

**I/A Series® Intelligent Vortex Flowmeter
Models 84S-T and 84S-U
With HART Communication**

Installation, Operation, Troubleshooting, and Maintenance

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1. Introduction

Overview

The 84S-T and 84S-U Vortex Flowmeters measure fluid (liquid, gas, or steam) flow rates using the principle of vortex shedding. The flowmeters produce a digital signal (HART protocol) and a 4-20 mA analog signal. The 84S-T also produces a pulse signal proportional to the volumetric flow rate.

Fluid flowing through the flowmeter body passes a specially shaped vortex shedder that causes vortices to form and shed alternately from the sides of the shedder at a rate proportional to the flow rate of the fluid. These shedding vortices create an alternating differential pressure that is sensed by a detector located above the shedder. A pulsed voltage is generated by the detector with a frequency that is synchronous with the vortex shedding frequency. This signal is then conditioned by an Electronic Module and processed by the microcontroller to produce a digital signal, an analog (4-20 mA dc) signal, and (in the 84S-T) a pulse signal.

The flowmeter allows direct analog connection to common receivers while still providing full digital communications using a HART Communicator or a PC-Based configurator.

Reference Documents

In addition to this instruction, there is other user documentation supporting the 84S-T, and 83S-U Vortex Flowmeters, as listed below.

Document Number	Document Description
Dimensional Prints	
DP 019-123	84S Sanitary Vortex Flowmeter
Parts Lists	
PL 008-717	84S Sanitary Vortex Flowmeter
Technical Information and Instructions	
B0800AJ	Ensuring Premium Performance with Foxboro 84 Series Vortex Flowmeters
MI 019-177	84 Vortex Flowmeter FM and CSA Connection Diagrams
MI 019-179	Flow Products Safety Information ^(a)

(a) Available in many languages on line at

www.ips.invensys.com/en/products/measurement/Pages/SafetyInstructionsforFlow.aspx

Standard Specifications

Process Temperature Limits:

Standard Temp/Fluorolube Fill: -20 and +90°C (0 and 200°F)

Standard Temp/Silicone Fill: -20 and +200°C (0 and 400°F)

High Temp/Unfilled: 200 and 430°C (400 and 800°F)

Ambient Temperature Limits:

With Indicator: -20 and +80°C (0 and +176°F)

Without Indicator: -40 and +80°C (-40 and +176°F)

Power Supply Requirements:

Supply Voltage Limits: 15.5 and 42 V dc

Supply Current:

Digital Mode: 10 mA dc nominal

Analog Mode: 22 mA dc maximum

Reynolds Number Requirements

Rd = 5000 minimum; Automatic compensation for the non-linear behavior of vortex shedding in the Rd range 5000 to 20,000 is built into the flowmeter. This compensation requires the user to input values for the flowing density and viscosity. Best accuracy is achieved at higher Reynolds numbers (>30,000 Rd).

Nominal Flow Velocity Limits: Can be calculated per Table 1.

Table 1. Nominal Flow Velocity Limits

Range Limit	Std. Temp. Range		High Temp. Range	
	ft/s	m/s	ft/s	m/s
Lower	$2.5/\sqrt{\rho_f}$	$3.0/\sqrt{\rho_f}$	$5.0/\sqrt{\rho_f}$	$6.0/\sqrt{\rho_f}$
Upper	$250/\sqrt{\rho_f}$	$300/\sqrt{\rho_f}$	$250/\sqrt{\rho_f}$	$300/\sqrt{\rho_f}$

— NOTE

The calculations in Table 1 apply for many applications but as they only provide nominal limits, Invensys recommends using the FlowExpert Pro™ sizing program for your specific application.

Static Pressure Limits:

Minimum: Pressure sufficient to prevent flashing and meet the pressure drop requirements to attain maximum flow rate. Refer to FlowExpert Pro sizing program.

Maximum: Determined by flange rating.

Flowmeter Output:

Analog: 4 to 20 mA dc into a maximum 1350 ohm load depending on power supply (see Figure 16).

Digital (HART): Digital signal conveyed at 1200 Baud transmission rates via FSK tones superimposed on power supply leads.

Pulse Output (84S-T only): Isolated 2 wire transistor switch.

Pulse rate (0 to 10, 100, or 1000 Hz) proportional to volumetric flow rate or total flow.

— NOTE

Accuracy of 0 to 10 Hz pulse rate is ±0.1% from 3 to 10 Hz and ±0.3% from 0 to 3 Hz.

Pulse Output Specifications

Isolated 2-wire transistor switch

Applied voltage: 5 to 30 V dc

Maximum 'ON' state voltage drop: 1.0 V dc

Maximum 'ON' state current: 20 mA dc

Reverse polarity protected

Short Circuit protected

Connectable to pull-up and pull-down counters

Electrical Safety Specifications

— NOTE —

1. These flowmeters have been designed to meet the electrical safety descriptions listed in Table 2. For detailed information or status of testing laboratory approvals/certifications, contact Invensys.
 2. See MI 019-179 for additional ATEX and IECEx safety information.
 3. With intrinsically safe approvals and certifications with a 24 V dc supply, an active barrier is required.
-

Table 2. Electrical Safety Specifications

Agency Certification, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX intrinsically safe: II 1 GD EEx ia IIC	Sira 06ATEX2067X Temperature Class T4, T103°C, Ta = -40 to +80°C.	E
ATEX flameproof: II 2 (1) GD EEx d [ia]	Sira 06ATEX2067X Temperature Class T4, T85°C, Ta = -20 to +80°C.	H
FM intrinsically safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F, G. Also, Class I, Zone 0, AEx ia IIC.	Connect per MI 019-177. Temperature Class T4; Ta = 80°C	F
FM explosionproof for Class I, Division 1, Groups B, C, and D; dust-ignitionproof for Class II, Division 1, Groups E, F, and G; Class III, Division 1.	Connect per MI 019-177. Temperature Class T5. Ta = 85°C	G
FM nonincendive for Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2.	Connect per MI 019-177. Temperature Class T4. T=80°C	K
CSA intrinsically safe for Class I, II, III, Division 1, Groups A, B, C, D, E, F, G. Also, Class I, Zone 0, Ex ia IIC.	Temperature Class T4; Ta = 80°C	C
CSA explosionproof for Class I, Division 1, Groups B, C, and D; dust-ignitionproof for Class II, Division 1, Groups E, F, and G; Class III, Division 1.	Temperature Class T5. Ta = 85°C	D
CSA nonincendive for Class I, Division 2, Groups A, B, C, and D; Class II, Division 2, Groups F and G; Class III, Division 2.	Temperature Class T4. T=80°C	M
IECEx intrinsically safe Ex ia IIC Dust-ignitionproof Ex tD A20 IP66	IECEx SIR 06.0020X Temperature Class T4, T103°C Ta = -40 to +80°C.	L
IECEx flameproof: Ex d [ia] Dust-ignitionproof Ex tD A20 IP66	IECEx SIR 06.0020X Temperature Class T4, T85°C Ta = -20 to +80°C.	B

Table 2. Electrical Safety Specifications (Continued)

Agency Certification, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
Unit with CE mark and PED controls and records.		Y
Unit does not have CE mark; not to be installed in European Union (EU) countries.		Z

ATEX and IECEx Warnings

Ensure area is known to be nonhazardous before removing cover.

To prevent ignition of flammable or combustible atmospheres, disconnect power before servicing.

Explosion Hazard - Do not disconnect equipment unless power has been turned off or the area is known to be nonhazardous.

Explosion Hazard - Substitution of components may impair safety.

Do not open while circuits are alive.

ATEX Compliance Documents

EN 50014: 1997

EN 50284: 1999

EN 50018: 2000

EN 50281-1-1: 1998

EN 50020: 2002

IECEx Compliance Documents

IEC 60079-0: 2000, Edition 3.1

IEC 60079-1: 2003, Edition 5

IEC 60079-11: 1999, Edition 4

IEC 61241-0: 2004, Edition 1

IEC 61241-1: 2004, Edition 1

Configurable Parameters

Table 3 lists all of the configurable parameters and the factory default for the 84 Vortex Flowmeter.

Table 3. Configurable Parameters

Parameter	Parameter Name	Capability	Factory Default	Configurable with		
				Integral Indicator	HART Comm.	PC-Based Config.
Fluid	2 Fluid					
Fluid Type	3 New	Gas, Liquid, Steam	Liquid	Yes	Yes	Yes
Fluid Name	3 Name		Water	Yes	Yes	Yes
Temperature Unit	3 TmpEGU	degK, degF, degC, degR	deg F	Yes	Yes	Yes
Flow Temperature	3 FlwTmp		70	Yes	Yes	Yes
Density Unit	3 DenEGU	Pick list of density units	lb/ft ³	Yes	Yes	Yes
Flow Density	3 FlwDen		62.315	Yes	Yes	Yes
Base Density	3 BasDen		62.378	Yes	Yes	Yes
Viscosity Unit	3 VisEGU	cPoise or cStoke	cP	Yes	Yes	Yes
Viscosity	3 Visc		0.98	Yes	Yes	Yes
Flow	2 Flow					
Flow Type	3 FlwMap	VolFlow, BVolFlow, MassFlow	VolFlow	Yes	Yes	Yes
Flow Units	3 FlwEGU	Picklist	gal/min	Yes	Yes	Yes
Flow Upper Range Value	3 FlwURV		232.73	Yes	Yes	Yes
Flow Damping Factor	3 FlwDmp	Pick list of 8 choices from 0 to 32 s	2	Yes	Yes	Yes
Flow Velocity Unit	3 VelEGU	Picklist	ft/s	Yes	No	No
Tuning	2 Tuning					
Signal Conditioning	3AddDrop	On or Off	On	Yes	Yes	Yes
Reynolds Number Correction	3 ReyCor	On or Off	Off	Yes	Yes	Yes
Low Flow Cut-In Level	3 LFCI	1 through 8	4	Yes	Yes	Yes
Total	2 Total					
Net Total	3 TotNet					
Map	4 Map	Volume, Mass, BVolume	Volume	Yes	Yes	Yes
EGU	4 EGU	Pick list dependent on Mapping	m ³	Yes	Yes	Yes
Grand Total	3 TotGrd					

Table 3. Configurable Parameters

Parameter	Parameter Name	Capability	Factory Default	Configurable with		
				Integral Indicator	HART Comm.	PC-Based Config.
Map	4 Map	Volume, Mass, BVolume	Volume	Yes	Yes	Yes
EGU	4 EGU	Pick list dependent on Mapping	m ³	Yes	Yes	Yes
Output	2 Output					
Coms	3 Coms					
Poll Address	4PolAdr	0 through 15	0	Yes	Yes	Yes
Preambles	4Preambl	2 to 20	5	Yes	Yes	Yes
Fail	3 Fail	Downscale or Upscale	Down-scale	Yes	Yes	Yes
Pulse	3 Pulse					
Pulse	4 Pulse	Raw, Rate, Total	Rate	Yes	Yes	Yes
(If Raw)	Pul=Raw			Yes	Yes	Yes
(If Rate)						
Upper Freq End Point	4 Freq	10, 100, 1000	1000	Yes	Yes	Yes
(If Total)						
Pulse Width	4 Pwidth		50 ms	Yes	Yes	Yes
Units	4 EGU		ft ³	Yes	Yes	Yes
Units per Pulse	4 U/Pulse		1	Yes	Yes	Yes
Display	3Display					
Show	4 Show	FlwVol, TotNet, TotGrd (measurements to be displayed and their format)	FlwVol	Yes	Yes	Yes
First Measurement	Show1st	FlwVol, Velcty, FlwBVo, FlwMas, Raw	FlwVol	Yes	Yes	Yes
Cycle	4 Cycle	Automatic or Manual	Auto	Yes	Yes	Yes
Pipe	2 Pipe					
Piping	3 Piping					
Configuration	4 Config	Picklist of 8 configurations	Straight	Yes	Yes	Yes
Upstream Distance	4 UpDist	(in pipe diameters)	0	Yes	Yes	Yes
Tags	2 Tags					
HART Description	3 HrtDes	(16 characters maximum)	HART Description	Yes	Yes	Yes
HART Tag	3 HrtTag	(8 characters maximum)	HART Tag	Yes	Yes	Yes

Table 3. Configurable Parameters

Parameter	Parameter Name	Capability	Factory Default	Configurable with		
				Integral Indicator	HART Comm.	PC-Based Config.
HART Message		32 characters maximum	HART Message	No	Yes	Yes
Flowtube	2NewTube					
Model Number	3 Model	(16 characters maximum)	84S-T02TJRF	Yes	Yes	Yes
Custom Design	3 Special					
Flowtube Diameter	4 TubDia	Flowtube diameter in meters	0.0491998	Yes	Yes	Yes
Coef of Expansion	4 TubAlp	(in m/m/°K)	1.7262e ⁻⁵	Yes	Yes	Yes
LFCI User Factor	4 LfUFac		1.0	Yes	Yes	Yes
Reference Number	3 Ref No	(16 characters maximum)	123456789 abcdefg	Yes	Yes	Yes
K-Reference	3 K Ref					
K-Factor Unit	4 K EGU	p/l, p/ft ³	p/ft ³	Yes	Yes	Yes
Reference K-Factor	4 K Ref	(from flowmeter tag)	258	Yes	Yes	Yes
Password	2 Passwd					
Password to reset Net and Pulse Totalizer	3 LoPwd	(4 characters)	(4 spaces)	Yes	No	No
Password for all functions	3 HiPwd	(4 characters)	(4 spaces)	Yes	No	No

2. Installation

Fundamental Installation Requirements

These flowmeters should be installed to meet all applicable local installation regulations, such as hazardous location requirements, electrical wiring codes, and mechanical piping codes. Persons involved in the installation should be trained in these code requirements in order to assure that the installation takes maximum advantage of the safety features designed into the flowmeters.

Unpacking

Your 84S Series Vortex Flowmeter is built to be durable but it is part of a calibrated precision system and should be handled as such. The flowmeter is shipped with the flowmeter body connected to the electronics housing by a flexible cable. Do **not** cut or disconnect the cable.

Remove the flowmeter body from the shipping carton using care to avoid dropping or otherwise subjecting it to impact, particularly at the flowmeter body ends. Never put anything through the flowmeter body for lifting purposes as damage to the shedder bar may occur.

After removing the flowmeter body from its shipping carton, inspect it for visible damage. If any damage is observed, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier. The calibration certificate and any other documentation shipped with the meter should be separated from the packing material and held for future reference.

Packing material should be disposed of in accordance with local regulations. All packing material is nonhazardous and is generally acceptable to landfills.

Flowmeter Identification

Before installing your flowmeter, check its data plate to assure that it is correct for your application. Specifications such as maximum ambient temperature, process temperature, and working pressure are given on the data plate. The model code is also stamped on the data plate as shown in Figure 1 and is digitally readable from the configuration menu. For interpretation of the Model Code, refer to PL 008-717.

Electrical certification information is located on the right end of the data plate.

The software version of your device can be found in View mode as **2 SW Rev.**

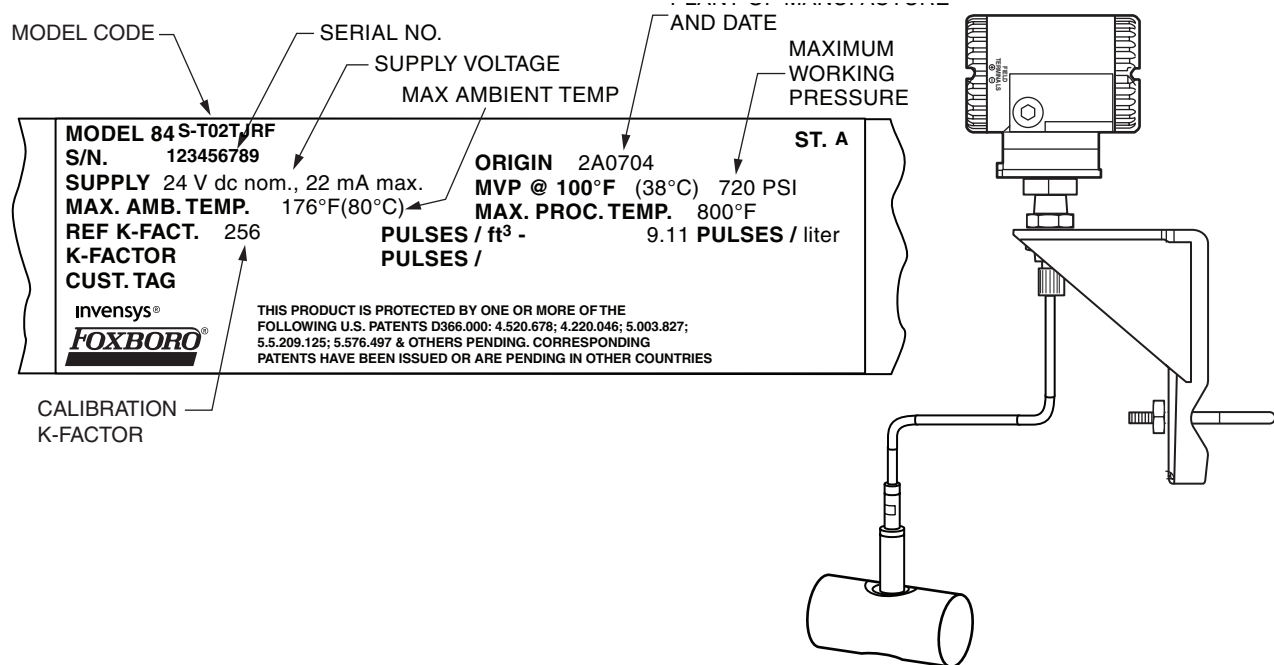


Figure 1. Flowmeter Identification

Mechanical Installation

For a summary of installation guidelines, refer to B0800AJ, *Ensuring Premium Performance with Foxboro 84 Series Intelligent Vortex Flowmeters*.

Dimensions

For overall dimensions of the flowmeter and end connections, refer to DP 019-123.

Piping Considerations

— NOTE —

1. Prior to installation, spring back the piping on either end of the flowmeter to allow as much space as is required to install the flowmeter without damaging the flowmeter body ends.
2. Mating end connection parts (clamps, connections, and gaskets) are required and are supplied by the user. Select a gasket or seal material which is suitable for the process liquid.
3. Firmly secure the cable that connects the flowmeter body to the electronic housing. The support should be approximately 30 cm (12 in) from the flowmeter body. A loose cable may cause wear at the cable connection and result in signal noise. The temperature limit of the cable is 105°C (220°F). Do **not** support the cable on a surface exceeding this temperature. See Figure 2.

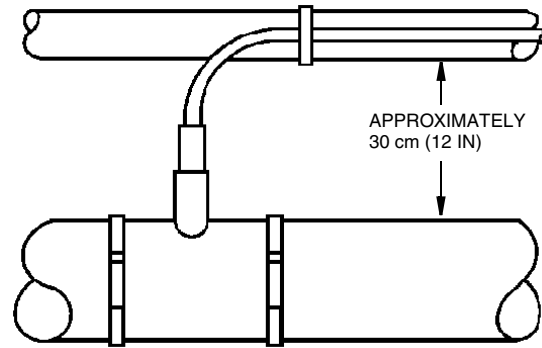


Figure 2. Flowmeter Body Cable Support

Effects of Piping on Flowmeter Performance

1. The vortex shedder axis can be oriented to reduce, or in some cases eliminate, vibration influence. Positioning the flowmeter body so that vibrations are parallel to the sensor diaphragms minimizes the effect of vibrations.
2. To ensure that your flowmeter performs to its fullest capabilities, it should be mounted in a straight, unobstructed pipe. The recommended minimum amount of straight pipe upstream is shown in Table 4. There should be a minimum of eight diameters of straight pipe downstream. See Figure 3.

Table 4. Typical Piping Configurations

Upstream Configuration	Recommended Upstream Pipe Diameters
90° Elbow	30
Two elbows in different planes with the closest elbow in the same plane as the shedder element ^(a) .	45
Two elbows in different planes with the closest elbow perpendicular to the plane of the shedder ^(a) .	35
1.5:1 reduction in piping diameter.	35
Butterfly valve (wide open)	30

(a)Shedder is located in bore of flowmeter.

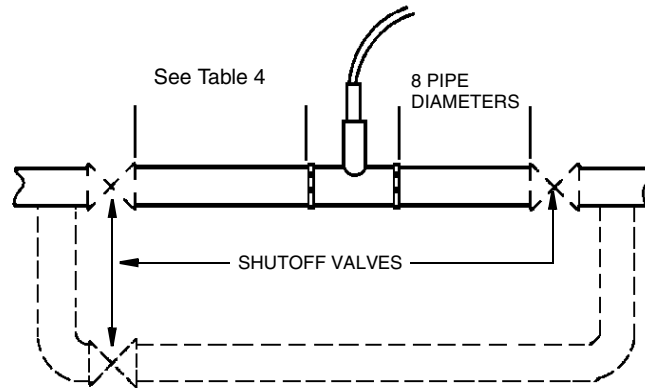


Figure 3. Bypass Piping

3. It is recommended that control valves, when required, be mounted downstream from the flowmeter body to ensure that back pressure is sufficient to maintain a full pipe, and to prevent pressure loss sufficient to cause flashing or cavitation. Ensure that gaskets do **not** protrude into pipe line.
4. The piping which attaches to the flowmeter body end connections must be rigidly supported. This minimizes the effects of piping vibration on flowmeter performance.
5. The flowmeter should not be located near pump discharge line or suction lines. Pumps often produce oscillatory flow which may affect vortex shedding or produce pipe vibration.
6. Flowmeters mounted near the discharge of liquid positive displacement pumps may experience severe flow fluctuations and cause damage to the sensor.
7. Good piping practice is to assume that for four pipe diameters upstream and two pipe diameters downstream, the internal surface of the pipe shall be free from mill scale, pits, holes, reaming scores, rifling, bumps, or other irregularities.

