### **Foxboro<sup>®</sup> S Series Pressure Transmitters**

**IDP10S Differential Pressure Transmitter with HART Communication** Installation, Operation, Calibration, Configuration, and Maintenance



by Schneider Electric

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## **Contents**

Figures	7
Tables	9
Important Information	
Please Note	
1. Introduction	
General Description	
Reference Documents	14
Transmitter Identification	15
Standard Specifications	
Product Safety Specifications	
ATEX and IECEx Considerations	
ATEX Compliance Documents	24
IECEx Compliance Documents	
2. Installation	25
Transmitter Mounting	25
Process Mounting	
Manifold Mounted Transmitter	
Transmitter Mounted on a Coplanar <sup>TM</sup> Manifold	
Pipe or Surface Mounting	
Standard Mounting Bracket	
Universal Mounting Bracket	
Venting and Draining	
Traditional Structure	
LP1 Low Profile Structure	
LP2 Low Profile Structure	
Installation of Flow Measurement Piping	
Filling System with Seal Liquid	
Positioning the Housing	
Positioning the Display	
Setting the Write Protect Jumper	
Cover Locks	
Wiring	

Accessing Transmitter Field Terminals	40
Wiring the Transmitter to a Control Loop	41
Multidrop Communication	44
Connecting the Transmitter to a Foxboro Distributed Control System	45
Putting a Differential Pressure Transmitter into Operation	45
Taking a Differential Pressure Transmitter out of Operation	46
3. Operation Via Local Display	
Entering Numerical Values	48
Reranging	49
Viewing the Database	50
Testing the Display	53
Messages	54
4. Configuration	
Configuration Using a PC50	
Configuration Using a HART Communicator	
Configuration Using the Optional Local Display	
Character Lists	
Messages	66
5. Calibration	69
Overview of FoxCal™ Multiple Calibration Technology	69
Calibration Certificate	69
Custom Factory Calibration	69
One-Point Calibration at LRV	
Two-Point Field Calibration	70
Enabling and Disabling FoxCal	70
General Calibration Notes	71
Calibration Setup	
Setup of Electronic Equipment	74
Field Calibration Setup	74
Bench Calibration Setup	76
Calibration Using a PC50	76
Calibration Using a HART Communicator	76
Calibration Using the Optional Local Display	76
Zero Adjustment Using External Zero Button	80
Messages	81

6. Using the HART Communicator	
Connecting the Communicator to the Transmitter	
Operation	
Online Configuration	83
Calibration	
PV Rerange	88
Edit LRV and URV	88
Apply Pressure (Linear Mode Only)	
PV Offset	88
PV Flow URV	
SV Rerange	89
Pressure Calibration	
Zero Trim	89
Scaled D/A Trim	90
Time in Service Meter	90
Viewing the Total Days	90
Resetting User Days	90
Enabling and Disabling the FoxCal Calibration Feature	91
7. Maintenance	93
Parts Replacement	
Replacing the Terminal Block Assembly	
Replacing the Sensor Assembly	94
Adding the Optional Display	
Rotating Process Covers for Venting	

# *Figures*

1	Transmitter Identification	.15
2	Minimum Allowable Absolute Pressure vs. Process Temperature with Fluorinert Fill Fluid.	.18
3	Typical Mounting of an IDP10S Transmitter Supported by Process Piping	.26
4	Typical Mounting of an IDP10S Transmitter Supported by a Bypass Manifold	.27
5	Typical Mounting of IDP10S Transmitter on Coplanar Manifold	.27
6	Pipe or Surface Mounted Transmitter Using a Standard Bracket	.28
7	Examples of Mounting With a Standard Bracket	.29
8	Details of a Universal Bracket	.29
9	Mounting a Transmitter with Traditional Structure Using a Universal Bracket	.30
10	Vertical Pipe Mounting a Transmitter with LP2 Structure Using a Universal Bracket	.30
11	Horizontal Mounting a Transmitter with LP2 Structure Using a Universal Bracket	.31
12	Vertical Mounting - Cavity Draining	.32
13	Vertical Mounting - Cavity Venting	.32
14	Horizontal Mounting - Cavity Venting	.32
15	Vertical Mounting - Cavity Venting	.33
16	Horizontal Mounting - Cavity Venting and Draining	.33
17	Cavity Venting and Draining	.33
18	Example of Horizontal Process Line Installation	.35
19	Example of Vertical Process Line Installation	.35
20	Housing Clip Location	.37
21	Write Protect Jumper	.38
22	Cover Lock Location	.39
23	Accessing Field Terminals	.40
24	Identification of Field Terminals	.40
25	Supply Voltage and Loop Load	.41
26	Loop Wiring Transmitters	.43
27	Wiring Several Transmitters to a Common Power Supply	.43
28	Typical Multidrop Network	.44
29	Local Display	.47
30	Top Level Menu Diagram	.48
31	Rerange Menu Diagram	.50
32	VIEW DB Menu Diagram	.51
33	Display Test Segment Patterns	.54
34	Configuration Menu Structure	.56
35	Configuration Menu Structure (Continued)	.57
36	Configuration Menu Structure (Continued)	.58
37	Configuration Menu Structure (Continued)	.59
38	4 to 20 mA Output Calibration Setup of Electronic Equipment	.74
39	Field and Bench Calibration Setup	.75
40	Calibration Menu Structure	.77
41	Calibration Menu Structure (Continued)	.78
42	Online Configuration Flowchart(1)	.84
43	Replacing the Sensor Assembly	.97

44	Bottomworks with Process Connector Code 7 (PVDF Inserts)	.97
45	Replacing the Optional Display	.98
46	Sensor Cavity Venting and Draining	.99

## **Tables**

1	Reference Documents	14
2	Minimum Loop Load and Supply Voltage Requirements	20
3	Electrical Safety Specifications	23
4	Transmitter Database Items	52
1	Transmitter Messages	54
5	Configuration Menu	60
6	Character Lists	65
7	Configuration Messages	66
8	Calibration Menu	
9	Calibration Messages	
10	Online Parameters	85

## Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a "Danger" or "Warning" safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

#### A DANGER

DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.

### **A** WARNING

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.

### **A** CAUTION

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

### NOTICE

NOTICE is used to address practices not related to physical injury.

### Please Note

Electrical equipment should be installed, operated, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

## 1. Introduction

### General Description

The IDP10S Intelligent Differential Pressure transmitters measure the difference between two pressures applied to opposite sides of a piezoresistive silicon microsensor within the sensor assembly. This microsensor converts differential pressure to a change in resistance. The resistance change is then converted to a 4 to 20 mA or digital signal proportional to differential pressure or to the square root of differential pressure. This measurement signal is transmitted to remote receivers over the same two wires that supply power to the transmitter electronics. These wires also carry two-way data signals between the transmitter and remote communication devices.

The transmitter allows direct analog connection to common receivers while still providing full Intelligent Transmitter Digital Communications using a HART communicator.

The transmitter is often used for measuring fluid flow rates across a primary device such as an orifice plate, but can also be used for other types of differential pressure measurements such as liquid level, interface level, or density measurements. The IDP10S can also be supplied with direct connected or remote pressure seals to isolate the measuring element from corrosive or viscous fluids.

### **Reference Documents**

### Table 1. Reference Documents

Document	Description		
Dimensional Prints			
DP 020-342	PSFLT Pressure Seals		
DP 020-343	PSFPS and PSFES Pressure Seals		
DP 020-345	PSFAR Pressure Seals		
DP 020-346	PSFAD Pressure Seals		
DP 020-347	PSTAR Pressure Seals		
DP 020-348	PSTAD Pressure Seals		
DP 020-349	PSISR Pressure Seals		
DP 020-350	PSISD Pressure Seals		
DP 020-351	PSSCR Pressure Seals		
DP 020-353	PSSCT Pressure Seals		
DP 020-354	PSSSR Pressure Seals		
DP 020-355	PSSST Pressure Seals		
DP 020-357	PSFFD Pressure Seals		
DP 022-335	Model CO Compact Orifice		
DP 020-464	IDP10S Differential Pressure Transmitters		
Parts Lists			
PL 006-172	Model CO Compact Orifice		
PL 009-026	IDP10S Differential Pressure Transmitters		
Instructions			
MI 020-328	Bubble Type Installation for Liquid Level		
MI 020-329	High Accuracy Flow Measurement		
MI 020-369	Pressure Seals		
MI 020-501	PC50 Intelligent Field Device Tool (Installation and Parts List)		
MI 020-520	PC50 Intelligent Field Device Tool with Advanced DTM Library		
MI 020-541	Pressure S Series Transmitters FM/CSA Safety Information		
MI 020-542	Pressure S Series Transmitters ATEX/IECEx Safety Information		
MI 022-138	Bypass Manifolds - Installation and Maintenance		
MI 022-335	Model CO Compact Orifice		
Technical Informa	tion		
TI 1-50a	Liquid Density Measurement		
TI 001-051	Liquid Interface Measurement		
TI 001-052	Liquid Level Measurement		
TI 37-75b	Transmitter Material Selection Guide		
TI 037-097	Process Sealing of Pressure Transmitters for use in Class I, Zone 0, 1, and 2 Hazardous Locations		

### Transmitter Identification

See Figure 1 for transmitter data plate contents. For a complete explanation of the Model Code, see the parts list. The firmware version is identified on the top line of the display when VIEW DB (View Database) is selected from the top level menu (see Figure 30).



During normal transmitter operation, the display shows either the primary measurement (M1) or secondary measurement (M2), depending on how the transmitter is configured. The 2-button keypad and the display on the front of the transmitter allow you to perform calibration and configuration functions as well as view the transmitter's configuration database, test the display, and rerange the transmitter. For information on using the local display, refer to "Operation Via Local Display".

### Standard Specifications

### **Operative Limits**

Influence	Operative Limits (a) (b)	
Sensor Body Temperature (c) Silicone Fill Fluid Fluorinert Fill Fluid PVDF Inserts	-46 and +121°C (-50 and +250°F) -29 and +121°C (-20 and +250°F) -7 and +82°C (20 and 180°F)	
Electronics Temperature With LCD Display	-40 and +85°C (-40 and +185°F) (d) -40 and +85°C (-40 and +185°F) (e)	
Relative Humidity	0 and 100% (f)	
Supply Voltage	11.5 and 42 Vdc	
Output Load (g)	0 and 1450 ohms	
Mounting Position	No Limit	
Vibration	<ul> <li>With aluminum housing:</li> <li>Per IEC 60770 for "field with high vibration level or pipeline with high vibration level": 0.42 mm peak to peak displacement from 10 to 60 Hz, 3 "g" constant acceleration input over a frequency range of 60 to 1000 Hz.</li> <li>With stainless steel housing:</li> <li>Per IEC 60770 for "field with general application or pipeline with low vibration level": 0.3 mm peak to peak displacement from 10 to 60 Hz, 2 "g" constant acceleration input over a frequency range of 60 to 1000 Hz.</li> </ul>	

a. Normal Operating Conditions and Operative Limits are defined per ANSI/ISA 51.1-1979 (R1993).

b. Selection of Option -J extends the low temperature operative limit of transmitters with silicone filled sensors down to -50°C (-58°F). Performance is not assured below -29°C. Sensor damage may occur if process is frozen. Contact Global Customer Support for availability of this option.

c. Refer to MI 020-369 for temperature limits with pressure seals.

d. -40 and +75°C (-40 and +167°F) for transmitters with ATEX flameproof classification.

e. Display updates are slowed and readability decreased at temperatures less than -20°C (-4°F).

f. The relative humidity refers to transmitters with the housing covers installed. To maintain IEC IP66/IP67 and NEMA Type 4X protection, plug the unused conduit opening with the metal plug provided. Use a suitable thread sealant on both conduit connections. In addition, the threaded housing covers must be installed. Turn covers to seat the o-ring into the housing and then continue to hand tighten until the cover contacts the housing metal-to-metal.

g. 250  $\Omega$  minimum load is required for communication with a HART communicator.

Span Limit Code	Span Limits $\Delta P$	Range Limits $\Delta P$ (a)	
В	0.12 and 50 kPa 0.02 and 7.21 psi	-50 and +50 kPa -7.21 and +7.21 psi	
С	0.625 and 250 kPa 0.09 and 36.06 psi	-250 and +250 kPa -36.06 and +36.06 psi	
D	0.025 and 2.1 MPa 3.75 and 300 psi	-0.21 and +2.1 MPa -30 and +300 psi	
E	0.26 and 21 MPa 37.5 and 3000 psi	0 and 21 MPa 0 and 3000 psi	

#### **Span and Range Limits**

a. Negative values of differential pressure indicate a higher pressure on the low side of the sensor. Positive values indicate a higher pressure on the high side of the sensor.

### Maximum Static, Overrange, and Proof Pressure

Transmitter Configuration	Maximum Static Pressure R	and Overrange ating (b) (c)	Proof Pressure Rating (d)	
(Bolting Material) (a)	MPa	psi	MPa	psi
Standard (B7 steel) or Options -B2 (17-4 PH ss), -D3, -D7, -P3, or -P7	25	3626	100	14500
Option -B1 (316 ss), -D5, -P2, -P6	15	2175	60	8700
Option -B3 (B7M), -P4, -P8	20	2900	700	11150
Option -D1	16	2320	64	9280
Option -D2, -D4, -D6, or -D8 (e)	10	1500	40	6000
Option -D9 (17-4 PH ss) or -Y	40	5800	100	14500
Structure Codes 78 and 79 (PVDF insert)	2.1	300	8.4	1200

a. Bolting options include the following:
-D1 = DIN Single ended process cover with M10 B7 bolting
-D2 = DIN Double ended process cover with M10 B7 bolting
-D3 = DIN Single ended process cover with 7/16 in B7 bolting
-D4 = DIN Double ended process cover with 7/16 in B7 bolting

-D5 = DIN Double ended process cover with 7/16 in 3/16 ss bolting -D5 = DIN Double ended process cover with 7/16 in 316 ss bolting -D7 = DIN Double ended process cover with 7/16 in 17-4 ss bolting -D8 = DIN Double ended process cover with 7/16 in 17-4 ss bolting -D9 = DIN Single ended process cover with 7/16 in 17-4 ss bolting

b. Either side can be at higher pressure during overrange.

When Structure Codes 78/79 are used (PVDF inserts in the Hi and Lo side process covers), the maximum overrange is 2.1 MPa (300 psi) and temperature limits are -7 and +82°C (20 and 180°F). c.

d. Meets ANSI/ISA Standard S82.03-1988.

e. Limited to operating temperatures ranging from 0 to 60°C (32 to 140°F).

### A DANGER

### HAZARD OF EXPLOSION

Exceeding the proof pressure can cause the sensor to rupture forcefully. Avoid exposing the transmitter to the proof pressure limit.

Failure to follow these instructions will result in death or serious injury.

### NOTICE

### POTENTIAL EQUIPMENT DAMAGE

Exceeding the overrange pressure limit for the transmitter can cause damage to the transmitter, degrading its performance.

The transmitter could become nonfunctional after exceeding the overrange pressure.

Avoid exposure to the overrange pressure limit.

Failure to follow these instructions can result in equipment damage.

### - NOTE

Static pressure zero shift for all calibrated spans can be eliminated by readjusting the zero output at nominal operating static pressure.

### Elevated Zero and Suppressed Zero

For applications requiring an elevated or suppressed zero, the maximum span and the upper and lower range limits of the transmitter cannot be exceeded.

### **Sensor Fill Fluid**

Silicone Oil (dodecamethylpentasiloxane 5cSt) or Fluorinert (FC-43).

### Minimum Allowable Absolute Pressure vs. Process Temperature

With Silicone Fill Fluid:	At full vacuum: Up to 121°C (250°F)
With Fluorinert Fill Fluid:	Refer to Figure 2.

Figure 2. Minimum Allowable Absolute Pressure vs. Process Temperature with Fluorinert Fill Fluid



### **Mounting Position**

The transmitter can be mounted in any orientation. It can be supported by the process piping. It can also be mounted directly to a vertical or horizontal pipe or surface-mounted using an optional mounting bracket. The housing can be rotated up to one full turn to any desired position for access to adjustments, display, or conduit connections. See "Positioning the Housing" on page 37. The display (if present) can also be rotated in the housing to any of four different positions at 90° increments. See "Positioning the Display" on page 37.

