Intelligent Vortex Flowmeters

Model 84C with HART Communication or Low Power

Master Instruction

MI 019-222
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Schneider Electric

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

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

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

⚠DANGER

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

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

⚠WARNING

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

⚠CAUTION

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

NOTICE

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

Please Note

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

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

Table of Contents

Introduction

Model 84C Vortex Flowmeters measure the flow rates of fluids (liquid, gas, or steam) using the principle of vortex shedding. 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 electronics module and processed by a microcontroller to produce a digital signal, a 4 to 20 mA analog signal (Electronics Version -T only), and a pulse signal that is proportional to the volumetric flow rate. These signals can be mapped to a variety of measurements.

The flowmeter is available with an optional integrated platinum RTD temperature sensor, which allows temperature compensation for density of saturated steam. With built-in ASME-based steam tables,[1] a Model 84C Vortex Flowmeter with the temperature compensation option performs mass flow metering of saturated steam, including specific enthalpy (heat content) and rate of heat flow.

In addition, a Model 84C Vortex Flowmeter with the RTD option provides algorithms for temperature-compensated mass flow of any user-defined liquid.

The flowmeter is offered with a flanged (84CF), wafer (84CW), or NPT male threaded (84CN) body design.

The flowmeter can be configured locally or remotely. If your flowmeter has an optional LCD display, pushbuttons allow you to easily configure the flowmeter locally. To configure the flowmeter remotely, use either a HART Communicator or a PC-based configurator.

The Low Power (Electronics Version -L) version of this flowmeter is intended for use with battery power that is recharged with any technology, such as a solar array or alternator. The supply current is fixed at a constant 10 mA and remains in operation down to a minimum terminal voltage of 10 V dc.

Reference Documents

Document	Description
MI 019-222	Model 84C with HART Communication or Low Power
MI 019-224	Model 84C with Modbus Communication
MI 019-177	Vortex Flowmeter FM and CSA Connection Diagrams
MI 019-179	Flow Products Safety Information (ATEX and IECEx)

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1.   Saturated steam based on *ASME International Steam Tables for Industrial Use* (Second Edition), 2009.

Terminology

This section defines terms that are used throughout this document.

Term	Description
Soft Limits	The maximum and minimum limits within which a measurement is expected to operate. These limits are based on the user-entered upper range value (URV) for each measurement. Measurement values that are outside the soft limits, but within the hard limits, are typically marked as alerts.
Hard Limits	The maximum and minimum limits that a measurement cannot exceed. Measurement values that are outside the hard limits are typically marked as bad.
Model Code	The model code defines the options associated with a product. **Figure 1 - Sample Model Code** 84CF010–TPRF1STFTJFA FA: FM Intrinsically Safe Certification J: With Optional Digital Indicator/Configurator T: Aluminum Integral 1/2-NPT Conduit Connections F: Fluorolube fill, Standard Temperature Range, SS T: Multivariable Temperature Compensation S: Single Measurement F1: ANSI Class 150 RF End Connection and Flange Rating R: 316SS Body, Flange, and Shedder Bar Material P: Standard Pulse Output Capability T: HART Electronics 010: 1 inch (DN25, 25 mm) Nominal Line Size F: Flanged Body Style

Communication Parameters

Table 1 - HART Communication Parameters

Parameter	HART Analog or Digital Multidrop Mode
Communication Format	• Analog 4 to 20 mA with HART superimposed • HART communications with fixed mA output
Remote Configurator/Communicator	HART communicator or PC-based configurator
Communication Rate	1200 baud
Communication Distance (Rated)	1,800 m (6,000 ft)
Measurement Update	5 times/s
Raw Pulse Measurement Update	Vortex Shedding Frequency

With HART, digital multidropping — the connection of multiple transmitters to a single communications line — is permitted.

Operating Conditions

Operating limits are based on nonflashing, noncavitating conditions. A minimum positive back pressure is required for proper operation to avoid these effects.

Table 2 - Operating Limits

Influence	Operating Limits
Process Fluid	liquid, gas, and steam
Process Temperature for Standard Temperature Flowmeters	
With fluorolube fill (Sensor Fill, Temperature Range, and Material selection D or F)	-18 and +93°C (0 and 200°F)
With silicone fill (Sensor Fill, Temperature Range, and Material selection R or S)	-18 and +204°C (0 and 400°F)
Process Temperature for Extended Temperature Flowmeters	
Unfilled (Sensor Fill, Temperature Range, and Material selection A or B), without temperature compensation (Multivariable selection N)	149 and 371°C (300 and 700°F)
Unfilled (Sensor Fill, Temperature Range, and Material selection E or G) without temperature compensation (Multivariable selection N)	149 and 427°C (300 and 800°F)
Unfilled (Sensor Fill, Temperature Range, and Material selection A, B, E, or G) with temperature compensation (Multivariable selection T)	149 and 260°C (300 and 500°F)
Ambient Temperature (Housing)[2]	
With local display	-20 and +80°C (0 and 176°F)
Without local display	-40 and +80°C (-40 and +176°F)
Relative Humidity	0 and 100%
Supply Voltage	
With Electronics Version -T (HART Communication)	15.75 and 42 V dc[3]
With Electronics Version -L (Low Power)	10 and 42 V dc[4]

Functional Specifications

Response Time (Without Damping)

Table 3 - Flowmeter Response Times

Flowmeter Output	Response Time (Without Damping)
Analog Mode	0.5 second or the vortex shedding period for frequencies less than 2 Hz.
Digital Mode	0.5 second or the vortex shedding period for frequencies less than 2 Hz.
Pulse Output	• Raw mode: Vortex shedding frequency • Frequency or Pulse mode: 0.25 second or the vortex shedding period for frequencies less than 2 Hz.

2. The 80°C (176°C) temperature is extended to 85°C (185°F) with certain electrical certifications. Refer to *Electrical Certifications, page 27*.
3. See *Supply Voltage vs Output Load for 4 to 20 mA Output, page 13*.
4. Supply current is fixed at a constant 10 mA for Electronics Version -L and remains in operation down to a minimum terminal voltage of 10 V dc.

Outputs

These flowmeters support the following outputs:

- HART Electronics Version -T: Digital and 4 to 20 mA output and pulse output
- Low Power Version -L: Fixed 10 mA output and pulse output

Table 4 - Flowmeter Outputs

Output Type	Description
Analog (HART flowmeters only)	Flow rate available as a 4 to 20 mA signal, with the 20 mA value being set by the configured full range flow rate. See *Supply Voltage vs Output Load for 4 to 20 mA Output, page 13*.
Digital	Digital information is superimposed on a 4 to 20 mA output signal (standard power HART flowmeters) or the power supply loop (low power flowmeters) at 1200 baud. See *HART Communication Parameters, page 10*. For low power versions, output is fixed at 10 mA.
Pulse Output	The pulse output can be configured with the electronics module in one of the following modes: - **Raw Mode**: The vortex shedding frequency is directly passed through, providing an instantaneous, nondampened frequency output. - **Frequency mode**: The frequency of this output is a 50% duty cycle pulse output with a frequency range of 0 to 10,000 Hz, proportional to zero flow to the full range flow rate/upper range value (URV). - **Pulse mode**: The frequency of this output is also a 50% duty cycle pulse output that is configured to provide a pulse when a determined volumetric/totalized unit has flowed through the meter.

Output Combinations

The flowmeter uses two combined power and digital communications lines. Pulse output requires wiring an additional two lines.

Pulse Output Specifications

The pulse output is an externally powered 2-wire transistor switch type output. This output can be configured using any applicable configuration device to select one of three pulse output modes: raw, frequency, and pulse. The following specifications apply to the three types of pulse output modes:

- 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

Power Supply Requirements

HART (Electronics Version -T)

Supply Current:

- Digital Mode: 10 mA dc nominal
- Analog Mode: 22 mA dc maximum
- Pulse Output: 20 mA dc maximum

Supply Voltage:

- 15.75 to 42 V dc, depending on electrical safety approvals and certifications[5]. Refer to the following figure.

  NOTE: When operating at ambient temperatures less than -29°C (-20°F), you must maintain a minimum terminal voltage of 15.75 V dc in order to maintain remote configurator communication capability.

Figure 2 - Supply Voltage vs Output Load for 4 to 20 mA Output
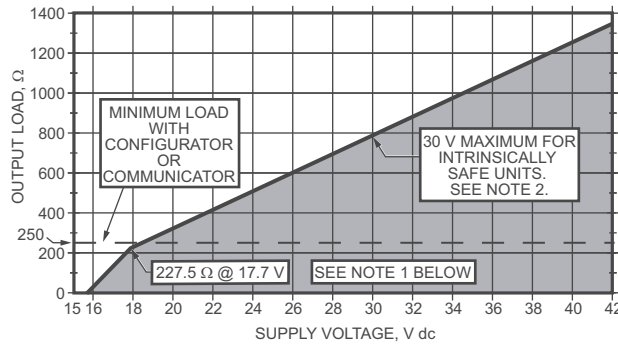
NOTES:

1. The flowmeter will function 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 in this area can cause output and/or communication disturbances.

2. With intrinsically safe certifications with a 24 V dc power supply, an active barrier is required.

Low Power (Electronics Version -L)

Supply Current:

- 10 mA dc nominal

Supply Voltage:

- 10 and 42 V dc[6]

  NOTE: For proper operation, 10 V dc must be maintained at the flowmeter terminals. For HART communication, a 250 Ω load resistor must be included in the power supply loop, and a voltage of 12.5 V dc must be maintained in the loop.

Flowmeter Ranges

The flowmeter is shipped with the flow range specified in the sales order or with a default flow range equal to the meter capacity. You can rerange the flowmeter and keep the same flow rate units, choose new flow rate units from a built-in menu-selectable list, or enter custom flow rate units.

To determine flow velocity limits and use other sizing tools, refer to the FlowExpertPro sizing program.

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5.   See *Electrical Certifications, page 27*
6.   Supply current is fixed at a constant 10 mA for Electronics Version -L and remains in operation down to a minimum terminal voltage of 10 V dc.

Nominal Flow Velocity Limits

Although the calculations in the following table apply for many applications, they only provide *nominal* flow velocity limits. Use the FlowExpertPro™ sizing program for your specific application.

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

Reference K-Factor

The reference K-factor is a coefficient that specifies the flowmeter calibration and is expressed as pulses per unit volume; where pulses/unit volume = pulses per second divided by volume flow per second.

The reference K-factor is the arithmetic mean value of K over the factory-calibrated flow range. It is determined at the factory by actual flow calibration with water by comparison to a master flowmeter calibration, or by actual static weight. Both calibrations are traceable to NIST. The reference K-factor is entered in the flowmeter database and stamped on the data plate. Once established, this K-factor is available to gas, liquid, or steam.

Flowing K-Factor

The flowing K-factor is computed from the K-reference expressed in specified flowing units, and can be corrected for the following:

- Process Temperature
- Mating Pipe
- Upstream Disturbances

Process Temperature Effect on K-Factor

There is an effect on the reference K-factor due to a diameter change of the flowtube bore with temperature. The effect is -0.3% of flow rate per 55°C (100°F) increase in temperature. These flowmeters automatically recompute a flowing K-factor based on detected changes in process temperature.

K-Factor Bias

Provisions are made in the configuration menu to bias the flowmeter K-factor by a percent (%) value. The flowing K-factor value is automatically recalculated when the % bias is entered.

Static Pressure Limits

To determine the pressure drop for Model 84C Vortex Flowmeters and use other sizing tools, refer to the FlowExpertPro sizing program (*FlowExpertPro™ Sizing Application, page 22*).

Minimum Static Pressure

The minimum static pressure is that pressure which is sufficient to help prevent flashing and meet the pressure drop requirements to attain maximum flow rate. Refer to the FlowExpertPro sizing program.

Maximum Static Pressure

Where reference temperature is 37.8°C (100°F):

- Flanged Body: 3750 psig (258.6 bar, 25855 kPa) or that imposed by flange rating
- Wafer Body: 1500 psig (103.4 bar, 10340 kPa) or that imposed by flange rating
- NPT Body as imposed by equivalent flange ratings:
    - Line size 010 equivalent to Class 1500 flanges
    - Line size 020 equivalent to Class 900 flanges

Minimum Back Pressure (Volatile Liquids or Low Pressure Conditions)

Proper system design, and operation of the flowmeter within the rated flow rate range, helps prevent conditions that tend to contribute to the release of vapor from the liquid (flashing), which can also induce cavitation.

When locating the flowmeter, consider the need for a back pressure valve, or for increasing inlet pressure. To help minimize flashing and support stable vortex generation, the minimum back pressure should be:

$$P_G = (3)(\Delta P) + (1.25)(p_v) - (p_{atm})$$

Where:

- P_G: Gauge pressure in kPa or psi five pipe diameters downstream of the flowmeter
- ΔP: Pressure loss in psi or kPa
- p_v: Vapor pressure at line conditions in psi or kPa absolute
- p_{atm}: Atmospheric pressure in psi or kPa absolute

Pressure Tolerance

Flowmeters are designed to withstand pressure within ANSI/ASME B16.5 Class 150, 300, 600, 900, or 1500 flange ratings, and DIN EN 10921 PN16, PN25, PN40, PN63, PN100, or PN160 flange ratings. See *Maximum Working Pressure, page 25* for flange pressure-temperature ratings.

For 84C wafer body flowmeters, the flowtube face outside diameter is designed to center between ANSI Class 150 flanges. For other flange ratings, specify centering spacers from the Mounting and Centering System selection in the Model Code.

Units

Table 5 - Analog Units

Unit	Description	Fluid Restriction
%	percent of 4 to 20 (0 to 100%)	No restriction
mA	milliamperes	No restriction
Norm	Normalized (0-1)	No restriction

Table 6 - Absolute Pressure Units

Unit	Description	Fluid Restriction
kPaa	kilopascals absolute	No restriction
Paa	pascals absolute	No restriction
psia	pounds per square inch absolute	No restriction

Table 7 - Temperature Units

Unit	Description	Fluid Restriction
degC	degrees Celsius	No restriction
degF	degrees Fahrenheit	No restriction
degR	degrees Rankine	No restriction
K	Kelvins	No restriction

Table 8 - Density Units

Unit	Description	Fluid Restriction
g/cm3	grams per cubic centimeter	No restriction
kg/l	kilograms per liter	No restriction
kg/m3	kilograms per cubic meter	No restriction
lb/ft3	pounds per cubic foot	No restriction
lb/gal	pounds per US gallon	No restriction
lb/Yd3	pounds per cubic yard	No restriction
LT/Yd3	long tons per cubic yard	No restriction
oz/in3	ounces per cubic inch	No restriction
ST/Yd3	short tons per cubic yard	No restriction

Table 9 - Mass Rate Units

Unit	Description	Fluid Restriction
g/d	grams per day	No restriction
g/h	grams per hour	No restriction
g/m	grams per minute	No restriction
g/s	grams per second	No restriction
kg/d	kilograms per day	No restriction
kg/h	kilograms per hour	No restriction
kg/m	kilograms per minute	No restriction
kg/s	kilograms per second	No restriction
lb/d	pounds per day	No restriction
lb/h	pounds per hour	No restriction
lb/m	pounds per minute	No restriction
lb/s	pounds per second	No restriction
LTon/d	long tons (2240 lb) per day	No restriction
LTon/h	long tons (2240 lb) per hour	No restriction

Table 9 - Mass Rate Units (Continued)

Unit	Description	Fluid Restriction
LTon/m	long tons (2240 lb) per minute	No restriction
mTon/d	metric tons per day	No restriction
mTon/h	metric tons per hour	No restriction
mTon/m	metric tons per minute	No restriction
mTon/s	metric tons per second	No restriction
oz/d	ounces per day	No restriction
oz/h	ounces per hour	No restriction
oz/m	ounces per minute	No restriction
oz/s	ounces per second	No restriction
STon/d	short tons (2000 lb) per day	No restriction
STon/h	short tons (2000 lb) per hour	No restriction
STon/m	short tons (2000 lb) per minute	No restriction
STon/s	short tons (2000 lb) per second	No restriction

Table 10 - Volume Rate Units

Unit	Description	Fluid Restriction
bbl/d	barrels (42 US gallons) per day	Liquids only
bbl/h	barrels (42 US gallons) per hour	Liquids only
bbl/m	barrels (42 US gallons) per minute	Liquids only
bbl/s	barrels (42 US gallons) per second	Liquids only
bbl3/d	barrels (31.5 US gallons) per day	Liquids only
bbl3/h	barrels (31.5 US gallons) per hour	Liquids only
bbl3/m	barrels (31.5 US gallons) per minute	Liquids only
bbl3/s	barrels (31.5 US gallons) per second	Liquids only
ft3/d	cubic feet per day	No restriction
ft3/h	cubic feet per hour	No restriction
ft3/m	cubic feet per minute	No restriction
ft3/s	cubic feet per second	No restriction
gal/d	US gallons per day	Liquids only
gal/h	US gallons per hour	Liquids only
gal/m	US gallons per minute	Liquids only
gal/s	US gallons per second	Liquids only
Igal/d	imperial gallons per day	Liquids only
Igal/h	imperial gallons per hour	Liquids only
Igal/m	imperial gallons per minute	Liquids only
Igal/s	imperial gallons per second	Liquids only
l/d	liters per day	Not for vapor
l/h	liters per hour	Not for vapor

Table 10 - Volume Rate Units (Continued)

Unit	Description	Fluid Restriction
l/m	liters per minute	Not for vapor
l/s	liters per second	Not for vapor
m3/d	cubic meters per day	No restriction
m3/h	cubic meters per hour	No restriction
m3/m	cubic meters per minute	No restriction
m3/s	cubic meters per second	No restriction
mcft/d	thousands of cubic feet per day	No restriction
Mgal/d	millions of US gallons per day	Liquids only
Ml/d	millions of liters per day	Not for vapor
Ml/h	millions of liters per hour	Not for vapor
mmcft/d	millions of cubic feet per day	No restriction

Table 11 - Standard Volume Rate Units

Unit	Description	Fluid Restriction
mmScft/d	millions of standard cubic feet per day	Not for vapor
mScft/d	thousands of standard cubic feet per day	Not for vapor
Sbbl/d	standard barrels (42 US gallons) per day	Liquids only
Sbbl/h	standard barrels (42 US gallons) per hour	Liquids only
Sbbl/m	standard barrels (42 US gallons) per minute	Liquids only
Sbbl/s	standard barrels (42 US gallons) per second	Liquids only
Sbl3/d	standard barrels (31.5 US gallons) per day	Liquids only
Sbl3/h	standard barrels (31.5 US gallons) per hour	Liquids only
Sbl3/m	standard barrels (31.5 US gallons) per minute	Liquids only
Sbl3/s	standard barrels (31.5 US gallons) per second	Liquids only
Sft3/d	standard cubic feet per day (US system)	Not for vapor
Sft3/h	standard cubic feet per hour (US system)	Not for vapor
Sft3/m	standard cubic feet per minute (US system)	Not for vapor
Sft3/s	standard cubic feet per second (US system)	Not for vapor
Sgal/d	standard US gallons per day	Liquids only
Sgal/h	standard US gallons per hour	Liquids only
Sgal/m	standard US gallons per minute	Liquids only
Sgal/s	standard US gallons per second	Liquids only
Sm3/d	standard cubic meters per day	Not for vapor
Sm3/h	standard cubic meters per hour	Not for vapor
Sm3/m	standard cubic meters per minute	Not for vapor
Sm3/s	standard cubic meters per second	Not for vapor

Table 12 - Normal Volume Rate Units

Unit	Description	Fluid Restriction
Nft3/s	normal cubic feet per second	Not for vapor
Ngal/d	normal US gallons per day	Liquids only
Ngal/h	normal US gallons per hour	Liquids only
Ngal/m	normal US gallons per minute	Liquids only
Ngal/s	normal US gallons per second	Liquids only
Nl/d	normal liters per day (MKS System)	Not for vapor
Nl/h	normal liters per hour (MKS System)	Not for vapor
Nl/m	normal liters per minute (MKS System)	Not for vapor
Nl/s	normal liters per second (MKS System)	Not for vapor
Nm3/d	normal cubic meters per day (MKS System)	Not for vapor
Nm3/h	normal cubic meters per hour (MKS System)	Not for vapor
Nm3/m	normal cubic meters per minute (MKS System)	Not for vapor
Nm3/s	normal cubic meters per second (MKS System)	Not for vapor

Table 13 - Mass Units

Unit	Description	Fluid Restriction
g	grams	No restriction
kg	kilograms	No restriction
lb	pounds	No restriction
LTon	long tons (2240 lb)	No restriction
mTon	metric tons	No restriction
oz	ounces	No restriction
STon	short tons (2000 lb)	No restriction

Table 14 - Volume Units

Unit	Description	Fluid Restriction
bbl	liquid barrels (42 US gallons)	No restriction
bbl3	liquid barrels (31.5 US gallons)	No restriction
ft3	cubic feet	No restriction
gal	gallons	No restriction
Igal	imperial gallons	No restriction
l	liters	No restriction
m3	cubic meters	No restriction
mcft	thousands of cubic feet	No restriction
Mgal	millions of US gallons	No restriction
Ml	millions of liters	No restriction
mmcft	millions of cubic feet	No restriction

Table 15 - Standard Volume Units

Unit	Description	Fluid Restriction
mmScft	millions of cubic feet	No restriction
mScft	thousands of cubic feet	No restriction
SBBL	standard liquid barrel (42 U.S. gallons)	Not for vapor
SBL3	standard liquid barrel (31.5 U.S. gallons)	Not for vapor
Sft3	standard cubic feet	Not for vapor
Sgal	standard US gallons	Liquids only
Sm3	standard cubic meters	Not for vapor

Table 16 - Normal Volume Units

Unit	Description	Fluid Restriction
Nft3	normal cubic feet	Not for vapor
Ngal	normal US gallons	Liquids only
Nl	normal liters (MKS System)	Not for vapor
Nm3	normal cubic meters (MKS System)	Not for vapor

Table 17 - Velocity Units

Unit	Description	Fluid Restriction
ft/d	feet per day	No restriction
ft/h	feet per hour	No restriction
ft/m	feet per minute	No restriction
ft/s	feet per second	No restriction
m/d	meters per day	No restriction
m/h	meters per hour	No restriction
m/m	meters per minute	No restriction
m/s	meters per second	No restriction

Table 18 - Absolute Viscosity Units

Unit	Description	Fluid Restriction
cPoise	centipoise	No restriction
PaSec	pascal seconds	No restriction

Table 19 - Heat Content Units

Unit	Description	Fluid Restriction
BTU/lb	British thermal units per pound	No restriction
J/kg	joules per kilogram	No restriction
KJ/kg	kilojoules per kilogram	No restriction
MCal/kg	megacalories per kilogram	No restriction

Table 20 - Energy Units

Unit	Description	Fluid Restriction
BTU	British thermal units[7]	No restriction
J	joules	No restriction
MCal	megacalories[8]	No restriction
MJ	megajoules	No restriction

Table 21 - Heat Flow Units

Unit	Description	Fluid Restriction
BTU/h	British thermal units per hour[7]	No restriction
J/s	joules per second	No restriction
MCal/h	megacalories per hour[8]	No restriction
MJ/h	megajoules per hour	No restriction

Table 22 - K-Factor Units

Unit	Description	Fluid Restriction
m3/p	cubic meters per pulse	No restriction
p/ft3	pulses per cubic foot	No restriction
p/l	pulses per liter	No restriction

Table 23 - Miscellaneous Units

Measurement	Unit	Description	Fluid Restriction
Frequency	Hz	hertz	No restriction
Pulse	Pulse	pulses	No restriction
Resistance	ohms	ohms	No restriction
Potential	Volt	volts	No restriction

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7.   1 BTU = 0.2519958 kcal.
8.   1 calorie = 4.184 joules.

FlowExpertPro™ Sizing Application

The FlowExpertPro application helps with flowmeter type selection as well as flowmeter sizing. In addition, the FlowExpertPro application offers:

- A large library of the physical properties of typical process fluids.
- Tabular and graphic presentation of results.
- Options to save, print, and email results.
- Access to applicable flowmeter PSS documents and related documentation.

The program calculates minimum and maximum flow rates, rangeability, pressure loss, and Reynolds Number, using established flow equations. It also allows for material and flange selection, and provides ANSI and DIN flange recommendations for predicted flow pressure and temperature.

You can access this tool at the free website *www.FlowExpertPro.com*, or on a mobile device with the iOS or Android operating system.

Website *www.FlowExpertPro.com*	App Store (Apple®)	Google Play™ Store (Android®)

Contact Global Customer Support for further information and technical support.

Physical Specifications

Process Wetted Materials

Parts	84CF	84CW	84CN
Body and Shedder Bar	Cast 316 ss (CF8M) or 304 ss	Cast 316 ss (CF8M) or nickel alloy[9] (CW2M)	Cast 316 ss (CF8M)
Flange or NPT Connection	316 ss or 304 ss	N/A	cast 316 ss (CF8M)
Sensor Seals	316 ss, 316 ss/grafoil, nickel alloy[9] (CW2M), or nickel alloy[9] (CW2M)/grafoil		

Housing Covers

A two compartment housing separates the electronics from the field connections. Housing and covers are low copper (0.6% maximum) die-cast aluminum alloy with an epoxy finish. O-ring seals are used to seal the housing covers, housing neck, and terminal block.

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9.   Equivalent to Hastelloy® C-4C. Hastelloy is a registered trademark of Haynes International, Inc.

Environmental Protection

The electronics housing has the dust tight and weatherproof rating of IP66 as defined by IEC 60529, and provides the environmental and corrosion resistant protection rating of NEMA 4X.

NACE Certification

The Model 84C flowmeters have been designed to meet the requirements of NACE Standard MR-0175-2003 for use in H_2S Sour Oilfield environments. The design and process wetted materials also comply with NACE Standard MR-0103-2007 for use in corrosive petroleum refining environments. A NACE compliance certificate is available by selecting model code option -Q option. See PSS 1-8A8 A and *Model Code, page 186* for more information.

Approximate Mass

The following tables list masses of different configurations of 84C flowmeters. The mass values shown are approximate and are meant as a guide.

Standard temperature flowmeter masses are listed for integrally mounted electronics housings. There is a slight difference in mass for high temperature flowmeters, which adds about 0.5 kg (1 lb), and for remote mounted housings (where the housing is replaced by a connector head assembly and junction box). The electronics housing itself weighs about 2 kg (4 lb) and varies slightly depending on whether the flowmeter is equipped with the indicator/configurator or the extended housing covers.

Table 24 - Approximate Mass of Model 84C Flanged Flowmeters

Nominal Line Size		Flange Specifications		Mass	
Model Code	Size	Type	Material	kg	lb
008	0.75 in	Class 150	316 ss	4.71	10.4
008	0.75 in	Class 1500	316 ss	8.75	19.3
010	1 in	Class 150	316 ss	5.53	12.2
010	1 in	Class 1500	316 ss	11.02	24.3
015	1.5 in	Class 150	316 ss	7.57	16.7
015	1.5 in	Class 1500	316 ss	15.65	34.5
020	2 in	Class 150	316 ss	9.48	20.9
020	2 in	Class 1500	316 ss	24.58	54.2
030	3 in	Class 150	316 ss	19.5	43
030	3 in	Class 1500	316 ss	49.76	109.7
040	4 in	Class 150	316 ss	21.05	46.4
040	4 in	Class 1500	316 ss	70.72	155.9
060	6 in	Class 150	316 ss	35.2	77.6
060	6 in	Class 600	316 ss	77.92	178.1
060	6 in	Class 1500	316 ss	161.93	357
080	8 in	Class 150	316 ss	57.74	127.3
080	8 in	Class 600	316 ss	131.26	289.4
080	8 in	Class 1500	316 ss	298.1	657.2
100	10 in	Class 150	304 ss	72.57	160
100	10 in	Class 600	304 ss	216	476.2
120	12 in	Class 150	304 ss	114.48	252.4

Table 24 - Approximate Mass of Model 84C Flanged Flowmeters (Continued)

Nominal Line Size		Flange Specifications		Mass	
Model Code	Size	Type	Material	kg	lb
120	12 in	Class 600	304 ss	245.12	540.4
008	DN15	PN40	316 ss	5.58	12.3
008	DN15	PN100	316 ss	7.35	16.2
010	DN25	PN40	316 ss	6.08	13.4
010	DN25	PN160	316 ss	8.66	19.1
015	DN40	PN40	316 ss	8.12	17.9
015	DN40	PN160	316 ss	12.79	28.2
020	DN50	PN40	316 ss	9.84	21.7
020	DN50	PN160	316 ss	17.42	38.4
030	DN80	PN40	316 ss	15.1	33.3
030	DN80	PN160	316 ss	26.58	58.6
040	DN100	PN40	316 ss	20.14	44.4
040	DN100	PN160	316 ss	36.83	81.2
060	DN150	PN16	316 ss	27.89	61.5
060	DN150	PN160	316 ss	88.81	195.8
080	DN200	PN16	316 ss	43	94.8
080	DN200	PN160	316 ss	161.79	356.7
100	DN250	PN16	304 ss	65.13	143.6
100	DN250	PN100	304 ss	191.23	421.6
120	DN300	PN16	304 ss	92.71	204.4
120	DN300	PN100	304 ss	280.32	618

Table 25 - Approximate Mass for Model 84C Wafer Flowmeters with 316 ss Body Material

Nominal Line Size			Mass	
Model Code	mm	in	kg	lb
008	DN15	0.75	2.3	5
010	DN25	1	2.7	6
015	DN40	1.5	3.2	7
020	DN50	2	4.5	10
030	DN80	3	8	18
040	DN100	4	11.5	25
060	DN150	6	16	35
080	DN2000	8	27	60

Table 26 - Approximate Mass for Model 84C NPT Flowmeters

Nominal Line Size			Weight	
Model Code	mm	in	kg	lb
010	DN25	1	2.7	6
020	DN50	2	4.5	10

Maximum Working Pressure

The maximum working pressure (MWP) of the flowmeter at 38°C (100°F) is shown on the data label.

Flanged Body Flowmeters

The MWP at various temperatures for a flanged body flowmeter is shown in the following graphs. To identify the applicable chart, refer to the model code printed on the data label for the nominal line size, flange material, and end connection type (flange rating):

84CF020-TPR F1...

END CONNECTIONS
(F1=ANSI Class 150)

BODY AND FLANGE MATERIAL
(R=316 ss Flanges for 2" Line Size)

NOMINAL LINE SIZE
(020=2 inches)
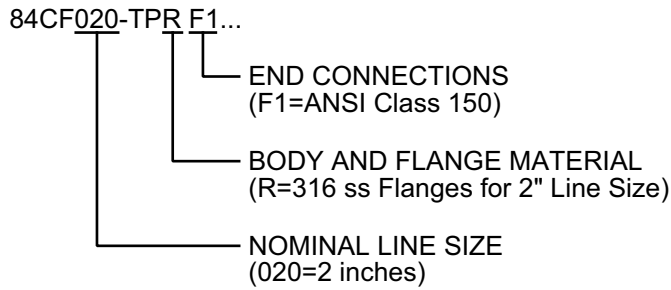
Refer to *Model Code, page 186* for an explanation of these codes.

Figure 3 - Pressure Ratings for Welded 316 ss ANSI Flanges, Line Sizes 008 to 040 (3/4 to 4 Inches), per ASME B16.5, Group 2.2 Materials
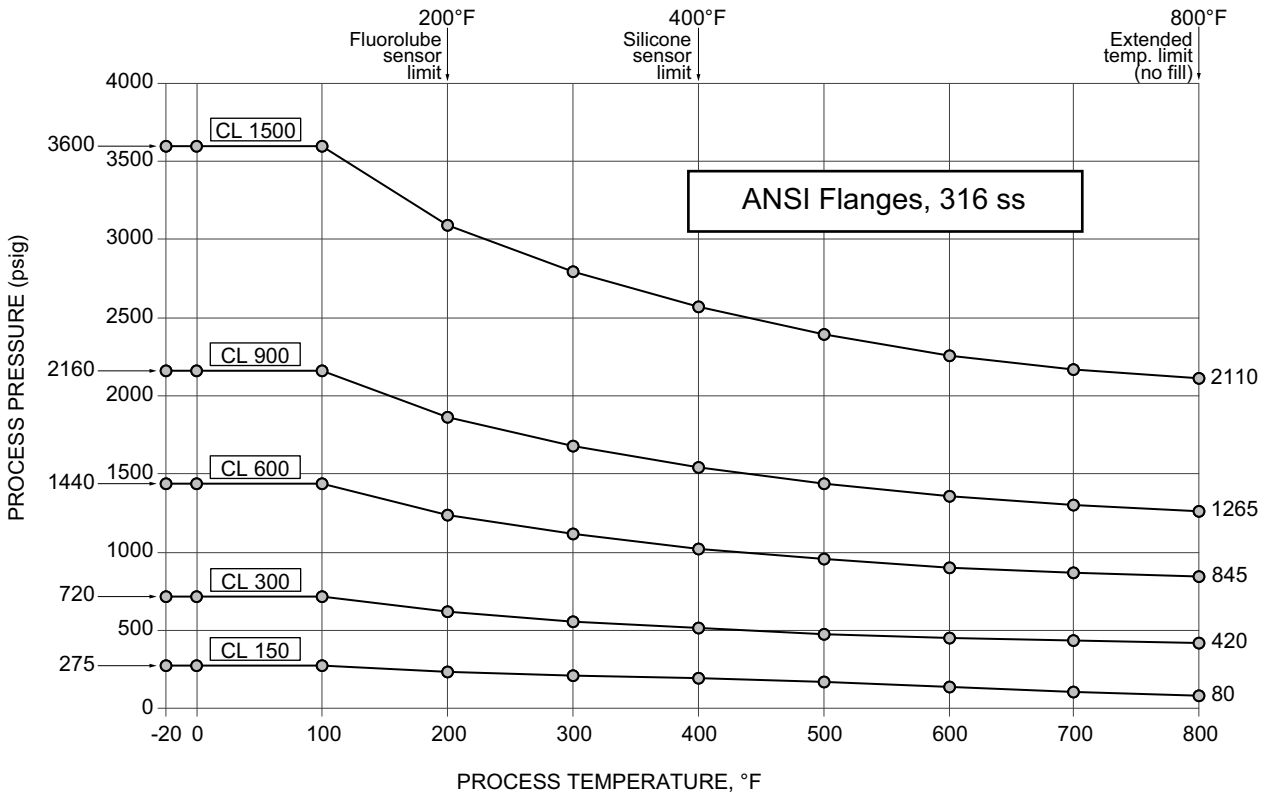
Figure 4 - Pressure Ratings for Welded 304 ss ANSI Flanges, Line Sizes 060 to 120 (6 to 12 inches), per ASME B16.5, Group 2.1 Materials
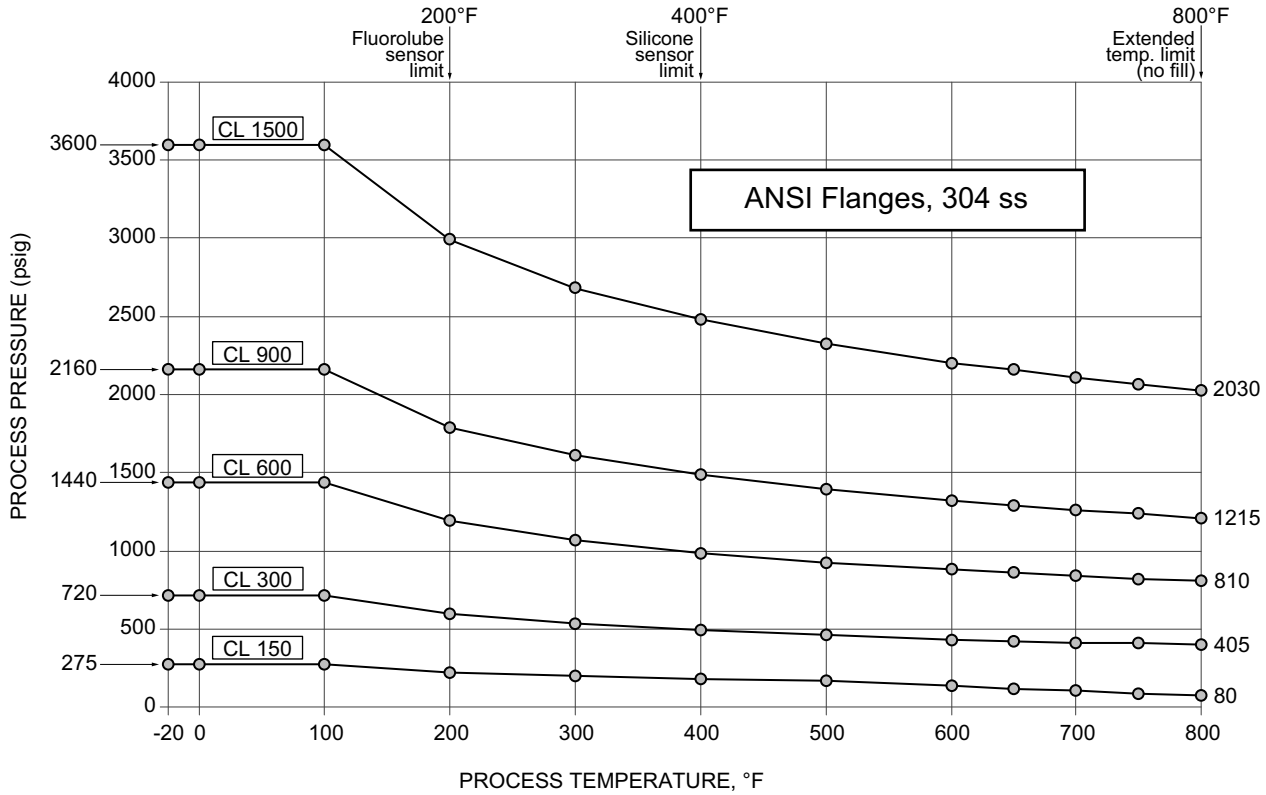
Figure 5 - Pressure Ratings for Welded 316 ss Metric Flanges, Line Sizes 008 to 040 (DN15 to DN100), per EN 1092-1, Material Group 14E0
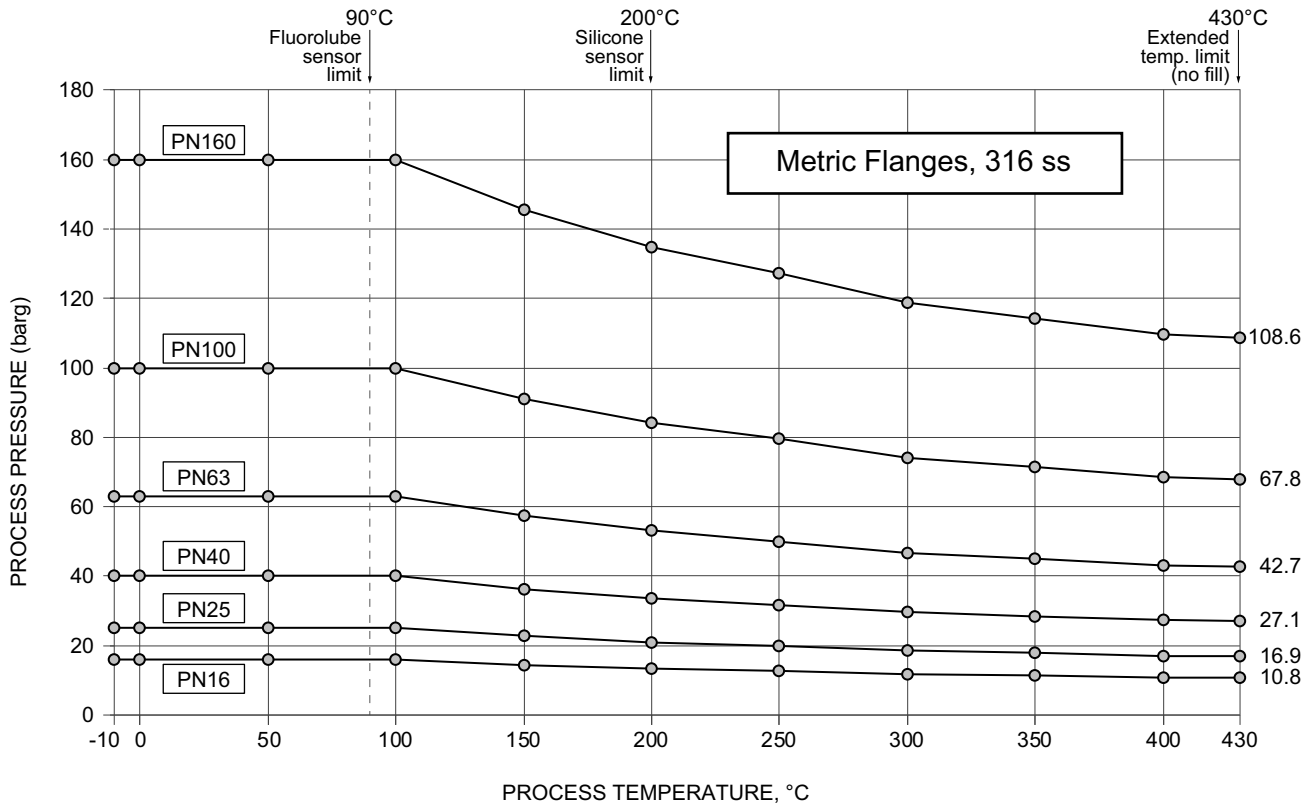
Figure 6 - Pressure Ratings for Welded 304 ss Metric Flanges, Line Sizes 060 to 120 (DN150 to DN300), per EN 1092-1, Material Group 10E0
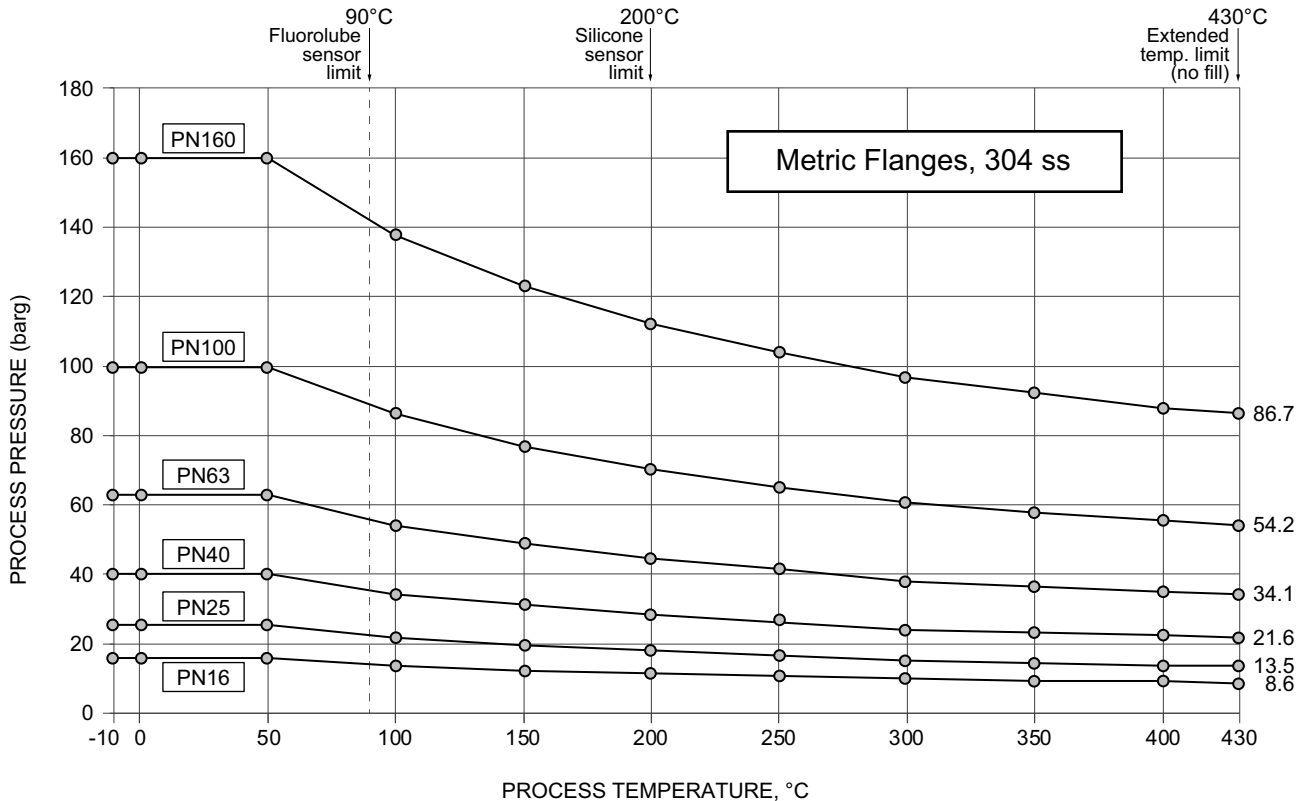
Wafer Body Flowmeters

The wafers are designed for a maximum PN100 (ANSI Class 600) working pressure.

NPT Flowmeters

For line size code 010, the pressure rating is comparable ANSI Class 1500.

For line size code 020, the pressure rating is comparable to ANSI Class 900.

Electrical Certifications

These flowmeters have been designed to meet the electrical safety descriptions listed in the following table. For detailed information or status of testing laboratory approvals/certifications, contact Global Customer Support.

- Refer to MI 019-177 for FM and CSA connection diagrams.
- Refer to MI 019-179 for ATEX and IECEx information.

   NOTE: For Electronics Version -T with and intrinsically safe approvals and certifications with a 24 V dc supply, an active barrier is required.

Table 27 - Electrical Certifications

Agency Certification, Types of Protection, and Area Classification	Application Conditions	Model Code Option
ATEX Intrinsically Safe: II 1G; II 2D; Ex ia IIC T4 Ga **ATEX Dust Ignition Protection**: Ex tb IIIC T103°C Db	Sira 06ATEX2067X Temperature Class T4; Ta = -40° to +80°C	AA
ATEX Flameproof Integral Electronics: II 2/1 (1) G; II 2D; Ex db [ia Ga] ia IIC T4 Gb Remote Electronics: II 2 (1) G; II 2D; Ex db [ia Ga] IIC T4 Gb **ATEX Dust Ignition Protection**: Ex tb IIIC T85°C Db	Sira 06ATEX2067X Temperature Class T4; Ta = -20° to +80°C	AD
INMETRO Intrinsically Safe: Ex ia IIC T4 Ga **INMETRO Dust Ignition Protection**: Ex tb IIIC T103°C Db	Temperature Class: -40°C ≤ Ta ≤ +80°C	BA
INMETRO Flameproof Integral Electronics: Ex d [ia Ga] IIC T4 Gb Remote Electronics: Ex d [ia Ga] IIC T4 Gb **INMETRO Dust Ignition Protection**: Ex tb IIIC T85°C Db	Temperature Class: -20°C ≤ Ta ≤ +80°C	BD
CSA Intrinsically Safe for Class I, II, III, Div. 1, Groups A, B, C, D, E, F, and G; Also Zone certified intrinsically safe Ex ia IIC T4; IP66, Type 4X; Dual Seal	Temperature Class T4; Ta = -40° to +80°C	CA
CSA Explosionproof with IS sensor connection for Class I, Div. 1, Groups B, C, and D; **CSA Dust-Ignitionproof** for Class II, Div. 1, Groups E, F, and G; Class III Div. 1; Also Zone certified Ex d [ia] IIC T5; Dual Seal	Temperature Class T5; Ta = 60°C (divisions) Temperature Class T5; Ta = -40° to +80°C (zones)	CD
CSA Division 2: Class I, Div. 2, Groups A, B, C, and D; Class II, Div. 2, Groups F and G; Class III, Div. 2; Type 4X; Dual Seal	Temperature Class T4; Ta = 80°C	CN
IECEx Intrinsically Safe: Ex ia IIC T4 Ga **IECEx Dust Ignition Protection**: Ex tb IIIC T103°C Db	Temperature Class T4; Ta = -40° to +80°C	EA
IECEx Flameproof Integral Electronics: Ex db [ia Ga] ia IIC T4 Gb Remote Electronics: Ex db [ia Ga] IIC T4 Gb **IECEx Dust Ignition Protection**: Ex tb IIIC T85°C Db	Temperature Class T4; Ta = -20° to +80°C	ED
FM Intrinsically Safe: Class I, II, III, Div. 1, Groups A, B, C, D, E, F, G; Also Zone approved AEx ia IIC T4	Temperature Class T4; Ta = 80°C	FA
FM Explosionproof with IS sensor connection for Class I, Div.1, Groups B, C, and D; **FM Dust-Ignitionproof** for Class II, Div. 1, Groups E, F, and G; Class III, Div. 1; T5	Temperature Class T5; Ta = 85°C	FD
FM Nonincendive: Class I, Div. 2, Groups A, B, C, and D; Class II, Div. 2, Groups F and G; Class III, Div. 2; T4	Temperature Class T4; Ta = 80°C	FN
KOSHA Flameproof Integral Electronics: Ex d [ia] ia IIC T4 Gb Remote Electronics: Ex d [ia] IIC T4 Gb	Temperature Class T4; Ta = -20° to +80°C	KD
NEPSI Intrinsically Safe: Ex ia IIC T4 Ga **NEPSI Dust Ignition Protection**: Ex tD A21 IP66 T103°C	Temperature Class T4; Ta = -40° to +80°C	NA
NEPSI Flameproof Integral Electronics: Ex d ia IIC T4 Gb Remote Electronics: Ex d [ia Ga] IIC T4 Gb **NEPSI Dust Ignition Protection**: Ex tD A21 IP66 T85°C	Temperature Class T4; Ta = -20° to +80°C	ND
EAC Intrinsically Safe: 0Ex ia IIC T4 Ga X **EAC Dust Ignition Protection**: Ex tb IIIC T103°C Db X	Temperature Class: -40°C ≤ Ta ≤ +80°C	RA
EAC Flameproof Integral Electronics – 1Ex d [ia Ga] ia IIC T4 Gb X Remote Electronics – 1Ex d [ia Ga] IIC T4 Gb X **EAC Dust Ignition Protection**: Ex tb IIIC T85°C Db X	Temperature Class: -20°C ≤ Ta ≤ +80°C	RD
CE mark only; PED controls and records	n/a	YY
No CE mark; do not install in European Union countries	n/a	ZZ

Installation

Process Fluid Warnings

⚠ WARNING

HAZARD OF ESCAPING CHEMICALS

If process containing parts are to be disassembled:

• Make sure that process fluid is not under pressure or at high temperature.

• Take proper precautions concerning leakage or spillage of any toxic or otherwise dangerous fluid. Follow any Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) recommendations.

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

⚠ WARNING

HAZARD OF CORROSION

The flowmeters are built using materials that are corrosion resistant to a wide variety of fluids. However, with aggressive fluids, a potential exists for corrosive failure. Therefore, verify the material compatibility with the NACE guidelines and/or user knowledge of the flowmeter material compatibility with the process fluid at operating conditions.

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

⚠ CAUTION

RISK OF PERSONAL AND PROPERTY DAMAGE

These flowmeters must be installed by trained personnel to meet all applicable local installation regulations, such as hazardous location requirements, electrical wiring codes, and mechanical piping codes.

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

Unpacking

Your flowmeter is built to be durable, but it is part of a calibrated precision system and should be handled as such.

• Flowmeters with remote-mounted electronics have a cable connecting the flowmeter junction box and electronics housing. Do not allow the weight of either the flowmeter body or the electronics housing to be supported by the remote cable.

• Avoid dropping or otherwise subjecting the flowmeter to impact, particularly at the flange faces.

• Never put anything through the flowmeter body for lifting purposes, as damage to the shedder bar may occur.

To unpack the flowmeter:

1. Carefully remove the flowmeter body from the shipping carton.

NOTE: Wafer body meters may (depending on the pressure rating of the flanges with which they used) have a set of centering spacers included. Do not discard the spacers. They are needed to install the flowmeter properly.

2. Inspect the flowmeter for visible damage. If you see any damage, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier.

3. Remove the calibration certificate and any other documentation shipped with the meter, and keep it for future reference.

4. Reinstall any flange covers or protective material to safeguard the meter until it is installed.

5. Dispose of packing material in accordance with local regulations. All packing material is nonhazardous and generally acceptable for landfills.

Flowmeter Identification

Before installing your flowmeter, check its data plate to verify 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 *Sample Flowmeter Dataplate, page 31* and can also be viewed from the **Configuration** menu. On flowmeters with remotely mounted electronics, an additional data plate on the flowtube junction box (see *Sample Junction Box Data Plate, page 31*) shows the Model Code and electrical safety data. For interpretation of the Model Code, see *Model Code, page 186*.

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

To view the flowmeter's software version on the display, navigate to the **Status** menu and select **2 SW Rev**.

Figure 7 - Sample Flowmeter Dataplate
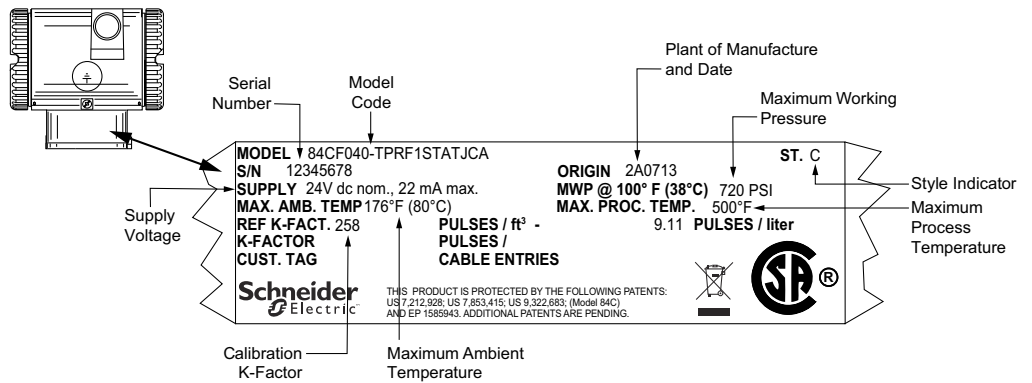
Figure 8 - Sample Junction Box Data Plate
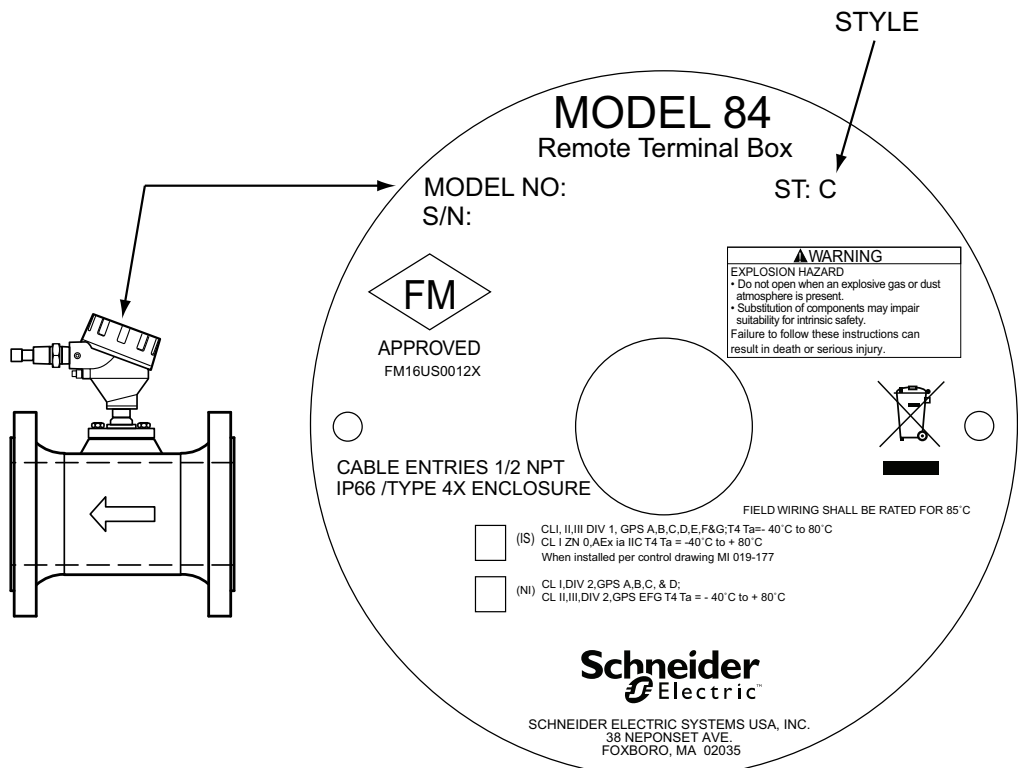
Piping

Hydrostatic Piping Testing

The Model 84C Vortex Flowmeter is designed to meet the pressure limits of the flange rating specified in the model code.

84CF∗∗∗-∗∗∗xy

└─ END CONNECTION AND FLANGE RATING

If your flowmeter is being installed in an application where hydrostatic testing is performed, do not remove the sensor from the flowmeter.

Effects of Piping on Flowmeter Performance

Flanges

The flange of the adjoining pipe must be the same nominal size and pressure rating as the flowmeter. Flanges with a smooth bore, similar to weld neck flanges, are preferred.

Mating Pipe

Your flowmeter was calibrated at the factory with Schedule 40 piping upstream and downstream of the meter. If your application does not have Schedule 40 pipe, enter the appropriate pipe size during configuration. This assures that the calibration factor and flowmeter accuracy are maintained.

High-pressure meters (Class 900 and PN160 for 6- and 8-inch line sizes and Class 1500 for line sizes greater than 2 inches) were calibrated using Schedule 160 because the meter bore is also Schedule 160.

Upstream and Downstream Disturbances

The flowmeter should normally be mounted in a straight, unobstructed pipe with a minimum of 30 pipe diameters upstream of the meter and five pipe diameters downstream. For those installations where this upstream requirement is not met, the type of disturbance must be selected from a pick list during configuration and the distance to the disturbance in pipe diameters entered. This assures that the flowmeter accuracy is maintained.

Piping Alignment

The bores of the pipe (flange) and flowmeter must be aligned (see *Installing the Flowmeter Body, page 40*), and the flange gaskets installed such that they do not protrude into the flow stream. If the adjoining piping cannot be properly aligned, make the best possible alignment with the upstream flange. This minimizes the flow disturbance in the flowmeter.

Flowmeters mounted near pump discharge or suction lines may be exposed to oscillatory flow that may affect vortex shedding or product pipe vibration. Also, flowmeters mounted near the discharge of a liquid positive displacement pump or near oscillating control valves may experience severe flow fluctuations that could damage the sensor. To avoid these adverse situations, install the meter at least 20 feet or 40 pipe diameters, whichever is larger, from the disturbance in question.

Good piping practice requires that the internal surface of the pipe be free from mill scale, pits, holes, reaming scores, rifling, bumps, or other irregularities for at least four pipe diameters upstream and two pipe diameters downstream of the meter.

Process Temperature

Your flowmeter was calibrated at 21°C (70°F). If your process temperature is different and the flowmeter does not have temperature compensation (Multivariable Selection N), enter the appropriate process operating temperature during configuration.

However, if the flowmeter does have temperature compensation (Multivariable Selection T), the temperature sensor in the flowmeter measures the actual temperature of the process material flowing through the meter. Your flowmeter adjusts the calibration factor to account for thermal expansion of the metals due to process temperatures that are different from the reference calibration temperature.

Pipe Position

Piping should be planned to maintain full pipe conditions at the flowmeter. When flow is moving with gravity, elevate the downstream pipe length above the meter installation level to maintain a full pipeline.

Mounting Position

For optimal performance, consider the mounting locations of the sensor and integral electronics relative to the piping. Factors that influence this decision include process fluid type, ambient temperature, and vibration. Mount the meter in accordance with the installation guidelines for process fluids described in *Process Fluids, page 33*. Also see *Recommended Mounting Arrangements, page 38*.

Process Fluids

Liquid Installations

For liquid flow installations, mount the meter upstream at least five pipe diameters from the control valve. In vertical installations, the meter should be mounted in the upward flowing leg. This helps to maintain a full pipe and helps to ensure that there is sufficient back pressure to prevent flashing or cavitation.

For liquid installations with occasional gas pockets or bubble formation, install piping as shown so as to not trap the gas pockets or bubbles inside the flowmeter.

Figure 9 - Piping Arrangements[10]
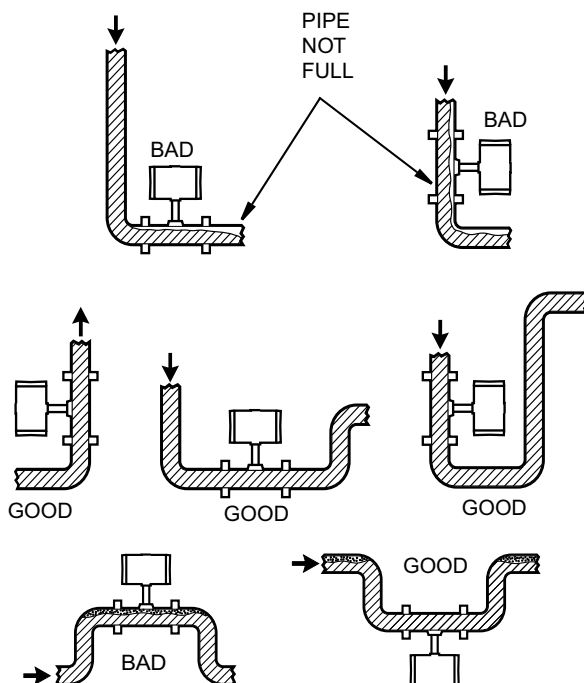
- For clean liquids, the electronics housing can be mounted either above or below the flowmeter body.
- The electronics housing can also be positioned to the side. This allows entrapped air to escape.
- Take care that entrapped air does not accumulate in the sensor cavity.
- If the meter is used with liquid, mount it upstream of a control valve.

Gas Installations

For gas flow installations, several choices for flowmeter location can be considered. For maximum rangeability, locate the flowmeter 30 or more pipe diameters downstream from a control valve. This ensures maximum velocity at the flowmeter and produces the most efficient signal from the sensor. This is especially recommended when several flowmeters/control valves are coming off a common header or pipe.

When the flow is more stable, the flowmeter can be mounted a minimum of five (5) pipe diameters upstream of the control valve. Pressure fluctuations often are lower on the upstream side of a control valve flow than on the downstream side. This is recommended when a pressure sensor is used with a flowmeter to provide inputs to a flow computer.

On gas flow installations, avoid piping conditions that create standing pockets of liquids inside the meter. The best approach is to install the meter in a vertical line with flow in the upwards direction.

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10.   Not drawn to scale.

NOTICE

WATER HAMMER FROM TRAPPED CONDENSATE

Trapped condensate can cause a "water hammer" during startup. If you cannot drain the condensate, open the valve slowly, allowing any trapped condensate to travel downstream through the flowmeter at low velocity so that no damage occurs.

Failure to follow these instructions can result in equipment damage.

Figure 10 - Piping for Gas Applications[11]
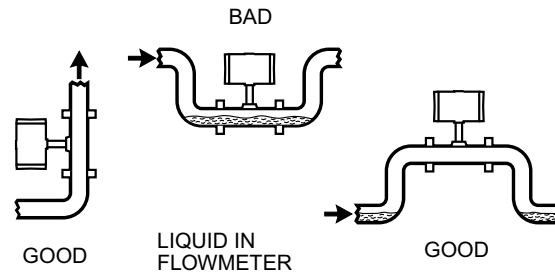
When the process fluid is gas, the electronics housing can be above or below the flowmeter body. The normal recommended position of the electronics housing is above the flowmeter body.

Steam Installations

For steam control installations, mount the flowmeter 30 pipe diameters or more downstream of the control valve. This is particularly useful when measuring saturated steam to help ensure that a minimum amount of condensate is present at the flowmeter.

NOTICE

WATER HAMMER FROM TRAPPED CONDENSATE

Trapped condensate can cause a "water hammer" during startup. If you cannot drain the condensate, open the valve slowly, allowing any trapped condensate to travel downstream through the flowmeter at low velocity so that no damage occurs.

Failure to follow these instructions can result in equipment damage.

Saturated Steam

When the process fluid is saturated steam, the electronics housing should be below the flowmeter body, so that the sensor cavity remains filled when condensate is present. Filling the sensor cavity with condensate results in a less noisy measurement caused by any flashing occurring in the flowmeter due to pressure drop.

Insulate your meter as described in *Insulation, page 36*.

Figure 11 - Piping for Saturated Steam Application

SATURATED STEAM

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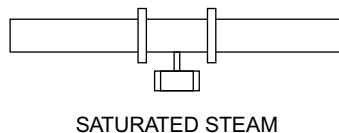
11. Not drawn to scale.

Superheated Steam

When the process fluid is superheated steam, the electronics housing can be either above or below the flowmeter body. The flowmeter should be insulated to maintain superheated conditions inside the flowmeter as well as insulating the electronics from heat. Assure that the electronics temperature does not exceed 80°C (176°F) under all flow and environmental conditions.

Insulate your meter as described in *Insulation, page 36*.

Insulation

The flowtube may be insulated up to the interface between the bonnet pad and the bonnet. No insulation is allowed beyond the bonnet pad. It is particularly important to insulate the flowtube on applications for saturated and superheated steam.

Figure 12 - Insulation
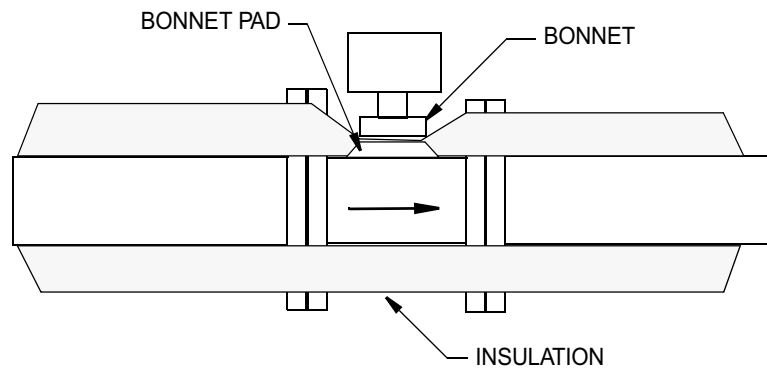
Vibration

The vortex shedder axis should be oriented to reduce or, if possible, virtually eliminate vibration influence. Position the flowmeter so that the sensor axis is perpendicular to the direction of the vibration.

