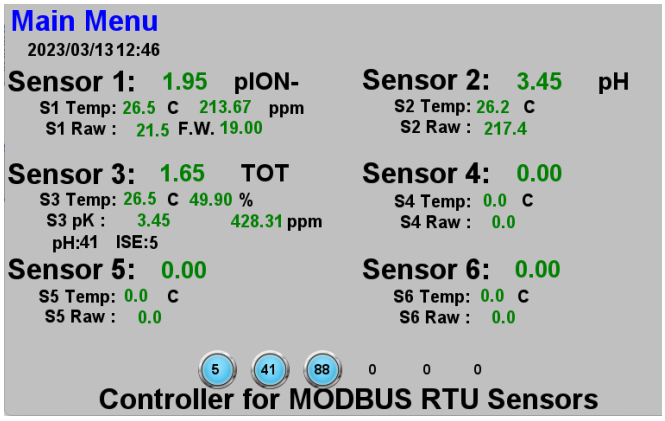
If using the 3TX-TOT-DT module with pH compensation feature you MUST account for percent (%) of ionization aspect before entering the reference calibration value to which the sensor will be adjusted. In example to right extent of ionization is 49.9%. Any offline grab sample analysis method includes implicit pH compensation. You need to multiply your offline determined reference value by the extent of ionization to get the correct reference value. For example if you got 500ppm for the offline determined value, then multiplying by 49.9% this yield the free ISE value as 249.50ppm. This would be the value that you enter in the ISE offset calibration screen.

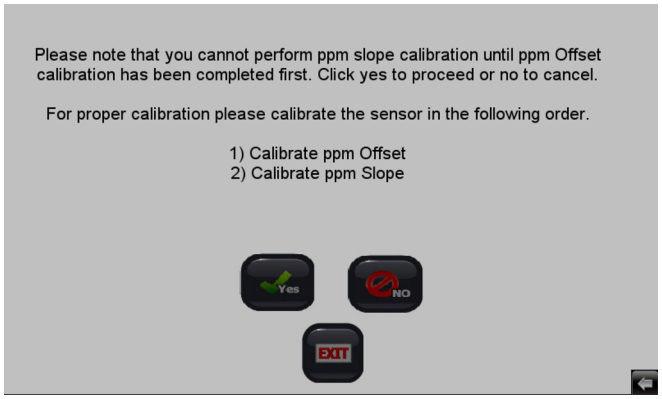
!!! Before proceeding to the manual ion selective (ISE) slope calibration it is necessary to have previously performed the ISE offset calibration first !!!

Use of standard solutions for slope calibrations is only recommended for advanced users that are very, very familiar with all aspects of ion selective sensors, ionic strength adjusters as well as the use of standard addition techniques necessary to successfully performed such calibrations. Contact factory for assistance if you plan to perform slope calibration with standard solutions for assistance BEFORE proceeding.









"Manual Calibrate Conductivity Slope"

The manual calibration of the conductivity sensor slope can be performed to either allow for agreement between the inline process reading and an offline grab sample determination or else to calibrate to a known conductivity standard solutions. **Such adjustments to a grab sample value should always be done in the 'Slope' mode.**

Usual procedure is required to select the conductivity sensor channel that you wish to calibrate before selecting "Calibrate Conductivity" choice from the menu.

Enter the value to which you wish to adjust the reading of the conductivity sensor. The supported calibration slope limits are 0.3000 to 1.700 from the raw conductivity reading of the sensor. The min and max supported values to be entered for the slope calibration are shown for reference purposes to ensure that the entered value does not exceed the permissible limits. **Calibrations are ONLY performed in conductivity units even if computed units are selected as the basis of the analog outputs and relays.**

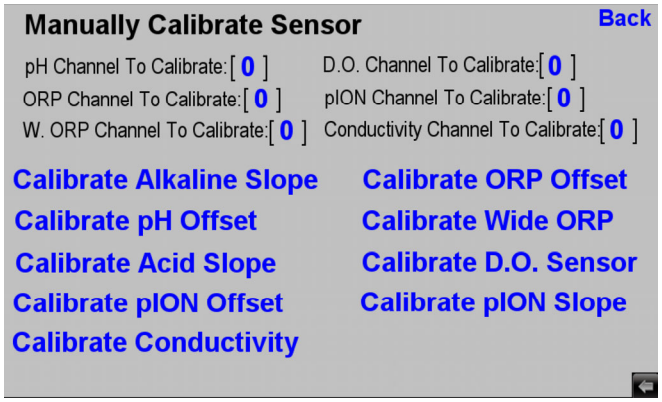
After pressing the "Calibrate" button the screen will display "Calibrating". If the calibration is successful it will show "Calibration Complete". The calibration might not be successful if the calibration limits are exceeded or else is a communication error occurs.

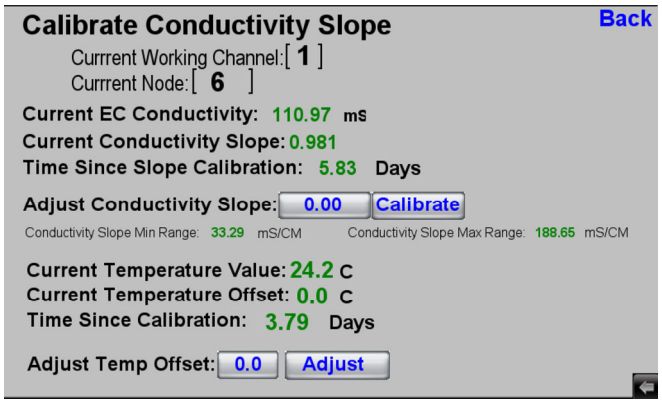
Finally after the dampener time is expired the new calibration results will be shown and the time since calibration will show as 0.00 days.

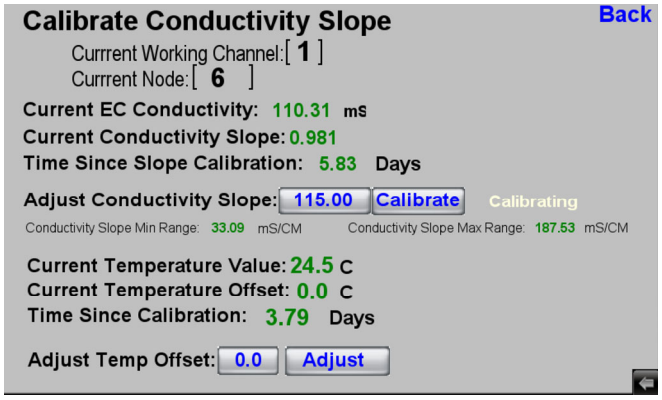
If the slope calibration is to be used to adjust the inline process reading to an offline determined value of a grab sample from the installed location analysis is typically done with field portable 4-electrode conductivity meter to minimize the time between taking the grab sample and entering the offline determined reference value for the slope calibration as short as possible.

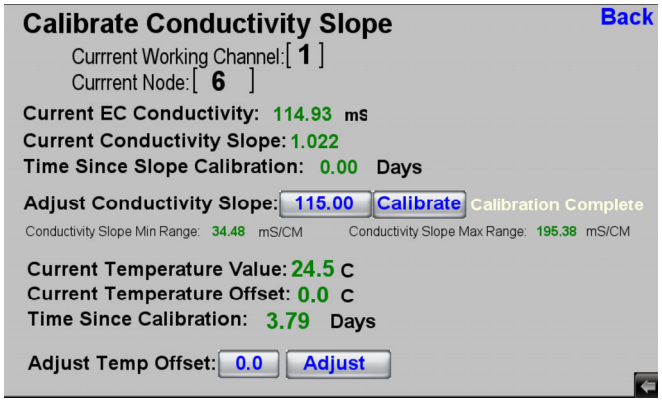
If the conductivity sensor is to be calibrated to a standard solution the channel should be placed on output hold prior to removing the sensor from the process service to avoid any issues with the connected devices using the analog outputs, contact relays or MODBUS TCP outputs.

Please see Appendix "G" for additional information about conductivity sensors before commissioning.



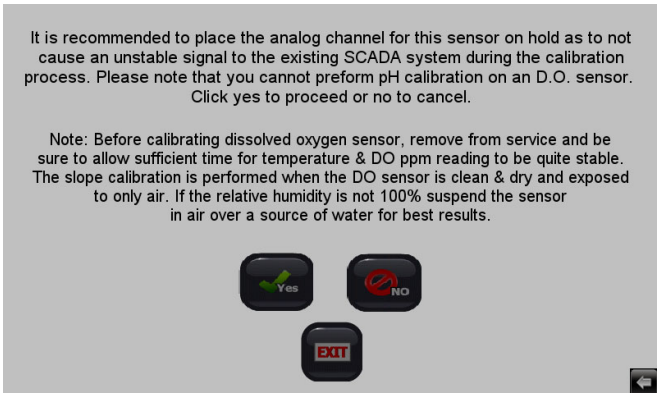






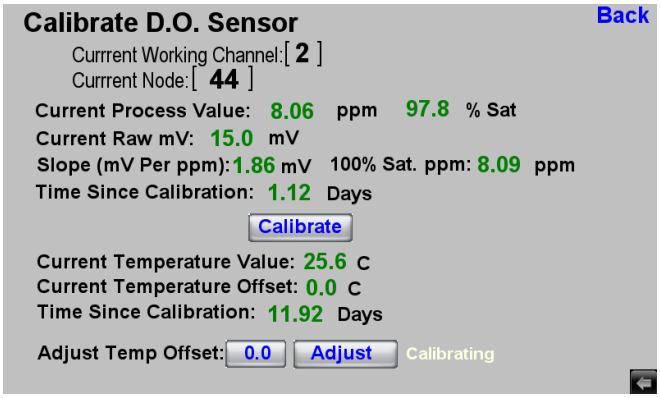
"Auto Calibrate D.O. Sensor" Menu - Temperature

You need to select the channel for which you wish to perform the fully automated dissolved oxygen sensor calibration. If you are not sure prefer to the main screen as it will display on what channel D.O. sensor(s) have been configured.

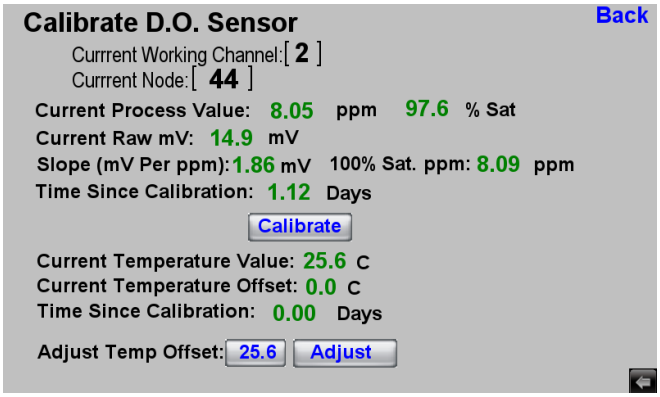


The usual caveats apply before performing calibration on you dissolved oxygen (D.O.) sensor. The channel that will be calibrated should be placed on hold prior to performing the calibration especially if the values obtained from the sensor are used for any type of real-time closed loop control purposes.

The D.O. sensor should be at thermal equilibrium before proceeding and be clean and dry, suspended over a source of water in cases of low humidity at the location where the sensor is to be calibrated.



The TEMPERATURE should always be CALIBRATED FIRST on the dissolved oxygen sensor. The reason is that the temperature is used as the main basis of obtaining the dissolved oxygen ppm value for the current dry in air condition used as the basis of the automated calibration routine. If the temperature is not stable before proceeding and not well calibrated you can obtain suboptimal results when calibrating the D.O. sensor in the field.



Finally after the dampener time is expired the new temperature calibration results will be shown and the time since calibration will show as 0.00 days. Following the instructions on the following page to proceed onto the calibration of the dissolved oxygen ppm reading for the process value next.

"Auto Calibrate D.O. Sensor" Menu – Dissolved Oxygen PPM readings

The current dissolved oxygen ppm readings, computed percent saturation values and temperature readings are shown for selected channel in this screen along with the existing currently slope calibration value as well as the time since this calibration was last performed.

The smart digital HiQDT MODBSU RTU dissolved oxygen sensors automatically compute the current dissolved oxygen ppm value for the current dry in air conditions using the temperature and ambient air pressure as the basis.

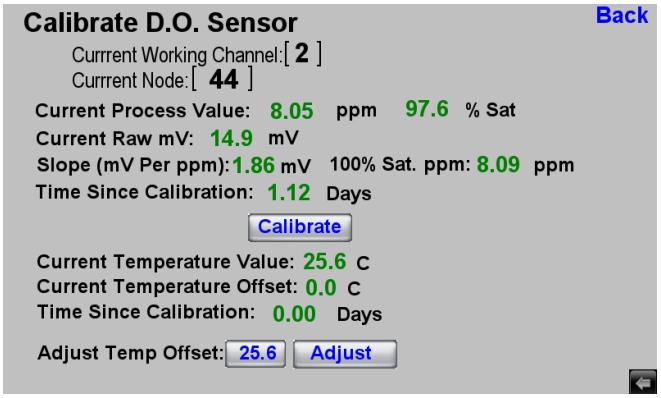
Click on the "Calibrate" button to start the fully automated calibration procedure. If calibration is successful then "Calibration Complete" is shown. After dampener time expires the new calibration result will be shown and the time since calibration will show as 0.00 days. The exact value of pH buffer at cal temp shown as "Calibrated Value".

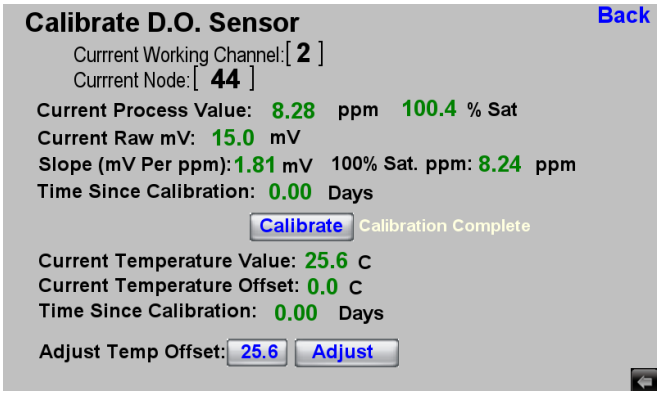
NOTE 1: The percent saturation value shown on this calibration screen (register 30006 from the HiQDT D.O. sensor) may differ from the percent saturation value that is shown on the main display. The percent (%) saturation value that is computed and shown in the calibration screen excludes the salinity correction since this is not appropriate during the dry in air calibration process of the sensor. The percent (%) saturation that is computed and displayed in the main screen (as well as the basis for all analog & digital outputs and relays) including the salinity correction. The ambient air pressure that is user entered is always used when computing the precent (%) saturation value in all modes.

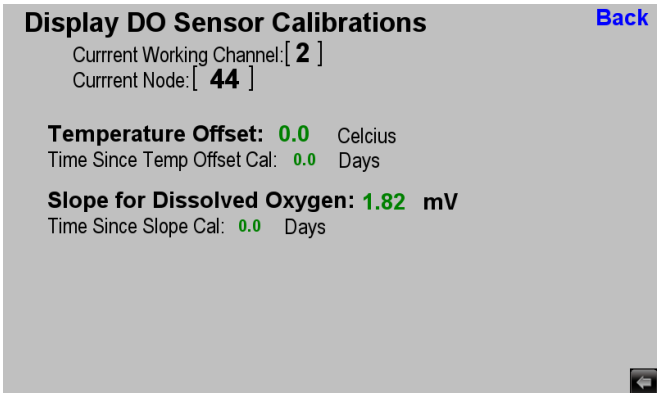
NOTE 2: Review "Appendix E & F" for details about how percent (%) saturation is computed from measured dissolved oxygen ppm and temperature values as well as the user entered air pressure and salinity.

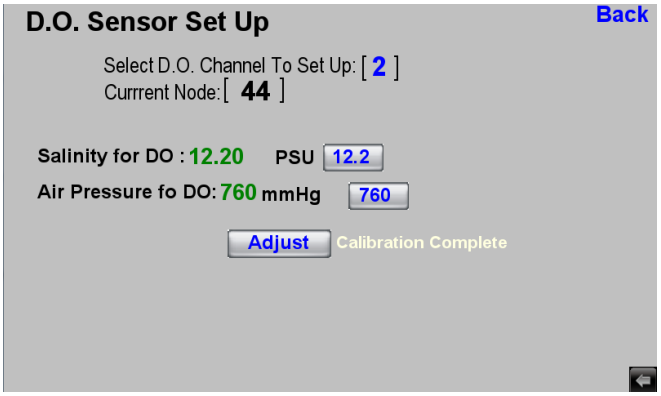
It is best practice to view the result of your calibrations to ensure that everything is shown as expected. An example is shown to the right for bringing up the sensor calibration display screen for the channel which was just calibrated in the screenshots showing the calibration of the dissolved oxygen sensor.

The "D.O. sensor Set Up" allows for user entered values for the salinity of the measured solution and the ambient air pressure where at the installation site.



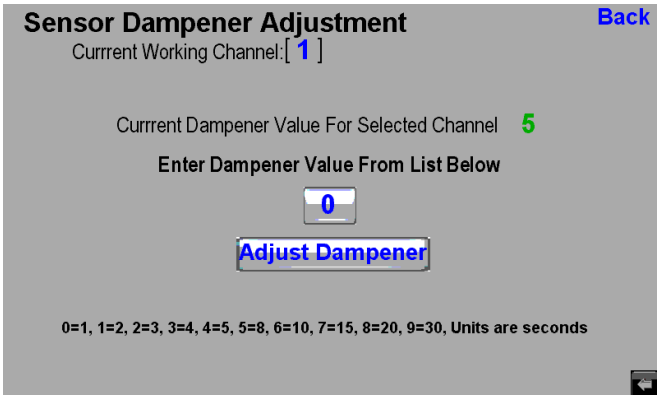






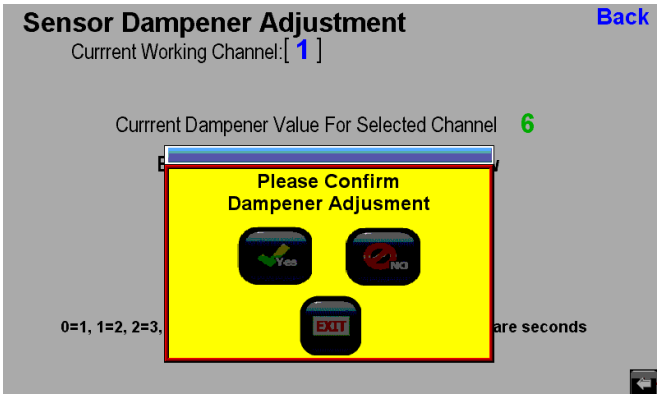
"Adjust Sensor Dampener" Menu

The available choices for sensor dampener of of the sensor are shown to the right.



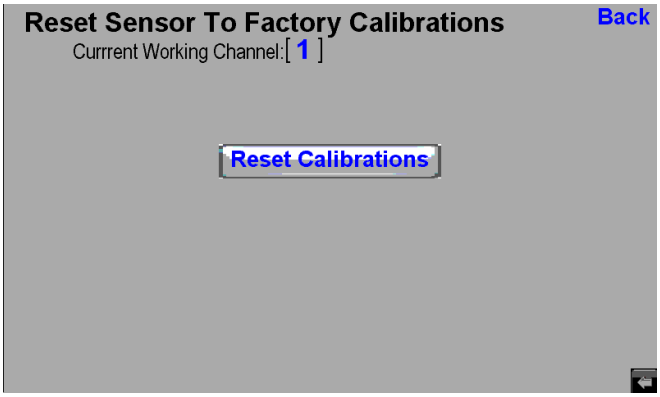
It can be desirable to reduce the dampening time before performing calibration to expedite the calibration process.

BE SURE TO RETURN THE DAMPENER BACK TO THE APPROPRIATE HIGHER VALUES FOR USE IN CONTINUOUS FIELD USE IF YOU RETURN THE DAMPENER FOR FASTER CALIBRATIONS.



"Reset All Calibrations" Menu

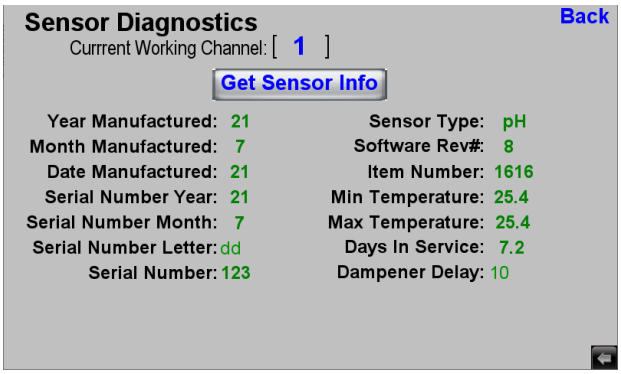
This will reset ALL available calibrations back to the values at time of dispatch from the factory.

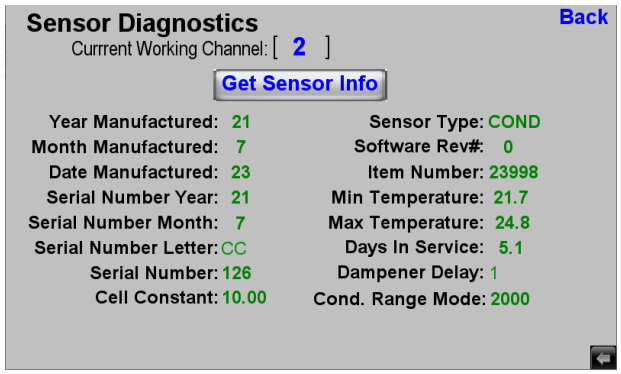


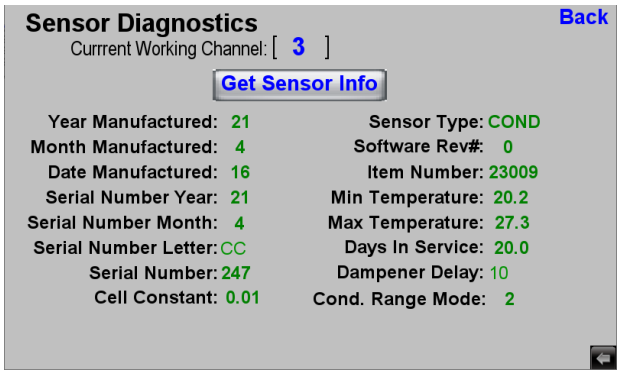
Once the reset all calibrations call has been performed it cannot be undone. With this in mind please be sure that you wish to reset the calibrations before proceeding.

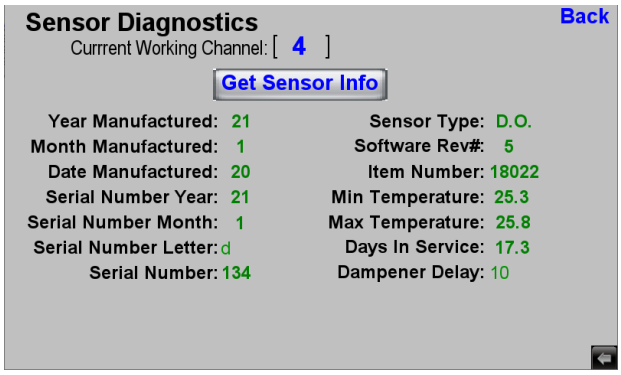
You may be asked to reset the calibrations on your sensor as part of a troubleshooting in case you have unusual calibration results.

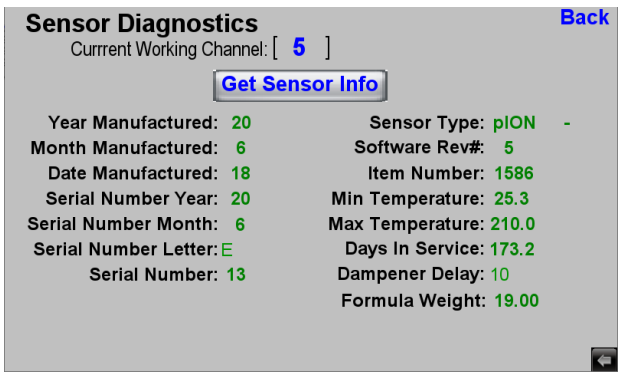
"Sensor Diagnostics" Menu

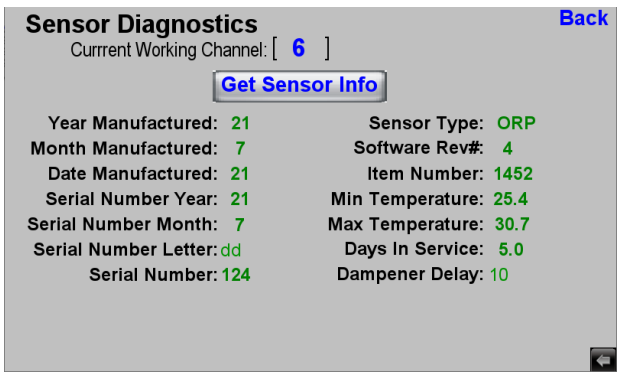












Date Stamps:

- Year Manufacture — Range fom 18 for 2018 up to 99 for 2099
- Month Manufactured — Range from 1 for January to 12 for December
- Date Manufactured — Release date for sensor in year and month of manufacture

Sensor Statistics:

- Sensor Serial Number: — Complete traceability of given sensor – Broken up into three separate fields:
  - Serial Number Month — Range from 1 for January to 12 for December
  - Serial Number Letter — Range from "A to Y" for single letter Alpha and "AA to to nY" dual letter Alpha
  - Serial Number — Range from 00 to 99 for given alpha character block
- Type: — pH, ORP, DO, ISE or EC (COND) depending upon connected sensor
- Software Revision: — Firmware on sensor board (contact factory to ensure most current version)
- Item Number: — Completely defines all features and capabilities of given sensor

Temperature Peak Values:

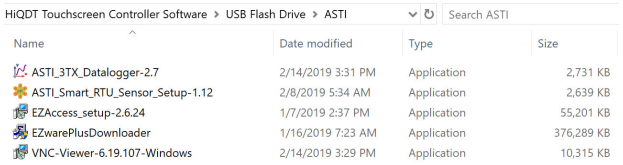
- Min Temperature: — Lowest temp (°C) experienced by sensor after manufacture date when energized
- Max Temperature: — Highest temp (°C) experienced by sensor after manufacture date when energized

Field Use Time & Dampener Setting:

- Integral Time Tracking: — The total days the HiQDT sensor has been energized after manufacture date
- Dampener: — Number of seconds used to smooth the process value reading from sensor

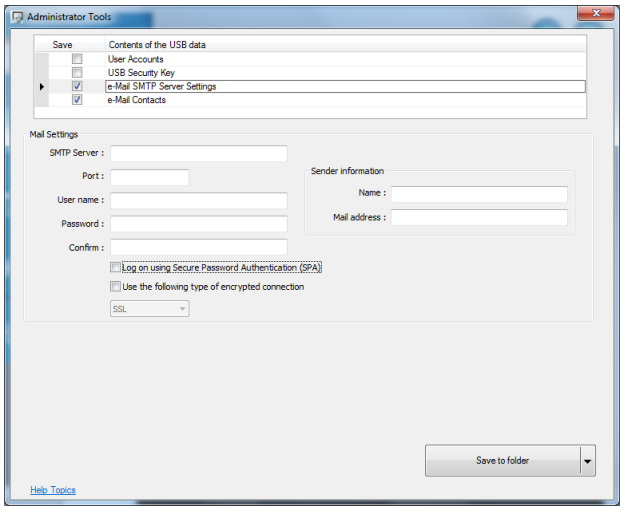
"Email Notifications" Setup

An email notificaiton will be sent for all users that have been properly setup whenever any relay event is triggered. The SMTP configuration file must be prepared from the Administrator Tools in the EZware Plus Downloaded software. This software is provided on the 32GB USB flash drive connected to the HMI5070 touchscreen of the controller. To the right is shown the typical software utilities that are provided at time of dispatch from the factory. It is recommended to copy them to a safe location to backup and archival purposes. Install the EZware Plus Downloader software.



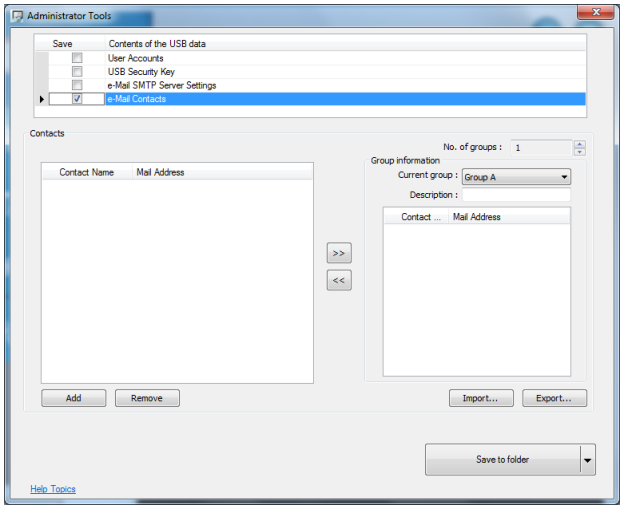
Navigate to the Maintenance tab in this software and click on the Administrator Tools

Complete the setup of the eMail SMTP server settings



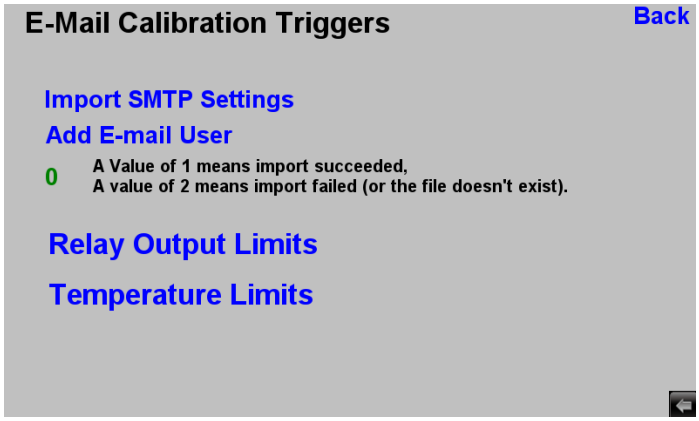
Complete the eMail Contacts.

Choose the "Save to USB" option in the bottom right of the Administrator Tools. Please be sure to have the USB flash drive that was provided with the HiQDT touchscreen controller into the Windows PC where this software is being used. You will need to connect this USB flash drive back into the controller before proceeding to the following page to complete setup of the Email notifications.

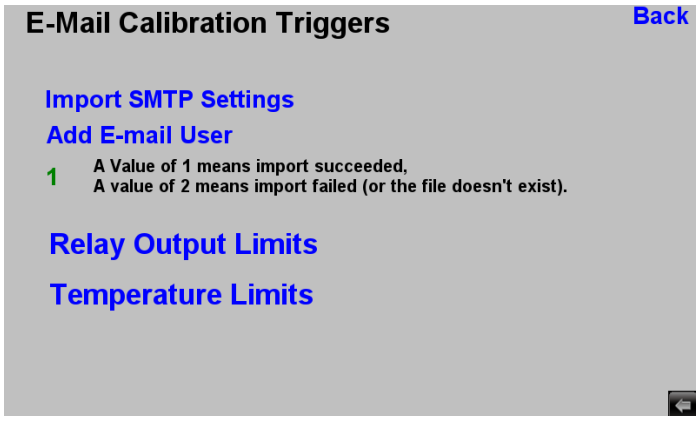


"Email Notifications" Menu

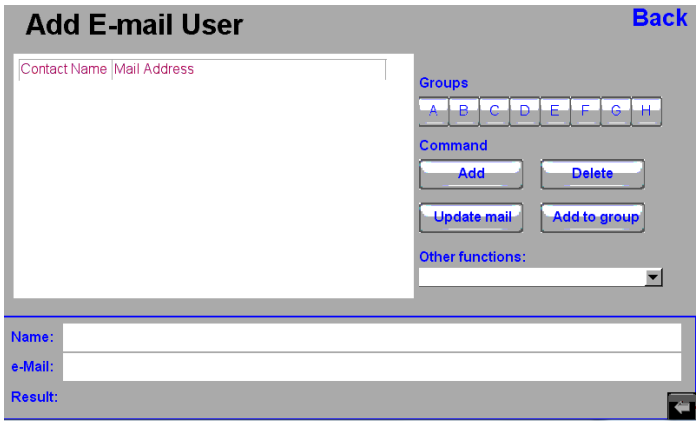
The default view of the Email Calibration Triggers screen is shown to the right. This will have a value of "0" shown for the Import SMTP Settings.



Click on the "Import SMTP Settings" when you have connected the USB flash drive with the email and SMTP setup from the Administrator tools portion of the EZware Plus Downloader software (see previous page for details). If the import is successful you will see a "1" as shown in the screen to the right.



While the setup of the SMTP settings must be done with the Administrator tools portion of the EZware Plus Downloader software and imported from the USB flash drive, it is possible to add and delete users from "Add E-mail User" screen accessible from this "E-mail Calibration Triggers" screen. The interface that is loaded is shown to the right.



"Controller Info" Menu

The system time and date are shown based upon what was loaded at the factory at time of dispatch.

The warranty period for the controller begins from the ship date from factory which is indicated by the serial number that is assigned on the label. You may be asked to give the software revision number and build date as displayed in this "Controller Info" screen for support and diagnostic purposes.

There exists a special version of the software when the total ammonium, total fluoride or total cyanide measurement system configuration is used which is reflected in the package type description at the top of this controller info screen (see screenshots to right).

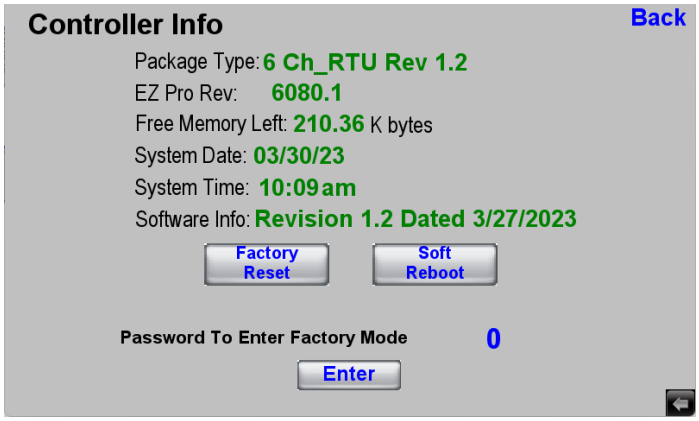
If your local time zone differs use the onscreen tools to adjust the time as appropriate to obtain the correct local time. Similarly the screen brightness can also be adjusted from the administration tools.

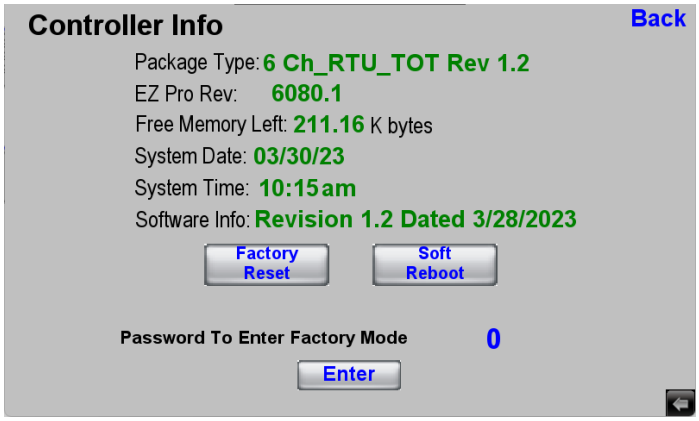
There exists a "Factory Reset" button available from this "Controller Info" screen. You must confirm resetting the controller back to factory default values.