Bypass Piping

It is sometimes desirable to provide bypass piping if the flow cannot be interrupted for servicing the flowmeter. See Figure 3.

! WARNING

If a bypass is used, it must also incorporate some means to relieve the pressure from the main line before the vortex flange bolts or clamps are loosened.

Installing the Flowmeter Body

The 84S Sanitary Vortex Flowmeter has six different end connection possibilities. The end connections on your flowmeter body were specified as part of your order. All end connections are welded to the flowmeter body. The mating end connections, gaskets, and clamps are supplied by you, the user.

! WARNING

The maximum pressure limit of the flowmeter is 1.9 MPa (275 psig) or the limit of the end connection used, whichever is less.

For interpretation of model code references, refer to PL 008-717.

Dimensional information on the end connections can be found in DP 019-123.

3A I-Line Fitting (Code "C")

The 3A I-Line fitting mates with Cherry Burrell 15 WI or equivalent. See Figure 4.

1. Insert the seals into the flowmeter body ends.
2. Insert the mating pipe ends and tighten the clamps securely.

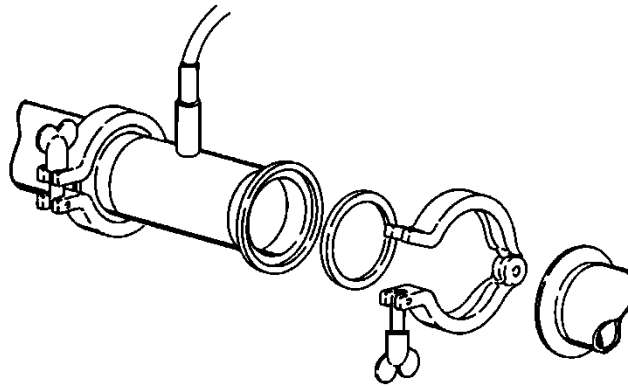


Figure 4. 3A I-Line Fitting

ANSI Class 150 RF Flange (Code "F")

The ANSI Class 150 RF flange is a crevice-free design for general sanitary service. See Figure 5.

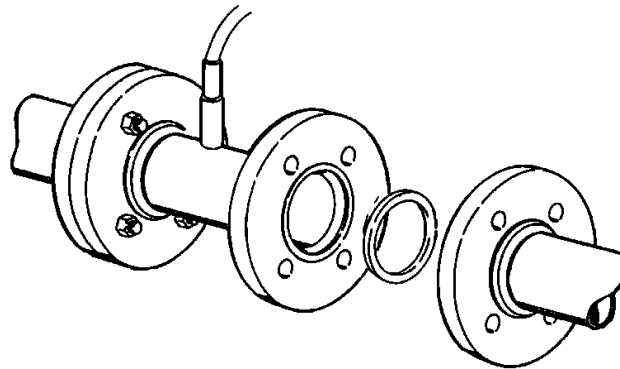


Figure 5. ANSI Class 150 RF Flange

1. Gaskets are normally required and are supplied by the user. Select a gasket material that is suitable for the process fluid.
2. Insert gaskets between body of flowmeter and adjacent flanges. Position gaskets so that the ID of each gasket is centered on the ID of the flowmeter body and adjacent piping.

— **! CAUTION** —

1. Verify that the ID of the gaskets is larger than that of the flowmeter bore and pipe and that they do not protrude into the process liquid. Failure to do this may adversely affect the accuracy of the measurement.
 2. Gaskets do not prevent flanges from being wetted by the process.
-

— **NOTE** —

If welding of the flanges to the process piping is required, protect the inside diameter of the flowmeter from weld splatter. Failure to do this may adversely affect flowmeter accuracy.

3. Visually inspect for concentricity of mating flanges.
4. Tighten bolts in accordance with conventional flange bolt tightening practice (that is, incremental and alternate tightening of bolts).

SI Coupling (Code “M”)

The SI (DIN 11851) coupling with an external knuckle thread is per Din 405. See Figure 6.

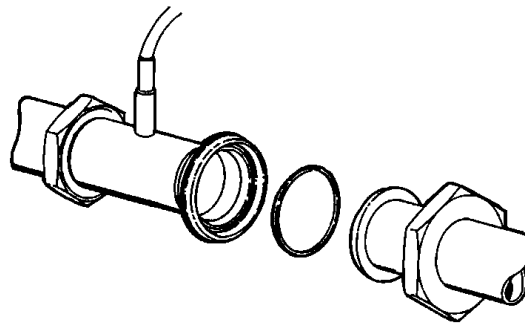


Figure 6. SI Coupling

1. Insert the seals into the grooves in the flowmeter body ends.
2. Tighten the nuts securely.

RJT Coupling (Code “R”)

The RJT (ring-type joint coupling) per BS 1864 has an external thread. See Figure 7.

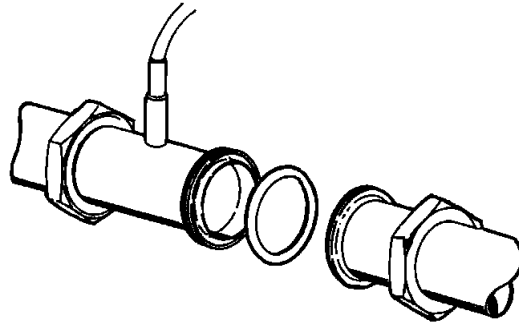


Figure 7. RJT Coupling

1. Insert the seals into the cavity in the flowmeter body ends.
2. Tighten the nuts securely.

3A Tri-Clamp (Code "T")

The 3A Tri-Clamp Type Quick-Disconnect Ferrule mates with a Tri-Clover 14 WMP or equivalent. See Figure 8.

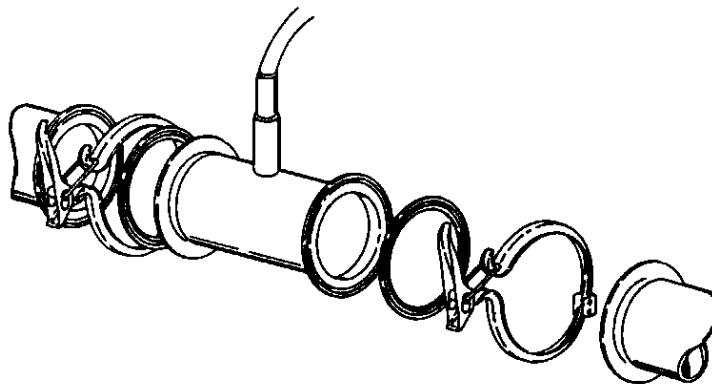


Figure 8. 3A Tri-Clamp

1. Insert the seal into the flowmeter body ends.
2. Make full face contact between the pipe and flowmeter body ends prior to installing and tightening the clamps.

ISS Coupling (Code "U")

The ISS (ISO 2853) coupling has an external thread. See Figure 9.

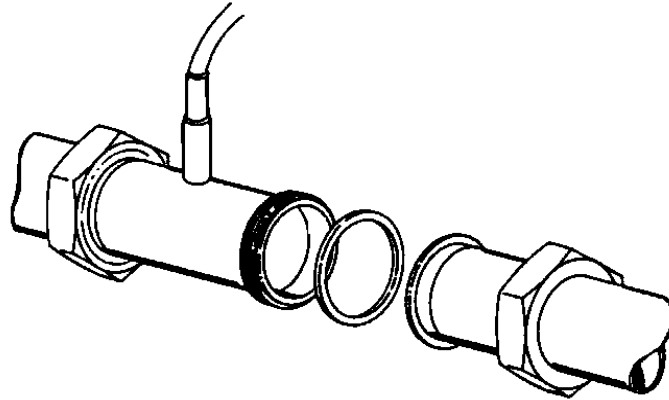


Figure 9. ISS Coupling

1. Insert the seals onto the flowmeter body ends.
2. Tighten the nuts securely.

Mounting the Electronic Housing

The remote electronics housing can be mounted to a vertical or horizontal DN 50 or 2-in pipe using the mounting bracket and U-bolt supplied. To mount the housing to a horizontal pipe, turn the U-bolt 90 degrees from the position shown in Figure 10.

The housing can be surface mounted by securing the mounting bracket to a wall using the U-bolt mounting holes. It may be easier to secure the mounting bracket to the wall without the housing attached. To do this, use the following procedure:

1. Remove the jam nut under the bracket.
2. Raise the housing until you can slide the cable through the cutout in the bracket.
3. Lay the housing aside and secure the mounting bracket to the wall.
4. Reverse steps 2 and 1.

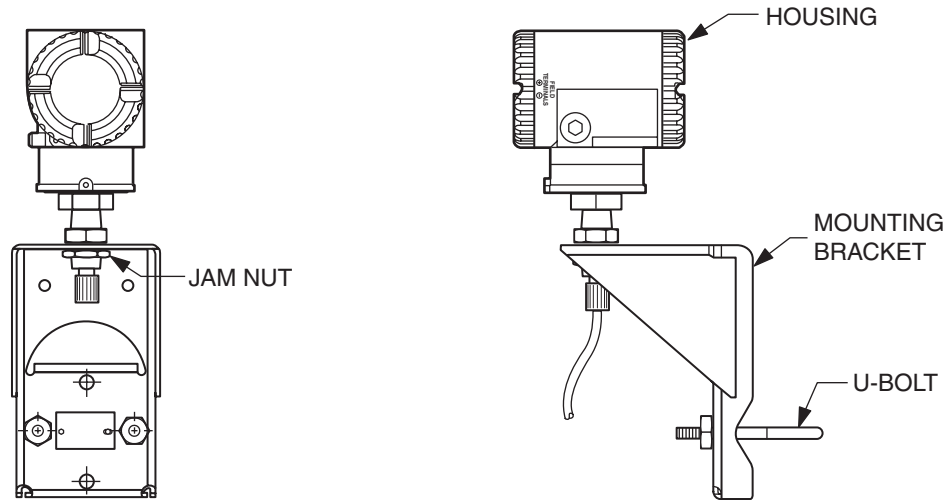


Figure 10. Mounting the Electronic Housing

Cover Locks

Electronic housing cover locks, shown in Figure 11, are provided as standard with certain agency certifications. 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.

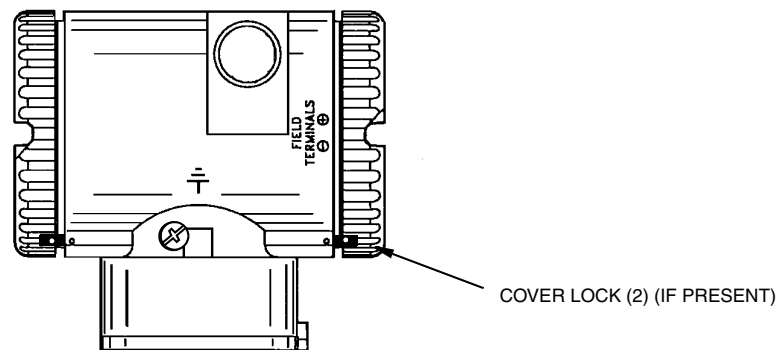


Figure 11. Cover Locks

Positioning the Display

The display (optional in some models) can be rotated within the housing to any of four positions at 90° increments. To do this, loosen the two captive screws, turn the display to the desired position, and retighten the screws.

— **! CAUTION** —

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

2. Carefully fold the ribbon cable in the space between display and the electronic module so that it is not pinched. The display molding should rest firmly against the module molding before tightening the screws.

Setting the Write Protect Jumper

Your transmitter has write protection capability which meets the security requirements of ISA-S84.01-1986 for use in safety shutdown systems. This means that the local display and remote electronics 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 display. To activate write protection, remove the display and remove the jumper or place it in the 'protect' position. In the 'write' position, writing to certain functions can be limited by password protection. See "Password" on page 30.

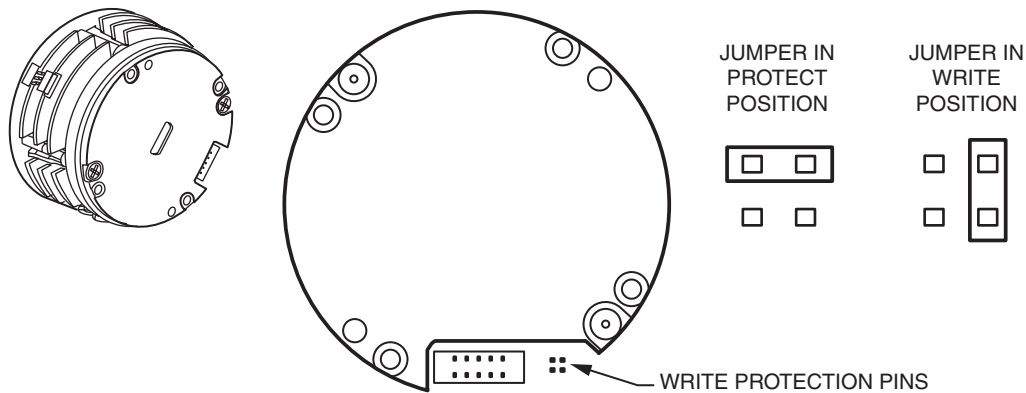


Figure 12. Write Protect Jumper

Positioning the Housing

The flowmeter 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 either an anti-rotation screw or a retention clip that prevent the housing from being rotated beyond a safe depth of housing/sensor thread engagement.

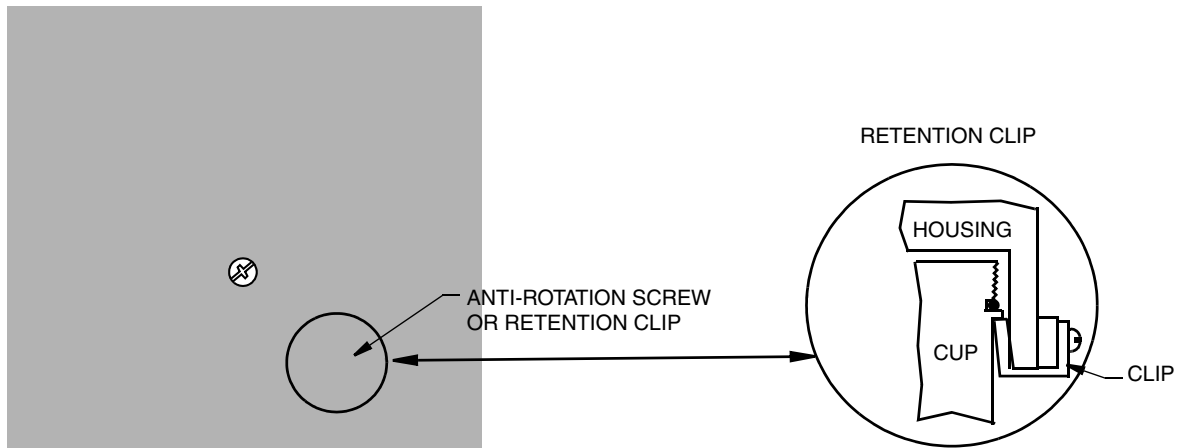


Figure 13. Housing Screw or Clip Location

Field Termination Wiring

The installation and wiring of your flowmeter must conform to local code requirements. Also, for FM installations, refer to MI 019-177; for ATEX and IECEx installations, refer to MI 019-179.

— NOTE —

Invensys recommends the use of transient/surge protection in installations prone to high levels of electrical transients and surges.

Conduit / Cable Gland Connections

The electronics housing has two conduit/cable gland connections to allow access from either side of the housing. These connections are 1/2 NPT or M20 threads per your order. Make sure to use the correct threaded devices when making these connections. The type of thread can be verified by viewing the sixth character after the dash in the model code on the data plate. The letter **R** indicates a 1/2 NPT thread; **W**, an M20 thread.

Accessing Flowmeter Field Terminals

For access to the field terminals, remove the cover from the field terminals compartment as shown in Figure 14. Note that the embossed letters **FIELD TERMINALS** identify the proper compartment.

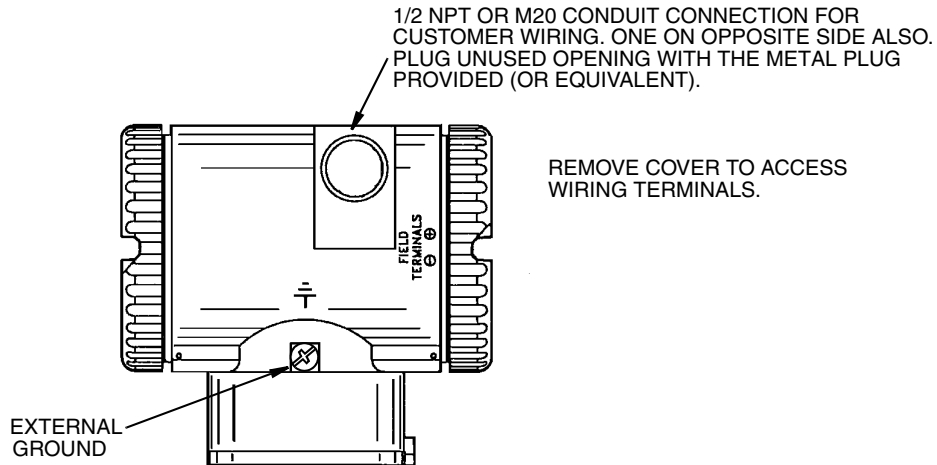


Figure 14. Accessing Field Terminals

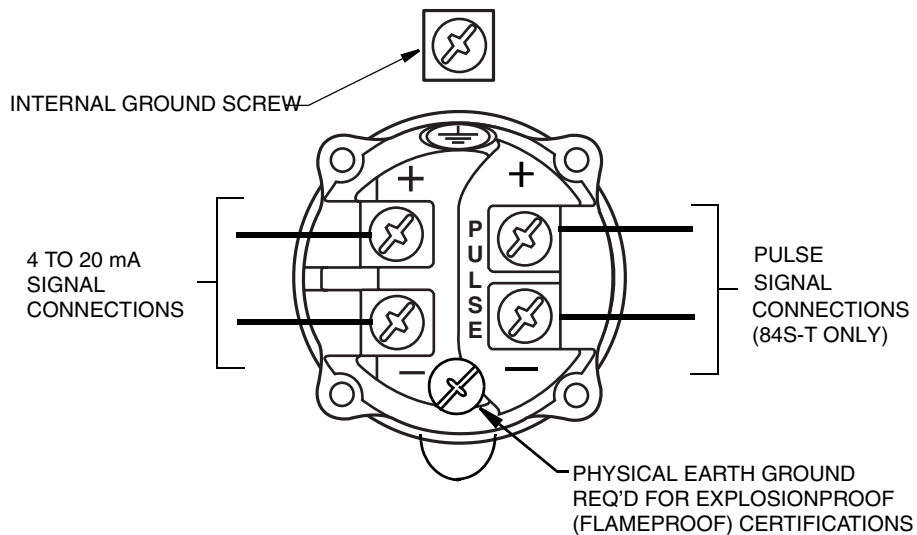


Figure 15. Identification of Field Terminals

Wiring the Flowmeter to a Control Loop

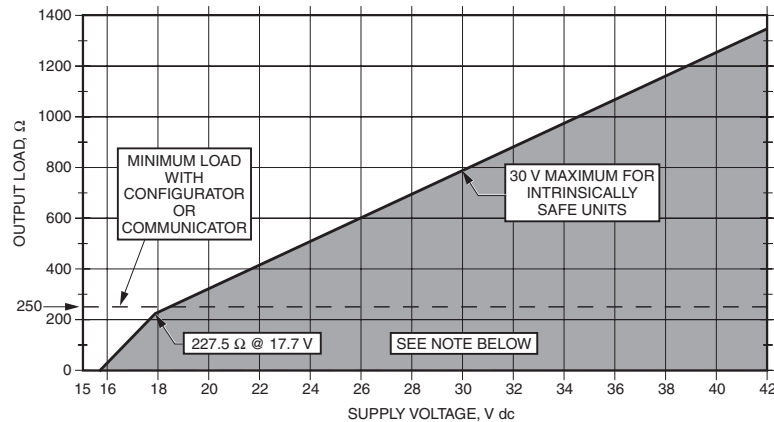
— NOTE —

To use a 4-20 mA output signal, your flowmeter must be configured **4-20 mA**.

When wiring a flowmeter with 4 to 20 mA output signal, the supply voltage and loop load must be within specified limits. The supply output load vs. voltage relationship is shown in Figure 16.

