INSTRUCTION MANUAL

MODEL X80 UNIVERSAL TRANSMITTER

REVISION HISTORY

REV	ECR	DESCRIPTION OF CHANGE	DATE	APPROVED
A	4329	INITIAL RELEASE	09/25/2018	GK
B	4524	ADD SPECIFIC CONDITIONS, SEPARATE APPENDIX X	2/24/2021	GK

ELECTRO-CHEMICAL DEVICES

SCREEN MAP

CAL (Calibration)	Auto	Cal 1 (Offset) using Calibration Solution				
		Cal 2 (Slope) using Calibration Solution				
	Standardize	Enter Grab Sample Determined Value				
	Manual	Enter Offset, the PV value and associated mV				
		Enter Slope, mV/pH, mV/decade, mV/ppm…				
	Temp	Enter measured Temperature				
CONFIG (Configuration)	XMTR	LCD	Set Up	Temp. Format	°C or °F	
				Contrast	Adj. 0-100%	
				Back Light	Enter ON time	
				Range Lock	Choose: Auto, ppb, ppm, ppt	
			Graph	Line	Screen Duration	
				Gauge		
				Bar		
			Label	TAG ID	Enter Name	
				TAG	ON/OFF	
				POP UP	ON/OFF	
				SENSOR	Enter Name	
		Output	4-20 mA (1 or 2)	Range (PV or Temp.)	4 mA =	
					20 mA =	
				Cal (more)	Trim 4.00 mA	
					Trim 20.00 mA	
				Fault (more)	3.5 mA	
					22 mA	
					NONE	
			RELAY	Relay 1	Alarm	Set Point
					Timed	Period, Duration
					Fault	
				Relay 2	Alarm	Set Point
					Timed	Period, Duration
					Fault	
				Relay 3	Alarm	Set Point
					Timed	Period, Duration
					Fault	
			HOLD	Time out: None, 15 min, 30 min…		
		Serial	Address			
			Baud rate			
			Format			
		Password	Menu	Off/On “ _ _ _ _ “		
			CAL	Off/On “ _ _ _ _ “		
			CNFG	Off/On “ _ _ _ _ “		
			SIM	Off/On “ _ _ _ _ “		
	Sensor	Sensor 1 or 2	Type	Choose Type: pH, Cond, ORP…..		
			T COMP	Enter % Comp		
			ISO PT	Enter mV value		
		Qty of Sensors	Choose 1 sensor or 2 sensors			
		COMP	Dissociation, Interference, Percentage, OFF			
	Load Default	Sensor/Transmitter	Yes/No			
	DAMP	Enter Signal Dampening (# of readings to average, 0-100)				
INFO (Information)	XMTR	Configuration, Serial #, Name, Outputs				
	Sensor	Calibration logs, Serial #, Name				
SIM (Simulate)	System	Sensor 1 or 2	Fixed value			
			Ramp			
	Relays	#1 ON/OFF				
		#2 ON/OFF				
		#3 ON/OFF				
	4-20 mA	4-20 mA Ch 1	Enter Value			
		4-20 mA Ch 2	Enter Value			

PREFACE

Purchasing products from Electro-Chemical Devices, Inc. provides you with the finest liquid analytical instrumentation available. If this is your first purchase from ECD, please read the entire manual before installing and commissioning your new equipment.

Manuals are accessible on the ECD website at http://ecdi.com/product-literature/manuals/

If there are any questions concerning this equipment, please contact your local ECD representative, or the factory directly at:

Electro-Chemical Devices, Inc.
1500 N. Kellogg Drive
Anaheim, CA 92807 USA
Telephone: +1-714-695-0051
FAX: +1-714-695-0057
Website: www.ecdi.com
Email: sales@ecdi.com

SYMBOLS USED IN MANUAL

	This symbol is used to designate important information, warnings and cautions. Failure to follow this information could lead to harm to the instrument or user.
	No operator serviceable parts, service by authorized service personnel only. La substitution de composants peut compromettre la sécurité intrinsèque.
	This symbol is used to designate a WARNING “Risk of Electrical Shock”
	Disconnect supply before servicing. Ouvrir le circuit avant d’enlever le couvercle.

	Read the complete manual before installing or using the equipment.

Contents of this manual are believed to be correct at the time of printing and are subject to change without notice. ECD is not responsible for damage to the instrument, poor performance of the instrument or losses resulting from such, if the problems are caused by:

- Incorrect operation by the user.
- Use of the instrument in incorrect applications.
- Use of the instrument in an inappropriate environment or incorrect utility program (power supply).
- Repair or modification of the related instrument by anyone not authorized by ECD.
- There are no operator accessible parts. Service and maintenance to be done by authorized personnel only.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Table of Contents

TERMS AND CONDITIONS OF SALE

1. **ACCEPTANCE.** If this writing differs in any way from the terms and conditions of Buyer's order or if this writing is construed as an acceptance or as a confirmation acting as an acceptance, then Seller's acceptance is **EXPRESSLY MADE CONDITIONAL ON BUYER'S ASSENT TO ANY TERMS AND CONDITIONS CONTAINED HEREIN THAT ARE DIFFERENT FROM OR ADDITIONAL TO THOSE CONTAINED IN BUYER'S WRITING.** Further, this writing shall be deemed notice of objection to such terms and conditions of Buyer. If this writing is construed as the offer, acceptance hereof is **EXPRESSLY LIMITED TO THE TERMS AND CONDITIONS CONTAINED HEREIN.** In any event, Buyer's acceptance of the goods shall manifest Buyer's assent to Seller's terms and conditions. No addition to or modification of these terms will be effective, unless set forth in writing and agreed to by Seller.

2. **WARRANTIES AND REMEDIES**
   a. **Warranty.** Seller warrants to Buyer that it holds and will pass marketable title to the goods sold hereunder. Seller warrants to Buyer that the items and components manufactured by Seller will be free from defects in material and workmanship (subject, however, to tolerances and variances permitted by the trade hereunder) for a period one (1) year for non-consumable products. Consumable electrodes and sensors have a conditional warranty based shelf life and process conditions and is determined by Seller.
   b. **Exclusion and Conditions.** Seller's obligations with respect to the express warranties and remedies contained herein are conditioned on the following: (i) Buyer's return of the non-conforming goods, if authorized by Seller: (ii) Buyer shall not assign its rights under these express warranties and any attempted assignment shall render such warranties, but not any disclaimers or limitations, void and the goods sold shall be sold **AS IS;** and (iii) all products shall be carefully inspected for damage by Buyer upon receipt, be properly calibrated for Buyer's particular use, and be used, repaired, and maintained by Buyer in accordance with the instructions set forth in Seller's product literature. Repair and maintenance by non-qualified personnel, product subjected to misuse or negligence, and/or damaged during shipment will invalidate the warranty, as will the use of non-approved consumables or spare parts. As with any other sophisticated product, it is essential, and a condition of Seller's warranty, that all personnel using the product be fully acquainted with its use, capabilities and limitations as set forth in the applicable product literature.

3. **DISCLAIMER OF IMPLIED WARRANTIES.** Seller gives no warranties except those expressly contained herein. Seller **disclaims** all other warranties implied by law usage of the trade, course of dealing or course of performance including, but not limited to, **the implied warranties of MERCHANTABILITY and fitness for a particular purpose.**

4. **LIMITATIONS OF LIABILITY.** The following limitations of Seller's liability are acknowledged by the parties to be fair and reasonable and shall apply to any act or omission hereunder, and to any breach of this contract of which these terms and conditions form a part:
   a. **Disclaimer of Damage.** In **no event shall Seller be liable for special, indirect, consequential or incidental damages whether arising under contract, warranty, tort, strict liability or any other theory of liability.** Such damages include but are not limited to loss of profits, loss of use of goods, damage to property, and claims of third parties.
   b. **Suitability.** Buyer acknowledges that it alone has determined the intended purpose and suitability of the goods sold hereunder. It is expressly agreed by the parties that any technical or other advice given by the Seller with respect to the use of the goods or services is given without charge and at Buyer's risk; therefore Seller assumes no obligation or liability for the advice given or results obtained.
   c. **Notice and Time of Claims.**
      i. Buyer agrees to check and inspect all products against shipping papers and for damage or shortage upon receipt of goods at destination.
      ii. Every claim for shortage, damage in transit, or other cause visible upon inspection shall be deemed waived by the Buyer, or the Buyer's customer in the case of resale, unless delivered in writing to Seller by Buyer thirty (30) days from the tender of delivery of the goods to Buyer, provided, however, that claims for shortage must be made within seven (7) days of receipt.
      iii. The parties expressly waive the statute of limitations and agree that any legal proceeding for any breach of this contract shall be waived unless filed within one (1) year after the accrual of the cause of action thereof.

5. **FORCE MAJEURE.** Seller shall not be liable for any delay in delivery, or failure to deliver, due to any cause beyond the Seller's control including but not limited to fires, floods, or other forces of the elements; strikes, or other labor disputes; accidents to machinery; acts of sabotage; riots; precedence or priorities granted at the request or for the benefit, directly or indirectly of the federal or any state government or any subdivision or agency thereof; delay in transportation or lack of transportation facilities; restrictions imposed by federal, state or other governmental legislation or rules or regulations thereof. If Seller, in its sole discretion, determines that Seller's performance hereunder would result in a loss to Seller's on this sale as computed under Seller's normal accounting procedures because of causes beyond Seller's control, then the Seller may terminate this agreement in whole or in part without liability for any delay in the delivery of, or failure to deliver, the goods sold hereunder

6. **TAXES AND OTHER CHARGES.** The Buyer will pay, or reimburse Seller if it pays, any and all taxes or tariffs or any other similar charges imposed upon this contract, the goods covered hereby or the delivery or use or resale thereof.

7. **FREIGHT CHARGES.** If the sale hereunder is other than F.O.B. Seller's facility, this acknowledgement is based upon the freight charges now in effect. In the event of an increase or decrease in applicable freight charges before the goods are shipped, such charge in freight will be for the Buyer's account.

8. **PRICES AND DELIVERY.** Prices quoted herein are F.O.B. shipping point. Deliveries specified are only our best estimate and are subject to change. This quotation is based upon freight charges now in effect. Buyer will be invoiced at the freight charge prevailing at the date of shipment. Prices are firm for orders meeting Seller's normal shipping schedules. If shipments are held or postponed for any reason other than Seller's fault, and a price increase becomes effective during the period of such hold or postponement, the increase will apply to all shipments that are held or postponed thirty (30) days or more from the effective date of the increase.

9. **PAYMENTS.** If in the judgment of Seller the financial condition of Buyer at any time prior to shipment does not justify the terms of payment specified, Seller may cancel the order, withhold shipment, and/or require full or partial payment in advance. If payment is not made when due, Seller may suspend all future delivery or other performance with respect to Buyer without liability or penalty and, in addition to all other sums payable hereunder, Buyer shall pay to Seller (i) the reasonable costs and expenses incurred by Seller in connection with all actions taken to enforce collection or to preserve and protect Seller's rights hereunder, whether by legal proceedings or otherwise, including without limitation reasonable attorneys' fees, court costs and other expenses and (ii) interest on all amounts unpaid after 30 days charged at the monthly rate of 1-1/2% or the highest rate permitted by law, whichever is lower.

10. **CANCELLATION OR ALTERATION.** Buyer may not alter or cancel any order without Seller's written consent. For any order altered or cancelled with Seller's consent, Buyer must pay for all expenses and labor incurred up to the time of Seller's consent, plus a reasonable percentage for profit. Any order delayed or deferred by Buyer will be subject to price escalation for increased costs of production, and any other expenses caused by the delay. Material on such orders will be stored at Buyer's risk. Seller reserves the right to invoice Buyer and require payment before shipment of any delayed or deferred order.

11. **TITLE AND RISK OF LOSS.** Title and risk of loss shall pass to buyer at Irvine, California, unless otherwise specified in the contract. If delivery is made by common carrier, risk of loss shall pass upon delivery to the carrier. Claims for loss or damage in transit must be made by Buyer to the carrier. Seller accepts no responsibility for loss or damage to product in transit.

12. **PATENT OR TRADEMARK INFRINGEMENT.** If the goods sold hereunder are to be prepared for manufacture according to Buyers specification, Buyer shall indemnify Seller against any claim or liability for patent, trademark, service mark or trade name infringement on account of preparation, manufacture and/or sale.

13. **NON-WAIVER.** If Government Contract Regulations require the addition, deletion, or modification of these terms and conditions upon prior notification to Seller and Seller's written acceptance thereof, such changes shall become a part of these terms and conditions. Seller shall not be bound by any Government Contract Regulations applicable to Buyer's contracts with the U.S. Government unless Buyer has expressly acknowledged, on the face of this document, the applicability of such Regulations to the transaction between Buyer and Seller contemplated herein. Absent such acknowledgement, Seller is making the assumption in issuing this document that no such Regulations apply.

14. **JURISDICTION.** All such disputes shall be resolved in a court of competent jurisdiction in Orange County, California. Buyer hereby consents to the jurisdiction of the State and Federal Courts sitting in Orange County. Notwithstanding the above, should either party contest the jurisdiction of such courts, the other party may institute its suit in any court of competent jurisdiction.

15. **APPLICABLE LAW.** All questions arising hereunder or in connection with the quotations or any order submitted in connection therewith and/or the performance of the parties hereunder shall be interpreted and resolved in accordance with the laws of the state of California without regard to its conflict of law provisions and excluding the United Nations Convention on the International Sale of Goods.

RETURN GOODS POLICY

All requests for returned goods must be initiated through our Customer Service Department. Please call our phone number +1 (714) 695-0051 with the specifics of your request. The following conditions must be satisfied for consideration of applicable credit for the return of products purchased from Electro-Chemical Devices:

1) The item is unused and in the original package.

2) The item was shipped directly from Electro-Chemical Devices.

3) The item has not been damaged in shipment to Electro-Chemical Devices.

4) Items containing date-sensitive parts such as electrodes, must be returned within 1 month of the invoiced date.

5) Items without date-sensitive parts must be returned within 3 months of the invoiced date.

A Return Merchandize Authorization Number must be obtained from Customer Service and be provided on all paperwork and packaging. To obtain a Return Merchandize Authorization Number, please provide the reason for return, the date of purchase, your original purchase order number, and either our order number or our invoice number. The issuance of a Return Merchandize Authorization Number is a verbal approval for return only and does not guarantee credit or allowance. Returned goods must be received within 30 days of the issuance date of the Return Merchandize Authorization Number or it will become null and void.