#### - NOTE

- 1. Mount the transmitter so that any moisture condensing or draining into the field wiring compartment can exit through one of the two threaded conduit connections.
- 2. Use a suitable thread sealant on all connections.
- 3. Position effect zero shift for all calibrated spans can be eliminated by readjusting zero output after installation.

### **Approximate Mass**

Without Process Connectors:	3.5 kg (7.8 lb)
With Process Connectors:	4.2 kg (9.2 lb)
With Optional 316 ss Housing:	Add 1.1 kg (2.4 lb)
With Low Profile Structure LP1:	Add 0.1 kg (0.2 lb)
With Low Profile Structure LP2:	Add 0.8 kg (1.8 lb)
With Optional LCD Local Display:	Add 0.2 kg (0.4 lb)
With Pressure Seals:	Varies with seal used

### **Process Connections**

IDP10S transmitters are connected to the process via a 1/4 NPT thread or any one of a number of optional process connectors.

### **Process Wetted Materials**

Diaphragm: 316L ss, Co-Ni-Cr, nickel alloy<sup>(1)</sup>, Monel, gold plated 316L ss, or tantalum Covers and Process Connections: 316 ss, carbon steel, nickel alloy<sup>(1)</sup>, Monel, or PVDF inserts Pressure Seals: Refer to MI 020-369

### **Process Pressure and Temperature Limits for Pressure Seals**

Refer to MI 020-369.

### **Electrical Connections**

Field wires enter through 1/2 NPT or M20 threaded entrances on either side of the electronics housing. Leads terminate under screw terminals and washers on the terminal block in the field terminal compartment.

### A WARNING

### EXPLOSION HAZARD

To help prevent possible explosions and to maintain RFI/EMI, environmental, flameproof, explosionproof, and dust-ignitionproof protection, observe applicable wiring practices. Plug unused conduit opening with provided metal pipe plug. Both plug and conduit must engage a minimum of five full threads for 1/2 NPT connections; seven full threads for M20 connections.

Failure to follow these instructions can result in death or serious injury.

### Field Wiring Reversal

Accidental reversal of field wiring does not damage the transmitter, provided the current is limited to 1 A or less by active current limiting or loop resistance. Sustained currents of 1 A do not damage the electronics module or sensor, but can damage the terminal block assembly and external instruments in the loop.

### Adjustable Damping

Damping is user-selectable to values of 0, 0.25, 0.5, 1, 2, 4, 8, 16, or 32 seconds.

<sup>1.</sup> Equivalent to Hastelloy® C-276. Hastelloy is a registered trademark of Haynes International, Inc.

- NOTE Selecting a value of DAMP 0 in the damping menu provides the fastest response.

#### **Output Signal**

4 to 20 mA dc linear or 4 to 20 mA dc square root; software selectable. The output is remotely configurable from the HART communicator and locally configurable with the pushbuttons on the display. HART 6 and 7 allow the mA signal to be fixed or live when multidrop is enabled.

Only 4 to 20 mA linear output on flange level transmitters.

### Zero and Span Adjustments

Zero and span are adjustable from the HART communicator. They are also adjustable at the transmitter using the pushbuttons on the optional local display. An optional external self-contained moisture sealed pushbutton assembly allows you to locally reset to zero without removing the housing cover.

### **Supply Voltage**

The power supply must be capable of providing 22 mA when the transmitter is configured for 4 to 20 mA output. Ripple of up to 2 V pp (50/60/100/120 Hz) is tolerable, but instantaneous voltage must remain within specified range.

The supply voltage and loop load must be within specified limits. This is explained in detail in "Wiring" on page 39. A summary of the minimum requirements is listed in Table 2.

	HART Communication	No HART Communication
Minimum Resistance	250 Ω	0
Minimum Supply Voltage	17 V	11.5 V

Table 2. Minimum Loop Load and Supply Voltage Requirements

### **Electrical Ground Connections**

The transmitter is equipped with an internal ground connection within the field wiring compartment and an external ground connection at the base of the electronics housing. To minimize galvanic corrosion, place the wire lead or contact between the captive washer and loose washer on the external ground screw. If shielded cable is used, ground the shield at the field enclosure **only**. Do **not** ground the shield at the transmitter.

#### **HART Communicator Connection Points**

The HART communicator can be connected in the loop as shown in "Wiring" on page 39. It can also be connected directly to the transmitter at the two upper banana plug receptacles.

#### **Test Points**

The two lower banana plug receptacles (designated CAL) can be used to check transmitter output when configured for 4 to 20 mA. Measurements should be 100-500 mVdc for 0-100% transmitter output.

### **Remote Communications**

The transmitter communicates bidirectionally over the 2-wire field wiring to a HART communicator. The information that can be continuously displayed is:

- Process Measurement (expressed in one or two types of units)
- Transmitter Temperature (sensor and electronics)
- mA Output (equivalent)
- Total number of days the transmitter has been powered up (not configurable)
- Number of days the transmitter has been powered up since the last Time in Service meter reset.

The information that can be remotely displayed and reconfigured includes:

- Output in Pressure Units. Output in Percent Flow (square root) or Pressure Units (linear). Percent Output on local display is also supported.
- Zero and Span, including reranging
- Zero Elevation or Suppression
- Linear Output or Square Root Output
- Pressure or Flow Units (from list provided)
- Temperature Sensor Failure Strategy
- User Damping (Process Noise Damping)
- Poll Address
- Loop Current Mode (Enable or Disable)
- External Zero (Enable or Disable)
- Failsafe Direction (Fail High or Fail Low)
- Tag, Long Tag, Description, and Message
- Date of Last Calibration
- Number of days the transmitter has been powered up since the last Time in Service meter reset.

#### **Communications Format**

Communication is based upon the FSK (Frequency Shift Keying) technique. The frequencies are superimposed on the transmitter power/signal leads.

T

### 4 to 20 mA Output

The transmitter sends its pressure measurement to the loop as a continuous 4 to 20 mA dc signal. It also communicates digitally with the HART communicator at distances up to 3000 m (10,000 ft). Communication between the remote configurator and the transmitter does not disturb the 4 to 20 mA output signal. Other specifications are:

Data Transmission Rate:	1200 Baud
4 to 20 mA Update Rate:	30 times/second
Output when Fail Low:	≤ 3.60 mA
Output when Fail High:	≥ 21.00 mA
Output when Underrange	3.8 mA
Output when Overrange	20.5 mA
Output when Offline:	User configurable to a constant value between 3.6 mA and 21.0 mA

### **Product Safety Specifications**

### A WARNING

### **EXPLOSION HAZARD**

To help prevent possible explosions and to maintain flameproof, explosionproof, and dustignitionproof protection, observe applicable wiring practices. Plug unused conduit opening with the provided metal pipe plug. Both plug and conduit must engage a minimum of five full threads for 1/2 NPT connections; seven full threads for M20 connections.

Failure to follow these instructions can result in death or serious injury.

### A WARNING

### **RISK OF MOISTURE INGRESS**

To maintain IEC IP66/IP67 and NEMA Type 4X protection, the unused conduit opening must be plugged with the metal plug provided. Use a suitable thread sealant on both conduit connections. In addition, the threaded housing covers must be installed. Turn covers to seat the o-ring into the housing and then continue to hand tighten until the cover contacts the housing metal-to-metal.

Failure to follow these instructions can result in death or serious injury.

These transmitters have been designed to meet the electrical safety description listed in Table 3. For detailed information or status of testing laboratory approvals/certifications, contact Global Customer Service.

See the Model Code for availability of Electrical Safety Design Codes with particular transmitter structures.

Wiring restrictions required to maintain electrical certification of the transmitter are provided in these instructions. See "Wiring" on page 39.

Agency Certification, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX intrinsically safe, Ex ia IIC	Temperature Class T4, Ta = -40°C to +80°C	AA
ATEX flameproof, Ex d IIC	Temperature Class T6, T85°C, Ta = -40°C to +75°C	AD
ATEX multiple certifications (includes ATEX Codes AA and AN)	Applies to Codes AA and AN	AM (a)
ATEX protection type n, Ex ic IIC	Temperature Class T4, Ta = -40°C to +80°C	AN
ATEX multiple certifications (includes ATEX Codes AA, AD and AN)	Applies to Codes AA, AN and AD	AP (a)
INMETRO intrinsically safe, Ex ia IIC	Temperature Class T4, Ta = $-40^{\circ}$ C to $+80^{\circ}$ C	BA
INMETRO flameproof, Ex d IIC	Temperature Class T6, T85°C, Ta = $-40^{\circ}$ C to $+75^{\circ}$ C	BD
INMETRO multiple certifications (includes INMETRO codes BA and BD)	Applies to BA and BD	BP (a)
CSA intrinsically safe, Divisions Class I Division I, and Zone certified Ex ia	Temperature Class T4A at 40°C and T3C at 85°C maximum ambient	CA
CSA Divisions and zone certified flameproof Ex d IIC; also explosion proof, dust ignition-proof	T6, Maximum Ambient Temperature 75°C	CD
CSA multiple certifications (includes CSA codes CA and CN)	Applies to codes CA and CN	CM (a)
CSA Class I, Division 2 non-incendive, Zone certified Ex nA IIC	Temperature Class T4A at 40°C and T3C at 85°C maximum ambient	CN
CSA multiple certifications (includes CSA codes CA, CD, and CN)	Applies to codes CA, CD, and CN	CP (a)
IECEx intrinsically safe, Ex ia IIC	Temperature Class T4, Ta = -40°C to +80°C	EA
IECEx flameproof, Ex d IIC	Temperature Class T6, Ta = $-40^{\circ}$ C to $+75^{\circ}$ C	ED
IECEx multiple certifications, ia, ic, nA	Applies to Codes EA and EN	EM (a)
IECEx protection type n, Ex ic IIC	Temperature Class T4, Ta = -40°C to +80°C	EN
IECEx multiple certifications, ia, ic, and d	Applies to Codes EA, EN and ED	EP (a)
FM Classes I, II and III Division 1 intrinsically safe, Zones AEx ia IIC	Temperature Class T4, Ta = -40°C to +80°C	FA
FM Classes I, II and III Division 1 explosion proof, dust-ignition proof, Zone approved AEx d IIC	Temperature Class T6 at 75°C and T5 at 85°C maximum ambient	FD
FM multiple certifications (includes FM codes FA or FN)	Applies to codes FA or FN	FM (a)
Classes I, II and III FM Division 2 non-incendive, Zone approved AEx nA IIC	Temperature Class T4, Ta = -40°C to +80°C	FN
FM multiple certifications (includes FM codes FA, FD, or FN)	Applies to codes FA, FD, or FN	FP (a)
EAC intrinsically safe, Ex ia (Russia)	Temperature Class T4, Ta = -40°C to +80°C	RA
EAC flameproof, Ex d (Russia)	Temperature Class T4, Ta = -40°C to +75°C	RD
EAC protection type n, Ex ic IIC or Ex nA (Russia)	Temperature Class T4, Ta = -40°C to +80°C	RN
Multi-marked for ATEX, CSA, and FM Intrinsically Safe Application	Applies to Codes FA, CA and AA	MA (b)
No certification		ZZ

Table 3. Electrical Safety Specification.	5
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a. When selecting Safety Design Code AM, AP, BP, CM, CP, EM, EP, FM, or FP, you must permanently mark (check off in the rectangular block on the data plate) one type of protection only (ia, d, n, IS, NL, or XP). Do not change this mark once it has been applied.

b. When selecting Safety Design Code MA, the user must permanently mark (check off in rectangular block on data plate) intrinsically safe certifications for ATEX, CSA, or FM, as applicable. Do not change this mark once it has been applied.

### ATEX and IECEx Considerations

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### RISK OF ATEX/IECEX NONCOMPLIANCE

Do not open while circuits are energized.

Failure to follow these instructions can result in death or serious injury.

### **ATEX Compliance Documents**

EN 60079-0:2012 EN 60079-1:2007 EN 60079-11:2012 EN 60079-26:2007 EN 60079-31:2009 EN 60079-15: 2010

### **IECEx Compliance Documents**

IEC 60079-0 (Edition 6): 2011 IEC 60079-1 (Edition 6): 2007 IEC 60079-11 (Edition 6): 2011 IEC 60079-15 (Edition 4): 2010 IEC 60079-31 (Edition 1): 2008 IEC 60079-26 (Edition 2): 2006

## 2. Installation

### NOTICE

### POTENTIAL EQUIPMENT DAMAGE

To avoid damage to the transmitter sensor, do not use any impact devices, such as an impact wrench or stamping device, on the transmitter.

Failure to follow these instructions can result in equipment damage.

#### - NOTE

- 1. Mount the transmitter so that any moisture condensing or draining into the field wiring compartment can exit through one of the two threaded conduit connections.
- 2. Use a suitable thread sealant on all connections.

### Transmitter Mounting

The IDP10S differential pressure transmitter can be supported by the process piping or mounted to a vertical or horizontal pipe or surface using the optional mounting bracket. See Figure 3.

For dimensional information, refer to DP 020-464.

Take these mounting considerations into account:

- If the transmitter is not installed in the vertical position, readjust the zero output to eliminate the position zero effect.
- When structure codes 78/79 (PVDF inserts) are used with the IDP10S transmitter, make the process connection directly to the PVDF inserts in the high and low side process covers.
- Do not directly mount the IDP10S transmitter to the process using the 1/4 NPT internal thread. Use this thread only to connect to the process when the transmitter is mounted with an optional mounting set (Options -M1 through -M8).
- ♦ Do not mount the IDP10S transmitter using the conduit connection and optional mounting set (-M1 through -M6) when vibration conditions exceed 20 m/s<sup>2</sup> (2 "g").
- Where necessary, intrinsically safe equipment may be connected and disconnected while the circuits are energized.
- When used in a dust zone with flammable dusts, fibers, and flyings in groups IIIA, IIB, or IIC, the layer auto-ignition temperature must be at least 75°C greater than the maximum surface temperature marked in the dust coding.
- The equipment is only certified for use in ambient temperatures marked on the equipment and should not be used outside this range.
- Do not exceed the maximum process pressure indicated on the marking.

• There are no special checking or maintenance conditions. Periodically inspect all explosion-protected equipment in accordance with the applicable code of practice.

### A DANGER

### HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

The main electronics enclosure for some models is manufactured from an aluminum alloy. In rare cases, ignition sources due to impact and friction sparks could occur. This must be considered during installation, particularly if the equipment is installed in a Zone 0 location.

Failure to follow these instructions will result in death or serious injury.

### A WARNING

### RISK OF ELECTROSTATIC CHARGE AND DUST INGRESS

When installed in flammable dust zones, under certain extreme circumstances an incendive electrostatic charge may build up on the painted surfaces, which are non-conducting. Therefore, take precautions to prevent the build-up of electrostatic charge; for example, place the equipment in a location where a charge-generating mechanism (such as wind-blown dust) is unlikely to be present, and clean with a damp cloth.

When installed in a flammable dust zone, ensure that the cable entry maintains the dust-tightness (IP6X) of the enclosure.

Failure to follow these instructions can result in death or serious injury.

### **Process Mounting**

With process mounting, the transmitter can be mounted to and supported by the process piping.

### Figure 3. Typical Mounting of an IDP10S Transmitter Supported by Process Piping



NOTE: MARK INDICATING LOW AND HIGH PRESSURE SIDE OF TRANSMITTER

### Manifold Mounted Transmitter

With manifold mounting, the transmitter is mounted to and supported by a bypass manifold. The bypass manifold can be mounted to a DN50 or 2 inch pipe with an optional mounting bracket. See MI 022-138.

Figure 4. Typical Mounting of an IDP10S Transmitter Supported by a Bypass Manifold



### Transmitter Mounted on a Coplanar™ Manifold

Figure 5. Typical Mounting of IDP10S Transmitter on Coplanar Manifold



### Pipe or Surface Mounting

To mount the transmitter to a pipe or surface, use the Standard Mounting Bracket Set (Model Code Option -M1 or M2) or Universal Bracket Mounting Set (Model Code Option -M3).