Any combination of supply voltage and loop load resistance in the shaded area can be used. To determine the loop load resistance (flowmeter output load), add the series resistance of each

component in the loop, excluding the flowmeter. The power supply must be capable of supplying 22 mA of loop current.



NOTE:
THE FLOWMETER FUNCTIONS WITH AN OUTPUT LOAD LESS THAN 250 Ω PROVIDED THAT A PC-BASED CONFIGURATOR OR HART COMMUNICATOR IS NOT CONNECTED TO IT. CONNECTING A PC-BASED CONFIGURATOR OR HART COMMUNICATOR WHILE OPERATING BELOW A 250 Ω LOAD MAY CAUSE OUTPUT DISTURBANCE AND/OR COMMUNICATION PROBLEMS.

Figure 16. Supply Voltage and Loop Load

Examples:

1. For a loop load resistance of 300 Ω, the supply voltage can be any value from 19.1 to 30 V dc.
2. For a supply voltage of 24 V dc, the loop load resistance can be any value from 250 to 520 Ω (zero to 520 Ω without a HART Communicator or PC-Based Configurator connected to the flowmeter).

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

1. Remove the cover from the field terminals compartment.
2. Run signal wires (0.50 mm² or 20 AWG, typical) through one of the flowmeter conduit connections. Use twisted pair to protect the 4 to 20 mA output and/or remote communications from electrical noise. Maximum recommended length for signal wires is 1800 m (6000 ft)

— NOTE —

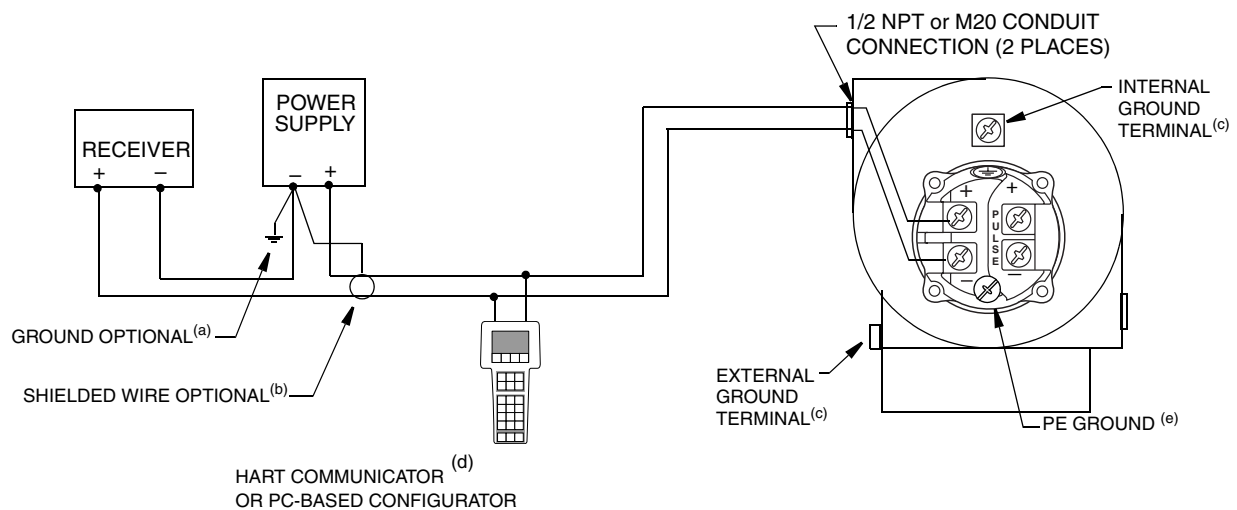
Do **not** run flowmeter wires in same conduit as mains (ac power) wires.

3. If shielded cable is used, ground the shield at the receiver **only**. Do **not** ground the shield at the flowmeter.
4. Plug the unused conduit opening with the 1/2 NPT or M20 metal plug provided (or equivalent). To maintain specified explosionproof and dust-ignitionproof protection, the plug must engage a **minimum** of five full threads.
5. The flowmeter is equipped with an internal and external ground connection. Connect a ground wire to either 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 flowmeter as shown in Figure 17.
8. Install the cover onto the flowmeter. Turn the cover to seat the O-Ring into the housing and continue to hand tighten until the cover contacts the housing metal-to-metal. If cover locks are present, refer to “Cover Locks” on page 17.
9. If wiring additional flowmeters to the same power supply, repeat Steps 1 through 8 for each additional flowmeter.
10. A HART Communicator or PC-based Configurator can be connected in the loop between the flowmeter and the power supply as shown in Figure 17. Note that a minimum of 250 Ω must separate the power supply from the HART Communicator or PC-Based Configurator.



- (a) GROUNDING THE LOOP AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY IS RECOMMENDED BUT NOT REQUIRED.
- (b) IF SHIELDED WIRE IS USED, TERMINATE THE SHIELD AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY.
- (c) THE TRANSMITTER IS EQUIPPED WITH AN INTERNAL AND EXTERNAL GROUND CONNECTION. CONNECT A GROUND WIRE TO EITHER TERMINAL IN ACCORDANCE WITH LOCAL PRACTICE.
- (d) THERE MUST BE AT LEAST 250 Ω TOTAL RESISTANCE BETWEEN THE PC-BASED CONFIGURATOR OR THE HART COMMUNICATOR AND THE POWER SUPPLY.
- (e) REQUIRED FOR EXPLOSIONPROOF (FLAMEPROOF) APPLICATIONS

Figure 17. Loop Wiring 4 to 20 mA Output Flowmeters

Multidrop Communication

“Multidropping” refers to the connection of several flowmeters to a single communications transmission line. Communications between the host computer and the flowmeters takes place digitally with the analog output of the flowmeter deactivated. With the HART communications protocol, up to 15 flowmeters 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 flowmeter, the combination of flowmeter models, and the length of the transmission line. Multidrop installations are not recommended where Intrinsic Safety is a requirement. Communication with the flowmeters can be accomplished with any HART compatible modem and a host implementing the HART protocol. Each flowmeter is identified by a unique address (1-15) and responds to the commands defined in the HART protocol.

Figure 18 shows a typical multidrop network. Do not use this figure as an installation diagram. Contact the HART Communications Foundation, (512) 794-0369, with specific requirements for multidrop applications.

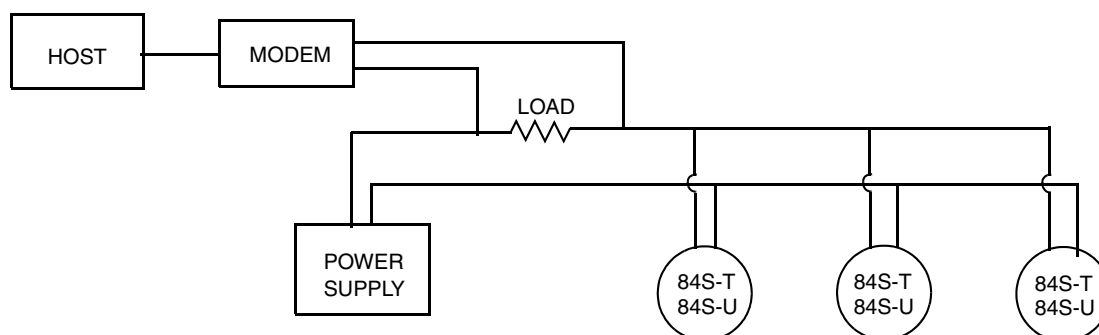


Figure 18. Typical Multidrop Network

The HART Communicator can operate, configure, and calibrate 84 Series Flowmeters with HART communication protocol in the same way as it can in a standard point-to-point installation.

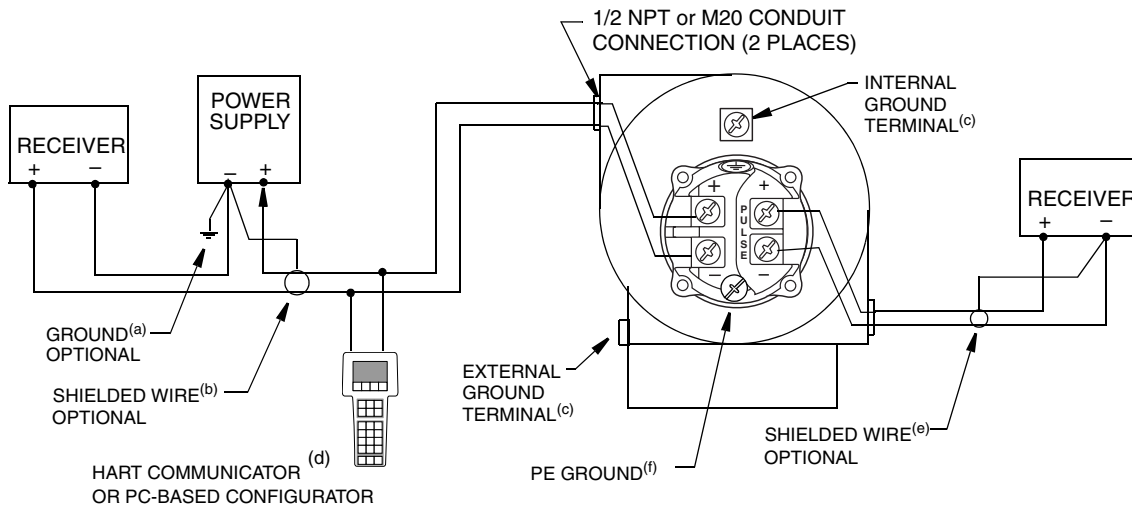
— NOTE —

84 Series Flowmeters with HART communication protocol are set to poll address 0 (**POLLADR 0**) at the factory, allowing them to operate in the standard point-to-point manner with a 4 to 20 mA output signal. To activate multidrop communication, the flowmeter address must be changed to a number from 1 to 15. Each flowmeter must be assigned a unique number on each multidrop network. This change deactivates the 4 to 20 mA analog output.

Wiring a Flowmeter With a Pulse Output

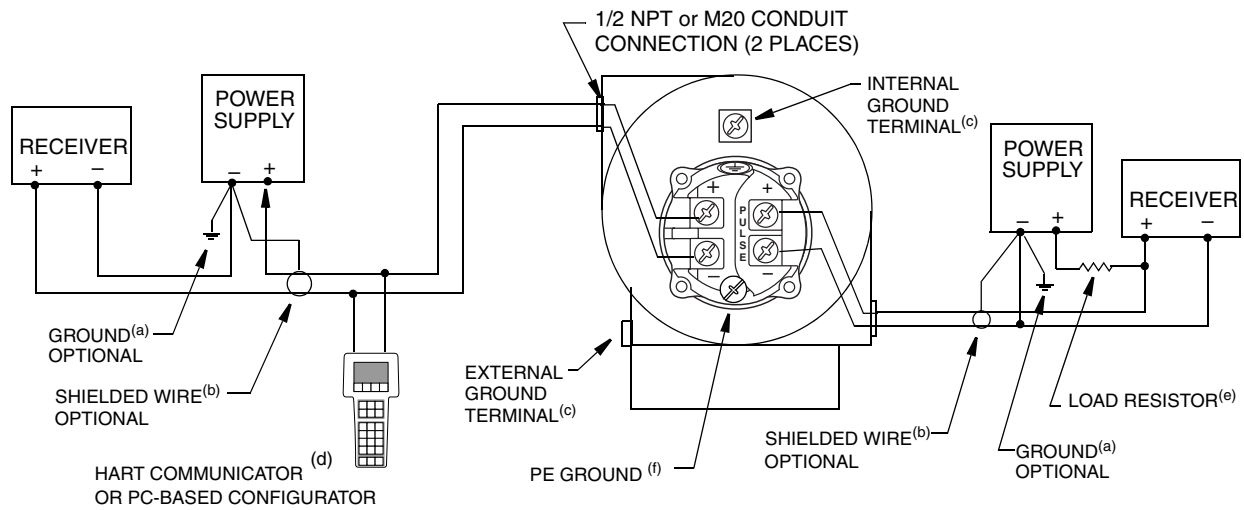
Two separate loops are required when using the pulse output on an 84F-T or 84W-T Flowmeter with the 4 to 20 mA or digital signal. Each loop requires its own power supply. Figure 19 shows the connections with a transistor switch (sinking) counter input with receiver supplied power; Figure 20, with a transistor switch (sinking) counter input and external power supply and pull-up

resistor; and Figure 21 with a transistor switch (sourcing) counter input and external power supply and pull-up resistor.



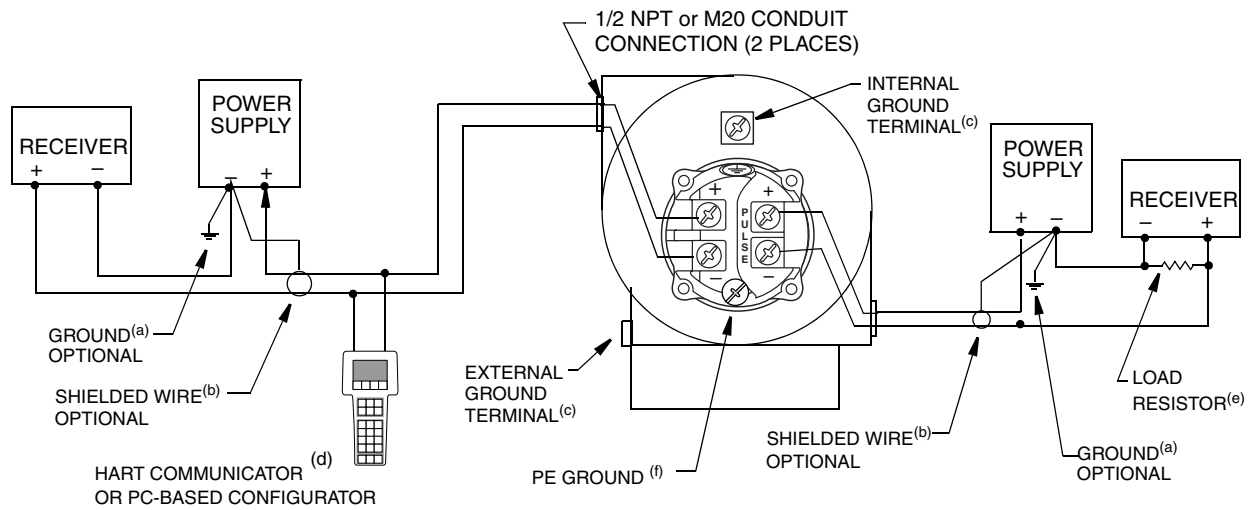
- (a) GROUNDING THE LOOP AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY IS RECOMMENDED BUT NOT REQUIRED.
 (b) IF SHIELDED WIRE IS USED, TERMINATE THE SHIELD AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY.
 (c) THE TRANSMITTER IS EQUIPPED WITH AN INTERNAL AND EXTERNAL GROUND CONNECTION. CONNECT A GROUND WIRE TO EITHER TERMINAL IN ACCORDANCE WITH LOCAL PRACTICE.
 (d) THERE MUST BE AT LEAST 250 Ω TOTAL RESISTANCE BETWEEN THE PC-BASED CONFIGURATOR OR THE HART COMMUNICATOR AND THE POWER SUPPLY.
 (e) IF SHIELDED WIRE IS USED, TERMINATE THE SHIELD AT THE NEGATIVE TERMINAL OF THE RECEIVER.
 (f) REQUIRED FOR EXPLOSIONPROOF (FLAMEPROOF) APPLICATIONS.

Figure 19. Wiring an 84S-T Flowmeter with a Pulse Output Transistor Switch (sinking) Counter Input with Receiver Supplied Power



- (a) GROUNDING THE LOOP AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY IS RECOMMENDED BUT NOT REQUIRED.
- (b) IF SHIELDED WIRE IS USED, TERMINATE THE SHIELD AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY.
- (c) THE TRANSMITTER IS EQUIPPED WITH AN INTERNAL AND EXTERNAL GROUND CONNECTION. CONNECT A GROUND WIRE TO EITHER TERMINAL IN ACCORDANCE WITH LOCAL PRACTICE.
- (d) THERE MUST BE AT LEAST 250 Ω TOTAL RESISTANCE BETWEEN THE PC-BASED CONFIGURATOR OR THE HART COMMUNICATOR AND THE POWER SUPPLY.
- (e) MAXIMUM PULSE OUTPUT CURRENT IS 20 mA. LOAD RESISTOR MUST BE SIZED ACCORDINGLY.
- (f) REQUIRED FOR EXPLOSIONPROOF (FLAMEPROOF) APPLICATIONS.

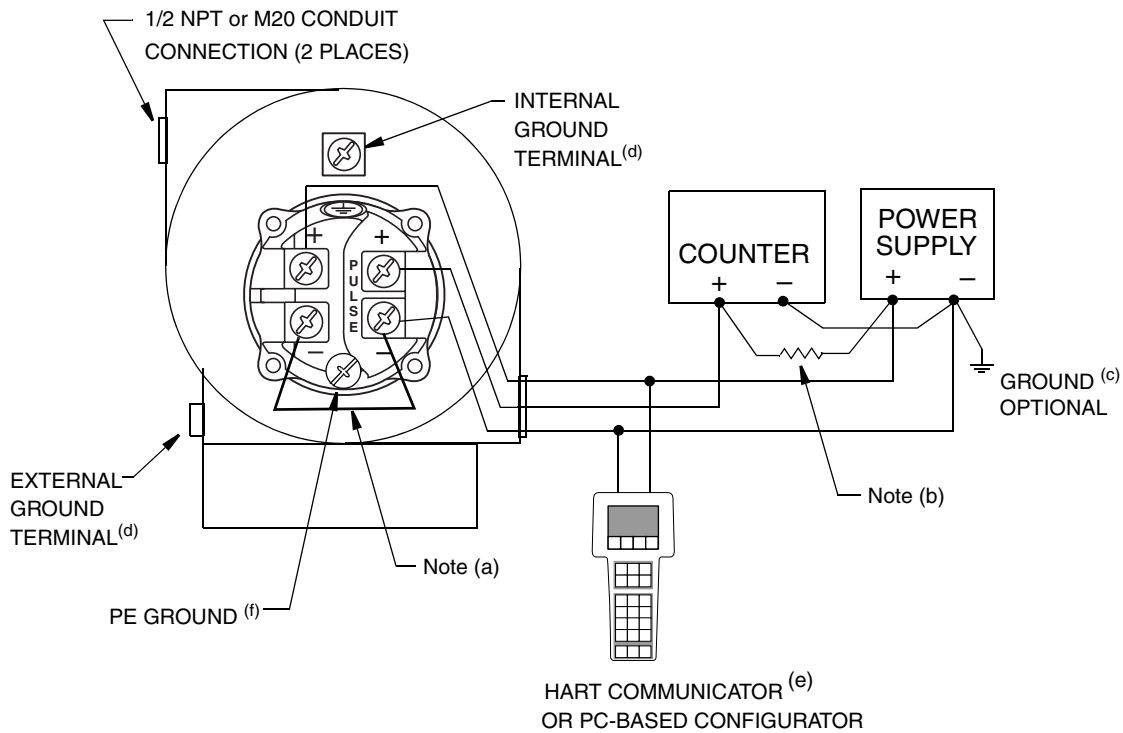
Figure 20. Wiring an 84S-T Flowmeter with a Pulse Output Transistor Switch (sinking) Counter Input with External Power Supply and Pull-Up Resistor



- (a) GROUNDING THE LOOP AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY IS RECOMMENDED BUT NOT REQUIRED.
 (b) IF SHIELDED WIRE IS USED, TERMINATE THE SHIELD AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY.
 (c) THE TRANSMITTER IS EQUIPPED WITH AN INTERNAL AND EXTERNAL GROUND CONNECTION. CONNECT A GROUND WIRE TO EITHER TERMINAL IN ACCORDANCE WITH LOCAL PRACTICE.
 (d) THERE MUST BE AT LEAST 250 Ω TOTAL RESISTANCE BETWEEN THE PC-BASED CONFIGURATOR OR THE HART COMMUNICATOR AND THE POWER SUPPLY.
 (e) MAXIMUM PULSE OUTPUT CURRENT IS 20 mA. LOAD RESISTOR MUST BE SIZED ACCORDINGLY.
 (f) REQUIRED FOR EXPLOSIONPROOF (FLAMEPROOF) APPLICATIONS.

Figure 21. Wiring an 84S-T Flowmeter with a Pulse Output Transistor Switch (sourcing) Counter Input with External Power Supply and Pull-Up Resistor

Wiring a Flowmeter with a Pulse Output (3-Wire)



- (a) PLACE JUMPER BETWEEN THE TWO NEGATIVE TERMINALS AS SHOWN.
- (b) ADD A 1200 OHM MINIMUM (1-2 WATT) RESISTOR BETWEEN POWER SUPPLY (+) AND COUNTER (+).
- (c) GROUNDING THE LOOP AT THE NEGATIVE TERMINAL OF THE POWER SUPPLY IS RECOMMENDED BUT NOT REQUIRED.
- (d) THE TRANSMITTER IS EQUIPPED WITH AN INTERNAL AND EXTERNAL GROUND CONNECTION. CONNECT A GROUND WIRE TO EITHER TERMINAL IN ACCORDANCE WITH LOCAL PRACTICE.
- (e) THERE MUST BE AT LEAST 250 Ω TOTAL RESISTANCE BETWEEN THE PC-BASED CONFIGURATOR OR THE HART COMMUNICATOR AND THE POWER SUPPLY.
- (f) REQUIRED FOR EXPLOSIONPROOF (FLAMEPROOF) APPLICATIONS.

