Instruction

MI 020-601
September 2014

Foxboro® Pressure S Series Transmitters

IAP10S Absolute Pressure and IGP10S Gauge Pressure with HART Communication

Installation, Operation, Calibration, Configuration, and Maintenance

Foxboro®
by Schneider Electric

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1. Introduction

General Description

The IAP10S Intelligent Absolute Pressure and IGP10S Intelligent Gauge Pressure Transmitters measure pressure by applying the pressure to a piezoresistive silicon microsensor within the sensor assembly. This microsensor converts the pressure to a change in resistance, and the resistance change is converted to a 4 to 20 mA or digital signal proportional to the 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 can be supplied with direct connected pressure seals or with remote pressure seals.

For more detailed information on the principle of operation of the transmitter, refer to document TI 037-096.

Reference Documents

Table 1. Reference Documents

Document	Description
Product Specification Sheets	
PSS 2A-1C13 P	Models IAP10S and IGP10S Absolute and Gauge Pressure Transmitters with HART Communication Protocol
Dimensional Prints	
DP 020-343	Dimensional Print – PSFPS and PSFES Pressure Seals
DP 020-345	Dimensional Print – PSFAR Pressure Seals
DP 020-346	Dimensional Print – PSFAD Pressure Seals
DP 020-347	Dimensional Print – PSTAR Pressure Seals
DP 020-348	Dimensional Print – PSTAD Pressure Seals
DP 020-349	Dimensional Print – PSISR Pressure Seals
DP 020-350	Dimensional Print – PSISD Pressure Seals
DP 020-351	Dimensional Print – PSSCR Pressure Seals
DP 020-354	Dimensional Print – PSSSR Pressure Seals
DP 020-357	Dimensional Print – PSFFD Pressure Seals
DP 020-463	Dimensional Print – IAP10S Absolute Pressure and IGP10S Gauge Pressure Transmitters
Parts Lists	
PL 009-025	Parts List – IAP10/IAP10S Absolute and IGP10/IGP10S Gauge Pressure Transmitters
Instructions	
MI 020-369	Instruction – Pressure Seals
MI 020-541	Instruction – I/A Series® Pressure S Series Transmitters FM/CSA Safety Information
MI 020-542	Instruction – I/A Series® Pressure S Series Transmitters ATEX/IECEx Safety Information
MI 020-501	Instruction – PC50 Intelligent Field Device Tool (Installation and Parts List)

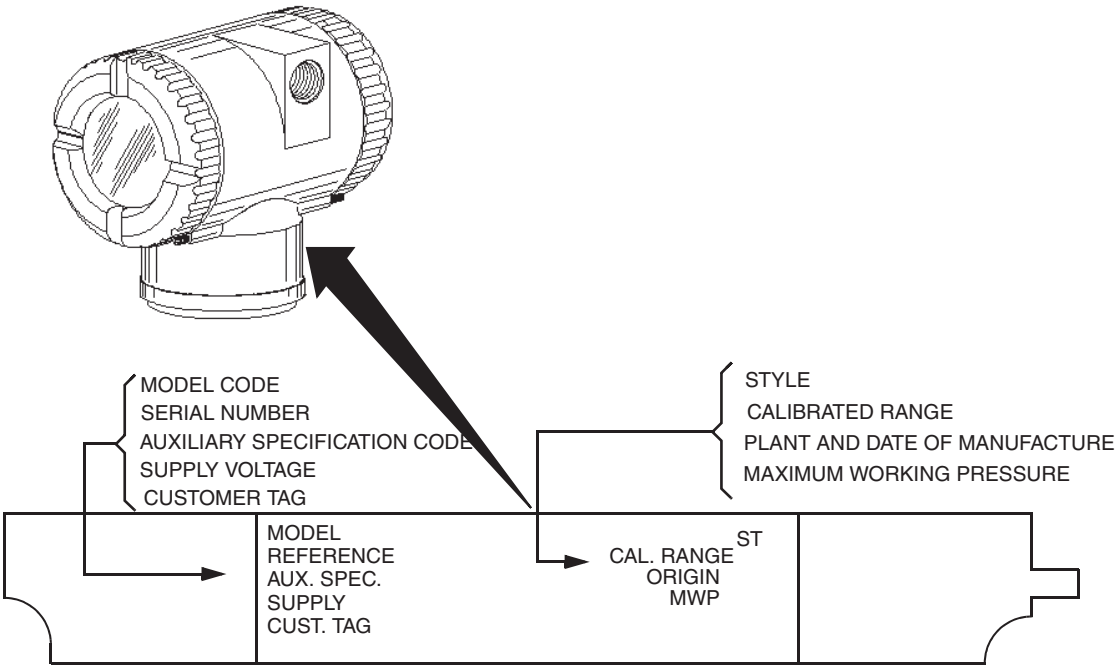
Table 1. Reference Documents (Continued)

Document	Description
MI 020-520	Instruction — PC50 Intelligent Field Device Tool with Advanced DTM Library
Technical Information	
TI 37-75b	Technical Information – Transmitter Material Selection Guide
TI 037-097	Technical Information – Process Sealing of I/A Series 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 15).

Figure 1. Transmitter Identification



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 Chapter 3, "Operation Via Local Display".

Standard Specifications

Operative Limits

Influence	Operative Limits (a)
Sensor Body Temperature (b) Silicone Fill Fluid Fluorinert Fill Fluid	 -46 and +121°C (-50 and +250°F) -29 and +121°C (-20 and +250°F)
Electronics Temperature With LCD Display	-40 and +85°C (-40 and +185°F) (c) -40 and +85°C (-40 and +185°F) (d)
Relative Humidity	0 and 100% (e)
Supply Voltage	11.5 and 42 V dc
Output Load (f)	0 and 1450 ohms
Mounting Position	No Limit
Vibration	With aluminum housing: ▸ 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. With stainless steel housing: ▸ 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.

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

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

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

d. Display updates are slowed and readability decreased at temperatures below -20°C (-4°F).

e. The relative humidity refers to transmitters with the housing covers installed. To maintain IEC IP66/IP68 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.

f. 250 Ω minimum load is required for communication with a HART communicator.

Span and Range Limits

Model	Span Limit Code	Normal Operating Span	Span Limits	Range Limits
IAP10S	C	3 to 30 psia 0.021 to 0.21 MPaa	0.5 and 30 psia 0.0034 and 0.21 MPaa	0 and 30 psia 0 and 0.21 MPaa
	D	2.5 to 200 psia 0.017 to 1.38 MPaa	0.5 psia and 200 psia 0.0034 and 1.38 MPaa	0 psia and 200 psia 0 and 1.38 MPaa
	E	25 to 2000 psia 0.17 to 13.8 MPaa	5 and 2000 psia 0.034 and 13.8 MPaa	0 and 2000 psia 0 and 13.8 MPaa
IGP10S	C	3 to 30 psi 0.021 to 0.21 MPa	0.3 and 30 psi 0.002 and 0.21 MPa	0 and 30 psi 0 and 0.21 MPa
	D	2.5 to 200 psi 0.017 to 1.38 MPa	0.5 and 200 psi 0.0034 and 1.38 MPa	0 and 200 psi 0 and 1.38 MPa
	E	25 to 2000 psi 0.17 to 13.8 MPa	5 and 2000 psi 0.034 and 13.8 MPa	0 and 2000 psi 0 and 13.8 MPa
	F (a)	75 to 6000 psi 0.52 to 41.4 MPa	75 and 6000 psi 0.52 and 41.4 MPa	0 and 6000 psi 0 and 41.4 MPa

a. Not available with pressure seals.

Maximum Overrange Pressure and Proof Pressure

Span Limit Code	Maximum Overrange Pressure (a)	Proof Pressure (b)
C	0.31 MPa (45 psi)	827 kPa (120 psi)
D	2.1 MPa (300 psi)	5.51 MPa (800 psi)
E	20.7 MPa (3000 psi)	55.1 MPa (8000 psi)
F (c)	58 MPa (8400 psi)	165 MPa (24000 psi)

a. Values listed are in absolute or gauge pressure units, as applicable.
b. Meets ANSI/ISA Standard S82.03-1988
c. Applicable to IGP10S transmitter only.

! CAUTION

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

Sensor Fill Fluid

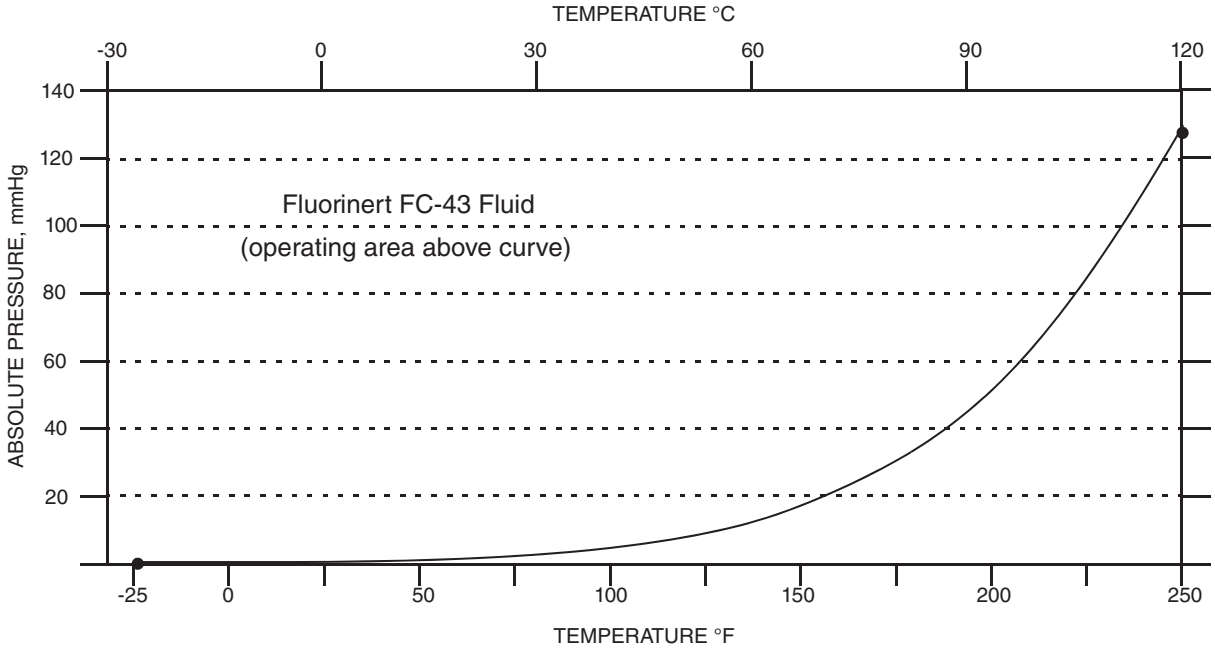
Silicone Oil (dodecamethylpentasiloxane 5cSt) or Fluorinert (FC-43)

Minimum Allowable Absolute Pressure vs. Process Temperature

IGP10S: Not Applicable.

IAP10S: With Silicone Fill Fluid: Up to 121°C (250°F) at full vacuum.
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 with considerations specified in Chapter 2, "Installation". It can be directly mounted to the process with either the direct connected or pipe mounted designs. 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 24. 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 25.

NOTE

1. The transmitter should be mounted 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

IAP10S, IGP10S:	1.4 kg (3.1 lb)
With 316 ss housing:	Add 1.1 kg (2.4 lb)
With optional display:	Add 0.2 kg (0.4 lb)
With pressure seals:	Varies with seal used

Process Connections

IAP10S and IGP10S transmitters can be directly connected to the process using its 1/2 NPT external thread or optional G 1/2 B connection. If an optional mounting bracket is used, the transmitter can be connected to the process via the 1/2 NPT external thread, 1/4 NPT internal thread, or optional G 1/2 B connection.

Process Wetted Materials

Diaphragm:	Co-Ni-Cr, 316L ss, or nickel alloy (equivalent to Hastelloy® C-276 (a))
Process Connectors:	316L ss or nickel alloy (equivalent to Hastelloy® C-276)
Pressure Seals:	Refer to MI 020-369

a. Hastelloy is a registered trademark of Haynes International, Inc.

Reference Pressure Side (Low Pressure Side) Materials

IGP10S: Silicon, Pyrex, RTV, and 316L ss.

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. To maintain RFI/EMI, environmental, and explosionproof ratings,

unused conduit connection must be plugged with metal plug (provided), inserted to five full threads for 1/2 NPT connections; seven full threads for M20 connections

Field Wiring Reversal

Accidental reversal of field wiring will 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 will not damage the electronics module or sensor, but could 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.

NOTE

Selecting a value of `DAMP 0` in the damping menu will provide the fastest response.

Transmitter Response Time

With damping set to 0 s, the transmitter response time is less than 100 ms for a 63% response to a pressure step change.

Output Signal

Output is 4 to 20 mA dc linear with digital HART communications. For multidrop applications, the mA signal is fixed at 4 mA to provide power to the device.

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

Power supply must be capable of providing 23 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 26. A summary of the minimum requirements is listed in the following table.

Table 2. Minimum Loop Load and Supply Voltage Requirements

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

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, earth (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 26. 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 mV dc 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. Percent Output on local display is also supported.
- Zero and Span, including reranging
- Zero Elevation or Suppression
- Linear Output
- Pressure Units (from list provided)
- Temperature Sensor Failure Strategy
- User Damping (Process Noise Damping)
- Poll Address
- Loop Current Mode (Active or Fixed)
- External Zero (Enable or Disable)
- Failsafe Direction (Fail High or Fail Low)
- 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.