Figure 13 - Sensor Mounting to Minimize the Effect of Vibration
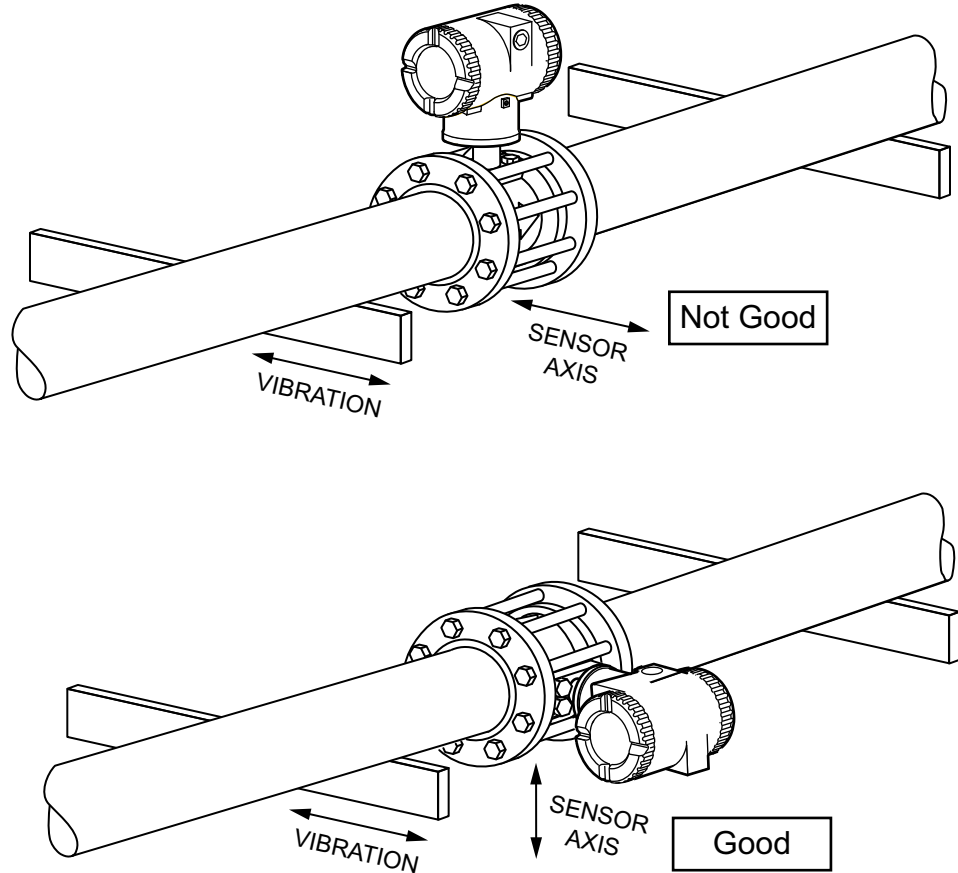
Ambient Temperature Limitations and Considerations

The temperature limits of the electronics housing are -20 and +80°C (0 and 176°F) with an optional display, or -40 and +80°C (-40 and +176°F) without the optional display. When installing the flowmeter, consider ambient temperature and proximity to other heat sources. For extended high temperature applications, this may require positioning the electronics housing to the side or bottom, and/or insulating pipes to ensure that the temperature limit is not exceeded. The maximum temperature rating of 80°C (176°F) is a requirement for many agency certifications.[12]
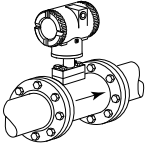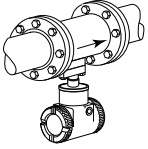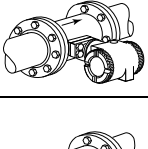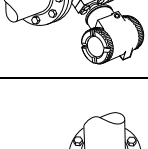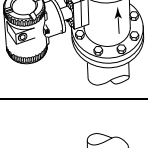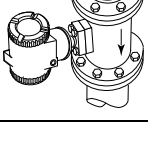
In installations where these agency certifications do not apply and ambient temperature limitations are not achievable, remotely mounting the electronics in a lower temperature area is recommended. In this configuration, only the preamplifier — which is rated for a maximum temperature of 105°C (221°F) — is near the flowmeter.

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12. The 80°C (176°C) temperature is extended to 85°C (185°F) with certain electrical certifications. Refer to *Electrical Certifications, page 27*.

Recommended Mounting Arrangements

The diagrams in the following table show flanged connections; however, these mounting arrangements apply to other connection types as well.

Table 28 - Mounting Arrangements

Flowmeter Orientation for:		Liquid	Gas	Saturated Steam	Superheated Steam
	Housing above pipe	Yes[13]	Yes	No	Yes[14]
	Housing below pipe	Yes[15] [16]	Yes[16]	Yes[14]	Yes[14]
	Housing to side of pipe	Yes	Yes	No	Yes[14]
	Housing to side and below pipe	Yes	Yes	No	Yes[14]
	Vertical pipe, upward flow	Yes	Yes	No	Yes[14]
	Vertical pipe, downward flow	Yes[17]	Yes	No	Yes[14]

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13. Possibility of temporary startup error due to trapped air.
14. Requires adequate insulation.
15. Best choice when errors due to startup cannot be tolerated.
16. Recommended only for clean fluids.
17. Not preferred; must maintain full pipe with no voids in fluid.

Meter Servicing

When you install the meter, consider meter repair. The meter should be accessible for servicing. For installations where the flow cannot be interrupted, depressurized, or drained, a flowmeter with an isolation valve is required.

Common practice is to install bypass piping so that the entire meter can be removed for servicing (see *Typical Piping Configuration, page 39*).

Figure 14 - Typical Piping Configuration
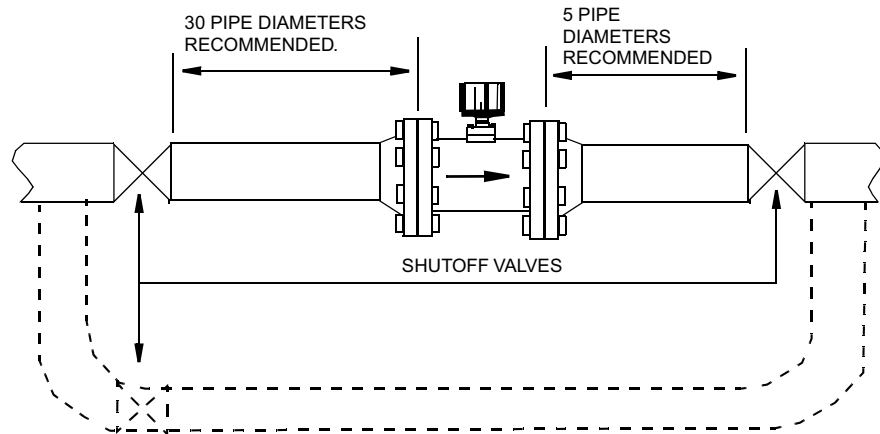
Location of Pressure and Temperature Taps

The inside of the pipe at the pressure and temperature taps must be free of burrs and obstructions.

Figure 15 - Pressure and Temperature Tap Locations
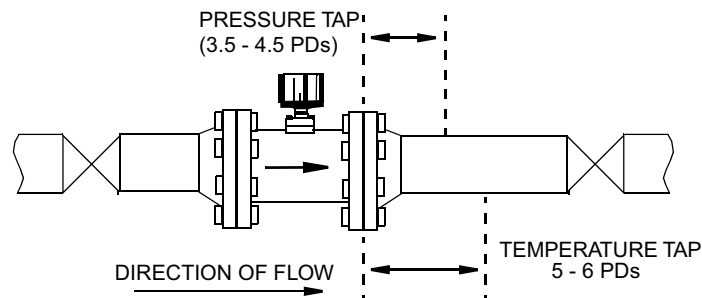
Pressure Taps

For density measurement (when required), locate the tap 3-1/2 to 4-1/2 pipe diameters downstream of the flowmeter. See *Pressure and Temperature Tap Locations, page 39*.

- On a gas flow installation, the pressure tap should be located on the top of the pipe.

- On a liquid installation, the pressure tap (if required) should be located on the side of the pipe.

- On a steam installation, the pressure tap should be located on the top when the pressure measuring device (typically a pressure transmitter) is above the pipeline, and on the side when the measuring device is below the pipeline.

- With vertical piping, the pressure tap can be located anywhere around the circumference of the pipeline.

Temperature Taps

For temperature measurement (when required), locate the tap 5 to 6 pipe diameters downstream of the flowmeter. To reduce flow disturbance, use the smallest possible probe. See *Pressure and Temperature Tap Locations, page 39*.

NOTE: With Multivariable Selection T, the flowmeter offers an integrated temperature measurement.

Installing the Flowmeter Body

If the electronics are mounted remotely, mount the flowmeter body so that the junction box is serviceable.

The arrow on the body of the flowmeter indicates the direction of the flow. When installing the flowmeter, be sure the arrow on the flowmeter points in the direction of the flow.

NOTE: Ground the flowmeter housing for proper operation and peak performance.

Flanged Body (84CF)

Figure 16 - Flanged Flowmeter Installation

GASKET
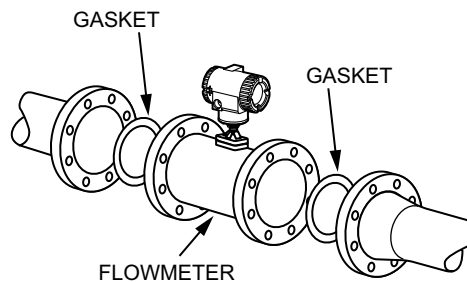
GASKET

FLOWMETER

NOTE: The arrow on the flowmeter body must point in the direction of the flow.

1. Insert gaskets between the body of the flowmeter and the adjacent flanges. Position the gaskets so that the inside diameter of each gasket is centered on the inside diameter of the flowmeter and adjacent piping.

   • User-supplied gaskets are required. Select a gasket material suitable for the process fluid.

   • Gaskets do not prevent flanges from being wetted by process fluids.

   • If you are welding flanges to the process piping, protect the inside of the flowmeter from weld splatter, which can affect flowmeter accuracy. Install a solid sheet of gasketing at each end of the meter during welding. After welding, remove this sheet and install the flange gaskets.

NOTICE
REDUCED PERFORMANCE
Verify that the internal diameter of the gaskets is larger than that of the flowtube bore and pipe. Also verify that the gaskets do not protrude into the meter entrance or exit. Protrusion into the flowstream has an adverse effect on performance.
Failure to follow these instructions can result in reduced performance.

2. Visually inspect the centering and alignment of the mating flanges.

3. Install the bolts. Tighten in accordance with conventional flange bolt tightening practice (that is, incremental and alternate tightening of bolts).

Wafer Body (84CW)

For optimal performance, the wafer body flowmeter should be centered with respect to the adjoining pipe. Normally, this requires the use of centering fixtures that are supplied with the meter.

Centering fixtures are not required with ANSI Class 150 flanges.

Figure 17 - Centering a Wafer Flowmeter with Spacers
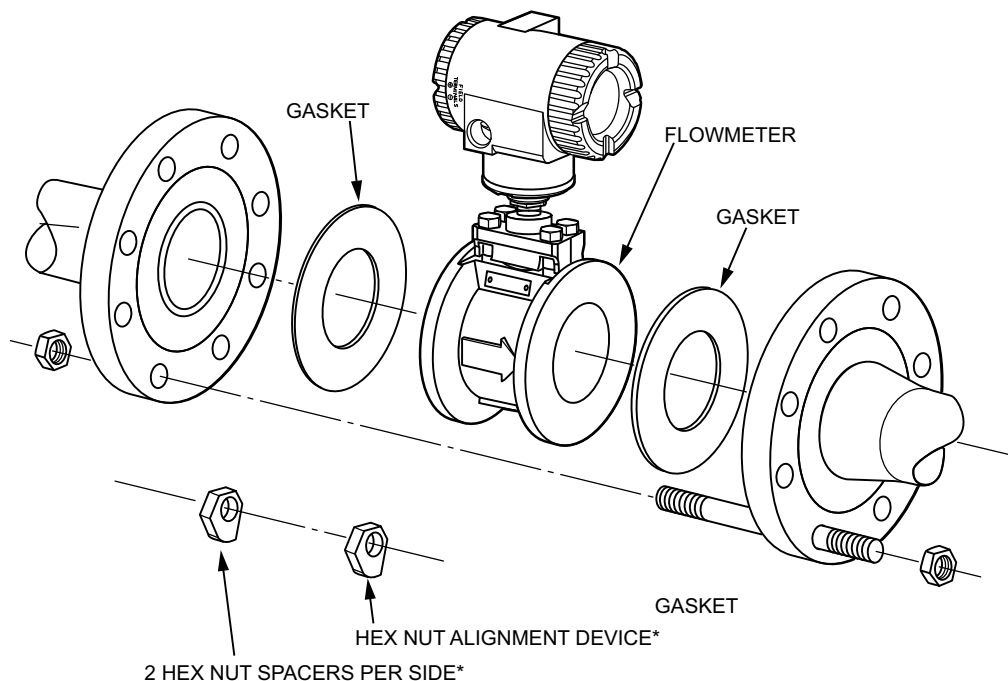
* Not required with ANSI Class 150 Flanges; the flowmeter is centered by the bolts alone.

NOTE: The arrow on the flowmeter body must point in the direction of the flow.

1. See *Centering a Wafer Flowmeter with Spacers, page 42*. Insert the first stud through the downstream flange at one of the lower holes, through the two hex-nut spacers, and then through the upstream flange. Place the nuts on both ends of the stud, but do not tighten.

   Using the remaining hex-nut spacers, repeat this step at the lower hole next to the first.

2. Set the flowmeter between the flanges. Then, rotate spacers to the thickness that centers the meter.

   By rotating the hex-nut spacers to the correct thickness, you can center the meter to any type of flange.

3. Insert gaskets between the body of the flowmeter and the adjacent flanges. Position the gaskets so that the inside diameter of each gasket is centered on the inside diameter of the flowmeter and adjacent piping.

    •   User-supplied gaskets are required. Select a gasket material suitable for the process fluid.

    •   Gaskets do not prevent flanges from being wetted by process fluids.

    •   If you are welding flanges to the process piping, protect the inside of the flowmeter from weld splatter, which can affect flowmeter accuracy. Install a solid sheet of gasketing at each end of the meter during welding. After welding, remove this sheet and install the flange gaskets.

NOTICE

REDUCED PERFORMANCE

Verify that the internal diameter of the gaskets is larger than that of the flowtube bore and pipe. Also verify that the gaskets do not protrude into the meter entrance or exit. Protrusion into the flowstream has an adverse effect on performance.

Failure to follow these instructions can result in reduced performance.

---

4. Visually inspect the centering and alignment of the mating flanges.

    If the adjoining flanges are misaligned, align the wafer body flowmeter with the upstream flange.

5. Install the rest of the studs and nuts. Tighten in accordance with conventional flange bolt tightening practice (that is, incremental and alternate tightening of bolts).

NPT Body (84CN)

1. Apply process-compatible thread sealant to the flowtube's threaded end connection.

2. Secure the threaded pipe adapter to the flowtube's threaded end connection.

3. Secure the pipeline end of the adapter to the pipeline.

Mounting the Remote Electronics Housing

The remote electronics housing allows for separation of the flowmeter body from the electronics.

A flowmeter with remote electronics consists of:

•   An electronics housing mounted to a pipe or wall mounting bracket with up to 15 m (50 ft) of interconnecting cable attached.

•   A flowmeter body with a junction box.

1/2 NPT or M20 conduit connections are provided on both the housing and the junction box.

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 the diagram.

Figure 18 - Mounting the Remote Electronics Housing
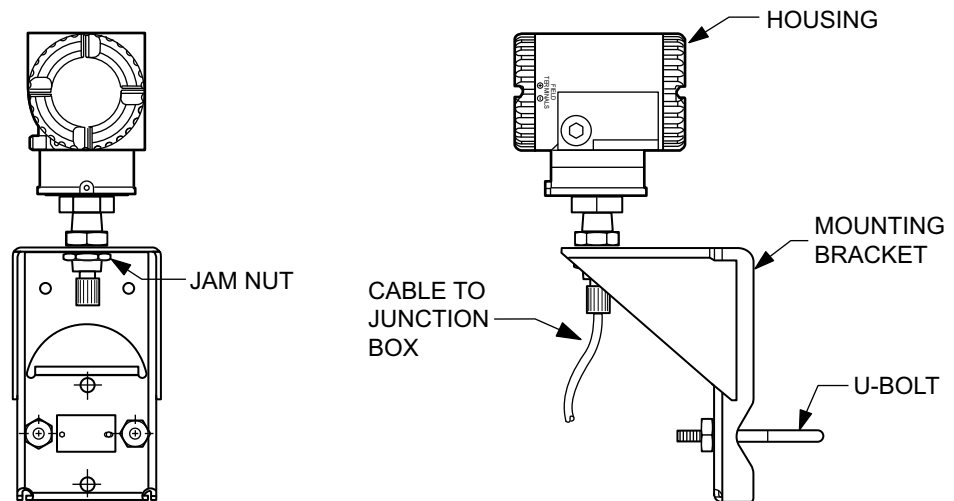
Surface Mounting

NOTE: Ground the flowmeter housing for proper operation and peak performance.

The housing can be surface mounted by securing the mounting bracket to a wall using the bracket 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. Place the housing in the bracket.

5. Tighten the jam nut under the bracket.

Cover Locks

Electronic housing cover locks are provided as standard with certain agency certifications.

To lock the covers:

1. 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.

2. Insert the seal wire through the two holes, slide the seal onto the wire ends, and crimp the seal.

Figure 19 - Cover Locks
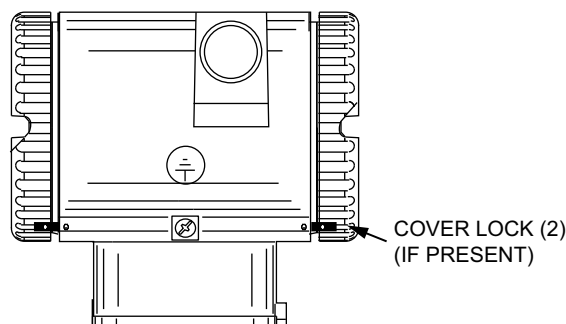
Positioning the Display

You can rotate the optional display 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.

NOTICE
POTENTIAL CABLE DAMAGE
• Do not turn the display more than 180° in either direction. Doing so can damage its connecting cable.
• Carefully fold the ribbon cable in the space between the display and the electronics module so that it is not pinched. The display molding should rest firmly against the module molding before you tighten the screws.
Failure to follow these instructions can result in equipment damage.

Setting the Write Protect Jumper

Your flowmeter has write protection capability which meets the 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.

NOTE: Even when the flowmeter is write-enabled, you can limit writing to certain functions by setting passwords. See *Using Passwords, page 97*.

To activate write protection:

1. Remove the display.
2. Remove the jumper.
3. Place the jumper in the "protect" position. Refer to the diagram.

   NOTE: Removing the jumper activates write protection. The "protect" position is simply a place to store the jumper when it is not in use.

4. To cancel write protection and enable writing, return the jumper to the "write" position.

Figure 20 - Write Protect Jumper
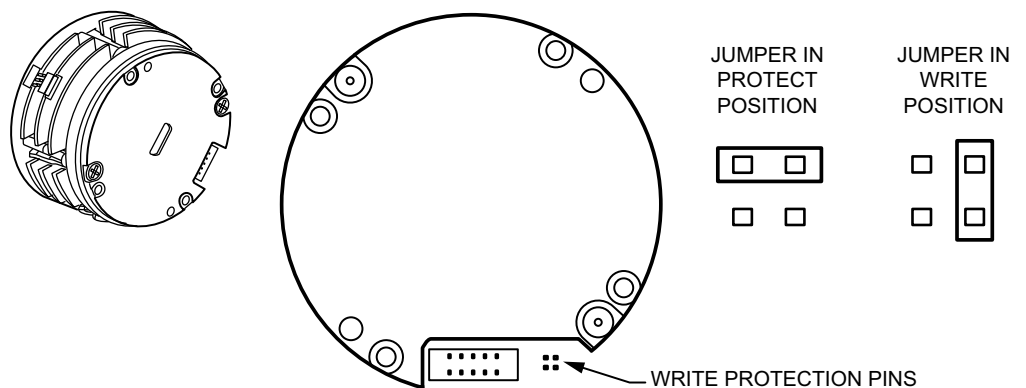
Positioning the Housing

You can rotate the flowmeter housing up to one full turn in the counterclockwise direction (when viewed from above) for optimal access to adjustments, display, and conduit connections. The housing has a retention clip that prevents rotating the housing beyond a safe depth of housing/sensor thread engagement.

Figure 21 - Housing Retention Clip Location
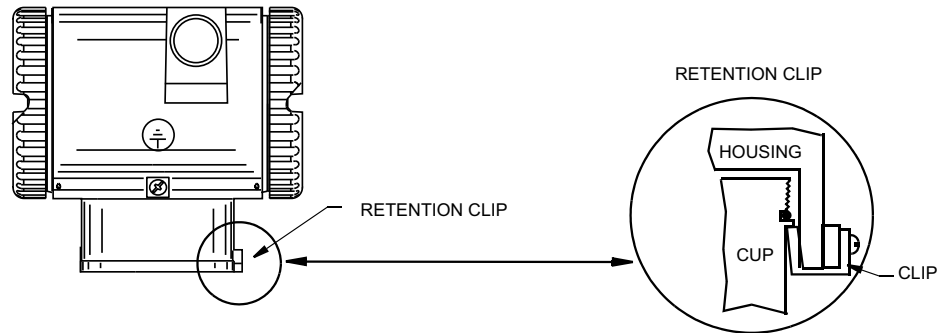
Electrical Installation

Field Termination Wiring

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

NOTICE
HAZARD OF ELECTRICAL TRANSIENT OR SURGE
Use transient/surge protection in installations prone to unusually high levels of electrical transients and surges.
Failure to follow these instructions can result in equipment damage.

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. Use the correct threaded devices when making these connections. You can verify the type of thread with the ninth character after the dash in the model code on the data plate. The letters T or R indicate a 1/2 NPT thread; V or W, an M20 thread. Refer to "Mounting and Conduit Openings for Electronics Housing" in *Model Code, page 186*.

The housing comes with an agency-approved threaded metal plug in one of the conduit holes and a plastic plug in the other. After you connect the conduit or cable gland, plug the unused hole with the metal plug.

> # ⚠⚠ WARNING
>
> **EXPLOSION HAZARD**
>
> To help prevent explosions and to maintain flameproof, explosionproof, and dust-ignitionproof protection, observe applicable wiring practices. Plug the unused conduit openings with approved conduit plugs. Both plug and conduit must engage a minimum of five full threads for 1/2NPT connections; seven full threads for M20 connections.
>
> **Failure to follow these instructions can result in death or serious injury.**

Accessing Flowmeter Field Terminals

For access to the field terminals, remove the cover from the field terminals compartment.

Figure 22 - Accessing Field Terminals

1/2 NPT OR M20 CONDUIT CONNECTION FOR CUSTOMER WIRING. ONE ON OPPOSITE SIDE ALSO. PLUG UNUSED OPENING WITH THE METAL PLUG PROVIDED OR EQUIVALENT.

REMOVE COVER TO ACCESS WIRING TERMINALS

EXTERNAL GROUND
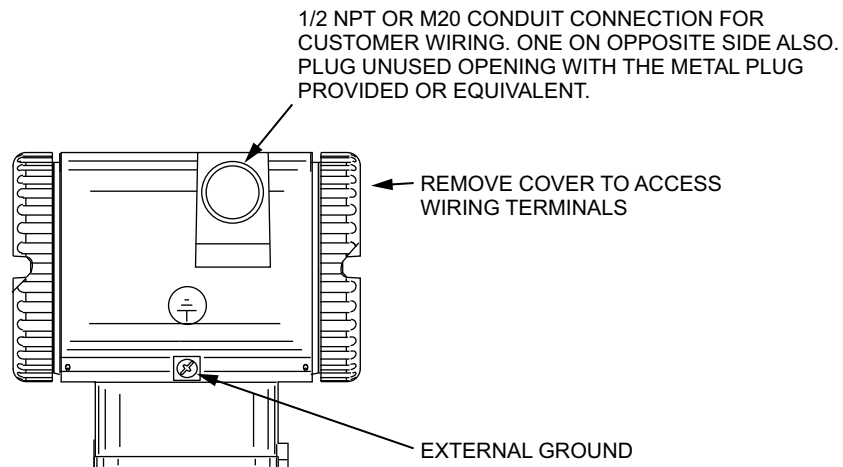
Figure 23 - Identification of Field Terminals
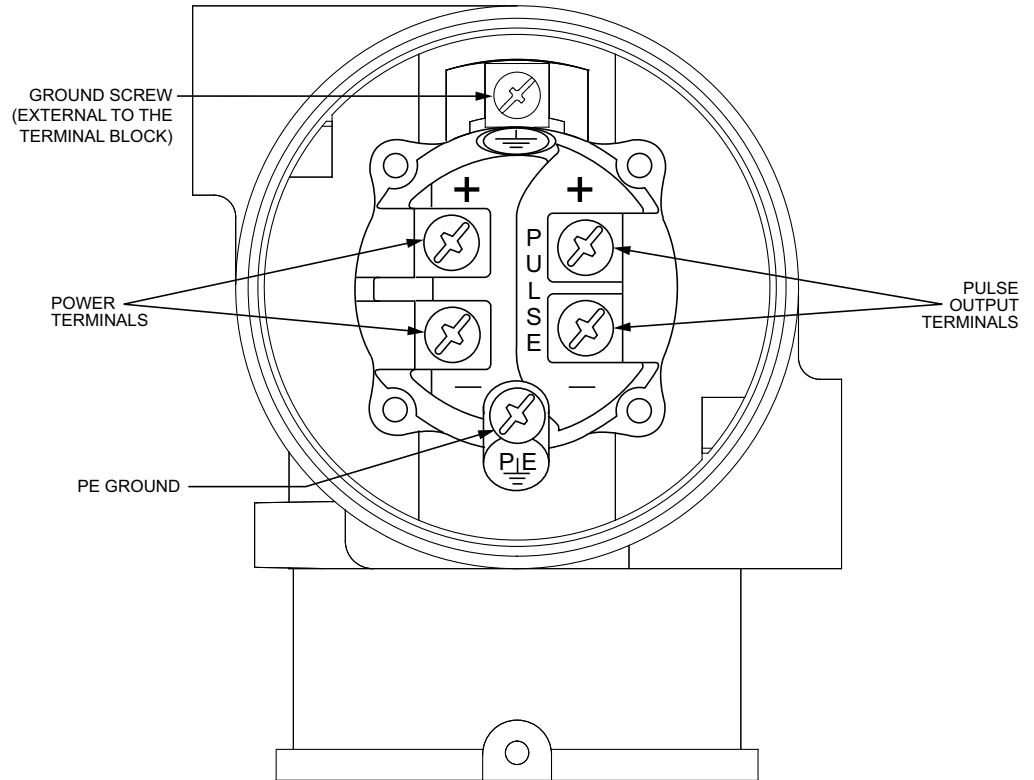
Remotely Mounted Electronics

To use the flowmeter as shipped with the cable attached at both ends, mount the electronics housing and flowmeter body within the limits of the cable length.

If the cable must be disconnected (to shorten the cable, run the cable through conduit, or for some other reason), you must disconnect the cable at the flowmeter (junction box) end. You cannot disconnect the cable at the electronics housing end because it has been epoxied into the metal connector. It is labeled: "Factory Sealed / Electronics End / Do Not Remove."

Preparing the Remote Signal Cable

If the cable must be shortened or re-terminated, prepare the flowmeter (junction box) end of the cable.

1. Insert the cable into the knurled nut and rubber grommet. Then remove the outer insulation to the dimension shown. Do not damage the copper braid.
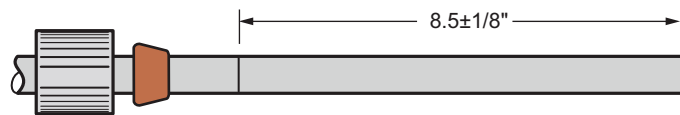
2. Cut the copper braid one inch from the end of the outer insulation.
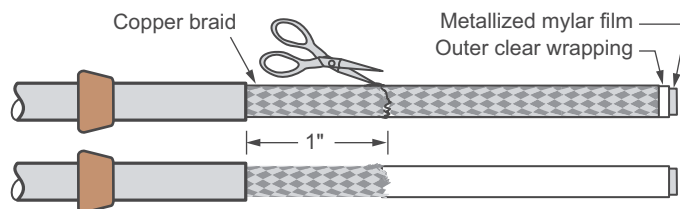
3. Insert the cable into the fitting until the cable is bottomed out inside the fitting. Rotate the fitting one or two turns to pack the braid into place. Remove the cable and examine the packed braid. If there are still strands of braid that have not packed, push them back by hand and reinsert the cable into the fitting. Remove the cable and examine the braid. It should be compressed to a length of approximately 3/8 to 1/2 inch.
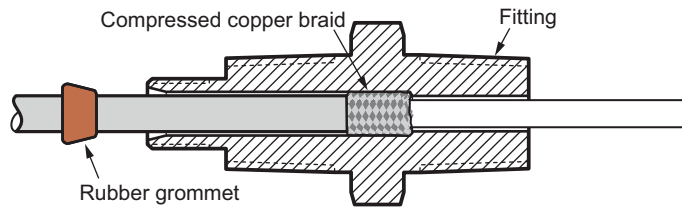
4. Remove the outer clear wrapping and the metallized mylar film to the end of the packed braid. This exposes the inner drain wire. The inner clear wrapping and filler material are still in place.
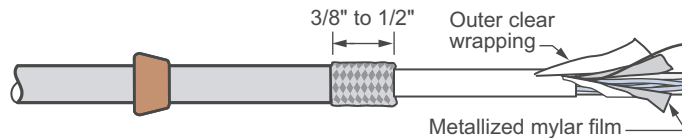
5. Make sure that the drain wire is not in contact with the outer braid, then use an ohm meter to verify that there is no electrical connection between the drain wire and the braid over the entire length of the cable. This step also verifies that the electronics end of the cable has been properly dressed, and that there is no damage or other issue with the cable.
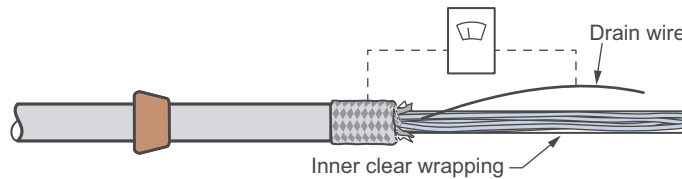
6. Fold the drain wire back onto the packed wire braid and wrap it around one full turn. Then cut off the remainder of the drain wire.
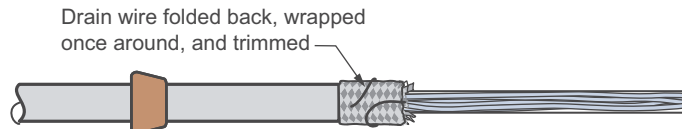
7. Cut back the inner clear wrapping and the filler to 1/2 to 5/8 inch from the end of the outer insulation.
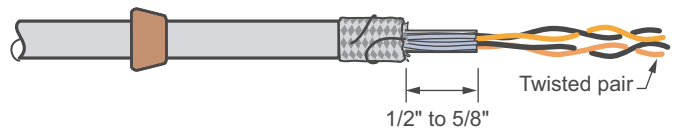
8. Cut a half-inch long piece of shrink wrap. Position it so that half the wrap covers the inner clear wrapping/filler, and half covers the exposed twisted wires. Apply heat to the shrink wrap.

    NOTE: You can use a half-inch piece of electrical tape in place of the shrink wrap.
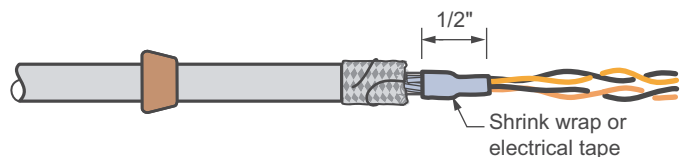
9. Strip 1/4 inch from the ends of the wires.
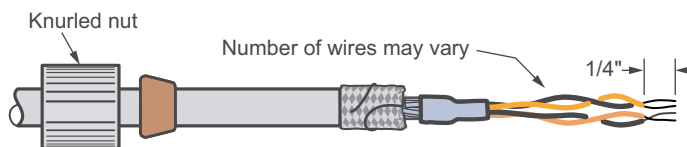
Connecting the Remote Signal Cable

After the cable end is prepared, connect the cable to the junction box..

1. Insert the cable into the fitting, making sure that the cable has bottomed out in the fitting.

2. Slide the rubber grommet into the fitting.

3. Screw the knurled nut into place, clamping the rubber grommet against the assembly. Hand tighten with moderate force to assure a water tight connection.

4. Dress the wires in the junction box as shown in the diagram.

Figure 24 - Connection of Remote Signal Cable (Junction Box End)
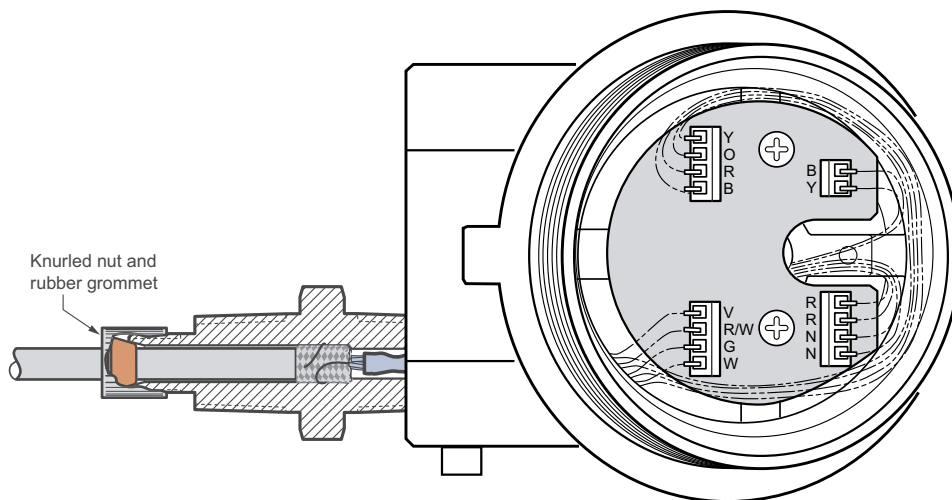
Installation with Conduit

The remote signal cable is shipped with the cable attached at both ends. To run the cable through conduit, the Mounting/Conduit Openings For Electronic Housing -T option must have been purchased. This option facilitates a standard 1/2 NPT conduit connection at both the housing end and the flowmeter end.

1. Disconnect the cable at the flowmeter (junction box) end.

2. Slide the remote conduit adapter (part number K0149LE), longer end first, up the cable and attach it at the housing end.

3. Slide the conduit and fittings over the cable.

4. Slide a second remote conduit adapter, shorter end first, onto the cable and attach it at the junction box end.

Explosionproof or Flameproof Certifications

The remote cable provides an explosionproof/flameproof connection at the electronics end. Explosionproof connections beyond this point are not required. See the diagram for installation guidelines for explosionproof or flameproof certifications.

Figure 25 - Installation of Remote Model 84C with Explosionproof or Flameproof Certification

WITH HART, THERE MUST BE AT LEAST 250 OHMS OF TOTAL RESISTANCE IN THE POSITIVE LEG BETWEEN THE TRANSMITTER AND THE PC-BASED CONFIGURATOR OR HART COMMUNICATOR

LOOP

GND

REMOTE FLOWTUBE

PE

PE GROUND

POWER SUPPLY

NEGATIVE TERMINAL MUST BE GROUNDED TO EARTH

THE PE GROUND WIRE MUST HAVE LESS THAN 1 Ω OF RESISTANCE FROM THE FARTHEST BARRIER TO THE MAIN GROUNDING ELECTRODE
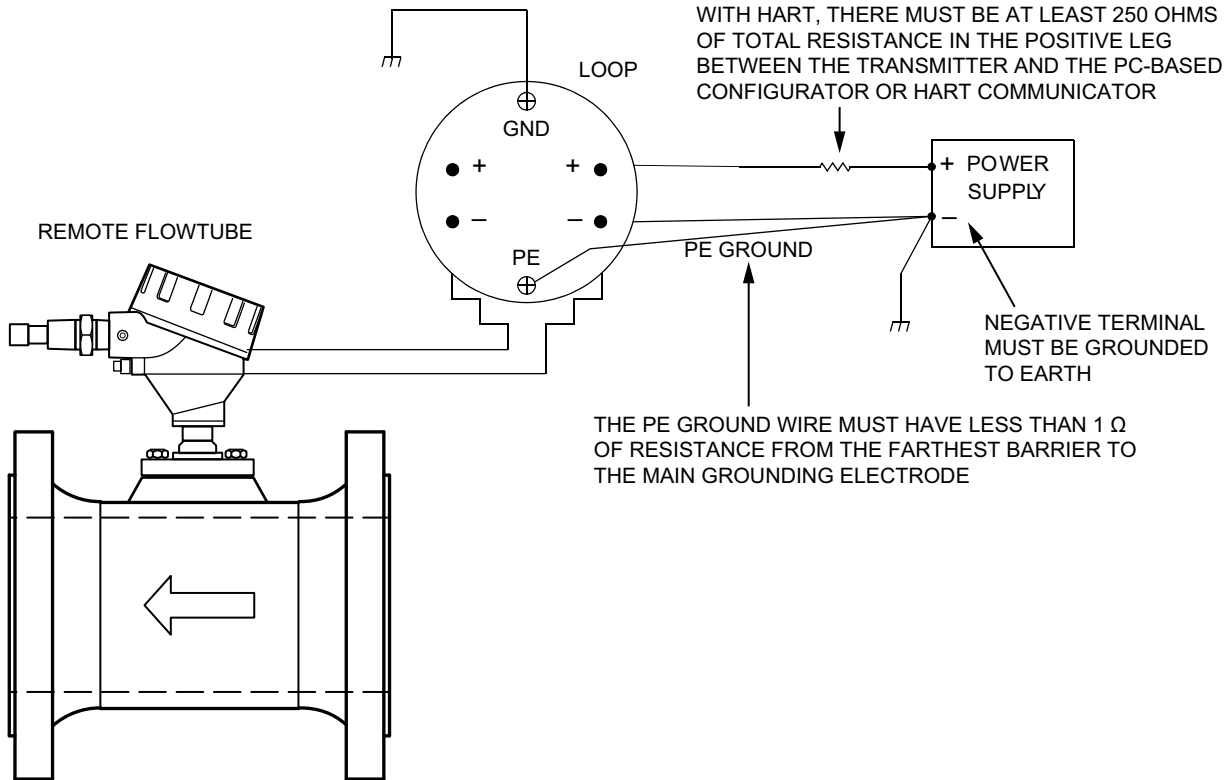
Loop Wiring

The HART flowmeter (Electronics Version -T) cannot output a 4 to 20 mA signal when loop current mode is disabled. The Low Power flowmeter (Electronics Version -L) does not output a 4 to 20 mA signal at all. In both cases, the mA output is set to a fixed value.

For HART communication, a 250 Ω load resistor must be present in the power supply loop, and a terminal voltage of at least 15.75 V dc (HART version) or 10 V dc (Low Power version) must be maintained. For Low Power, there must be at least 12.5 V dc loop voltage.

When wiring a flowmeter with a 4 to 20 mA output signal, the supply voltage and loop load must be within specified limits. The supply output load versus voltage relationship is shown in the following graph. You can use any combination of supply voltage and loop load resistance in the shaded area. 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.

Figure 26 - Supply Voltage and Loop Load
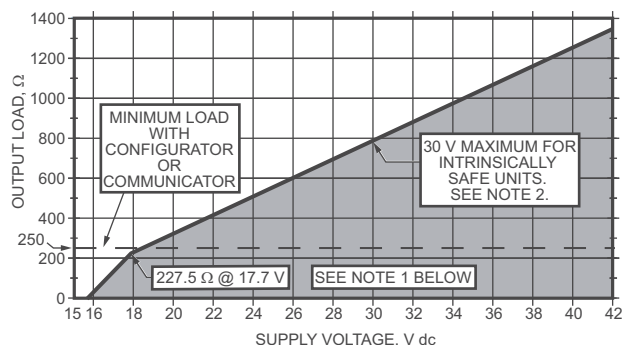
NOTE:

1. The flowmeter can function with an output load less than 250 Ω if a HART Communicator or PC-based configurator is not connected to it.

    Connecting a HART Communicator or PC-based configurator while operating with an output load less than 250 Ω may result in output and/or communication disturbances.

2. With intrinsically safe certifications with a 24 V dc power supply, an active barrier is required.

Examples

*   For a loop load resistance of 300 Ω, the supply voltage can be any value from 19.1 to 30 V dc(up to 42 V dc if not certified intrinsicially safe).

*   For a supply voltage of 24 V dc, the loop load resistance can be:

    ◦   250 to 520 Ω with a HART Communicator or PC-based configurator connected

    ◦   0 to 520 Ω without a HART Communicator or PC-based configurator connected

Wiring the Flowmeter to a Power Supply

1. Remove the cover from the field terminals compartment.

2. Run signal wires through one of the flowmeter's conduit connections. (Do not run flowmeter wires in the same conduit as the mains/ac power wires.)

    *   Twisted pair helps protect the 4 to 20 mA output and/or remote communications from electrical noise.

    *   Typical signal wires are 0.50 mm² (20 AWG).

    *   The maximum recommended length for signal wires is 1,800 m (6,000 ft).

3. If you use shielded cable, ground the shield at the negative terminal of the power supply only. Do not ground the shield at the flowmeter.

4. Plug unused conduit openings.

> ## ⚠⚠ WARNING
>
> **EXPLOSION HAZARD**
>
> To help prevent explosions and to maintain flameproof, explosionproof, and dust-ignitionproof protection, observe applicable wiring practices. Plug the unused conduit openings with approved conduit plugs. Both plug and conduit must engage a minimum of five full threads for 1/2NPT connections; seven full threads for M20 connections.
>
> **Failure to follow these instructions can result in death or serious injury.**

5. The flowmeter is equipped with both an internal and an external ground connection. Connect a ground wire to either terminal in accordance with local practice.

> ## *NOTICE*
>
> **POTENTIAL REDUCED PERFORMANCE OR EQUIPMENT DAMAGE**
>
> If the signal circuit must be grounded, it is preferable to ground it at the negative terminal of the dc power supply. To avoid errors resulting from ground loops or the possibility of short-circuiting groups of instruments in a loop, there should be only one ground in a loop.
>
> **Failure to follow these instructions can result in reduced performance or equipment damage.**

6. Connect the power supply and receiver loop wires to the "+" and "–" terminals.

7. Connect receivers (such as controllers, recorders, or indicators) in series with the power supply and flowmeter.

8. Install the cover onto the flowmeter. Turn the cover to seat the o-ring into the housing. Continue to hand-tighten until the cover contacts the housing metal-to-metal. If cover locks are present, refer to *Cover Locks, page 44*.

9. To wire additional flowmeters to the same power supply, repeat these steps for each flowmeter.

You can connect a HART Communicator or PC-based configurator in the loop between the flowmeter and the power supply as shown in the diagram.

- There must be at least 250 Ω total resistance between the PC-based configurator or HART Communicator and the power supply. Refer to *Supply Voltage and Loop Load, page 52*.

- For HART communication with a Low Power flowmeter, a 250 Ω load resistor must be present in the supply loop, and a minimum loop voltage of 12.5 V dc must be maintained.

Figure 27 - Wiring the Flowmeter to a Power Supply
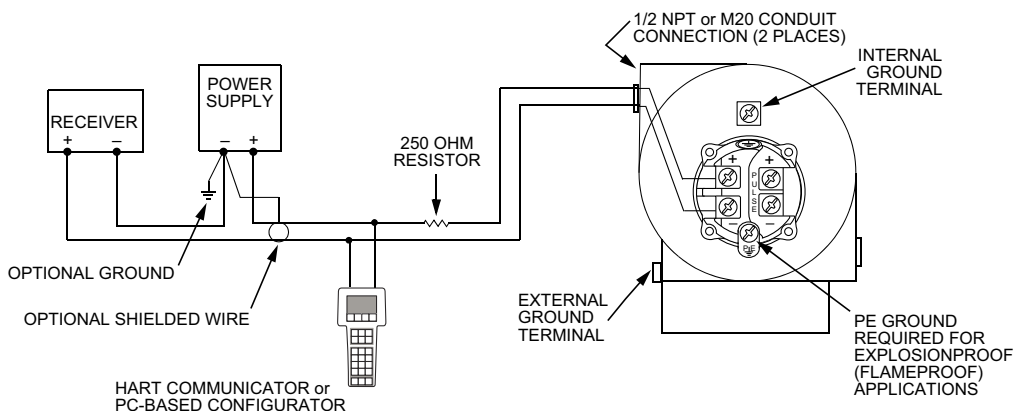
Wiring a Flowmeter with a Pulse Output

See *Wiring the Flowmeter to a Power Supply, page 52* for an overview of wiring, grounding, voltage, and resistance requirements.

If you are replacing an E83FA, E83WA, or Model 83 flowmeter that was previously wired with a three-wire hookup, use the three-wire method of wiring a flowmeter with pulse output.

For new installations, the four-wire method is recommended because the three-wire method can interfere with HART communications at certain pulse output frequencies.

Four-Wire Method

An additional, separate loop is required when using the pulse output on a flowmeter with the 4 to 20 mA or digital signal. Each loop requires its own power supply.

The maximum pulse output current is 20 mA. Use a load resistor that is sized accordingly. An 1000 ohm load resistor is shown as an example in the diagram.

Figure 28 - Four-Wire Method of Wiring a Flowmeter with Pulse Output
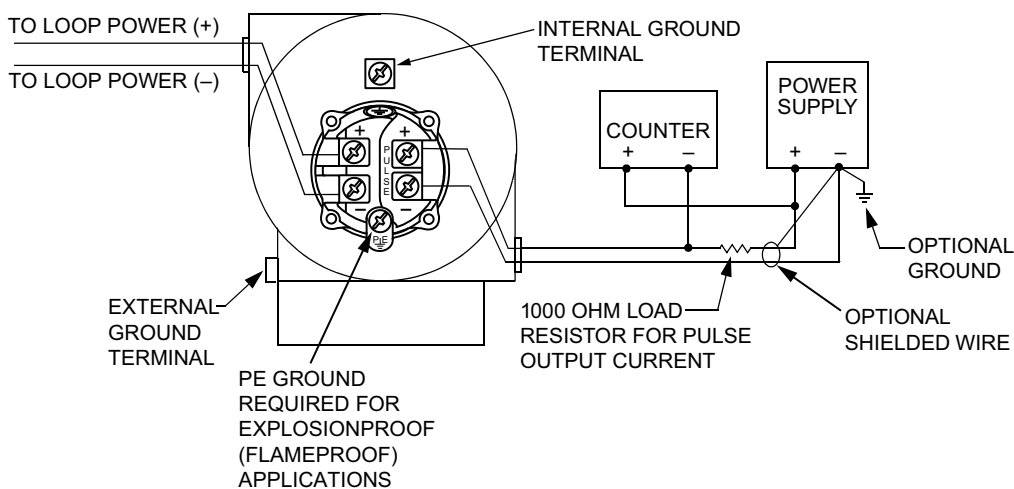
Three-Wire Method

The maximum pulse output current is 20 mA. Use a load resistor that is sized accordingly.

Place a jumper between the two negative terminals as shown in the diagram.

Figure 29 - Three-Wire Method
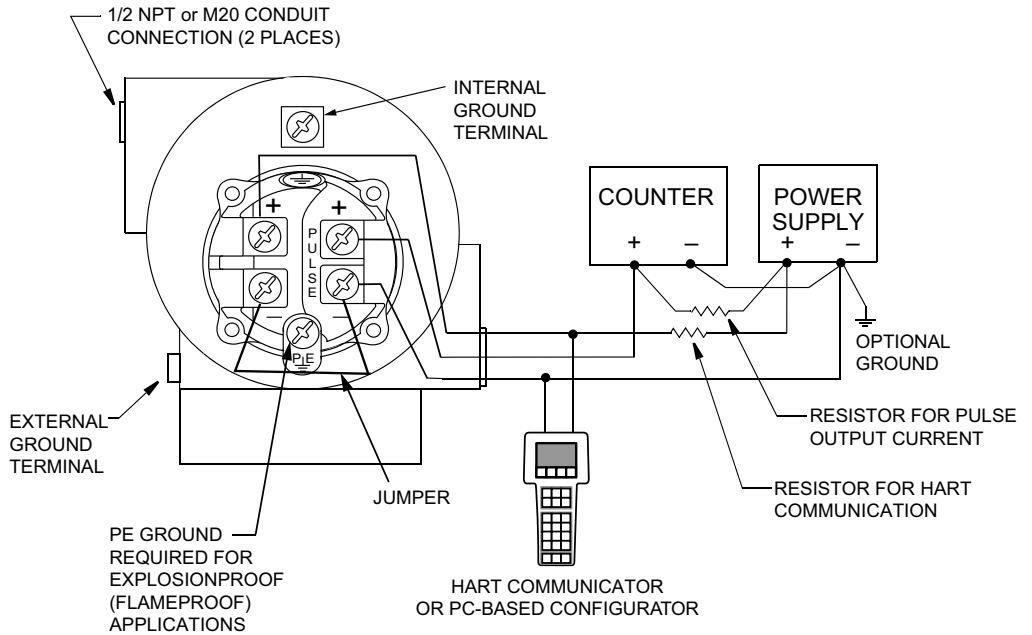
Multidrop Communication

Multidrop technology refers to the connection of several devices to a single communications transmission line. Communication between the host computer and the devices takes place digitally with the analog output of the flowmeter deactivated.

The application of a multidrop installation requires consideration of the update rate necessary from each device, the combination of devices, and the length of the transmission line. Communication with the 84C flowmeters can be accomplished with any HART compatible modem and a host implementing the HART protocol. Each flowmeter is identified by a unique address (0 through 63) and responds to the commands defined in the HART protocol.

> **NOTE:** Multidrop installations of these flowmeters are not recommended where Intrinsic Safety is a requirement.

The next figure shows a typical multidrop network. Do not use this figure as an installation diagram. Contact the FieldComm Group (*http://www.fieldcommgroup.org*) for specific requirements for multidrop applications.

Figure 30 - Multidrop Network
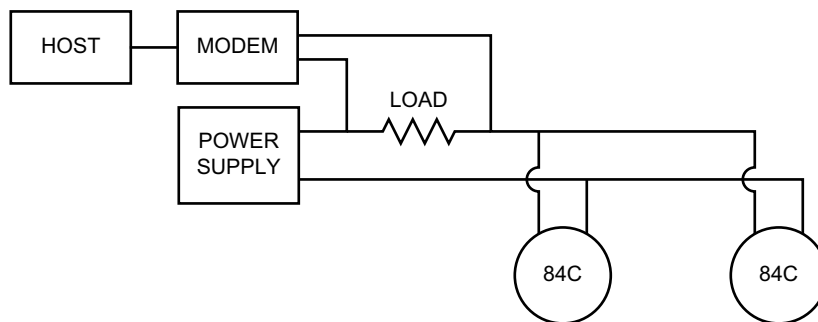
The HART Communicator can operate, configure, and calibrate Model 84C Vortex Flowmeters with HART communication protocol the same way it can in a standard point-to-point installation.

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

Changing the poll address does not automatically deactivate the 4 to 20 mA analog output. Only one device per multidrop network can be configured with loop current enabled.

To activate multidrop communication, assign each flowmeter a unique address (0 through 63) on each multidrop network. Then, to fix the mA output value, set the loop current mode to "disabled."

Operating the Flowmeter

You can operate the flowmeter with the optional local display, a HART Communicator, or a PC-based configurator and the DTM.

The specifics of each communication method are provided as follows:

- Using the flowmeter with the Optional Local Display (see *Using the Local Display, page 96*)

- Using the flowmeter with the HART Communicator (see the manual for the HART Communicator and *Using the HART Communicator, page 151*)

- Using the flowmeter with a PC-based configurator (see the manual for the PC-based configurator and MI 020-520, *PC50 Intelligent Field Device Tool with DTM Library - Operation Using HART Communications Protocol*)

    NOTE: The names or organization of the options available vary between the different communication methods, but the functions are the same.

Personalities

You can select a **personality** for the flowmeter. The purpose of a personality is to preconfigure and simplify (or limit) some of the flowmeter settings and measurements available for a specific user application or set of applications. Measurement generation, configuration setting options, and behaviors available may be different depending on the personality selected.

If you specify the personality to be used when you purchase your flowmeter, it will be preconfigured at the factory with that selected personality.

    NOTE: It is possible to change the personality that was preconfigured at the factory. See *Setting Advanced Options, page 87*.

The following personalities are available:

- The **General** personality provides all the possible functions and settings. This is the most unrestricted personality. It can be used for all user defined fluids and Model Code options.

- The **Steam** personality is targeted to applications for steam flow. The fluid selection in this personality is limited to saturated steam or superheated steam. When using the Steam personality, the alert behavior of the flowmeter is modified to allow configuration of an Upper Range Value (URV) for the Mass Flow measurement based on the nominal operating region of the Steam fluid (even if the current operating temperature is at room temperature, rather than in the Steam region). In this case, you can set the URV and a "NoSteam?" message will be alternately flashed on the third line of the local display.

    Additionally, the Base Volume measurement is not displayed or active when using the Steam personality, as it is not relevant to Steam flow. The Steam personality can be used with all Model Code options.

- The **Oil & Gas** personality is targeted to simplify configuration for the measurement of flow in oil and gas applications. When using the Oil & Gas personality, a limited set of EGUs is available and easy-to-use menus are provided. The Oil & Gas personality supports a single totalizer labeled "Total" which is always mapped to Volumetric flow. The Total EGU follows the Volume Rate EGU (for example, bbl/d results in a total of barrels).

    There is no user configuration for the single totalizer, Total. You can start, stop, or clear Total from the local display or a HART command.

    Additionally, if pulse output is available, it is mapped to Volumetric flow and preconfigured for Frequency mode using the user liquid upper range limit of the meter for limiting the maximum pulse output frequency. Like the totalizer, the pulse output is always On when the meter is online; and the only user

configuration is the Pulse Per Unit Factor, which you can set from the local display or a HART command.

The reduced EGU list for the Oil & Gas personality is:

gal/m	gallons per minute
bbl/h	barrels per hour
bbl/d	barrels per day
m3/s	meters cubed per second
m3/d	meter cubed per day

Although there are other options available in the menus, you typically need to configure only the Flowmeter EGU and the Pulse per Unit Factor when using the Oil & Gas personality.

The Oil & Gas personality can be used with all Model Code options.

If you change the personality of the flowmeter, the parameters are automatically set to the default values for the new personality. The table below lists the default parameter values for each personality.

Table 29 - Default Parameter Values for Personalities

Parameter Name	General Personality	Steam Personality	Oil & Gas Personality
Adaptive Filter enable	Enabled (normal setting)	no change	FixedGas setting
LFCI Level	4		5
Volume Rate Configuration	Calculation Method=User On; Alert Strategy=OnAlert Bad		Calculation Method=User On; Alert Strategy=OnAlert Bad
Volume Rate Unit	no change		bbl/d (barrels/day)
Measurement Damping	2 seconds		0 seconds
Base Volume Configuration	Calculation Method=User On; Alert Strategy=OnAlert Continue	n/a	no change
Temperature Configuration	Calculation Method is based on Model Code: UserOn if RTD is present; Alert Strategy=OnAlert Bad		
Density Configuration	Calculation Method=User On; Alert Strategy=OnAlert Continue		
Fluid Identifier	User Liquid	Saturated Steam	User Liquid
Fluid Material Name	Default Water	Default Steam	Default Water
Mass Flow Configuration	Calculation Method=User On; Alert Strategy=OnAlert Continue	no change	Calculation Method=User On; Alert Strategy=OnAlert Continue
Velocity Configuration			no change
Viscosity Configuration			
Pulse Output Configuration	Calculation Method=User On; Alert Strategy=OnAlert Use Default	no change	Calculation Method=User On; Alert Strategy=OnAlert Continue
Pulse Output Mode	None		Freq
Pulse Output Mapped Source	Volume Rate		Volume Rate
Pulse Output Upper Range Value	1000Hz		350Hz
Pulse Output Default Frequency	0Hz		0Hz
Pulse Output Factor	1		3.79E-05

Table 29 - Default Parameter Values for Personalities (Continued)

Parameter Name	General Personality	Steam Personality	Oil & Gas Personality
Pulse Output Pulse Mode Mapped Source	Volume Flow Rate	no change	Volume Flow Rate
Pulse Output Pulse Mode Factor EGU	gallons		n/a
Pulse Output Pulse Mode Default Value	0		
Pulse Output Pulse Mode Units/Pulse Factor	1		
PV Map	Volume Flow Rate	no change	Volume Flow Rate
SV Map	Total1		Total1
TV Map	Total2		
QV Map	Vortex Frequency		Vortex Frequency
mA Offline Value	0		no change
Multidrop Indicator	1		
Total 1 Configuration	Total Off, cleared	Total Off, cleared	Total Off, cleared
Total 2 Configuration			unavailable
Total 3 Configuration			
Total 1 Units	no change	kg	bbl (barrels)
Total 2 Units		m3	
Total 3 Units			
Total 1 Mapped Source	no change	Mass Flow Rate	Volume Flow Rate
Total 2 Mapped Source		Volume Flow Rate	
Total 3 Mapped Source			
Personality	General	Steam	Oil&Gas
Noise Reduction Mode	Method1	Method1	Method1
Enthalpy Configuration	Alert Strategy=OnAlert Continue		
Heat Content Configuration			

Flowmeter Functions and Actions

You can perform the following functions and actions on the flowmeter.

- **Measurement** - The normal operating mode of the flowmeter where you can display real-time flowmeter measurements. The display indicates whether diagnostic conditions exist, and displays rollover counter values for totalizers 1, 2, and 3. The selected default measurement is displayed when the transmitter is turned on. (See *Measurement, page 97*.)

- **Status** - Provides the status of various parameters, write protection (local display only), and any diagnostic messages.

- **Setup** - Used to set up (configure) the flowmeter for your application. This includes defining fluid, flow, tuning, total output, piping, tags, flowtube, and password parameters. Depending on the Personality selected, the setup parameters may be limited.

- **Calibration/Test** - Used to perform several calibration and test functions on the flowmeter.

- **Pulse Actions** (available only if Pulse Output is configured for Pulse Mode) - Used to control how the flowmeter starts and stops the accumulation of the total flow value. Also allows you to select whether or not the flowmeter is actively accumulating values and transmitting pulse signals.

- **Totalizer Actions** - The flowmeter has three separate totalizers that accumulate flow measurement to keep track of amounts of flow. (For the Oil & Gas personality, there is only a single totalizer.) Each totalizer can be mapped independently to keep track of different measurements. The Totalizer functions are used to control how the flowmeter starts and stops the accumulation of the total flow value.

Status

Status functions include:

- Measurement Status - Allows you to review the units, value, and status of the system parameters and thus assess the performance of the loop. You cannot edit parameters from this function.

- Write Protection (local display only) - Allows you to view whether write protection is enabled or disabled.

- Diagnostic Messages and Alerts - Shows diagnostic messages and alerts generated by the flowmeter.

- Reason Codes - Shows messages in hexadecimal format used by Global Customer Support to diagnose issues.

- Software Revisions - Shows the software revision currently running in the flowmeter.

- Time in Service Meter - Shows the values of the Time in Service meter for the flowmeter. Two values are displayed:
  - Primary - The number of days the flowmeter has been powered up over its lifetime.
  - User - The number of days the flowmeter has been powered up since the last reset.

See the *Status Menu Diagram, page 105* for the menu on the local display for the General and Steam personalities, see the *Status Menu Diagram, page 138* for the menu on the local display for the Oil & Gas personality, and see *HART Communicator Menus, page 154* for the menus on the HART Communicator.

The status values associated with the diagnostic messages are shown in *Messages, page 93*.

Setup

Setup enables you to configure your fluid, tuning, totalizer, measurement, output, pipe, tag, and flowtube parameters. It also enables you to reset the flowmeter back to factory defaults. When using the local display, Setup functions can be password protected. You can establish and change your passwords from the Setup menu. See *Using Passwords, page 97*.

For easy configuration of your Model 84C Vortex Flowmeter, it is recommended that you configure the flowmeter in the sequence described in *Recommended Setup Procedure, page 62*.

When you are configuring the flowmeter using the local display, you are asked to confirm that your control loop is in manual mode. Verify that your control system is in manual mode before proceeding beyond this prompt. Once you confirm the prompt, the flowmeter enters offline mode with no output.

NOTE: When in offline mode, all outputs stop and all configured totalizers stop accumulating. A totalizer alert is generated.

When configuring the flowmeter using the HART Communicator, the flowmeter does not switch to offline mode for configuration. All configuration changes are made when the flowmeter is operational and the new parameter values become active as soon as they are set.

The following types of parameters can be configured:

- Fluid
- Tuning
- Measurement
- Totalizer
- Output
- Piping
- Flowtube identification
- Advanced options, including selecting a personality
- Database reset
- Password (local display only). See *Using Passwords, page 97*.

The configuration parameters available depend on the personality that is enabled.

For convenience, there is a set of measurement parameters that can be configured from either the Fluid menu or the Measurement Configuration menu:

- Flow Temperature
- Density
- Pressure
- Viscosity

Measurement Properties

You configure measurement properties for many of the parameters in the Fluid menu and the Measurement Configuration menu. The following table defines each of these measurement properties. See the parameter descriptions for the default values for each measurement property.

Table 30 - Measurement Properties

Local Display	HART Communicator	Description
EGU	Units	**Engineering units (EGUs):** Select an appropriate engineering unit for each fluid measurement type. Refer to *Units, page 15*.
EGUTYP	N/A	**EGU Type:** (For Base Volumetric Flow only) Choose to use the standard or normalized volume for the Base Volume Rate (BVolrate) measurement parameter.
LRV	LRV	**Lower Range Value:** Enter the lower range value for the measurement type. Some fluid parameters (flow, for example) do not have an LRV option because it should always be 0.
URV	URV	**Upper Range Value:** Enter the upper range value for the measurement type.
Default	Default	**Default:** Enter the default value to which the flowmeter will set the measurement value if an error occurs.

Table 30 - Measurement Properties (Continued)

Local Display	HART Communicator	Description
AlertSt	Alert Strategy	**Alert Strategy:** This property allows you to configure how the flowmeter will react to an alert with regard to the measurement you are configuring. • On Alert Continue (NoAlert): On an alert, the flowmeter continues to run, but the measurement is set to a clipped lower or upper limit and a status alert is generated. • On Alert (AlertBad): On an alert, the output value is set to the upper or lower hard limit, and a status alert is generated. For example, the mA output is set to 3.6 mA or 22 mA, depending on whether you configured the mA to fail low (DownScale) or high (UpScale). • On Alert Use the Default (AlertDef): On an alert, the flowmeter continues to run, but the measurement is set to a user-defined default. **NOTE:** • mA output only supports On Alert (AlertBad). • Pulse output only supports On Alert Use the Default (AlertDef).
CMethod	Mode	**Calculation Method:** This property describes how the particular measurement is calculated: • User Def: The measurement always uses a default. • User On: When the Calculation method is set to User On, the measurement is calculated by the flowmeter. For example, the flowmeter can correct density and viscosity of liquids. See *Fluid Parameters, page 67*. **NOTE:** Pressure does not support the UserOn calculation method. • By Remote: The measurement is transmitted by remote communications.
4 Damp	Damp	**Damping:** This property allows you to set damping for fluid configuration parameters. Possible settings are: • None, 0.25, 0.5, 1, 2, 4, 8, 16, 32

Recommended Setup Procedure

Configure your flowmeter in the following sequence:

1. Change the model code if necessary.

   Typically, the model code of the flowmeter should not be reset. You reset the model code only if you are replacing a module with the assistance of Global Customer Support. However, in the unlikely event that you need to perform this action, it must be the first step of the configuration process.

2. Determine which personality you want to use and verify that the flowmeter was preconfigured with the correct personality at the factory. For details on how to change the personality, see *Setting Advanced Options, page 87*.

3. Configure the required settings in the order listed below:

   a. Fluid type

   b. Measurement properties

   c. Flowmeter's output

   d. Noting which measurements are mapped to which outputs, check and set the appropriate measurement ranges.

4. Configure the optional settings in the order listed below:

    a. Configure the Low Flow Cut-In (LFCI).

    b. Map the totalizers.

    c. Configure the piping parameters.

    d. Configure the reference K-factor.

    e. Configure passwords, if applicable.

    f. Turn totalizers on.

For a detailed example of how to achieve a 4 to 20 analog output for Mass Flow, pulse output for Mass Flow, and how to display Total Mass using the local display, see *Configuration Example, page 101*.

Setting Fluid Parameters

You can configure the following fluid parameters: the fluid type, fluid name (optional), flowing temperature, base temperature, density, base density, pressure, base pressure, viscosity, and thermal coefficients for density and velocity.

> **NOTE:** The flowing temperature, density, pressure and viscosity parameters can be set from either the Fluid menu or the Measurement Configuration menu.

Changing the fluid type causes the fluid parameters to be set to default values for that type:

- **Liquid** - water at 15°C (59°F ambient)
- **Gas** - air at 101.00 kPaa (14.65 psia)
- **Vapor/Saturated Steam** - at 957.34 kPaa (138.85 psia)

> **NOTE:** Changing the fluid type may affect the mapped output you have selected.

Fluid Types

The following fluid types are available for each personality:

- General Personality
  - ◦ User Liquid - Configurable fluid type for user-defined liquids.
  - ◦ User Vapor - Configurable fluid type for user-defined vapors.
  - ◦ User Gas - Configurable fluid type for user-defined gases.
- Steam Personality
  - ◦ Saturated Steam - Non-configurable fluid type for steam in a saturated condition.
  - ◦ Superheated Steam - Non-configurable fluid type for steam in a super heated condition.
- Oil & Gas Personality
  - ◦ User Liquid - Configurable fluid type for user-defined liquids.

You can configure User Liquid, User Vapor, and User Gas. Saturated Steam and Superheated Stream are predefined (see *Default Configuration Databases, page 64*). The following parameters can be set for the user configurable fluid types:

- Thermal Coefficient of Density (**ThCoefD**)
- Reference Temperature of Density (**ThRefTD**)
- Reference Density of Liquid (**ThRefD**)
- Thermal Coefficient of Viscosity (**ThCoefV**)
- Reference Temperature for Viscosity (**ThRefTV)**)

- Reference Viscosity of Liquid (**ThRefV**)

These parameters do not appear in the menu tree for predefined fluid types.

Default Configuration Databases

Each flowmeter is shipped with an operating configured database. However, the flowmeter may not be configured for the actual fluid and flow conditions of your application.

> **NOTE:** Check the configuration of your flowmeter before start-up.

If information is not supplied with the purchase order, the flowmeter is shipped with the defaults in the following tables. These defaults are not recommended for general operation. If no other process information is available, entering **User Liquid**, **User Vapor**, **User Gas**, **SaturatedSteam** or **SuperHeatedSteam** as the fluid type during configuration establishes the default databases as shown in the following tables.

Table 31 - Default Database for User Liquid

Parameter	Metric	U.S.
Fluid Type	User Liquid (Default Water)	User Liquid (Default Water)
Type of Flow	Volume	Volume
Measurement Units	m^3/s	gal/min
Flowing Temperature	15ºC	159ºF
Flowing Density	999.14 kg/m^3	62.37 lb/ft^3
Absolute Viscosity	1.14 cP	
Upper Range Value	Upper Range Limit for Flowmeter Size	
Pressure	101.00 kPaa	14.65 psia
Heat Content[18]	0 Joules/kg	0 BTU/lb

Table 32 - Default Database for User Vapor

Parameter	Metric	U.S.
Fluid Type	User Vapor (Default Steam)	User Vapor (Default Steam)
Type of Flow	Same as present configuration	
Measurement Units	Same as present configuration	
Flowing Temperature	178ºC	352.4ºF
Flowing Density	4.94 kg/m^3	0.31 lb/ft^3
Absolute Viscosity	0.015 cP	
Upper Range Value	Upper Range Limit for Flowmeter Size	
Pressure	957.34 kPaa	138.85 psia
Heat Content[19]	0 Joules/kg	0 BTU/lb

Table 33 - Default Database for User Gas

Parameter	Metric	U.S.
Fluid Type	User Gas (Default Air)	User Gas (Default Air)
Type of Flow	Same as present configuration	

---

18. Heat Content is a valid measurement only for steam. Set it to 0 for User Liquid.
19. Heat Content is a valid measurement only for steam. Set it to 0 for User Vapor.