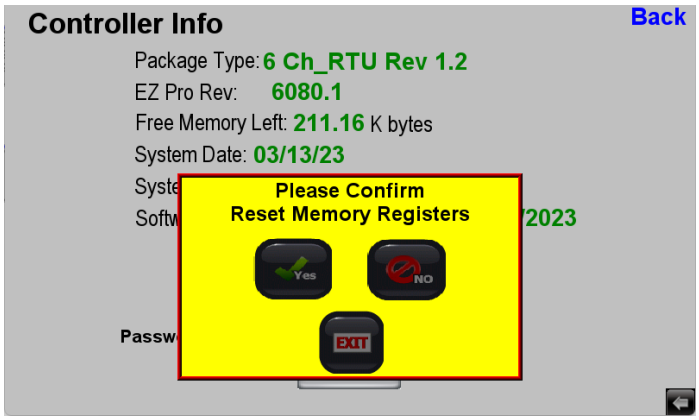
NOTE THAT THE FACTORY RESET FOR ALL MEMORY REGISTERS CANNTO BE UNDONE! PLEASE CONSULT WITH FACTORY BEFORE INVOKING THIS FACTORY RESET.

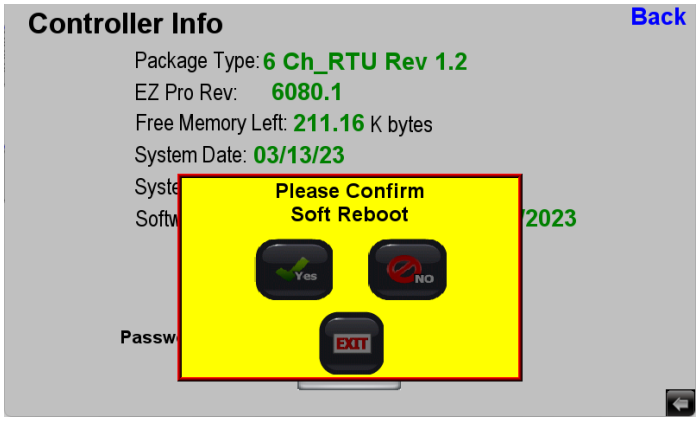
All settings are stored in retentive registers to allow for configuration to be maintained in the event of a power loss or planned shutdown (with the sole exception of the time delay for the alarms which will revert back to zero).

The soft reboot option allows for rebooting of JUST the HMI portion of the touchscreen controller. This might be requested as part of troubleshooting from the ASTI factory in case your system does not operate as expected. Since the connected sensors are polled by the 3TX-RTU-D transmitters even if the HMI is not energized the scaled analog output value and real-time reading are NOT affected by performing a soft reboot of the HMI from this controller info screen.









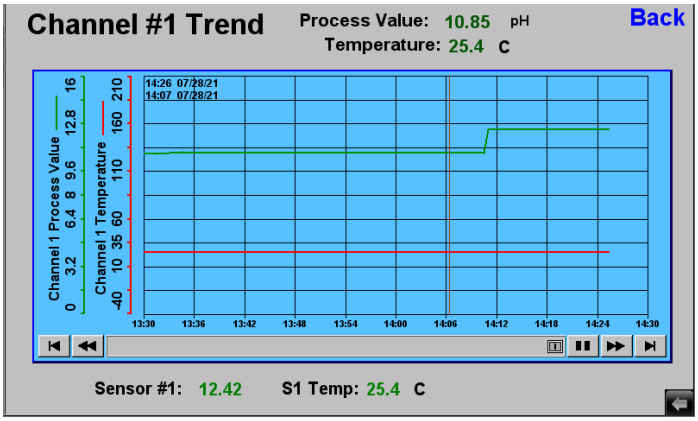
"Trend Display" Menus

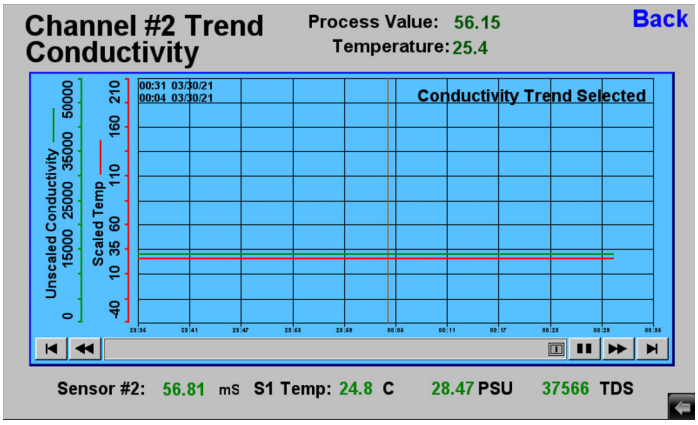
The last 1,000 records that are datalogged are stored in the system RAM and can be visualized in the trend display. Since datalogging occurs every 30 secons for the process values and temperature from each connected sensor this equates to slightly more than the last 8 hours of trending is available for each channel. Of course all is automatically logged in permanent manner onto the integral USB flash drive and can be downloaded remotely via FTP as desired. Selecting the desired channel will load the trend display graph that is appropriate for the sensor type.

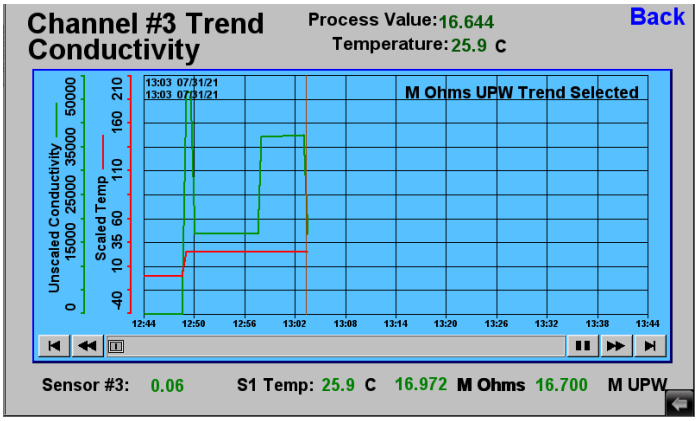
In the six (6) channel touchscreen controller used for these screenshots channel #1 is pH, channel #2 is standard/high range conductivity (EC), channel #3 is ultralow range conductivity (EC), channel #4 is dissolved oxygen (D.O.) and channel #5 is ion selective (ISE) while channel #6 is ORP (not shown). These five representative trend graphs shown below illustrate what typically loads for each sensor type.

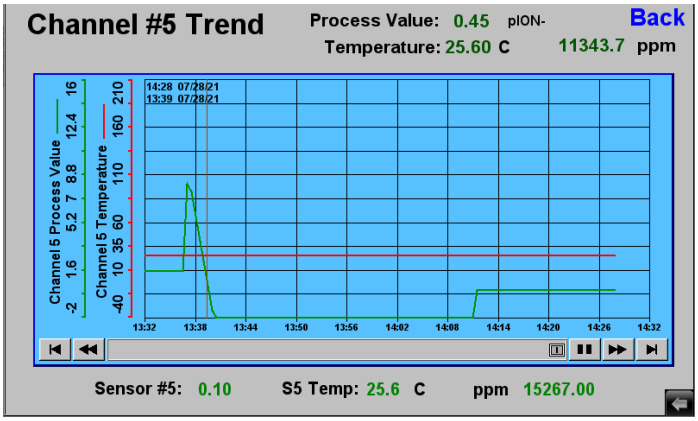
It is possible to rewind and fast forward the graph to anywhere in the last 8 hour period. At any sampling point clicking on the graph will yield the exact process and temperature values at that moment. For the conductivity and dissolved oxygen type sensors the units for the pick a point feature will be in the unit selected at the time that the sensor was added.

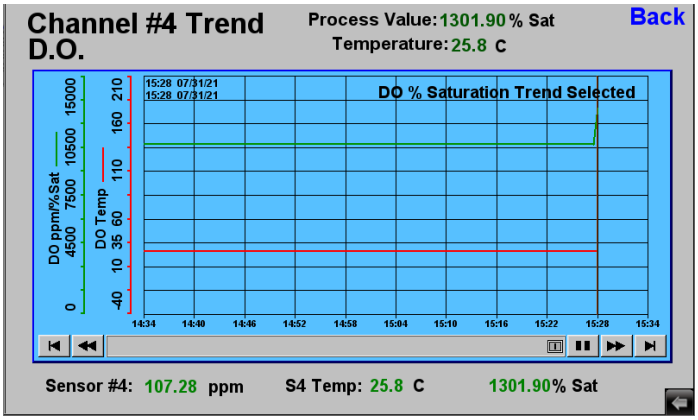
Since values for these real-time on-screen trending graphs are stored in the RAM, they will disappear once the unit is powered down. Also since they are a rolling 8 hour period new values will replace older values once the 1,000 sample limit is reached.



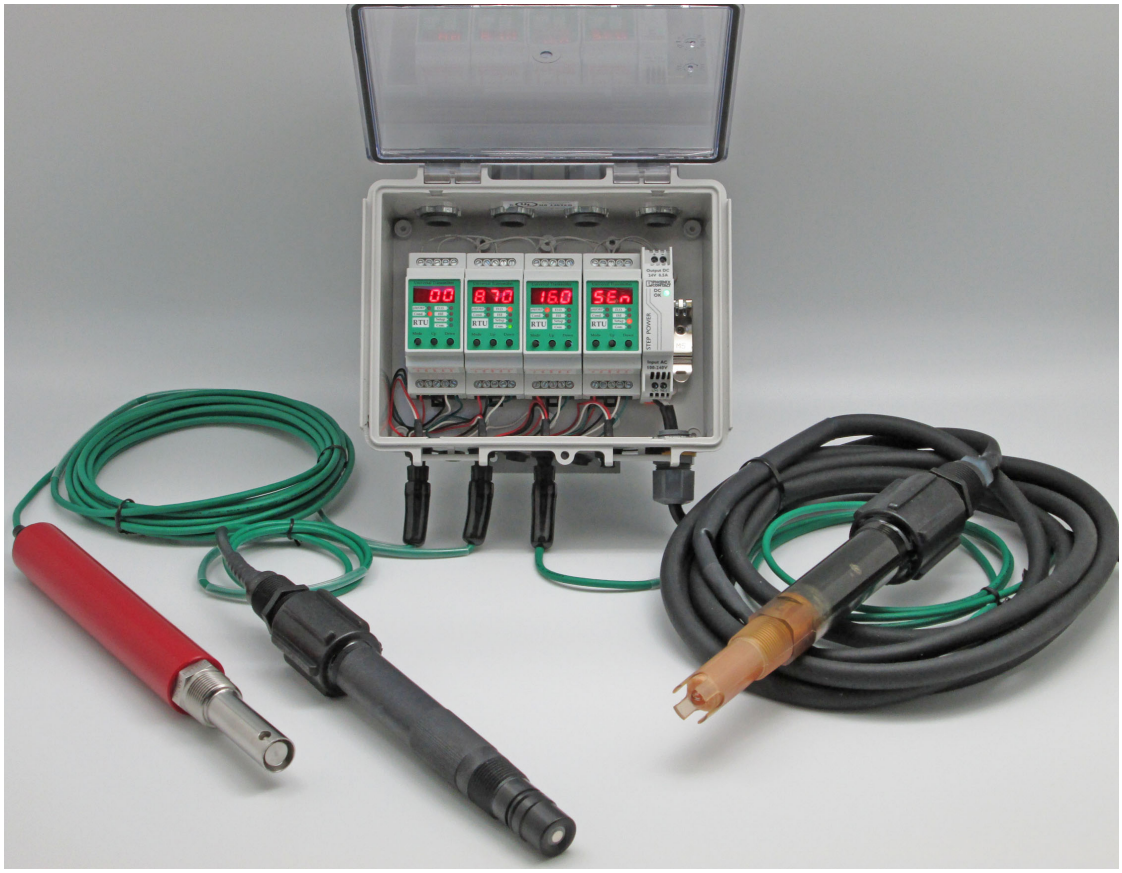








Universal Transmitters for Smart Digital HiQDT Sensors

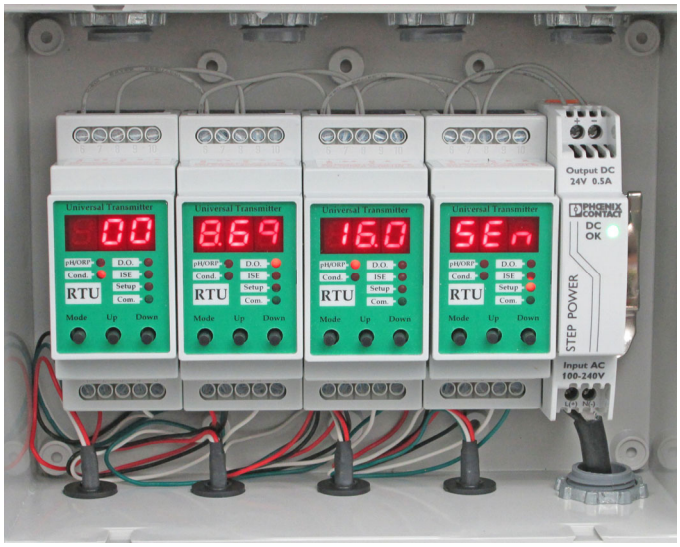


Measurements

- **pH**
- **ORP**
- **Dissolved Oxygen (D.O.)**
- **Ion Selective (ISE)**
- **Conductivity (EC)**

Features

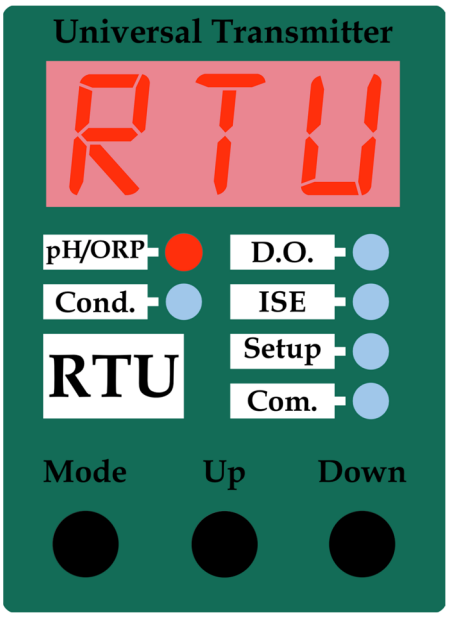
- **Automatic recognition of HiQDT sensors**
- **Isolated, Reversible & Scalable 4-20mA**
- **Security for IIoT Smart Field Installations**
- **Seamless plug & play hot-swap of sensors**
- **Sensor remote capabilities include:**
  - Calibrate & Modify Configuration
  - View all smart analytics such as serial number, time in use & current calibrations
- **Transmitter remote capabilities include:**
  - Scale & Configure 4-20mA output
  - Modify MODBUS master & slave nodes



- *Type of connected sensor is indicated with illuminated LED in main display mode. If node of sensor is not known the automated search node feature will find it. Once the node address is found the sensor type is automatically determined.*
- *Additional parameters beyond main process value can be shown using the 'Up' and 'Down' keys as detailed in this documentation. Output is configured in setup LED mode.*
- ***All major functionality from physical interface can also be achieved remotely via MODBUS RTU calls***

3TX-RTU-D UNIVERSAL SMART 4-20mA TRANSMITTER for HiQDT MODBUS RTU pH, ORP, Dissolved Oxygen (D.O.), Ion Selective (ISE) & Conductivity (EC) Smart Digital Sensors

- Provides local display & isolated, scalable & reversible 0-20mA or 4-20mA output
- Simultaneously functions as MODBUS RTU master to smart HiQDT MODBUS RTU sensor and MODBUS RTU slave to upstream PLC. ALL sensor registers can be made accessible from MODUS RTU slave port. Security parameter allows for field adjustable access control levels on MODBUS RTU slave port anywhere from read only for sensor and transmitter, to write only for transmitter or allowing full read & write access for both sensor & transmitter. Page 5 provides further details.
- Automatic translation between transmitter & sensor node addresses (see page 6)
- Display current mA output based upon current sensor reading & scaling setup
- **Galvanic isolation between sensor input, power & analog output (3000V rating)**
- **Universal software automatically detects measurement type of mating sensor & loads all necessary associated parameters without any user action required**
- Temperature & Absolute mV can be display for pH/ORP/ISE/DO sensors. Temperature & raw conductivity can be displayed for conductivity sensors.
- Customized user-defined default settings can be programmed without charge
- Provides isolated 9VDC power & RS-485 serial port for smart HiQDT sensors
- Smart HiQDT MODBUS RTU sensors store calibration & analytic info in non-volatile EEPROM memory for for seamless plug and play hot-swap in field
- **Sensors calibrations are performed by handheld communicator (HHC), Windows software or Touchscreen Controller through MODBUS slave port.**
- **Notifies when connected sensor needs recalibration (user adjustable threshold)**
- Supported Data Ranges for Mating Smart digital HiQDT MODBUS RTU Sensors:
  - **pH:** -2.000 to +16.000 *(actual range is always limited by sensor specs)*
  - **ORP:** ±1000.0mV Standard Style or ±2000.0mV Wide Range Style
  - **Dissolved Oxygen (D.O.):** 0.00-150.00 ppm | 0.0-1,500.0 % Saturation
  - **Ion Selective (ISE):** 0.01-9.99 / 10.0-99.9 / 100-999 for ppm ranges & 1.00-9.99 / 10.0-99.9 / 100-99 kilo-ppm ranges (ppm equivalent is X 1000)
  - **Conductivity (EC):** 0.01-9.99/10.0-99.9/100-999 for µS/cm ranges and 1.00-9.99 / 10.0-99.9 / 100-999 for mS/cm ranges. The computed units salinity (PSU), TDS & resistivity (MΩ) supported for display & output
  - **Temperature:** -40.0 to +210.0 °C for all sensor types (display values only)



Programming

3TX-RTU has 3 digit display & 6 LEDs to setup & display values. 'Mode' is used to navigate. Programming done by 3 keys. 'Mode' toggles & 'Up' or 'Down' used to scroll & select. Setup Parameters entered via 'Mode'. Values changed using 'Up' or 'Down'. The 3TX-RTU automatically selects & illuminates LED based upon the type of sensor which is connected.
If softwarelock (P01) "On" no changes can be made. Set P01 to "Off " to allow for changes to scaling & configuration. If keys are not used for several minutes then software lock resets back "On".

MAIN FEATURES

SMART UNIVERSAL TRANSMITTER:

The 3TX-RTU-D supports all of the common liquid analytical electrochemical measurements parameter of pH, ORP, dissolved oxygen (D.O.), ion selective (ISE) and conductivity. **Scanning feature finds node address of sensor. Universal transmitter automatically loads appropriate parameters for sensor type found at node address obtained from scan.**

COMPLEMENTARY 3TX MODULES FOR 3TX-RTU:

3TX-REL: Alarm & Relay controller with simple supervision, On/Off or Time Proportional Control (TPC) Modes
3TX-TOT: Computes pH compensated "Total ISE" from Free ISE & pH analog inputs, 0/4-20mA analog & MODbus output

SMART DIGITAL MODBUS RTU SENSOR INPUT

3TX-RTU-D interfaces smart digital HiQDT MODBUS RTU sensors for low-noise operation. **Cable lengths up to 1,000 meters (3,280 feet) can be supported in field. All sensors terminated with NEMA 6P rated waterproof snap connector.**

HIGHLY CONFIGURABLE ANALOG OUTPUT

3TX-RTU provides scalable, proportional reversible 4-20mA or 0-20mA analog current loop output for any mating connected sensor input. **Minimum scaling down to 2% of the full range input of sensor allowing for a very high resolution signal to be sent to the mating analog input device.** Analog output is galvanically isolated from input with 3KV rated optocoupler.

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%
Power Consumption:	60mA max when pH/ORP/ISE/DO 80mA max when conductivity (EC)
Input Ranges:	See pages 6 to 16 for details
Sensor Input:	Smart Digital HiQDT MODBUS RTU
Temp Sensor:	Integral Platinum TC Element
Temp Range:	-40 to +210°C ± 0.3°C
Temperature Compensation:	Automatic Temperature Compensation (ATC) is Standard
Analog Output:	0-20mA or 4-20mA, max. 500Ω
Output Hold:	Automatic if sensor is not connected

BENEFITS OF USING MATING SMART DIGITAL HiQDT RS-485 MODBUS RTU SENSORS

- **Integral RS-485 MODBUS RTU interfaces all-modern PLC controllers & data acquisition systems.**
- **Communicator provides easy management of field installations** without the cost of a mating transmitter. This is ideal for locations where a local display is not necessary or possible due to installation limitations.
- **Intelligent management of sensor calibrations and service life-cycle** for efficient commissioning & maintenance. All aspects of installation are completely portable from the shop to the field site location.
- **Days in use** value is stamped for calibrations that are performed. This allows for predictive scheduling of maintenance in the PLC to ensure the accurate measurement in the field based upon user defined criteria.
- **All digital sensors ensure** reliable operation even in noisy process environments unlike analog sensors.
- **No degradation in digital communications** with very long cable runs. **Max 1,000 meters (3,280 feet) for pH, ORP, ISE & DO sensors & Max 610 meters (2,000 feet) for conductivity sensors with 3TX-RTU-D.**
- Bridging connections & modifying installations easily without loss of signal quality with **NEMA 6P & IP67 rated quick disconnect waterproof and corrosion-resistant dual snap connector**. Simple plug and play operation for intelligent maintenance planning & smart management of sensor installations and stocking.
- **Low-cost snap digital extension cables** facilitate consolidation of very many HiQDT sensors outputs into one panel enclosure where very many remote field installations can all be conveniently all viewed at once.
- **Intelligent HiQDT handheld communicator software identifies type of sensor connected** & autoloads correct features. There exists no possibility of accidentally using the wrong set of options or settings.
- **All Extension cables for HiQDT sensors are inter-compatible**. Uniform extension cables minimize stocking. Separate field installation guide details available options to commission & exchange sensors.

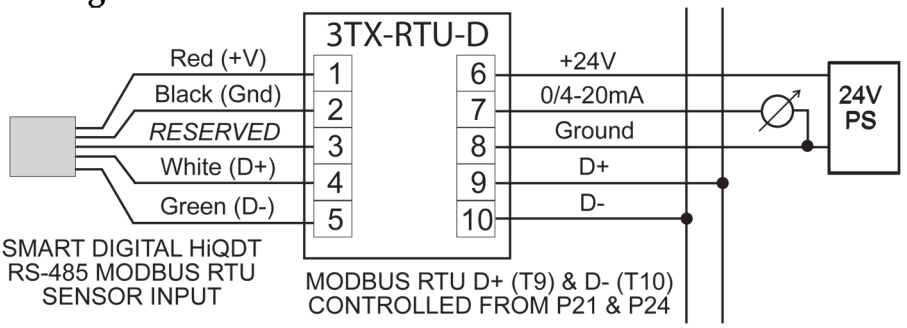
SMART MODBUS RTU SENSORS FOR USE WITH 3TX-RTU UNIVERSAL TRANSMITTER

- **Entire line of proven Iotron™** inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable **pH & ORP sensors** made by ASTI are **ALL available** for use with 3TX-RTU universal smart transmitter
- The very rugged low-profile **impact & break resistant parabolic pH glass element** optimized for use in **slurries & high viscosity applications** (X3XX series) is **ONLY** available for the smart digital type sensors
- The novel **extreme dehydration resistant** style reference technology that allows for **prolonged exposure to dry conditions** and **intermittent wet & dry use** is **ONLY** available for the smart digital type sensors
- **Entire line of proven Iotron™** inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable **ion selective (ISE) sensors** made by ASTI are **ALL available** in the smart digital HiQDT type configuration
- **Rugged Industrial AST-DO-UNIVERSAL Galvanic Dissolved Oxygen Sensors** for inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable installations are available in HiQDT configuration
- **Entire line of proven industrial** inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable **2-electrode contacting conductivity** are **ALL available** in the smart digital HiQDT type configuration
- **Waterproofing Option "A", "B", "C", "G", "H" or "IT" is recommended for any** HiQDT smart digital sensor with integral RS-485 MODBUS RTU digital output for immersion or fully submersible installations.

Field Commissioning of Transmitter

The 3TX-RTU universal smart transmitter is typically supplied preconfigured with female snap to tinned leads tinned leads panel mount connector installed onto a suitable field ready enclosure assembly. The HiQ4M male snap connector of the smart digital MODBUS RTU sensor is interfaced with female snap connector on 3TX-RTU universal smart transmitter assembly. HiQDT MODBUS RTU sensors are precalibrated ready for immediate plug & play field use.

Wiring Schematic



If softwarelock (Setup parameter P01) is "On" all of parameters can only be read. Set P01 Software Lock to "Off "to change values. The P01 software lock will automatically reset back to "On" if no key is pressed for several minutes.

User Setup Parameters

No	Parameter	Description	Range	Default
P01	Lock	Software Lock	On / Off	On
P02	Address	Address on MODbus	Off, 1…247	Per Order
P03	Baudrate	MODbus baudrate	9,600 / 19,200	Per Order
P04	Analog Output Type	Toggle for Current Loop Type	4-20mA, 0-20mA	Per Order
P05	Analog Output Mode	Select Polarity of Analog Output	noninverted, inverted	Per Order
P06	0/4 mA Whole	Scale Low setpoint for output – Whole Percent	0% to 98%	Per Order
P07	0/4 mA Dec.	Scale Low setpoint for output – Decimal Point 0-97.XX	XX.00% - XX.99%	Per Order
P08	20 mA Set	Scale High setpoint for output – Whole Percent	2% to 100%	Per Order
P09	20 mA Set	Scale High setpoint for output – Decimal Point 2-99.XX	XX.00% - XX.99%	Per Order
P10	D.O. Units Selected	Select between ppm and % Saturation units for output	ppm or % Sat	Per Order
P11	Conductivity Units Selected for Output	If Conductivity Sensor Type = 6 (Standard/High) then choices are uS/cm, Salinity (PSU) or TDS If Conductivity Sensor Type = 7 (Ultralow) then choices are uS/cm, MΩ Standard or MΩ for UPW	For Sensor Type = 6 uS/cm, PSU, TDS or For Sensor Type = 7 uS/cm, MΩ, UPW	Per Order
P12	Conductivity Sensor Cell Constant (K)	Indicates nominal cell constant for connected sensor From K=0.01/cm to K=20.00/cm	0.01 to 20.0	Per EC Sensor
P13	Conductivity Sensor Range Mode	Indicates the range mode scaling factor for EC sensor "UL"=2, "Std"=200, "Hi"=2,000	2..2,000	Per EC Sensor
P14	0/4mA Offset	Trim Low	±9.99% *	Per Factory Cal
P15	20mA Gain (Span)	Trim High	±9.99% *	Per Factory Cal
P16	Sampling Rate	Set sampling frequency in seconds	0.5, 1.0, 2.0 and 4.0	Per Order
P17	Recalibrate Notify	Set max time since cal last peformed before notification	1 to 999 Days	Per Order
P18	Display Sensor Type	1=pH, 2=ORP, 3=Wide ORP, 4=DO, 5=ISE, 6=Cond Standard/High Style, 7=Cond Ultralow Style	1..7	Per Sensor
P19	Formula Weight	Formula Weight of Measured Ion – Only for ISE sensors	6.94..655.35	Per ISE Sensor
P20	Type of TDS Units	Type of TDS units which are sent from EC Sensor	0=NaCl, 1=442, 2=KCl	Per EC Sensor
P21	Slave Node Address	Node Address of Upstream RTU Master Device	Off, 1…247	Per Order
P22	Slave Baudrate	MODbus baudrate of Upstream RTU Master Device	9,600 / 19,200	Per Order
P23	Output Hold	Current State of Analog Output Hold Feature	Off, On	Off
P24	Write Lock	Write Permissions for Upstream RTU Master Device	Off, RTU, All	Per Order
P25	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par
P26	Parity of Slave Node	Even, None	Even, None	Even

** Negative values will be shown as flashing.* *Shaded portions of chart above indicate display only parameters.*

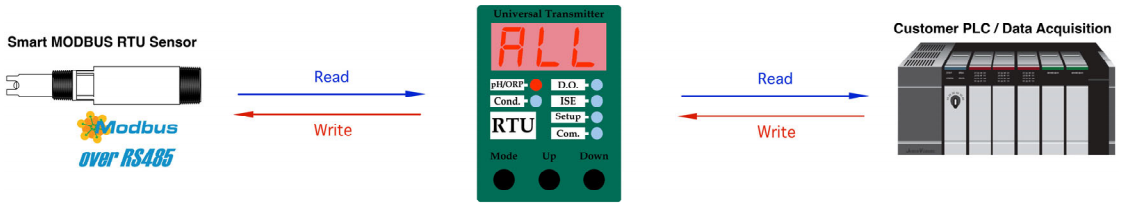
Par. no. 2 set node address of sensor. **If no sensor is found at the current node setting then 'SEn' will flash on screen. Press any button to enter P02 node select mode. Use 'Up' & 'Down' keys to select between 'Set' to manually define node address or 'SCn' for automatic node scanning feature (use 'Mode' to enter 'SEt' or 'SCn' feature). When node is found during scan the sensor type & node address are toggled. Accept the node address & sensor type found with 'Mode' key or press 'Up' or 'Down' to continue search**

Par. no. 3 sets baudrate to be used. Choices are 9,600 or 19,200.
Par. no. 4 select whether output type is 0-20mA or 4-20mA.
Par. no. 5 select whether output is inverted or non-inverted type.

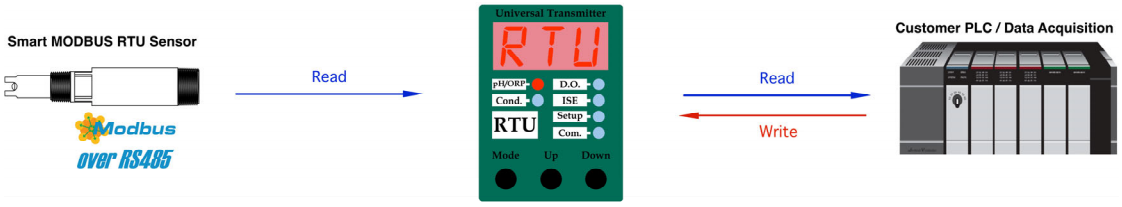
Par. no. 6, 7, 8 & 9 define 0/4mA and 20mA setpoints. Appendix provides percentages corresponding with specific engineered units for various sensor. Min scaling between low/high setpoints 2% full range. Excel worksheet to compute % setpoints available.

Par. no. 10 selects ppm or % saturations units to be used as basis for output & main LED display for connected D.O. sensor.
Par. no. 11 selects measured conductivity or else computed PSU, TDS or MΩ units as basis for analog output & main LED display.
Par. no. 12 & 13 displays cell constant & range mode of EC sensor.
Par. no. 14 & 15 Trim offset for 4mA and Trim span for 20mA
Par. no. 16 define sampling rate for connected sensor in seconds
Par. no. 17 Number of days after which recalibration notification is displayed. If limit is exceeded then 'CAL' 'OLd' is displayed.
Par. no. 18 Display the sensor type which is connected
Par. no. 19 Display the formula weight of the measured ion for ISE Sensor. For anion selective sensor value is shown as flashing
Par. no. 20 Display type of TDS units which are sent by EC sensor
Par. no. 21 Set node address of MODBUS RTU slave serial port
Par. no. 22 Set baudrate of MODBUS RTU slave serial port
Par. no. 23 Set status of analog output hold feature
Par. no. 24 Security feature for slave port. If "Off" no writing is permitted at all. If "RTU" then writing allowed to transmitter. If "All" then writing is allowed to BOTH sensor & transmitter.
Par. no. 25 Resets **ALL** parameters back to factory set defaults

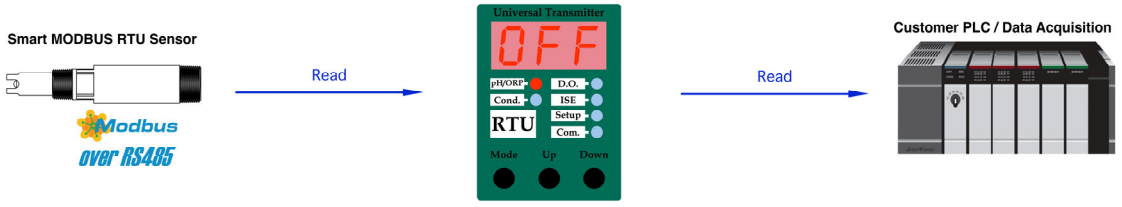
ILLUSTRATION OF VARIOUS CONFIGURATIONS FOR P24 SECURITY FEATURE



SET P24 WRITE LOCK TO "ALL"



SET P24 WRITE LOCK TO "RTU"



SET P24 WRITE LOCK TO "OFF"

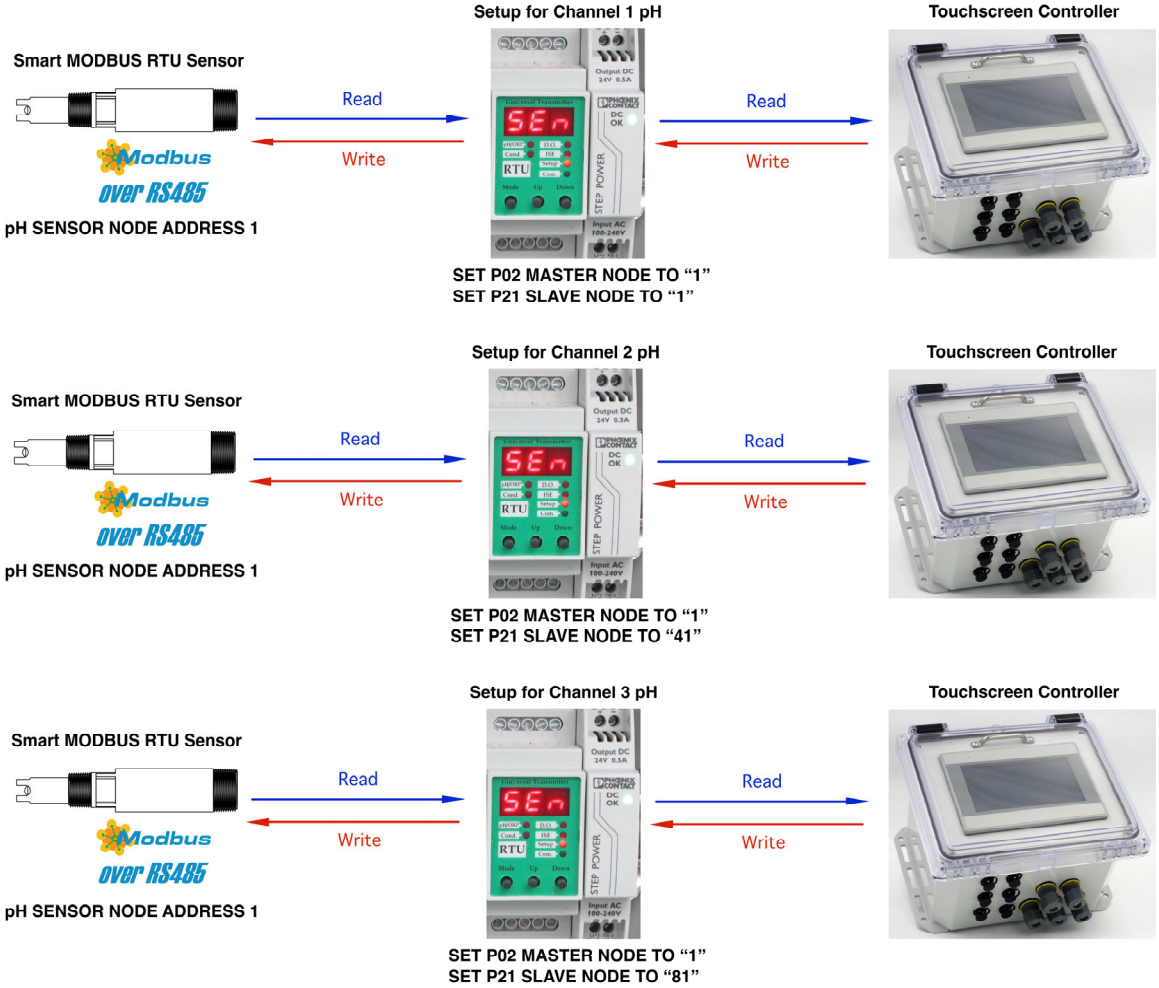
SPECIAL MODBUS SLAVE REGISTERS AVAILABLE ONLY ON 3TX-RTU-D

Access to 3TX-RTU-D modbus registers gained through MODBUS function code (03) READ HOLDING REGISTERS. Nine (9) values are available when requesting process values. Each of these registers corresponds to a user parameter on the 3TX-RTU-D transmitter. If parameter P24 is set to "RTU" or "All" then it is also possible to write to these registers as well as read through MODBUS function code (16) preset multiple registers. Values sent in succession from starting index.