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

DANGER

To prevent possible explosions and to maintain flameproof, explosionproof, and dust-ignitionproof 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.

WARNING

To maintain IEC IP66/IP68 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.

NOTE

1. 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 Invensys.
2. Wiring restrictions required to maintain electrical certification of the transmitter are provided in these instructions. See “Wiring” on page 26.

Table 3. Electrical Safety Specifications

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
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
INMETRO intrinsically safe, Ex ia IIC.	Temperature Class T4, Ta = -40°C to +80°C.	BA
INMETRO flameproof, Ex d IIC.	Temperature Class T4, T85°C, Ta = -40°C to +75°C.	BD
INMETRO multiple certifications, ia, ic.	Applies to Codes BA and BN.	BM
INMETRO protection type n, Ex ic IIC.	Temperature Class T4, Ta = -40°C to +80°C.	BN
INMETRO multiple certifications, ia, ic, and d.	Applies to Codes BA, BN and BD.	BP
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 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
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°C to +75°C.	ED
IECEx multiple certifications, ia, ic, nA.	Applies to Codes EA and EN.	EM
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
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
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
Multi-marked for ATEX, CSA, and FM Intrinsically Safe Application.	Applies to Codes FA, CA and AA	MA
NEPSI intrinsically safe, Ex ia IIC.	Temperature Class T4, Ta = -40°C to +80°C.	NA
NEPSI flameproof, Ex d IIC	Temperature Class T6, T85°C, Ta = -40°C to +75°C.	ND
NEPSI multiple certifications, ia, ic	Applies to Codes NA and NN	NM
NEPSI protection type n, Ex ic IIC	Temperature Class T4, Ta = -40°C to +80°C.	NN
NEPSI multiple certifications, ia, ic, and d	Applies to Codes NA, NN and ND.	NP
No certification		ZZ

a. Transmitter has been designed to meet the electrical safety descriptions listed. Contact Invensys Operations Management for information or status of testing laboratory approvals or certifications.

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

c. Refer to applicable Instruction Manual for application conditions and connectivity requirements.

d. When selecting Safety Design Code AP, AM, NM, NP, EM, EP, BP, or BM, the user must permanently mark (check off in rectangle block on data plate) one type of protection only (ia and ib, d, or n). Do not change this mark once it has been applied.

e. 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 Warnings

Do not open while circuits are energized.

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

⚠ CAUTION

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

NOTE

1. The transmitter should be mounted 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 IAP10S and IGP10S transmitters with the 1/2 NPT external thread can be directly connected to the process or mounted to a vertical or horizontal pipe or a surface using the optional mounting set. See Figure 3.

For dimensional information, refer to DP 020-463.

Take the following mounting considerations into account:

- Do **not** directly mount the IAP10S and IGP10S transmitters to the process using the 1/4 NPT internal thread. This thread should only be used to connect to the process when the transmitter is mounted with an optional mounting set (Options -M1 through -M8).
- Do not mount IAP10S or IGP10S transmitters using the conduit connection and optional mounting set (-M1 through -M6) when vibration conditions exceed 20 m/s^2 (2 “g”).
- If the transmitter is not installed in the vertical position, readjust the zero output to eliminate the position zero effect. Be aware that an absolute pressure transmitter cannot be zeroed by venting the transmitter to atmosphere.

NOTE

1. Where necessary, intrinsically safe equipment may be connected and disconnected while the circuits are energized.
2. 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 above the maximum surface temperature marked in the dust coding.
3. The equipment is only certified for use in ambient temperatures marked on the equipment and should not be used outside this range.
4. The maximum process pressure indicated on the marking must not be exceeded.

5. There are no special checking or maintenance conditions. All explosion-protected equipment should be periodically inspected in accordance with the applicable code of practice.

! CAUTION

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.

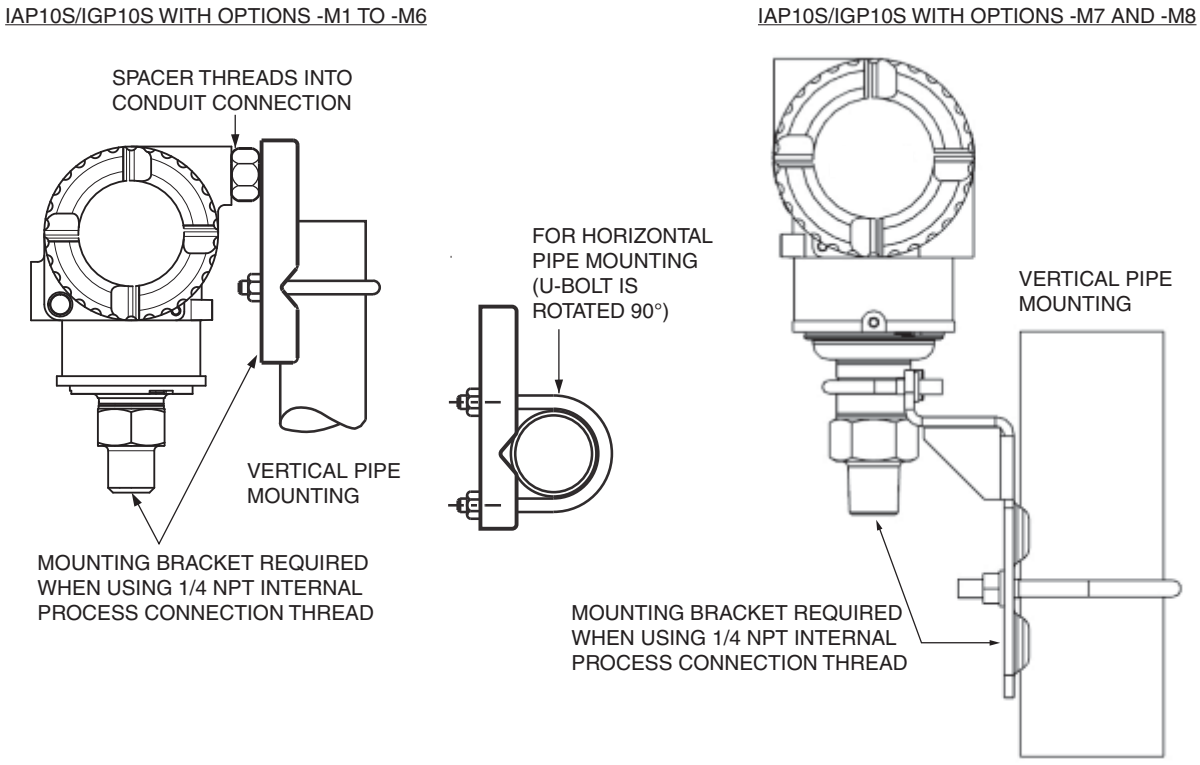
! WARNING

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, the user/installer must 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.

! WARNING

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

Figure 3. IAP10S and IGP10S Transmitter Mounting



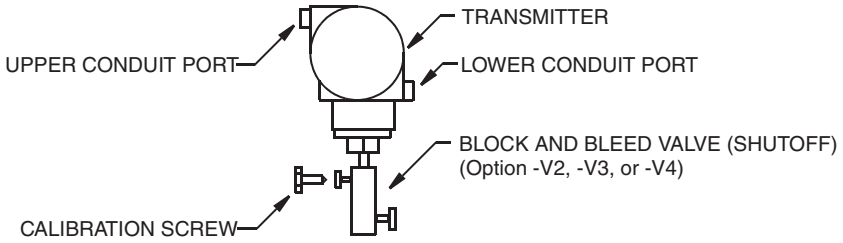
Typical Transmitter Piping

Figure 4 shows a typical piping application. Calibration supply pressure can be applied via a calibration screw. The lower conduit port can be used as a drain for moisture buildup in terminal compartment.

NOTE

1. Invensys recommends the use of snubbers in installations prone to high levels of fluid pulsations.
2. IAP10S and IGP10S Transmitters mounted directly to process piping or a pressure vessel could require the use of a shutoff valve (shown) to comply with the requirements of ASME Power Piping Code B31.1 and Chemical and Petroleum Piping Code B31.3.

Figure 4. Typical Transmitter Piping



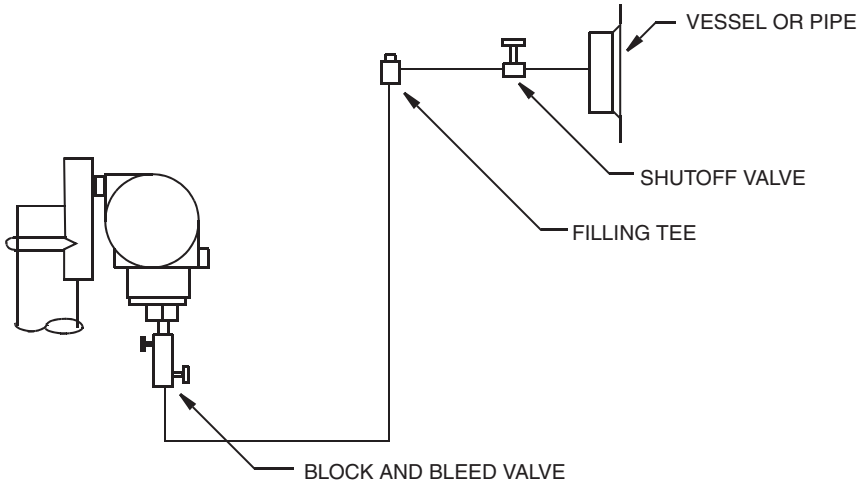
NOTE

1. Block and Bleed Valve Maximum Pressure
   40 MPa (6000 psi at 38°C) (100°F)
   25 MPa (4000 psi at 250°C) (400°F)
2. Calibration Screw Maximum Pressure
   0.7 MPa (100 psi with Poly-Flo Fitting) (F0101ES)

For hot process applications above the operative limits of your transmitter [121°C (250°F) for silicone fill fluid or 82°C (180°F) for fluorinert fill fluid], such as steam, additional piping is required to protect the transmitter from the hot process. See Figure 5. The piping is filled with water or process fluid. Mount the transmitter below the pressure connection at the pipe. Although the transmitter is shown mounted vertically, you can also mount it horizontally unless sediment is present. The calibration tee is not required if a calibration screw is used for field calibrations.

If trapped vapor pockets cannot be tolerated in a liquid service and a horizontal process connection is used, install a pipe elbow and vertically position the transmitter with the housing **below** the process connection.

Figure 5. Hot Process Piping



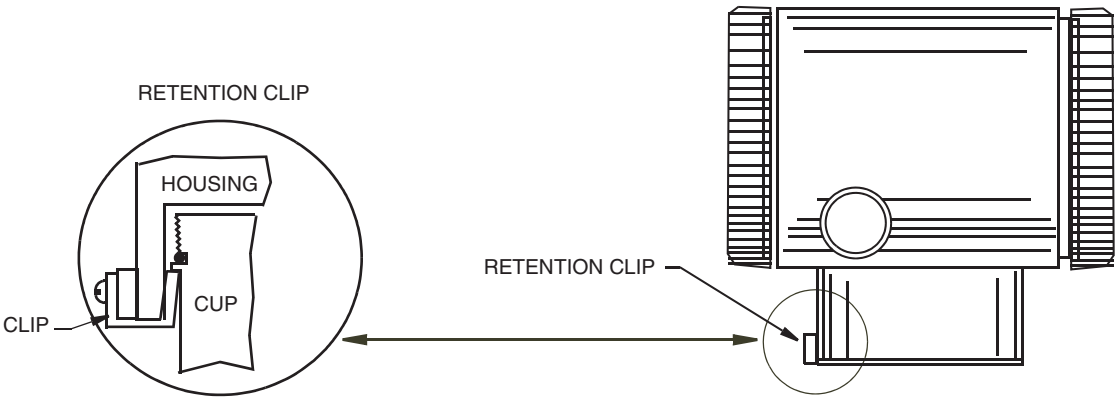
Positioning the Housing

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.

WARNING

If the electronics housing is removed for maintenance, it must be hand tightened to the bottom of the threads, but not over-tightened upon reassembly. See "Removing and Reinstalling a Housing Assembly" on page 74.

Figure 6. 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.

⚠ CAUTION

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

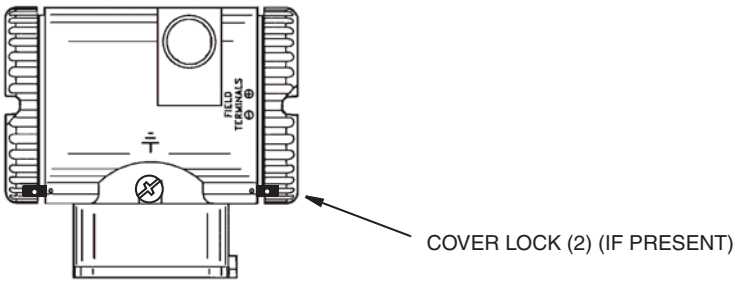
Setting the Write Protect Jumper

Your transmitter has write protection capability. This means that external zero, local display, and remote communications can be prevented from writing to the electronics. Write protection is set 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 the previous section, 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 7, 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.

Figure 7. Cover Lock Location



Wiring

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

WARNING

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

NOTE

It is recommended that you 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 8. Note that the embossed letters `FIELD TERMINALS` identify the proper compartment.