Table 33 - Default Database for User Gas (Continued)

Parameter	Metric	U.S.
Measurement Units	Same as present configuration[20]	
Flowing Temperature	20ºC	68ºF
Flowing Density	1.20 kg/m3	0.08 lb/ft3
Absolute Viscosity	0.18 cP	
Upper Range Value	Upper Range Limit for Flowmeter Size	
Pressure	101.00 kPaa	14.65 psia
Heat Content[21]	0 Joules/kg	0 BTU/lb

Table 34 - Default Database for Saturated Steam

Parameter	Metric	U.S.
Fluid Type	SaturatedSteam	SaturatedSteam
Type of Flow	Same as present configuration	
Measurement Units	Same as present configuration[22]	
Flowing Temperature	178ºC	352.4ºF
Flowing Density	4.94kg/m3	0.31 lb/ft3
Absolute Viscosity	0.015 cP	
Upper Range Value	Upper Range Limit for Flowmeter Size	
Pressure	957.34kPaa	138.85 psia
Heat Content	2775400.00 Joules/kg	1193207.22 BTU/lb

Table 35 - Default Database for Superheated Steam

Parameter	Metric	U.S.
Fluid Type	SuperHeatedSteam	SuperHeatedSteam
Type of Flow	Same as present configuration	
Measurement Units	Same as present configuration[22]	
Flowing Temperature	178ºC	352.4ºF
Flowing Density	4.94kg/m3	0.31 lb/ft3
Absolute Viscosity	0.015 cP	
Upper Range Value	Upper Range Limit for Flowmeter Size	
Pressure	957.34kPaa	138.85 psia
Heat Content	2775490.25 Joules/kg	1193246.02 BTU/lb

Example: Configuring a User-Defined Fluid

Set up a user-configurable fluid type with the following characteristics:

---

20. Liquid units of gallons, liters, imperial gallons, or barrels per unit time are not transferable to gas.
21. Heat Content is a valid measurement only for steam. Set it to 0 for User Gas.
22. Liquid units of gallons, liters, imperial gallons, or barrels per unit time are not transferable to steam.

ThRefTD (Reference Temperature)	ThRefD (Reference Density of the Liquid)	ThCoefD (Δ Density/ Δ Temperature)	Density
75 °F	49.0172 lbs/ft^3	-0.034529561 lbs/ft^3/°F	49.0172 lbs/ft^3

The following formula calculates the density values for a user defined fluid:

Density = ThRefD + (Current Temperature – ThRefTD) * ThCoefD

Refer to the diagram.

Figure 31 - Calculating Density Values
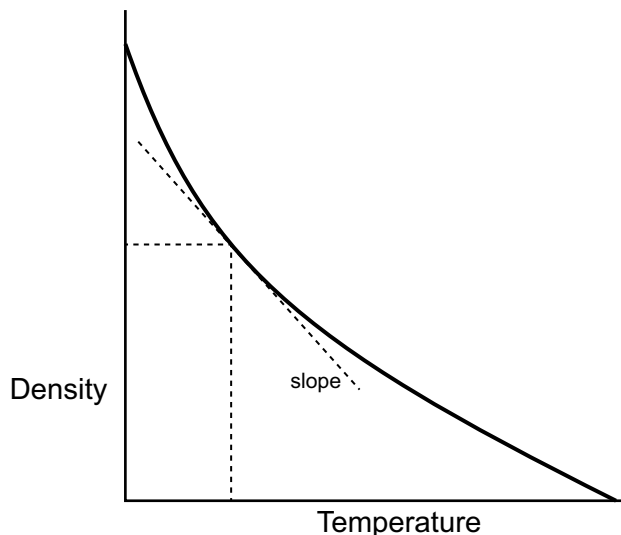
Density = ThRefD + (Current Temperature – ThRefTD) x slope

where **slope = ThCoefD = Δ Density/Δ Temperature**

For a detailed example of how to achieve a 4 to 20 analog output for Mass Flow, pulse output for Mass Flow, and how to display Total Mass using the local display, see *Configuration Example, page 101*.

Updating Fluid Parameters

To update fluid parameters:

1. Configure the parameters from the **1 Setup > 2 Fluid** menu selection (local display) or the **Detailed Setup > Fluid** menu selection (HART Communicator).

   See the *Fluid Menu Diagram, page 109* for the menu on the local display for the General or Steam personalities. The Fluid menu is not available for the Oil & Gas personality. See *HART Communicator Menus, page 154* for the menus on the HART Communicator.

2. For the Flow Temperature, Density, Pressure and Viscosity parameters listed below, configure the properties in *Measurement Properties, page 61*. Refer to the menu diagrams for the specific properties that apply to each parameter.

   NOTE: For convenience, the following measurement parameters can be configured from either the Fluid menu or the Measurement Configuration menus:

   • Flow Temperature

   • Density

   • Pressure

   • Viscosity

Table 36 - Fluid Parameters

Local Display	HART Communicator	Factory Default	Description
3 Fluid	Fluid Type	(Default value varies based on the personality selected.)	**Fluid Type:** Select the type of fluid: **User Liquid**, **User Vapor**, **User Gas**, **SaturatedSteam** or **SuperHeatedSteam**. Default values for these fluid types are listed in the tables in *Default Configuration Databases, page 64*. **User Liquid**, **User Vapor**, and **SselectionUser Gas** are user configurable fluid types, while **SaturatedSteam** and **SuperHeatedSteam** are predefined. Only **User Liquid**, **User Vapor**, and **User Gas** are available in the General personality. Only **SaturatedSteam** and **SuperHeatedSteam** are available in the Steam personality. The Fluid menu is not available for the Oil & Gas personality.
3 Name	Fluid Name	Default Water	**Fluid Name:** Enter a name for this fluid (optional).
3 Config FlwTmp	Temperature Config	EGU: degF LRV: N/A URV: N/A Default: 59 4AlertSt: N/A CMethod: N/A Damp: None	**Flow Temperature:** Configure the measurement properties associated with the flow temperature. Depending on whether the Vortex flowmeter is configured with an RTD for multivariable temperature compensation, this parameter either displays the temperature of the flowing process material or allows you to enter a flow temperature. For a flowmeter with temperature compensation (Multivariable Selection T), the Flow Temperature shows the temperature of the process material flowing through the Vortex meter. For a flowmeter without temperature compensation (Multivariable Selection N), enter the flow temperature in this parameter in the specified units.
3 BasTmp	Base Temperature	59	**Base Temperature:** Enter the base temperature in the temperature unit specified.
3 Config Densty	Density Config	EGU: lb/ft^3 LRV: N/A URV: N/A Default: 62.372 4AlertSt: N/A CMethod: N/A Damp: None	**Density:** Configure the measurement properties associated with the density of the fluid. If you configure the calculation method to User On, be sure to enter the reference density (ThRefD), reference temperature (ThRefTD), and the thermal coefficient of density (ThCoefD). If you choose to use a custom density unit, define your custom unit by first entering a Label for your custom unit using up to eight alphanumeric characters. Then, enter any Offset and a conversion factor (Slope) to convert from kilograms per cubic meter to the custom unit.
3 BasDen	Base Density	62.372	**Base Density:** Enter the base density in the density unit specified.
3 Config Press	Pressure Config	EGU: kPaa LRV: N/A URV: N/A Default: 100.1010 4AlertSt: N/A CMethod: N/A Damp: None	**Pressure:** Configure the measurement properties associated with the pressure of the fluid. Pressure can be configured once using this command or a Host system can be used to update Pressure remotely using HART command 192 (see *Setting Digital Measurement Values Remotely, page 151*).
3 BasPrs	Base Pressure	100.1010	**Base Pressure:** Enter the base pressure in the unit specified.
3 Config Visc	Viscosity Config	EGU: cPoise Default: 1.1219 4AlertSt: N/A CMethod: N/A	**Viscosity:** Configure the measurement properties associated with the viscosity of the fluid. If you configure the Calculation Method to User On, be sure to enter the reference viscosity (ThRefV), reference temperature (ThRefTV), and the thermal coefficient of viscosity (ThCoefV).

Table 36 - Fluid Parameters (Continued)

Local Display	HART Communicator	Factory Default	Description
3ThCoefD	Thermal Coef Density	-0.0191111	**Thermal Coefficient of Density, Reference Temperature of Density, and Reference Density of Liquid:** These parameters apply to configurable fluid types only (**User Liquid**, **User Vapor**, and **User Gas**).
3ThRefTD	Thermal Dens Ref Temp	58.99996	
3 ThRefD	Thermal Density	62.37183	The Vortex Model 84C Flowmeter uses the following thermo-coefficient equation to apply temperature correction for density (for liquids only): **Density = ThRefD + (Current Temperature - ThRefTD) * ThCoefD** See *Calculating Density Values, page 66*. where: • ThRefD is the reference density of the liquid • ThRefTD is the reference temperature • ThCoefD = Δ Density / Δ Temperature
3ThCoefV	Thermal Coef Viscosity	-0.006316	**Thermal Coefficient of Viscosity, Reference Temperature of Viscosity, and Reference Viscosity of Liquid:** These parameters apply to configurable fluid types only (**User Liquid**, **User Vapor**, and **User Gas**).
3ThRefTV	Thermal Visc Ref Temp	59.99990	Use these parameters only if you expect to have Reynolds Number Correction turned on and expect to have a Reynolds Number of less than 20,000. For more information, see *Setting Tuning Parameters, page 68*.
3 ThRefV	Thermal Ref Viscosity	1.121900	The flowmeter uses the following thermo-coefficient equation to apply temperature correction for viscosity (for liquids only): **Viscosity = ThRefV + (Current Temperature - ThRefTV) * ThCoefV** where: where: • ThRefV is the reference viscosity of the liquid • ThRefTV is the reference temperature • ThCoefV = Δ Viscosity / Δ Temperature

Setting Tuning Parameters

The Tuning function allows you to turn the Reynolds number correction feature on or off and set the Low Flow Cut-In (LFCI).[23]

Configure the Tuning parameters from the **1 Setup > 2 Tuning** menu selection (local display) or the **Detailed Setup > Tuning** menu selection (HART Communicator).

See the *Tuning Menu Diagram, page 114* for the menu on the local display for the General and Steam personalities, see the *Tuning Menu Diagram, page 141* for the menu on the local display for the Oil & Gas personality, and see *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 37 - Tuning Parameters

Local Display	HART Communicator	Factory Default	Description
3 Rd Corr (General and Steam personalities only)	Reynolds Correction	Off	**Reynolds number correction:** Set the Reynolds number correction to On or Off.
3MaxRate (Oil & Gas personality only)	Max Rate	The Liquid upper range value for the flow meter. (line size dependent)	Maximum Flow Rate, same as upper range value.

---

23. LFCI is also known as Low Flow Cut Off (LFCO).

Table 37 - Tuning Parameters (Continued)

Local Display	HART Communicator	Factory Default	Description
3MxRt Hz (Oil & Gas personality only)	Pulse Max	Line size dependent.	Pulse output frequency that corresponds to the Max Rate flowing rate (3MaxRate).
3 LFCI > 4 FlowEGU	LFCI	gal/m (for General and Steam personalitites) and bbl/d (for Oil & Gas personality)	**LFCI Flow Units:** Set the flow units associated with the LFCI.
3 LFCI > 4Setting	LFCI - Setting	LFCI 4	**LFCI Settings:** Set the LFCI setting (LFCI 1 through LFCI 8). Higher settings reject more noise, but also require a higher flow before flow is detected.
3 LFCI > 4 LfUFac (Oil & Gas personality only)	LfUFac	1.0000000	LFCI User Factor per Model 84C Special Flowtube Confgurator.
3 FlwDmp (Oil & Gas personality only)	Filter	None	**Flow Damping Time:** Select the damping factor. Choose 0 to 32 seconds.
3 Filter (Oil & Gas personality only)	Flow Damp	FixGas	**Filter Mode:** Choices are: • Normal: Noise Filter On (Base Low Filter Limit = User URV). • FixGas: Noise Filter On (Base Low Filter Limit = Air URL). • DynGas: Noise Filter On (Base Low Filter switches). • Off: Noise Filter off.

You can also set LFCI automatically. See *Calibration and Test, page 89*.

Setting Measurement Parameters

If you map output to anything other than Flow Temperature and then change fluid parameters, the output may be affected. Check the measurement configuration settings for all mapped measurements.

Updating Measurement Parameters

To update measurement parameters:

1. Navigate to the **1 Setup > 2Measure > 3MeasCfg** menu selection (local display) or the **Detailed Status > Measurement** menu selection (HART Communicator) and configure flow damping. Choose from None, 0.25, 0.5, 1, 2 (factory default), 4, 8, 16, or 32.

   Flow damping is applied to volumetric flow, mass flow, and heat flow measurements. Flow damping does not apply to Raw measurements.

2. Configure the other measurement parameters below from the **1 Setup > 2Measure > 3MeasCfg** menu selection (local display) or the **Detailed Status > Measurement** menu selection (HART Communicator).

See the *Measurement Configuration Menu Diagram, page 115* for the menu on the local display for the General and Steam personality, see the *Oil Gas Main Menu, page 140* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

For each parameter listed below, configure the properties provided in *Measurement Properties, page 61*. Refer to the menu diagrams for the specific properties that apply to each parameter.

> **NOTE:** For convenience, the following measurement parameters can be configured from either the Fluid menu or the Measurement Configuration menus:
>
> •   Flow Temperature
>
> •   Density
>
> •   Pressure
>
> •   Viscosity

Table 38 - Measurement Parameters

Local Display	HART Communicator	Factory Default	Description
4 Config FlwVol	FlowVol Config	EGU: gal/m URV: N/A Default: 0 4AlertSt: N/A	**Flow Volume:** Configure the measurement properties associated with the volumetric flow.
4 Config FlwBVo (Not available in Steam personality)	FlowBaseVol Config	EGUTYP: StdVol EGU: Sgal/m URV: N/A Default: 0 4AlertSt: N/A	**Base Volumetric Flow:** Configure the measurement properties associated with the base volumetric flow.
4 Config Press	Pressure Config	EGU: kPaa LRV: N/A URV: N/A Default: 100.1010 4AlertSt: N/A CMethod: N/A Damp: None	**Pressure:** Configure the measurement properties associated with the pressure of the fluid. Pressure can be configured once using this command or a Host system can be used to update Pressure remotely using HART command 192 (see *Setting Digital Measurement Values Remotely, page 151*).
4 Config FlwTmp	Flow Temp Config	EGU: degF LRV: N/A URV: N/A Default: 59 4AlertSt: N/A CMethod: N/A Damp: None	**Flow Temperature:** Configure the measurement properties associated with the flow temperature. Depending on whether the Vortex flowmeter is configured with an RTD for multivariable temperature compensation, this parameter either displays the temperature of the flowing process material or allows you to enter a flow temperature. For a flowmeter with temperature compensation (Multivariable Selection T), the Flow Temperature shows the temperature of the process material flowing through the Vortex meter. For a flowmeter without temperature compensation (Multivariable Selection N), enter the flow temperature in this parameter in the specified units.

Table 38 - Measurement Parameters (Continued)

Local Display	HART Communicator	Factory Default	Description
4 Config Densty	Density Config	EGU: lb/ft³ LRV: N/A URV: N/A Default: 62.372 4AlertSt: N/A CMethod: N/A Damp: None	**Density:** Configure the measurement properties associated with the density of the fluid. If you configure the calculation method to User On, be sure to enter the reference density (ThRefD), reference temperature (ThRefTD), and the thermal coefficient of density (ThCoefD). If you choose to use a custom density unit, define your custom unit by first entering a Label for your custom unit using up to eight alphanumeric characters. Then, enter any Offset and a conversion factor (Slope) to convert from kilograms per cubic meter to the custom unit.
4 Config FlwMas	Flow Mass Config	EGU: lb/h URV: N/A Default: 59 4AlertSt: N/A	**Mass Flow:** Configure the measurement properties associated with the mass flow measurement.
4 Config Velcty	Velocity Config	EGU: ft/s URV: N/A 4AlertSt: N/A	**Velocity:** Configure the measurement properties associated with the velocity.
4 Config Visc	Viscosity Config	EGU: cPoise Default: 1.1219 4AlertSt: N/A CMethod: N/A	**Viscosity:** Configure the measurement properties associated with the viscosity of the fluid. If you configure the Calculation Method to User On, be sure to enter the reference viscosity (ThRefV), reference temperature (ThRefTV), and the thermal coefficient of viscosity (ThCoefV).
4 Config Raw	Raw Frequency	EGU: Hz URV: N/A	**Raw Vortex Frequency:** Configure the measurement properties associated with the raw vortex frequency.
4 Config EleTemp	Ele Temp Config	EGU: degF LRV: N/A URV: N/A Default: 70 4AlertSt: N/A Damp: None	**Electronics Temperature:** Configure the measurement properties associated with the temperature of the electronics module.
4 Config HtCon	Heat Content Config	EGU: degF LRV: N/A URV: N/A Default: Fluid based (0 for custom fluids) 4AlertSt: N/A CMethod: N/A	**Heat Content:**[24] Configure the measurement properties associated with the heat content.

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24. This measurement only applies to steam (SaturatedSteam and SuperHeatedSteam). Set HtCon to 0 for User Liquid, User Vapor, and User Gas.

Table 38 - Measurement Parameters (Continued)

Local Display	HART Communicator	Factory Default	Description
4 Config HtFlow	Heat Flow Config	EGU: J/sec LRV: N/A URV: N/A 4AlertSt: N/A	**Heat Flow:** Configure the measurement properties associated with the heat flow.
2 FlwEGU (Available for Oil & Gas personality only. This parameter is accessed from the **1 OilGas > 2 FlwEGU** menu selection.)	Flow Vol Units	bbl/d	**Flowmeter EGU:** (Applies to Oil & Gas personality only) Select an appropriate engineering unit for Oil and Gas applications.

Setting Totalizer Parameters

The flowmeter provides three separate totalizers that track various measurements as material flows through the meter. You can map each of the totalizers independently to track different flow measurements. For example, one totalizer can track the total volume of material that flows through the transmitter while another totalizer can track the total mass.

- When totalizing Heat Flow, the result is the total amount of Energy in the form of heat that has been transferred with the flowing fluid.
- Mass Flow is totalized to Mass.
- Velocity is the only rate that is not totalized.
- When using the Oil & Gas personality, the flowmeter supports a single totalizer labeled "Total" which is always mapped to Volumetric flow. The Total EGU follows the Volume Rate EGU (for example, bbl/d will result in a total in barrels).

In addition to the values that the totalizer accumulates, each totalizer also has a status describing the validity of the totalizer's value at a particular point in time, and a two-digit rollover counter. Each totalizer's value, status, and rollover counter value can be displayed using a variety of methods.

You can assign any totalizer's output to the HART secondary, tertiary, or quaternary variables (SV, TV, or QV). By default, the output of Totalizer 1 is mapped to the HART SV and the output of Totalizer 2 is mapped to the HART TV.

You can perform the following operations on totalizers:

- Starting totalizer accumulation
- Stopping totalizer accumulation
- Resuming totalizer accumulation
- Clearing existing totals

See *Totalizer Actions, page 92* for more information.

You can also configure each totalizer independently with the following operations:

- Changing engineering units
- Changing totalizer mapping
- Changing display formats, which also sets the rollover limit

Totalizer values, both reported and intermediate, as well as configuration and status information are persistent and are maintained over a flowmeter power cycle. An alert appears if a totalizer is turned on during a power cycle.

If a totalizer is on and the flowmeter enters an offline state:

- Totalizers that are currently on are turned off.

- The totalizer is not cleared and its value remains at the last known value, as long as the totalizer configuration is not changed. The totalizer is not cleared and its value remains at the last known value.

- Totalizer status is set to either the status at the time the flowmeter went offline or **W:Offline**, whichever is worse.

- If the totalizer configuration changes, for example, if you change totalizer mapping, engineering units, or rollover limits, the totalizer is cleared and its value is set back to zero, even if you ultimately cancel the totalizer configuration change.

When the flowmeter returns to an online state, the totalizer remains off.

Controlling Access to Totalizer Configuration and Data

You can control access to totalizer configuration and data by moving a write protect jumper in the flowmeter hardware. When using the local display, you can also control access by configuring passwords. Such safeguards are important when using totalizers for custody transfer applications, where the total flow of a material from one place to another needs to be carefully and accurately tracked, or to prevent unintentional or malicious changes to configuration and data.

For information on setting the jumper to the protect or write positions, refer to *Setting the Write Protect Jumper, page 45*.

For information on controlling totalizer access using passwords on the local display, see *Totalizer Access Restrictions, page 99*.

Totalizer Display Options

Totalizers accumulate data from their mapped flow in one of the following user-configurable formats:

- XXXXXXX
- XXXXXX.X
- XXXXX.XX
- XXXX.XXX
- XXX.XXXX
- XX.XXXXX
- X.XXXXXX

Each display format has a rollover counter and a built in rollover limit. For example, if you set the display format to **XXX.XXXX**, values up to **999.9999** will appear on the display. For values of 1,000 and above, a rollover counter is incremented and the totals that appear on the display restart at 0.

Since the rollover counter is a two-digit number on the local display, the maximum value the rollover counter can reach is 99. For rollover counters above 99, **RO **** appears on the local display, but the flowmeter continues to accumulate totals and increment the rollover counter, and the totalizer value continues to appear on the display. You can find the true value of a saturated rollover counter by using the HART Communicator (go to the **Diag/Service > Totalizers** menu selection and choose the appropriate **Totalizer x RO** value, where x = 1, 2 or 3).

Note that totalizer display formats cannot be changed while the totalizer is on. Instructions for configuring display formats for totalizers and other measurements are provided in *Configuring the Home Screen, page 83*.

Totalizer Status

Totalizer Status describes the validity of the totalizer value at a particular time. In order of least to most severe, a totalizer's status can be:

- OK

- ALERT

- BAD

A totalizer's status is "sticky," meaning that a totalizer's status will persist even if the condition causing the alert condition has cleared. For example, you may see a message indicating the mapped source's value has reached its configured hard upper limit since last clearing the totalizer. The totalizer must be explicitly cleared in order for its status to change.

Generally, totalizers inherit the status of their mapped flow measurement, with a few exceptions. First, if a flow measurement mapped to a totalizer has an OUT OF SERVICE status, the totalizer's status will be BAD. Additionally, a totalizer may set its status to a higher severity than that of the mapped flow measurement based on totalizer operation.

Like totalizer values, totalizer status persists across a flowmeter power cycle.

Configuring a Totalizer (T1, T2, or T3)

Configure each totalizer as follows:

> **NOTE:** Be aware that changing the totalizer configuration using this procedure will turn the totalizer off and clear it.

1. Configure each totalizer from the **1 Setup > 2 Total > 3 Tot1** (or **3 Tot2** or **3 Tot3**) menu selection (local display) or the **Detailed Setup > Totalizers** menu selection (HART Communicator).

   See the *Totalizer Configuration Menu Diagram, page 125* for the menu for the General or Steam personalities. The Totalizer Configuration menu is not available for the Oil & Gas personality. See *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 39 - Totalizer Parameters (for Totalizer 1, Totalizer 2, and Totalizer 3)

Local Display	HART Communicator	Factory Default	Description
4 Map	Totalizer x Map, where x=1, 2, or 3.	Volume	**Map Totalizer:** Allows you to map each totalizer to a measurement. Choose Volume, BVolume, Mass, Vor Cnt, or Energy. When mapping a totalizer, consider the following guidelines: • You cannot map a totalizer to a measurement that uses custom units at the time of mapping. If you want the mapped measurement to use custom units, configure the custom units after mapping the measurement to the totalizer. • You cannot map one totalizer as an input to another totalizer. • You cannot map two or more totalizers to the same measurement.
4 EGU	Totalizer x Units, where x=1, 2, or 3.	gal	**Engineering Units:** Allows you to configure units for each totalizer. Initially , each totalizer's EGUs are set to a non-rate version of the mapped measurement's default units. For example, if you mapped a totalizer to Volume and the volumentric flow EGU is configured to cubic feet per second, the totalizer's EGU is set to cubic feet by default. If you select Custom, define the custom unit first. First, enter a label for your custom units, using up to eight alphanumeric characters. Then, enter any offset and conversion factor (slope) to convert from base units to your custom units in kilograms (for mass units) or cubic meters (for volume or base volume units). For example, The slope for a custom unit of a 42 gallon barrel would be 6.2898 because 6.2898 bbl =1 m^3.

2. If desired, configure access to the totalizer configuration and data:

   a. For information on installing the write protect jumper, see *Setting the Write Protect Jumper, page 45*.

b. For information on configuring passwords (local display only), see *Using Passwords, page 97*.

3. If desired, configure the totalizer display options, which also sets the rollover limit. See *Configuring the Home Screen, page 83*.

4. To turn the totalizer on, see *Totalizer Actions, page 92*.

Setting Output Parameters

The Output function allows you to configure communication parameters (including mapping measurements to HART outputs), mA output, pulse output, and display parameters.

Mapping Measurements to HART Outputs

You can map four separate flowmeter measurements to specific HART output variables: primary variable (PV), secondary variable (SV), tertiary variable (TV), and quaternary variable (QV). The measurement that is mapped to the PV will drive the 4 to 20 mA analog output.

NOTE: When a measurement is mapped to the PV, the Alert Strategy (AlertSt) will be set to On Alert (AlertBad). This is to ensure notification via the configured NAMUR settings.

This table shows the measurements and the HART outputs to which each measurement can be mapped. You can map outputs to only one measurement at a time.

Table 40 - Mapping Measurements to HART Outputs

Measurement	HART (mA) PV	HART SV	HART TV	HART QV
Volumetric Flow Rate (VolFlow)	Yes (Default)	Yes	Yes	Yes
Base Volumetric Flow Rate (BVolFlow)	Yes	Yes	Yes	Yes
Mass Flow Rate (MassFlow)	Yes	Yes	Yes	Yes
Velocity	Yes	Yes	Yes	Yes
Pressure (via HART)		Yes	Yes	Yes
Flow (Process) Temp. (FlwTmp)	Yes	Yes	Yes	Yes
Density		Yes	Yes	Yes
Viscosity		Yes	Yes	Yes
Electronics Temp.		Yes	Yes	Yes
Heat Content		Yes	Yes	Yes
Heat Flow	Yes	Yes	Yes	Yes
Reynolds		Yes	Yes	Yes
Totalizer1		Yes (Default)	Yes	Yes
Totalizer2		Yes	Yes (Default)	Yes
Totalizer3		Yes	Yes	Yes
mA Output				
Pulse Output (Pulse)		Yes	Yes	Yes
Raw Vortex				

Table 40 - Mapping Measurements to HART Outputs (Continued)

Measurement	HART (mA) PV	HART SV	HART TV	HART QV
Vortex Signal (Vor Freq)	Yes	Yes	Yes	Yes (Default)
Rtd Ohms		Yes	Yes	Yes
1/Kref (K Actual)		Yes	Yes	Yes
K Flowing				

Map the measurements to HART outputs one measurement at a time from the **1 Setup > 2 Output > 3 Coms > 4Com Map** menu selection (local display) or from the **Detailed Setup > Output Configuration > Digital Output** menu selection (HART Communicator).

See the *Communications Mapping (Com Map) Menu Diagram (1 of 2), page 126* for the menus on the local display for the General and Steam personalities, see the *Output Menus - Communication Mapping (Com Map) Menu Diagram (1 of 2), page 143* for the menus on the local display for the Oil & Gas personality, and see *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 41 - Parameters for Mapping Measurements to HART Outputs

Local Display	HART Communicator	Factory Default	Description
5 Map PV	mA/PV Map	VolFlow	**Map Primary Variable:** Map a valid measurement to the HART primary variable. This measurement drives the 4 to 20 mA output.
5 Map SV	SV Map	Totalizer1	**Map Secondary Variable:** Map a valid measurement to the HART secondary variable.
5 Map TV	TV Map	Totalizer2	**Map Tertiary Variable:** Map a valid measurement to the HART tertiary variable.
5 Map QV	QV Map	VorFreq	**Map Quaternary Variable:** Map a valid measurement to the HART quaternary variable.

Setting Communication Parameters

1. Configure the Communications parameters from the **1 Setup > 2 Output > 3 Coms** menu selection (local display) or the **Detailed Setup > Output Configuration > HART Output** menu selection (HART Communicator).

   See the *HART Communication and Tag Configuration Menu Diagram, page 128* for the menu on the local display for the General and Steam personalities, see the *Output Menus - HART Communication and Tag Configuration Menu Diagram, page 142* for the menu on the local display for the Oil and Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 42 - Communication Parameters

Local Display	HART Communicator	Factory Default	Description
4PolAdr	Poll addr	0	**Poll Address:** Specify the poll address from a list of numbers from 0 to 63.
4Preambl	Num req preams	5	**Preambles:** Set the number of preambles between 2 and 20.
4LoopCur	Loop current mode	Enabled	**Loop Current:** Enable or disable Loop Current Mode. By default, this parameter is enabled and the flowmeter operates with a 4 to 20 mA output signal. To lock the flowmeter's mA output to a fixed value of 3.8 mA, disable Loop Current Mode.

2. Configure the HART identification parameters from the **1 Setup > 2 Output > 3 Coms > 4 Tags** menu selection (local display) or the **Detailed Setup >**

Output Configuration > Device Information menu selection (HART Communicator).

Table 43 - Identification Parameters

Local Display	HART Communicator	Factory Default	Description
5HartTag	Tag	N/A	**HART Tag:** Set the HART tag (up to 8 characters).
5HartLtg	Long Tag	N/A	**HART Long Tag:** Set the HART long tag (up to 32 characters).
4HartMsg	Message	N/A	**HART Message:** Set the HART message (up to 32 characters).
5HartDes	Descriptor	N/A	**HART Descriptor:** Set the HART device descriptor (up to 16 characters).

Configuring mA Output

Configure mA output from the **1 Setup > 2 Output > 3 mA** menu selection (local display) or the **Detailed Setup > Output Configuration > Analog Output** menu selection (HART Communicator).

> **NOTE:** You cannot configure the mA output with Low Power flowmeters or if Loop Current Mode is disabled.

See the *mA Output Configuration Menu Diagram, page 129* for the menu on the local display for the General and Steam personalities, see the *Output Menus - mA Output Configuration Menu Diagram, page 145* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 44 - mA Outputs

Local Display	HART Communicator	Factory Default	Description
4 Map	mA/PV Map	VolFlow	**Measurements to Map:** Select the measurement to which you want to map the mA output: VolFlow, BVolFlow, FlwTmp, MassFlow, Velocity, Vor Freq, or HeatFlow. • You cannot map the mA output to flow temperature (FlwTmp) unless your flowmeter is configured to measure process temperature (Multivariable T model code selection). • When a measurement is mapped to the mA output, the Alert Strategy (AlertSt) is set to On Alert (AlertBad) to ensure notification via the configured NAMUR settings.
4 Damp	mA Damp	No	**Damping:** Select the damping factor (10 to 32 seconds).
4Fail	N/A	DwnScale	**Failure:** Configure the mA output to go downscale (low) or upscale (high) upon a failure. This parameter is only available when Loop Current Mode is enabled.

Configuring Pulse Output

The flowmeter produces a pulse signal in addition to the standard signal. You can configure the flowmeter's pulse output to one of the following modes:

- **Pulse Output, Raw mode** generates a pulse frequency according to the detected raw vortex frequency after filtering according to the low flow cut-in (LFCI) parameter.
- **Pulse Output, Pulse mode** generates one pulse output per given quantity of material flowing through the sensor. Valid measurement mappings are shown in the table.
- **Pulse Output, Frequency mode** generates a pulse frequency proportional to a mapped measurement. Valid measurement mappings are shown in the table.

- **None** allows you to turn off the pulse output capability. When Pulse Output is off, the flowmeter maintains its digital output continuously in the non-conductive state.

Table 45 - Mapping Measurements to Pulse Outputs

Measurement	Raw Mode	Pulse Mode	Freq Mode
Volume Rate (VolFlow)		Yes (Default)	Yes (Default)
Base Volume Rate		Yes	Yes
Mass Flow Rate		Yes	Yes
Pressure			Yes
Flow (Process) Temp			Yes
Density			Yes
Raw Vortex	Yes		Yes
Vortex Signal		Yes	Yes
Heat Content			Yes
Heat Flow		Yes	Yes

Configuring Pulse Output, Raw Mode

Use Pulse Output, Raw mode if you want to generate a pulse frequency according to the detected raw vortex frequency.

To configure raw mode, navigate to the **1 Setup > 2 Output > 3 Pulse > 4 Pulse** menu (local display) or **Device Setup > Detailed Status > Pulse Output > Pulse Mode** menu (HART Communicator), and select **Raw** as the type of pulse output.

(Applies to local display only) When the flowmeter enters an offline state (for example, if you enter the Setup or Cal/Test menus), Pulse Output becomes zero. When the flowmeter returns to an online state, the Pulse Output returns to the raw output.

Configuring Pulse Output, Pulse Mode

Use Pulse Output, Pulse mode if you want to track the total quantity of material flowing through the sensor and generate individual pulse output signals for each fixed quantity of material that flows through the sensor.

Consider the following points when using Pulse Output, Pulse mode:

- Turning Pulse Output, Pulse mode On clears the accumulated pulse output values. Resume turns Pulse mode on without clearing the values. To turn Pulse Output, Pulse mode on, see *Pulse Actions, page 92*.

- The Pulse Factor parameter allows you to configure either the number of flow units one pulse output signal represents (units per pulse) or the number of pulse output signals that represent a single unit of flow (pulses per unit).

- The Pulse Factor's engineering units are configured in the Pulse Factor Units parameter.

    ◦ When you initially enter Pulse mode, the Pulse Factor engineering units parameter is set to the non-rate version of the currently mapped source's engineering units (EGUs). For example, if pulse output is mapped to VolFlow and the units for volumetric flow are gallons per second, the Pulse Factor engineering units parameter is set to gallons.

        – If the mapped source is configured with custom units at the time of mapping, mapping will not be allowed. The mapped source EGU can be

changed to custom units after mapping, but this will have no effect on the Pulse Factor engineering units parameter.

◦ The Pulse Factor engineering units parameter is set automatically when entering Pulse mode, or when mapping or remapping the pulse output. However, the Pulse Factor engineering units parameter does not automatically update when the units associated with the mapped source change.

◦ You can also set the Pulse Factor engineering units parameter from a list of options when you are configuring Pulse output, Pulse mode.

• Because the pulse duty cycle is fixed at 50%, configuring the minimum pulse width can limit the frequency of the pulse output. The pulse width limits the frequency of the pulse output because of the signal's 50% duty cycle. For example, configuring a pulse width of 50 ms means that the fastest the pulse signal will be sent out is at 10 Hz: $1/(2 \times 0.05 \text{ s}) = 10$ Hz

The following table shows the minimum pulse width settings and their maximum frequency equivalents. Alternatively, you can select a custom pulse width between 0.05 and 500 ms.

> **NOTE:** If the value of the rate measurement mapped to the Pulse Output exceeds its Upper Range Value, the actual pulse output frequency may exceed the maximum frequency shown in the table by up to 5%.

Table 46 - Minimum Pulse Widths and Maximum Frequency Equivalents

Minimum Pulse Width	Maximum Frequency Equivalent
0.05 ms	10,000 Hz
0.5 ms	1,000 Hz
5 ms	100 Hz
50 ms	10 Hz
Custom (user entered value between 0.05 ms and 50 ms)	10 Hz – 10,000 Hz

• As shown in *Pulse Output Mapping to Rate Measurement, page 80*, the Pulse Factor setting (Pulse Factor Units per Pulse or Pulse Factor Pulses per Unit) and Minimum Pulse Width settings are bounded such that the Maximum Frequency represents at most the Upper Range Value and at least, the minimum span of the mapped measurement.

Any attempt to set the Pulse Factor or Minimum Pulse Width to a value would require:

◦ A Pulse Frequency greater than the Maximum Frequency to represent the mapped measurement's Upper Range, or

◦ A Pulse Frequency less than the Minimum Frequency to represent the mapped measurement's minimum span will be rejected by the transmitter.

Figure 32 - Pulse Output Mapping to Rate Measurement
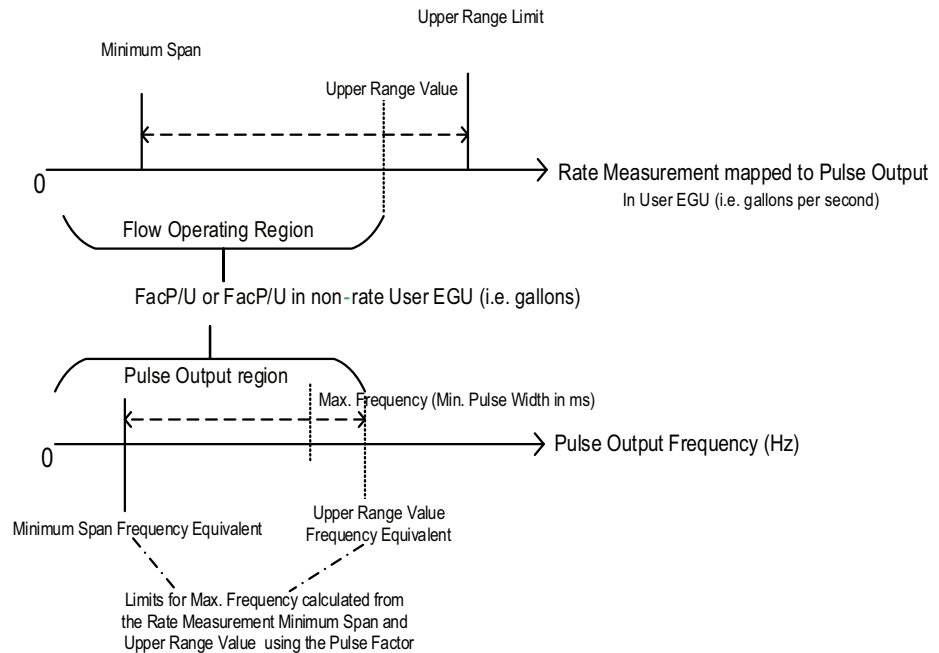
- When the transmitter enters an offline state, for example, if you enter the Setup menu, the following actions are taken, even if you ultimately cancel the configuration change.

  ◦ Pulse Output is turned off and becomes zero.

  ◦ Pulse output status is set to the worse of **W:Offline** and status before it went offline.

  ◦ When the transmitter returns to an online state, Pulse Output remains off and remains at zero, and the status remains set.

- If the pulse output configuration changes, for example, if you change pulse output mapping, the pulse output is cleared and its value is set back to zero, even if you ultimately cancel the configuration change.

- If the flowmeter has an alert, the following occurs:

  ◦ Output will be set to 0 Hz. The Pulse Output does not accumulate for the duration of the alert.

  ◦ A status is set.

  ◦ A diagnostic alert will be set by the source of the alert.

  ◦ If the flowmeter recovers from the alert, the original output will resume, but the status and diagnostic error remain.

  ◦ Pulse output continues during a self-test operation, but the output does not represent a valid flow measurement.

  ◦ Similar to totalizers, the pulse accumulation can be stopped and resumed.

Configure Pulse Output, Pulse mode from the **1 Setup > 2 Output > 3 Pulse** menu selection (local display) or the **Device Setup > Detailed Setup > Output Configuration > Pulse Output** menu selection (HART Communicator).

See the *Pulse Output, Pulse Mode Configuration Menu Diagram, page 130* for the menu on the local display for the General and Steam personalities. The Pulse Output, Pulse Mode Configuration menu is not available for the Oil and Gas personality. See the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 47 - Pulse Output, Pulse Mode Parameters

Local Display	HART Communicator	Factory Default	Description
4 Pulse	Pulse Mode	Freq	**Pulse Mode:** Select **Pulse** to configure the Pulse Output to pulse mode.
4MapPul	Pulse Map	VolFlow	**Pulse Map:** Select the measurement to which you want to map the pulse output. Choose VolFlow, BVolFlow, MassFlow, Vor Freq, or Heat Flow.
4PWidth	Pulse Width	5 ms	**Pulse Width:** Select the pulse width, which is a function of the mapped flow rate, how much flow each pulse represents, and the maximum pulse frequency. Choose standard pulse widths of 0.05, 0.5, 5, or 50 ms, or select Custom. Keep in mind that configuring the pulse width may also limit the frequency of the pulse output because of the signal's 50% duty cycle. See *Minimum Pulse Widths and Maximum Frequency Equivalents, page 79*.
4FacEGU	Fac Units	gal	**Pulse Factor Units:** Select the engineering units that the Pulse Factor will (see the Pulse Factor Units Per Pulse or Pulse Factor Pulses per Unit parameters below). If possible, this parameter is initially set to the non-rate version of the currently configured mapped source's EGUs. For example, if Pulse Output is mapped to VolFlow and the units for volumetric flow are gallons per second, Pulse Factor Units would be gallons.
4 FacU/P	Fac Units per Pulse	1	**Pulse Factor Units per Pulse** and **Pulse Factor Pulses per Unit:** Enter the Pulse Factor. You can choose to configure the number of flow units one pulse output signal represents (units per pulse) or conversely, you can configure the number of pulse output signals that represent a single unit of flow (pulses per unit). • If you want to configure the number of units per pulse, navigate to units per pulse and enter the number of flow units represented by one pulse signal. The opposite Pulse Factor, pulses per unit, updates automatically. • If you want to configure the number of pulses per unit, navigate to pulses per unit and enter the number of pulses that will represent one unit of flow. The opposite Pulse Factor, units per pulse, updates automatically.
4 FacP/U	Fac Pulses per Unit	1	

Configuring Pulse Output, Frequency Mode

Use Pulse Output, Frequency mode if you want to generate a pulse frequency proportional to a mapped measurement.

Consider the following points when using Pulse Output, Frequency mode:

- (Applies to local display only) When the flowmeter enters an offline state, for example if you select the Setup or Calibration/Test menus, pulse output becomes zero. When the flowmeter returns to an online state, the pulse output returns to the calculated pulse frequency.

- Pulse output continues during a self-test operation, but the output does not represent a valid flow measurement.

- If the output frequency is less than 0.5 Hz, the pulse output is held permanently non-conducting.

- Pulse output produces outputs up to 125% of the pulse URV. For example, if the pulse URV is 100 Hz, the flowmeter will continue to transmit a linear output up to 125 Hz, but will not exceed 125 Hz.

- If the source measurement **AlertSt** is set to AlertBad and the source measurement has an alert, the following occurs:

  ◦ Output will be set to the user-selected default frequency; however, the pulse output signal transmitted will be 0 or ≥ 150% of the pulse URV.

  ◦ A status is set.

  ◦ A diagnostic alert will be set by the source of the alert.

- ◦ If the flowmeter recovers from the alert, the original output will resume and the status returns to OK, but the diagnostic alert remains.
- • If the source measurement alert strategy is set to On Alert Continue and the source measurement has an alert, the pulse output follows the source measurement and could go up to, but will not exceed, 125% of the selected output.

Configure Pulse Output, Frequency mode from the **1 Setup > 2 Output > 3 Pulse** menu selection (local display) or the **Device Setup > Detailed Setup > Output Configuration > Pulse Output** menu selection (HART Communicator).

See the *Pulse Output, Frequency Mode Configuration Menu Diagram, page 131* for the menu on the local display for the General and Steam personalities. The Pulse Output, Frequency Mode Configuration menu is not available for the Oil & Gas personality; however the Pulse per Unit Factor parameter is available from the Oil & Gas main menu (see *Oil Gas Main Menu, page 140*. See *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 48 - Pulse Output, Frequency Mode Parameters

Local Display	HART Communicator	Factory Default	Description
4 Pulse	Pulse Mode	Freq	**Pulse Mode:** Select **Freq** or **Frequency** to configure the Pulse Output to pulse frequency.
4MapFreq	Frequency Map	VolFlow	**Map Frequency:** Select the measurement to which you want to map the pulse output. Choose VolFlow, BVolFlow, MassFlow, Velocity, Vor Freq, Density, FlwTmp, Heat Con, or Heat Flow.
4 LRV	Frequency LRV	0	**Lower Range Value:** LRV should be 0, indicating a no flow condition.
4 URV	Set Frequency URV	1000	**Upper Range Value:** Set the output frequency that corresponds to the mapped measurement's upper range value. Choose 10, 100, 1000, 10,000, or Custom..
4DefFrq	Set Default Frequency	0.000 Hz	**Default Frequency:** Set the offline default frequency end point. Values are limited to 0 or ≥ 150% of the mapped measurement's Upper Range Value (URV).
4 Damp	Damping	None	**Damping:** Select the damping factor. Choose 0 to 32 seconds.
2 Puls/U (Available for Oil & Gas personality only. This parameter is accessed from the **1 OilGas > 2 Puls/U** menu selection.)	Pulse Frequency Factor	4200	**Pulse per Unit Factor:** (Applies to Oil & Gas personality only) Enter the number of pulse output signals that represent a single flow unit.

Turning Off Pulse Mode

To turn pulse output off, navigate to the **1 Setup > 2 Output >3 Pulse > 4 Pulse** menu (local display) or the **Device Setup > Detailed Setup > Output Configuration > Pulse Output > Pulse Mode** menu (HART Communicator), and select **None**.

Pulse Output Status

Pulse Output Status describes the validity of the pulse output value at a particular point in time. In order of least to most severe, a pulse output status can be:

- • **OK**
- • **ALERT**
- • **BAD**

When the flowmeter is in Pulse mode, the pulse status is "sticky," meaning that the status will persist even if the condition causing the alert condition has cleared.

For example, you may see **B:>HardU**, which means that the mapped source's value has reached its configured hard upper limit since last clearing the pulse output. You must explicitly clear the pulse output total value for its status to change. Generally, pulse output inherits the status of its mapped flow measurement, with a few exceptions. First, if a flow measurement mapped to the pulse output has an **OUT OF SERVICE** status, the pulse output status will be **BAD**. Additionally, pulse output may set its status to a higher severity than that of the mapped flow measurement based on operation. Like pulse values, pulse status persists across the flowmeter power cycle.

Configuring the Home Screen

The following measurements can be configured to appear on the home screen:

- FlwVol: Volume flow
- FlwBVo: Base volume flow
- FlwMas: Mass flow
- Velcty: Velocity
- Total1: Totalizer 1 reading
- Total2: Totalizer 2 reading
- Total3: Totalizer 3 reading
- Densty: Density
- Visc: Viscosity
- Press: Pressure
- FlwTmp: Process Temperature
- mA Out: Milliamp Output
- PulFrq: Pulse Output frequency (in Frequency mode) or Pulse Output total value (in Pulse mode)
- Raw: Raw Vortex Count
- Heat Content: HtCon
- Heat Flow: HtFlow

   NOTE: You cannot change totalizer display formats while the totalizer is accumulating values.

Choose whether each measurement will be displayed (On) or hidden (Off). On the local display, you also select the display format for each measurement that is turned on. The following are display formats for most measurements:

AutoFormat	**XXXXX.XX**	**XX.XXXXX**
XXXXXXXX	**XXXX.XXX**	**X.XXXXX**
XXXXXX.X	**XXX.XXXX**	**XXXXeXXX**

If you select **AutoFormat**, the flowmeter selects the most appropriate display format based on the measurement's upper range value.

Configure the home screen from the **1 Setup > 2 Output > 3Display** menu selection (local display) or the **Detailed Setup > Output Configuration > Local Display** menu selection (HART Communicator).

See the *Display Configuration Menu Diagram (1 of 2), page 132* for the menus on the local display for the General and Steam personalities, see the *Output Menus - Display Configuration Menu Diagram (1 of 2), page 146* for the menus on the local display for the Oil & Gas personality, and see *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 49 - Home Screen Parameters

Local Display	HART Communicator	Factory Default	Description
4CfgShow > 5 Select 4 CfgShow > 5 Select > 6 Show 4 CfgShow > 5 Select > 6 Format	Show	FlwVol: On/AutoFmt The remaining measurements are set to Off/ AutoFmt: FlwBvo, FlwMas, Velcty, Tot1, Tot2, Tot3, Densty, Visc, Press, FlwTmp, mAOut, PulFrq, Raw, HtCon, HtFlow	**Show Measurements:** Select the measurements to be shown on the display. Specify whether each measurement should be displayed (turned on) or not display (turned off). For the local display only, specify the display format for each measurement that is turned on.
4Show1st	Primary Display	FlwVol	**Show First:** Select the measurement that will appear first when the measurements are automatically or manually scanned on the display. Only the Show Measurements parameters that have been turned On are displayed and available for selection.
4 Cycle	Display Cycle	Manual	**Display Cycle:** Specify whether the list of measurements configured will be scanned automatically (Auto) or manually (Manual). For example, if you specify that Total1 should be shown first and you set the Display Cycle to Manual, the Totalizer 1 reading appears first and you can manually cycle through the other configured measurement parameters.

Setting Piping Parameters

Configure piping from the **1 Setup > 2 Pipe** menu selection (local display) or the **Detailed Setup > Pipe** menu selection (HART Communicator).

See the *Pipe Configuration Menu Diagram, page 135* for the menu on the local display for the General and Steam personalities, see the *Pipe Configuration Menu Diagram, page 147* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 50 - Piping Parameters

Local Display	HART Communicator	Factory Default	Description
3 Piping > 4 Config	Piping > Piping Configuration	Straight	**Upstream Piping Configuration:** Select the upstream piping configuration from the following: • 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 perpendicular to plane of closest elbow and distance between elbows is 5 pipe diameters) • Reducer See *Piping Configurations, page 86*.
3 Piping > 4 UpDist	Piping > Upstream Distance	0	**Upstream Distance:** Enter the distance to the first upstream flow disturbance in pipe diameters.
3BoreSch	Bore Schedule	Sched 40	**Bore Schedule:** Select the pipe bore. Choose from Sched 10, Sched 40 Sched 80, PN16, PN40, PN64, PN100, or Sanitary.
3 Custom	Custom K Reference Bias	0	**Custom Kref Bias:** Input the Kref Bias in percent (%). For example, to change Kref by 2%, enter 2.0000.

Figure 33 - Piping Configurations
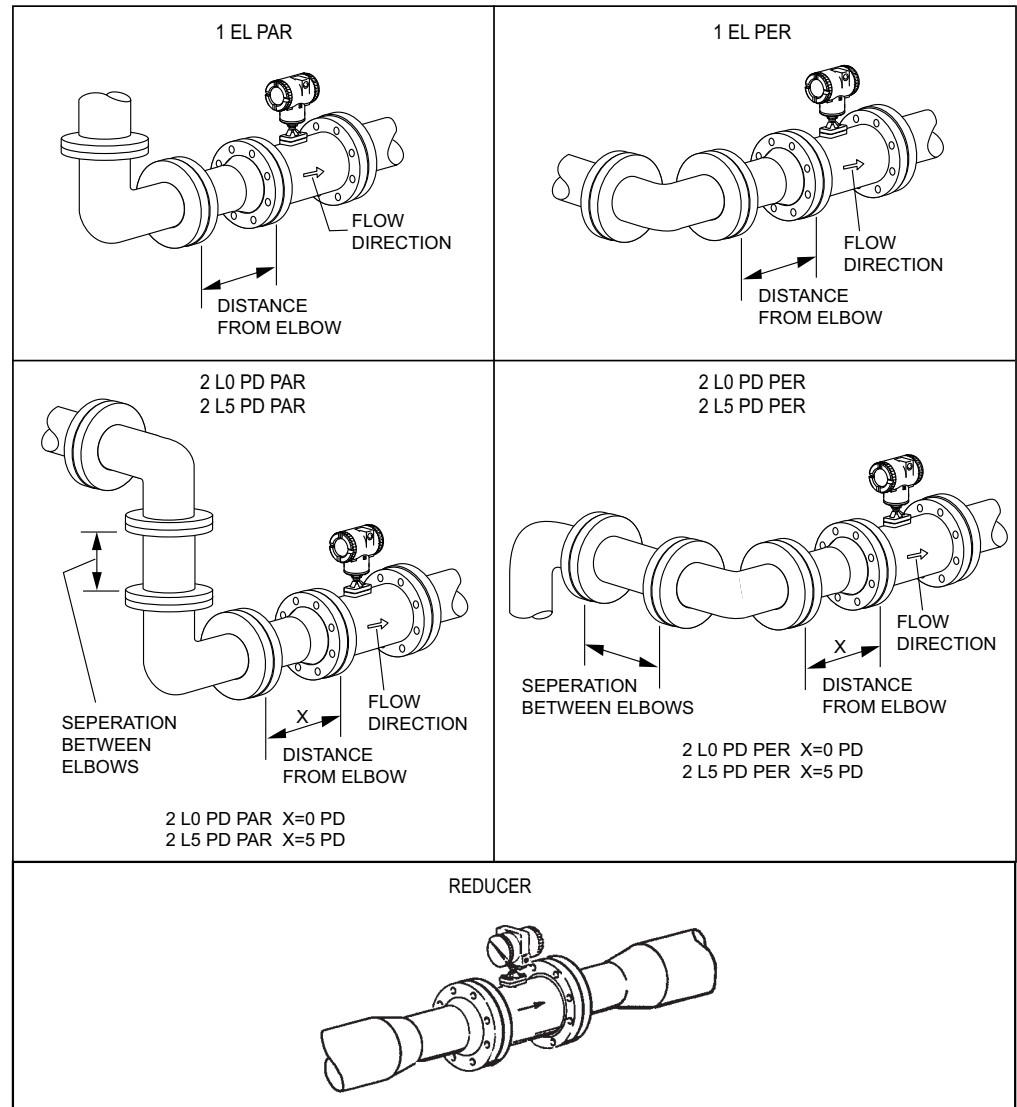
Setting Flowtube Parameters

Configure flowtube parameters such as model code, serial number, and the K Factor from the **1 Setup > 2 NewMod** menu selection (local display) or the **Detailed Setup > New Tube** menu selection (HART Communicator).

See the *NewMod Configuration Menu Diagram, page 136* for the menu on the local display for the General and Steam personalities, see the *NewMod Configuration Menu Diagram, page 148* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 51 - Flowmeter Parameters

Local Display	HART Communicator	Factory Default	Description
3 Model	Model Code	N/A	**Model Code:** Enter the model code of the flowtube as found on the flowmeter tag. If the flowtube and electronics were shipped as a unit, the model code was preconfigured. NOTE: When entering the Model Code, do not select a space character as it will truncate the entered string and process the model code entry incorrectly.
3 Ref No	Reference Number	123456789abc-defg	**Reference Number:** Enter the reference number (serial number) of the flowtube (16 characters maximum) as found on the flowmeter tag. The reference number was preconfigured if the flowtube and electronics were shipped as a unit. Update the reference number only if you have modified the flowmeter model code. Do not change the model code or the reference number if the transmitter was shipped with the flowtube as a unit.
3 K Ref > 4 K EGU	K Reference > K Corrected Units	p/ft^3	**K Reference Units:** Select the unit for the reference K-factor. See *Units, page 15*.
3 K Ref > 4 K Ref	K Reference > K Reference	258	**Reference K Factor:** Enter the reference K-factor as found on the flowmeter tag.

Setting Advanced Options

Configure advanced options from the **1 Setup > 2 Advance** menu selection (local display) or the **Detailed Setup > Advance** menu selection (HART Communicator).

See the *Advanced Options Menu Diagram, page 136* for the menu on local display for the General and Steam personalities, see the *Advanced Options Menu Diagram, page 148* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Table 52 - Advanced Option Parameters

Local Display	HART Communicator	Factory Default	Description
3 Per Sel	Personality	General	**Personality:** Select the personality to be used for this application. Choose from General, Steam, or Oil & Gas. NOTE: When you change from one personality to another, many configuration parameters are automatically set to default values. NOTE: Pulse must be turned off before changing the personality.
3AdvOpts[25]	N/A	N/A	**Advanced Options:** The selections provide a additional options for configuring custom flowtubes. Contact Global Customer Support for information and assistance.

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25. This menu is reserved for advanced options.

Table 52 - Advanced Option Parameters (Continued)

Local Display	HART Communicator	Factory Default	Description
3SetMode	N/A	Normal	**Menu Mode:** Select the menu mode to be used. Select Normal (the default), ViewOnly, or ShowAll. • Normal: Only the appropriate configuration-specific menu items are visible in the menu system. For example, because the mA output is set to a fixed value for low power vortex flowmeters, the mA Output does not appear when you view the menu in Normal mode. • ViewOnly: Like Normal mode, only the appropriate configuration-specific menu items are visible in the menu system. In this mode, the menu system is read-only. With the exception of changing the menu mode, you cannot make any changes to the flowmeter's configuration or operating parameters. • ShowAll: All menu entries, regardless of whether they apply to the current configuration, are shown in the menu system. Only safety limits are applied to lists and enterable fields; otherwise, all options are shown in the menu system.
3NoiseRd	Noise Reduction Behavior	Method1	**Noise Reduction Method:** The flowmeter provides noise reduction methods which can be applied to the Raw Vortex frequency measurement in noisy environments. Select either Method1 or Basic: • Method1: Default behavior. If the Raw Vortex frequency exceeds its Soft Limit, the reported frequency is clamped when it reaches a value slightly above the Soft Limit value. The Raw Vortex frequency status is set to **W:>SoftU**, indicating it has exceeded its Soft Limit, and the VolumeFlow, MassFlow, and BaseVolumeFlow Rates will be calculated using the reported Raw Vortex frequency based on the Flow damping setting. The status of all Flow Rates is set according to the selected **AlertSt** (see the Alert Strategy parameter in *Measurement Properties, page 61*). • Basic: Selects the behavior of the previous models, 84 Style A and Style B. When the measured VolumeFlow, MassFlow, or BaseVolumeFlow Rate exceeds its Hard Limit, Flow damping is bypassed and the reported Rate is set to the corresponding Hard Limit value. Totalization and Pulse Output then follow the Reported Rate value. The status of all Flow Rates is set according to the selected **AlertSt** (see the Alert Strategy parameter in *Measurement Properties, page 61*). This should only be used if you desire an immediate indication via a full scale Rate value being reported, when an undamped rate measurement exceeds its Hard Limit, even momentarily.

Resetting the Database

To reset the flowmeter to its factory default values:

1. Navigate to the **1 Setup > 2 SetDef** menu selection (local display) or the **Detailed Setup > Advance** menu selection (HART Communicator).

   See the *Resetting the Database Menu Diagram, page 136* for the menu on the local display for the General and Steam personalities, see the *Oil Gas Main Menu, page 140* for the menu on the local display for the Oil & Gas personality, or see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

2. When prompted to reset to the factory defaults, choose **Yes**.

3. The message **DONE** displays.

4. Save the configuration changes.

Calibration and Test

The following Calibration and Test functions can be performed on the flowmeter.

- Set the Low Flow Cut-In (LFCI)
- Calibrate the 4 and 20 mA output
- Calibrate the process temperature (if the flowmeter has an optional temperature sensor, RTD)
- Clear the Time in Service meter
- Use the flowmeter to test the loop
- Use the flowmeter to test the pulse output

See the *Calibration/Test Menu Diagram, page 137* for the menu on the local display for the General and Steam personalities, see the *Calibration/Test Menu Diagram, page 149* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

Calibration

You can set the automatic LFCI, calibrate the 4 mA and 20 mA outputs, and calibrate the process temperature (if your flowmeter has an optional temperature sensor) from Calibration.

Automatic LFCI Selection

The flowmeter's Auto-LFCI function automatically sets the Low Flow Cut-In threshold to reject ambient no-flow noise conditions; the flowmeter chooses the lowest level at which no signal is detected over a fixed time interval.

> **NOTE:** The Auto-LFCI function is NOT a dynamically adjusting value.

This one-time function "watches" a zero-flow condition and determines the best LFCI setting. The zero flow is based on seeing a nonzero reported vortex frequency. The flowmeter uses this LFCI setting until you change it manually or run the Auto-LFCI function again.

If the LFCI gets to the largest LFCI value and still detects a vortex frequency, the Auto-LFCI function reports it. It does not change the LFCI setting. In this case, you can set the LFCI manually.

The flow must be zero during this procedure.

> **NOTE:** This procedure may confirm your choice of LFCI setting in *Setting Tuning Parameters, page 68*. However, if it selects a different value, it overwrites your selection unless you cancel the changes.

1. Set the process flow to zero.

2. Select **1Cal/Tst > 2 Calib > 3CalLFCI** (local display) or **Diag/Service > Auto LFCI** (HART Communicator).

   The flowmeter starts testing the most sensitive LFCI setting. If a false flow signal is detected within a fixed time period, the LFCI is increased to the next level. This process continues until a level is reached where the flowmeter does not detect any false flow signals. While the function is executing, **Busy** and the maximum time remaining appear on the display.

When complete, the new LFCI setting appears on the display.

Calibrating the 4 mA and 20 mA Outputs

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 addition, you cannot perform this procedure on low power Vortex flowmeters or on standard flowmeters where the Loop Current Mode is disabled. In both cases, the mA output is set at a fixed value: 10 mA for low power flowmeters and 3.8 mA for flowmeters with Loop Current Mode disabled.

To calibrate the flowmeter's 4 and 20 mA outputs, perform the following steps:

1. Set the flow to zero.

2. Select to calibrate the 4 to 20 mA output by selecting **1 Setup > 2 Calib > 3 Cal mA** (local display) or **Diag/Service > Calibration** (HART Communicator).

   a. Select **4Restore** (local display) or **Restore mA Calibration** (HART Communicator) to restore the factory calibration.

   b. Select **4Cal 4mA** and **4Cal20mA** (local display) or **D/A Trim** or **Scaled D/A Trim** (HART Communicator) to 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.

   c. Select **4CalDate** (local display) or **Calibration Date** (HART Communicator) and enter the date of the last calibration, if desired.

   d. Select **4Initial** (local display) and enter the initials of the person who performed the last calibration, if desired. **4Initial** is not available on the HART Communicator.

Calibrating the Temperature Sensor

If your flowmeter has an optional temperature sensor (RTD), you can calibrate the temperature sensor or restore the sensor's factory calibration. Calibration of the temperature sensor is normally not required. This calibration procedure adds an offset to match another device.

To calibrate the temperature sensor:

1. Navigate to the **1Cal/Tst > 2 Calib > 3 CalRtd > 4CalUser** (local display) or **Diag/Service > RTD Calibration** (HART Communicator).

2. Select **5RtdEgu** (local display), or follow the prompts on the screen (HART Communicator). Note the engineering units used by the temperature sensor.

3. Select **5CurTmp** (local display), or follow the prompts on the screen (HART Communicator). Enter the current temperature in the selected engineering units.

4. Save your changes.

Restoring the Temperature Sensor Factory Settings

To restore the temperature sensor's factory calibration settings:

1. Select **1Cal/Tst > 2 Calib > 3 CalRtd > 4Restore** (local display) or **Diag/Service > RTD Calibration > Restore RTD Calibration** (HART Communicator).

   The message **Applying** appears on the display.

2. Save your changes.

Clearing the Time in Service Meter

The flowmeter has a Time in Service meter which tracks the number of days that the flowmeter has been in service. The Clear Time in Service function allows you to clear the User-Managed Time in Service meter that reports the number of days the flowmeter has been in service since the last reset.

To reset the Time in Service meter:

1. Navigate to **1 Cal/Tst > 2 Calib > 3ClrSrvT** and select **ENTER**.

2. At the **Clr Now?** prompt, select **ENTER**.

3. When the Time in Service meter has been reset, a **DONE** prompt displays.

Test

In Test mode, you can self test the flowmeter or use the flowmeter to test the loop.

Testing the Loop

The flowmeter can 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, frequency pulse output, or digital output signals to any value within the range limits of the meter.

> **NOTE:** You cannot set the mA output with Low Power flowmeters or if Loop Current Mode is disabled.

To test the loop:

1. Navigate to **1 Cal/Tst > 2 Test** (local display) or **DIag/Service > Loop Test** (HART Communicator) and select the calibration source:

    - Analog output: **3 Set mA** (local display) or **Set Analog Out** (HART Communicator)

    - Frequency pulse output (applies to Pulse Frequency Mode): **3 Set Hz** (local display) or **Set Pulse Out** (HART Communicator)

    - Digital output **3 Set DIG** (local display) or **Set Digital Out** (HART Communicator)

    Set the selected signal to any value within the range limits of the meter.

2. Save your changes.

Testing the Flowmeter

The self test 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.

During the self test, the status of measurements will be set to **Offline**. In addition, totalizer values will not be updated, but totalizer status will indicate that the totalizer has not been running for a period of time.

To run a self-test:

1. Select **1 Cal/Tst > 2 Test > 3SelfTst** (local display) or **Diag/Service > Self Test** (HART Communicator).

    Pulse output continues during a self-test operation, but the output does not represent a valid flow measurement.

2. Clear the totalizers after the self test. Refer to *Totalizer Actions, page 92* for instructions.

Pulse Actions

If Pulse Output is configured for Pulse mode, the number of pulse signals that the flowmeter transmits up to the current point in time represents the total flow value up to that point, where individual pulse signals represent a user-specified amount of the total flow value.

You can control how the flowmeter starts and stops the accumulation of the total flow value.

When in Pulse mode, Pulse Output can be in one of two states:

- ON: The flowmeter is actively accumulating values and transmitting pulse signals.
- OFF: The flowmeter is not actively accumulating values or transmitting pulse signals, and any previously collected values may or may not have been cleared.

For information on the flowmeter's pulse output and how to configure pulse output, refer to *Configuring Pulse Output, page 77*.

When Pulse Output is set to Pulse mode, you can turn pulse accumulation on, turn pulse accumulation off, clear the pulse output totals collected up to the current point in time, or resume collecting pulse outputs by selecting the following options:

- **On**: This option clears existing pulse totals and the flowmeter starts transmitting and accumulating pulse signals. This option can be selected only if pulse output is off.
- **Resume**: Without clearing the existing pulse totals, the flowmeter starts transmitting and accumulating pulse signals. This option can be selected only if pulse output is off.
- **Clear**: If pulse output accumulation is off, this option clears existing pulse totals. You cannot clear existing pulse output totals while the flowmeter is accumulating values.
- **Off**: The flowmeter stops transmitting and accumulating pulse signals. The existing pulse totals are saved up to the current point. This option can be selected only if pulse output is on.

To turn the pulse output accumulation on, turn pulse output accumulation off, clear the pulse output accumulation, or resume collecting pulse output totals, complete the steps below.

See the *Pulse Actions Top Level Menu Diagram, page 133* for the menu on the local display for the General and Steam personalities. The Pulse Actions Top Level menu is not available for the Oil & Gas personality. See the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

1. On the local display, press **ENTER** to stop the display of measurements and select **ENTER** at the **1 Pulse** menu. On the HART Communicator, select **Diag/Service > Totalizers > Pulse Operation**.
2. Select **On**, **Off**, **Resume**, or **Clear**.
3. Save the selection.

Totalizer Actions

The flowmeter provides three separate totalizers that accumulate flow measurements to keep track of amounts of flow. (If you are using the Oil & Gas personality, there is only a single totalizer.) Each of the totalizers can be mapped independently to keep track of different flow measurements.