Name	Range	Engineered Values	Register	Parameter
Analog Output Hold Feature	0,1	0="Off", 1="On"	40401	P23
Analog Output Set for 0-20mA or 4-20mA	0,1	0=0-20mA, 1=4-20mA	40402	P04
Toggle non-inverted or inverted output	0,1	0= non.inv, 1=inverted	40403	P05
Low 0/4mA Setpoint for Analog Output	0..9,800	0.00% to 98.00%	40404	P06/P07
High 20mA Setpoint for Analog Output	200..10,000	2.00% to 100.00%	40405	P08/P09
Units selected for D.O. sensors for output	ppm or % Sat	0=ppm, 1=% Sat	40406	P10
Units set for Std/Hi EC sensors output	EC, PSU, TDS	0=EC, 1=PSU, 2=TDS	40407	P11
Units set for Ultralow EC sensors output	EC, MΩ, MΩ UPW	0=EC, 1= MΩ, 2= MΩ UPW	40407	P11
Modbus Slave Node Address	1..247	1..247	40408	P21
Modbus Master Node Address	1..247	1..247	40409	P02

Note: Registers 40401 to 40409 correspond to Index 400 to 408

ILLUSTRATION OF P02 MASTER NODE ADDRESS & P21 SLAVE NODE ADDRESS CONFIGURATIONS WHEN INTERFACED WITH TOUCHSCREEN CONTROLLER



Example shown above is for use with touchscreen controller where channels 1, 2 & 3 are configured for pH. This scheme allows for seamless hot-swap plug and play operation without having to change the node address on the smart pH sensor no matter the channel. The 3TX-RTU-D P21 slave node address defines the channel to the touchscreen controller to which it is connected (see table below). For other sensor types the P02 and P21 node address assignments would differ, but the concepts would be the same as shown above.

Node Address Scheme when using with Touchscreen HiQDT PLC Controller

When 3TX-RTU-D transmitter is used with Touchscreen HiQDT PLC Controller node address MUST be set as defined in the table below. If 3TX-RTU-D transmitter & controller are ordered together node addresses can be preset at factory.

Channel #	1	2	3	4	5	6
pH sensor	1	41	81	121	161	201
Standard ORP sensor	2	42	82	122	162	202
Wide Range ORP Sensor	3	43	83	123	163	203
Dissolved Oxygen Sensor	4	44	84	124	164	204
Ion Selective (ISE) Sensor	5	45	85	125	165	205
Conductivity (EC) Sensor	6	46	86	126	166	206

COMMISSIONING AND SETUP:

ONLY the HiQDT Windows software or Handheld Communicator (HHC) can change the node address of the HiQDT smart digital RS-485 MODBUS RTU sensors (see respective manuals for details).

IMPLEMENTATION APPROACH #1 – OBTAIN PROCESS VALUES ONLY (1)

Access to **READ** core process values is gained through MODBUS function code (04) READ INPUT REGISTERS. Eight (8) values are available when requesting process values. Values can be called starting at any index and any number of values can be requested so long as it does not exceed the total number available from the starting index of the call. Values are sent in succession from the starting index of the call. If only one value is requested, then just the starting index is sent.

#	Name	Range	Engineered Values	Register	Index
1	Measurement pH	0..18,000	-2.000 to +16.000	30001	0
1	Measurement Standard Range ORP (mV)	0..20,000	-1,000.0 to +1,000.0	30001	0
1	Measurement Wide Range ORP (mV)	0..20,000	-2,000.0 to +2,000.0	30001	0
1	Measurement Dissolved Oxygen (DO) - ppm	0..15,000	0.00 to 150.00	30001	0
1	Measurement Ion Selective in pION Units	0..18,000	-2.000 to +16.000	30001	0
1	Measurement Temperated Compensated Conductivity (EC)	0..50,000	See HiQDT Modbus Implementation Guide	30001	0
2	Measurement °C	0..2,500	-40.0 to +210.0 °C	30002	1
3	Measurement raw mV for pH & Std ORP & ISE	5,000..45,000 *	-1,000.0 to +1,000.0	30003	2
3	Measurement raw mV for Wide Range ORP	5,000..45,000 *	-2,000.0 to +2,000.0	30003	2
3	Measurement raw mV for Dissolved Oxygen	0..25,000	+0.00 to +250.00	30003	2
3	Measurement raw Conductivity	0..50,000	See HiQDT Modbus Implementation Guide	30003	2
4	Measurement raw °C	0..2,500 **	-40.0 to +210.0 °C	30004	3
5	Measurement DO - % Saturation with Salinity	0..15,000	0.0 to 1,500.0 %	30005	4
5	Measurement computed salinity when Conductivity Sensor Type 6 (Std/High Range)	0..50,000	0.000 to 50.000 PSU	30005	4
5	Measurement computed resistivity using linear temperature compensation scheme when Conductivity Sensor Type 7 Ultralow Rage	0..50,000	0.000 to 50.000 MΩ	30005	4
6	Measurement DO - % Saturation w/o Salinity	0..15,000	0.0 to 1,500.0 %	30006	5
6	Measurement computed TDS NaCl, 442 or KCl when Conductivity Sensor Type 6 (Std/High)	0..50,000	0 to 100,00 ppm	30006	5
6	Measurement computed resistivity using special non-linear ultrapure water (UPW) temperature compensation scheme for Type 7 Ultralow Rage	0..50,000	0.000 to 50.000 MΩ	30006	5
7	Sensor Connection Status	0,1	0 = Not Connected, 1 = Connected	30007	6
8	mA Output Value from 3TX-RTU Transmitter	0..2,000	0.00 to 20.00	30008	7

i.e. <node> <code> <index> <#values>

** When raw mV is below engineered value limit, then this is indicated by the integer 4,999 being sent for this index.*
** When raw mV is above engineered value limit, then this is indicated by the integer 45,001 being sent for this index.*
*** When raw °C is above engineered value limit, then this is indicated by the integer 2,501 being sent for this index.*

NOTE FOR HiQDT-ISE Ion Selective Sensors:
Please Appendix 0 in HiQDT MODBUS implementation guide for instructions on how to convert from the scientific pION units used by this sensor to the common ppm units. The analog output scaling setpoints are sent in % of full scale corresponding to pION units.

NOTE FOR HiQDT-CON-ISO Conductivity Standard/High Range Type Sensors:
The type of TDS ppm units which are computed is defined by user register 40020 and the default is defined by system register 40051

GENERAL NOTE 1:
Please refer to the "IMPLEMENTATION OF HiQDT SMART DIGITAL RS-485 MODBUS RTU SENSORS WITH CUSTOMER PLC" modbus implementation guide for the overall MODBUS RTU communication setup as well as implementation approach # 2 that provide the details to access all smart analytic & calibration information for the smart sensor connected to the 3TX-RTU-D transmitter.

GENERAL NOTE 2:
Please refer to the implementation approach # 3 on "IMPLEMENTATION OF HiQDT SMART DIGITAL RS-485 MODBUS RTU SENSORS WITH CUSTOMER PLC" modbus implementation guide if you plan to implement any functionality that requires writing to the connected sensor. This requires that the P24 security feature is set to "All" to enable writing to the connected sensor.

Display Features

- **For Sensor Type 1 pH** - the "pH / ORP" LED will be continuous illuminated unless otherwise indicated below
  - -2.00 to -0.01 displayed as 2.00 to 0.01 flashing
  - 0.00 to 9.99 displayed not flashing with two decimal points
  - 10.0 to 16.0 display with one decimal point
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the absolute mV will be shown *
    - If the 'Up' button is pressed, then the mA for the current process value and scaling will be shown
- **For Sensor Type 2 ORP** - the "pH / ORP" LED will be continuous illuminated unless otherwise indicated below
  - -999 to -1 displayed as 999 to 1 flashing
  - 0 to +999 displayed not flashing
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the absolute mV will be shown *
    - If the 'Up' button is pressed, then the mA for the current process value and scaling will be shown
- **For Sensor Type 3 Wide ORP** - the "pH / ORP" LED will be continuous illuminated unless otherwise indicated below
  - -2,000 to -1,000 display as 2.00 to 1.00 with LED flashing (units are Volts)
  - -999 to -1 displayed as 999 to 1 flashing
  - 0 to +999 displayed not flashing
  - +1,000 to +2,000 display as 1.00 to 2.00 with LED not flashing (units are Volts)
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the absolute mV will be shown *
    - If the 'Up' button is pressed, then the mA for the current process value and scaling will be shown
- **For Sensor Type 4 Dissolved Oxygen (D.O.)** - the "D.O." LED will be continuous illuminated unless otherwise indicated below
  - If P10 is 'ppm' then 0.00 to 150.00 ppm units displayed not flashing as 0.00 to 9.99, 10.0-99.9 and 100-150 ppm
  - If P10 is '%Sat' then 0.0-1,500.0 percent (%) saturation units displayed not flashing as 0.0-99.9%, 100-999% with the special range of 1,000-1,500% displayed as 1.00-1.50 with LED flashing (kilo % Saturation Units)
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the absolute mV will be shown *
    - If the 'Up' button is pressed, then the mA for the current process value and scaling will be shown
      - If 'Up' button held and P10 is 'ppm' (basis of 4-20mA output) then % Saturation units are displayed
      - If 'Up' button held and P10 is '%Sat' (basis of 4-20mA output) then ppm units are displayed
- **For Sensor Type 5 Ion Selective (ISE)** - the "ISE" LED will be continuous illuminated unless otherwise indicated below
  - 0.00-9.99, 10.0-99.9, 100-999 ppm units displayed same as per 3TX-ISE transmitter
    - **kilo-ppm units displayed with LED flashing to signify kilo-ppm scale is in use same as per 3TX-ISE-kilo**
      - 1.00-9.99 (1,000-9,990 ppm), 10.0-99.9 (10,000-99,900 ppm) and 100-999 (100,000-999,000 ppm)
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the absolute mV will be shown *
    - If the 'Up' button is pressed, then the mA for the current process value and scaling will be shown
      - If 'Up' button held for 3 to 5 seconds, pION value is shown with same scheme used display the pH
- **For Sensor Type 6 or 7 Conductivity (EC)** - the "Cond" LED will be continuous illuminated unless otherwise indicated below
  - **<1.00 mS shown as flashing** from 1 to 999 uS/cm with 0.01-9.99, 10.0-99.9 and 100-999 floating decimal point
  - 1.00 to 999 mS/cm shown displayed not flashing with 0.01-9.99, 10.0-99.9 and 100-999 floating decimal point
  - **1,000 to 2,000 mS/cm display as 1.00 to 2.00 with the LED flashing (kilo-mS/cm)**
  - If P11 is 'PSU or MΩ' then salinity (sensor type 6) or resistivity (sensor type 7) is shown as 0.00-9.99 and 10.0-50.0
  - If P11 is 'TDS' then ppt is shown as 0.00-9.99 and 10.0-99.9 (multiply by 1,000 to get ppm units instead of ppt units)
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then raw conductivity will be shown per scheme above
    - If the 'Up' button is pressed, then the mA for the current process value and scaling will be shown
      - If 'Up' button is held for 3 to 5 seconds and P11 is 'PSU', 'TDS' or 'MΩ' then reading in conductivity units will be shown (see scheme above). If conductivity units selected for P11 then nothing is shown.
- Production data (yy.m) displayed by pressing 'Down' & 'Mode' "Mode" simultaneously in any main LED display mode. The month will display as 1..9 and then A for October, B for November and C for December. I.e. October 2011 will display as "11.A".
- Revision of software is displayed by pressing the 'Up' 'Mode' simultaneously in any main display mode.

** Negative values will be shown as flashing.*

ORDERING INFO FOR 3TX-RTU-D UNIVERSAL SMART TRANSMITTERS

ENCLOSURE TYPE CODING & DETAILED DESCRIPTION	
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) in IP65 Enclosure; Up to 2 Total Modules (**Wall Installations Only**)
3TX-2M	3TX Transmitter(s) in IP65 Enclosure; Up to 2 Total Modules (Wall or Pipe Installations)
3TX-3MP	3TX Transmitter(s) in NEMA 4X CSA/UL Rated Enclosure; ½-DIN **Panel**; Max 3 Modules (**Panel Bracket assy**)
3TX-3MF	3TX Transmitter(s) in NEMA 4X CSA/UL Rated Enclosure; Up to 3 Total Modules (Wall or Pipe Installations)
3TX-4MW	3TX Transmitter(s) in IP65 Enclosure; Up to 4 Total Modules (**Wall Installations Only**)
3TX-4M	3TX Transmitter(s) in IP65 Enclosure; Up to 4 Total Modules (Wall or Pipe Installations)
3TX-5MF	3TX Transmitter(s) in NEMA 4X CSA/UL Rated Enclosure; Up to 5 Total Modules (Wall or Pipe Installations)
3TX-6MW ***	3TX Transmitter(s) in IP65 Enclosure; Up to 6 Total Modules (Wall or Pipe Installations)
3TX-6M ***	3TX Transmitter(s) in IP65 Enclosure; Up to 6 Total Modules (Wall or Pipe Installations)
3TX-7MF ***	3TX Transmitter(s) in NEMA 4X CSA/UL Rated Enclosure; Up to 7 Total Modules (Wall or Pipe Installations)
3TX-9MF ***	3TX Transmitter(s) in NEMA 4X CSA/UL Rated Enclosure; Up to 9 Total Modules (Wall or Pipe Installations)
MEASUREMENT MODULES (FROM 1 TO 9 TOTAL, PRICE IS PER EACH MODULE)	
CODE	**DESCRIPTION**
-RTU-D-TYPE	Universal Transmitter for Use with Smart Digital HiQDT MODBUS RTU pH, ORP, DO, ISE & Conductivity Sensors Standard with isolated, scalable & reversible 0-20mA or 4-20mA analog current loop output & RS-485 MODBUS RTU TYPE: The default sensor type and all user configurable parameters can be customized to be any values of desired so long as this is done at time of order. Upon reset of transmitter default values requested at time of order will be restored.
ADD-ON MODULES FOR MEASUREMENT MODULES IN 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 Converter for operation from 5V Batteries or USB Power Supply
-SW	On/Off Power Switch (½ Width of power supply module and ¼ width of standard 3TX transmitter)
-REL	Programmable Alarm & Relay Controller with tight integration with all 3TX measurement modules for easy setup Standard with simple supervision, On/Off, Time Proportional Control (TPC) or Variable Pulse Control Modes
-TOT	pH compensated "Total ISE" from ISE & pH inputs, 0/4-20mA analog & MODbus digital ouputs

2"NPT Pipe mounting bracket kits supplied separately. For 3MP, 3MF, 6MW & 7MF enclosures the power supply is not counted as a module for space purposes. ***Refer to documentation for 3TX transmitter for use with analog sensors for all 3TX measurement modules not listed here.*** *3TX transmitter measurement modules for analog sensors and the 3TX-RTU & 3TX-HiQ transmitter modules for smart digital sensors can be mixed and matched into any enclosure without limitation. The female panel mount snap connector is only available for the 3TX-RTU & 3TX-HiQ-pH transmitters.*

* Enclosures standard with ½" MNPT cable glands for sensor inputs & transmitter outputs. Base enclosure cost includes this feature standard.

** Enclosures for use with 3TX-RTU can be supplied with female panel mount snap connector installed into the input side of the enclosure as an option. This option is designated by adding –XH to the end of the enclosure part number were X is the number of female panel mount snap connectors desired for the given enclosure. There exists a surcharge to the base enclosure cost for each snap connector that is installed. The number of snap connector cannot exceed the number of 3TX modules supported for the enclosure type. Examples are given below for elucidation of this –XH snap connector female panel mount option available for the HiQ digital sensors. The standard cable gland and snap connector inputs can be mixed and matched as desired. Analog 3TX transmitter can likewise be mixed and matched with digital 3TX-HiQ style transmitter modules although the snap input option is only supported on the 3TX-RTU & 3TX-HiQ-pH transmitters. All seals for the transmitter outputs are always cable glands.

*** For 2" NPT pipe mounting additional adapter plate is required for 6MW, 6M, 7MF & 9MF enclosures. The 2M, 4M, 3MF & 5MF enclosures support pipe mounting without adapter plate while 2MW, 4MW, 6MW & 3MP enclosures are not supported for pipe mounting (not even with adapter plate).

Model: **3TX-2MW-H-RTU-pH-REL**
Description: Single Channel Controller in IP65 Weatherproof Enclosure; 1 each female snap panel mount connectors installed ready for HiQDT sensors; 3TX-RTU Universal transmitters preconfigured for pH with 3TX-REL alarm/relay controller module; No AC Power Supply, 3-wire 24VDC Powered

Model: **3TX-3MF-3H-RTU-DO-SAT-RTU-CON-PSU-RTU-ORP-PS-SW**
Description: Triple Channel Transmitter Assembly in NEMA 4X CSA/UL rated Enclosure for Wall or Pipe Mounting Installations with 3 each 3TX-RTU Universal transmitter preconfigured for dissolved oxygen sensor using computed percent (%) saturation units and conductivity sensor using salinity PSU units and ORP sensor for main LED display and analog outputs; Universal 100-240 VAC Power Supply; On/Off Toggle Power Switch

Model: **3TX-6MW-4H-RTU-ISE-RTU-pH-TOT-NH3-RTU-DO-ppm-RTU-CON-PS**
Description: Four Channel Measurement Transmitter Assy in IP65 Weatherproof Enclosure (Max 6 Modules); 3 each 3TX-RTU Universal transmitters preconfigured for use with ion selective sensor, pH sensor, dissolved oxygen sensor in ppm mode and conductivity sensor in uS/cm or mS/cm units plus 1 each TOT module to compute total ammonia *(NH_3+NH_4^+)* from ammonium & pH sensor inputs; Universal 100-240 VAC Power Supply included

Measurement	pH	Setup Parameter
Configuration	1	N/A
Sensor Type	1	P18
Default Node	1	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	11	P06
Default Low Decimal	11	P07
Default Hi Whole	88	P08
Default Hi Decimal	89	P09
Days to Recalibrate	14	P17

Integer Limits	Engineered pH Limits
0	-2.000
18,000	16.000

% of Full Range	Engineered pH Units	RTU Integer
0.00%	-2.000	0
5.56%	-1.000	1000
11.11%	0.000	2000
16.67%	1.000	3000
22.22%	2.000	4000
27.78%	3.000	5000
33.33%	4.000	6000
38.89%	5.000	7000
44.44%	6.000	8000
50.00%	7.000	9000
55.56%	8.000	10000
61.11%	9.000	11000
66.67%	10.000	12000
72.22%	11.000	13000
77.78%	12.000	14000
83.33%	13.000	15000
88.89%	14.000	16000
94.44%	15.000	17000
100.00%	16.000	18000

11.11%	0.000	Default Low Setpoint	P06/P07
88.89%	14.000	Default High Setpoint	P08/P09

CHANGING pH VALUE ABOVE GET % SCALING COMPUTED

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

Measurement	ORP	Setup Parameter
Configuration	2	N/A
Sensor Type	2	P18
Default Node	2	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	0	P06
Default Low Decimal	0	P07
Default Hi Whole	100	P08
Default Hi Decimal	0	P09
Days to Recalibrate	30	P17

Integer Limits	Engineered ORP Limits
0	-1,000.0
20,000	1,000.0

% of Full Range	Engineered ORP Units	RTU Integer
0.00%	-1,000.0	0
5.00%	-900.0	1000
10.00%	-800.0	2000
15.00%	-700.0	3000
20.00%	-600.0	4000
25.00%	-500.0	5000
30.00%	-400.0	6000
35.00%	-300.0	7000
40.00%	-200.0	8000
45.00%	-100.0	9000
50.00%	0.0	10000
55.00%	100.0	11000
60.00%	200.0	12000
65.00%	300.0	13000
70.00%	400.0	14000
75.00%	500.0	15000
80.00%	600.0	16000
85.00%	700.0	17000
90.00%	800.0	18000
95.00%	900.0	19000
100.00%	1,000.0	20000

0.00%	-1,000.0	Default Low Setpoint	P06/P07
100.00%	1,000.0	Default High Setpoint	P08/P09

CHANGING ORP VALUE ABOVE GET % SCALING COMPUTED

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

Measurement	Wide ORP	Setup Parameter
Configuration	3	N/A
Sensor Type	3	P18
Default Node	3	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	0	P06
Default Low Decimal	0	P07
Default Hi Whole	100	P08
Default Hi Decimal	0	P09
Days to Recalibrate	30	P17

Integer Limits	Engineered ORP Limits
0	-2,000.0
20,000	2,000.0

% of Full Range	Engineered ORP Units	RTU Integer
0.00%	-2,000.0	0
5.00%	-1,800.0	1000
10.00%	-1,600.0	2000
15.00%	-1,400.0	3000
20.00%	-1,200.0	4000
25.00%	-1,000.0	5000
30.00%	-800.0	6000
35.00%	-600.0	7000
40.00%	-400.0	8000
45.00%	-200.0	9000
50.00%	0.0	10000
55.00%	200.0	11000
60.00%	400.0	12000
65.00%	600.0	13000
70.00%	800.0	14000
75.00%	1,000.0	15000
80.00%	1,200.0	16000
85.00%	1,400.0	17000
90.00%	1,600.0	18000
95.00%	1,800.0	19000
100.00%	2,000.0	20000

0.00%	-2,000.0	Default Low Setpoint	P06/P07
100.00%	2,000.0	Default High Setpoint	P08/P09

CHANGING ORP VALUE ABOVE GET % SCALING COMPUTED

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

Measurement	Dissolved Oxygen ppm	Setup Parameter
Configuration	4	N/A
Sensor Type	4	P18
Default Node	4	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	0	P06
Default Low Decimal	0	P07
Default Hi Whole	100	P08
Default Hi Decimal	0	P09
Days to Recalibrate	30	P17
DO Units for Output	ppm	P10

Integer Limits	Engineered DO ppm Limits
0	0.00
15,000	150.00

% of Full Range	Engineered DO ppm Units	RTU Integer
0.00%	0.00	0
6.67%	10.00	1000
13.33%	20.00	2000
20.00%	30.00	3000
26.67%	40.00	4000
33.33%	50.00	5000
40.00%	60.00	6000
46.67%	70.00	7000
53.33%	80.00	8000
60.00%	90.00	9000
66.67%	100.00	10000
73.33%	110.00	11000
80.00%	120.00	12000
86.67%	130.00	13000
93.33%	140.00	14000
100.00%	150.00	15000

0.00%	0.00	Default Low Setpoint	P06/P07
100.00%	150.00	Default High Setpoint	P08/P09

CHANGING DO ppm VALUE ABOVE GET % SCALING COMPUTED

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

Measurement	Dissolved Oxygen % Saturation	Setup Parameter
Configuration	5	N/A
Sensor Type	4	P18
Default Node	4	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	0	P06
Default Low Decimal	0	P07
Default Hi Whole	100	P08
Default Hi Decimal	0	P09
Days to Recalibrate	30	P17
DO Units for Output	% Sat with Salinity Correction	P10

Integer Limits	Engineered DO % Sat Limits
0	0.0
15,000	1,500.0

% of Full Range	Engineered DO % Sat Units	RTU Integer
0.00%	0.0	0
6.67%	100.0	1000
13.33%	200.0	2000
20.00%	300.0	3000
26.67%	400.0	4000
33.33%	500.0	5000
40.00%	600.0	6000
46.67%	700.0	7000
53.33%	800.0	8000
60.00%	900.0	9000
66.67%	1,000.0	10000
73.33%	1,100.0	11000
80.00%	1,200.0	12000
86.67%	1,300.0	13000
93.33%	1,400.0	14000
100.00%	1,500.0	15000

0.00%	0.0	Default Low Setpoint	P06/P07
100.00%	1,500.0	Default High Setpoint	P08/P09

CHANGING DO % SATURATION VALUE ABOVE GET % SCALING COMPUTED

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

Measurement	ISE	Setup Parameter	NOTE
Configuration	6	N/A	
Sensor Type	5	P18	Read Only
Default Node	5	P02	Adjustable from 01 to 247
Default Baudrate	19,200	P03	9,600 or 19,200
Default Output Type	4-20mA	P04	0-20mA or 4-20mA
Default Polarity	non inverted	P05	non-inverted or inverted
Default Low Whole	22	P06	See notes below for limits
Default Low Decimal	22	P07	See notes below for limits
Default Hi Whole	44	P08	See notes below for limits
Default Hi Decimal	44	P09	See notes below for limits

Integer Limits	Engineered pION Limits
0	-2.000
18,000	16.000

CHANGE VALUE BELOW TO MATCH
P19 FROM 3TX-RTU-D TRANSMITTER AFTER ISE
SENSOR IS CONNECTED & NODE IS CONFIGURED

if P19 Value is: 19.00

THEN OUTPUT IS FOR FLUORIDE

% of Full Range	Engineered pION Units	RTU Integer	ppm units
0.00%	-2.000	0	1900000
5.56%	-1.000	1000	190000
11.11%	0.000	2000	19000
16.67%	1.000	3000	1900
22.22%	2.000	4000	190
27.78%	3.000	5000	19
33.33%	4.000	6000	1.9
38.89%	5.000	7000	0.19
44.44%	6.000	8000	0.019
50.00%	7.000	9000	0.0019
55.56%	8.000	10000	0.00019
61.11%	9.000	11000	0.000019

44.44%	6.000	ppm Low Set	0.01900	P08/P09
22.22%	2.000	ppm High Set	190.00000	P06/P07

% FULL RANGE COMPUTED FOR PPM VALUES ENTERED TO THE RIGHT

CHANGE ppm VALUES ABOVE TO DESIRED VALUES FOR LOW & HIGH SETPOINTS

44.44%	6.000	Default High Setpoint in pION (Low Setpoint in ppm)
22.22%	2.000	Default Low Setpoint in pION (High Setpoint in ppm)

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.
NOTE 2: 0 ppm not a valid number for low setpoint since there exists no corresponding pION value.
NOTE 3: The logic of the high & low setpoints is inverted because while they are set in pION units the analog output itself is linear in ppm units. That is to say that the "high setpoint" in pION units is really the "low setpoint" in ppm units. Conversely the "low setpoint" in PION units is then really the "high setpoint" in ppm units. Contact factory if there should be any questions or concerns.

Measurement	ISE	Setup Parameter	NOTE
Configuration	6	N/A	
Sensor Type	5	P18	Read Only
Default Node	5	P02	Adjustable from 01 to 247
Default Baudrate	19,200	P03	9,600 or 19,200
Default Output Type	4-20mA	P04	0-20mA or 4-20mA
Default Polarity	non inverted	P05	non-inverted or inverted
Default Low Whole	22	P06	See notes below for limits
Default Low Decimal	22	P07	See notes below for limits
Default Hi Whole	44	P08	See notes below for limits
Default Hi Decimal	44	P09	See notes below for limits

Integer Limits	Engineered pION Limits	CHANGE VALUE BELOW TO MATCH P19 FROM 3TX-RTU-D TRANSMITTER AFTER ISE SENSOR IS CONNECTED & NODE IS CONFIGURED
0	-2.000	if P19 Value is: 18.04
18,000	16.000	THEN OUTPUT IS FOR AMMONIUM

% of Full Range	Engineered pION Units	RTU Integer	ppm units
0.00%	-2.000	0	1804000
5.56%	-1.000	1000	180400
11.11%	0.000	2000	18040
16.67%	1.000	3000	1804
22.22%	2.000	4000	180.4
27.78%	3.000	5000	18.04
33.33%	4.000	6000	1.804
38.89%	5.000	7000	0.1804
44.44%	6.000	8000	0.01804
50.00%	7.000	9000	0.001804
55.56%	8.000	10000	0.0001804
61.11%	9.000	11000	0.00001804

44.44%	6.000	ppm Low Set	0.01804	P08/P09
22.22%	2.000	ppm High Set	180.40000	P06/P07
% FULL RANGE COMPUTED FOR PPM VALUES ENTERED TO THE RIGHT			CHANGE ppm VALUES ABOVE TO DESIRED VALUES FOR LOW & HIGH SETPOINTS	

44.39%	5.991	Default High Setpoint in pION (Low Setpoint in ppm)
22.22%	2.000	Default Low Setpoint in pION (High Setpoint in ppm)

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.
NOTE 2: 0 ppm not a valid number for low setpoint since there exists no corresponding pION value.
NOTE 3: The logic of the high & low setpoints is inverted because while they are set in pION units the analog output itself is linear in ppm units. That is to say that the "high setpoint" in pION units is really the "low setpoint" in ppm units. Conversely the "low setpoint" in PION units is then really the "high setpoint" in ppm units. Contact factory if there should be any questions or concerns.

Measurement	Conductivity	Setup Parameter
Configuration	7	N/A
Sensor Type	6 or 7 or 9	P18
Default Node	6	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	0	P06
Default Low Decimal	0	P07
Default Hi Whole	100	P08
Default Hi Decimal	0	P09
Days to Recalibrate	90	P17
Units for Output	Con	P11

STANDARD RANGE MODE * - All values are given in microSiemens/cm

Range Scaling Factor	200	P13		P06/P07		P08/P09
Cell Constant P12	Max Conductivity	Resolution	0/4mA Low Setpoint	% of Full Range	20mA High Setpoint	% of Full Range
0.01	200	0.004	0.00	0.00%	200.00	100.00%
0.02	400	0.008	0.00	0.00%	400.00	100.00%
0.05	1,000	0.02	0.00	0.00%	1,000.00	100.00%
0.10	2,000	0.04	0.00	0.00%	2,000.00	100.00%
0.20	4,000	0.08	0.00	0.00%	4,000.00	100.00%
0.50	10,000	0.2	0.00	0.00%	10,000.00	100.00%
1.00	20,000	0.4	0.00	0.00%	20,000.00	100.00%
2.00	40,000	0.8	0.00	0.00%	40,000.00	100.00%
3.00	60,000	1.2	0.00	0.00%	60,000.00	100.00%
5.00	100,000	2	0.00	0.00%	100,000.00	100.00%
10.00	200,000	4	0.00	0.00%	200,000.00	100.00%
20.00	400,000	8	0.00	0.00%	400,000.00	100.00%

HIGH RANGE MODE * - All values are given in microSiemens/cm

Range Scaling Factor	2,000	P13		P06/P07		P08/P09
Cell Constant P12	Max Conductivity	Resolution	0/4mA Low Setpoint	% of Full Range	20mA High Setpoint	% of Full Range
0.01	2,000	0.04	0.00	0.00%	1,000.00	50.00%
0.02	4,000	0.08	0.00	0.00%	2,000.00	50.00%
0.05	10,000	0.2	0.00	0.00%	5,000.00	50.00%
0.10	20,000	0.4	0.00	0.00%	10,000.00	50.00%
0.20	40,000	0.8	0.00	0.00%	20,000.00	50.00%
0.50	100,000	2	0.00	0.00%	50,000.00	50.00%
1.00	200,000	4	0.00	0.00%	100,000.00	50.00%
2.00	400,000	8	0.00	0.00%	200,000.00	50.00%
3.00	600,000	12	0.00	0.00%	300,000.00	50.00%
5.00	1,000,000	20	0.00	0.00%	500,000.00	50.00%
10.00	2,000,000	40	0.00	0.00%	1,000,000.00	50.00%
20.00	4,000,000	80	0.00	0.00%	2,000,000.00	50.00%

ULTRALOW RANGE MODE * - All values are given in microSiemens/cm

Range Scaling Factor	**2**	**P13**		**P06/P07**		**P08/P09**
Cell Constant P12	Max Conductivity	Resolution	0/4mA Low Setpoint	% of Full Range	20mA High Setpoint	% of Full Range
0.01	2	0.00004	0.00	0.00%	2.00	100.00%
0.02	4	0.00008	0.00	0.00%	4.00	100.00%
0.05	10	0.0002	0.00	0.00%	10.00	100.00%
0.10	20	0.0004	0.00	0.00%	20.00	100.00%
0.20	40	0.0008	0.00	0.00%	40.00	100.00%
0.50	100	0.002	0.00	0.00%	100.00	100.00%
1.00	200	0.004	0.00	0.00%	200.00	100.00%
2.00	400	0.008	0.00	0.00%	400.00	100.00%
3.00	600	0.012	0.00	0.00%	600.00	100.00%
5.00	1,000	0.02	0.00	0.00%	1,000.00	100.00%
10.00	2,000	0.04	0.00	0.00%	2,000.00	100.00%
20.00	4,000	0.08	0.00	0.00%	4,000.00	100.00%

NOTE 1: Difference between Low & High Analog Setpoints should be at least 2% of the Full Range Apart

NOTE 2: Minimum Recommend Scaling is 4.00% of the full range if the low setpoint is 0.00%.

NOTE 3: For High Range Mode the maximum recommended High 20mA Setpoint is 50% of Full Range

Measurement	Conductivity	Setup Parameter
Configuration	8	N/A
Sensor Type	6 or 7 or 9	P18
Default Node	6	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	0	P06
Default Low Decimal	0	P07
Default Hi Whole	100	P08
Default Hi Decimal	0	P09
Days to Recalibrate	90	P17
Units for Output	PSU or MegaOhm	P11

Integer Limits	Engineered PSU / MOhm Limits
0	0.000
50,000	50.000

% of Full Range	Engineered PSU / MOhm Units	RTU Integer
0.00%	0.000	0
10.00%	5.000	5000
20.00%	10.000	10000
30.00%	15.000	15000
40.00%	20.000	20000
50.00%	25.000	25000
60.00%	30.000	30000
70.00%	35.000	35000
80.00%	40.000	40000
90.00%	45.000	45000
100.00%	50.000	50000

0.00%	0.000	Default Low Setpoint	P06/P07
100.00%	50.000	Default High Setpoint	P08/P09
	CHANGING PSU VALUES GET % SCALING COMPUTED (SENSOR TYPE 6)		

0.00%	0.000	Default Low Setpoint	P06/P07
40.00%	20.000	Default High Setpoint	P08/P09
	CHANGING MOhm VALUES GET % SCALING COMPUTED (SENSOR TYPE 7)		

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

NOTE 2: Units are PSU for Sensor Type 6 or 9 and MegaOhms for Sensor Type 7

Measurement	Conductivity	Setup Parameter
Configuration	9	N/A
Sensor Type	6 or 7 or 9	P18
Default Node	6	P02
Default Baudrate	19,200	P03
Default Output Type	4-20mA	P04
Default Polarity	non-inverted	P05
Default Low Whole	0	P06
Default Low Decimal	0	P07
Default Hi Whole	100	P08
Default Hi Decimal	0	P09
Days to Recalibrate	90	P17
Units for Output	TDS or MegaOhms for UPW	P11

Integer Limits	Engineered TDS ppm Limits	*Engineered TDS ppt Limits*
0	0	*0.00*
50,000	100,000	*100.00*

% of Full Range	Engineered TDS Units	RTU Integer
0.00%	0	0
5.00%	5,000	2500
10.00%	10,000	5000
15.00%	15,000	7500
20.00%	20,000	10000
25.00%	25,000	12500
30.00%	30,000	15000
35.00%	35,000	17500
40.00%	40,000	20000
45.00%	45,000	22500
50.00%	50,000	25000
55.00%	55,000	27500
60.00%	60,000	30000
65.00%	65,000	32500
70.00%	70,000	35000
75.00%	75,000	37500
80.00%	80,000	40000
85.00%	85,000	42500
90.00%	90,000	45000
95.00%	95,000	47500
100.00%	100,000	50000

0.00%	0	Default Low Setpoint	P06/P07
100.00%	100,000	Default High Setpoint	P08/P09

CHANGING TDS VALUE ABOVE GET % SCALING COMPUTED

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

NOTE 2: Units are TDS for Sensor Type 6 or 9 and MegaOhms for UPW for Sensor Type 7

Integer Limits	Engineered MOhm for UPW Limits
0	0.000
50,000	50.000

% of Full Range	Engineered MOhm for UPW Units	RTU Integer
0.00%	0.000	0
10.00%	5.000	5000
20.00%	10.000	10000
30.00%	15.000	15000
40.00%	20.000	20000
50.00%	25.000	25000
60.00%	30.000	30000
70.00%	35.000	35000
80.00%	40.000	40000
90.00%	45.000	45000
100.00%	50.000	50000

0.00%	0.000	Default Low Setpoint	P06/P07
40.00%	20.000	Default High Setpoint	P08/P09

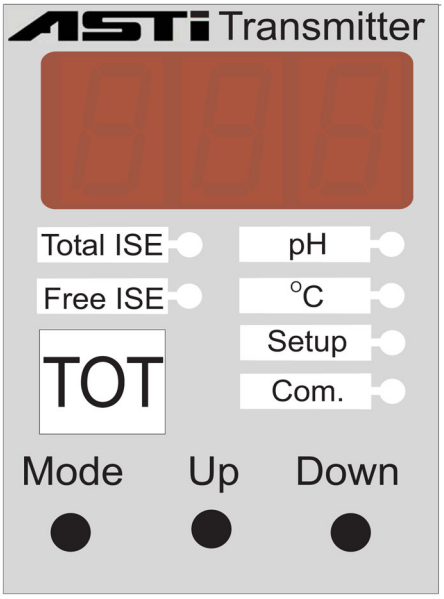
CHANGING MOhm FOR UPW VALUE ABOVE GET % SCALING COMPUTED

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.