Figure 8. Accessing Field Terminals

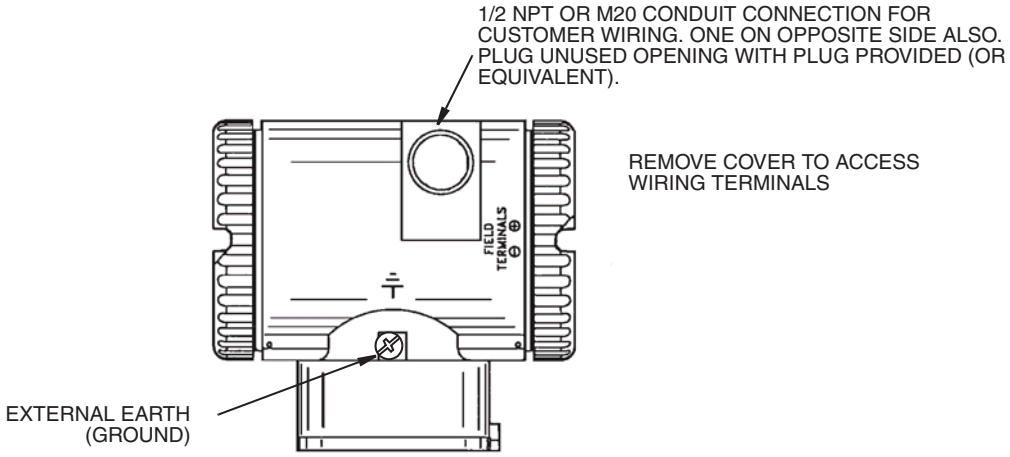
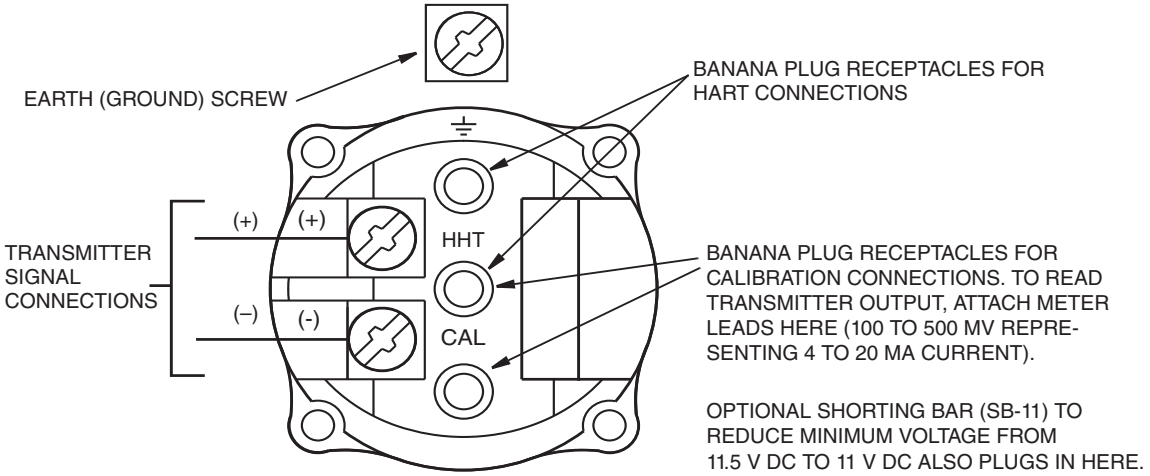


Figure 9. Identification of Field Terminals



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 10, is:

$R_{max} = 47.5 (V - 11.5)$

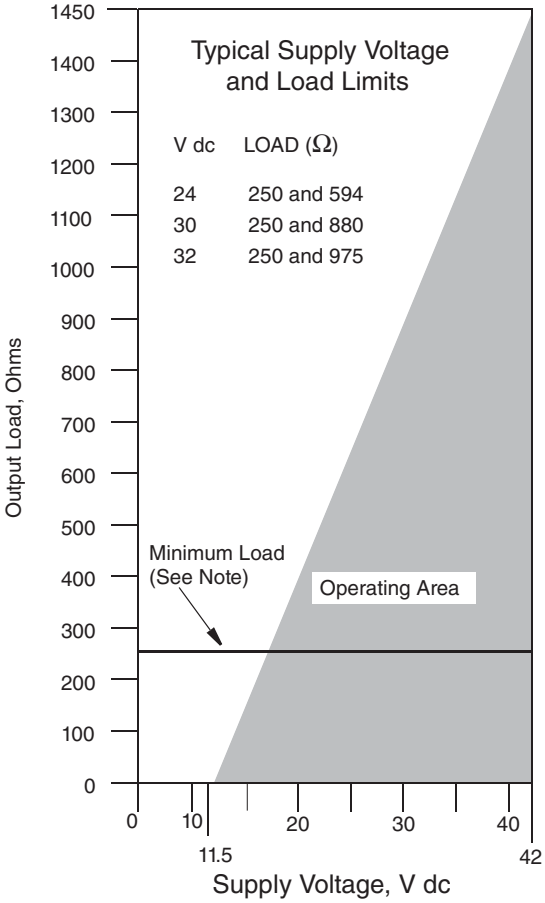
NOTE

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 10. 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.

Figure 10. Supply Voltage and Loop Load



NOTES:
1. The minimum load for the HART communicator is 250 Ω.
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 disturbances and/or communication failure.

Examples:

1. For a loop load resistance of 880 Ω, the supply voltage can be any value from 30 to 42 V dc.
2. For a supply voltage of 24 V dc, the loop load resistance can be any value from 250 to 594 Ω (zero to 594 Ω without a HART communicator connected to the transmitter).

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

1. Remove the cover from the transmitter field terminals compartment.
2. Run signal wires (0.50 mm^2 or 20 AWG, typical) through one of the transmitter conduit connections. Use twisted single pair to 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.
     Screened (shielded) cable could be required in some locations.

NOTE

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

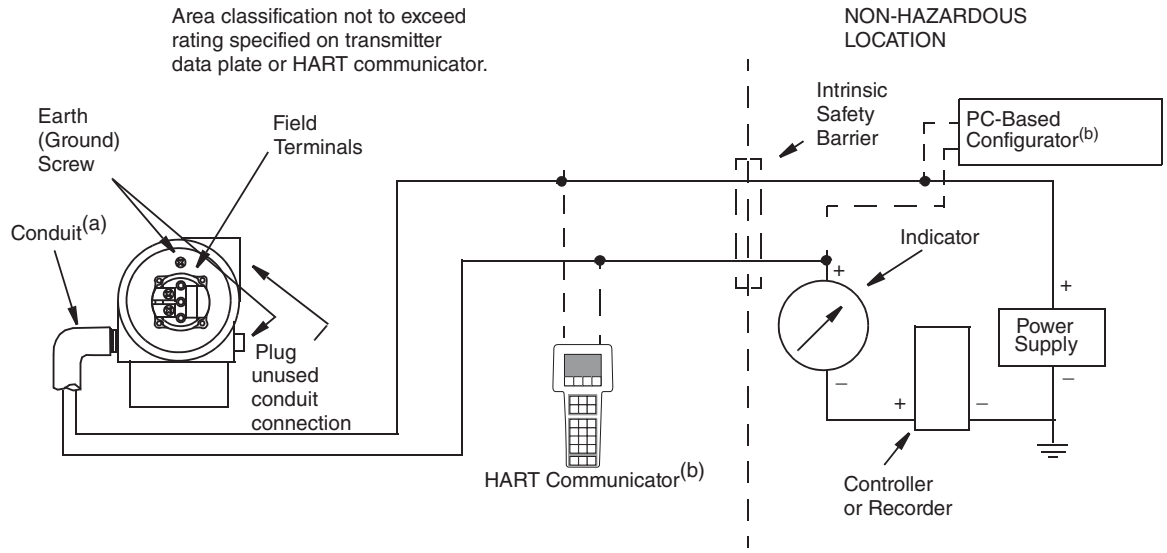
3. If shielded cable is used, earth (ground) the shield at the power supply **only**. Do not ground the shield at the transmitter.
4. Plug unused conduit connection with the 1/2 NPT or M20 metal plug provided (or equivalent). To maintain specified explosionproof and dust-ignitionproof protection, plug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

! CAUTION

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

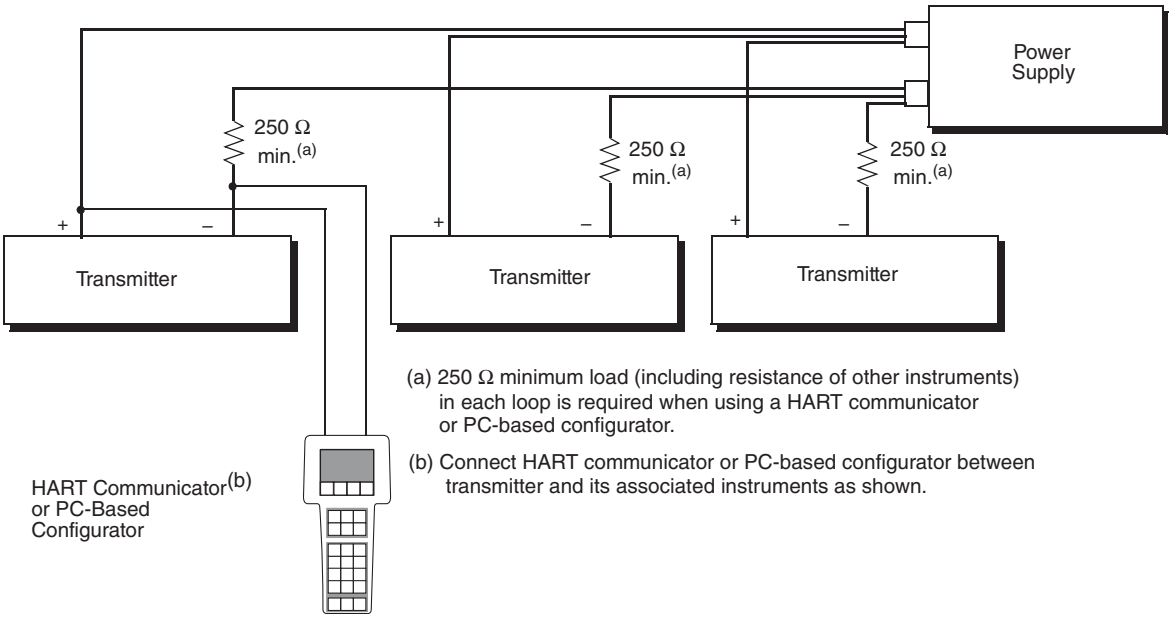
6. Connect the power supply and receiver loop wires to the "+" and "–" terminal connections.
7. Connect receivers (such as controllers, recorders, indicators) in series with power supply and transmitter as shown in Figure 11.
8. Reinstall the cover onto the housing by rotating it clockwise to seat the 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 25.
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 12.
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 11 and 12. Note that a minimum of 250 Ω must separate the power supply from the HART communicator and PC-based configurator.

Figure 11. Loop Wiring Transmitters



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

Figure 12. Wiring Several Transmitters to a Common Power Supply



(a) 250 Ω minimum load (including resistance of other instruments) in each loop is required when using a HART communicator or PC-based configurator.

(b) Connect HART communicator or PC-based configurator between transmitter and its associated instruments as shown.

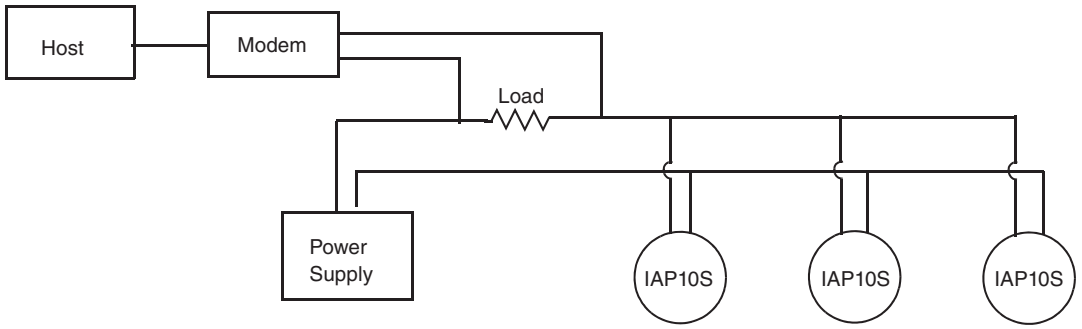
Multidrop Communication

"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 15 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 13 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.

Figure 13. Typical Multidrop Network



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

NOTE

IAP10S and IGP10S transmitters are shipped from the factory with a poll address of 0 and with the loop current mode set to “enabled” or “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, the transmitter address must be changed to a number from 1 to 63, plus one analog transmitter at address 0. Each transmitter must be assigned a unique number on each multidrop network. However, this change does not automatically deactivate the 4 to 20 mA analog output. To fix the mA output value, set the loop current mode to “fixed” or “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 above. For other system wiring details, refer to the installation instructions provided with the Foxboro control system.

