TELEDYNE
ANALYTICAL INSTRUMENTS
Everywhereyoulook™

User Manual

MODEL LXT-330

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UNIVERSAL TRANSMITTER

MLXT-330, Rev. A / December 2020

CE

DECLARATION OF CONFORMITY

DIRECTIVES AND STANDARDS	:	**EMC Directive 89/336/EEC, 92/31/EEC, 93/68/EEC** **Low Voltage Directive 72/23/EEC**
MANUFACTURER'S ADDRESS	:	**16830 Chestnut Street** **City of Industry, CA 91748** **U.S.A.**
TYPE OF EQUIPMENT	:	**pH, DO, Conductivity, Redox**
EQUIPMENT CLASS	:	**Laboratory, Measurement & Process Control Equipment : Normal Enviroment**
MODEL NUMBER	:	**LXT330 & LXT380**

I, the undersigned, hereby declare that the equipment specified above is in conformity with the European Directive based on the application of the Directives and Standards.

SIGNATURE: _____

FULL NAME: Angel Alegria

POSITION: New Products Manger

Date: 8-22-17

PLACE: City of Industry, California

WARNING: ALL INDIVIDUALS WHO, HAVE OR WILL HAVE, RESPONSIBILITY FOR USING, MAINTAINING, OR SERVICING THIS PRODUCT, MUST READ THIS ENTIRE MANUAL CAREFULLY. FAILURE TO USE THIS EQUIPMENT PROPERLY COULD RESULT IN SERIOUS INJURY OR DEATH.

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Teledyne Analytical Instruments (referred to hereafter as "the Company") warrants this equipment is free from defects of material and of construction, and that the Company's liability shall be limited to replacing or repairing at the Company's factory (without charge, except for transportation), or at customer plant at the Company's option, any material or construction in which defects become apparent within one year from the date of shipment, except in cases where quotations or acknowledgments provide for a shorter period. Components manufactured by others bear the warranty of their manufacturer. This warranty does not cover defects caused by wear, accident, misuse, neglect, or repairs other than those performed by the Company or an authorized service center. The Company assumes no liability for direct or indirect damages of any kind, and the purchaser by the acceptance of the equipment will assume all liability for any damage which may result from its use or misuse.

The Company reserves the right to employ any suitable material in the manufacture of our apparatus, and to make any alterations in the dimensions, shape or weight of any parts, in so far as such alterations do not adversely affect our warranty.

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The international transport of this device is regulated under United States export regulations and may be regulated by the import regulations of other countries.

Important Notice

This instrument provides measurement readings to its user, and serves as a tool by which valuable data can be gathered. The information provided by the instrument may assist the user in eliminating potential hazards caused by his process; however, it is essential that all personnel involved in the use of the instrument or its interface be properly trained in the process being measured, as well as all instrumentation related to it.

The safety of personnel is ultimately the responsibility of those who control process conditions. While this instrument may be able to provide early warning of imminent danger, it has no control over process conditions, and it can be misused. In particular, any alarm or control systems installed must be tested and understood, both as to how they operate and as to how they can be defeated. Any safeguards required, such as locks, labels, or redundancy, must be provided by the user or specifically requested of the Company at the time the order is placed.

Therefore, the purchaser must be aware of the hazardous process conditions. The purchaser is responsible for the training of personnel, for providing hazard warning methods and instrumentation per the appropriate standards, and for ensuring that hazard warning devices and instrumentation are maintained and operated properly.

The Company cannot accept responsibility for conditions beyond its knowledge and control. No statement expressed or implied by this document, or any information disseminated by the manufacturer or its agents, is to be construed as a warranty of adequate safety control under the user's process conditions.

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Table of Contents

1. About This Guide

This guide provides instructions on the features and usage of the MLXT-330 Universal Transmitter (also referred to as "the Transmitter"). It also provides information on configuration, operation, maintenance, specifications, and trouble shooting. This user guide assumes the reader has a basic knowledge of liquid analytical instrumentation.

1.1. Guide Conventions

The following visual elements are used throughout this guide:

WARNING: THIS ICON AND TEXT INDICATE A POTENTIALLY HAZARDOUS SITUATION, WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR INJURY.

CAUTION: This icon and text indicate an action or situation, which, if not avoided, could result in damage to the equipment.

NOTE: This icon and text designates information of special note to the operator.

1.2. General Safety Information

WARNING: READ, UNDERSTAND AND FOLLOW THE ENTIRE CONTENT OF THIS GUIDE PRIOR TO USE. FAILURE TO DO SO MAY RESULT IN SERIOUS INJURY OR DEATH.

WARNING: ALL INDIVIDUALS WHO HAVE OR WILL HAVE RESPONSIBILITY FOR USING OR TESTING THIS PRODUCT MUST READ AND UNDERSTAND THE CONTENTS OF THIS MANUAL. THE PRODUCT WILL PERFORM AS DESIGNED ONLY IF USED AND TESTED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. FAILURE TO FOLLOW MANUFACTURER'S INSTRUCTIONS WILL RENDER THE WARRANTY AND APPROVALS NULL AND VOID. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY ALSO RESULT IN SERIOUS INJURY OR DEATH

The Company takes no responsibility for use of its equipment if it is not used in accordance with the instructions. If further operational or maintenance details are required but not provided in this guide, contact the Company or their agent. The Company shall not be liable for any incidental or consequential damages in connection with any modifications, errors, or omissions in this guide.

Observed all pertinent regional and local safety regulations when installing and using this product. For reasons of safety, and to assure compliance with documented system data, only the manufacturer may perform repairs to components.

Additionally, industry standards, codes, and legislation are subject to change. Users must obtain updated copies to ensure the most recently issued regulations, standards and guidelines are available.

Observed all pertinent regional and local safety regulations when handling and disposing of hazardous material, batteries, and other similar items that may fall under the classification of hazardous material.

1.3. Warnings and Cautions – Device Use and Care

WARNING: ONLY QUALIFIED PERSONNEL — AS DEFINED ACCORDING TO LOCAL, COUNTY, STATE, FEDERAL AND INDIVIDUAL COMPANY STANDARDS — MAY OPERATE AND SERVICE THIS EQUIPMENT. READ AND UNDERSTAND THE GUIDE COMPLETELY BEFORE OPERATING OR SERVICING.

WARNING: VERIFY THE COVER, INTERNAL PCBS AND FIELD WIRING ARE SECURELY IN PLACE BEFORE APPLYING POWER AND OPERATION. FAILURE TO DO SO COULD RESULT IN INJURY OR DEATH.

WARNING: DO NOT USE THE DEVICE IF ITS ENCLOSURE IS DAMAGED, CRACKED, OR HAS MISSING COMPONENTS. FAILURE TO DO SO COULD RESULT IN INJURY OR DEATH.

CAUTION: Do not expose the device to continuous, severe mechanical or electrical shock. Doing so could seriously damage the device.

CAUTION: Protect the device from dripping liquids and high power sprays. Failure to do so could seriously damage the device.

2. Introduction

The MLXT-330 Universal Transmitter (also referred to as "the Transmitter) is a single or dual channel, intelligent, multi- parameter transmitter designed for the online continuous measurement of pH, ORP, pION, dissolved oxygen, conductivity, resistivity and turbidity in a general purpose industrial environment. The Transmitter digitally communicates with any TAI SP3 digital sensor, automatically configuring the transmitter menus and display screens to the measured parameter.

The Transmitter can be loop powered, 24 VDC powered or 100-240 VAC line powered. The standard configuration has a 4-20 mA output and a RS485 serial communication port with MODBUS®RTU output. A HART® communication version (single channel version only) is also available. Alarm relays are optionally available on either line powered transmitter.

2.1. Features

- Multi-Parameter, pH, ORP, Specific Ion, Dissolved Oxygen, Conductivity, Resistivity
- Simple, user friendly menu structure
- Noise free digital communication with sensors
- Reads and writes calibration data to sensor
- Dual Channel option has interactive channels, pH compensated readings, interfering ion corrections.
- Non-Isolated 4-20 mA output and MODBUS® RTU standard, optional HART®

2.2. Model Codes

Table 2-1: Model Codes

Model LXT-330						
!st Channel	**1** (SP3) SP3 Digital Sensor, pH, ORP,pION,DO,DO90 ppb DO,Conductivity, Resistivity,TR Series, SP3-ODO					
	3 Internal Preamp, Digital to pH Steam Sterilizable Products					
	4 Internal Preamp, Digital to SGTC Conductivity/Resistivity (CSX2 or 2 electrode contacting)					
	2nd Channel	**0** No Second Channel				
		1 (SP3) SP3 Digital Sensor, pH, ORP, pION, DO, Conductivity, Resistivity, SP3-ODO,TR Series				
		Power Supply	**-0** Loop Powered Transmitter			
			-1 24 VDC Powered Transmitter			
			-2 100-240 VAC powered Transmitter			
			Relay Option	**0** No Relays		
				1 (3)form 1C 250 V 3A relays		
				Outputs	**0** 4-20 mA output and MODBUS	
					1 HART®	
					2 2 x 4-20 mA & MODBUS	
					3 Hart (Channel one only) & (2x) 4-20 mA	
					Mounting Hardware	**00** No Mounting
						01 Universal
						02 Panel Mount
						03 Handrail Mount
						04 Sunshield Pole
						05 Sunshield Rail
LXT-330	**1**	**1**	**-2**	**1**	**2**	**01**

3. Installation

3.1. Unpacking the Instrument

The Transmitter has been carefully packaged to protect it from damage during shipment and dry storage. Upon receipt please follow the procedure outlined below.

1. Before unpacking, inspect the condition of the shipping container to verify proper handling by the carrier. If damage is noted, save the shipping container as proof of mishandling for the carrier.
2. Check the contents of the shipping container with the items and quantities shown on the packing list. Immediately report any discrepancies to the Company.
3. Save the original packing material until you are satisfied with the contents. In the event the product(s) must be returned to the Company, the packing material will allow you to properly ship it.
4. Familiarize yourself with the Transmitter before installation, and follow proper installation and wiring procedures.

WARNING: ELECTRICAL INSTALLATION MUST BE IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (ANSI/NFPA-70), CANADIAN ELECTRICAL CODE AND/OR ANY OTHER APPLICABLE NATIONAL OR LOCAL CODES.

3.1.1. Basic Parts List

1. LXT-330 Transmitter
2. Mounting Hardware
3. Instruction Manual

3.1.2 Installation and Wiring

Failure to follow the proper instructions may cause damage to this Transmitter and warranty invalidation. Use only qualified personnel to install, operate and maintain the Transmitter.

The Transmitter should only be used with equipment that meets the relevant IEC, American or Canadian standards. The Company accepts no responsibility for the misuse of this unit.

3.2. Mounting

Mount the Transmitter in a location where there is easy access to the analyzer and sensors. Install the system in an area where vibrations, electromagnetic and radio frequency interference are minimized or absent. Do not mount in direct sunlight or areas of extreme heat (temperature > 120°F). The IP65 Transmitter is suitable for outdoor use, but it is best to mount it with a protective cover or sunshield to prevent discoloring over the years.

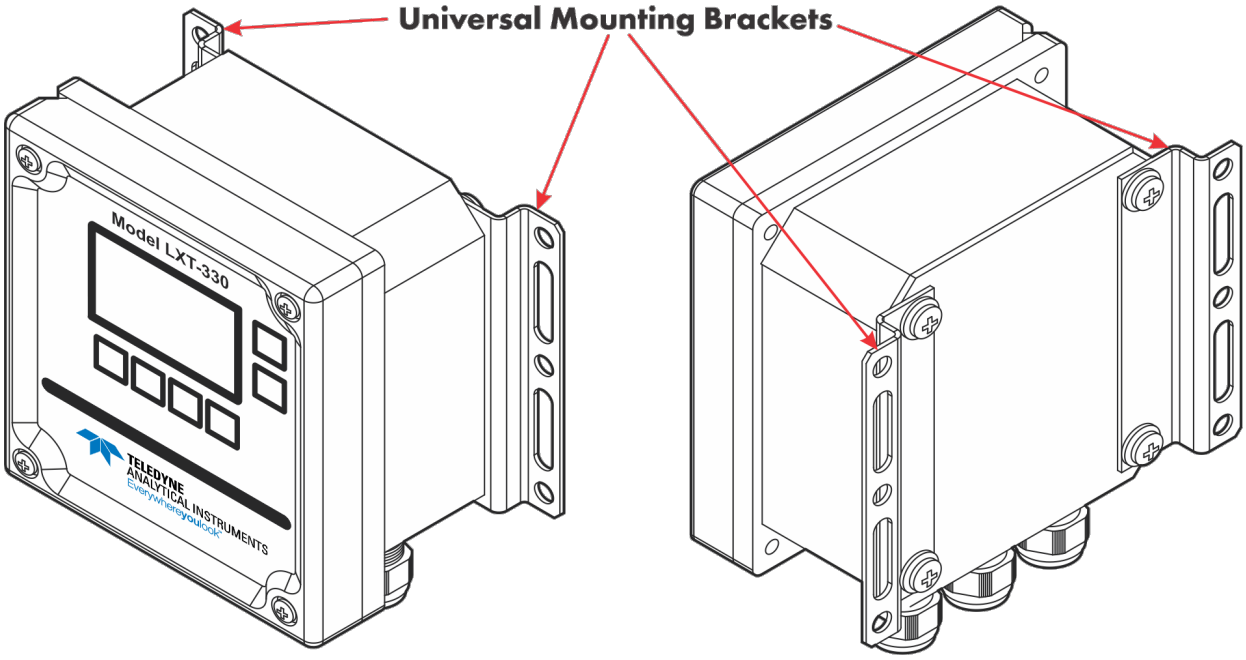

Figure 3-1: Universal Mounting Brackets

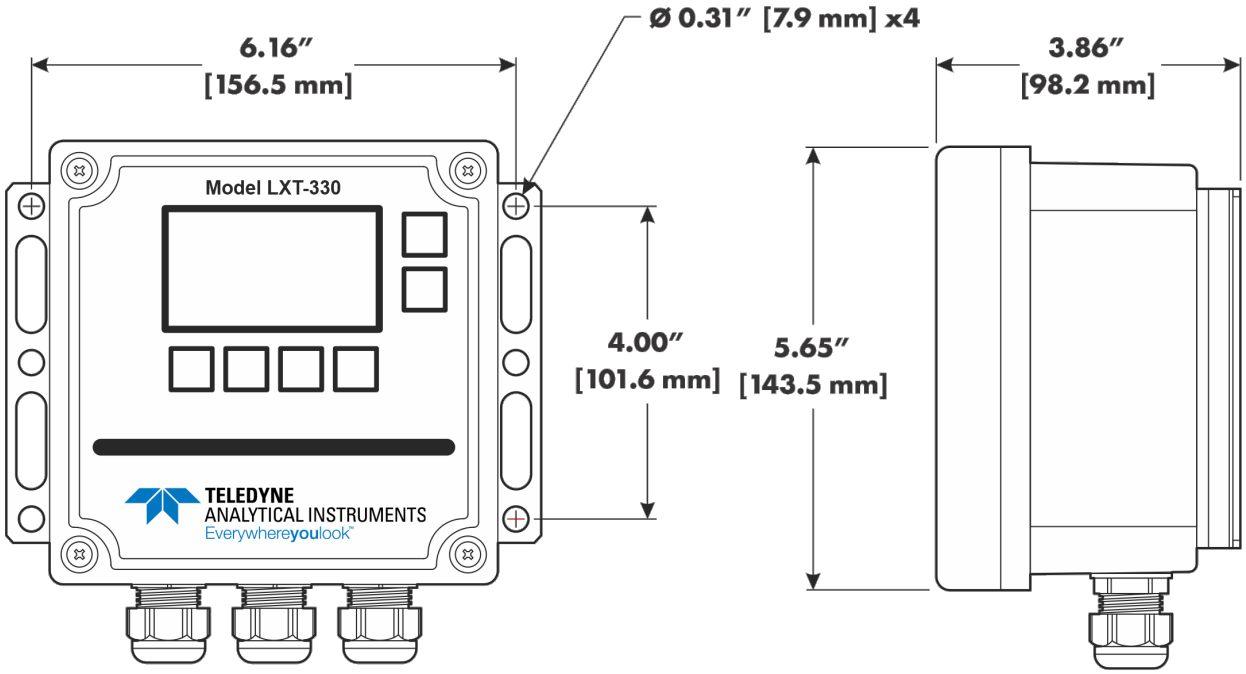

Figure 3-2: Universal Mounting Bracket Dimensions

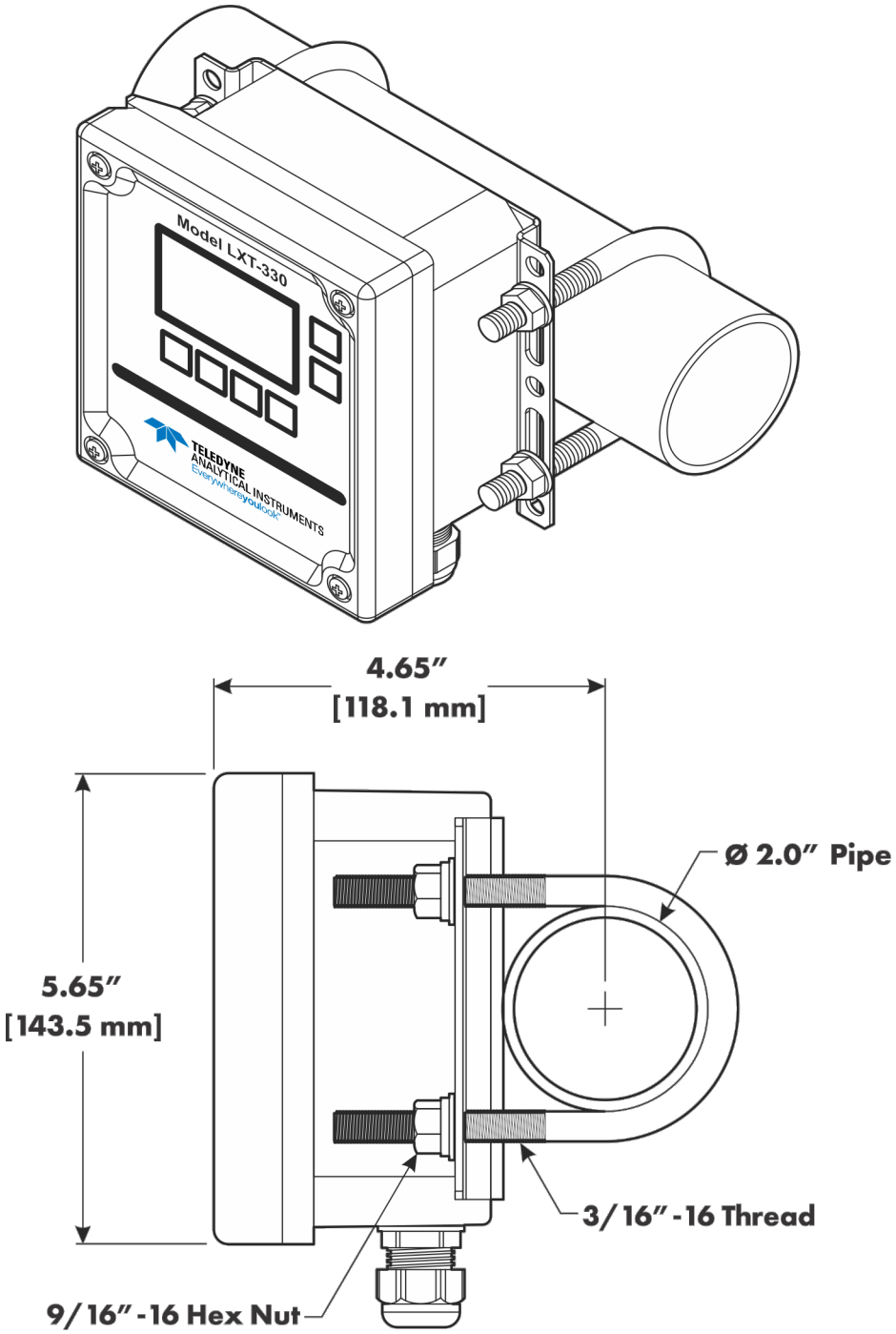

Figure 3-3: Rail Mounting the Transmitter

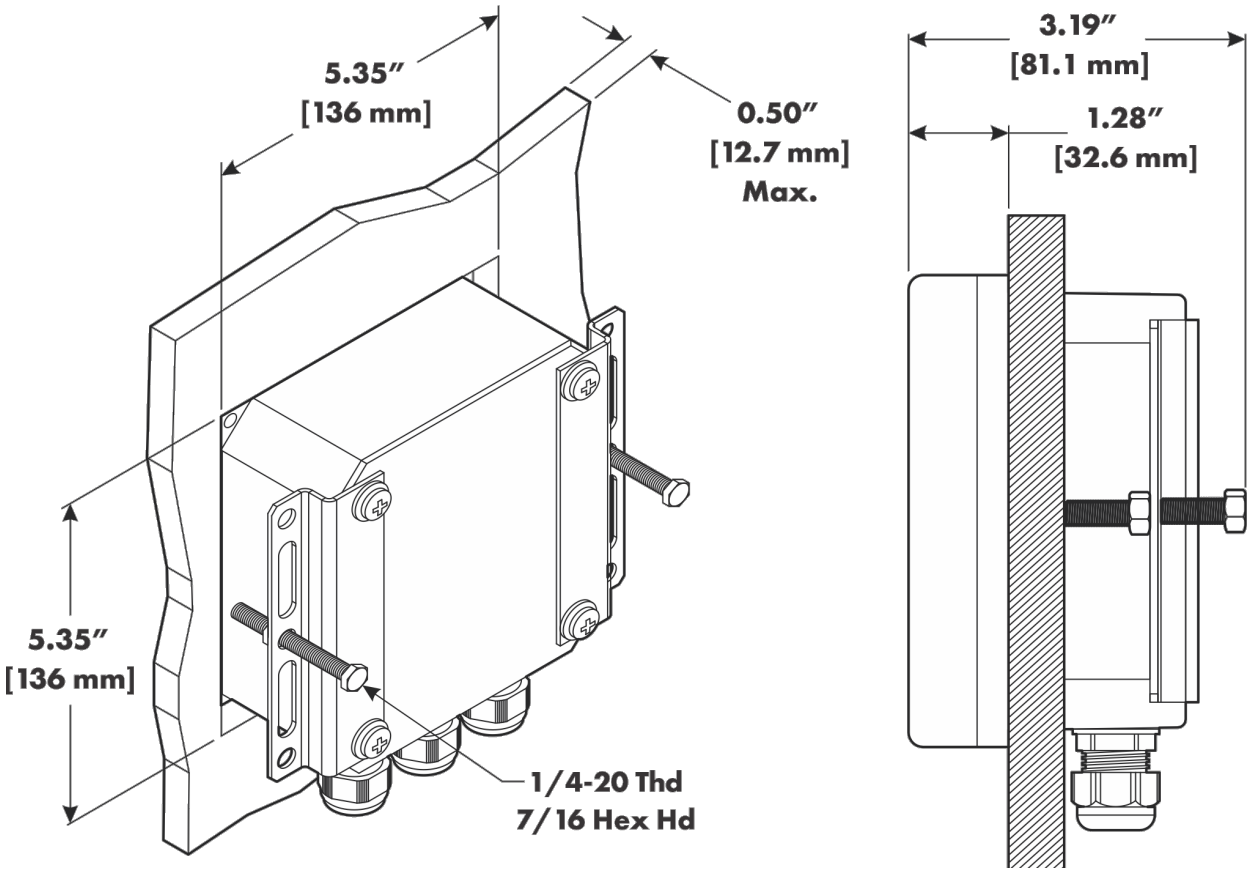

Figure 3-4: Panel Cut Out

3.3. Wiring

Electrical wiring should only be conducted by qualified personnel. See the LXT330 wiring diagram in