You can control how the flowmeter starts and stops accumulation of the total flow value. For information on the flowmeter's totalizer capabilities and how to configure totalizers, refer to *Setting Totalizer Parameters, page 72*.

Each totalizer can be in one of two states:

- ON: The totalizer is actively accumulating flow values.

- OFF: The totalizer is not actively accumulating flow values, and any previously collected totalizer values may or may not have been cleared.

You can turn totalizers on, turn totalizers off, clear the totalizers, or resume accumulation by selecting the following options:

- **On**: This option clears existing totals and the flowmeter starts totalizer accumulation. This option can only be selected if the totalizer isoff.

- **Resume**: Without clearing the existing totals, the flowmeter starts totalizer accumulation. This option can be selected only if the totalizer is off.

- **Clear**: If accumulation is off, this option clears existing totals. You cannot clear existing totals while the flowmeter is accumulating values.

- **Off**: The flowmeter stops totalizer accumulation. The existing totals are saved up to the current point. This option can be selected only if the totalizer is on.

To turn the pulse output accumulation on, turn pulse output accumulation off, clear the pulse output accumulation, or resume collecting pulse output totals, complete the steps below.

See the *Totalizer Actions Top Level Menu Diagram, page 134* for the menu on the local display for the General and Steam personalities, see the *Totalizer Actions Top Level Menu Diagram, page 150* for the menu on the local display for the Oil & Gas personality, or see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

1. On the local display, press **ENTER** to stop the display of measurements and select **ENTER** at the **1 Totx** menu selection (**x** can be 1, 2, or 3). On the HART Communicator, select **Diag/Service > Totalizers > Totalizer x Operation** (**x** can be defined as 1, 2, or 3.)

2. If prompted, enter the Lo password (local display only).

3. Select **On**, **Off**, **Clear**, or **Resume**.

4. Save the selection.

Messages

These tables define the most common operation, configuration, and status messages, and the actions needed to address them.

Some messages may appear periodically with a valid flow measurement. This typically occurs when soft limits are exceeded; the messages mean that a hard limit is approaching.

Operational Messages

Table 53 - Operational 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 a notification that the flowmeter is being overridden.
W: Input	Alert: An input to a specific measurement or calculation has exceeded the normal limit and is in the soft limit region.	Make sure configured flowing temperature is within the temperature limits of the sensor.
B: Input	Bad Input: An input to a specific measurement or calculation has exceeded the soft limit. This adversely affects all measurements.	Check the raw frequency to determine if it is out of limits for the flowmeter size.

Table 53 - Operational Messages (Continued)

Message	Explanation	Corrective Action
W: Offln	Alert: The transmitter goes offline when a totalizer is running.	When the transmitter enters an offline state, any running totalizers are turned off, and this message is generated. Resume, or turn the totalizer(s) back on using the Totalizer Actions menu (see *Totalizer Actions, page 92*.
Boot App	The firmware is corrupted. This may be due to an incomplete firmware upgrade through special hardware supplied to the user.	Contact Global Customer Support.
Boot CMD	The unit has been commanded to stay in boot mode.	

Configuration Messages

Table 54 - Configuration Messages

Message	Explanation	Corrective Action
WrProtct	The write protect jumper is missing or is in the PROTECT position.	You cannot change the configuration 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, page 45*.
Cfg Err MsCode	An incorrect model code was entered.	Enter the correct model code as it appears on the flowmeter's data plate.
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. Verify 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. Verify that the LFCI setting and the value for Flowing Density is correct. The minimum URV is three times the LFCI flow rate. For applications where the URV is very low relative to the flowmeter's capacity, this error message may appear when this constraint is violated. This can be the result of lowering the URV, increasing the LFCI setting, or decreasing the Flowing Density (increasing the corresponding LFCI flow rate values).
FcErr E:0x####	An internal function did not execute successfully.	If this message occurs at startup, an invalid configuration exists. Recheck the configuration. If this message occurs during setup, review the inputs associated with the last menu function. If these steps do not resolve the problem, re-enter the model code.

Status Messages

The following tables describe four types of status messages:

- Informational messages indicate that the measurement is operating within normally expected limits.

- Alert status (**W:**) messages indicate that the measurement is operating outside the normally expected limits, but not outside the hard limits. An alert message is also generated if a measurement is configured to continue when encountering a bad value (that is, **AlertSt** is set to **NoAlert**).

- BAD status (**B:**) messages indicate that the measurement is outside the hard limits, and the mA output is set to the failure status.

- Out-of-Service status (**O:**) messages usually mean that the measurement is not supported by the available hardware.

Table 55 - Informational Status Messages

Message	Description
Ok	All inputs and calculations are okay.
InputFxd	An input is fixed. Other input is live.
Paused	A measurement is frozen.
Override	A measurement has been overridden.
IsDeflt	A measurement is always using default.

Table 56 - Alert Status Messages

Message	Description
W:<SoftL	Outside lower soft limit. Value not clamped.
W:>SoftU	Outside upper soft limit. Value not clamped.
W:Input	An input has an alert status.
W:RtdSht	RTD is shorted.
W:RtdOpn	RTD is open.

Table 57 - Bad Status Messages

Message	Description
B:<HardL	Outside lower hard limit. Value is clamped.
B:>HardU	Outside upper hard limit. Value is clamped.
B:Input	An input has a BAD status.
B:NotRdy	Measurement is not ready.
B:iNoRdy	An input is not ready.
B:iUsrOf	An input is turned off by the user.
B:iFacOf	An input is turned off by the factory.
B:IntBad	Measurement has an internal bad value.
B:RtdSht	RTD is shorted.
B:RtdOpn	RTD is open.
B:OvrHL	Override is outside the hard limit. Value is clamped.
B:OvrSL	Override outside soft limit. Value not clamped.

Table 58 - Out-of-Service Status Messages

Message	Description
O:UsrOff	Measurement was turned off by the user. This message may appear when changing the model code, for example. If the hardware is supported, update the model code to put a measurement in service.
O:FacOff	Measurement is turned off because measurement hardware is not available.

Using the Local Display

This chapter describes how to operate the flowmeter using the optional local display. It also provides menu diagrams that are available on the local display.

Local Display and Home Screen

An optional local display provides real-time measurement information, function status, and reference information. With four multi-function keys, the display also provides a means of performing device configuration, calibration, and self-test, along with Totalizer and Pulse actions.

During normal operation, the flowmeter displays a selected measurement value, the name and engineering units of the measurement currently being displayed, and other status and diagnostic information specific to the selected measurement on the home screen (shown in *Local Display and Home Screen, page 96*). You can configure one or more measurements appropriate for your application to appear on the home screen, and use the up and down arrows to scroll through the selected measurements' values.

The home screen is fully configurable. Depending on your application and the flowmeter's model code, you can customize the home screen to manually or automatically cycle among one or more flowmeter measurements including: volume flow, mass flow, velocity, density, viscosity, pressure, process temperature, mA output, pulse output, raw vortex count, heat content, heat flow, or any of the totalizer readings. The home screen also displays rollover counters for totalizer readings and any alerts that exist have been generated.

Figure 34 - Local Display and Home Screen

Name of measurement currently being displayed

Engineering units (EGUs) of measurement currently being displayed

BACK

Total1   gal

ESC

999999.9

ENTER

Four multi-function keys (ESC, BACK, ENTER, NEXT) to navigate through the menu system

Measurement value

RO 00   Paused

Rollover counter indicator and value (appears only for totalizers)

Status of measurement currently being displayed

NEXT
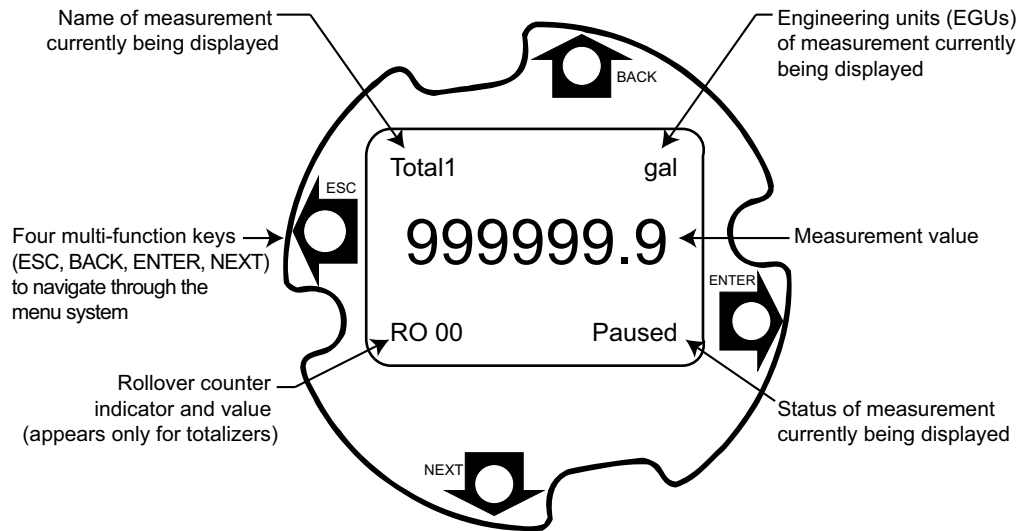
Flowmeter configuration and operation is accomplished with the four multi-function keys:

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 pick list menu or data entry[26] • Answers No to prompts
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 the changed menu pick list choices or data entry[26] • Answers Yes to prompts (for example, Save ->) • Allows you to view information containing too many characters to appear on the display. For example, use **ENTER** when checking fluid parameter values to view all digits of the values.
Up Arrow (BACK)	• Moves upward in the menu structure, a pick list menu, or list of characters
Down Arrow (NEXT)	• Moves downward in the menu structure, a pick list menu, or list of characters

Measurement

During normal operation, the real-time flowmeter measurements that you specify during flowmeter configuration display. By default, the volumetric flow rate appears on the display, and you can also view the list of all the other configured values.

The values displayed are fully configurable.

If the display is configured for a Manual cycle, a user-configured measurement appears on the display, and you can manually scroll through the other configured measurements manually. If configured for an Auto cycle, the display cycles through the measurements you specified during flowmeter configuration automatically.

For additional information on configuring the measurement display, see *Configuring the Home Screen, page 83*.

Using the Flowmeter Software

Using Passwords

Viewing the flowmeter's operation and configuration data does not require that you enter a password. However, the flowmeter has a two-level password system that can restrict access to specific flowmeter functions during online and offline local configuration.

- The **Hi** password is an administrator password that controls access to all flowmeter functions such as configuring, calibrating, and testing the flowmeter.

- The **Lo** password controls access to starting, stopping, resuming, and clearing totalizers, and also switching between the menu modes (View Only, Normal or Show All).

Once you enter the appropriate password, the menu system "remembers" the password until you exit the menu session, that is when the display returns to showing measurements.

Both Hi and Lo passwords are 4-character alphanumeric strings.

---

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

NOTE:

- If you want to use the Lo password, a non-blank Hi password must also be configured. The Lo password has no effect if the Hi password is not configured or is blank (set to 4 spaces)

- The flowmeter is shipped from the factory with blank passwords. This allows access to all flowmeter functions. If password protection is required, configure the Hi password from the **1 Setup > 2 Passwd > 3 HiPwd** menu selection first, and then configure a Lo password from **1 Setup > 2 Passwd > 3 LoPwd** menu selection, if required.

- If you lose your password, contact Global Customer Support for assistance.

When navigating to a function that requires a password, perform the following steps:

1. The prompt **HiPswd?** or **LoPswd?** appears on the display if the function requires a Hi or Lo password, respectively. Press **ENTER** at the prompt.

2. Two brackets surrounding four spaces appear on the display with a flashing cursor positioned at the first character.

3. Use the up and down arrow keys (**BACK** and **NEXT**) to scroll through the list of acceptable characters.

4. Select the desired character and press the right arrow key (**ENTER**) to move to the next character.

5. Continue this process until the password is complete, and then press the right arrow key (**ENTER**) to move the flashing cursor to the right bracket.

6. Press **ENTER** to complete entering the password. If you need to modify an incorrect character, use the left (**ESC**) and right (**ENTER**) arrow keys to move back and forth.

After passwords have been configured, if you enter an incorrect password when prompted for one, the display indicates **Sorry Error**, and then redisplays the password prompt to allow you to enter the correct password. If you exit out of the prompt by pressing the left arrow key (**ESC**) without entering a password, the menu system displays **2Rd Only** and is set to Read Only mode.

Turning On Password Restrictions

To turn on password restrictions:

1. Set the Hi (Admin) password first:

   a. Go to **1 Setup > 2 Passwd > 3 HiPwd** and press **ENTER**. See the *Password Configuration Menu Diagram, page 137* for the menu on the local display for the General and Steam personalities, see the *Password Configuration Menu Diagram, page 148* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

   b. Enter four alphanumeric characters for the Hi password using the arrow keys and then press **ENTER**.

      NOTE: You must configure the **HiPwd** before configuring the **LoPwd**.

2. Set the Lo (User) password:

   a. Navigate to **1 Setup > 2 Passwd > 3 LoPwd** and press **ENTER**.

   b. Enter four alphanumeric characters for the Lo password using the arrow keys and then press **ENTER**.

3. Save your configuration changes and exit to the Home screen for the passwords to take effect.

Turning Off Password Restrictions

To turn off password restrictions:

1. Go to **1 Setup** and enter the Hi password at the **HiPwd?** prompt. See the *Password Configuration Menu Diagram, page 137* for the menu on the local display for the General and Steam personalities, see the *Password Configuration Menu Diagram, page 148* for the menu on the local display for the Oil & Gas personality, and see the *HART Communicator Menus, page 154* for the menus on the HART Communicator.

2. Navigate to **2 Passwd > 3 HiPwd** and press **ENTER**.

3. Enter four blanks (spaces) for the Hi password using the arrow keys and then press **ENTER**.

4. Navigate to **3 LoPwd** and press **ENTER**.

5. Enter four blanks (spaces) for the Lo password using the arrow keys and then press **ENTER**.

6. Save your configuration changes and exit to the Home screen for the password configuration changes.

Totalizer Access Restrictions

You can control access to totalizer configuration and data by configuring passwords. Such safeguards are important when using totalizers for custody transfer applications, where the total flow of a material from one place to another needs to be carefully and accurately tracked, or to prevent unintentional or malicious changes to configuration and data.

The table describes access restrictions for various totalizer operations. Although there are exceptions as noted in the table below, generally, the **Lo** (User) password restricts the ability to start, stop, or resume accumulating totals and clear existing totals, and the **Hi** (Admin) password restricts access to the Setup menu, which contains the options for changing engineering units and mapping.

Table 59 - Totalizer Access Restrictions

| | | Access Restriction for Totalizer Actions | | | | | |
| | | Totalizer 1 Operations | | Totalizer 2 Operations | | Totalizer 3 Operations | |
Write Protection	**Hi and Lo Passwords Configured**	**Start Resume Stop Clear**	**Change Units or Mapping**	**Start Resume Stop Clear**	**Change Units or Mapping**	**Start Resume Stop Clear**	**Change Units or Mapping**
Off	No	Not restricted	Not restricted	Not restricted	Not restricted	Not restricted	Not restricted
On	Both	Read only	Read only	Lo (User)	Read only	Not restricted	Read only
Off	Both	Lo (User)	Hi (Admin)	Lo (User)	Hi (Admin)	Not restricted	Hi (Admin)
Off	Hi only	Not restricted	Hi (Admin)	Not restricted	Hi (Admin)	Not restricted	Hi (Admin)

> **NOTE:** To use the **Lo** (User) password, you must also have a **Hi** (Admin) password configured.

For information on configuring passwords, refer to *Using Passwords, page 97*.

Calibration/Test Access Restrictions

Access to the Calibration/Test menu can be restricted with passwords.

If passwords are configured, you may need to enter the Hi password to perform the functions available from the Calibration/Test 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

You can edit any number or string in the menu system the same way that you would enter a password. The up and down arrow keys (**BACK** and **NEXT**) scroll through a list of acceptable characters for the current position. The right arrow key (**ENTER**) moves the cursor to the right. It also accepts the change at the end. The left arrow key (**ESC**) moves the cursor to the left. It also cancels the change at the beginning.

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

Signed Number

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

Unsigned Number

For unsigned numbers, cycle through the digits 0-9, and the decimal point, with the up and down arrow keys (**BACK** and **NEXT**). When you enter a decimal point in any position, and there is already a decimal point, the new decimal point overrides the old one.

Strings

Characters in strings can be changed to any character provided in the pick list. You can sequence through the list of characters by pressing the up or down arrow keys (**BACK** or **NEXT**). 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 (**ENTER**).

Picking from a List

Pick list items allow you to choose a selection from a flowmeter-supplied list of choices. Go to the applicable parameter, and press **ENTER**. The entire bottom line of the display flashes. If you press the up or down arrow keys (**BACK** or **NEXT**), the display shows the previous or next choice respectively from its list. Pressing **ENTER** accepts the change; pressing **ESC** returns the previous selection.

Accessing the Menu System from the Home Screen

From the Home screen, you can access the flowmeter's main menu and the Pulse and Totalizer action menus ss shown in *Accessing the Top Level Menus from the Home Screen, page 101*.

Figure 35 - Accessing the Top Level Menus from the Home Screen

Press **ESC** on the Home screen to go to the Main Menu, then use the up and down arrows (**BACK** and **NEXT**) to scroll through the choices in the menu:
- **1Measure** (see Measure Mode)
- **1 Status** (see Status Mode)
- **1 Setup** (see Setup Mode
- **1Cal/Tst** (see Calibration/Test Mode)

Measurement n (optional)
...
Measurement 1

999.9999

ESC

ENTER

Press **ENTER** on the Home screen to go to the Total/Pulse Actions menu, then use the up and down arrows (**BACK** and **NEXT**) to scroll through the choices in the menu:
- **1 Pulse** (see Pulse Actions) (a)
- **1 Tot1** (see Totalizer Actions)
- **1 Tot2** (see Totalizer Actions)
- **1 Tot3** (see Totalizer Actions)

(a) The Pulse Actions menu appears only when pulse output is in Pulse mode.

Configuration Example

This example demonstrates how to achieve a 4 to 20 mA analog output for Mass Flow, a pulse output for Mass Flow, and how to display Total Mass.

The example includes the following configuration steps performed using the local keypad/display pushbuttons:

1. Configuring a User Fluid
2. Configuring 4 to 20 mA Analog Output for Mass Flow
3. Configuring Pulse Output for Mass Flow
4. Displaying Total Mass

Configuring a User Fluid

Configure the following parameters:
- Fluid Type (Fluid) = User Liquid
- Fluid Name (Name) = Example Liquid
- Reference density of the liquid (ThRefD) = 49.0172
- Reference Temperature (ThRefTD) = 75
- Δ Density/Δ Temperature (ThCoefD) = -0.034529561

For more information, see *Updating Fluid Parameters, page 66*.

1. Select **1 Setup > 2 Fluid > 3 Flud** as follows:

    a. Press the left arrow (**ESC**) to access the main menu and use the down arrow to select **1 Setup**.

    b. Press **ENTER**.

    c. The **Loop in Manual?** prompt displays. This prompt reminds you that you are going offline. If you are using the output of this meter for control, set your control loop to manual, and then press **ENTER** in response to this prompt.

    d. The **2 Fluid** menu displays. Press **ENTER**.

    e. The **3 Fluid User Liquid** menu displays. Press **ENTER**. The display blinks with asterisks (*********).

    f. Select the desired fluid type from the pick list using the up and down arrows, then then press **ENTER** to lock-in your selection.

2. Press **NEXT** to select **3 Name**. Enter the name ("Example Liquid") by editing the string. When done, press **ENTER**. You are asked to confirm your entry with the **Sure?** prompt. Press **ENTER**.

3. Press **NEXT** to select **3 Config FlwTmp**. Use the right arrow and the up and down arrows to select and enter values for the **EGU**, **LRV**, and **URV**. When done, press **ENTER** to return to **3 Config FlwTmp**.

4. Press **NEXT** to select **3 BasTmp** and enter the base temperature for Standard or Normal Volume by editing the value. When done, press **ENTER**.

5. Press **NEXT** to select **3 Config Density**. Use the right arrow and the up and down arrows to select and enter values for the **EGU**, **LRV**, and **URV**. When done, press **ENTER** to return to **3 Config Density**.

6. Press **NEXT** to select **3 BasDen** and enter the base density for Standard or Normal Volume by editing the value. When done, press **ENTER**.

7. Press **NEXT** to select **3 Config Press**. Use the right arrow and the up and down arrows to select and enter values for the **EGU**, **LRV**, and **URV**. When done, press **ENTER** to return to **3 Config Press**.

8. Press **NEXT** to select **3 BasPres** and enter the base pressure for Standard or Normal Volume by editing the value. When done, press **ENTER**.

9. Press **NEXT** to select **3 Config Visc**. Use the right arrow and the up and down arrows to select and enter values for the **EGU**, **LRV**, and **URV**. When done, press **ENTER** to return to **3 Config Visc**.

10. Press **NEXT** to select **3 ThCoefD** and enter the Thermal Coefficient Expansion for Density (**-0.034529561**). When done, press **ENTER**.

11. Press **NEXT** to select **3 ThRefTD** and enter the Thermal Reference Temperature by editing the string (**75**). When done, press **ENTER**.

12. Press **NEXT** to select **3 ThRefD** and enter the Thermal Reference Density (**49.0172**). When done, press **ENTER**.

13. Set the ThCoefV, ThRefTV, and ThRefV using the same procedure as Steps 10, 11, and 12.

14. Press **ESC** to select **2 Fluid**.

15. Press **ESC** to display **<-CANCEL SAVE->**.

16. Press **ENTER** to save the configuration. You are asked to confirm your entries with the **SURE?** prompt. Press **ENTER** to complete the configuration.

The user fluid is now fully configured.

Configuring 4 to 20 mA Analog Output for Mass Flow

For details, see *Configuring mA Output, page 77*.

1. Select **1 Setup > 2 Output > 3 mA** as follows:

   a. Press the left arrow (**ESC**) to access the main menu and use the down arrow to select **1 Setup**.

   b. Press **ENTER**.

   c. The **Loop in Manual?** prompt displays. This prompt reminds you that you are going offline. If you are using the output of this meter for control, set your control loop to manual, then press **ENTER** in response to this prompt.

   d. The **2 Fluid** menu displays. Use the down arrow to select **2 Output**. Press **ENTER**.

   e. The **3 Coms** menu displays. Use the down arrow to select **3 mA**. Press **ENTER**.

2. The **4 Map VolFlow** menus displays. Press **ENTER** and then use the down arrow to select MassFlow. Press **ENTER**.

   The remaining settings can use the default values.

3. Press **ESC** to display the **3 mA** menu.

4. Press **ESC** to display **2 Output** menu.

5. Press **ESC** to display **<-CANCEL SAVE->**.

6. Press **ENTER** to save the configuration. You are asked to confirm your entries with the **SURE?** prompt. Press **ENTER** to complete the configuration.

Configuring Pulse Output for Mass Flow

Configure the following parameters:
- 4 Pulse = Pulse
- 4 MapPul = MassFlow
- 4 PWidth = 0.500 ms
- 4 FacEGU = lb
- 4 FacU/P = 2.204633 lbs per pulses
- 4 FacP/U = no change (driven by FacU/P setting)

For details, see *Configuring Pulse Output, Pulse Mode, page 78*.

1. Select **1 Setup > 2 Output > 3 Pulse** as follows:

   a. Press the left arrow (**ESC**) to access the main menu and use the down arrow to select **1 Setup**.

   b. Press **ENTER**.

   c. The **Loop in Manual?** prompt displays. This prompt reminds you that you are going offline. If you are using the output of this meter for control, set your control loop to manual, then press **ENTER** in response to this prompt.

   d. The **2 Fluid** menu displays. Use the down arrow to select **2 Output**. Press **ENTER**.

   e. The **3 Coms** menu displays. Use the down arrow to select **3 Pulse**. Press **ENTER**.

2. The **4 Pulse None** menus displays. Press **ENTER** and then use the down arrow to select **Pulse**. Press **ENTER**.

3. The **4 MapPul VolFlow** menu displays. Use the down arrow to select **MassFlow**. Press **ENTER**.

4. The **4 PWidth 0.500 ms** displays. Press **ENTER** to modify that value, or press the down arrow to use it as is.

5. The **4FacEGU lb** menu displays. Press **ENTER** to modify that value, or press the down arrow to use it as is.

6. The **4 FacU/P** menu displays. Enter **2.204633**. When done, press **ENTER**.

7. The **4 FacP/U** menu displays. This setting is driven by the **FacU/P** setting. Press the down arrow.

8. Press **ESC** to display the **3 Pulse** menu.

9. Press **ESC** to display the **2 Output** menu.

10. Press **ESC** again to display **<-CANCEL SAVE->**.

11. Press **ENTER** to save the configuration. You are asked to confirm your entries with the **SURE?** prompt. Press **ENTER** to complete the configuration.

Displaying Total Mass

First specify that Mass is displayed in one of the Totalizers (Tot1) and then turn on Tot1.

For more information, see *Configuring a Totalizer (T1, T2, or T3), page 74* and *Totalizer Actions, page 92*.

1. To specify that Mass is displayed in Totalizer 1, select **1 Setup > 2 Total > 3 Tot1** as follows:

    a. Press the left arrow (**ESC**) to access the main menu and use the down arrow to select **1 Setup**.

    b. Press **ENTER**.

    c. The **Loop in Manual?** prompt displays. This prompt reminds you that you are going offline. If you are using the output of this meter for control, set your control loop to manual, then press **ENTER** in response to this prompt.

    d. The **2 Fluid** menu displays. Use the down arrow to select **2 Total**. Press **ENTER**.

    e. The **3 Tot1** menu displays. Press **ENTER**.

2. The **4 Map Volume** menu displays. Press **ENTER**.

3. Use the down arrow to select **Mass**. Press **ENTER**.

4. The **4 EGU lb** menu displays. Select the desired **EGU** and press **ENTER**.

5. Press **ESC** to display the **3 Tot1** menu.

6. Press **ESC** to display the **2 Total** menu.

7. Press **ESC** again to display **<-CANCEL SAVE->**.

8. Press **ENTER** to save the configuration. You are asked to confirm your entries with the **SURE?** prompt. Press **ENTER** to complete the configuration.

9. To turn on Totalizer 1, press **ENTER** to display **1 Tot1 Off** menu.

10. Press **ENTER**. Use the down arrow to select **On**. Press **ENTER**.

The configuration is now complete.

Menus

The menus that are available on the local display depend on the personality that was selected for the flowmeter. For more information on personalities, see *Personalities, page 57*.

Menus for the General and Steam Personalities

Figure 36 - Status Menu Diagram
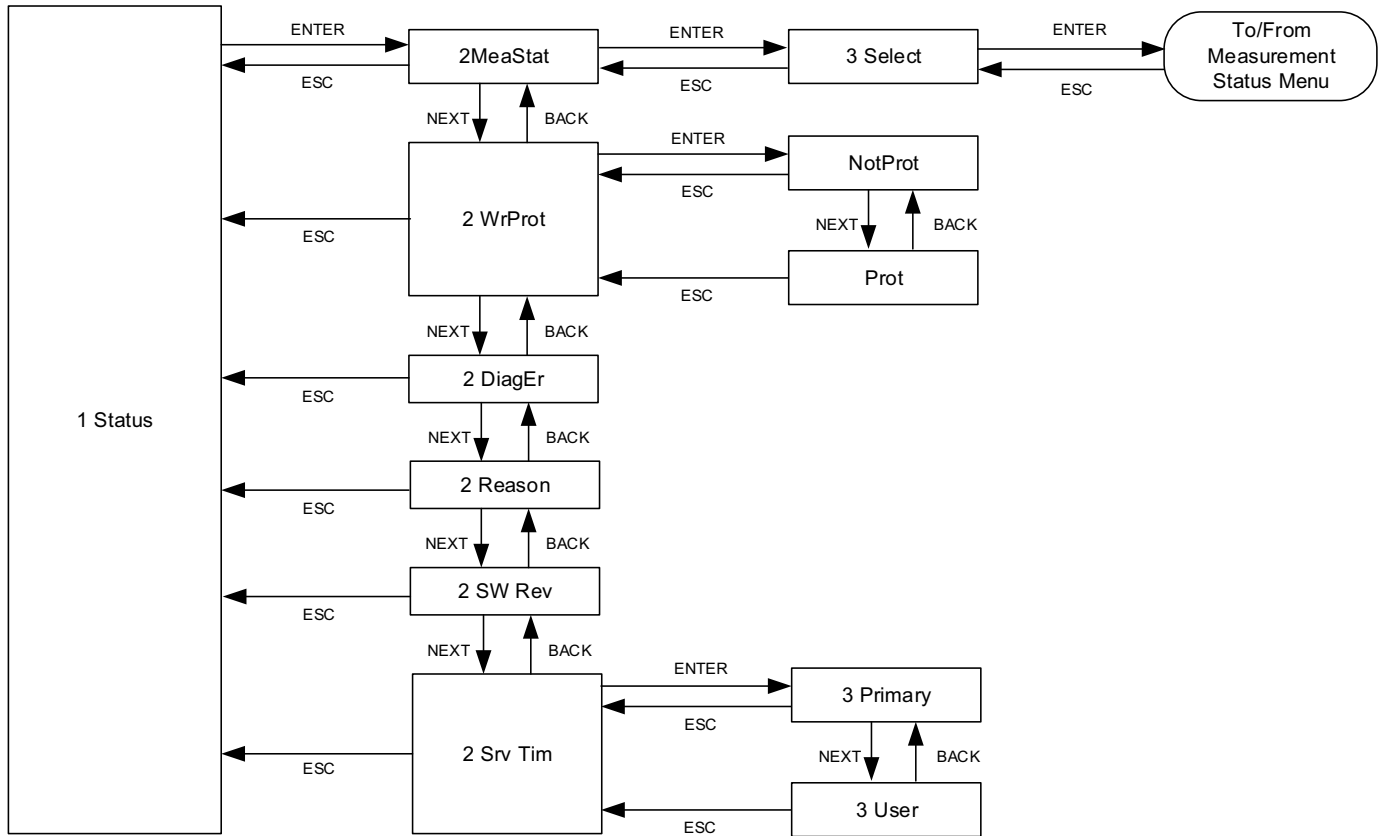
Figure 37 - Measurement Status Menu Diagram (1 of 2)
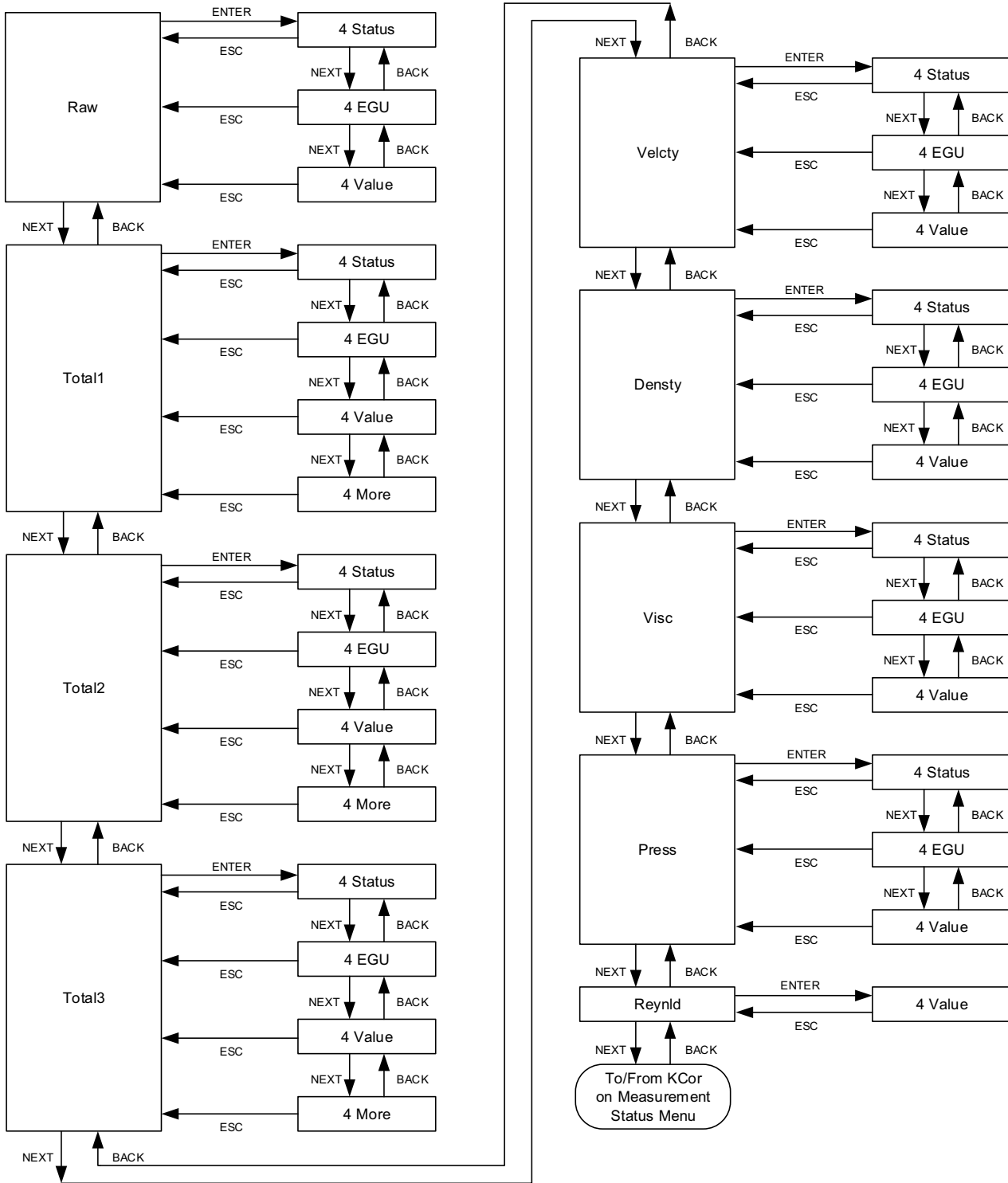
Figure 38 - Measurement Status Menu Diagram (2 of 2)
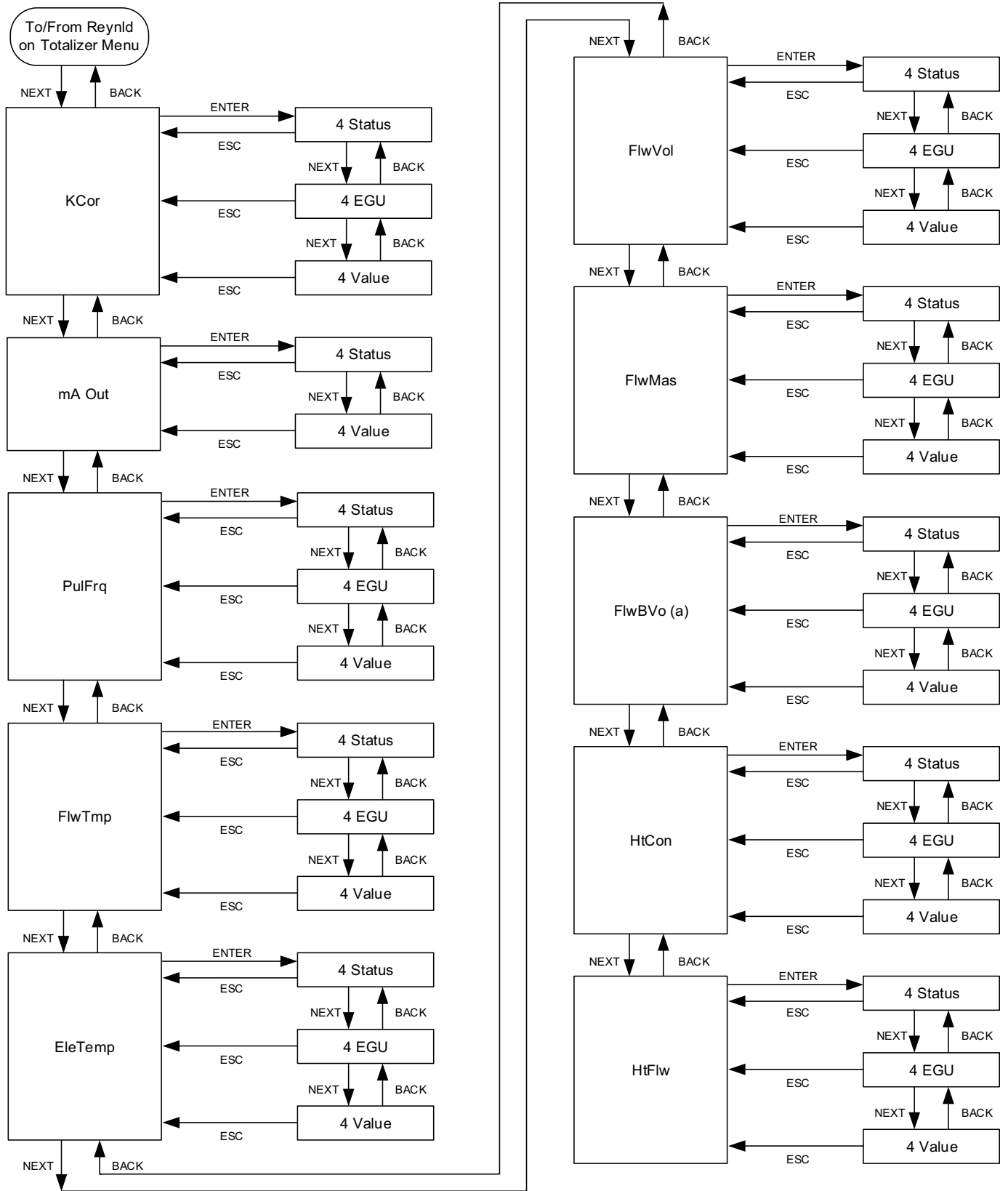
(a) FlwBVo is not available in the Steam personality.

Figure 39 - Setup Main Menu
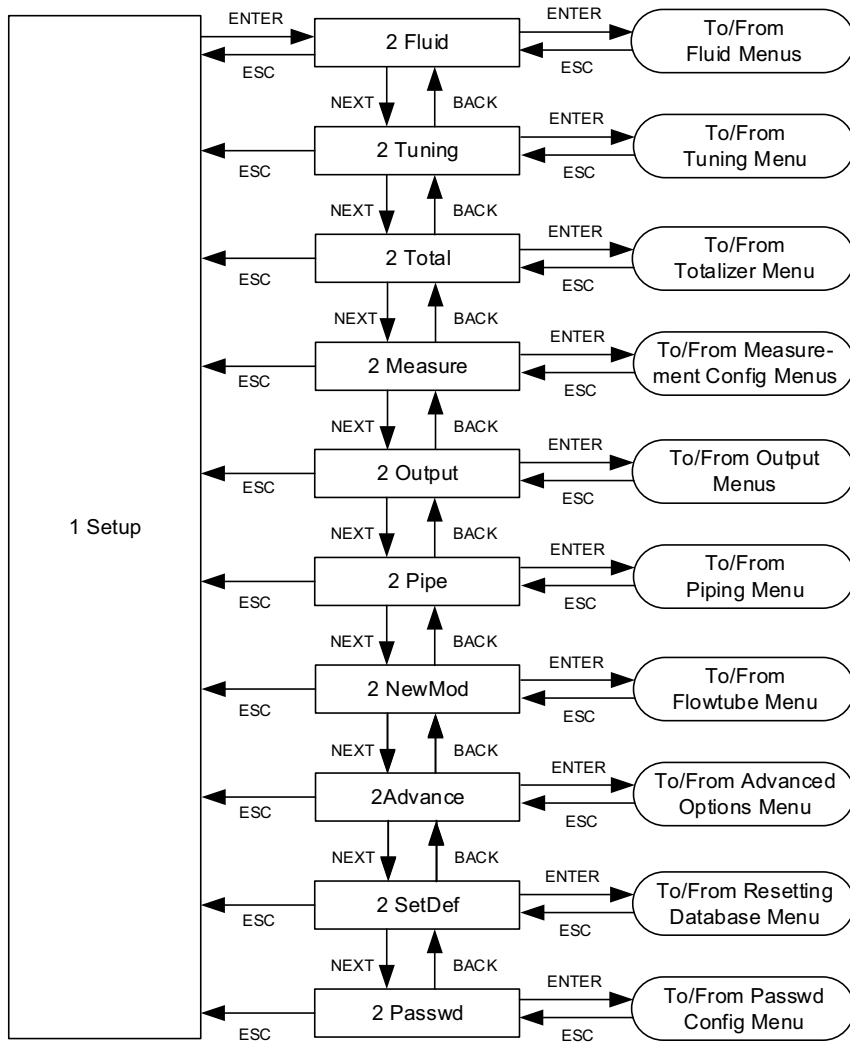
Figure 40 - Fluid Menu Diagram
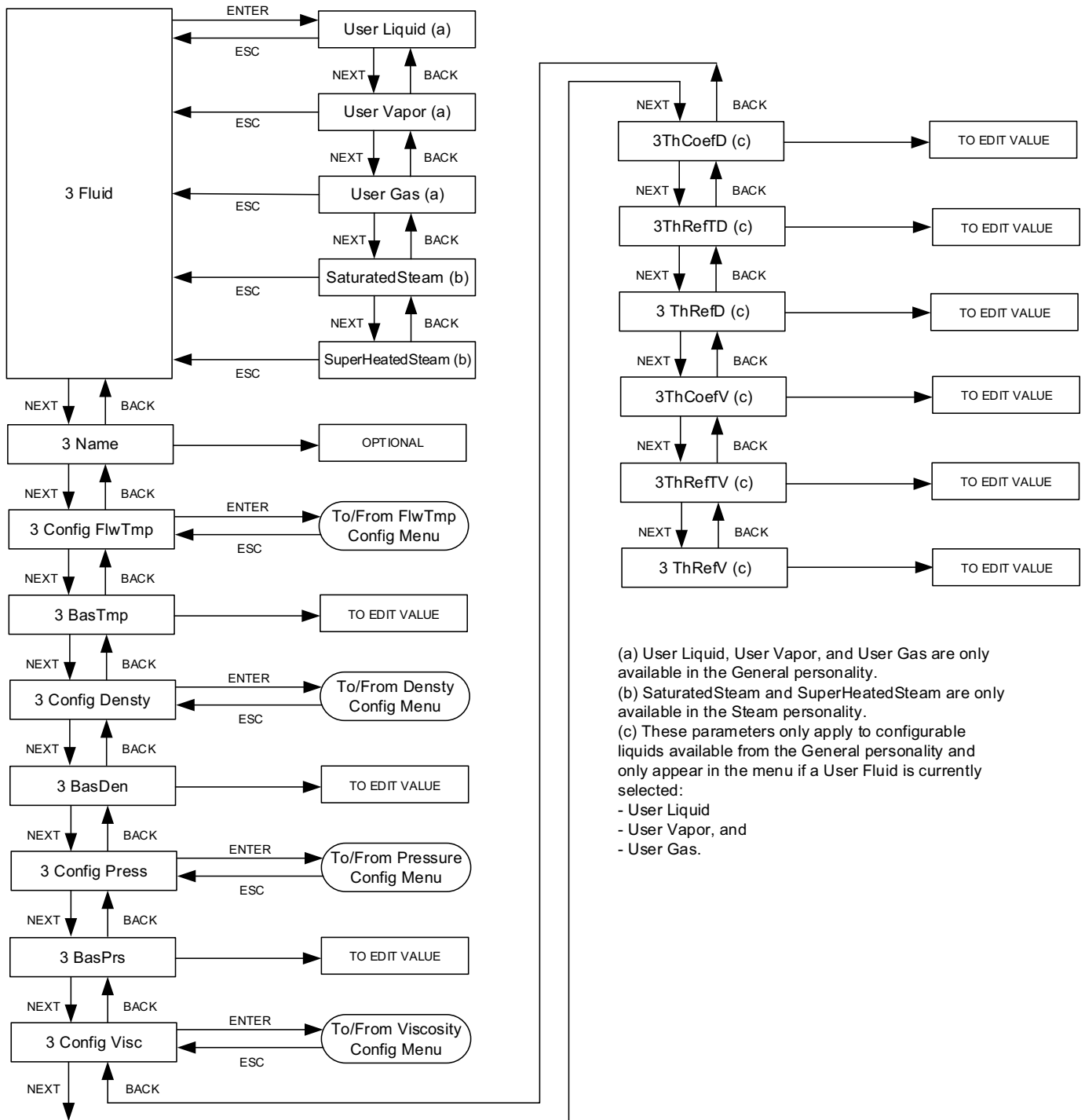
(a) User Liquid, User Vapor, and User Gas are only available in the General personality.
(b) SaturatedSteam and SuperHeatedSteam are only available in the Steam personality.
(c) These parameters only apply to configurable liquids available from the General personality and only appear in the menu if a User Fluid is currently selected:
- User Liquid
- User Vapor, and
- User Gas.

Figure 41 - Process Temperature (FlwTmp) Configuration Menu Diagram
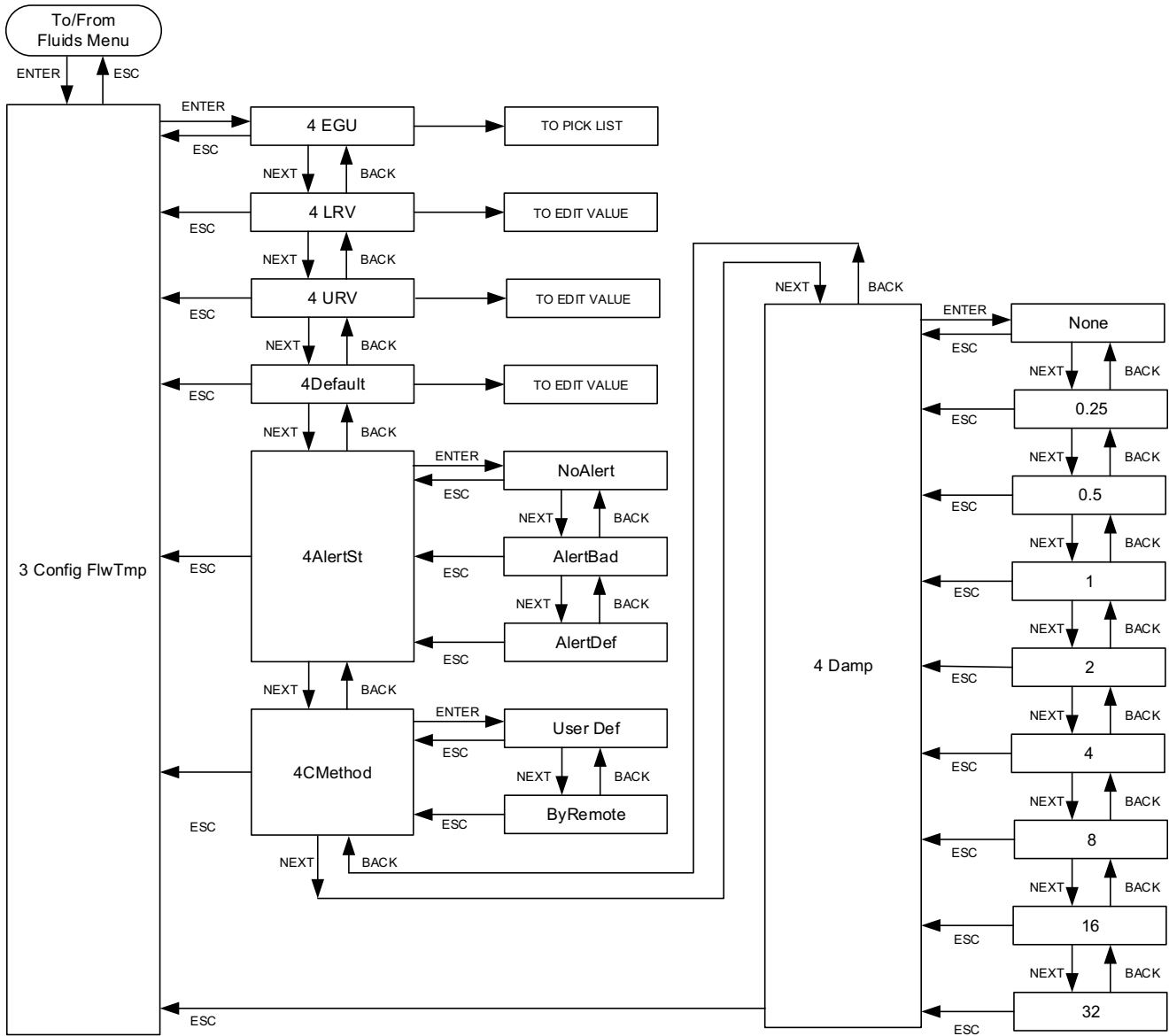
Figure 42 - Density Configuration Menu Diagram
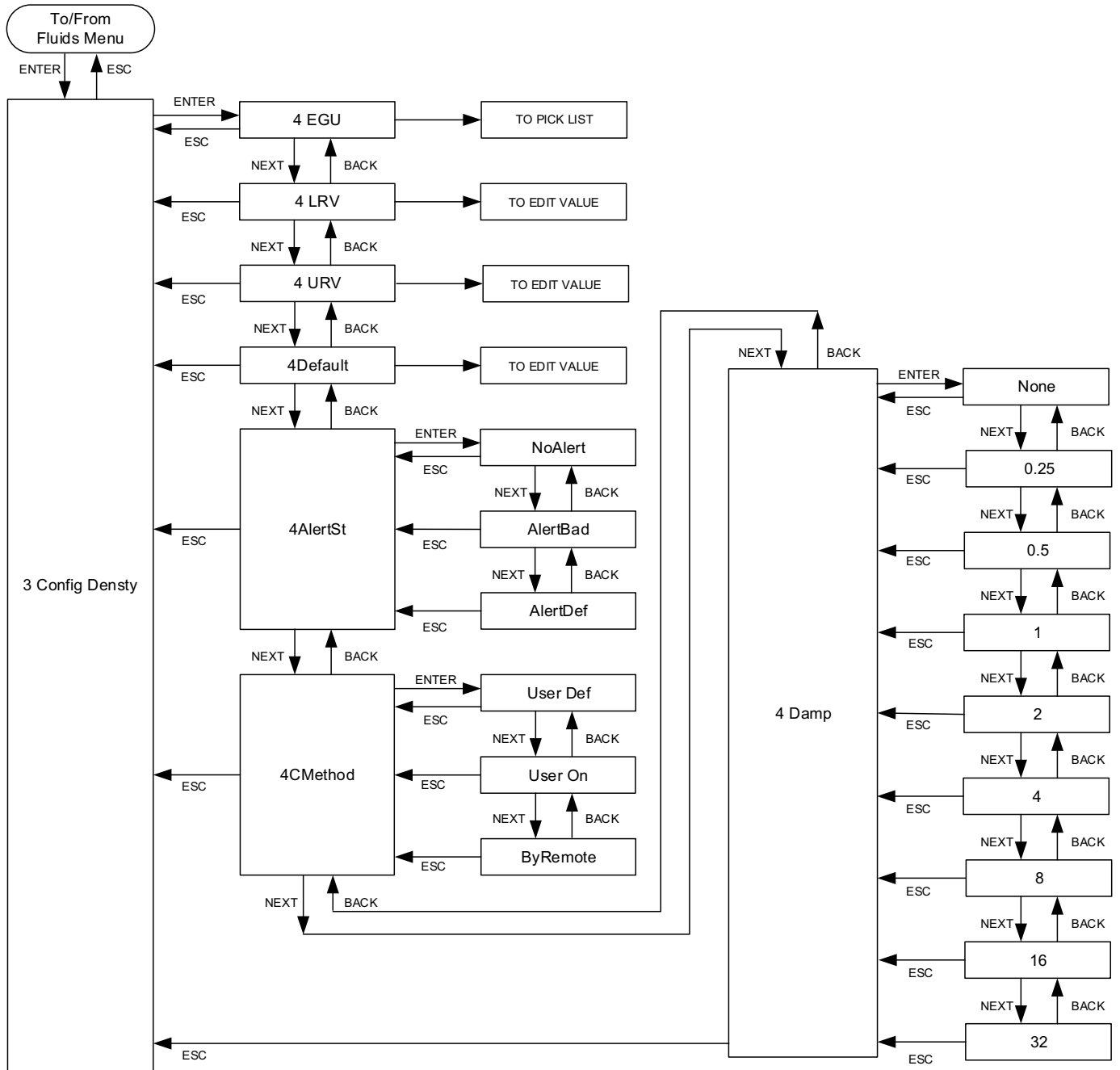
Figure 43 - Pressure Configuration Menu Diagram
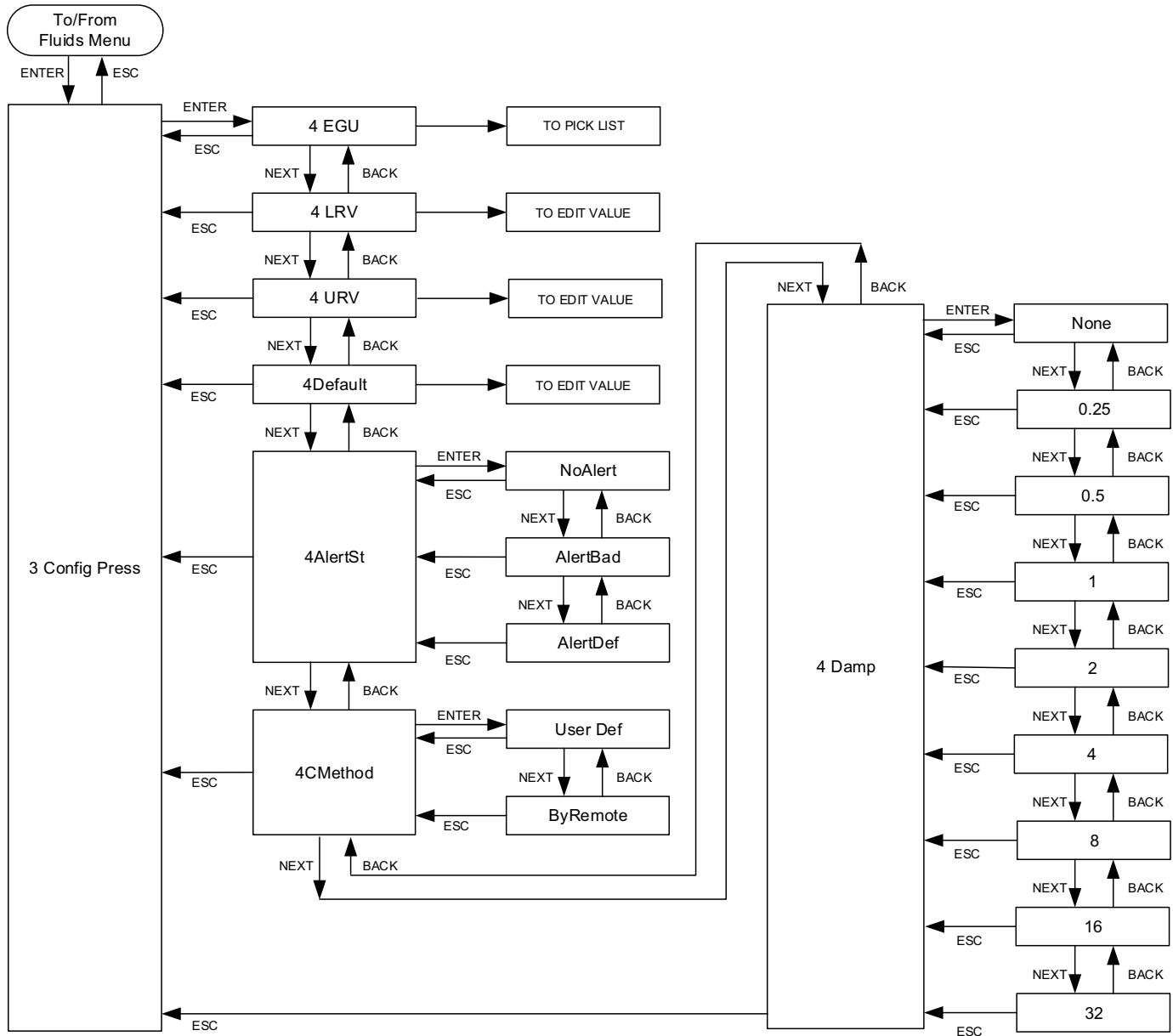
Figure 44 - Viscosity Configuration Menu Diagram
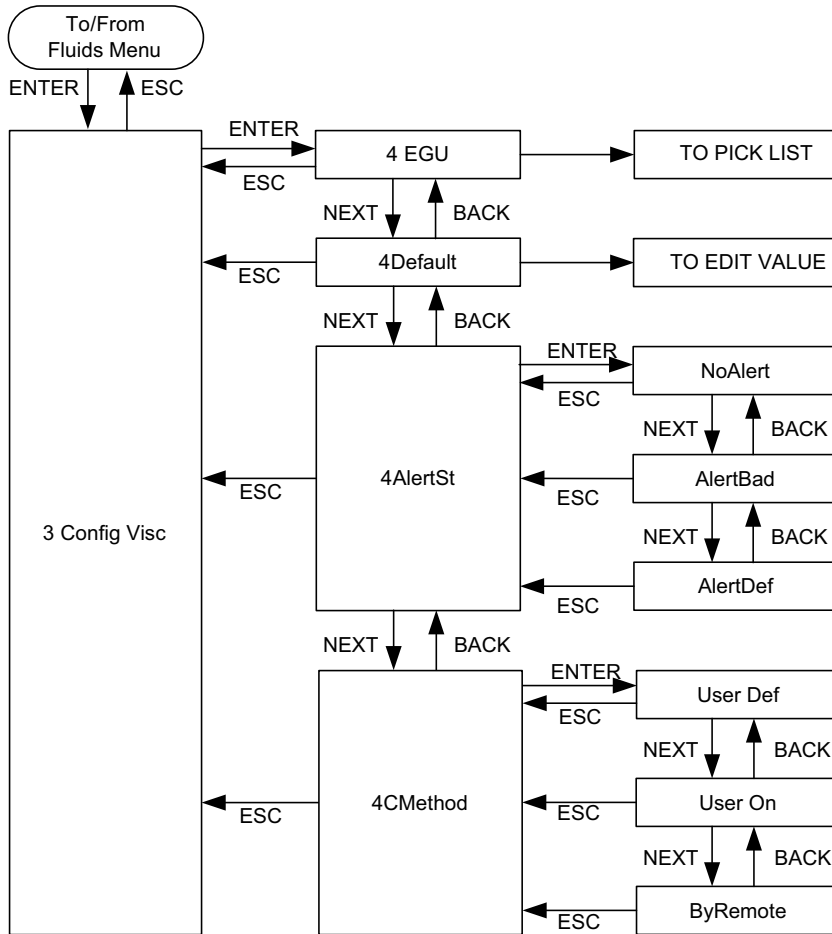
Figure 45 - Tuning Menu Diagram
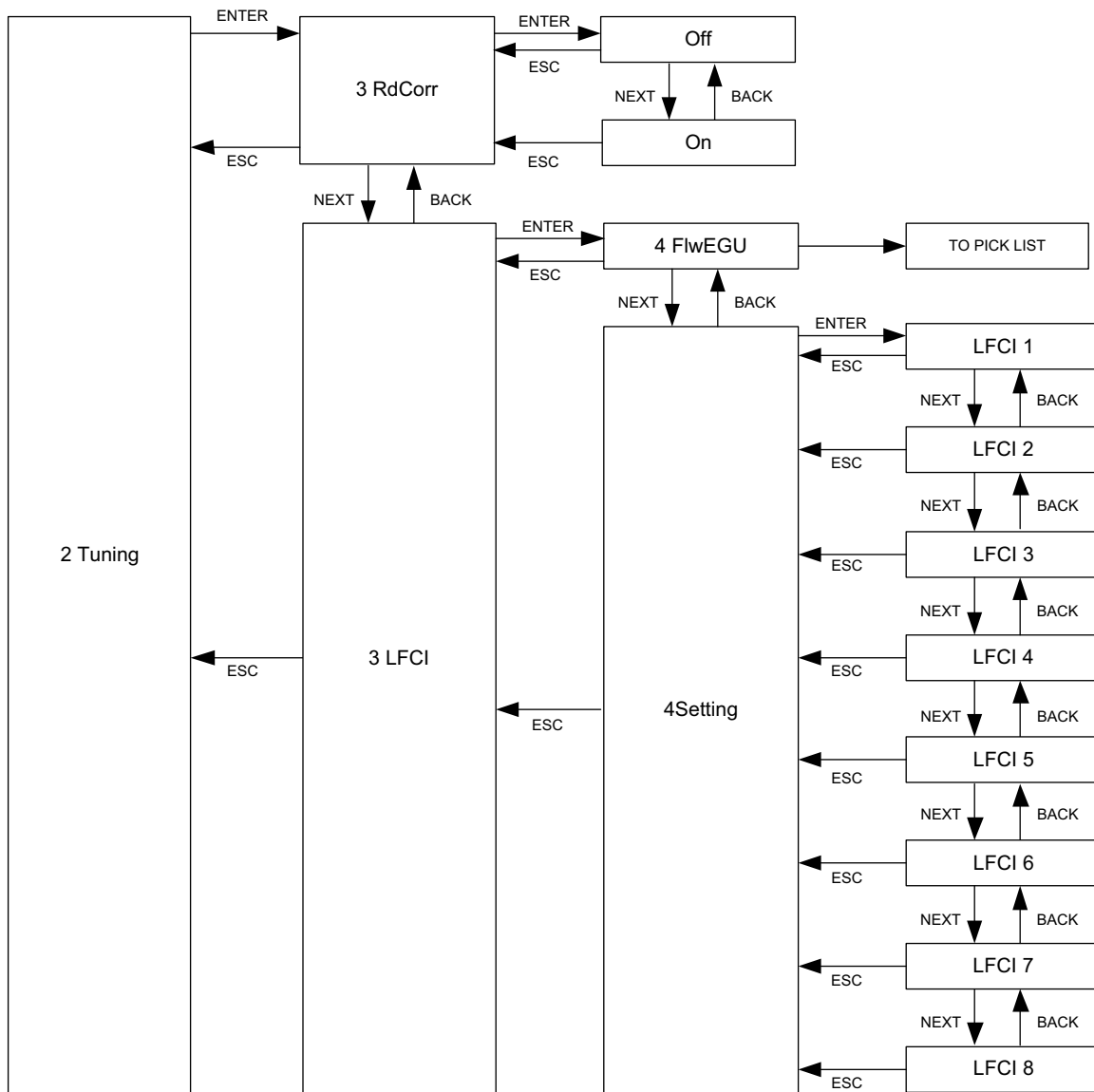
Figure 46 - Measurement Configuration Menu Diagram

(a) 4Config FlwBVo is not available in the Steam personality.
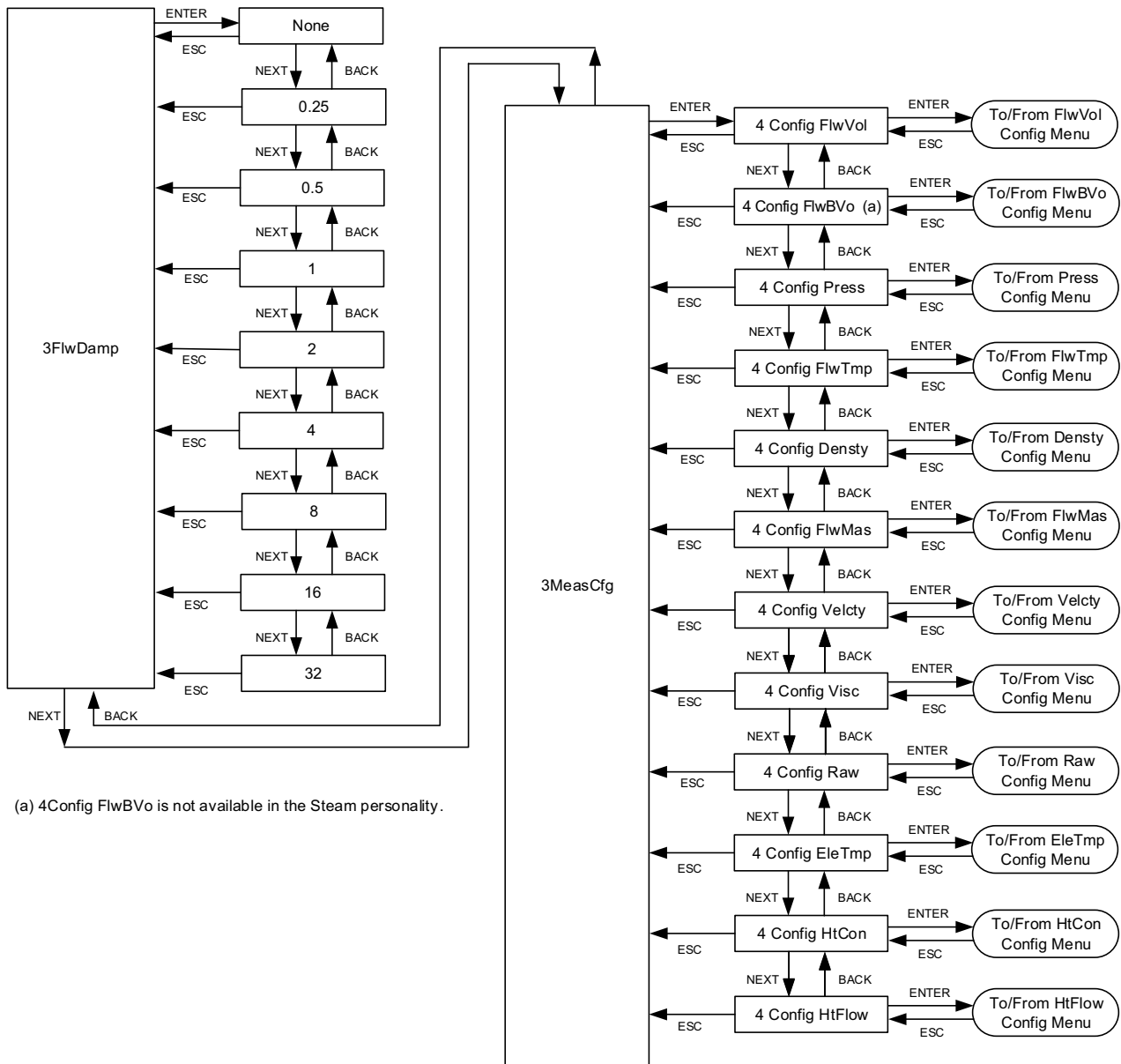
Figure 47 - Volumetric Flow (FlwVol) Configuration Menu Diagram
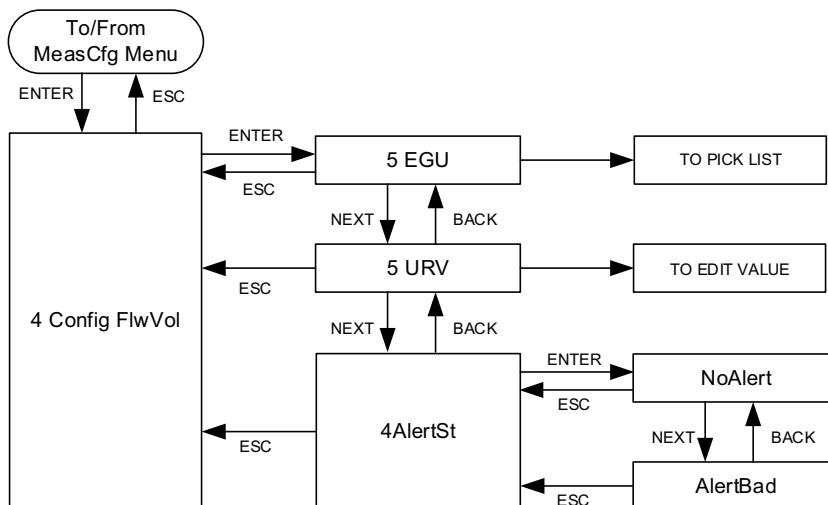
Figure 48 - Base Volumetric Flow (FlwBVo) Configuration Menu Diagram
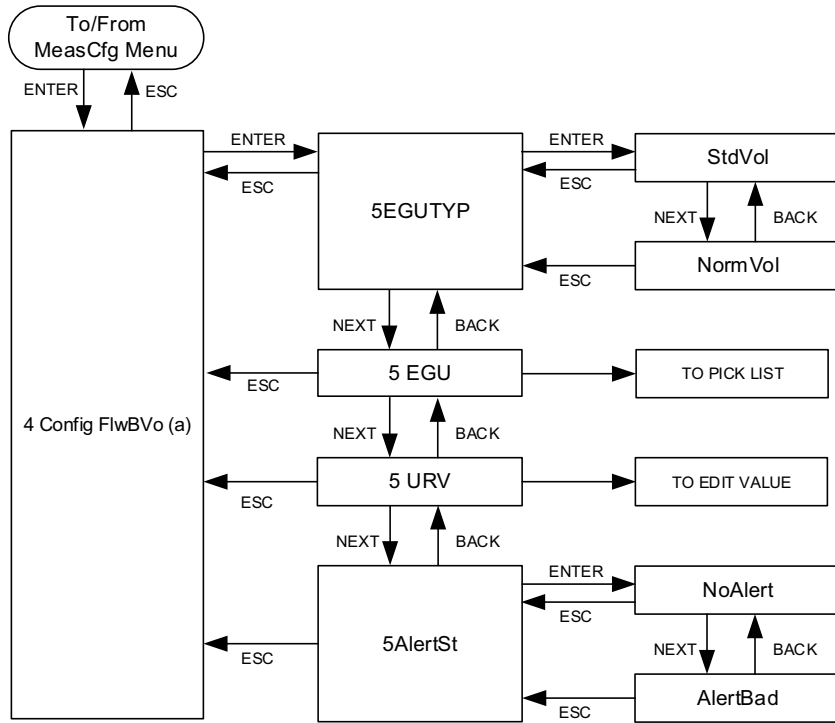
(a) The Config FlwBVo menu is not available in the Steam personality.