Necessary physical and mechanical inspection is completed upon receipt of the item. Applicable credit or equivalent allowance is determined after inspection of the returned item. If all of the above conditions are met, and the item has been approved to return to our stock, a restocking charge of 25% of the purchase price is deducted from the applicable credit.

UNPACKING THE INSTRUMENT

Your Electro-Chemical Devices instrument 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 ECD.
3. Save the original packing material until you are satisfied with the contents. In the event the product(s) must be returned to ECD, the packing material will allow you to properly ship it to ECD.
4. Familiarize yourself with the instrument 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.

Installation and wiring

Failure to follow the proper instructions may cause damage to this instrument and warranty invalidation.

Use only qualified personnel to install, operate and maintain the product.

The Model X80 transmitter should only be used with equipment that meets the relevant American or Canadian standards. ECD accepts no responsibility for the misuse of this unit.

Basic Parts List

1. Model X80 Transmitter
2. Instruction Manual
3. B88 Barrier
4. S88 Sensor
5. Cable Lockout Device

1.0 GENERAL DESCRIPTION

The ECD Model X80 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 in a hazardous industrial environment. The Model X80 transmitter communicates digitally with any ECD S88 digital sensor, automatically configuring the transmitter's menus and display screens to the measured parameter.

The Model X80 transmitter can be loop powered or 24 VDC 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 any 24 VDC powered transmitter.

SPECIFIC CONDITIONS OF USE

1. The flame paths of the equipment are not intended to be repaired. Consult the manufacturer if repair of the flame path joint is necessary.
2. Part of the probe enclosure is constructed from plastic. To prevent the risk of electrostatic sparking the plastic surface should only be cleaned with a damp cloth.

1.1 MODEL X80 TRANSMITTER

FM C US APPROVED

Class I, Division 1, Groups B,C,D,E,F and G, T4 -40^{o}C to +85^{o}C
Class I, Zone 1 IIB+H_2 , T4 -40^{o}C to +85^{o}C Type 4X; IP 66

Model X80 Transmitter is intended for installation in hazardous locations with Class I Division 1 or Class I Zone 1 classification. It is not intended to be installed in Zone 0 locations and must only be installed in ambient temperature conditions of -40^{o}C $\leq T_a \leq$ +85^{o}C. Power connections into the X80 transmitter must be made with flame-proof conduit and cable glands certified for hazardous locations and compatible with Ex certified equipment. Additionally, connections between the X80 Transmitter and the B88 Barrier must be made with approved conduit and cable glands certified for hazardous locations.

- Ensure installation complies with all local, state and national codes for the installation of equipment in hazardous locations.
- Refer to Control Drawing 1700003 for specific installation requirements.
- Do not install equipment approved for non-hazardous locations in a hazardous area.
- Do not install this equipment into a Zone 0 location.
- Substitution of components is NOT PERMITTED and may impact intrinsic safety.
- Do not open housing when a hazardous or explosive atmosphere exists.

- Ouvrir le circuit avant d'enlever le couvercle.
- La substitution de comppsants peut compromettre la sécurité intrinsèque.

1.2 B88 BARRIER

EXPLOSION-PROOF WITH ASSOCIATED INTRINSICALLY SAFE CONNECTIONS FOR
Class I, Division 1, Groups B,C and D T5 -40^{o}C to +80^{o}C
Class I, Zone 1 IIB+H_2 , T5 -40^{o}C to +80^{o}C

B88 Barrier is intended for installation in hazardous locations with Zone 1 classification and functions to limit energy available to the S88 Sensor. The barrier is installed using approved conduit, fittings and cable glands suitable for the area classification. The B88 barrier may not be modified, altered or substituted with any other components which may impair the safety of the system. The B88 Barrier may only be used with an S88 Sensor and may not be used with any other device.

- Ensure the installation complies with all local, state and national codes for the installation of equipment in hazardous locations.
- Refer to Control Drawing 1700003 for specific install requirements.
- Do not install equipment approved for non-hazardous locations in a hazardous area.
- Do not install this equipment into a Zone 0 location.
- Substitution of components is NOT PERMITTED and may impact intrinsic safety.
- Ensure a minimum 5 full threads of engagement.
- Connect and verify green wire to X80 grounding lug.
- Do not open housing when a hazardous or explosive atmosphere exists.

- Ouvrir le circuit avant d'enlever le couvercle.
- La substitution de comppsants peut compromettre la sécurité intrinsèque.

1.3 S88 SENSOR

INTRINSICALLY SAFE/SÉCURITÉ INTRINSÈQUE FOR
Class I, Division 1, Groups B,C and D T5 -40^{o}C to +80^{o}C
Class I, Zone 0 IIB+H_2 , T5 -40^{o}C to +80^{o}C

Model S88 Sensor is intrinsically safe and intended for installation in hazardous locations with Zone 0 classification. The S88 Sensor may only be used with an accompanying B88 Barrier to limit the energy available to intrinsically safe levels. The maximum stored energy in the S88 Sensor is below the level needed to generate spark ignition of the environment. Ambient temperature conditions must within -40^{o}C $\leq$ T_a $\leq$ +80^{o}C to maintain product approval.

- Ensure the installation complies with all local, state and national codes for the installation of equipment in hazardous locations.
- Refer to Control Drawing 1700003 for specific install requirements.
- Do not install equipment approved for non-hazardous locations in a hazardous area.
- Only connect the S88 Sensor to an associated B88 Barrier.
- Substitution of components is NOT PERMITTED and may impact intrinsic safety.

- La substitution de comppsants peut compromettre la sécurité intrinsèque.

1.4 STOPPING PLUG 9310062

Class I, Division 1, Groups A,B,C and D
Class II, Division I Groups E,F and G
NEMA 4X

Stopping plug P/N 9310062 is intended for installation in hazardous locations with Zone 1 classification. The plug is factory installed into the X80 flame-proof housing to maintain the flame-proof integrity for un-used wiring ports in single channel configuration. Do not remove or modify the plug or flame-path of the plug. Verify plug is tightened to a torque of 55Nm (41ft-lbs).

- Ensure the installation complies with all local, state and national codes.
- Refer to Control Drawing 1700003 for specific install requirements.
- DO NOT substitute or alter this component as it may impact flame-proof integrity.
- La substitution de comppsants peut compromettre la sécurité intrinsèque.

1.5 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
- A 4-20mA output and MODBUS® RTU standard, optional HART®

1.6 SPECIFICATIONS

1.6.1 INPUT SPECIFICATION

Digital protocol, all ECD S88 sensors

1.6.2 INPUT RANGES

pH	-1.00 - 15.00 pH
ORP	-1500 - +1500 mV
pION	000.1 - 999.9, Auto Ranging: ppb ↔ ppm ↔ ppt (thousand)
Dissolved Oxygen	000.1 - 999.9, Auto Ranging: ppb ↔ 20.00 ppm, % SAT, mg/L
Conductivity	0.000 - 2.000, Auto Ranging: µS ↔ mS ↔ S
	TDS 0.00 - 9999 ppm
Resistivity	0.00 - 50.00 MΩ
Temperature	100 K-ohm TC, -40°C + 85°C

1.6.3 ACCURACY

pH	0.02 pH
ORP	± 1 mV
pION	Specific to electrode type
Dissolved Oxygen	2% of range
Conductivity	2% of range
Resistivity	2% of range
Temperature	± 0.3°C

1.6.4 OUTPUT SIGNALS

4-20 mA output (standard, one per Channel), Fault Condition: 3.5 mA, 22 mA or none
Modbus RTU (standard)
HART® (optional)

1.6.5 CONTACT RELAYS

(Optional) Three (3) SPDT, 1 form C, 250 VAC, 10 Amp resistive maximum, relays, user configurable as Hi/Lo alarms with expiration timer, Periodic Timers or Fault alarms

1.6.6 DISPLAY

128 x 64 pixels (2.0" x 1.1") LCD, Black on Grey background on loop powered instruments, Blue on White background with LED backlight on 24 VDC powered instruments, English, numeric and graphical displays

1.6.7 ENCLOSURE

Explosion Proof Certified: FM, CSA, ATEX and IECEx
Materials: Electro Polished 316 SS

Mounting:
2 x M4 (3/16") and 3 x ¾" FNPT

1.6.8 POWER

Code -0	Loop powered, 24 VDC 600 Ω maximum load (18-36VDC @ 35 mW minimum)
Code -1	24 VDC (18-36 VDC @ 250 mW minimum)

1.6.9 ENVIRONMENTAL CONDITIONS

Outdoor use (IP65)	
Ambient Temperature	-40°C to +80°C
Storage Temperature	-40°C to +80°C
Relative Humidity	0 – 80%, up to 31°C
	Decreasing linearly to 50% RH at 40°C
Altitude	Up to 2000 m (6500 Ft.)

1.6.10 SHIPPING

Size	5.5" x 5.1" x 5" (14 cm x 13 cm x 12.7 cm)
Weight:	316 SS, 8.0 lbs. (3.65 kg)

1.7 MODEL CODES

Model X80-						
1st Channel	**1** (S88) S88 Digital Sensor, pH, ORP, pION, DO, DO90 ppb DO, Conductivity, Resistivity					
	2nd Channel	**0** No Second Channel				
		1 (S88) S88 Digital Sensor, pH, ORP, pION, DO, Conductivity, Resistivity				
		Power Supply	**-0** Loop Powered Transmitter			
			-1 24 VDC Powered Transmitter			
			Relay Option	**0** No Relays		
				1 (3) 250V 10A relays (DC Powered ONLY)		
				Outputs	**0** 4-20 mA output and MODBUS	
					1 HART®	
					2 2 x 4-20 mA & MODBUS	
					3 2 x 4-20 mA & HART® (1CH)	
					Approvals	**00** None
						01 FM Approval
						02 ATEX/IEC 1CH
						03 ATEX/IEC 2CH
Model X80-	**1**	**1**	**-2**	**1**	**2**	**01**

Example above shows part# X80-11-112-01, a two channel X80 transmitter for use with two S88 sensors, 24 VDC powered with two 4-20 mA outputs and MODBUS RTU with FM Approval.

Model B88 - Barrier Assembly, B88 with mounting bracket

Example above shows B88 Barrier with mounting bracket p/n 1000088-1.

1.8 APPROVALS

1.8.1 ENCLOSURE

FM APPROVED

Class I, Div 1, Groups B, C and D;
Class II, Div 1, Groups E, F and G;
Class III, NEMA 4X, IP66;

IECEx

Ex d II C Gb
Ex tb Db IIIC IP68
Ta = -40℃ to +85℃

Ex

II 2 G D
Ex d IIC Gb
Ex tb Db IIIC IP68
Ta = -40℃ to +85℃

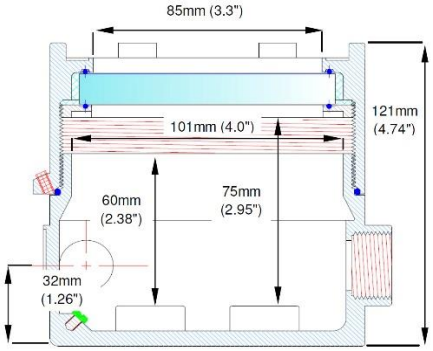
CSA®

Class I, Div 1, Groups B, C and D;
Class II, Div 1, Groups E, F and G;
Class III, Div 1;
Type 4X Ex d IIB+H2;

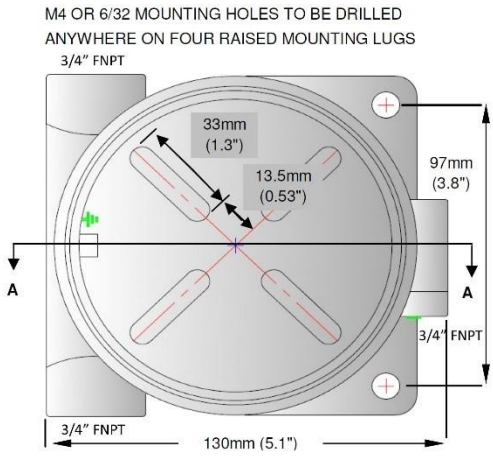
2.0 INSTALLATION

2.1 MOUNTING

Mount the X80 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. The IP65 X80 is suitable for outdoor use but it is best to mount it with a protective cover or sunshield to prevent discoloring over the years.



Dimensions SS Housing



Dimensions SS Housing

2.2 WIRING

The X80 installation consists of a flame-proof transmitter with enclosure; an external flame-proof/intrinsically-safe energy limiting B88 Barrier and flame-proof seal; and an Intrinsically-safe S88 Sensor. Substitution of parts or unauthorized repairs are prohibited and will invalidate certification. Examples of unauthorized repairs include flame-path alteration or modification of flame-proof components. Omission of components, including but not limited to flame-proof conduit, flame-proof seals and stopping plugs is not permitted. Flame-proof stopping plug shall be tightened to a specified torque of 55Nm (41ft-lbs). Refer to local, state and national codes for specific installation requirements and refer to additional documents as necessary (NFPA33, NEC 500 and 516, IEC 60079-14).