Figure 22. Wiring an 84S-T Flowmeter with a Pulse Output Using a 3-Wire Hookup

3. Operation Via Local Display

Introduction

Communication with the 84S-T and 84S-U Vortex Flowmeters is carried out using the HART Communicator, a PC-Based configurator, or the optional Local Keypad/Display. General instructions for using the HART Communicator can be found in MAN 4250, HART Communicator Product Manual. Instructions for using the HART Communicator with an 84 Series flowmeter is located in Section 4 of this document. Instructions on using the PC-Based Configurator are included with the configurator software. Complete instructions for using the Local Keypad/Display is found in this section.

— NOTE —

For proper communication with a HART Communicator, the communicator must contain the proper DD for the 84 Vortex Flowmeter. This DD is available from Invensys or any other authorized HART Foundation source.

Local Keypad/Display

A local display, as shown in Figure 23 provides local indication of the measurement information, function status, and reference information. The display also provides a means of performing totalizer reset and full configuration, calibration, and self-test. Operation is accomplished via four multi-function keys.

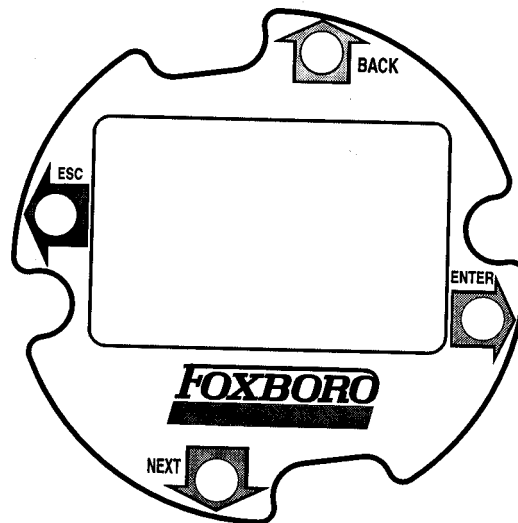


Figure 23. Local Display

Table 5. Operation of Function Keys

Key	Function
Left Arrow (ESC)	Moves left in the menu structure. Moves the cursor to the left in a data entry field. Escapes from changes in a picklist menu or data entry.* Answers No.
Right Arrow (ENTER)	Moves right in the menu structure. Used to access the data entry edit mode of a parameter. Moves the cursor to the right in a data entry field. Enters and saves the changed menu picklist choices or data entry.* Answers Yes.
Up Arrow (BACK)	Moves upward in the menu structure, a picklist menu, or list of characters.
Down Arrow (NEXT)	Moves downward in the menu structure, picklist menu, or list of characters.

*On data entry, repeatedly press the key until the cursor reaches the end of the display.

Display Bar Indicator

The bar indicator at the top of the display indicates the flow measurement, as a percentage of the upper range value.

— NOTE

If the flow measurement is out-of-range, the bar indicator blinks.

If the flowmeter is off-line, the middle four bars of the bar indicator blink.

Password

Display of information requires no password. However, the ability to access certain functions, (for purposes other than Read Only), such as totalizer, setup, and calibration/testing, may require a user-definable password. The **LoPwd** allows you to reset the Net Totalizer and Pulse Totalizer. The **HiPwd** gives you access to all flowmeter functions. In addition, the write protect jumper must be in the 'write' position. See "Setting the Write Protect Jumper" on page 18.

— NOTE

The flowmeter is shipped from the factory with a blank password. This allows access to all flowmeter functions. If password protection is required, enter a **LoPwd** and/or **HiPwd** in Setup mode.

Entering the Password

The totalizer, setup, and calibration/test functions may require a password (a 4-character alphanumeric string). Select the **TotPul**, **TotNet**, **TotGrd**, **Setup** or **Cal/Tst** top level menu and press **Enter** at the password prompt. Two brackets surrounding four spaces ([_ _ _ _]) then appear on the second line of the display. The cursor, a flashing icon, appears at the first character.

To enter the password, use the Up/Down arrow keys to scroll through the list of acceptable characters. After selecting the desired character, press the Right arrow key to move to the next character. Continue this process until the password is complete. Pressing the Right arrow key once more moves the flashing cursor to the right bracket. Pressing **Enter** now completes the process. Prior to pressing **Enter**, you can use the Left/Right arrow keys to move back and forth to modify an incorrect selection.

If you enter an incorrect password, the display indicates **Sorry** for one second, then goes to Read Only.

You can change a password in the **Passwd** parameter in the Setup menu.

Activating an Edit, Pick-List, or User Menu Block

To open a menu block that allows you to edit or select data or to perform a function, move to the menu block and press the Right arrow (**Enter**) key.

Editing Numbers and Strings

Editing any number or string in the menu system is done in the same way as entering the password. The Up/Down arrow keys scroll through a list of acceptable characters for the current position. The Right arrow key moves the cursor to the right. It also accepts the change at the end. The Left arrow key moves the cursor to the left. It also cancels the change at the beginning.

There are three kinds of edit items: signed numbers, unsigned numbers, and strings.

Signed Numbers

Signed numbers always have a + or - sign at the beginning. The + can only be changed to –, and vice versa.

Unsigned Numbers

For unsigned numbers, cycle through the digits 0-9, and the decimal point, with the Up/Down arrow keys. When you enter a decimal point in any position, and there is already a decimal point to the left of the cursor, the new decimal point overrides the old one.

Strings

Characters in strings can be changed to any valid character. You can sequence through the list of characters by pressing the Up/Down arrow keys. To enter the change, you must still press **Enter** from the right side of the data field, after scrolling to the right side with the Right arrow key.

Picking from a List

Picklist items allow you to choose a selection from a flowmeter-supplied list of alternatives. Go to the applicable parameter, and press **Enter**. The entire bottom line of the display flashes. If you press the Up/Down arrow keys, the display shows the previous or next choice respectively from its list. Pressing **Enter** accepts the change; pressing **Esc** returns the previous selection.

Configuration Database

Each flowmeter is shipped from the factory with an operating configuration database. However, the flowmeter will not provide an accurate measurement if the configuration does not fit your application. **Be sure to check the configuration of our flowmeter prior to start-up.**

If the user information is not supplied with the purchase order, the flowmeter is shipped with the following defaults:

Table 6. Default Database When User Information Not Supplied

Item	Metric	English
Fluid Type	Liquid (water)	Liquid (water)
Type of Flow	Volume	Volume
Measurement Units	m ³ /s	gal/min
Flowing Temperature	20°C	68°F
Flowing Density	998.21 kg/m ³	62.316 lb/ft ³
Absolute Viscosity	1.002 cP	1.002 cP
Upper Range Value	Upper Range Limit for Flowmeter Size	Upper Range Limit for Flowmeter Size

These defaults are **not** recommended for general operation. If no other process information is available, entering **Liquid**, **Gas**, or **Steam** as fluid type in Setup establishes default data bases as shown in Tables 7, 8, or 9 respectively.

Table 7. Default Database for Liquid

Parameter	Metric	English
Fluid Type	Liquid (water)	Liquid (water)
Type of Flow	Same as present configuration	
Measurement Units	Same as present configuration	
Flowing Temperature	20°C	68°F
Flowing Density	998.21 kg/m ³	62.316 lb/ft ³
Absolute Viscosity	1.002 cP	1.002 cP
Upper Range Value	Upper Range Limit for Flowmeter Size	Upper Range Limit for Flowmeter Size

Table 8. Default Database for Gas

Parameter	Metric	English
Fluid Type	Gas (air)	Gas (air)
Type of Flow	Same as present configuration	
Measurement Units	Same as present configuration*	
Flowing Temperature	20°C	68°F
Flowing Density	9.546 kg/m ³	0.596 lb/ft ³
Absolute Viscosity	0.0185 cP	0.0185 cP
Upper Range Value	Upper Range Limit for Flowmeter Size	Upper Range Limit for Flowmeter Size

*Liquid units of gallons, liters, imperial gallons, or barrels per unit time are not transferable to gas.

Table 9. Default Database for Steam

Parameter	Metric	English
Fluid Type	Steam	Steam
Type of Flow	Same as present configuration	
Measurement Units	Same as present configuration*	
Flowing Temperature	178.3°C	352.9°F
Flowing Density	4.966 kg/m ³	0.310 lb/ft ³
Absolute Viscosity	0.015 cP	0.015 cP
Upper Range Value	Upper Range Limit for Flowmeter Size	Upper Range Limit for Flowmeter Size

*Liquid units of gallons, liters, imperial gallons, or barrels per unit time are not transferable to steam.

Using the Menu Tree

Moving Inside the Menu System

Pressing the **Enter** key stops the display of measurements and shows the first top level Totalizer menu item, 1 **TotPul**. Use the Down arrow key to go to 1 **TotNet** and 1 **Tot Grd**. At any one of these choices, press **Enter** to edit your selection. Use the Down arrow key to select Off (turn the totalizer off), On (turn the totalizer on), or Clear (reset the totalizer) and then press **Enter**. Press the **ESC** key to return to Measure mode.

Pressing the **Esc** key stops the display of measurements, and shows the first item in the rest of the top level menu, 1 **Measure**. From here, the four keys allow you to move around the menu tree, as indicated by the arrows. Press the Down arrow key to cycle through each of the current menu level items. Press the Right arrow key to move from the current level to its submenu level. Press the Left arrow key to move from the current level to the next higher level.

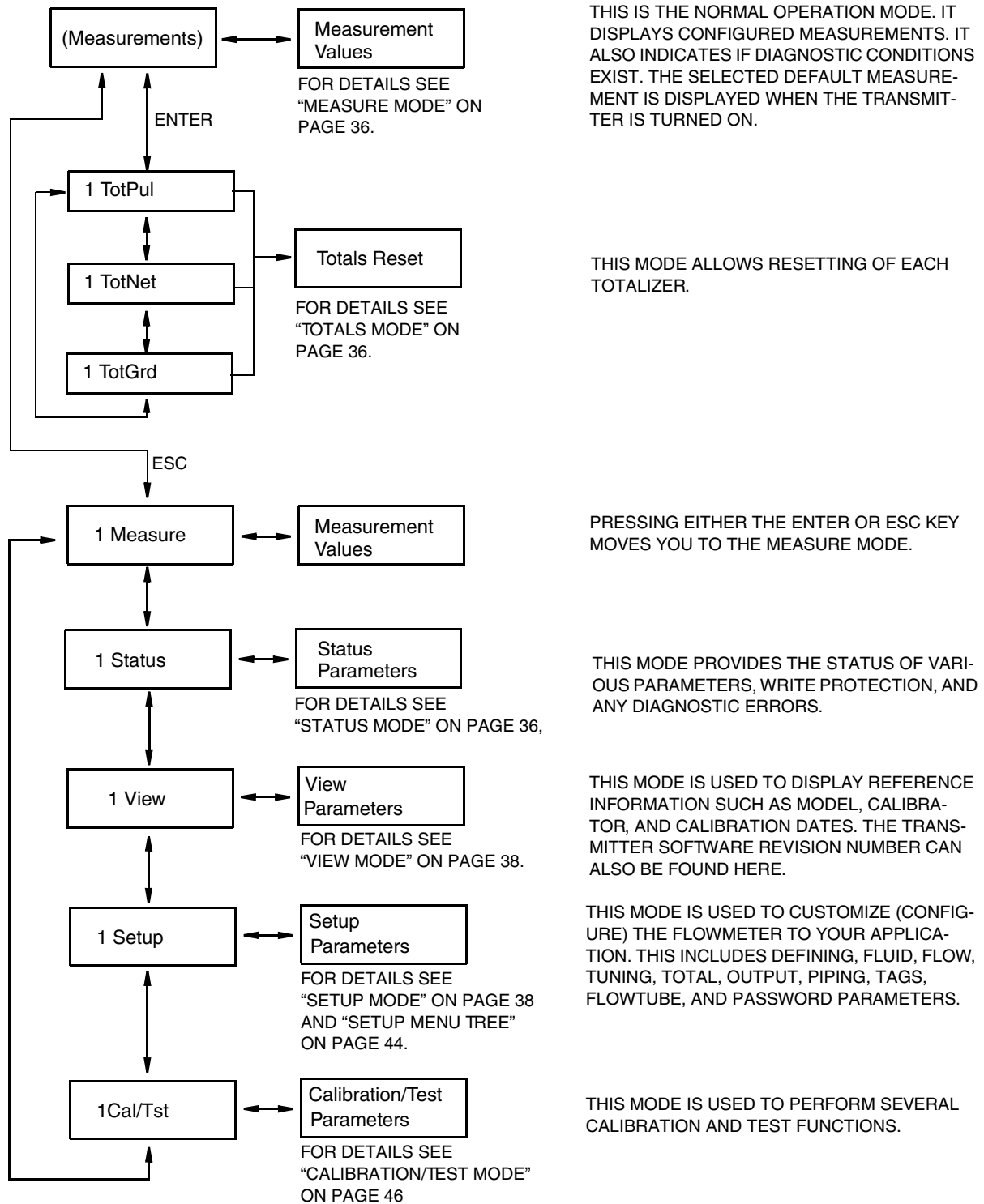
— NOTE —

Each menu item has its level (1 - 5) displayed at the beginning of the top line.

Top Level Menu

The three totalizer items in the main menu were discussed immediately above. The remainder of the Top Level menu displays six modes – Measure, Status, View, Setup, and Calibration/Test. You can switch from one to another in sequence by using the Up/Down arrow keys. To enter the second level menu from a particular top level display, press the Right arrow key. To return to the top level from a second level menu item, press the Left arrow key. The level of the first, second, third, fourth, and fifth level menus is indicated by the digit appearing as the first character in Line 1 of the display; a 1 indicates Level 1 (Top Level), a 2 indicates Level 2, and a 3 indicates Level 3, and so forth.

The top level menu is shown in Figure 24.



THIS IS THE NORMAL OPERATION MODE. IT DISPLAYS CONFIGURED MEASUREMENTS. IT ALSO INDICATES IF DIAGNOSTIC CONDITIONS EXIST. THE SELECTED DEFAULT MEASUREMENT IS DISPLAYED WHEN THE TRANSMITTER IS TURNED ON.

THIS MODE ALLOWS RESETTING OF EACH TOTALIZER.

PRESSING EITHER THE ENTER OR ESC KEY MOVES YOU TO THE MEASURE MODE.

THIS MODE PROVIDES THE STATUS OF VARIOUS PARAMETERS, WRITE PROTECTION, AND ANY DIAGNOSTIC ERRORS.

THIS MODE IS USED TO DISPLAY REFERENCE INFORMATION SUCH AS MODEL, CALIBRATOR, AND CALIBRATION DATES. THE TRANSMITTER SOFTWARE REVISION NUMBER CAN ALSO BE FOUND HERE.

THIS MODE IS USED TO CUSTOMIZE (CONFIGURE) THE FLOWMETER TO YOUR APPLICATION. THIS INCLUDES DEFINING, FLUID, FLOW, TUNING, TOTAL, OUTPUT, PIPING, TAGS, FLOWTUBE, AND PASSWORD PARAMETERS.

THIS MODE IS USED TO PERFORM SEVERAL CALIBRATION AND TEST FUNCTIONS.

Figure 24. Top Level Modes and Their Basic Functions

— NOTE

Certain parameters may be missing as you step through the menus described in this chapter depending on the configuration of your instrument.

Measure Mode

In normal operation, the flowmeter displays those measurements specified in Setup mode. If configured for **Manual** cycle, you can cycle through the measurements manually by using the Up/Down arrow keys. If configured for **Auto** cycle, the display cycles through the measurements specified. If, while in **Auto** cycle, you want to see a specific measurement momentarily, advance to that measurement with the Down arrow key. Use the Up arrow key to go to a specific measurement and stay there. You can then resume scanning by pressing the Down arrow key.

Totals Mode

TotPul, **TotNet**, or **TotGrd** is used to turn a totalizer on, pause the totalizer, or to clear (reset) the total. This is done by pressing the **Enter** key and selecting **On**, **Paused**, or **Clear** and pressing the **Enter** key again. Before doing this you may be asked for a password. If so, enter the **LoPwd** or **HiPwd** for **TotPul** and **TotNet**; enter the **HiPwd** for **TotGrd**.

— **NOTE** —

Clearing **TotGrd** also clears **TotPul** and **TotNet**.

Status Mode

The **MeaStat** sublevel of this mode enables you to view the units, value, and status of system parameters and thus assess the performance of the loop. You can not edit them in this mode. To step through the displays of the parameters, use the Up/Down arrow keys. The Status mode structure diagram is shown in Figure 25.

The **WrProt** sublevel of this mode shows whether write protection has been enabled (**Prot**) or is disabled (**NotProt**).

The **DiagEr** sublevel of this mode shows any diagnostic errors. The display **0000** means no diagnostic errors.

— **NOTE** —

A new diagnostic condition only appears after a diagnostic is detected while in Measure mode.

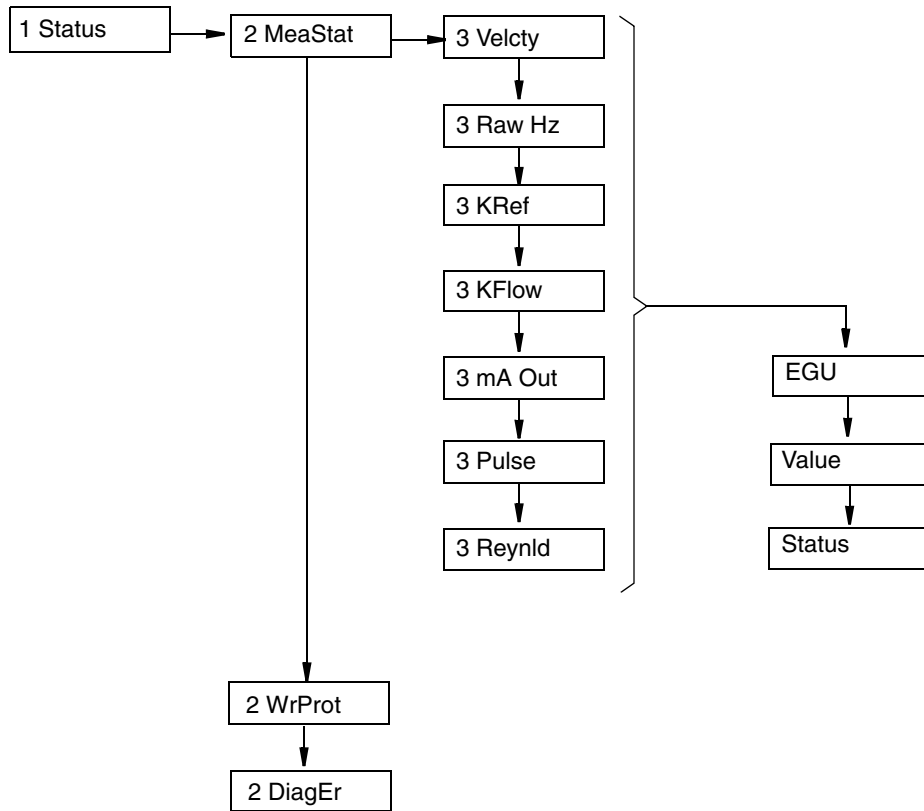


Figure 25. Status Mode Structure Diagram

View Mode

The View mode enables you to view the identity parameters. You can not edit them in this mode. To step through the list of the following parameters, use the Up and Down arrow keys.

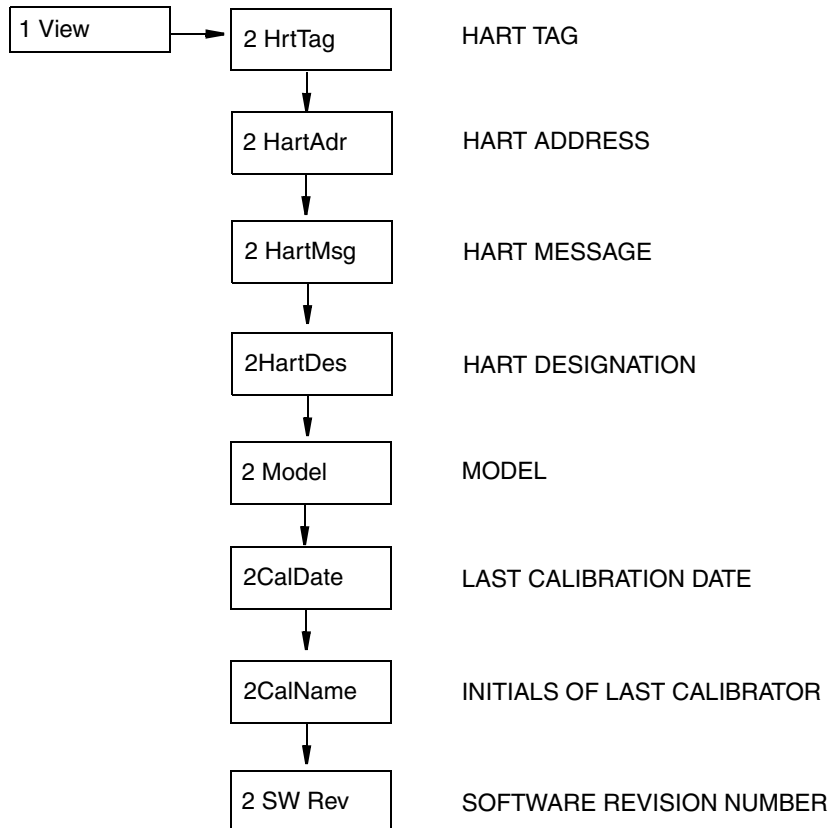


Figure 26. View Mode Structure Diagram

Setup Mode

The Setup mode enables you to configure your flowmeter fluid, flow, tuning, totalizer, output, pipe, tag, and flowtube parameters. You can also establish and change your passwords in this mode.