### Standard Mounting Bracket

The transmitter (with either traditional or LP2 low-profile structures) can be mounted to a vertical or horizontal, DN 50 or 2-in pipe using a standard bracket. See Figures 6 and 7 for details of a standard bracket and examples of different mounting situations. Secure the mounting bracket to the transmitter using the four screws provided. Mount the bracket to the pipe. To mount to a horizontal pipe, turn the U-bolt 90° from the position shown. The mounting bracket can also be used for wall mounting by securing the bracket to a wall using the U-bolt mounting holes.





### Figure 7. Examples of Mounting With a Standard Bracket



LP2 STRUCTURE

TRADITIONAL STRUCTURE

LP2 STRUCTURE



TRADITIONAL STRUCTURE

### Universal Mounting Bracket

The transmitter (with either traditional or LP2 low-profile structure) can be mounted in a myriad of positions to a vertical or horizontal, DN 50 or 2-in pipe using a universal bracket. See the following figures for details of a universal bracket and examples of different mounting situations. Secure the mounting bracket to the transmitter using the two long or four short screws provided. Mount the bracket to the pipe. The mounting bracket can also be used for wall mounting by securing the bracket to a wall using the U-bolt mounting holes.

#### **U-BOLT ASSEMBLY** FOR DN 50 OR 2 in PIPE (((( HOLES FOR **U-BOLT AND** SURFACE BOLTS TO MOUNT MOUNTING TRANSMITTER ON FOUR TO BRACKET SIDES OF THIS BRACKET LEG, Ø BOLTS TO MOUNT TRANSMITTER TO BRACKET 0 HOLES TO MOUNT TRANSMITTER 0 0 TO BRACKET OR FOR SURFACE MOUNTING ON FOUR SIDES OF THIS BRACKET LEG

### Figure 8. Details of a Universal Bracket



### Figure 9. Mounting a Transmitter with Traditional Structure Using a Universal Bracket

Figure 10. Vertical Pipe Mounting a Transmitter with LP2 Structure Using a Universal Bracket





### Figure 11. Horizontal Mounting a Transmitter with LP2 Structure Using a Universal Bracket

### Venting and Draining

### Traditional Structure

Sensor cavity venting and draining is provided for both vertical and horizontal mounting. For vertical mounted units, draining is via a drain screw and venting is possible with side vents (Option Code -V). For horizontal mounted units, the unit is self draining and venting is via a vent screw.





Figure 13. Vertical Mounting - Cavity Venting



Figure 14. Horizontal Mounting - Cavity Venting



### LP1 Low Profile Structure

Sensor cavity venting and draining is provided for both vertical and horizontal mounting. For vertical mounted units, the transmitter is self draining and venting is via a vent screw. For horizontal mounted units, the transmitter can simply be 'turned over' (rotated 180 degrees) to orient the high and low pressure sides in the preferred locations. There is no need to unbolt the process covers. If the transmitter is connected with a length of impulse piping, such piping should slope up to the transmitter for gas applications and down for liquid applications.





Figure 16. Horizontal Mounting - Cavity Venting and Draining



### LP2 Low Profile Structure

The transmitter with LP2 low profile structure has a full-featured vent and drain design with separate vent and drain screws positioned in each cover for complete venting and draining from the sensor cavity.





### Installation of Flow Measurement Piping

Figures 18 and 19 show typical installations with horizontal and vertical process pipes.

The transmitters are shown below the level of the pressure connections at the pipe (usual arrangement, except for gas flow without a seal liquid), and with filling tees in the lines to the transmitter (for a seal liquid).

If the process fluid being measured must not come in contact with the transmitter, the transmitter lines must be filled with a suitable seal liquid (see procedure in next section). In such a case, mount the transmitter below the level of the pressure connections at the pipe. With steam flow, the lines are filled with water to protect the transmitter from the hot steam. The seal liquid (or water) is added to the lines through the filling tees. To prevent unequal heads on the transmitter, the tees must be at the same elevation, and the transmitter must be mounted vertically as shown. If a seal liquid is not required, elbows can be used in place of the tees.

Tighten drain plugs and optional vent screws to 20 N·m (15 lb·ft). Tighten the four process connector bolts to a torque of 61 N·m (45 lb·ft).

The low and high pressure sides of the transmitter are identified by an L-H marking on the side of the sensor above the label.

With medium viscosity seal liquids and/or long transmitter lines, use larger valve sizes.

### — NOTE -

- 1. With a **horizontal** line, pressure connections at the pipe should be at the side of the line. However, with gas flow without a seal liquid, connections should be at top of line.
- 2. With a **vertical** line, flow should be upwards.
- 3. For **liquid** or **steam** flow, the transmitter should be mounted **lower** than the pressure connections at the pipe.
- 4. For **gas** flow **without** a seal liquid, the transmitter should be mounted **above** the pressure connections at the pipe; for **gas** flow **with** a seal liquid, the transmitter should be mounted **below** the pressure connections.
- 5. It is recommended that you use snubbers in installations prone to high levels of fluid pulsations.



Figure 18. Example of Horizontal Process Line Installation





### Filling System with Seal Liquid

If the process fluid being measured must not come in contact with the transmitter, the transmitter lines must be filled with a suitable seal liquid. The procedure to do this is as follows:

- 1. If the transmitter is in service, follow the procedure for "Taking a Differential Pressure Transmitter out of Operation" on page 46.
- 2. Close both process shutoff valves.
- 3. Open all three valves on the 3-valve manifold.
- 4. Partially open the vent screws on the transmitter until all air has been forced out of the transmitter body and lines. Close the vent screws.
- 5. Refill the tee connections. Replace the plugs and close the bypass valve. Check for leaks.
- 6. Follow the procedure for "Putting a Differential Pressure Transmitter into Operation" on page 45.

#### NOTICE

## POTENTIAL EQUIPMENT DAMAGE AND PROCESS FLUID CONTAMINATION

To help prevent loss of seal liquid and contamination of process fluid, never open both process shutoff valves and manifold shutoff valves if the bypass valve is open.

Failure to follow these instructions can result in equipment damage and process fluid contamination.
### Positioning the Housing

The transmitter housing (topworks) can be rotated up to one full turn in the counterclockwise direction when viewed from above for optimum access to adjustments, display, or conduit connections. Housings have a retention clip that prevents the housing from being rotated beyond a safe depth of housing/sensor thread engagement.

#### NOTICE

#### POTENTIAL EQUIPMENT DAMAGE

If you remove the electronics housing for maintenance, hand-tighten it to the bottom of the threads, but do not over-tighten it upon reassembly. See "Replacing the Sensor Assembly" on page 94.

Failure to follow these instructions can result in equipment damage.



Figure 20. Housing Clip Location

### Positioning the Display

The optional display can be rotated within the housing to any of four positions at 90° increments. To do this, grasp the two tabs on the display and rotate it about 10° in a counterclockwise direction. Pull out the display. Ensure that the o-ring is fully seated in its groove in the display housing. Turn the display to the desired position, reinsert it in the electronics module, aligning the tabs on the sides of the assembly, and twist it in the clockwise direction.

#### NOTICE

#### POTENTIAL EQUIPMENT DAMAGE

Do not turn the display more than 180° in any direction. Doing so can damage its connecting cable.

Failure to follow these instructions can result in equipment damage.

### Setting the Write Protect Jumper

Your transmitter has write protection capability. This means that external zero, local display, and remote communications can be prevented from writing to the electronics. Enable write protection by moving a jumper that is located in the electronics compartment behind the optional display. To activate write protection, remove the display as described in "Positioning the Display" on page 37, then remove the jumper or move it to the lower position as shown on the exposed label. Replace the display.



### Cover Locks

Electronic housing cover locks, shown in Figure 22, are provided as standard with certain agency certifications and as part of the Custody Transfer Lock and Seal option. To lock the covers, unscrew the locking pin until approximately 6 mm (0.25 in) shows, lining up the hole in the pin with the hole in the housing. Insert the seal wire through the two holes, slide the seal onto the wire ends and crimp the seal.





### Wiring

The installation and wiring of your transmitter must conform to local code requirements.

#### **A** WARNING

#### **EXPLOSION HAZARD**

ATEX requires that when equipment is intended to be used in an explosive atmosphere caused by the presence of combustible dust, cable entry devices and blanking elements must provide a degree of ingress protection of at least IP6X. They must be suitable for the conditions of use and correctly installed.

Failure to follow these instructions can result in death or serious injury.

#### - NOTE

Use transient/surge protection in installations prone to high levels of electrical transients and surges.

### Accessing Transmitter Field Terminals

For access to the field terminals, thread the cover lock (if present) into the housing to clear the threaded cover and remove the cover from the field terminals compartment as shown in Figure 23.



### Wiring the Transmitter to a Control Loop

When wiring the transmitter, the supply voltage and loop load must be within specified limits. The supply output load vs. voltage relationship, shown in Figure 25, is:  $R_{max} = 47.5$  (V - 11.5)

#### - NOTE

When using the optional shorting bar, the supply output load vs. voltage relationship is:  $R_{max} = 46.8$  (V - 11).

You can use any combination of supply voltage and loop load resistance in the shaded area shown in Figure 25. To determine the loop load resistance (transmitter output load), add the series resistance of each component in the loop, excluding the transmitter. The power supply must be capable of supplying 22 mA of loop current.





#### NOTES:

- 1. The minimum load for the HART communicator is 250  $\Omega$ .
- 2. The transmitter can function with an output load less than the minimum, but using a remote configurator while operating in this area will result in output and/or communication disturbances.

#### **Examples:**

- For a loop load resistance of 880 Ω, the supply voltage can be any value from 30 to 42 Vdc.
- For a supply voltage of 24 Vdc, the loop load resistance can be any value from 250 to 594 Ω (zero to 594 Ω without a HART communicator or PC-based configurator connected to the transmitter).

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To wire one or more transmitters to a power supply, proceed with these steps.

- 1. Remove the cover from the transmitter field terminals compartment.
- 2. Run signal wires (0.50 mm<sup>2</sup> or 20 AWG, typical) through one of the transmitter conduit connections. Use twisted single pair to help protect the 4 to 20 mA output and/or remote communications from electrical noise. Maximum recommended length for signal wires is:
  - ♦ 3050 m (10,000 ft) using single pair cable and adhering to requirements of HART physical layer implementation defined in HART Document HCF\_SPEC-53. Use CN=1 when calculating maximum lengths.
  - 1525 m (5000 ft) in a multidrop mode. Shielded cable could be required in some locations.

#### — NOTE -

Do not run transmitter wires in same conduit as mains (ac power) wires.

- 3. If shielded cable is used, ground the shield at the power supply **only**. Do not ground the shield at the transmitter.
- 4. Plug unused conduit connection with the 1/2 NPT or M20 metal plug provided (or equivalent). To maintain specified explosionproof and dust-ignitionproof protection, plug must engage a **minimum** of five full threads for 1/2 NPT connections; seven full threads for M20 connections.
- 5. Connect a ground wire to the ground terminal in accordance with local practice.

#### NOTICE

#### POTENTIAL REDUCED PERFORMANCE OR EQUIPMENT DAMAGE

If the signal circuit must be grounded, it is preferable to do so at the negative terminal of the dc power supply. To avoid errors resulting from ground loops or the possibility of short-circuiting groups of instruments in a loop, there should be only one ground in a loop.

Failure to follow these instructions can result in reduced performance or equipment damage.

- 6. Connect the power supply and receiver loop wires to the "+" and "-" terminal connections.
- 7. Connect receivers (such as controllers, recorders, indicators) in series with power supply and transmitter as shown in Figure 26.
- 8. Reinstall the cover onto the housing by rotating it clockwise to seat the o-ring into the housing and then continue to hand tighten until the cover contacts the housing metal-to-metal. If cover locks are present, lock the cover per the procedure described in "Cover Locks" on page 39.
- 9. If wiring additional transmitters to the same power supply, repeat Steps 1 through 8 for each additional transmitter. The setup with multiple transmitters connected to a single power supply is shown in Figure 27.

10. A HART communicator or PC-based configurator can be connected in the loop between the transmitter and the power supply as shown in Figures 26 and 27. A minimum of 250  $\Omega$  must separate the power supply from the HART communicator and PC-based configurator.



- (a) Run conduit down to avoid moisture buildup in terminals compartment.
- (b) There must be at least 250  $\Omega$  total resistance between the HART communicator or PC-based configurator and the power supply.



Figure 27. Wiring Several Transmitters to a Common Power Supply

### Multidrop Communication

"Multidrop communication" refers to the connection of several transmitters to a single communications transmission line. Communications between the host computer and the transmitters takes place digitally with the analog output of the transmitter deactivated. With the HART communications protocol, up to 63 transmitters can be connected on a single twisted pair of wires or over leased telephone lines.

The application of a multidrop installation requires consideration of the update rate necessary from each transmitter, the combination of transmitter models, and the length of the transmission line. Communication with the transmitters can be accomplished with any HART compatible modem and a host implementing the HART protocol. Each transmitter is identified by a unique address (0 through 63) and responds to the commands defined in the HART protocol.

Figure 28 shows a typical multidrop network. Do not use this figure as an installation diagram. Contact the HART Communications Foundation (http://www.hartcomm.org/) for specific requirements for multidrop applications.



The HART communicator can operate, configure, and calibrate IDP10S transmitters with HART communication protocol in the same way as it can in a standard point-to-point installation.

#### - NOTE

IDP10S transmitters are shipped from the factory with a poll address of 0 and with the loop current mode set to "enabled" (active), allowing the transmitters to operate in a standard point-to-point manner with a 4 to 20 mA output signal.

To activate multidrop communication, assign each transmitter a unique address (0 through 63) on each multidrop network. However, changing the transmitter poll address does not automatically deactivate the 4 to 20 mA analog output.

Only one device per multidrop network can be configured with loop current enabled. To fix the mA output value, set the loop current mode to "disabled."

### Connecting the Transmitter to a Foxboro Distributed Control System

The transmitter can also send its measurement to a Foxboro Distributed Control System as a digital signal via an FBM214/215. Wiring terminations at the transmitter are the same as described in this section. For other system wiring details, refer to the installation instructions provided with the control system.

# Putting a Differential Pressure Transmitter into Operation

This procedure explains how to sequence the valves in your flow measurement piping or optional bypass manifold to ensure that your transmitter is not overranged and that seal liquid is not lost. Refer to Figures 18 and 19.

#### - NOTE -

This procedure assumes that the process shutoff valves are open.

- 1. Make sure that both upstream and downstream manifold valves are closed.
- 2. Make sure that the bypass valve is open.
- 3. Slowly open the upstream manifold valve.
- 4. Close the bypass valve.
- 5. Slowly open the downstream manifold valve.

# Taking a Differential Pressure Transmitter out of Operation

This procedure explains how to sequence the valves in your flow measurement piping or optional bypass manifold to ensure that your transmitter is not overranged and that seal liquid is not lost. Refer to the Figures 18 and 19.

#### — NOTE -

This procedure assumes that the process shutoff valves are open.

- 1. Close the downstream manifold valve.
- 2. Close the upstream manifold valve.
- 3. Open the bypass valve.
- 4. Carefully open the vent screw to release any residual pressure before disconnecting lines.

#### 

#### **RISK OF EXPOSURE**

When venting pressure from the transmitter, wear suitable protective equipment to prevent possible injury from process material, temperature, or pressure.

Failure to follow these instructions can result in death or serious injury.

## 3. Operation Via Local Display

A local display, as shown in Figure 29, has two lines of information. The upper line is a 5-digit numeric display (4-digit when a minus sign is needed); the lower line is a 7-digit alphanumeric display. The display provides local indication of measurement information.

During normal transmitter operation, the display shows either the primary measurement (M1) or secondary measurement (M2), depending on how the transmitter is configured. The display can be configured to meet your specific needs:

- If configured Show 1, the display shows the primary measurement value (M1) along with its configured units during normal transmitter operation.
- If configured Show 2, the display shows the secondary measurement value (M2) along with its configured units during normal transmitter operation.
- To temporarily view the alternate measurement, press the Enter button. The alternate measurement appears on the display for a brief period, and then the display reverts to the configured display.
- If configured Toggle, the display toggles between the primary and secondary measurements, M1 and M2. When M2 is displayed, the digit 2 blinks in the lower right of the display.