NOTE 2: Units are TDS for Sensor Type 6 or 9 and MegaOhms for UPW for Sensor Type 7

3TX–TOT-DT pH Compensation Module for Total ISE

- 3TX-TOT-DT module computes Total ISE using pH compensation algorithm using smart RS-485 MODBUS RTU HiQDT ISE sensor & pH sensor as inputs
- Total Ammonium ($NH_3 + NH_4^+$), Total Fluoride ($HF + F^-$) or Total Cyanide ($HCN + CN^-$) computed depending on type of ISE sensor which is connected
- Computed Total ISE value sent via isolated 4-20mA analog output as well as RS-485 MODBUS RTU digital communications for computed total ISE plus process readings, analytic data & calibrations from all connected sensors
- Simultaneously functions as MODBUS RTU master to smart HiQDT MODBUS RTU sensors connected to 3TX-RTU-D transmitters and MODBUS RTU slave to upstream PLC. ALL sensor registers can be made accessible from MODUS RTU slave port meaning completely transparent communications with sensor inputs
- Automatically detects type of ISE sensor connected and selects appropriate pH compensation algorithm to be used. Automatic ranging for ISE values from 0.01ppm up to 999,000ppm (999 kilo-ppm) and anywhere in between.
- Display mA output based upon computed Total ISE value and scaling for analog output. See display features for additional values which can be shown.



FEATURES

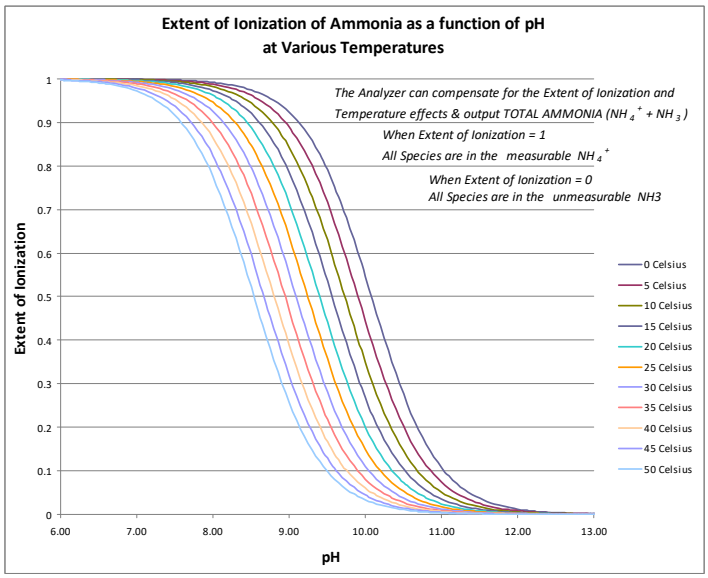
SMART UNIVERSAL TRANSMITTER:
3TX-TOT-DT pH compensation module computes the Total Ammonium ($NH_3 + NH_4^+$) or Total Fluoride ($HF + F^-$) or Total Cyanide ($HCN + CN^-$). The type of ISE sensor that is connected automatically determines the type of pH compensation curve used to compute the Total ISE value.

COMPLEMENTARY 3TX MODULES FOR 3TX-TOT-DT:
3TX-REL: Alarm & Relay controller with simple supervision, On/Off or Time Proportional Control (TPC) Modes

SMART DIGITAL MODBUS RTU SENSOR INPUT
3TX-RTU-D interfaces smart digital HiQDT MODBUS RTU sensors for low-noise operation. **Cable lengths up to 1,000 meters (3,280 feet) with all sensors terminated with NEMA 6P rated waterproof snap connectors.**

HIGHLY CONFIGURABLE ANALOG OUTPUT
3TX-TOT-DT provides scalable, proportional and reversible 4-20mA or 0-20mA analog current loop output for total ISE with linear scaling in ppm units. Selectable non-inverted or inverted polarity. Analog output is galvanically isolated from input using 3KV rated optocoupler.

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 setup options and scaling limits.**



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-DT module computes, displays & transmit what would be 100% of the weak acid or base activity, even if only a small fraction is actually in the measurable form.

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%
Typical Power Consumption:	60mA max
Input Ranges:	Per Sensor Type
Sensor Inputs for Total ISE:	Smart Digital HiQDT MODBUS RTU ISE & pH Sensors
Temp Sensor:	Integral Platinum TC Element
Temp Range:	-40 to +210°C ± 0.3°C
Analog Output:	0-20mA or 4-20mA, max. 500Ω
Output Hold:	Automatic if sensor is not connected

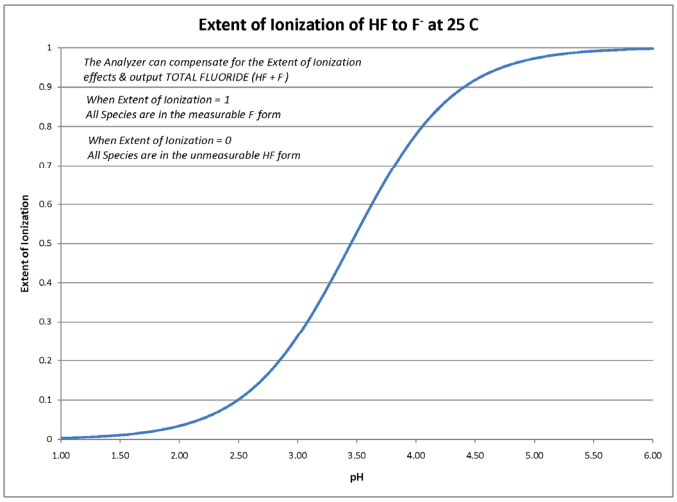
BENEFITS OF USING MATING SMART DIGITAL HiQDT RS-485 MODBUS RTU SENSORS

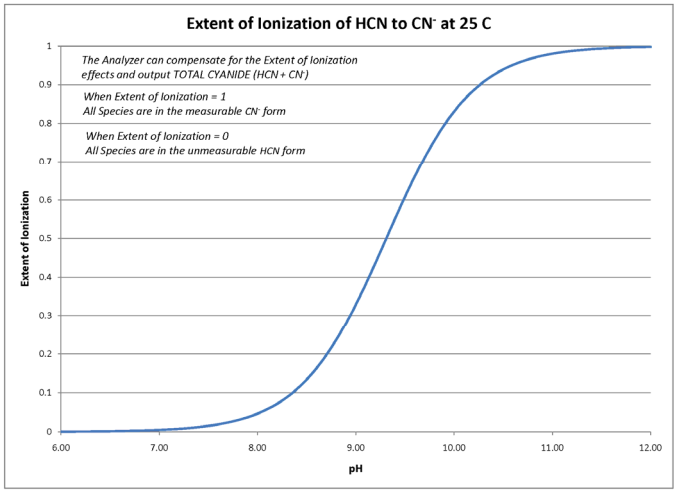
- **Integral RS-485 MODBUS RTU interfaces all-modern PLC controllers & data acquisition systems.**
- **Communicator provides easy management of field installations** without the cost of a mating transmitter. This is ideal for locations where a local display is not necessary or possible due to installation limitations.
- **Intelligent management of sensor calibrations and service life-cycle** for efficient commissioning & maintenance. All aspects of installation are completely portable from the shop to the field site location.
- **Days in use** value is stamped for calibrations that are performed. This allows for predictive scheduling of maintenance in the PLC to ensure the accurate measurement in the field based upon user defined criteria.
- **All digital sensors ensure** reliable operation even in noisy process environments unlike analog sensors.
- **No degradation in digital communications** with very long cable runs. **Max 1,000 meters (3,280 feet) for pH, ORP, ISE & DO sensors & Max 610 meters (2,000 feet) for conductivity sensors with 3TX-TOT-DT**
- Bridging connections & modifying installations easily without loss of signal quality with **NEMA 6P & IP67 rated quick disconnect waterproof and corrosion-resistant dual snap connector**. Simple plug and play operation for intelligent maintenance planning & smart management of sensor installations and stocking.
- **Low-cost snap digital extension cables** facilitate consolidation of very many HiQDT sensors outputs into one panel enclosure where very many remote field installations can all be conveniently all viewed at once.
- **Intelligent HiQDT handheld communicator software identifies type of sensor connected** & autoloads correct features. There exists no possibility of accidentally using the wrong set of options or settings.

SMART MODBUS RTU SENSORS FOR USE WITH 3TX-TOT-DT UNIVERSAL TRANSMITTER

- **Entire line of proven Iotron™** inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable **pH & ORP sensors** made by ASTI are **ALL available** for use with 3TX-RTU-D universal smart transmitter
- The very rugged low-profile **impact & break resistant parabolic pH glass element** optimized for use in **slurries & high viscosity applications** (X3XX series) is **ONLY** available for the smart digital type sensors
- The novel **extreme dehydration resistant** style reference technology that allows for **prolonged exposure to dry conditions** and **intermittent wet & dry use** is **ONLY** available for the smart digital type sensors
- **Entire line of proven Iotron™** inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable **ion selective (ISE) sensors** made by ASTI are **ALL available** in the smart digital HiQDT type configuration
- **Rugged Industrial AST-DO-UNIVERSAL Galvanic Dissolved Oxygen Sensors** for inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable installations are available in HiQDT configuration
- **Entire line of proven industrial** inline, immersion, submersible, twist lock, sanitary, HOT-TAP retractable **2-electrode contacting conductivity** are **ALL available** in the smart digital HiQDT type configuration
- **Waterproofing Option "A", "B", "C", "G", "H" or "IT" is recommended for any** HiQDT smart digital sensor with integral RS-485 MODBUS RTU digital output for immersion or fully submersible installations.

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 simpler 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-DT performs is below to understand the conditions under which this module should be used in conjunction with the 3TX-RTU-D transmitters for these measurement types.





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) 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 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 detect by the ISE sensor and so not pH compensation is required because all NH_3 gas is in the NH_4^+ ion form, all HF gas is in the F^- ion form and all HCN gas is in the CN^- ion form. The portion 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-DT module makes it as though all 100% were in the measurable form. A simple example is given below:

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

Extent of Ionization at this pH & Temp 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 (NH_3, HF, HCN) at the current pH and temperature. The Total ISE is found by simply taking the Free ISE and diving 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 in the measurable form.

For the 3TX-TOT-DT module the only things required for configuration are to define the node address of the connected ISE sensor on the 3TX-RTU-D transmitter on parameter P03 and the node address of the connected pH sensor on the 3TX-RTU-D transmitter on parameter P04. Naturally all devices must share the same baudrate as defined in parameter P02. 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 the RS-485 MODBUS RTU digital output as documented in the following pages. In addition, the selectable 0-20mA or 4-20mA analog current loop can send the total ISE value linear in ppm units with either standard non-inverted or else inverted style output configurations. The wiring schematics on the following two pages detail all of the supported configurations including the simplest single total ISE setup, redundant dual total ISE setup as well as configurations where additional parameters such as ORP, conductivity or dissolved oxygen are also to be measured by other sensors in the same installation point or from other remote locations.

If the 3TX-TOT-DT 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 for your system. As such, quite often very few of the parameters may need to be modified to begin using your 3TX-TOT-DT module.

User Setup Parameters

No	Parameter	Description	Range	Default
P01	Lock	Software Lock	On / Off	On
P02	Master Baudrate	MODbus baudrate of ALL Connected HiQDT Sensors	9,600 / 19,200	Per Order
P03	Master ISE Address	Node Address of Connected HiQDT **ISE** RTU Sensor	Off, 1…247	Per Order
P04	Master ISE Address	Node Address of Connected HiQDT **pH** RTU Sensor	Off, 1…247	Per Order
P05	Analog Output Type	Toggle for Current Loop Type	4-20mA, 0-20mA	Per Order
P06	Analog Output Mode	Select Polarity of Analog Output	noninverted, inverted	Per Order
P07	0/4 mA Whole	Scale Low setpoint for output – Whole Percent	0% to 98%	Per Order
P08	0/4 mA Dec.	Scale Low setpoint for output – Decimal Point 0-97.XX	XX.00% - XX.99%	Per Order
P09	20 mA Set	Scale High setpoint for output – Whole Percent	2% to 100%	Per Order
P10	20 mA Set	Scale High setpoint for output – Decimal Point 2-99.XX	XX.00% - XX.99%	Per Order
P11	0/4mA Offset	Trim Low	±9.99% *	Per Factory Cal
P12	20mA Gain	Trim High	±9.99% *	Per Factory Cal
P13	Sampling Rate	Set sampling frequency in seconds	0.5, 1.0, 2.0 and 4.0	Per Order
P14	Display Sensor Type	8 = TOTAL ISE for 3TX-TOT-RTU Module	8	Fixed
P15	Formula Weight	Formula Weight of Measured Ion of ISE Sensor *NOTE: The appropriate pH compensation algorithm is automatically selected based upon ISE sensor type*	19.00 = Fluoride 18.04 = Ammonium 26.02 = Cyanide	Per ISE Sensor
P16	pH Compensation	nH3,HF,HCN,HS	Defined by ISE Sensor	Per ISE Sensor
P17	Slave Node Address	Node Address of Upstream TOT Master Device	Off, 1…247	Per Order
P18	Slave Baudrate	MODbus baudrate of Upstream TOT Master Device	9,600 / 19,200	Per Order
P19	Output Hold	Current State of Analog Output Hold Feature	Off, On	Off
P20	Write Lock	Write Permissions for Upstream TOT Master Device	Off, TOT, All	All
P21	Back to Default	Reset to Default	Def=Reset, Par=NoReset	Par
P22	Parity of Slave Node	Even, None	Even, None	Even

** Negative values will be shown as flashing.* *Shaded portions of chart above indicate display only parameters.*

SPECIAL MODBUS REGISTERS AVAILABLE ONLY ON 3TX-TOT-DT

Access to 3TX-TOT-DT modbus registers gained through MODBUS function code (03) READ HOLDING REGISTERS. Nine (9) values are available when requesting process values. Each of these registers corresponds to a user parameter on the 3TX-TOT-DT transmitter. If parameter P20 is set to "TOT" or "All" then it is also possible to write to these registers as well as read through MODBUS function code (16) preset multiple registers. Values can be called starting at any index and any number of values can be requested so long as it does not exceed the total number available from starting index of call. Values sent in succession from starting index of the call. If only one value is requested, then just the starting index is sent.

Name	Range	Engineered Values	Register	Parameter
Analog Output Hold Feature	0,1	0="Off", 1="On"	40401	P19
Analog Output Set for 0-20mA or 4-20mA	0,1	0=0-20mA, 1=4-20mA	40402	P05
Toggle non-inverted or inverted output	0,1	0= non.inv, 1=inverted	40403	P06
Low 0/4mA Setpoint for Analog Output	0..9,800	0.00% to 98.00%	40404	P07/P08
High 20mA Setpoint for Analog Output	200..10,000	2.00% to 100.00%	40405	P09/P10
Master ISE Address	1…247	1…247	40406	P03
Master pH Address	1…247	1…247	40407	P04
Modbus Slave Node Address	1..247	1..247	40408	P17
N/A	N/A	N/A	40409	N/A
Write Enable for 3TX-TOT-DT Module	0,1,2	0=Off, 1=TOT, 2=All	40450	P20

Note 1: Registers 40401 to 40409 correspond to Index 400 to 408, Register 40450 corresponds to Index 449.
Note 2: Register 40450 is read only.

IMPLEMENTATION APPROACH #1 – OBTAIN PROCESS VALUES ONLY (1)

Access to **READ** core process values is gained through MODBUS function code (04) READ INPUT REGISTERS. Eight (8) values are available when requesting process values. Values can be called starting at any index and any number of values can be requested so long as it does not exceed the total number available from the starting index of the call. Values are sent in succession from the starting index of the call. If only one value is requested, then just the starting index is sent.

#	Name	Range	Engineered Values	Register	Index
1	Computed pH Compensated Total ISE sent in pION units	0..18,000	-2.000 to +16.000	30001	0
2	Measured Free ISE sent in pION Units	0..18,000	-2.000 to +16.000	30002	1
3	Measured pH	0..18,000	-2.000 to +16.000	30003	2
4	Measurement °C (from ISE Sensor)	0..2,500	-40.0 to +210.0 °C	30004	3
5	pK at current temperature for Total ISE	0..18,000	-2.000 to +16.000	30005	4
6	Extent of Ionization	0..1,000	0.0 to 100.0 %	30006	5
7	Sensor Connection Status	0,1	0 = Not Connected, 1 = Connected	30007	6
8	mA Output from 3TX-TOT-DT Transmitter	0..2,000	0.00 to 20.00	30008	7

i.e. <node> <code> <index> <#values>

NOTE FOR HiQDT-ISE Ion Selective Sensors:
Please Appendix 0 in HiQDT MODBUS implementation guide for instructions on how to convert from the scientific pION units used by this sensor to the common ppm units. The analog output scaling setpoints are sent in % of full scale corresponding to pION units.

Display Features

- **For Sensor Type 8 TOTAL ISE** - the "TOTAL ISE" LED will be continuous illuminated unless otherwise indicated below
  - 0.00-9.99, 10.0-99.9, 100-999 ppm units displayed same as per 3TX-ISE transmitter
    - **kilo-ppm units displayed with LED flashing to signify kilo-ppm scale is in use same as per 3TX-ISE-kilo**
      - 1.00-9.99 (1,000-9,990 ppm), 10.0-99.9 (10,000-99,900 ppm) and 100-999 (100,000-999,000 ppm)
    - If the 'Down' button is pressed, then the pK of the pH compensation algorithm currently used is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the percent (%) extent of ioniziation will be shown *
    - If the 'Up' button is pressed, then the mA for the total ISE pH compensated process value will be shown
      - If 'Up' button held for 3 to 5 seconds, pION value of TOTAL ISE pH compensated value is shown
- **For Sensor Type 1 pH** - the "pH" LED will be continuous illuminated unless otherwise indicated below
  - -2.00 to -0.01 displayed as 2.00 to 0.01 flashing
  - 0.00 to 9.99 displayed not flashing with two decimal points
  - 10.0 to 16.0 display with one decimal point
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the absolute mV will be shown *
- **For Sensor Type 5 Ion Selective (ISE)** - the "ISE" LED will be continuous illuminated unless otherwise indicated below
  - 0.00-9.99, 10.0-99.9, 100-999 ppm units displayed same as per 3TX-ISE transmitter
    - **kilo-ppm units displayed with LED flashing to signify kilo-ppm scale is in use same as per 3TX-ISE-kilo**
      - 1.00-9.99 (1,000-9,990 ppm), 10.0-99.9 (10,000-99,900 ppm) and 100-999 (100,000-999,000 ppm)
    - If the 'Down' button is pressed, then the temperature of connected sensor is shown *
      - If 'Down' button is held for 3 to 5 seconds, then the absolute mV will be shown *
    - If 'Up' button held is pressed then the pION value is shown with same scheme used display the pH
- Production data (yy.m) displayed by pressing 'Down' & 'Mode' simultaneously in main Total ISE LED display mode. The month will display as 1..9 and then A for October, B for November and C for December. i.e. October 2011 will display as "11.A".
- Revision of software is displayed by pressing the 'Up' 'Mode' simultaneously in main Total ISE LED display mode.

** Negative values will be shown as flashing.*

Measurement	TOTAL ISE	Setup Parameter	NOTE
Sensor Type	8	P14	Read Only
Default Node	88	P17	Adjustable from 01 to 247
Default Baudrate	19,200	P18	9,600 or 19,200
Default Output Type	4-20mA	P05	0-20mA or 4-20mA
Default Polarity	non inverted	P06	non-inverted or inverted
Default Low Whole	18	P07	See notes below for limits
Default Low Decimal	22	P08	See notes below for limits
Default Hi Whole	45	P09	See notes below for limits
Default Hi Decimal	99	P10	See notes below for limits

CHANGE VALUE BELOW TO MATCH
P15 FROM 3TX-TOT-DT TRANSMITTER AFTER ISE SENSOR IS CONNECTED & NODE IS CONFIGURED

Integer Limits	Engineered pION Limits
0	-2.000
18,000	16.000

if P15 Value is: 19.00

THEN OUTPUT IS FOR TOTAL FLUORIDE

% of Full Range	Engineered pION Units	RTU Integer	ppm units
0.00%	-2.000	0	1900000
5.56%	-1.000	1000	190000
11.11%	0.000	2000	19000
16.67%	1.000	3000	1900
22.22%	2.000	4000	190
27.78%	3.000	5000	19
33.33%	4.000	6000	1.9
38.89%	5.000	7000	0.19
44.44%	6.000	8000	0.019
50.00%	7.000	9000	0.0019
55.56%	8.000	10000	0.00019
61.11%	9.000	11000	0.000019

45.99%	6.279	ppm Low Set	0.01000	P09/P10
18.22%	1.279	ppm High Set	1000.00000	P07/P08

% FULL RANGE COMPUTED FOR PPM VALUES ENTERED TO THE RIGHT

CHANGE ppm VALUES ABOVE TO DESIRED VALUES FOR LOW & HIGH SETPOINTS

45.99%	6.279	Default High Setpoint in pION (Low Setpoint in ppm)
18.22%	1.279	Default Low Setpoint in pION (High Setpoint in ppm)

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.
NOTE 2: 0 ppm not a valid number for low setpoint since there exists no corresponding pION value.
NOTE 3: The logic of the high & low setpoints is inverted because while they are set in pION units the analog output itself is linear in ppm units. That is to say that the "high setpoint" in pION units is really the "low setpoint" in ppm units. Conversely the "low setpoint" in PION units is then really the "high setpoint" in ppm units. Contact factory if there should be any questions or concerns.

Measurement	TOTAL ISE	Setup Parameter	NOTE
Sensor Type	8	P14	Read Only
Default Node	88	P17	Adjustable from 01 to 247
Default Baudrate	19,200	P18	9,600 or 19,200
Default Output Type	4-20mA	P05	0-20mA or 4-20mA
Default Polarity	non inverted	P06	non-inverted or inverted
Default Low Whole	18	P07	See notes below for limits
Default Low Decimal	9	P08	See notes below for limits
Default Hi Whole	45	P09	See notes below for limits
Default Hi Decimal	87	P10	See notes below for limits

CHANGE VALUE BELOW TO MATCH
P15 FROM 3TX-TOT-DT TRANSMITTER AFTER ISE SENSOR IS CONNECTED & NODE IS CONFIGURED

Integer Limits	Engineered pION Limits
0	-2.000
18,000	16.000

if P15 Value is: 18.04

THEN OUTPUT IS FOR TOTAL AMMONIUM

% of Full Range	Engineered pION Units	RTU Integer	ppm units
0.00%	-2.000	0	1804000
5.56%	-1.000	1000	180400
11.11%	0.000	2000	18040
16.67%	1.000	3000	1804
22.22%	2.000	4000	180.4
27.78%	3.000	5000	18.04
33.33%	4.000	6000	1.804
38.89%	5.000	7000	0.1804
44.44%	6.000	8000	0.01804
50.00%	7.000	9000	0.001804
55.56%	8.000	10000	0.0001804
61.11%	9.000	11000	0.00001804

45.87%	6.256	ppm Low Set	0.01000	P09/P10
18.09%	1.256	ppm High Set	1000.00000	P07/P08

% FULL RANGE COMPUTED FOR PPM VALUES ENTERED TO THE RIGHT

CHANGE ppm VALUES ABOVE TO DESIRED VALUES FOR LOW & HIGH SETPOINTS

45.87%	6.256	Default High Setpoint in pION (Low Setpoint in ppm)
18.09%	1.256	Default Low Setpoint in pION (High Setpoint in ppm)

NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.
NOTE 2: 0 ppm not a valid number for low setpoint since there exists no corresponding pION value.
NOTE 3: The logic of the high & low setpoints is inverted because while they are set in pION units the analog output itself is linear in ppm units. That is to say that the "high setpoint" in pION units is really the "low setpoint" in ppm units. Conversely the "low setpoint" in PION units is then really the "high setpoint" in ppm units. Contact factory if there should be any questions or concerns.

Measurement	TOTAL ISE	Setup Parameter	NOTE
Sensor Type	8	P14	Read Only
Default Node	88	P17	Adjustable from 01 to 247
Default Baudrate	19,200	P18	9,600 or 19,200
Default Output Type	4-20mA	P05	0-20mA or 4-20mA
Default Polarity	non inverted	P06	non-inverted or inverted
Default Low Whole	18	P07	See notes below for limits
Default Low Decimal	97	P08	See notes below for limits
Default Hi Whole	46	P09	See notes below for limits
Default Hi Decimal	75	P10	See notes below for limits

CHANGE VALUE BELOW TO MATCH
P15 FROM 3TX-TOT-DT TRANSMITTER AFTER ISE SENSOR IS CONNECTED & NODE IS CONFIGURED

Integer Limits	Engineered pION Limits
0	-2.000
18,000	16.000

if P15 Value is: 26.02

THEN OUTPUT IS FOR TOTAL CYANIDE

% of Full Range	Engineered pION Units	RTU Integer	ppm units
0.00%	-2.000	0	2602000
5.56%	-1.000	1000	260200
11.11%	0.000	2000	26020
16.67%	1.000	3000	2602
22.22%	2.000	4000	260.2
27.78%	3.000	5000	26.02
33.33%	4.000	6000	2.602
38.89%	5.000	7000	0.2602
44.44%	6.000	8000	0.02602
50.00%	7.000	9000	0.002602
55.56%	8.000	10000	0.0002602
61.11%	9.000	11000	0.00002602

46.75%	6.415	ppm Low Set	0.01000	P09/P10
18.97%	1.415	ppm High Set	1000.00000	P07/P08

% FULL RANGE COMPUTED FOR PPM VALUES ENTERED TO THE RIGHT

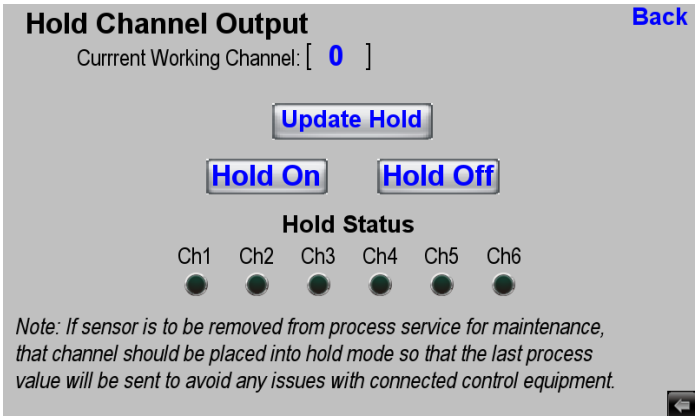
CHANGE ppm VALUES ABOVE TO DESIRED VALUES FOR LOW & HIGH SETPOINTS

46.75%	6.415	Default High Setpoint in pION (Low Setpoint in ppm)
18.97%	1.415	Default Low Setpoint in pION (High Setpoint in ppm)

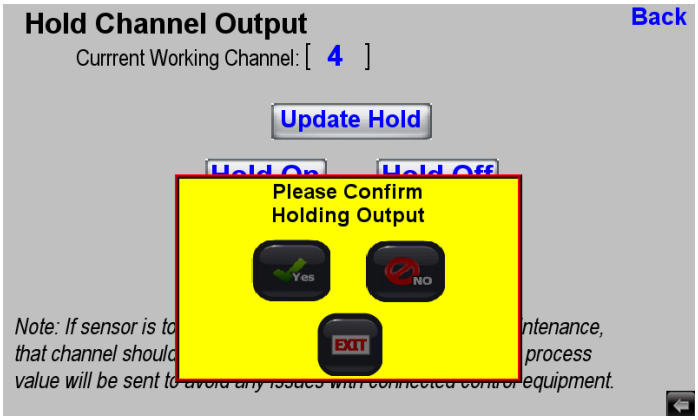
NOTE 1: Low & High Analog Setpoints should be at least 1,000 MODBUS RTU steps apart.
NOTE 2: 0 ppm not a valid number for low setpoint since there exists no corresponding pION value.
NOTE 3: The logic of the high & low setpoints is inverted because while they are set in pION units the analog output itself is linear in ppm units. That is to say that the "high setpoint" in pION units is really the "low setpoint" in ppm units. Conversely the "low setpoint" in PION units is then really the "high setpoint" in ppm units. Contact factory if there should be any questions or concerns.

"Hold Channel Output" Menu

Before performing any cleaning or re-calibration place the sensor for the channel in question on hold first. The default settings where no channels are on hold is shown to the right.



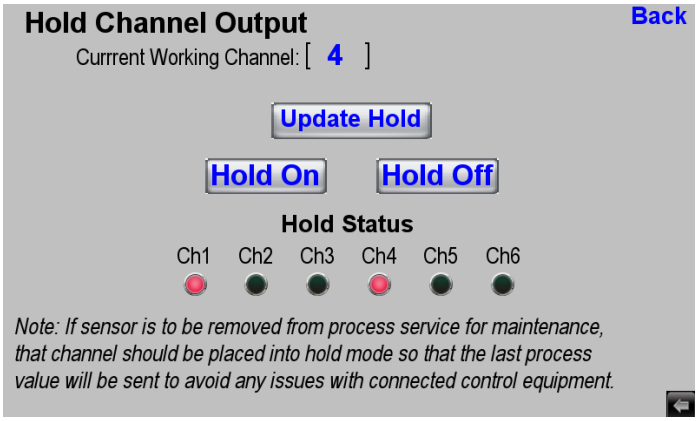
Select the channel of the sensor to be removed from service for cleaning and/or re-calibration.



Place the selected channel on hold before removing from service for cleaning and/or recalibration.

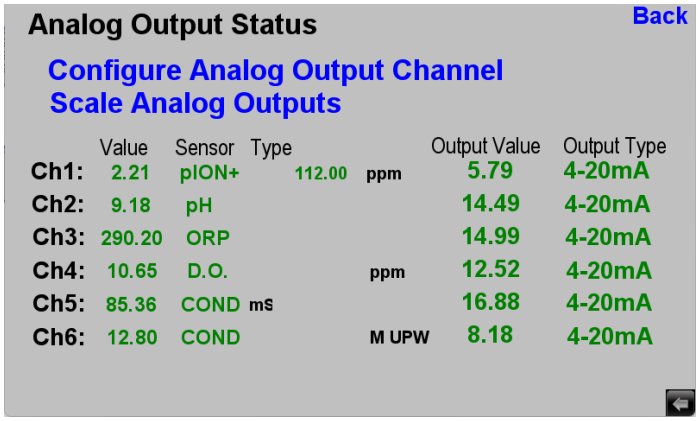
After completing the cleaning and/or recalibration connect the sensor back into service and then take that channel off from hold.

In the example should to the right the sensors for channel #1 and #4 are currently out of service.



"Analog Output Status" & "Configure Analog Output" Menus

The current process and output value for each analog output for each channel is shown based upon the current scaling setup. In addition, the type of sensor that is assigned for that channel and hold status is also displayed for each channel.



To change the output type, click on the "Configure Analog Outputs Channel" which will load the screen below. You must first choose the channel for which you wish make any changes to the analog output.

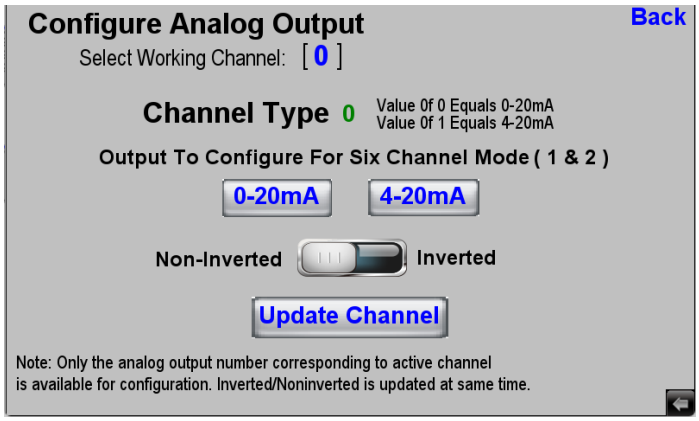
UNIT NOTE FOR DISSOLVED OXYGEN (DO) SENSORS:
The units selected for the dissolved oxgyen sensor at time channel is added to controller (ppm or % Saturation) will also be the units used for the analog outputs and relays.

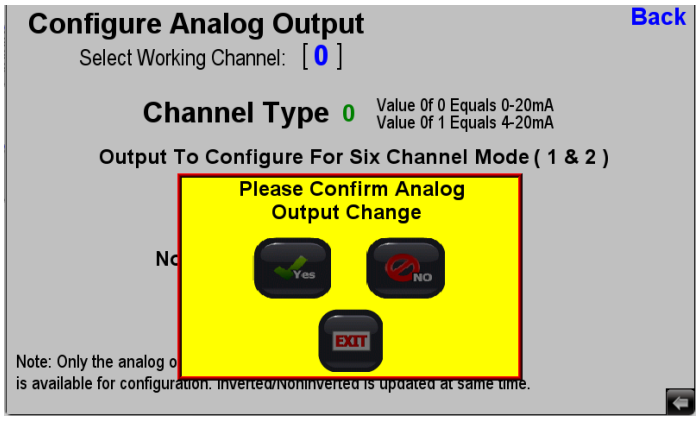
UNIT NOTES FOR CONDUCTIVITY (EC) SENSORS:
The units selected for the conductivity sensor at time channel is added to controller (mS/PSU/TDS for standard/high range and uS/MΩ/MΩ-UPW for the utlralow range) will also be the units used used for the analog outputs and relays. For conductivity units note whether you are operating in uS/cm or mS/cm when entering your analog outputs or relay setpoints.

From the "Configure Analog Outputs Channel" choose either 0-20mA or 4-20mA output type. You must also select whether you wish the output to be non-inverted or inverted. If inverted it will show in the analog output status screen 20-0mA or 20-4mA.

When you click the "Update Channel" button you will be prompted to confirm the change with yellow dialog box. The change will take effect immediately once you exit this dialog box.

After choosing the output type for the given channel click "Back" to return to the "Analog Outputs Status" screen and then click on the "Scale Analog Outputs" and follow the instructions on following page to define the low and high septoints for the current working analog output channel and type.





"Scale Analog Outputs" Menu

The current process value and low & high setpoints for each analog output for each channel is shown based upon the current scaling setup. Each low and high setpoint is individually adjustable. The values entered will not be loaded for the analog output channel until the "Update Scaling" button is clicked and confirmed. The sensor type is indicated below the channel number for ease of configuration to ensure that the proper scaling choices are used.

Dissolved Oxygen Scaling Notes:
There exists a toggle switch in the "Analog Output Status" screen that allows for selecting the units for the basis of the analog outputs to be either ppm or percent saturation (% Sat). The units displayed in yellow that indicate the current reading reflect the unit choice which is made in this screen.