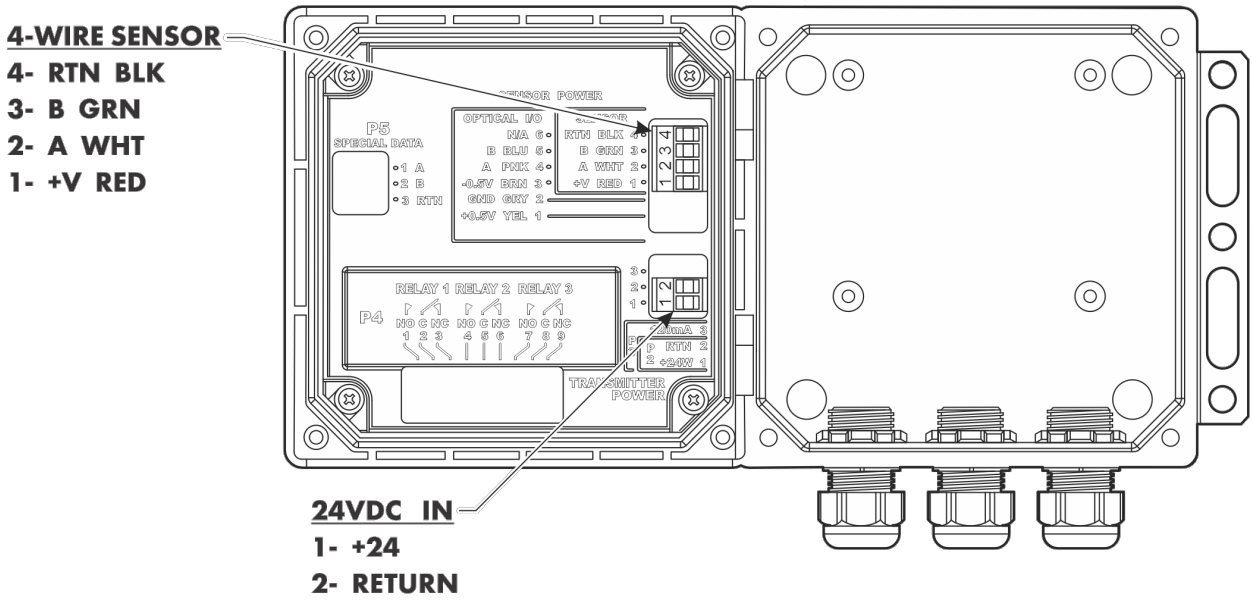

Figure 3-5: Loop Powered Transmitter

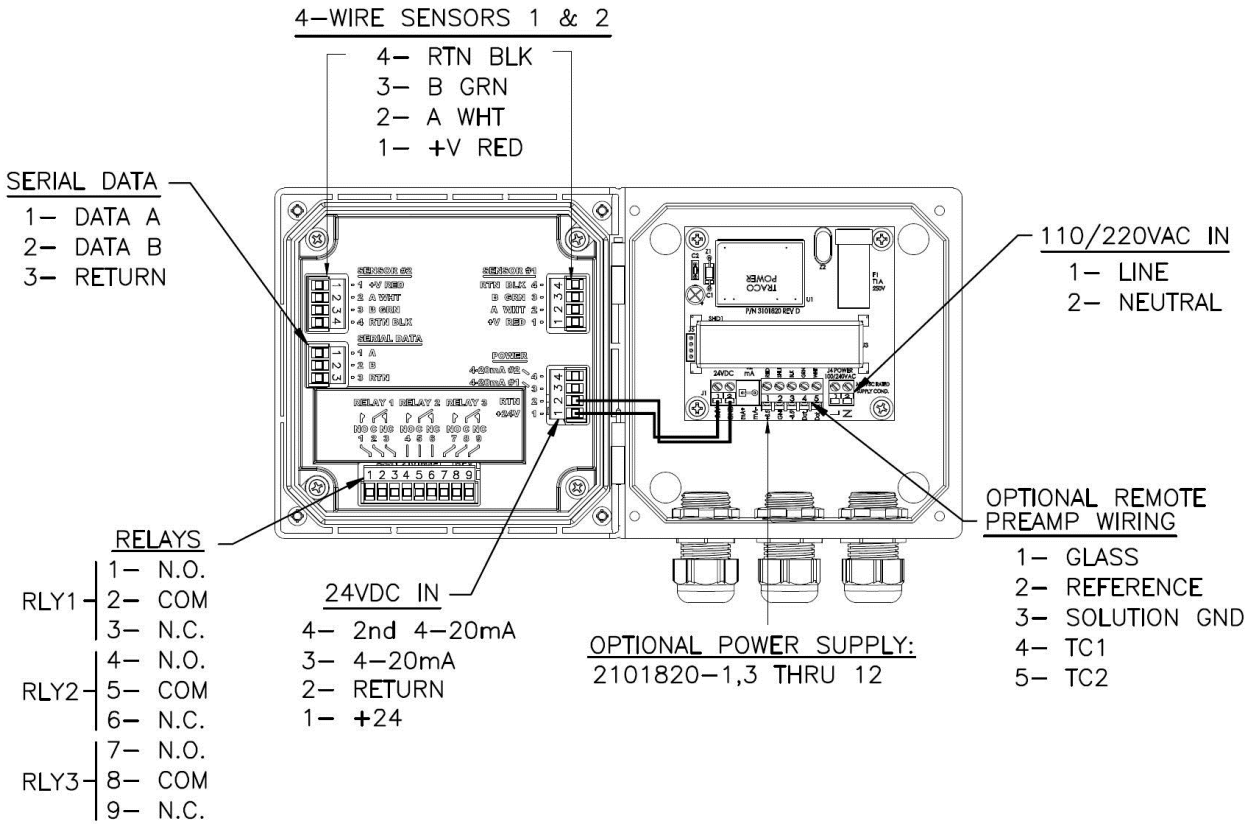

Figure 3-6: 4-Wire Transmitter
(24VDC or / 110/220 VAC, MODBUS, Relays/Optional Digital Preamp)

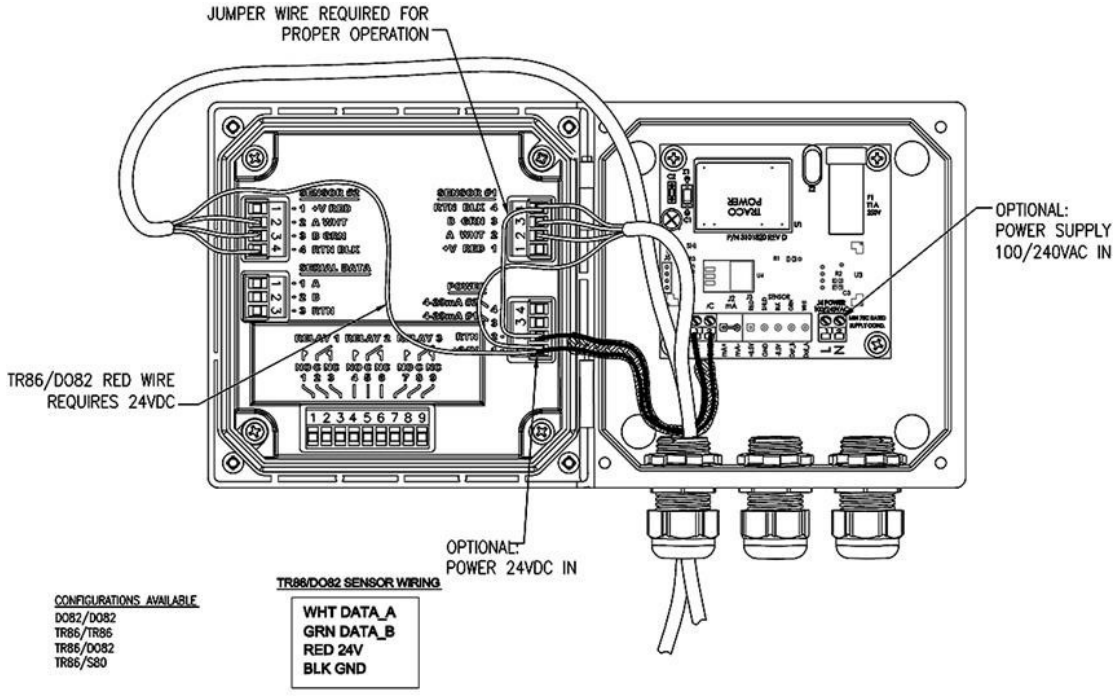

Figure 3-7: 4-Wire Transmitter
(Model LXT330, SP3-TSS turbidity, or Model SP3-ODO Dissolved Oxygen sensors)

3.3.1. Wiring - Power

The Company recommends using a thermoplastic, outdoor sunlight resistant jacketed cable, wet location rated and ½" flexible conduit. Power should be hard wired with a switch or breaker to disconnect the Transmitter from the main power supply. Install the switch or breaker near the Transmitter and label it as the Power Switch for the Transmitter.

3.3.1.1. Loop Powered (2 wire configuration)

Attach the 24VDC signal cable to terminals #1 and #2 as shown in Figure 3-5: Loop Powered Transmitter and on the diagram inside of the Transmitter cover. Feed the cable through the gland fitting on the right hand side of the Transmitter. Tighten the cable gland to provide a good seal to the cable. The Transmitter can be powered up at this point with no harm to the analyzer but it is best to wait until the sensor is installed.

3.3.1.2. 24VDC (4 wire configuration)

Attach the 24VDC power cable to terminals #1 and #2 as shown in Figure 3-6: 4-Wire Transmitter and on the diagram inside of the LXT330 cover. Attach the 4-20 mA1 cable to terminals #3 (out) and #2 (return) single channel unit and attach the 4- 20 mA2 cable to terminals #4 (out) and #2 (return) for a two channel instrument. Feed the cables through the gland fitting on the right hand side of the LXT330. Tighten the cable gland to provide a good seal to the cable. The Transmitter can be powered up at this point with no harm to the analyzer but it is best to wait until the sensor is installed.

3.3.1.3. 110/220 VAC (4 wire configuration)

Attach power cable as shown in Figure 3-7: 4-Wire Transmitter or as on the diagram inside of the LXT330 cover. Feed the cable through the gland fitting on the right hand side of the LXT330. Tighten the cable gland to provide a good seal to the cable. The Transmitter can be powered up at this point with no harm to the analyzer but it is best to wait until the sensor is installed.

3.3.2 Wiring - Sensor

Attach the sensor wires as described on the diagram inside the LXT330 cover. Feed the sensor cable through the gland fitting on the left hand side of the LXT330. Do not use the same gland fitting for the AC power or Alarm/Relays. The green terminal strip connectors are detachable from the circuit boards. Remove the connector by pulling straight back from the circuit board.

3.3.3 Wiring, 4-20 mA Outputs

3.3.3.1. Loop Powered Instruments

Connect the 4-20mA cable to terminals #1 (+24V) and #2 (-24V), Model LXT330-XX-0 X-XX.

3.3.3.2. 24 VDC or 110/220 VAC Powered Instruments

For instruments powered with 24VDC or the internal power supply, Model LXT330-XX-1X-XX (24VDC) and LXT330-XX- 2X-XX (110/220 VAC), connect the 4-20 mA cable(s) to terminals #3 (out) for channel 1 and #2 (return) and to terminals #4 (out) for channel 2 and #2 (return).

Transmitters with HART® Communication can be wired as shown below. See HART® Communication menu in Appendix 9.2

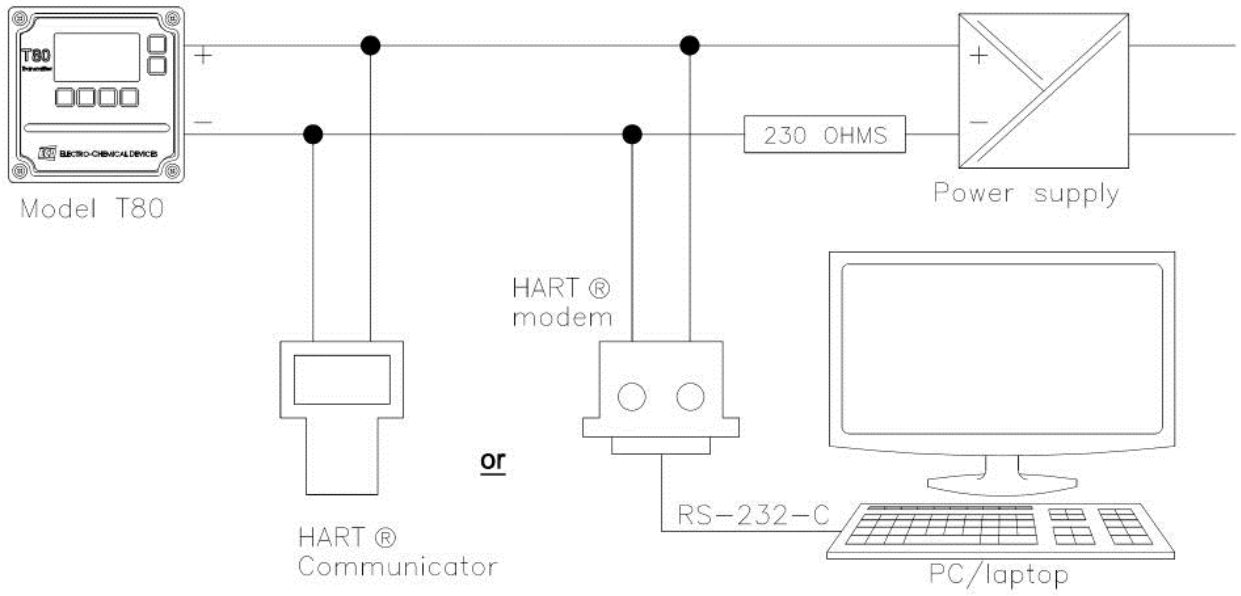

Figure 3-8: Wiring Diagram

3.3.4 Wiring, Contact Relay Outputs

The standard configuration has three SPDT 230V 5 A relays that can be wired either normally open (NO) or

normally closed (NC). The default configuration is set to use the relays as normally open.

3.3.5 Wiring, Serial Output MODBUS RTU

Attach the sensor wires as shown in Figure 2.2.2 or as described on the diagram inside the LXT330 cover. Feed the sensor cable through the gland fitting on the left hand side of the LXT330. Do not use the same gland fitting for the AC power or Alarm/Relays. See MODBUS command register in Appendix D.

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4. Operation

The TAI Model LXT330 transmitter is an intelligent, single or dual channel multi-parameter transmitter designed for the online continuous measurement of pH, ORP, pION, conductivity, resistivity or Dissolved Oxygen in a general purpose industrial environment. The Model LXT330 transmitter digitally communicates with any TAI SP3 digital sensor. The measurement identity is contained in the sensor's memory. When an SP3 sensor is connected to the transmitter it automatically configures the transmitter's menus and display screens to the measured parameter.

4.1. Keys

The functions associated with each Selection Adjustment Keys are displayed on the screen above each key, and the functions associated with the Home/Exit and Back Keys are displayed on the screen to the left of each key. Pressing any Selection Adjustment key twice within one second brings up the HOME Menu Screen.

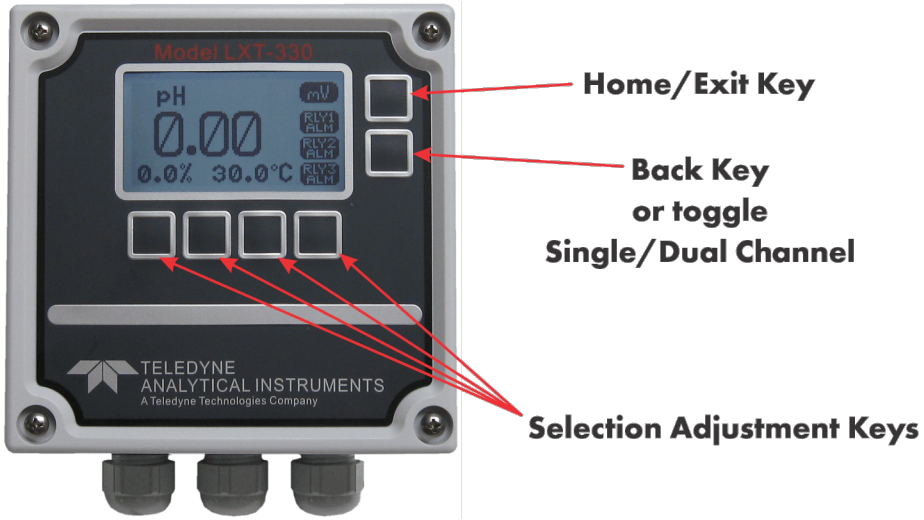


Figure 4-1: Function Keys

4.1.1. Home/Exit Key

The HOME key performs two functions, it selects which Home Screen is displayed and it returns the active screen to the HOME Menu Screen from anywhere inside the menu structure.

Three Display screens are available:

1. DATA SCREEN: Displays the measurement type, numerical value, engineering Units, % Output of the 4-20 mA channel and temperature.
2. mV SCREEN: Displays the measurement type, the sensor's raw millivolt Value, % Output of the 4-20 mA channel and temperature.
3. GRAF SCREEN: Displays a Graphical representation of the 4-20 mA channel % Output, the measurement type, the engineering units, and temperature. Only one of the three graphical display styles is available through the HOME key, either the Bar, Gauge, or Line display. Choose

which style will be displayed in the Graph Menu. (pathway to Graph Menu: CONFIG > XMTR > LCD > Graph menu)

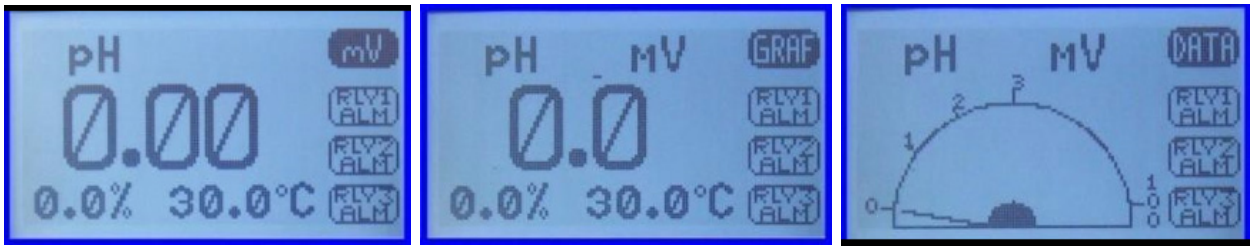


Figure 4-2: Three Display Screens

Each of the above screens also displays the condition of the optional Alarm Relays, black if energized and white if de-energized.

The HOME key changes to the EXIT key in the MENU HOME screen. Pressing **EXIT** prompts the user to "Save Changes" YES/NO when exiting the MENU HOME screen. Pressing **YES** applies any changes made in the menus; pressing **NO** exits the MENU HOME screenu without applying any changes made in the menus.

Figure 4-3: Menu/Home Screen

4.1.2 Back/Hold Key

The BACK key changes the screen to the previously displayed screen when inside a menu, it moves BACK one screen. On a dual channel transmitter it toggles between the PV1, PV2 and Dual Channel Screens. The HOLD key toggles the output HOLD function ON/OFF in the MENU HOME screen.

4.1.3 Selection Adjustment Keys

The (4) Selection/Adjustment keys allow navigation and numerical adjustments to be made in the MENUs. To enter the HOME Menu screen press any of the Selection/Adjustment keys twice within one second. The various Menu choices and adjustment tools are displayed above the buttons once inside the MENU.

4.1.4 Alpha Numeric Entry

The LABEL and PASSWORD (Caps and Numbers only) Menus allow alphanumeric entry. Entry is accomplished by scrolling through the alphanumeric list with the ▲ (forward) and ▼ (backwards) arrows to the character of choice and then moving to the NEXT digit. Pressing and holding the ▲ or ▼

keys will initiate two speed auto scrolling. The character set is sequentially listed below. The first character in the set is an empty space.

! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [¥] ^ _ ' a b c d e f g h I j k l m n o p q r s t u v w x y z { | } →←

4.2. Menu Structure

Double tap any Selection/Adjustment key to enter the HOME Menu Screen. Five menu choices will appear: CAL, CONFIG, INFO, SIM and HOLD. Each of the Menus is detailed below.

4.2.1. HOLD (Output Hold)

Pressing the **HOLD** Key activates the HOLD function. *Hold is ON* is displayed.

- Freezes the 4-20 mA output at the last value prior to activation
- Freezes optional Alarm Relays in the current state
- While in the HOLD mode, the % Output display toggles between the last value and HOLD

Pressing **HOLD** again turns the hold function off. *Hold is OFF* is displayed. The HOLD function remains ON until it is turned OFF. (See Time Out in CONFIG>XMTR>OUTPUT>HOLD)

Figure 4-4: Hold is ON Screen

4.2.2 CAL (Calibration Menu)

Four options are available: AUTO, STAND, MANUAL and TEMP. On dual channel instruments, choose **Sensor 1** or **Sensor 2** when prompted.

The first screen asks, *IS THIS A NEW SENSOR, YES / NO*. Select **YES** to clear the calibration history from the previous sensor from memory and start a new register; select **NO** to write the calibration to the memory stack. Three (3) sets of data are stored.

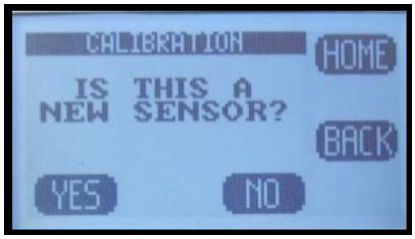


Figure 4-5: IS THIS A NEW SENSOR? Screen

- AUTO is a two point calibration. The calibration proceeds in two steps: AutoCal 1 is an offset calibration and AutoCal 2 is a slope calibration. Auto Cal provides automatic solution recognition of the calibration solutions used for each measurement in accordance with the following list:
  - ~ pH Calibration Buffers (US Standard), pH 4.01, pH 7.00 and pH 10.00 (see Appendix A)
  - ~ ORP Calibration Solutions: Quinhydrone saturated: pH 4.01= +89 mV, pH 7.00= +266 mV
  - ~ pIon Calibration Solutions: 1.00, 10.00, 100.0 ppb, ppm, ppt (thousand)
  - ~ Dissolved Oxygen: Zero ppm (Sodium sulfite, Na2SO3 in water), Air saturated water, 8.25 ppm

  Any two solutions can be used for AUTO calibration however if solutions other than those listed above are used for calibration then the calibration values must be entered manually.

Figure 4-6: PLACE SENSOR IN CAL SOLUTION Screen

- STAND is standardization, a single point calibration. Standardizations are typically used to adjust the process reading to agree with a laboratory determined "grab sample" reading.
- MANUAL is a data entry screen. Manual calibration allows the user to enter a concentration with the corresponding mV value and a slope for an electrode. Laboratory generated calibration data for an electrode can be input to a remote analyzer where calibration is difficult or impractical.
- TEMP allows the displayed temperature to be trimmed to agree with actual process temperature.