The display and 2-button keypad on the front of the transmitter also provide a means for performing calibration and configuration, viewing the database, testing the display, and reranging the transmitter. The transmitter and 2-button keypad are shown in Figure 29.



External Zero Button (Latched [Nonactivating] Position)

You can access these operations by means of a multi-level menu system. To access the multi-level menu from the transmitter's normal operating mode, press Next. To exit this menu, cancel your calibration or configuration, and return to the normal operating mode at any time, navigate to Cancel and then press Enter.

A diagram of the top level menu is shown in Figure 30.



Figure 30. Top Level Menu Diagram

### **Entering Numerical Values**

The general procedure for entering numerical values in the Calibration and Configuration menus is as follows:

- 1. At the appropriate prompt, press the Enter button. The display shows the last (or default) value with the first digit flashing.
- 2. Use the Next button to select the desired first digit, then press the Enter button. Your selection is entered and the second digit flashes.
- 3. Repeat Step 2 until you have created your new value. If the number has less than five characters, use leading or trailing zeros for the remaining spaces. When you have configured the fifth space, the display prompts you to place the decimal point.
- 4. Move the decimal point with the Next button until the decimal point is placed as desired, and then press the Enter button.

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- 1. The decimal point cannot be placed directly after the first digit. For example, you cannot enter a value as 1.2300; enter it as 01.230.
- 2. The decimal position is identified by flashing except at the position after the fifth digit. At that position (representing a whole number), the decimal point is assumed.
- 5. The display advances to the next menu item.

### Reranging

Since the transmitter continuously determines an internal digital value of the measured pressure from the lower range limit (LRL) to the upper range limit (URL), the 4 and 20 mA output points can be assigned to any pressure values (within the span and range limits) without the application of pressure.

#### - NOTE

- 1. Reranging does not affect the calibration of the transmitter; that is, it does not affect the optimization of the internal digital value of pressure over a specific calibrated range.
- 2. If the reranged LRV and URV are not within the calibrated range, the measured values may not be as accurate as when they are within the calibrated range.
- 3. If you need to perform a span calibration after reranging the transmitter, make sure you perform an offset calibration (Cal LRV) before performing the span calibration (Cal URV) operation. If you do not perform the offset calibration, you may get a BADSPAN message.
- 4. If M1 MODE is in a square root mode, regardless of engineering units selected, RERANGE is automatically done in the following "default" pressure units:
  - inH20, if M2 MODE is a type of square root (IDP10S-B and IDP10S-C).
  - psi, if M2 MODE is a type of square root (IDP10S-D and IDP10S-E).
  - M2 EGU units, if M2 MODE is linear all ranges.

The bottom line of the display indicates the "default units" during RERANGE. After RERANGE, the display automatically switches back to the configured engineering units.

You can rerange the transmitter by simply entering new database values for the LRV and URV:

- 1. From the transmitter's normal operating mode, press the Next button to access the transmitter's top level menu (see Figure 30). The display reads RERANGE.
- 2. Adjust M1\_URV and/or M1\_LRV as desired:
  - a. To edit the upper range value, press Enter at the prompt M1\_URV. Use the procedure in "Entering Numerical Values" on page 48 to edit this parameter.
  - b. To edit the lower range value, press Enter at the prompt M1\_LRV. Use the procedure in "Entering Numerical Values" on page 48 to edit this parameter.

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#### - NOTE

M1\_LRV is bypassed if M1 MODE is configured as square root since M1\_LRV must be zero.

#### Figure 31 shows the RERANGE menu.



### Viewing the Database

You can view the database using the multi-level menu system described above. To view the transmitter's database:

- 1. From the transmitter's normal operating mode, press the Next button to access the transmitter's top level menu (see Figure 30).
- 2. Navigate to VIEW DB, and then press Enter. The display shows the first item in the database, FMW REV.
- 3. Continue stepping through the database display by pressing the Next button, or exit out of the database view by pressing the Enter button.

Figure 32 shows the VIEW DB menu, and the list of database items is described in Table 4.



Figure 32. VIEW DB Menu Diagram

Database Item	Available Settings or Example	Additional Information
Firmware revision (FMW REV)	1.007	-
Write protection: enabled or disabled	WP DISA or WP ENA	page 38
Status of FoxCal™ multiple calibration (MULTICL)	MCALON or MCALOFF	page 70
Poll Address (POLLADR)	0 through 63	page 60
External Zero (EX ZERO): enabled or disabled	EXZ ENA or EXZ DIS	page 60
Temperature Sensor Failure Strategy (S2 FAIL)	S2FATAL or S2N0FTL	page 60
4 to 20 mA output direction (OUT DIR): forward or reverse	OUT FWD or OUT REV	page 60
4 to 20 mA output fail mode (OUTFAIL): low or high	FAIL LO or FAIL HI	page 60
4 to 20 mA Output in offline mode (0FFL MA): last or user set	4.000 or LAST_MA	page 61
DAMPING: 0, 1/4, 1/2, 1, 2, 4, 8, 16, or 32 seconds	DAMP0, DAMP1/4, DAMP1/2, DAMP1, DAMP2, DAMP4, DAMP8, DAMP16, or DAMP32	page 61
M1 mode output (M1 MODE): linear or type of square root	M1 LIN, M1SQ<1C, M1SQ<4L, M1SQ <nc< td=""><td>page 61</td></nc<>	page 61
M1 display (M1 DISP)	M1 EGU, LIN PCT	page 61
Engineering Units for M1 (M1_EGU)	<pre>If M1 Mode is linear: psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, inH20 (at 68°F), inHg, ftH20, mmH20, or mmHg.</pre>	page 62
	<pre>gal/m, gal/h, gal/d, Mgal/d, ft3/s, ft3/m, ft3/h, ft3/d, Igal/s, Igal/m, Igal/h, Igal/d, 1/s, 1/m, 1/h, M1/d, m3/s, m3/m, m3/h, m3/d, bb1/s, bb1/m, bb1/h, bb1/d, t/d, t/h, 1b/h, kg/h, Nm3/h (normal m<sup>3</sup>/h), Sm3/h (standard m<sup>3</sup>/h), Am3/h (actual m<sup>3</sup>/h), or MMSCFD (million scfd), MSCFD (thousand scfd).</pre>	
M1 engineering factor (M1EFAC)	30.000	page 62
Offset applied to the primary value (M1EOFF)	0.000	page 62
Primary upper range value (M1_URV <units>)</units>	30.000	page 49
Primary lower range value (M1_LRV <units>)</units>	0.000	page 49
M2 mode output (M2 MODE): linear or type of square root	M2 LIN, M2SQ<1C, M2SQ<4L, M2SQ <nc< td=""><td>page 63</td></nc<>	page 63
Engineering units for M2 (M2_EGU)	<pre>If M2 Mode is linear: psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4, inH20 (at 68°F), inHg, ftH20, mmH20, or mmHg.</pre>	page 63
	If M2 Mode is square root: %flow, gal/s, gal/m, gal/h, gal/d, Mgal/d, ft3/s, ft3/m, ft3/h, ft3/d, Igal/s, Igal/m, Igal/h, Igal/d, 1/s, 1/m, 1/h, M1/d, m3/s, m3/m, m3/h, m3/d, bb1/s, bb1/m, bb1/h, bb1/d, t/d, t/h, 1b/h, kg/h, Nm3/h (normal $m^3/h$ ), Sm3/h (standard $m^3/h$ ), Am3/h (actual $m^3/h$ ), or MMSCFD (million scfd), MSCFD (thousand scfd).	
M2 engineering factor (M2EFAC)	30.000	page 62
Offset applied to the secondary value (M2EOFF)	0.000	page 62
DISPLAY M1, M2, or toggle between M1 and M2	SHOW M1, SHOW M2, or TOGGLE	page 64

#### Table 4. Transmitter Database Items

Database Item	Available Settings or Example	Additional Information
Date of last calibration (CALDATE)	19APR13	page 79, page 64
Current password settings: Enable password, no password, configuration only, or configuration and calibration	NO PWDS, ENA PWD, CFGONLY, CFG+CAL	page 64
The number of days the transmitter has been running since the Time In Service Meter has been reset (USRDAYS)	1	page 79
The number of days the transmitter has been running since it has been installed (TOTDAYS)	4	page 79

#### Table 4. Transmitter Database Items (Continued)

### Testing the Display

You can test the transmitter display using the multi-level menu system described above. To test the display:

- 1. From the transmitter's normal operating mode, press the Next button to access the transmitter's top level menu (see Figure 30).
- 2. Press Next to navigate to TST DSP, and press the Enter button. The display shows the first test segment pattern.
- 3. Step through the five test patterns by pressing the Next button, or exit out of the display test by pressing the Enter button.

The TST DSP menu and five patterns are shown in Figure 33.

E = Enter

I



### Messages

Table 1.	Transmitter	Messages
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Parameter	Condition Tested	Message	Action
Normal Operation	Write Protection Enabled	WR PROT	Displays periodically to notify user that unit is in Write Protect.
	Any non-on-line condition	OFFLINE	Notifies user of a non-on-line condition.
Startup	Database corrupted	INITERR	Perform SET GDB procedure. See "SET GDB" on page 65.

## 4. Configuration

### Configuration Using a PC50

To configure the transmitter using a PC50 Configurator, follow the procedure in MI 020-501 and MI 020-520.

### Configuration Using a HART Communicator

To configure the transmitter using a HART communicator, follow the procedures in Chapter 6, "Using the HART Communicator".

### Configuration Using the Optional Local Display

To access the Configuration mode from normal operating mode, press the Next button. Repeatedly press the Next button to navigate to the CONFIG menu, and then press Enter. The display shows the first item in the Configuration menu. You can then configure items shown in Table 5. The standard factory default configuration is also given in this table.

The standard factory default configuration is not used if custom configuration option -C2 has been specified. Option -C2 is a full factory configuration of all parameters to the user's specifications.

#### - NOTE

- 1. You can configure most parameters using the local display. However, for more complete configuration capability, use a HART communicator or PC-based configurator.
- 2. During configuration, a single change can affect several parameters. For this reason, if you make a mistake, re-examine the entire database or use the Cancel feature to restore the transmitter to its starting configuration and begin again.

Proceed to configure your transmitter by using the Next button to select your item and the Enter button to specify your selection per the following figures. At any point in the configuration you can Cancel your changes and return to the on-line mode, or Save your changes.



#### Figure 34. Configuration Menu Structure

- 1. This selection is not available when LOOP MD is set to MA DIS.
- 2. OUTFAIL sets the mA output to go either High or Low under certain conditions, such as sensor failure. This selection is not available when LOOP MD is set to MA DIS.
- 3. Setting "DAMP 0" in the damping menu enables the fastest response.



#### Figure 35. Configuration Menu Structure (Continued)

M1\_LRV is only available if M1 MODE is linear (M1\_LIN). 6.



#### Figure 36. Configuration Menu Structure (Continued)

Continued on next page

#### Notes:

- 1. Square root functions are not available for level transmitters.
- 2. If character is not the last position on the display line, advances to next character.
- 3. If character is the last position on the display line, advances to next menu item.



#### Figure 37. Configuration Menu Structure (Continued)

- 1. If character is not the last position on the display line, advances to next character.
- 2. If character is the last position on the display line, advances to next menu item.

Item	Description	Initial Factory Configuration	
POLLADR	The transmitter poll address can be set to a value of 0 through 63. An address of 0 is used in a standard point-to-point configuration with a 4 to 20 mA output signal. Addresses 1 through 63 are used for multidrop mode.	0	
	To configure the transmitter poll address, press Enter at the POLLADR prompt. Use the Next button to select an address between 0 and 63, then press Enter.		
LOOP MD	mA Loop Current Mode can be set to 4 to 20 mA or Fixed Current. Enabled (Active) 4 to 20 mA or Disabled (Fixed) 4 to 20 mA	Enabled (Active), 4 to 20 mA	
	To configure mA Loop Mode, navigate to the LOOP MD menu selection and press Enter. Use the Next button to select MA DIS to disable mA Loop Mode or MA ENA to enable mA Loop Mode.		
	By default, the LOOP MD parameter is set to enabled (MA ENA), which allows the transmitter to operate with a 4 to 20 mA output signal.		
	To lock the transmitter's milliamp output at a fixed value of 4.0 mA, set LOOP MD to disabled (MA DIS). When loop mode is disabled, the OUTFAIL, OUT DIR, OFFL MA, and mA adjustment selections will not be available from the menu structure after you save the configuration.		
EX ZERO (a)	The External Zero feature allows you to enable the optional external zero pushbutton or disable the button.	Disabled (EXZ DIS)	I
	To enable or disable the external zero pushbutton, navigate to the EX_ZERO menu selection and press Enter. Use the Next button to select EXZ_DIS or EXZ_ENA and press Enter.		
S2 FAIL	The temperature sensor compensates for changes in temperature in the transmitter electronics. Failure of this sensor can cause a 4 to 20 mA accuracy change of up to 0.25%. The S2 FAIL feature allows you to specify action (or no action) if such a failure occurs.	S2NOFTL	
	To configure this feature, navigate to the S2 FAIL menu selection and press Enter. Use the Next button and select S2FATAL if you want the output go to the value configured in OUTFAIL, or select S2NOFTL to continue operation with a temperature sensor failure.		
	This menu option is not available when the milliamp output is fixed at 4.0 mA (that is, when LOOP MD is set to MA DIS), and is bypassed if either M1 MODE or M2 MODE is configured as square root.		
OUT DIR	The 4 to 20 mA Output Direction can be set to forward or reverse.	Forward (4 to 20 mA)	
	To configure the output direction, navigate to OUT DIR menu selection and press Enter. Use the Next button to select OUT FWD (4 to 20 mA) or OUT REV (20 to 4 mA) and press Enter.	(OUT FWD)	
OUTFAIL	The 4 to 20 mA output failure mode can be configured so that the transmitter's output will be set to either the high value or low value under specific failure conditions.	High (FAIL HI)	
	To configure the fail mode output, navigate to the OUTFAIL menu selection and press Enter. Use the Next button to select FAIL LO or FAIL HI and press Enter.		
	This menu option is not available when the milliamp output is fixed at 4.0 mA (that is, when LOOP MD is set to MA DIS).		

#### Table 5. Configuration Menu

Item	Description	Initial Factory Configuration
OFFL MA	This parameter allows you to configure the 4 to 20 mA output in offline mode. OFFL MA can be configured so that the transmitter's output will be set to either the last output value or to a user-specified value if the transmitter goes off-line.	User set (USER MA)
	To configure the off-line output, press Enter at the prompt OFFL MA.	
	• To use the last good output value, press Next to select LAST MA, and then press	
	<ul> <li>If you want to specify the value to which the output will be set, navigate to USER MA by pressing Next, and then press Enter. A display appears that allows you to enter digits. Enter the desired value, and then press Enter. The display advances to the next menu item. Refer to "Entering Numerical Values" on page 48.</li> </ul>	
	This menu option is not available when the milliamp output is fixed at 4.0 mA (that is, when LOOP MD is set to MA DIS).	
DAMPING	Damping can be set to 0, 1/4, 1/2, 1, 2, 4, 8, 16, or 32 seconds.	0.25 second (DAMP1/4)
	To configure damping, navigate to the DAMPING menu selection and press Enter. Use the Next button to select DAMP 0, DAMP1/4, DAMP1/2, DAMP1, DAMP2, DAMP4, DAMP8, DAMP16, or DAMP32, and then press Enter. 0 = the fastest response.	
M1 MODE	The mode of the primary output can be set to linear mode or a type of square root mode. (Square root is not applicable to absolute pressure, gauge pressure, and level measurement.)	Linear (M1 LIN)
	To configure the mode of the primary output, press Enter at the prompt M1 MODE, and then use the Next button to select one of the following: M1 LIN: Linear (pressure units)	
	M1SQ<1C: square root flow calculation with cutoff below 1% of calibrated differential pressure range	
	M1SQ<4L: square root flow calculation with linear extrapolation below 4% of calibrated pressure range	
	M1SQ <nc: a="" calculation="" cutoff="" flow="" root="" specified<br="" square="" user-configured="" with="">between 0 and 20% of the flow upper range value, M1EFAC</nc:>	
	<b>Note</b> : Cutoff in M1SQ<1C and M1SQ<4L is in percent of differential pressure but cutoff in M1SQ <nc flow="" in="" is="" of="" percent="" rate.<="" td=""><td></td></nc>	
M1 DISP	If the primary output is in linear mode, the M1 DISP parameter allows you to configure the optional local display to show engineering units or percent. If the primary output is a square root flow calculation, M1 DISP menu option is not available.	Engineering units (M1 EGU)
	To configure the optional local display to show engineering units or percent, navigate to the M1 DISP menu selection and press Enter. Use the Next button to select M1 EGU or LIN PCT and press Enter.	
	LIN PCT only provides percent readings on the local display. The M1 engineering unit is used for remote communication of Measurement #1, even if LIN PCT is selected.	