3. Operation Via Local Display

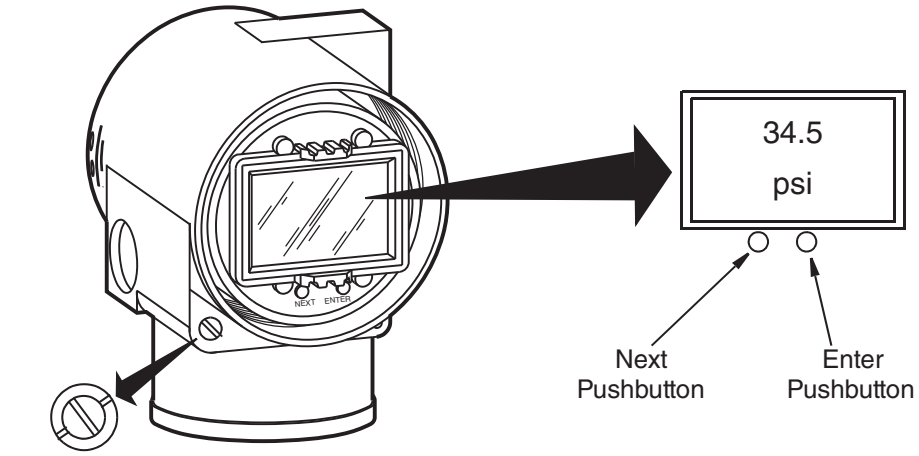
A local display, as shown in Figure 14, has two lines of information. The upper line is a 5-digit numeric display (4-digit when a minus sign is needed); the lower line is a 7-digit alphanumeric display. The display provides local indication of measurement information.

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.

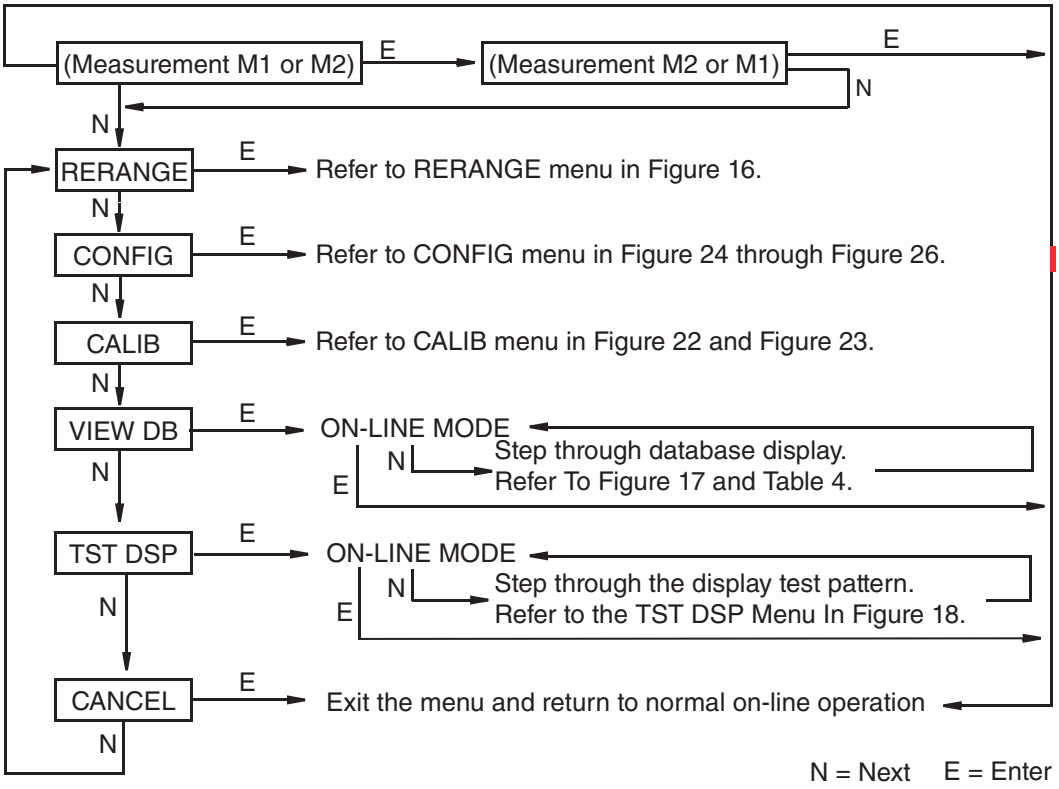
The display and 2-button keypad on the front of the transmitter also provide a means for performing calibration and configuration, viewing the database, testing the display, and reranging the transmitter. The transmitter and 2-button keypad are shown in Figure 14.

Figure 14. Local Display



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`.

Figure 15. 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.

NOTE

The decimal point cannot be placed directly after the first digit. For example, you cannot enter a value as 1.2300; you must enter it as 01.230.

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.

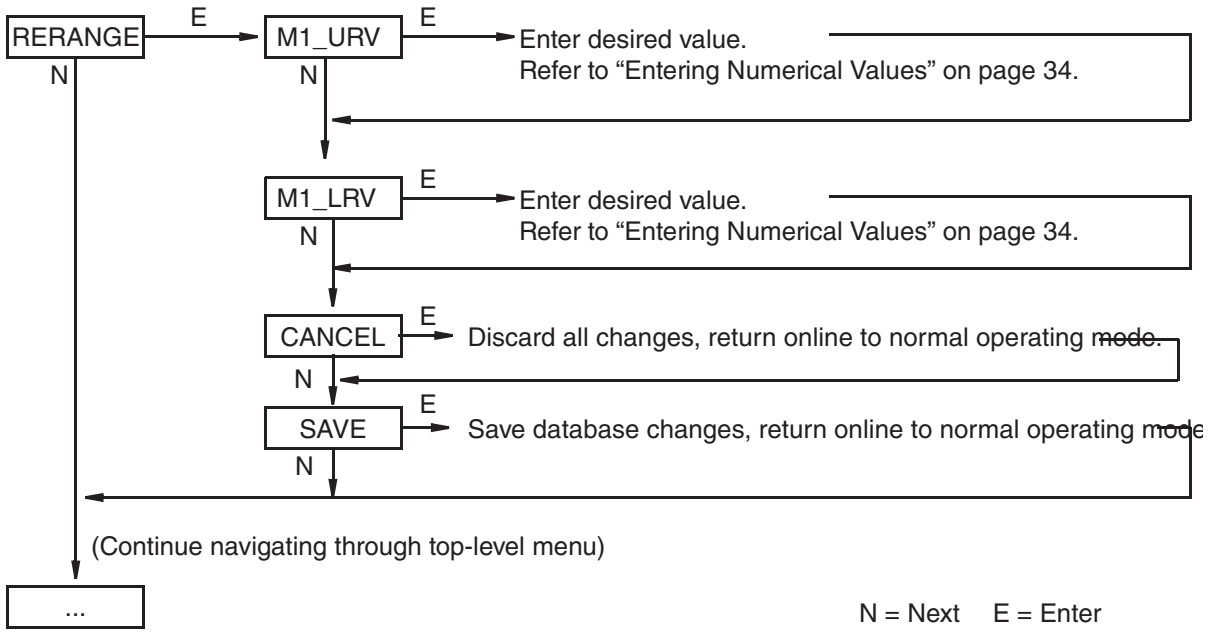
NOTE

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. Failure to perform the offset calibration may result in a `BADSPAN` error.

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 15). 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 34 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 34 to edit this parameter.

Figure 16. Rerange Menu Diagram



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 15).
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 17 shows the `VIEW DB` menu, and the list of database items is described in Table 4.

Figure 17. VIEW DB Menu Diagram

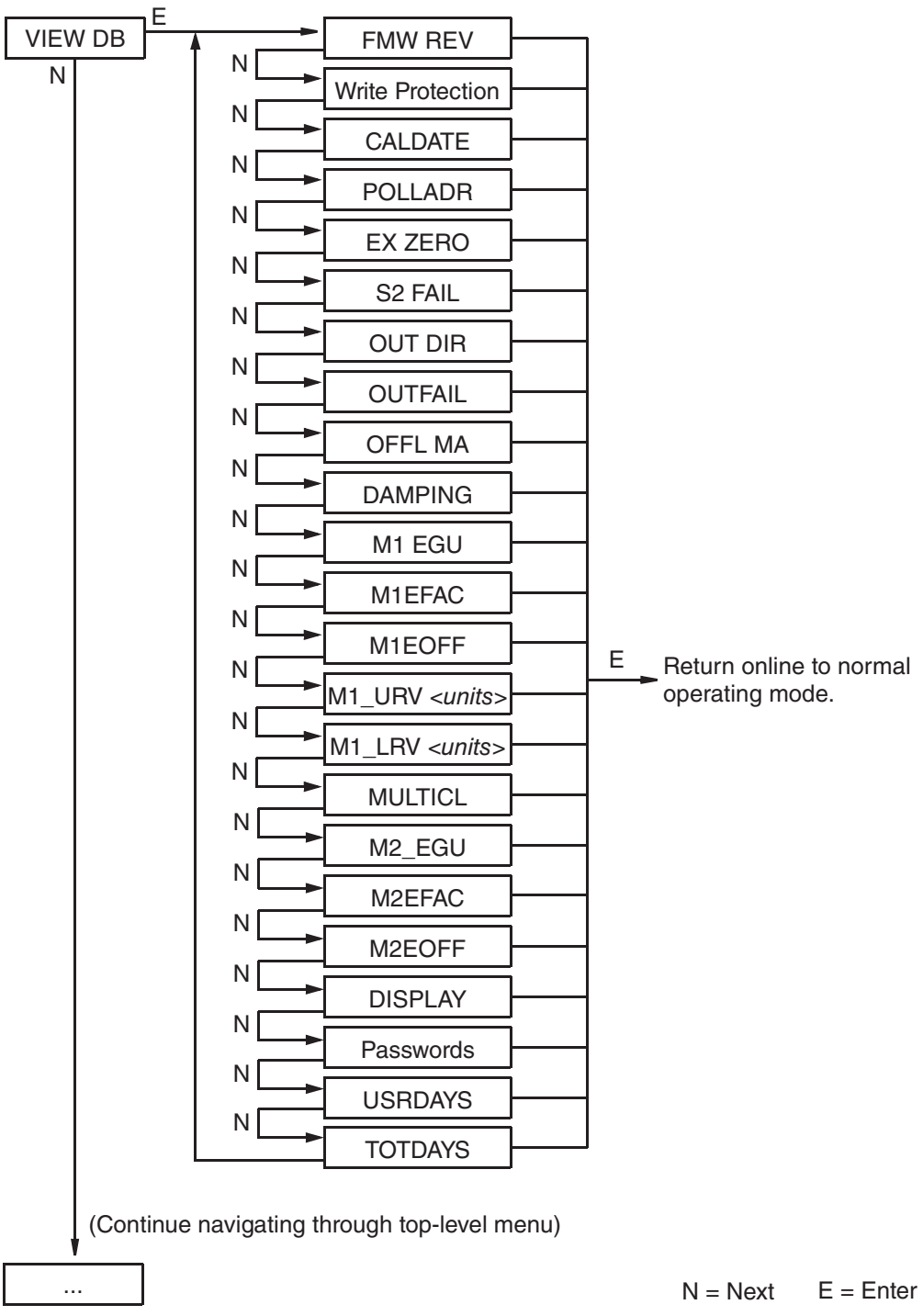


Table 4. Transmitter Database Items

Database Item	Available Settings or Example	Additional Information
Firmware revision (FMW REV)	1.001	–
Write protection: enabled or disabled	WP DISA or WP ENA	page 25
Date of last calibration (CALDATE)	01JAN13	page 51, page 62
Poll Address (POLLADR)	0 through 63	page 62
External Zero (EX ZERO): enabled or disabled	EXZ ENA or EXZ DIS	page 60
Temperature Sensor Failure Strategy (S2 FAIL)	S2FATAL or S2NOFTL	page 62
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 (OFFL 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
Engineering Units for M1 (M1_EGU)	psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4, inH2O (at 68°F), inHg, ftH2O, mmH2O, or mmHg.	page 61
M1 engineering factor (M1EFAC)	30.000	page 61
Offset applied to the primary value (M1EOFF)	0.000	page 61
Primary upper range value (M1_URV *<units>*)	30.000	page 35
Primary lower range value (M1_LRV *<units>*)	0.000	page 35
Status of FoxCal™ multiple calibration (MULTICL)	MCALON or MCALOFF	page 42
Engineering units for M2 (M2_EGU)	psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4, inH2O (at 68°F), inHg, ftH2O, mmH2O, or mmHg.	page 62
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 62
Current password settings: Enable password, no password, configuration only, or configuration and calibration	NO PWDS, ENA PWD, CFGONLY, CFG+CAL	page 63
The number of days the transmitter has been running since the Time In Service Meter has been reset (USRDAYS)	1	page 51, page 68
The number of days the transmitter has been running since it has been installed (TOTDAYS)	90	page 68