4.2.3 CONFIG (Configuration Menu)

Four options are available in the Configure Menu: XMTR, SENSOR, LOAD DEFAULT, and DAMP.

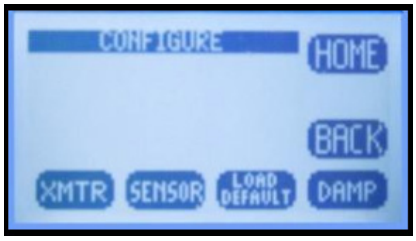


Figure 4-7: CONFIGURE Screen

- XMTR enters the Transmitter Configuration menu.

Figure 4-8: CONFIGURE XMTR Screen

~ LCD access the Display Configuration Menu

+ SETUP adjust screen lighting characteristics

- Temp. Choose °C or °F
- CONT adjust Contrast
- BACK LIGHT adjust Backlight Timeout, from always ON to OFF after 10 minutes

+ GRAPH provides the choice of which Graph style is displayed on the Home screen.

Figure 4-9: CONFIGURE GRAPH Screen

- LINE , Moving average, vertical scale set to 0-100% of the 4-20 mA output and user defined time scale
- GAUGE, Current reading 0-100% of 4-20 mA range
- BAR, Current reading 0-100% of 4-20 mA range

+ LABELS

Figure 4-10: DISPLAY LABELS Screen

- TAG, Enter up to 2 lines x 16 characters, example, Name, tag #... Displayed in INFO screen
- TAG ON, Turn TAG ON/OFF, adds TAG to Main Display Sequence, DATA → mV → GRAF → TAG → DATA
- POP UP, Turns ON/OFF, the double tap HOME Screen pop up memo

- SENSOR, Enter up to 2 lines x 16 characters

~ OUTPUT: access the Output Configuration Menu

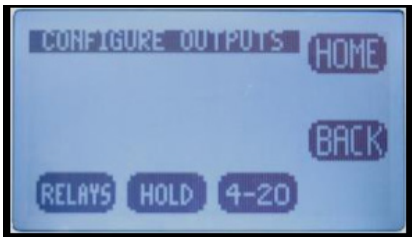


Figure 4-11: CONFIGURE OUTPUTS Screen

+ 4-20 mA: configure 4-20 mA output (PV or Temp or More)
  - RANGE: Enter 4 mA value and 20 mA value
  - CAL: Trim 4.00 mA output and 20.00 mA output
  - FAULT: Choose fault condition 3.5 mA, 22 mA, None
+ Optional 2nd 4-20 mA: same as above
+ RELAY

Figure 4-12: CONFIGURE RELAY 1 Screen

- RLY1,2,3: Choose relay type:
  > Alarm: enter the Set point ON, Set Point OFF, Expiration time, Delay ON and Delay OFF times and the State, energize: changes state from de-energized to energized on alarm.
  > Timed: Enter Period, Duration times and Hold On/Off
  > Fault: No input required, relay condition changes from energize to de-energize.
  > Disable: Inactivates relay and removes the relay 1 button from the HOME Screen display.

+ HOLD: Freezes outputs at current value and locks relays in their current state.
  - Hold Timeout: Removes HOLD after a certain period of time, default setting: No Timeout, selections include 15 minutes, ½ hour, 1 hour

~ SERIAL MODBUS configure serial output:

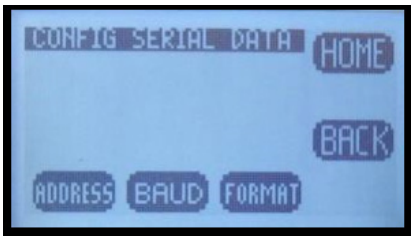


Figure 4-13: CONFIG SERIAL DATA Screen

+ ADDRESS: enter address: 001 to 247
+ BAUD: Choose baud rate, default 9600
+ FORMAT: set serial data format, default value: 8N1, 8 bit, no parity bit, 1 stop bit

~ SERIAL HART configure output:

Figure 4-14: HART Screen

+ ADDRESS: enter address: 01-63
+ BAUD: default 1200, no adjustment available
+ FORMAT: default value: 8O1, 8 bit, Odd parity bit, 1 stop bit, no adjustment available

~ PASSWD Enter 4 character password to protect access to MENU Level, CAL Menu, CONFIG Menu and SIM Menu (simulate). Each level can be turned ON or OFF and can have a unique password.

Figure 4-15: CHOOSE PASSWORD Screen

+	MENU	ON/OFF	_ _ _ _	Locks Main Menu
+	CAL	ON/OFF	_ _ _ _	Locks CAL and CONFIG
+	CONFIG	ON/OFF	_ _ _ _	Locks CONFIG
+	SIM	ON/OFF	_ _ _ _	Locks SIM and CONFIG

• SENSOR enters the sensor configuration menu.

~ Choose SENSOR 1 or 2

Figure 4-16: CHOOSE SENSOR Screen

+ TYPE: Allows the Transmitter to configure the SP3 sensor. For use only when switching the measurement electrode type in an SP3 sensor, i.e. for a pH electrode to a pION electrode. Select Sensor Type: pH, ORP, DO2, NH_3, NH_4^+, Br^-, Ca^{++}, Cd^{++}, Cl^-, Conductivity, Resistivity, Cu^{++}, CN^-, F^-, NO_3^-, K^+, Pb^{++}, Ag^+, Na^+, S^{--}
+ T COMP: Enter % temperature compensation per degree: pH, pION 0.33%, ORP 0.00%, DO2 4%, Conductivity 2%, Resistivity -5.4% (see Table Appendix D)
+ ISO PT: Enter Iso Potential value in mV. The Iso Potential is the point where changes in the temperature do not cause changes to the signal.

Figure 4-17: CONFIGURE SENSOR Screen

~ COMP Dual Channel Only: Sets compensation type: Dissociation (pKa), NH_4^+, Free Chlorine, HF, S^{-2}, Interference, X ppm Sensor 1 = 1 ppm Sensor 2, Percentage % change per pH.
~ Qty of SENSORS: Choose 1 or 2

- Load Default: resets all Menus to factory default configuration.

4.2.4 INFO (Information Menu)

The Information Menu provides two choices:

- Transmitter Screen: details the Name, Power type, Serial #, Firmware version and the output configuration(s).

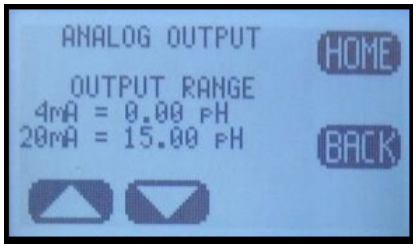


Figure 4-18: Sensor Screen

- Sensor Screen: details the Name, Part #, Serial # and three sets of Calibration data.

Figure 4-19: Transmitter Screen

4.2.5 SIM (Simulation Menu)

The Simulation menu allows the Input or Output signals to be simulated.

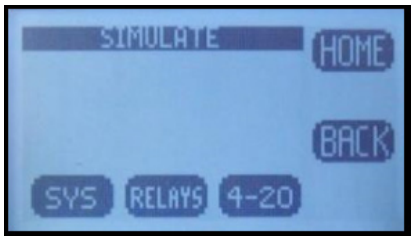


Figure 4-20: SIMULATE Screen

- SYSTEM: allows the Input to be simulated. Two choices are available, FIXED is a fixed value, RAMP varies the signal across the 4-20 mA range, from the lowest value to the highest value and back, activating and deactivating relays if present. The RAMP has two adjustments the Ramp period, 30 seconds to 2 minutes and Duration; 1 cycle, 5, 10, 20, 30 minutes.
- RELAYS: allows individual relays, #1, #2, and #3 to be activated and deactivated
- 4-20 mA: allows the output to be simulated from 4.00 mA to 20.00 mA.

4.2.6 Fault Screens

Fault	Definition	Recommendation
Memory Error	An error was found with the memory of the microcontroller	Return to factory for service
Input Voltage OOT	Power is out of tolerance	Check wiring to the transmitter
+12V OOT	Onboard 12V is out of tolerance	Return to factory for service
+3.3V OOT	Onboard 3.3V is out of tolerance	Return to factory for service
Loss of Comm	Communication with the sensor was lost	Check wiring to the sensor
No Sensor	No sensor was found at start-up	Check wiring to the sensor

Fault	Definition	Recommendation
Cal Failed	Sensor calibration filed	1. Clean sensing tip 2. Verify solutions 3. Do not leave unattended 4. Re-calibrate
Relay 1 Expired	Relay 1 Time On expired	1. Check sensor OP 2. Check aux. equip. A. Pumps B. Tanks
Relay 2 Expired	Relay 2 Time On expired	1. Check sensor OP 2. Check aux. equip. A. Pumps B. Tanks
Relay 3 Expired	Relay 3 Time On expired	1. Check sensor OP 2. Check aux. equip. A. Pumps B. Tanks

4.2.7 SENTINEL® Screens

The SENTINEL feature allows the Model LXT330 transmitter to provide Pre-pHault diagnostic information about the accuracy of a pH, ORP or pIon measurement. The SENTINEL displays a filled triangular gauge that decreases proportionally to the degradation of the reference electrode. A filled gauge indicates a properly functioning measurement while the emptying gauge indicates the remaining life of the electrode. This Pre-pHault diagnostic alerts the user to potential problems and provides a visual indicator of the sensor's remaining life before the measurement actually fails.

Figure 4-21: SENTINEL Electrode Life

The Model LXT330 transmitter only displays the SENTINEL functions when a Model SP3 SENTINEL sensor is connected. The Model SP3 SENTINEL sensor uses Diagnostic electrodes designated by Part#'s 20053XX, these electrodes use a triaxial connector with a, PV connection (pH, ORP, Ion), Reference connection and Diagnostic connection.

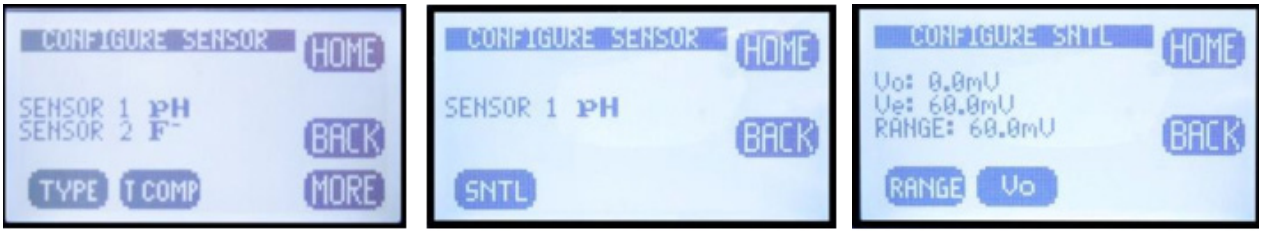
On a dual channel instrument an asterisk *, will be displayed in the sensor name block, SENSOR 2 *. The SENTINEL function will only be visible in the Single Screen mode, not in the Dual Screen mode. Toggle the BACK Key from Dual → Sensor 1 → Sensor 2 to see the SENTINEL function.

4.2.7.1. Configure SENTINEL Function

The SENTINEL function is located in the Configure Sensor menu: CONFIG → SENSOR → SENSOR 1 or 2 → MORE → SNTL

There are three values displayed:

- V_o = SENTINEL Voltage offset, The diagnostic voltage of a new electrode
- V_e = SENTINEL expiration Voltage, V_o + Range
- RANGE = The shift in the diagnostic voltage required to trigger diagnostic fault.



V_o Screen **V_e Screen** **RANGE Screen**

Figure 4-22: Configure SENTINEL Screens

The default values of V_o = 0.0 mV and the Range = 60 mV are good for most situations. The starting diagnostic voltage is typically near 0 mV on a new electrode and if the readings have drifted 60 mV apart (a full pH unit) then electrode service is required.

4.2.8 HYDRA Screens

The Ammonium (NH_4-N) Analyzer measures the concentration of dissolved ammonium as nitrogen (NH4+-N) in water. The sensor uses three electrodes to determine the NH4+-N concentration, an Ammonium Ion Electrode, a Potassium Ion Electrode and a pH electrode. It is designed for use in all kinds of water. Typical applications include monitoring environmental waters, lakes, streams and wells as well as wastewater treatment in aeration basins and effluent. The Ammonium will correspond as Sensor 1.

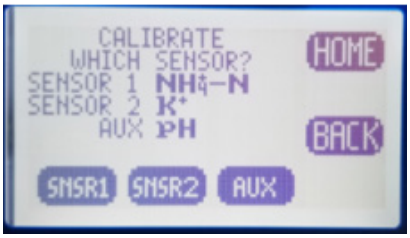


Figure 4-23: HYDRA Screen

4.2.8.1. Potassium Ion Compensation

The Ammonium Ion Electrode provides the primary measurement. Any potassium ion in the sample, due to its similar size and charge to the ammonium ion, causes a positive interference in the measurement. A Potassium Ion Electrode measures the amount of potassium ion present in the sample

and LXT330 Analyzer subtracts the appropriate amount of signal from the Ammonium Measurement. Potassium will correspond as Sensor 2. The ratio of interference is 8:1. So for every 8 parts of Potassium, there will be an increase of 1 part of Ammonium.

4.2.8.2. pH Compensation

The Ammonium Ion Electrode only measures the ammonium ion (NH4+) not ammonia (NH3). Ammonium ion and ammonia coexist in a pH dependent ratio in solution. At pH 9.2 the ratio is 1:1, at pH 7 nearly all of the ammonia is in the ammonium state and at pH 11 it is nearly all ammonia which is invisible to the sensor. The more acidic values favor the NH4+ and the more basic values favor ammonia gas, NH3. The pH Electrode measures the pH and the LXT330 Analyzer calculates the total NH4+-N concentration based on the pH vs. concentration profile. pH will correspond as AUX.

See Appendix G for Wiring and Sensor dimension diagrams.

4.3. Start Up Guide

Install and wire the LXT330 Transmitter as described in Section 3. Installation above. Connect the sensor to the transmitter as described in Section 3. Installation above.

Supply power to the Model LXT330 transmitter.

Verify the proper measurement type is displayed, pH, ORP or Ion. The sensor automatically uploads the measured parameter, the calibration data and the range of measurement to the transmitter. The default configuration of the 4-20 mA output is the range of the sensor, 0-14 pH for pH sensors, -1500 - +1500 for ORP or 0-XXXX ppm for a pIon Sensor. To change the 4-20 mA range, follow the instructions in Section 4.3.1. Configure 4-20 mA Output Range below.

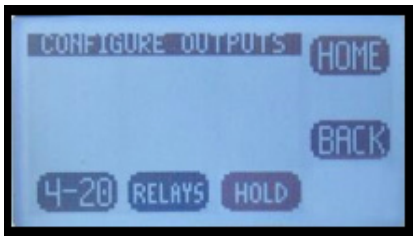


Figure 4-24: CONFIGURE OUTPUTS Screen

4.3.1. Configure 4-20 mA Output Range

Double press any key except the HOME key to enter the HOME Menu. Follow the path below to set the 4-20 mA range.

1. HOME Menu → Press CONFIG → XMTR → OUTPUT → 4-20 (1)(2) → PV or TEMP
2. Press CHANGE to enter New Values.

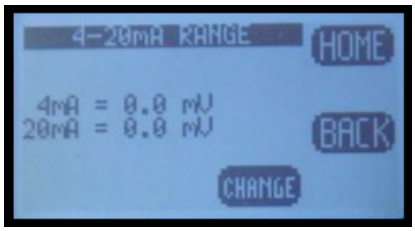


Figure 4-25: Configure 4-20 mA Output Range, Screen 1

3. Choose 4 mA value, press OK
4. Enter value using ▲ or ▼and NEXT to move to the next digit, press OK → Back

Figure 4-26: Configure 4-20 mA Output Range, Screen 2

5. Choose 20 mA value, press OK,
6. Enter value using ▲ or ▼ and NEXT to move to the next digit, press OK → Back

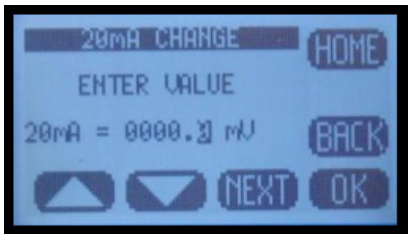


Figure 4-27: Configure 4-20 mA Output Range, Screen 3

7. Press BACK to return to the CONFIGURE 4-20 mA screen or HOME to return to the HOME Menu screen.

4.3.2 Configure 4-20 mA FAult Condition and CAL

1. In the CONFIGURE 4-20 mA screen, Press MORE → FAULT or
2. Choose Low Fault 3.5 mA or Hi Fault 22 mA or NONE, (default setting NONE), Press OK
3. Press BACK ? CAL, connect DVM to 4-20 mA line, Press 4.00 mA then adjust value to the DVM reading, Press 20.00 mA and adjust value to the DVM reading. The 4-20 mA output is calibrated.

4.3.3 Configure Alarm Relays (Relays Optional)

1. HOME Menu → Press CONFIG → XMTR → OUTPUT → RELAYS?RLY1

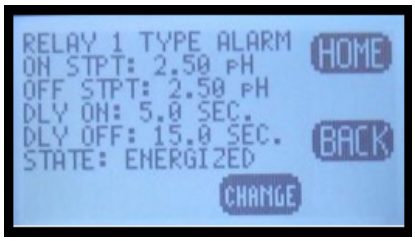


Figure 4-28: Configure Alarm Relays

2. Choose the **ALARM**, **TIMER**, **FAULT** or **DISABLE** mode for Relay 1
3. ALARM Displays:
   - SET POINT ON: The Process Variable Value that activates the relay.

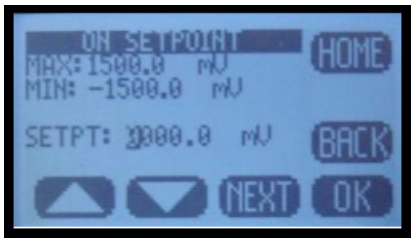


Figure 4-29: SETPOINT ON Screen

   - EXPIRATION: Enter a time that should not be exceeded before the PV should have changed enough to activate the OFF set point. At the Expiration time the relay is deactivated and a Fault condition is initiated. Fault: Relay 1 Time expired: Cause: Loss of reagent, failed sensor ....
   - Delay ON: The amount of time the PV must remain above/below the set point before the relay activates.
   - SET POINT OFF: The Value of the process variable that deactivates the relay.
     ~ SET POINT OFF > Set Point → Low Set Point
     ~ SET POINT OFF < Set Point → Hi Set Point
   - Delay OFF: The amount of time the PV must remain above/below the hysteresis point before the relay deactivates.
   - STATE: Energize (relay is energized on activation)/De-energize (relay is de-energized on activation)
4. TIMER activates the relay periodically for a specific duration, user configured period and duration
5. FAULT sets the relay condition to a de-energize state and NC relay closes in response to a Fault condition.
6. DISABLE turns off the relay and removes it's icon from the HOME screen

4.3.4 Setting up an Alarm Relay

1. Choose **ALARM**
2. Press **CHANGE** to enter new values

3. Choose **ON Set Point**, Press **OK**.
4. Enter value using ▲ or ▼ and **NEXT** to move to the next digit, press **OK**, press **BACK** (Min - Max values indicate the range of acceptable values).
5. Choose **Expiration**, Press **OK**.
6. Choose time from drop down menu using ▲ or ▼, press **OK**, press **BACK**.
7. Choose **OFF Set Point**, Press **OK**.
8. Enter value using ▲ or ▼ and **NEXT** to move to the next digit, press **OK**, press **BACK**.
9. Choose **Delay ON**, press **OK**.
10. Enter value using ▲ or ▼ and **NEXT** to move to the next digit, press **OK**, press **BACK**.
11. Choose **Delay OFF**, press **OK**.
12. Enter value using ▲ or ▼ and **NEXT** to move to the next digit, press **OK**, and press BACK when done to exit Relay 1.
13. Repeat for Relay 2 and Relay 3.

4.3.5 Exit Menus and Return to Main Display

1. Press **HOME** Key to return to the Home Menu Screen.

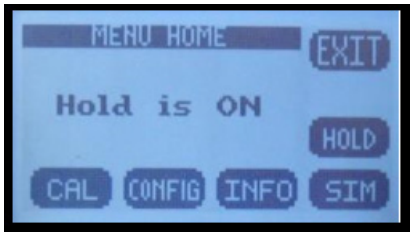


Figure 4-30: Hold is On Screen

2. Press **Hold** to turn OFF Hold.

Figure 4-31: Hold is Off Screen

3. Press **EXIT** Key to exit the menu.
4. "Save Changes?" press **YES**.

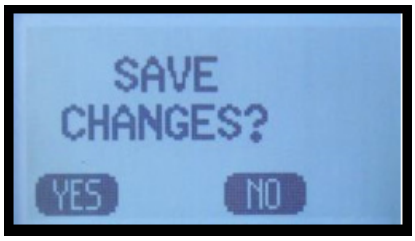


Figure 4-32: SAVE CHANGES? Screen

5. Choose Display Mode, **DATA, mV** or **GRAF** by pressing selection Key. The selection key displays which screen will be displayed next.
   - The type of graphical display used, Line, Bar or Gauge is selected in CONFIG → XMTR → LCD → GRAPH → LINE, GAUGE, BAR.

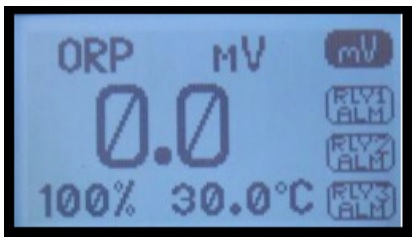


Figure 4-33: mV Display Mode

4.3.6 Sensor Start Up

All sensors are supplied with protective caps over the sensing end. Remove the cap(s) from the sensor before installing in the process. All sensors were calibrated at the factory before shipment, no calibration should be necessary before use.

Allow the sensor to equilibrate to the process solution conditions for ½ hour before verifying the reading against a grab sample. If calibration is required follow the instruction in Section 4.0 below.

4.4. User Selectable Options

4.4.1. Screen Lighting

LED back lighting is available on AC and DC powered instruments only, this feature is inactive on loop powered instruments.

Contrast can be adjusted for optimal viewing. The Backlight can be adjusted to timeout after a set period of time or remain on.

Location: CONFIG → XMTR → LCD → Set Up → CONT, BACK LIGHT.

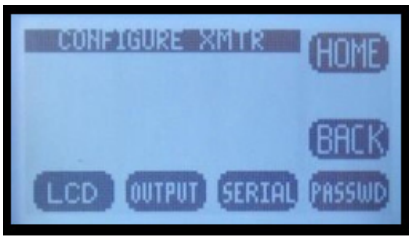


Figure 4-34: Screen Lighting

4.4.2 Graphical Display

There are three graphical display choices:

- LINE, The Line graph is a moving average of the process variable with the 4-20 mA range as the maximum/minimum values and a choice of time scales.

  The Time scale is the amount of time displayed across the full screen. Choices include:

Full Screen Period	15 mins.	1 hour	12 hours	1 day	2 days
Sample Rate (1 point every)	10 secs.	40 secs.	8 mins.	15 mins.	30 mins.

- GAUGE, Live reading displaying 0-100% of 4-20 mA range. The Alarm Relay number(s), #1, #2 and#3 mark the respective set points on graph.
- BAR, Live reading displaying 0-100% of 4-20 mA range. The Alarm Relay number(s), #1, #2 and#3 mark the respective set points on graph.

Pressing **OK** after selecting a Graphical Display will exit the menu structure and return to the Main Display.