Table 5.	Configuration	Menu	(Continued)
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Item	Description	Initial Factory Configuration
M1_EGU	This parameter allows you to set the engineering units for the primary measurement.	inH2O or psi
	<ul> <li>When M1 MODE is set to M1 LIN:</li> <li>Configure any of the following pressure engineering units for your display and transmission: psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4, inH20 (at 68°F), inHg, ftH20, mmH20, or mmHg.</li> <li>The transmitter then automatically adjusts M1EFAC (engineering factor), M1_URV (upper range value), M1_LRV (lower range value), and defaults the M1EOFF parameter to zero.</li> </ul>	
	When M1 MODE is set to any of the square root settings (M1SQ<1C, M1SQ<4L, or M1SQ <nc):< td=""><td></td></nc):<>	
	Configure any of the following now engineering units for your display and transmission: %flow, gal/s, gal/m, gal/h, gal/d, Mgal/d, ft3/s, ft3/m, ft3/h, ft3/d, Igal/s, Igal/m, Igal/h, Igal/d, 1/s, 1/m, 1/h, M1/d, m3/s, m3/m, m3/h, m3/d, bb1/s, bb1/m, bb1/d, bb1/d, t/d, t/h, 1b/h, kg/h, Nm3/h, (normal m <sup>3</sup> /h)	
	Sm3/h (standard m <sup>3</sup> /h), Am3/h (actual m <sup>3</sup> /h), MMSCFD (million scfd), or MSCFD (thousand scfd). ► Check the M1EFAC (M1 engineering factor) and adjust it if necessary.	
M1EOFF	This parameter allows you to configure an offset value to apply to the primary	0
	Measurement. You can introduce an offset by entering a nonzero value for M1E0FF. The offset affects the value of the PV that is transmitted in engineering units, transmitted as an analog mA signal, and displayed in the optional local display.	
	This feature can be used in applications such as an elevated water storage tank where the transmitter is at grade level but the output corresponds to the level of the tank. An offset value can also be used for a grade level water storage tank where the transmitter is installed above the bottom of the tank where the output should correspond to the level in the tank.	
M1EFAC	The M1EFAC parameter is the numerical relationship between the measured span in pressure units and the displayed (and transmitted) span in flow units. It is the displayed URV in flow units (which is also the span in flow units, since flow ranges must be zero-based).	
	For example, for a 200 in $H_2O$ transmitter with a measured range of 0 to 100 in $H_2O$ and displayed range of 0 to 500 gal/m, set M1EFAC to 500.	
	Note: Actual flow rates in the process are dependent upon your specific installation (pipe diameter, for example). Be sure to use values for M1EFAC and M2EFAC that correspond to your specific installation and process conditions.	
	To edit the span in your configured flow units, navigate to the M1EFAC menu selection and press Enter. Use the procedure "Entering Numerical Values" on page 48 to edit this parameter.	
M1_URV	This parameter allows you to configure the upper range value of the primary measurement.	URL
	To edit the upper range value of M1, navigate to the M1_URV menu selection and press Enter. Use the procedure "Entering Numerical Values" on page 48 to edit this parameter.	
M1_LRV	This parameter allows you to configure the lower range value of the primary measurement.	0
	To edit the lower range value of M1, navigate to the M1_LRV menu selection and press Enter. Use the procedure "Entering Numerical Values" on page 48 to edit this parameter.	

#### Table 5. Configuration Menu (Continued)

Item	Description	Initial Factory Configuration
M2 MODE	M2 is a secondary measurement that is read by the HART communicator and can be displayed on the optional display. You might use this feature to display M1 in your primary pressure units and M2 in a different set of pressure units, or in flow units.	Linear (M2 LIN)
	The mode of the secondary output can be set to linear mode (pressure units) or a type of square root mode (flow units). Square root is not applicable to absolute pressure, gauge pressure, and level measurement.	
	<ul> <li>To configure the mode of the secondary output, press Enter at the prompt M2 MODE, and then use the Next button to select one of the following:</li> <li>M2 LIN: Linear (pressure units)</li> <li>M2SQ&lt;1C: square root flow calculation with cutoff below 1% of calibrated differential pressure range</li> <li>M2SQ&lt;4L: square root flow calculation with linear extrapolation below 4% of calibrated differential pressure range</li> <li>M2SQ&lt;0C: square root flow calculation with a user-configured cutoff specified</li> </ul>	
	between 0 and 20% of the flow upper range value, M2EFAC Note: Cutoff in M2SQ<1C and M2SQ<4L is in percent of differential pressure but	
	cutoff in M2SQ <nc flow="" in="" is="" of="" percent="" rate.<="" td=""><td></td></nc>	
M2_EGU	This parameter allows you to set the engineering units for the secondary measurement.	Same as M1_EGU
	<ul> <li>When M2 MODE is set to M2 LIN:</li> <li>Configure any of the following pressure engineering units for your display and transmission: psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4, inH20 (at 68°F), inHg, ftH20, mmH20, or mmHg.</li> <li>The transmitter then automatically adjusts M2EFAC (engineering factor), M2_URV (upper range value), M2_LRV (lower range value), and defaults the M2EOFF parameter to zero.</li> </ul>	
	<ul> <li>When M2 MODE is set to any of the square root settings (M2SQ&lt;1C, M2SQ&lt;4L, or M2SQ<nc):< li=""> <li>Configure any of the following flow engineering units for your display and transmission: %flow, gal/s, gal/m, gal/h, gal/d, Mgal/d, ft3/s, ft3/m, ft3/h, ft3/d, Igal/s, Igal/m, Igal/h, Igal/d, 1/s, 1/m, 1/h, M1/d, m3/s, m3/m, m3/d, bbl/s, bbl/m, bbl/h, bbl/d, t/d, t/h, 1b/h, kg/h, Nm3/h (normal m<sup>3</sup>/h), Sm3/h (standard m<sup>3</sup>/h), Am3/h (actual m<sup>3</sup>/h), MMSCFD (million scfd) or MSCFD (thousand scfd).</li> <li>Check the M2EFAC (M2 engineering factor) and adjust it if necessary.</li> </nc):<></li></ul>	
M2EOFF	This parameter allows you to configure an offset value to apply to the secondary measurement.	0
	You can introduce an offset by entering a nonzero value for M2EOFF. The offset affects the value of the PV that is transmitted in engineering units, transmitted as an analog mA signal, and displayed in the optional local display.	
	This feature can be used in applications such as an elevated water storage tank where the transmitter is at grade level but the output corresponds to the level of the tank. An offset value can also be used for a grade level water storage tank where the transmitter is installed above the bottom of the tank where the output should correspond to the level in the tank.	

Table 5. Co	nfiguration	Menu	(Continued)
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Item	Description	Initial Factory Configuration
M2EFAC	The M2EFAC parameter is the numerical relationship between the measured span in pressure units and the displayed (and transmitted) span in flow units. It is the displayed URV in flow units (which is also the span in flow units, since flow ranges must be zerobased).	
	For example, for a 200 in $\rm H_2O$ transmitter with a measured range of 0 to 100 in $\rm H_2O$ and displayed range of 0 to 500 gal/m, set M2EFAC to 500.	
	Note: Actual flow rates in the process are dependent upon your specific installation (pipe diameter, for example). Use values for M1EFAC and M2EFAC that correspond to your specific installation and process conditions.	
	To edit the span in your configured flow units, navigate to the M2EFAC menu selection and press Enter. Use the procedure "Entering Numerical Values" on page 48 to edit this parameter.	
DISPLAY	This parameter allows you to configure whether the optional local display shows M1, M2, or toggles between M1 and M2.	M1 (SHOW M1)
	To configure the display value, navigate to the DISPLAY menu selection and press Enter. Use the Next button to select SHOW M1, SHOW M2, or TOGGLE and press Enter.	
CALDATE	CALDATE allows you to set the date of the last calibration. This parameter is optional, but it can be used for record-keeping or plant maintenance purposes.	
	To edit the calibration date, navigate to the CALDATE menu selection and press Enter. You can then change the day, month, and year. The display shows the last date with the day flashing. Use the Next button to step through the library of digits to select the desired day, then press Enter. Repeat this process for the month and year.	
ENA PWD	This parameter allows you to enable or disable password(s). By default, passwords are disabled.	Passwords are not enabled
	<b>Note</b> : CAL PWD allows access to only calibration mode, but CFG PWD allows access to both configuration and calibration.	(NO PWD)
	<ul> <li>To set a password for configuration only or for both configuration and calibration:</li> <li>Navigate to ENA PWD and press Enter.</li> <li>Navigate to CFGONLY or CFG+CAL and press Enter. If you selected CFG+CAL, the CAL PWD prompt appears. If you selected CFGONLY, the CFG PWD prompt appears.</li> <li>Press either Next or Enter.</li> <li>Use the Next button to step through the library of characters to select the desired first character, then press Enter. Your selection is entered and the second character flashes. Repeat this procedure until you have created your password. If you selected CFG+CAL, the CFG PWD prompt appears. Use the same procedure to create the configuration password.</li> <li>When you have configured the sixth space, the display advances to the next menu item.</li> <li>Record your new password before saving changes to the database.</li> </ul> To disable passwords: <ul> <li>Navigate to the ENA PWD menu selection and press Enter.</li> <li>Navigate to the NO PWDS menu selection and press Enter.</li> <li>If a configuration password was previously configured, you are asked to enter it.</li> </ul>	
CFG PWD	User set configuration password (six characters)	
CAL PWD	User set calibration password (six characters)	

#### Table 5. Configuration Menu (Continued)

Item	Description	Initial Factory Configuration
SET GDB	SET GDB allows you to rewrite calibration values (slope and offset) with default values. It resets M1 and M2 EGUs to PSI. If your transmitter database becomes corrupted and you receive an INITERR message upon startup, this function enables you to rewrite the calibration values with default values.	
	not select SET_GDB if your transmitter is functioning normally.	

Inou J. Configuration Interna (Continuea)	Table 5.	Configuration	Menu	(Continued)
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a. Applies only if transmitter contains External Zero option.

### Character Lists

Alphanumeric C	Numeric Character List	
Alphanumeric C @ , (comma) A-Z (uppercase) [ \ ] ^ _ (underscore) space ! " #	character List (a) ( ) * + - / 0-9 ; ; <	Numeric Character List . (decimal point) 0 1 2 3 4 5 6 7 8
\$ % &	> = ?	9

Table 6. Character Lists

a. List only applies to a HART communicator not to the optional local display.

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### Messages

Parameter	Condition Tested	Message	User Action
Password Protection	Password	BAD PWD	Bad password entered, use another.
Write Protection	Write Protection Enabled	REJECT	Displays when user attempts an action that is write protected.
M1 MODE (being changed to square root)	M1_LRV ≠ 0	LRVnot0	Square root mode with nonzero LRV is not valid. Change M1_LRV to 0.
	M1_URV < 0	URV <lrv< td=""><td>Square root mode with negative URV is not valid. Change M1_URV to positive value.</td></lrv<>	Square root mode with negative URV is not valid. Change M1_URV to positive value.
	OUT DIR is OUT REV	URV <lrv< td=""><td>Square root mode with URV &lt; LRV is not valid. Change M1_LRV to 0 and M1_URV to positive value.</td></lrv<>	Square root mode with URV < LRV is not valid. Change M1_LRV to 0 and M1_URV to positive value.
	M1EFAC < 0	-M1EFAC	Negative M1EFAC is not valid. Change M1EFAC to positive value.
	M2EFAC < 0	-M2EFAC	Negative M2EFAC is not valid. Change M2EFAC to positive value.
	M1EFAC = 0	0M1EFAC	M1EFAC = 0 is not valid. Change M1EFAC to positive value.
	M2EFAC = 0	0M2EFAC	M2EFAC = 0 is not valid. Change M2EFAC to positive value.
	M1EOFF ≠ 0 or M2EOFF ≠ 0	BADEOFF	Square root mode with nonzero M1E0FF and M2E0FF is not valid. Change M1E0FF and M2E0FF to 0.
M1EFAC	M1EFAC < 0	-M1EFAC	Negative M1EFAC is not valid. Change M1EFAC to a positive value.
	M1EFAC = 0	0M1EFAC	M1EFAC = 0 is not valid. Change M1EFAC to a positive value.
M1_URV	M1_URV > max pressure in EGU	URV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1_URV < min pressure in EGU	URV <fmn< td=""><td>Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.</td></fmn<>	Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.
	M1_URV = M1_LRV	LRV=URV	Cannot set span to 0. Check entry. Check M1_LRV.
	M1 turndown exceeds limit	BADTDWN	Check entry. Check M1_LRV.
	URV < 0 with M1 or M2 SqRt	URV <lrv< td=""><td>Square root mode with nonzero LRV is not valid. Change M1_LRV to 0.</td></lrv<>	Square root mode with nonzero LRV is not valid. Change M1_LRV to 0.
M1_LRV	M1_LRV > max pressure in EGU	LRV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1_LRV < min pressure in EGU	LRV <fmn< td=""><td>Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.</td></fmn<>	Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.
	M1_URV = M1_LRV	LRV=URV	Cannot set span to 0. Check entry. Check M1_URV.
	M1 turndown exceeds limit	BADTDWN	Check entry. Check M1_URV.

#### Table 7. Configuration Messages

Parameter	Condition Tested	Message	User Action
M2 MODE (being changed to square root)	M1_LRV ≠ 0	LRVnot0	Square root mode with nonzero LRV is not valid. Change M1_LRV to 0.
	M1_URV < 0	URV <lrv< td=""><td>Square root mode with negative URV is not valid. Change M1_URV to positive value.</td></lrv<>	Square root mode with negative URV is not valid. Change M1_URV to positive value.
	OUT DIR is OUT REV	URV <lrv< td=""><td>Square root mode with URV &lt; LRV is not valid. Change M1_LRV to 0 and M1_URV to positive value.</td></lrv<>	Square root mode with URV < LRV is not valid. Change M1_LRV to 0 and M1_URV to positive value.
	M1EFAC < 0	-M1EFAC	Negative M1EFAC is not valid. Change M1EFAC to positive value.
	M2EFAC < 0	-M2EFAC	Negative M2EFAC is not valid. Change M2EFAC to positive value.
	M1EFAC = 0	0M1EFAC	M1EFAC = 0 is not valid. Change M1EFAC to positive value.
	M2EFAC = 0	0M2EFAC	M2EFAC = 0 is not valid. Change M2EFAC to positive value.
	$ \begin{array}{l} M1EOFF \neq 0 \text{ or } M2EOFF \\ \neq 0 \end{array} $	BADEOFF	Square root mode with nonzero M1E0FF and M2E0FF is not valid. Change M1E0FF and M2E0FF to 0.
M2EFAC	M2EFAC < 0	-M2EFAC	Negative M2EFAC is not valid. Change M2EFAC to a positive value.
	M2EFAC = 0	0M2EFAC	M2EFAC = 0 is not valid. Change M2EFAC to a positive value.