Testing the Display

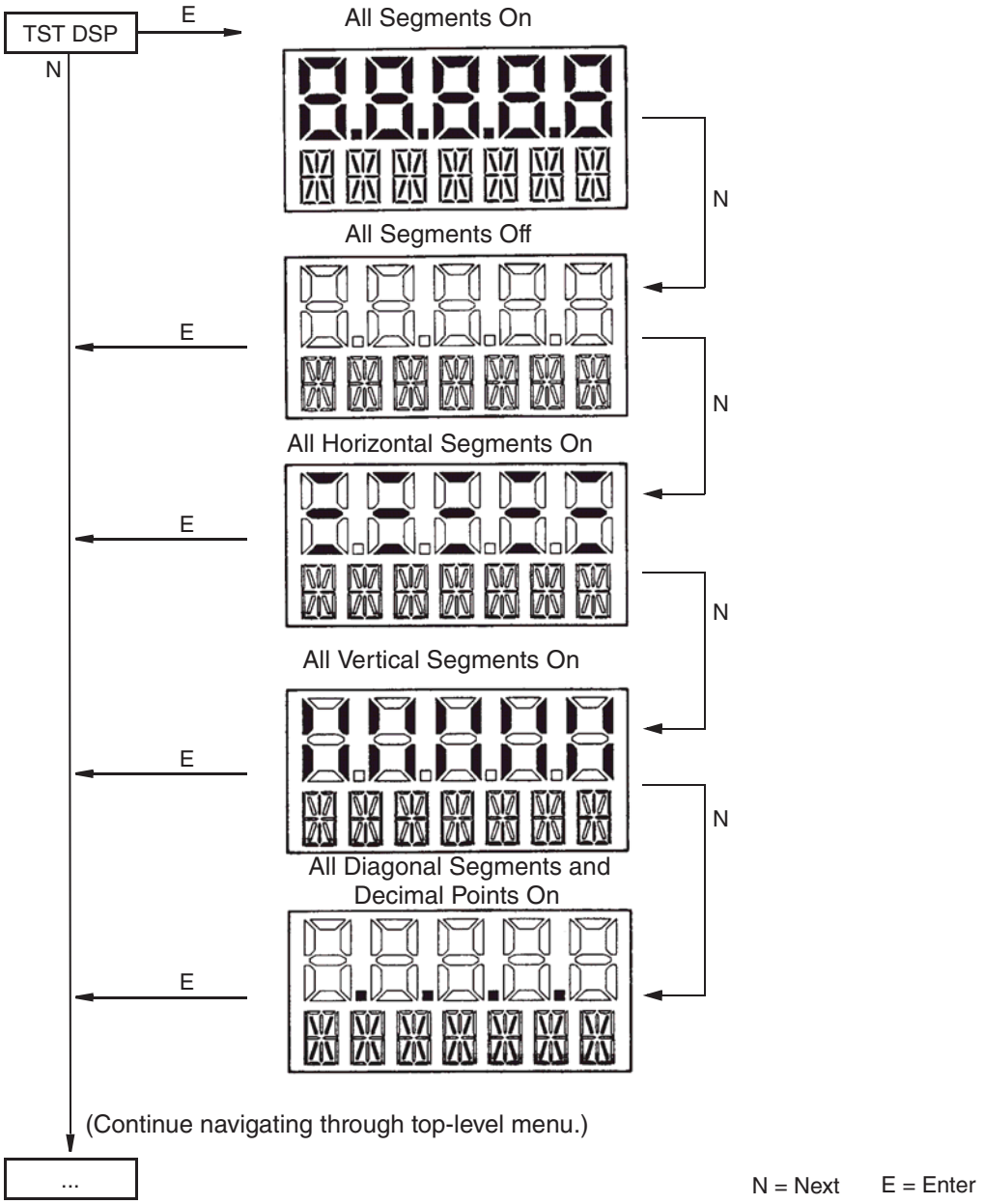
You can test the transmitter display using the multi-level menu system described above. To test the display:

1. From the transmitter's normal operating mode, press the Next button to access the transmitter's top level menu (see Figure 15).
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 18.

Figure 18. Display Test Segment Patterns



Error Messages

Parameter	Condition Tested	Error 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 OK or corrupted	`INITERR`	User should perform `SET GDB` procedure. See “`SET GDB`” on page 63.

4. Calibration

Overview of FoxCal™ Multiple Calibration Technology

The S Series gauge and absolute pressure transmitters offer a patented FoxCal multiple calibration feature that eliminates 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 13.

Calibration Certificate

Optionally, you can request a calibration certificate with your IAP10S or IGP10S 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, FoxCal 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 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

All transmitters, including transmitters shipped with the FoxCal multiple calibration feature enabled, can be recalibrated to a specific LRV and URV. The calibration at the LRV point applies to both FoxCal and the two-point calibration. However, the calibration at the URV point applies only to the two-point calibration. The 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.

! CAUTION

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 will typically result in degradation of transmitter performance from the factory calibrated state.

Enabling and Disabling the FoxCal Multiple Calibration Feature

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 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 will be 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. You can re-enable the FoxCal multiple calibration feature by selecting `MULTICL` from the `CALIB` menu and selecting `MCALON`.

⚠ CAUTION

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, large mismatches should be avoided.

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. After calibrating transmitters operating with a 4 to 20 mA (or 1 to 5 V dc) output signal, check the underrange and overrange output values to ensure that they extend beyond 4 and 20 mA (or 1 and 5 V dc) respectively.
4. Each transmitter is factory characterized over its full rated pressure range. One benefit of this process is that every transmitter can measure any applied pressure within its range limits. The applied pressure is measured and converted into an internal digital value of pressure. This digital value of pressure is always available.
5. The internal digital value of pressure can be displayed on the optional local display, transmitted digitally, and converted to a 4 to 20 mA analog output signal.
6. If you perform a two-point calibration when FoxCal is enabled, the new calibration is used and FoxCal is disabled.
7. 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 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 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 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.

8. When the optional local display is used, the internal digital value of pressure is sent directly to the display.
   - The display can show any measured 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 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.
9. When configured for 4 to 20 mA output, the internal digital value of 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 pressure or the transmission or display of measured pressure.
   - The mA trim can be done with or without pressure applied to the transmitter.
10. 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 pressure applied (`CAL LRV`) or zero 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 pressure transmitter having a range of 50 to 100 psig. If it is not feasible to vent the transmitter to atmosphere for zeroing, it can be adjusted while the LRV 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, it can be zeroed while open to atmosphere by using the `CAL AT0` function.

    a. Zeroing with LRV pressure applied (`CAL LRV`):
       - Before using this zeroing function, apply a 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 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 pressure is different from the LRV pressure value in the database, the internal digital value of pressure is biased by the difference in the values but the output is still set at 4 mA.
- The `CAL LRV` and `CAL URV` function should be used when calibrating a transmitter for a specific range with known input pressures applied for the LRV and URV. Note that FoxCal is automatically disabled by the `CAL URV` function.

b. Zeroing a gauge pressure transmitter with zero pressure applied (`CAL AT0`):

- Make sure that the applied pressure is at zero. This means venting the transmitter to atmosphere.
- When you zero the transmitter, the internal digital value of the 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.

c. Zeroing an Absolute Pressure Transmitter

To zero adjust an absolute pressure transmitter, the LRV can be temporarily set to the barometric pressure and a `CAL LRV` function performed with the transmitter vented to atmosphere. Then, the LRV can be set back to the proper value.

NOTE

The `CAL AT0` function is not applicable with an absolute pressure transmitter. If an absolute pressure transmitter is vented to atmosphere, it does **not** have zero pressure applied but instead has the barometric pressure (approximately 14.7 psia at sea level) applied.

Calibration Setup

The following 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 errors may be introduced.

! CAUTION

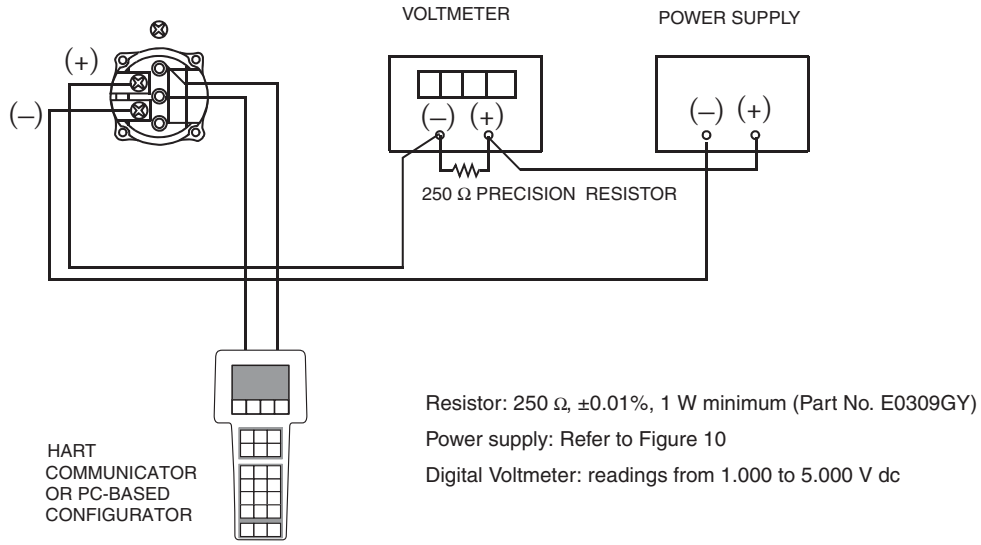
For both field calibration and bench calibration procedures, using a pressure source that is less accurate than the transmitter's reference accuracy specification will typically result in degradation of transmitter performance from the factory calibrated state. The accuracy of the input pressure should be a minimum of four times better than the transmitter's reference accuracy specification.

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

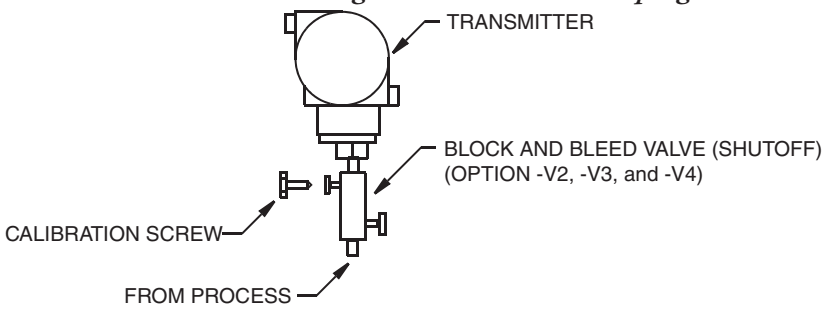
Figure 19. 4 to 20 mA Output Calibration Setup of Electronic Equipment



Field Calibration Setup

Field calibration is performed without disconnecting the process piping. This is only possible if the transmitter is piped as shown in Figure 20.

Figure 20. Transmitter Piping



NOTE

Block and Bleed Valve Maximum Pressure
40 MPa (6000 psi at 38°C (100°F)
25 MPa (4000 psi at 250°C (400°F)
Calibration Screw Maximum Pressure
0.7 MPa (100 psi with Poly-Flo Fitting (F0101ES)

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

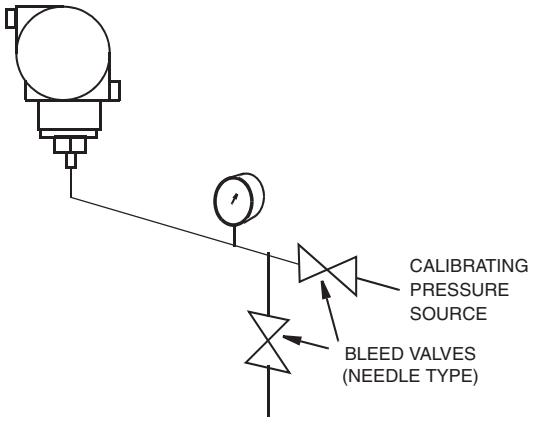
An adjustable supply and a pressure measuring device are required. For example, a dead weight tester or an adjustable clean air supply and pressure gauge can be used.

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” above.

The bench calibration setup is shown in Figure 21. If calibrating the output signal, also connect equipment as shown in Figure 19.

Figure 21. Bench Calibration Setup



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

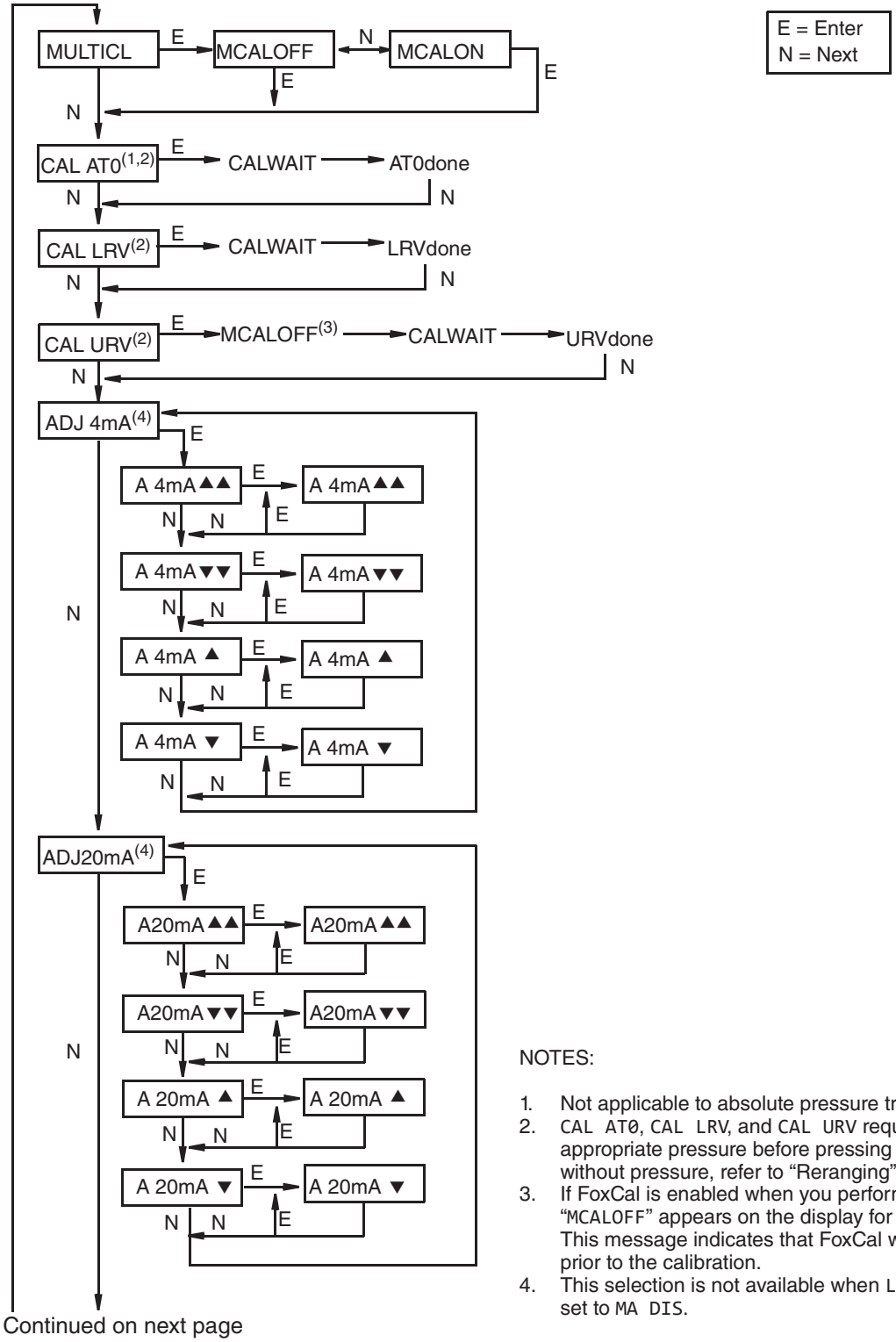
To access the Calibration mode (from normal operating mode), press the `Next` button until the `CALIB` menu appears on the display, and then press `Enter`. The display shows the first item in the Calibration menu.