Electrical wiring should only be conducted by qualified personnel. See the X80 wiring diagram in Figure 2.2.1

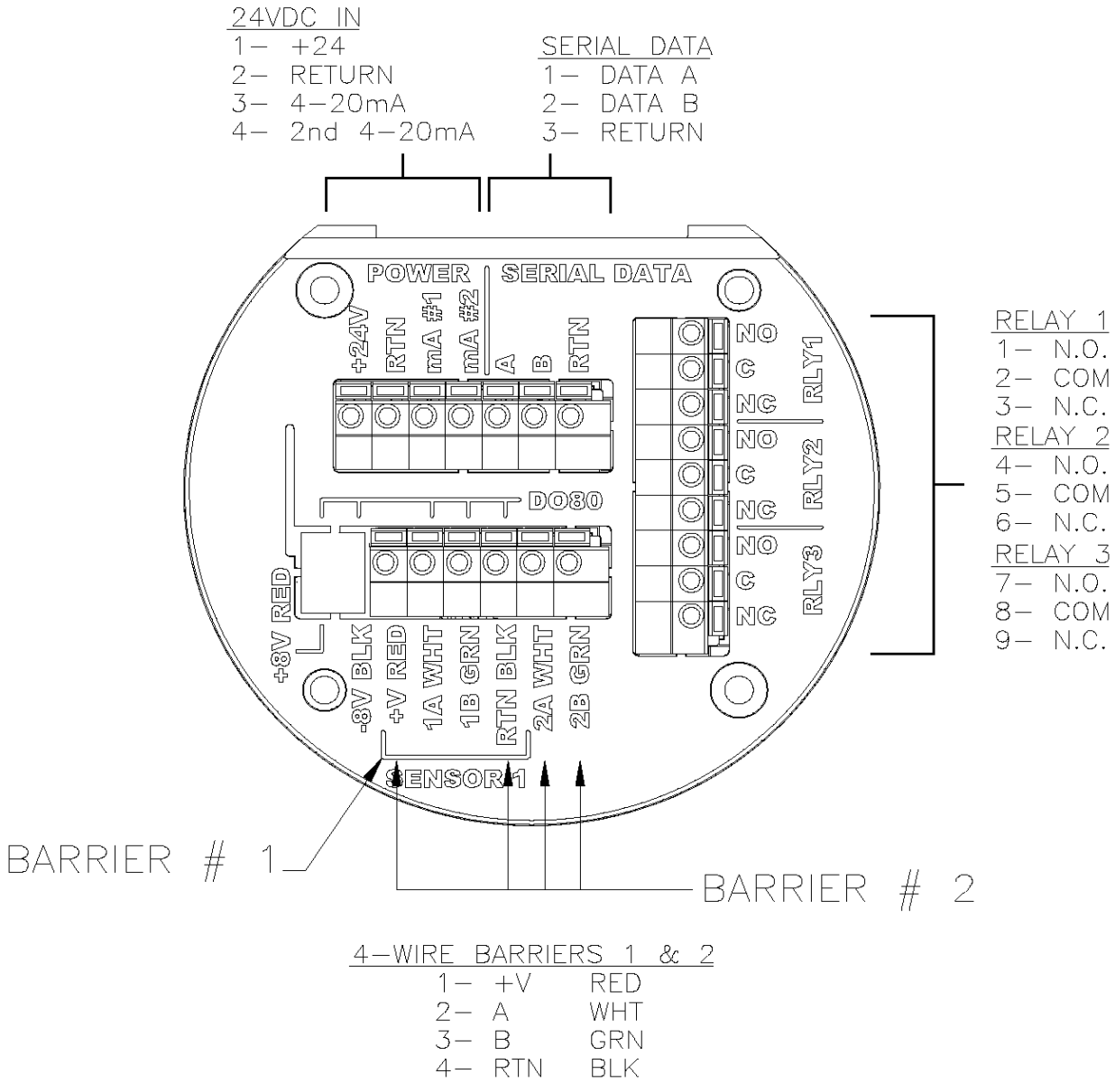


Figure 2.2.1 X80 Transmitter Wiring Terminals

	Warning: RISK OF ELECTRICAL SHOCK
	Disconnect Power before opening instrument. Ouvrir le circuit avant d'enlever le couvercle.
	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.

2.2.1 WIRING, X80 POWER

Field connections, including input power and user wiring is to be supplied via conduit suitable for the environment classification. Mount the enclosure and connect with conduit as per the conduit manufacturers recommendations. Pull wiring thru the conduit and attach to the terminals listed below. Tighten all joints and seal conduit as required to ensure compliance with installation requirements.

Loop Powered (2 wire configuration)
Attach the 24VDC signal cable to terminals #1 and #2 as shown in Figure 2.2.1 and on the diagram inside of the X80 cover. Feed the cable through the gland fitting on the left hand side of the X80. Tighten the cable gland to provide a good seal to the cable. Proceed to wiring B88 Barrier listed below.

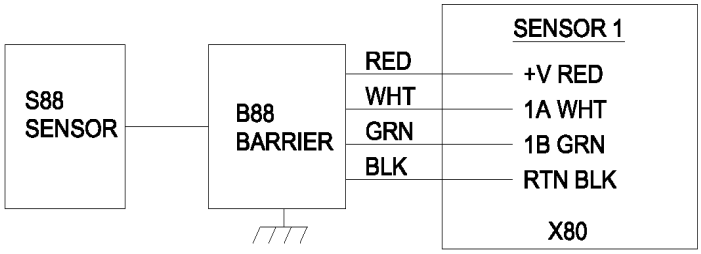
24VDC (4 wire configuration)
Attach the 24VDC power cable to terminals #1 and #2 as shown in Figure 2.2.1 and on the diagram inside of the X80 cover. Attach the 4-20 mA1 cable to terminals #3 (out) and #2 (return)single channel unit and attach the 4-20 mA2 cable to terminals #4 (out) and #2 (return) for a two channel instrument. Feed the cables through the gland fitting on the left hand side of the X80. Tighten the cable gland to provide a good seal to the cable. Proceed to wiring B88 Barrier listed below.

2.2.2 WIRING, X80 TO B88 BARRIER

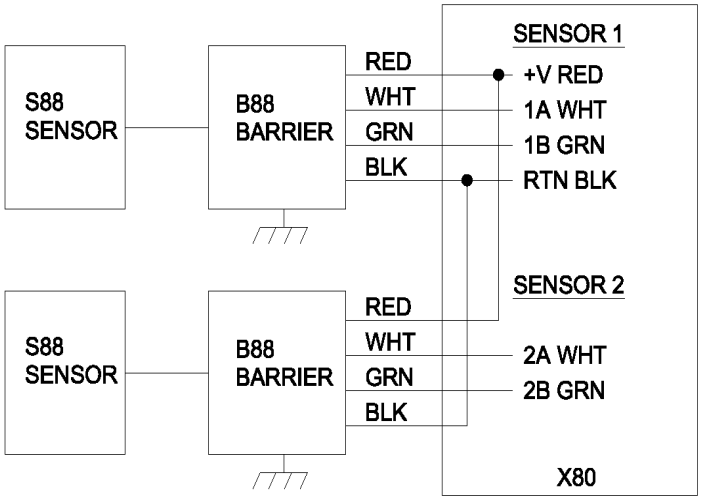
Pass the B88 Barrier cable thru the selected X80 ¾" NPT port and tighten to complete flameproof Ex-d seal. Ensure at least 5 full threads of engagement. Insert the corresponding wires into the terminal block locations identified below. For single channel configurations, connect a RED wire to position +V RED above the label Sensor #1. Connect a WHITE wire to position 1A WHT and connect a GREEN wire to the 1B GRN position. Connect a BLACK to the RTN BLK position. Connect Green Grounding wire to the chassis ground lug provided inside the X80 housing. Refer to wiring diagram below. If the installation is a single channel unit remember to install the sealing plug (supplied) and tighten to 55nM (41ft-lbs) maintain the flameproof integrity. If the installation is dual channel, an additional B88 Barrier is required to support the Sensor #2. Install as per directions above and use alternate 2A WHT and 2B GRN positions indicated on the wiring diagram. Attached cover to X80 housing and tighten to ensure at least 5 full threads of engagement. Secure cover using the provided retaining screw to complete X80 installation.

2.2.2 WIRING, B88 BARRIER TO X80

Pass the X80 cable into the B88 housing thru the ¾" NPT port and tighten to complete flameproof Ex-d seal. Ensure at least 5 full threads of engagement. Insert the corresponding wires into the terminal block connector as follows and tighten to secure: #1 = RED, #2 = WHITE; #3 = GREEN and #4 = BLACK. Connect a green grounding wire to the chassis ground lug provided inside the B88 housing. Plug terminal block into connector, install cover and tighten to ensure at least 5 full threads of engagement. Tighten the locking screw to complete installation.



X80 SINGLE CHANNEL SENSOR WIRING



X80 DUAL CHANNEL SENSOR WIRING

Figure 2.2.2 B88 Barrier Wiring

2.2.3 WIRING, SENSOR S88

Mount the S88 Sensor into the process as required. Route the sensor cabling as needed and attach to the B88 Barrier by plugging in the connector and rotating the knurl clockwise. Attach the Lockout Guard onto the cable with the directional arrow pointing toward the B88 barrier and snap to complete installation.

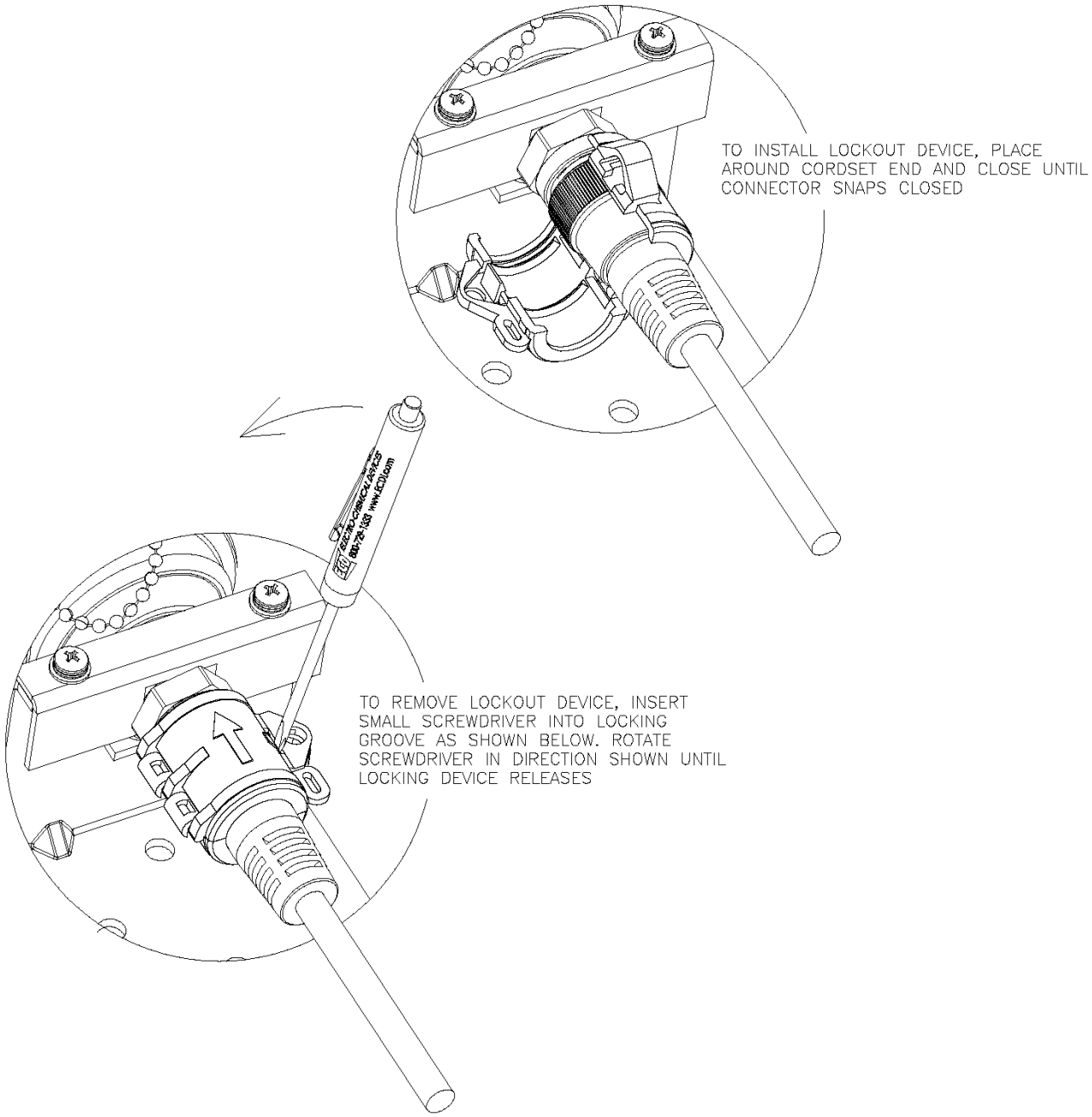


Figure 2.2.3 S88 Sensor Connector Wiring

2.2.4 Wiring, 4-20 mA Outputs

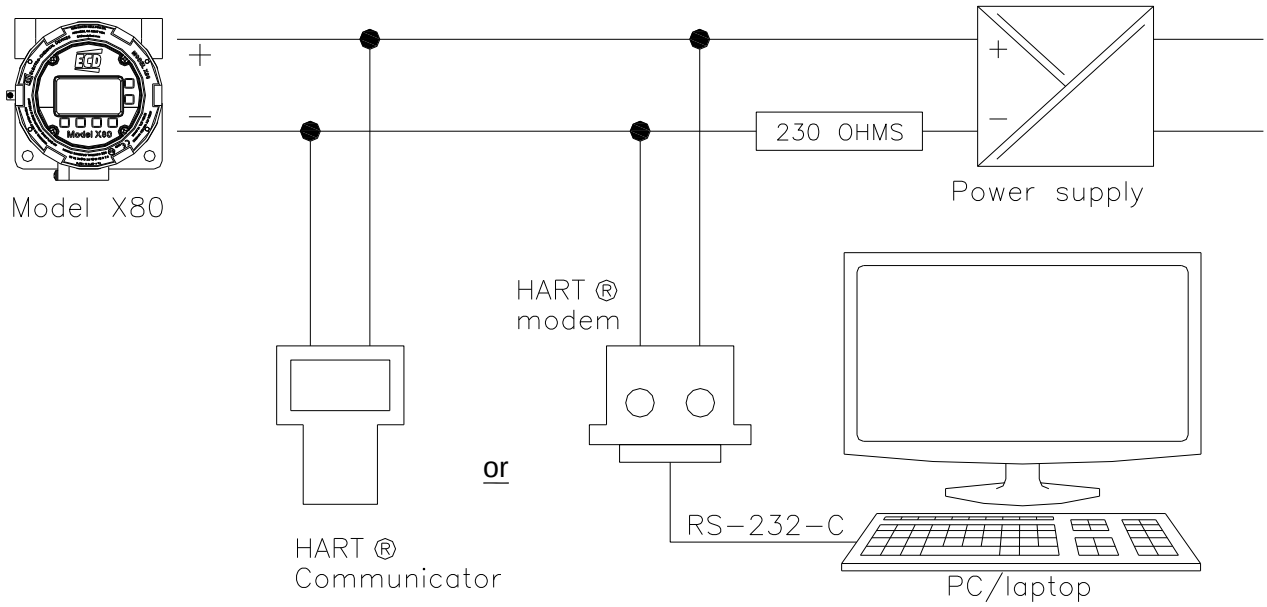
Loop Powered Instruments:

Connect the 4-20 mA cable to terminals #1 (+24V) and #2 (GND), Model X80-XX-0 X-XX.