Table 7. Configuration Messages (Continued)

## 5. Calibration

### Overview of FoxCal<sup>™</sup> Multiple Calibration Technology

The S Series differential pressure transmitters offer FoxCal<sup>™</sup> technology, which is a patented multiple calibration feature that helps eliminate the need for a traditional single span calibration at an application-specific pressure range. Transmitters with the FoxCal feature enabled use multiple calibrated ranges that are stored in on-board memory. The calibrated ranges are preset in the factory and cover the full pressure range of the transmitter. During operation, a real-time, seamless transition from one calibrated range to another maintains digital accuracy as a percent of reading from 3% to 100% of the upper range limit (URL).

Factory calibration and field calibration for specific applications are not required for zero-based ranges up to 30:1 turndown. You can simply configure or Rerange the upper range value (URV) without performing a recalibration at the URV. You will only need to perform a zero adjustment after installation to obtain performance to the specified reference accuracy.

Refer to "Span and Range Limits" on page 16.

### Calibration Certificate

Optionally, you can request a calibration certificate with your IDP10S transmitter, which provides verification that the transmitter meets the reference accuracy specification within a user specified range.

For transmitters shipped with the FoxCal feature enabled and the Calibration Certificate option selected, the transmitters are not recalibrated to the user specified range. The LRV and URV points are configured (Reranged) to the user specified values and the accuracy is verified over that specific range.

### **Custom Factory Calibration**

A custom two-point factory calibration is also available as a model code option. This option is useful if your application requires non-zero based ranges, calibrated ranges greater than 30:1 turndown, or when mandated by a specific requirement. When a transmitter is shipped with the custom factory calibration option, the FoxCal feature is automatically disabled and a traditional two-point calibration is applied over the user-specified range.

### One-Point Calibration at LRV

A one-point offset calibration at LRV can be performed on transmitters with either FoxCal or the last two-point calibration enabled.

When a one-point calibration at LRV is performed, the offset adjustment applies to both the last two-point calibration and all the multiple calibrations. The calibrated accuracy at the LRV point

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is adjusted and maintained for both calibrations, regardless of which selection is enabled at the time of the adjustment. This allows you to enable or disable FoxCal without also performing two independent offset adjustments.

### **Two-Point Field Calibration**

IDP10S transmitters, including transmitters shipped with the FoxCal feature enabled, can be recalibrated to a specific LRV and URV. The calibration at the LRV point applies to both transmitters with the FoxCal feature enabled and transmitters calibrated with a two-point calibration. However, the calibration at the URV point applies only to the two-point calibration. Multiple calibrations stored in the transmitter in the factory do not change when a URV calibration is performed. Instead, as with a Custom Factory Calibration, a field calibration at URV automatically disables the FoxCal feature and enables a single two-point calibration.

#### NOTICE

#### POTENTIAL REDUCED PERFORMANCE

The accuracy of the input pressure for field span calibration should be a minimum of four times better than the transmitter's reference accuracy specification. An inaccurate span pressure input typically results in degradation of transmitter performance from the factory calibrated state.

Failure to follow these instructions can result in reduced performance.

### Enabling and Disabling FoxCal

The transmitter can be shipped with or without the FoxCal feature enabled. If you select the -C1 option in the sales order, FoxCal is not enabled and the transmitter is factory calibrated over the specified range. If you do not select the -C1 option in the sales order, FoxCal is enabled.

The FoxCal calibration feature can be enabled or disabled by selecting MULTICL from the CALIB menu and selecting MCALON or MCALOFF. When FoxCal is disabled, the last two-point calibration is enabled. As shipped, the last 2-point calibration defaults to a calibration from 0 to URL, or, for transmitters ordered with the -C1 option, the two-point Custom Factory Calibration range. If a two-point field calibration has been subsequently performed, the last calibration becomes the last field calibration.

If you perform a 2-point calibration in a transmitter with FoxCal enabled, the new calibration is used, and FoxCal is disabled. Re-enable FoxCal by selecting MULTICL from the CALIB menu and selecting MCALON.

#### NOTICE

#### POTENTIAL REDUCED PERFORMANCE

When disabling FoxCal, the last two-point calibrated range may not match the current configuration of the Lower Range Value and Upper Range Value. For optimal performance, avoid large mismatches.

Failure to follow these instructions can result in reduced performance.

### General Calibration Notes

- 1. For best results in applications where high accuracy is required, rezero the transmitter output once it has stabilized at the final operating temperature.
- 2. Zero shifts resulting from position effects can be eliminated by rezeroing the transmitter output.
- 3. When checking the zero reading of a transmitter operating in the square root mode, return the output to the linear mode. This eliminates an apparent instability in the output signal. Return the transmitter output to the square root mode after the zero check is complete.
- 4. After calibrating transmitters operating with a 4 to 20 mA (or 1 to 5 Vdc) output signal, check the underrange and overrange output values to ensure that they extend beyond 4 and 20 mA (or 1 and 5 Vdc) respectively.
- 5. Each transmitter is factory characterized over its full rated pressure range. One benefit of this process is that every transmitter can measure any applied differential pressure within its range limits regardless of the calibrated range. The applied differential pressure is measured and converted into an internal digital value of differential pressure. This digital value of differential pressure is always available whether the transmitter is calibrated or not. Calibration assures that the transmitter rated accuracy is achieved over the calibrated range.
- 6. The internal digital value of differential pressure can be displayed on the optional local display, transmitted digitally, and converted to a 4 to 20 mA analog output signal.
- 7. If you perform a two-point calibration when the FoxCal feature is enabled, the new calibration is used and FoxCal is disabled.
- 8. The transmitter database has configurable values for both lower range value (LRV) and upper range value (URV). These values are used for two functions.
  - a. Defining the calibrated range when using local pushbuttons for calibration:
    - When either CAL LRV or CAL URV is initiated from the local pushbuttons, the transmitter expects that the pressure applied at the time the button is pressed is equal to the LRV or URV value respectively.
    - This function trims the internal digital value of pressure; that is, it performs a calibration based on the application of accurate pressures equal to the values entered for LRV and URV in the transmitter database.
    - This function also sets the 4 and 20 mA output points; that is, the 4 and 20 mA points that correspond to the values of LRV and URV in the database.
    - The value of LRV can be larger than the value of URV.
  - b. Reranging without the application of pressure:
    - Since the transmitter continually determines an internal digital value of the measured differential pressure from the lower range limit (LRL) to the upper range limit (URL), the 4 and 20 mA output points can be assigned to any differential pressure values (within the span and range limits) without application of pressure.

- The reranging function is accomplished by entering new database values for LRV and URV.
- Reranging does not affect the calibration of the transmitter; that is, it does not affect the optimization of the internal digital value of differential pressure over the calibrated range.
- If FoxCal is disabled and the reranged LRV and URV are not within the calibrated range, the measured values may not be as accurate as when they are within the calibrated range.

If the transmitter is in square root mode for flow rate measurement, the URV in the database is displayed as the flow rate URV when the view database (VIEW DB) function is used. However, the LRV and URV in pressure units can be displayed by selecting the reranging (RERANGE) function. LRV is always zero when the transmitter is configured for square root mode.

- 9. When the optional local display is used, the internal digital value of differential pressure is sent directly to the display.
  - The display can show any measured differential pressure in selected units regardless of the calibrated range and the values of LRV and URV (within the limits of the transmitter and display).
  - If the measured differential pressure is outside the range established by the LRV and URV values in the database, the display shows the measurement but also continually blinks to indicate that the measurement is out of range. The mA current signal is saturated at either the low or high overrange limit respectively but the display continually shows the pressure.
- 10. When configured for 4 to 20 mA output, the internal digital value of differential pressure is converted to an analog current signal.
  - The transmitter sets the output at 4 mA for the LRV and 20 mA for the URV.
  - There is an independent trim on the digital-to-analog conversion stage. This trim allows for slight adjustment of the 4 and 20 mA outputs. This compensates for any slight difference that exists between the transmitter mA output and an external reference device which is measuring the current.
  - The mA trim does not affect the calibration or the reranging of the transmitter and does not affect the internal digital value of differential pressure or the transmission or display of measured pressure.
  - The mA trim can be done with or without pressure applied to the transmitter.
- 11. Zeroing from the local display does not affect the span.

When the transmitter is zeroed to compensate for installed position effect, the transmitter can have either LRV differential pressure applied (CAL LRV) or zero differential pressure applied (CAL AT0). If the range is zero-based, either method produces the same result. However, if the range is not zero-based, it is advantageous to have both methods available.
For example, consider a differential pressure transmitter having a range of 50 to 100 psig. If it is not feasible to vent the transmitter to atmosphere or to bypass the high and low sides for zeroing, it can be adjusted while the LRV differential pressure of 50 psi is applied by using the CAL LRV function. On the other hand, if the transmitter has been installed but there is no pressure in the process line yet (or the high and low sides can be connected by a bypass valve), it can be zeroed while open to atmosphere by using the CAL ATO function.

- a. Zeroing with LRV pressure applied (CAL LRV):
  - Before using this zeroing function, apply a differential pressure to the transmitter equal to the value of LRV stored in the transmitter database.
  - When you zero the transmitter, the internal digital value of the differential pressure is trimmed to be equal to the value of LRV stored in the database and the mA output set to 4 mA.
  - If zeroing is done when the applied differential pressure is different from the LRV pressure value in the database, the internal digital value of differential pressure is biased by the difference in the values but the output is still set at 4 mA.
  - Use the CAL LRV and CAL URV functions when calibrating a transmitter for a specific range with known input differential pressures applied for the LRV and URV. FoxCal is automatically disabled by the CAL URV function.
- b. Zeroing a pressure transmitter with zero pressure applied (CAL AT0):
  - Make sure that the applied differential pressure is at zero. This means venting the transmitter to atmosphere or opening a bypass valve to connect the high and low sides
  - When you zero the transmitter, the internal digital value of the differential pressure is trimmed to be equal to zero and the mA output set to an appropriate value such that the mA output is a normal 4 mA when the LRV pressure is applied later.

## Calibration Setup

These sections show setups for field or bench calibration. Use test equipment that is at least four times as accurate as the specified accuracy of the transmitter; otherwise measurement inaccuracy may be introduced.

### NOTICE

### POTENTIAL REDUCED PERFORMANCE

For both field calibration and bench calibration procedures, using a pressure source that is less accurate than the transmitter's reference accuracy specification typically results in degradation of transmitter performance from the factory calibrated state.

The accuracy of the input pressure should be a minimum of four times better than the transmitter's reference accuracy specification.

Failure to follow these instructions can result in reduced performance.

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#### - NOTE

It is not necessary to set up calibration equipment to rerange the transmitter to a different range. The transmitter can be accurately reranged by simply changing the lower range value and the upper range value, which are stored in the transmitter database.

### Setup of Electronic Equipment

Figure 38. 4 to 20 mA Output Calibration Setup of Electronic Equipment



### Field Calibration Setup

Field calibration is performed without disconnecting the process piping. In order to do this, you must have a bypass and shutoff valves between the process and the transmitter and one of the following:

- Access to the process connections on the nonprocess side of the transmitter
- The optional vent screw in the side of the process covers.

If the transmitter is to be removed from the process for calibration, refer to "Bench Calibration Setup" below.

For field calibration, an adjustable supply and a pressure measuring device are required. For example, a dead weight tester or an adjustable clean air supply and pressure gauge can be used. The pressure source can be connected to the transmitter process connection with pipe fittings or it can be connected to the vent screw assembly using a calibration screw. The calibration screw has a Polyflo fitting and can be used for pressures up to 700 kPa (100 psi). It is available as Foxboro Part Number F0101ES.

To set up the equipment, refer to Figure 39 and use the following procedure.

1. If the transmitter is in operation, follow the "Taking a Differential Pressure Transmitter out of Operation" on page 46.



### POTENTIAL REDUCED PERFORMANCE

With liquid service, drain both sides of the transmitter to avoid calibration errors.

Failure to follow these instructions can result in reduced performace.

2. If a calibration screw is being used, remove the vent screw and replace it with the calibration screw. Connect the pressure source to the calibration screw using 6 x 1 mm or 0.250 inch tubing.

If a calibration screw is **not** being used, remove the entire vent screw assembly or drain plug (as applicable) from the high pressure side of the transmitter. Connect calibration tubing using a suitable thread sealant.

- 3. Close the bypass valve opened in Step 1.
- 4. Complete the setup shown in Figure 39.

5. If calibrating the output signal, also connect equipment as shown in Figure 38.



#### Figure 39. Field and Bench Calibration Setup

<sup>—</sup> NOTE -

For vacuum applications, connect the calibrating pressure source to the low pressure side of the transmitter.

### Bench Calibration Setup

The bench calibration setup requires disconnecting the process piping. For calibration setup without disconnecting the process piping, refer to "Field Calibration Setup".

The bench calibration setup is shown in Figure 39. Connect the input piping to the high pressure side of the transmitter as shown. Vent the low pressure side of the transmitter.

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For vacuum applications, connect the calibrating pressure source to the low pressure side of the transmitter.

If calibrating the output signal, also connect equipment as shown in Figure 38.

## Calibration Using a PC50

To calibrate the transmitter using a PC50 Configurator, follow the procedure in MI 020-501 and MI 020-520.

### Calibration Using a HART Communicator

To calibrate the transmitter using a HART communicator, follow the procedure in Chapter 6, "Using the HART Communicator".

# Calibration Using the Optional Local Display

To access the Calibration mode (from normal operating mode), press the Next button until the CALIB menu appears on the display, and then press Enter. The display shows the first item in the Calibration menu.

#### - NOTE

- 1. During calibration, a single change could affect several parameters. For this reason, if you make a mistake, re-examine the entire database or use the **Cancel** feature to restore the transmitter to its starting configuration and begin again.
- 2. During adjustment of 4 and 20 mA in the Calibration menu, the milliampere output does not reflect live measurement values.

Proceed to calibrate your transmitter by using the Next and Enter buttons to specify your selection as illustrated in Figure 40 and Figure 41. At any point in the calibration you can cancel, restore your prior calibration and return to on-line mode, or save your new calibration.



#### Figure 40. Calibration Menu Structure

Continued on next page

#### Figure 41. Calibration Menu Structure (Continued)



Table 8. Calibration Menu
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	Item	Description
MULTICL		This menu option allows you to enable or disable FoxCal.
		To enable FoxCal calibrations, select MULTICL from the CALIB menu, and then select MCALON. Similarly, to disable FoxCal, select MCALOFF.
С	AL ATO (a)	This menu option calibrates the transmitter at zero pressure.
		To set or reset the zero point at zero pressure, apply zero pressure to the transmitter. When CAL ATØ appears on the display, press Enter. This can be done whether LRV is zero or not. When the process is complete, ATØ Done appears on the display.
С	AL LRV	This menu option calibrates the transmitter at 0% of the transmitter's range (LRV).
		To set or reset 0% of range input, apply pressure to the transmitter equal to the lower range value (LRV) in the transmitter database. When CAL LRV appears on the display, press Enter. When the process is complete, LRV Done appears on the display.
С	AL URV (b)	This menu option calibrates the transmitter at 100% of the transmitter's upper range value (URV).
		If FoxCal is enabled, the CAL URV process will disable it and display MCALOFF.
		To set or reset 100% of range input, apply pressure to the transmitter equal to the upper range value (URV) in the transmitter database. When CAL URV appears on the display, press Enter. To indicate that FoxCal is being disabled, MCALOFF will briefly appear on the display if FoxCal was enabled prior to starting the calibration. CALWAIT appears on the display while the calibration is taking place, and URV Done appears when the process is complete.