NOTE

1. During calibration, a single change could affect several parameters. For this reason, if an entry is entered in error, 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 22 and Figure 23. 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 22. Calibration Menu Structure



NOTES:

1. Not applicable to absolute pressure transmitters.
2. `CAL AT0`, `CAL LRV`, and `CAL URV` require application of appropriate pressure before pressing Enter. For reranging without pressure, refer to "Reranging" on page 35.
3. If FoxCal is enabled when you perform the `CAL URV`, "`MCALOFF`" appears on the display for a few seconds. This message indicates that FoxCal will be disabled prior to the calibration.
4. This selection is not available when `LOOP MD` is set to `MA DIS`.

Continued on next page

Figure 23. Calibration Menu Structure (Continued)

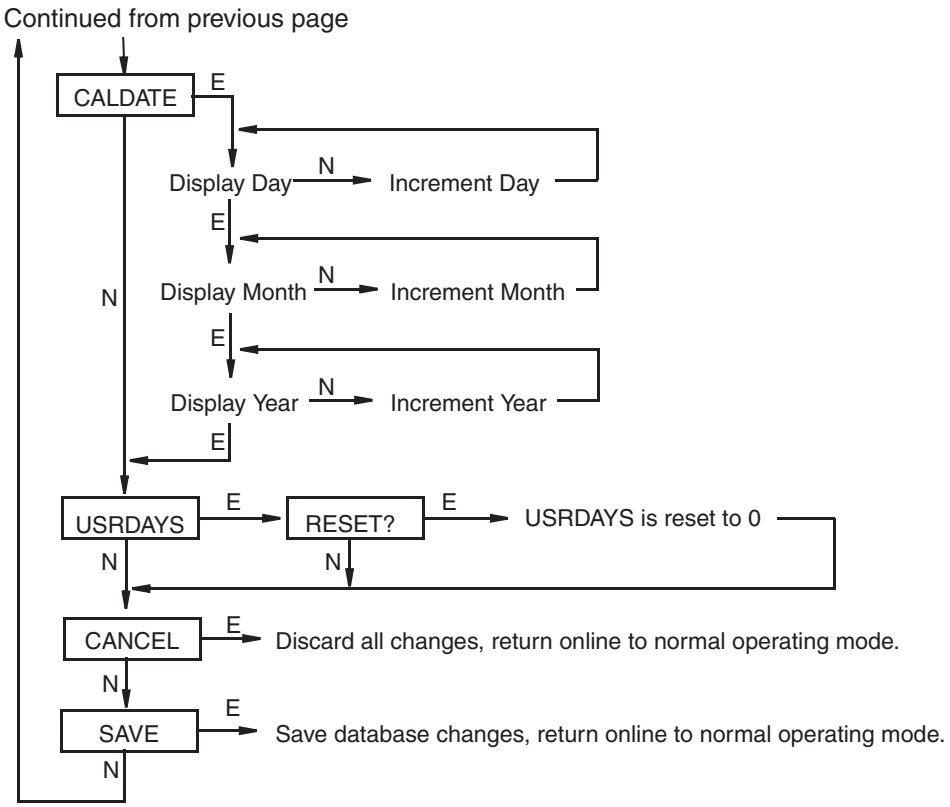


Table 5. Calibration Menu

Item	Description
MULTICL	This menu option allows you to enable or disable FoxCal. To enable the FoxCal multiple calibration feature, select MULTICL from the CALIB menu, and then select MCALON. Similarly, to disable FoxCal, select MCALOFF.
CAL AT0 (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 AT0 appears on the display, press Enter. This can be done whether LRV is zero or not. When the process is complete, AT0 Done appears on the display.
CAL 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.
CAL 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.

Table 5. Calibration Menu (Continued)

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 is not a required entry but 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.

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.

Zero Adjustment Using External Zero Button

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

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.

2. To set or reset the zero point at zero pressure, apply zero pressure to the transmitter and press the external zero button until the display reads `CAL AT0`. Release the button. The display reads `CALWAIT` and then `AT0done` (calibration is complete).

   To set or reset the 0% of range input, apply the lower range value (LRV) 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 prevent 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` (IGP10S only), and pressing the button for 5 or more seconds allows you to execute a `CAL LRV` (IAP10S or IGP10S).

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 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) pressure to the transmitter, press and hold the external zero button for at least 5 seconds, and then release the button.

! CAUTION

Use caution 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 AT0` and `CAL LRV`.

   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 prevent pressing the button accidentally. Do not push the button in with the screwdriver while doing this.

Error Messages

Table 6. Calibration Error Messages

Parameter	Condition Tested	Error 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 M1EOFF.
SPAN	Slope too large or too small	BADSPAN	Check applied pressure, configured M1_LRV and configured M1EFAC.
M1 URV	M1URV > max pressure in EGU	URV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1URV < min pressure in EGU	URV<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.
M1 LRV	M1LRV > max pressure in EGU	LRV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1LRV < min pressure in EGU	LRV<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.

5. Configuration

Configurable Parameters

The following table lists all the configurable parameters and the factory default values for the IAP10S and IGP10S Transmitters. The factory default values have been customized if the transmitter was ordered with optional feature -C2. The table also shows which parameters are configurable with the local display and/or with remote configurators.

Table 7. Configurable Parameters

Parameter	Capability	Factory Default	Configurable with		Application Requirement
			Local Display	Remote Config.	
Descriptors					
Long Tag	32 characters maximum	Long Tag	No	Yes	
Descriptor	16 characters max	Tag Name	No	Yes	
Message	32 characters max	Inst Location	No	Yes	
Input					
Calibrated Range	LRV to URV specified in any of the units listed in footnote (a)	See footnote (b) below when not specified per sales order	Yes	Yes	
Output					
Meas #1 Output	4 to 20 mA or Fixed Current. Set the loop current mode to fixed or disabled for a fixed current.	4 to 20 mA	Yes	Yes	
Meas #1 EGUs	Select from units listed in footnote(a)	Specified per sales order (default is psi)	Yes	Yes	
Meas #2 EGUs	Select from units listed in footnote(a)	Specified per sales order (default is psi)	Yes	Yes	
Temp. Sensor Fail Strategy	Normal operation or fail-safe	S2NOFTL	Yes	Yes	
Fail-safe	High or Low	High	Yes	Yes	
External Zero	Enabled or Disabled	Enabled	Yes	Yes	
Damping	0 to 32 seconds	0.25 seconds	Yes	Yes	
Poll Address	0 to 63	0	Yes	Yes	
Loop Mode	Enabled (Active) or Disabled (Fixed)	Enabled (Active)	Yes	Yes	
LCD Indicator (c)	Meas #1 EGU or % Lin	Meas #1 EGU	Yes	No	

a. psi, inHg, ftH_2O, inH_2O (at 68°F), atm, bar, mbar, MPa, Pa, kPa, kg/cm^2, g/cm^2, mmHg, torr, mmH_2O, inWC60 (at 60°F), mWC4, inWC4, mmWC4

b. Span Limit Code C (IAP10S): 0.5 and 30 psi; Span Limit Code C (IGP10S): 0.3 and 30 psi; Span Limit Code D (IAP10S/IGP10S): 0.5 and 200 psi; Span Limit Code E (IAP10S/IGP10S): 5 and 2000 psi; Span Limit Code F (IGP10S): 75 and 6000 psi

c. Measurement #2 can be displayed at any time by pressing the `Enter` button regardless of the local display configuration. The display reverts to Measurement #1 or % Lin (as configured) after a few seconds.

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 the following table. The standard factory default configuration is also given in this table.

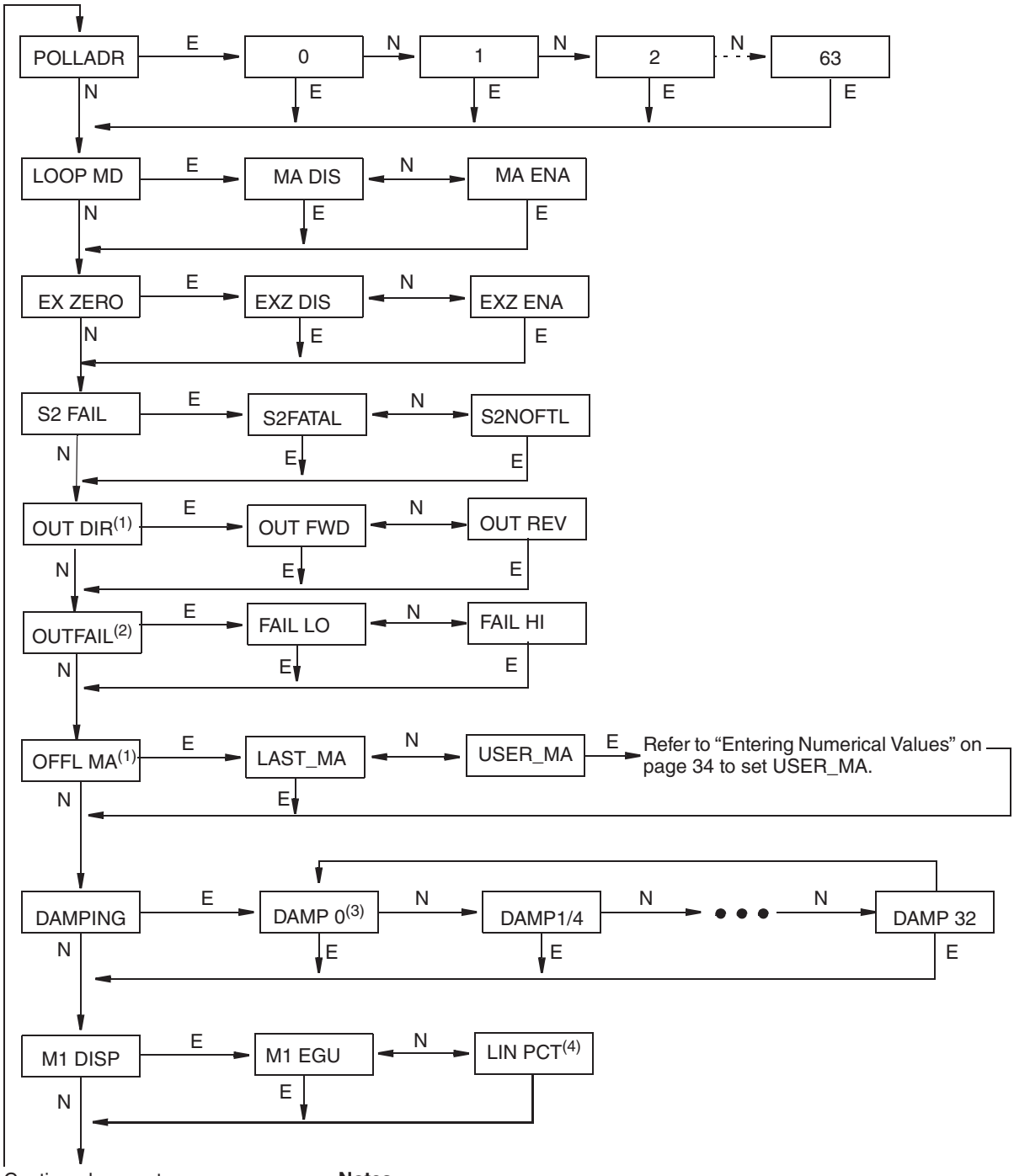
The standard factory default configuration is not used if custom configuration option -C2 has been specified. Option -C2 is a full factory configuration of all parameters to the user's specifications.

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 an entry is entered in error, 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 three figures. At any point in the configuration you can `Cancel` your changes and return to the on-line mode, or `Save` your changes.