24 VDC powered instruments:

For instruments powered by 24VDC (Model X80-XX-1X-XX), 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:



2.2.5 Wiring, Contact Relay Outputs

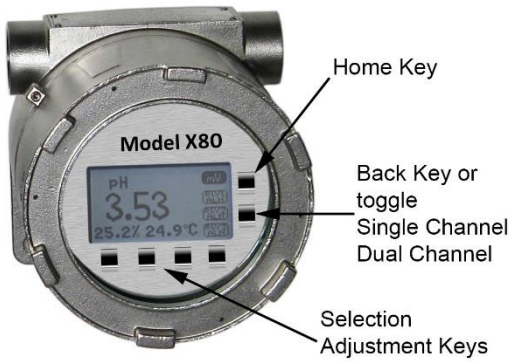
The standard configuration has three SPDT 230V 5 A relays that can be wired either **normally open (NO)** or **normally closed (NC)**. The default configuration is set to use the relays as normally open.

2.2.6 Wiring, Serial Output MODBUS RTU

Attach the sensor wires as shown in Figure 2.2.1 or as described on the diagram inside the X80 cover. Feed the sensor cable through the gland fitting on the left hand side of the X80. Do not use the same gland fitting for the AC power or Alarm/Relays. See MODBUS command register in Appendix D.

3.0 OPERATION

The Model X80 transmitter communicates digitally with any ECD S88 digital sensor. The measurement identity is contained in the sensor's memory. When an S88 sensor is connected to the transmitter it automatically configures the transmitter's menus and display screens to the measured parameter.



3.1 MAGNETIC KEYS

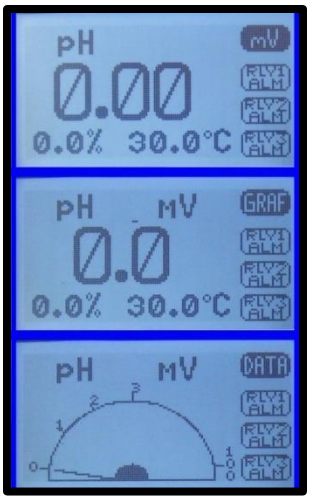
The keys on the Model X80 transmitter are magnetic Hall Effect switches. Use the magnetic end of the supplied instrument screw driver to actuate the switches. Bringing the magnet within ¼" (6 mm) of the key will trigger the switch. The functions associated with each key are displayed on the screen, above or beside the key for the Selection Adjustment Keys and to the left of the key for the HOME and BACK keys. **Actuate any Selection Adjustment key twice within one second to enter the HOME Menu Screen.**

3.1.1 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)



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 HOME Menu Screen, pressing EXIT prompts the user to "Save Changes" YES/NO when exiting the HOME Menu. YES applies any changes made in the menus, NO exits the HOME Menu without applying any changes made in the menus.

3.1.2 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.

3.1.3 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 actuate 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.

3.1.4 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. Actuating 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 { | } → ←

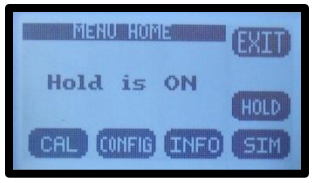
3.2 MENU STRUCTURE

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.

3.2.1 HOLD (Output Hold)

Actuating the **HOLD Key** activates the HOLD function, HOLD is ON, 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

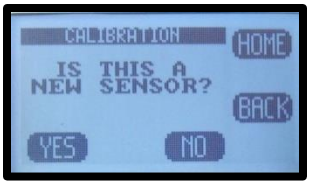


Actuating HOLD again turns the hold function off, Hold is OFF, displayed. The HOLD function remains ON until it is turned OFF. (See Time Out in CONFIG>XMTR>OUTPUT>HOLD)

3.2.2 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**". If YES the calibration history from the previous sensor is cleared from memory and a new register is started, if NO then the calibration is written to the memory stack, (3) sets of data are stored.

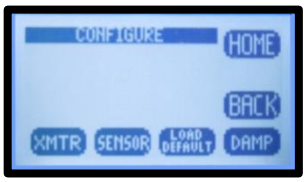


- **AUTO** is a two point calibration. The calibration proceeds in two steps, Auto Cal 1 is an offset calibration and Auto Cal 2 is a slope calibration. Auto Cal provides automatic solution recognition of the calibration solutions used for each measurement in accordance with the following list:
  1. pH Calibration Buffers (US Standard), pH 4.01, pH 7.00 and pH 10.00 (see Appendix A)
  2. ORP Calibration Solutions: Quinhydrone saturated: pH 4.01= +89 mV, pH 7.00= +266 mV
  3. pION Calibration Solutions: 1.00, 10.00, 100.0 ppb, ppm, ppt (thousand)
  4. Dissolved Oxygen: Zero ppm (Sodium sulfite, Na_2SO_3 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.

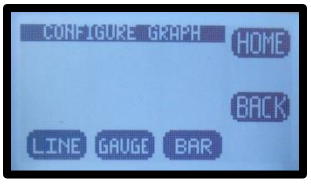
- **STAND** is standardization, a single point calibration. Standardizations are typically used to adjust the process reading to agree with a laboratory determined "grab sample" reading.
- **MANUAL** is a data entry screen. Manual calibration allows the user to enter a concentration with the corresponding 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.

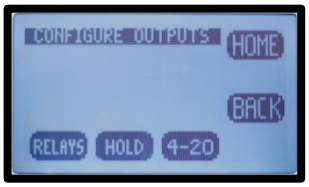
3.2.3 CONFIG (CONFIGURATION MENU)



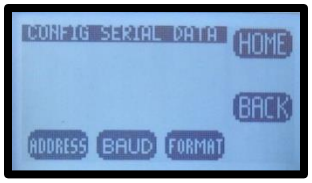
Four options are available in the Configure Menu, **XMTR, SENSOR, LOAD DEFAULT** and **Dampen**.

- **XMTR** enters the Transmitter Configuration menu.
  - **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.
      - **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**
      - **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
    - **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**
      - **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 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,
    - **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,
    - **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.
    - **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**
    - **TYPE,** Allows X80 transmitter to configure the S88 sensor. For use only when switching the measurement electrode type in an S88 sensor, i.e. for a pH electrode to a pION electrode. Select Sensor Type: pH, ORP, DO_2, NH_3, NH_4^+, Br^-, Ca^{++}, Cl^-, Conductivity, Resistivity, Cu^{++}, CN^-, F^-, NO_3^-, K^+, Ag^+, Na^+, S^{--}

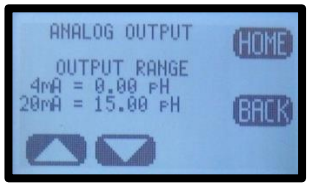
    - **T COMP,** Enter % temperature compensation per degree: pH, pION 0.33%, ORP 0.00%, DO_2 4%, Conductivity 2%, Resistivity -5% (see Table Appendix E)
    - **ISO PT,** Enter Iso Potential value in mV. The Iso Potential is the point where changes in the temperature do not cause changes to the signal.

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

- **Qty of SENSORS,** Choose 1 or 2

❖ **Load Default** resets all Menus to factory default configuration.

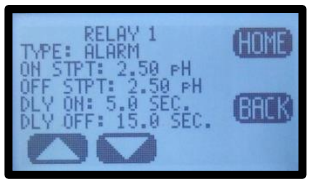
3.2.4 INFO (INFORMATION MENU)



The Information Menu provides two choices,

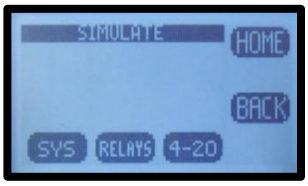
❖ **Transmitter Screen**, details the Name, Power type, Serial #, Firmware version and the output configuration(s).

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



3.2.5 SIM (SIMULATION MENU)

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



❖ **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.

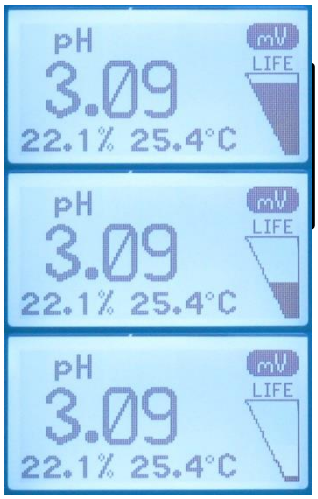
❖ **RELAYS** allows individual relays, #1, #2, and #3 to be activated and deactivated

❖ **4-20 mA** allows the output to be simulated from 4.00 mA to 20.00 mA.

3.2.6 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
Cal Failed	SENSOR CALIBRATION FAILED	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

3.2.7 SENTINEL® SCREENS



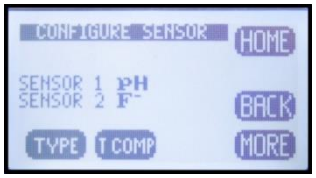
The SENTINEL feature allows the Model X80 transmitter to provide Pre-pHault diagnostic information about the accuracy of a pH, ORP or pION measurement. The SENTINEL displays a filled triangular gauge that decreases proportionally to the degradation of the reference electrode. A filled gauge indicates 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.

The Model X80 transmitter only displays the SENTINEL functions when a Model S88 SENTINEL sensor is connected. The Model S88 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.

Configure SENTINEL Function

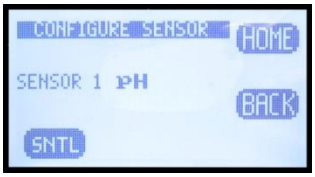
The SENTINEL function is located in the Configure Sensor menu:



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.



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.

3.3 START UP GUIDE

Install and wire the X80 Transmitter as described in Sections 2.1 and 2.2 above.

Connect the sensor to the transmitter as described in Section 2.2 above.

Supply power to the Model X80 transmitter.

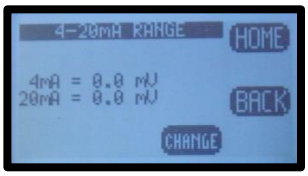
Verify the proper measurement type is displayed, pH, ORP or Ion. The sensor automatically uploads the measured parameter, the calibration data and the range of measurement to the transmitter. The default configuration of the 4-20 mA output is the range of the sensor, 0-14 pH for pH sensors, -1500 - +1500 for ORP or 0-XXXX ppm for a pION Sensor. To change the 4-20 mA range, follow the instructions in Section 3.3.1 below.

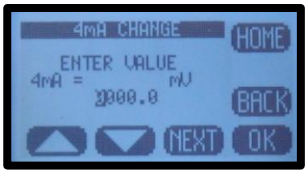
3.3.1 CONFIGURE 4-20 MA OUTPUT RANGE

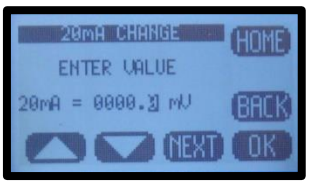
- Double press any key except the HOME key to enter the HOME Menu. Follow the path below to set the 4-20 mA range.
- HOME Menu → Press CONFIG → XMTR → OUTPUT → 4-20 (1)(2) → PV or TEMP
- Press CHANGE to enter New Values.
- Choose 4 mA value, press OK
- Enter value using ▲ or ▼and NEXT to move to the next digit, press OK→Back
- Choose 20 mA value, press OK,
- Enter value using ▲ or ▼and NEXT to move to the next digit, press OK→Back
- Press BACK to return to the CONFIGURE 4-20 mA screen or HOME to return to the HOME Menu screen.

3.3.2 CONFIGURE 4-20 MA FAULT CONDITION AND CAL

- In the CONFIGURE 4-20 mA screen, Press **MORE** → **FAULT** or
- Choose **Low Fault 3.5 mA** or **Hi Fault 22 mA** or **NONE**, (default setting **NONE**), Press OK
- 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. (PW=0000)

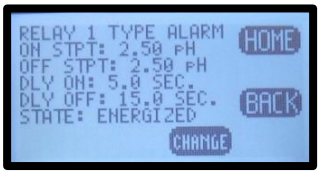






3.3.3 CONFIGURE ALARM RELAYS (RELAYS OPTIONAL)

- HOME Menu → Press CONFIG → XMTR → OUTPUT → RELAYS→RLY1
- Choose the **ALARM**, **TIMER**, **FAULT** or **DISABLE** mode for Relay 1
- **ALARM** Displays:
  - **SET POINT ON**: The Process Variable Value that activates the relay.
  - **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) NO relay closes on activation/**De-energize** (The energized relay is de-energized on activation) NO relay opens on activation

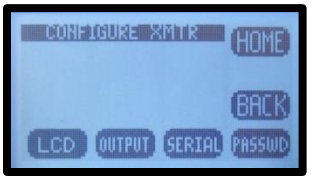


- **TIMER** activates the relay periodically for a specific duration, user configured period and duration
- **FAULT** sets the relay condition to a de-energize state and a NO relay opens and a NC relay closes in response to a Fault condition.
- **DISABLE** turns off the relay and removes it's icon from the HOME screen

Setting up an Alarm Relay

- Choose **ALARM**

- Press **CHANGE** to enter new values
- Choose ON Set Point, Press OK
- 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)
- Choose Expiration, Press OK,
- Choose time from drop down menu using ▲ or ▼, press OK, press BACK
- Choose Delay ON, Press OK
- Enter value using ▲ or ▼and NEXT to move to the next digit, press OK, press BACK
- Choose OFF Set Point, Press OK
- Enter value using ▲ or ▼and NEXT to move to the next digit, press OK, press BACK
- Choose Delay OFF, Press OK
- Enter value using ▲ or ▼and NEXT to move to the next digit, press OK, and press BACK when done to exit Relay 1.
- Repeat for Relay 2 and Relay 3.

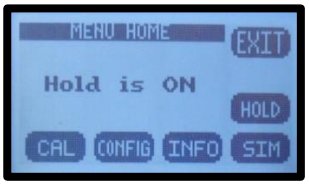


3.3.4 Exit Menus and Return to Main Display

- Press HOME Key to return to the Home Menu Screen
- Press Hold to turn OFF Hold
- Press EXIT Key to exit the menu
- "Save Changes?" press YES
- 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

3.3.5 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.