Item	Description
ADJ 4mA (c)	This menu option adjusts the nominal 4 mA output.
	If you configured your transmitter operating mode as 4 to 20 mA, you can adjust the 4 mA output by going to ADJ4mA using the Next button and press Enter.
	The mA adjustment menu options are not available when the milliamp output is fixed at 4.0 mA (that is, when LOOP MD is set to MA DIS).
A 4mA▲▲	Increases 4 mA output by a large step (0.095 mA).
A 4mA▼▼	Decreases 4 mA output by a large step (0.095 mA).
A 4mA ▲	Increases 4 mA output by a small step (0.003 mA).
A 4mA ▼	Decreases 4 mA output by a small step (0.003 mA).
ADJ20mA	This menu option adjusts the nominal 20 mA output.
	If you configured your transmitter operating mode as 4 to 20 mA, you can adjust the 20 mA output by navigating to ADJ20mA using the Next button and pressing Enter.
	The mA adjustment menu options are not available when the milliamp output is fixed at 4.0 mA (that is, when LOOP MD is set to MA DIS).
A20mA▲▲	Increases 20 mA output by a large step (0.095 mA).
A20mA▼▼	Decreases 20 mA output by a large step (0.095 mA).
A20mA 🔺	Increases 20 mA output by a small step (0.003 mA).
A20mA ▼	Decreases 20 mA output by a small step (0.003 mA).
CALDATE	This menu option allows you to enter the calibration date.
	This entry is not required, but it can be used for record-keeping or plant maintenance purposes. To edit the calibration date, go to CALDATE with the Next button and press Enter. You then can change the day, month, and year. The display shows the last date with the day flashing. Use the Next button to step through the menu of digits to select the desired day, then press Enter. Repeat this process for the month and year.
USRDAYS	Similar to how a trip odometer allows an automobile owner to track the number of miles driven since the last oil change, for example, the Time in Service meter tracks the number of days the pressure transmitter has been in service since the last Time in Service meter reset. For example, the Time in Service meter could be reset back to 0 when the transmitter is calibrated.
	Reset the number of days the transmitter has been in service by navigating to USRDAYS using the Next button.

#### Table 8. Calibration Menu (Continued)

a. This function is not applicable to absolute pressure transmitters

b. Performing the CAL URV function automatically disables FoxCal.

c. It is not necessary to use the ADJ4mA or ADJ20mA menu selections (commonly known as mA Trim) unless there is a plant requirement to make the 4 and 20 mA output values exactly match readings on certain plant calibration equipment and the calibration operations result in small but unacceptable differences between the transmitter mA output and the test equipment mA readout values.

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### Zero Adjustment Using External Zero Button

An optional external zero adjustment mechanism in the electronics housing allows calibration at zero differential pressure (the CAL AT0 function) or at the lower range value differential pressure (the CAL LRV function) without removing the electronics compartment cover. The mechanism is magnetically activated through the housing wall to help prevent moisture from entering the enclosure.

#### 

Do **not** use **CAL AT0** if pressure seals are used that are at different elevations from the transmitter.

To use this feature on transmitters with the optional display:

- 1. Unlatch the external zero button by turning it 90 degrees in a counterclockwise direction so that the screwdriver slot lines up with the two holes in the face of the adjacent part. Do not push the button in with the screwdriver while doing this.
- To set or reset the zero point at zero differential pressure, apply zero differential pressure to the transmitter or use a bypass valve to equalize pressure on both sides of the transmitter. Press the external zero button until the display reads CAL ATO. Release the button. The display reads CALWAIT and then ATOdone (calibration is complete).

To set or reset the 0% of range input, apply the lower range value (LRV) differential pressure to the transmitter and press and hold the external zero button until the display reads CAL LRV (it reads CAL AT0 first). Release the button. The display reads CALWAIT and then LRVdone (calibration is complete).

Other possible messages are:

- DISABLD if EX ZERO is configured as EXZ DIS.
- EXZ DIS IGNORED if the transmitter is not in the on-line mode.
- WP ENAB if the write protection jumper is in write protect position.

If additional rezeroing is required after Steps 1 and 2 have been accomplished, repeat Step 2.

3. Relatch the external zero button by turning it 90 degrees in a clockwise direction to avoid pressing the button accidentally. Do **not** push the button in with the screwdriver while doing this.

If the optional display is not present, you can accomplish the same functions by using the external zero button. Different functions are carried out by pressing the external zero button for different lengths of time. Pressing the button for 1 to 3 seconds allows you to execute a CAL AT0 and pressing the button for 5 or more seconds allows you to execute a CAL LRV.

To use this feature on transmitters without the optional display:

1. Unlatch the external zero button by turning it 90 degrees in a counterclockwise direction so that the screwdriver slot lines up with the two holes in the face of the adjacent part. Do not push the button in with the screwdriver while doing this.

2. To set or reset the zero point at zero pressure, apply zero differential pressure to the transmitter, press the external zero button for 1 to 3 seconds, and then release the button. To set or reset 0% of range input, apply the lower range value (LRV) differential pressure to the transmitter, press and hold the external zero button for at least 5 seconds, and then release the button.

#### NOTICE

#### POTENTIAL MISCONFIGURATION

Use care when using the external zero button without the optional display. You must rely strictly on the length of time you press and hold the external zero button to differentiate between the CAL ATO and CAL LRV.

Failure to follow these instructions can result in misconfiguration.

If additional rezeroing is required after Steps 1 and 2 have been accomplished, repeat Step 2.

3. Relatch the external zero button by turning it 90 degrees in a clockwise direction to avoid pressing the button accidentally. Do not push the button in with the screwdriver while doing this.

### Messages

Parameter	Condition Tested	Message	User Action
Password Protection	Password	BAD PWD	Bad password entered, use another.
Write Protection	Write protection enabled	REJECT	Displays when user attempts an action that is write protected.
ZERO	Internal offset too large	BADZERO	Check applied pressure, configured M1_LRV and configured M1E0FF.
SPAN	Slope too large or too small	BADSPAN	Check applied pressure, configured M1_LRV and configured M1EFAC.
M1_URV	M1_URV > max pressure in EGU	URV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1_URV < min pressure in EGU	URV <fmn< td=""><td>Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.</td></fmn<>	Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.
	$M1_URV = M1_LRV$	LRV=URV	Cannot set span to 0. Check entry. Check M1_LRV.
	M1 turndown exceeds limit	BADTDWN	Check entry. Check M1_LRV.
	URV < 0 with M1 or M2 SqRt	URV <lrv< td=""><td>Square root mode with nonzero LRV is not valid. Change LRV to 0.</td></lrv<>	Square root mode with nonzero LRV is not valid. Change LRV to 0.
M1_LRV	M1_LRV > max pressure in EGU	LRV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1_LRV < min pressure in EGU	LRV <fmn< td=""><td>Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.</td></fmn<>	Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.
	$M1_URV = M1_LRV$	LRV=URV	Cannot set span to 0. Check entry. Check M1_URV.
	M1 turndown exceeds limit	BADTDWN	Check entry. Check M1_URV.

#### Table 9. Calibration Messages

# 6. Using the HART Communicator

S Series pressure transmitters with HART communications may be configured, operated, and calibrated using a HART communicator.

## Connecting the Communicator to the Transmitter

Connect the communicator to the transmitter as shown in "Calibration Setup" on page 73. Also refer to the manual supplied with the communicator.

### Operation

The value of the primary variable in engineering units (PV), the output value of the primary variable in mA (PV Loop Current), the primary variable lower range value (LRV), and the primary variable upper range value (URV) are displayed in the main menu.

### **Online Configuration**

There are two ways to configure your pressure transmitter using a HART communicator: online and offline. The most common practice is to configure your pressure transmitter online. To configure your online transmitter with the communicator:

- 1. Connect your HART communicator to your transmitter loop.
- 2. Select 1 Device Setup from the Online menu.
- 3. Select 3 Basic Configuration or 4 Full Configuration from the next menu.
- 4. If you selected 4 Full Configuration, select 1 View Parameters to view existing parameters or 2 Edit Parameters to edit one or more parameters.



#### Figure 42. Online Configuration Flowchart<sup>(1)</sup>

### Table 10. Online Parameters

Parameter	Description
AO Fixed	Analog Output is set to fixed value (4 mA) when Loop Current Mode is set to fixed (Multi- drop Mode).
AO Saturated	The mA current signal is saturated at either the low or high overrange limit respectively (3.8 mA or 20.5 mA).
Apply Pressure	This reranging function requires the application of pressure. The purpose of this function is to allow the transmitter to determine and change the values of the LRV and URV based on applied pressures.
Database verify	Indicates whether the device is performing database verification actions that are required for SIL compliance. This is always shown as Idle for the current (non-SIL) version of the device.
Date	Date entered in the form mm/dd/yyyy.
DD Revision	Revision level of the device description.
Descriptor	Normally configured as the Tag Name. The description is limited to 16 characters.
Dev id	Uniquely identifies the transmitter when combined with the manufacturer identification and device type.
Display	This feature allows you to select whether the optional local display will show M1 EGU (the primary measurement), M2 EGU (the secondary measurement), or TOGGLE between the two.
Distributor	The company responsible for the distribution of the transmitter to customers.
Electronics Temp Fail	The external temperature failure can be set to Fatal or Non-Fatal.
External Zero	Enabled or Disabled. The External Zero feature allows you to disable the optional external zero pushbutton or enable the button.
Final asmbly num	Number associated with the overall transmitter.
Firmware version	Version of the transmitter firmware.
Fld dev rev	Revision level of the specific transmitter description.
FoxCal On/Off	Enables/disables the FoxCal calibration feature.
Hardware rev	Revision level of the hardware.
Long tag	Normally configured to the plant tag number. The Long Tag is the primary identifier when communicating with a transmitter using the HART communicator. The tag is limited to 32 characters.
Loop current mode	Loop current mode can be Active or Fixed.
	When this parameter is set to Active, the transmitter operates in a standard point-to-point manner with a 4 to 20 mA output signal. When this parameter is Fixed, the transmitter's milliamp output is locked at a fixed value of 4.0 mA.
	If loop mode is fixed, the OUTFAIL, OUT DIR, OFFL MA, and mA adjustment selections will not be available from the menu structure after you save the configuration.
Loop test	Procedure to use the transmitter as a calibration source to check other instruments in the loop.
Lower sensor trim	Lower sensor trim is for calibrating pressure at 0% of transmitter range (LRV).
Manufacturer	The company responsible for the manufacture of the transmitter.
Message	Normally configured as the instrument location. The message is limited to 32 characters.
Model	The model number of the transmitter.
Num req preams	Number of preambles to be sent in a request message from the transmitter to the host.
Physicl signl code	The type of physical layer that has been implemented in the hardware that is responsible for the HART communication port.
Poll addr	A number from 0 through 63.
Pressure Calibration	Calibration procedure using applied pressures.
PV	The primary variable is a dynamic digital value representing the process measurement in selected engineering units.

Parameter	Description
DV % ppgo	This is a variable that tracks digital value representation with regard to the range defined by
	the LRV and URV in normal operating modes.
PV Alrm typ	The user selection for the 4 to 20 mA output setting when a device failure occurs, which can be either Hi (21.0 mA) or Lo (3.55 mA).
PV Damp	Output damping in seconds. Damping can be set to 0, 0.25, 0.5, 1, 2, 4, 8, 16, or 32 seconds.
PV Flow URV	If PV Xfer fnctn is set to square root, this parameter shows the maximum flow rate value corresponding to the PV URV.
PV Loop Current	The PV Loop Current value tracks the digital value representation under normal operating mode.
PV LRL	Minimum usable value for PV LRV (lower sensor range limit).
PV LRV	Primary Lower Range Value in PV units.
PV Min span	Also known as the lower span limit, this is the smallest allowable difference between the URV and the LRV.
PV Offset	PV offset (does not change LRV and URV).
PV Rerange	Allows adjustment of 0 and 100% range values for the Primary Variable.
PV Snsr s/n	Serial number of sensor from which the digital value representation or transmitter variable is primarily derived.
PV Sqrt Cut	Set value of n if PV Xfer fnctn is Sqrt cut 0-20% Flow. This is a user entered value.
PV Unit	PV units (pressure units) when PV Xfer fnctn is linear: inH20 (at 68°F), inHg, ftH20, mmH20, mmHg, psi, bar, mbar, g/Sqcm, kg/Sqcm, Pa, kPa, MPa, torr, atm, inH20@60DegF, mH20, inH204, mmH204.
	PV units (flow units) when PV Xfer fnctn is square root: gal/s, gal/min, gal/h, gal/d, MMgal/d, Cuft/s, Cuft/min, Cuft/h, Cuft/d, Impgal/s, Impgal/min, Impgal/h, Impgal/d, L/s, L/min, L/h, ML/d, Cum/s, Cum/min, Cum/h, Cum/d, bbl/s, bbl/min, bbl/h, bbl/d, t/d, t/h, lb/h, kg/h, Nm3/h, Sm3/h, Am3/h, MMSCFD, MSCFD, %Flow.
PV URL	Maximum usable value for PV URV (upper sensor range limit).
PV URV	Primary Upper Range Value in PV units.
PV Xfer fnctn	Primary Variable Transfer Function (Linear, Sqrt cut<1% DP, Sqrt lin<4% DP, or Sqrt cut 0-20% Flow).
Reset User Days	Allows you to reset User Days (the number of days the transmitter has been powered up since the last Time in Service meter reset) back to zero.
Scaled D/A trim	Calibration procedure to match the 4-20 mA output to the calibration of the receiving device.
Send Master REINIT	Procedure to send a command to re-initialize the transmitter.
SIL Mode	Indicates whether the device is performing more stringent verification activities that are required for SIL compliance. This is always shown as Not Available for the current (non-SIL) version of the device.
Status	Indicates whether the device has detected abnormal operating conditions within the hardware or related to the validity of internal variables.
Status group 0-5	Status groups 0, 1, 2, 3, 4, and 5 consist of conditions related to communications, various device modes, diagnostic messages, input range messages, hardware messages, and failures.
Status group 14-15	Status groups 14 and 15 consist of conditions related to communications, database verification, SIL mode, verification, etc.
SV	The secondary variable is an alternate value representing the process measurement in selected engineering units.
SV Flow URV	If SV Xfer fnctn is set to square root, this parameter shows the maximum flow rate value corresponding to the PV URV.
SV Offset	SV offset. This is a user entered value.
SV Rerange	Allows adjustment of SV Offset and SV Unit for Secondary Variable.

#### Table 10. Online Parameters (Continued)

Parameter	Description
SV Sqrt Cut	Set value of n if SV Xfer fnctn is Sqrt cut 0-20% Flow. This is a user entered value.
SV Unit	SV units (pressure units) when SV Xfer fnctn is linear: inH2O (at 68°F), inHg, ftH2O, mmH2O, mmHg, psi, bar, mbar, g/Sqcm, kg/Sqcm, Pa, kPa, MPa, torr, atm, inH2O@60DegF, mH2O, inH2O4, mmH2O4.
	SV units (flow units) when SV Xfer fnctn is square root:gal/s, gal/min, gal/h, gal/d, MMgal/d, Cuft/s, Cuft/min, Cuft/h, Cuft/d, Impgal/s, Impgal/min, Impgal/h, Impgal/d, L/s, L/min, L/h, ML/d, Cum/s, Cum/min, Cum/h, Cum/d, bbl/s, bbl/min, bbl/h, bbl/d, t/d, t/h, lb/h, kg/h, Nm3/h, Sm3/h, Am3/h, MMSCFD, MSCFD, %Flow.
SV Xfer fnctn	Secondary Variable Transfer Function (Linear, Sqrt cut<1% DP, Sqrt lin<4% DP, or Sqrt cut 0-20% Flow).
Tag	Normally configured to the plant tag number. The Tag Number is the primary identifier when communicating with a transmitter using the HART communicator. The tag is limited to eight characters.
Time in Service Meter	IDP10S transmitters have two ways of tracking the time that a particular transmitter has been in service. Total Days is a non-configurable value that represents the number of days the transmitter has been powered up in the field over its lifetime, and User Days is the number of days the transmitter has been powered up since the last Time in Service meter reset.
Total Days	This parameter allows you to view the number of days that a transmitter has been powered up in the field in its entire lifetime.
TV	The tertiary value is a digital representation of the approximate sensor temperature, which is used internally to compensate pressure calculations.
Universal rev	Revision level of the Universal Device Description that the transmitter conforms to.
Upper sensor trim	Upper sensor trim is for calibrating pressure at 100% of transmitter range (URV).
User Days	User Days is the number of days the transmitter has been powered up since the last Time in Service meter reset.
Write protect	No or Yes. Indicates whether variables can be written to the transmitter or whether commands that cause actions to be performed in the transmitter can or cannot occur.
Zero trim	Calibration procedure to make the sensor input the new zero input reference. Zero trim does not affect span.
4V	The fourth value is a digital representation of the approximate electronics module temperature.