Figure 49 - Pressure Configuration Menu Diagram
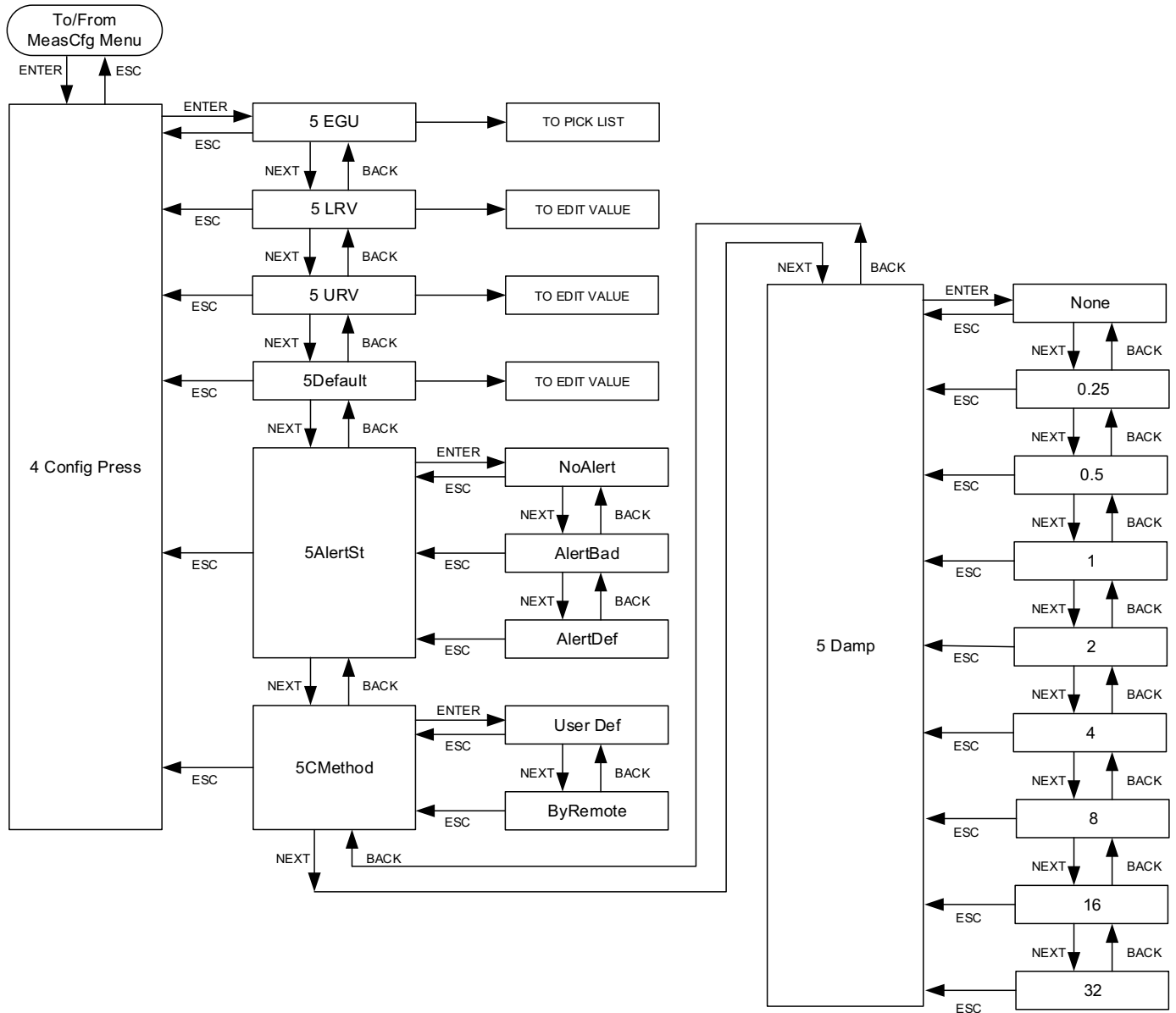
Figure 50 - Process Temperature Configuration Menu Diagram
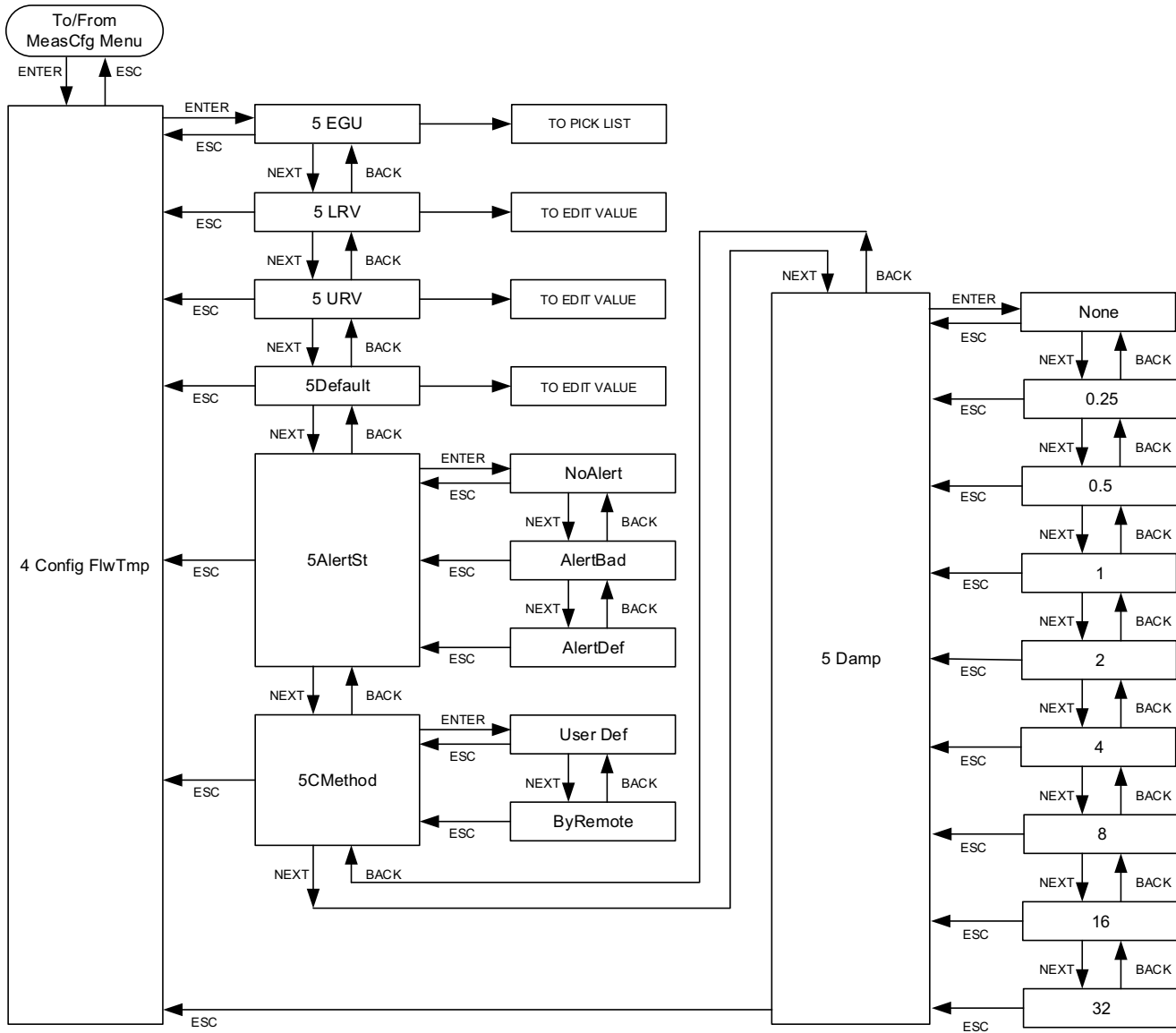
Figure 51 - Density Configuration Menu Diagram
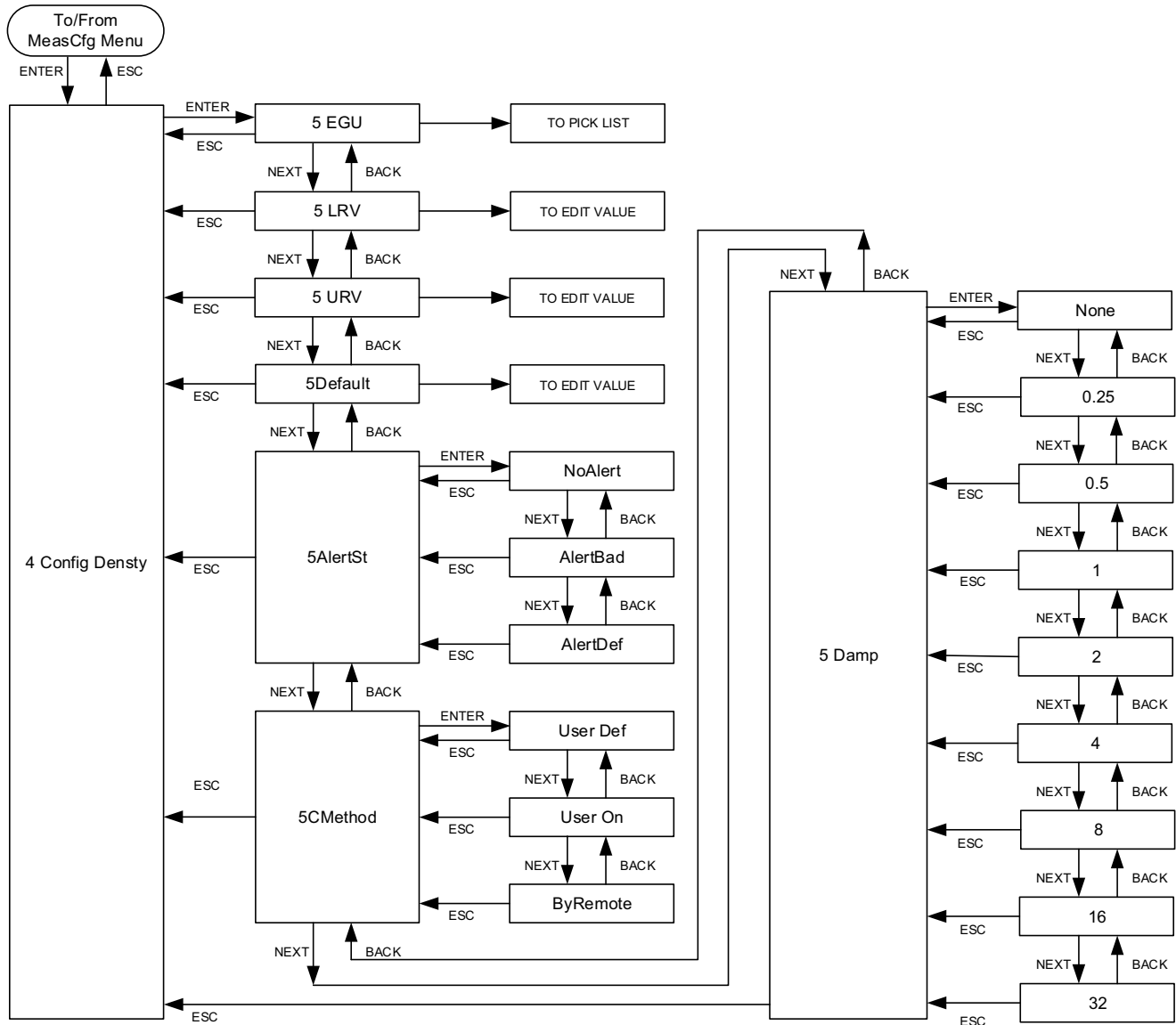
Figure 52 - Mass Flow (FlwMas) Configuration Menu Diagram
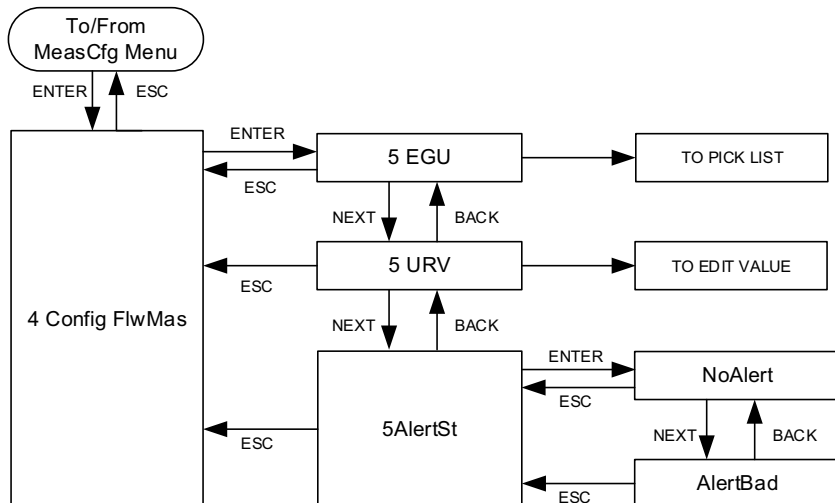
Figure 53 - Velocity (Velcty) Configuration Menu Diagram
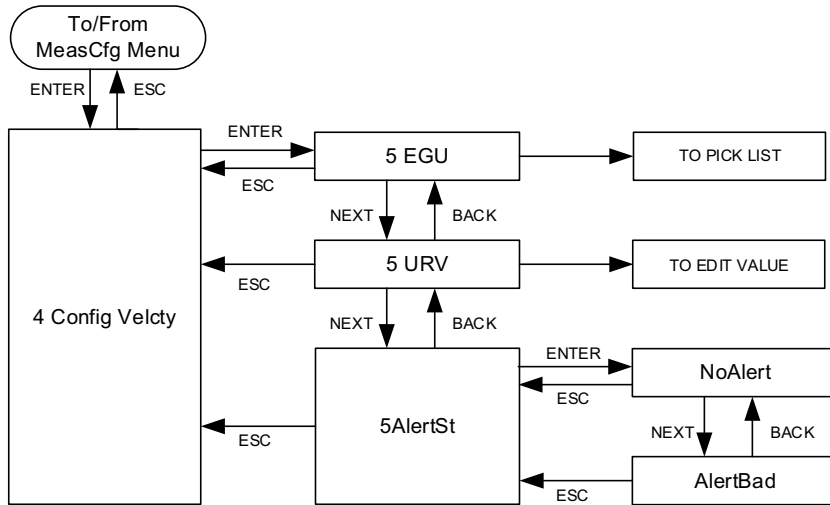
Figure 54 - Viscosity (Visc) Configuration Menu Diagram
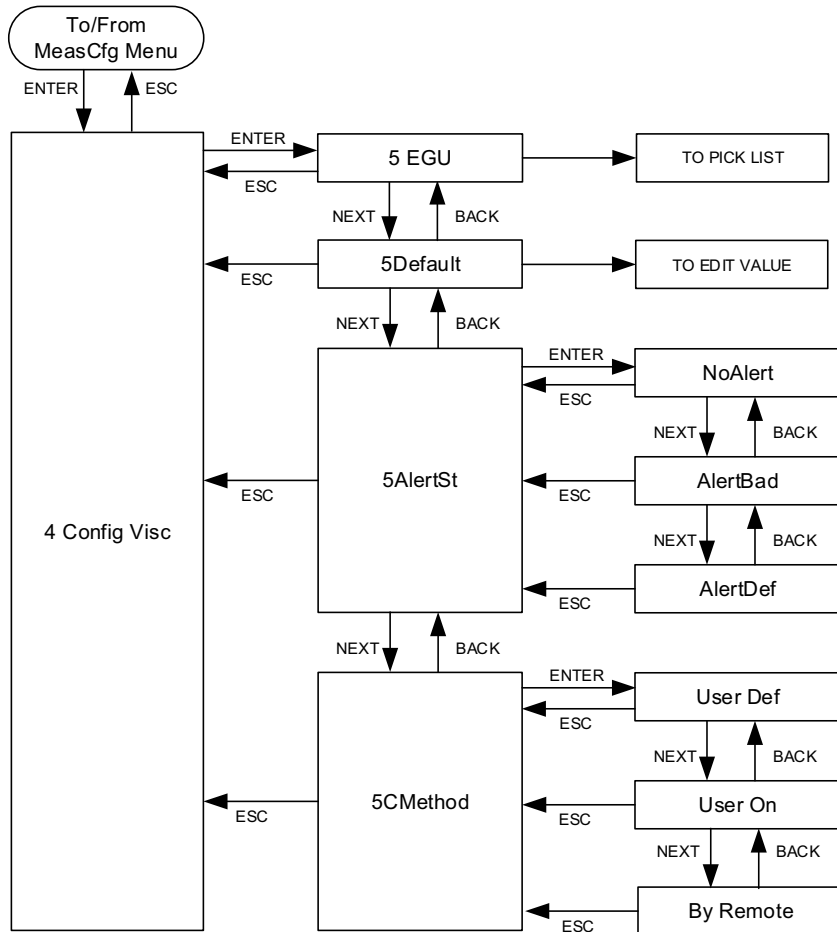
Figure 55 - Raw Vortex Frequency (Raw) Configuration Menu Diagram
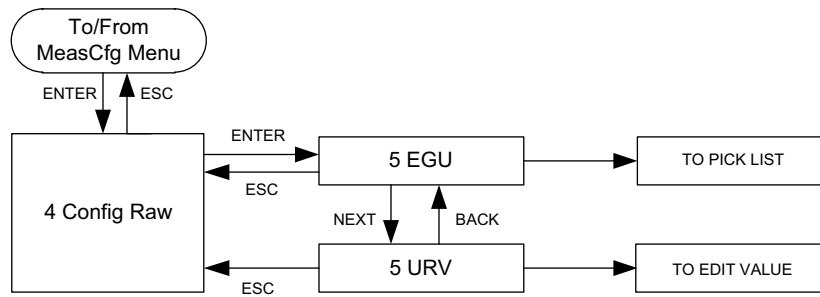
Figure 56 - Electronic Temperature (EleTemp) Configuration Menu Diagram
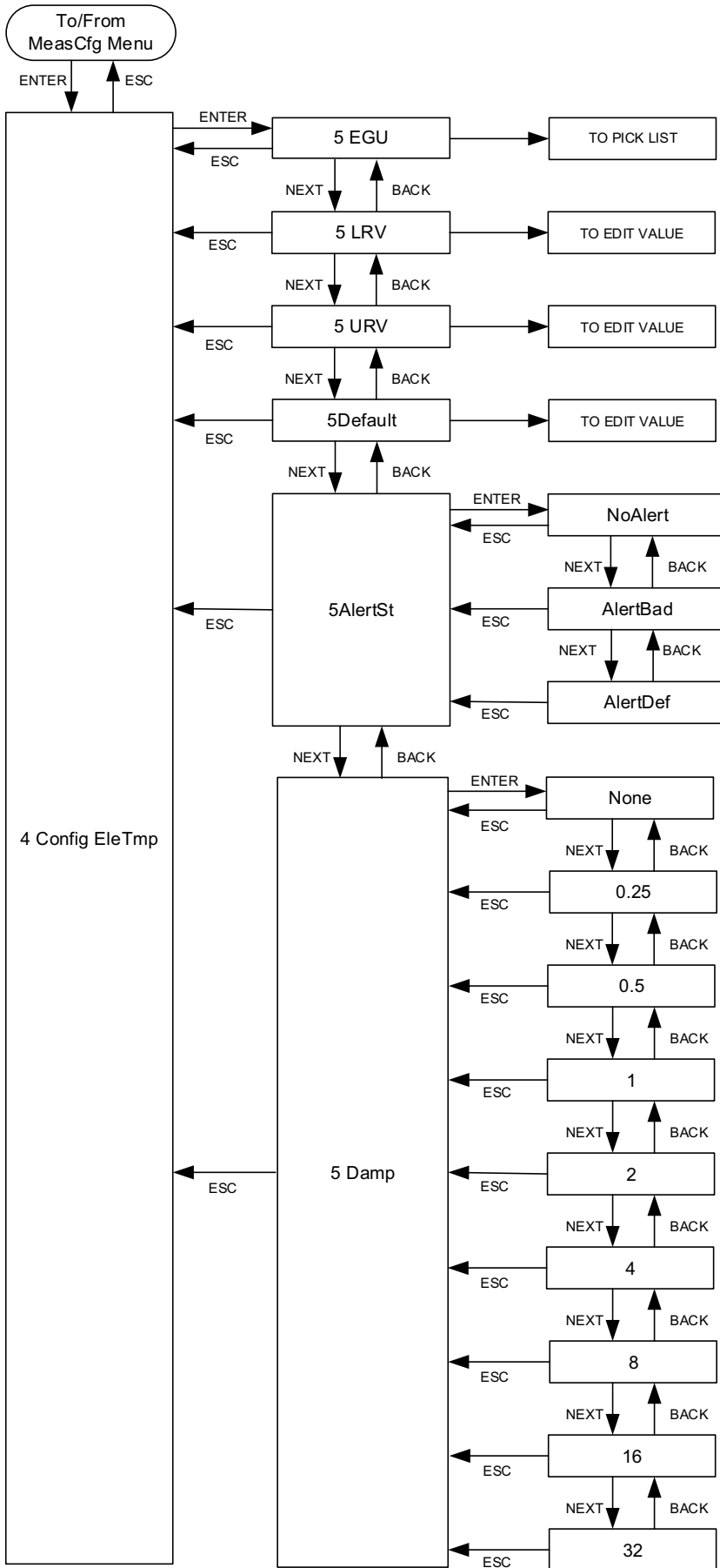
Figure 57 - Heat Content (HtCon) Configuration Menu Diagram
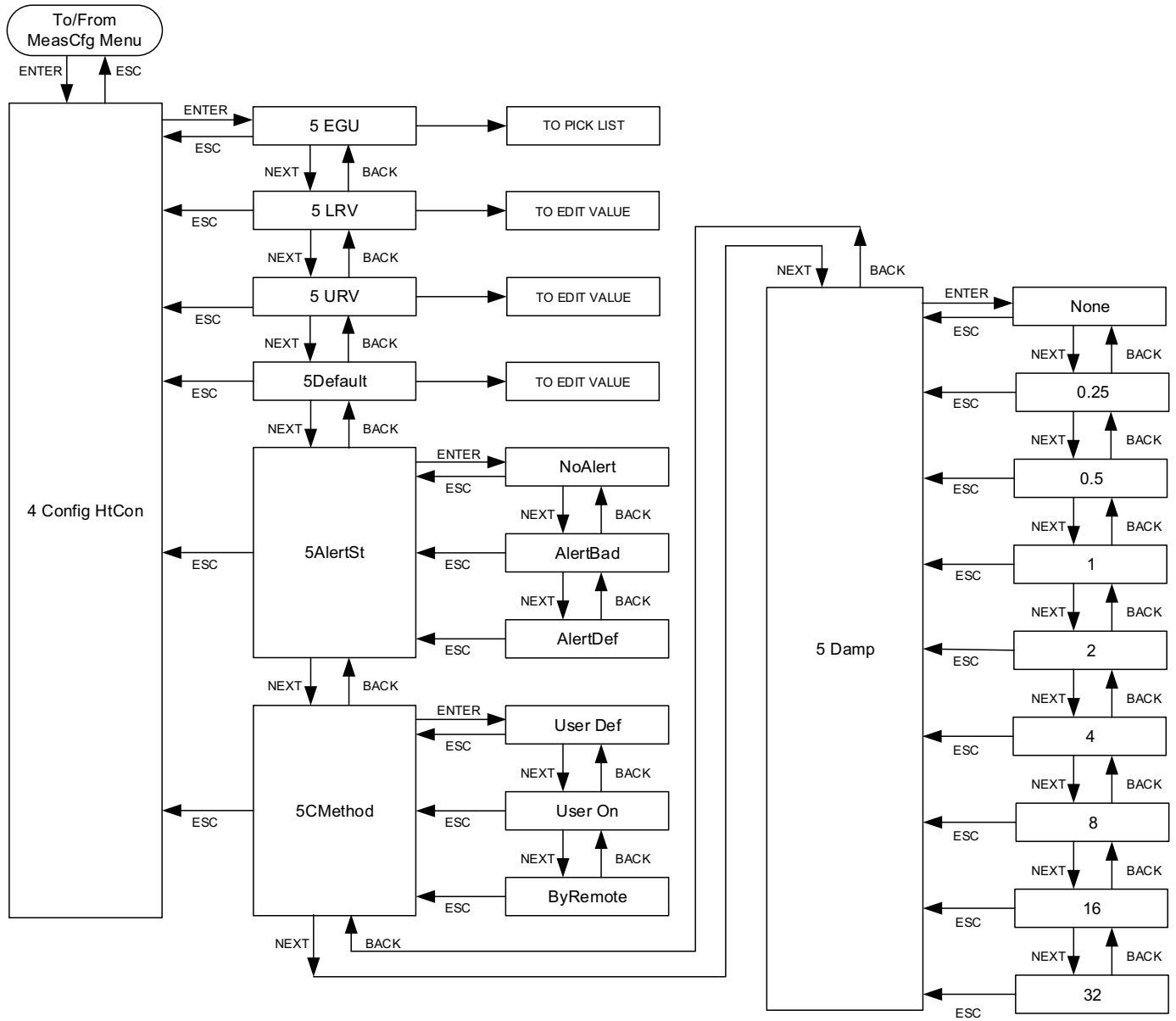
Figure 58 - Heat Flow (HtFlow) Configuration Menu Diagram
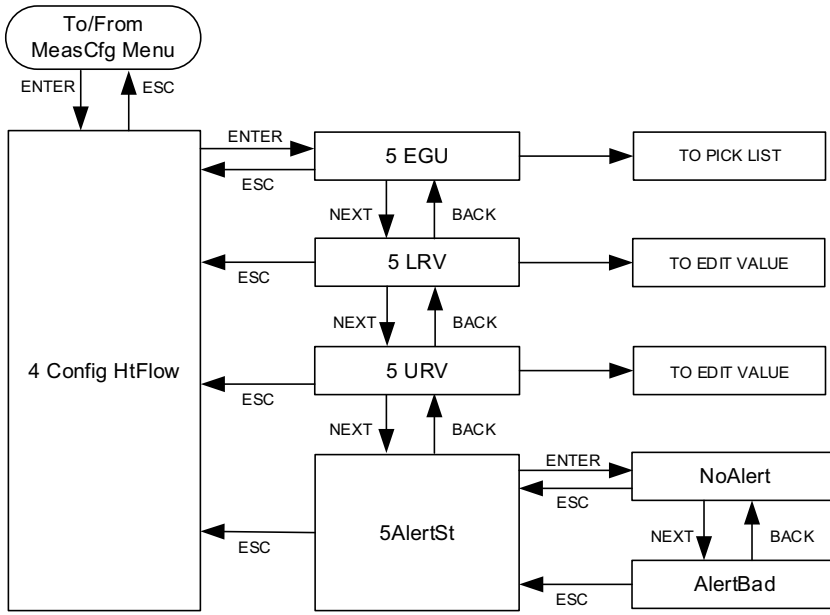
Figure 59 - Totalizer Configuration Menu Diagram
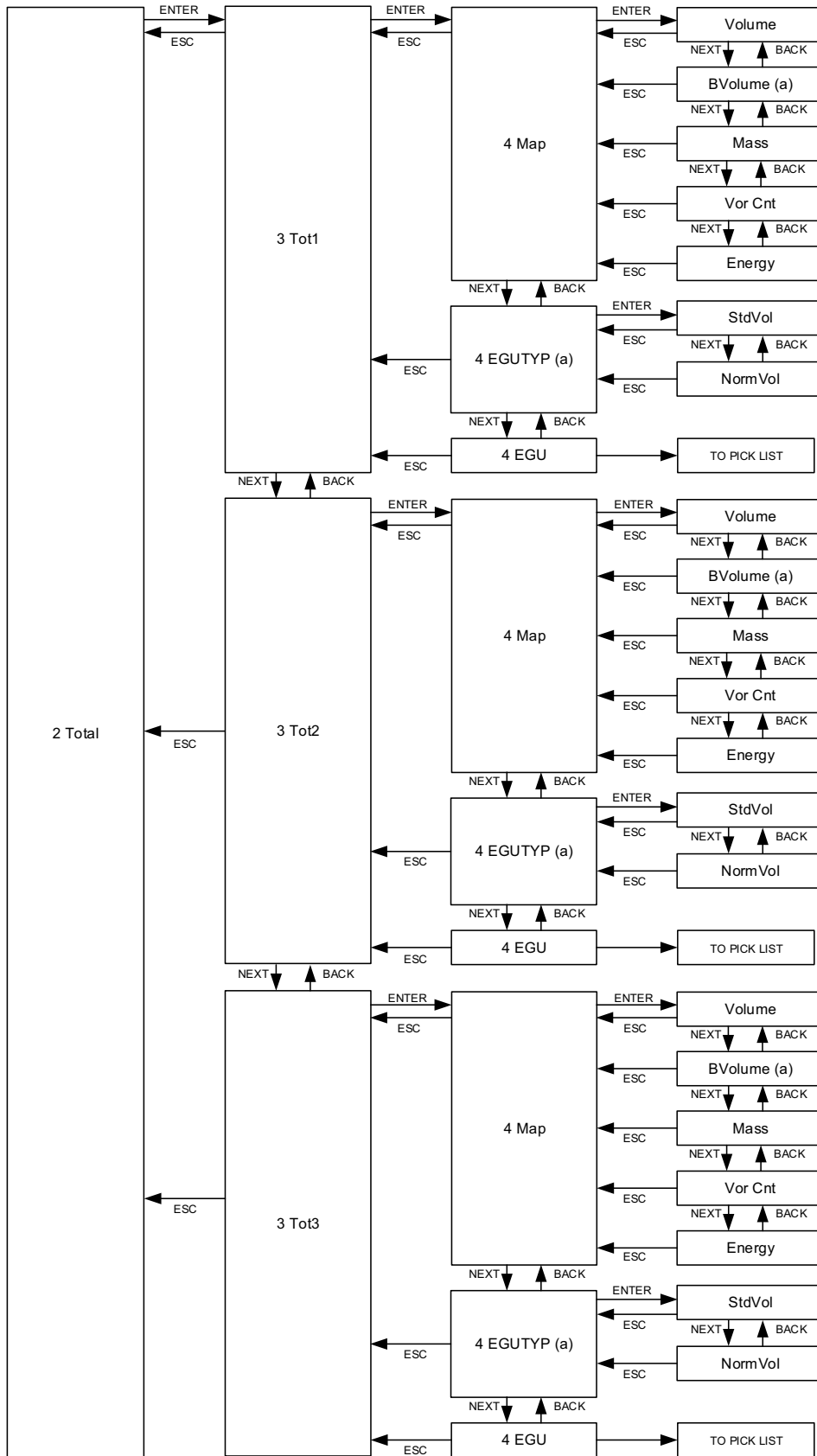
(a) BVolume and 4 EGUTYP are not available in the Steam personality.

Figure 60 - Communications Mapping (Com Map) Menu Diagram (1 of 2)

(a) Appears only if these options are selected
    in the Model Code.
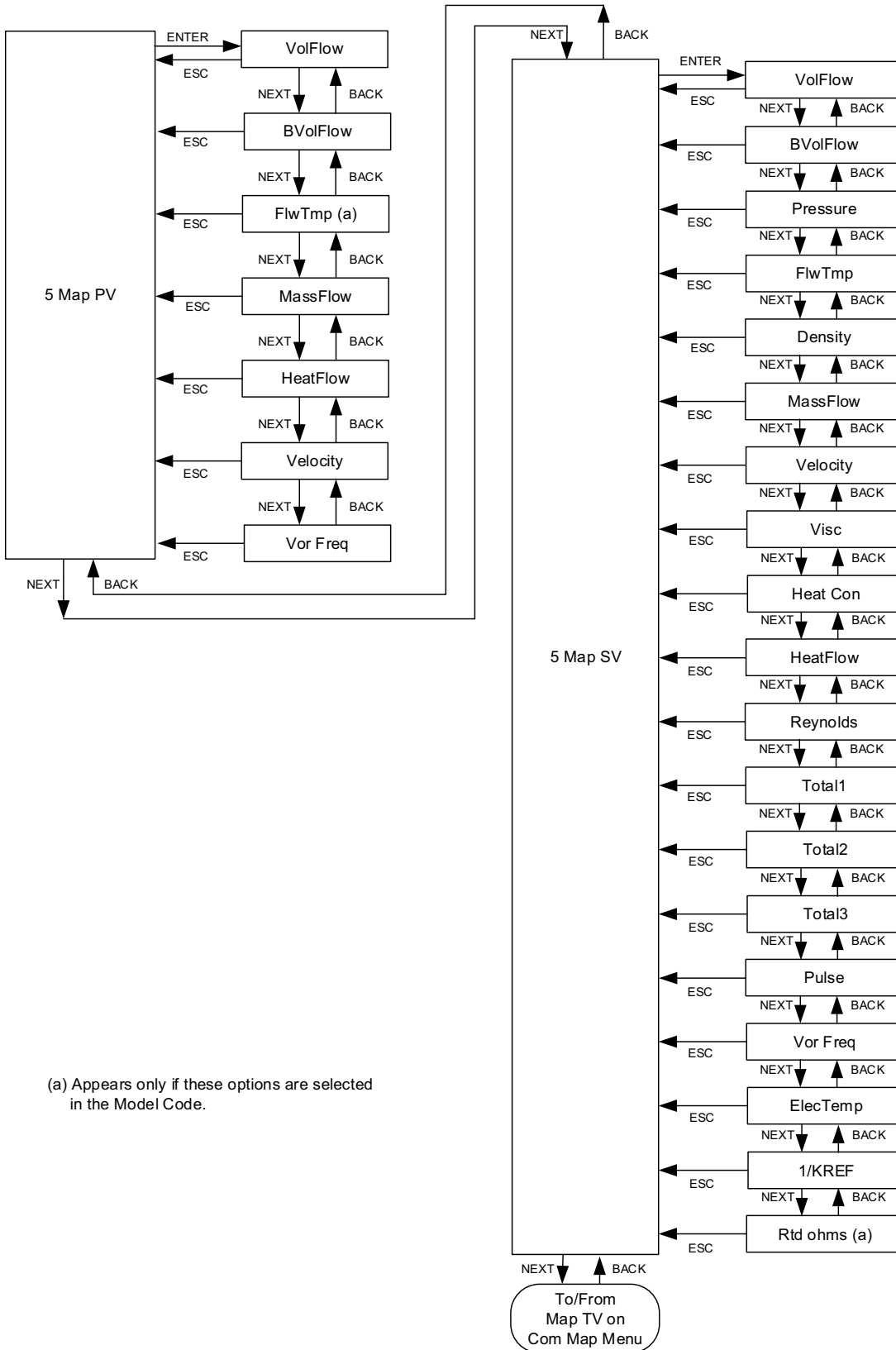
Figure 61 - Communications Mapping (Com Map) Menu Diagram (2 of 2)
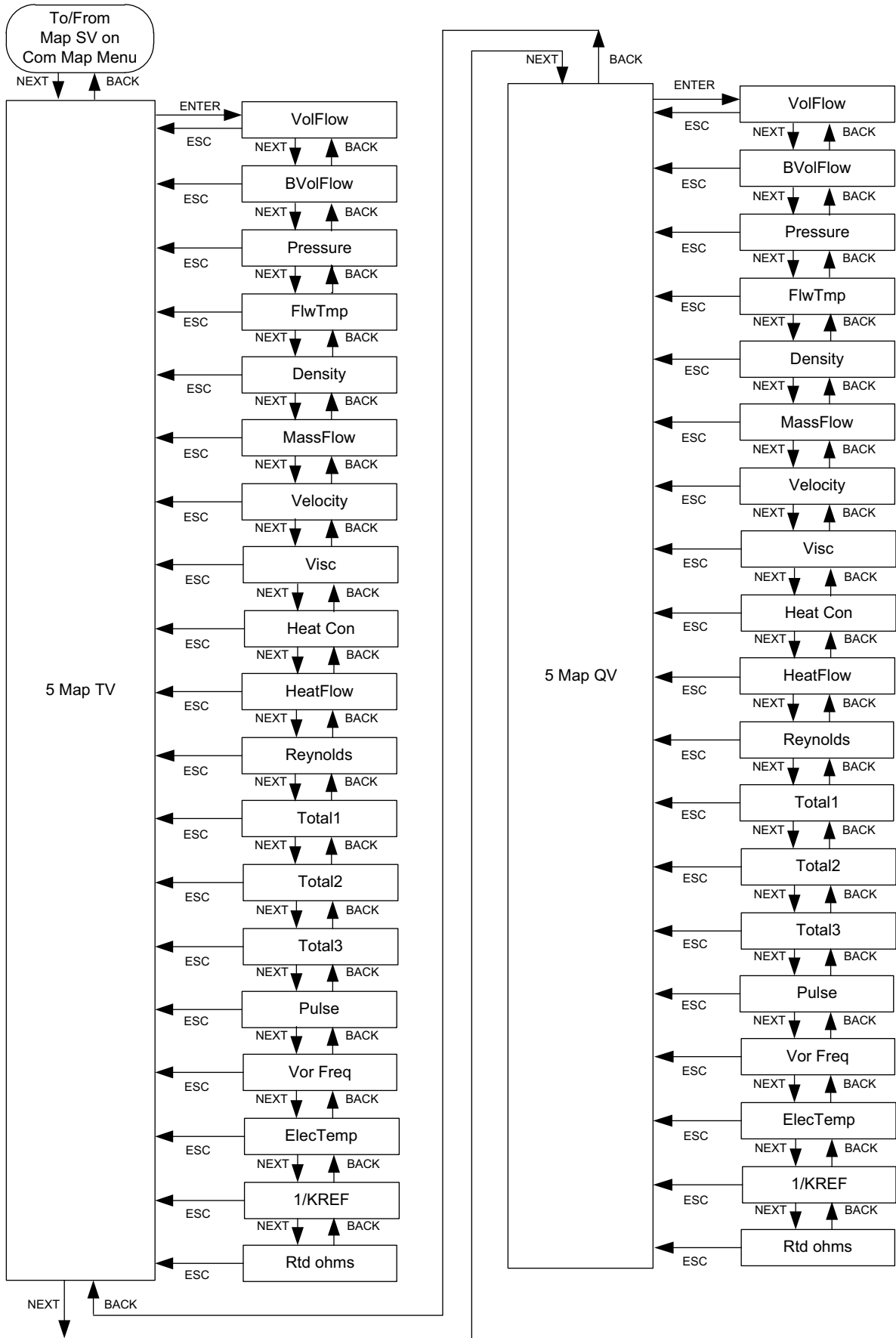
Figure 62 - HART Communication and Tag Configuration Menu Diagram
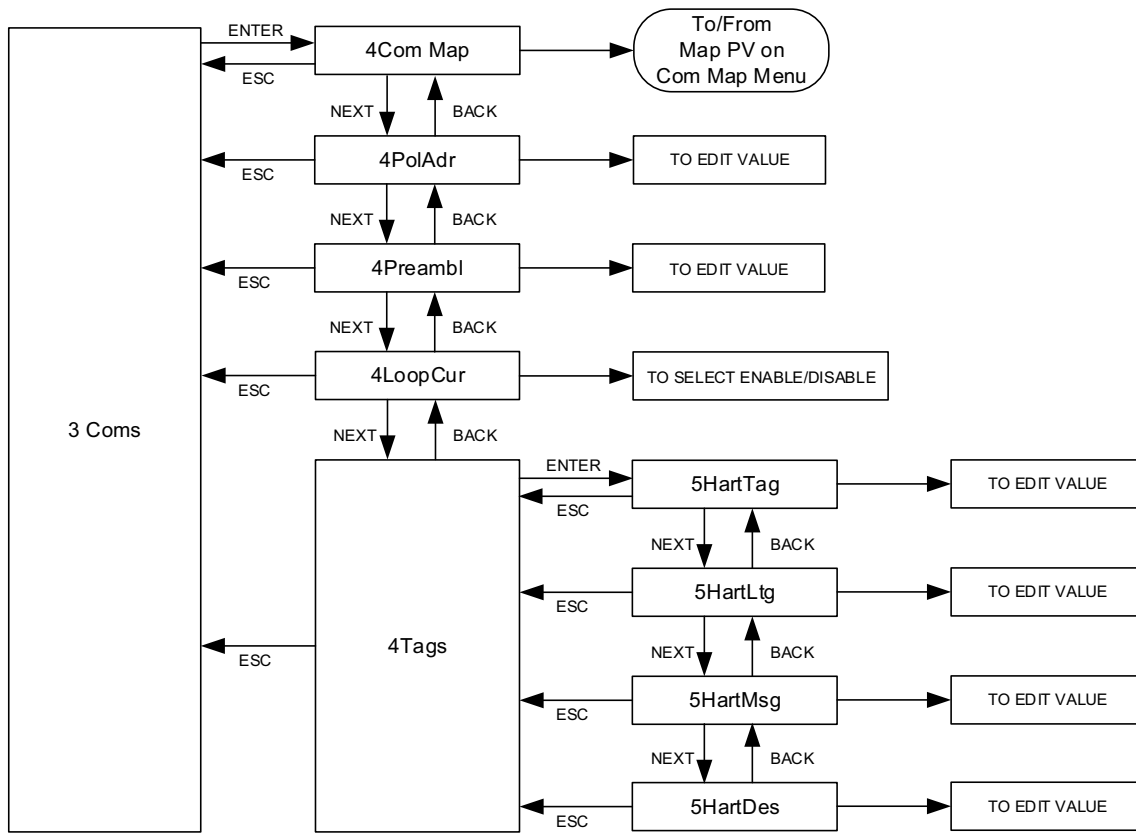
Figure 63 - mA Output Configuration Menu Diagram
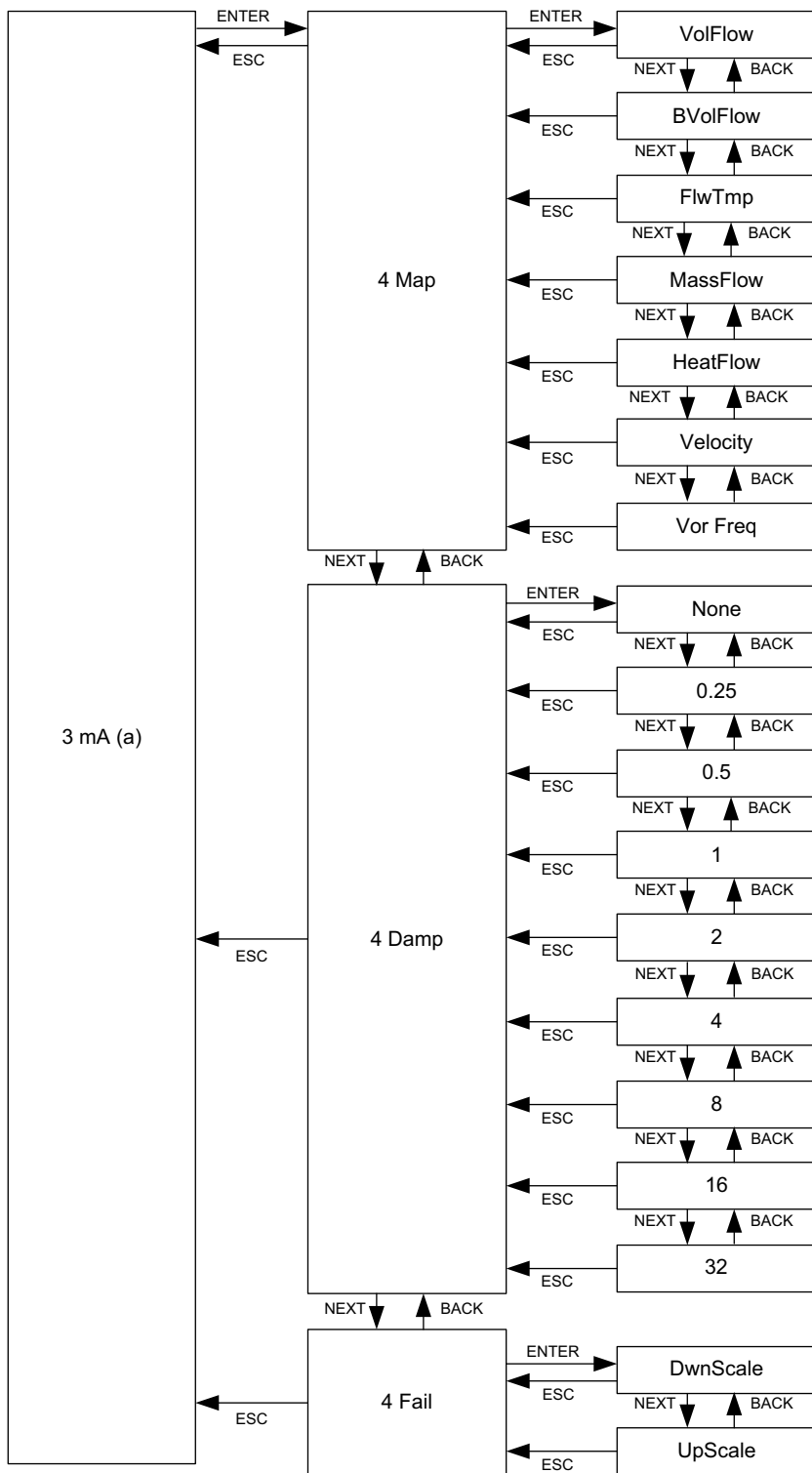
(a) **mA** does not apply to low power transmitters or to transmitters with Loop Current Mode disabled. In both cases, the mA output is set at a fixed value.

Figure 64 - Pulse Output, Pulse Mode Configuration Menu Diagram
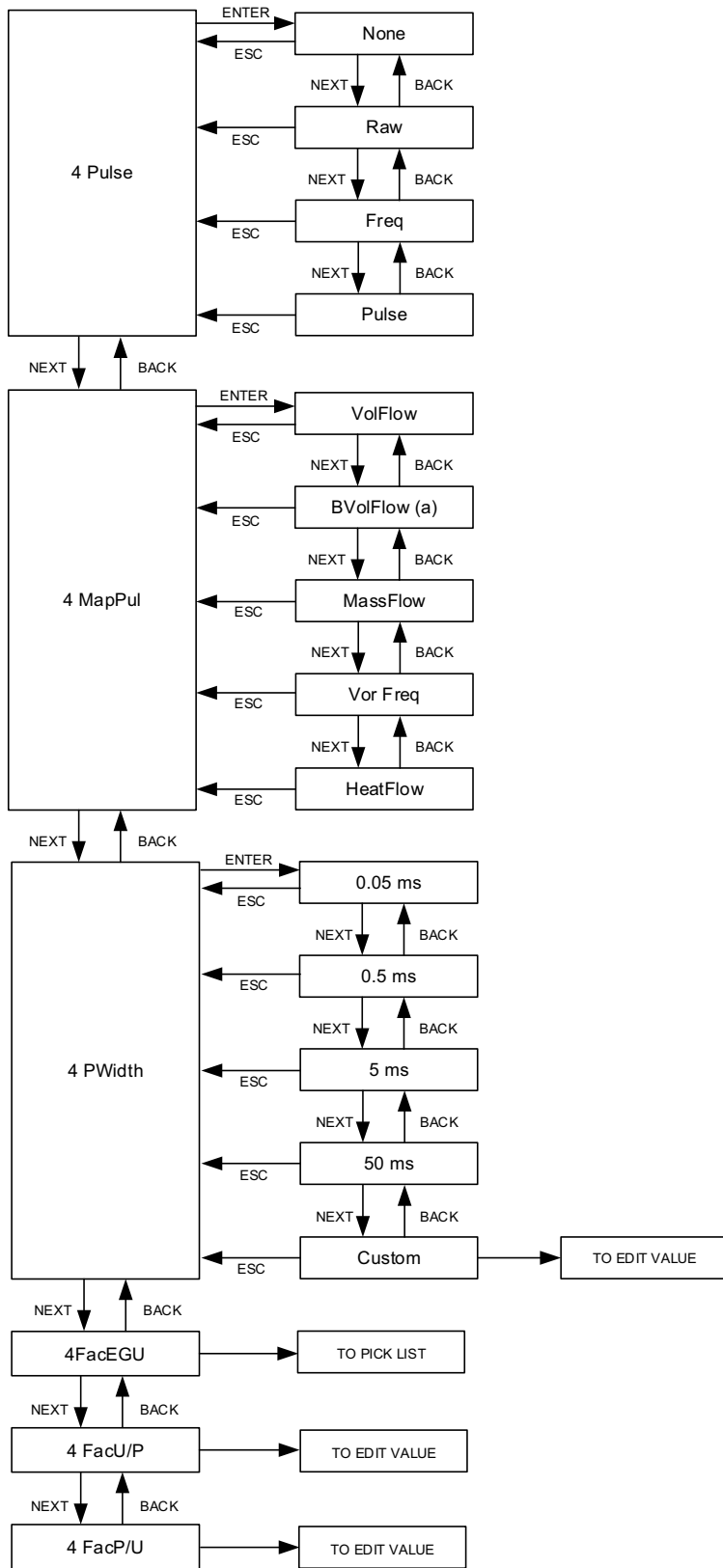
(a) BVolFlow is not available in the Steam
personality.

Figure 65 - Pulse Output, Frequency Mode Configuration Menu Diagram
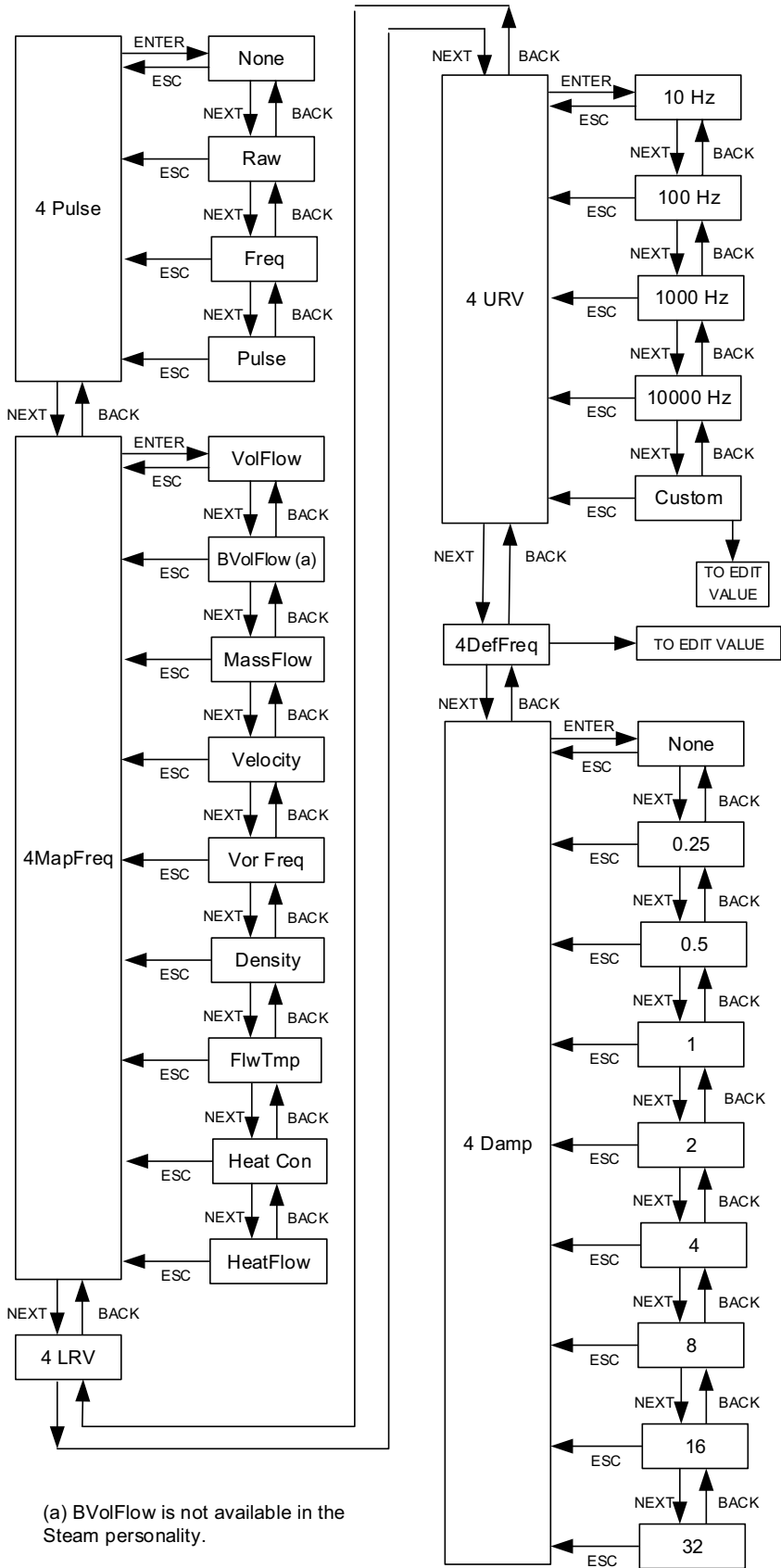
(a) BVolFlow is not available in the Steam personality.

Figure 66 - Display Configuration Menu Diagram (1 of 2)
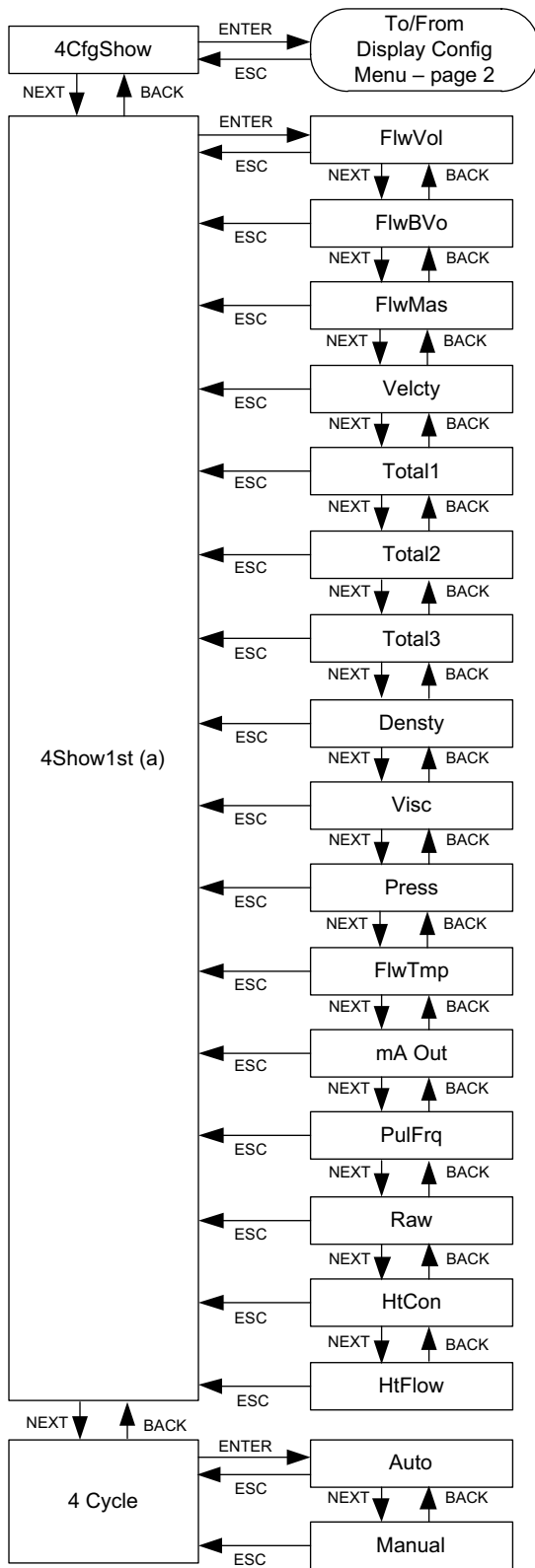
(a) If **Show** is set to **Off** for a particular measurement, that
measurement does not appear in the **4Show1st** menu.
4Show1st only shows those measurements that are configured
to appear on the Home screen.

Figure 67 - Display Configuration Menu Diagram (2 of 2)
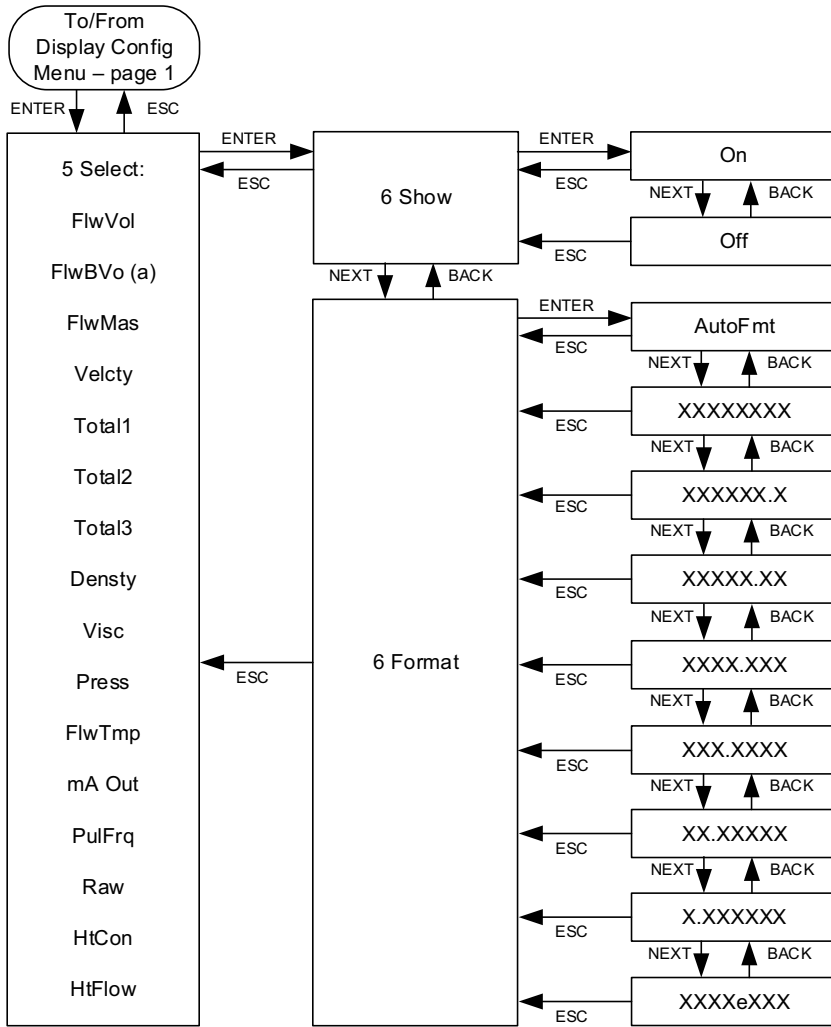
(a) FlwBVo is not available in the Steam personality.

Figure 68 - Pulse Actions Top Level Menu Diagram
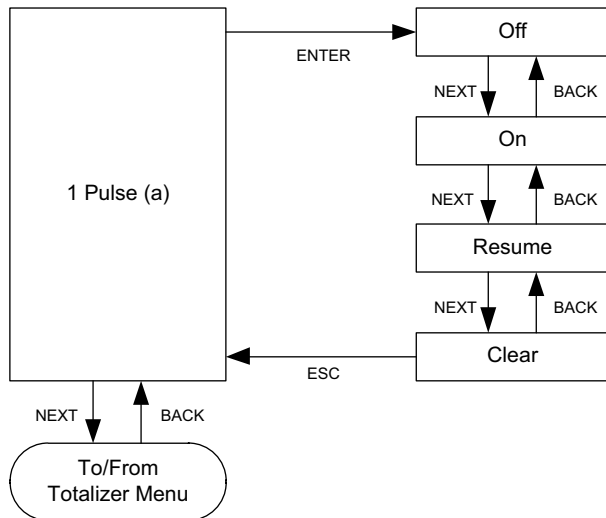
(a) Only available when Pulse Output is configured in Pulse mode.

Figure 69 - Totalizer Actions Top Level Menu Diagram
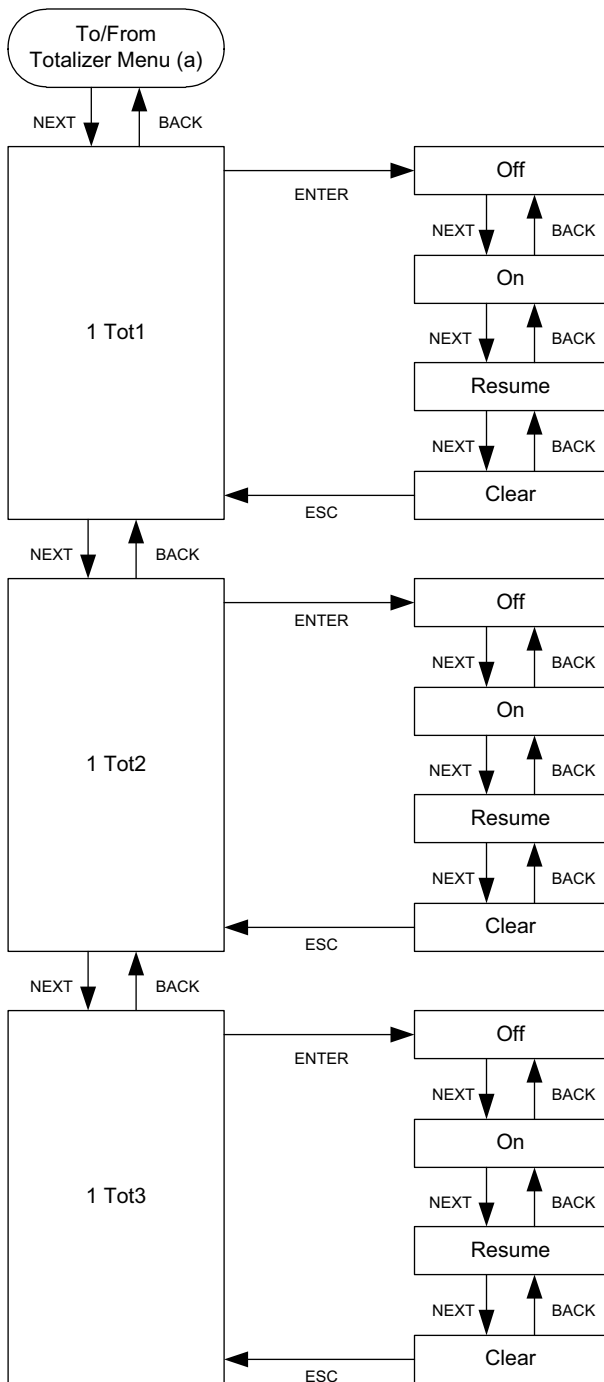
(a) Goes back to the **1 Pulse** menu only when Pulse Output is
configured to Pulse Mode..

Figure 70 - Pipe Configuration Menu Diagram
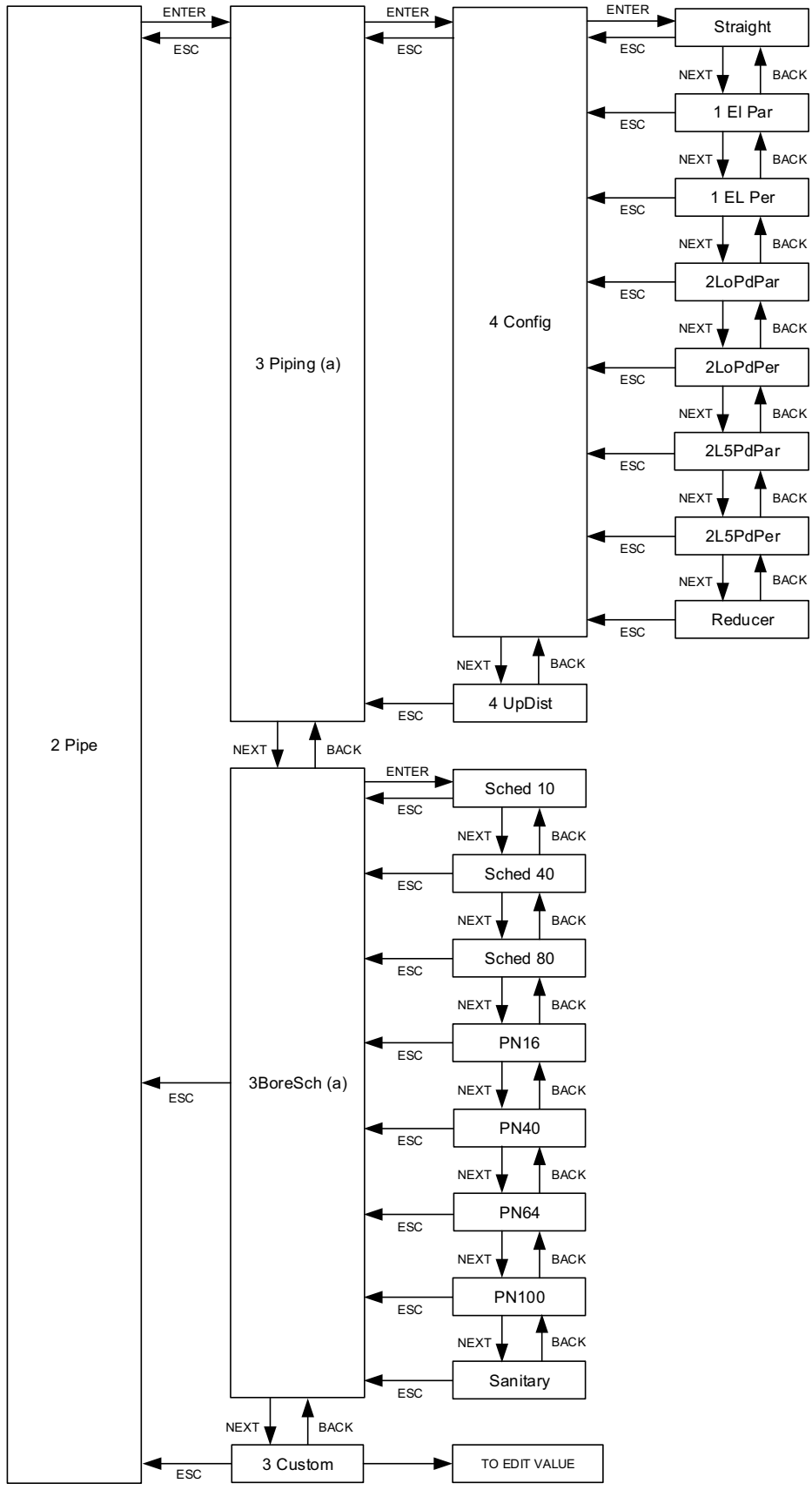
(a) Not available for all model codes.