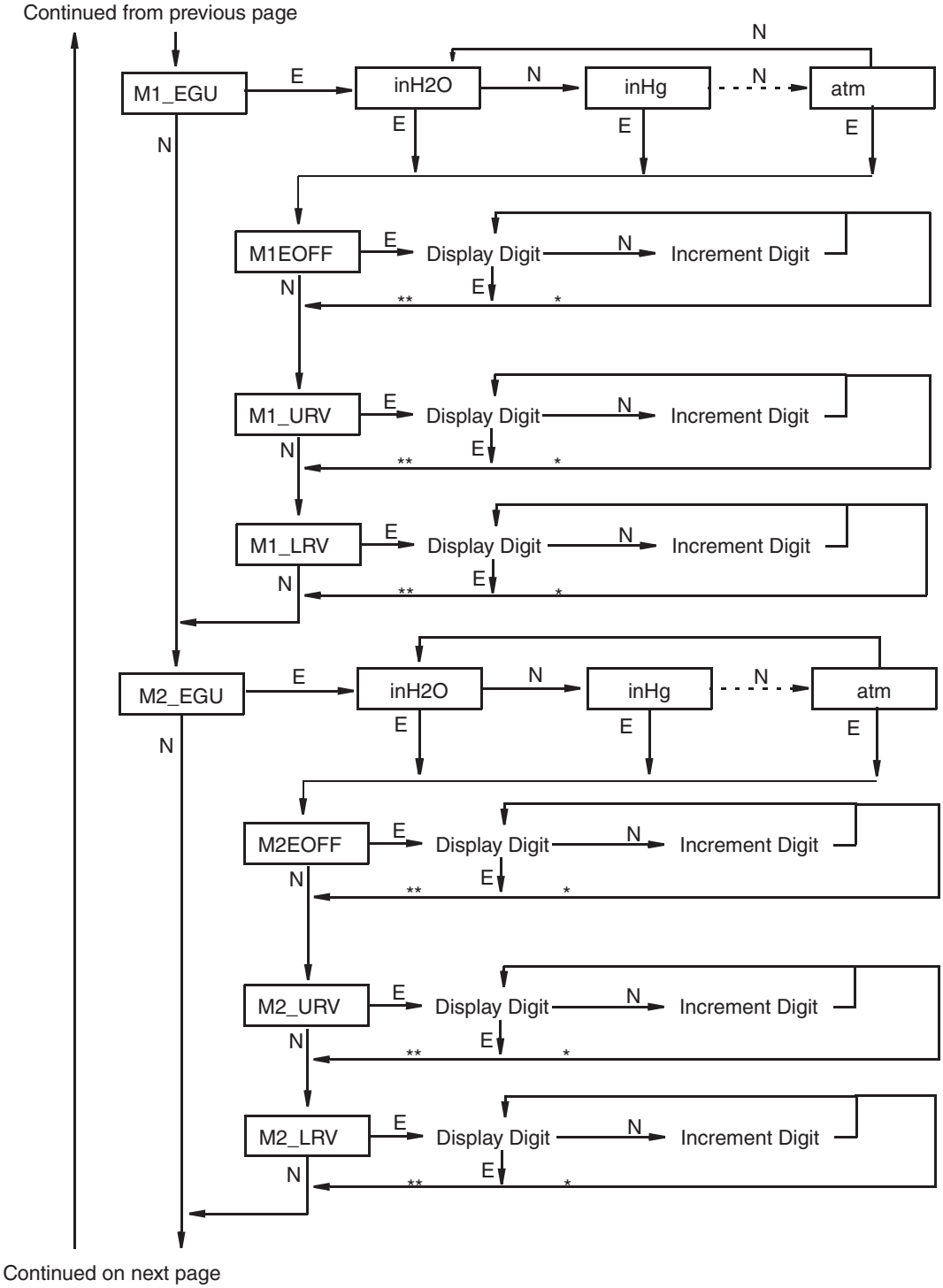
Figure 24. Configuration Menu Structure



Notes:

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 failure 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.
4. LIN PCT provides percent output on the local display only.

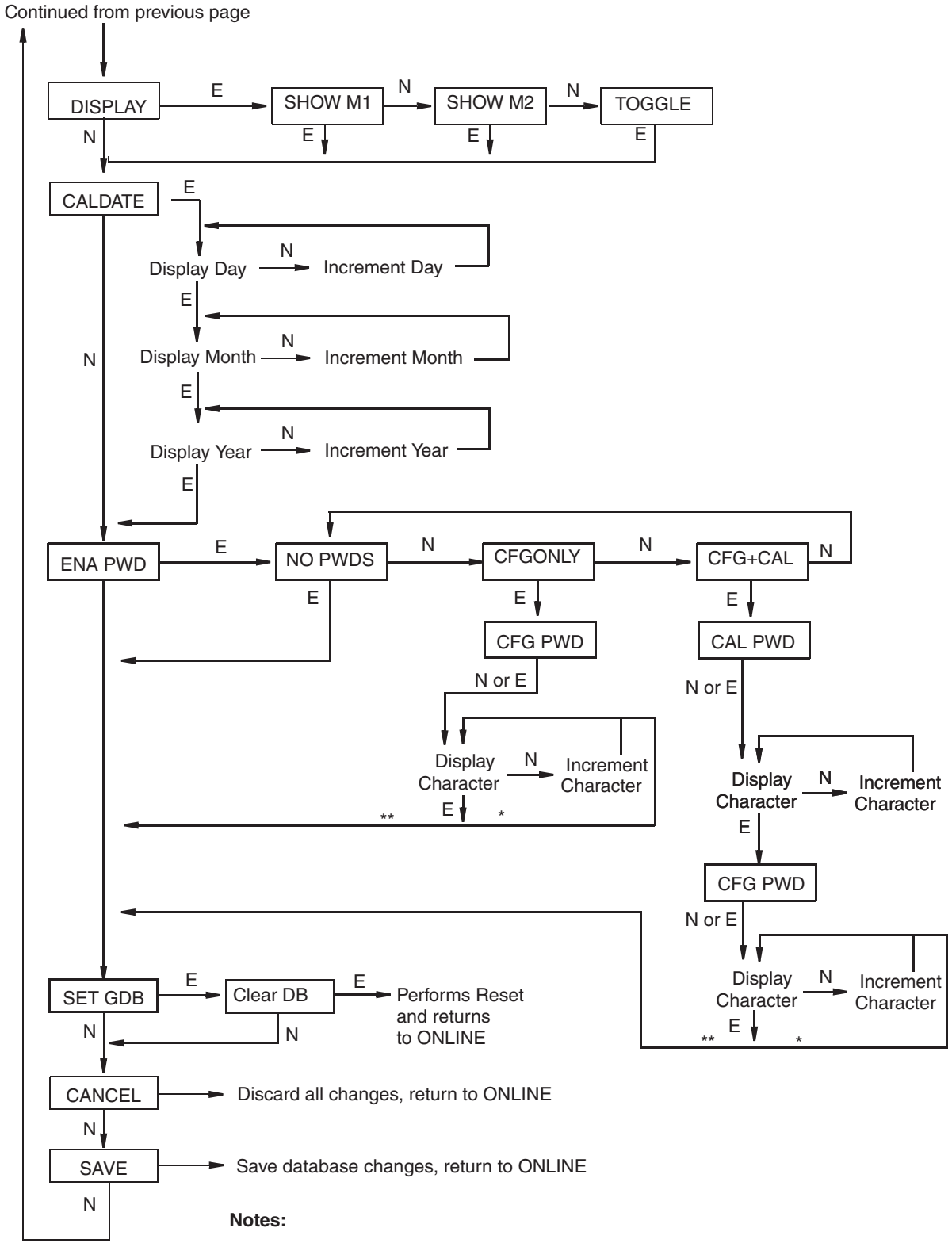
Figure 25. Configuration Menu Structure (Continued)



Notes:

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

Figure 26. Configuration Menu Structure (Continued)



Notes:

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

Table 8. Configuration Menu

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. 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.	0
LOOP MD	mA Loop Current Mode can be enabled or disabled. 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.	Enabled (MA ENA)
EX ZERO (a)	The External Zero feature allows you to enable the optional external zero pushbutton or disable the button for added security. 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.	Enabled (EXZ ENA)
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. 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).	Output goes to value configured in OUTFAIL (S2NOFTL)
OUT DIR	The 4 to 20 mA Output Direction can be set to forward or reverse. 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. 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).	Forward (4 to 20 mA) (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. 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).	High (FAIL HI)

Table 8. Configuration Menu (Continued)

Item	Description	Initial Factory Configuration
OFFL MA	This parameters 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. 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 Enter. ▸ 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 34. 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).	User set (USER MA)
DAMPING	Damping can be set to 0, 1/4, 1/2, 1, 2, 4, 8, 16, or 32 seconds. 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.	0.25 second (DAMP1/4)
M1 DISP	The M1 DISP parameter allows you to configure the optional local display to show engineering units or percent. 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.	Engineering units (M1 EGU)
M1_EGU	This parameter allows you to set the engineering units for the primary measurement. To configure pressure engineering units for your display and transmission, navigate to the M1_EGU menu selection and press Enter. Specify one of the following pressure labels: psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4, inH2O (at 68°F), inHg, ftH2O, mmH2O, or mmHg. 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.	psi
M1EOFF	This parameter allows you to configure an offset value to apply to the primary measurement. You can introduce an offset by entering a nonzero value for M1EOFF. 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.	0

Table 8. Configuration Menu (Continued)

Item	Description	Initial Factory Configuration
M1_URV	This parameter allows you to configure the upper range value of the primary measurement. 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 34 to edit this parameter.	URL
M1_LRV	This parameter allows you to configure the lower range value of the primary measurement. 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 34 to edit this parameter.	0
M2_EGU	This parameter allows you to set the engineering units for the secondary measurement. To configure M2 pressure engineering units for your display and transmission, navigate to the M2_EGU menu selection and press Enter. Specify one of the following pressure labels: psi, bar, mbar, g/cm2, kg/cm2, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4, inH2O (at 68°F), inHg, ftH2O, mmH2O, or mmHg.	Same as M1_EGU
M2EOFF	This parameter allows you to configure an offset value to apply to the secondary measurement. 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.	0
M2_URV	This parameter allows you to configure the upper range value of the secondary measurement. To edit the upper range value of M2, navigate to the M2_URV menu selection and press Enter. Use the procedure "Entering Numerical Values" on page 34 to edit this parameter.	URL
M2_LRV	This parameter allows you to configure the lower range value of the secondary measurement. To edit the lower range value of M2 navigate to the M2_LRV menu selection and press Enter. Use the procedure "Entering Numerical Values" on page 34 to edit this parameter.	0
DISPLAY	This parameter allows you to configure whether the optional local display shows M1, M2, or toggles between M1 and M2. 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.	M1 (SHOW M1)
CALDATE	CALDATE allows you to set the date of the last calibration. It is not required that you set the calibration date, but this parameter 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.	---

Table 8. Configuration Menu (Continued)

Item	Description	Initial Factory Configuration
ENA PWD	This parameter allows you to enable or disable password(s). By default, passwords are disabled. **Note**: CAL PWD allows access to only calibration mode, but CFG PWD allows access to both configuration and calibration. To set a password for configuration only or for both configuration and calibration: ▸ Navigate to ENA PWD and press Enter. ▸ 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. ▸ Press either Next or Enter. ▸ 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 the password has less than six characters, use blanks for the remaining spaces. ▸ If you selected CFG+CAL, the CFG PWD prompt appears. Use the same procedure to create the configuration password. ▸ When you have configured the sixth space, the display advances to the next menu item. ▸ **IMPORTANT**: Record your new password before saving changes to the database. To disable passwords: ▸ Navigate to the ENA PWD menu selection and press Enter. ▸ Navigate to the NO PWDS menu selection and press Enter. ▸ If a configuration password was previously configured, you are asked to enter it.	Passwords are not enabled (NO PWD)
CAL PWD	User set calibration password (six characters)	- - -
CFG PWD	User set configuration password (six characters)	- - -
SET GDB	SET GDB allows you to rewrite calibration values (slope and offset) with default values. 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. **Caution**: Any user calibration values that you have entered will be lost. Therefore, SET GDB should **not** be selected if your transmitter is functioning normally.	- - -

a. Applies only if transmitter contains External Zero option.

Character Lists

Table 9. Character Lists

Alphanumeric Character List (a)		Numeric Character List
@	‘	–
, (comma)	(	. (decimal point)
A-Z (uppercase)	)	0 through 9
[	*	
\	+	
]	-	
^	.	
_ (underscore)	/	
space	0-9	
!	:	
“	;	
#	<	
$	>	
%	=	
&	?	

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

Error Messages

Table 10. Configuration Error Messages

Parameter	Condition Tested	Error 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.
M1EFAC	M1EFAC < 0	-M1EFAC	Negative M1EFAC is not valid. Change M1 EFAC to a positive value.
	M1EFAC = 0	0M1EFAC	M1EFAC = 0 is not valid. Change M1 EFAC to a positive value.
M1 URV	M1URV > max pressure in EGU	URV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1URV < min pressure in EGU	URV<FMN	Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.
	M1URV = M1LRV	LRV=URV	Cannot set span to 0. Check entry. Check M1 LRV.
	M1 turndown exceeds limit	BADTDWN	Check entry. Check M1 LRV.
M1LRV	M1LRV > max pressure in EGU	LRV>FMX	Entered pressure is greater than maximum rated pressure of transmitter. Check entry. Verify EGUs.
	M1LRV < min pressure in EGU	LRV<FMN	Entered pressure is less than minimum rated pressure of transmitter. Check entry. Verify EGUs.
	M1URV = M1LRV	LRV=URV	Cannot set span to 0. Check entry. Check M1 URV.
	M1 turndown exceeds limit	BADTDWN	Check entry. Check M1 URV.
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.

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 45. Also refer to MAN 4250, 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 AO`), 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 Config` or `4 Full Config` from the next menu.
4. If you selected `4 Full Config`, select `1 View Params` to view existing parameters or `2 Edit Params` to edit one or more parameters.