# Calibration

### **PV** Rerange

PV Rerange sets new values for the LRV and URV, which correspond to the 4 mA and 20 mA output values. The 4 to 20 mA output signal is always linked to the PV.

Two selections are provided for reranging the PV. Neither selection affects the calibration of the transmitter.

- Edit LRV URV
- Apply pressure (Linear Mode Only)

### Edit LRV and URV

This reranging function does not require the application of pressure. If the transmitter has pressure applied, it is not used for the editing function and does not affect the result. The purpose of this function is to allow keying in new known values of the LRV and URV. For example, use this function to change the range from '0 to 200 inH<sub>2</sub>O' to '0 to 100 inH<sub>2</sub>O'. The LRV and URV can be independently edited. Changing the LRV does not affect the URV and vice versa. Changing either value alone changes the span.

### Apply Pressure (Linear Mode Only)

This reranging function requires the application of pressure. The purpose of this function is to allow the transmitter to determine and change the values of the LRV and URV based on applied pressures. Use this function if the range of the transmitter is to be reset to unknown values. For example, if the liquid level in a tank is brought to the minimum level that is to correspond to the new LRV (4 mA point), this function enables the transmitter to rewrite its LRV and provide a 4 mA output at that level. Similarly, if the level is brought to the maximum level, this function enables the transmitter to rewrite at that level.

Changing the LRV automatically changes the URV by the same amount, keeping the span unchanged. Changing the URV has no effect on the LRV and thus the span is changed.

### PV Offset

When PV is in Linear mode, a function named PV Offset is accessible from 1 Device Setup > 4 Full Configuration > 1 View Parameters or 2 Edit Parameters. Editing PV Offset causes both the PV and mA output to have an offset without changing either the LRV or URV. For example, if a transmitter has a range of 0 to 100 inH<sub>2</sub>O (LRV = 0 and URV = 100), entering a value of -10 for PV Offset causes the transmitter to provide a PV reading of 10 inH<sub>2</sub>O and a mA output of 5.6 mA when applied pressure is 0 inH<sub>2</sub>O.

### PV Flow URV

When PV is in Square Root mode, a function named PV Flow URV is accessible from 1 Device Setup > 4 Full Configuration > 2 Edit Parameters. It is also automatically displayed in Square Root mode when PV Units are changed. PV Flow URV allows the entry of the maximum flow rate value corresponding to the PV URV and the 20 mA output.

### SV Rerange

A transmitter having PV in Square Root mode can have SV in Linear mode and vice versa. This allows easy checking of the measured differential pressure when a transmitter is configured for square root operation.

SV Rerange does not function like PV Rerange. Instead it allows you to perform the SV Offset and SV Flow URV function. SV Offset and SV Flow URV provide a similar function to the corresponding PV functions.

### Pressure Calibration

Use this procedure if you wish to perform a calibration with applied pressure. Apply a pressure to your transmitter that is equal to or near the LRV. Key in that pressure as the pressure for the lower trim point when requested. Similarly, apply a pressure equal to or near the URV and key in that pressure for the upper trim point.

Foxboro transmitters are factory characterized and calibrated. There is usually no need for the user to do a pressure calibration. The Zero Trim function can be used to correct for position effects and Reranging can be used to change the range. Your transmitter uses its factory entered and stored characterization and calibration data to convert any input pressure within range limits to a digital value of pressure which can be transmitted, displayed, and converted into a mA current signal.

However, if a pressure calibration is desired, use the Pressure Calibration function to trim the internal digital values of the interpreted pressures based on precise user entered values of the applied lower and upper range pressures.

Also, at times it is desirable to perform a single point calibration (or zeroing) with a nonzero pressure input while not affecting the span. For example, to zero an absolute pressure transmitter at a measured atmospheric pressure, use a trim point within the Pressure Calibration function to achieve a single point calibration that does not change the span.

### NOTICE

### POTENTIAL REDUCED PERFORMANCE

The accuracy of the input pressure for field span calibration should be a minimum of four times better than the transmitter's reference accuracy specification. An inaccurate span pressure input typically results in degradation of transmitter performance from the factory calibrated state.

Failure to follow these instructions can result in reduced performance.

### Zero Trim

This procedure is used for adjusting the lower trim point to compensate for positioning effects. Set up the calibration equipment per your transmitter instruction. See the "Calibration" chapter. Zero trim has no effect on the LRV. Zero Trim requires the application of zero pressure (or equal pressures on both sides of a differential pressure transmitter). The LRV does not have to be zero. Do **not** use Zero Trim on an absolute pressure transmitter unless the transmitter has full vacuum applied.

### Scaled D/A Trim

If you use the 4 to 20 mA output, you can trim the output at 4 mA and 20 mA or at other values by connecting a digital voltmeter and precision resistor in the output loop and adjusting the output with this procedure. Set up the calibration equipment using instructions in the "Calibration" chapter.

Application of pressure is not required. This adjustment has no effect on the internal digital interpretation of pressure or on the displayed and transmitted digital values representing the applied pressures. It only trims the conversion of the digital values of pressure to the transmitted 4 to 20 mA analog signal.

#### - NOTE

It is not normally necessary to use this procedure. However, in special cases it can be used to eliminate minor differences between the transmitter mA output and plant test equipment mA readings.

### Time in Service Meter

IDP10S transmitters have two ways of tracking the time that a particular transmitter has been in service. Total Days is a non-configurable value that represents the number of days the transmitter has been powered up in the field over its lifetime, and User Days is the number of days the transmitter has been powered up since the last Time in Service meter reset.

### Viewing the Total Days

To view the number of days that a transmitter has been in the field, and then use the 1 Device Setup > 2 Calibration > Time in Service Meter menu selection.

### Resetting User Days

You can reset the number of User Days to zero at any point. You may want to reset this value to zero when the transmitter is calibrated or reset, for example.

To reset the number of days that a transmitter has been in service since the last Time in Service meter reset, use the 1 Device Setup > 2 Calibration > Reset User Days menu selection.

### Enabling and Disabling the FoxCal Calibration Feature

The transmitter can be shipped with or without FoxCal enabled. Refer to the "Calibration" chapter for information on the multiple calibration feature.

If you need to turn FoxCal on or off, use the 1 Device Setup > 2 Calibration > FoxCal On/Off menu selection.

#### NOTICE

#### POTENTIAL REDUCED PERFORMANCE

When disabling FoxCal calibration, the last two-point calibrated range may not match the current configuration of the Lower Range Value and Upper Range Value. For optimal performance, avoid large mismatches.

Failure to follow these instructions can result in reduced performance.

#### - NOTE -

- 1. For best results in applications where high accuracy is required, rezero the transmitter output once it has stabilized at the final operating temperature.
- 2. Zero shifts resulting from position effects can be eliminated by rezeroing the transmitter output.

After calibrating transmitters operating with a 4 to 20 mA (or 1 to 5 Vdc) output signal, check the underrange and overrange output values to ensure that they extend beyond 4 and 20 mA (or 1 and 5 Vdc) respectively.

# 7. Maintenance

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### EXPLOSION HAZARD

For nonintrinsically safe installations, to help prevent a potential explosion in a Division 1 hazardous area, de-energize transmitters before you remove the threaded housing covers.

For explosion proof and non-incendive installations, do not disconnect equipment when a flammable or combustible atmosphere is present.

Failure to follow these instructions can result in death or serious injury.

### Parts Replacement

Parts replacement is generally limited to the terminal block assembly, sensor assembly, optional display, and cover o-rings.

#### - NOTE

For optimum transmitter performance, send the transmitter to the factory to replace parts. Removing the process covers may require recalibration of the transmitter for FoxCal.

### Replacing the Terminal Block Assembly

To replace the terminal block assembly, proceed as follows:

- 1. Turn off the transmitter power source.
- 2. Remove the covers from the field terminals and electronics compartments by rotating the covers counterclockwise. Screw in cover lock if applicable.
- 3. Remove the digital display (if applicable) as follows: grasp the two tabs on the display and rotate it about 10° in a counterclockwise direction.
- 4. Remove the electronics module from the housing by loosening the two captive screws that fasten it to the housing. Then pull the module out of the housing far enough to gain access to the cable connectors on the rear of the module.
- 5. Remove the four socket head screws fastening the terminal block.
- 6. Disconnect the terminal block cable connector from the electronics module.
- 7. Remove the terminal block and the gasket under it.
- 8. Connect the new terminal block cable connector to the electronics module.
- 9. Install the new terminal block and new gasket and reinstall the four screws to 0.67 N-m (6 lbf-in) in several even increments.
- 10. Reinstall the electronics module (and digital display, if applicable).

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- 11. Reinstall the covers onto the housing by rotating them clockwise to seat the o-ring into the housing and then continue to hand tighten until the each cover contacts the housing metal-to-metal. If cover locks are present, lock the cover per the procedure described in "Cover Locks" on page 39.
- 12. Turn on the transmitter power source.

### Replacing the Sensor Assembly

To replace the sensor assembly (see Figure 43), proceed as follows:

- 1. Turn off the transmitter power source and disconnect the customer termination wires.
- 2. Remove the electronics compartment cover by rotating it counterclockwise. Screw in cover lock if applicable.
- 3. Remove the digital display (if applicable) as follows: Grasp the two tabs on the display and rotate it about 10° in a counterclockwise direction. Pull out the display and remove its cable.
- 4. Remove the electronics module from the housing by loosening the two captive screws that fasten it to the housing. Then pull the module out of the housing far enough to gain access to the cable connectors on the rear of the module.

#### NOTICE

#### POTENTIAL EQUIPMENT DAMAGE

The electronics module is "one assembly" at this point and is electrically and mechanically connected to topworks with a flexible ribbon signal cable, a 2-wire power cable, and in some cases, a cable for an external zero pushbutton. Do not exceed the slack available in these cables when removing the assembled module.

Handling electronics without proper grounding may cause ESD damage to critical electronic components and result in electronics module failure.

Failure to follow these instructions can result in equipment damage.

- 5. Unplug all cable connectors from the rear of the electronics module and place the module on a clean surface. Be careful when removing the cable connectors from the headers on the electronics module or damage may occur. Connectors must be disconnected by gently rocking while pulling them away.
- 6. Remove the red lacquer from the screw recess in the housing's retention clip. Remove the screw completely, and slide the clip off the housing. Save the clip and screw for future use.
- 7. Remove the housing by rotating it counterclockwise (when viewed from the top). Use caution to avoid damaging the sensor cable.
- 8. Remove the process covers from the sensor by removing the two hex head bolts and nuts.
- 9. Replace the gaskets in the process covers.

- 10. Install the process covers on the new sensor. (For Process Connector Code 7, place the PVDF insert into the process cover and then place the gasket into the PVDF insert as shown in Figure 44.) Tighten the cover bolts to a torque of 100 N-m (75 lbf-ft) in several even increments. Torque values are 68 N-m (50 lbf-ft) when 316 ss bolts are specified; 75 N-m (55 lbf-ft) when B7M bolts are specified.
- 11. Apply silicone lubricant (Part Number 0048130 or equivalent) to the o-ring.
- 12. Before installing the o-ring on the neck of the sensor, protect the o-ring from damage during installation by covering the threads and edges on the neck. Verify that the o-ring is properly installed in the groove and is not twisted.
- 13. Apply lubricant to the sensor neck threads. Use Lubriplate/X0114AT for aluminum housings (provided in Kit X0118CC) or Never Seez/X0114AA for stainless steel housings.

#### A WARNING

#### EXPLOSION HAZARD

Failure to reuse or install the proper o-ring for a CSA labeled product violates ANSI/ISA 12.27.01.

Failure to follow these instructions can result in death or serious injury.

- 14. Pass sensor cable through the hole in the bottom of the housing. Do no damage the wire insulation. Thread the housing onto the neck until the housing bottoms out. Back off no more than one turn to orient the housing to the sensor.
- 15. Apply thread locker (PN S0106ML) to the threads of the screw. Install the antirotation clip and screw. Torque the screw to 7 ±1 lbf-in.
- 16. Apply torque sealant into hex of screw only.
- 17. Re-install the electronics module by inserting the sensor cable and power cable into the module receptacles. Apply silicone grease sparingly to the o-ring circumference of the module. Rotate the module two rotations and install the module into the housing and torque to  $7 \pm 1$  lbf-in.

#### NOTICE

#### POTENTIAL EQUIPMENT DAMAGE

Do not pinch cables between the housing and module.

Failure to follow these instructions can result in equipment damage.

18. For Display option code -L1, apply silicone grease sparingly to the o-ring circumference of the display module. Connect the cable ends to the electronics and display modules. Install the display module by rotating it into the electronics module to an upright position. 19. Pressure test the sensor and process cover assembly on the high pressure side by applying a hydrostatic pressure of 150% of the maximum overrange pressure rating to the process cover/sensor assembly simultaneously through the process connection. Hold pressure for one minute. There must be no leakage of the test fluid through the gasket. If leakage occurs, retighten the cover bolts per Step 10 (or replace the gasket) and retest.

### 

#### RISK OF POTENTIAL INJURY AND/OR REDUCED PERFORMANCE

Perform hydrostatic test with a liquid and follow proper hydrostatic test procedures.

Failure to follow these instructions can result in injury or reduced performance.

- 20. Reinstall the customer termination wires.
- 21. Reinstall the covers onto the housing by rotating them clockwise to seat the o-rings into the housing. Continue to hand-tighten until the cover contacts the housing metal-to-metal. If cover locks are present, lock the cover as described in "Cover Locks" on page 39.
- 22. Turn on the transmitter power source.



Figure 44. Bottomworks with Process Connector Code 7 (PVDF Inserts)



### Adding the Optional Display

To add the optional display, refer to Figure 45 and proceed as follows:

- 1. Turn off the transmitter power source.
- 2. Remove the electronics compartment cover by rotating it counterclockwise. Screw in cover lock if applicable.
- 3. Plug the display into the receptacle at the top of the electronics assembly.
- 4. Ensure that the o-ring is seated in its groove in the display housing. Then insert the display into the electronics compartment by grasping the two tabs on the display and rotating it about 10° in a clockwise direction.
- 5. Install the new cover (with a window) onto the housing by rotating it clockwise to seat the o-ring into the housing, then continue to hand-tighten until the cover contacts the housing metal-to-metal. If cover locks are present, lock the cover as described in "Cover Locks" on page 39.
- 6. Turn on the transmitter power source.



# Rotating Process Covers for Venting

Your transmitter provides sensor cavity draining without the need for side drain connections, regardless of whether the transmitter is mounted vertically or horizontally. Sensor cavity venting is provided by mounting the transmitter horizontally or with the optional vent screw (-V). However, if you did not specify this option, you can achieve venting (instead of draining) with vertical mounting by rotating the process covers.



Figure 46. Sensor Cavity Venting and Draining

To rotate the process covers, proceed as follows:

- 1. Turn off the transmitter power source and remove the transmitter from the process.
- 2. Remove the process covers from the sensor by removing two hex head bolts.
- 3. Replace the gaskets in the process covers.
- 4. Rotate the process covers so that the longer tab is at the bottom.
- Reinstall the process covers and bolts. Torque cover bolts to 100 N-m (75 lbf-ft) in several even increments. Torque values are 68 N-m (50 lbf-ft) for 316 ss bolts; 75 N-m (55 lbf-ft) for B7M bolts.
- 6. Pressure test the sensor and process cover assembly by applying a hydrostatic pressure of 150% of the maximum static and overrange pressure (see "Standard Specifications" on page 16) to both sides of the process cover/sensor assembly simultaneously through the process connections. Hold pressure for one minute. There should be no leakage of the test fluid through the gaskets. If leakage occurs, re-tighten the cover bolts per Step 5 or replace the gaskets and retest.

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RISK OF POTENTIAL INJURY AND/OR REDUCED PERFORMANCE

Perform hydrostatic test with a liquid and follow proper hydrostatic test procedures.

Failure to follow these instructions can result in injury or reduced performance.

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