Conductivity (EC) Sensor Scaling Note:
There exists three possible units for the conductivity sensors to serve as the basis of the analog output. For the **standard range mode** (scaling factor is 200 in sensor diagnostics screen) or **high range mode** (scaling factor is 2,000 in sensor diagnostics screen) there exists three choices which are made at the time that the sensor it added to the channel:

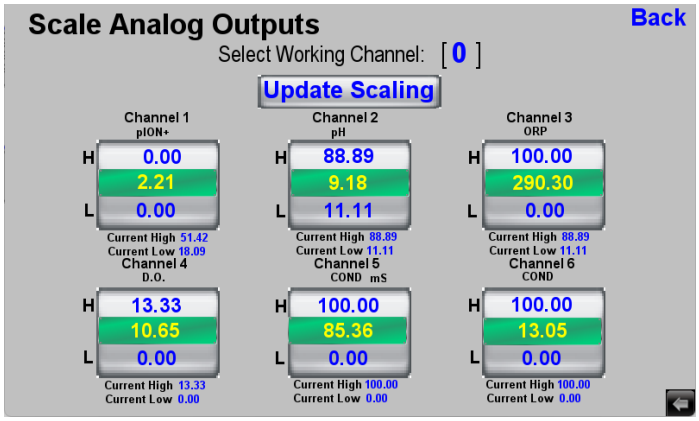
Temperature Compensated Conductivity (uS or mS)
Salinity (PSU)
TDS (ppm)

For the ultralow range mode (scaling factor is 2 in the sensor diagnostics screen) there also exists three choices which are made at the time that the sensor it added to the channel:

Temperature Compensated Conductivity (uS or mS)
MegaOhms (MΩ) using standard ATC
MegaOhms (MΩ) using special UPW ATC

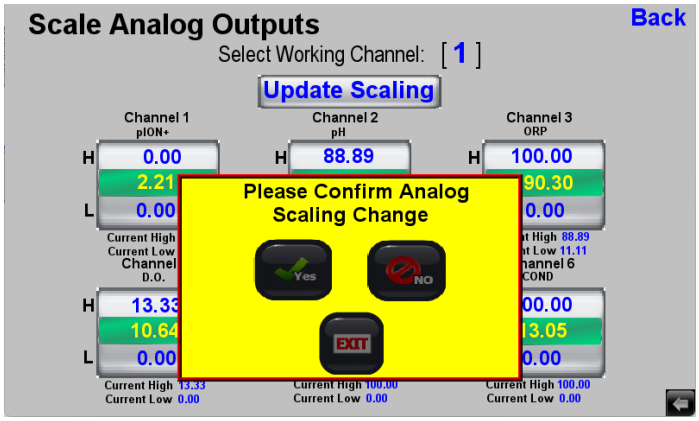
Temperature conductivity can be in microSiemens units (indicated as uS) or else in milliSiemens units (indicated as mS). Look for unit designation next to the chanel sensor type description. The value displayed in yellow is in the units shown above.

See Appendix "G" for details about the various unit types available for the conductivity sensors.



UNIT NOTE FOR DISSOLVED OXYGEN (DO) SENSORS:
The unit selected for the dissolved oxygen sensor at time channel is added to controller (ppm or % Saturation) will be the unit used for the analog output and relays.

UNIT NOTES FOR CONDUCTIVITY (EC) SENSORS:
The unit selected for the conductivity sensor at time channel is added to controller (mS/PSU/TDS for standard/high range and uS/MΩ/MΩ-UPW for the utlralow range) will be the unit used for the analog output and relays. For conductivity unit mode please note whether you are operating in uS/cm or mS/cm when entering your analog output or relay setpoints.



When you click the "Update Scaling" button you will be prompted to confirm the change with yellow dialog box. The change will take effect immediately once you exit this dialog box.

"Notes for Analog Outputs"

Please refer to the scaling charts for the 3TX-RTU-D portion of this manual from pages 40 to 52 and for the 3TX-TOT-DT from pages 58 to 60. The MS Excel worksheets that allow for you to readily convert from the engineered units of the measurement channel to the percent (%) scaling output units for the low and high setpoints on these transmitters are available upon request (contact factory for assistance).

Commonly Ask Question Analog Output Question 1:
How do you wire up the analog output from the 3TX transmitter to a data acquisition or control system?

Answer:
All 3TX transmitters are 3-wire devices (it is a part of their name). This means there is an ACTIVE 4-20mA analog current loop output, like a 4-wire type device. The data acquisition or control device to which this 3TX active 4-20mA output is connected 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.

NEVER apply voltage across terminals 7 & 8 on any 3TX transmitter! This could happen if a 3-wire type 3TX transmitters is wired as though it were a 2-wire type device. The result of such an improper wiring would destroy the output circuit with the damage not covered under warranty due to abuse/misuse.

The lead providing +24VDC power always goes to terminal 6 and the 4-20mA current loop output is always sent from terminal 7. The DC common (ground) is shared as terminal 8. 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.

Commonly Ask Question Analog Output Question 2:
Can I connect the output from 3TX transmitter to non-isolated 4-20mA analog inputs on my PLC?

Answer:
No. The output from the 3TX MUST ALWAYS be connected to isolated analog inputs. If your PLC does not have isolated analog inputs, then you must add an isolator for each current loop to be used. The ground cannot be shared on both the analog current output from the 3TX (which it is since it is a 3-wire device) and on the analog input on the PLC. The ground for each analog input on the PLC must then always be isolated.

Commonly Ask Question Analog Output Question 3:
Are there programmable relays available for this touchscreen controller?

Answer:
Yes. The 3TX-REL natively supports all available measurements of pH, ORP, dissolved oxygen, ion selective and conductivity parameters. The programming of the 3TX-RELis accomplished by local 3-digit LED and push buttons rather than through the touchscreen interface. Fefer to the 3TX-REL manual for further details:

https://www.astisensor.com/3TX-REL.pdf

Inquire to be factory if you plan to perform local alarm or control function this device prior to purchase. Note that if 3TX-REL is used then only one input channel will be available.

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 1						
1	pH	1	0-18,000	30001	310700	-2.00 to +16.00
2	ORP	2	0-20,000	30001	310700	-1,000 to +1,000
3	Wide ORP	3	0-20,000	30001	310700	-2,000 to +2,000
4	Dissolved Oxygen ppm	4	0-15,000	30001	310700	0.00 to 150.00
5	Ion Selective pION	5	0-18,000	30001	310700	-2.000 to +16.000
6,7	Conductivity	6	0-50,000	30001	310700	Per Cell & Range Mode
1,2,3,4,5,6 & 7	°C	1,2,3,4,5,6	0-2,500	30002	310701	-40.0 to +210.0
1,2,5	Raw mV pH/ORP/ISE *	1,2,5	5,000-45,000	30003	310702	-1,000 to +1,000
3	Raw mV Wide ORP *	3	5,000-45,000	30003	310702	-2,000 to +2,000
4	Raw mV Dissolved Oxygen	4	0-25,000	30003	310702	0.00 to 250.00
6,7	Raw Conductivity	6	0-50,000	30003	310702	Per Cell & Range Mode
1,2,3,4,5,6 & 7	Raw °C **	1,2,3,4,5,6	0-2,500	30004	310703	-40.0 to +210.0
4	D.O. % Sat with Salinity	4	0-15,000	30005	310704	0.0 to 1,500.0
4	D.O. % Sat w/o Salinity	4	0-15,000	30006	310705	0.0 to 1,500.0
6	Salinity PSU	6	0-50,000	30005	310704	0.000 to 50.000
6	TDS ppm	6	0-50,000	30006	310705	0 to 100,000
7	MegaOhms	6	0-50,000	30005	310704	0.000 to 50.000
7	MegaOhms w/ UPW ATC	6	0-50,000	30006	310705	0.000 to 50.000
Channel # 2						
1	pH	41	0-18,000	30001	310710	-2.00 to +16.00
2	ORP	42	0-20,000	30001	310710	-1,000 to +1,000
3	Wide ORP	43	0-20,000	30001	310710	-2,000 to +2,000
4	Dissolved Oxygen ppm	44	0-15,000	30001	310710	0.00 to 150.00
5	Ion Selective pION	45	0-18,000	30001	310710	-2.000 to +16.000
6,7	Conductivity	46	0-50,000	30001	310710	Per Cell & Range Mode
1,2,3,4,5,6 & 7	°C	41,42,43,44,45,46	0-2,500	30002	310711	-40.0 to +210.0
1,2,5	Raw mV pH/ORP/ISE *	41,42,45	5,000-45,000	30003	310712	-1,000 to +1,000
3	Raw mV Wide ORP *	43	5,000-45,000	30003	310712	-2,000 to +2,000
4	Raw mV Dissolved Oxygen	44	0-25,000	30003	310712	0.00 to 250.00
6,7	Raw Conductivity	46	0-50,000	30003	310712	Per Cell & Range Mode
1,2,3,4,5,6 & 7	Raw °C **	41,42,43,44,45,46	0-2,500	30004	310713	-40.0 to +210.0
4	D.O. % Sat with Salinity	44	0-15,000	30005	310714	0.0 to 1,500.0
4	D.O. % Sat w/o Salinity	44	0-15,000	30006	310715	0.0 to 1,500.0
6	Salinity PSU	46	0-50,000	30005	310714	0.000 to 50.000
6	TDS ppm	46	0-50,000	30006	310715	0 to 100,000
7	MegaOhms	46	0-50,000	30005	310714	0.000 to 50.000
7	MegaOhms w/ UPW ATC	46	0-50,000	30006	310715	0.000 to 50.000

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 3						
1	pH	81	0-18,000	30001	310720	-2.00 to +16.00
2	ORP	82	0-20,000	30001	310720	-1,000 to +1,000
3	Wide ORP	83	0-20,000	30001	310720	-2,000 to +2,000
4	Dissolved Oxygen ppm	84	0-15,000	30001	310720	0.00 to 150.00
5	Ion Selective pION	85	0-18,000	30001	310720	-2.000 to +16.000
6,7	Conductivity	86	0-50,000	30001	310720	Per Cell & Range Mode
1,2,3,4,5,6 & 7	°C	81,82,83,84,85,86	0-2,500	30002	310721	-40.0 to +210.0
1,2,5	Raw mV pH/ORP/ISE *	81,82,85	5,000-45,000	30003	310722	-1,000 to +1,000
3	Raw mV Wide ORP *	83	5,000-45,000	30003	310722	-2,000 to +2,000
4	Raw mV Dissolved Oxygen	84	0-25,000	30003	310722	0.00 to 250.00
6,7	Raw Conductivity	86	0-50,000	30003	310722	Per Cell & Range Mode
1,2,3,4,5,6 & 7	Raw °C **	81,82,83,84,85,86	0-2,500	30004	310723	-40.0 to +210.0
4	D.O. % Sat with Salinity	84	0-15,000	30005	310724	0.0 to 1,500.0
4	D.O. % Sat w/o Salinity	84	0-15,000	30006	310725	0.0 to 1,500.0
6	Salinity PSU	86	0-50,000	30005	310724	0.000 to 50.000
6	TDS ppm	86	0-50,000	30006	310725	0 to 100,000
7	MegaOhms	86	0-50,000	30005	310724	0.000 to 50.000
7	MegaOhms w/ UPW ATC	86	0-50,000	30006	310725	0.000 to 50.000
Channel # 4						
1	pH	121	0-18,000	30001	310730	-2.00 to +16.00
2	ORP	122	0-20,000	30001	310730	-1,000 to +1,000
3	Wide ORP	123	0-20,000	30001	310730	-2,000 to +2,000
4	Dissolved Oxygen ppm	124	0-15,000	30001	310730	0.00 to 150.00
5	Ion Selective pION	125	0-18,000	30001	310730	-2.000 to +16.000
6,7	Conductivity	126	0-50,000	30001	310730	Per Cell & Range Mode
1,2,3,4,5,6 & 7	°C	121,122,123,124,125,126	0-2,500	30002	310731	-40.0 to +210.0
1,2,5	Raw mV pH/ORP/ISE *	121,122,125	5,000-45,000	30003	310732	-1,000 to +1,000
3	Raw mV Wide ORP *	123	5,000-45,000	30003	310732	-2,000 to +2,000
4	Raw mV Dissolved Oxygen	124	0-25,000	30003	310732	0.00 to 250.00
6,7	Raw Conductivity	126	0-50,000	30003	310732	Per Cell & Range Mode
1,2,3,4,5,6 & 7	Raw °C **	121,122,123,124,125,126	0-2,500	30004	310733	-40.0 to +210.0
4	D.O. % Sat with Salinity	124	0-15,000	30005	310734	0.0 to 1,500.0
4	D.O. % Sat w/o Salinity	124	0-15,000	30006	310735	0.0 to 1,500.0
6	Salinity PSU	126	0-50,000	30005	310734	0.000 to 50.000
6	TDS ppm	126	0-50,000	30006	310735	0 to 100,000
7	MegaOhms	126	0-50,000	30005	310734	0.000 to 50.000
7	MegaOhms w/ UPW ATC	126	0-50,000	30006	310735	0.000 to 50.000

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 5						
1	pH	161	0-18,000	30001	310740	-2.00 to +16.00
2	ORP	162	0-20,000	30001	310740	-1,000 to +1,000
3	Wide ORP	163	0-20,000	30001	310740	-2,000 to +2,000
4	Dissolved Oxygen ppm	164	0-15,000	30001	310740	0.00 to 150.00
5	Ion Selective pION	165	0-18,000	30001	310740	-2.000 to +16.000
6,7	Conductivity	166	0-50,000	30001	310740	Per Cell & Range Mode
1,2,3,4,5,6 & 7	°C	161,162,163,164,165,166	0-2,500	30002	310741	-40.0 to +210.0
1,2,5	Raw mV pH/ORP/ISE *	161,162,165	5,000-45,000	30003	310742	-1,000 to +1,000
3	Raw mV Wide ORP *	163	5,000-45,000	30003	310742	-2,000 to +2,000
4	Raw mV Dissolved Oxygen	164	0-25,000	30003	310742	0.00 to 250.00
6,7	Raw Conductivity	166	0-50,000	30003	310742	Per Cell & Range Mode
1,2,3,4,5,6 & 7	Raw °C **	161,162,163,164,165,166	0-2,500	30004	310743	-40.0 to +210.0
4	D.O. % Sat with Salinity	164	0-15,000	30005	310744	0.0 to 1,500.0
4	D.O. % Sat w/o Salinity	164	0-15,000	30006	310745	0.0 to 1,500.0
6	Salinity PSU	166	0-50,000	30005	310744	0.000 to 50.000
6	TDS ppm	166	0-50,000	30006	310745	0 to 100,000
7	MegaOhms	166	0-50,000	30005	310744	0.000 to 50.000
7	MegaOhms w/ UPW ATC	166	0-50,000	30006	310745	0.000 to 50.000
Channel # 6						
1	pH	201	0-18,000	30001	310750	-2.00 to +16.00
2	ORP	202	0-20,000	30001	310750	-1,000 to +1,000
3	Wide ORP	203	0-20,000	30001	310750	-2,000 to +2,000
4	Dissolved Oxygen ppm	204	0-15,000	30001	310750	0.00 to 150.00
5	Ion Selective pION	205	0-18,000	30001	310750	-2.000 to +16.000
6,7	Conductivity	206	0-50,000	30001	310750	Per Cell & Range Mode
1,2,3,4,5,6 & 7	°C	201,202,203,204,205,206	0-2,500	30002	310751	-40.0 to +210.0
1,2,5	Raw mV pH/ORP/ISE *	201,202,205	5,000-45,000	30003	310752	-1,000 to +1,000
3	Raw mV Wide ORP *	203	5,000-45,000	30003	310752	-2,000 to +2,000
4	Raw mV Dissolved Oxygen	204	0-25,000	30003	310752	0.00 to 250.00
6,7	Raw Conductivity	206	0-50,000	30003	310752	Per Cell & Range Mode
1,2,3,4,5,6 & 7	Raw °C **	201,202,203,204,205,206	0-2,500	30004	310753	-40.0 to +210.0
4	D.O. % Sat with Salinity	204	0-15,000	30005	310754	0.0 to 1,500.0
4	D.O. % Sat w/o Salinity	204	0-15,000	30006	310755	0.0 to 1,500.0
6	Salinity PSU	206	0-50,000	30005	310754	0.000 to 50.000
6	TDS ppm	206	0-50,000	30006	310755	0 to 100,000
7	MegaOhms	206	0-50,000	30005	310754	0.000 to 50.000
7	MegaOhms w/ UPW ATC	206	0-50,000	30006	310755	0.000 to 50.000

** When raw mV is below engineered value limit, then this is indicated by the integer 4,999 being sent for this index.*
** When raw mV is above engineered value limit, then this is indicated by the integer 45,001 being sent for this index.*
*** When raw °C is above engineered value limit, then this is indicated by the integer 2,501 being sent for this index.*

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 1						
1, 2, 3 or 5	Offset mV **	1,2,3,5	0-5,000	40001	310600	-250 to +250 mV
5	ISE mV Offset **	5	0-20,000	40001	310600	-1,000.00-1,000.00 mV
6	EC Offset Zero Dry in Air	6	0-1,000	40001	310600	0.00-2.00 %
1	Acid Slope *	1	600-1,800	40002	310601	30.0 to 90.0 mV/pH
4	DO Cell Slope *	4	70-600	40002	310601	0.70 to 6.00 mV/ppm
5	ISE Slope *	5	200-2,000	40002	310601	10.00-100.00 mV/pION
6,7	Slope for Ultralow & Standard EC	6	300-1,700	40002	310601	0.300 to 1.700 Gain
1	Base Slope ***	1	600-1,800	40003	310602	30.0 to 90.0 mV/pH
6	Slope for High Range Mode EC	6	300-1,700	40002	310602	0.300 to 1.700 Gain
1,2,3,4,5,6,7	Offset °C	1,2,3,4,5,6	0-500	40004	310603	-25.0 to +25.0 °C
1,2,3,5,6,7	Time since Offset mV or EC ZDA	1,2,3,4,5,6	0-65,535	40014	310604	Hours
1,4,5,6,7	Time since Acid/DO/ISE/EC Slope *	1,4,5,6	0-65,535	40015	310605	Hours
1,6	Time since Base pH / Hi EC Slope *	1,6	0-65,535	40016	310606	Hours
1,2,3,4,5,6,7	Time Since Offset °C	1,2,3,4,5,6	0-65,535	40017	310607	Hours
Channel # 2						
1, 2, 3 or 5	Offset mV **	41,42,43,45	0-5,000	40001	310610	-250 to +250 mV
5	ISE mV Offset **	45	0-20,000	40001	310610	-1,000.00-1,000.00 mV
6	EC Offset Zero Dry in Air	46	0-1,000	40001	310610	0.00-2.00 %
1	Acid Slope *	41	600-1,800	40002	310611	30.0 to 90.0 mV/pH
4	DO Cell Slope *	44	70-600	40002	310611	0.70 to 6.00 mV/ppm
5	ISE Slope *	45	200-2,000	40002	310611	10.00-100.00 mV/pION
6,7	Slope for Ultralow & Standard EC	46	300-1,700	40002	310611	0.300 to 1.700 Gain
1	Base Slope ***	41	600-1,800	40003	310612	30.0 to 90.0 mV/pH
6	Slope for High Range Mode EC	46	300-1,700	40002	310612	0.300 to 1.700 Gain
1,2,3,4,5,6,7	Offset °C	41,42,43,44,45,46	0-500	40004	310613	-25.0 to +25.0 °C
1,2,3,5,6,7	Time since Offset mV or EC ZDA	41,42,43,45,46	0-65,535	40014	310614	Hours
1,4,5,6,7	Time since Acid/DO/ISE/EC Slope *	41,44,45,46	0-65,535	40015	310605	Hours
1,6	ime since Base pH or High EC Slope	41,46	0-65,535	40016	310606	Hours
1,2,3,4,5,6,7	Time Since Offset °C	41,42,43,44,45,46	0-65,535	40017	310607	Hours

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 3						
1, 2, 3 or 5	Offset mV **	81,82,83,85	0-5,000	40001	310620	-250 to +250 mV
5	ISE mV Offset **	85	0-20,000	40001	310620	-1,000.00-1,000.00 mV
6	EC Offset Zero Dry in Air	86	0-1,000	40001	310620	0.00-2.00 %
1	Acid Slope *	81	600-1,800	40002	310621	30.0 to 90.0 mV/pH
4	DO Cell Slope *	84	70-600	40002	310621	0.70 to 6.00 mV/ppm
5	ISE Slope *	85	200-2,000	40002	310621	10.00-100.00 mV/pION
6,7	Slope for Ultralow & Standard EC	86	300-1,700	40002	310621	0.300 to 1.700 Gain
1	Base Slope ***	81	600-1,800	40003	310622	30.0 to 90.0 mV/pH
6	Slope for High Range Mode EC	86	300-1,700	40002	310622	0.300 to 1.700 Gain
1,2,3,4,5,6,7	Offset °C	81,82,83,84,85,86	0-500	40004	310623	-25.0 to +25.0 °C
1,2,3,5,6,7	Time since Offset mV or EC ZDA	81,82,83,85,86	0-65,535	40014	310624	Hours
1,4,5,6,7	Time since Acid/DO/ISE/EC Slope *	81,84,85,86	0-65,535	40015	310625	Hours
1,6	Time since Base pH or High EC Slope	81,86	0-65,535	40016	310626	Hours
1,2,3,4,5,6,7	Time Since Offset °C	81,82,83,84,85,86	0-65,535	40017	310627	Hours
Channel # 4						
1, 2, 3 or 5	Offset mV **	121,122,123,125	0-5,000	40001	310630	-250 to +250 mV
5	ISE mV Offset **	125	0-20,000	40001	310630	-1,000.00-1,000.00 mV
6	EC Offset Zero Dry in Air	126	0-1,000	40001	310630	0.00-2.00 %
1	Acid Slope *	121	600-1,800	40002	310631	30.0 to 90.0 mV/pH
4	DO Cell Slope *	124	70-600	40002	310631	0.70 to 6.00 mV/ppm
5	ISE Slope *	125	200-2,000	40002	310631	10.00-100.00 mV/pION
6,7	Slope for Ultralow & Standard EC	126	300-1,700	40002	310631	0.300 to 1.700 Gain
1	Base Slope ***	121	600-1,800	40003	310632	30.0 to 90.0 mV/pH
6	Slope for High Range Mode EC	126	300-1,700	40002	310632	0.300 to 1.700 Gain
1,2,3,4,5,6,7	Offset °C	121,122,123,124,125,126	0-500	40004	310633	-25.0 to +25.0 °C
1,2,3,5,6,7	Time since Offset mV or EC ZDA	121,122,123,125,126	0-65,535	40014	310634	Hours
1,4,5,6,7	Time since Acid/DO/ISE/EC Slope *	121,124,125,126	0-65,535	40015	310635	Hours
1,6	Time since Base pH or High EC Slope	121,126	0-65,535	40016	310636	Hours
1,2,3,4,5,6,7	Time Since Offset °C	121,122,123,124,125,126	0-65,535	40017	310637	Hours

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 5						
1, 2, 3 or 5	Offset mV **	161,162,163,165	0-5,000	40001	310640	-250 to +250 mV
5	ISE mV Offset **	165	0-20,000	40001	310640	-1,000.00-1,000.00 mV
6	EC Offset Zero Dry in Air	166	0-1,000	40001	310640	0.00-2.00 %
1	Acid Slope *	161	600-1,800	40002	310641	30.0 to 90.0 mV/pH
4	DO Cell Slope *	164	70-600	40002	310641	0.70 to 6.00 mV/ppm
5	ISE Slope *	165	200-2,000	40002	310641	10.00-100.00 mV/pION
6,7	Slope for Ultralow & Standard EC	166	300-1,700	40002	310641	0.300 to 1.700 Gain
1	Base Slope ***	161	600-1,800	40003	310642	30.0 to 90.0 mV/pH
6	Slope for High Range Mode EC	166	300-1,700	40002	310642	0.300 to 1.700 Gain
1,2,3,4,5,6,7	Offset °C	161,162,163,164,165,166	0-500	40004	310643	-25.0 to +25.0 °C
1,2,3,5,6,7	Time since Offset mV or EC ZDA	161,162,163,165,166	0-65,535	40014	310644	Hours
1,4,5,6,7	Time since Acid/DO/ISE/EC Slope *	161,164,165,166	0-65,535	40015	310645	Hours
1,6	Time since Base pH or High EC Slope	161,166	0-65,535	40016	310646	Hours
1,2,3,4,5,6,7	Time Since Offset °C	161,162,163,164,165,166	0-65,535	40017	310647	Hours
Channel # 6						
1, 2, 3 or 5	Offset mV **	201,202,203,205	0-5,000	40001	310650	-250 to +250 mV
5	ISE mV Offset **	205	0-20,000	40001	310650	-1,000.00-1,000.00 mV
6	EC Offset Zero Dry in Air	206	0-1,000	40001	310650	0.00-2.00 %
1	Acid Slope *	201	600-1,800	40002	310651	30.0 to 90.0 mV/pH
4	DO Cell Slope *	204	70-600	40002	310651	0.70 to 6.00 mV/ppm
5	ISE Slope *	205	200-2,000	40002	310651	10.00-100.00 mV/pION
6,7	Slope for Ultralow & Standard EC	206	300-1,700	40002	310651	0.300 to 1.700 Gain
1	Base Slope ***	201	600-1,800	40003	310652	30.0 to 90.0 mV/pH
6	Slope for High Range Mode EC	206	300-1,700	40002	310652	0.300 to 1.700 Gain
1,2,3,4,5,6,7	Offset °C	201,202,203,204,205,206	0-500	40004	310653	-25.0 to +25.0 °C
1,2,3,5,6,7	Time since Offset mV or EC ZDA	201,202,203,205,206	0-65,535	40014	310654	Hours
1,4,5,6,7	Time since Acid/DO/ISE/EC Slope *	201,204,205,206	0-65,535	40015	310655	Hours
1,6	Time since Base pH or High EC Slope	201,206	0-65,535	40016	310656	Hours
1,2,3,4,5,6,7	Time Since Offset °C	201,202,203,204,205,206	0-65,535	40017	310657	Hours

* *Not applicable when sensor type is ORP*

** *Not applicable when sensor type is Dissolved Oxygen (D.O.)*

*** *Not applicable when sensor type is Dissolved Oxygen (D.O.), ISE or ORP*

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 1						
1,2,3,4,5,6 & 7	Dampener (Averaging)	1,2,3,4,5,6	0-10	40007	310500	See Below *
1,2,3,4,5,6 & 7	Year of Manufacture	1,2,3,4,5,6	00-99	40024	310501	2000 to 2099
1,2,3,4,5,6 & 7	Month of Manufacture	1,2,3,4,5,6	1-12	40025	310502	1=Jan…12=Dec
1,2,3,4,5,6 & 7	Serial Number Letter	1,2,3,4,5,6	0-18	40026	310503	See Below **
1,2,3,4,5,6 & 7	Serial Number #	1,2,3,4,5,6	000-255	40027	310504	Identifier in Alpha Block
1,2,3,4,5,6 & 7	Sensor Item Number	1,2,3,4,5,6	0-65,535	40028	310505	Unique Sensor Config
1,2,3,4,5,6 & 7	Min Temp in Use	1,2,3,4,5,6	0-2,500	40029	310506	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Max Temp in Use	1,2,3,4,5,6	0-2,500	40030	310507	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Total Time in Use	1,2,3,4,5,6	0-65,535	40031	310508	Hours
Channel # 2						
1,2,3,4,5,6 & 7	Dampener (Averaging)	41,42,43,44,45,46	0-10	40007	310510	See Below *
1,2,3,4,5,6 & 7	Year of Manufacture	41,42,43,44,45,46	00-99	40024	310511	2000 to 2099
1,2,3,4,5,6 & 7	Month of Manufacture	41,42,43,44,45,46	1-12	40025	310512	1=Jan…12=Dec
1,2,3,4,5,6 & 7	Serial Number Letter	41,42,43,44,45,46	0-18	40026	310513	See Below **
1,2,3,4,5,6 & 7	Serial Number #	41,42,43,44,45,46	000-255	40027	310514	Identifier in Alpha Block
1,2,3,4,5,6 & 7	Sensor Item Number	41,42,43,44,45,46	0-65,535	40028	310515	Unique Sensor Config
1,2,3,4,5,6 & 7	Min Temp in Use	41,42,43,44,45,46	0-2,500	40029	310516	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Max Temp in Use	41,42,43,44,45,46	0-2,500	40030	310517	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Total Time in Use	41,42,43,44,45,46	0-65,535	40031	310518	Hours
Channel # 3						
1,2,3,4,5,6 & 7	Dampener (Averaging)	81,82,83,84,85,86	0-10	40007	310520	See Below *
1,2,3,4,5,6 & 7	Year of Manufacture	81,82,83,84,85,86	00-99	40024	310521	2000 to 2099
1,2,3,4,5,6 & 7	Month of Manufacture	81,82,83,84,85,86	1-12	40025	310522	1=Jan…12=Dec
1,2,3,4,5,6 & 7	Serial Number Letter	81,82,83,84,85,86	0-18	40026	310523	See Below **
1,2,3,4,5,6 & 7	Serial Number #	81,82,83,84,85,86	000-255	40027	310524	Identifier in Alpha Block
1,2,3,4,5,6 & 7	Sensor Item Number	81,82,83,84,85,86	0-65,535	40028	310525	Unique Sensor Config
1,2,3,4,5,6 & 7	Min Temp in Use	81,82,83,84,85,86	0-2,500	40029	310526	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Max Temp in Use	81,82,83,84,85,86	0-2,500	40030	310527	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Total Time in Use	81,82,83,84,85,86	0-65,535	40031	310528	Hours

Sensor Type	Name of Value	Node	Integer Range	Sensor Register	Maple Register	Engineered Values
Channel # 4						
1,2,3,4,5,6 & 7	Dampener (Averaging)	121,122,123,124,125,126	0-10	40007	310530	See Below *
1,2,3,4,5,6 & 7	Year of Manufacture	121,122,123,124,125,126	00-99	40024	310531	2000 to 2099
1,2,3,4,5,6 & 7	Month of Manufacture	121,122,123,124,125,126	1-12	40025	310532	1=Jan…12=Dec
1,2,3,4,5,6 & 7	Serial Number Letter	121,122,123,124,125,126	0-18	40026	310533	See Below **
1,2,3,4,5,6 & 7	Serial Number #	121,122,123,124,125,126	000-255	40027	310534	Identifier in Alpha Block
1,2,3,4,5,6 & 7	Sensor Item Number	121,122,123,124,125,126	0-65,535	40028	310535	Unique Sensor Config
1,2,3,4,5,6 & 7	Min Temp in Use	121,122,123,124,125,126	0-2,500	40029	310536	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Max Temp in Use	121,122,123,124,125,126	0-2,500	40030	310537	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Total Time in Use	121,122,123,124,125,126	0-65,535	40031	310538	Hours
Channel # 5						
1,2,3,4,5,6 & 7	Dampener (Averaging)	161,162,163,164,165,166	0-10	40007	310540	See Below *
1,2,3,4,5,6 & 7	Year of Manufacture	161,162,163,164,165,166	00-99	40024	310541	2000 to 2099
1,2,3,4,5,6 & 7	Month of Manufacture	161,162,163,164,165,166	1-12	40025	310542	1=Jan…12=Dec
1,2,3,4,5,6 & 7	Serial Number Letter	161,162,163,164,165,166	0-18	40026	310543	See Below **
1,2,3,4,5,6 & 7	Serial Number #	161,162,163,164,165,166	000-255	40027	310544	Identifier in Alpha Block
1,2,3,4,5,6 & 7	Sensor Item Number	161,162,163,164,165,166	0-65,535	40028	310545	Unique Sensor Config
1,2,3,4,5,6 & 7	Min Temp in Use	161,162,163,164,165,166	0-2,500	40029	310546	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Max Temp in Use	161,162,163,164,165,166	0-2,500	40030	310547	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Total Time in Use	161,162,163,164,165,166	0-65,535	40031	310548	Hours
Channel # 6						
1,2,3,4,5,6 & 7	Dampener (Averaging)	201,202,203,204,205,206	0-10	40007	310550	See Below *
1,2,3,4,5,6 & 7	Year of Manufacture	201,202,203,204,205,206	00-99	40024	310551	2000 to 2099
1,2,3,4,5,6 & 7	Month of Manufacture	201,202,203,204,205,206	1-12	40025	310552	1=Jan…12=Dec
1,2,3,4,5,6 & 7	Serial Number Letter	201,202,203,204,205,206	0-18	40026	310553	See Below **
1,2,3,4,5,6 & 7	Serial Number #	201,202,203,204,205,206	000-255	40027	310554	Identifier in Alpha Block
1,2,3,4,5,6 & 7	Sensor Item Number	201,202,203,204,205,206	0-65,535	40028	310555	Unique Sensor Config
1,2,3,4,5,6 & 7	Min Temp in Use	201,202,203,204,205,206	0-2,500	40029	310556	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Max Temp in Use	201,202,203,204,205,206	0-2,500	40030	310557	-40 to +210.0 °C
1,2,3,4,5,6 & 7	Total Time in Use	201,202,203,204,205,206	0-65,535	40031	310558	Hours

* 0=1, 1=2, 2=3, 3=4, 4=5, 5=8, 6=10, 7=15, 8=20, 9=30 Where Units are Seconds

** 0=A, 1=b, 2=C, 3=d, 4=E, 5=F, 6=g, 7=H, 8=i, 9=J, 10=L, 11=n, 12=o, 13=P, 14=r, 15=S, 16=t, 17=U, 18=Y

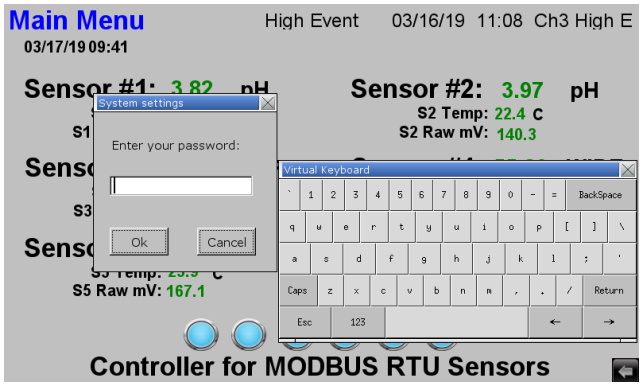
Note for Serial Number: Complete serial is the follow string of indexes <XXX23>.<XXX24>-<XXX25>.<XXX26>

APPENDIX 3 FOR REGISTER 40026

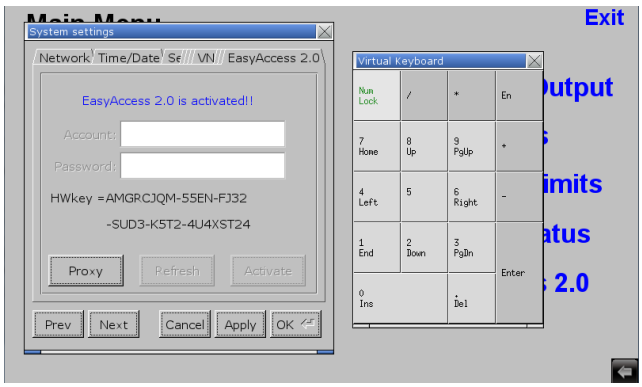
A 0	bA 38	dA 76	FA 114	HA 152	JA 190	nA 228
b 1	bb 39	db 77	Fb 115	Hb 153	Jb 191	nb 229
C 2	bC 40	dC 78	FC 116	HC 154	JC 192	nC 230
d 3	bd 41	dd 79	Fd 117	Hd 155	Jd 193	nd 231
E 4	bE 42	dE 80	FE 118	HE 156	JE 194	nE 232
F 5	bF 43	dF 81	FF 119	HF 157	JF 195	nF 233
g 6	bg 44	dg 82	Fg 120	Hg 158	Jg 196	ng 234
H 7	bH 45	dH 83	FH 121	HH 159	JH 197	nH 235
i 8	bi 46	di 84	Fi 122	Hi 160	Ji 198	ni 236
J 9	bJ 47	dJ 85	FJ 123	HJ 161	JJ 199	nJ 237
L 10	bL 48	dL 86	FL 124	HL 162	JL 200	nL 238
n 11	bn 49	dn 87	Fn 125	Hn 163	Jn 201	nn 239
o 12	bo 50	do 88	Fo 126	Ho 164	Jo 202	no 240
P 13	bP 51	dP 89	FP 127	HP 165	JP 203	nP 241
r 14	br 52	dr 90	Fr 128	Hr 166	Jr 204	nr 242
S 15	bS 53	dS 91	FS 129	HS 167	JS 205	nS 243
t 16	bt 54	dt 92	Ft 130	Ht 168	Jt 206	nt 244
U 17	bU 55	dU 93	FU 131	HU 169	JU 207	nU 245
Y 18	bY 56	dY 94	FY 132	HY 170	JY 208	nY 246
AA 19	CA 57	EA 95	gA 133	iA 171	LA 209	
Ab 20	Cb 58	Eb 96	gb 134	ib 172	Lb 210	
AC 21	CC 59	EC 97	gC 135	iC 173	LC 211	
Ad 22	Cd 60	Ed 98	gd 136	id 174	Ld 212	
AE 23	CE 61	EE 99	gE 137	iE 175	LE 213	
AF 24	CF 62	EF 100	gF 138	iF 176	LF 214	
Ag 25	Cg 63	Eg 101	gg 139	ig 177	Lg 215	
AH 26	CH 64	EH 102	gH 140	iH 178	LH 216	
Ai 27	Ci 65	Ei 103	gi 141	ii 179	Li 217	
AJ 28	CJ 66	EJ 104	gJ 142	iJ 180	LJ 218	
AL 29	CL 67	EL 105	gL 143	iL 181	LL 219	
An 30	Cn 68	En 106	gn 144	in 182	Ln 220	
Ao 31	Co 69	Eo 107	go 145	io 183	Lo 221	
AP 32	CP 70	EP 108	gP 146	iP 184	LP 222	
Ar 33	Cr 71	Er 109	gr 147	ir 185	Lr 223	
AS 34	CS 72	ES 110	gS 148	iS 186	LS 224	
At 35	Ct 73	Et 111	gt 149	it 187	Lt 225	
AU 36	CU 74	EU 112	gU 150	iU 188	LU 226	
AY 37	CY 75	EY 113	gY 151	iY 189	LY 227	

"Remote Access 2.0" Setup

Remote access capabilities are provided by the EZ Access 2.0 secure industrial platform from the Maple Systems Advanced HMI. In order to setup the EZ Access 2.0 feature the hardware key of the HMI need to be determined from the onscreen menu accessible from icon located at the bottom right of the screen. A password is required to accessed the onscreen features integral to the Maple Systems HMI. The default password is "111111" as shipped from the factory. This can and should be changed after the initial commissioning for good security practice.