Location: CONFIG → XMTR → LCD → GRAPH

4.4.3 TAG Transmitter Name

Two 16 character lines are available for naming the transmitter, Upper and Lower case characters, Numbers and Punctuation are available. The information entered will be displayed in the INFO screen and optionally in the Main display sequence if activated in the TAG ON menu. The character set is listed below sequentially; the first character in the set is an empty space.

Figure 4-35: DISPLAY LABELS Screen

! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [¥] ^ _ ' a b c d e f g h I j k l m n o p q r s t u v w x y z { | } →←

Entry is accomplished by scrolling through the alphanumeric list with the ▲ (forward) and ▼ (backwards) arrows to the character of choice and then pressing **NEXT** to advance the cursor to the next digit. Pressing and holding the ▲ or ▼ keys will initiate two speed auto scrolling. Press **BACK** to exit the screen.

Figure 4-36: XMTR TAG Screen

Location: CONFIG → XMTR → LCD → LABELS → TAG.

4.4.4 Sensor Name

Two 16 character lines are available for naming the Sensor, Upper and Lower case characters, Numbers and Punctuation are available. The information entered will be displayed in the INFO screen. Entry is accomplished by scrolling through the alphanumeric list with the ▲ (forward) and ▼ (backwards) arrows to the character of choice and then pressing **NEXT** to advance the cursor to the next digit. Pressing and holding the ▲ or ▼ keys will initiate two speed auto scrolling. Press **BACK** to exit the screen.

Location: CONFIG → XMTR → LCD → LABELS → SENSOR.

4.4.5 Password Protection

PASSWD Enter 4 character password to protect access to MENU Level, CAL Menu, CONFIG Menu and SIM Menu (simulate). Each level can be turned ON or OFF and can have a unique password. Upper Case Characters and Numbers are available for use.

Place the cursor in front of the level to be changed and Press **OK**. Move the cursor to ON and press **OK** to change the password status from OFF to ON.

Figure 4-37: CHOOSE PASSWORD Screen

Entry is accomplished by scrolling through the alphanumeric list with the ▲ (forward) and ▼ (backwards) arrows to the character of choice and then pressing **NEXT** to advance the cursor to the next digit. Pressing and holding the ▲ or ▼ keys will initiate two speed auto scrolling.

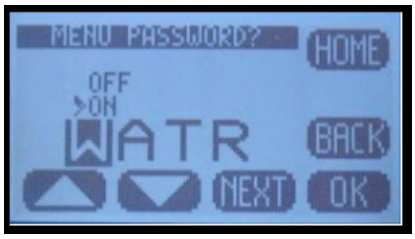


Figure 4-38: MENU PASSWORD? Screen

• MENU	ON/OFF	----	Locks Main Menu
• CAL	ON/OFF	----	Locks CAL and CONFIG
• CONFIG	ON/OFF	----	Locks CONFIG
• SIM	ON/OFF	----	Locks SIM and CONFIG

In the case of a Lost or Forgotten password, enter **MSTR** to access the screen.

Location: CONFIG → XMTR → PSSWD.

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5. Calibration

5.1. Calibration Methods

The Model LXT330 transmitter provides three methods of calibration: AUTO, STANDardize, and MANUAL.

Figure 5-1: Calibration Selections

5.1.1. AUTO Calibration Description

AUTO calibration is the primary calibration method for all measurements. AUTO calibration automatically recognizes the calibration solution the sensor is in and proposes the actual temperature compensated value for acceptance. AUTO calibration can be a single point or two point calibration. A single point calibration sets the zero point or offset value of the sensor. The second calibration sets the slope or span of the sensor.

When the **AUTO** key is pressed the transmitter displays the PV (Process Variable) and the associated mV signal from the sensor. When the reading has stabilized a calibration value is automatically proposed, i.e. 7.00 pH, 10 ppm Fluoride ion, 0.00 mg/L Dissolved Oxygen. The user is prompted to accept the proposed calibration value or enter and accept another value. Once Cal 1 is accepted the user is ask to continue to Cal 2, yes/no. If yes, then a second calibration value is proposed when the sensor has stabilized in the second calibration solution. Accept the value and the calibration is complete.

At the end of each calibration the Offset and Slope are displayed in the respective units, pH, mV, ppm, mg/l.

Figure 5-1: AUTO Calibration

5.1.2. STANDardize Calibration Description

A Standardize Calibration is a single point calibration where the transmitter's reading is adjusted to agree with a solution of known value, either a calibration standard, a grab sample or laboratory

determined value. In many cases the constituents and the pressure and temperature of the process solution are very different from the calibration solution. In these cases, once the sensor has

equilibrated, the Zero Point or Offset value may have shifted from the original calibration point. Standardization allows for correction of this type of offset.

When the **STAND** key is pressed, the user is prompted to ENTER VALUE. The user enters the value they want the transmitter to read and press **OK**. The user is then prompted to accept the value, yes/no, and the calibration is complete. Standardizations are single point calibrations.

At the end of each calibration the Offset and Slope are displayed in the respective units, pH, mV, ppm, mg/l.

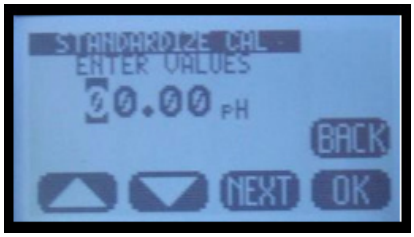

Figure 5-1: STANDardize Calibration

5.1.3. MANUAL Calibration Description

Manual calibration allows the user to enter calibration data for an electrode into the transmitter without performing a calibration. A MANUAL Calibration requires the entry of three pieces of

data, (1) A concentration with the (2) corresponding mV value and (3) a slope for the electrode. This allows laboratory generated calibration data for an electrode to be entered in a remote analyzer where calibration is difficult or impractical.

Example: MANUAL Calibration for a pH electrode

1. Calibrate the pH electrode in the laboratory
2. Record the mV value of some pH Standard, pH 7.00 buffer = 6.8 mV (any pH - mV pair will work)
3. Calculate and Record the slope of the electrode, -58.2 mV/pH
4. Install the electrode into the field mounted sensor
5. Press **MANUAL** and enter the pH value, 7.00 pH, press mV and enter the corresponding mV value, 6.8 mV, press **OK**, Accept Offset?, press **YES**, enter slope- 58.2 mV/pH, press **OK**, Accept Slope?, Press **YES**
6. The Calibration is complete, the Offset and Slope values are displayed, press **OK** to exit.

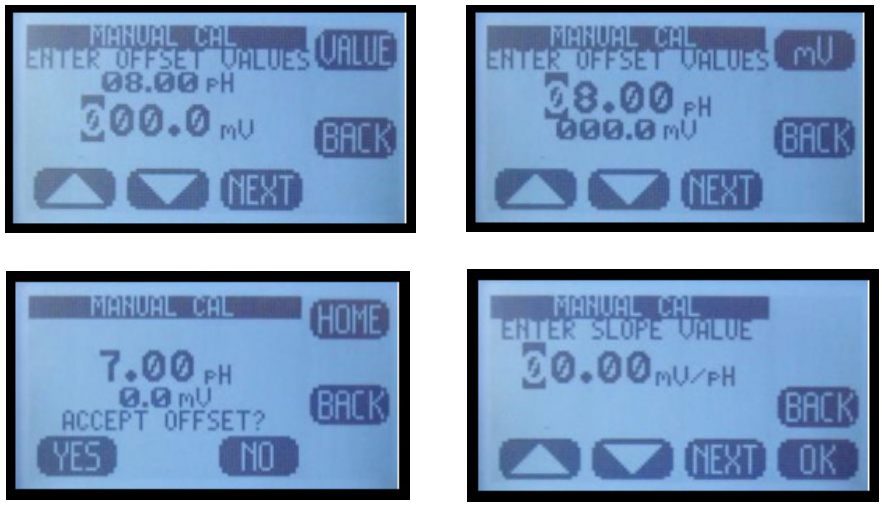

Figure 5-1: MANUAL Calibration

5.2. PH Calibration Procedures

AUTO Calibration recognizes pH 4.01, pH 7.00 and pH 10.00 buffer solutions for automatic, temperature compensated calibrations. Any calibration solutions can be used but the pH value will have to be entered manually. Follow the steps below to accomplish a pH calibration. Example uses pH 7.00 and pH 4.01 buffers.

5.2.1. AUTO Cal Using pH 4.01, 7.00, 10.00 Buffers

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Place Sensor in CAL Solution (use pH 7.00 buffer)
Press **AUTO** then **CAL 1**	STABILIZING, 7.00 pH x.x mV, 7.00 pH corrected Accept Cal 1?
Press **YES**	CAL1 Value 7.00 pH, Continue to CAL2? Move sensor to 4.01 pH buffer solution
Press **YES**	STABILIZING, 4.00 pH xxx.x mV, 4.00 pH corrected Accept Cal?
Press **YES**	OFFSET: 7.00 pH x.x mV, SLOPE: -59.16 mV/pH (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.2.2. AUTO CAL Using Other pH Buffers

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Place Sensor in CAL Solution
Press **AUTO** then **CAL 1**	STABILIZING, 7.00 pH x.x mV, 7.00 pH corrected Accept Cal 1?
Press **NO**	Enter CAL 1 Value
Press ▲ ▼ **NEXT**	xx.xx pH (use arrows and NEXT to enter pH Buffer value)
Press **OK**	xx.xx pH, xxx.x mV, Accept this Value
Press **YES**	CAL 1 Value xx.xx pH, Continue to CAL 2? (Place Sensor in 2nd calibration buffer)
Press **YES**	STABILIZING, xx.xx pH xxx.x mV, 4.00 pH corrected Accept Cal?
Press **NO**	Enter CAL 2 Value
Press ▲ ▼ **NEXT**	xx.xx pH (use arrows and NEXT to enter pH Buffer value)
Press **OK**	xx.xx pH, xxx.x mV, Accept this Value
Press **YES**	OFFSET: xx.xx pH x.x mV, SLOPE: -59.16 mV/pH (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.2.3. STANDARDIZE

Leave the sensor in the process solution, take a grab sample from the process and determine the pH or place sensor in a calibration standard solution.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (or leave in the process solution)
Press **STAND**	Enter Value
Press ▲ ▼ **NEXT**	xx.xx pH (use arrows and NEXT to enter process pH value)

Action	Prompt
Press **OK**	xx.xx pH, xxx.x mV, Accept Value?
Press **YES**	OFFSET: xx.xx pH x.x mV, SLOPE: xx.xx mV/pH (this data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON (Press HOLD to turn off Hold)
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.3. ORP Calibration Procedures

AUTO Calibration recognizes Quinhydrone solutions (mVa), pH 7.00 quinhydrone solution (90 mV) and pH 4.01 quinhydrone solution (267 mV) for automatic ORP calibrations. Any calibration solutions can be used but the ORP value will have to be entered manually. Follow the steps below to accomplish an ORP calibration.

5.3.1. AUTO CAL with Quinhydrone

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Place Sensor in CAL Solution (use pH 7.00 Q solution)
Press **AUTO** then **CAL 1**	STABILIZING, xxx.x mV, xxx.x mVa, 90.0 mV corrected Accept Cal?
Press **YES**	CAL1 Value 90.0 mV, Continue to CAL2? Move sensor to pH 4.01 Q solution
Press **YES**	STABILIZING, 269.2 mV 267.0 mVa, 267 mV corrected Accept Cal?
Press **YES**	OFFSET: 90.0 mVa, 87 mV, SLOPE: 1.02 mV/ mVa (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.3.2. STANDARDIZE

Leave the sensor in the process solution, take a grab sample from the process and determine the ORP.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (or leave in the process solution)
Press **STAND**	Enter Value
Press ▲ ▼ **NEXT**	xx.xx mV (use arrows and NEXT to enter process ORP value)
Press **OK**	xxx.x mV, xxx.x mV, Accept Value?
Press **YES**	OFFSET: xxx.x mV xxx.x mV, SLOPE: xx.xx mV/mV (this data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.4. pION Calibration Procedures

AUTO Calibration recognizes 1, 10 or 100 ppm/ppb calibration solutions. Any calibration solutions can be used but the ppm value will have to be entered manually. Follow the steps below to accomplish a pION calibration.

5.4.1. AUTO CAL Using 1, 10, 100 PPM Solutions

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Place Sensor in CAL Solution (use 10 ppm solution)
Press **AUTO** then **CAL 1**	STABILIZING, 10.00 ppm, xxx.x mV, 10.00 ppm corrected, Accept Cal?
Press **YES/NO**	CAL1 Value 10.00 ppm, Continue to CAL2? Move sensor to 100 ppm solution
Press **YES**	STABILIZING, 100.0 ppm, xx.xx mV, 100 ppm corrected, Accept Cal?
Press **YES**	OFFSET: 10.00 ppm, 310 mV, SLOPE: 55.1 mV/ decade (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON

Action	Prompt
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.4.2. AUTO CAL Using Non-decimal PPM Solutions

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Place Sensor in CAL Solution
Press **AUTO** then **CAL 1**	STABILIZING, xx.xx pH x.x mV, 10.00 ppm corrected Accept Cal?
Press **NO**	Enter CAL 1 Value
Press ▲ ▼ **NEXT**	xxxx.x ppm (use arrows and NEXT keys to enter Cal value)
Press **OK**	xxxx.x ppm, xxx.x mV, Accept this Value
Press **YES**	CAL 1 Value xxxx.x ppm, Continue to CAL 2? (Place Sensor in 2nd calibration solution)
Press **YES**	STABILIZING, xxxx.x ppm xxx.x mV, xxx.x ppm corrected Accept Cal 2?
Press **NO**	Enter CAL 2 Value
Press ▲ ▼ **NEXT**	xxxx.x ppm (use arrows and NEXT keys to enter Cal value)
Press **OK**	xxxx.x ppm, xxx.x mV, xxx.x ppm corrected Accept Cal 2?
Press **YES**	OFFSET: xxxx.x ppm xxx.x mV, SLOPE: 55.40mV/decade (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.4.3. STANDARDIZE

Leave the sensor in the process solution, take a grab sample from the process and determine the Ion concentration.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration

Action	Prompt
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (or leave in the process solution)
Press **STAND**	Enter Value
Press ▲ ▼ **NEXT**	xxxx.x ppm (use arrows and NEXT to enter process Ion ppm value)
Press **OK**	xxxx.x ppm, xxx.x mV, Accept Value?
Press **YES**	OFFSET: xxxx.x ppm xxx.x mV, SLOPE: xx.xx mV/DEC (this data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.5. SP3/DO90 DISSOLVED OXYGEN Calibration Procedures

There are two separate calibration procedures for Dissolved Oxygen sensors, Section 4.4 for SP3 DO and DO90 ppb DO and Section 4.5 for TRITON® SP3-ODO Optical.

The dissolved oxygen AUTO Cal acknowledges zero ppm, mg/l, % SAT for CAL 1 and the temperature compensated value for atmospheric oxygen, 8.25 ppm, mg/l at 25°C or 100 % SAT for CAL 2.

The zero point is set by placing the sensor into an oxygen free solution and verifying the displayed value drops to a value below 1 mV. The sensor will take a few minutes to equilibrate to the zero oxygen solution but for the highest accuracy it is best to wait 15-20 minutes before initiating a calibration. The typical sensor will burn down to 0.5 - 0.7 mV in an hour or so in a zero ppm solution. A zero ppm O2 solution can be made by adding approximately 5 grams of sodium sulfite to a liter of distilled water or purging the sample with nitrogen gas.

The slope (CAL 2) is set by placing the sensor in air saturated distilled water or water saturated (100% humidity) air. The easiest method is to suspend the sensor vertically in beaker with a ½" of water in the bottom slightly above the water.

A STANDardize calibration adjusts the CAL 2 value, resetting the slope of the sensor, mV/ppm.

The actual concentration in mg/L (C) is equal to the Saturation value at the given temperature multiplied by the altitude and air pressure corrections. Determine the calibration temperature and look up the saturation value

(S) in Table 1 below. Then determine the altitude correction (K) from Table 2 and the current air pressure in bar (P), 1 bar equals 14.7 psi. Use 1 bar if the actual air pressure is unknown.

$$C = S \times K \times P$$

Example:

Temperature = 20°C ? Saturation = 9.08 mg/L, Altitude = 1200 ft ? K = 0.960, Air Pressure 1.014 bar
C = 9.08 x 0.960 x 1.014 = 8.84 mg/L

The LXT330 transmitter uses the temperature compensated Saturation Index for AUTO Cal, however the user can enter the altitude and pressure compensated value of 8.84 ppm as the calibration value when prompted to "Accept Value?" in CAL 2.

Saturation Index					
Temperature °C (°F)	**Saturation mg/L**	**Temperature °C (°F)**	**Saturation mg/L**	**Temperature °C (°F)**	**Saturation mg/L**
0 (32)	14.64	14 (57)	10.28	28 (82)	7.82
1 (34)	14.23	15 (59)	10.06	29 (84)	7.69
2 (36)	13.83	16 (61)	9.85	30 (86)	7.55
3 (38)	13.45	17 (63)	9.64	31 (88)	7.42
4 (39)	13.09	18 (64)	9.45	32 (90)	7.30
5 (41)	12.75	19 (66)	9.26	33 (91)	7.18
6 (43)	12.42	20 (68)	20 (68)	34 (93)	7.06
7 (45)	12.11	21 (70)	8.90	35 (95)	6.94
8 (46)	11.81	22 (72)	8.73	36 (97)	6.83
9 (48)	11.53	23 (73)	8.57	37 (99)	6.72
10 (50)	11.25	24 (75)	8.41	38 (100)	6.61
11 (52)	10.99	25 (77)	8.25	39 (102)	6.51
12 (54)	10.75	26 (79)	8.11	40 (104)	6.41
13 (55)	10.51	27 (81)	7.96		

Altitude Correction					
Altitude m (ft)	**K**	**Altitude m (ft)**	**K**	**Altitude m (ft)**	**K**
Sea Level (0)	1.000	700 (2300)	0.922	1400 (4600)	0.849
50 (160)	0.994	750 (2450)	0.916	1450 (4750)	0.844
100 (330)	0.988	800 (2600)	0.911	1500 (4900)	0.839
150 (500)	0.982	850 (2800)	0.905	1550 (5100)	0.834
200 (660)	0.977	900 (2950)	0.900	1600 (5250)	0.830
250 (820)	0.971	950 (3100)	0.895	1650 (5400)	0.825
300 (980)	0.966	1000 (3300)	0.890	1700 (5600)	0.820
350 (1200)	0.960	1050 (3450)	0.885	1750 (5750)	0.815
400 (1300)	0.954	1100 (3600)	0.879	1800 (5900)	0.810
450 (1500)	0.949	1150 (3775)	0.874	1850 (6050)	0.805

Altitude Correction					
Altitude m (ft)	**K**	**Altitude m (ft)**	**K**	**Altitude m (ft)**	**K**
500 (1650)	0.943	1200 (3950)	0.869	1900 (6200)	0.801
550 (1800)	0.938	1250 (4100)	0.864	1950 (6375)	0.796
600 (2000)	0.932	1300 (4250)	0.859	2000 (6550)	0.792
650 (2150)	0.927	1350 (4400)	0.854		

5.5.1. AUTO CAL Using Zero PPM Solution and Air

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Place Sensor in CAL 1 Solution (use 0.00 ppm solution) or CAL 2 Solution (Air)
	To perform zero CAL press CAL 1, to skip zero cal press CAL 2
Press **AUTO** then **CAL ?**	STABILIZING, 0.00 ppm, xxx.x mV, 0.00 ppm corrected, Accept Cal?
Press **YES**	CAL 1 Value 0.00 ppm, Continue to CAL2? Move sensor to Air or saturated water
Press **YES**	STABILIZING, 8.25 ppm, xxx.x mV, 8.25 ppm corrected, Accept Cal?
Press **YES**	OFFSET: 0.00 ppm, 2.3 mV, SLOPE: 40.1 mV/ ppm (data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.5.2. STANDARDIZE

Leave the sensor in the process solution or in the air, take a grab sample from the process and determine the dissolved oxygen concentration or enter the temperature and pressure corrected value for air.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration

Action	Prompt
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in Air or the process solution
Press **STAND**	Enter value
Press ▲ ▼ **NEXT**	xxx.xx ppm or % SAT (use arrows and NEXT to enter process value)
Press **OK**	xxx.xx ppm, xxx.x mV, Accept Value?
Press **YES**	OFFSET: 0.00 ppm xx.x mV, SLOPE: xx.xx mV/ppm (this data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.5.3. MANUAL CAL

Leave the sensor in the process solution or in the air, take a grab sample from the process and determine the dissolved oxygen concentration or enter the temperature and pressure corrected value for air.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in Air or the process solution, it doesn't matter which
Press **MANUAL**	Enter Zero Value
Press ▲ ▼ **NEXT**	000.00 ppm or % SAT (use arrows and NEXT to enter ppm value)
Press **mV** Button	Enter mV value for zero ppm solution (default use 0.5 mV)
Press ▲ ▼ **NEXT**	000.00 mV (use arrows and NEXT to enter mV value)
Press **OK**	OFFSET: 0.00 ppm 00.5 mV, Accept Value?
Press **YES**	Slope 000.0 mV/ppm or 000.0 mV/% SAT
Press ▲ ▼ **NEXT**	048.00 mV/ppm (use calculated value or 45 mV/ppm or 4.0 mV/% SAT)
Press **OK**	Slope 48.00 mV/ppm, Accept this Value?
Press **YES**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold

Action	Prompt
Press **EXIT**	Main Display

5.6. TRITON® Dissolved Oxygen Calibration Procedures

Before starting a calibration Enter the Salinity and Barometric pressure in the CONFIG?SENSOR menu. The default values are Salinity 0% and 1013 mbar. Use the Altitude Correction Table above to calculate the pressure using elevation if the actual pressure is not known.

The TRITON® SP3-ODO sensor was calibrated at the factory prior to shipment and should not require a re- calibration at start up. Calibration is required whenever the fluorescence cap/membrane cap is replaced.

Calibrations can be performed as a one point (Air cal), a two point (zero point & Air cal) or a standardization, there is no Manual Cal option available for the TRITON® dissolve oxygen sensors.

The Auto Cal allows both 0% and100% calibrations. The sensor senses the oxygen partial pressure and if it is less than 20% of saturation it assumes a Zero Point calibration and calibrates to 0.00% saturation, 0.00 mg/l or 0.00 mbar depending on the measurement mode. If the sensed value is above 75% of saturation it assumes an Air Calibration and calibrates to the value equivalent to 100% saturation.

The zero point of the sensor is relatively stable through the life of the fluorescence/membrane cap. The zero point is checked by placing the sensor into an oxygen free solution and verifying the displayed value drops to a value near zero ppm. The sensor will take a few minutes to equilibrate to the zero oxygen solution but it is best to wait 15-20 minutes before initiating a calibration (up to a 10 minute cycle time) for the highest accuracy. A zero ppm O_2 solution can be made by adding approximately 5 grams of sodium sulfite to a liter of distilled water or purging the sample with nitrogen gas.

Air saturated water and water saturated air (100% humidity) have the same oxygen partial pressure. The preferred calibration method uses water saturated air. The Protective Guard can be removed from the front of the sensor and filled a small amount of distilled water, ~5 ml, for an easy to use Calibration Cap.