Figure 71 - NewMod Configuration Menu Diagram

```
                    ENTER
2 NewMod  ─────────────────→  3 Model  ──────→  TO EDIT VALUE
          ←─────────────────
                    ESC
                 NEXT ↓ ↑ BACK
          ←──────────────      3 Ref No  ──────→  TO EDIT VALUE
                    ESC
                 NEXT ↓ ↑ BACK
                              ENTER
          ←──────────────     3 K Ref  ────────→  4 K EGU  ──────→  TO PICK LIST
                    ESC                ←─────────
                                          ESC
                                       NEXT ↓ ↑ BACK
                                     ←──────────   4 K Ref  ──────→  TO EDIT VALUE
                                          ESC
```
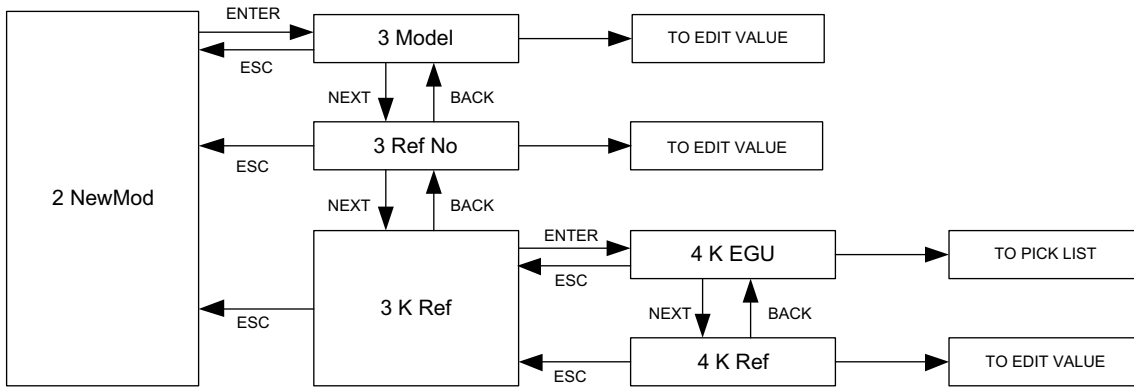
Figure 72 - Advanced Options Menu Diagram
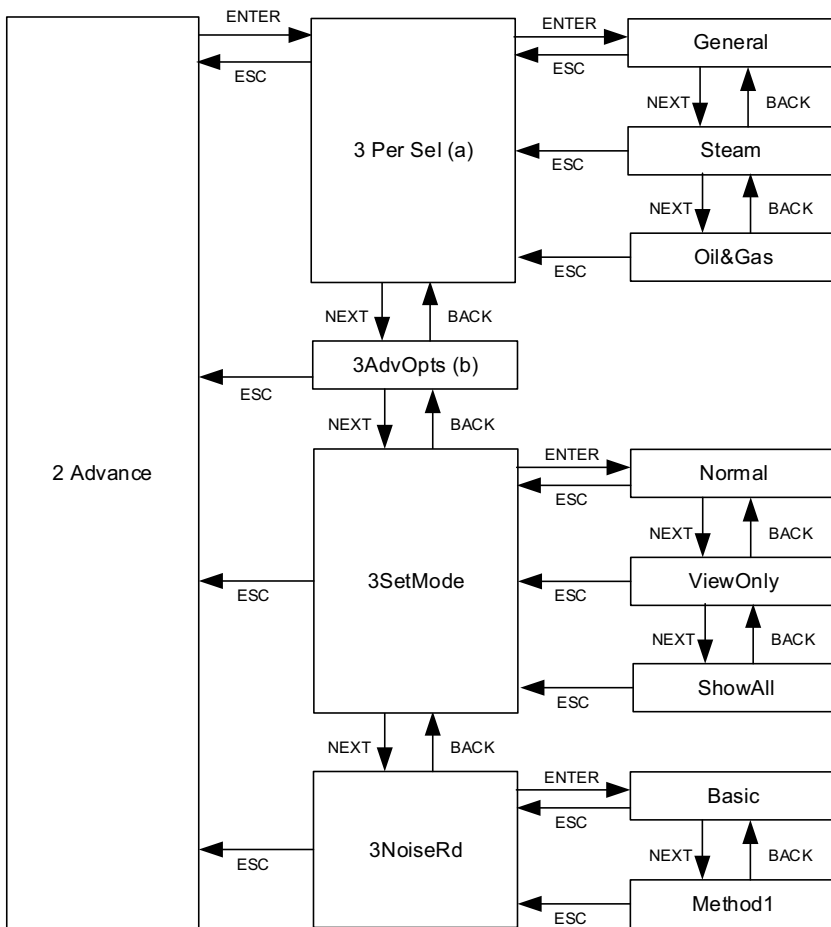
```
                    ENTER                   ENTER
2 Advance  ────────────────→  3 Per Sel (a)  ──────→  General
           ←────────────────                ←────────
                    ESC                        ESC
                                            NEXT ↓ ↑ BACK
                                     ←──────────   Steam
                                          ESC
                                            NEXT ↓ ↑ BACK
                                     ←──────────   Oil&Gas
                                          ESC
                 NEXT ↓ ↑ BACK
           ←──────────────     3AdvOpts (b)
                    ESC
                 NEXT ↓ ↑ BACK
                              ENTER
           ←──────────────    3SetMode  ──────→  Normal
                    ESC                ←─────────
                                          ESC
                                       NEXT ↓ ↑ BACK
                                     ←──────────   ViewOnly
                                          ESC
                                       NEXT ↓ ↑ BACK
                                     ←──────────   ShowAll
                                          ESC
                 NEXT ↓ ↑ BACK
                              ENTER
           ←──────────────    3NoiseRd  ──────→  Basic
                    ESC                ←─────────
                                          ESC
                                       NEXT ↓ ↑ BACK
                                     ←──────────   Method1
                                          ESC
```

(a) Pulse must be turned off before changing the personality.
(b) 3AdvOpts is reserved for advanced options. Contact Global Customer Support for
     information and assistance.

Figure 73 - Resetting the Database Menu Diagram

```
                 ENTER
2 SetDef  ──────────────→  Set Now?
          ←──────────────
                 ESC
```
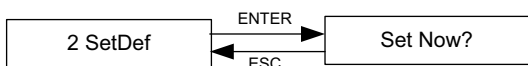
Figure 74 - Password Configuration Menu Diagram
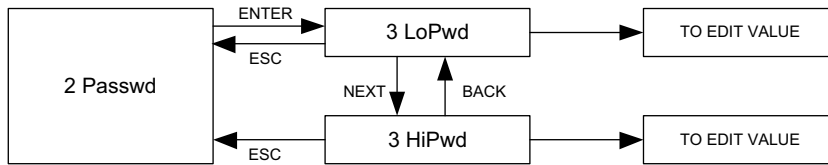
Figure 75 - Calibration/Test Menu Diagram
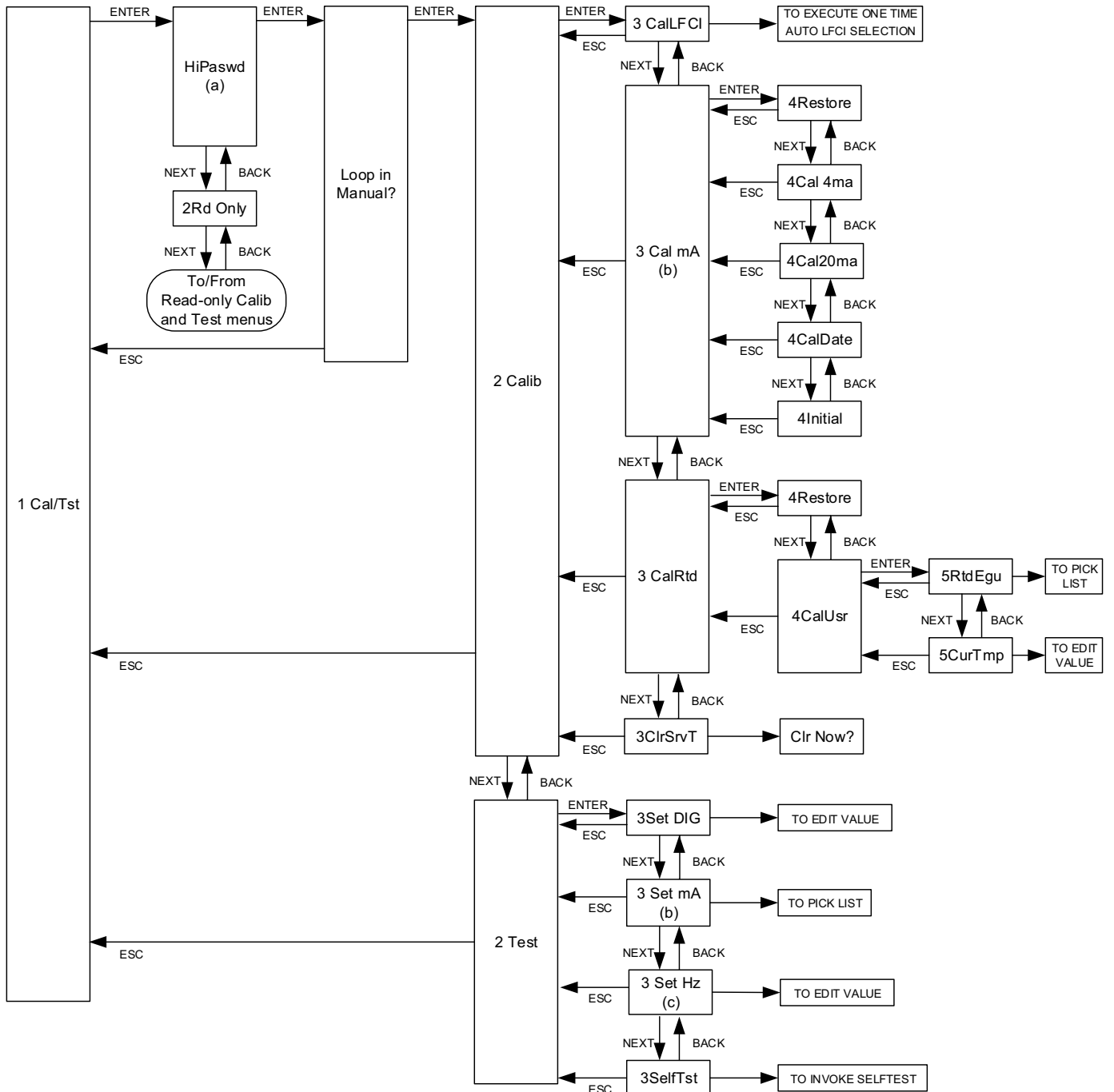
(a) Appears only when the Hi password is configured. Entering the password at this point puts the flowmeter in an offline mode and allows you to proceed with the calibration and test functions. If you do not enter the password, a prompt appears indicating that the menus are read-only. You can view the menus, but cannot perform calibration or test functions.

(b) Cal mA and Set mA functions are not available when Loop Current is disabled or for Low Power Vortex flowmeters.

(c) Applies to Pulse Frequency Mode only.

Menus for the Oil & Gas Personality

Figure 76 - Status Menu Diagram
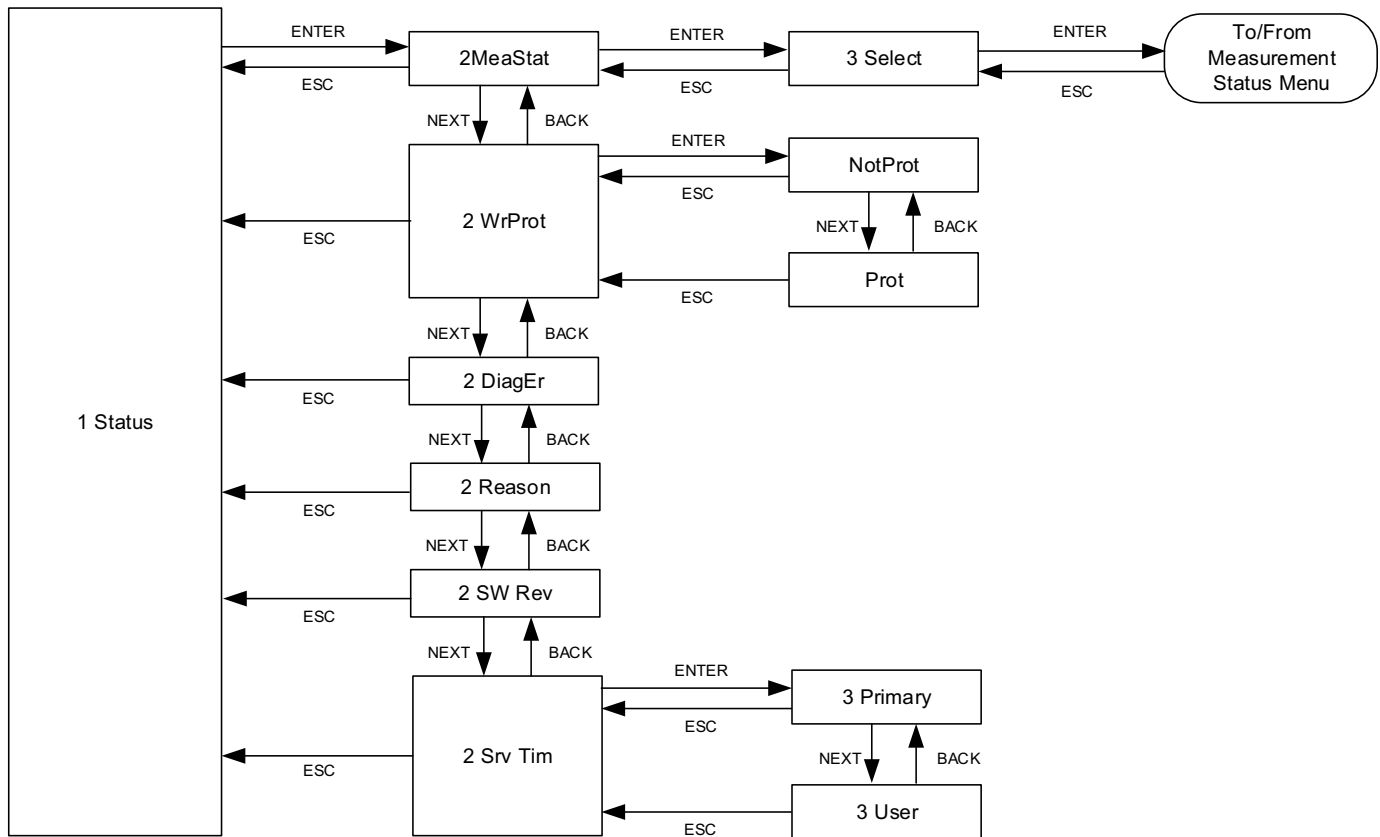
Figure 77 - Measurement Status Menu Diagram
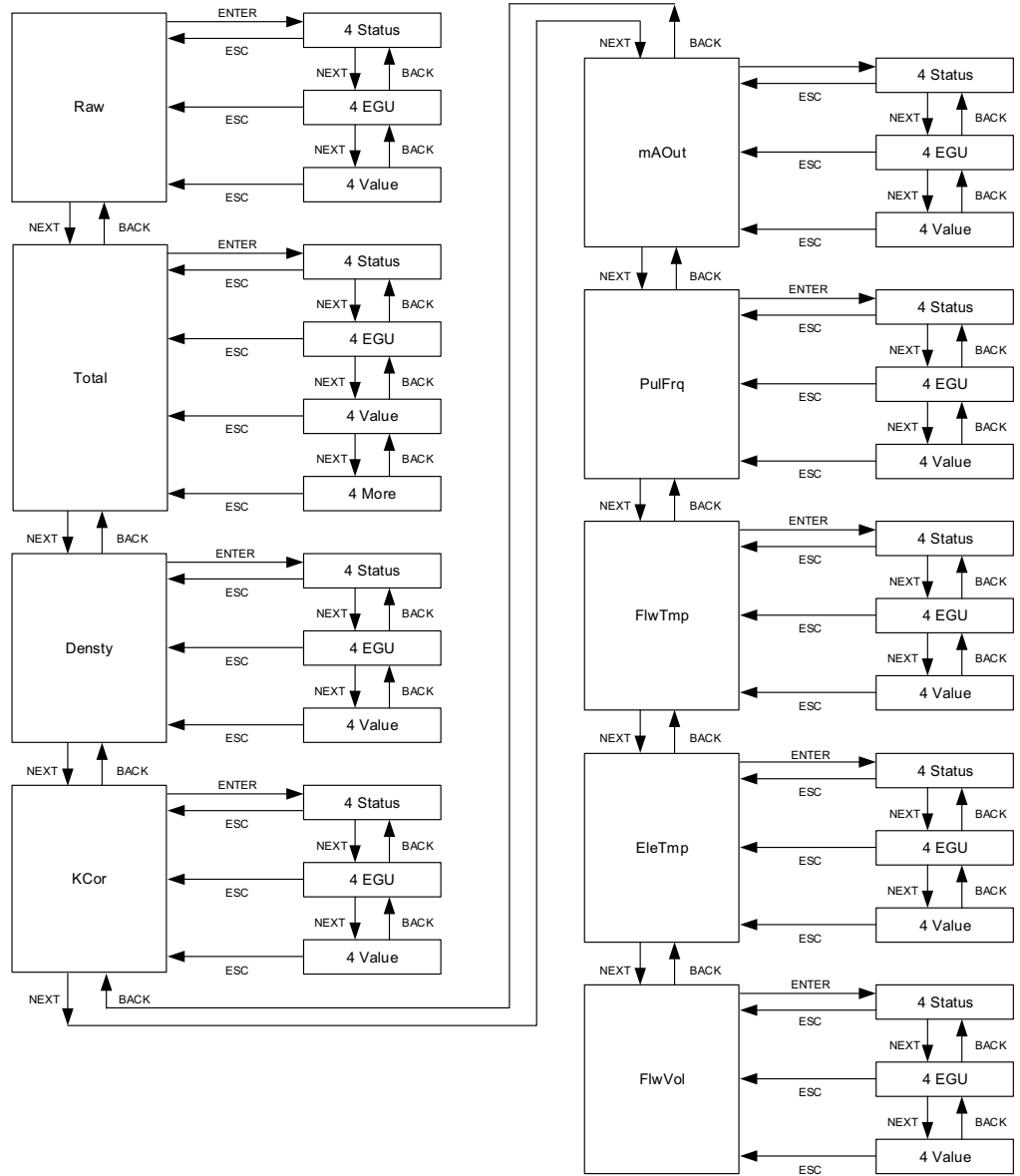
Figure 78 - Oil Gas Main Menu

```
┌──────────────┐   ENTER   ┌──────────────┐
│  2 SetDef    │ ────────► │   Set Now?   │
│              │ ◄──────── │              │
└──────────────┘    ESC    └──────────────┘
  NEXT ↓  ↑ BACK
┌──────────────┐           ┌──────────────┐
│  2 FlwEGU    │ ────────► │ TO PICK LIST │
└──────────────┘           └──────────────┘
  NEXT ↓  ↑ BACK
┌──────────────┐           ┌──────────────┐
│  2 Puls/U    │ ────────► │ TO EDIT VALUE│
└──────────────┘           └──────────────┘
  NEXT ↓  ↑ BACK
┌──────────────┐   ENTER   ╭──────────────╮
│  2Tuning     │ ────────► │ To/From Tuning│
│              │ ◄──────── │    Menu      │
└──────────────┘           ╰──────────────╯
  NEXT ↓  ↑ BACK
┌──────────────┐   ENTER   ╭──────────────╮
│  2 Output    │ ────────► │ To/From Output│
│              │ ◄──────── │ Config Menu  │
└──────────────┘    ESC    ╰──────────────╯
  NEXT ↓  ↑ BACK
┌──────────────┐   ENTER   ╭──────────────╮
│  2 Pipe      │ ────────► │ To/From Pipe │
│              │ ◄──────── │ Config Menu  │
└──────────────┘    ESC    ╰──────────────╯
  NEXT ↓  ↑ BACK
┌──────────────┐   ENTER   ╭──────────────╮
│  2 NewMod    │ ────────► │ To/From NewMod│
│              │ ◄──────── │ Config Menu  │
└──────────────┘    ESC    ╰──────────────╯
  NEXT ↓  ↑ BACK
┌──────────────┐   ENTER   ╭──────────────╮
│  2Advance    │ ────────► │ To/From Advance│
│              │ ◄──────── │ Config Menu  │
└──────────────┘    ESC    ╰──────────────╯
  NEXT ↓  ↑ BACK
┌──────────────┐   ENTER   ╭──────────────╮
│  2Passwd     │ ────────► │ To/From Passwd│
│              │ ◄──────── │ Config Menu  │
└──────────────┘    ESC    ╰──────────────╯
```

Figure 79 - Tuning Menu Diagram
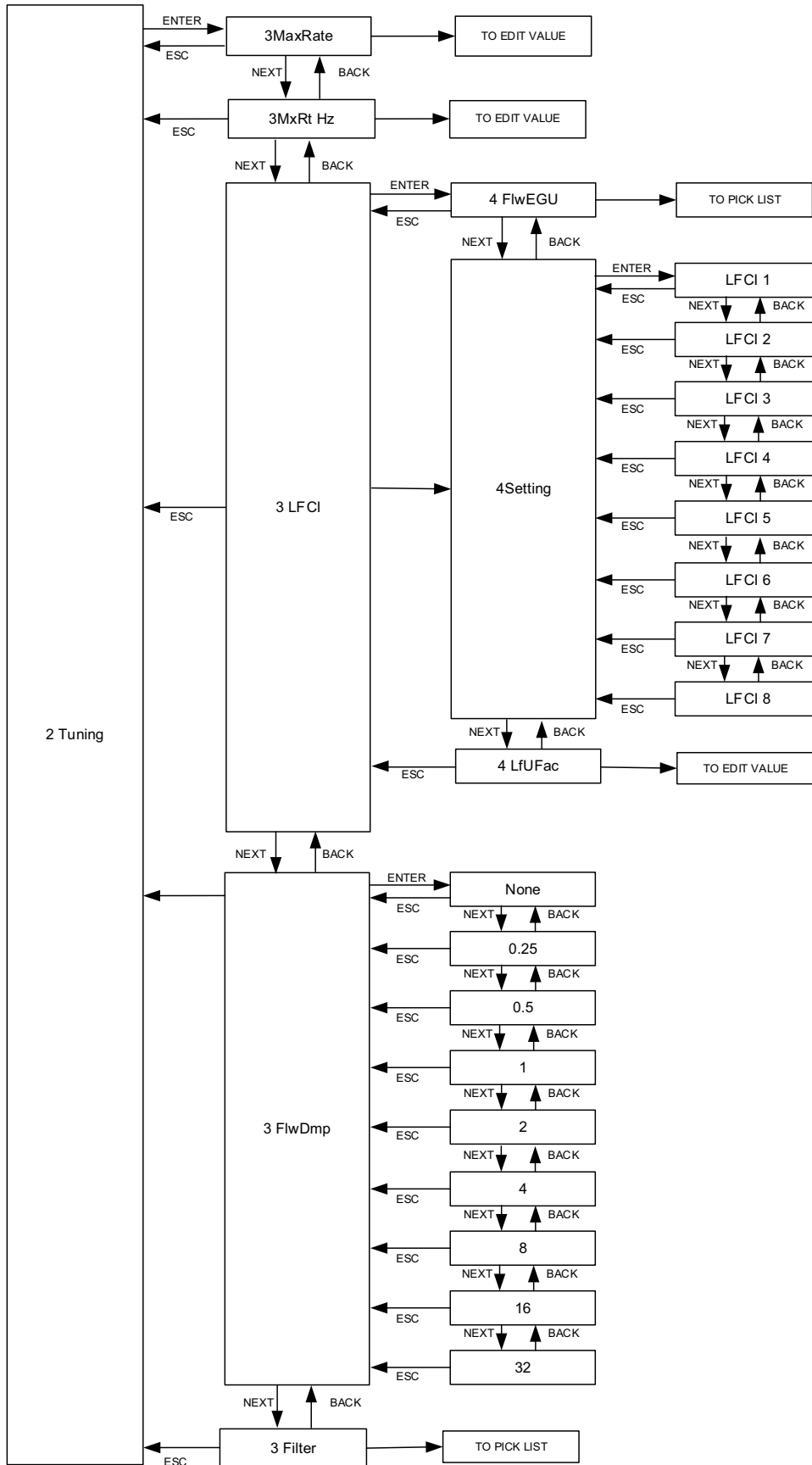
Figure 80 - Output Menus - HART Communication and Tag Configuration Menu Diagram
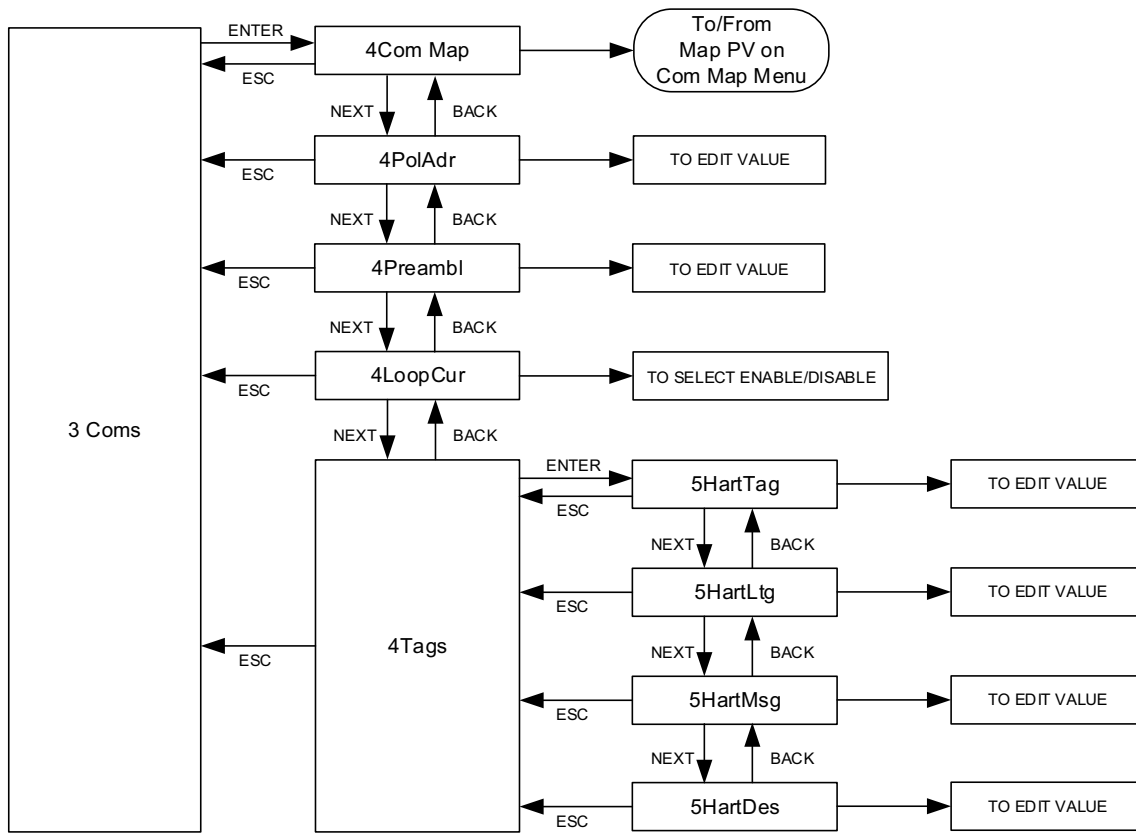
Figure 81 - Output Menus - Communication Mapping (Com Map) Menu Diagram (1 of 2)

(a) Appears only if these options are selected in the Model Code.
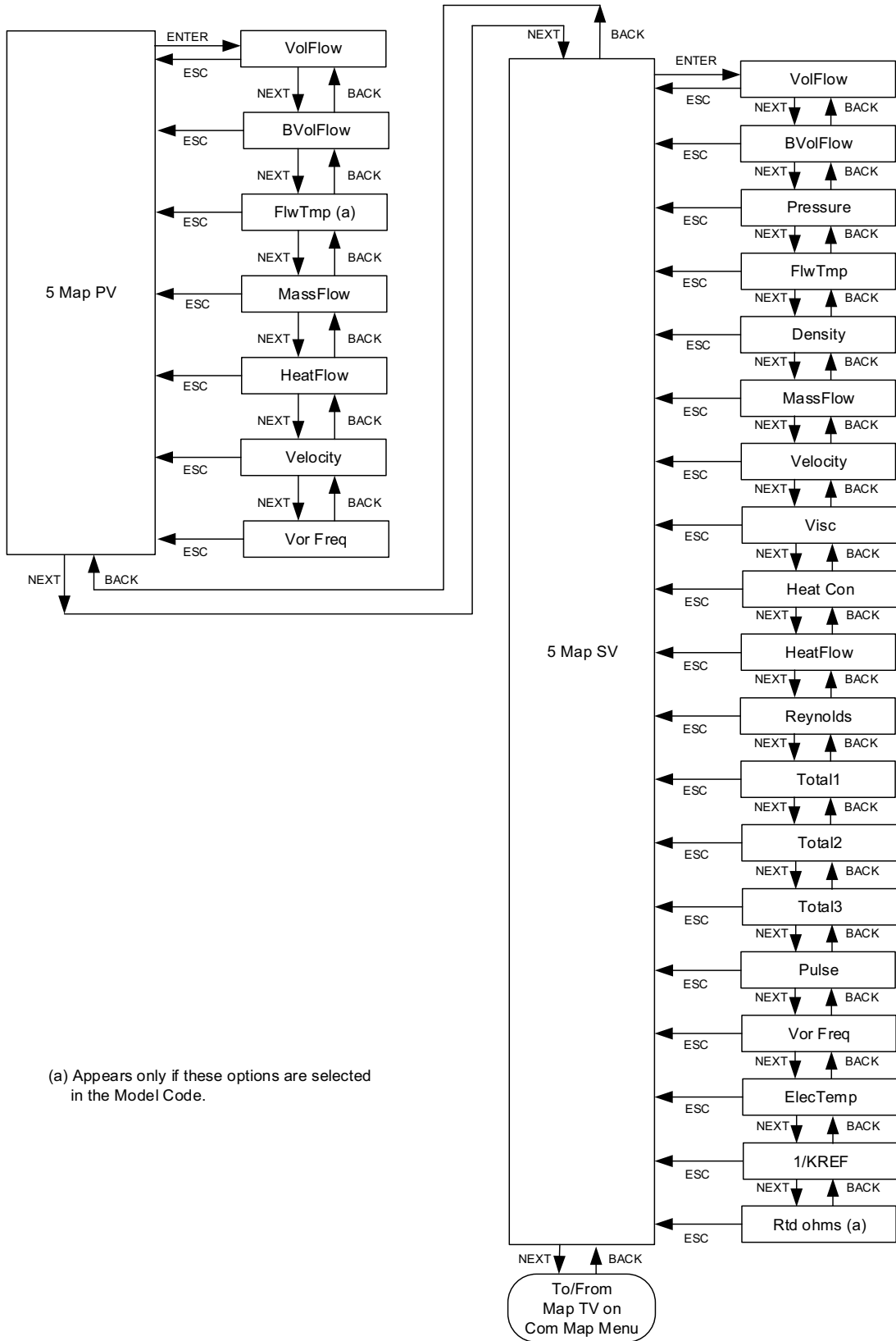
Figure 82 - Output Menus - Communication Mapping (Com Map) Menu Diagram (2 of 2)
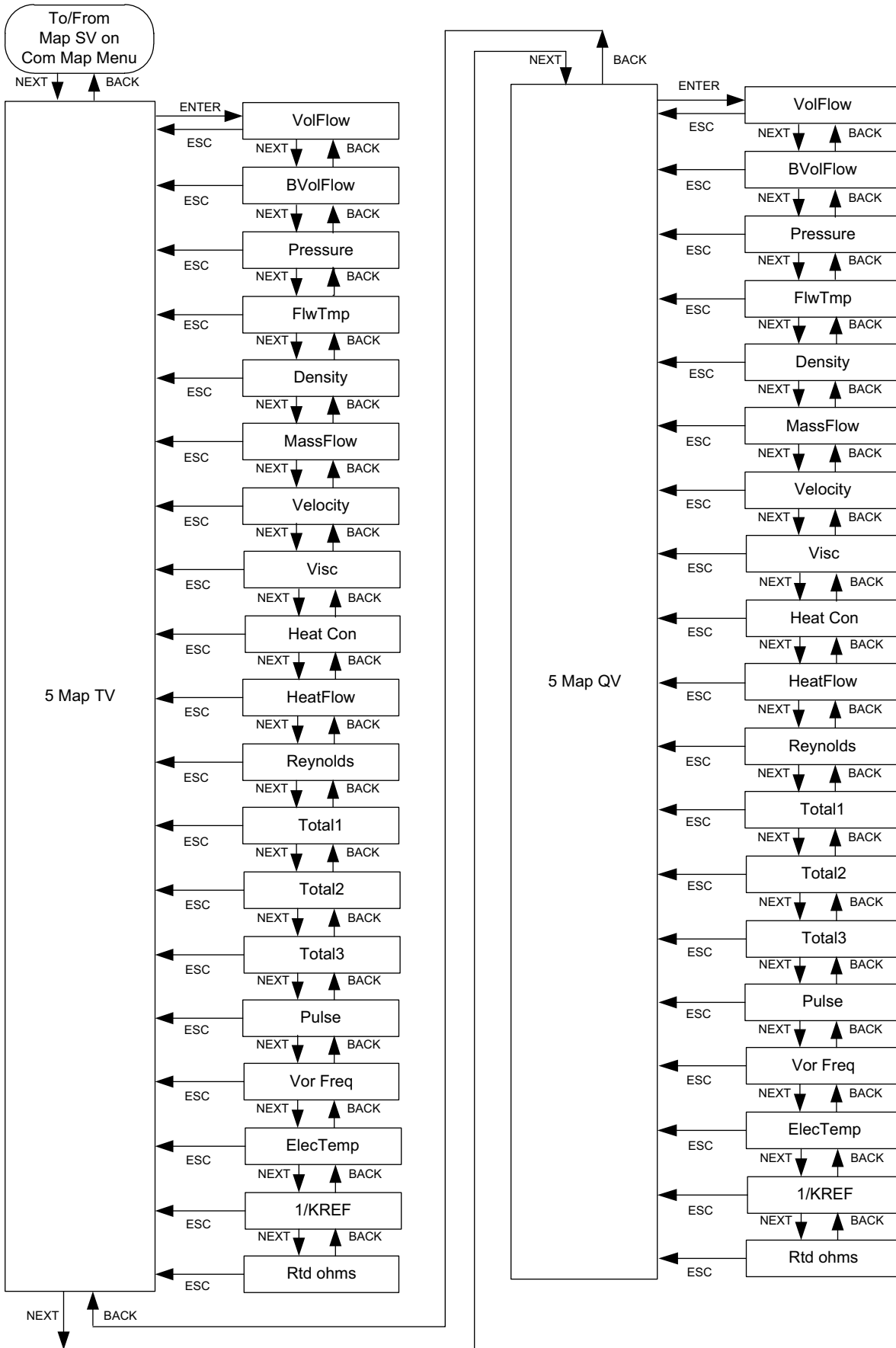
Figure 83 - Output Menus - mA Output Configuration Menu Diagram
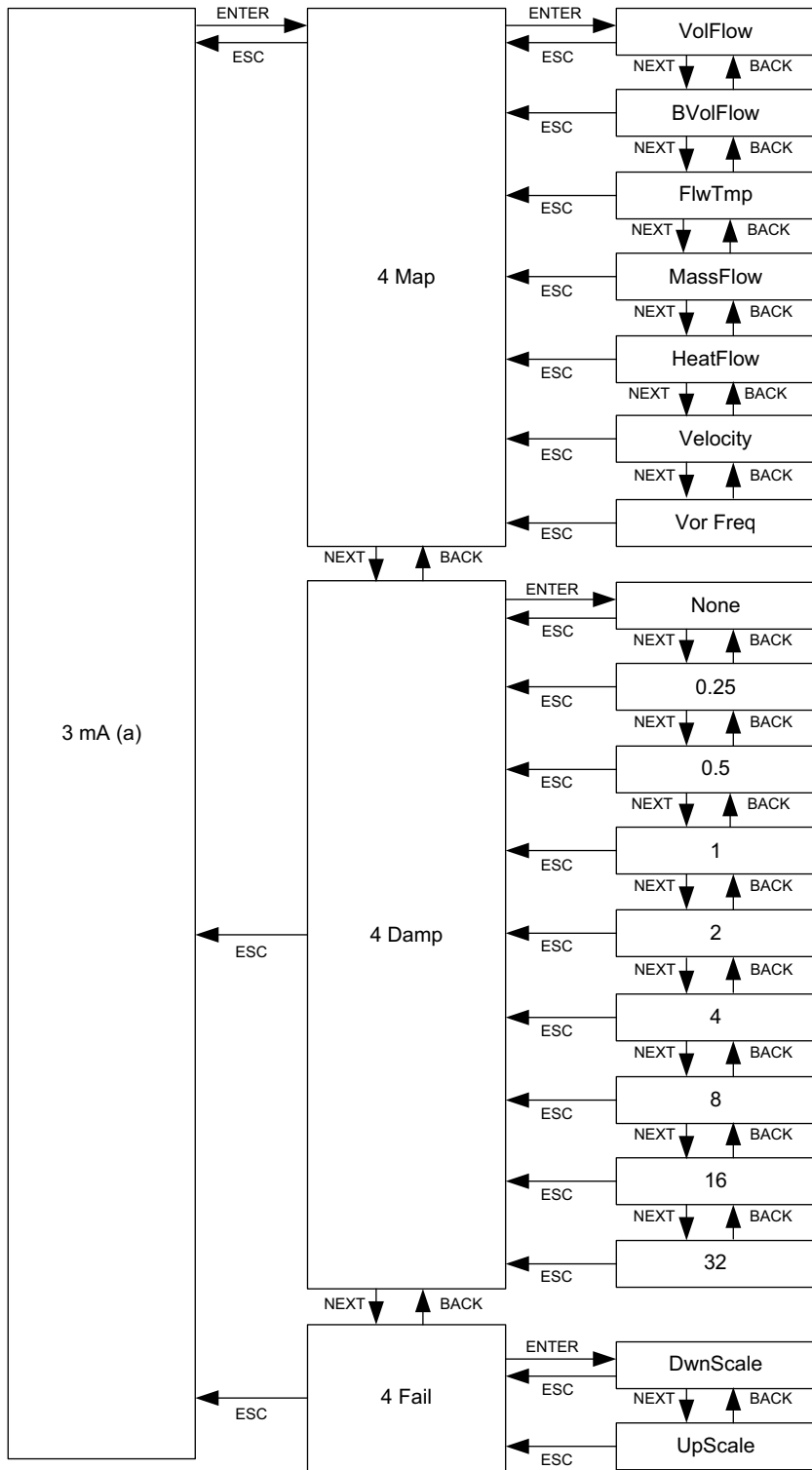
(a) **mA** does not apply to low power transmitters or to transmitters with Loop Current Mode disabled.
In both cases, the mA output is set at a fixed value.

Figure 84 - Output Menus - Display Configuration Menu Diagram (1 of 2)
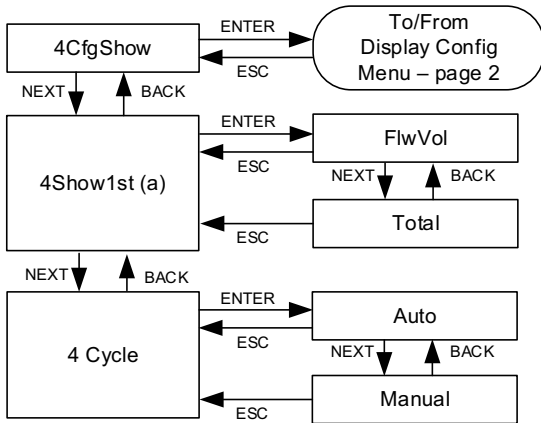
(a) If Show is set to Off for a particular measurement, that
measurement does not appear in the 4Show1st menu.
4Show1st only shows those measurements that are configured
to appear on the Home screen.

Figure 85 - Output Menus - Display Configuration Menu Diagram (2 of 2)
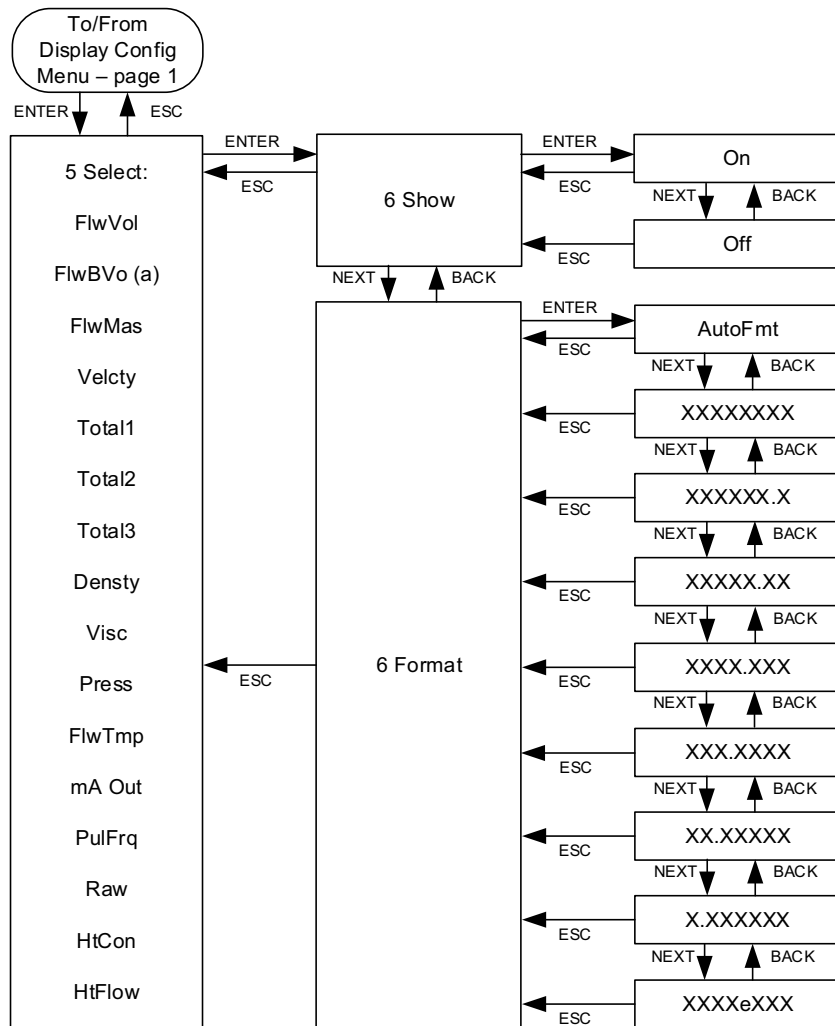
(a) FlwBVo is not available in the Steam personality.

Figure 86 - Pipe Configuration Menu Diagram
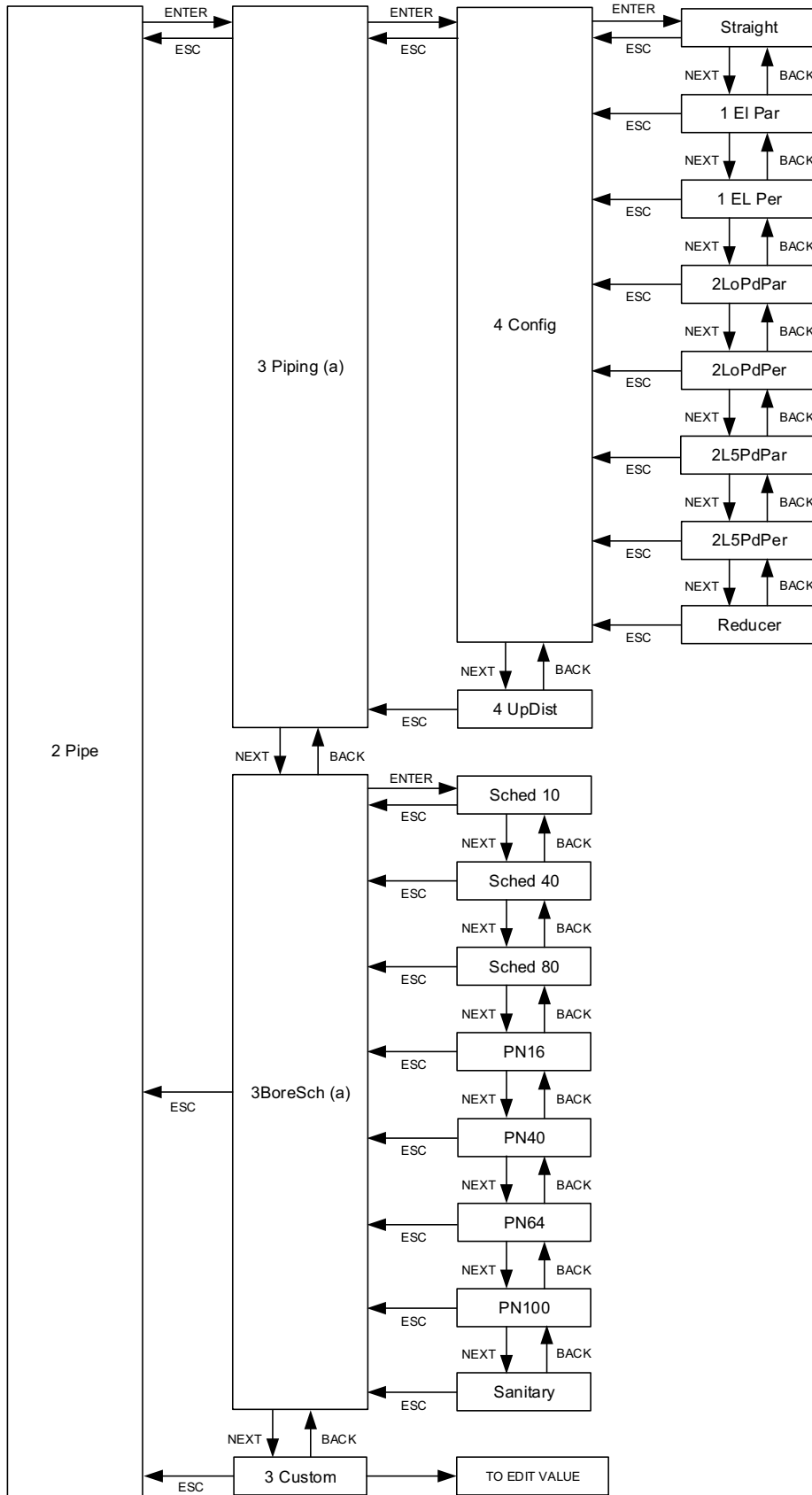
(a) Not available for all model codes.

Figure 87 - NewMod Configuration Menu Diagram

```
                    ENTER
           ┌────────────►┌──────────────┐─────────►┌──────────────┐
           │             │   3 Model    │          │ TO EDIT VALUE│
           │◄────────────└──────────────┘          └──────────────┘
           │     ESC          │    ▲
           │             NEXT │    │ BACK
           │◄─────────────┌──────────────┐─────────►┌──────────────┐
           │     ESC      │   3 Ref No   │          │ TO EDIT VALUE│
 ┌────────┐│              └──────────────┘          └──────────────┘
 │        ││                   │    ▲
 │2 NewMod││              NEXT │    │ BACK       ENTER
 │        ││              ┌──────────────┐─────────►┌──────────┐───────►┌────────────┐
 │        ││              │              │          │  4 K EGU │        │TO PICK LIST│
 │        ││              │              │◄─────────└──────────┘        └────────────┘
 │        ││◄─────────────│   3 K Ref    │   ESC      │    ▲
 └────────┘│     ESC      │              │       NEXT │    │ BACK
           │              │              │          ┌──────────┐───────►┌────────────┐
           │              │              │          │  4 K Ref │        │TO EDIT VALUE│
           │              └──────────────┘◄─────────└──────────┘        └────────────┘
                                            ESC
```
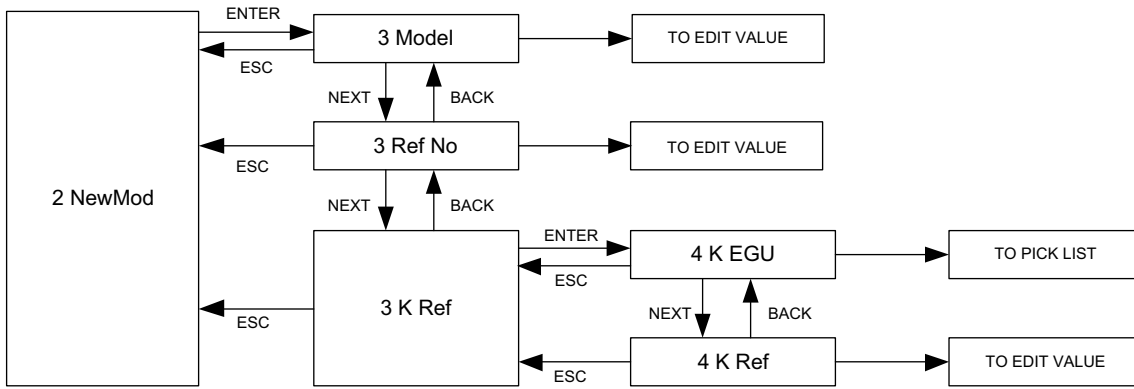
Figure 88 - Advanced Options Menu Diagram
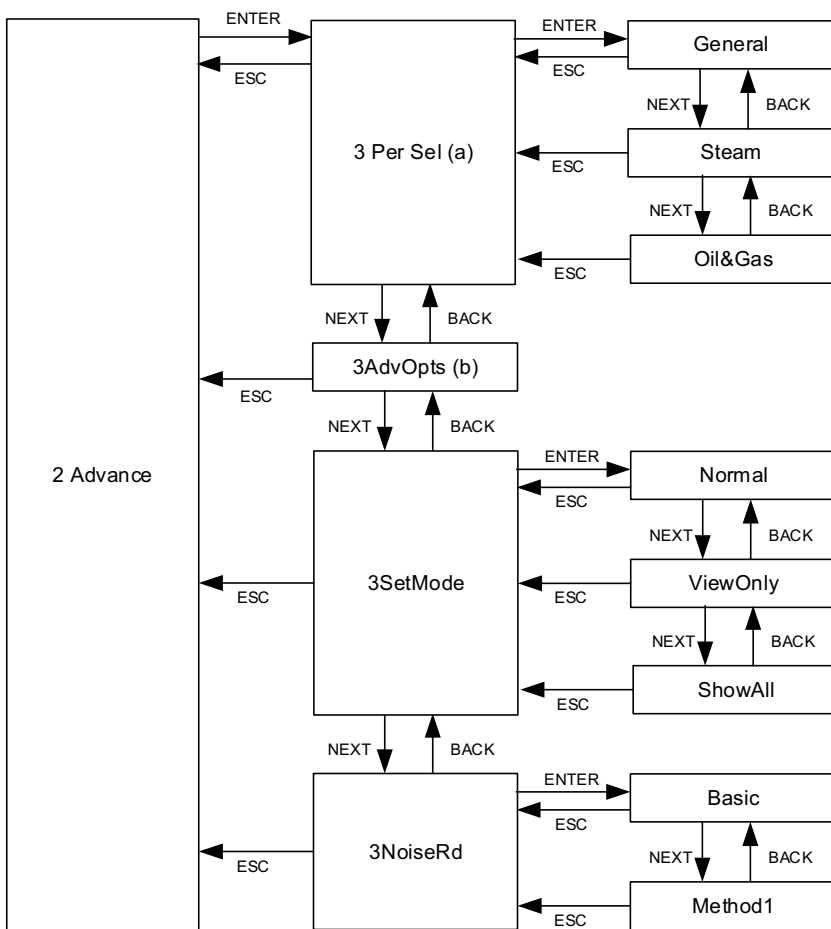
```
                ENTER                         ENTER
       ┌───────────►┌───────────────┐───────────►┌──────────┐
       │            │               │            │ General  │
       │◄───────────│               │◄───────────└──────────┘
       │    ESC     │               │   ESC        │    ▲
       │            │               │         NEXT │    │ BACK
       │            │  3 Per Sel (a) │◄───────────┌──────────┐
       │            │               │   ESC      │  Steam   │
       │            │               │            └──────────┘
       │            │               │              │    ▲
       │            │               │         NEXT │    │ BACK
       │            │               │◄───────────┌──────────┐
       │            └───────────────┘   ESC      │  Oil&Gas │
       │                  │    ▲                 └──────────┘
       │             NEXT │    │ BACK
       │◄───────────┌───────────────┐
       │    ESC     │  3AdvOpts (b)  │
       │            └───────────────┘
       │                  │    ▲
 ┌─────────┐         NEXT │    │ BACK      ENTER
 │         │         ┌───────────────┐───────────►┌──────────┐
 │2 Advance│         │               │            │  Normal  │
 │         │         │               │◄───────────└──────────┘
 │         │         │               │   ESC        │    ▲
 │         │◄────────│  3SetMode     │         NEXT │    │ BACK
 │         │  ESC    │               │◄───────────┌──────────┐
 │         │         │               │   ESC      │ ViewOnly │
 │         │         │               │            └──────────┘
 │         │         │               │              │    ▲
 │         │         │               │         NEXT │    │ BACK
 │         │         │               │◄───────────┌──────────┐
 │         │         └───────────────┘   ESC      │ ShowAll  │
 │         │              │    ▲                  └──────────┘
 │         │         NEXT │    │ BACK      ENTER
 │         │         ┌───────────────┐───────────►┌──────────┐
 │         │         │               │            │  Basic   │
 │         │         │               │◄───────────└──────────┘
 │         │◄────────│  3NoiseRd     │   ESC        │    ▲
 └─────────┘  ESC    │               │         NEXT │    │ BACK
                     │               │◄───────────┌──────────┐
                     └───────────────┘   ESC      │ Method1  │
                                                  └──────────┘
```

(a) Pulse must be turned off before changing the personality.
(b) 3AdvOpts is reserved for advanced options. Contact Global Customer Support for
    information and assistance.

Figure 89 - Password Configuration Menu Diagram

```
                    ENTER
           ┌───────────►┌──────────────┐─────────►┌──────────────┐
           │            │   3 LoPwd    │          │ TO EDIT VALUE│
           │◄───────────└──────────────┘          └──────────────┘
 ┌────────┐│    ESC          │    ▲
 │        ││            NEXT │    │ BACK
 │2 Passwd││            ┌──────────────┐─────────►┌──────────────┐
 │        ││◄───────────│   3 HiPwd    │          │ TO EDIT VALUE│
 └────────┘│    ESC     └──────────────┘          └──────────────┘
```
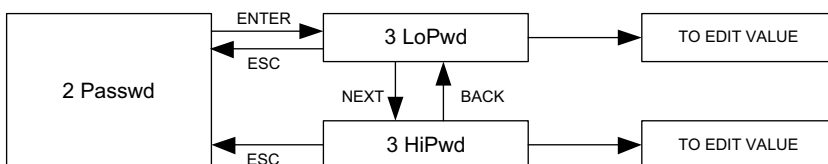
Figure 90 - Calibration/Test Menu Diagram
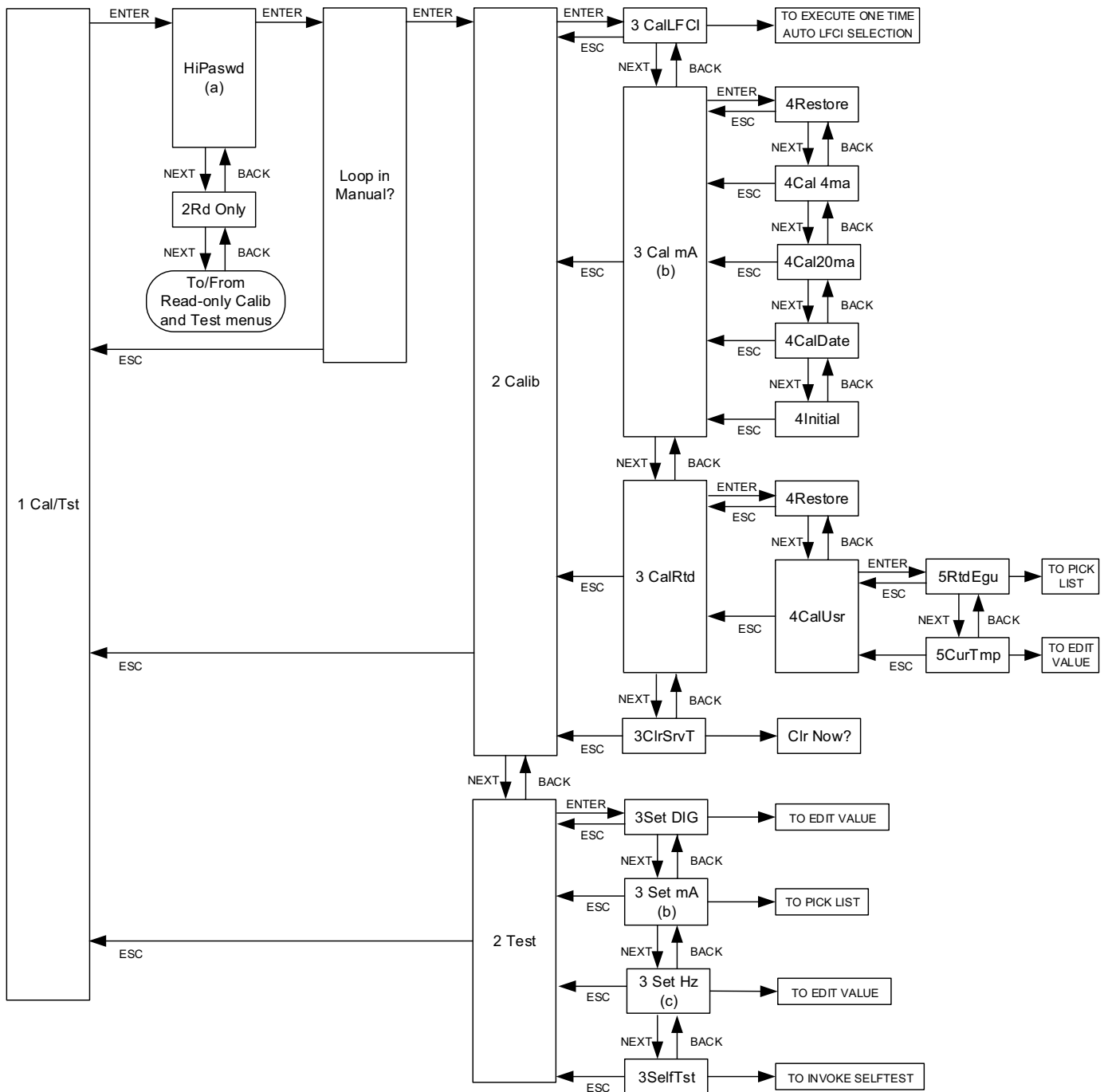
(a) Appears only when the Hi password is configured. Entering the password at this point puts the flowmeter in an offline mode and allows you to proceed with the calibration and test functions. If you do not enter the password, a prompt appears indicating that the menus are read-only. You can view the menus, but cannot perform calibration or test functions.

(b) Cal mA and Set mA functions are not available when Loop Current is disabled or for Low Power Vortex flowmeters.

(c) Applies to Pulse Frequency Mode only.

Figure 91 - Totalizer Actions Top Level Menu Diagram
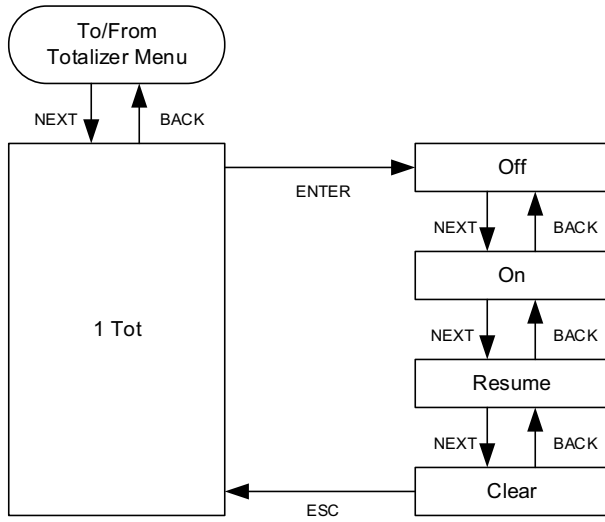
Using the HART Communicator

This chapter describes how to operate the flowmeter with the HART Communicator. It also provides the menu diagrams that are available from the HART Communicator.

Setting Digital Measurement Values Remotely

Use **Cmd: 192 (0xC0) Write Measurement Remote Data** to set digital measurement values remotely.

Example: Setting Pressure to 14.7 psia

NOTE: Pressure is used only for the SuperHeatedSteam fluid type. For SuperHeatedSteam, pressure can be set to a default value or can be configured to be read with HART.

HART Command Type	Device Specific
HART Version	7
HART Operation Type	WRITE
HART Command	82xxxxxxxxxxC007030300416B3333

Table 60 - Request: 16 (0x10) Bytes (Plus Preambles)

Pos	Size	Type	Fixed	Example	Description
0	1	byte	Fixed	0x82	Request delimiter
1	5	byte	Variable	0x??????????	Device address
6	1	byte	Fixed	0xC0	Command 192
7	1	byte	Fixed	0x07	Data length (not including checksum)
8	1	byte	Variable	0x03	Transmitter variable (Pressure)
9	2	byte	Variable	0x0300	Measurement units (psia). This measurement unit is for reference only. It must match the device's currently configured measurement. If the measurement does not match, the command is rejected with status error 12 (0x0C).
11	4	real	Variable	0x416B3333	Measurement remote value (14.7)
15	1	byte	Variable	0x??	HART checksum

Table 61 - Response: 18 (0x12) Bytes (Plus Preambles)

Pos	Size	Type	Fixed	Example	Description
0	1	byte	Fixed	0x82	Response delimiter
1	5	byte	Variable	0x??????????	Device address
6	1	byte	Fixed	0xC0	Command 192
7	1	byte	Fixed	0x09	Data length (not including checksum)
8	1	byte	Variable	0x00	HART command status (Return Code)
9	1	byte	Variable	0x??	HART device status (Configuration Changed flag set)

Table 61 - Response: 18 (0x12) Bytes (Plus Preambles) (Continued)

Pos	Size	Type	Fixed	Example	Description
10	1	byte	Variable	0x03	Transmitter variable (Pressure)
11	2	byte	Variable	0x0300	Measurement units (psia)
13	4	real	Variable	0x416B3333	Measurement remote value (14.7)
15	1	byte	Variable	0x??	HART checksum

Parameters for Cmd: 192

Table 62 - Possible HART Command Status Errors from the Transmitter

(0)	0x00	Success	No command-specific errors
(2)	0x02	Error	Invalid code or index for transmitter variable
(3)	0x03	Error	Passed parameter too large
(4)	0x04	Error	Passed parameter too small
(5)	0x05	Error	Too few data bytes received
(6)	0x06	Error	Device-specific command error
(12)	0x0C	Error	Invalid units code
(16)	0x10	Error	Access restricted (mode error or busy for HART universal or common practice commands)
(32)	0x20	Error	Device busy

Table 63 - Transmitter Variables

Pressure (Absolute)	0x03
Temperature (RTD)	0x05
Density	0x06
Viscosity (Absolute)	0x09
Heat Content	0x0D

Table 64 - Measurement Units

Measurement	Hex Value	EGU	Description
Pressure (Absolute)	0x0300	psia	pounds per square inch, absolute
Pressure (Absolute)	0x0309	Paa	pascals, absolute
Pressure (Absolute)	0x0308	kPaa	kilopascals, absolute
Pressure (Absolute)	0x03FF	Custom	custom absolute pressure
Temperature (RTD)	0x0602	degF	degrees Fahrenheit
Temperature (RTD)	0x0603	degR	degrees Rankine
Temperature (RTD)	0x0600	degC	degrees Celsius
Temperature (RTD)	0x0601	K	Kelvins
Density	0x0803	lb/ft^3	pounds per cubic foot
Density	0x0807	lb/gal	pounds per US gallon
Density	0x0802	oz/in^3	ounces per cubic inch
Density	0x0800	kg/m^3	kilograms per cubic meter

Table 64 - Measurement Units (Continued)

Measurement	Hex Value	EGU	Description
Density	0x0808	kg/l	kilograms per liter
Density	0x0801	g/cm^3	grams per cubic centimeter
Density	0x0804	lb/Yd^3	pounds per cubic yard
Density	0x0805	LT/Yd^3	long tons per cubic yard
Density	0x0806	ST/Yd^3	short tons per cubic yard
Density	0x08FF	Custom	custom density
Viscosity (Absolute)	0x1500	PaSec	pascal-second
Viscosity (Absolute)	0x1501	cPoise	centipoise
Heat Content	0x2100	J/kg	joules per kilogram
Heat Content	0x2101	kJ/kg	kilojoules per kilogram
Heat Content	0x2102	BTU/lb	BTU per pound
Heat Content	0x2103	MCal/kg	megacalories per kilogram

HART Communicator Menus

NOTE: If you are making changes to the flowmeter's configuration in the Basic or Detailed Setup, make sure you turn off totalizer and pulse outputs first, and then turn it back on after the changes are complete.