Navigate to "Easy Access 2.0" tab to find hardware key (HWkey) required for Maple Systems activation card to register your device for remote access. **It may be necessary to hit "Refresh" button after entering valid Account & Password information.**



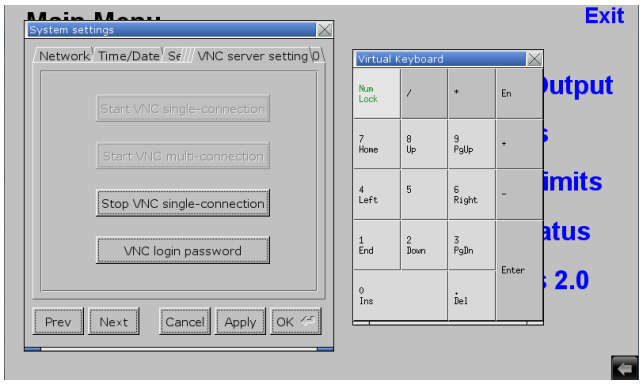
The EZ Access 2.0 tab on your system should look similar after following the steps that are detailed in the webpages linked below. You must create the EZAccess 2.0 domain and users before you can activate the HMI in question on screen.

INITIAL SETUP:

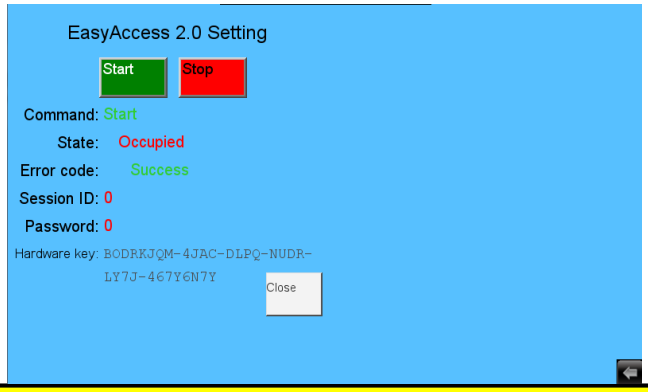
Follow Steps # 1 to 5 after the text "Activate units using an EasyAccess 2.0 Activation card (separate purchase). See Products tab for complete list" in the webpage linked below:

https://www.maplesystems.com/iiot/easy-access-2.0/

You will need to start either a single-connection or multi-connection VNC session from the system settings. Once this is successfully done your screen will look similar to the one shown to the right. **It is VERY strongly suggested to use a completely different password for VNC login than the local password used to access the system settings. This allows for a two-tiered access scheme were remote users can only alter system settings if provided with the additional different local password.**

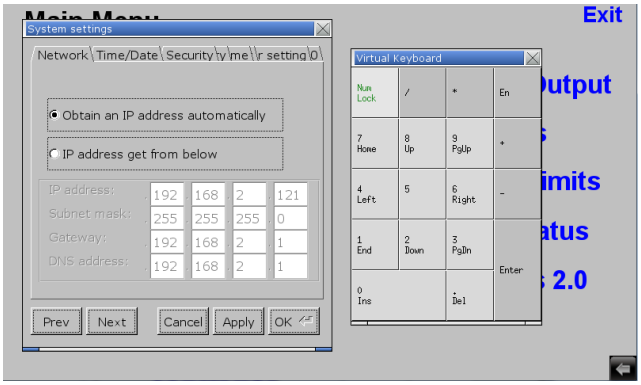


Finally you will need to start the EZAccess 2.0 service from the EasyAccess 2.0 screen on the controller. This screen in an active running state is shown to the right. Your screen should look similar if your setup has been successfully performed.

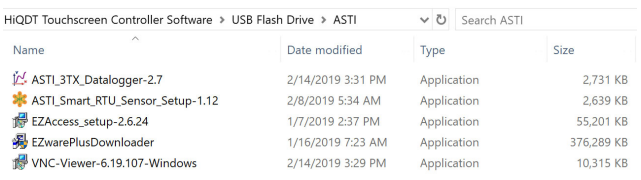


"Remote Access 2.0" Remote Login

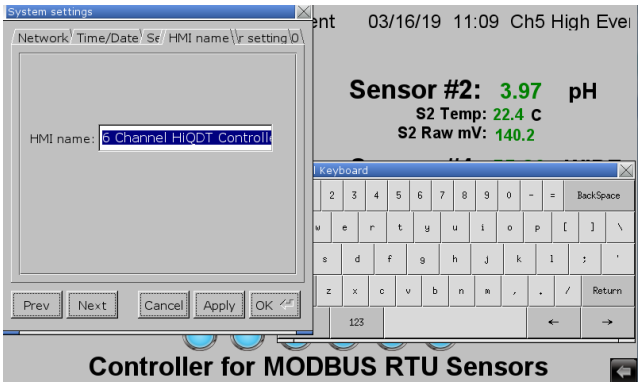
The core network information needs to be entered from the appropriate tab on the system settings (see right). This will ensure that there exists proper connectivity to activate and use the EZAccess installation for the given HMI as well as for the communications required for the MODBUS TCP slave features (see previous section for details on the register assignments for each sensor). The network used can be either public node or else be located on a subnet behind a firewall.



It is possible to remotely access the controller that has been properly setup for EZAccess 2.0 from a Windows PC, smartphone running iOS or Android as well as any tablets that are also running iOS or Android. This manual will focus on remote access from a Windows PC. Please install the apps on your smartphone or tablet and follow the provided instructions if you wish to access from one of these devices.



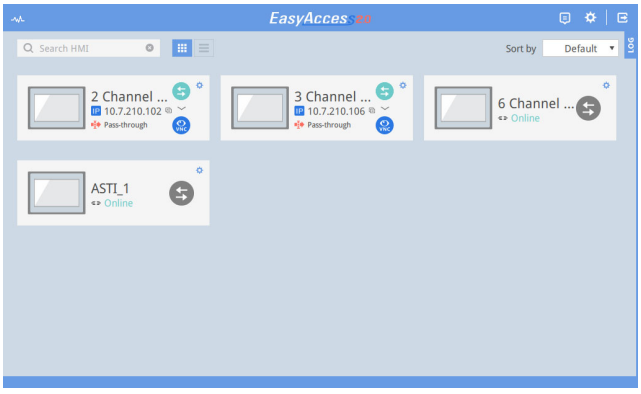
For your convenience the most current version of the EZAccess Setup & VNC Viewer for Windows at time of dispatch is provided on the USB flash drive connected to your HMI (see screenshot to the top on the right). Please install these two software on the Windows machine from which you wish to remotely access your controller and setup the path of the VNC viewer.



The most current version can be downloaded directly from Maple Systems and Real VNC websites:

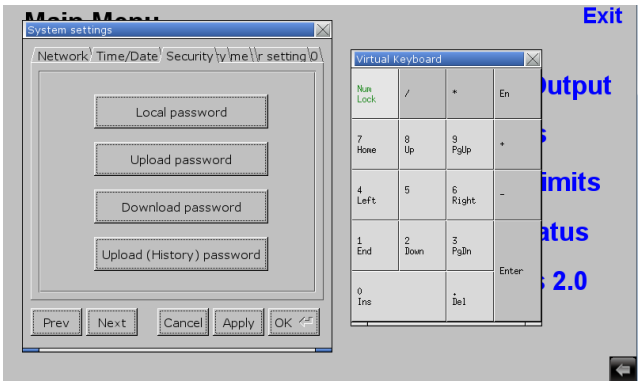
https://www.maplesystems.com/SupportCenter/index.htm

https://www.realvnc.com/en/connect/download/viewer/



Each controller can be assigned an HMI name. This is what will appear when you login via the EZ Access Windows application and must choose the machine to which you will connect. In the example to the right the HMI in question has been named as "6 Channel HiQDT Controller". For your field installation the most descriptive name is recommended for ease of deciding which machine you desire to remotely access.

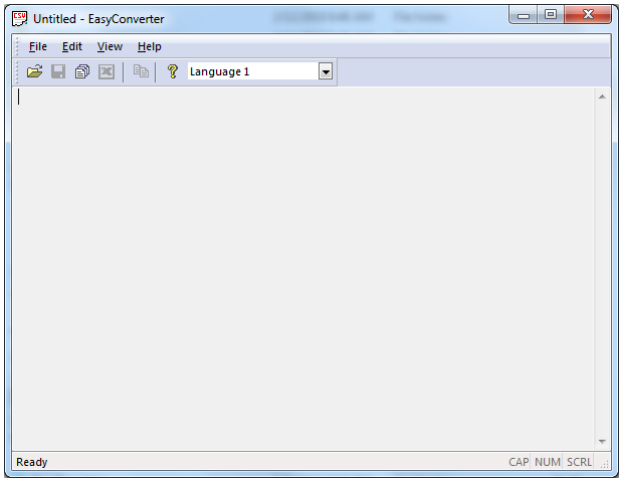
Clicking on the appropriate icon will load the VNC session. Click on the VNC session and follow the on-screen instructions. The password to be entered is the one that is set from the onscreen menu with the default value being "111111". The password for the local machine can be changed from the appropriate onscreen tab (see screenshot to right for visualization purposes).



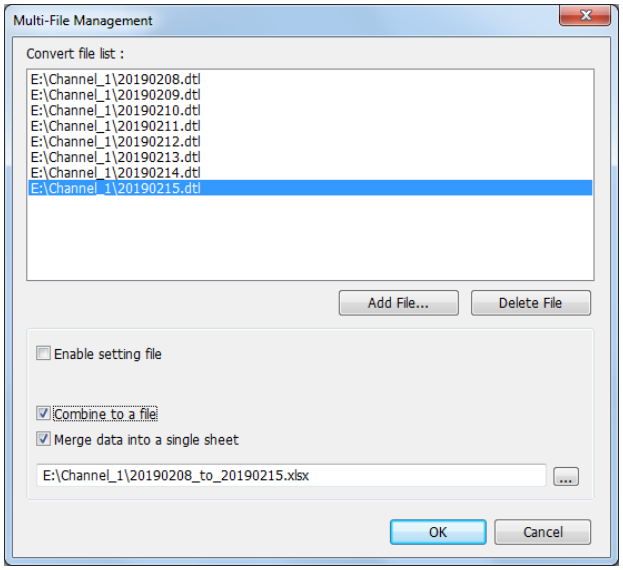
Downloading & Viewing Logged Data from Controller – Part 1 of 2

Your controller automatically records the process values, temperature and raw mV input from each connected sensor that has been properly setup for an available channel every 30 seconds including a date stamp for each logged data set. In addition the sensor analytic information and calibrations are also recorded every 30 minutes for each channel. The sampling rates from the factory are set at the time the software is installed and cannot be changed later from the HMI in the field. If for some reason these default sampling rates are not suitable alternate sampling rates can be achieved on a special order software configuration basis (MOQ may apply for such special configuration orders).

The data that is logged must be must be converted from the "DTL" file format in the EZware Plus Downloaded software. This software is provided on the 32GB USB flash drive connected to the HMI5070 touchscreen of the controller. To the right is shown the typical software utilities that are provided at time of dispatch from the factory. It is recommended to copy them to a safe location to backup and archival purposes. Install the EZware Plus Downloader software.



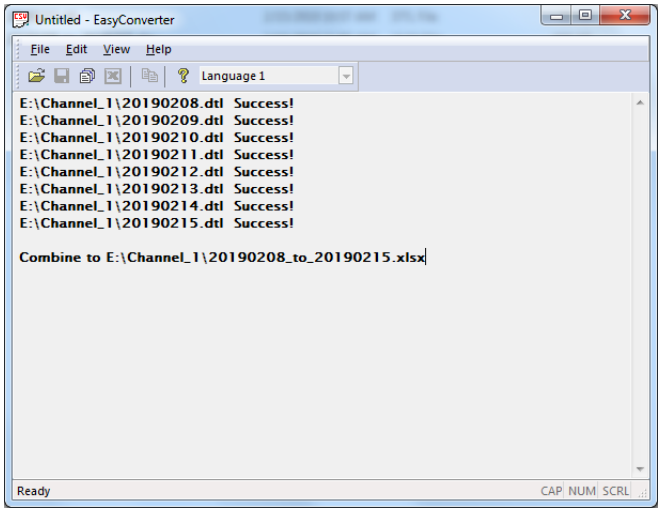
Navigate to the Data Conversion tab in this software and click on the Easy Converter icon. This will load program as shown to the right.



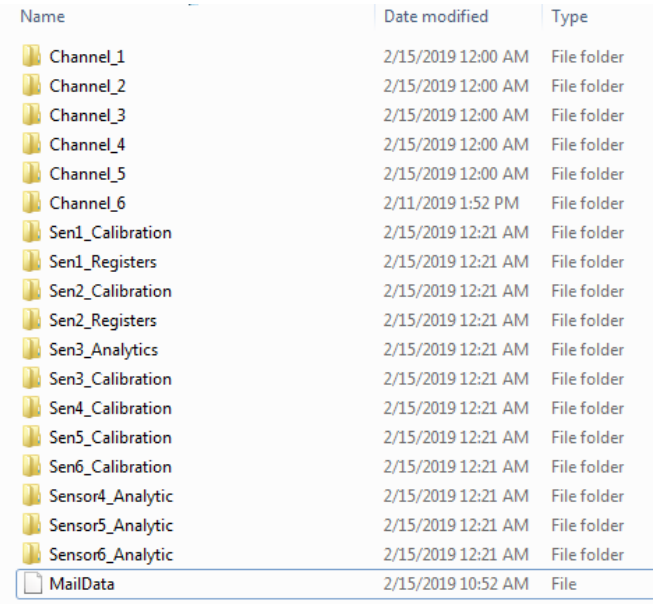
Each individual DTL file that is created for each channel on a daily basis can be converted individually to the excel worksheet or else multiple days can be combined into file. Can example of converting the daily process values into a single file for channel one is shown to the right for visualization purposes as an example.

Downloading & Viewing Logged Data from Controller – Part 2 of 2

An example of the window return the successful combining of multiple days of process value datalog files into a single excel file is shown to the right as an example for a multi-file batch conversion operation.



The folder directory for the USB flash drive in the controller is shown to the right. For each sensor channel that has been properly configured there will exist a channel directory to store the process values. A new DTL file with the date is created inside of the folder. For each sensor channel that has ever had a calibration performed there will exist a calibration directory for that channel. For each sensor channel that has ever had the sensor diagnostic information viewed there will exist a "Registers" directory. You will need to nagivate to each folder separate and create either the individual or combined excel worksheet files for further workup and analysis. Since you will need to place this USB flash drive back into the controller for further datalogging it is recommended to copy such file to your local Windows machine as well as onto the USB flash drive.



Name	Date modified	Type
Channel_1	2/15/2019 12:00 AM	File folder
Channel_2	2/15/2019 12:00 AM	File folder
Channel_3	2/15/2019 12:00 AM	File folder
Channel_4	2/15/2019 12:00 AM	File folder
Channel_5	2/15/2019 12:00 AM	File folder
Channel_6	2/11/2019 1:52 PM	File folder
Sen1_Calibration	2/15/2019 12:21 AM	File folder
Sen1_Registers	2/15/2019 12:21 AM	File folder
Sen2_Calibration	2/15/2019 12:21 AM	File folder
Sen2_Registers	2/15/2019 12:21 AM	File folder
Sen3_Analytics	2/15/2019 12:21 AM	File folder
Sen3_Calibration	2/15/2019 12:21 AM	File folder
Sen4_Calibration	2/15/2019 12:21 AM	File folder
Sen5_Calibration	2/15/2019 12:21 AM	File folder
Sen6_Calibration	2/15/2019 12:21 AM	File folder
Sensor4_Analytic	2/15/2019 12:21 AM	File folder
Sensor5_Analytic	2/15/2019 12:21 AM	File folder
Sensor6_Analytic	2/15/2019 12:21 AM	File folder
MailData	2/15/2019 10:52 AM	File

On the following pages you will find examples of the exported Excel worksheets for the process values, sensor calibrations and analytic information for channel 1 for visualization purposes. The process values are exported in floating point engineered values as they have been converted on the controller from the raw unsigned integer values sent from the sensors. The sensor analytic and calibration information is exported in the raw unsigned integer values exactly as they are sent from the sensors. In order to convert them as may be required into a more intuitive engineered value you will need to use the RS-485 MODBUS RTU sensor implementation guide as the basis for making any such conversions.

REMOTELY Downloading Logged Data from Touchscreen Controller

In addition to accessing logged data by removing the USB flash drive and following instructions on the previous pages the touchscreen controllers also allow for the logged data as detailed in the previous pages to be accessed remotely via FTP. This can be done on a local subnet, a public IP or securely behind a firewall using EZ Access 2.0. Instructions are below for how to access this logged data.
Note that data cannot be deleted but rather only downloaded.

Note 1: Determine the IP address of the HMI. You can find the IP address by opening the "System Information" window from the System Toolbar in HMI. For purposes of this instruction set we shall assume the HMI is on a local subnet with the IP address 192.168.1.50 although you will need to find the actual IP address of your machine. If using EZ Access 2.0 you will need to note the IP address that was dynamically assigned when you connect to the desired HMI and use that IP address.

Note 2: Make sure your computer is connected to the same local area network as the HMI.
Note 3: If connecting to HMI directly from Ethernet port on your computer, you must use an ethernet crossover cable. If going through an Ethernet switch, you can use a straight- thru or crossover cable.

From Windows Explorer or Web Browser:

1. Enter the following address, using the IP address of the HMI:
   ftp://uploadhis:111111@192.168.1.50
2. 111111 is the default "Upload history" password. If your password differs from the default please use the ACTUAL password set in your HMI. **It is STRONGLY recommended to change the upload history password from the default for best security practice.**
3. Press "Enter." Click on *"usbdisk"* and then the actual USB flash drive present (typically *"disk_a_1"*)
4. Click on the folder names (Directory) to access the individual files. Click on a file to download it to your computer. With this remote access method files are downloaded individually.

In addition to downloading data from Windows Explorer or Web Browser it can also be accessed from any FTP client such as FileZilla (filezilla-project.org/). **Using an FTP client has the advantage of being able to download multiple files automated in batch.** The settings would be as follows:

Host:
192.168.1.50 (use ACTUAL IP address when logging in to your particular HMI)

Encryption:
None (Plain FTP)

User:
uploadhis

Password:
111111 (use your ACTUAL password if it differs from the default)

Date	Time	Channel 1 Process Value	Channel 1 Temperature	Channel 1 mV
2/8/19	14:32:26	4.13	23.5	141.3
2/8/19	14:34:11	4.11	23.5	142.8
2/8/19	14:34:41	4.12	23.5	144.2
2/8/19	14:35:11	4.12	23.5	142.0
2/8/19	14:36:06	4.13	23.5	140.6
2/8/19	14:36:36	4.14	23.5	140.6
2/8/19	14:37:06	4.12	23.5	141.3
2/8/19	14:37:36	4.13	23.5	140.3
2/8/19	14:38:06	4.13	23.5	140.7
2/8/19	14:38:36	4.13	23.5	140.5
2/8/19	14:39:06	4.12	23.5	143.8
2/8/19	14:39:36	4.13	23.5	140.9
2/8/19	14:40:06	4.12	23.5	144.2
2/8/19	14:40:36	4.14	23.5	140.3
2/8/19	14:41:06	4.12	23.5	144.8
2/8/19	14:41:36	4.12	23.5	141.9
2/8/19	14:42:06	4.13	23.5	140.5
2/8/19	14:42:36	4.13	23.5	140.8
2/8/19	14:43:06	4.11	23.5	144.7
2/8/19	14:43:36	4.13	23.5	140.2
2/8/19	14:44:06	4.12	23.5	143.9
2/8/19	14:44:36	4.12	23.5	144.5
2/8/19	14:45:06	4.13	23.5	143.3
2/8/19	14:45:36	4.11	23.5	144.3
2/8/19	14:46:06	4.13	23.5	140.4
2/8/19	14:46:36	4.13	23.5	142.6
2/8/19	14:47:06	4.13	23.5	140.3
2/8/19	14:47:36	4.12	23.5	142.0
2/8/19	14:48:06	4.12	23.5	144.3
2/8/19	14:48:36	4.12	23.5	143.1
2/8/19	14:49:06	4.12	23.5	143.5
2/8/19	14:49:36	4.13	23.5	140.3
2/8/19	14:50:06	4.13	23.5	141.2
2/8/19	14:50:36	4.12	23.5	144.2
2/8/19	14:51:06	4.13	23.5	142.7
2/8/19	14:51:36	4.13	23.5	141.5
2/8/19	14:52:06	4.12	23.5	144.8
2/8/19	14:52:36	4.12	23.5	144.7
2/8/19	14:53:06	4.13	23.5	140.3
2/8/19	14:53:36	4.13	23.5	140.3
2/8/19	14:54:06	4.13	23.5	141.4

Date	Time	pH_ORP Offset	Low_pH Slope	Hi_pH Slope	C Offset	Hours mV_Offset	Hours Low_Slope	Hours Hi_Slope	Hours C_Offset
2/8/19	15:05:36	2197	1208	1115	249	79	79	79	79
2/8/19	15:35:36	2197	1208	1115	249	79	79	79	79
2/8/19	16:05:36	2197	1208	1115	249	80	80	80	80
2/8/19	16:35:36	2197	1208	1115	249	80	80	80	80
2/8/19	17:05:36	2197	1208	1115	249	81	81	81	81
2/8/19	17:35:36	2197	1208	1115	249	81	81	81	81
2/8/19	18:05:36	2197	1208	1115	249	82	82	82	82
2/8/19	18:35:36	2197	1208	1115	249	82	82	82	82
2/8/19	19:05:36	2197	1208	1115	249	83	83	83	83
2/8/19	19:35:36	2197	1208	1115	249	83	83	83	83
2/8/19	20:05:36	2197	1208	1115	249	84	84	84	84
2/8/19	20:35:36	2197	1208	1115	249	84	84	84	84
2/8/19	21:05:36	2197	1208	1115	249	85	85	85	85
2/8/19	21:35:36	2197	1208	1115	249	85	85	85	85
2/8/19	22:05:36	2197	1208	1115	249	86	86	86	86
2/8/19	22:35:36	2197	1208	1115	249	86	86	86	86
2/8/19	23:05:36	2197	1208	1115	249	87	87	87	87
2/8/19	23:35:36	2197	1208	1115	249	87	87	87	87
2/9/19	0:05:36	2197	1208	1115	249	88	88	88	88
2/9/19	0:35:36	2197	1208	1115	249	88	88	88	88
2/9/19	1:05:36	2197	1208	1115	249	89	89	89	89
2/9/19	1:35:36	2197	1208	1115	249	89	89	89	89
2/9/19	2:05:36	2197	1208	1115	249	90	90	90	90
2/9/19	2:35:36	2197	1208	1115	249	90	90	90	90
2/9/19	3:05:36	2197	1208	1115	249	91	91	91	91
2/9/19	3:35:36	2197	1208	1115	249	91	91	91	91
2/9/19	4:05:36	2197	1208	1115	249	92	92	92	92
2/9/19	4:35:36	2197	1208	1115	249	92	92	92	92
2/9/19	5:05:36	2197	1208	1115	249	93	93	93	93
2/9/19	5:35:36	2197	1208	1115	249	93	93	93	93
2/9/19	6:05:36	2197	1208	1115	249	94	94	94	94
2/9/19	6:35:36	2197	1208	1115	249	94	94	94	94
2/9/19	7:05:36	2197	1208	1115	249	95	95	95	95
2/9/19	7:35:36	2197	1208	1115	249	95	95	95	95
2/9/19	8:05:36	2197	1208	1115	249	96	96	96	96
2/9/19	9:04:44	2197	1208	1115	249	97	97	97	97
2/9/19	9:34:44	2197	1208	1115	249	97	97	97	97
2/9/19	10:04:44	2197	1208	1115	249	97	97	97	97
2/9/19	10:34:44	2197	1208	1115	249	97	97	97	97
2/9/19	11:04:44	2197	1208	1115	249	98	98	98	98
2/9/19	11:34:44	2197	1208	1115	249	98	98	98	98
2/9/19	12:04:44	2197	1208	1115	249	99	99	99	99
2/9/19	12:34:44	2197	1208	1115	249	99	99	99	99

Date	Time	Dampen	Year	Month	Serial Letter	Serial Number	Sensor Item #	Min Temp	Max Temp	Time In Service
2/8/19	15:05:36	6	18	11	3	0	1418	591	705	570
2/8/19	15:35:36	6	18	11	3	0	1418	591	705	570
2/8/19	16:05:36	6	18	11	3	0	1418	591	705	571
2/8/19	16:35:36	6	18	11	3	0	1418	591	705	571
2/8/19	17:05:36	6	18	11	3	0	1418	591	705	572
2/8/19	17:35:36	6	18	11	3	0	1418	591	705	572
2/8/19	18:05:36	6	18	11	3	0	1418	591	705	573
2/8/19	18:35:36	6	18	11	3	0	1418	591	705	573
2/8/19	19:05:36	6	18	11	3	0	1418	591	705	574
2/8/19	19:35:36	6	18	11	3	0	1418	591	705	574
2/8/19	20:05:36	6	18	11	3	0	1418	591	705	575
2/8/19	20:35:36	6	18	11	3	0	1418	591	705	575
2/8/19	21:05:36	6	18	11	3	0	1418	591	705	576
2/8/19	21:35:36	6	18	11	3	0	1418	591	705	576
2/8/19	22:05:36	6	18	11	3	0	1418	591	705	577
2/8/19	22:35:36	6	18	11	3	0	1418	591	705	577
2/8/19	23:05:36	6	18	11	3	0	1418	591	705	578
2/8/19	23:35:36	6	18	11	3	0	1418	591	705	578
2/9/19	0:05:36	6	18	11	3	0	1418	591	705	579
2/9/19	0:35:36	6	18	11	3	0	1418	591	705	579
2/9/19	1:05:36	6	18	11	3	0	1418	591	705	580
2/9/19	1:35:36	6	18	11	3	0	1418	591	705	580
2/9/19	2:05:36	6	18	11	3	0	1418	591	705	581
2/9/19	2:35:36	6	18	11	3	0	1418	591	705	581
2/9/19	3:05:36	6	18	11	3	0	1418	591	705	582
2/9/19	3:35:36	6	18	11	3	0	1418	591	705	582
2/9/19	4:05:36	6	18	11	3	0	1418	591	705	583
2/9/19	4:35:36	6	18	11	3	0	1418	591	705	583
2/9/19	5:05:36	6	18	11	3	0	1418	591	705	584
2/9/19	5:35:36	6	18	11	3	0	1418	591	705	584
2/9/19	6:05:36	6	18	11	3	0	1418	591	705	585
2/9/19	6:35:36	6	18	11	3	0	1418	591	705	585
2/9/19	7:05:36	6	18	11	3	0	1418	591	705	586
2/9/19	7:35:36	6	18	11	3	0	1418	591	705	586
2/9/19	8:05:36	6	18	11	3	0	1418	591	705	587
2/9/19	9:04:44	6	18	11	3	0	1418	591	705	588
2/9/19	9:34:44	6	18	11	3	0	1418	591	705	588
2/9/19	10:04:44	6	18	11	3	0	1418	591	705	588
2/9/19	10:34:44	6	18	11	3	0	1418	591	705	588
2/9/19	11:04:44	6	18	11	3	0	1418	591	705	589
2/9/19	11:34:44	6	18	11	3	0	1418	591	705	589
2/9/19	12:04:44	6	18	11	3	0	1418	591	705	590
2/9/19	12:34:44	6	18	11	3	0	1418	591	705	590

APPENDIX "A"

Temperature Considerations for Calibrating pH Sensors with pH Buffers – Part 1 of 2

Exact pH Values of the NIST Traceable pH buffers at Various Temperatures
Nominal pH Buffer Designation @ 25°C Shown in Gray at Top of Column

Temp °C	**1.68**	**4.00**	**6.86**	**7.00**	**9.18**	**10.01**	**12.45**
0	1.67	4.01	6.98	7.11	9.46	10.32	13.42
5	1.67	4.00	6.95	7.08	9.39	10.25	13.21
10	1.67	4.00	6.92	7.06	9.33	10.18	13.00
15	1.67	4.00	6.90	7.03	9.28	10.12	12.81
20	1.68	4.00	6.88	7.01	9.23	10.06	12.63
25	1.68	4.00	6.86	7.00	9.18	10.01	12.45
30	1.68	4.01	6.85	6.98	9.14	9.97	12.29
35	1.69	4.02	6.84	6.98	9.10	9.93	12.13
40	1.69	4.03	6.84	6.97	9.07	9.89	11.98
45	1.70	4.04	6.83	6.97	9.04	9.86	11.84
50	1.71	4.06	6.83	6.97	9.02	9.83	11.71
55	1.72	4.07	6.83	6.97	8.99	9.80	11.57
60	1.72	4.09	6.84	6.98	8.97	9.78	11.45

NIST traceable pH buffers are the most commonly used methods for calibration of pH sensors. On each pH buffer bottle is written the exact pH value of the buffer at variety of temperature conditions. Listed above are exact pH values for the most commonly used buffers between 0 and 60 °C. When using the ASTI HiQDT Touchscreen Controller for calibration of your IOTRON™ series Smart Digital HiQDT type RS-485 MODBUS RTU pH sensors use the autobuffer calibration mode if using the pH buffers detailed above. For any other pH buffers you will need to obtained the exact pH value for the current temperature condition. This information is typically provided on the label of the pH buffer.

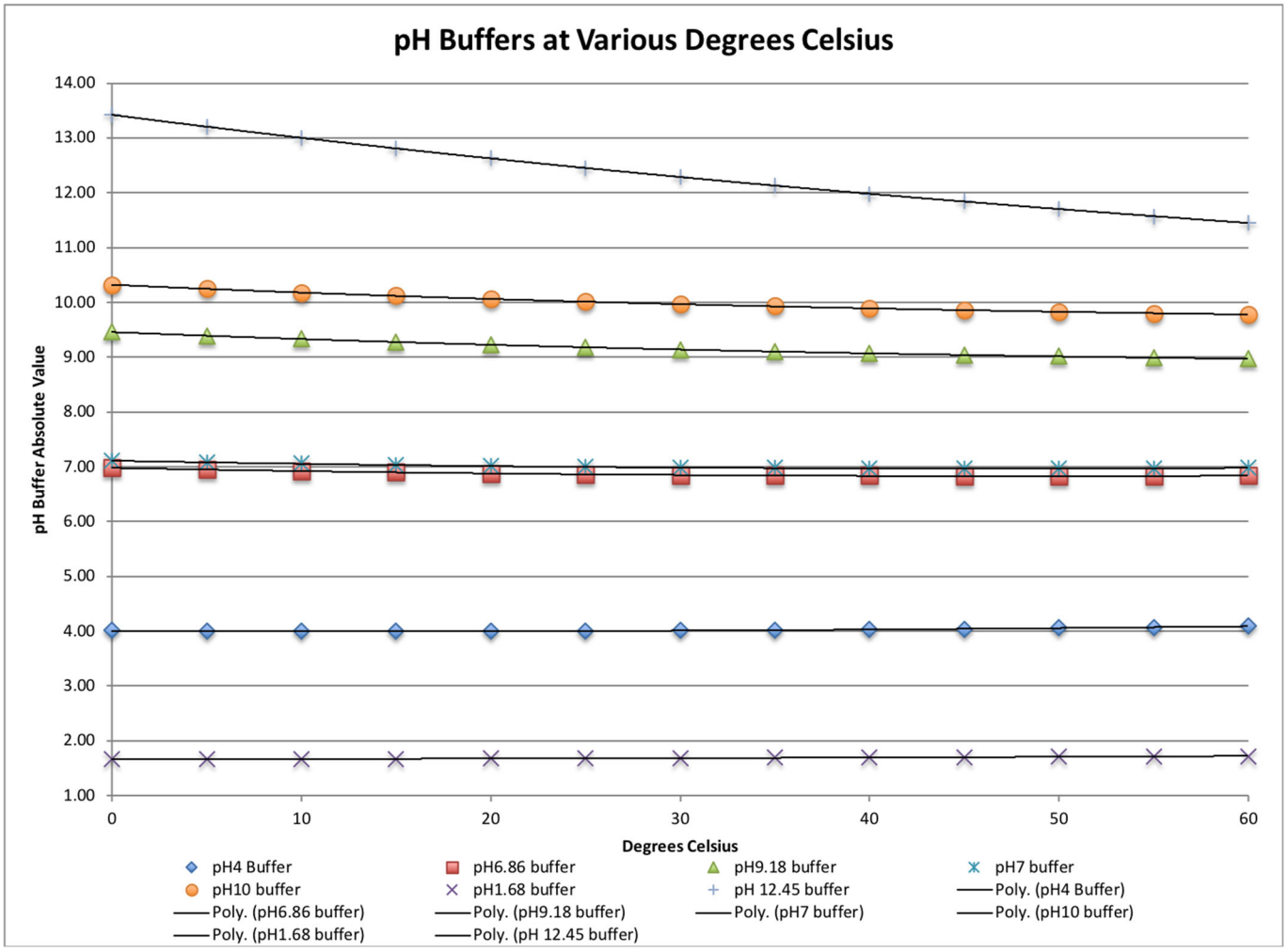
NOTE: ASTI HiQDT touchscreen controller software automatically corrects for temperature induced change to buffer to compute the exact pH value of buffer automatically when calibrations are performed with autobuffer calibration mode. Exact pH value of the buffer at the current temperature obtained from the connected HiQDT pH sensor is used for calibration. This may differ from the nominal value of the buffer at the reference 25 degree Celsius condition.