Setup mode can be a passcode protected mode. So after the initial configuration, you may need to enter the **HiPwd** to make changes in this mode. See “Password” on page 30.

— NOTE —

If you lose your password, call our Global Client Support Center for assistance.

If your transmitter is write protected, the display reads **Rd Only** if you try to enter Setup mode. In this case, you cannot enter Setup mode to make changes. You can, however, view but not edit the setup.

Upon attempts to enter this mode, you are asked, **Loop in Manual?** After placing the loop in manual, indicate ‘yes’ with the **Enter** key. This is also an off-line mode. Analog output is driven to 4 mA, pulse to 0.

The structural diagrams for the Setup mode begin on page 44.

Setting Fluid Parameters

The **2 Fluid** section of the Setup mode allows you to configure parameters for fluid type, fluid name (optional), temperature unit, flow temperature, density unit, flow density, base density, viscosity unit, and viscosity.

— NOTE —

If you are satisfied with the existing fluid parameters, do **not** enter the **3 New** parameter; doing so will reset all the other fluid parameters.

- ◆ In **3 New**, select the fluid as Liquid, Gas, or Steam to get the default data base for that medium. Refer to Tables 7, 8, and 9.
Selecting **3 Edit** enables you to edit the present fluid configuration.
- ◆ **FlidTyp** shows the type of fluid presently configured.
- ◆ In **3 Name**, name the particular fluid (optional).
- ◆ In **3 TmpEGU**, select your choice of temperature unit (degF, degC, degR, or degK).
- ◆ In **3 FlwTmp**, enter the flow temperature in the temperature unit specified.
- ◆ In **3 DenEGU** select the density unit from the following picklist: kg/m³, lb/Yd³, lb/gal, oz/in³, lb/ft³, g/cm³, ST/Yd³, LT/Yd³, Custom.
If you pick Custom, you must define your custom unit. First, enter a **Label** for your custom unit using up to eight alphanumeric characters. Then, enter any **Offset** and a conversion factor (**Slope**) from kilograms per cubic meter to the custom unit.
- ◆ In **3 FlwDen**, enter the flow density in the density unit specified.
- ◆ In **3 BasDen**, enter the base density in the density unit specified.
- ◆ **LfciEGU** shows the units of the low flow cut-in.
- ◆ **Lfci** shows the Lfci presently configured.
- ◆ In **3 VisEGU**, select the viscosity unit (cPoise, Poise, cStoke, or PaSec).
- ◆ In **3 Visc**, enter the viscosity in the viscosity unit specified.

Setting Flow Parameters

The **2 Flow** section of the Setup mode allows you to configure parameters for flow.

In **3 FlwMap**, select **VolFlow**, **BVolFlow**, or **MassFlow**.

In **3 FlwEGU**, select the desired unit of flow from the picklist. If you pick **Custom**, you must define your custom unit. First, enter a **Label** for your custom units using up to eight alphanumeric characters. Then, enter any offset (**Offset**) and a conversion factor (**Slope**) from kilograms per second (kg/s) for mass flow units or cubic meters per second (m³/s) for volume or base volume flow units to the custom units.

Example: The slope for a custom unit of yd³/min would be 78.47704 because $78.47704 \text{ yd}^3/\text{min} = 1 \text{ m}^3/\text{s}$.

In **3 FlwURV**, enter the upper range value in the flow unit just specified.

In **3 FlwDmp**, select the damping factor from the picklist.

In **3 VelEGU**, select the desired velocity unit from the picklist.

Setting Tuning Parameters

The **2Tuning** section of the Setup mode allows you to specify several flowmeter options.

- ◆ In **3AddDrop**, configure the pulse compensation (signal conditioning) feature as **On** or **Off**.
- ◆ In **3 RdCorr**, configure the Reynolds number correction feature as **On** or **Off**.
- ◆ In **3 LFCI**, set the low flow cut-in parameter to the level above which the flowmeter begins to measure flow. Select an output that provides no output under no flow conditions. In **4 FlwEGU**, note the flow units in which the setting selections are shown. In **4 Setting**, select a setting from the picklist presented.

— NOTE

The LFCI can be automatically set by the flowmeter in the Calibration/Test mode.

Setting Totals Parameters

The **2 Total** section of the Setup mode allows you to configure each of two totalizers. This is done in **3 TotNet** and **3 TotGrd**. For each totalizer:

- ◆ In **4 Map**, map the totalizer to **Volume**, **Mass**, or **BVolume**.
- ◆ In **4 EGU**, select the desired unit from the picklist presented.

If you pick **Custom**, you must define your custom unit. First, enter a **Label** for your custom units using up to eight alphanumeric characters. Then, enter any offset (**Offset**) and a conversion factor (**Slope**) from kilograms (for mass units) or cubic meters (for volume or base volume units) to the custom units.

Example: The slope for a custom unit of a 42 gallon barrel would be 6.2898 because $6.2898 \text{ bbl} = 1 \text{ m}^3$.

Setting Output Parameters

The **2 Output** section of the Setup mode allows you to configure the communications, mA output, pulse output, and display parameters.

Communications

There is no need to map the measurements to be displayed in the I/A Series system as they are already defined. The primary measurement is flow rate (volume, base volume, or mass); the secondary measurement is net total; the tertiary measurement is grand total.

In **3 Coms**, configure the communications parameters:

- ◆ In **4PolAddr**, specify the poll address from the picklist of numbers from 0 through 15.
- ◆ In **4Preambl**, set the number of preambles between 2 and 20.

mA Output

In **3 Fail**, configure the mA output to go fully downscale or upscale upon a failure.

Pulse Output (If pulse output specified)

In **3 Pulse**, go to **4 Pulse** and select the type of pulse output as **Rate**, **Total**, **Raw**, or **Off**.

If **Rate**, configure the following:

- ◆ In **4 Freq**, select the upper frequency end point corresponding to the highest frequency generated as 10, 100, or 1000 Hz.

If **Total**, configure the following:

- ◆ In **4 Pwidth**, select, the pulse width as 0.5, 5, or 50 ms.
- ◆ In **4 EGU**, select the units from the picklist provided.
- ◆ In **4 U/Pulse**, enter the units per pulse.

If **Raw**, no further action is required.

Display

Under **3Display**, configure the display parameters

Under **4 Show**, specify whether the reading is to be shown for each of the following measurements and, if shown, the **Format** (decimal point placement) of the displayed value:

- ◆ In **5 FlwVol**, the volume flow output display.
- ◆ In **5 TotNet**, the net totalizer reading.
- ◆ In **5 TotGrd**, the grand totalizer reading.

In **4 Show1st**, select the first measurement to be shown as FlwVol, Velcty, FlwBVo, FlwMas, or Raw.

In **4 Cycle**, specify whether the list of measurements configured to be shown are scanned automatically (Auto) or manually (Manual).

Setting Piping Parameters

The **2 Pipe** section of the Setup mode allows you to configure the parameters related to piping.

Piping

Under **3 Piping**, configure the parameters used by the flowmeter to correct for the effects of upstream piping and disturbances on the Flowing K-Factor as follows:

- ◆ In **4 Custom**, enter a custom K-factor bias (with sign in percent) to compensate for additional known biases in the flow measurement system.
- ◆ In **4 Config**, select the upstream piping configuration from the following picklist (see Figure 27):
 - ◆ Straight
 - ◆ 1 EL PAR (1 elbow with shedder parallel to elbow plane)
 - ◆ 1 EL PER (1 elbow with shedder perpendicular to elbow plane)

- ◆ 2L0PDPAR (2 elbows with shedder parallel to plane of closest elbow and distance between elbows is zero pipe diameters)
- ◆ 2L0PDPER (2 elbows with shedder perpendicular to plane of closest elbow and distance between elbows is zero pipe diameters)
- ◆ 2L5PDPAR (2 elbows with shedder parallel to plane of closest elbow and distance between elbows is 5 pipe diameters)
- ◆ 2L5PDPER (2 elbows with shedder parallel to plane of closest elbow and distance between elbows is 5 pipe diameters)
- ◆ Reducer
- ◆ In **4 UpDist**, enter the distance to the first upstream flow disturbance in pipe diameters.

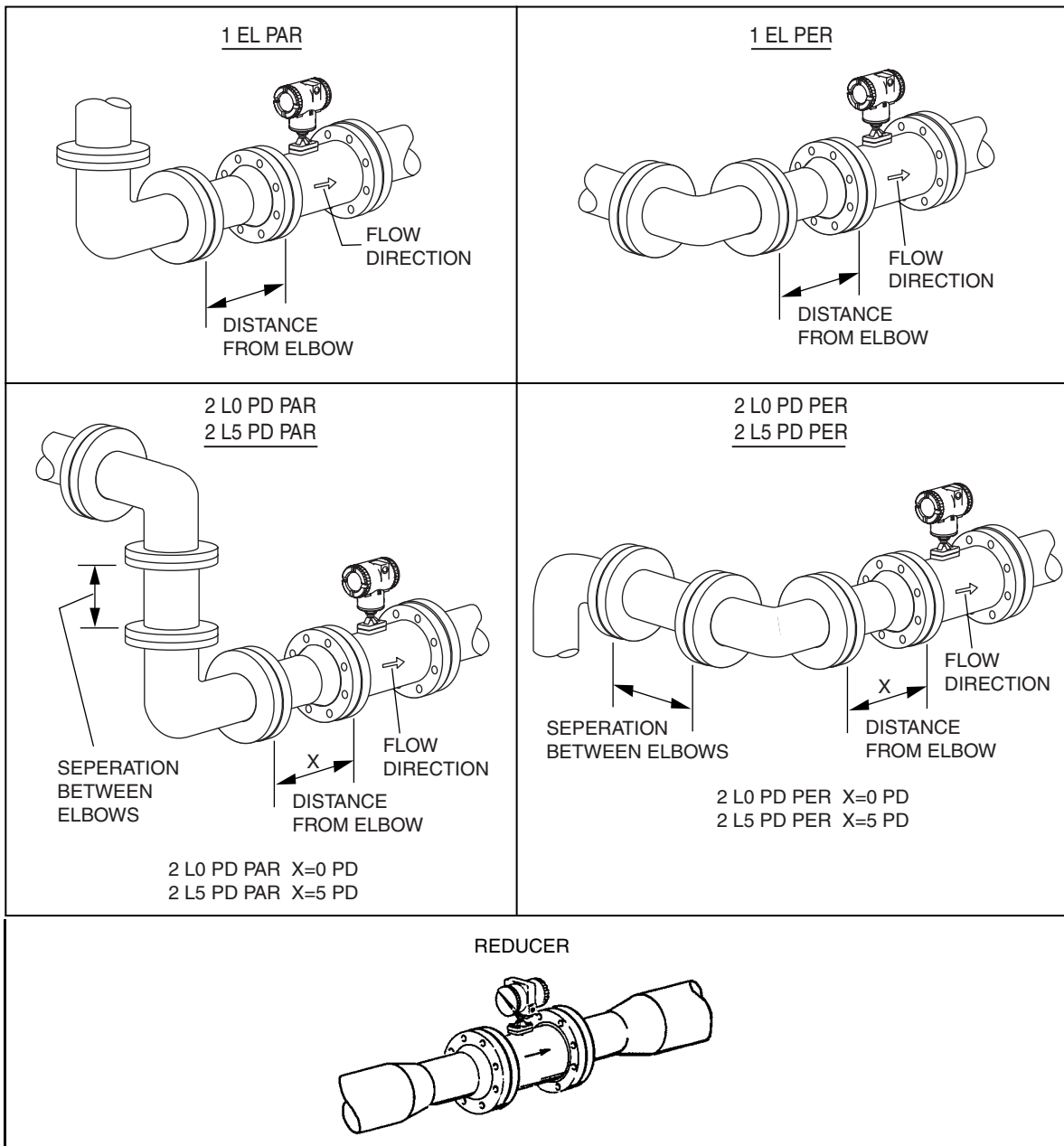


Figure 27. Piping Configurations

Setting Tag Parameters

The **2 Tags** section of the Setup mode allows you to configure the following identification parameters:

- ◆ In **3 HrtDes**, enter the device description.
- ◆ In **3 HrtTag**, enter an alphanumeric description if desired.

Setting Flowtube Parameters

The **2 NewTube** section of the Setup mode allows you to configure the following flowtube parameters:

Model

In **3 Model**, enter the model number of the flowtube (16 characters maximum) as found on the flowmeter tag. It is already in the database if the flowtube and electronics were shipped as a unit.

Special Flowtube

If your flowtube was customized to be different from the model number entered, you can override certain descriptions in the model code in **3 Special** as follows:

- ◆ In **4 TubDia**, enter the custom flowtube diameter in meters
- ◆ In **4 TubAlp** enter the thermal coefficient of expansion (alpha) in $m/m^{\circ}K$
- ◆ In **4 LfUFac** enter the low flow cut-in user factor.

Reference Number

In **3 Ref No**, enter the reference number (serial number) of the flowtube (16 characters maximum) as found on the flowmeter tag. It is already in the database if the flowtube and electronics were shipped as a unit.

K-Factor

In **3 K Ref**, enter the k-factor as follows:

- ◆ In **4 K EGU**, select p/l or p/ft³ as the unit of the k-factor.
- ◆ In **4 K Ref**, enter the reference K-factor as found on the flowmeter tag.

Changing the Password

The **2 Passwd** section of the Setup mode allows you to create or change the passwords.

In **4 LoPwd**, enter the new password for access to clear (reset) the net and pulse totalizers.

In **4 HiPwd**, enter the new password for access to all modes.

— NOTE —

1. Passwords contain four characters.
 2. Use four spaces to configure 'No Password'.
-

Setup Menu Tree

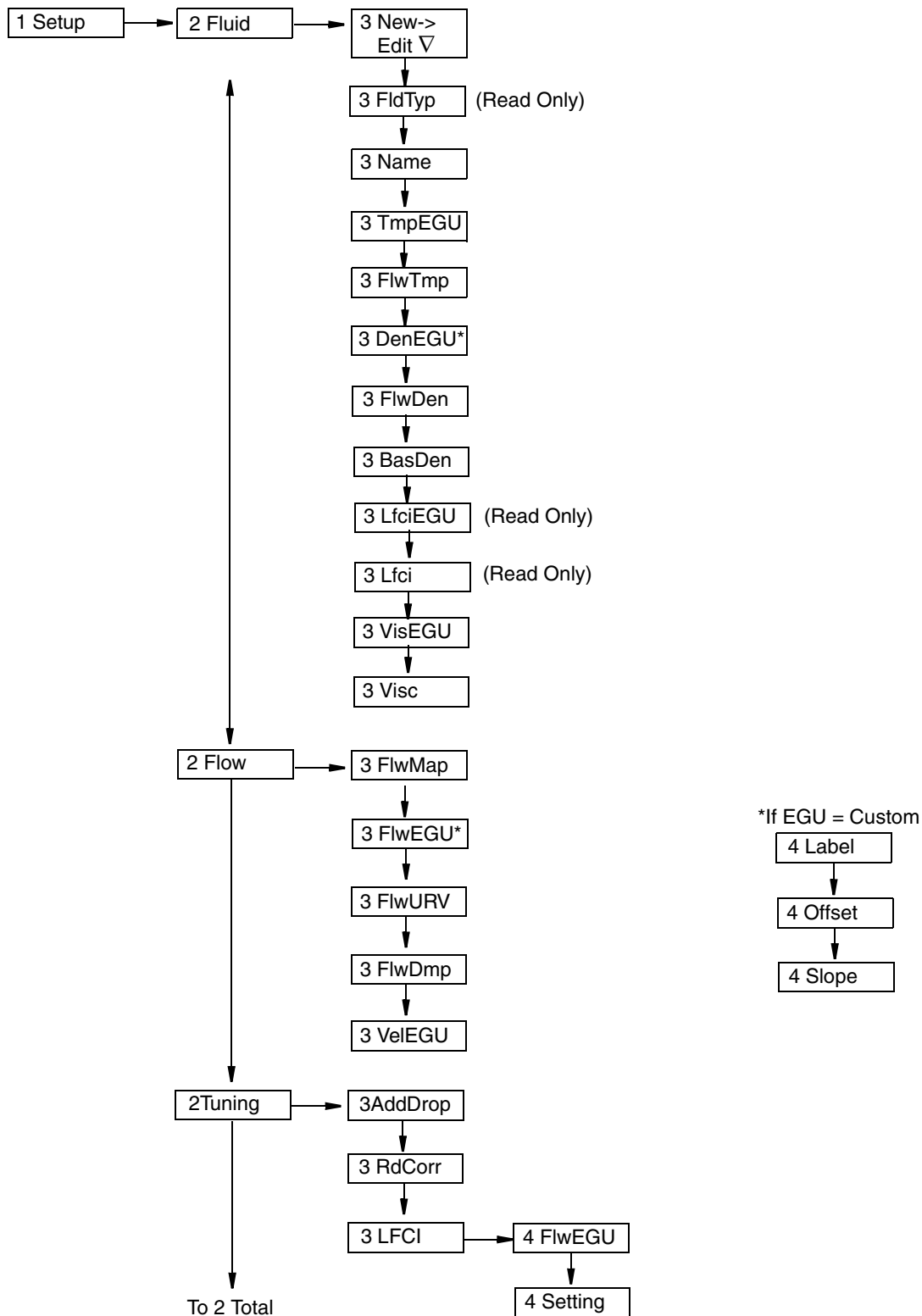


Figure 28. Setup Menu Tree (1 of 3)

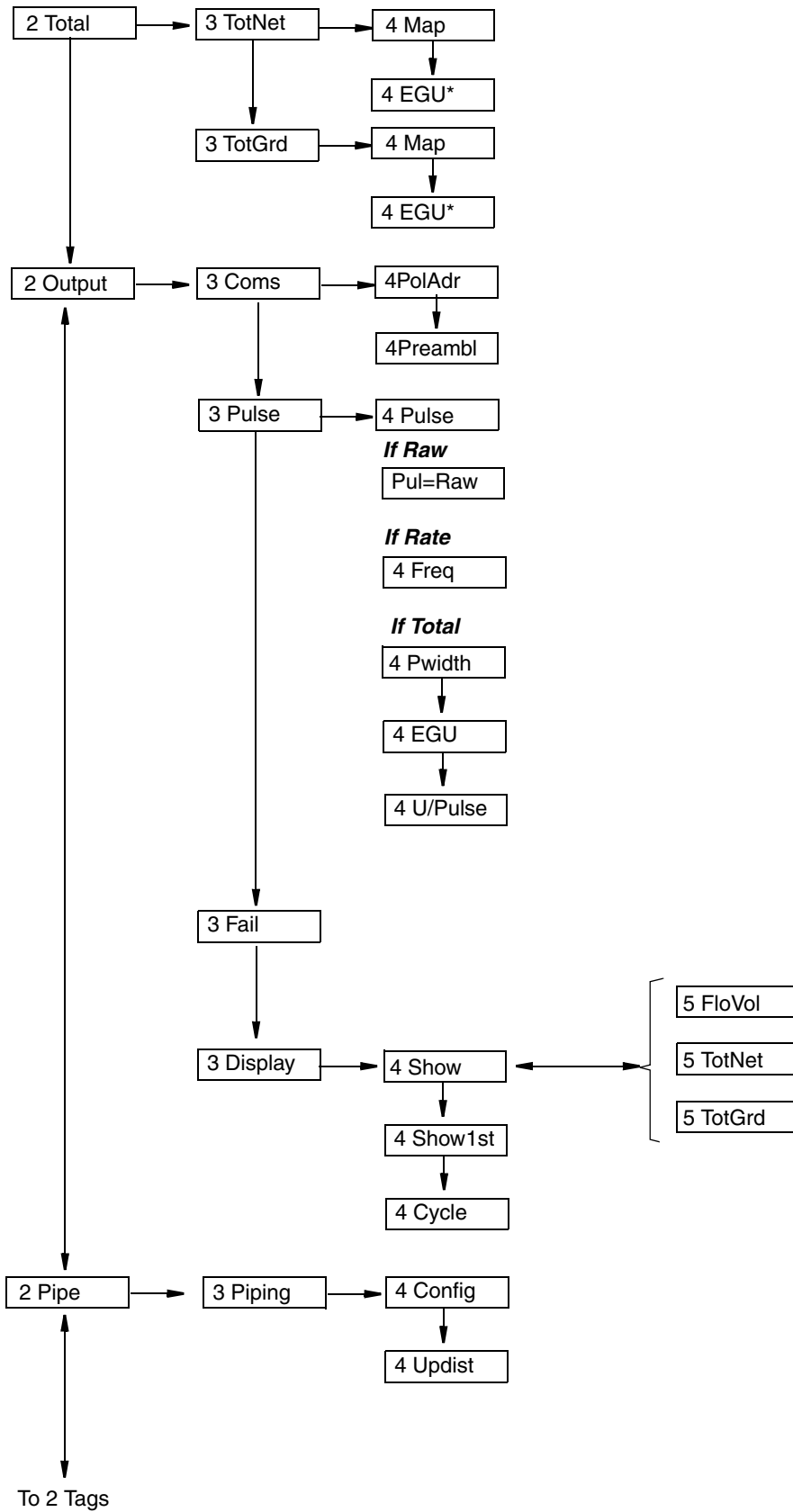


Figure 29. Setup Menu Tree (2 of 3)

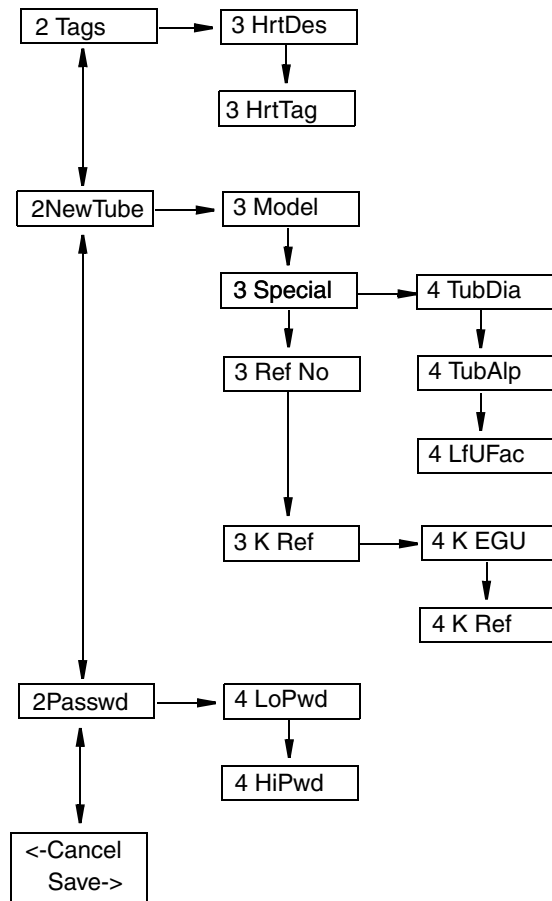


Figure 30. Setup Menu Tree (3 of 3)

Calibration/Test Mode

The Calibration/Test mode enables you to:

- ◆ Set the Low Flow Cut In (LFCI)
- ◆ Calibrate the 4 and 20 mA output
- ◆ Self test the flowmeter
- ◆ Use the flowmeter to test the loop.