3.4 USER SELECTABLE OPTIONS

3.4.1 Screen Lighting

LED back lighting is available on DC powered instruments only and this feature is inactive on all 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

3.4.2 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 minutes	1 hour	12 hours	1 day	2 days
Sample Rate (1 point every)	10 seconds	40 seconds	8 minutes	15 minutes	30 minutes

- **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

3.4.3 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.

! " # $ % & ' ( ) * + , - . / 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.

Location: CONFIG → XMTR → LCD → LABELS → TAG

3.4.4 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

3.4.5 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.

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.

- **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.

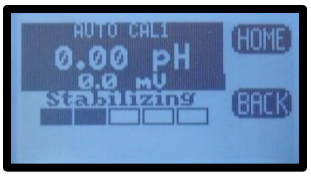
Location: CONFIG → XMTR → PSSWD

4.0 CALIBRATION

The Model X80 transmitter provides three methods of calibration:

4.0.1 AUTO CALIBRATION DESCRIPTION

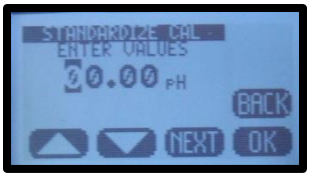
Auto calibration is the primary calibration method for all measurements. AUTO calibration automatically recognizes the calibration solution the sensor is in and proposes the actual temperature compensated value for acceptance. AUTO calibration can be a single point or two point calibration. A single 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.

4.0.2 STANDARDIZE CALIBRATION DESCRIPTION

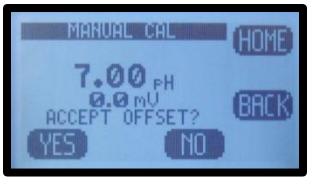


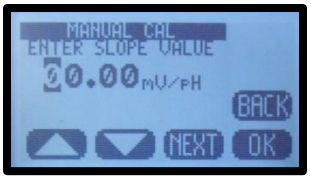
A Standardize Calibration is a single point calibration where the transmitter's reading is adjusted to agree with a solution of known value, either a calibration standard, a grab sample or laboratory determined value. In many cases the constituents and the pressure and temperature of the process solution 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.

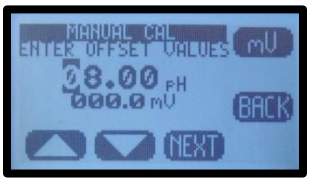
4.0.3 MANUAL CALIBRATION DESCRIPTION





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.

4.1 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.

4.1.1 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

4.1.2 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, xx.xx pH x.x mV, 7.00 pH corrected Accept Cal?
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

4.1.3 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)
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

4.2 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.

4.2.1 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 mV_a, 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 mV_a, 267 mV corrected Accept Cal?
Press **YES**	OFFSET: 90.0 mV_a, 87 mV, SLOPE: 1.02 mV/ mV_a (data written to Log)
Press **OK**	Calibration complete
Press **HOME**	Hold is ON
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

4.1.2 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 to turn off Hold)
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

4.3 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.

4.3.1 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
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

4.3.2 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

4.3.3 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

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 to turn off Hold)
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

4.4 S88 DISSOLVED OXYGEN CALIBRATION PROCEDURES

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 x K x 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 X80 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.

Table 1 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)**	9.08	**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		

Table 2 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
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		

4.5 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.

4.5.1 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

4.5.2 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 (Press HOLD to turn off Hold)
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

4.6 TDS CONDUCTIVITY SENSORS

The Total Dissolved Solids measurement (TDS) on the Model X80 transmitter is made with an S88 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 (see section 4.7.1 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.

4.6.1 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 (Press HOLD to turn off Hold)
Press **HOLD**	Turn off Hold
Press **EXIT**	Main Display

4.7 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 MΩ. The Cal 1, air calibration value is very stable and need not be done for every calibration.

4.7.1 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 MΩ, 1.20 V, 55.000 MΩ corrected, Accept Cal?
Press **YES**	CAL 1 Value 55.000 MΩ, Continue to CAL2? Move sensor to MΩ solution
Press **YES**	STABILIZING, 9.875 MΩ, 517 mV, 9.875 MΩ corrected, Accept Cal?
Press **NO**	Enter actual MΩ value of the solution, Accept Cal
Press Y**ES**	OFFSET: 55.000 MΩ, 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

4.7.2 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 MΩ (use arrows and NEXT to enter process value)
Press **OK**	Current Value xx.xx MΩ, Desired Value: xx.xx MΩ, Offset XX.XX OK?
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

5.0 MAINTENANCE

No periodic maintenance is required for the ECD Model X80 Transmitter.

Do not open the X80 Transmitter or B88 Barrier enclosure in a hazardous environment without ensuring that NO hazardous gases, vapor or dust is present. Remove power prior to opening cover and/or performing any service, repair or cleaning.

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.

5.1 CLEANING

The Model X80 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.

5.2 REPAIR/SERVICE

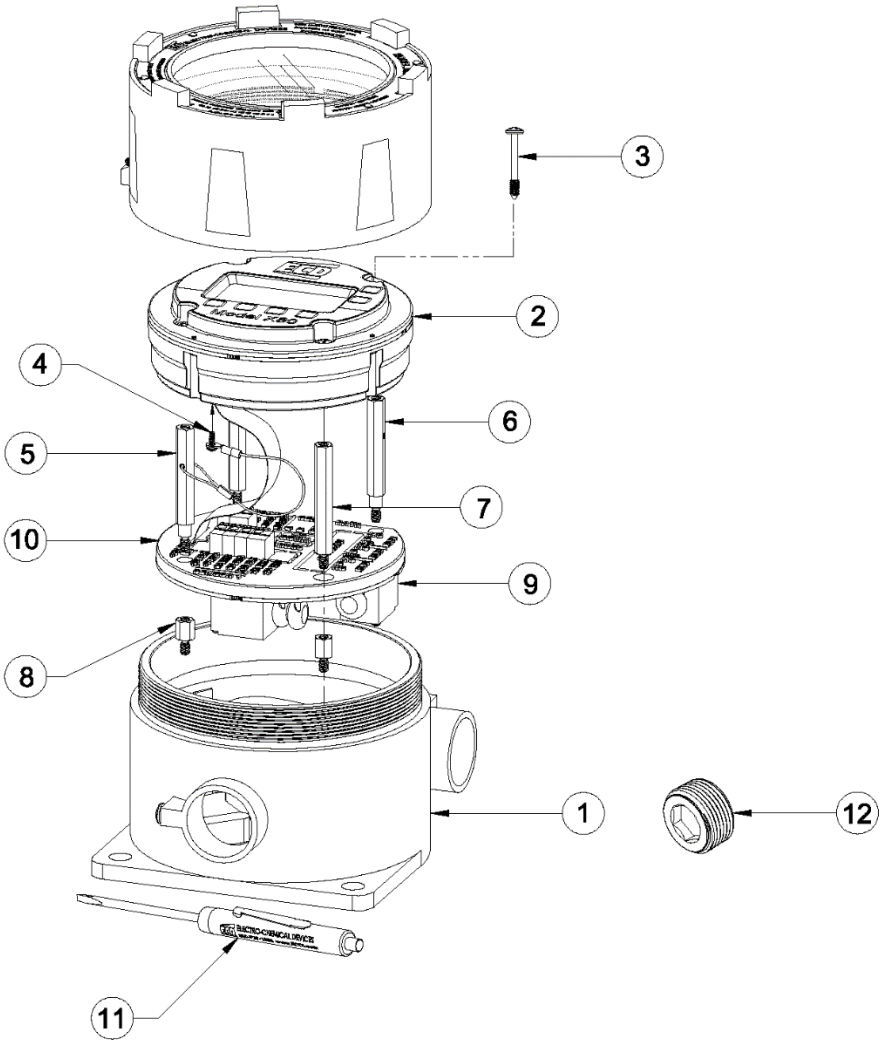
Repairs on X80 transmitter components may be accomplished only after declassifying the area and assuring that NO hazardous environment exists. Additionally, the power supplying the transmitter shall be de-energized. Replacement of components may only be accomplished by replacing the complete three (3) circuit board assembly with similar parts. No board-level components are serviceable and shall be returned to the manufacturer for repair.

6.0 TROUBLESHOOTING

Symptom	Probable cause	Remedy
Blank Display	No Power Sensor Failure, causing power draw down below transmitter threshold	Check power source, 24VDC loop, 24VDC Unplug sensor from transmitter, replace sensor if instrument powers up.
Incorrect Readings	Sensor needs calibration Incorrect Temperature measurement Temperature Compensation set up incorrectly	Perform a standardization calibration. See INFO for calibration log Calibrate/Trim Temperature to correct value 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

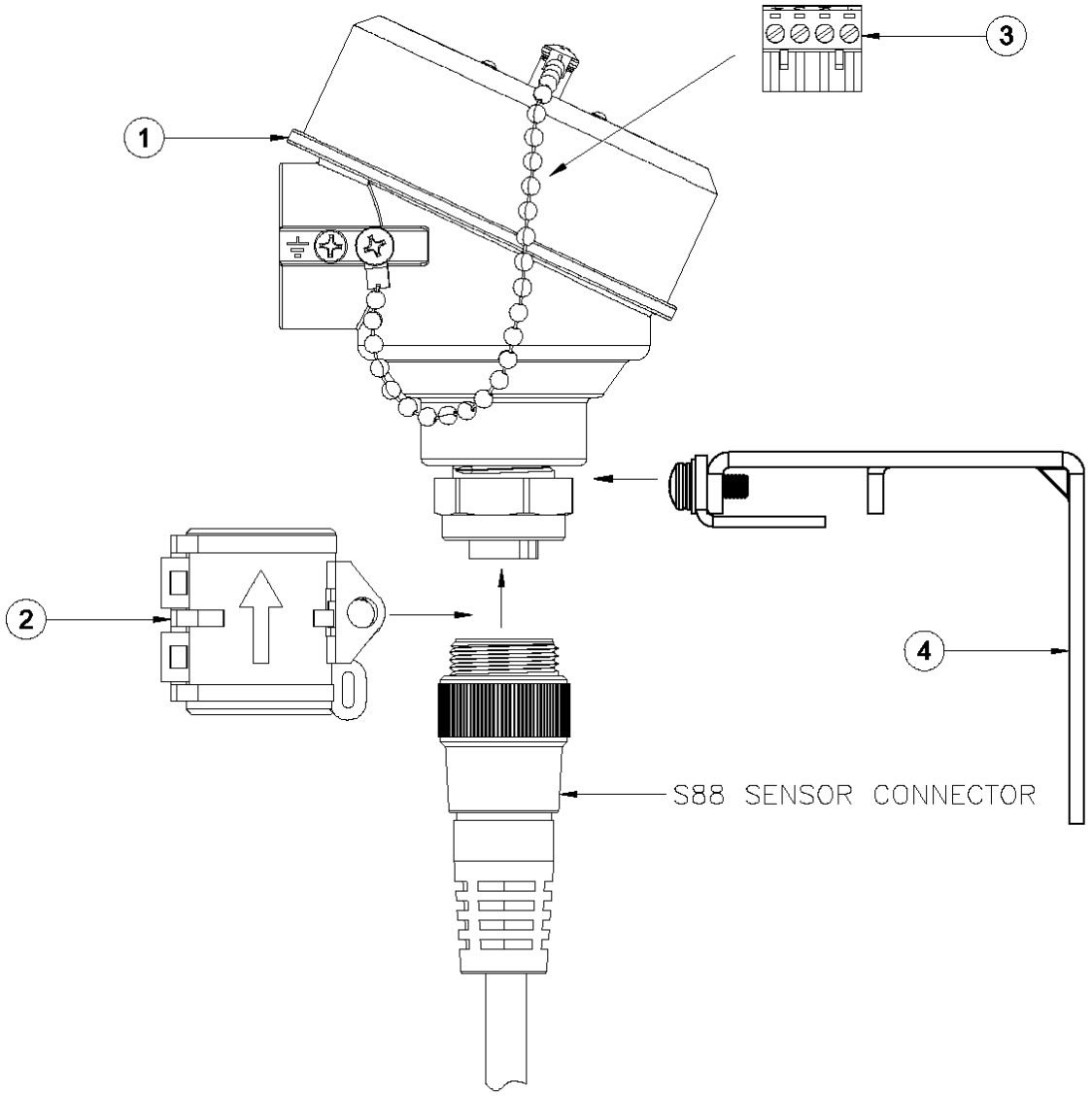
7.0 PARTS AND ACCESSORIES

7.1 X80 REPLACEMENT PARTS



Item #	Part #	Description
1	9250055	Housing, X/P Stainless Steel ¾" PORTS
2	2000150-x	Assembly, Module X80 Sensor & Display
3	3200005	Screw, Stainless Steel 6-32x1 Modified
4	9730204	Screw, Stainless Steel #2x ¼" Self-Tap
5	3000022	Lanyard, PCB Support X80
6	3600566	Standoff, ¼" HEX M/F 6-32x1.75" Stainless Steel Modified
7	9941626	Standoff, ¼" HEX M/F 6-32x1.75" Stainless Steel
8	9941605	Standoff, ¼" HEX M/F 6-32x 5/16" Stainless Steel
9	2100240-x	Assembly, PCB X80 Connector Board
10	3400015	Cover X80 Connector Board
11	9680044.1	Magnetic Screwdriver
12	9310062	Plug, Flameproof X/P ¾" NPT Stainless Steel

7.2 B88 REPLACEMENT PARTS



Item #	Part #	Description
1	1000088-1	B88 Barrier Assembly
2	9080067.1	Lock, Cable
3	9090114	Terminal Block, Plug, 4 Position
4	2000380	Bracket Assembly, B88

8.0 S88 SENSORS

S88 sensors are a family of digital sensors designed for use with the Model X80 transmitters. S88 sensors accept the standard ECD electrode cartridges. The S88 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 ECD 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 S88 pH sensor to a Model X80 Transmitter and the Transmitter configures itself into a calibrated pH transmitter.