To use any pH buffer besides 1.68, 4.00, 6.86, 7.00, 9.18, 10.01 or 12.45 you will need to account for the temperature induced shift of the pH value for the buffer in both the Windows software as well as any other devices used to perform calibrations of the HiQDT pH sensors. There are no reliable pH buffers below 1.69 and above 12.45 and so specialized and custom calibration schemes needed to be used for these situations. Contact factory for assistance in such cases.

Inquire to the factory if you plan to measure consistently below pH=1.0 or above pH=13.0 for special assistance. As can be seen from mere inspection the temperature dependence of high pH buffers is much more significant than for low pH buffers. Similarly for process solutions with high pH the temperature induced pH dependence may be quite significant and should be considered when trying to control such systems with fluctuating temperature. Process solutions with relatively weak ionic strength (low conductivity) are also rather prone to higher temperature induced pH shifts whereas process solution with relatively high ionic strength (high conductivity) are less prone to temperature induced pH shifts.

APPENDIX "B"

Temperature Considerations for Calibrating pH Sensors with pH Buffers – Part 2 of 2



The HiQDT touchscreen controller automatic calibration mode computes the exact values of the pH 1.68, 4.00, 6.86, 7.00, 9.18, 10.01 and 12.45 buffers in the automatic calibration mode for anywhere between 0 to 60 °C. If calibrating with pH buffers in the temperature condition below 0°C or above 60 °C automatic calibration mode cannot be used (manual mode must be used instead). The HiQDT touchscreen controller software can also perform manual calibration to any pH value for Offset, Slope Low (Acidic) or Slope High (Alkaline). In this way this controller is not limited to pH 1.68, 4.00, 6.86, 7.00, 9.18, 10.00 and 12.45 buffers for calibration but rather can perform offset and slope calibrations to any value desired.

Temperature compensation only accounts for the change in the mV response of the pH sensor itself with temperature. The type of temperature induced shifts such as those demonstrated in the table above for the pH buffers are NOT corrected in default Nernstian temperature compensation scheme. For process solutions the change in the pH value with temperature can be significantly more pronounced than for pH buffers which are inherently designed to shift in only the most minimal way due to changes in temperature, dilution, evaporation and other typical conditions in field use. Thankfully the HiQDT-pH sensors allow for a user defined temperature compensation coefficient to account for the NET temperature effects. The temperature impact on the pH sensor and the temperature impact on the measured solution cannot be cleanly separated (deconvoluted). It is, however, possible to determine the effective net mV per °C change and enter this as a custom temperature compensation coefficient. Contact the ASTI factory for assistance with such situations requiring special temperature compensation schemes. The default temperature compensation setting is the classical Nernstian 198µV (0.198mV) per °C with the allowable range of 000-999 µV to any custom value for your given process. The temperature compensation coefficient can be changed by the Windows software or handheld communicator.

APPENDIX "C"

HiQDT-pH " Buffer Choices for Autocalibration

AVAILABLE pH BUFFERS FOR AUTOCALIBRATION MODE:

Asymmetric Potential (A.P):	7.00 or 6.86
Acid Slope:	4.00 of 1.68
Alkaline Slope:	10.00 or 9.18 or 12.45

CALIBRATION SCHEME # 1 – Typical for most installations in the USA

Asymmetric Potential (A.P):	7.00
Acid Slope:	4.00
Alkaline Slope:	10.00

This scheme is the most common pH buffer scheme for most customers in the USA. The 10.01 pH buffer must be used carefully since it is more prone to shifting substantially more than the very stable 4.00 or even the 7.00 pH buffer. Intrusion of carbon dioxide into the 10.01 pH buffer from the atmosphere is the main culprit creating an erroneous non-temperature induced shift in pH by exceeding the buffer capacity. Care should be taken that the pH10 buffer is fresh to ensure relaible alkaline slope calibration results.

CALIBRATION SCHEME # 2 – Typical for most installations in Europe

Asymmetric Potential (A.P):	6.86
Acid Slope:	4.00
Alkaline Slope:	9.18

Typical values for most European pH installations are 4.00, 6.86 and 9.18 pH buffers. This is the best practice pH buffer scheme for most pH measurements that do not commonly go much below pH 4.00 and or else much above pH 9.20. The 6.86 & 9.18 pH buffers are most stable than the 7.00 & 10.01 pH buffer counterparts but are still more prone to shifting then the very stable 4.00 pH buffer. Care should be taken that the pH 9.18 buffer is fresh to ensure best alkaline slope calibration results

CALIBRATION SCHEME # 3 – For batch style installations where pH can vary quite considerably

Asymmetric Potential (A.P):	1.68
Acid Slope:	6.86
Alkaline Slope:	12.45

This pH buffer calibration scheme is typical for batch type process applications that often go below pH2 and above pH12. The 1.69 and 6.86 pH buffers are quite stable but the 12.45 pH buffer shifts in value quite easily. Great care should be taken when using the 12.45 buffer to ensure accurate results. In particular this buffer should always be in code, well stored in a cool dry place and not exposed to light or air. Make sure that the 12.45 pH buffer is always fresh to ensure reliable alkaline slope calibrations results.

APPENDIX "D"

HiQDT-pH " Best Practice Tips for Calibration with pH Buffers

TEMPERATURE OFFSET CALIBRATION SETUP FOR AUTOREAD:

It is best practice to wait until the temperature reading on the sensor is no longer moving before selecting the setup temperature and starting calibration(s) with pH buffers. The temperature of the sensor may take some time to reach the ambient conditions of the pH buffer solution(s) if it was previously installed into field service at conditions that are significantly below or above the ambient temperature.

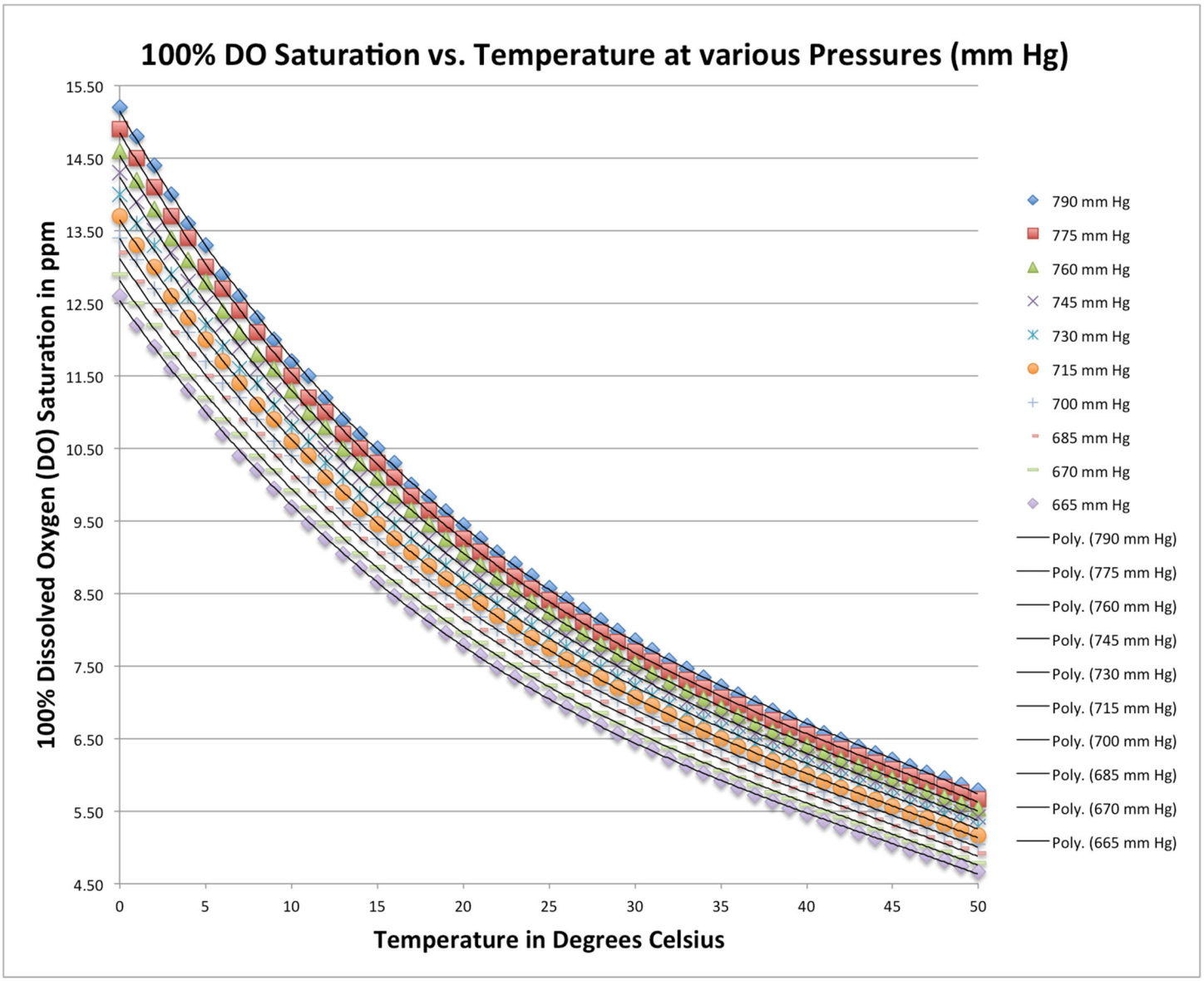
GENERAL BEST PRACTICE COMMENTS FOR CALIBRATION WITH pH BUFFERS

Only the amount of buffer required for the given calibration should be dispensed. Buffers should not be reused to avoid dilution & cross-contamination. Buffers should not be left exposed to air or direct light for prolonged periods of time to avoid the impact of dissolved carbon dioxide from the atmosphere and other potential decomposition pathways. Special care should be taken the pH buffers above 7.00 are always fresh when used for calibrations as these tend to loose the integrity of their values much faster than pH buffers below 7.00. Buffers should be stored in a cool, dry location away from light and chemicals. The pH sensor should at a stable ambient temperature before performing any calibration.

APPENDIX "E"

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

The HiQDT-DO sensor 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.

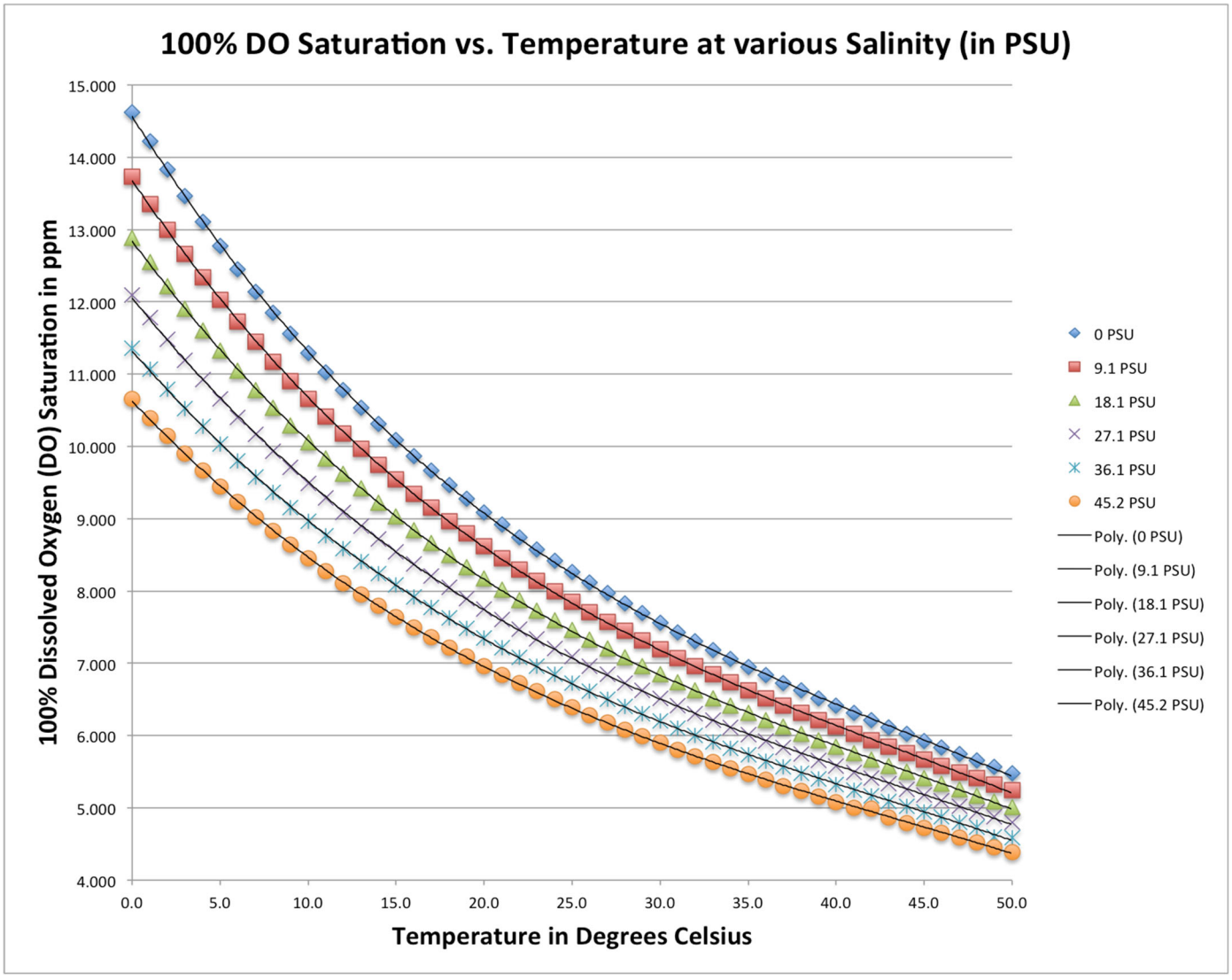


For the calibration function, either the field condition should be 100% relative humidity for best accuracy or else the sensor should be suspended dry in air but over a water source to simulate locally the 100% relative humidity condition. The water molecule in air (humidity) is then saturated with oxygen 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 HiQDT-DO sensor uses the internally stored curve visualization above.

APPENDIX "F"

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

The HiQDT-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 HiQDT-DO sensor to perform this correction. The value of the salinity can be determined by a handheld meter or else monitoring continuously using a conductivity transmitter from which one can readily convert into common salinity units.

APPENDIX "G" – PAGE 1 of 4

STANDARD RANGE MODE * - in microSiemens/cm

Range Scaling Factor	200		Max Temp. Compensated Conductivity using 2% per °C Coefficient			
Cell Constant (K)	Max Raw Input Limit	Resolution	Lowest Recommended Measurement @ 25°C	@ 25 °C	@ 75 °C	@ 125°C
0.01	200	0.004	2	200	100	66.67
0.02	400	0.008	4	400	200	133.33
0.05	1,000	0.02	10	1,000	500	333.33
0.10	2,000	0.04	20	2,000	1,000	666.67
0.20	4,000	0.08	40	4,000	2,000	1,333.33
0.50	10,000	0.2	100	10,000	5,000	33,33.33
1.00	20,000	0.4	200	20,000	10,000	66,66.67
2.00	40,000	0.8	400	40,000	20,000	13,333.33
3.00	60,000	1.2	600	60,000	30,000	20,000.00
5.00	100,000	2	1,000	100,000	50,000	33,333.33
10.00	200,000	4	2,000	200,000	100,000	66,666.67
20.00	400,000	8	4,000	400,000	200,000	133,333.33

HIGH RANGE MODE * - in microSiemens/cm

Range Scaling Factor	2,000		Max Temp. Compensated Conductivity using 2% per °C Coefficient			
Cell Constant (K)	Max Raw Input Limit	Resolution	Lowest Recommended Measurement @ 25°C	@ 25 °C to 75°C	@ 125°C	@ 175°C
0.01	2,000	0.04	20	1000	666.67	500
0.02	4,000	0.08	40	2,000	1,333.33	1,000
0.05	10,000	0.2	100	5,000	3,333.33	2,500
0.10	20,000	0.4	200	10,000	6,666.67	5,000
0.20	40,000	0.8	400	20,000	13,333.33	10,000
0.50	100,000	2	1,000	50,000	33,333.33	25,000
1.00	200,000	4	2,000	100,000	66,666.67	50,000
2.00	400,000	8	4,000	200,000	133,333.33	100,000
3.00	600,000	12	6,000	300,000	200,000.00	150,000
5.00	1,000,000	20	10,000	500,000	3333,33.33	250,000
10.00	2,000,000	40	20,000	1,000,000	666,666.67	500,000
20.00	4,000,000	80	40,000	2,000,000	1,333,333.33	1,000,000

* **Sensor can toggle between standard/high range mode range mode using handheld communicator.** Standard/high range mode sensor is one configuration & associated sensor board hardware. Ultralow range mode sensor is a different configuration & associated sensor board. While you can toggle between standard and high range modes you cannot toggle between the standard/high and ultralow modes since these are two different sensor boards. Two slope calibrations are stored in dual mode standard/high sensors; slope low is used for standard mode and slope high for the high mode. Slope calibrations are automatically assigned based upon range mode in use for at time when calibration is performed. The ultralow range mode only uses the single low slope (slope high is unused).

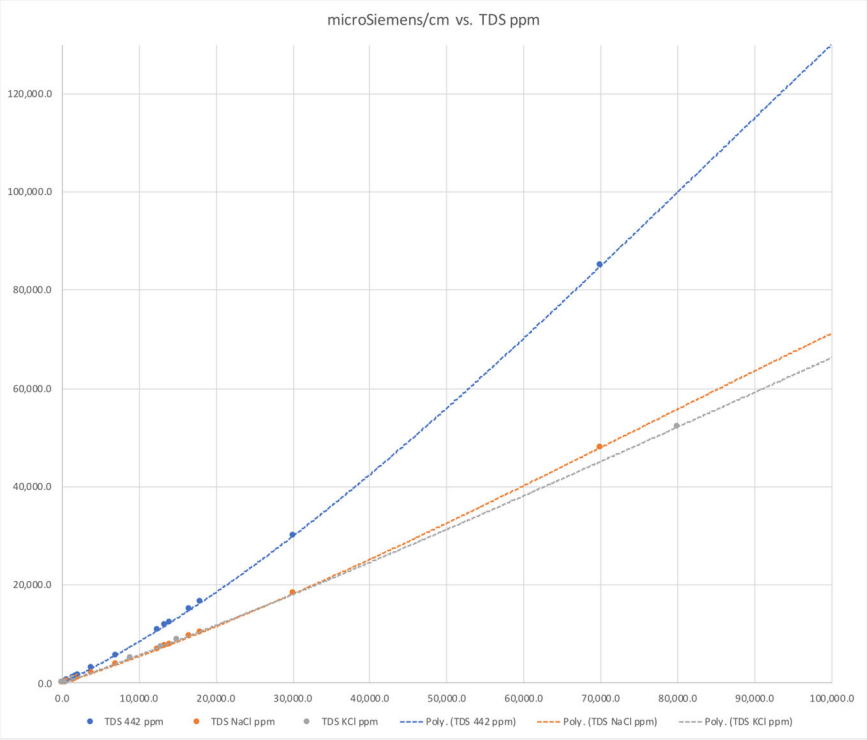
	CELL CONSTANT										
SENSOR	**0.01**	**0.02**	**0.05**	**0.10**	**0.20**	**1.00**	**2.00**	**3.00**	**5.00**	**10.00**	**20.00**
AST10											
AST51											
AST41											
ASTXX-TRI											
AST42											
AST40											
AST50											
AST60											
AST52											

Color Coding — Available in Cell Constant; Not available in that Cell Constant

All contacting conductivity sensors are available in smart digital MODBUS RTU configuration although not all cell constants are available for each model. Use the standard & high range mode cell constant table above & ultralow range mode table below to determine most suitable selection for your sample. ***Cell constants above K=2.00/cm omitted from ultralow range table but available on request.***

ULTRA-LOW RANGE MODE - in microSiemens/cm

Range Scaling Factor	2		Max Temp. Compensated Conductivity using 2% per °C Coefficient			
Cell Constant (K)	Max Raw Input Limit	Resolution	Lowest Recommended Measurement @ 25°C	@ 25°C	@ 75°C	@ 125°C
0.01	2	0.00004	0.02	2	1	0.667
0.02	4	0.00008	0.04	4	2	1.333
0.05	10	0.0002	0.1	10	5	3.333
0.10	20	0.0004	0.2	20	10	6.667
0.20	40	0.0008	0.4	40	20	13.333
0.50	100	0.002	1.0	100	50	33.333
1.00	200	0.004	2.0	200	100	66.667
2.00	400	0.008	4.0	400	200	133.33

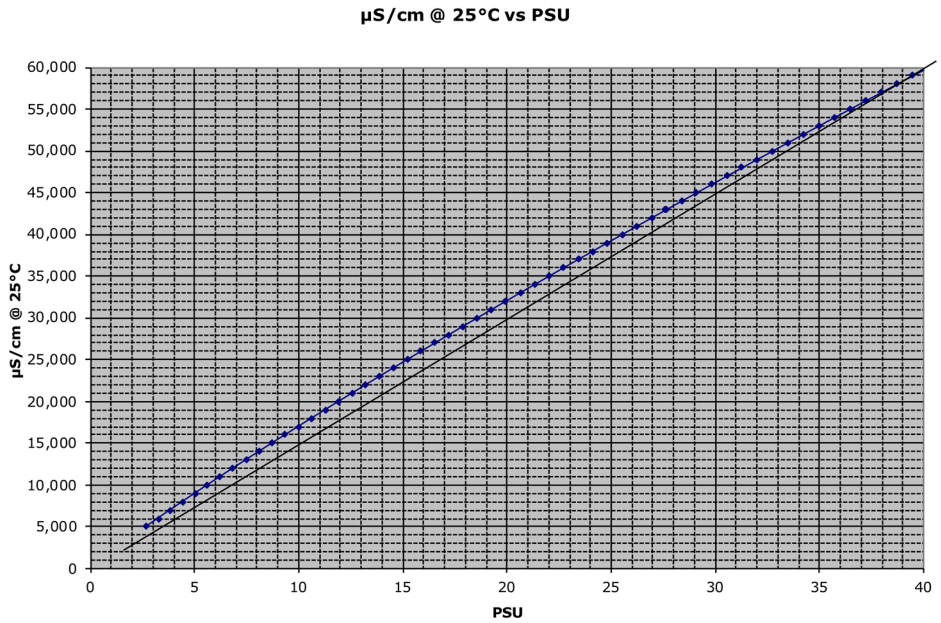


Total dissolved solids (TDS) *units are computed from measured conductivity. The curves that define relationship between the measured conductivity and user selectable total dissolved solid (TDS) units of NaCl, KCl or 442 are preprogrammed into sensor with full range of 0 to 100,000 ppm. The actual usable range may be limited by the choice of cell constant and range mode in which the sensor is operated.*

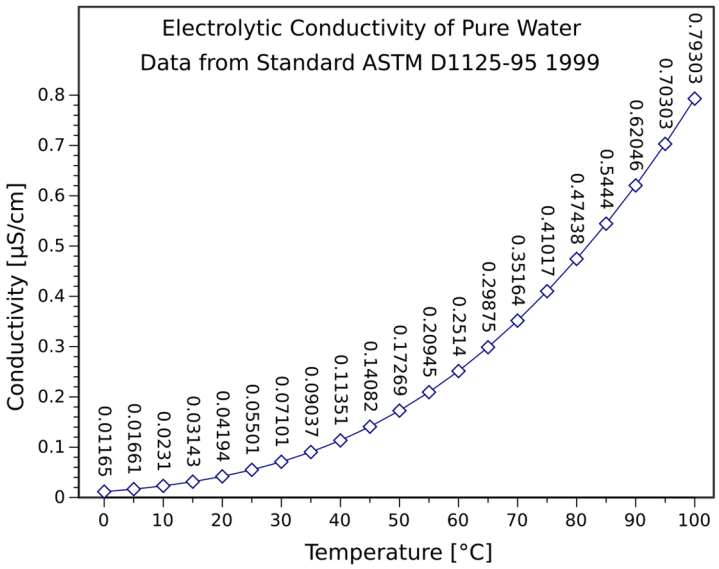
Other types of total dissolved solids (TDS) for other electrolytes or electrolyte mixtures can be programmed into the sensor on a special-order basis (minimum order requirements apply for such special programming requests). Inquire to the factory if you have need for such special TDS units for your smart digital HiQDT MODBUS RTU conductivity sensors.

Salinity computed from the measured conductivity. *Curves that define the relationship between measured conductivity and the computed salinity in PSU are preprogrammed into the sensor with a full range of 0.000 to 50.000 PSU.*

The actual supported range may be limited by cell constant & range mode used). Contact the factory to determine the most suitable sensor model and cell constant configuration for your desired salinity range of interest.



Ultralow Range Conductivity Sensors for Ultrapure Water (UPW)



The conductivity of pure water varies significantly with temperature in a well-defined but non-linear fashion as detailed in the graph to left. This behavior is preprogrammed into the HiQDT-CON-L MODBUS RTU conductivity sensors for the automatic temperature compensation feature to make it suitable for ultrapure water (UPW) type applications.

Although the recommended cell constant for performing conductivity measurement in UPW is K=0.01/cm for best resolution and lower bounds of measurement there may be situations where this K=0.01/cm cell constant cannot be used for the planned installation location because of limitations such as piping arrangement and low-flow. The higher cell constants of K=0.05/cm or K=0.10/cm can be used instead in such cases albeit they require the sample to be at a higher temperature to ensure best results. Table below details recommended minimum temperature for various cell constants for use in UPW. The minimum temperature for UPW measurement for each cell is determined based upon the lowest absolute conductivity value for which the cell constant is recommended & temperature at which this conductivity occurs for UPW. Resistivity are computed units are the inverse of the measured conductivity value.

ULTRA-LOW RANGE MODE - MicroSiemens/cm

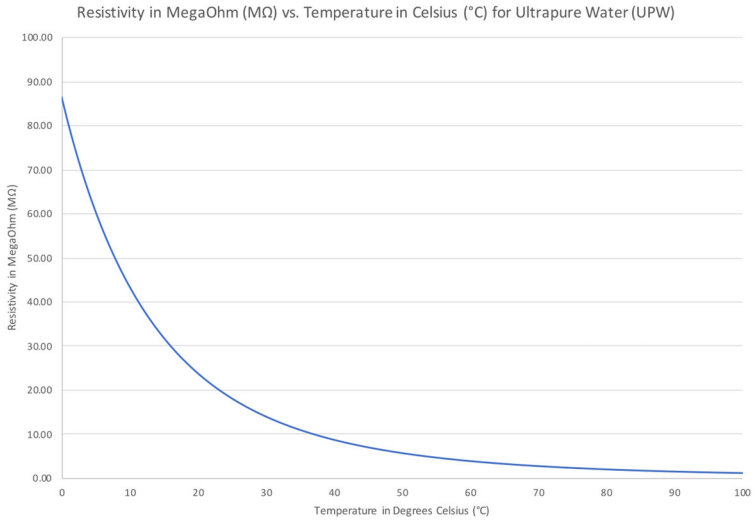
Range Scaling Factor 2

Cell Constant (K)	Raw Max Input @ 25°C	Resolution	Lowest Recommended Absolute Measurement	Minimum Temp °C *	Absolute MegaOhm (MΩ) @ Min Recommended °C *
0.01	2	0.00004	0.02	8	50
0.05	10	0.0002	0.1	40	10
0.10	20	0.0004	0.2	55	5

** Minimum recommended temperature is conductivity of UPW which is 1% of ultralow range mode for the given cell and the associated MegaOhm units. Measurements can be performed below the recommended minimum temperature with an associated higher uncertainty for those situations.*

For ultralow range conductivity sensors the 5th read input register (30005) sends the computed resistivity MegaOhm (MΩ) using the user defined linear automatic temperature compensation (ATC) while the 6th read input register (30006) sends computed resistivity MegaOhm (MΩ) using the special non-linear ultrapure water style automatic temperature compensation. The resistivity values sent as 0 to 50,000 steps corresponding to 0.000-50.000 MegaOhm (MΩ) for both the 5th (30005) & 6th (30006) read input registers. Theoretical temperature compensated resistivity value can never go above 18.18 MegaOhm (MΩ) for uncontaminated pure water since this is the ideal value at 25 degrees Celsius.

Temperature compensated conductivity and resistivity are referenced back to the 25 °C condition for all ATC. Ultrapure water with no contaminants has a value of 0.055 µS/cm conductivity or 18.18 MΩ in resistivity. The most common units for measurement of pure water is resistivity (MΩ) MegaOhm due to high resolution and convenient scaling in the very low conductivity levels. Temperature compensated conductivity and computed resistivity values sent for the ultralow range mode smart digital HiQDT-CON-L style MODBUS RTU conductivity sensors as well as the raw conductivity.



Graph above shows relationship between the resistivity of pure water at various temperatures. Computed resistivity MegaOhm (MΩ) units are the inverse of measured conductivity and so are the mirror image of the conductivity at various temperatures for ultrapure water (UPW). Graph above shows absolute raw resistivity at various temperatures. Resistivity values sent include ATC referencing reading to 25 °C state.

HiQDT-CON-ISO-L-10X SENSOR CELL & RANGE TABLE FOR ULTRALOW-10X HARDWARE

ULTRA-LOW RANGE MODE 10X * - in microSiemens/cm

Range Scaling Factor	2			Max Temp. Compensated Conductivity using 2% per °C Coefficient			
Nominal Cell Int **	**ACTUAL** Cell Constant	Max Raw Input Limit	Resolution ***	Lowest Recommended Measurement @ 25°C	@ 25°C	@ 75°C	@ 125°C
10	0.01	20	0.0004	0.2	20	10	6.667
20	0.02	40	0.0008	0.4	40	20	13.333
50	0.05	100	0.002	1.0	100	50	33.333
100	0.10	200	0.004	2.0	200	100	66.667
200	0.20	400	0.008	4.0	400	200	133.33
500	0.50	1,000	0.02	10.0	1,000	500	333.33
1000	1.00	2,000	0.04	20.0	2,000	1,000	666.667
2000	2.00	4,000	0.08	40.0	4,000	2,000	1,333.33

* Range mode defined by register 40018. When register 40018 is 2 then range scaling factor is ultralow mode. **This register 40018 is read only for the ultralow mode sensor type.**

** The nominal cell constant of conductivity sensor is found by dividing integer obtained from register 40019 by 100.

*** The resolution is always 50,000 steps no matter the nominal cell constant of sensor or range mode that is in operation.

If sensor used is only ever just one cell constant and range mode, then simple scaling of 0-50,000 steps to conductivity range is possible. Procedure below supports any cell constant in any range mode without changing programming of MODBUS RTU master PLC device:

1) Converting registers 30001 & 30003 for conductivity sensors into µS/cm conductivity units

To display calibrated & temperature compensated conductivity in µS/cm units, use the following formula:

uS/cm = ((REG30001 * REG40019) * REG40018) / 50,000

To display calibrated raw conductivity in µS/cm units use register 30003 instead of 30001 in formula above.

2) Converting µS/cm conductivity units into native 0-50,000 step sensor resolution units

When performing the autocalibration calls on the conductivity sensor you will need to convert from the engineered µS/cm conductivity units to the 0 to 50,000 native resolution units of the conductivity sensor using this formula:

Native 0-50,000 sensor resolution units = (uS/cm * 50,000) / (REG40019 * REG40018)

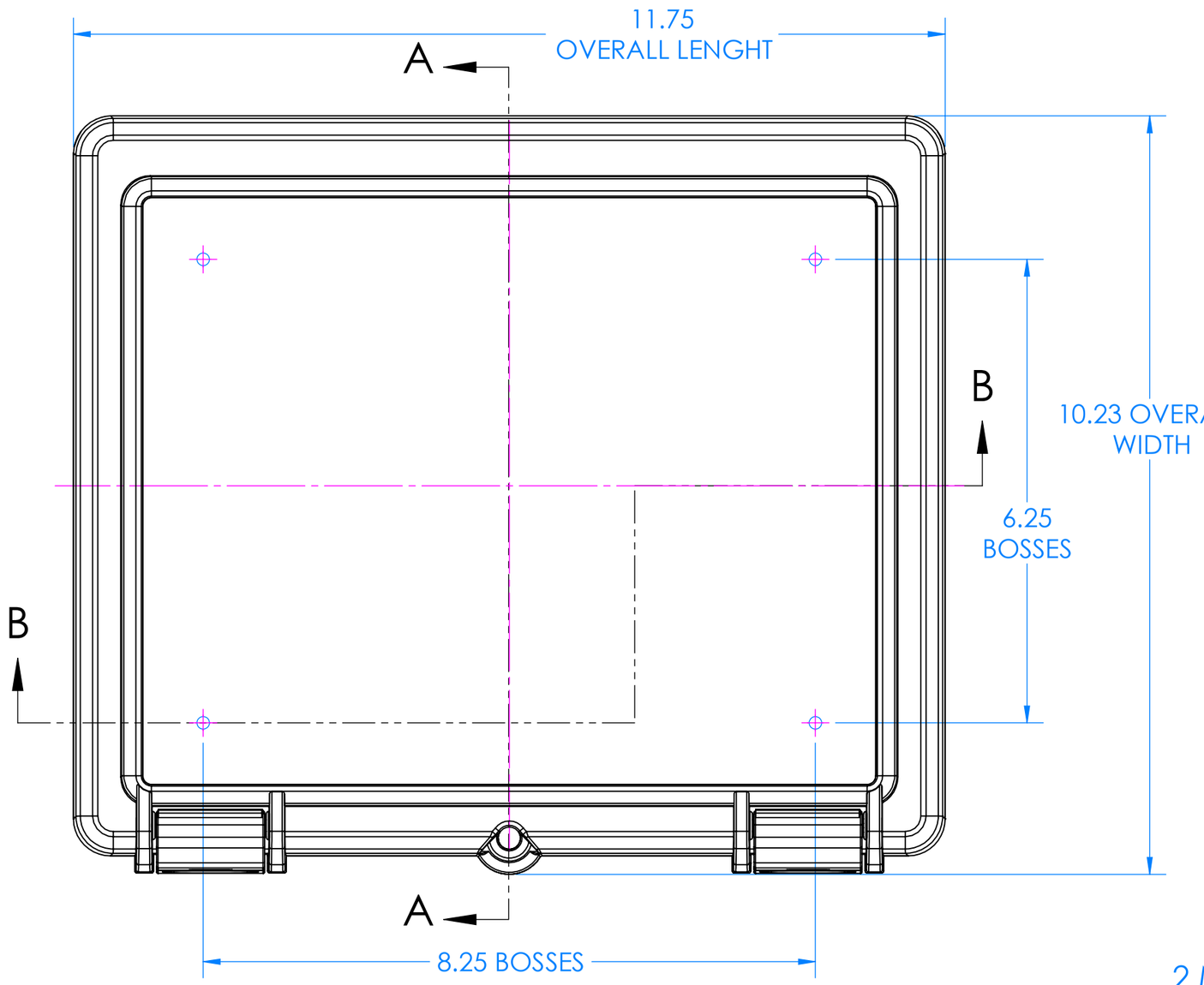
Native 0-50,000 sensor resolution units are what is sent to register 40011 (ultralow slope).