The Calibration/Test mode can be a passcode protected mode. So after the initial configuration, you may need to enter the **HiPwd** to perform the procedures in this mode. See “Password” on page 30.

— NOTE

If you lose your password, our Global Client Support Center for assistance.

The structural diagram for the Calibration/Test mode is shown in Figure 31.

Calibration

In **2 Calib**, go to **3 SetLFCI** to have the flowmeter automatically set the Low Flow Cut-In. In doing this, the flowmeter chooses the lowest level at which no signal is detected over a 20-second time interval. It is important that the flow be zero during this procedure.

— **NOTE** —

This procedure may confirm your choice of LFCI setting in “Setting Tuning Parameters” on page 40. However, if it picks a different selection, it overwrites your selection.

In **2 Calib**, go to **3 Cal mA** to calibrate the 4 and 20 mA output.

- ◆ The **4Restore** parameter restores the factory calibration.
- ◆ The **4Cal 4mA** and **4Cal20mA** parameters allow the 4 to 20 mA output of the flowmeter to be calibrated or matched to the calibration of the receiving device to an accuracy of 0.005 mA.

— **NOTE** —

The flowmeter has been accurately calibrated at the factory. Recalibration of the output is normally **not** required, unless it is being adjusted to match the calibration of the receiving device.

- ◆ In **4CalDate**, enter the date of the last calibration if desired.
- ◆ In **4Initial**, enter the initials of the last calibrator if desired.

Test

In **2 Test**, you can self test the flowmeter and use the flowmeter to test the loop.

Testing the Loop

The flowmeter can also be used as a signal source to check and/or calibrate other instruments in the control loop, such as indicators, controllers, and recorders. To do this, set the mA output (**3 Set mA**), rate pulse output (**3 Set Hz**), or digital output (**3 SetDig**) signals to any value within the range limits of the meter.

Testing the Flowmeter

The self test parameter (**3SelfTst**) checks the flowmeter operation by injecting, near the front end of the electronics, an internally generated periodic signal of known frequency. The frequency of this signal is in turn measured and checked against the injected signal.

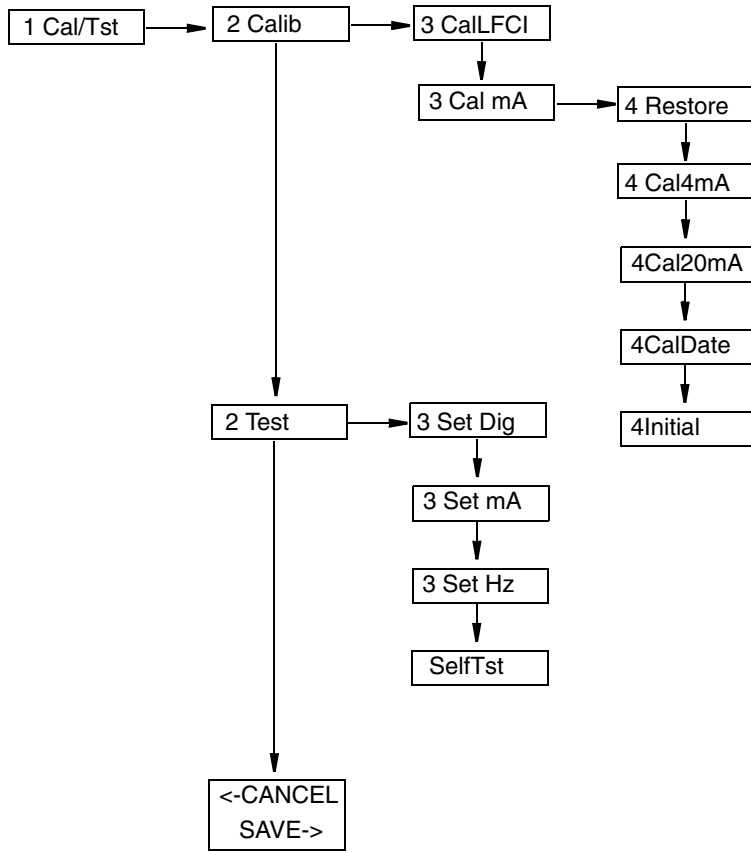


Figure 31. Calibration/Test Menu Tree

Error Messages

Operation Error Messages

This section defines error messages that may be displayed and actions that can be taken to correct the error. Some messages appear periodically while seeing a valid flow measurement. This typically occurs when 'soft' limits have been exceeded and the flowmeter is warning that a hard limit is approaching.

Table 10. Operation Error Messages

Message	Explanation	Corrective Action
Override	The flowmeter is being overridden by an external host such as another configurator or control system.	None - This is an awareness message that the flowmeter is being overridden
W: Input xxxxxxx	Warning: An input to a specific measurement or calculation has exceeded the normal limit and is in the 'soft limit' region. The measurement or calculation is defined on the second line of the message.	1. Check inputted temperature flowing temperature to make sure it is within the temperature limits of the sensor. 2. Check the raw frequency to determine if it is out of limits for the flowmeter size.
B: Input xxxxxxx	Bad Input: Same as above except the inputs have now exceeded the 'soft' limit. This adversely affects all measurements.	Same as above.
W: Input Total	Warning: The total (pulse, net, or grand) may not be correct due to a momentary loss of power.	Clear the total. Pulse and Net total can be cleared independently. Clearing the grand total clears pulse and net totals also.
FcErr E:0x####	An internal function did not execute successfully.	If this occurs at startup, an invalid configuration exists. Recheck the configuration. If this does not resolve the problem, re-enter the Model.

Configuration Error Messages

Table 11. Configuration Error Messages

Message	Explanation	Corrective Action
WrProtct	The write protect jumper is in the 'protect' position or is missing. The configuration cannot be changed unless the jumper is in the 'write' position.	Install or move the write protect jumper to the 'write' position. See "Setting the Write Protect Jumper" on page 18.
Cfg Err MsCode	An incorrect model code has been entered.	Enter the correct model code.

Table 11. Configuration Error Messages

Message	Explanation	Corrective Action
No Pulse Hardware	An incorrect model code has been entered. The model code entered was for a flowmeter with a pulse output. The electronics module does not have a pulse output PWB.	Enter the correct model code which begins with 84F-E, 84W-E, 84F-U, or 84W-U.
Bad URV URV=URL	The entered URV has exceeded the URL (meter capacity) of the flowmeter.	Press Enter to change the URV to the value of the URL. Make sure that the entered value for Flowing Density is correct.
Bad URV URV=Min	The entered URV is less than the minimum value allowed for the URV.	Press Enter to change the URV to the minimum value allowed. Make sure that the LFCI setting and the value for Flowing Density is correct. See Note (a).
FcErr E:0x####	An internal function did not execute successfully.	Review the inputs associated with the last menu function. If this does not resolve the problem, re-enter the Model.
(a) The minimum URV value is three times (3x) the LFCI flow rate. For applications where the URV is very low relative to the flowmeter capacity, this error message may appear when this constraint is violated. This could be the result of lowering the URV, increasing the LFCI setting, or decreasing the flowing density (increasing the corresponding LFCI flow rate values).		

4. Operation Via HART Communicator

Online Menu

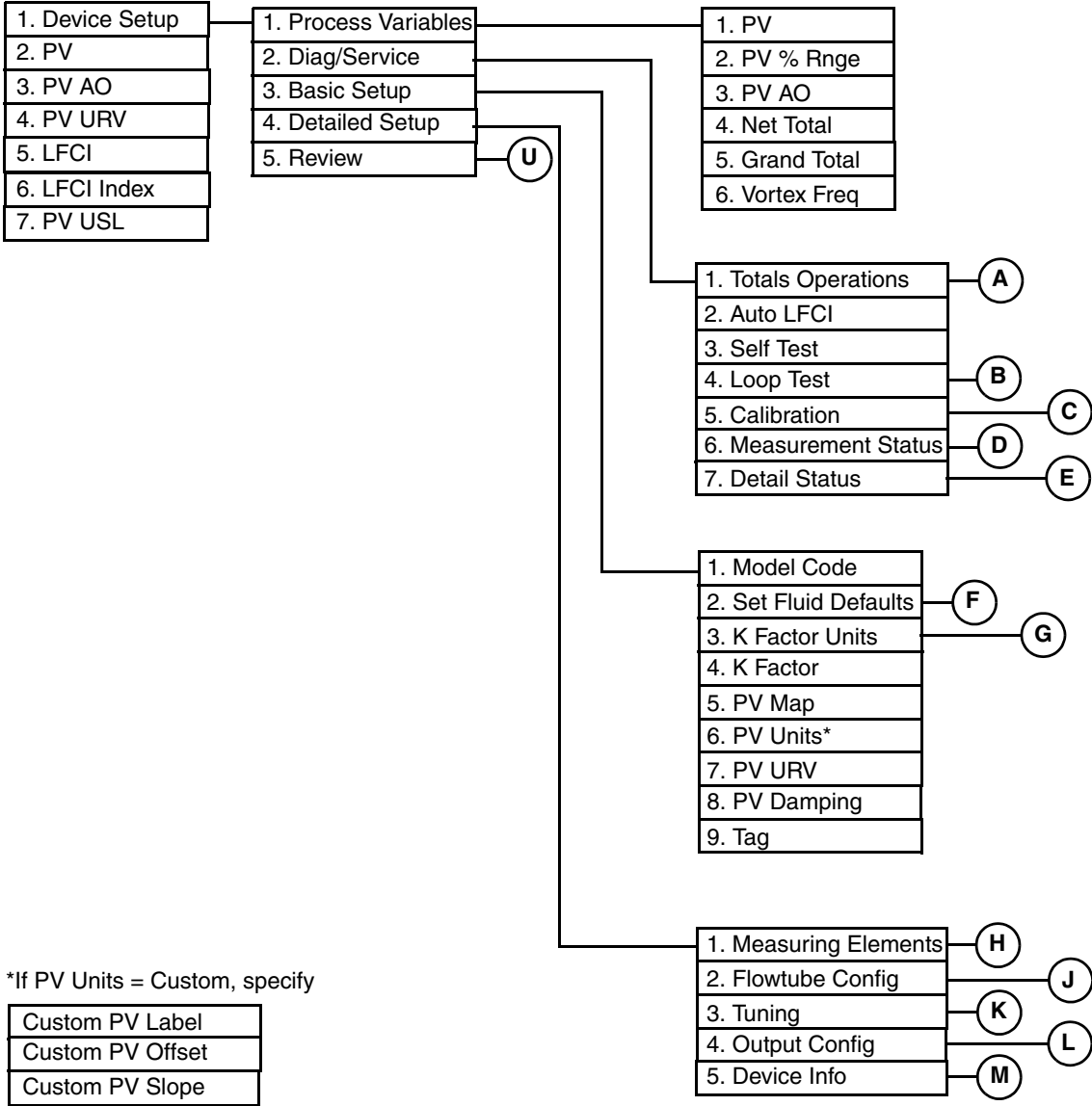


Figure 32. 84 Vortex Flowmeter Online Menu Tree (1 of 4)

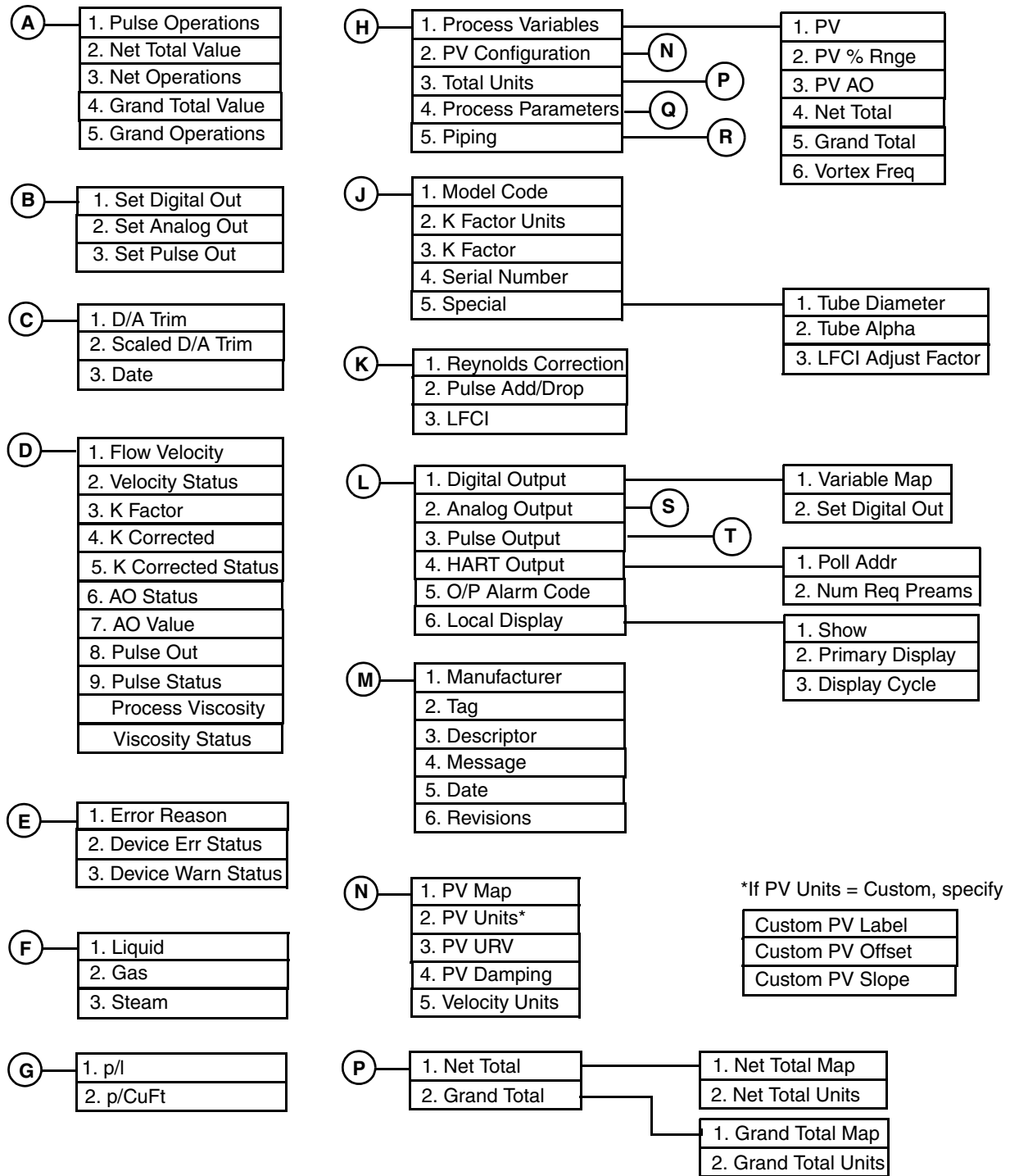


Figure 33. 84 Vortex Flowmeter Online Menu Tree (2 of 4)

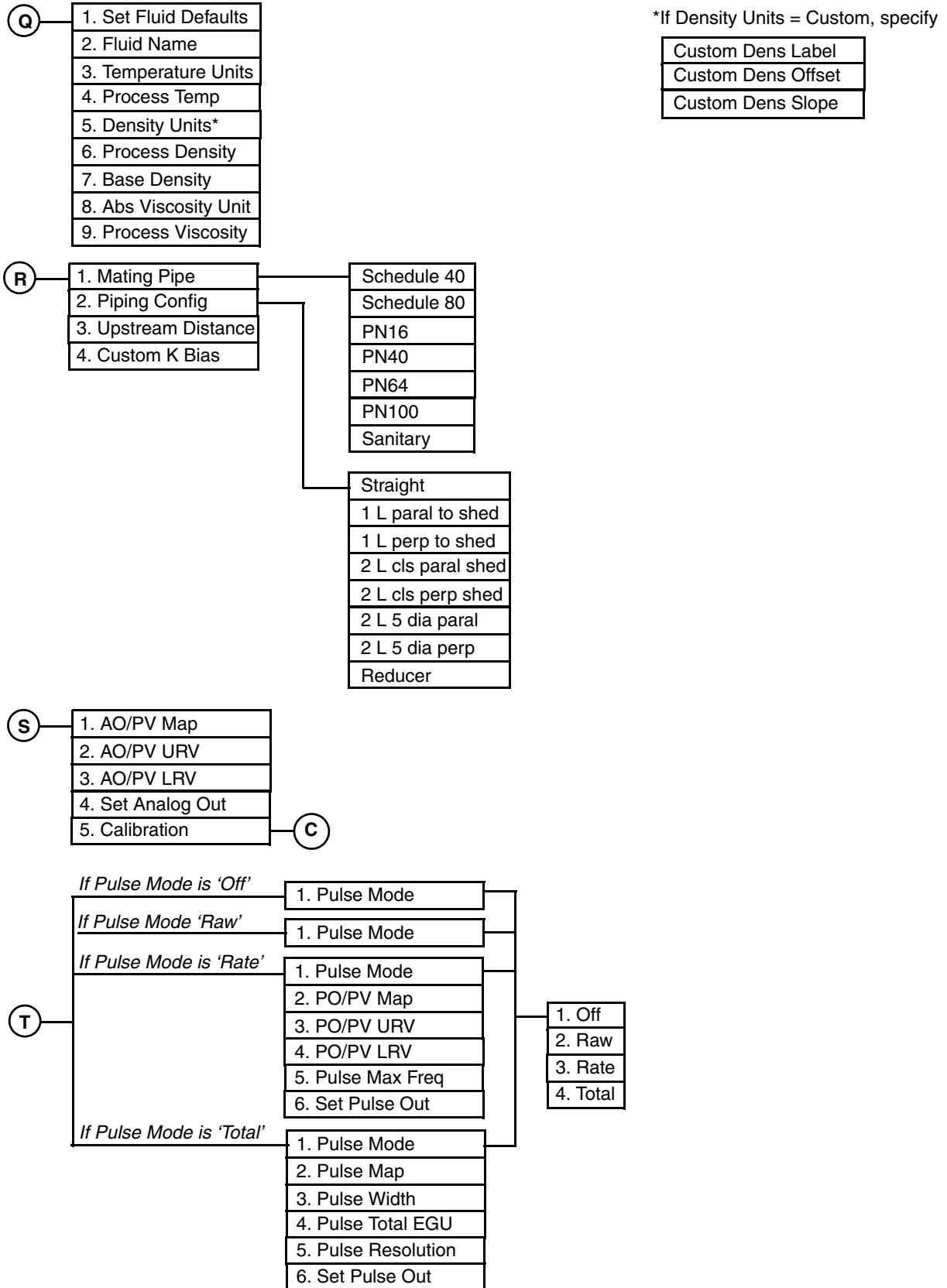
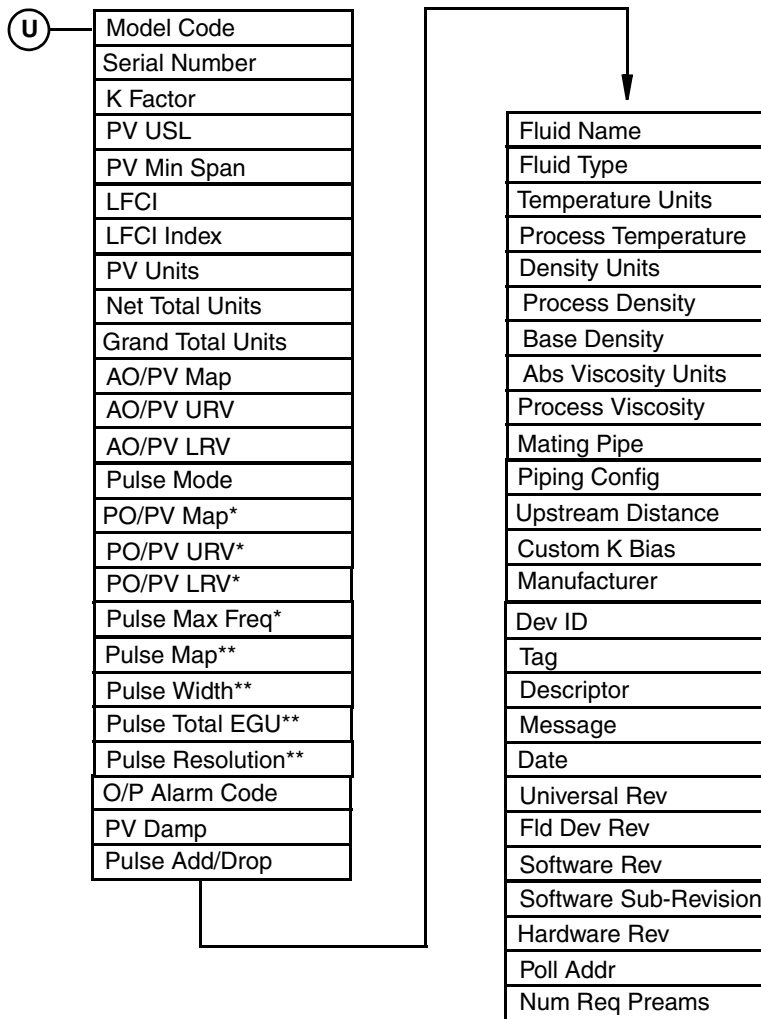