The calibration cycle takes up to 10 minutes once initiated. The SP3-ODO sensor should be equilibrated for 10-15 minutes to the air sample (100% humidity, 0% Salinity) and the ambient temperature before starting the calibration. When measuring in the "% Saturation mode", 100% will be reported as the calibration value.

5.6.1. AUTO CAL Using Zero PPM Solution and Air

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)

Action	Prompt
Press **AUTO** (Optional)	CALIBRATING, SAVING CAL, AUTO CAL COMPLETE, OK? (up to 10 minutes)
Press **OK** (Optional)	
AIR CALIBRATION	Move sensor to Air (100% humidity) or Air saturated water
Press **AUTO**	CALIBRATING, SAVING CAL, AUTO CAL COMPLETE, OK?
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.6.2. STANDARDIZE

Leave the sensor in the process solution or in the air, take a grab sample from the process and determine the dissolved oxygen concentration or enter the temperature and pressure corrected value for air.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Place Sensor in Air or with the sensor in the process solution
Press **STAND**	Enter Value
Press **▲ ▼ NEXT**	xx.xx ppm or % SAT (use arrows and NEXT to enter process value)
Press **OK**	xx.xx ppm, Accept Value?
Press **YES**	CALIBRATING, SAVING CAL, CURRENT VALUE: x.xx ppm, DESIRED VALUE: x.xx ppm, OFFSET xxx ppb or ppm
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.7. Conductivity Sensors

AUTO Calibration recognizes Air for zero point (Cal 1) and 50µS, 100µS, 500µS, 1mS, 5mS, 10mS, 50mS and 100mS solutions for the span (Cal 2). Any calibration solutions can be used but the conductivity value will have to be entered manually. Use a calibration standard near the conductivity of the process solution. Example uses air and 1mS.

5.7.1. AUTO CAL Using Air and Conductivity Standard

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Remove the Sensor from Solution and dry the front end, Air = 0.00 µS
To perform zero CAL press CAL 1, to skip zero cal press CAL 2, only if a zero cal was previously done on the sensor.	
Press **AUTO** then **CAL 1**	STABILIZING, 0.00 µS, 1.17 V, 0.00 µS corrected, Accept Cal?
Press **YES**	CAL 1 Value 0.00 µS, Continue to CAL2? Move sensor to 1.00 mS solution
Press **YES**	STABILIZING, 1.00 mS, 98X.X mV, 1.000 µS corrected, Accept Cal?
Press **YES**	OFFSET: 0.00 ppm, 174.4 mV, SLOPE: 984 (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.7.2. STANDARDIZE

With the sensor in the process solution, take a grab sample from the process and determine the conductivity using a qualified laboratory conductivity meter.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	With the sensor in the process solution
Press **STAND**	Enter the laboratory determined conductivity value
Press **▲ ▼ NEXT**	xxx.xx µS/mS (use arrows and NEXT to enter process value)
Press **OK**	xxx.xx µS/mS, xxx.x mV, Accept Value?
Press **YES**	OFFSET: 0.00 µS 1.0 mV, SLOPE: xx.xx mV/ppm (this data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON

Action	Prompt
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.8. TDS Conductivity Sensors

The Total Dissolved Solids measurement (TDS) on the Model LXT330 transmitter is made with an SP3 conductivity sensor and a correlation factor. (Conductivity in µS x correlation factor = ppm)

Conductivity is a measurement of a solution's electrolytic conductivity, 1/ohms. The type of dissolved ions in the solution is irrelevant to the measurement. TDS is a measurement of concentration, ppm (mg/L). Since different salts contribute different amounts of conductivity to a solution, TDS measurements are only valid between solutions of the same chemical makeup. As an example, 1000 ppm of TDS in natural waters has a conductivity around 1400 µS (correlation factor 0.6712), 1000 ppm of KCl has a conductivity around 2000 µS (correlation factor 0.5000) and 1000 ppm of NaOH has a conductivity around 6000 µS (correlation factor 0.1667). All three solutions have a TDS of 1000 ppm but the conductivities are 1400 µS, 2000 µS and 6000 µS. A TDS measurement is only valid for a solution with the same chemical make up as the solution used for calibration.

Calibration is accomplished in two steps; Step 1 Conductivity AUTO Calibration of the sensor (Section 5.7.1. AUTO CAL Using Air and Conductivity Standard above) and then Step 2 correlation of conductivity to the TDS. The second step can be done by entering the correlation factor into the CONFIG → SENSOR → TDS menu or by standardizing the sensor in a solution of known TDS in the CAL?STAND menu by entering the TDS value. Since the correlation of conductivity to concentration is not linear it is best to calibrate the sensor near the measured value.

5.8.1. STANDARDIZE

With the sensor in the process solution, take a grab sample from the process and determine the TDS using a qualified laboratory method.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	With the sensor in the process solution or calibration standard
Press **STAND**	Enter the laboratory determined TDS value.
Press **▲ ▼ NEXT**	xxx.xx ppm (use arrows and NEXT to enter process value)
Press **OK**	xxx.xx ppm, xxx.x mV, Accept Value?
Press **YES**	Current value: xx.xx ppm, Desired value: xx.xx ppm, Offset: xx.xx ppm
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON

Action	Prompt
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.9. Resistivity Sensors

AUTO Calibration recognizes Air for zero point (Cal 1) and a Meg-Ohm process solution for the span (Cal 2). Use the actual process solution or a solution near the resistivity of the process solution. The example below uses air and 15 M?. The Cal 1, air calibration value is very stable and need not be done for every calibration.

5.9.1. AUTO CAL Using Air and Meg-Ohm Process Water

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **YES/NO**	Remove the Sensor from Solution and dry the front end
To perform zero CAL press CAL 1, to skip zero cal press CAL 2, only if a zero cal was previously done on the sensor	
Press **AUTO** then **CAL 1**	STABILIZING, 55.000 M?, 1.20 V, 55.000 M? corrected, Accept Cal?
Press **YES**	CAL 1 Value 55.000 M?, Continue to CAL2? Move sensor to M? solution
Press **YES**	STABILIZING, 9.875 M?, 517 mV, 9.875 M? corrected, Accept Cal?
Press **NO**	Enter actual M? value of the solution, Accept Cal
Press **YES**	OFFSET: 55.000 M?, 1.20 V , SLOPE: 0.938 (data written to Log)
Press **OK**	Calibration Complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.9.2. STANDARDIZE

With the sensor in the process solution, take a grab sample from the process and determine the conductivity using a qualified laboratory conductivity meter.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	With the sensor in the process solution
Press **STAND**	Enter the laboratory determined conductivity value
Press ▲ ▼ **NEXT**	xxx.xx M? (use arrows and NEXT to enter process value)
Press **OK**	Current Value xx.xx M?, Desired Value: xx.xx M?, Offset XX.XX OK?
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.10. Ammonium (NH_4-N) Sensor

The NH_4-N Ammonium Analyzer was calibrated at the factory using the Two Point Calibration described below. The sensor was assembled and placed beaker of equilibration solution for 8-12 hours before starting the calibration. The Potassium Ion and Ammonium Ion electrodes sensing membranes require several hours to properly hydrate/ equilibrate to the measured solution.

Since the factory calibration characterizes the complete measurement system the initial user calibration should only require a standardization of the Ammonium Ion Electrode once the HYDRA has equilibrated to the process solution.

The Factory Calibration and all subsequent calibrations should be performed in the following sequence:

1. pH Electrode calibration in pH 7.00 buffer and pH 4.01 buffer (2 point)
2. Potassium Electrode calibration in 10 ppm and 100 ppm solutions (2 point)
3. Ammonium Electrode calibration in 10 ppm and 100 ppm solutions (2 point)

Calibration checks should be performed weekly by comparison to a grab sample or immersing the HYDRA sensor into a standard solution with known pH, K+ and NH4-N values. Performing a Single Point Calibration will eliminate any offset found in the calibration check. Continuous drifting of the potassium or ammonium ion reading may indicate the electrode needs to be replaced.

Two Point Calibration is required whenever an electrode is replaced, pH, Potassium or Ammonium. Two Point Calibrations are also recommended every two months to verify the response of the electrodes is greater than 50 mV/decade.

Rinsing the sensor with copious amount of De-ionized water or RO Water between calibrations is required. There are large amounts of potassium ions in pH buffer causing carryover.

5.10.1. AUTO CAL Using pH 4.01, 7.00, 10.00 Buffers

pH is indicated in the Transmitter as AUX in the calibration menu.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Select Sensor AUX for pH calibration.
Press **AUX**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (use pH 7.00 buffer)
Press **AUTO** then **CAL 1**	STABILIZING, 7.00 pH x.x mV, 7.00 pH corrected Accept Cal 1?
Press **YES**	CAL1 Value 7.00 pH, Continue to CAL2? Move sensor to 4.01 pH buffer solution
Press **YES**	STABILIZING, 4.00 pH xxx.x mV, 4.00 pH corrected Accept Cal?
Press **YES**	OFFSET: 7.00 pH x.x mV, SLOPE: -59.16 mV/pH (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.10.2. STANDARDIZE pH

Leave the sensor in the process solution, take a grab sample from the process and determine the pH or place sensor in a calibration standard solution.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Select Sensor AUX for pH calibration.
Press **AUX**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (or leave in the process solution)
Press **STAND**	Enter Value
Press ▲ ▼ **NEXT**	xx.xx pH (use arrows and NEXT to enter process pH value)
Press **OK**	xx.xx pH, xxx.x mV, Accept Value?
Press **YES**	OFFSET: xx.xx pH x.x mV, SLOPE: xx.xx mV/pH (this data written to Log)
Press **OK**	Back to Cal Menu

Action	Prompt
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.10.3. AUTO CAL Using 10ppm and 100ppm Potassium Calibration Solutions

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Select Sensor AUX for pH calibration.
Press **Sensor 2**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (use pH 7.00 buffer)
Press **AUTO** then **CAL 1**	STABILIZING, 10 ppm x.x mV, 10 ppm corrected Accept Cal 1?
Press **YES**	CAL1 Value 10 ppm, Continue to CAL2? Move sensor 100 ppm calibration solution
Press **YES**	STABILIZING, 100 ppm xxx.x mV, 100 ppm corrected Accept Cal?
Press **YES**	OFFSET: 10 ppm x.x mV, SLOPE: -59.16 mV/pH (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.10.4. STANDARDIZE Potassium Ion

Leave the sensor in the process solution, take a grab sample from the process and determine the potassium or place sensor in a calibration standard solution.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Select Sensor AUX for pH calibration.
Press **Sensor 2**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (or leave in the process solution)

Action	Prompt
Press **STAND**	Enter Value
Press ▲ ▼ **NEXT**	xx.xx ppm (use arrows and NEXT to enter process concentration value)
Press **OK**	xx.xx ppm, xxx.x mV, Accept Value?
Press **YES**	OFFSET: xx.xx pH x.x mV, SLOPE: xx.xx mV/pH (this data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.10.5. AUTO CAL Using 10ppm and 100ppm Ammonium Calibration Solutions

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Select Sensor AUX for pH calibration.
Press **Sensor 1**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (use pH 7.00 buffer)
Press **AUTO** then **CAL 1**	STABILIZING, 10 ppm x.x mV, 10 ppm corrected Accept Cal 1?
Press **YES**	CAL1 Value 10 ppm, Continue to CAL2? Move sensor 100 ppm calibration solution
Press **YES**	STABILIZING, 100 ppm xxx.x mV, 100 ppm corrected Accept Cal?
Press **YES**	OFFSET: 10 ppm x.x mV, SLOPE: -59.16 mV/pH (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

5.10.6. STANDARDIZE Ammonium Ion

Leave the sensor in the process solution, take a grab sample from the process and determine the Ammonium or place sensor in a calibration standard solution.

Action	Prompt
Double Press any Button	MENU HOME, Hold is OFF
Press **HOLD**	Hold freezes 4-20 mA Output and locks Alarm Relays during Calibration
Press **CAL**	Select Sensor AUX for pH calibration.
Press **Sensor 1**	Is this a new Sensor? (Yes erases CAL Log in INFO, NO adds CAL to existing Log)
Press **NO**	Place Sensor in CAL Solution (use pH 7.00 buffer)
Press **STAND**	Enter Value
Press ▲ ▼ **NEXT**	xx.xx ppm (use arrows and NEXT to enter process concentration value)
Press **OK**	xx.xx ppm, xxx.x mV, Accept Value?
Press **YES**	OFFSET: xx.xx pH x.x mV, SLOPE: xx.xx mV/pH (this data written to Log)
Press **OK**	Back to Cal Menu
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

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6. Maintenance

No periodic maintenance is required for the Transmitter.

When you open the front cover and/or cable glands, make sure that the seals are clean and correctly fitted when the unit is re-assembled in order to maintain the housing's NEMA 4X weatherproof integrity against water and water vapor.

Fuse: There is a circuit board mounted fuse protecting the instrument. If you suspect that this needs to be replaced, contact Technical Support for parts and instructions.

6.1. Cleaning

The Model LXT330 transmitter requires no periodic maintenance, except to make sure the front window is kept clean in order to permit a clear view of the display and allow proper operation of the navigation buttons. If the window becomes soiled, clean it using a soft damp cloth or soft tissue. To deal with more stubborn stains, a neutral detergent or spray cleaner like Windex may be used. Never use harsh chemicals or solvents.

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7. Troubleshooting

Symptom	Probable Cause	Remedy
Blank Display	No Power	Check power source, 24VDC loop, 24VDC, 110/220VAC
	Sensor Failure, causing power draw down below transmitter threshold	Unplug sensor from transmitter, replace sensor if instrument powers up.
Incorrect Readings	Sensor needs calibration	Perform a standardization calibration. See INFO for calibration log
	Incorrect Temperature measurement	Calibrate/Trim Temperature to correct value
	Temperature Compensation set up incorrectly	Verify: 0.33% for pH, pIon 0.00% for ORP 4.0% for DO
"Looking For Sensor" prompt	Lost connection between sensor and transmitter	Check sensor connection to transmitter, loose connector? Visually inspect cable for cuts or crushed areas, replace sensor if cable is compromised

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8. Parts and Accessories

8.1. Front Panel Control Board

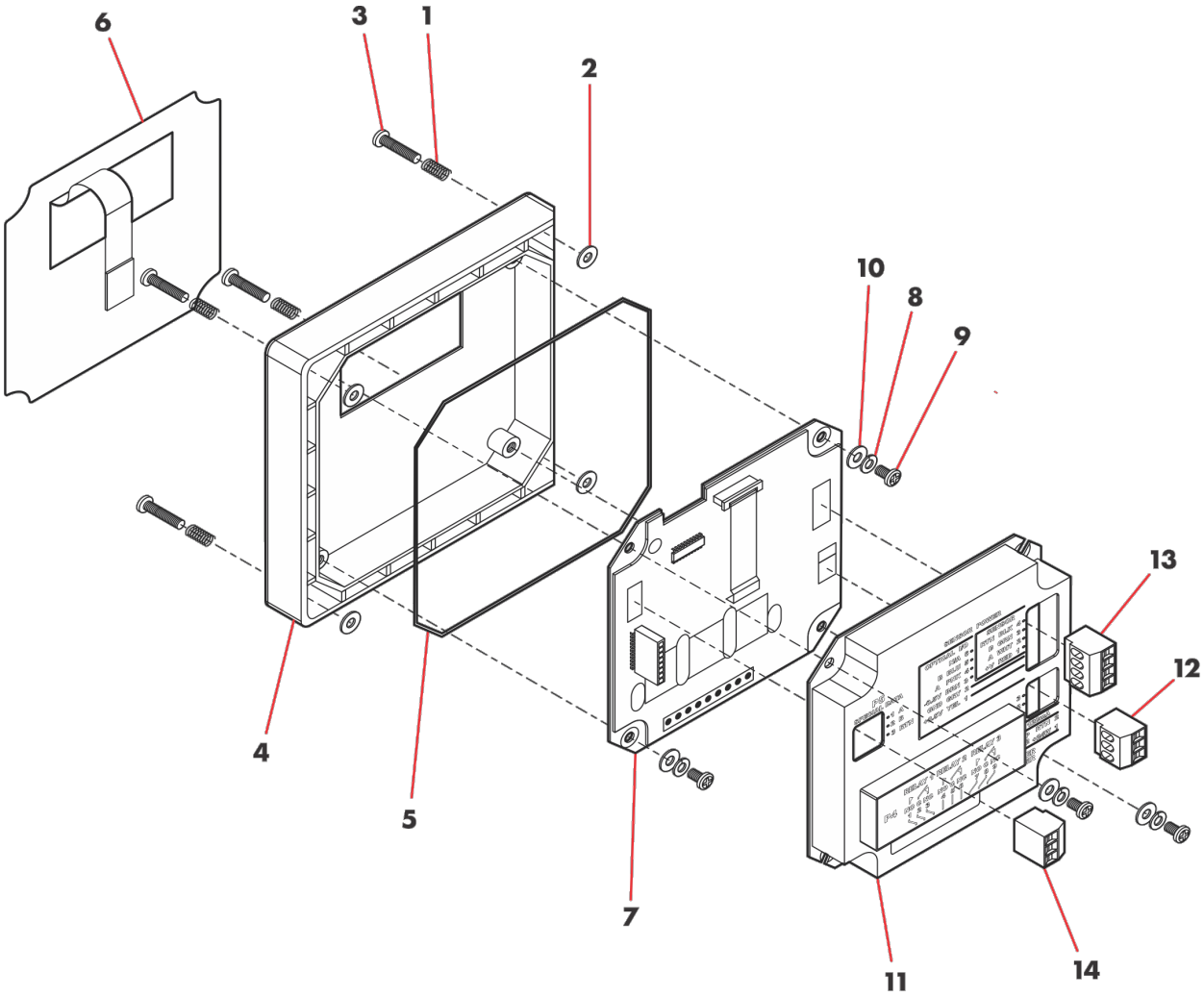

Figure 8-1: Exploded Diagram of Front Panel Control Board

8.2. Front Panel Control Board with Relays

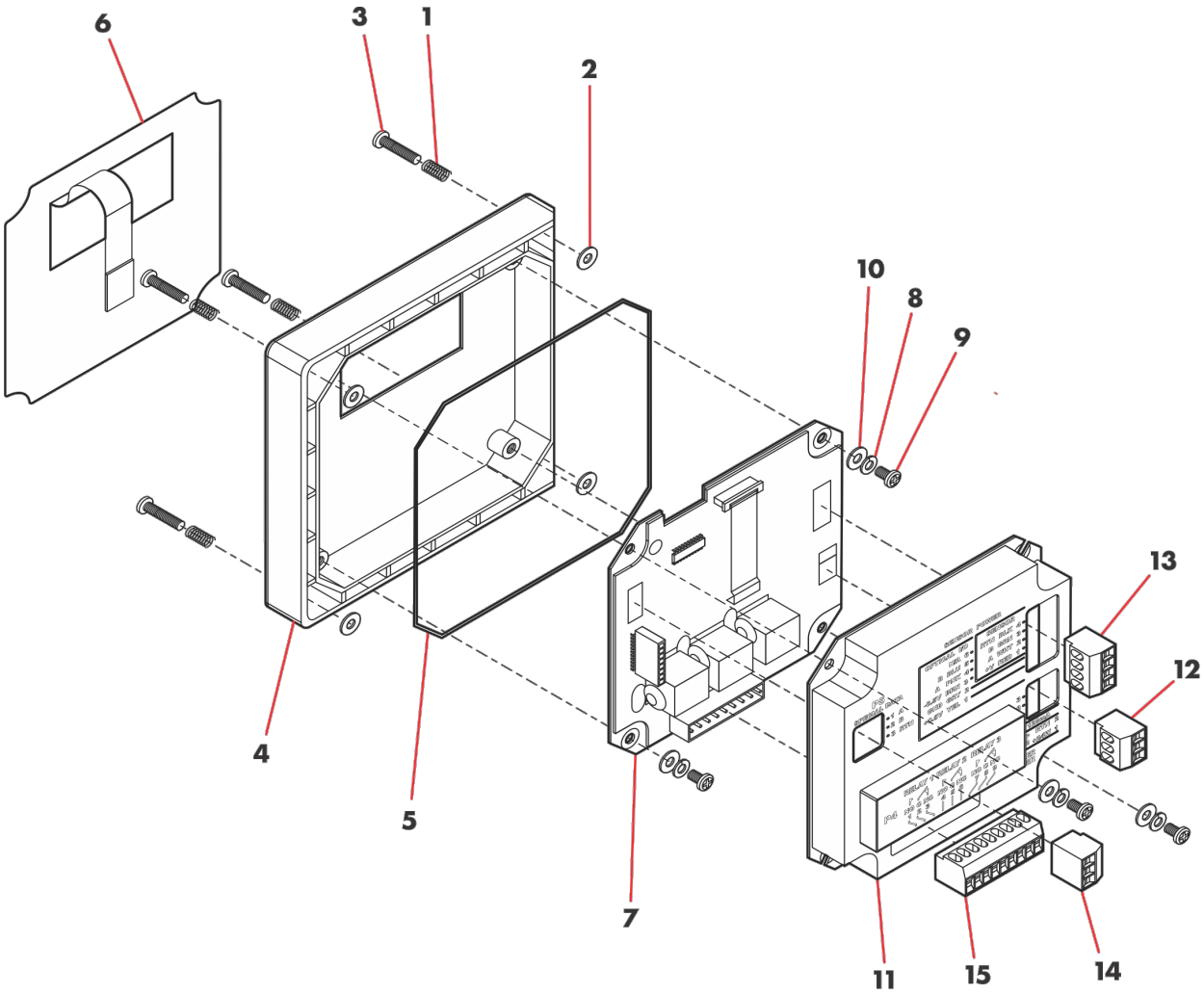

Figure 8-1: Exploded Diagram of Front Panel Control Board with Relays

Item #	Part #	Description
1		Spring, Mounting Screw Set
2		Retaining Washer, Mounting Screw Set
3		8-32 x 1" SS Screw, Mounting Screw Set
4		Front Housing
5		Sealing O-ring, grey silicone
6		Touch pad membrane
7	T2101800-1	PCB, Control Board, Loop Powered
	T2101800-2	PCB, Control Board, Loop Powered, Relays
	T2101800-3	PCB, Control Board, Loop Powered, HART
8		Locking Washer, PCB Screw Set
9		6-32 x 5/16" SS Screw, PCB Screw Set
10		Flat Washer, PCB Screw Set
11		Control Board Cover
12	T9090112	24 VDC, 4-20 mA Terminal Block/2 pins
13	T9090114	Sensor Terminal Block/4 pins
14	T9090113	Serial connection Terminal Block/3 pins
15	T9090119	Relay Connection Terminal Block/9 pins