Menus for the General and Steam Personalities

Figure 92 - Main Menu Diagram

(a) Flow Base Vol is not available in the Steam personality.
(b) Available when model code supports "Pulse" and Pulse mode is set to Raw, Frequency, or Pulse.

Figure 93 - Diag/Service Menu Diagrams

Device Setup > Diag/Service > Totalizers

(1)
1. Pulse State (a)
2. Pulse Operation (a)
3. Totalizer 1
4. Totalizer 1 RO Value
5. Totalizer 1 State
6. Totalizer 1 Operations
7. Totalizer 2
8. Totalizer 2 RO Value
9. Totalizer 2 State
Totalizer 2 Operations
Totalizer 3
Totalizer 3 RO Value
Totalizer 3 State
Totalizer 3 Operations

Device Setup > Diag/Service > Loop Test

(2)
1. Set Digital Out
2. Set Analog Out
3. Set Pulse Out (a)

Device Setup > Diag/Service > Calibration

(3)
1. D/A Trim (b)
2. Scaled D/A trim (b)
3. Restore mA Calibration
4. RTD Calibration
5. Calibration Date
6. Time in Service

1. Restore RTD Calibration (c)
2. RTD Calibration (c)

1. User Days
2. Total Days
3. Reset Time in Service

Device Setup > Diag/Service > Measurement Status

(4)
1. Raw Frequency
2. Raw Frequency Status
3. Totalizer 1
4. Totalizer 1 Status
5. Totalizer 1 RO Value
6. Totalizer 2
7. Totalizer 2 Status
8. Totalizer 2 RO Value
9. Totalizer 3
Totalizer 3 Status
Totalizer 3 RO Value
Velocity
Velocity Status
Density
Density Status
Viscosity
Viscosity Status
Pressure
Pressure Status
Reynolds Number
Reynolds Number Status
K Corrected
K Corrected Status
mA
mA Status
Pulse (a)
Pulse Status (a)
Temperature
Temperature Status
Elec Temp (c)
Elec Temp Status (c)
Flow Vol
Flow Vol Status
Flow Mass
Flow Mass Status
Flow Base Vol
Flow Base Vol Status
Heat Content
Heat Content Status
Heat Flow
Heat Flow Status

Device Setup > Diag/Service > Detail Status

(5)
1. Reason Code
2. Device Alert Status
3. Device Notice Status
4. PV Overrange
5. Stuck Key
6. Heart Beat
7. Diag Alert
8. Write Protect

(a) Available when model code has Pulse and Pulse
    Mode is set to Pulse.
Available when model code supports Pulse and Pulse
    mode is set to Raw, Frequency, or Pulse.
(b) Available when Loop Current Mode is Enabled.
(c) Available when MS Code is RTD.
(d) Available when model code supports Temperature.
(e) Flow Base Vol and Flow Base Vol Status are not
    available in the Steam personality.

Figure 94 - Detailed Setup - Fluid Menu Diagram

Device Setup > Detiled Setup > Fluid

⑥	1. Fluid Type	⑯
	2. Fluid Name	
	3. Temperature Config	⑰
	4. Base Temperature	
	5. Density Config	⑱
	6. Base Density	
	7. Pressure Config	⑲
	8. Base Pressure	
	9. Viscosity Config	⑳
	Custom Fluid Coef	㉑

Set Fluid Default

⑯	1. User Gas (a)
	2. User Vapor (a)
	3. User Liquid (a)
	4. Saturated Steam (b)
	5. Superheated Steam (b)

Temperature Config

⑰	1. Temperature Units
	2. Temperature LRV
	3. Temperature URV
	4. Temperature Default
	5. Temperature Alert Strategy
	6. Temperature Mode
	7. Temperature Damp

Density Config

⑱	1 Density Units (c)
	2 Density LRV
	3. Density URV
	4. Density Default
	5. Density Alert Strategy
	6. Density Mode
	7. Density HART Remote Value (d)
	8. Density Damp

Pressure Config

⑲	1 Pressure Units (c)
	2 Pressure LRV
	3. Pressure URV
	4. Pressure Default
	5. Pressure Alert Strategy
	6. Pressure Mode
	7. Pressure HART Remote Value (d)
	8. Pressure Damping

Viscosity Config

⑳	1 Viscosity Unit
	2 Viscosity Default
	3. Viscosity Alert Strategy
	4. Viscosity Mode
	5. Viscosity HART Remote Value (d)

Custom Fluid Coef

㉑	Thermal Coef Density (e)
	Thermal Dens Ref Temp (e)
	Reference Density (e)
	Thermal Coef Viscosity (e)
	Thermal Visc Ref Temp (e)
	Thermal Ref Viscosity (e)

(a) User Liquid, User Vapor, and User Gas are only available in the General Personality.
(b) Saturated Steam and Superheated Steam are only available in the Steam personality.
(c) If Units are set to Custom, additional fields for Custom Label, Custom Offset, and Custom Slope are available.
(d) Available only when Mode is set to ByRemote.
(e) Not available in the Steam personality.

Figure 95 - Detailed Setup - Tuning Menu Diagram

Device Setup > Detailed Setup > Tuning

⑦ — | 1. Reynolds Correction |
| 2. LFCI - Setting |
| 3. LFCI |

Figure 96 - Detailed Setup - Totalizers Menu Diagram

Device Setup > Detailed Setup > Totalizers

⑧ — | 1. Totalizer 1 |
| 2. Totalizer 2 |
| 3. Totalizer 3 |

| 1. Totalizer 1 Map |
| 2. Totalizer 1 Units (a) |

| 1. Totalizer 2 Map |
| 2. Totalizer 2 Units (a) |

| 1. Totalizer 3 Map |
| 2. Totalizer 3 Units (a) |

(a) If Units are set to Custom, additional fields for Custom
Label, Custom Offset, and Custom Slope are available.

Figure 97 - Detailed Setup - Measurement Menu Diagram

Device Setup > Detailed Setup > Measurement

(9)— 1. Flow Vol Damp
2. Measurement Configuration

1. Flow Vol Config	(22)
2. Flow Base Vol Config	(23)
3. Pressure Config	(24)
4. Temperature Config	(25)
5. Density Config	(26)
6. Flow Mass Config	(27)
7. Velocity Config	(28)
8. Viscosity Config	(29)
9. Raw Frequency Config	(30)
Ele Temp Config	(31)
Heat Content Config	(32)
Heat Flow Config	(33)

Flow Vol Config

(22)— 1. Flow Vol Units (a)
2. Flow Vol URV
3. Flow Vol Alert Strategy

Flow Base Vol Config (b)

(23)— 1. Flow Base Vol Units (a)
2. Flow Base Vol URV
3. Flow Base Vol Alert Strategy

Pressure Config

(24)— 1. Pressure Units (a)
2. Pressure LRV
3. Pressure URV
4. Pressure Default
5. Pressure Alert Strategy
6. Pressure Mode
7. Pressure HART Remote Value (c)
8. Pressure Damp

Temperature Config

(25)— 1. Temperature Units
2. Temperature LRV
3. Temperature URV
4. Temperature Default
5. Temperature Alert Strategy
6. Temperature Mode
7. Temperature HART Remote Value (c)
8. Temperature Damp

Density Config

(26)— 1. Density Units (a)
2. Density LRV
3. Density URV
4. Density Default
5. Density Alert Strategy
6. Density Mode
7. Density HART Remote Value (c)
8. Density Damp

Flow Mass Config

(27)— 1. Flow Mass Units (a)
2. Flow Mass URV
3. Flow Mass Alert Strategy

Velocity Config

(28)— 1 Velocity Config
2 Velocity URV
3. Velocity Alert Strategy

Viscosity Config

(29)— 1. Viscosity Units
2. Viscosity Default
3. Viscosity Alert Strategy
4. Viscosity Mode
5. Viscosity HART Remote Value (c)

Raw Frequency

(30)— 1. Raw Frequency Units
2. Raw Frequency URV

Ele Temp Config (d)

(31)— 1. Ele Temp Units
2. Ele Temp LRV
3. Ele Temp URV
4. Ele Temp Default
5. Ele Temp Alert Strategy
6. Ele Temp Damp

Heat Content Config

(32)— 1. Heat Content Units
2. Heat Content LRV
3. Heat Content URV
4. Heat Content Default
5. Heat Content Alert Strategy
6. Heat Content Mode
7. Heat Content HART Remote Value (c)
8. Heat Content Damp

Heat Flow Config

(33)— 1. Heat Flow Units
2. Heat Flow LRV
3. Heat Flow URV
4. Heat Flow Alert Strategy

(a) If Units are set to Custom, additional fields for Custom
     Label, Custom Offset, and Custom Slope are available.
(b) Not available in the Steam personality.
(c) Available only when Mode is set to ByRemote.
(d) Available when MS Code is RTD.

Figure 98 - Detailed Setup - Output Configuration Menu Diagram

Device Setup > Detailed Setup > Output Configuration

(10)
1. Digital Output — (34)
2. Analog Output (a) — (35)
3. Pulse Output (b) — (36)
4. HART Output — (37)
5. Alarm Code (a) — (38)
6. Local Display — (39)

Digital Output

(34)
1. mA/PV Map
2. SV Map
3. TV Map
4. QV Map

Analog Output (a)

(35)
1. mA/PV Map
2. mA Damp

Pulse Output (b)

(36)
1. Pulse Mode —
- None
- Raw
- Frequency
- Pulse

Frequency:
1. Frequency Map
2. Set Frequency URV
3. Frequency URV
4. Frequency LRV
5. Damping

Pulse:
1. Pulse Map
2. Set Pulse Width
3. Pulse Width
4. Fac Units
5. Fac Pulses per Pulse
6. Fac Pulses per Units

HART Output

(37)
1. Poll Addr
2. Loop Current Mode
3. Num Req Preams
4. Num Resp Preams

Alarm Code (a)

(37)
1. Set mA Fully Downscale
2. Set mA Fully Upscale

Local Display

(39)
1. Show
2. Primary Display (c)
3. Display Cycle

1. Flow Vol (On/Off)
- 1. Flow Vol Display (On/Off)
- 2. Flow Vol Display Format

2. Flow Base Vol (On/Off) (d)
- 1. Flow Base Vol Display (On/Off)
- 2. Flow Base Vol Display Format

3. Flow Mass (On/Off)
- 1. Flow Mass (On/Off)
- 2. Flow Mass Display Format

4. Velocity (On/Off)
- 1. Velocity Display (On/Off)
- 2. Velocity Display Format

5. Totalizer 1 (On/Off)
- 1. Totalizer 1 Display (On/Off)
- 2. Totalizer 1 Display Format

6. Totalizer 2 (On/Off)
- 1. Totalizer 2 Display (On/Off)
- 2. Totalizer 2 Display Format

7. Totalizer 3 (On/Off)
- 1. Totalizer 3 Display (On/Off)
- 2. Totalizer 3 Display Format

8. Density (On/Off)
- 1. Density Display (On/Off)
- 2. Density Display Format

9. Viscosity (On/Off)
- 1. Viscosity Display (On/Off)
- 2. Viscosity Display Format

Pressure (On/Off)
- 1. Pressure Display (On/Off)
- 2. Pressure Display Format

Temperature (On/Off)
- 1. Temperature Display (On/Off)
- 2. Temperature Display Format

mA Out (On/Off)
- 1. mA Out Display (On/Off)
- 2. mA Out Display Format

Pulse Output (On/Off) (e)
- 1. Pulse Frequency Display (On/Off)
- 2. Pulse Frequency Display Format

Raw (On/Off)
- 1. Raw Frequency (On/Off)
- 2. Raw Frequency Format

Heat Content (On/Off)
- 1. Heat Content Display (On/Off)
- 2. Heat Content Display Format

Heat Flow (On/Off)
- 1. Heat Flow Display (On/Off)
- 2. Heat Flow Display Format

(a) Available only when Loop Current Mode is enabled.
(b) Available only when Model Code has Pulse.
(c) Available only if at least one of the measurement's display is On.
(d) Not available in the Steam personality.
(e) Available when Pulse Mode is Pulse.

Figure 99 - Detailed Setup - Pipe, New Tube, Advance, and Device Info Menu Diagram

Device Setup > Detailed Setup > Pipe

⑪

| 1. Piping |
| 2. Bore Schedule |
| 3. Custom K Reference Bias |

| 1. Piping Configuration |
| 2. Upstream Distance |

Device Setup > Detailed Setup > New Tube

⑫

| 1. Model Code |
| 2. Pulse Available |
| 3. Elec Temp Available |
| 4. Loop Current Mode |
| 5. Reference Number |
| 6. K Reference |

| 1. K Corrected Units |
| 2. K Reference |

Device Setup > Detailed Setup > Advance

⑬

| 1. Personality |
| 2. Noise Reduction Behavior |

Device Setup > Detailed Setup > Device Information

⑭

| 1. Manufacturer |
| 2. Tag |
| 3. Long Tag |
| 4. Descriptor |
| 5. Message |
| 6. Calibration Date |
| 7. Revisions |

| 1. Universal Rev |
| 2. Fld Dev Rev |
| 3. Software Rev |
| 4. Software Sub-Revision |
| 5. Hardware Rev |
| 6. Firmware Revision |

Figure 100 - Review Menu Diagram

Device Setup > Review

(15) 1. Model Code	Alarm Code
2. Reference Number	Fluid Name
3. K Reference	Fluid Type
4. mA/PV Map	Temperature Units
5. PV URV	Temperature
6. PV Damp	Elec Temp Units (d)
7. PV USL	Elec Temp (d)
8. PV Min Span	Density Units (a)
9. LFCI - Setting	Density
LFCI	Base Density
Totalizer 1 Units (a)	Viscosity Units
Totalizer 1	Viscosity
Totalizer 1 RO Value	Heat Content Units
Totalizer 2 Units (a)	Heat Content
Totalizer 2	Heat Flow Units
Totalizer 2 RO Value	Heat Flow
Totalizer 3 Units (a)	Bore Schedule
Totalizer 3	Piping Configuration
Totalizer 3 RO Value	Upstream Distance
Flow Vol Units (a)	Custom K Reference Bias
Flow Vol	Manufacturer
Flow Base Vol Units (a)	Dev id
Flow Base Vol	Tag
Flow Mass Units (a)	Long Tag
Flow Mass	Descriptor
Pressure Units (a)	Message
Pressure	Calibration Date
Velocity Units	Universal Rev
Velocity	Fld Dev Rev
Pulse Mode (b)	Software Rev
Frequency Map (c)	Software Sub-Revision
Frequency URV (c)	Firmware Revision
Frequency LRV (c)	DD Revision
Default Frequency (c)	Hardware Rev
Damping (c)	Poll Addr
Pulse Map (c)	Loop Current Mode
Pulse Width (c)	Num Req Preams
Fac Units per Pulse (c)	Num Resp Preams
Fac Pulses per Unit (c)	

(a) If Units are set to Custom, additional fields for Custom
    Label, Custom Offset, and Custom Slope are available.
(b) This field depends on the Pulse Mode selected.
(c) The fields displayed are based on the Pulse Mode that
    was selected.
(d) Available when MS Code is RTD.

Menus for the Oil & Gas Personality

Figure 101 - Main Menu Diagram

Device Setup
1. Device Setup
2. PV
3. PV Loop Current
4. PV URV
5. PV USL
6. LFCI - Setting
7. LFCI
8. SV
9. TV
QV

Process Variables menu
1. Process Variables
2. Diag/Service
3. Basic Setup
4. Detailed Setup
5. Review ⑫

Process Variables detail
1. PV Unit
2. PV % Range
3. PV Loop Current
4. PV
5. SV
6. TV
7. QV
8. Raw Frequency
9. Totalizer 1
Totalizer 1 RO Value
Density
K Corrected
Temperature
Flow Vol
LFCI - Setting
LFCI
Pulse (a)

Basic Setup
1. Model Code
2. Pulse Available
3. Elec Temp Available
4. K Corrected Units
5. K Reference
6. Tag
7. Long Tag
8. Loop Current Mode
9. Flow Vol Units
Pulse Frequency Factor

Diag/Service
1 Totalizer ①
2 Auto LFCI
3. Self Test
4. Loop Test ②
5. Calibration ③
6. Measurement Status ④
7. Detail Status ⑤

Detailed Setup
1. Tuning ⑥
2. Output Configuration ⑦
3. Pipe ⑧
4. New Tube ⑨
5. Advance ⑩
6. Device Information ⑪

(a) Available when model code has Pulse.

Figure 102 - Diag/Service Menu Diagrams

Device Setup > Diag/Service > Totalizers

① 1. Totalizer 1
2. Totalizer 1 RO Value
3. Totalizer 1 State
4. Totalizer 1 Operations

Device Setup > Diag/Service > Loop Test

② 1. Set Digital Out
2. Set Analog Out
3. Set Pulse Out (a)

Device Setup > Diag/Service > Calibration

③ 1. D/A Trim (b)
2. Scaled D/A Trim (b)
3. Restore mA Calibration (b)
4. RTD Calibration
5. Calibration Date
6. Time in Service

1. Restore RTD Calibration (c)
2. RTD Calibration (c)

1. User Days
2. Total Days
3. Reset Time in Service

(a) Available when model MS Code is Pulse only.
(b) Available when Loop Current Mode is Enabled.
(c) Available when MS Code is RTD.

Device Setup > Diag/Service > Measurement Status

④ 1. Raw Frequency
2. Raw Frequency Status
3. Totalizer 1
4. Totalizer 1 Status
5. Totalizer 1 RO Value
6. Density
7. Density Status
8. K Corrected
9. K Corrected Status
mA
mA Status
Pulse (a)
Pulse Status (a)
Temperature
Temperature Status
Flow Vol
Flow Vol Status

Device Setup > Diag/Service > Detail Status

⑤ 1. Reason Code
2. Device Alert Status
3. Device Notice Status
4. PV Overrange
5. Stuck Key
6. Heart Beat
7. Diag Alert
8. Write Protect

Figure 103 - Detailed Setup - Tuning Menu Diagram

Device Setup > Detiled Setup > Tuning

⑥ 1. Max Rate
2. Pulse Max
3. LFCI - Setting
4. LFCI
5. Flow Vol Damp
6. Filter

Figure 104 - Detailed Setup - Output Configuration Menu Diagram

Device Setup > Detailed Setup > Output Configuration

7 —
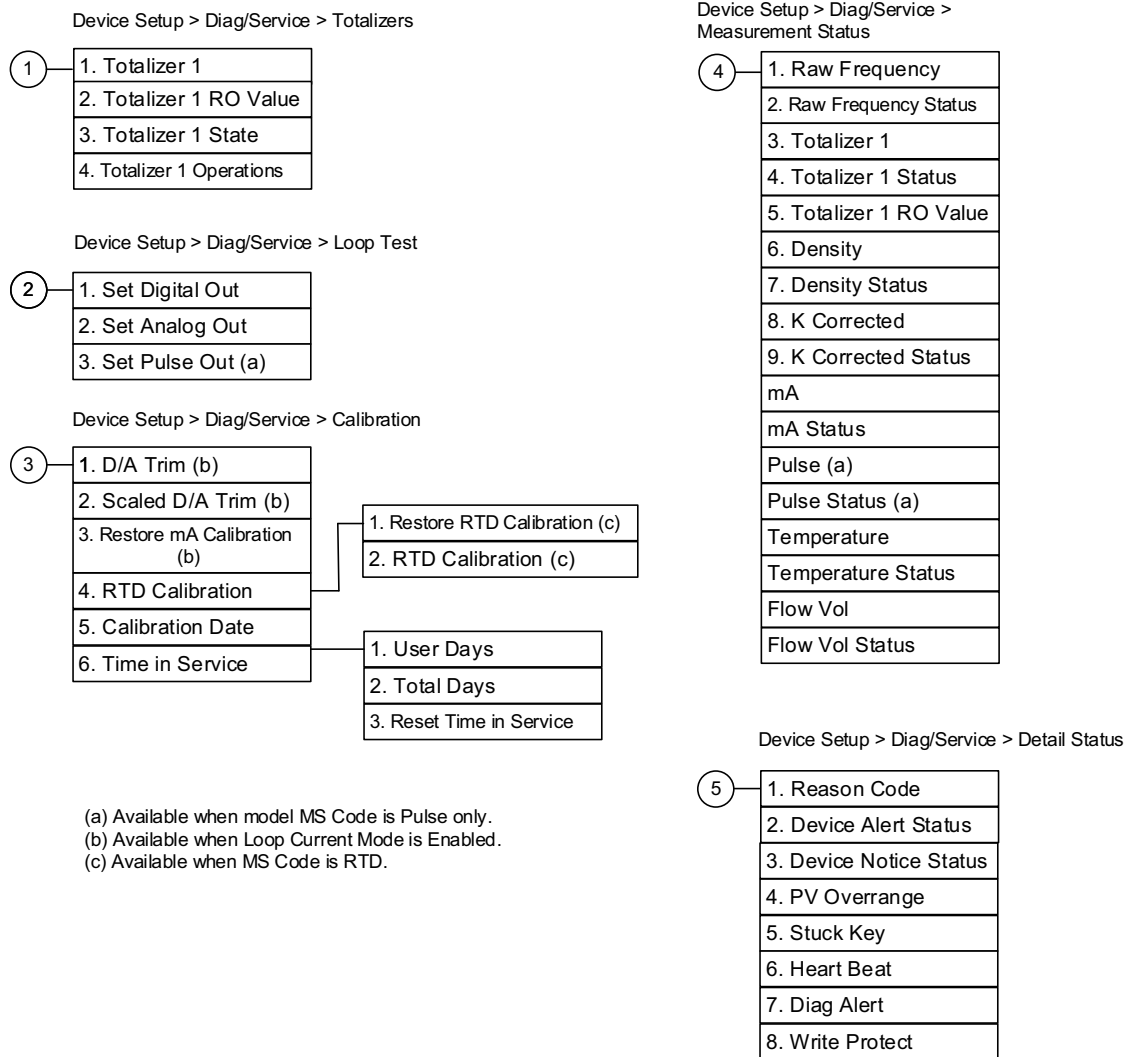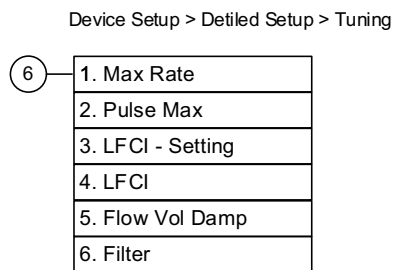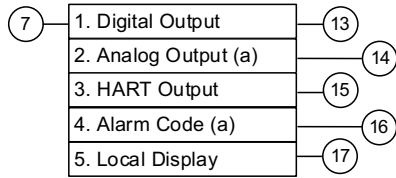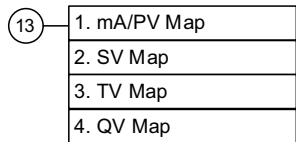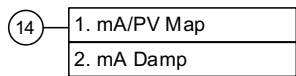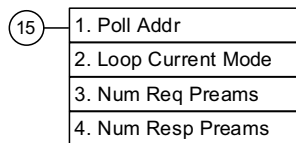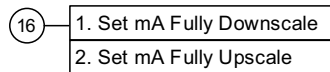| 1. Digital Output | — 13 |
2. Analog Output (a)	— 14
3. HART Output	— 15
4. Alarm Code (a)	— 16
5. Local Display	— 17

Digital Output

13 —
| 1. mA/PV Map |
| 2. SV Map |
| 3. TV Map |
| 4. QV Map |

Analog Output (a)

14 —
| 1. mA/PV Map |
| 2. mA Damp |

HART Output

15 —
| 1. Poll Addr |
| 2. Loop Current Mode |
| 3. Num Req Preams |
| 4. Num Resp Preams |

Alarm Code (a)

16 —
| 1. Set mA Fully Downscale |
| 2. Set mA Fully Upscale |

Local Display

17 —
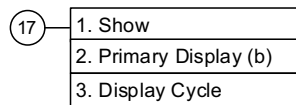| 1. Show |
| 2. Primary Display (b) |
| 3. Display Cycle |

(a) Available only when Loop Current Mode
     is enabled.
(b) Available only if at least one of the
     measurement's display is On.
(c) Available when Pulse Mode is Pulse.

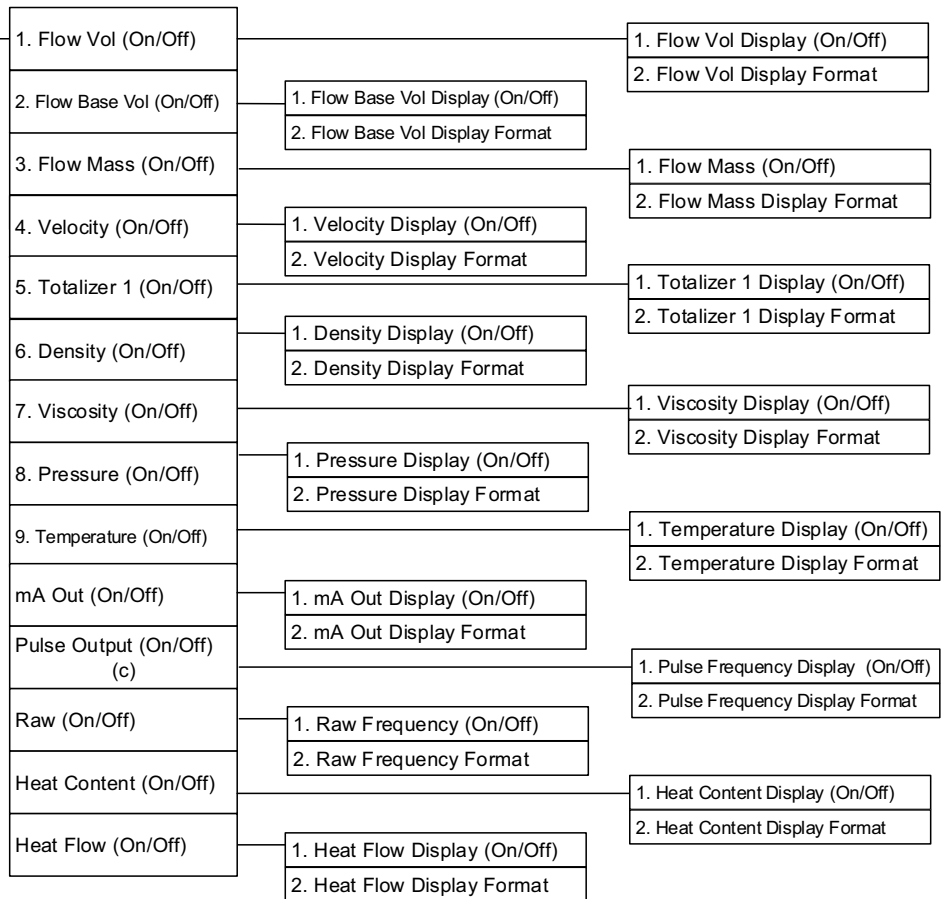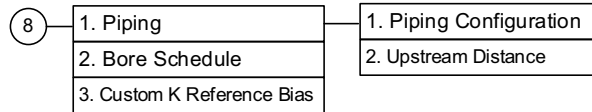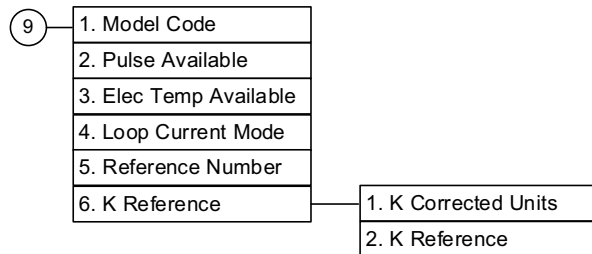| 1. Flow Vol (On/Off) | | 1. Flow Vol Display (On/Off) |
		2. Flow Vol Display Format
2. Flow Base Vol (On/Off)	1. Flow Base Vol Display (On/Off)	
	2. Flow Base Vol Display Format	
3. Flow Mass (On/Off)		1. Flow Mass (On/Off)
		2. Flow Mass Display Format
4. Velocity (On/Off)	1. Velocity Display (On/Off)	
	2. Velocity Display Format	
5. Totalizer 1 (On/Off)		1. Totalizer 1 Display (On/Off)
		2. Totalizer 1 Display Format
6. Density (On/Off)	1. Density Display (On/Off)	
	2. Density Display Format	
7. Viscosity (On/Off)		1. Viscosity Display (On/Off)
		2. Viscosity Display Format
8. Pressure (On/Off)	1. Pressure Display (On/Off)	
	2. Pressure Display Format	
9. Temperature (On/Off)		1. Temperature Display (On/Off)
		2. Temperature Display Format
mA Out (On/Off)	1. mA Out Display (On/Off)	
	2. mA Out Display Format	
Pulse Output (On/Off) (c)		1. Pulse Frequency Display (On/Off)
		2. Pulse Frequency Display Format
Raw (On/Off)	1. Raw Frequency (On/Off)	
	2. Raw Frequency Format	
Heat Content (On/Off)		1. Heat Content Display (On/Off)
		2. Heat Content Display Format
Heat Flow (On/Off)	1. Heat Flow Display (On/Off)	
	2. Heat Flow Display Format	

Figure 105 - Detailed Setup - Pipe, New Tube, Advance, and Device Info Menu Diagram

Device Setup > Detailed Setup > Pipe

⑧—
| 1. Piping |
| 2. Bore Schedule |
| 3. Custom K Reference Bias |

| 1. Piping Configuration |
| 2. Upstream Distance |

Device Setup > Detailed Setup > New Tube

⑨—
| 1. Model Code |
| 2. Pulse Available |
| 3. Elec Temp Available |
| 4. Loop Current Mode |
| 5. Reference Number |
| 6. K Reference |

| 1. K Corrected Units |
| 2. K Reference |

Device Setup > Detailed Setup > Advance

⑩—
| 1. Personality |
| 2. Noise Reduction Behavior |

Device Setup > Detailed Setup > Device Info

⑪—
| 1. Manufacturer |
| 2. Tag |
| 3. Long Tag |
| 4. Descriptor |
| 5. Message |
| 6. Calibration Date |
| 7. Revisions |

| 1. Universal Rev |
| 2. Fld Dev Rev |
| 3. Software Rev |
| 4. Software Sub-Revision |
| 5. Hardware Rev |
| 6. Firmware Revision |
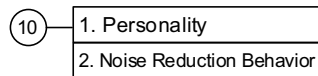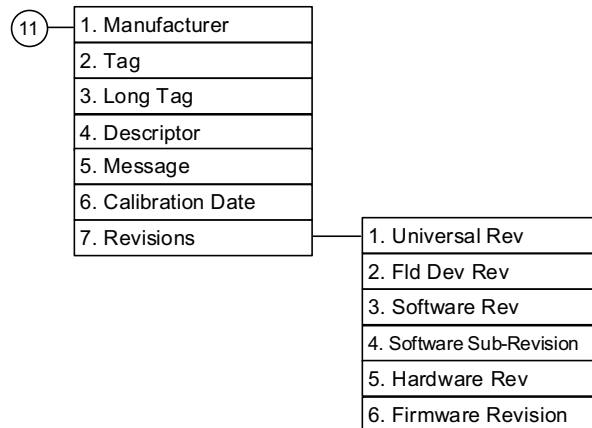
Figure 106 - Review Menu Diagram

Device Setup > Review

1. Model Code
2. Reference Number
3. K Reference
4. LFCI - Setting
5. LFCI
6. Totalizer 1
7. Flow Vol Units
8. Flow Vol
9. Alarm Code
Temperature
Density
Manufacturer
Dev id
Tag
Long Tag
Descriptor
Message
Calibration Date
Universal Rev
Field Dev Rev
Software Rev
Software Sub-Revision
Firmware Revision
DD Revision
Hardware Revision
Poll Addr
Loop Current Mode
Num Req Preams
Num Resp Preams

(15)

Troubleshooting

Before troubleshooting the flowmeter, verify that the flowmeter has been configured with the correct model, flow, and output parameters. If there is a problem, the display indicates **W:Input** (warning), **B:Input** (bad), or **CfgErr** (configuration error, such as **RTD Open**).

Loss of Signal Warning

⚠ **WARNING**
HAZARD OF FLOWMETER CORROSION OR WEAR
If the flowrate signal appears to have a calibration shift or goes to zero, check the flowmeter for corrosion or wear.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTICE
POTENTIAL EQUIPMENT DAMAGE
Components in your flowmeter are ESD-sensitive, and thus are susceptible to damage resulting from electrostatic discharge. When performing maintenance in the electronics compartment or remote junction box, or when working with the housing cover removed, ground yourself with a conductive wrist strap or stand on an ESD mat.
Failure to follow these instructions can result in equipment damage.

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 vibrational noise sources such as pumps.

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

  The LFCI setting determines the sensitivity of the electronics to the sensor output signal. There are eight LFCI settings. The default is level 4, which 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. Refer to *Setting the LFCI, page 172*.

- If the LFCI is higher than desired, there are several possible causes:

  ◦ Check the flowmeter sizing. The flowmeter could be too big for the application, resulting in the need to provide a measurement at a very low flow velocity. Refer to *FlowExpertPro™ Sizing Application, page 22* to validate meter sizing.

  ◦ Check for excessive vibration. For most applications where the electronics are top mounted and the pipe has horizontal pipe supports, lateral vibration of the pipes may result in false signal. Reposition the meter so that the electronics are at approximately the 3 o'clock or 4 o'clock position (see *Sensor Mounting to Minimize the Effect of Vibration, page 37*). The sensor axis is then perpendicular to the vibration.

  ◦ Examine peripheral equipment and potential vibration sources to be sure that they are not imparting vibration into the flowmeter.

- Other sources of false signal:

  ◦ 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.

  ◦ If the flowmeter is remotely mounted, verify that the remote cable is properly terminated. The cable was properly terminated at the factory. If the cable was shortened, check the termination. See *Remotely Mounted Electronics, page 48*.

    > **NOTE:** If you must shorten the cable, shorten it from the flowtube end only.

No Output with Flow

If a flowmeter has no or low output during flow conditions, follow these troubleshooting steps.

The Display (if Applicable) Is Blank

1. Remove the field wiring cover and check the power supply voltage. The voltage across the + and - terminals must be between 15.75 and 42 V dc for HART; between 10 and 42 V dc[27] for Low Power.

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 is not fully engaged.

3. If voltage at the terminals is 0, check for a blown fuse in the power supply, or damaged wires.

4. If voltage is below the minimum, check the loop load vs supply voltage. Refer to *Supply Voltage vs Output Load for 4 to 20 mA Output, page 13*.

5. If voltage is correct, check the voltage on the cable inside the housing to verify that 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.

There Is a Low Output Signal (and a Lighted Display, if Applicable)

1. Check the LFCI setting. This sets the point below which flow is not measured.

   If flow is greater than this level, and there is still no change in output, continue to the next step.

2. Check the flowmeter status to see if it has "failed low." The flowmeter is configurable to fail either low or high.

   - The fail-low mode value is 3.6 mA.
   - The fail-high mode value is 21 mA.

3. Verify that the flowmeter can output the desired signal by going to the Test mode and setting the outputs for fail-low and fail-high.

4. Check the pulse output default value, if applicable.

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27. Supply current is fixed at a constant 10 mA for Electronics Version -L and remains in operation down to a minimum terminal voltage of 10 V dc.

No or Low Output with Remotely Mounted Electronics

If a flowmeter with remotely mounted electronics has no or low output during flow conditions, follow these troubleshooting steps.

1. Inspect the preamplifier for discoloration, which could be the result of overheating. Check the maximum ambient temperature specification in the electrical certification table (see *Electrical Certifications, page 27*) and/or the flowmeter's data label.

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. Check the voltage levels at the junction box on top of the flowmeter body.

   The following values should be observed:

   • Red to yellow: +3.0 ±0.3 V

   • Orange to yellow: -3.0 ±0.3 V

   If these values are not observed, there may be a break or cut in the cable between the flowmeter and the remote electronics. Or, the preamplifier may not be working.

4. Verify that the wires are fully engaged in the connectors. Lightly tug each wire to verify that it is firmly held in place by the connector, on the metal conductor and not on the wire insulation. If any wires are not engaged, press the lever in the connector, insert the bare conductor, and release the lever, checking again that the wire is firmly clamped.

5. Check for sensor output using a small portable scope meter. There should be a sinelike waveform on the meter. This waveform does not have to be sinusoidal, but it should show alternating output. The amplitude of the signal depends on the sensor type and velocity. The frequency of the output should be in accordance with the expected flow rate.

6. Check the preamplifier:

    a. Disconnect the sensor leads.

    b. For a standard temperature sensor, connect a 2200 pF ±5% 50 V NPO ceramic capacitor to the brown (+) terminal of the sensor terminal block.

    c. For an extended temperature sensor, replace the 2200 pF capacitor with a 22 pF capacitor. Set the frequency input amplitude to 0.5 V peak-to-peak. The output from the preamplifier should be 1.5x the input value, or 0.75 V peak-to-peak, and be at the same frequency as the input.

    d. Connect a portable frequency generator that can supply a sinusoidal 0.5 V peak-to-peak signal to the sensor input terminals.

    e. Identify the expected sensor frequency for the flow rate going through the flowmeter. Use the FlowExpertPro™ sizing program to determine this, or compute the frequency based on the K-factor stamped on the flowmeter body.

    f. Recheck the output at the remote electronics.

        •   If there is output at the electronics, the sensor may need to be replaced.

        •   If there is no output at the remote electronics, check the preamplifier by disconnecting the blue and yellow wires from the remote cable. (The orange and red wires should stay connected, as they provide power to the preamplifier.) Connect the scope meter to the blue and yellow (+ and -) terminals on the output terminal block. The amplitude of the signal should be approximately the same (0.5 V) as the input signal, and the same frequency.

    g. If the output from the preamplifier is correct:

        •   Inspect the cable for breaks and cuts.

        •   Verify that the remote cable is correctly connected to the junction box at the flowmeter.

            The remote cable is factory-terminated and sealed at the electronics end. The cable cannot be removed or re-terminated at the electronics end. If the cable was tampered with at the electronics end, this is likely the root cause of the improperly working flowmeter. Replace the cable. See *Preparing the Remote Signal Cable, page 48*.

    h. If the flowmeter still has no output, proceed to *Testing the Electronics Module, page 170*.

Testing the Electronics Module

Refer to *Replacing the Electronics Module, page 176* for detailed instructions on removing and replacing the electronics module.

1. Remove the electronics compartment cover at the remote electronics.

2. Make sure there is no moisture in the electronics compartment. Moisture can be the result of a loose cable/conduit connection, or a cover that was not fully engaged. Buildup of corrosive moisture in this compartment may affect the performance of the electronics.

3. 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.

4. Test the output by putting the flowmeter in Test mode and setting the output value.

    –   If the meter has no output in test mode, replace the module.

    –   If there is output from the meter, continue to the next step.

5. Remove the electronics module from the compartment by loosening the two captured screws.

6. Check inside for broken or pinched wires, or connectors that are not engaged.

7. 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. If there is a difference, the terminal block electronics assembly may have been damaged in a severe transient, such as a lightning strike.

8. 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, use a test connector (part number K0152KU).

9. 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. Look for a change in the output signal (in Frequency mode). Change the input frequency over the expected vortex frequency range and verify the output changes accordingly.

10. If there is still no output, replace the electronics module.

Output Suddenly Drops

The flowmeter output increases with flow, but when it approaches full scale, output suddenly drops.

A sudden drop in output indicates an intrinsically safe loop that is using a passive (unpowered) barrier. As the output increases, the voltage at the terminals drops below the minimum.

Install an active, externally powered barrier, such as a Pepperl+Fuchs model KFD0-SCS-Ex1.55.

Other Incorrect Output

Output Is Less Than Expected at All Flow Rates

- Verify that the upper range value (URV) is correct.
- Verify that the zero and span of the output are correct.
- Check for vibration levels that might influence the output signal. Refer to *Setting the LFCI, page 172*.
- Check the flowmeter configuration to verify that the fluid flowing density is entered correctly. Incorrect configuration can result in band pass filters being set to improper values, with in-band signals being adversely affected.
- Check the load resistance.
- In the test mode, verify that the output at the receivers is correct.

Output Is Less Than Expected at Low Flow Rates

If the problem appears only at low flow rates, there may be a pulsating flow condition, resulting in missed pulses when the fluid velocity is very low.

- Verify that the upper range value (URV) is correct.
- Verify that the zero and span of the output are correct.
- Check for vibration levels that might influence the output signal. Refer to *Setting the LFCI, page 172*.

- Check the flowmeter configuration to verify that the fluid flowing density is entered correctly. Incorrect configuration can result in band pass filters being set to improper values, with in-band signals being adversely affected.
- Check the load resistance.
- In the test mode, verify that the output at the receivers is correct.

Output Is Constant When Flow Is Increasing or Decreasing

This condition may result from an in-band noise source overriding the vortex signal. Check the LFCI setting procedure (refer to *Setting the LFCI, page 172*). Verify that the URV is in line with the actual measurement range.

Output Is Greater Than Expected

- Verify that the upper range value (URV) is correct.
- Verify that the zero and span of the output are correct.
- Check for vibration levels that might influence the output signal. Refer to *Setting the LFCI, page 172*.
- Check the flowmeter configuration to verify that the fluid flowing density is entered correctly. Incorrect configuration can result in band pass filters being set to improper values, with in-band signals being adversely affected.
- Check the load resistance.
- In the test mode, verify that the output at the receivers is correct.
- Verify that the flowmeter is not in a failsafe mode, where full-scale output has been configured as the failsafe output condition.
- Verify that the URV is correctly configured.

Incorrect Pulse Output Value

1. Verify the configuration of the pulse output:
    - Raw Pulse: The raw vortex shedding frequency.
    - Frequency Mode: Verify that the pulse is configured to the correct full range value of 10 Hz, 100 Hz, or 1000 Hz.
    - Pulse Mode: Verify that Pulse Output, Pulse Mode is properly defined.
2. If pulse output is configured for Frequency Mode, set the output frequency in the test mode and verify the correct value.

Setting the LFCI

Take these steps to set the Low-Flow Cut-In (LFCI).

1. To determine the magnitude of any false excitation, set damping to 0 seconds.
2. Make sure there is a no-flow condition. Preferably, block valves should be closed. (Control valves can leak when closed, resulting in some flow that the flowmeter can detect.)
3. Increase the LFCI setting by one level and observe the signal output. Increase the LFCI again until there is no false signal.

    Alternatively, you can use the automatic LFCI selection function (**1Cal/Tst** > **2 Calib** > **3CalLFCI**). When this command is executed, the flowmeter starts at the most sensitive LFCI setting. If a false signal is detected within a fixed period, the LFCI increases to the next level, and so on until a level is reached where there is no false signal. See *Automatic LFCI Selection, page 89*.

4. If damping was changed to 0 seconds, restore it to the desired level.

5. If you changed the LFCI level, make sure controllers and receivers can accommodate the increased LFCI setting. Output remains at 4 mA from zero flow until this flow rate is reached.

Troubleshooting the Temperature Sensor

The RTD temperature sensor is integral to the vortex sensor in the flowmeter. To troubleshoot the temperature measurement, take these steps:

1. Make sure the model code is entered correctly.

2. Check the sensor wiring.

3. Check the resistance of the RTD for a nominal value of 1,000 Ω.

4. Replace the vortex sensor.

Maintenance

Process Fluid Warnings

⚠ WARNING

HAZARD OF ESCAPING CHEMICALS

If process containing parts are to be disassembled:

• Make sure that process fluid is not under pressure or at high temperature.

• Take proper precautions concerning leakage or spillage of any toxic or otherwise dangerous fluid. Follow any Material Safety Data Sheet (MSDS) or Safety Data Sheet (SDS) recommendations.

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

⚠ WARNING

HAZARD OF CORROSION

The flowmeters are built using materials that are corrosion resistant to a wide variety of fluids. However, with aggressive fluids, a potential exists for corrosive failure. Therefore, verify the material compatibility with the NACE guidelines and/or user knowledge of the flowmeter material compatibility with the process fluid at operating conditions.

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

⚠ CAUTION

RISK OF PERSONAL AND PROPERTY DAMAGE

Personnel involved in the maintenance of vortex flowmeters must be trained and qualified in the use of the equipment required, and in the removal and replacement of the flowmeter in the piping. They must also be qualified for the routine maintenance of the flowmeter's components.

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

NOTICE

POTENTIAL EQUIPMENT DAMAGE

Components in your flowmeter are ESD-sensitive, and thus are susceptible to damage resulting from electrostatic discharge. When performing maintenance in the electronics compartment or remote junction box, or when working with the housing cover removed, ground yourself with a conductive wrist strap or stand on an ESD mat.

Failure to follow these instructions can result in equipment damage.

Maintenance Overview

The operation of the Model 84C Vortex Flowmeters consists of three basic functions:

- Generating and shedding vortices in the fluid stream
- Sensing vortices
- Amplifying, conditioning, and processing the signal from the vortex sensor

If you suspect a malfunction of the flowmeter, you can usually isolate the cause to one of these functions.

Vortex Generation and Shedding

Vortex generation and shedding can be degraded or destroyed by disturbances in the upstream flow, the nature of the flowing fluid, or (rarely) by damage to the vortex shedding element. Flow disturbances can 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 can be impaired.

> **NOTE:** The length of straight, unobstructed upstream piping is important. Refer to *Effects of Piping on Flowmeter Performance, page 32*.

Vortex Sensing

The Model 84C Vortex Flowmeters employ two basic types of sensors: standard temperature range, and extended temperature range.

- The standard temperature range sensor can be filled with Fluorolube for applications with process temperature limits of -18 to +93°C (0 to 200°F), or with silicone oil for applications with process temperature limits of -18 to +204°C (0 to 400°F).

  The standard temperature range 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. The pressure is transmitted to the crystal via the diaphragms and fill fluid.

- The extended temperature range sensor is an unfilled sensor for applications up to 371°C (700°F).

  The extended temperature range sensor consists of two piezoelectric crystals sealed inside a capsule having two process diaphragms, on opposing sides, connected internally by a mechanical shuttle. The vortex shedding process creates an alternating differential pressure across the capsule. The pressure is transmitted to the crystals via the diaphragm-shuttle mechanism.

  The alternating force acting on the crystals causes them to develop a pulsed voltage with a frequency equal to the vortex shedding frequency. Damage to the sealing diaphragms, or other physical damage, can cause the sensors to operate improperly.

Replacing the Electronics Module

The electronics module is located in the flowmeter housing, opposite the side with the retention clip. On the back of the electronics module (and on its side, if your flowmeter has an RTD) are several connectors:

Table 65 - Connectors on the Electronics Module

Number of Pins	Color[28]	Description	
2 to terminal block	Red (R)	Loop +	
	Blue (B)	Loop −	
3 to terminal block	Yellow (Y)	Pulse Out +	
	Green (G)	Pulse Out −	
4 to potted neck module		**With Preamplifier**[29]	**Without Preamplifier**[30]
	Blue (B)	Preamp Out +	Sensor +
	Red (R)	Preamp Power +	n/a
	Orange (O)	Preamp Power −	n/a
	Yellow (Y)	Preamp Out −	Sensor −
4 (on side) to potted neck module	Gray	Temperature Sensor Ribbon Cable (if applicable)	

NOTICE

POTENTIAL EQUIPMENT DAMAGE

The replacement part is shipped in a protective antistatic bag. Do not remove the part from this bag until you are ready to install it. This helps prevent damage due to accidental electrostatic discharge.

Failure to follow these instructions can result in equipment damage.

Removing the Electronics Module

1. Shut off power to the flowmeter.

2. If the flowmeter electronics compartment has a cover lock, rotate the cover lock screw into the housing to unlock the cover.

3. Remove the cover from the electronics compartment. The electronics compartment is the side with the optional display. If you do not have an optional display, the electronics compartment is to the left of the ground symbol on the outside of the housing.

    If you cannot remove the cover by hand, insert a flat bar in the cover slot.

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28. On more recent models, the wires or cables are black. However, the connectors are designed to aid in placing the connectors in the correct blocks and in the correct orientation.
29. Integrally mounted flowmeters with **extended** temperature range sensors have preamplifiers. All flowmeters that are remotely mounted also have preamplifiers.
30. Integrally mounted flowmeters with **standard** temperature range sensors do not have preamplifiers.

4. If an optional display is mounted to the electronics module, remove it by
    loosening the two mounting screws and unplugging the ribbon cable from the
    front of the electronics module. Refer to the diagram.

Figure 107 - Optional Display Connection

RIBBON CABLE
CONNECTOR

ELECTRONICS
MODULE
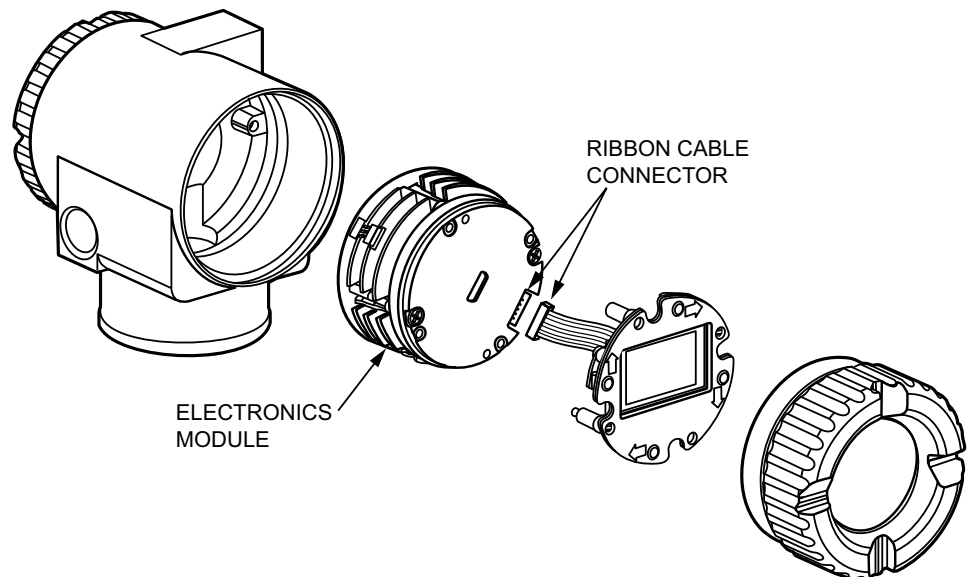
5. Loosen the two captive screws, one on each side of the electronics module.

6. Pull the electronics module out of the housing just far enough to be able to reach
    the cable connectors on the back of the electronics module.

7. Disconnect the cables from the back (and side, if the flowmeter has a
    temperature sensor) of the electronics module.

8. Remove the electronics module from the housing.

Installing the Electronics Module

1. Turn off power to the flowmeter and remove the electronics module, if you have not done so already. Refer to *Removing the Electronics Module, page 176*.

2. Remove the new electronics module from its protective bag.

3. Connect the cables to the terminal blocks on the back (and side, if applicable) of the electronics module. Refer to the diagram.

   The connectors are designed to fit only in the correct terminal blocks, and in the correct orientation on the electronics module.

Figure 108 - Electronics Module Connections
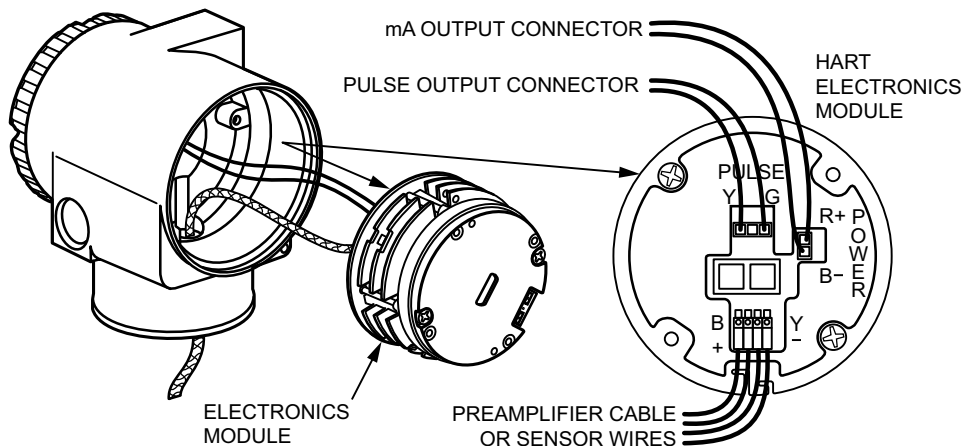
4. Back the two electronics module captive screws out of the module until the screws are captured by the plastic housing.

5. Rotating the electronics module no more than one full turn to take up the slack in the wires, place the module in the housing over the two mounting holes.

6. Tighten the captive mounting screws, taking care that no wires are pinched under the module.

7. If the electronics module was equipped with an optional display, reinstall the display. Carefully fold the ribbon cable in the space between the display and the electronics module so that it is not pinched. The display molding should rest firmly against the module molding before you tighten the mounting screws. See *Optional Display Connection, page 177*.

8. Configure the new electronics module to match the one that was just removed.

9. Replace the electronics compartment cover before operating the flowmeter. If the housing has a cover lock, rotate the cover lock outwards from the housing to lock the cover.

Replacing the Potted Neck Module

All Model 84C Vortex Flowmeters have a printed wiring board located in a potted module that resides in the neck of the instrument. This potted neck module functions as a preamplifier, barrier, and/or interface depending on the model:

- In all Model 84C Vortex Flowmeters, it acts as an interface module.

- In an integrally-mounted flowmeter that has an extended temperature range sensor, it acts as a preamplifier module.

- In a flowmeter that has explosionproof/flameproof electrical certification, it acts as a barrier module. These flowmeters also have a PE ground in the electronics housing. This ground must be disconnected as part of the replacement procedure.

Refer to the following diagram when replacing the potted neck module.

Figure 109 - Potted Neck Module and Preamplifier Assembly — Integrally Mounted
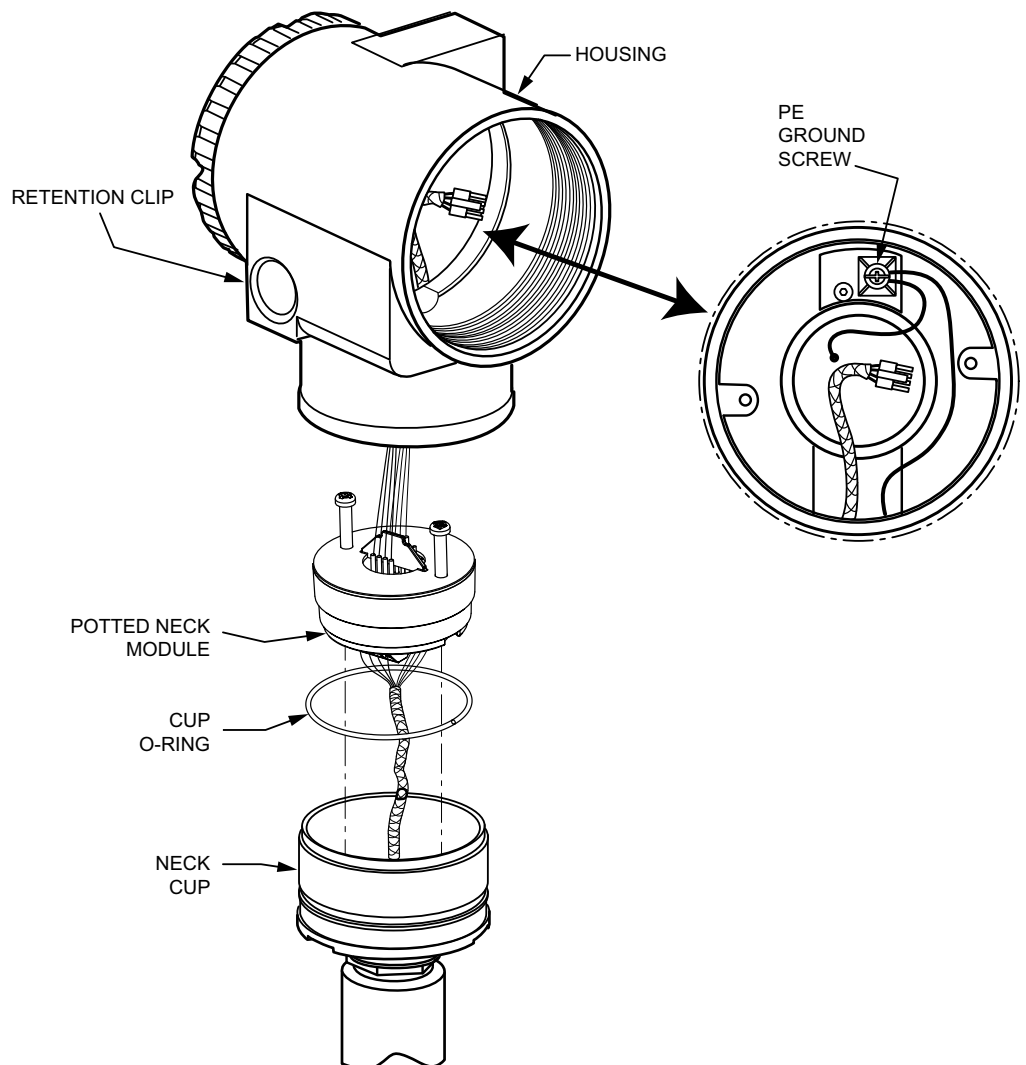
NOTICE
POTENTIAL EQUIPMENT DAMAGE
The replacement part is shipped in a protective antistatic bag. Do not remove the part from this bag until you are ready to install it. This helps prevent damage due to accidental electrostatic discharge.
Failure to follow these instructions can result in equipment damage.

Removing the Potted Neck Module

Refer to *Potted Neck Module and Preamplifier Assembly — Integrally Mounted, page 179*.

1. Turn off power to the flowmeter and remove the electronics module. Refer to *Removing the Electronics Module, page 176*. (You do not need to disconnect the display).

2. If the flowmeter has explosionproof/flameproof electrical certification, disconnect the two green PE ground wires from the PE ground screw in the electronics housing.

3. Remove the red lacquer from the anti-rotation screw.

4. Remove the anti-rotation screw completely, and slide the clip off of the housing. Save the screw and clip.

5. Remove the housing by rotating it counterclockwise as viewed from the top.

6. Remove the two screws on the black potting cup. Save the screws.

7. Remove the module from the cup.

8. Flip the potting cup over to access the two 4-position terminal blocks.

9. Disconnect the wires from the 4-position terminal block(s) on the potted neck module.

Installing the Potted Neck Module

1. Turn off power to the flowmeter and remove the potted neck module, if you have not done so already. Refer to *Removing the Potted Neck Module, page 180*.

2. Remove the new potted neck module from its protective bag.

3. Feed the wires from the sensor through the hole in the center of the neck machining and connect them to the two 4-position terminal blocks on the potted neck module, using the color codes on the wires and labels.

4. Install the potted neck module into its cup and secure it with the two screws previously removed.

5. Feed the electronics cable, temperature sensor cable (if applicable), and PE ground wires (if applicable) through the housing neck and into the electronics compartment.

6. Inspect the cup o-ring for damage. If the o-ring is damaged, replace it with the appropriate o-ring.

⚠ **WARNING**

RISK OF ANSI/ISA NONCOMPLIANCE

Failure to reuse or install the proper cup o-ring for a CSA-labeled product violates ANSI/ISA12.27.01.

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

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7. Lubricate the o-ring with silicone lubricant (part number 0048130 or equivalent). Verify that the o-ring is situated in the groove of the neck.

8. Screw the housing onto the cup. Hand-tighten until it bottoms. Do not over-tighten.

9. If the flowmeter has explosionproof/flameproof electrical certification, reconnect the two green PE ground wires to the PE ground screw in the electronics housing.

10. Insert the retention clip over the boss in the housing neck so that the hole in the clip is aligned with the hole in the boss. Refer to the diagram.
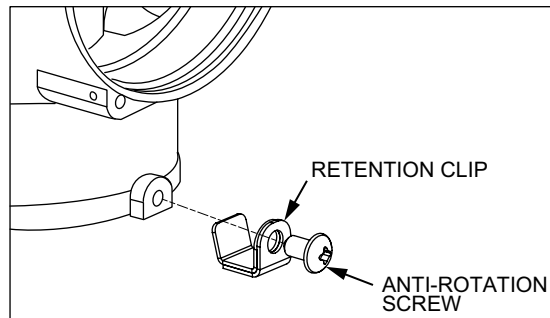
11. Rotate the housing up to one full turn counterclockwise for optimum access.

12. Tighten the anti-rotation screw (to a torque of 7 lbf-in) and fill the screw recess with red lacquer (part number X0180GS or equivalent).

13. Connect the cables to the terminal blocks on the back (and side, if applicable) of the electronics module. Refer to the diagram.

The connectors are designed to fit only in the correct terminal blocks, and in the correct orientation on the electronics module.

Figure 110 - Electronics Module Connections
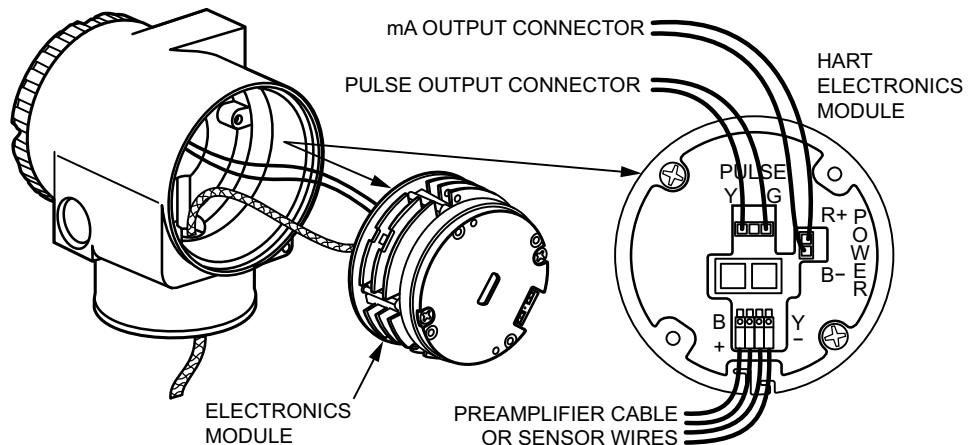
14. Back the two electronics module captive screws out of the module until the screws are captured by the plastic housing.

15. Rotating the electronics module no more than one full turn to take up the slack in the wires, place the module in the housing over the two mounting holes.

16. Tighten the captive mounting screws, taking care that no wires are pinched under the module.

17. Replace the electronics compartment cover before operating the flowmeter. If the housing has a cover lock, rotate the cover lock outwards from the housing to lock the cover.

Replacing the Preamplifier

All remotely mounted flowmeters have a preamplifier. For flowmeters with remotely mounted electronics, use the procedures in this section.

Integrally mounted flowmeters with extended temperature range sensors also have a preamplifier; however, this preamplifier is located on the potted neck module. Refer to *Replacing the Potted Neck Module, page 179* for instructions.

Integrally mounted flowmeters with standard temperature range do not have a preamplifier.

Figure 111 - Preamplifier Assembly — Remotely Mounted
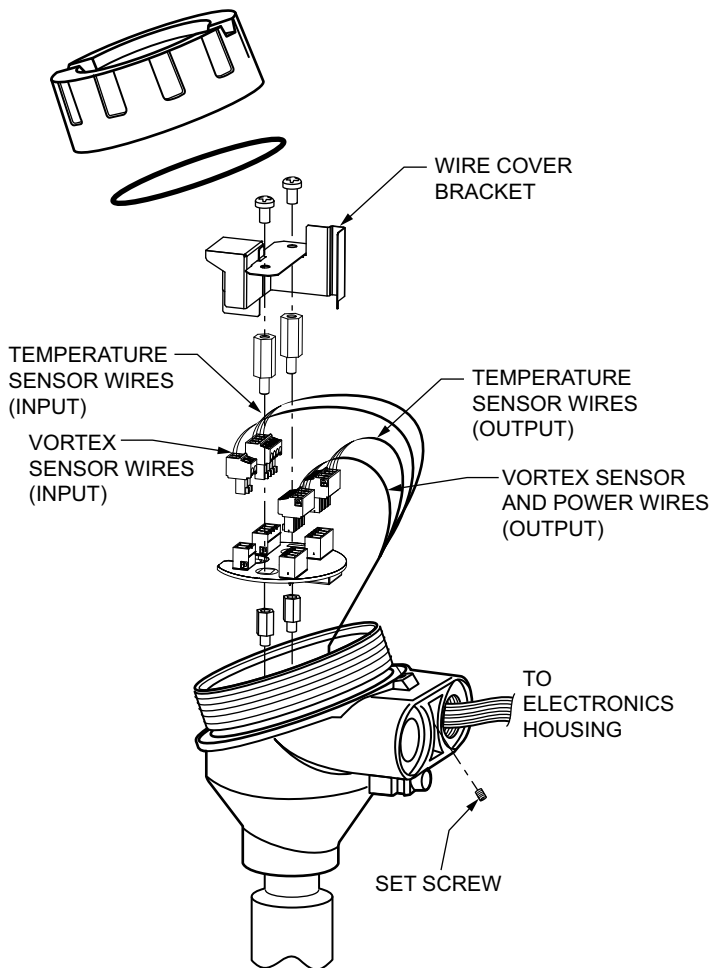
NOTICE

POTENTIAL EQUIPMENT DAMAGE

The replacement part is shipped in a protective antistatic bag. Do not remove the part from this bag until you are ready to install it. This helps prevent damage due to accidental electrostatic discharge.

Failure to follow these instructions can result in equipment damage.

Removing the Preamplifier

Refer to *Preamplifier Assembly — Remotely Mounted, page 183*.

1. Shut off power to the flowmeter.

2. Rotate the set screw into the junction box to unlock the cover. Remove the cover.

3. Remove the wire cover bracket. Save the screws.

4. Disconnect all of the wires from the front of the preamplifier module.

5. Remove the two screws securing the preamplifier. Save the screws.

6. Lift the preamplifier out of the junction box.

Installing the Preamplifier

Refer to *Preamplifier Assembly — Remotely Mounted, page 183*.

1. Turn off power to the flowmeter and remove the preamplifier, if you have not done so already. Refer to *Removing the Preamplifier, page 184*.

2. Remove the new preamplifier from its protective bag. Be sure to install the correct board:
   - L0123HT — standard temperature
   - L0123HV — extended temperature

3. Connect the yellow and brown sensor wires to the 2-position Y/B terminal block on the neck board.

4. If the flowmeter has a temperature sensor, attach the ribbon cable to the R/R/N/N terminal block on the neck board.

5. Connect the remaining wires to the 4-position terminal blocks in accordance with the color coding shown on the labels.

6. Mount the new preamplifier in the junction box using the two screws from the old preamplifier.

7. Verify that the wires are fully engaged in the connectors. Lightly tug each wire to verify that it is firmly held in place by the connector, on the metal conductor and not on the wire insulation. If any wires are not engaged, press the lever in the connector, insert the bare conductor, and release the lever, checking again that the wire is firmly clamped.

8. Add the wire cover bracket and secure it with the screws you saved when you removed it.

9. Replace the junction box cover. Rotate the set screw outwards from the junction box to lock the cover before operating the flowmeter.

Replacing the Sensor

Always shut down the pipeline and empty it before you loosen the bonnet bolts.

If the flowmeter housing is in a vertical mounting position, you do not need to remove the flowmeter from the pipeline in order to replace the sensor. However, the flowmeter housing must be in a vertical mounting position so that the bonnet bolts can be properly torqued. If the flowmeter housing is not mounted vertically, remove the flowmeter from the line before performing a sensor replacement.