Figure 34. 84 Vortex Flowmeter Online Menu Tree (3 of 4)



* If Pulse mode = Rate
 ** If Pulse Mode = Total

Figure 35. 84 Vortex Flowmeter Online Menu Tree (4 of 4)

Explanation of Parameters

— NOTE —

The fast-key path shown is based on a frequently used configuration. If certain parameters are configured off or infrequently used parameters configured on, the fast-key path may be different.

Parameter	Fast-Key Path	Explanation
Abs Viscosity Unit	1,4,1,4,8	Select the viscosity unit from the picklist provided.
Abs Viscosity Units	1,5	Shows the absolute viscosity unit.
Analog Output	1,4,4,2	Path to configuring the analog output.
AO Status	1,2,6,6	Shows the AO status.
AO Value	1,2,6,7	Shows the AO value
AO/PV LRV	1,4,4,2,3 1,5	Shows the AO/PV LRV.
AO/PV Map	1,4,4,2,1 1,5	Shows whether the PV is mapped to Volume Flow, Mass Flow, BVolFlow, or Velocity.
AO/PV URV	1,4,4,2,2 1,5	Shows the AO/PV URV.
Auto LFCI	1,2,2	Procedure for the flowmeter to automatically set the LFCI.
Base Density	1,4,1,4,7 1,5	In Detailed Setup, enter the base density in the density unit specified. This is only used to calculate the base volumes. In Review, shows the base density.
Basic Setup	1,3	Path to basic setup parameters.
Calibration	1,2,5 1,4,4,2,5	Path to performing a D/A trim or scaled D/A trim.
Custom K Bias	1,4,1,5,4 1,5	In Detailed Setup, enter the custom K-factor (with sign in percent). In Review, shows the custom K-Factor.
Custom Dens Label	1,4,1,4,5	Enter the label for your custom density unit.
Custom Dens Offset	1,4,1,4,5	Enter any offset.
Custom Dens Slope	1,4,1,4,5	Enter a conversion factor for the custom density unit.
Custom PV Label	1,3,6 1,4,1,2,2	Enter the label for your custom PV unit.
Custom PV Offset	1,3,6 1,4,1,2,2	Enter any offset.
Custom PV Slope	1,3,6 1,4,1,2,2	Enter a conversion factor for the custom PV unit.
D/A Trim	1,2,5,1 1,4,4,2,5,1	Procedure to trim the 4 and 20 mA output values of the flowmeter to match the output of a plant standard measurement device.

Parameter	Fast-Key Path	Explanation
Date	1,2,5,3 1,4,5,5 1,4,4,2,5,3 1,5	In Diag/Service, enter the date of the last calibration. In Detailed Setup, enter the date of the last calibration. In Review, shows the last calibration date.
Date	1,4,5,5 1,4,4,2,5,3	Enter the date of the last calibration (mm/dd/yyyy).
Density Units	1,4,1,4,5 1,5	In Detailed Setup, select the density unit from the picklist provided. In Review, shows the density units.
Descriptor	1,4,5,3 1,5	In Detailed Setup, enter the descriptor (16 characters maximum). In Review shows the descriptor.
Detailed Setup	1,4	Path to detailed setup parameters.
Detail Status	1,2,7	Path to viewing the status of various device parameters.
Device Err Status	1,2,7,2	Shows the device error status.
Dev ID	1,5	Shows the device identification number.
Device Info	1,4,5	Path to configuring the device description parameters.
Device Setup		Path to all other parameters.
Device Warn Status	1,2,7,3	Shows the device warning status.
Diag/Service	1,2	Path to status, test, and calibration parameters.
Digital Output	1,4,4,1	Path to configuring the digital output.
Display Cycle	1,4,4,6,3	Specify whether the list of measurements configured to be displayed are scanned automatically or manually.
Error Reason	1,2,7,1	Shows the error reason code.
Fld Dev Rev	1,5	Shows the software version of the vortex flowmeter.
Flow Velocity	1,2,6,1	Shows the flow velocity value.
Flowtube Configuration	1,4,2	Path to configuring the flowtube parameters.
Fluid Name	1,4,1,4,2 1,5	In Detailed Setup, enter the name of the fluid. In Review, shows the fluid name.
Fluid Type	1,5	Shows the fluid type.
Grand Operations	1,2,1,4	Procedure to start, pause or clear the grand total.
Grand Total	1,1,5 1,4,1,1,5 1,4,1,3,2	In Process Variables, shows the grand total. In Detailed Setup, path to configuring the grand total mapping and units.
Grand Total Map	1,4,1,3,2,1	Map the Grand Total to Volume, Mass, or BVolume.
Grand Total Units	1,4,1,3,2,2 1,5	In Detailed Setup, select the grand total units from the picklist provided. In Review, shows the grand total units.
Grand Total Value	1,2,1,3	Shows the grand total value.
Hardware Rev	1,5	Shows the vortex flowmeter hardware revision level.
HART Output	1,4,4,4	Path to configuring the HART output.
K Corrected	1,2,6,4	Shows the K Corrected value.
K Corrected Status	1,2,6,5	Shows the K Corrected status

Parameter	Fast-Key Path	Explanation
K Factor	1,2,6,3 1,3,4 1,4,2,3 1,5	In Diag/Service, shows the K-Factor value. In Basic Setup, enter the K-Factor. In Detailed Setup, enter the K-Factor. In Review, shows the K-Factor.
K Factor Units	1,3,3 1,4,2,2	In Basic Setup, path to selecting the K-Factor unit. In Detailed Setup, path to selecting the K-Factor unit.
LFCI	5 1,4,3,3 1,5	In the Main Menu, shows the low flow cut-in value. In Detailed Setup, confirm or change the LFCI. In Review, shows the LFCI.
LFCI Index	6 1,5	Shows the low flow cut-in picklist number.
LFCI Adjust Factor	1,4,2,5,3	Enter the low flow cut-in user factor.
Local Display	1,4,4,6	Path to configuring the local display.
Loop Test	1,2,4	Procedure to use the flowmeter as a calibration source to check other instruments in the loop.
Manufacturer	1,4,5,1 1,5	Shows the manufacturer as Foxboro.
Mating Pipe	1,4,1,5,1 1,5	In Detailed Setup, select the type of mating pipe from the picklist provided. In Review, shows the type of mating pipe.
Measurement Status	1,2,6	Path to viewing the status of various measurement parameters.
Measuring Elements	1,4,1	Path to configuring the measuring element parameters.
Message	1,4,5,4 1,5	In Detailed Setup, enter the message (32 characters max). In Review shows the message.
Model Code	1,3,1 1,4,2,1 1,5	In Basic Setup, enter the model code. In Detailed Setup, enter the model code. In Review, shows the model code.
Net Operations	1,2,1,2	Procedure to start, pause or clear the net total.
Net Total	1,1,4 1,4,1,1,4 1,4,1,3,1	In Process Variables, shows the net total. In Process Variables, shows the net total. In Detailed Setup, path to configuring the net total mapping and units.
Net Total Map	1,4,1,3,1,1	Map the Net Total to Volume, Mass, or BVolume.
Net Total Units	1,4,1,3,1,2 1,5	In Detailed Setup, select the net total units from the picklist provided. In Review, shows the net total units.
Net Total Value	1,2,1,1	Shows the net total value.
Num Req Preams	1,4,4,4,2 1,5	In Detailed Setup, configure the number of preambles to be sent in a response message from the flowmeter to the host. In Review, shows the number of preambles.
O/P Alarm Code	1,4,4,5 1,5	In Detailed Setup, configure the output to go fully upscale or downscale if a failure occurs. In Review, shows the O/P Alarm Code.

Parameter	Fast-Key Path	Explanation
Output Configuration	1,4,4	Path to configuring the output parameters.
p/CuFt	1,3,3,2	Sets the K-Factor unit to pulses per cubic foot.
p/l	1,3,3,1	Sets the K-Factor unit to pulses per liter.
Piping	1,4,1,5	Path to configuring the piping parameters.
Piping Config	1,4,1,5,2 1,5	In Detailed Setup, select the type of piping configuration from the picklist provided. In Review shows the type of piping configuration.
PO/PV LRV	1,4,4,3,4 1,5	Shows the PO/PV LRV.
PO/PV Map	1,4,4,3,2 1,5	Shows whether the PV is mapped to Volume Flow, Mass Flow, BVolFlow, or Velocity.
PO/PV URV	1,4,4,3,3 1,5	Shows the PO/PV URV.
Poll Addr	1,4,4,4,1 1,5	In Detailed Setup, configure the poll address to a number from 0 through 15. A nonzero number applies to multidrop applications. In Review, shows the poll address.
Primary Display	1,4,4,6,2	Select the first measurement to be displayed.
Process Density	1,4,1,4,6 1,5	In Detailed Setup, enter the flow density in the density unit specified. In Review, shows the process density.
Process Parameters	1,4,1,4	Path to configuring the process parameters.
Process Temperature	1,4,1,4,4 1,5	In Detailed Setup, enter the flow temperature in the temperature unit specified. In Review, shows the process temperature.
Process Variables	1,1 1,4,1,1	Path to viewing the process variable values.
Process Viscosity	1,2,6 1,4,1,4,9 1,5	In Diag/Service, shows the process viscosity value. In Detailed Setup, enter the base viscosity in the viscosity unit specified. In Review, shows the process viscosity.
Pulse Add Drop	1,4,3,2 1,5	In Detailed Setup, configure the pulse compensation (signal conditioning) feature On or Off. In Review, shows the pulse compensation as On or Off.
Pulse Map	1,4,4,3,2 1,5	Shows whether the pulse is mapped to Volume Flow, Mass Flow, BVolFlow, or Velocity.
Pulse Max Freq	1,4,4,3,5 1,5	In Detailed Setup, set the upper frequency end point corresponding to the highest frequency as 10, 100, or 1000 Hz. In Review, shows the pulse maximum frequency.
Pulse Mode	1,4,4,3,1 1,5	In Detailed Setup, select the type of pulse output as Rate, Total, Raw, or Off. In Review, shows the type of pulse output.
Pulse Operations	1,2,1,1	Procedure to start, pause or clear the pulse total.
Pulse Out	1,2,6,8	Shows the pulse value.

Parameter	Fast-Key Path	Explanation
Pulse Output	1,4,4,3	Path to configuring the pulse output.
Pulse Resolution	1,4,4,3,5	Enter the units per pulse.
Pulse Status	1,2,6,9	Shows the pulse status.
Pulse Total EGU	1,4,4,3,4	Select the unit from the picklist provided.
Pulse Width	1,4,4,3,3	Select the pulse width as 0.5, 5, or 50 ms.
PV	2 1,1,1 1,4,1,1,1	Shows the value of the process variable.
PV % Rnge	1,1,2 1,4,1,1,2	Shows the process variable in percent of range.
PV AO	3 1,1,3 1,4,1,1,3	Shows the analog output of the process variable.
PV Configuration	1,4,1,2	Path to configuring the PV parameters.
PV Damp	1,5	Shows the damping time.
PV Damping	1,3,8 1,4,1,2,4	Enter the damping time if different than the one shown.
PV Map	1,3,5 1,4,1,2,1	Map the PV to Volume Flow, Mass Flow, BVolFlow, or Velocity.
PV Min Span	1,5	Shows the minimum span.
PV Units	1,3,6 1,4,1,2,2 1,5	In Basic Setup, select the PV units from the picklist. In Detailed Setup, select the PV units from the picklist. In Review, shows the PV units.
PV URV	4 1,3,7 1,4,1,2,3	In the Basic Menu, shows the process variable upper range value. In Basic Setup, enter the PV URV. In Detailed Setup, enter the PV URV.
PV USL	7 1,5	In the Basic Menu, shows the upper sensor limit. In Review, shows the upper sensor limit.
Review	1,5	Path to viewing flowmeter values and settings.
Revisions	1,4,5,6	Path to configuring the various revision levels.
Reynolds Number	1,4,3,1	Configure the Reynolds Number correction feature On or Off.
Scaled D/A Trim	1,2,5,2 1,4,4,2,5,2	Procedure to trim the low and high mA output values of the flowmeter to match the output of a plant standard measurement device.
Self Test	1,2,3	Procedure to self test the device.
Serial Number	1,4,2,4 1,5	In Detailed Setup, enter the serial number. In Review, shows the serial number.
Set Analog Out	1,2,4,2 1,4,4,2,4	Procedure to set the analog output to 4 mA, 20 mA, or another value.
Set Digital Out	1,2,4,1 1,4,4,1,2	Procedure to set the digital output to override the PV, net total, grand total, or vortex frequency.

Parameter	Fast-Key Path	Explanation
Set Fluid Defaults	1,3,2 1,4,1,4,1	Path to setting the default parameters for the type of fluid selected (liquid, gas, or steam).
Set Pulse Out	1,2,4,3 1,4,4,3,6	Procedure to set the pulse output to 0 Hz, the maximum frequency, or another value.
Show	1,4,4,6,1	Specify which measurements are to be displayed and their format (decimal point placement).
Software Rev	1,5	Shows the software revision level.
Software Sub-Revision	1,5	Shows the software sub-revision level.
Special	1,4,2,5	Path to configuring special flowtube parameters.
Tag	1,3,9 1,4,5,2 1,5	In Basic Setup, enter the tag (8 characters maximum). In Detailed Setup, enter the tag (8 characters maximum). In Review, shows the tag.
Temperature Units	1,4,1,4,3 1,5	In Detailed Setup, select the temperature unit from the picklist provided. In Review, shows the temperature units.
Total Units	1,4,1,3	Path to configuring the totals parameters.
Totals Operations	1,2,1	Path to viewing, starting, stopping, or clearing the totalizers.
Tube Alpha	1,4,2,5,2	Enter the thermal coefficient of expansion (alpha) in m/m/°K.
Tube Diameter	1,4,2,5,1	Enter the custom flowtube diameters in meters.
Tuning	1,4,3	Path to configuring the tuning parameters.
Universal Rev	1,5	Shows the universal command set revision level.
Upstream Distance	1,4,1,5,3 1,5	In Detailed Setup, enter the distance to the first upstream disturbance in pipe diameters. In Review, shows the upstream distance.
Variable Map	1,4,4,1,1	Map the output as the primary, secondary, tertiary, or fourth output.
Velocity Status	1,2,6,2	Shows the flow velocity status.
Velocity Units	1,4,1,2,5	In Detailed Setup, select the unit from the picklist.
Viscosity Status	1,2,6	Shows the process viscosity status.
Vortex Freq	1,1,6 1,4,1,1,6	Shows the vortex frequency.

5. Troubleshooting

— **! CAUTION** —

Components in your flowmeter are ESD sensitive and thus are susceptible to damage resulting from electrostatic discharge. Invensys recommends that you be grounded via a conductive wrist strap or by standing on an ESD mat when performing maintenance in the electronics compartment and if the housing is removed.

— **NOTE** —

Before troubleshooting your vortex flowmeter, verify that the flowmeter has been correctly configured for the model, flow, and output parameters.

Flowmeter Output Indicates Flow When There Is No Flow

In some installations, the flowmeter can indicate flow when the line is shut down. This could be the effect of a leaking valve, sloshing fluid, or noise sources such as pump-induced pipe vibration.

1. Check the Low Flow Cut-In (LFCI) setting.

The LFCI setting sets the sensitivity of the electronics to the sensor output signal. There are eight LFCI settings. The default setting leaving the factory is level 4 and is suitable for most applications. Should there be excessive vibration, resulting in false excitation of the vortex sensor, it may be necessary to increase the LFCI setting. To set the LFCI:

- a. Make sure there is a no-flow condition. Preferably block valves should be closed. Control valves can leak when closed, resulting in some flow through the flowmeter that it can detect.

— **NOTE** —

Setting the dampening to 0 seconds will show the magnitude of any false excitation.)

- b. Increase the LFCI setting by one level and observe the signal output. The LFCI should be increased until there is no false signal. Alternately, the **AUTO LFCI** command can be used. When this command is executed, the flowmeter starts at the most sensitive LFCI setting. If false signal is detected within a 20 second period, the LFCI is increased to the next level and so on until a level is reached where there is no false signal after a 20 second time period.
 - c. If dampening was changed to 0 seconds, change dampening to a desired level.
 - d. If the LFCI level has changed, make sure controllers and receivers can accommodate the increased LFCI setting. Output will go to 4 mA when this flow rate is reached.
2. If the LFCI is higher than desired, there are several possible causes:

- a. Check the flowmeter sizing. The flowmeter could be over-sized for the application, resulting in the need to provide a measurement at a very low flow velocity. Consult FlowExpertPro™ to validate the meter sizing.
 - b. Check for excessive vibration in a plane that is parallel to the vortex sensor. The vortex sensor axis is perpendicular to the pipe diameter. For most applications where the electronics are top mounted and the pipe is supported by horizontal pipe supports, this may result in false signal. In these cases, reposition the meter so the electronics are pointed to the side. The sensor axis will then be vertical.
 - c. Examine peripheral equipment and vibration sources to assure they are not imparting vibration into the vortex flowmeter.
3. Other sources of false signal:
 - a. Check for 60 Hz signal pickup. Check the output of the flowmeter against the expected value for a 60 Hz input signal. If 60 Hz interference is present, examine the flowmeter and interconnecting wiring for proper grounding and shielding.
 - b. Check the cable between the flowmeter body and the electronics housing to make sure it is firmly secured.

Flowmeter Has No Output (No mA Output and the Display [If So Equipped] Is Blank)

1. Remove the field wiring cover and check the power supply voltage. The voltage across the + and - terminals must be between 15.5 and 42 volts dc.
2. Make sure there is no moisture in the termination compartment. Moisture could be a result of a loose cable/conduit connection or a cover that was not fully engaged.
3. If voltage at the terminals is 0, check for a blown fuse in power supply or for damaged wires.
4. If voltage is below minimum, check the loop load vs supply voltage per Figure 16.
5. If voltage is correct, check the voltage on the cable inside the housing to verify the protection circuit in the terminal block assembly has not been damaged. If no voltage is present on the cable inside the housing, replace the terminal block assembly.