8.3. Transmitter Case, Back with Cable Glands

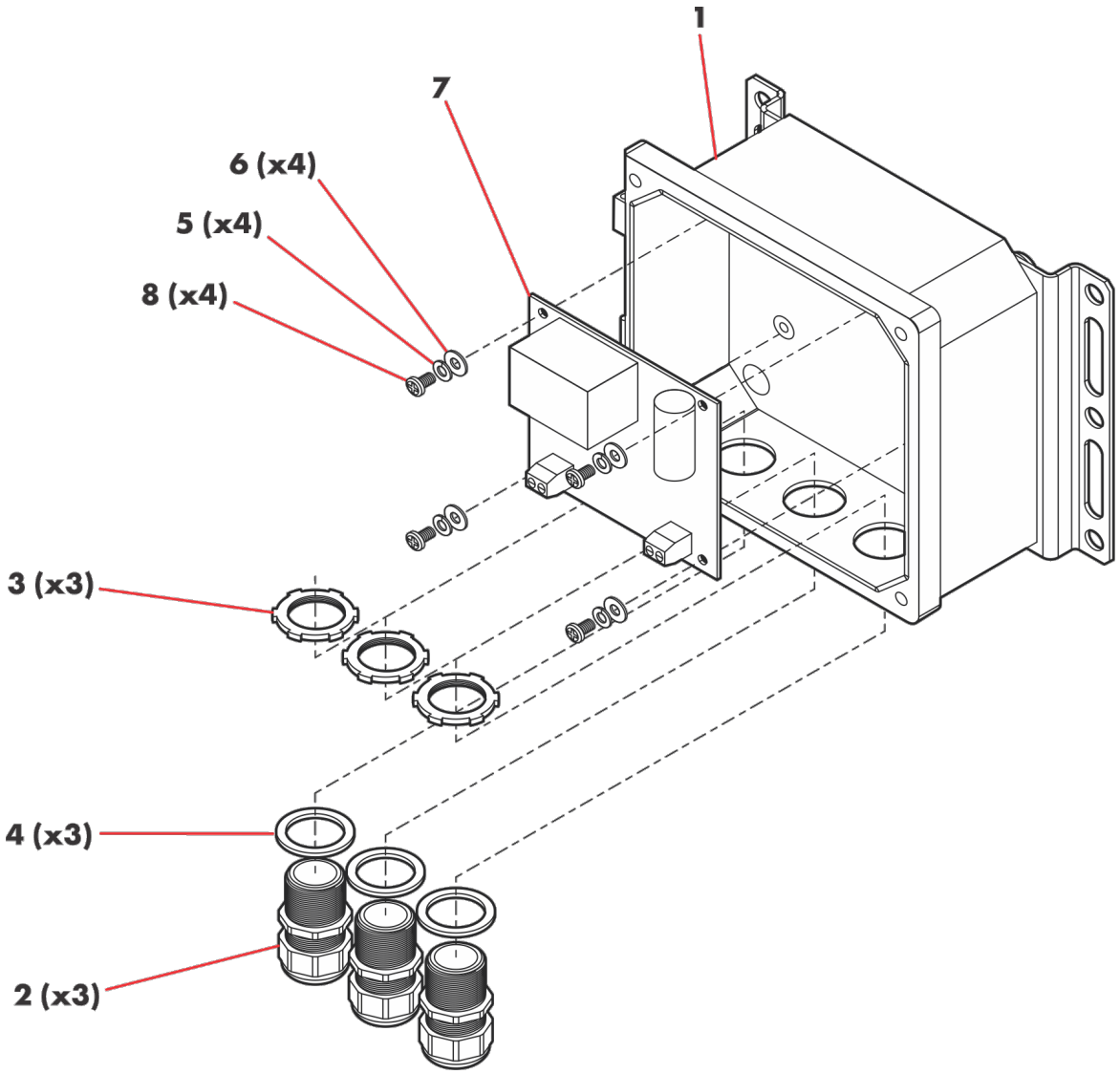

Figure 8-1: Exploded Diagram of Back of Transmitter Case with Cable Glands

Item #	Part #	Description
1		Transmitter Case
2	T9360005	PVC Cable Gland, ½" NPT, Grey
3	T9300034	Locking Nut, ½" NPT, Steel
4	T9300017	Sealing ring, ½" elastomer
5		Split Washer, PS mounting
6		Flat Washer, PS mounting
7	T2101820-1	Power Supply Board
8		6-32 x ¼" screw, SS, PS mounting

8.4. Replacement Parts

Part #	Description
T2000002-1	Front Panel, Loop-Powered
T2000002-2	Front Panel, AC/DC Powered
T2000002-3	Front Panel, Loop-Powered, Hart Output
T2101820-1	Power Supply Board, 110/220 VAC Input
T2101820-3	Power Supply Board, 110/220 VAC Input, w/preamp
T2101820-4	Preamp Board
T3400006	Control Board Cover
T9090112	Connector Plug, 2 Position (Loop, AC/DC, or Hart Versions)
T9090113	Connector Plug, 3 Position (Loop or AC/DC Versions)
T9090114	Connector Plug, 4 Position (Loop, AC/DC or Hart Versions)
T9090119	Connector Plug, 9 Position (AC/DC Version)
T9240503-1	Front Panel Membrane Switch
T9300017	Sealing ring, Cable Gland
T9300034	Locking Nut, Cable Gland
T9360005	Fitting, Cable Gland
T9830214	Screw, Front Panel

8.5. Accessories

Part #	Description
T2000006	Kit, Universal Mount
T2000007	Kit, Handrail Mount
T2000008	Kit, Panel Mount
T1000300-1	4-20 mA USB Data Logger
T9130007	Replacement Battery for Data Logger
T1000260-1	Sunshield for Pole Mount
T1000260-2	Sunshield for Rail Mount

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9. SP3 Sensors

SP3 sensors are a family of digital sensors designed for use with TAI digital analyzers, the Model LXT330 transmitter. SP3 sensors accept the standard TAI electrode cartridges. The SP3 sensors convert the analog signals into a temperature compensated digital protocol that allows two way communications with the transmitter. The type of sensor, identity and serial number are stored in the sensor's memory along with three calibration registers. When connected to an TAI digital analyzer the sensor's information is uploaded to

the analyzer configuring the displays and outputs to the values appropriate to the sensor's measured parameter. Connect an SP3 pH sensor to a Model LXT330 Transmitter and the Transmitter configures itself into a calibrated pH transmitter.

The internal components of the SP3 sensors, the signal conditioner, temperature sensor and cable assembly are epoxy encapsulated inside the ¾" O.D. housing. Epoxy encapsulation of the components increases the reliability of the sensor by eliminating failures caused by wiring and connector breakage. The SP3 sensors use the same easily replaceable electrode cartridges as the S10 and S17 sensor assemblies.

9.1. SP3 Installation

Four typical installation configurations are available for TAI sensors: insertion, immersion, flow-through and valve-retraction. Although there are many ways to accomplish these mounting configurations, TAI recommends the following installation configurations.

9.1.1. Insertion

The SP3 sensor is installed using a ¾" MNPT compression fitting with choice of nylon, Teflon or 316 SS ferrule. The ¾" MNPT can be inserted into a pipe Tee or through a tank wall, the SP3 is then inserted through the fitting and compression gland is tightened to secure the sensor in place. The torque specification for the gland fitting is 20-ft/lbs. Over-tightening of the nut may swage the nylon or Teflon ferrules to the housing crushing the internal sensor components.

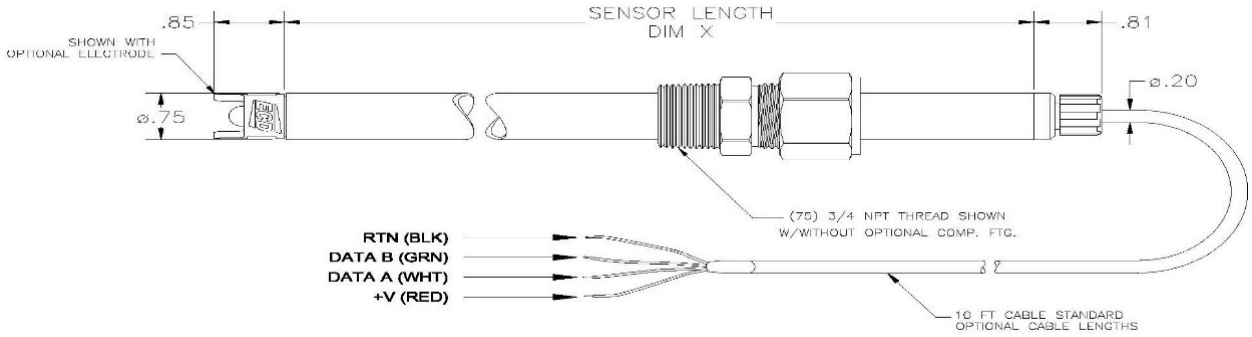

Figure 9-1: SP3 Sensor

9.1.2. Immersion

The ¾" MNPT compression fitting is reversed and threaded into an extension/immersion pipe so the compression gland is facing the measurement end of the sensor. Feed the cable through the immersion tube, insert the SP3 sensor at least 5" into the tube and tighten the sensor in place.

9.1.3. Flow Through

Although the insertion configuration can be used as a flow-through mounting by inserting the SP3 sensor into a pipe tee, TAI has various flow cells available for convenience. The flow cells are 2.0" diameter by 5" long, ported

½" FNPT through and ¾" FNPT for the sensor. The flow cells are available in 316 Stainless Steel, PVC and Kynar. Use of the flow cell can facilitate an optional spray cleaning nozzle for the electrode. Connecting 40+ psi of water or air to the nozzle will remove particulate materials or biofilms from the sensor tip. Detergents or solvents can be used to remove greases or oils from the sensor while acids can be used for hard water scale.

9.1.4. Valve Retractable

The SP3 sensor is optionally designed for valve retraction service, (-1) Sensor Style. Mounting is directly into a process line or through a tank wall. The ball valve system allows the sensor to be removed from service without shutting down the line or emptying the tank. TAI recommends the valve-retraction mounting for ease of maintenance or in applications where the process line cannot be shut down and the pressure does not exceed 100 psig.

To remove the sensor from the valve assembly refer to the following directions:

CAUTION: Do not put hands or fingers between the safety lanyard cables and any part of the sensor. Use the external cable seal/handle to pull or guide the sensor through the valve.

1. Loosen the small swage nut at the rear of the fitting assembly slowly as this compression fitting is holding the sensor in place. CAUTION the sensor may snap back quickly if it is under pressure. (do not remove the nut from the body of the fitting).
2. Slide the sensor to its stop by pulling it through the ball valve. The safety lanyards will be extended, confirming that the sensor is fully retracted. Note: the safety lanyards are redundant protection; the sensor will come to a stop when the high pressure stop reaches the front of the retainer fitting.
3. Close the ball valve.
4. Remove the handle retaining nut and the valve handle.
5. Remove the safety lanyards from the valve stem.
6. For the stainless steel ball valves, loosen and remove the large retainer nut from the retainer fitting. For Kynar ball valves, loosen and remove the union nut on the sensor side of the ball valve.
7. Firmly pull the retainer fitting from the valve. The sensor will be removed with the fitting.

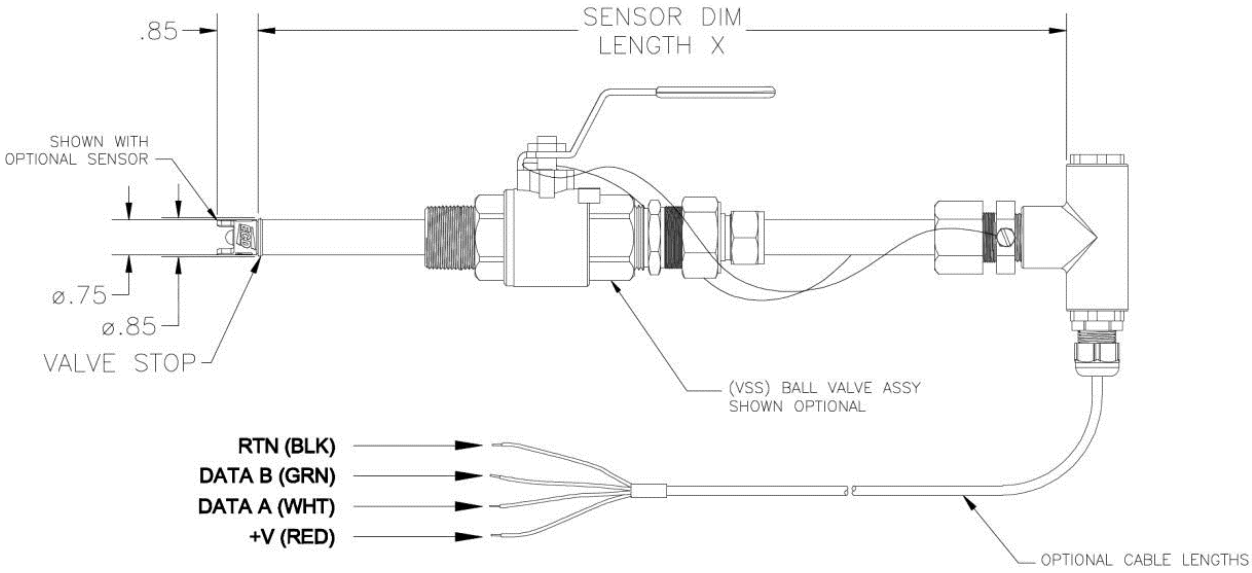

Figure 9-2: Valve Removal

9.1.5. Flange Fittings

Flange mountings can be accomplished with the insertion and valve-retraction configurations using the desired flange and by mounting the gland fitting or valve-retraction assembly to the flange.

9.2. SP3 Part Number Configurator

SP3 sensors are available in five measurement types, (-0) a millivolt style for pH, ORP and ion selective measurements, (-1) dissolved oxygen style, (-2) contacting conductivity style, (-3) inductive conductivity style and (-4) resistivity style. Each style is available in a variety of materials and insertion lengths.

SP3 Digital Sensor				
	Measurement Type			
	-0 SP3 Digital Sensor, pH, ORP, pION measurement			
	-1 SP3 Digital Sensor, Dissolved Oxygen measurement			
	-2 SP3 Digital Sensor, Contacting Conductivity, 1µS to 50 mS			
	-3 SP3 Digital Sensor, Inductive Conductivity, 50 mS to 1000 mS			
	-5 SP3 Diagnostic Sensor, pH, ORP, pION measurement SENTINEL SP3 Sensor			
	-6 SP3 Digital sensor, ppb Dissolved Oxygen			
	-7 SP3 Digital Sensor, Resistivity			
		Sensor Style		
		0 Insertion Style (Standard)		
		1 Valve Retractable Style with flanged blow out protector		
			Housing Material	
			-0 Stainless Steel, ¾" O.D., (Standard)	
			-1 Titanium, ¾" O.D.	
			-2 Hastelloy, ¾" O.D.	
			-5 Polypropylene, 1"O.D.	
			-9 Other Material, Consult with Factory	
				Housing Length
				0 10" length
				1 17" length
				2 24" length
				3 30" length
				4 36" length
				Process Connection
				00 No Fitting or Valve Assembly
				01 (75)¾" MNPT SS Fitting with Nylon Ferrule
				02 (75HT) ¾" MNPT, 316 SS gland, Teflon ferrule
				03 (75SF) ¾" MNPT, 316 SS gland, SST ferrule
SP3	**-0**	**0**	**-0**	**0**	**01**	**-1**	**1**	**1**	**0**

	Process Connection, cont.									
	04 (75HC) ¾" MNPT, Hastelloy gland, Teflon ferrule									
	05 (75TT) ¾" MNPT, Titanium gland, Teflon ferrule									
	06 (75PP) ¾" MNPT, All Polypropylene gland fitting									
	07 (75K)¾" MNPT, All Kynar gland Fitting									
	08 (75TFE) ¾" MNPT, All Teflon gland fitting									
	29 Other Fittings, Consult Factory									
	30 (VSS)1" NPT 316 Stainless Steel Valve Retraction Assembly, nylon									
	31 (VSSHT) 1" NPT 316 Stainless Steel Valve Retraction Assembly, Teflon									
	32 (VSSE) 1" NPT 316 Stainless Steel Valve Retraction Assembly Toroidal									
	33 (VHC)1" NPT Hastelloy Valve Retraction Assembly									
	34 (VTT)1" NPT Titanium Valve Retraction Assembly									
	36 (VPP)1" NPT All Poly Propylene Valve Retraction Assembly									
	37 (VKY)1" NPT All Kynar Valve Retraction Assembly									
	59 Other Assemblies, Consult Factory									
	80 1/1.5" Sanitary Flange, 316ss, Viton o-rings, nylon ferrule									
	81 2" Sanitary Flange, 316ss, Viton o-rings, nylon ferrule									
	82 2 ½" Sanitary Flange, 316ss, Viton o-rings, nylon ferrule									
	99 Other Fittings, Consult Factory									
		Detachable Cable Connector								
		0 None								
		1 Straight (axial) Connector								
		2 Right Angle Connector								
			Cable Length							
			-0 No Cable (Detachable Cable Version only)							
			-1 10 ft. (Standard)							
			-2 20 ft.							
			-3 30 ft.							
			-4 40 ft.							
			-5 50 ft.							
			-A 100 ft.							
				"T" Handle						
				0 No "T" Handle						
				1 (T) "T" Style handle with Lanyards for Valve Retractable						
				2 (TP) "T" Style handle, ¾" polypro fitting (1000096)						
SP3	**-0**	**0**	**-0**	**0**	**01**	**-1**	**1**	**1**	**0**	

	"T" Handle, cont.	
	3 (TS) "T" Style handle, ¾" stainless steel fitting (1000098)	
	4 (TN) "T" Style handle , 1" Nylon fitting (1000104)	
	5 (TD) 3/4" Tee for INSERTION w/ Detachable Conn (2000092)	
	6 (TDV) 3/4" Tee for VALVE w/ Detachable Conn (2000166)	
	7 (1TD) 1" Tee for INSERTION w/ Detachable Conn (2000119)	
	8 (1TDV) 1" Tee for VALVE w/ Detachable Conn (2000118)	
	O-Rings Guard & Fittings	
	0 Viton Any/All	
	1 HF Viton Cond Guard	
	2 EPR Cond Guard	
	3 Kalrez Cond Guard	
	4 CV75 Cond Guard	
	5 HF Viton Valve & Fitting	
	6 EPR Valve & Fitting	
	7 Kalrez Valve & Fitting	
	9 CV-75 Valve & Fitting	
	A HF Viton Grd & Val & Fit	
	B EPR Grd & Val & Fit	
	C Kalrez Grd & Val & Fit	
	D CV-75 Grd & Val & Fit	
SP3 -0 0 -0 0 01 -1 1 1 0		

9.3. SP3 Sensor Maintenance

All electrochemical sensors require periodic cleaning and/or replacement. The life of an electrode is dependent on the process conditions it is exposed to, a pH electrode may last a year or longer in potable water and only a few weeks in a hot caustic bath. The chemical constituents in the process may coat the electrode surfaces requiring the electrode to be removed and cleaned or replaced.

Cleaning agents should be specific to the type of coating, detergents and alcohols for removing greases and oils, acids for removing hard water scales and metallic deposits or spray washing for flocculants and biofilms.

9.3.1. Electrode Cartridge Installation

Unless ordered separately, electrode cartridges are generally shipped installed in a sensor. Sensors ordered without an electrode are shipped with a shipping plug to keep contamination from getting inside the sensor during shipment or storage. The following procedure explains how to install the electrode cartridge in the sensor assembly:

1. Remove the shipping plug by turning it counterclockwise.
2. Remove the electrode cartridge from the protective soaker boot. Be careful not to flex the electrode body while removing the tape and the protective boot.
3. Rinse the electrode tip in tap water and wipe the electrode body dry then lubricate the o-ring seals with the included lubricant. Save the protective soaker boot in the event the electrode must be stored at a future time.
4. Carefully insert the electrode cartridge into the sensor assembly by turning until hand tight. The first o- ring, closest to the front of the electrode, will be slightly visible if held horizontally.

NOTE: If excess force is required during electrode installation, check for proper thread engagement or for an obstruction.

9.3.2. Electrode Cartridge Replacement

Periodic replacement of the electrode cartridge is required for pH, ORP and Specific Ion sensors. The following procedure explains how to replace the electrode cartridge in the sensor assembly:

1. Remove the electrode cartridge from the front of the sensor assembly by turning it counterclockwise.
2. For installation procedure follow steps 2, 3, and 4 in Section 9.3.1. Electrode Cartridge Installation.

9.3.3. Electrode Cleaning

An important aspect of sensor maintenance is the service of the electrode cartridge. After being in operation, an electrode may begin to exhibit slow response or non-reproducible measurements. This may be due to coating of the measurement electrode or clogging of the reference junction. Regular electrode cleaning reduces problems associated with the coating and clogging. Frequency of cleaning will depend on the process and application. The following procedures are used to clean pH and ORP electrodes.

If possible, the electrode should be cleaned without removing it from the sensor body. However, if the electrode must be removed, the o-rings must be inspected and re-lubricated (See Section 9.3.1. Electrode Cartridge Installation).

9.3.4. pH Electrode Cartridge Cleaning

Remove the sensor from the process and carefully wash the wetted end of the electrode cartridge in a mild solution of detergent and water or with methyl alcohol. If the electrode response is not improved,

soak the electrode in 0.1 Molar HCl for 5 minutes. Remove and rinse the electrode with tap water and soak in 0.1 Molar NaOH for 5 minutes.

Remove the electrode from the NaOH solution, rinse the electrode and soak in a 4 pH buffer solution for 10 minutes. This should improve the response of the electrode. If not, replace the electrode.

If the electrode must be left out of the process for an extended period of time, store it in a solution of water saturated with KCl or a 4.0 pH buffer solution. TAI does not recommend the storage of electrodes in distilled or deionized water.

9.3.5. ORP Electrode Cartridge Cleaning

Cleaning the platinum surface to remove coating can be done using an abrasive cleaner like 600-800 grit wet/dry sand paper or chemical reagents specific for the type of coating. Abrasive cleaning is the most common method of cleaning and is usually sufficient to restore the platinum surface; however, some processes can form a hard coating requiring chemical cleaning with a strong acid solution. Acid solutions greater than 10% are not recommended.

9.3.6. pIon Electrode Cartridge Cleaning

Ion selective electrodes require periodic service. Weekly checks should be performed to assure the accuracy of the measurement.

The ion selective crystal that senses the ion concentration can become sluggish in response due to coating or reactions with the process solution. Periodic cleaning or polishing will minimize drift and maintain the sensors response.

9.3.6.1. Cleaning

The solid state crystal based electrodes, bromide, chloride, copper, cyanide, fluoride, silver, sulfide are fairly robust and can be cleaned with alcohols, detergents or dilute acids to remove coatings caused by greases, oils or films. A soft tooth brush or paper towel should be used to remove stubborn coatings. Do not clean with a wire brush. Metal carryover from the brush will compromise the measurement. Cleaning should be followed by polishing before calibrating the sensor.

The PVC membrane sensors, Ca++, K+, NH_4+, NO_3- are fragile membranes and should be cleaned using a soft artist style paint brush while rinsing with a stream of water. Dilute dish washing detergents can be used to remove oily films Solvents or strong acid/alkaline solution will irreparably harm the electrode.

Calibration may be necessary after cleaning.

9.3.6.2. Polishing

Abrasive polishing is only recommended for the solid state crystal style Combination Electrodes. TAI supplies two styles of abrasive cleaning kits, a package of light blue colored polishing strips or a small vial of 0.3 micron alumina powder with Q-tips with the fluoride electrodes.

The sensing surface of solid state electrodes can wear over time, which causes drift, poor reproducibility and loss of response in low level samples. The electrode can be restored by polishing the sensing surface with a polishing kit. The polishing kit can also be used if the sensing surface has been etched or chemically poisoned.

9.3.6.2.1. Fluoride Electrodes

1. Moisten the end of the Q-tip with water and dip it in the alumina polishing powder to pick up a small amount of the powder.
2. Rub the polishing powder onto the fluoride crystal in a circular motion and moisten the tip if necessary to produce a liquid consistency more than a paste.
3. Polish the electrode for about 30 seconds and examine the tip for a shiny surface, repeat if necessary.
4. Rinse the electrode with distilled water and soak the electrode in a low ppm Calibration solution for a few minutes.
5. Perform a Two Point Calibration.