Figure 27. Online Configuration Flowchart

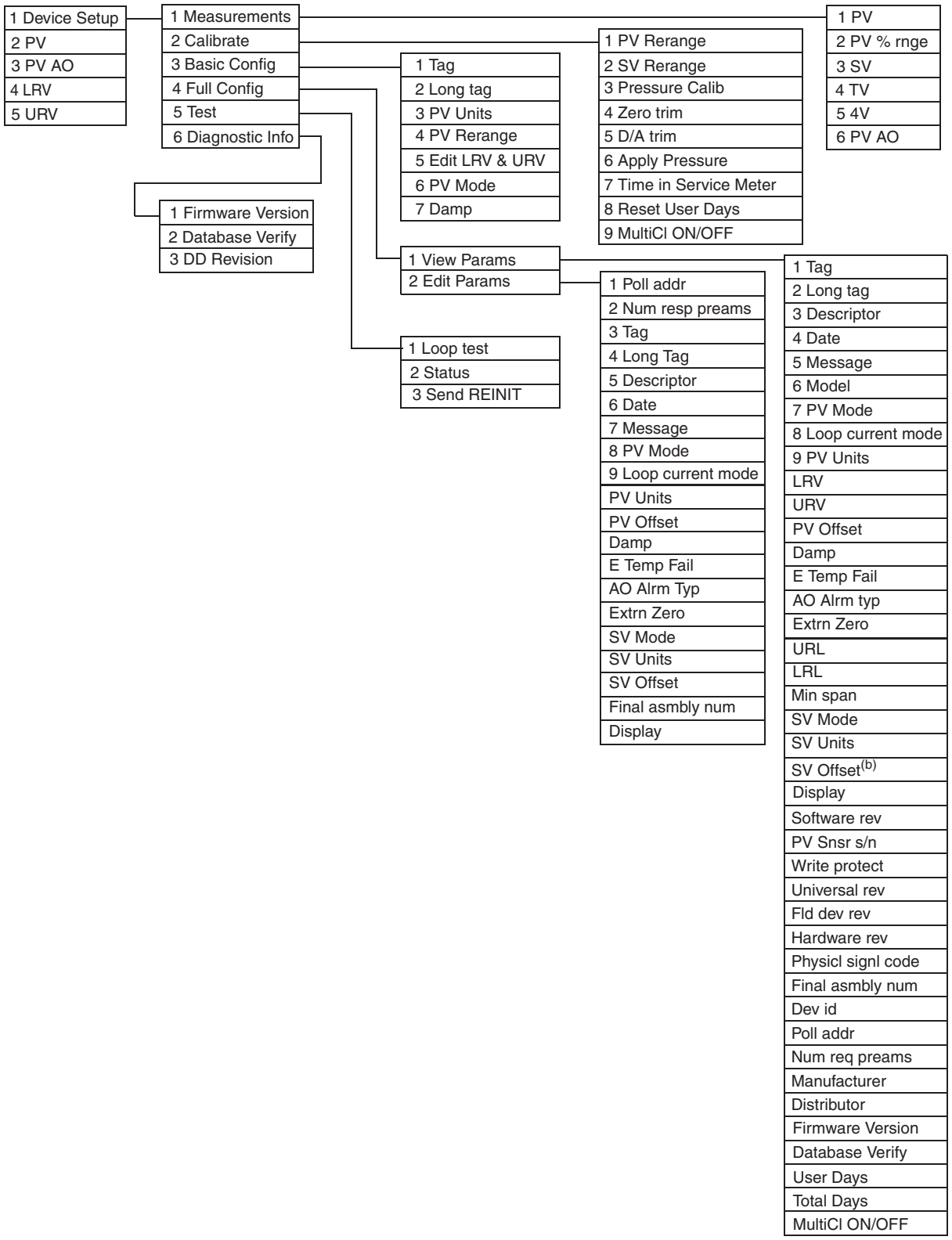


Table 11. Online Parameters

Parameter	Description
AO Alrm typ	Hi, Lo, or None. 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.
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.
D/A trim	Calibration procedure to match the 4-20 mA output to the calibration of the receiving device.
Damp	Output damping in seconds. Damping can be set to 0, 0.25, 0.5, 1, 2, 4, 8, 16, or 32 seconds.
Database Verify	Validation sequence after a configuration change. Refer to MI 020-357 (Safety Manual) for details.
Date	Date entered in the form mm/dd/yy.
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.
E Temp Fail	The external temperature failure can be set to Fatal or Non-Fatal.
Extrn Zero	Enabled or Disabled. The External Zero feature allows you to disable the optional external zero pushbutton for added security 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.
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.
LRL	Minimum usable value for PV LRV (lower sensor range limit).
LRV	Primary Lower Range Value in PV units.
Manufacturer	The company responsible for the manufacture of the transmitter.
Message	Normally configured as the instrument location. The message is limited to 32 characters.
Min span	Also known as the lower span limit, this is the smallest allowable difference between the URV and the LRV.
Model	The model number of the transmitter.
MultiCl ON/OFF	Enables/disables the FoxCal multiple calibration feature.
Num req preams	Number of preambles to be sent in a request message from the transmitter to the host.
Num resp preams	Number of preambles to be sent in a response 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.

Table 11. Online Parameters

Parameter	Description
Poll addr	A number from 0 through 63.
Pressure Calib	Calibration procedure using applied pressures.
PV	The primary variable is a dynamic digital value representing the process measurement in selected engineering units.
PV % rnge	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 AO	The PV Analog Output value tracks the digital value representation under normal operating mode.
PV Mode	Primary Variable Mode (Linear,).
PV Offset	PV and mA 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 Units	inH2O (at 68°F), inHg, ftH2O, mmH2O, mmHg, psi, bar, mbar, g/Sqcm, kg/Sqcm, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4.
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.
Send REINIT	Procedure to send a command to re-initialize the transmitter.
Software rev	The revision level of the software or firmware that is embedded in the transmitter.
Status	Conditions in the transmitter relating to its hardware, the validity of the variable, its operating status, and internal process.
SV	The secondary variable is an alternate value representing the process measurement in selected engineering units.
SV Mode	Secondary Variable Mode (Linear).
SV Offset	SV offset (does not change SV LRV and SV URV).
SV Rerange	Allows adjustment of 0 and 100% SV range values for Secondary Variable.
SV Units	inH2O (at 68°F), inHg, ftH2O, mmH2O, mmHg, psi, bar, mbar, g/Sqcm, kg/Sqcm, Pa, kPa, MPa, torr, atm, inWC60 (at 60°F), mWC4, inWC4, mmWC4.
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	IAP10S/IGP10S 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.
URL	Maximum usable value for PV URV (upper sensor range limit).
URV	Primary Upper Range Value in PV units.
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

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_2O' to '0 to 100 inH_2O'. 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.

NOTE

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. Failure to perform the offset calibration may result in a `BADSPAN` error.

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. 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 its URV and provide 20 mA outputs 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

A function named `PV Offset` is accessible from `Device Setup` > `Full Config` > `Edit Params`. 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_2O (LRV = 0 and URV = 100), entering a value of -10 for PV Offset causes the transmitter to provide a PV reading of 10 inH_2O and a mA output of 5.6 mA when applied pressure is 0 inH_2O.

SV Rerange

`SV Rerange` does not function like PV Rerange. Instead it allows you to perform the `SV Offset` function. SV Offset provides a similar function to the corresponding PV function.

Pressure Calib

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 (described below) can be used to correct for position effects and Reranging (described above) 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 Calib 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 Calib function to achieve a single point calibration that does not change the span.

! CAUTION

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 will typically result in degradation of transmitter performance from the factory calibrated state.

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 Chapter 4, "Calibration". 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.

D/A Trim

If you are using 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 Chapter 4, “Calibration”.

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

IAP10S/IGP10S 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 `Device Setup` > `Calibrate` > `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 `Device Setup` > `Calibrate` > `Reset User Days` menu selection.

Enabling and Disabling the FoxCal Multiple Calibration Feature

The transmitter can be shipped with or without FoxCal enabled. Refer to Chapter 4, "Calibration" for information on the FoxCal feature.

If you need to turn the FoxCal multiple calibration feature on or off, use the `Device Setup` > `Calibrate` > `MultiCl ON/OFF` menu selection to enable or disable FoxCal.

! CAUTION

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, large mismatches should be avoided.

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

7. Maintenance

DANGER

For nonintrinsically safe installations, to prevent a potential explosion in a Division 1 hazardous area, de-energize transmitters before you remove threaded housing covers. Failure to comply with this warning could result in an explosion resulting in severe injury or death.

WARNING

EXPLOSION HAZARD: For explosionproof and non-incendive installations, do not disconnect equipment when a flammable or combustible atmosphere is present.

Error Messages

For error messages displayed on the HART communicator refer to Chapter 6, “Using the HART Communicator”.

Parts Replacement

Parts replacement is generally limited to the terminal block assembly, housing 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 Field Terminals and the Electronics compartment covers by rotating them 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 secure 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 securing 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 in·lb) in several even increments.
10. Reinstall the electronics module (and digital display if applicable).
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 25.
12. Turn on the transmitter power source.

Removing and Reinstalling a Housing Assembly

To remove and reinstall a housing assembly, 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. 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 disconnect its cable.
4. Remove the electronics module from the housing by loosening the two captive screws that secure 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.

! CAUTION

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.

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 should 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. Inspect the sensor O-ring for damage. If the O-ring is damaged, replace it with the appropriate O-ring. (See parts list for your transmitter). Lubricate the O-ring with silicone lubricant (Foxboro Part Number 0048130 or equivalent). Verify that the O-ring is situated in the groove of the neck.

WARNING

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

9. Twist the sensor cable through the housing neck into the electronics compartment.
10. Screw the housing onto the sensor neck until it bottoms. Do not over tighten. Be careful not to damage the sensor cable or dislodge the neck O-ring.
11. Insert the retention clip over the boss in the housing neck so that the hole in the clip is aligned with the hole in the boss. Install the screw but do not tighten it. Rotate the housing up to one full turn counterclockwise for optimum access. Tighten the retention clip screw and fill the screw recess with red lacquer (Foxboro Part Number X0180GS or equivalent). The housing can still be rotated for optimum access.
12. Predetermine connector orientation, then insert the cable connectors into the electronics module. Replace the module in the housing using care not to pinch the cables between the module and the housing. Tighten the two screws that secure the module to the housing.
13. Connect the cable from the digital display to the electronics module. Ensure that the O-ring is fully seated in the display housing. Then, holding the digital display by the tabs at the sides of the display, insert it into the housing. Secure the display to the housing by aligning the tabs on the sides of the assembly and rotating it about 10° in a clockwise direction.

CAUTION

When replacing a housing cover, hand tighten it as much as possible so that the O-ring is fully captured. The flange of the cover should come in contact with the flange on the housing.

14. 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 25.
15. Turn on the transmitter power source.

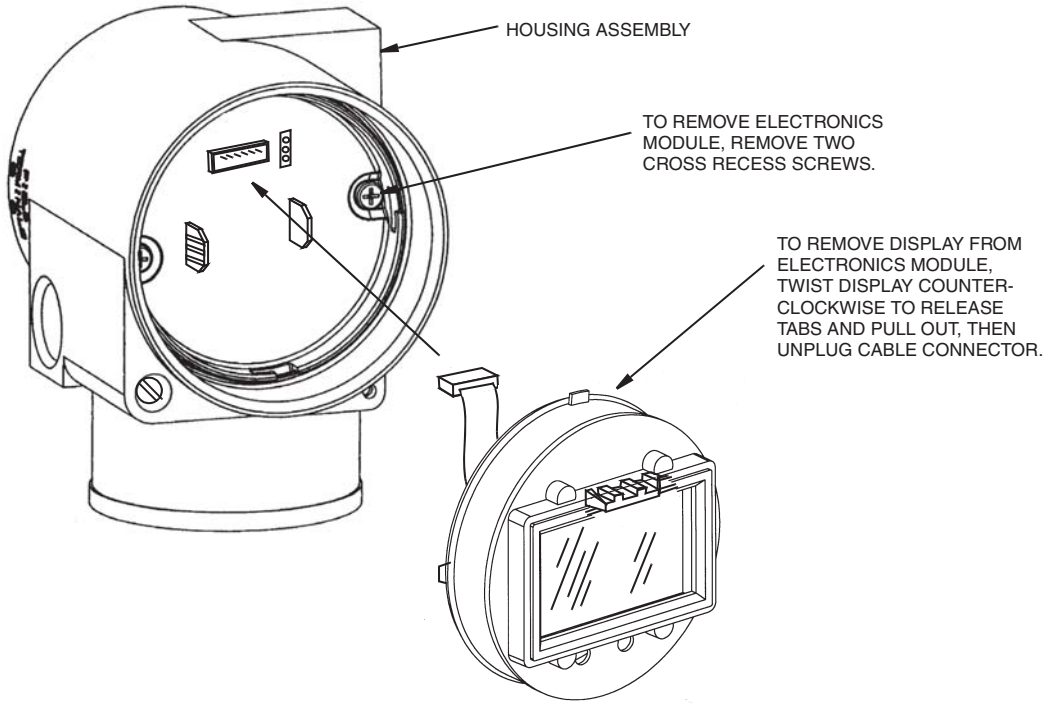
Adding the Optional Display

To add the optional display, refer to Figure 28 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 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 25.
6. Turn on the transmitter power source.

Figure 28. Replacing the Optional Display



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