Flowmeter Has No Output With Flow, But Has a 4 mA Signal and a Lighted Display (If So Equipped).

1. Check the LFCI setting. This sets the point where the mA output remains at 4 mA from zero flow to the LFCI flow rate. If flow is above this level, and there is still no change in output, proceed as follows:
2. Check the flowmeter status to see it has not "failed low". The flowmeter is configurable to fail either "low" or "high". The mA value in the fail-low mode is 3.6 mA. (The mA value in the fail-high mode is 22 mA.)
3. Check to see that the module can output the desired mA or pulse output frequency by going to the Test mode and setting the outputs as previously described.

Flowmeter Output Increases With Flow, However When It Approaches Full Scale, the Output Suddenly Goes To 4 mA.

1. This is indicative of an intrinsically safe loop that is using a passive (unpowered) barrier. As the mA value increases, the voltage at the terminals has dropped below the minimum and the output has gone to 4 mA.
2. Install an active (externally powered) barrier such as a Pepperl+Fuchs model KFD0-SCS-Ex1.55

Electronics Module Test

1. Remove the cover from the electronics compartment of the housing.
2. Make sure there is no moisture in the electronics compartment. Moisture could be a result of a loose cable/conduit connection or a cover that was fully engaged. A build up of corrosive moisture in this compartment could affect the performance of the electronics. Also examine the electronics for exposure to excessive heat. The maximum temperature the electronics can withstand is 80°C (176°F). Make sure the installation is such that the electronics do not exceed this temperature.
3. Test the mA or pulse output by putting the flowmeter in the Test mode and setting either the mA or pulse output value. If the meter has no output in this test mode, replace the module. If there is output from the meter, proceed to the next step.
4. Remove the electronics from the compartment by loosening the two captured screws.
5. Check the inside for broken or pinched wires and/or connectors that are not engaged.
6. Check the voltage level at the cable end of the blue and red wires. The voltage should be the same as was measured on the field terminals. Should there be a difference, the terminal block electronics assembly may have been damaged in a severe transient (lightening strike).
7. Remove the 4-wire connector from the back of the electronics module. This is the signal input connector from the sensor to the electronics module. In place of this connector, connect a test connector (part number K0152KU).
8. Connect a frequency generator to the brown (+) and yellow (-) wires. Inject a sinusoidal 0.5 V peak to peak signal that is in the vortex shedding frequency range for the flowmeter. Observe there is a change in the 4-20 mA or rate pulse output signal. Change the input frequency over the expected vortex frequency range and verify the output changes accordingly.
9. If there is still no output, replace the electronics module.

Flowmeter Has Incorrect Output

1. Output is lower than expected at all flow rates
 - a. Verify that the upper range value (URV) is correct.
 - b. Verify that the zero and span of the mA output is correct.

- c. Check for vibration levels, that may influence the output signal. This is best accomplished by following the procedure for setting the low flow cut-in in “Flowmeter Output Indicates Flow When There Is No Flow” on page 61.
 - d. Check the flowmeter configuration to verify that the fluid flowing density is entered correctly. An incorrect configuration could result in band pass filters being set to improper values, with in-band signals being adversely affected.
 - e. Check the load resistance.
 - f. In the test mode, verify that the mA output at the receivers is correct.
2. Output is lower than expected at low-flow rates.
- Check the steps in the above test, however if the problem only appears at low flow rates, the likelihood is that there is a pulsating flow condition, resulting in missed pulses when the fluid velocity is very low.
3. Output is constant when flow is increasing or decreasing.
- a. This condition is likely the result of an in-band noise source. Where the vortex signal is being over-ridden by the noise source.
 - b. Check the LFCI setting procedure. Check the URV value to make sure that it is in line with the actual measurement range.
4. Output is greater than the expected value.
- a. Test the above.
 - b. Verify that the flowmeter is not in a "fail safe" mode where full scale output has been configured as the fail safe output condition.
 - c. Verify the URV is correctly configured.
5. Incorrect pulse output value.
- a. Check the configuration of the pulse output to verify that it is correct.
 - ◆ Raw Pulse: the raw vortex shedding frequency.
 - ◆ Rate Pulse: verify that the rate pulse is configured to the correct full range value of 10 Hz, 100 Hz, or 1000 Hz.
 - ◆ Total pulse: verify that the total pulse is properly defined.
 - b. If rate pulse is configured, set the output frequency in the test mode and verify the correct value.

6. Maintenance

— **! CAUTION** —

Components in your flowmeter are ESD sensitive and thus are susceptible to damage resulting from electrostatic discharge. Invensys recommends that you be grounded via a conductive wrist strap or by standing on an ESD mat when performing maintenance in the electronics compartment and if the housing is removed.

Introduction

The operation of the 84S-T and 84S-U Vortex Flowmeters consists of three basic functions: (1) generation and shedding of vortices in the fluid stream, (2) sensing of vortices, and (3) amplification, conditioning, and processing of the signal from the vortex sensor. Should a malfunction of the flowmeter be suspected, the cause can normally be isolated to one of these three functions.

Personnel involved in maintenance of vortex flowmeters should be trained and qualified in the use of the equipment required and in the removal and replacement of the meter in the piping. They should also be qualified for the routine maintenance of the meter components.

Vortex Generation and Shedding

The process of vortex generation and shedding can be degraded or destroyed by disturbances in the upstream flow, the nature of the flowing fluid, or by damage to the vortex shedding element (rare). Such flow disturbances may be created by gaskets protruding into the flowing stream, by some form of partial blockage in the upstream piping, by the piping configuration, or by the existence of two-phase flow. Should the vortex shedding element become heavily caked, coated, or physically damaged to the extent that its basic shape or dimensions are changed, the vortex shedding process may be impaired. Also, the length of straight, unobstructed run of upstream piping is important (refer to “Effects of Piping on Flowmeter Performance” on page 11).

Vortex Sensing

The sanitary flowmeter sensor is filled with silicone oil for applications with process temperature limits of -20 to $+200^{\circ}\text{C}$ (0 to 400°F).

The sanitary sensor consists of a piezoelectric bimorph crystal that is sealed inside a liquid-filled capsule having two diaphragms on opposing sides. The vortex shedding process creates an alternating differential pressure across the capsule that is transmitted via the diaphragms and fill-fluid to the crystal.

Electronic Module

The electronic module is housed in the flowmeter housing opposite the side labeled **FIELD TERMINALS**. On the back of the module are three terminal blocks. See Table 12 for a summary of the terminal block connections.

Table 12. Electronic Module Terminal Block Connections

No. of Connectors	Color	Description
2	Red (R) Blue (B)	Loop + Loop -
3	Yellow (Y) Green (G)	Pulse Out + Pulse Out -
4	Blue (B) Red (R) Orange (O) Yellow (Y)	Sensor + Not used Not used Sensor -

Electronic Module Removal

See Figure 36.

! WARNING

Before proceeding, ensure that power is removed from the flowmeter.

1. For flowmeters with housing cover locks, screw the electronic compartment cover lock screw into the housing to unlock the cover.
2. Remove the electronic module compartment threaded cover.

NOTE

If the cover cannot be removed by hand, insert a flat bar in the cover slot.

3. If a display is mounted to the electronic module, remove the display, loosen the two mounting screws, and unplug the ribbon cable from the electronic module.
4. Unscrew the two captive screws, one on each side of the electronic module.
5. Pull the electronic module out of the housing far enough to be able to disconnect the wires from the terminal blocks on the back of the electronic module.
6. Disconnect the mA output (red-blue), pulse output (yellow-green), and sensor (blue-red-orange-yellow) cable connectors from the 2-, 3-, and 4-pin terminal blocks respectively.
7. Remove the electronic module from the housing.

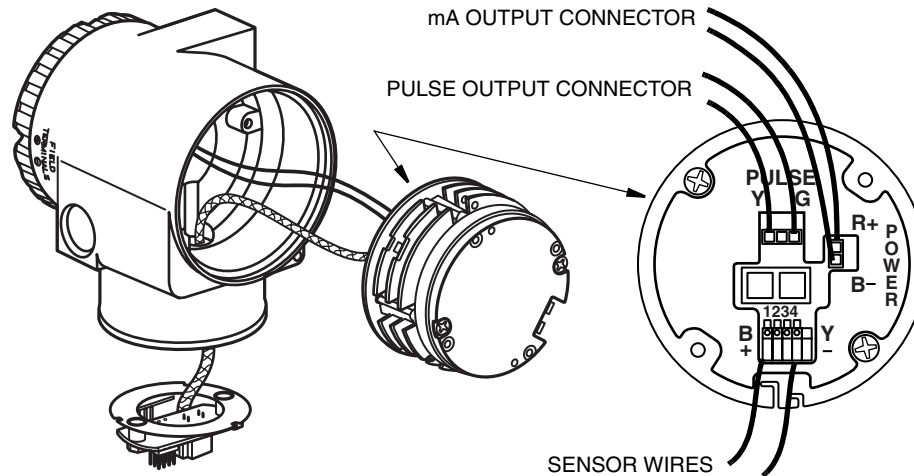


Figure 36. Electronic Module Connections

Electronic Module Replacement

— **! WARNING** —

Before proceeding, ensure that power is removed from the flowmeter.

1. Remove the electronic module. See “Electronic Module Removal” on page 66.

— **! CAUTION** —

The replacement electronic module is shipped in a protective antistatic plastic bag. Do **not** remove it from this bag **until** it is ready to be installed in a flowmeter. This minimizes the possibility of damage due to accidental electrostatic discharge.

2. Remove the new electronic module from its protective bag.
3. Connect the mA output (red - blue) and pulse output (yellow - green), and preamplifier/sensor (blue - red - orange - yellow) cable connectors to the 2-, 3-, and 4-pin terminal blocks respectively on the back of the electronic module.
4. Back the two electronic module captive screws out of the module until the screws are captured by the plastic housing.
5. Turning the electronic module one turn maximum to take up the slack in the wires, locate the module in the housing over the two mounting holes. Making sure that no wires are pinched under the module, tighten the captive mounting screws.
6. If the electronic module was equipped with a display, reinstall the display. Carefully fold the ribbon cable in the space between display and the electronic module so that it is not pinched. The display molding should rest firmly against the module molding before tightening the screws. See Figure 37.

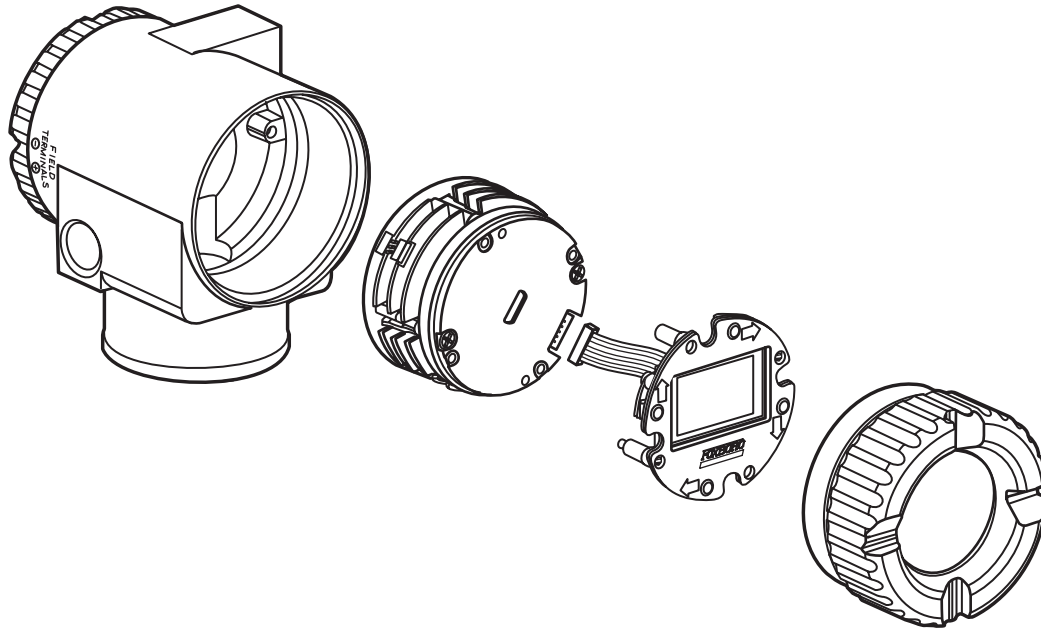


Figure 37. Electronic Module with Display Connections

7. The new electronic module must be configured to match the one just removed.
8. Perform the “Post-Assembly Dielectric Test” on page 71.
9. Replace the electronic module compartment cover.
10. On flowmeters with housing cover locks, relock the electronic compartment cover **before** operating the flowmeter.

Neck Board Replacement

All 84S Series Vortex Flowmeters have a printed wiring board located in the neck of the instrument. This board (henceforth referred to as a neck board) functions as a barrier and/or interface depending on the specific model.

Barrier Board: In flowmeters with explosionproof/flameproof electrical certification. These flowmeters also have a PE ground in the electronics housing which must be disconnected as part of the preamplifier replacement procedure.

Interface Board: In all 84S Series flowmeters.

Removal Procedure

— **! WARNING** —

Before proceeding, ensure that power is removed from the flowmeter.

1. Remove the electronic module. See “Electronic Module Removal” on page 66.
2. If your flowmeter has explosionproof/flameproof electrical certification, disconnect the two wires from the PE ground screw in the electronics housing.

3. If your housing has an anti-rotation screw, remove the red lacquer from the screw recess. Turn the screw three full turns counterclockwise (see Figure 11 for location). Remove the housing by rotating it counterclockwise (when viewed from the top).
4. If your housing has a retention clip, remove the red lacquer from the screw recess. Remove the screw completely, and slide the clip off the housing. Save the clip and screw for future use. Remove the housing by rotating it counterclockwise (when viewed from the top).
5. Disconnect the wires from the 4-position terminal block on the neck board.
6. Remove the two screws securing the neck board in its cup and remove the board from the cup. Save the screws (and barrier if applicable).

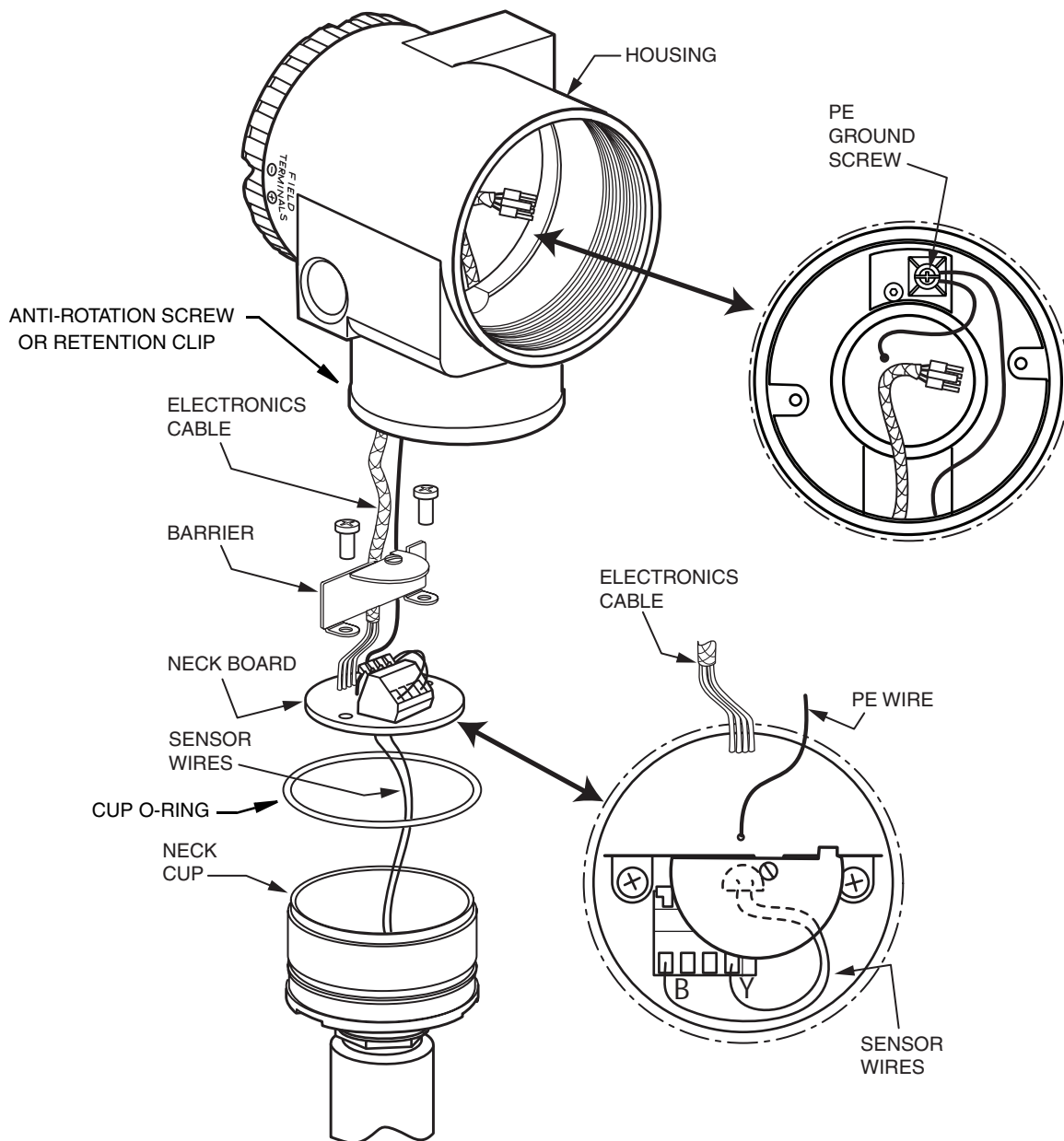


Figure 38. Preamplifier Assembly - Integrally Mounted

Installation Procedure

WARNING

Before proceeding, ensure that power is removed from the flowmeter.

NOTE

The replacement neck board is shipped in a protective antistatic plastic bag. Do **not** remove the preamplifier from this bag **until** it is ready to be installed in a flowmeter. This prevents damage due to accidental electrostatic discharge.

1. Remove the neck board. See “Removal Procedure” on page 68.
2. Feed the (2 or 4) wires from the cup through the hole in the center of the neck board and connect them to the 4-position terminal block on the board.
3. Install the neck board into its cup and secure it (and the barrier if applicable) with the two screws previously removed.
4. Feed the electronics cable (and the PE ground wire if applicable) through the housing neck and into the electronics compartment.
5. Inspect the cup 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 “Cup” O-ring for CSA labeled product violates ANSI / ISA 12.27.01.

6. Screw the housing onto the cup. Hand tighten. until it bottoms. Do not over tighten.
7. If your housing has an anti-rotation screw, engage the anti-rotation screw until it touches the cup and back it off 1/8th turn. It is important that the screw is not touching the cup. Fill the screw recess with red lacquer (Foxboro Part Number X0180GS or equivalent). the housing may then be rotated up to one full turn counterclockwise for optimum access.
8. If your housing has a retention clip, insert the 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. 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.
9. If your flowmeter has explosionproof/flameproof electrical certification, reconnect the two (green) PE ground wires to the PE ground screw in the electronics housing.
10. Connect the mA output (red - blue) and pulse output (yellow - green), and electronics (blue - red - orange - yellow) cable connectors to the 2-, 3-, and 4-pin terminal blocks respectively on the back of the electronic module.

11. Back the two captive screws out of the module until the screws are captured by the plastic housing.
12. Rotate the module one-half to one full turn to slightly twist the wires together.
13. Locate the electronic module over the mounting holes, assure that no wires are pinched, and tighten the captive mounting screws.
14. Perform the “Post-Assembly Dielectric Test” on page 71.
15. Replace the electronic compartment cover. On flowmeters with housing cover locks, relock the electronic compartment cover **before** operating the flowmeter.

Flowtube or Sensor Replacement

The flowtube and sensor of the 84S Flowmeter are not user replaceable. Return the entire flowmeter to Invensys for repair or replacement.

Post-Assembly Dielectric Test

To ensure there are no faults to ground in any of the internal wiring, apply 500 V ac or 707 V dc dielectric strength test for one minute between the four shorted terminals and the housing ground as shown in Figure 39.

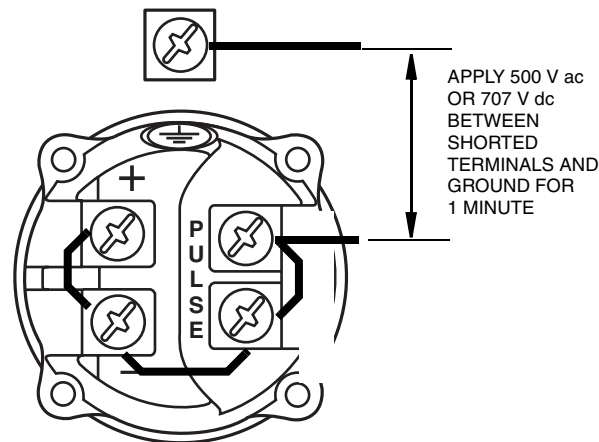


Figure 39. Connections for Post-Assembly Dielectric Test

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