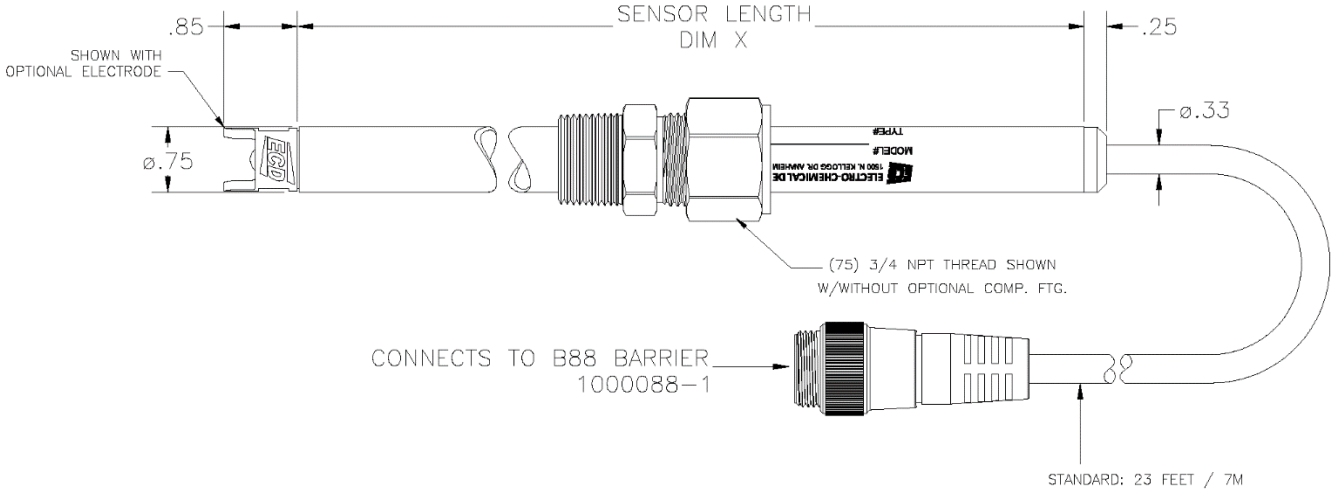
The internal components of the S88 sensors, the signal conditioner, temperature sensor and cable assembly are epoxy encapsulated inside the ¾" O.D. housing. Epoxy encapsulation of the components increases the reliability of the sensor by eliminating failures caused by wiring and connector breakage. The S88 sensors use the same easily replaceable electrode cartridges as the S10 and S17 sensor assemblies.

8.1 S88 INSTALLATION

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

8.1.1 INSERTION

The S88 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 S88 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.



8.1.2 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 S88 sensor at least 5" into the tube and tighten the sensor in place.

8.1.3 FLOW THROUGH

Although the insertion configuration can be used as a flow-through mounting by inserting the S88 sensor into a pipe tee, ECD 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.

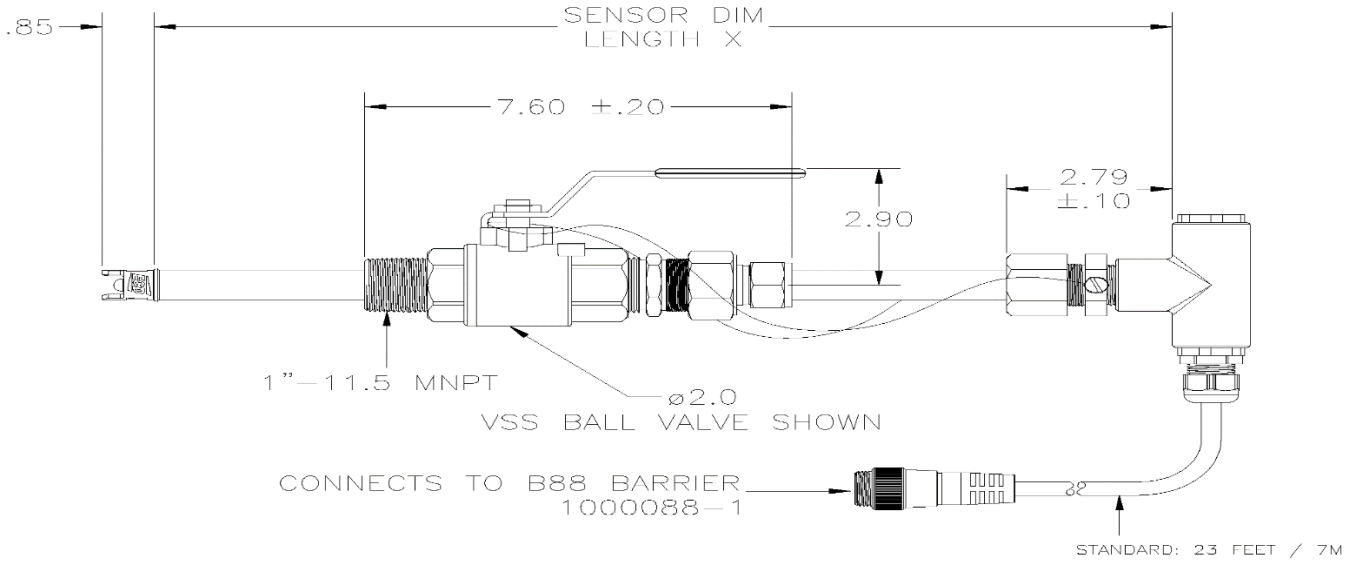
8.1.4 VALVE RETRACTABLE

The S88 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. ECD 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.



8.1.5 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.

8.2 S88 PART NUMBER CONFIGURATOR

S88 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.

S88 Digital Sensor					
Measurement Type					
-0 S88 Digital Sensor, pH, ORP, pION measurement					
-1 S88 Digital Sensor, Dissolved Oxygen measurement					
-2 S88 Digital Sensor, Contacting Conductivity, 1µS to 50 mS					
-5 S88 Diagnostic Sensor, pH, ORP, pION measurement SENTINEL S88 Sensor					
-6 S88 Digital sensor, ppb Dissolved Oxygen					
-7 S88 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.			
		-3 Monel, ¾" O.D.			
		-5 Polypropylene, 1"O.D.			
		-6 Kynar, 1"O.D.			
		-7 PVC, 1"O.D.			
		-8 Kynar, 1"O.D. No Metal Solution Ground			
		-9 Other Material, Consult with Factory			
			Housing Length		
			0 10" length		
			1 17" length		
			2 24" length		
			3 30" length		
			4 36" length		
			X Other length – Contact Factory		
				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	
				04 (75HC) ¾" MNPT, Hastelloy 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	
				09 (75V) ¾" MNPT, Fitting Set for 1" Ball Valve	
				10 (100N) 1" Nylon Fitting	
				11 (100P) 1" Poly Propylene Fitting	
				12 (100K) 1" Kynar Fitting	
				14 (100HT) 1" SS Fitting w/ Nylon Ferrule for ¾" Sensor	
				15 (100HTF) 1" SS Fitting w/ Teflon Ferrule for ¾" Sensor	
				16 (175) 1" SS Fitting for ¾" Sensor	
				17 (75KV) ¾" SS Fitting for Ball Valve	
				18 (75KV2) 1" x ¾" Fitting for Kynar Ball Valve	
				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 (VSF) 1" Valve w/ 2" Sanitary Flange	

					37 (VM) 1” NPT All Monel Valve Retraction Assembly				
					40 (VKY) 1” NPT All Kynar Valve Retraction Assembly				
					42 (VPP) 1” NPT All Poly Propylene 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 Flanges, Consult Factory				
						Approval			
						3 FM Approved Sensor Assy (w/ B88 Barrier and FM Connector)			
						4 FM Approved Sensor Only (Spare Sensor and FM Connector)			
						5 ATEX/IEC Approved (w/ ATEX Connector)			
							Cable Length		
							-2 20 ft. Standard		
							-3 30 ft.		
							-5 50 ft.		
							-X Other length – Contact Factory		
								“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)	
								3 (TS) “T” Style handle, ¾” stainless steel fitting (1000098)	
								4 (TN) “T” Style handle , 1” Nylon fitting (1000104)	
									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
S88	**-0**	**0**	**- 0**	**0**	**01**	**-0**			

8.3 S88 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.

8.3.1 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.

8.3.2Electrode 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 8.3.1 electrode cartridge installation.

8.3.3 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 3.10.

8.3.4 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. *ECD does not recommend the storage of electrodes in distilled or deionized water*.

8.3.5 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.

8.3.6 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.

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+, NH4+, NO3- 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.

POLISHING

Abrasive polishing is only recommended for the solid state crystal style Combination Electrodes. ECD 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.

Fluoride Electrodes

a. 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.
b. 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.
c. Polish the electrode for about 30 seconds and examine the tip for a shiny surface, repeat if necessary.
d. Rinse the electrode with distilled water and soak the electrode in a low ppm Calibration solution for a few minutes.
e. Perform a Two Point Calibration.

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

a. Place a few drops of distilled water on the blue polishing strip to wet the polishing surface.
b. Hold the electrode with the sensing surface facing up.
c. 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.
d. Polish the electrode for about 30 seconds and examine the tip for a shiny surface, repeat if necessary.
e. Rinse the electrode with distilled water and soak the electrode in a low ppm Calibration solution for a few minutes.
f. Perform a Two Point Calibration.

8.3.7 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.

8.3.8 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.

8.4 S88 Sensor Specifications

Dimensions:

S88 - 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, Hastelloy (H), C-22,

O-Ring Materials:

Viton™ (VIT), Standard, Ethylene Propylene (EPR), Optional, Fluoro-silicone (FSIL), Optional, Silicone (SIL), Optional, KALREZ™ (KLZ), Optional, CV75 (CV), Optional

Process Connections:

-75 ¾" 316 SS gland fitting with nylon ferrule

-75PP ¾" poly propylene gland fitting with ferrule

-75SF ¾" 316 SS gland fitting with stainless steel ferrule

-75TFE ¾" Teflon™ gland fitting with Teflon™ ferrule

-100 1" Teflon™ glands fitting for PVDF housing only

-VSS 1" 316 SS valve retraction assembly

-VKY 1" PVDF valve retraction assembly

Shipping Weight:

S88 2.5 lbs (1.2 kg)

S88 with VSS 5.8 lbs (2.65 kg)

8.4.1 pH electrodes

Part#	Description	pH Range	Temperature	Max. Pressure
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,	0-14 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
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

8.4.2 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

8.4.3 Dissolved Oxygen

Part#: 2005622
2 mil Teflon membrane
Galvanic cell: Silver/Lead
Construction: PEEK body,
Measurement Range: 0-20 ppm
Temperature Range: -10° - 85°C
Pressure Range: 30 psig

8.4.4 Ammonium Electrode

Part #: 2005083 (2005383 SENTINEL)
ISE sensor: PVC membrane
Construction: Radel (PES) body,
Reference Electrode: double porous Teflon junction
Measurement range: 0.05 - 18,000 ppm
pH Range: 2-10 pH
Temperature Range: 0°- 40°C
Pressure Range: 50 psig

8.4.5 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: 150 psig

8.4.6 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

8.4.7 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

8.4.8CUPRIC 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

8.4.9 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

8.4.10 FLUORIDE ELECTRODE

Part #: 2005163 (2005363 SENTINEL)
ISE sensor: solid state LaF crystal
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

8.4.11 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

8.4.12 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

8.4.13 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

8.4.14 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

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	

B. X80 HART MENU

X80 Root Menu					
1 DEVICE SETUP	DEVICE SETUP	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	PID 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		
		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		
			4 Fld dev rev		
		2 SENSOR	SENSOR INFO		
			1 Serial #		
			2 FW Rev		
			3 HW Rev		
		3 DEVICE	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		
2 PV					
3 Temperature					
4 Output %					
5 Sensor Name					

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.

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

Response

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

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

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.

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

Response

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

*N = Quantity of Registers

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

REGISTERS

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

Name	Meaning (2 bytes each register)	Number of Registers	Return Data Format	Read Write	Requires Storage Initiate	Register #	
						dec	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 X80 (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 X80 (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 X80 Model Number (Modbus)	The Model Number of the Unit polled	1	16 bit Integer	R		12	0C
X80 Serial Number (hi word)	Unit Serial Number (32 bit integer hi word, bytes 3 and 2)	2	32 bit Long Integer	R		13	0D
X80 Serial Number (lo word)	Unit Serial Number (32 bit integer lo word, bytes 1 and 0)					14	0E
X80 Mode	Unit operating mode (1-Startup, 2-Sensor Search, 3-Operate)	1	16 bit Integer	R		15	0F
X80 Fault Status	Unit Fault flags, bit defined	1	16 bit Integer	R		16	10
X80 2nd Fault Status	Unit Fault flags (2nd word reserved, currently not used)	1	16 bit Integer	R		17	11
X80 Warning Status	Unit Warning flags, bit defined	1	16 bit Integer	R		18	12
X80 2nd Warning Status	Unit Warning flags (2nd word reserved, currently not used)	1	16 bit Integer	R		19	13
X80 FW Rev	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	Y	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
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 to both 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 bytes4 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
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 X80 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
S88 Mode	Unit operating mode (0-	1	16 bit Integer	R		53	35