9.3.6.2.2. Other Solid State electrodes, Bromide, Cadmium, Chloride, Copper, Lead, Sulfide, Silver

1. Place a few drops of distilled water on the blue polishing strip to wet the polishing surface.
2. Hold the electrode with the sensing surface facing up.
3. Slide the polishing strip back and forth across the electrode tip, the sensing tip will be abraded and a new electrode surface will be generated.
4. Polish the electrode for about 30 seconds and examine the tip for a shiny surface, repeat if necessary.
5. Rinse the electrode with distilled water and soak the electrode in a low ppm Calibration solution for a few minutes.
6. Perform a Two Point Calibration.

9.3.7. Dissolved Oxygen Cartridges

The Teflon membrane of the Dissolved Oxygen sensors is fragile and should be cleaned using a soft cloth or an artist style paint brush while rinsing with a stream of water. Dilute dish washing detergents can be used to remove oily films. Solvents are not recommended as they could diffuse through the membrane and harm the electrode. Strong acid/alkaline solutions should not harm the electrode but should only be used as a last resort before replacing the electrode.

9.3.8. Triton® SP3-ODO Dissolved Oxygen

The Triton® SP3-ODO sensor should receive maintenance on a regular basis. The maintenance interval should be determined empirically as it will depend on the installation conditions and the nature of the media being measured. The interval should be no greater than every two months.

9.3.8.1. Maintenance Procedure

The typical procedure would include;

- Cleaning the sensor
- Check the measuring function:
  - ~ Remove the sensor from the medium.
  - ~ Clean and dry the sensor/membrane.
  - ~ After about 10 minutes in air, measure the oxygen saturation index (without recalibration).
  - ~ The measured value should be at 100 ± 4 % SAT
- If necessary, replace a defective membrane or one which cannot be cleaned any more.
- Recalibration, if necessary.

9.3.8.2. Cleaning the Sensor

The fluorescence cap of the Triton® SP3-ODO sensor must be clean to ensure an accurate measurement. The measurement will degrade as the fluorescence cap gets coated. Build-up of material on the cap will increase the response time and decrease the slope. The sensor should be cleaned on a regular basis and before every calibration.

CAUTION: Do not scrub the sensing portion of the cap with any abrasive material, use only a soft sponge or cloth and water to clean the tip.

The cleaning method depends on the nature of the coating. For insoluble mineral or salt deposits, the sensor should be soaked in a 1-5 % solution of HCl, hydrochloric acid, for no more than 10 minutes. After this acid treatment rinse the sensor with copious amounts of tap water and then allow it to soak in the tap water for at least 5 minutes before evaluating the performance. Repeat if necessary.

For biological films or dirt, rinse the tip with tap water and gently wipe the sensing surface with a soft sponge or cloth.

9.3.8.3. Cleaning Internal Optics

The internal optical surface should only need cleaning if the Fluorescence Cap is broken or defective. The following steps should be followed in the case of a leaking cap.

1. Unscrew the protective guard and the fluorescence cap from the sensor head.
2. Carefully clean the optical surface with a soft cloth and water until the buildup is fully removed.

3. Use only drinking or distilled water to clean the optics, do not scratch the optical surface.
4. Dry the optics with a soft lint free cloth and screw on a new fluorescence cap.

9.3.8.4. Replacing the Fluorescent Cap

The Fluorescence Cap (P/N 2500207) can provide up to and greater than two years service, if damaged or when it expires, it is easily replaced.

9.3.8.4.1. Removing the Old Fluorescence Cap

1. Remove the sensor from the medium.
2. Unscrew the protection guard.
3. Clean the outside of the sensor.
4. Unscrew the fluorescence cap.
5. Clean and dry the optical surface if necessary.

9.3.8.4.2. Installing the New Fluorescence Cap

1. Make sure that there are no dirt particles on the sealing surface.
2. Visually inspect the sealing o-ring, replace if necessary. (P/N 1000225)
3. Carefully screw the fluorescence cap onto the sensor head until the stop.
4. Screw the protection guard back on.

CAUTION: After replacing the Fluorescence Cap the sensor must be calibrated.

9.3.9. Conductivity And Resistivity Sensors

Cleaning agents should be specific to the type of coating, detergents or alcohols for removing greases and oils, acids for removing hard water scales and metallic deposits or spray washing with water and a soft brush for flocculants and biofilms.

Resistivity sensors rarely need cleaning due to the nature of the measurement. If cleaning is necessary or the sensor has been in service for greater than two years follow the instructions listed below.

Rinse the sensing end with alcohol, methanol, ethanol or isopropyl will work fine.

Soak for 5 minutes in a dilute nitric acid solution, a 3.5% solution is made by a 20:1 dilution of concentrated Nitric Acid (5 ml HNO_3 in 100ml of water).

Then rinse thoroughly with tap water and soak in distilled water for 5-10 minutes.

9.4. SP3 Sensor Specifications

Dimensions:	SP3 - ¾"OD x 10" Length, optional lengths, 17", 24", 30", 36" .... in 6" increments to 8 ft.
Cable Length:	10 ' standard, Optional lengths in 10 ' increments 4 conductors shielded
Housing Materials:	Standard, 316 Stainless Steel, Optional, Titanium (T), grade 2, Hastelloy (H), C-22, PVDF (K),
O-Ring Materials:	Viton™ (VIT), Standard, Ethylene Propylene (EPR), Optional, Fluorosilicone (FSIL), Optional, Silicone (SIL), Optional, KALREZ™ (KLZ), Optional, CV75 (CV), Optional
Process Connections:	-75¾" 316 SS gland fitting with nylon ferrule -75PP¾" poly propylene gland fitting with ferrule -75SF¾" 316 SS gland fitting with stainless steel ferrule -75TFE ¾" Teflon™ gland fitting with Teflon™ ferrule -1001" Teflon™ glands fitting for PVDF housing only -VSS1" 316 SS valve retraction assembly -VKY1" PVDF valve retraction assembly
Shipping Weight:	SP3 2.5 lbs (1.2 kg) SP3 with VSS 5.8 lbs (2.65 kg)

9.4.1. pH Electrodes

Part #	Description	pH Range	Temp.	Max. Press.
2005005-HPW	High Purity Water, RADEL Body, dbl jct TFE Ref, Full bulb pH glass	2-12 pH	-10°-90°C	150 psig
2005145	General Purpose, RADEL body, dbl jct TFE Ref, Flat pH glass	2-12 pH	-10°-90°C	150 psig
2005146	General Purpose, PEEK body, dbl jct ceramic Ref, Flat pH glass	0-14 pH	-10°-90°C	150 psig
2005148	Non aqueous service, RADEL body, dbl jct TFE Ref, Flat pH glass	0-14 pH	-10°-90°C	150 psig
2005157	Hi Temp/ Hi pH, PEEK body, dbl jct TFE Ref, Hemi pH glass	0-14 pH	0°-130°C	150 psig
2005059	Recessed Bulb, RADEL Body, dbl jct TFE Ref, Hemi pH glass	0-14 pH	-10°-90°C	150 psig
2005066	Chemical Resistant, PEEK body, triple jct TFE Ref, Flat pH glass	0-14 pH	0°-130°C	150 psig
2005169	Chemical Resistant, PEEK body, dbl jct TFE Ref, Hemi pH glass	0-14 pH	0°-130°C	150 psig

Part #	Description	pH Range	Temp.	Max. Press.
2005130	Sulfide Resistant, PEEK body, triple jct TFE Ref, Hemi pH glass	0-14 pH	0°-130°C	150 psig
2005150	Solvent Resistant, PEEK body, dbl jct TFE Ref, Flat pH glass	0-14 pH	-10°-90°C	150 psig
2005103	Fluoride resistant, Peek body, Rugged pH glass, dbl jct TFE Ref	0-14 pH	-10°-90°C	150 psig
2005013	pH, antimony, RADEL body, TFE junction	3-10 pH	10°-50°C	150 psig
2005111	Extended Life, RADEL body, TFE junction, Flat Glass	0-14 pH	10°-50°C	150 psig

9.4.2. ORP Electrodes

Part #:	2005167 (2005367 SENTINEL)
ORP Sensor:	Platinum
Construction:	PEEK body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	-1500 mV - +1500 mV
Temperature Range:	-10° - 80°C
Pressure Range:	150 psig

9.4.3. Dissolved Oxygen

Part #:	2005622
Sensor:	2 mil Teflon membrane
Galvanic cell	Silver/Lead
Construction:	PEEK body
Measurement Range:	0-20 ppm
Temperature Range:	-10° - 130°C
Pressure Range:	30 psig

9.4.4. Ammonium Electrode

Part #:	2005083 (2005383 SENTINEL)
ISE Sensor:	PVC membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.5-18,000 ppm
pH Range:	2-10 pH
Temperature Range:	0° - 40°C
Pressure Range:	50 psig

9.4.5. Bromide Electrode

Part #:	2005062 (2005362 SENTINEL)
ISE Sensor:	Solid state AgS/AgBr membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0. 1 - 80,000 ppm
pH Range:	2-12 pH
Temperature Range:	0° - 50°C
Pressure Range:	50 psig

9.4.6. Cadmium Electrode

Part #:	2005140 (2005340 SENTINEL)
ISE Sensor:	Solid state CdS membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	100 ppb - 11,200 ppm
pH Range:	3-9 pH
Temperature Range:	0° - 80°C
Pressure Range:	50 psig

9.4.7. Calcium Electrode

Part #:	2005043 (2005343 SENTINEL)
ISE Sensor:	PVC membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.1 - 40,000 ppm
pH Range:	2.5-10 pH
Temperature Range:	0° - 40°C
Pressure Range:	50 psig

9.4.8. Chloride Electrode

Part #:	2005008 (2005308 SENTINEL)
ISE Sensor:	Solid state AgS/AgCl membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	2 - 35,000 ppm
pH Range:	2-12 pH
Temperature Range:	0° - 80°C
Pressure Range:	150 psig

9.4.9. Cupric Electrode

Part #:	2005058 (2005358 SENTINEL)
ISE Sensor:	Solid state CuS membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	1 ppb - 6,300 ppm
pH Range:	2-8 pH
Temperature Range:	0° - 80°C
Pressure Range:	150 psig

9.4.10. Cyanide Electrode

Part #:	2005042 (2005342 SENTINEL)
ISE Sensor:	Solid state AgS/AgCN membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.1- 260 ppm
pH Range:	11-13 pH
Temperature Range:	0° - 80°C
Pressure Range:	150 psig

9.4.11. Flouride Electrode

Part #:	2005163 (2005363 SENTINEL)
ISE Sensor:	Solid state LaF membrane
Construction:	PEEK body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.02 - 2,000 ppm
pH Range:	5-8 pH
Temperature Range:	0° - 80°C
Pressure Range:	50 psig

9.4.12. Lead Electrode

Part #:	2005141 (2005341 SENTINEL)
ISE Sensor:	Solid state PbS membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	2 ppm - 20,700 ppm
pH Range:	4-8 pH
Temperature Range:	0° - 80°C
Pressure Range:	50 psig

9.4.13. Potassium Electrode

Part #:	2005034 (2005334 SENTINEL)
ISE Sensor:	PVC membrane
Construction:	Radel (PES) body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.1- 40,000 ppm
pH Range:	2-12 pH
Temperature Range:	0° - 40°C
Pressure Range:	50 psig

9.4.14. Silver Electrode

Part #:	2005016 (2005316 SENTINEL)
ISE Sensor:	Solid state AgS membrane
Construction:	PEEK body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.1-107,000 ppm
pH Range:	2-14 pH
Temperature Range:	0° - 80°C
Pressure Range:	150 psig

9.4.15. Sodium Electrode

Part #:	2005031 (2005331 SENTINEL)
ISE Sensor:	Sodium selective Glass membrane
Construction:	PEEK body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.2 - 23,000 ppm
pH Range:	2-14 pH (pH must be 3 units higher than pNa)
Temperature Range:	0° - 80°C
Pressure Range:	150 psig

9.4.16. Sulfide Electrode

Part #:	2005122 (2005322 SENTINEL)
ISE Sensor:	Solid state AgS membrane
Construction:	PEEK body
Reference Electrode:	Double porous Teflon junction
Measurement Range:	0.01 - 32,000 ppm
pH Range:	11-14 pH
Temperature Range:	0° - 80°C
Pressure Range:	150 psig

9.4.17. Triton® SP3-ODO

Measurement Range:	0 - 20 mg/l (0 - 20 ppm) 0 - 200 % Saturation 0 - 400 mbar (0 - 6 psi)
Pressure Range:	Maximum Pressure 10 bar (159 psi)
Temperature Range:	-5° - 50°C (20° - 120°F) Measuring -20° - 60°C (0° - 140°F) Ambient
Response Time:	T90 = 60 sec
Accuracy:	Max. Error < 2 % of measured range
Repeatability:	±0.5 % of measured range
Resolution:	0.01 ppm or 0.01 % Saturation
Operating Lifetime of Sensor Cap:	Up to 2 years in recommended service, typically > 1 year
Wetted Materials:	316 SS, POM, PVC, Silicone
Sensor Cable:	4 Conductor shielded available in 10ft increments
Process Connection:	G1 Thread (¾" FNPT adapter available)
Maximum Cable Length:	100 m maximum
Dimensions:	Length 8.7" (220 mm), Diameter 1.6" (40 mm)

Appendix A. Auto Cal Buffer Tables

°C	pH	pH	pH
0	4.00	7.115	10.32
5	4.00	7.085	10.25
10	4.00	7.06	10.18
15	4.00	7.04	10.12
20	4.00	7.015	10.06
25	4.005	7.00	10.01
30	4.015	6.985	9.97
35	4.025	6.98	9.93
40	4.03	6.975	9.89
45	4.045	6.975	9.86
50	4.06	6.97	9.83
55	4.075	6.97	
60	4.085	6.97	
65	4.10	6.98	
70	4.13	6.99	
75	4.14	7.01	
80	4.16	7.03	
85	4.18	7.05	
90	4.21	7.08	

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Appendix B. LXT330 HART Menu

LXT330 Root Menu					
1 Device Setup	Device	Calibration			
	1 Calibration	1 Auto			
		2 Standardize			
		3 Manual			
		4 Temp			
	2 Basic Setup	Config			
		1 XMTR	XMTR Config	Analog Config	
			1 Analog	1 Scale	Analog Scale
					1 Upper
					2 Lower
				2 PID	PIF Config
					1 P Term
					2 I Term
					3 D Term
				3 Calibrate	Calibrate
					1 Zero Cal
					2 Gain Cal
					3 Save
			2 Alarms	Alarm Config	
				1 Alrm 1 thresh	
				2 Alrm 1 hyst	
				3 Alrm 1 dly on	
				4 Alrm 1 dly off	
				5 Alrm 2 thresh	
				6 Alrm 2 hyst	
				7 Alrm 2 dly on	
				8 Alrm 2 dly off	
				9 Alrm 3 thresh	
				10 Alrm 3 hyst	
				11 Alrm 3 dly on	
				12 Alrm 3 dly off	
			3 Address		

LXT330 Root Menu

		2 Device Information	Device Information
			1 Distributor
			2 Model
			3 Dev ID
			4 Cfg chng count
			5 Tag
			6 Long Tag
			7 Date
			9 Descriptor
			10 Message
			11 Final asmbly num
	3 Information	Information	
		1 XMTR	XMTR Info
			1 Serial #
			2 FW Rev
			3 HW Rev
		2 Sensor	Sensor Info
			1 Serial #
			2 FW Rev
			3 HW Rev
		3 Device	Device Info
			1 Distributor
			2 Model
			3 Dev ID
			4 Cfg chng count
			5 Tag
			6 Long tag
			7 Date
			9 Descriptor
			10 Message
			11 Final asmbly num
2 PV			
3 Temperature			

LXT330 Root Menu
4 Output %
5 Sensor Name

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Appendix C. MODBUS RTU Register Listing

C.1. 03(0x03) Read Holding Registers

This function code is used to read the contents of a contiguous block of holding registers in a remote device. The Request Protocol Data Unit specifies the starting register address and the number of registers. In the Protocol Data Unit Registers are addressed starting at zero. Therefore registers numbered 1-16 are address as 0-15.

The register data in the response message are packed as to bytes per register, with the binary contents right justified within each byte. For each register, the first byte contains the high order bits and the second contains the low order bits.

C.1.1. Request

Modbus ID (Slave Address):	1 Byte	1 to 247 (0x01 to 0xF7)
Function code:	1 Byte	0x03
Starting Address:	2 Bytes	0x0000 to 0xFFFF
Quantity of Registers:	2 Bytes	1 to 125 (0x01 to 0x7D)
CRC:	2 Bytes	calculated

C.1.2. Request

Modbus ID (Slave Address):	1 Byte	1 to 247 (0x01 to 0xF7)
Function code:	1 Byte	0x03
Byte Count:	1 Bytes	2 X N*
Register Value(s):	*N X 2 Bytes	
CRC:	2 Bytes	calculated

*N = Quantity of Registers

C.1.3. Error

Modbus ID (Slave Address):	1 Byte	1 to 247 (0x01 to 0xF7)
Error code:	1 Byte	0x86
Exception code:	1 Byte	01, 02, 03, or 04
CRC:	2 Bytes	calculated

C.2. 06 (0x06) Write Single Register

This function code is used to write a single holding register in a remote device.

The Request Protocol Data Unit specifies the address of the register to be written. Registers are addressed starting at zero. Therefore register number 1 is addressed as 0.

The normal response is an echo of the request, returned after the register contents have been written.

C.2.1. Request

Modbus ID (Slave Address):	1 Byte	1 to 247 (0x01 to 0xF7)
Function code:	1 Byte	0x06
Register Address:	2 Bytes	0x0000 to 0xFFFF
Register Value:	2 Bytes	0x0000 to 0xFFFF
CRC:	2 Bytes	calculated

C.2.2. Request

Modbus ID (Slave Address):	1 Byte	1 to 247 (0x01 to 0xF7)
Function code:	1 Byte	0x06
Register Address:	2 Bytes	0x0000 to 0xFFFF
Register Value:	2 Bytes	0x0000 to 0xFFFF
CRC:	2 Bytes	calculated

C.2.3. Error

Modbus ID (Slave Address):	1 Byte	1 to 247 (0x01 to 0xF7)
Error code:	1 Byte	0x86
Exception code:	1 Byte	01, 02, 03, or 04
CRC:	2 Bytes	calculated

C.3. Registers

Per the MODBUS Application Protocol Specification (V1.1b)

Name	Meaning (2 bytes each register)	# of Reg's	Return Data Format	Read/ Write	Req's Storage Initiate	Register # Dec	Register # Hex
Modbus ID (slave address)	Defined as 1 to 247 per the Modbus Application Protocol Specification (V1.1b)	1	16 bit Integer	RW		0	00
Data Format	Data Format of the User Bus to the LXT330 (0-DF8N2, 1-DF8O1, 2-DF8E1, 3-DF8N1)	1	16 bit Integer	RW		1	01
Baud Rate	Baud Rate of the User Bus to the LXT330 (0-1200, 1-2400, 2-4800, 3-9600)	1	16 bit Integer	RW		2	02
BusMessage	Total message count detected by the slave (remote device)	1	16 bit Integer	R		3	03
BusCommunicationsError	Total CRC error count	1	16 bit Integer	R		4	04
SlaveExceptionError	Total count of exceptions detected	1	16 bit Integer	R		5	05
SlaveMessage	Total messages addressed to the slave (remote device)	1	16 bit Integer	R		6	06
SlaveNoResponse	Total count of messages not responded to by the slave (remote device)	1	16 bit Integer	R		7	07
SlaveNAK	Total Negative Acknowledges returned by slave (remote device)	1	16 bit Integer	R		8	08
SlaveBusy	Total count of "slave busy" was returned for an address message	1	16 bit Integer	R		9	09
BusCharacterOverrun	Count of messages that couldn't be handled due to character over-run condition	1	16 bit Integer	R		10	0A
Reset all Modbus Error Counters	Resets all of the Modbus Error counters (defined in Modbus spec) to 0, Write any value.	1	16 bit Integer	W		11	0B
Product LXT330 Model Number (Modbus)	The Model Number of the Unit polled	1	16 bit Integer	R		12	0C
LXT330 Serial Number (hi word)	Unit Serial Number (32 bit integer hi word, bytes 3 and 2)	2	32 bit Long Integer	R		13	0D
LXT330 Serial Number (lo word)	Unit Serial Number (32 bit integer lo word, bytes 1 and 0)					14	0E
LXT330 Mode	Unit operating mode (1-Startup, 2-Sensor Search, 3-Operate)	1	16 bit Integer	R		15	0F
LXT330 Fault Status	Unit Fault flags, bit defined	1	16 bit Integer	R		16	10

Name	Meaning (2 bytes each register)	# of Reg's	Return Data Format	Read/ Write	Req's Storage Initiate	Register # Dec	Register # Hex
LXT330 2nd Fault Status	Unit Fault flags (2nd word reserved, currently not used)	1	16 bit Integer	R		17	11
LXT330 Warning Status	Unit Warning flags, bit defined	1	16 bit Integer	R		18	12
LXT330 2nd Warning Status	Unit Warning flags (2nd word reserved, currently not used)	1	16 bit Integer	R		19	13
LXT330 FW Revs	Firmware revision of the Control BD in ASC, ex. "1"	1	16 bit Integer	R		20	14
Relay Number to read/write	Relay number to access data (0 - Relay 1, 1 - Relay 2, 2 - Relay 3)	1	16 bit Integer	RW		21	15
Relay Type	Read/Write Relay Type (0 - Fault Type, 1 - Alarm Type, 2 - Disabled, 3 - Timed	1	16 bit Integer	RW		22	16
Relay ON Setpoint (hi word)	Read/Write Relay ON Setpoint (byte 3 and byte 2)	2	32 bit Floating Point	RW	Y	23	17
Relay ON Setpoint (lo word)	Read/Write Relay ON Setpoint (byte 1 and byte 0)					24	18
Relay OFF Setpoint (hi word)	Read/Write Relay OFF Setpoint (byte 3 and byte 2)	2	32 bit Floating Point	RW	Y	25	19
Relay OFF Setpoint (lo word)	Read/Write Relay OFF Setpoint (byte 1 and byte 0)					26	1A
Relay ON Delay (hi word)	Read/Write Relay turn on Delay time (byte 3 and byte 2)	2	32 bit Floating Point	RW	Y	27	1B
Relay ON Delay (lo word)	Read/Write Relay turn on Delay time (byte 1 and byte 0)					28	1C
Relay OFF Delay (hi word)	Read/Write Relay turn off Delay time (byte 3 and byte 2)	2	32 bit Floating Point	RW	Y	29	1D
Relay OFF Delay (lo word)	Read/Write Relay turn off Delay time (byte 1 and byte 0)					30	1E
Relay Energized State	Read/Write Relay 0 - Energized, 1 - De-Energized	1	16 bit Integer	RW	Y	31	1F
Relay Expiration	Read/Write Expiration Time, used with alarm type (0 - None, 2 - 5min., 3 - 10min., 4 - 15min., 6 - 30min.)	1	16 bit Integer	RW	Y	32	20
Relay Period	Read/Write Timed Relay Period (0 - 15min., 1 - 30min., 2 - 1hr., 3 - 2hr., 4 - 4hr., 5 - 8hr., 6 - 24hr.)	1	16 bit Integer	RW	Y	33	21