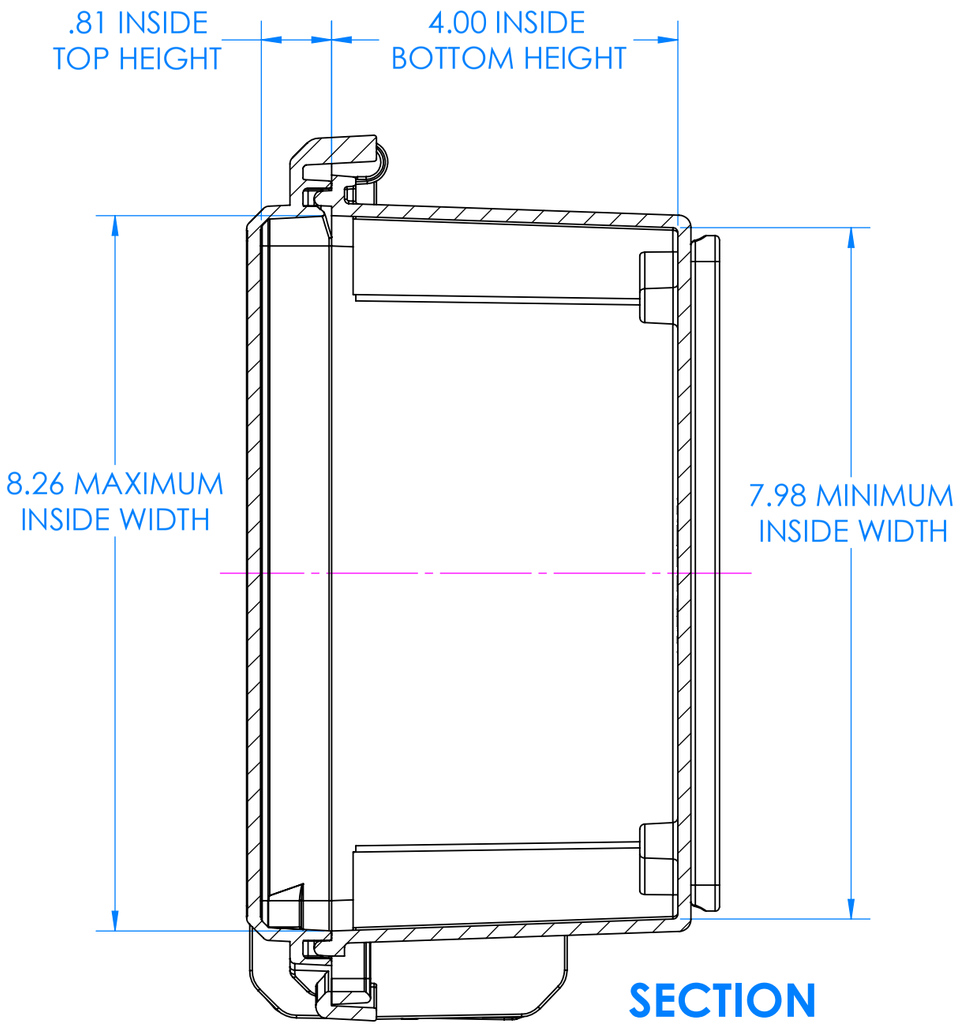
SPECIAL NOTES ABOUT ULTRALOW-10X STYLE SPECIAL ORDER SENSORS:

It is not possible to tell whether the sensor that you have is the Ultralow style or the Ultralow-10X style simply from looking at register 40018 since this would be 2 in both cases. The only way to tell that you have the Ultralow-10X style hardware is that the nominal cell constant detailed in register 40019 will be 10 times higher than the actual cell constant as indicated on the sensor label. This ten-fold deviation between the nominal and the actual cell constant is what is to be expected if you have purchased the Ultralow-10X style sensor. The range of the Ultralow-10X follows what would be expected if the actual cell constant was ten times higher for the same ultralow sensor configuration. Contact factory if you should have any questions or concerns prior to ordering.

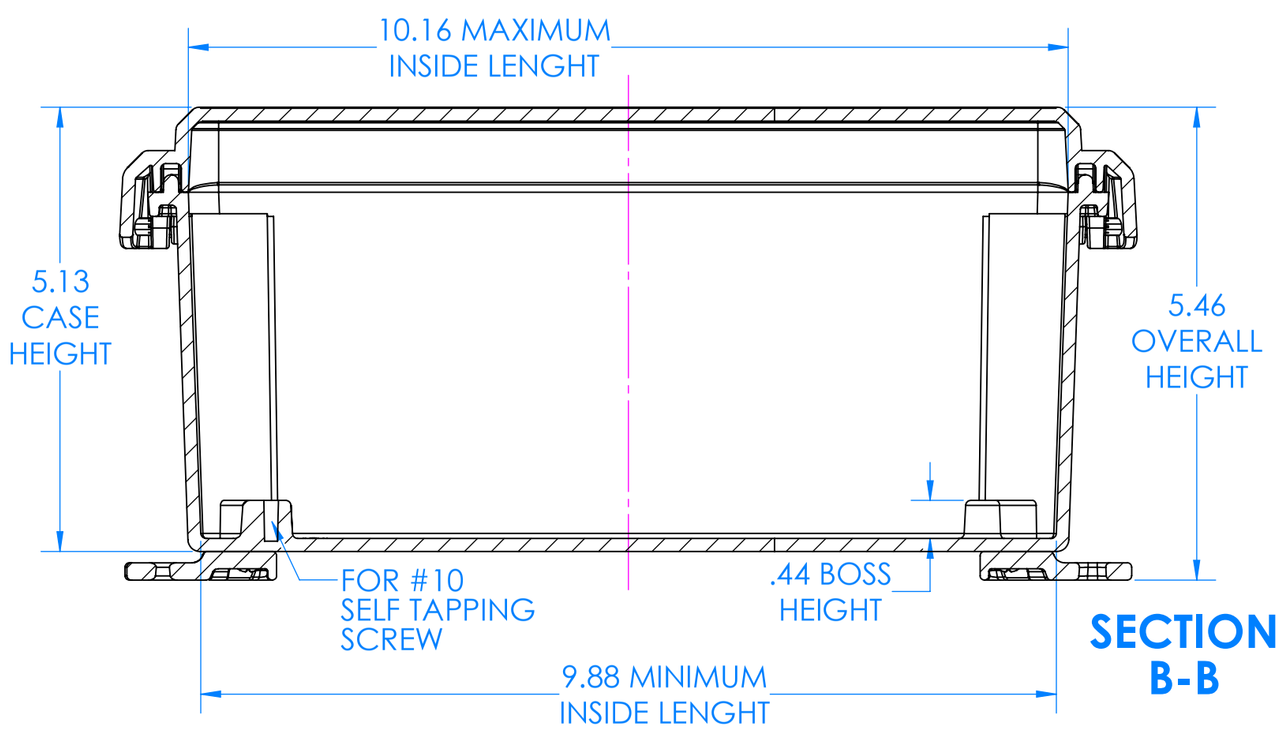
SERPAC Electronic Enclosures

I342HL



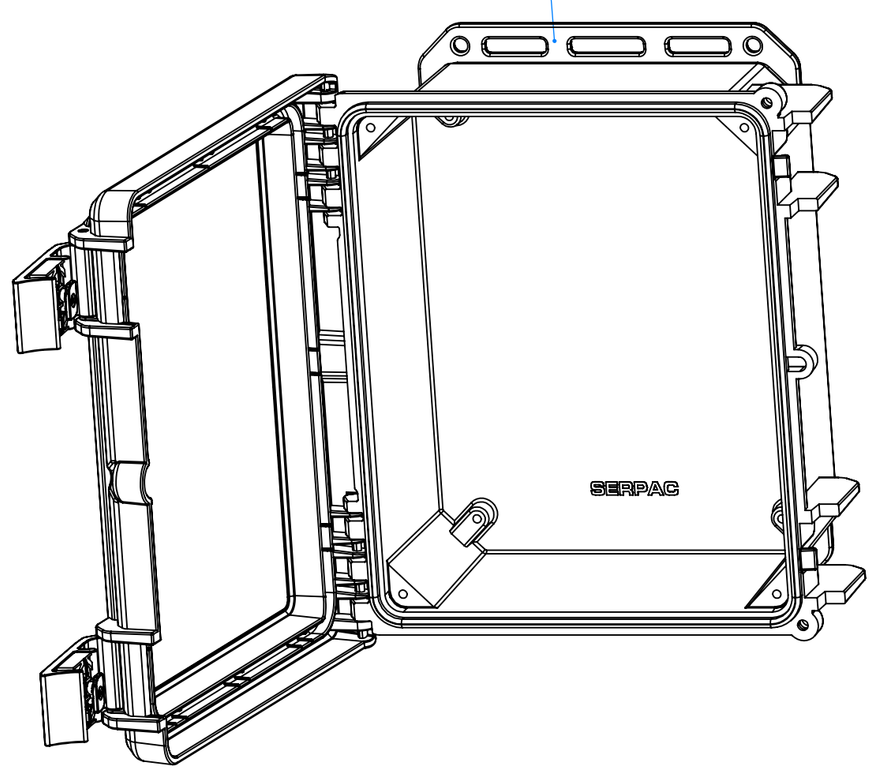


SECTION A-A



SECTION B-B

2 Mounting Brackets included, see sheet 2 for dimensions and for optional mounting Corner Feet and Brackets.



Aluminum and Plastic Panel Kits are available as options, see sheets 3-6.
The aluminum panel options are:
Bottom Panel Kit p/n 7200B
Top Panel Kit p/n 7200T
Hinged Top Panel Kit p/n 7200TH
The plastic panel option is:
Hinged Panel Kit p/n 7200HP

-UL listed to UL 508A 4/4X standard (UL file E519183).
-Material: UV stabilized Polycarbonate Flammability V0, F1 rated material.
-Watertight enclosure meets or exceed Nema 4 and or IP67.

PARTS INCLUDED		
P/N	**Qty.**	**Description**
I352 HLT	1	I352 Hinged Latch Top
I340 HLB	1	I340 Hinge Latch Bottom
8350	1	350 Perimeter O-ring
7011PCM	2	Safety Latch fot I-series (PC)
1305	2	Mounting Bracket
6028	4	SS #10 X 5/8" Pan H/L

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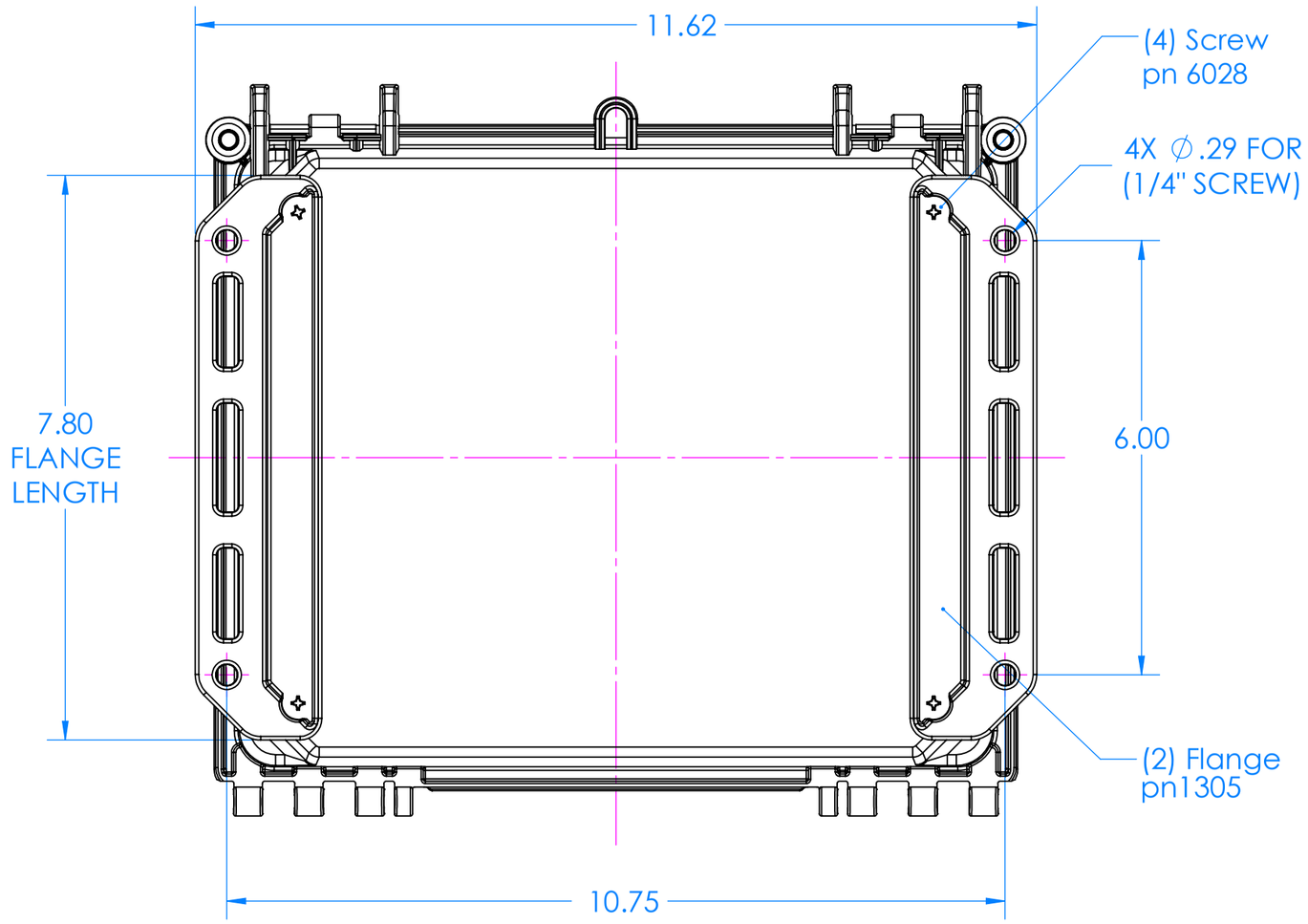
I352/I342 Mounting Bracket Dimensions



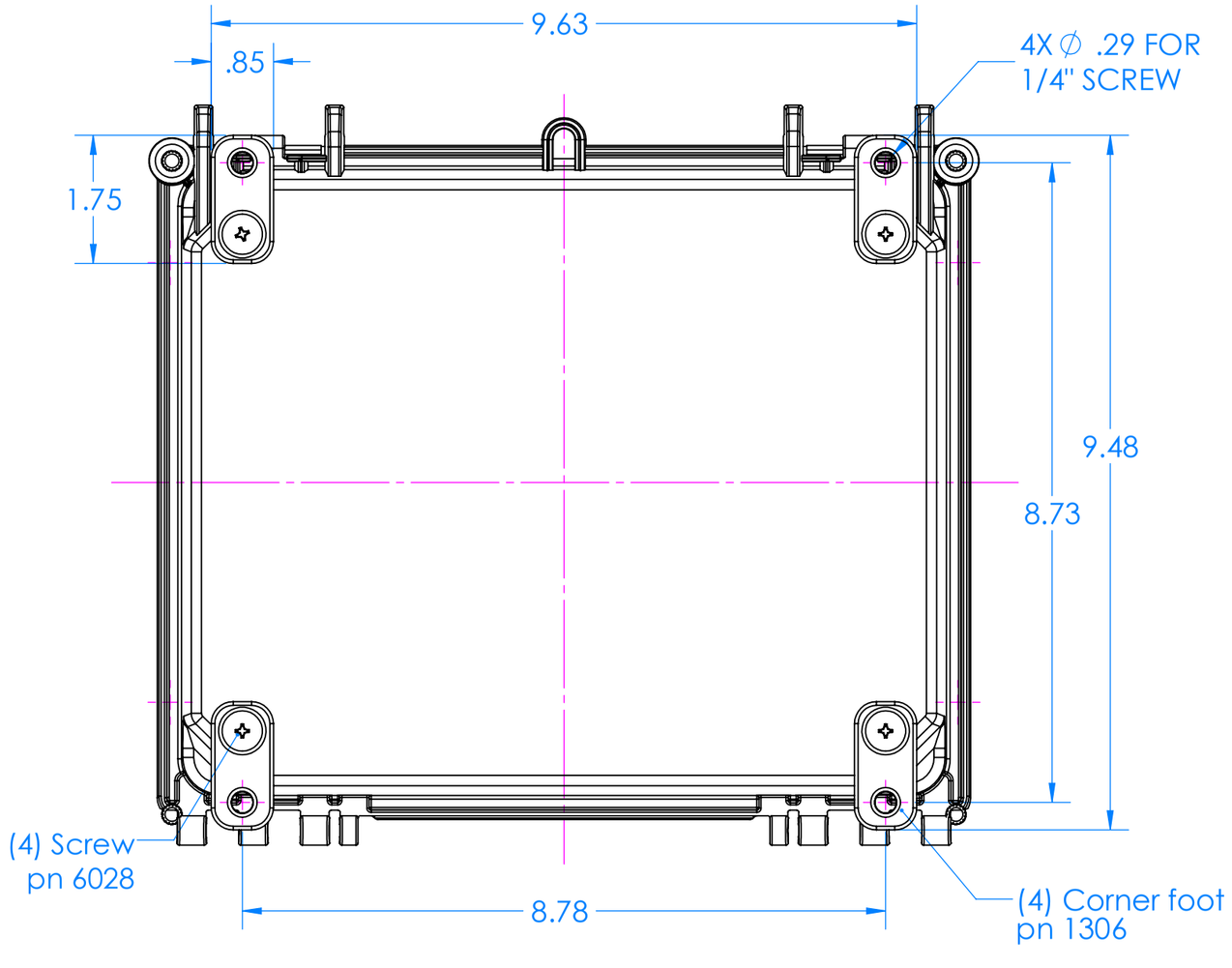
TOP & LATCHES REMOVED FOR CLARITY FROM ALL VIEWS

STANDARD INCLUDED 1305 FLANGE KIT

Part included in Kit number 1305		
P/N	**Qty.**	**Description**
1305	2	Flange
6028	4	SS #10 X 5/8" Pan Combo H/L Screw

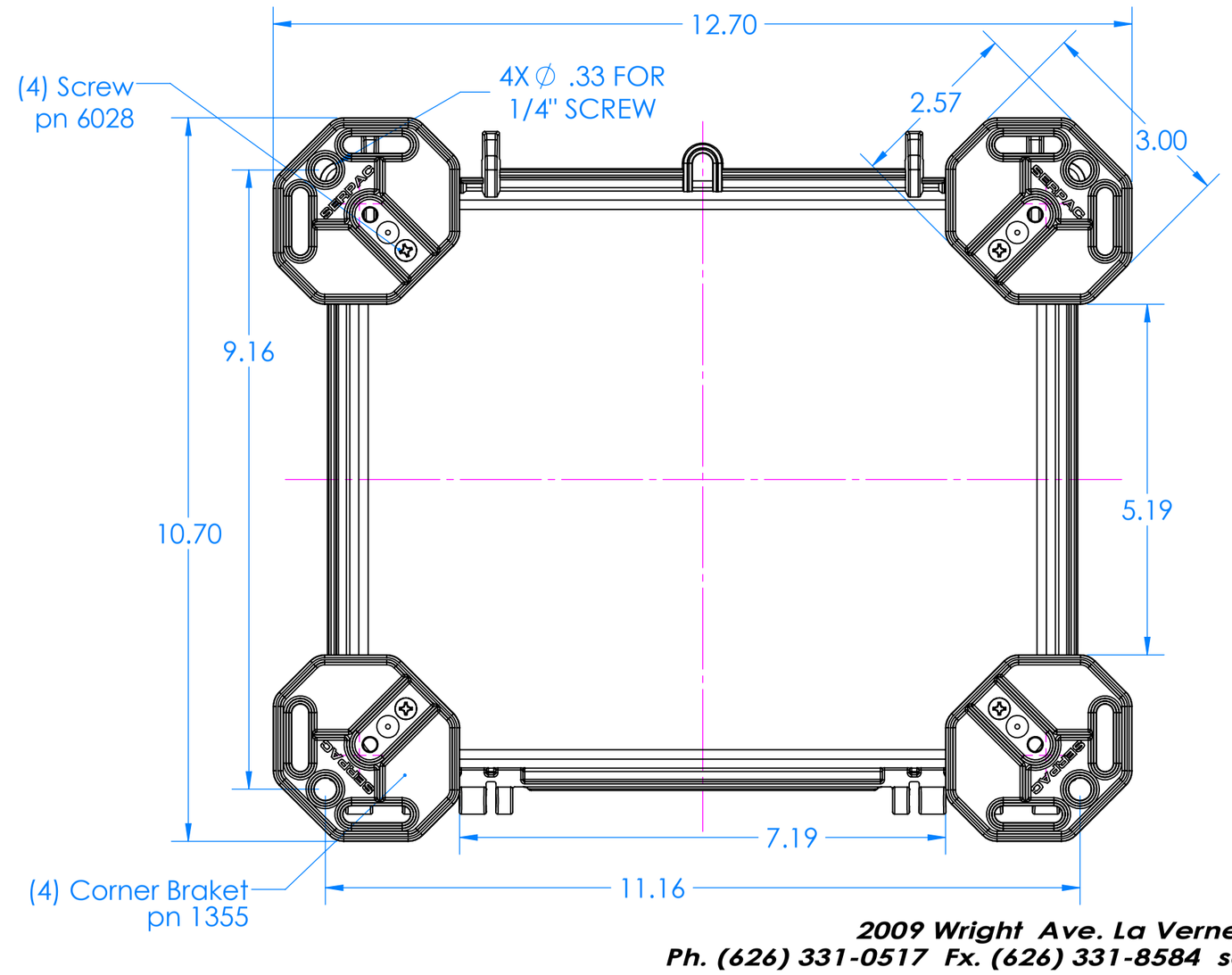
OPTIONAL 1306 CORNER FEET KIT

Part included in Kit number 1306		
P/N	**Qty.**	**Description**
1306	4	Mounting Corner Foot
6028	4	SS #10 X 5/8" Pan Combo H/L Screw



OPTIONAL 1355 CORNER BRACKETS KIT

Part included in Kit number 1355		
P/N	**Qty.**	**Description**
1355	4	Mounting Corner Bracket
6028	4	SS #10 X 5/8" Pan Combo H/L Screw



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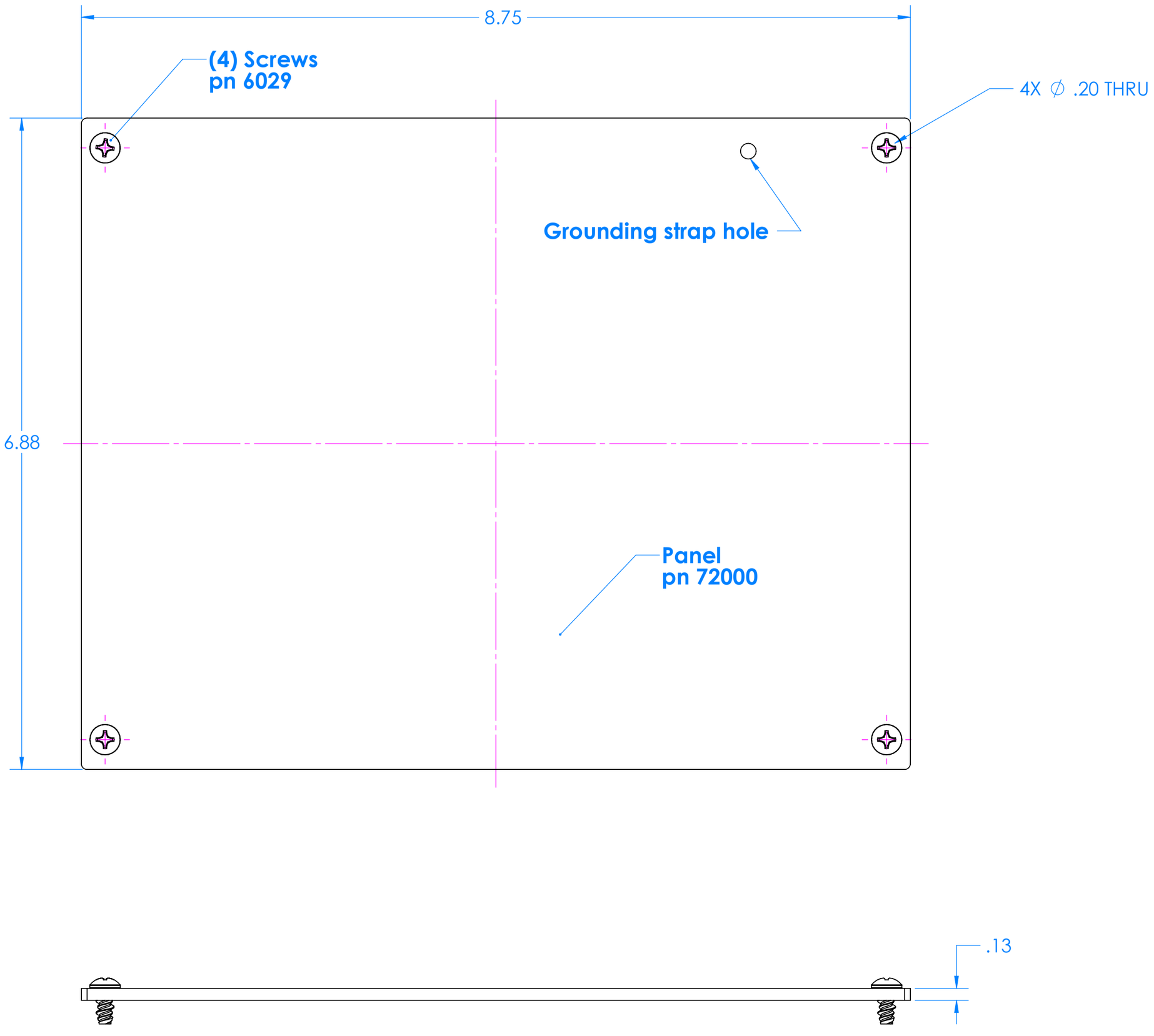
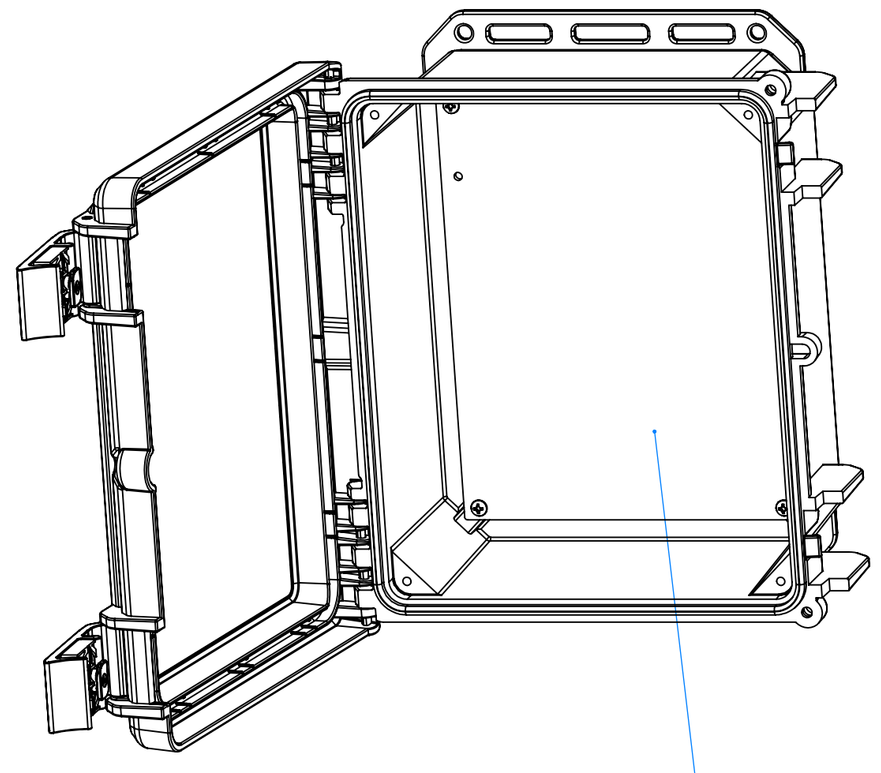
7200B Aluminum Bottom Panel Kit for 352HL, 342HL, 352HS, 342HS, 352S and 342S





Part included in Kit number 7200B		
P/N	Qty.	Description
72000	1	Aluminum Bottom Panel
6029	4	SS #10 X 3/8" Pan HL Screw

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7200HP Plastic Hinged Top Panel Kit for 352HL, 342HL, 352HS, 342HS, 352S and 342S

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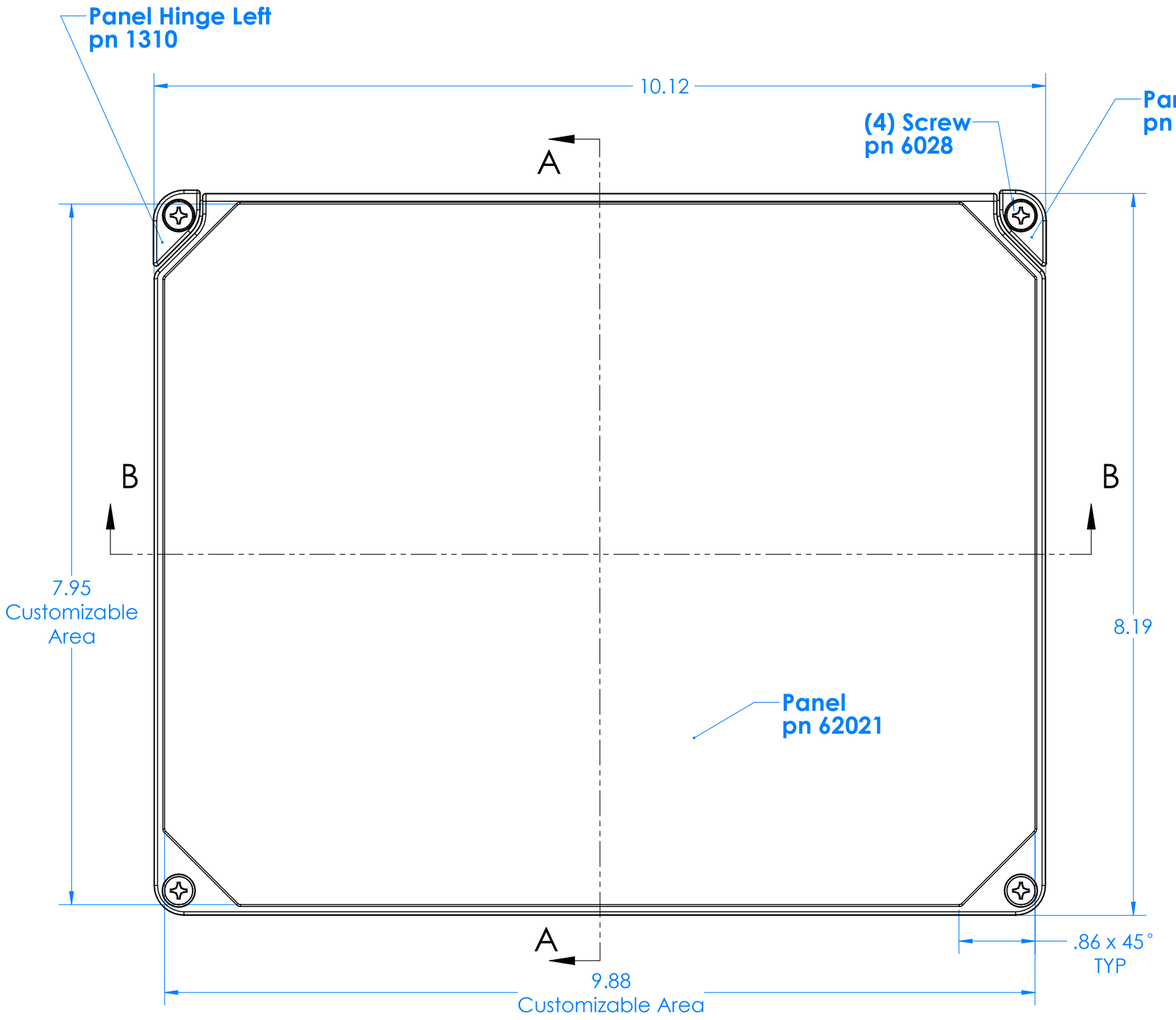
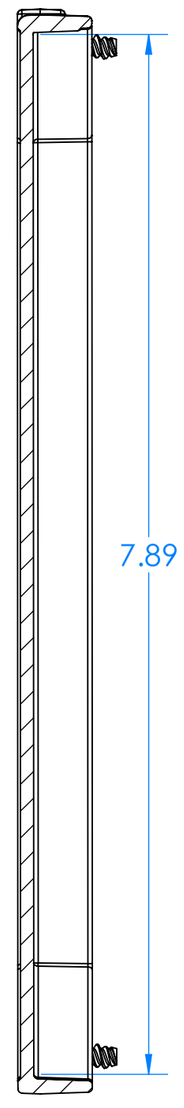
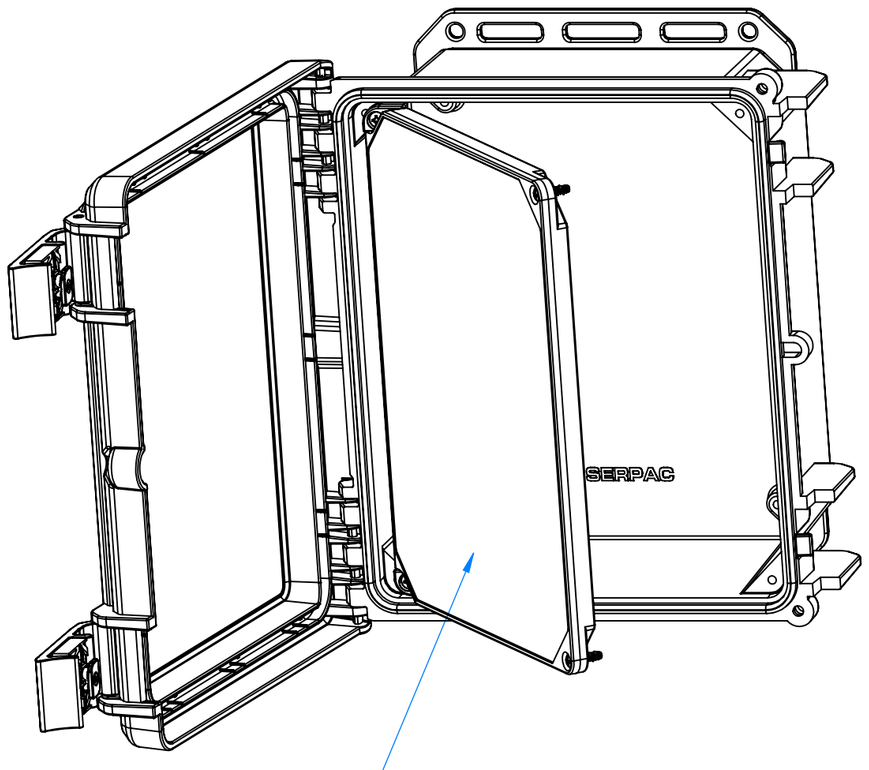
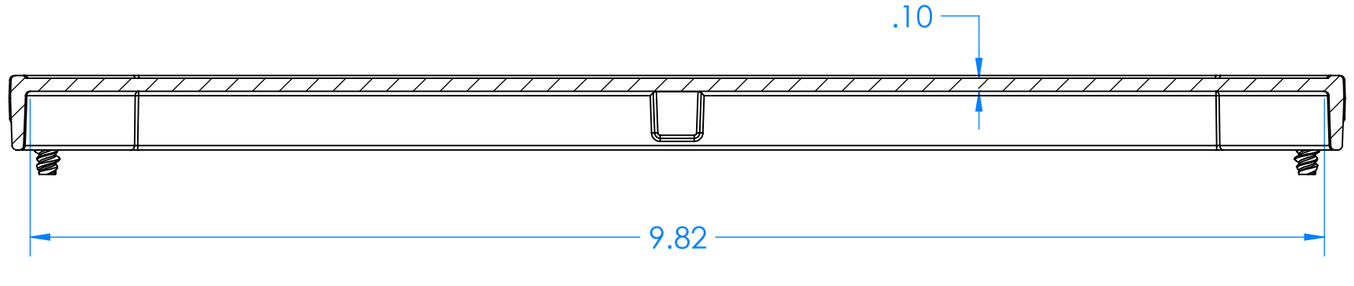




SECTION A-A





SECTION B-B

Parts Included in kit number 7200HP		
P/N	Qty.	Description
72021	1	Plastic Hinged Top Panel
1310	1	Panel Hinge Left
1311	1	Panel Hinge Right
6028	4	SS #10 X 5/8" Pan H/L Screw

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ASTI HiQDT Touchscreen Controller for Smart Digital MODBUS RTU Sensors End User License Agreement (EULA)

Revision 1.2 March 2023

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