S88 Serial Number (hi word)	Unit Serial Number (32 bit integer hi word)	2	32 bit Long Integer	R		54	36
S88 Serial Number (lo word)	Unit Serial Number (32 bit integer lo word)					55	37
S88 Fault Status		1	16 bit Integer	R		56	38
S88 Sensor Type	Specific S88 sensor type (see S88 Sensor Types tab)	1	16 bit Integer	R		57	39
S88 Sensor Chemical Type	Specific chemicals the S88 is set to detect (see S88 Sensor Types tab)	1	16 bit Integer	RW	Y	58	3A
S88 Max Range (hi word)	Max sensor range (bytes 3 and 2)	2	32 bit Floating Point	R		59	3B
S88 Max Range (lo word)	Max sensor range (bytes 1 and 0)					60	3C
S88 Min Range (hi word)	Min sensor range (bytes 3 and 2)	2	32 bit Floating Point	R		61	3D
S88 Min Range (lo word)	Min sensor range (bytes 1 and 0)					62	3E
S88 Sensor Value (hi word)	Current sensor value (bytes 3 and 2)	2	32 bit Floating Point	R		63	3F
S88 Sensor Value (lo word)	Current sensor value (bytes 1 and 0)					64	40
S88 Sensor Voltage (hi word)	Corresponding sensor voltage to the sensor value (byte 3 and byte 2)	2	32 bit Floating Point	R		65	41
S88 Sensor Voltage (lo word)	Corresponding sensor voltage to the sensor value (byte 1 and byte 0)					66	42
S88 Sensor Temperature (hi word)	Sensor Temperature (bytes 3 and 2)	2	32 bit Floating Point	R		67	43
S88 Sensor Temperature (lo word)	Sensor Temperature (bytes 1 and 0)					68	44
S88 Sensor is a Sentinel	Sensor is a Sentinel Type (0 - No, 1 - Yes)	1	16 bit Integer	R		69	45
S88 Sentinel Life %	% of Sensor life remaining	1	16 bit Integer	R		70	46
S88 Sentinel Vs (hi word)	Scaled Sentinel Voltage (in mV) normalized to Vo (bytes 3 and 2)	2	32 bit Floating Point	R		71	47
S88 Sentinel Vs (lo word)	Scaled Sentinel Voltage (in mV) normalized to Vo (bytes 1 and 0)					72	48
S88 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
S88 Sentinel Vo (lo word)	Sentinel 100% value (in mV) on the life relative to 0V (bytes 1 and 0)					74	4A
S88 Sentinel Range (hi word)	Sentinel Range (bytes 3 and 2)	2	32 bit Floating Point	RW	Y	75	4B
S88 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
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	
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 S88 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	RW		91	5B
S88 Cal Log slope (hi word)	(bytes 3 and 2)	2	32 bit Floating Point	R		92	5C
S88 Cal Log slope (lo word)	(bytes 1 and 0)					93	5D
S88 Cal Log offset (hi word)	(bytes 3 and 2)	2	32 bit Floating Point	R		94	5E
S88 Cal Log offset (lo word)	(bytes 1 and 0)					95	5F
S88 Cal Log offset Voltage (hi word)	(bytes 3 and 2)	2	32 bit Floating Point	R		96	60
S88 Cal Log offset Voltage (lo word)	(bytes 1 and 0)					97	61

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

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
13	NU
14	NU
15	NU

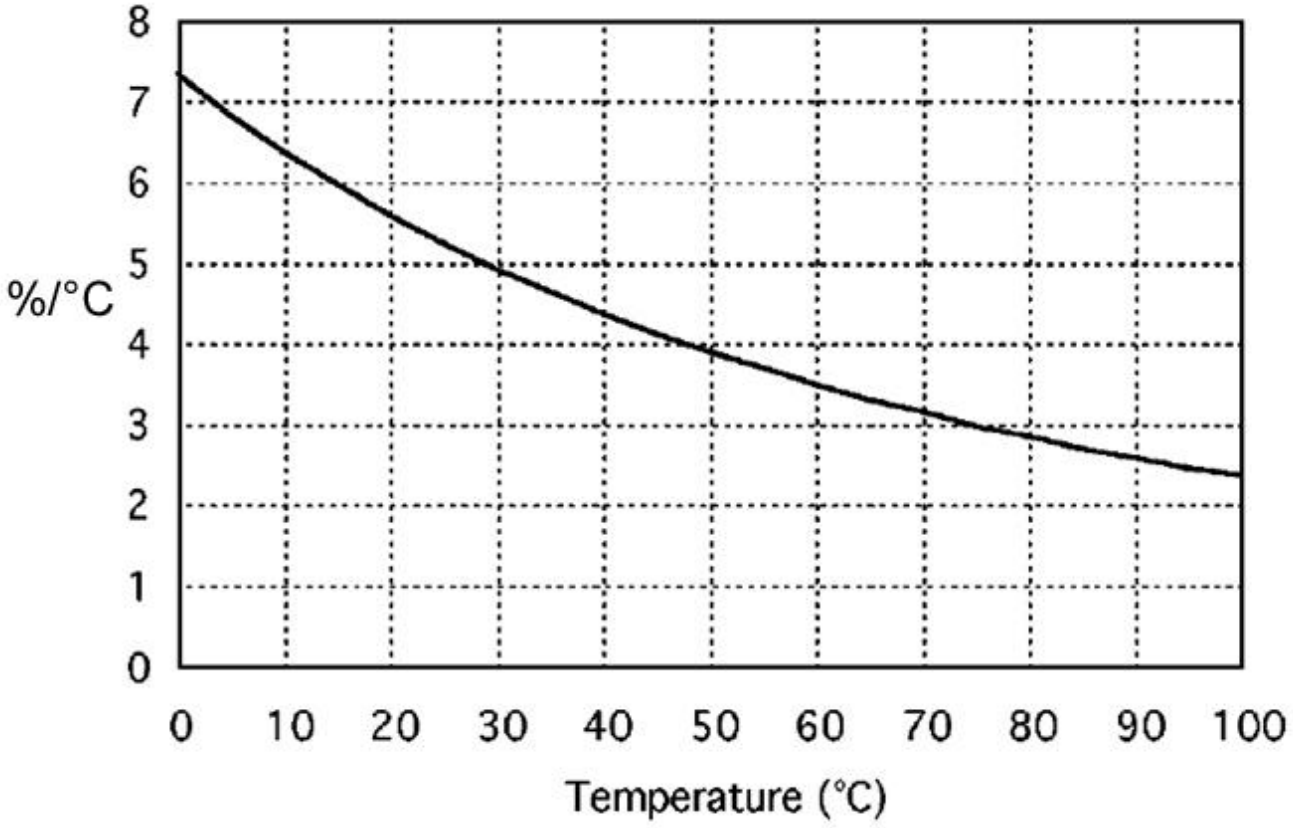
SENSOR TYPE

Data		Meaning		
Decimal	Hexadecimal	Chemical	Sensor Type	Measurement 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	Fluoride	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	TR6	FNU
23	0017	Turbidity	TR6	NTU
24	0018	Turbidity	TR6	ppm
25	0019	Turbidity	TR6	mg/L
26	001A	Turbidity	TR6	% solid
27	001B	DO	DO80	ppm
28	001C	DO	DO80	% saturation
29	001D	DO	DO80	mg/L
30	001E	Calcium	mV	mg/L
31	001F	TDS	Conductivity	ppm
32	0020	Nitrite	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

E. 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 X80. 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%



APPENDIX X HAZARDOUS LOCATION INFORMATION

REVISION HISTORY

REV	ECR	DESCRIPTION OF CHANGE	DATE	APPROVE
A	4524	INITIAL RELEASE OF HAZARDOUS LOCATION INFORMATION TO APPENDIX X	2/23/2021	GK

Note: Appendix X is a controlled drawing. No modifications permitted without notice to FM Approvals.

TABLE OF CONTENTS

EX.1.1 MODEL X80 TRANSMITTER

Class I, Division 1, Groups B,C,D,E,F and G, T4 -40^{o}C to +85^{o}C
Class I, Zone 1 IIB+H_2 , T4 -40^{o}C to +85^{o}C Type 4X; IP 66

Model X80 Transmitter is intended for installation in hazardous locations with Class I Division 1 or Class I Zone 1 classification. It is not intended to be installed in Zone 0 locations and must only be installed in ambient temperature conditions of -40^{o}C $\leq T_a \leq$ +85^{o}C. Power connections into the X80 transmitter must be made with flame-proof conduit and cable glands certified for hazardous locations and compatible with Ex certified equipment. Additionally, connections between the X80 Transmitter and the B88 Barrier must be made with approved conduit and cable glands certified for hazardous locations.

- Ensure installation complies with all local, state and national codes for the installation of equipment in hazardous locations.
- Refer to Control Drawing 1700003 for specific installation requirements.
- Do not install equipment approved for non-hazardous locations in a hazardous area.
- Do not install this equipment into a Zone 0 location.
- Substitution of components is NOT PERMITTED and may impact intrinsic safety.
- Do not open housing when a hazardous or explosive atmosphere exists.

- Ouvrir le circuit avant d'enlever le couvercle.
- La substitution de composants peut compromettre la sécurité intrinsèque

SPECIAL CONDITIONS OF USE

1. The flame paths of the equipment are not intended to be repaired. Consult manufacturer if repair of the flame path joint is necessary.
2. Part of the probe enclosure is constructed from plastic. To prevent the risk of electrostatic sparking the plastic surface should only be cleaned only with a damp cloth.

EX.1.2 MODEL B88 BARRIER

EXPLOSION-PROOF WITH ASSOCIATED INTRINSICALLY SAFE CONNECTIONS FOR
Class I, Division 1, Groups B,C and D T5 -40°C to +80°C
Class I, Zone 1 IIB+H_2 , T5 -40°C to +80°C

B88 Barrier is intended for installation in hazardous locations with Zone 1 classification and functions to limit energy available to the S88 Sensor. The barrier is installed using approved conduit, fittings and cable glands suitable for the area classification. The B88 barrier may not be modified, altered or substituted with any other components which may impair the safety of the system. The B88 Barrier may only be used with an S88 Sensor and may not be used with any other device.

- Ensure the installation complies with all local, state and national codes for the installation of equipment in hazardous locations.
- Refer to Control Drawing 1700003 for specific install requirements.
- Do not install equipment approved for non-hazardous locations in a hazardous area.
- Do not install this equipment into a Zone 0 location.
- Substitution of components is NOT PERMITTED and may impact intrinsic safety.
- Ensure a minimum 5 full threads of engagement.
- Connect and verify green wire to X80 grounding lug.
- Do not open housing when a hazardous or explosive atmosphere exists.

- Ouvrir le circuit avant d'enlever le couvercle.
- La substitution de composants peut compromettre la sécurité intrinsèque

EX.1.3 MODEL S88 SENSOR

INTRINSICALLY SAFE / SÉCURITÉ INTRINSÈQUE FOR
Class I, Division 1, Groups B,C and D T5 -40°C to +80°C
Class I, Zone 0 IIB+H_2 , T5 -40°C to +80°C

Model S88 Sensor is intrinsically safe and intended for installation in hazardous locations with Zone 0 classification. The S88 Sensor may only be used with an accompanying B88 Barrier to limit the energy available to intrinsically safe levels. The maximum stored energy in the S88 Sensor is below the level needed to generate spark ignition of the environment. Ambient temperature conditions must within -40°C $\leq T_a \leq$ +80°C to maintain product approval.

- Ensure the installation complies with all local, state and national codes for the installation of equipment in hazardous locations.
- Refer to Control Drawing 1700003 for specific install requirements.
- Do not install equipment approved for non-hazardous locations in a hazardous area.
- Only connect the S88 Sensor to an associated B88 Barrier.
- Substitution of components is NOT PERMITTED and may impact intrinsic safety.

- La substitution de composants peut compromettre la sécurité intrinsèque

EX.1.4 STOPPING PLUG 9310062

Class I, Division 1, Groups A,B,C and D
Class II, Division I Groups E,F and G
NEMA 4X

Stopping plug P/N 9310062 is intended for installation in hazardous locations with Zone 1 classification. The plug is factory installed into the X80 flame-proof housing to maintain the flame-proof integrity for un-used wiring ports in single channel configuration. Do not remove or modify the plug or flame-path of the plug. Verify plug is tightened to a torque of 55Nm (41ft-lbs).

- Ensure the installation complies with all local, state and national codes.
- Refer to Control Drawing 1700003 for specific install requirements.
- DO NOT substitute or alter this component as it may impact flame-proof integrity.

- La substitution de composants peut compromettre la sécurité intrinsèque

EX.1.5 WARNINGS & APPROVALS

1.5.1 ENCLOSURE

Class I, Div 1, Groups B, C and D;
Class II, Div 1, Groups E, F and G;
Class III, NEMA 4X, IP66;

Ex d II C Gb
Ex tb Db IIIC IP68
Ta = -40℃ to +85℃

II 2 G D
Ex d IIC Gb
Ex tb Db IIIC IP68
Ta = -40℃ to +85℃

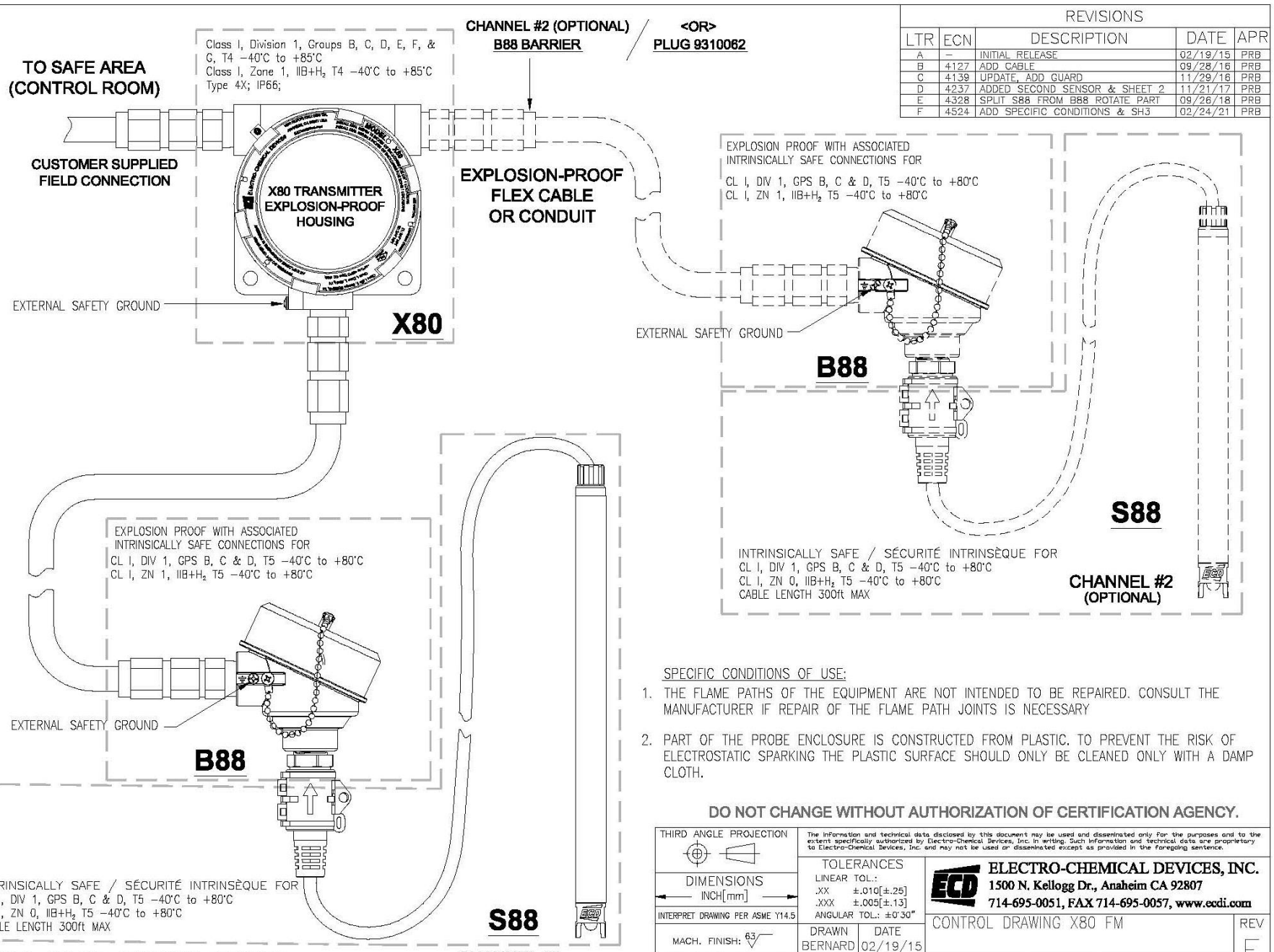
Class I, Div 1, Groups B, C and D;
Class II, Div 1, Groups E, F and G;
Class III, Div 1;
Type 4X Ex d IIB+H2;

	Warning: RISK OF ELECTRICAL SHOCK
	Disconnect Power before opening instrument. Ouvrir le circuit avant d'enlever le couvercle.
	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.