Name	Meaning (2 bytes each register)	# of Reg's	Return Data Format	Read/ Write	Req's Storage Initiate	Register # Dec	Register # Hex
Relay Duration	Read/Write Timed Relay Duration (0 - 15sec., 1 - 30sec., 2 - 1min., 3 - 2min., 4 - 5min., 5 - 15min., 6 - 10min.)	1	16 bit Integer	RW	Y	34	22
Relay Hold Time	Read/Write Timed Relay Hold Time (0 - Off, 1 - held for the duration time, 2 - duration + 15sec., 3 - duration + 30sec., 4 - duration + 1min., 5 - duration + 2min., 6 - duration + 5 min., 7 - duration + 15min., 8 - duration + 30min.)	1	16 bit Integer	RW	Y	35	23
4-20 mA Channel Number to read/write	4-20 mA channel number to access data (0 - 1st 4- 20mA, 1 - 2nd 4-20)	1	16 bit Integer	RW	Y	36	24
4-20 Analog Type	Read/Write 4-20 Type (0 - Range, 1 - Temperature, 2 - Sentinel)	1	16 bit Integer	RW	Y	37	25
4-20 Analog Range, 4mA range (hi word)	Read/Write 4mA range (bytes 3 and 2) applies to both range and temperature types	2	32 bit Floating Point	RW	Y	38	26
4-20 Analog Range, 4mA range (lo word)	Read/Write 4mA range (bytes 1 and 0) applies to both range and temperature types					39	27
4-20 Analog Range, 20mA range (hi word)	Read/Write 4mA range (bytes 3 and 2) applies to both range and temperature types	2	32 bit Floating Point	RW	Y	40	28
4-20 Analog Range, 20mA range (lo word)	Read/Write 4mA range (bytes 1 and 0) applies toboth range and temperature types					41	29
Long Tag Line number to read/write	Tag Line number to access data (0 - Line 1, 1 - Line 2)	1	16 bit Integer	RW	Y	42	2A
Long Tag Line 1 (16 characters max)	ASCII character bytes 0 and 1, ex. "AB" A - 65 (41 hexadecimal), B - 66 (42 hex), send 6566 (4142 hex). The characters permitted are space ' ' (32 base 10, 20 hex) through '}' 125 base 10, 7D hex).	1	16 bit Integer	RW	Y	43	2B
Long Tag Line	ASCII bytes 2 and 3	1	16 bit Integer	RW	Y	44	2C
Long Tag Line	ASCII bytes 4 and 5	1	16 bit Integer	RW	Y	45	2D
Long Tag Line	ASCII bytes 6 and 7	1	16 bit Integer	RW	Y	46	2E
Long Tag Line	ASCII bytes 8 and 9	1	16 bit Integer	RW	Y	47	2F
Long Tag Line	ASCII bytes 10 and 11	1	16 bit Integer	RW	Y	48	30

Name	Meaning (2 bytes each register)	# of Reg's	Return Data Format	Read/ Write	Req's Storage Initiate	Register # Dec	Register # Hex
Long Tag Line	ASCII bytes 12 and 13	1	16 bit Integer	RW	Y	49	31
Long Tag Line	ASCII bytes 14 and 15	1	16 bit Integer	RW	Y	50	32
Initiate LXT330 Parameter Storage	Signals the user has completed entering the data and wants it stored. Write any value.	1	16 bit Integer	RW		51	33
Sensor Channel to read/write	Sensor channel number to access data (0 - Sensor 1, 1 - Sensor 2)	1	16 bit Integer	RW		52	34
LXT330 Mode	Unit operating mode (0-	1	16 bit Integer	R		53	35
LXT330 Serial Number (hi word)	Unit Serial Number (32 bit integer hi word)	2	32 bit Floating Point	R		54	36
LXT330 Serial Number (lo word)	Unit Serial Number (32 bit integer lo word)	2				55	37
LXT330 Fault Status		1	16 bit Integer	R		56	38
LXT330 Sensor Type	Specific LXT330 sensor type (see LXT330 Sensor Types tab)	1	16 bit Integer	R		57	39
LXT330 Sensor Chemical Type	Specific chemicals the SP3 is set to detect (see LXT330 Sensor Types tab)	1	16 bit Integer	RW	Y	58	3A
LXT330 Max Range (hi word)	Max sensor range (bytes 3 and 2)	2	32 bit Floating Point	R		59	3B
LXT330 Max Range (lo word)	Max sensor range (bytes 1 and 0)					60	3C
LXT330 Min Range (hi word)	Min sensor range (bytes 3 and 2)	2	32 bit Floating Point	R		61	3D
LXT330 Min Range (lo word)	Min sensor range (bytes 1 and 0)					62	3E
LXT330 Sensor Value (hi word)	Current sensor value (bytes 3 and 2)	2	32 bit Floating Point	R		63	3F
LXT330 Sensor Value (lo word)	Current sensor value (bytes 1 and 0)					64	40
LXT330 Sensor Voltage (hi word)	Corresponding sensor voltage to the sensor value (byte 3 and byte 2)	2	32 bit Floating Point	R		65	41
LXT330 Sensor Voltage (lo word)	Corresponding sensor voltage to the sensor value (byte 1 and byte 0)					66	42

Name	Meaning (2 bytes each register)	# of Reg's	Return Data Format	Read/ Write	Req's Storage Initiate	Register # Dec	Register # Hex
LXT330 Sensor Temperature (hi word)	Sensor Temperature (bytes 3 and 2)	2	32 bit Floating Point	R		67	43
LXT330 Sensor Temperature (lo word)	Sensor Temperature (bytes 1 and 0)					68	44
LXT330 Sensor is a Sentinel	Sensor is a Sentinel Type (0 - No, 1 - Yes)	1	16 bit Integer	R		69	45
LXT330 Sentinel Life %	% of Sensor life remaining	1	16 bit Integer	R		70	46
LXT330 Sentinel Vs (hi word)	Scaled Sentinel Voltage (in mV) normalized to Vo (bytes 3 and 2)	2	32 bit Floating Point	R		71	47
LXT330 Sentinel Vs (lo word)	Scaled Sentinel Voltage (in mV) normalized to Vo (bytes 1 and 0)					72	48
LXT330 Sentinel Vo (hi word)	Sentinel 100% value (in mV) on the life relative to 0V (bytes 3 and 2)	2	32 bit Floating Point	RW	Y	73	49
LXT330 Sentinel Vo (lo word)	Sentinel 100% value (in mV) on the life relative to 0V (bytes 1 and 0)					74	4A
LXT330 Sentinel Range (hi word)	Sentinel Range (bytes 3 and 2)	2	32 bit Floating Point	RW	Y	75	4B
LXT330 Sentinel Range (lo word)	Sentinel Range (bytes 1 and 0)					76	4C
Sensor Full Name (18 characters max)	ASCII character bytes 0 and 1, ex. "AB" A - 65 (41 hexidecimal), B - 66 (42 hex), send 6566 (4142 hex). The characters permitted are space ' ' (32 base 10, 20 hex) through '}' 125 base 10, 7D hex).	1	16 bit Integer	RW	Y	77	4D
Sensor Full Name	ASCII bytes 2 and 3	1	16 bit Integer	RW	Y	78	4E
Sensor Full Name	ASCII bytes 4 and 5	1	16 bit Integer	RW	Y	79	4F
Sensor Full Name	ASCII bytes 6 and 7	1	16 bit Integer	RW	Y	80	50
Sensor Full Name	ASCII bytes 8 and 9	1	16 bit Integer	RW	Y	81	51
Sensor Full Name	ASCII bytes 10 and 11	1	16 bit Integer	RW	Y	82	52
Sensor Full Name	ASCII bytes 12 and 13	1	16 bit Integer	RW	Y	83	53

Name	Meaning (2 bytes each register)	# of Reg's	Return Data Format	Read/ Write	Req's Storage Initiate	Register # Dec	Register # Hex
Sensor Full Name	ASCII bytes 14 and 15	1	16 bit Integer	RW	Y	84	54
Sensor Full Name	ASCII bytes 16 and 17	1	16 bit Integer	RW	Y	85	55
Sensor Abbreviated Name (8 characters max)	ASCII character bytes 0 and 1, ex. "AB" A - 65 (41 hexidecimal), B - 66 (42 hex), send 6566 (4142 hex). The characters permitted are space ' ' (32 base 10, 20 hex) through '}' 125 base 10, 7D hex).	1	16 bit Integer	RW	Y	86	56
Sensor Abbreviated Name	ASCII bytes 2 and 3	1	16 bit Integer	RW	Y	87	57
Sensor Abbreviated Name	ASCII bytes 4 and 5	1	16 bit Integer	RW	Y	88	58
Sensor Abbreviated Name	ASCII bytes 6 and 7	1	16 bit Integer	RW	Y	89	59
Initiate SP3 Storage	Signals the user has completed entering the data and wants it stored. Write any value.	1	16 bit Integer	W		90	5A
Cal log number to read	Cal log number to read (0 - Cal Log 1, 1 - Cal Log 2, 2 - Cal Log 3)	1	16 bit Integer	RE		91	5B
SP3 Cal Log slope (hi word)	(bytes 3 and 2)	2	32 bit Integer	R		92	5C
SP3 Cal Log slope (lo word)	(bytes 1 and 0)					93	5D
SP3 Cal Log offset (hi word)	(bytes 3 and 2)	2	32 bit Integer	R		94	5E
SP3 Cal Log offset (lo word)	(bytes 1 and 0)					95	5F
SP3 Cal Log offset Voltage (hi word)	(bytes 3 and 2)	2	32 bit Integer	R		96	60
SP3 Cal Log offset Voltage (lo word)	(bytes 1 and 0)					97	61

C.4. Fault Status

Bit #	Bit Meaning
0	Memory Error, either a Program Flash, RAM or NVM RAM checksum error has occurred
1	Input Voltage Out Of Tolerance
2	The On Board +12V is Out of Tolerance
3	The On Board +3.3V is Out of Tolerance
4	The Transmitter has lost communication link with the Sensor
5	There is no Sensor connected
6	Sensor Calibration Failed
7	Relay 1 on-time expired
8	Relay 2 on-time expired
9	Relay 3 on-time expired
10	Sentinel Error (useable life has expired)
11	Sentinel Poisoned
12	Membrane Error
13	NU
14	NU
15	NU

C.5. Warning Status

Bit #	Bit Meaning
0	The Sensor has changed from previously connect Sensor
1	Not Used (NU)
2	NU
3	NU
4	NU
5	NU
6	NU
7	NU
8	NU
9	NU
10	NU
11	NU
12	NU

Bit #	Bit Meaning
13	NU
14	NU
15	NU

C.6. Sensor Type

Data		Meaning		
Decimal	**Hexadecimal**	**Chemical**	**Sensor Type**	**Measure. Units**
0	0000	Unknown Chemical	None	None
1	0001	Ammonia	mV	ppm
2	0002	Ammonium	mV	ppm
3	0003	Bromide	mV	ppm
4	0004	Calcium	mV	ppm
5	0005	Chloride	mV	ppm
6	0006	Conductivity	Conductivity	S
7	0007	Cupric	mV	ppm
8	0008	Cyanide	mV	ppm
9	0009	DO	mV	ppm
10	000A	DO	mV	% saturation
11	000B	DO	mV	mg/L
12	000C	FLouride	mV	ppm
13	000D	Hardness ($CaCO_3$)	mV	ppm
14	000E	Nitrate	mV	ppm
15	000F	ORP	mV	mVa
16	0010	pH	mV	None
17	0011	Potassium	mV	ppm
18	0012	Resistivity	Conductivity	Ohm (W)
19	0013	Silver	mV	ppm
20	0014	Sodium	mV	ppm
21	0015	Sulfide	mV	ppm
22	0016	Turbidity	TR Series	FNU
23	0017	Turbidity	TR Series	NTU
24	0018	Turbidity	TR Series	ppm
25	0019	Turbidity	TR Series	mg/L

Data		Meaning		
Decimal	**Hexadecimal**	**Chemical**	**Sensor Type**	**Measure. Units**
26	001A	Turbidity	TR Series	% solid
27	001B	DO	SP3-ODO	ppm
28	001C	DO	SP3-ODO	% saturation
29	001D	DO	SP3-ODO	mg/L
30	001E	Calcium	mV	mg/L
31	001F	TDS	Conductivity	ppm
32	0020	Nitrate	mV	ppm
33	0021	TCA (max range)	TCA	mg/L
34	0022	TCA (min range)	TCA	mg/L
35	0023	FCA (max range)	FCA	mg/L
36	0024	FCA (min range)	FCA	mg/L
37	0025	FCA HR	FCA	mg/L
38	0026	Resistivity	Resistivity	ohm
39	0027	Conductivity	Conductivity	S
40	0028	PAA (mid range)	PAA	mg/L
41	0029	Lead	mV	mg/L
42	002A	Salinity	Conductivity	PSU
43	002B	Ozone (min range)	OZ	mg/L
44	002C	Ozone (max range)	OZ	mg/L
45	002D	HP (low range)	HP	mg/L
46	002E	HP (high range)	HP	mg/L
47	002F	HP (low percent)	HP	%
48	0030	HP (high percent)	HP	%
49	0031	Hardness	mV	Gr
50	0032	H_2SO_4 (low percent)	H_2SO_4	%
51	0033	H_2SO_4 (mid percent)	H_2SO_4	%
52	0034	H_2SO_4 (max percent)	H_2SO_4	%
53	0035	PAA (low range)	PAA	mg/L
54	0036	PAA (max range)	PAA	mg/L
55	0037	Nickle	mV	mg/L

Data		Meaning		
Decimal	**Hexadecimal**	**Chemical**	**Sensor Type**	**Measure. Units**
56	0038	NaOH	Conductivity	%
57	0039	FCL (max range)	FCL	mg/L
58	003A	Cadmium	mV	mg/L
60	003B	NH_4 as N	mV	mg/L
61	003C	ClO_2 Low	mA	mg/L
62	003D	ClO_2 High	mA	mg/L

Appendix D. Resistivity Temperature Compensation

The temperature coefficient of pure water changes with concentration and temperature. The graph below shows the % change per °C for 18.2 MΩ water. For the range of 20°- 40°C the mean value is -5% per °C, this is the default value set in the Model LXT330. The temperature coefficient of 10 MΩ water drops to a mean value of

-2.6%. The standard Resistivity temperature coefficient of -2.0%/°C is valid for all values below 1.0 MΩ water. The Temperature Coefficient is set in CONFIG→SENSOR→T COMP→-5.000%.

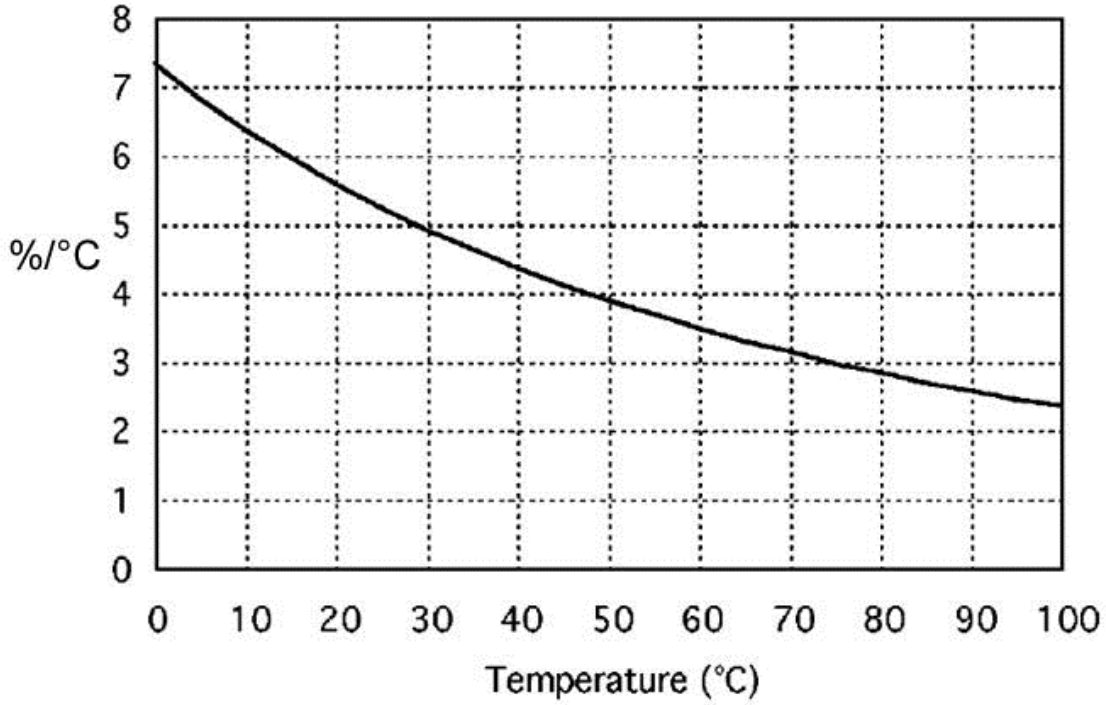

Figure D-1: % Change per °C for 18.2 MΩ Water

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Appendix E. Software History

Date	Version	Changes
July 2012	Rev. A	Initial Release
Feb. 2013	Rev. B	Conductivity Resistivity specifications added
June 2013	Rev. C	TRITON® SP3-ODO added
July 2013	Rev. D	Conductivity Calibrations added
July 2013	Rev. E	MODBUS Register update
May 2014	Rev. F	2 Channel addition, MODBUS Register update
July 2014	Rev. G	Resistivity Calibrations added
Aug. 2014	Rev. H	SP3 Table corrected
Aug. 2014	Rev. I	Icons deleted

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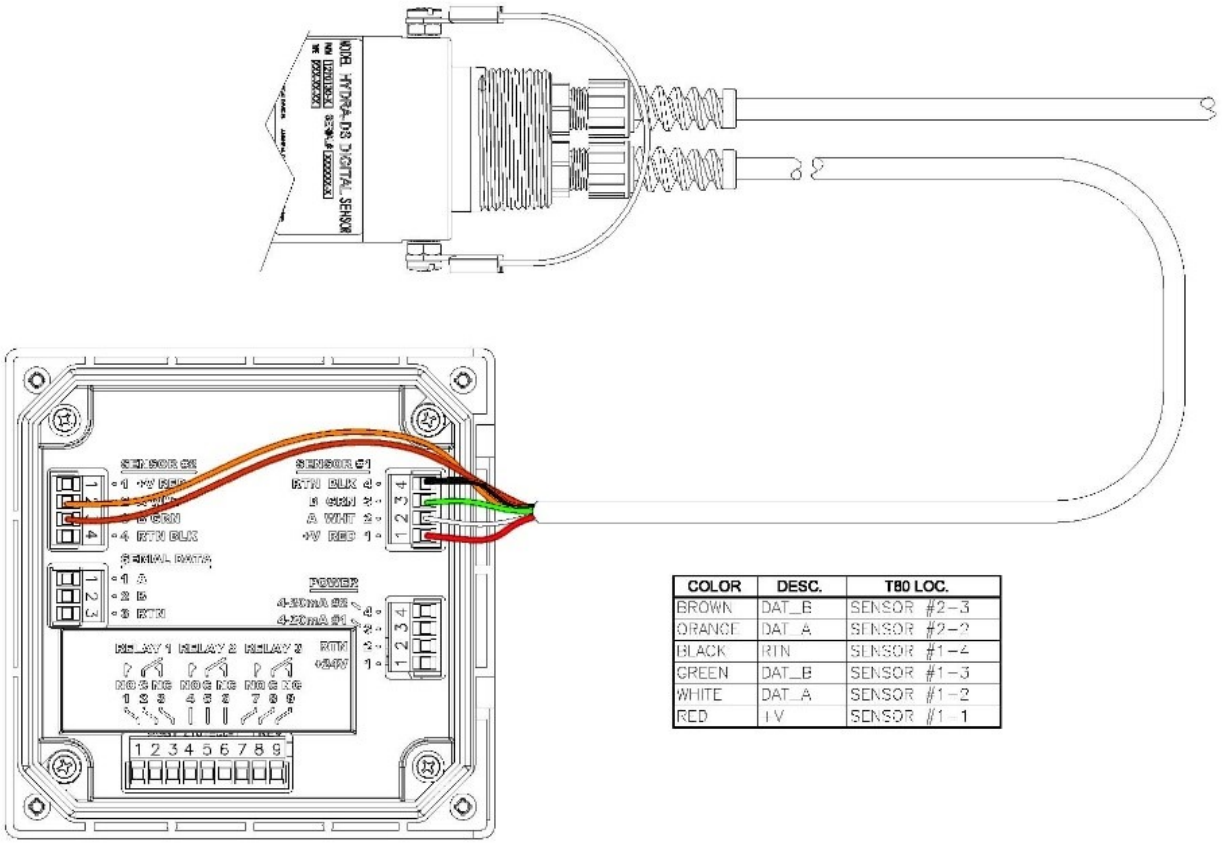
Appendix F. Ammonium (NH_4-N)



COLOR	DESC.	T80 LOC.
BROWN	DAT_B	SENSOR #2-3
ORANGE	DAT_A	SENSOR #2-2
BLACK	RTN	SENSOR #1-4
GREEN	DAT_B	SENSOR #1-3
WHITE	DAT_A	SENSOR #1-2
RED	+V	SENSOR #1-1

Figure F-1: Wiring Diagram Ammonium NH_4-N

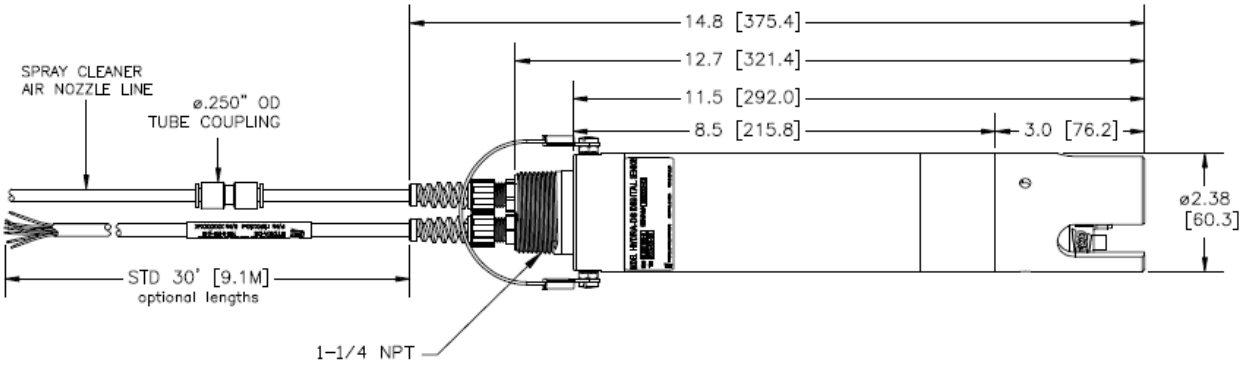


Figure F-2: Ammonium NH_4-N Dimensions

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Appendix G. Technical Support

This product is designed to provide you with reliable, trouble-free service. Contact your regional Technical Support if you have technical questions, need support, or if you need to return a product. Details can be found at:

Tech Support website: http://www.teledyne-ai.com/services/tech-support-repairs

Tech Support email: taitechsupport@Teledyne.com

Customer Service email: tai_rma@Teledyne.com

NOTE: When returning a product, contact Technical Support to obtain a Return Material Authorization (RMA) number prior to shipping.

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