EX.1.6 CONTROL DRAWING

Consult the following Control Drawing for guidance in completing installation into hazardous locations.

REVISIONS				
LTR	ECN	DESCRIPTION	DATE	APR
A	–	INITIAL RELEASE	02/19/15	PRB
B	4127	ADD CABLE	09/28/16	PRB
C	4139	UPDATE, ADD GUARD	11/29/16	PRB
D	4237	ADDED SECOND SENSOR & SHEET 2	11/21/17	PRB
E	4328	SPLIT S88 FROM B88 ROTATE PART	09/26/18	PRB
F	4524	ADD SPECIFIC CONDITIONS & SH3	02/24/21	PRB



SPECIFIC CONDITIONS OF USE:

1. THE FLAME PATHS OF THE EQUIPMENT ARE NOT INTENDED TO BE REPAIRED. CONSULT THE MANUFACTURER IF REPAIR OF THE FLAME PATH JOINTS IS NECESSARY
2. PART OF THE PROBE ENCLOSURE IS CONSTRUCTED FROM PLASTIC. TO PREVENT THE RISK OF ELECTROSTATIC SPARKING THE PLASTIC SURFACE SHOULD ONLY BE CLEANED ONLY WITH A DAMP CLOTH.

DO NOT CHANGE WITHOUT AUTHORIZATION OF CERTIFICATION AGENCY.

THIRD ANGLE PROJECTION

DIMENSIONS INCH[mm]

INTERPRET DRAWING PER ASME Y14.5

MACH. FINISH: 63

PARTS TO BE DELIVERED CLEAN AND DEBURRED. BREAK SHARP EDGES.

TOLERANCES
LINEAR TOL.:
.XX ±.010[±.25]
.XXX ±.005[±.13]
ANGULAR TOL.: ±0°30"

DRAWN BERNARD | DATE 02/19/15

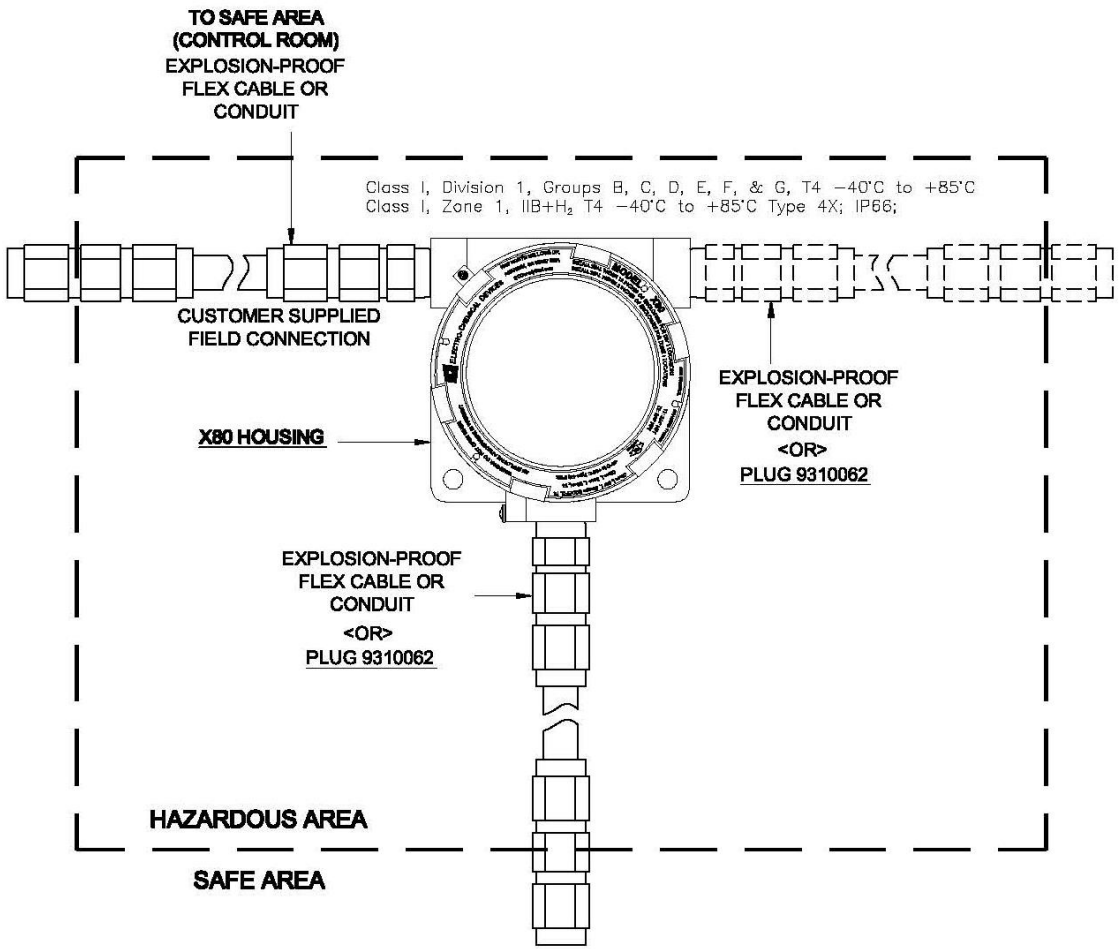
SCALE: 1/2

ELECTRO-CHEMICAL DEVICES, INC.
1500 N. Kellogg Dr., Anaheim CA 92807
714-695-0051, FAX 714-695-0057, www.ecdi.com

CONTROL DRAWING X80 FM

REV F

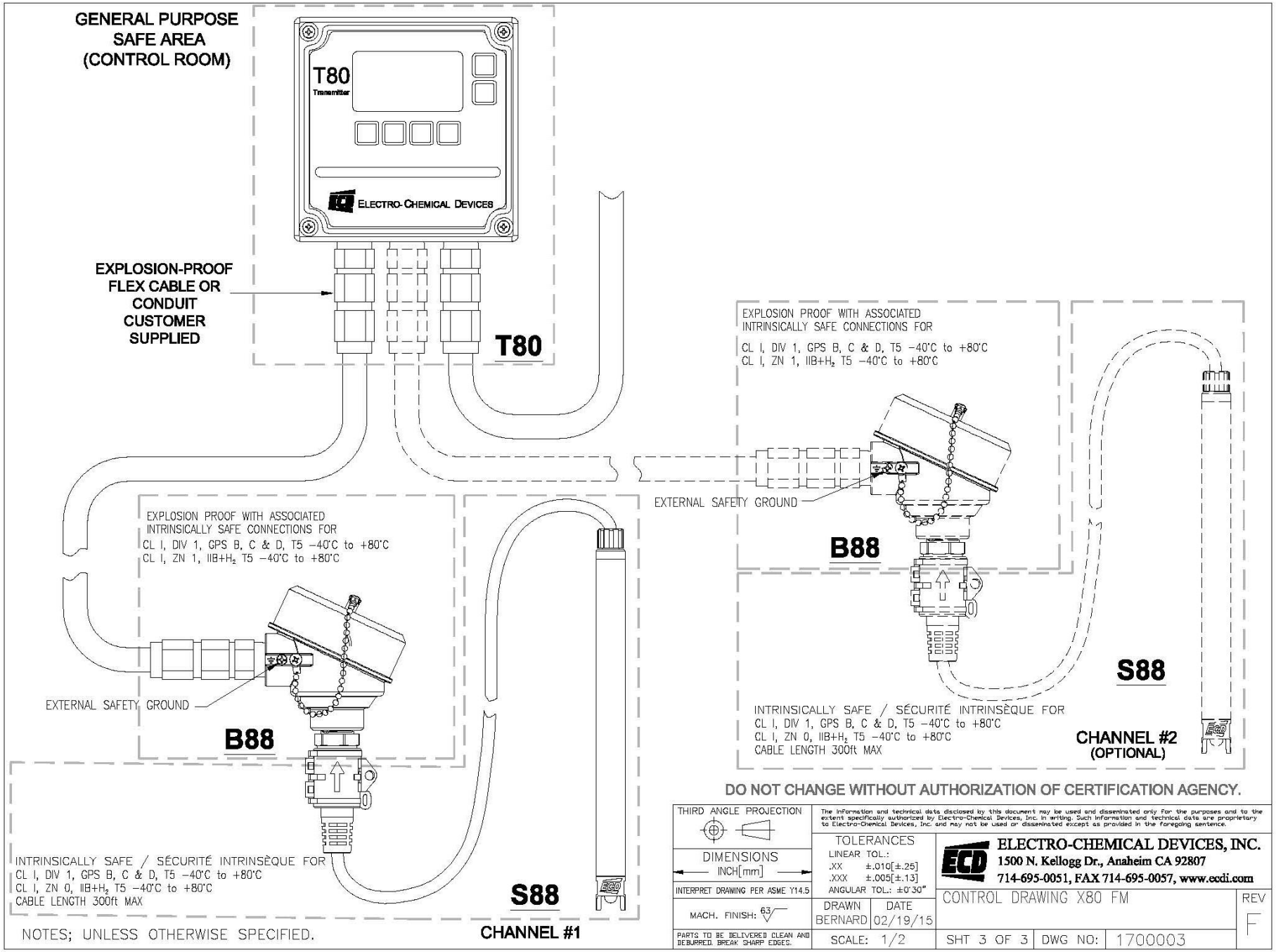
SHT 1 OF 3 | DWG NO: 1700003



DO NOT CHANGE WITHOUT AUTHORIZATION OF CERTIFICATION AGENCY.

THIRD ANGLE PROJECTION			
DIMENSIONS INCH[mm]	TOLERANCES LINEAR TOL.: .XX ±.010[±.25] .XXX ±.005[±.13] ANGULAR TOL.: ±0°30"	ELECTRO-CHEMICAL DEVICES, INC. 1500 N. Kellogg Dr., Anaheim CA 92807 714-695-0051, FAX 714-695-0057, www.ecdi.com	
INTERPRET DRAWING PER ASME Y14.5		CONTROL DRAWING X80 FM	REV
MACH. FINISH: 63	DRAWN BERNARD / DATE 02/19/15		F
PARTS TO BE DELIVERED CLEAN AND DEBURRED. BREAK SHARP EDGES.	SCALE: 1/2	SHT 2 OF 3 / DWG NO: 1700003	

NOTES; UNLESS OTHERWISE SPECIFIED.


GENERAL PURPOSE
SAFE AREA
(CONTROL ROOM)
T80
Transmitter
ELECTRO-CHEMICAL DEVICES
EXPLOSION-PROOF
FLEX CABLE OR
CONDUIT
CUSTOMER
SUPPLIED
T80
EXPLOSION PROOF WITH ASSOCIATED
INTRINSICALLY SAFE CONNECTIONS FOR
CL I, DIV 1, GPS B, C & D, T5 −40°C to +80°C
CL I, ZN 1, IIB+H2 T5 −40°C to +80°C
EXTERNAL SAFETY GROUND
B88
S88
INTRINSICALLY SAFE / SÉCURITÉ INTRINSÈQUE FOR
CL I, DIV 1, GPS B, C & D, T5 −40°C to +80°C
CL I, ZN 0, IIB+H2 T5 −40°C to +80°C
CABLE LENGTH 300ft MAX
CHANNEL #2
(OPTIONAL)
EXPLOSION PROOF WITH ASSOCIATED
INTRINSICALLY SAFE CONNECTIONS FOR
CL I, DIV 1, GPS B, C & D, T5 −40°C to +80°C
CL I, ZN 1, IIB+H2 T5 −40°C to +80°C
EXTERNAL SAFETY GROUND
B88
INTRINSICALLY SAFE / SÉCURITÉ INTRINSÈQUE FOR
CL I, DIV 1, GPS B, C & D, T5 −40°C to +80°C
CL I, ZN 0, IIB+H2 T5 −40°C to +80°C
CABLE LENGTH 300ft MAX
S88
CHANNEL #1
NOTES; UNLESS OTHERWISE SPECIFIED.
DO NOT CHANGE WITHOUT AUTHORIZATION OF CERTIFICATION AGENCY.
THIRD ANGLE PROJECTION
DIMENSIONS
INCH[mm]
INTERPRET DRAWING PER ASME Y14.5
MACH. FINISH: 63
PARTS TO BE DELIVERED CLEAN AND DEBURRED. BREAK SHARP EDGES.
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TOLERANCES
LINEAR TOL.:
.XX ±.010[±.25]
.XXX ±.005[±.13]
ANGULAR TOL.: ±0°30"
DRAWN BERNARD
DATE 02/19/15
SCALE: 1/2
ELECTRO-CHEMICAL DEVICES, INC.
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714-695-0051, FAX 714-695-0057, www.ecdi.com
CONTROL DRAWING X80 FM
REV F
SHT 3 OF 3
DWG NO: 1700003