Replacing the sensor does not cause a shift in the K-factor. Therefore, the flowmeter does not require recalibration.

Refer to MI 019-223 for sensor replacement procedures.

Model Code

These tables list all of the options, including other electronics versions, for the Model 84C Vortex Flowmeters.

Flanged Body Style

Table 66 - Model Code for 84CF Flowmeters

Code	Description
Model	
84C	Vortex Flowmeter
Body Style	
F	Flanged
Nominal Line Size	
008	DN15; 15 mm (3/4 in)
010	DN25; 25 mm (1 in)
015	DN40; 40 mm (1 1/2 in)
020	DN50; 50 mm (2 in)
030	DN80; 80 mm (3 in)
040	DN100; 100 mm (4 in)
060	DN150; 150 mm (6 in)
080	DN200; 200 mm (8 in)[31]
100	DN250; 250 mm (10 in)
120	DN300; 300 mm (12 in)
Electronics Version	
-T	HART Communication and 4 to 20 mA Output
-L	Low Power with HART Communication; Output Fixed at 10 mA
-M	Modbus Communication
Pulse Output	
P	Pulse Output Capability
Body, Shedder Bar, and Flange Material	
R	ASTM A351-CF8M (Cast 316 ss) Body and Shedder Bar • 316 ss Flanges for Line Sizes 008 to 040 • 304 ss Flanges for Line Sizes 060 to 080
E	Fabricated 304 ss Body and Shedder Bar, with 304 ss Flanges (Line Sizes 100 to 120)
Y	316 ss with face-to-face lengths that are backwards compatible with Style A Model 84 Vortex Flowmeters[32] • For Line Sizes 008 to 040, Cast 316 ss (CF8M) Body and Shedder Bar with 316 ss Flanges • Line Sizes 060 to 120 already have backward-compatible face-to-face lengths

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31. For Line Size 080 with End Connection F4, F5, T4, T5, D5, or B5, Optional Welding Certificate -X is included.
32. Selection Y is recommended *only* for replacement of Style A flowmeters that have lay-length differences greater than ±6.35 mm (1/4 inch).

Table 66 - Model Code for 84CF Flowmeters (Continued)

Code	Description
End Connections and Flange Pressure Rating	
F1	ANSI Class 150 Raised Face
F2	ANSI Class 300 Raised Face
F3	ANSI Class 600 Raised Face
F4	ANSI Class 900 Raised Face (not available with Line Sizes 100 and 120)
F5	ANSI Class 1500 Raised Face (not available with Line Sizes 100 and 120)
T1	ANSI Class 150 Ring-Type Joint (not available with Line Size 008)
T2	ANSI Class 300 Ring-Type Joint
T3	ANSI Class 600 Ring-Type Joint
T4	ANSI Class 900 Ring-Type Joint (not available with Line Sizes 100 and 120)
T5	ANSI Class 1500 Ring-Type Joint (not available with Line Sizes 100 and 120)
D1	PN16 EN1092-1 Raised Face Type "D" Nut Groove (not available with Line Sizes 008 to 040)
D2	PN25 EN1092-1 Raised Face Type "D" Nut Groove (not available with Line Sizes 008 to 060)
D3	PN40 EN1092-1 Raised Face Type "D" Nut Groove
D6	PN63 EN1092-1 Raised Face Type "D" Nut Groove (not available with Line Sizes 008 to 015)[33]
D7	PN100 EN1092-1 Raised Face Type "D" Nut Groove
D5	PN160 EN1092-1 Raised Face Type "D" Nut Groove (not available with Line Sizes 008, 100, and 120)
B1	PN16 EN1092-1 Raised Face Finish Type B1 (not available with Line Sizes 008 to 040)
B2	PN25 EN1092-1 Raised Face Finish Type B1 (not available with Line Sizes 008 to 060)
B3	PN40 EN1092-1 Raised Face Finish Type B1
B6	PN63 EN1092-1 Raised Face Finish Type B2 (not available with Line Sizes 008 to 015)[34]
B7	PN100 EN1092-1 Raised Face Finish Type B2
B5	PN160 EN1092-1 Raised Face Finish Type B2 (not available with Line Sizes 008, 100, and 120)
C3	PN40 EN1092-1 Raised Face Finish Type F
C7	PN100 EN1092-1 Raised Face Finish Type F
Single or Dual Measurement; Isolation Manifold	
S	Single Measurement; No Isolation Manifold
Multivariable Selection	
N	None
T	Temperature Compensation up to 260°C (500°F)[35]

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33. For Line Sizes 008, 010, and 015, select End Connection D7.
34. For Line Sizes 008, 010, and 015, select End Connection B7.
35. For Multivariable Selection T, pulse output is always enabled.

Table 66 - Model Code for 84CF Flowmeters (Continued)

Code	Description
Sensor Fill, Temperature Range, and Material	
Standard Temperature Range (with Fill Fluid)	
D	Fluorolube Fill, -18 to +93°C (0 to 200°F), Cast Nickel Alloy CW2M[36]
F	Fluorolube Fill, -18 to +93°C (0 to 200°F), Cast Stainless Steel CF3M
R	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Nickel Alloy CW2M[36]
S	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Stainless Steel CF3M
Extended Temperature Range (No Fill Fluid)	
A	Unfilled, 149 to 371°C (300 to 700°F), Cast Nickel Alloy CW2M[36] [37]
B	Unfilled, 149 to 371°C (300 to 700°F), Cast Stainless Steel CF3M[37]
E	Unfilled, 149 to 427°C (300 to 800°F), Cast Nickel Alloy CW2M[36] [38] [39]
G	Unfilled, 149 to 427°C (300 to 800°F), Cast Stainless Steel CF3M[38] [39]
Mounting and Conduit Openings for Electronics Housing	
T	Aluminum, Integral, Top-Mounted, with 1/2 NPT Conduit Connections
V	Aluminum, Integral, Top-Mounted, with M20 Conduit Connections
R	Aluminum, Remote-Mounted, with 1/2 NPT Conduit Connections[40]
W	Aluminum, Remote-Mounted, with M20 Conduit Connections[40]
Local Digital Indicator/Configurator	
N	No Digital Indicator/Configurator
J	Digital Indicator/Configurator
Electrical Certifications (refer to *Electrical Certifications, page 27*)[41]	
AA	ATEX Intrinsically Safe[42]
AD	ATEX Flameproof
BA	INMETRO Intrinsically Safe[42]
BD	INMETRO Flameproof[42]
CA	CSA Intrinsically Safe[42]
CD	CSA Explosionproof
CN	CSA Division 2[42]
EA	IECEx Intrinsically Safe[42]
ED	IECEx Flameproof
FA	FM Intrinsically Safe[42]
FD	FM Explosionproof
FN	FM Nonincendive[42]
KD	KOSHA Flameproof[42]

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36. Equivalent to Hastelloy® C-4C. Hastelloy is a registered trademark of Haynes International, Inc.
37. With Multivariable Selection T, the temperature element of the RTD is rated to 260°C (500°F). Use care with a Vortex high temperature sensor, which is rated to a higher temperature.
38. Not available with temperature compensation (Multivariable Selection T).
39. Includes Optional Welding Certificate -X.
40. For remote mounting, select a cable length with the Cable for Connecting to Remote-Mounted Electronics option.
41. Contact Global Customer Support for availability.
42. Not available with Modbus (Electronics Version -M).

Table 66 - Model Code for 84CF Flowmeters (Continued)

Code	Description
NA	NEPSI Intrinsically Safe[43]
ND	NEPSI Flameproof[43]
RA	EAC Intrinsically Safe[43]
RD	EAC Flameproof[43]
YY	CE mark only; PED controls and records
ZZ	No CE mark; do not install in European Union countries
Cable for Connecting to Remote-Mounted Electronics (Optional)	
-B	6 m (20 ft) Cable
-D	9 m (30 ft) Cable
-E	12 m (40 ft) Cable
-G	15 m (50 ft) Cable
Certificates of Compliance/Conformance (Optional)	
-L	Standard Certificate of Compliance
-M	Material Certification of Process Wetted Metal (Conforms to EN 10204 Type 3.1 Certificate)
-Q	Process Wetted Parts Comply with NACE Standards MR-0175-2003 and MR-0103-2007
Cable Connectors — with Mounting and Conduit Openings for Electronics Housing codes T and R only (1/2 NPT)	
-P	Hawke Cable Gland (available only with Electrical Certifications YY and ZZ)
-R	PG11 Cable Gland, Trumpet-Shaped (available only with Electrical Certifications YY and ZZ)
Welding Certificate (Optional) (select only one)	
-F	Welding Certified to Conform to ASME Boiler and Pressure Vessel Code, Section IX
-X	Welding Certified to Conform to ASME Boiler and Pressure Vessel Code, Section IX, and Radiographic (X-Ray) Examination of Welds[44]
Tamper-Resistant Options	
-A	Tamper-Resistant Sealing for Housing and Covers
-S	Tamper-Resistant Cover over Bonnet Bolts
Miscellaneous Optional Selections	
-H	Cleaning of Process Wetted Parts for Oxygen/Chlorine Service per Compressed Gas Association's CGA G-4.1 and ASTM G93[45]
-J	Gold-Plated Sensor
-N	Calibration and Pressure Test Certified Copy
-T	Adapter for 1/2–14 NPT Conduit (available only with Mounting and Conduit Openings for Electronics Housing code R, and with Electrical Certifications YY and ZZ)

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43. Not available with Modbus (Electronics Version -M).
44. This option is already included with: Line Size 080 with End Connection F4, F5, T4, T5, D5, or B5; and with Sensor Fill, Temperature Range, and Material codes E and G.
45. Available only with sensors that have Fluorolube fill. Not available with unfilled sensors or sensors that have silicone fill.

Wafer Body Style

Table 67 - Model Code for 84CW Flowmeters

Code	Description
Model	
84C	Vortex Flowmeter
Body Style	
W	Wafer
Nominal Line Size	
008	DN15; 15 mm (3/4 in)
010	DN25; 25 mm (1 in)
015	DN40; 40 mm (1 1/2 in)
020	DN50; 50 mm (2 in)
030	DN80; 80 mm (3 in)
040	DN100; 100 mm (4 in)
060	DN150; 150 mm (6 in)
080	DN200; 200 mm (8 in)
Electronics Version	
-T	HART Communication and 4 to 20 mA Output
-L	Low Power with HART Communication; Output Fixed at 10 mA
-M	Modbus Communication
Pulse Output	
P	Pulse Output Capability
Body and Shedder Bar Material	
R	ASTM A351-CF8M (Cast 316 ss) Body and Shedder Bar
H	ASTM A494-CW2M (Nickel Alloy) Body and Shedder Bar[46] (Line Sizes 008 to 040)
Mounting and Centering System	
W1	Centering for: • ANSI Class 150, 300, and 600 Flanges (Line Sizes 008 to 040) • PN16 Flanges (Line Sizes 010 to 030) • PN40 Flanges (Line Sizes 010 to 030, 060, and 080) • PN63 and PN100 Flanges (All Line Sizes)
W3	Centering for ANSI Class 600 Flanges (Line Sizes 060 to 080)
W4	Centering for PN16 Flanges (Line Sizes 040 to 080)
W5	Centering for PN40 Flanges (Line Size 040)
W9	Centering for PN16 and PN40 Flanges (Line Size 008)
Single or Dual Measurement; Isolation Manifold	
S	Single Measurement; No Isolation Manifold

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46. Equivalent to Hastelloy® C-4C. Hastelloy is a registered trademark of Haynes International, Inc.

Table 67 - Model Code for 84CW Flowmeters (Continued)

Code	Description
Multivariable Selection	
N	None
T	Temperature Compensation up to 260°C (500°F)[47]
Sensor Fill, Temperature Range, and Material	
Standard Temperature Range (with Fill Fluid)	
D	Fluorolube Fill, -18 to +93°C (0 to 200°F), Cast Nickel Alloy CW2M[48]
F	Fluorolube Fill, -18 to +93°C (0 to 200°F), Cast Stainless Steel CF3M
R	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Nickel Alloy CW2M[48]
S	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Stainless Steel CF3M
Extended Temperature Range (No Fill Fluid)[49]	
E	Unfilled, 149 to 427°C (300 to 800°F), Cast Nickel Alloy CW2M[48]
G	Unfilled, 149 to 427°C (300 to 800°F), Cast Stainless Steel CF3M
Mounting and Conduit Openings for Electronics Housing	
T	Aluminum, Integral, Top-Mounted, with 1/2 NPT Conduit Connections
V	Aluminum, Integral, Top-Mounted, with M20 Conduit Connections
R	Aluminum, Remote-Mounted, with 1/2 NPT Conduit Connections[50]
W	Aluminum, Remote-Mounted, with M20 Conduit Connections[50]
Local Digital Indicator/Configurator	
N	No Digital Indicator/Configurator
J	Digital Indicator/Configurator
Electrical Certifications (refer to *Electrical Certifications, page 27*)[51]	
AA	ATEX Intrinsically Safe[52]
AD	ATEX Flameproof
BA	INMETRO Intrinsically Safe[52]
BD	INMETRO Flameproof[52]
CA	CSA Intrinsically Safe[52]
CD	CSA Explosionproof
CN	CSA Division 2[52]
EA	IECEx Intrinsically Safe[52]
ED	IECEx Flameproof
FA	FM Intrinsically Safe[52]
FD	FM Explosionproof
FN	FM Nonincendive[52]
KD	KOSHA Flameproof[52]

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47. For Multivariable Selection T, pulse output is always enabled.
48. Equivalent to Hastelloy® C-4C. Hastelloy is a registered trademark of Haynes International, Inc.
49. With Multivariable Selection T, the temperature element of the RTD is rated to 260°C (500°F). Use care with a Vortex high temperature sensor, which is rated to a higher temperature.
50. For remote mounting, select a cable length with the Cable for Connecting to Remote-Mounted Electronics option.
51. Contact Global Customer Support for availability.
52. Not available with Modbus (Electronics Version -M).

Table 67 - Model Code for 84CW Flowmeters (Continued)

Code	Description
NA	NEPSI Intrinsically Safe[53]
ND	NEPSI Flameproof[53]
RA	EAC Intrinsically Safe[53]
RD	EAC Flameproof[53]
YY	CE mark only; PED controls and records
ZZ	No CE mark; do not install in European Union countries
Cable for Connecting to Remote-Mounted Electronics (Optional)	
-B	6 m (20 ft) Cable
-D	9 m (30 ft) Cable
-E	12 m (40 ft) Cable
-G	15 m (50 ft) Cable
Certificates of Compliance/Conformance (Optional)	
-L	Standard Certificate of Compliance
-M	Material Certification of Process Wetted Metal (Conforms to EN 10204 Type 3.1 Certificate)
-Q	Process Wetted Parts Comply with NACE Standards MR-0175-2003 and MR-0103-2007
Cable Connectors — with Mounting and Conduit Openings for Electronics Housing codes T and R only (1/2 NPT) (Optional)	
-P	Hawke Cable Gland (available only with Electrical Certifications YY and ZZ)
-R	PG11 Cable Gland, Trumpet-Shaped (available only with Electrical Certifications YY and ZZ)
Tamper-Resistant Options	
-A	Tamper-Resistant Sealing for Housing and Covers
-S	Tamper-Resistant Cover over Bonnet Bolts
Miscellaneous Optional Selections	
-H	Cleaning of Process Wetted Parts for Oxygen/Chlorine Service per Compressed Gas Association's CGA G-4.1 and ASTM G93[54]
-J	Gold-Plated Sensor
-N	Calibration and Pressure Test Certified Copy
-T	Adapter for 1/2–14 NPT Conduit (available only with Mounting and Conduit Openings for Electronics Housing code R, and with Electrical Certifications YY and ZZ)

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53. Not available with Modbus (Electronics Version -M).
54. Available only with sensors that have Fluorolube fill. Not available with unfilled sensors or sensors that have silicone fill.

NPT (Threaded) Body Style

Table 68 - Model Code for 84CN Flowmeters

Code	Description
Model	
84C	Vortex Flowmeter
Body Style	
N	NPT (Male) Threaded Connection
Nominal Line Size	
010	DN25; 25 mm (1 in)
020	DN50; 50 mm (2 in)
Electronics Version	
-T	HART Communication and 4 to 20 mA Output
-L	Low Power with HART Communication; Output Fixed at 10 mA
-M	Modbus Communication
Pulse Output	
P	Pulse Output Capability
Body and Shedder Bar Material	
R	ASTM A351-CF8M (Cast 316 ss) Body and Shedder Bar
End Connections and Pressure Rating	
V4	NPT Male Connection and: • ANSI Class 1500 Pressure Rating (Line Size 010) • ANSI Class 900 Pressure Rating (Line Size 020)
Single or Dual Measurement; Isolation Manifold	
S	Single Measurement; No Isolation Manifold
Multivariable Selection	
N	None
T	Temperature Compensation up to 260°C (500°F)[55]
Sensor Fill, Temperature Range, and Material	
Standard Temperature Range (with Fill Fluid)	
D	Fluorolube Fill, -18 to +93°C (0 to 200°F), Cast Nickel Alloy CW2M[56]
F	Fluorolube Fill, -18 to +93°C (0 to 200°F), Cast Stainless Steel CF3M
R	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Nickel Alloy CW2M[56]
S	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Stainless Steel CF3M

55. For Multivariable Selection T, pulse output is always enabled.
56. Equivalent to Hastelloy® C-4C. Hastelloy is a registered trademark of Haynes International, Inc.

Table 68 - Model Code for 84CN Flowmeters (Continued)

Code	Description
Extended Temperature Range (No Fill Fluid)	
A	Unfilled, 149 to 371°C (300 to 700°F), Cast Nickel Alloy CW2M[57] [58]
B	Unfilled, 149 to 371°C (300 to 700°F), Cast Stainless Steel CF3M[58]
E	Unfilled, 149 to 427°C (300 to 800°F), Cast Nickel Alloy CW2M[57] [59]
G	Unfilled, 149 to 427°C (300 to 800°F), Cast Stainless Steel CF3M[59]
Mounting and Conduit Openings for Electronics Housing	
T	Aluminum, Integral, Top-Mounted, with 1/2 NPT Conduit Connections
V	Aluminum, Integral, Top-Mounted, with M20 Conduit Connections
R	Aluminum, Remote-Mounted, with 1/2 NPT Conduit Connections[60]
W	Aluminum, Remote-Mounted, with M20 Conduit Connections[60]
Local Digital Indicator/Configurator	
N	No Digital Indicator/Configurator
J	Digital Indicator/Configurator
Electrical Certifications (refer to *Electrical Certifications, page 27*)[61]	
AA	ATEX Intrinsically Safe[62]
AD	ATEX Flameproof
BA	INMETRO Intrinsically Safe[62]
BD	INMETRO Flameproof[62]
CA	CSA Intrinsically Safe[62]
CD	CSA Explosionproof
CN	CSA Division 2[62]
EA	IECEx Intrinsically Safe[62]
ED	IECEx Flameproof
FA	FM Intrinsically Safe[62]
FD	FM Explosionproof
FN	FM Nonincendive[62]
KD	KOSHA Flameproof[62]
NA	NEPSI Intrinsically Safe[62]
ND	NEPSI Flameproof[62]
RA	EAC Intrinsically Safe[62]
RD	EAC Flameproof[62]
YY	CE mark only; PED controls and records
ZZ	No CE mark; do not install in European Union countries

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57. Equivalent to Hastelloy® C-4C. Hastelloy is a registered trademark of Haynes International, Inc.
58. With Multivariable Selection T, the temperature element of the RTD is rated to 260°C (500°F). Use care with a Vortex high temperature sensor, which is rated to a higher temperature.
59. Not available with temperature compensation (Multivariable Selection T).
60. For remote mounting, select a cable length with the Cable for Connecting to Remote-Mounted Electronics option.
61. Contact Global Customer Support for availability.
62. Not available with Modbus (Electronics Version -M).

Table 68 - Model Code for 84CN Flowmeters (Continued)

Code	Description
Cable for Connecting to Remote-Mounted Electronics (Optional)	
-B	6 m (20 ft) Cable
-D	9 m (30 ft) Cable
-E	12 m (40 ft) Cable
-G	15 m (50 ft) Cable
Certificates of Compliance/Conformance (Optional)	
-L	Standard Certificate of Compliance
-M	Material Certification of Process Wetted Metal (Conforms to EN 10204 Type 3.1 Certificate)
-Q	Process Wetted Parts Comply with NACE Standards MR-0175-2003 and MR-0103-2007
Cable Connectors — with Mounting and Conduit Openings for Electronics Housing codes T and R only (1/2 NPT) (Optional)	
-P	Hawke Cable Gland (available only with Electrical Certifications YY and ZZ)
-R	PG11 Cable Gland, Trumpet-Shaped (available only with Electrical Certifications YY and ZZ)
Tamper-Resistant Options	
-A	Tamper-Resistant Sealing for Housing and Covers
-S	Tamper-Resistant Cover over Bonnet Bolts
Miscellaneous Optional Selections	
-H	Cleaning of Process Wetted Parts for Oxygen/Chlorine Service per Compressed Gas Association's CGA G-4.1 and ASTM G93[63]
-J	Gold-Plated Sensor
-N	Calibration and Pressure Test Certified Copy
-T	Adapter for 1/2–14 NPT Conduit (available only with Mounting and Conduit Openings for Electronics Housing code R, and with Electrical Certifications YY and ZZ)

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63. Available only with sensors that have Fluorolube fill. Not available with unfilled sensors or sensors that have silicone fill.

Nominal Dimensions

For dimensional information specific to your sales order, contact your sales representative to order a Certified Dimensional Print (CDP).

All dimensions in diagrams are shown in millimeters over inches ($\frac{mm}{in}$).

Dimensions for 84C Flanged Body Flowmeters

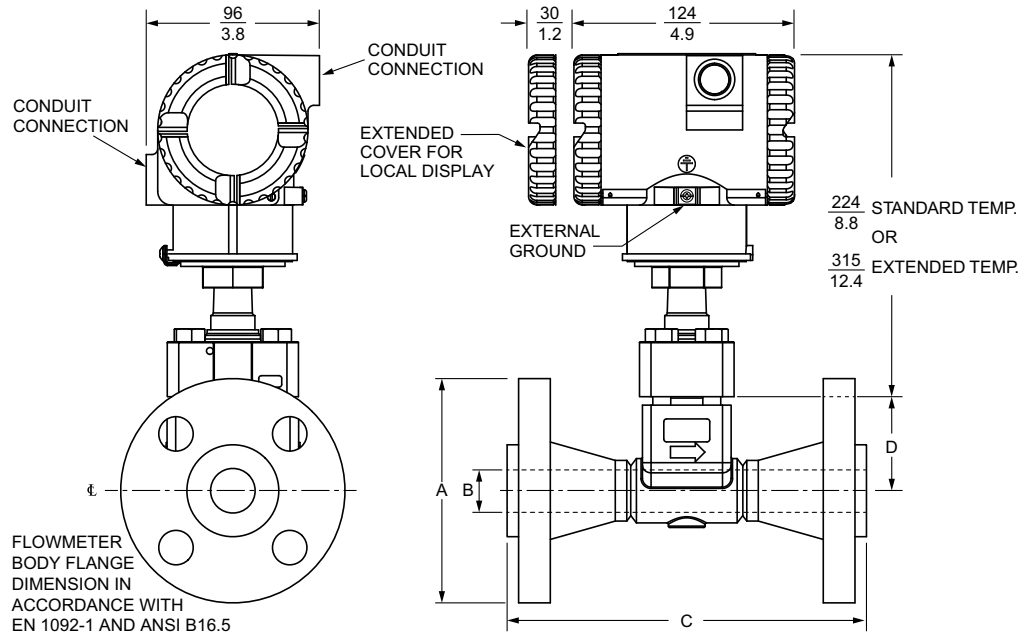**Figure 112 - Flanged Body Flowmeter with Integrally Mounted Electronics Housing**
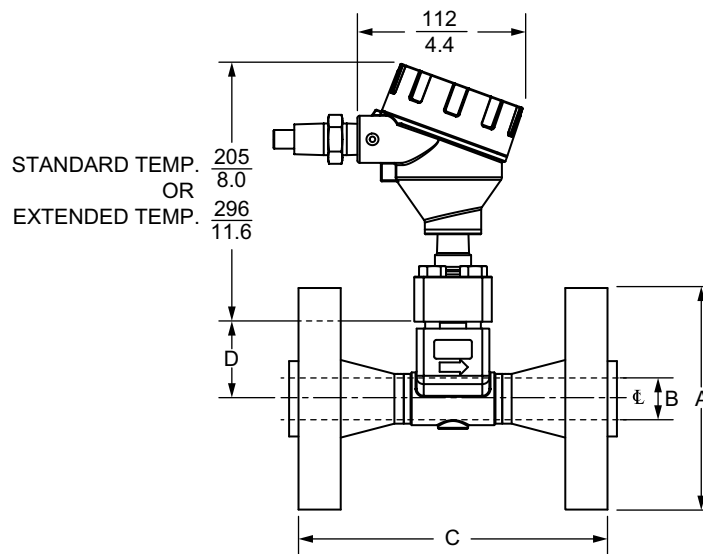

Figure 113 - Flanged Body Flowmeter with Junction Box

Table 69 - Flanged Body, with ANSI Flanges and Material Code R or E

Nominal Line Size	Flange Type	Dimension A (OD)	Dimension B (ID)	Dimension C[64]		Dimension D
				RF Flange	RTJ Flange	
008	Class 150	3.88 in	0.74 in	6.56 in	—	1.82 in
	Class 300	4.62 in		6.94 in	7.32 in	
	Class 600			7.44 in	7.44 in	
	Class 900	5.12 in		8.44 in	8.44 in	
	Class 1500					
010	Class 150	4.25 in	0.96 in	6.80 in	7.18 in	1.93 in
	Class 300	4.88 in		7.32 in	7.70 in	
	Class 600			7.82 in	7.82 in	
	Class 900	5.88 in		8.70 in	8.70 in	
	Class 1500					
015	Class 150	4.62 in	1.50 in	7.32 in	7.70 in	2.20 in
	Class 300	6.12 in		7.82 in	8.20 in	
	Class 600			8.44 in	8.44 in	
	Class 900	7.00 in		9.44 in	9.44 in	
	Class 1500					
020	Class 150	6.00 in	1.94 in	7.75 in	8.13 in	2.32 in
	Class 300	6.50 in		8.25 in	8.75 in	
	Class 600			9.01 in	9.13 in	
	Class 900	8.50 in		11.25 in	11.37 in	
	Class 1500		1.69 in			2.20 in
030	Class 150	7.50 in	2.87 in	8.88 in	9.26 in	2.75 in
	Class 300	8.25 in		9.62 in	10.12 in	
	Class 600			10.38 in	10.50 in	
	Class 900	9.50 in		11.88 in	12.00 in	
	Class 1500	10.50 in	2.63 in	13.12 in	13.25 in	2.62 in
040	Class 150	9.00 in	3.83 in	9.62 in	10.00 in	3.35 in
	Class 300	10.00 in		10.38 in	10.88 in	
	Class 600	10.75 in		12.12 in	12.24 in	
	Class 900	11.50 in		13.12 in	13.24 in	
	Class 1500	12.25 in	3.44 in	13.88 in	14.00 in	
060	Class 150	11.00 in	5.76 in	12.00 in	12.38 in	4.42 in
	Class 300	12.50 in		12.76 in	13.26 in	
	Class 600	14.00 in		14.74 in	14.86 in	
	Class 900	15.00 in	5.19 in	16.50 in	16.62 in	
	Class 1500	15.50 in		19.00 in	19.25 in	

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64. For line sizes 008 through 010, the overall length (dimension C) is ±6.4mm (±0.250in). For line size 120, the overall length is ±8.9mm (±0.350in).

Table 69 - Flanged Body, with ANSI Flanges and Material Code R or E (Continued)

Nominal Line Size	Flange Type	Dimension A (OD)	Dimension B (ID)	Dimension C[65]		Dimension D
				RF Flange	RTJ Flange	
080	Class 150	13.50 in	7.63 in	15.00 in	15.38 in	5.47 in
	Class 300	15.00 in		15.75 in	16.26 in	
	Class 600	16.50 in		18.00 in	18.12 in	
	Class 900	18.50 in	6.81 in	20.26 in	20.38 in	
	Class 1500	19.00 in		24.26 in	24.64 in	
100	Class 150	16.00 in	9.56 in	15.00 in	15.38 in	6.55 in
	Class 300	17.50 in		16.24 in	16.74 in	
	Class 600	20.00 in		19.5 in	19.62 in	
120	Class 150	19.00 in	11.37 in	17.00 in	17.38 in	7.55 in
	Class 300	20.50 in		18.24 in	18.24 in	
	Class 600	22.00 in		20.74 in	20.76 in	

Table 70 - Flanged Body, with DIN Flanges and Material Code R or E

Nominal Line Size	Flange Type	Dimension A (OD)	Dimension B (ID)	Dimension C[65]	Dimension D
008	PN 40[66]	95 mm	19 mm	138 mm	46 mm
	PN 100	105 mm		152 mm	
010	PN 40[66]	115 mm	24.31 mm	142 mm	49 mm
	PN 100	140 mm		178 mm	
	PN 160				
015	PN 40[66]	150 mm	38.10 mm	152 mm	56 mm
	PN 100	170 mm		186 mm	
	PN 160			190 mm	
020	PN 40[66]	165 mm	49 mm	166 mm	59 mm
	PN 63	180 mm		194 mm	
	PN 100	195 mm		206 mm	
	PN 160			220 mm	
030	PN 40[66]	200 mm	73 mm	202 mm	70 mm
	PN 63	215 mm		230 mm	
	PN 100	230 mm		242 mm	
	PN 160			258 mm	
040	PN 40[66]	235 mm	97 mm	222 mm	85 mm
	PN 63	250 mm		248 mm	
	PN 100	265 mm		272 mm	
	PN 160			292 mm	

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65. For line sizes 008 through 010, the overall length (dimension C) is ±6.4mm (±0.250in). For line size 120, the overall length is ±8.9mm (±0.350in).
66. May be used with a PN25 mating flange.

Table 70 - Flanged Body, with DIN Flanges and Material Code R or E (Continued)

Nominal Line Size	Flange Type	Dimension A (OD)	Dimension B (ID)	Dimension C[67]	Dimension D
060	PN 16	285 mm	146 mm	237 mm	112 mm
	PN 40[68]	300 mm		277 mm	
	PN 63	345 mm		317 mm	
	PN 100	355 mm		357 mm	
	PN 160		132 mm	383 mm	
080	PN 16	340 mm	194 mm	302 mm	139 mm
	PN 25	360 mm		338 mm	
	PN 40	375 mm		354 mm	
	PN 63	415 mm		398 mm	
	PN 100	430 mm		438 mm	
	PN 160		173 mm	458 mm	
100	PN 16	405 mm	243 mm	318 mm	166 mm
	PN 25	425 mm		354 mm	
	PN 40	450 mm		388 mm	
	PN 63	470 mm		428 mm	
	PN 100	505 mm		492 mm	
120	PN 16	460 mm	289 mm	359 mm	192 mm
	PN 25	485 mm		387 mm	
	PN 40	515 mm		433 mm	
	PN 63	530 mm		483 mm	
	PN 100	585 mm		543 mm	

Table 71 - Flanged Body, with ANSI Flanges and Material Code Y (Backward Compatible with Style A)

Nominal Line Size	Flange Rating[69]	Dimension A (OD)	Dimension B (ID)	Dimension C[70]	Dimension D
008	Class 150	3.88 in	0.74 in	6.00 in	1.82 in
	Class 300	4.62 in			
	Class 600			6.50 in	
010	Class 150	4.25 in	0.96 in	6.50 in	1.93 in
	Class 300	4.88 in			
	Class 600			7.00 in	
015	Class 150	4.62 in	1.50 in	7.25 in	2.20 in
	Class 300	6.12 in			
	Class 600			7.88 in	
020	Class 300	6.50 in	1.94 in	7.75 in	2.32 in
	Class 600			8.50 in	

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67. For line sizes 008 through 010, the overall length (dimension C) is ±6.4mm (±0.250in). For line size 120, the overall length is ±8.9mm (±0.350in).
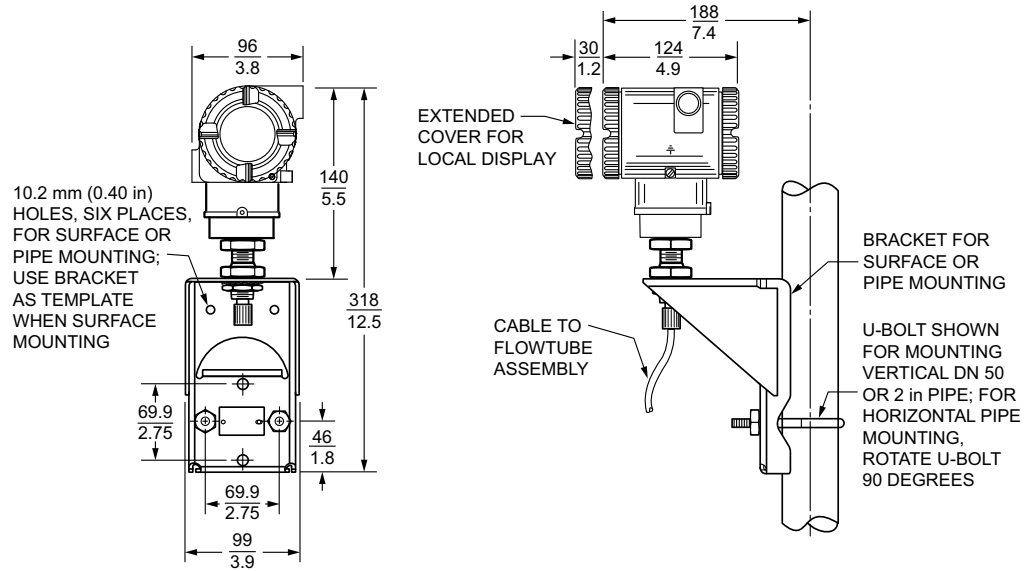68. May be used with a PN25 mating flange.
69. For ANSI flanges, material code Y offers face-to-face lengths that are backward compatible with the Style A vortex flowmeters model code selection S. Use material code Y when replacing a Model 84F Style A meter.
70. Overall length (C) is ±0.250 in (±6.4 mm).

Table 71 - Flanged Body, with ANSI Flanges and Material Code Y (Backward Compatible with Style A) (Continued)

Nominal Line Size	Flange Rating[71]	Dimension A (OD)	Dimension B (ID)	Dimension C[72]	Dimension D
030	Class 300	8.25 in	2.87 in	8.75 in	2.75 in
	Class 600			9.50 in	
040	Class 300	10.00 in	3.83 in	9.50 in	3.35 in
	Class 600	10.75 in		10.50 in	

Figure 114 - Remotely Mounted Electronics Housing for 84CF

NOTE: WHEN THE BRACKET IS USED FOR WALL MOUNTING, REPLACE THE U-BOLT WITH TWO OR FOUR 0.375 in BOLTS LONG ENOUGH TO PASS THROUGH THE BRACKET AND SURFACE.

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71. For ANSI flanges, material code Y offers face-to-face lengths that are backward compatible with the Style A vortex flowmeters model code selection S. Use material code Y when replacing a Model 84F Style A meter.
72. Overall length (C) is ±0.250 in (±6.4 mm).

Dimensions for 84C Wafer Body Flowmeters

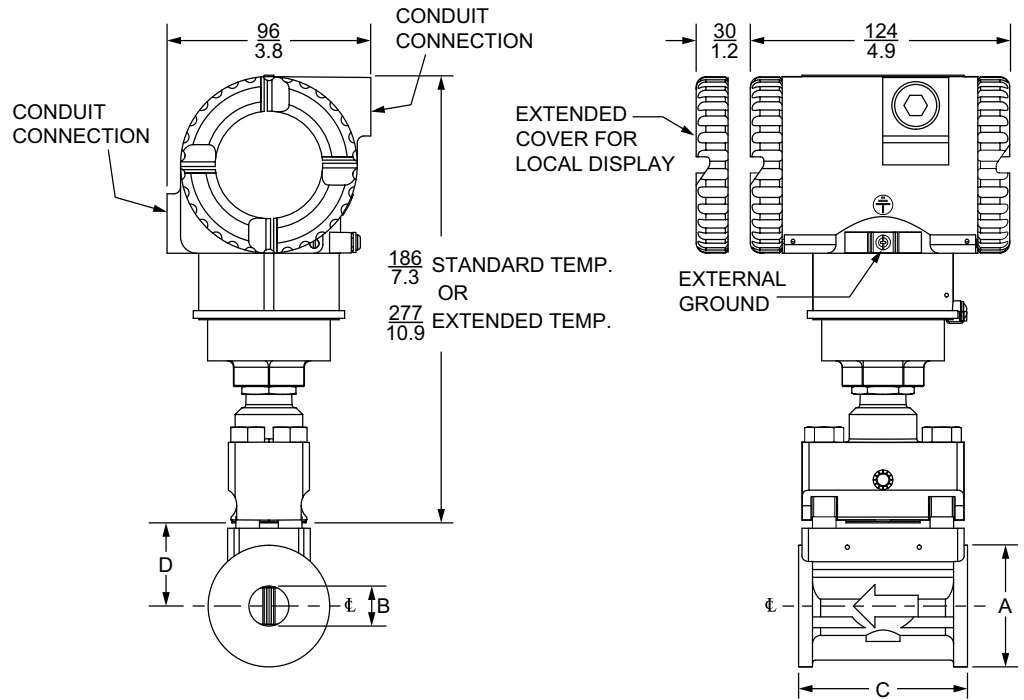**Figure 115 - Wafer Body Flowmeter with Integrally Mounted Electronics Housing**

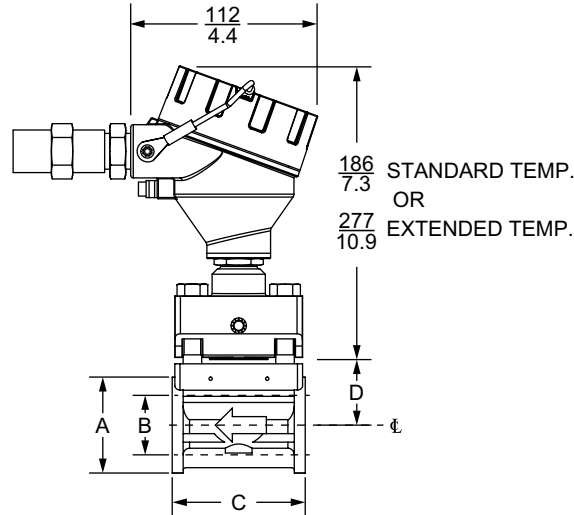**Figure 116 - Wafer Body Flowmeter with Junction Box**

Table 72 - Wafer Body Dimensions

| Nominal Line Size[73]	Dimension A (OD)	Dimension B (ID)[74]	Dimension C	Dimension D
008	57.2 mm (2.25 in)	18.8 mm (0.74 in)	79.5 mm (3.13 in)	36.6 mm (1.44 in)
010	66.8 mm (2.63 in)	24.3 mm (0.96 in)	79.5 mm (3.13 in)	39.4 mm (1.55 in)
015	85.9 mm (3.38 in)	38.1 mm (1.50 in)	79.5 mm (3.13 in)	46.2 mm (1.82 in)

73. Flowmeter body fits between ANSI Class 150, 300, or 600 raised face flanges, or between PN 16, 40, 63, or 100 flanges.
74. Bore equivalent to Schedule 80 pipe.

Table 72 - Wafer Body Dimensions (Continued)

Nominal Line Size[75]	Dimension A (OD)	Dimension B (ID)[76]	Dimension C	Dimension D
020	104.6 mm (4.12 in)	49.2 mm (1.94 in)	79.5 mm (3.13 in)	49.3 mm (1.94 in)
030	136.7 mm (5.38 in)	72.9 mm (2.87 in)	95.3 mm (3.75 in)	60.2 mm (2.37 in)
040	174.5 mm (6.87 in)	96.7 mm (3.81 in)	120.7 mm (4.75 in)	73.9 mm (2.91 in)
060	222.3 mm (8.75 in)	147.3 mm (5.80 in)	177.8 mm (7.00 in)	98.0 mm (3.86 in)
080	279.4 mm (11.00 in)	193.0 mm (7.60 in)	228.6 mm (9.00 in)	122.9 mm (4.84 in)

Figure 117 - Remotely Mounted Electronics Housing for 84CW
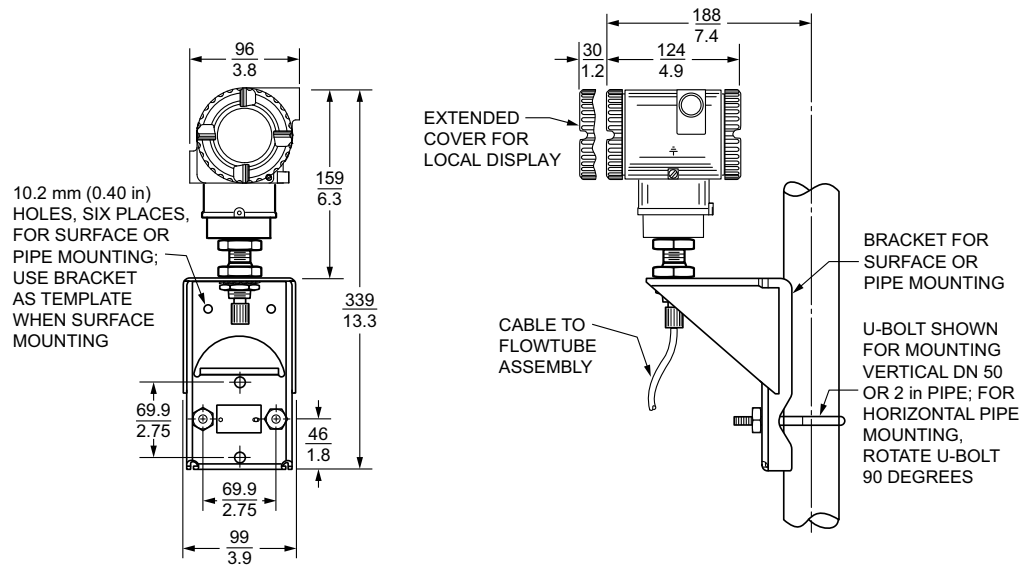
NOTE: WHEN THE BRACKET IS USED FOR WALL MOUNTING, REPLACE THE U-BOLT WITH TWO OR FOUR 0.375 in BOLTS LONG ENOUGH TO PASS THROUGH THE BRACKET AND SURFACE.

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75. Flowmeter body fits between ANSI Class 150, 300, or 600 raised face flanges, or between PN 16, 40, 63, or 100 flanges.
76. Bore equivalent to Schedule 80 pipe.

Dimensions for 84C NPT Body Flowmeters

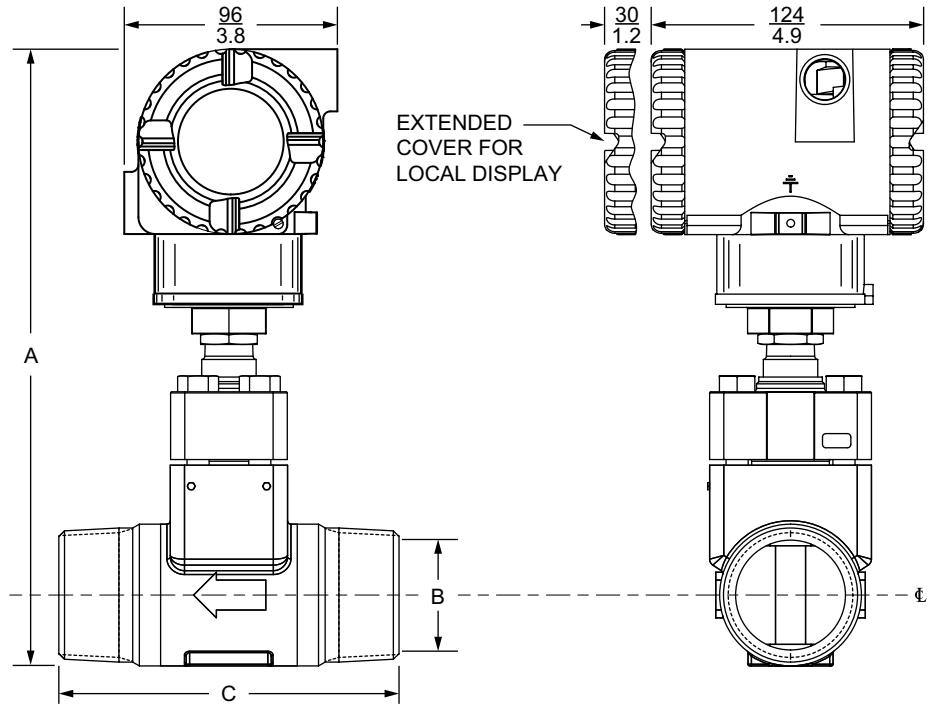**Figure 118 - NPT Body Flowmeter with Integrally Mounted Electronics Housing**

Figure 119 - NPT Body Flowmeter with Junction Box
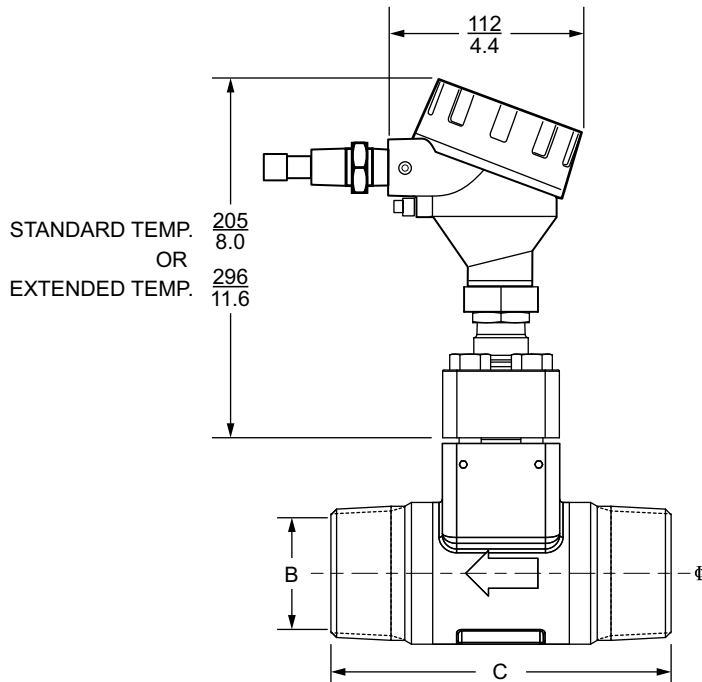
Table 73 - NPT Body Dimensions

Nominal Line Size	Dimension A		Dimension B (ID)	Dimension C
	Standard Temperature	Extended Temperature		
010	251 mm (9.9 in)	342 mm (13.5 in)	24.3 mm (0.96 in)	101.6 mm (4.0 in)
020	277 mm (10.9 in)	368 mm (14.5 in)	49.2 mm (1.94 in)	152.4 mm (6.0 in)

Figure 120 - Remotely Mounted Electronics Housing for 84CN
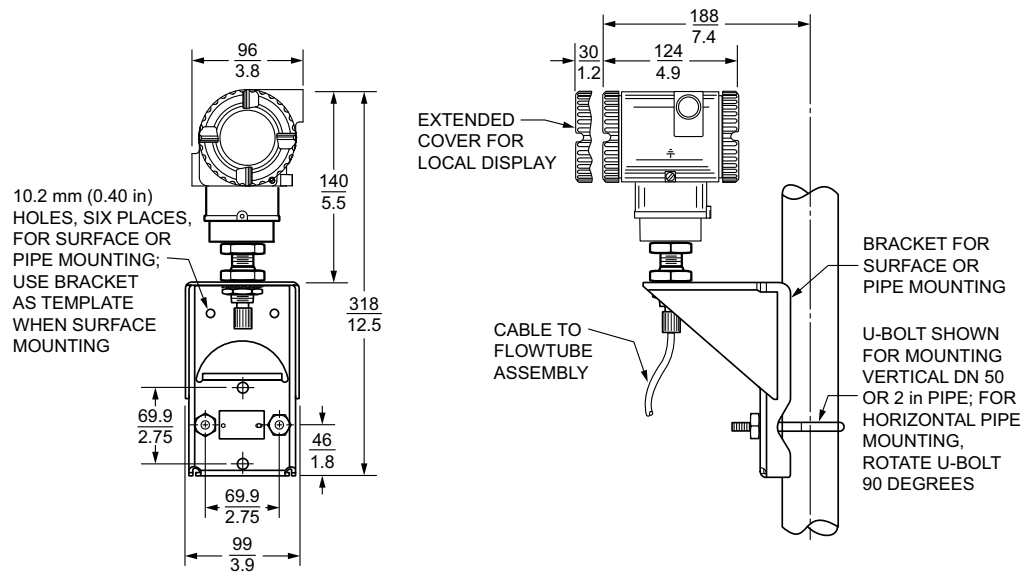
NOTE: WHEN THE BRACKET IS USED FOR WALL MOUNTING, REPLACE THE U-BOLT WITH TWO OR FOUR 0.375 in BOLTS LONG ENOUGH TO PASS THROUGH THE BRACKET AND SURFACE.

Parts List

Electronics Housing

The electronics housing can be integrally mounted to the flowtube, or remotely mounted to a bracket. See *Junction Box and Remote Mounting, page 208* for remote mounting parts and configuration.

Figure 121 - Electronics Housing Assembly

Table 74 - Parts for Electronics Housing Assembly
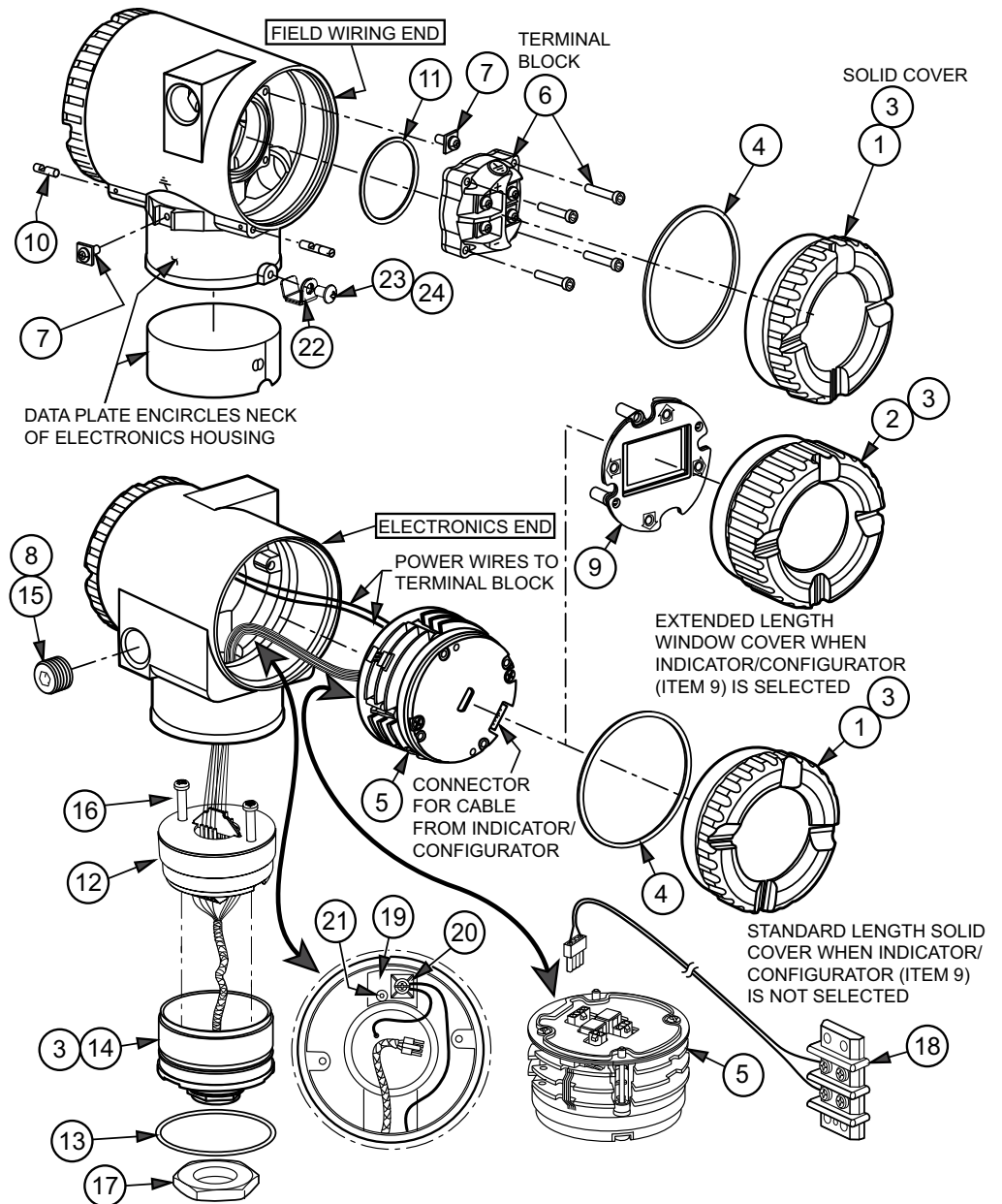
Item	Part No.	Qty.	Part Name
1	D0162AP	2	Cover, Aluminum; No Indicator/Configurator
2	K0147YA	1	Cover, Aluminum; with Window; used when Indicator/Configurator is selected, replaces Item 1 on electronics end
3	X0114AT	A/R	Grease, 14 ounce can
4	X0201FC	2	O-Ring, Cover
5	**Below**	1	**Electronics Module Assembly**
	K0168GF		HART Communication and 4 to 20 mA Output (Version -T)
	K0168RS		Low Power with HART Communication; Output Fixed at 10 mA (Version -L)
	D0219DB		Modbus Communication (Version -M)
6	**Below**	1	**Terminal Block Assembly - with Pulse Output** (includes 4 mounting screws)
	K0168QY		HART Communication or Low Power, Non-Explosionproof Installations
	K0168QZ		HART Communication or Low Power, Flameproof/Explosionproof Installations
	K0171BU		Modbus Communication
7	D0162VJ	2	Screw Assembly, Plated ss, 0.164-32 x 0.375
8	B1270KE	A/R	Sealant, Thread
9	K0149GV	1	Digital Indicator/Configurator Replacement Kit (includes indicator/configurator, label, screws, and instructions)
10	D0162WM	2	Screw, Cover Lock, 0.164-32[77]
11	X0144KR	1	O-Ring, Terminal Block
12	Potted Cup Assembly Module; see *Potted Cup Assembly Part Numbers, page 207*		
13	X0144KW	1	O-Ring, Housing Neck
14	K0168GG	1	Cup Housing Neck, Machining
15	**Below**	1	**Plug, Pipe**
	B0139CA		1/2 NPT; Aluminum; with Housing Codes T and R
	D0179FK		M20; ss; with Housing Codes V and W

> # ⚠WARNING
>
> **RISK OF MOISTURE INGRESS**
>
> To maintain IP66 (IEC 60529) and NEMA 4X protection, the unused conduit opening must be closed with a metal plug. In addition, the threaded housing covers must be properly installed.
>
> **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Item	Part No.	Qty.	Part Name
16	X0174GF	2	Screw, Panhead; Cross Recessed; ss; M4 x 0.7 x 28 mm
17	K0148TQ	1	Nut, Jam; Hexhead; ss; 0.500-14

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77. Cover lock screws are provided with ATEX/IECEx/NEPSI flameproof electrical certifications. They are used to help prevent rotation of the housing covers. To remove a cover, turn the screw clockwise until the screw clears the cover groove; then remove the cover. To put the cover back in place, screw the cover on, and then turn the screw counterclockwise until it engages the cover groove.

Table 74 - Parts for Electronics Housing Assembly (Continued)

Item	Part No.	Qty.	Part Name
18	K0152KU	1	Harness, Test; Accessory[78]
19	K0152JV	1	Molding, PE Ground
20	K0152JX	1	Screw Assembly, PE Ground; ss; 0.164-32 x 0.315
21	X0133VN	1	Screw, Socket Head; ss; 0.132-32 x 0.437
22	D0197PS	1	Retention Clip
23	X0174EK	1	Button Head Screw
24	X0180GS	1	Red Lacquer

Potted Cup Assembly Part Numbers

Table 75 - With Flameproof or Explosionproof Agency Certification

Multivariable Selection:		No Temperature Compensation (N)		Temperature Compensation (T)	
Sensor Temperature Range:		**Standard**	**Extended**	**Standard**	**Extended**
Electronics Housing:	Integrally Mounted	K0168MW	K0168MX	K0168MW	K0168MX
	Remotely Mounted	K0171CB		K0168QD	

Table 76 - With Non-Flameproof/Explosionproof Agency Certification

Multivariable Selection:		No Temperature Compensation (N)		Temperature Compensation (T)	
Sensor Temperature Range:		**Standard**	**Extended**	**Standard**	**Extended**
Electronics Housing:	Integrally Mounted	K0168GJ	K0168HF	K0168GJ	K0168HF
	Remotely Mounted	K0168QB			

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78. The test harness provides a means for inputting a test frequency using a frequency generator, for users who require a test input for validation.

Junction Box and Remote Mounting
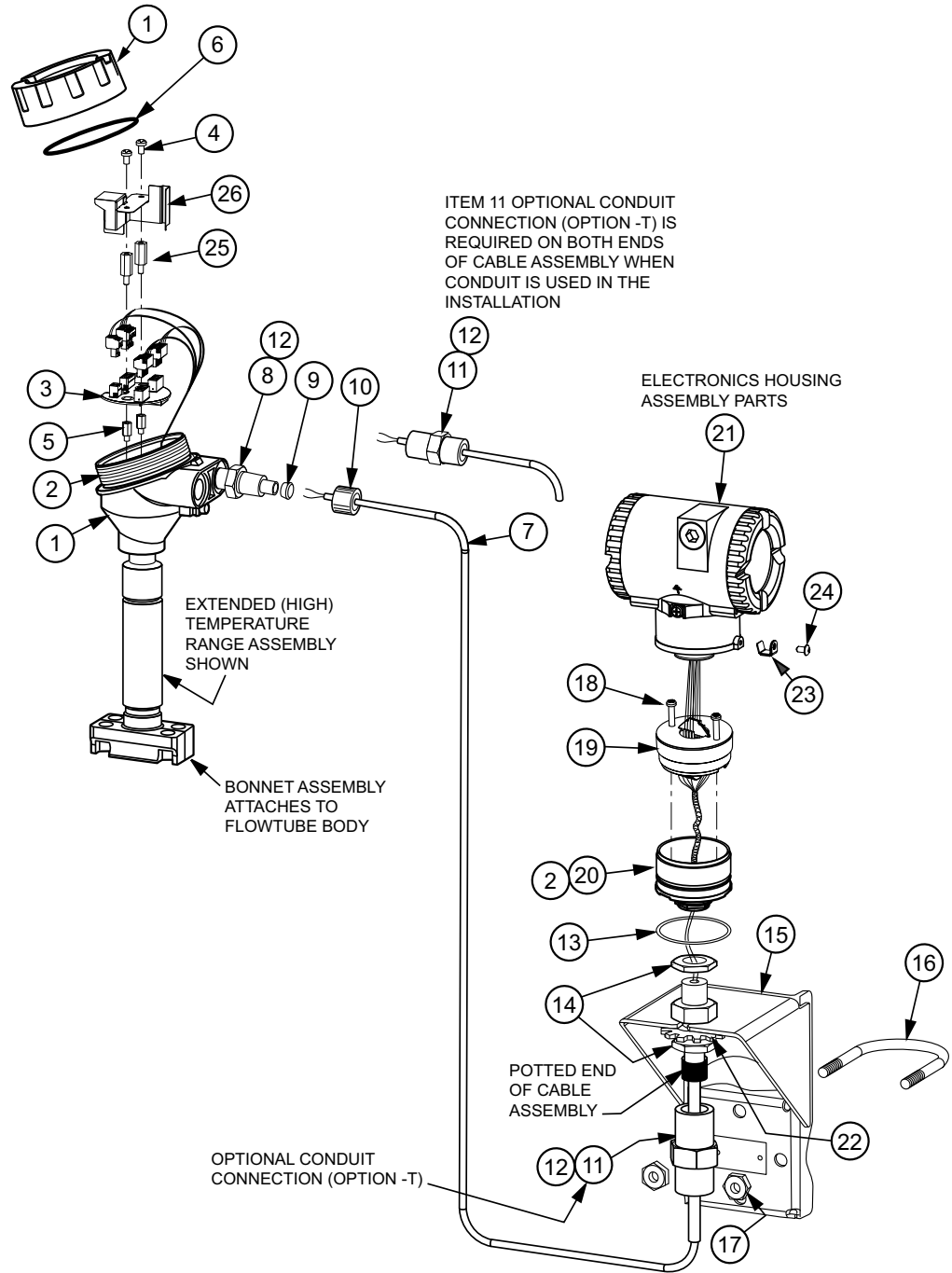
Figure 122 - Junction Box and Remote Mounting

ITEM 11 OPTIONAL CONDUIT CONNECTION (OPTION -T) IS REQUIRED ON BOTH ENDS OF CABLE ASSEMBLY WHEN CONDUIT IS USED IN THE INSTALLATION

ELECTRONICS HOUSING ASSEMBLY PARTS

EXTENDED (HIGH) TEMPERATURE RANGE ASSEMBLY SHOWN

BONNET ASSEMBLY ATTACHES TO FLOWTUBE BODY

POTTED END OF CABLE ASSEMBLY

OPTIONAL CONDUIT CONNECTION (OPTION -T)

Table 77 - Parts for Junction Box and Remote Mounting

Item	Part No.	Qty.	Part Name
1	K0152GB	1	Connection Head Assembly (Junction Box); for explosionproof; ss. Includes housing, cover, cover lock, and cover o-ring
2	X0114AT	A/R	Grease, 14 ounce can
3	**Below**	1	**Preamplifier Assembly**
	D0159SX		Standard Temperature Remote
	D0159SZ		Extended Temperature Remote

Table 77 - Parts for Junction Box and Remote Mounting (Continued)

Item	Part No.	Qty.	Part Name
4	X0173UN	2	Screw, Panhead; Cross-recessed; ss; M4 x 0.7 x 9 mm
5	X0201KL	2	Standoff, hexagonal head; ss; M4 x 10 mm
6	D0179EG	1	O-Ring, Cover; included in Item 1 but also available separately
7	**Below**	1	**Cable Assembly, Remote Housing (includes Connector Assembly)**[79]
	K0168HB		20 ft (6 m) long
	K0168HC		30 ft (9 m) long
	K0168HD		40 ft (12 m) long
	K0168HE		50 ft (15 m) long
8	B0185AJ	1	Adapter; 1.125 Hexhead; ss; 1/2 NPT and 0.500-20
9	K0146JV	1	Bushing, silicone rubber; 0.275 in long; 0.280 ID.
10	B0185AK	1	Nut, Knurled; ss; 0.542 in long; 0.5-20
11	K0149LE	2	Connector, Conduit; Option -T (required when conduit is used)
12	B1270KE	A/R	Sealant, Thread
13	Housing; see *Electronics Housing, page 205*		
14	K0148TQ	1	Nut, Jam; 1.259 Hexhead; ss; 0.500-20
15	K0149HR	1	Bracket Assembly, Mounting; painted steel
16	D0114SM	1	U-Bolt, 0.312-18; plated steel
17	0011962	2	Nut, 0.312-18; plated steel
18	X0143SL	1	Washer, Lock; Extended Tooth; ss; 0.875
19	K0168RY	1	Wire Cover Bracket
20	K0201QE	2	Standoff, Hex

79. The cable assembly is potted on the electronics housing end. The opposite end is assembled to the connection head assembly using a bushing and a knurled nut. If a conduit is used during installation, a conduit connector is used at each end of the cable assembly. See *Remotely Mounted Electronics, page 48*.

Bonnet Assembly and Sensor Parts
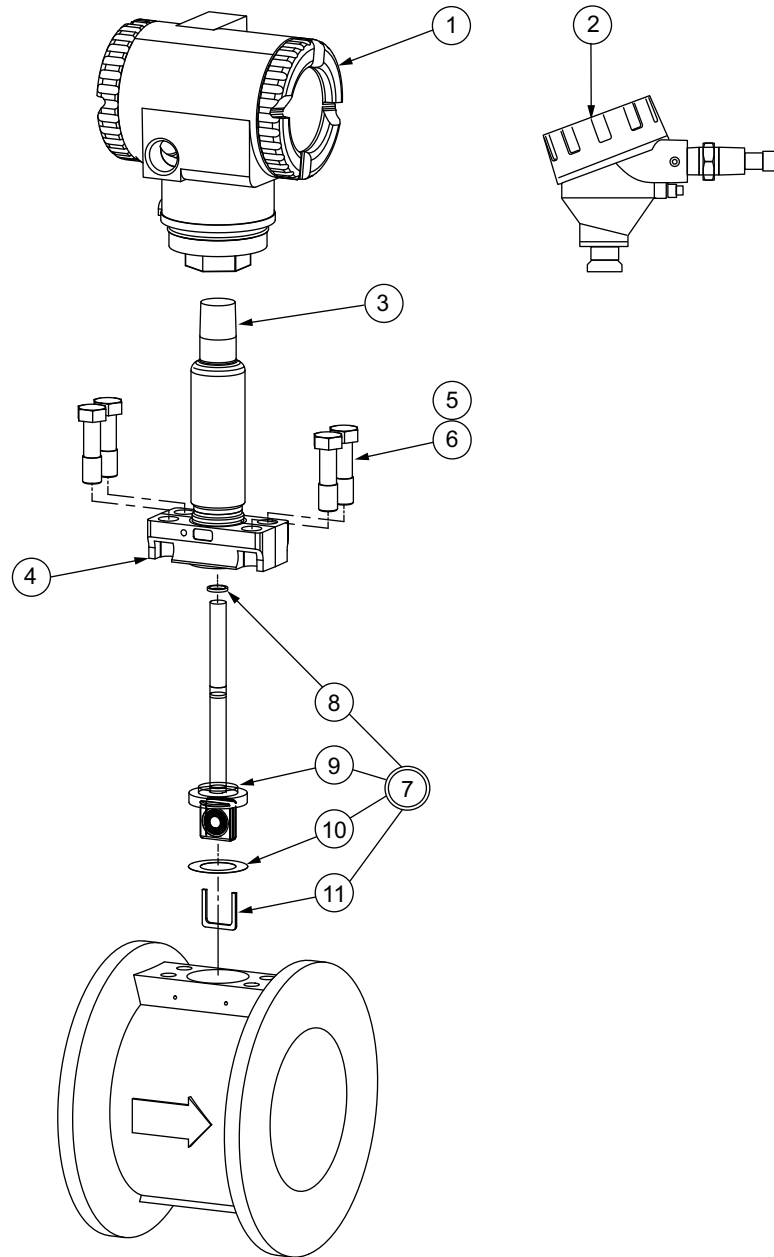
Figure 123 - Bonnet Assembly and Sensor Parts

Table 78 - Parts for Bonnet Assembly and Sensor Replacement Kits

Item	Part No.	Qty.	Part Name
1	Housing; see *Electronics Housing, page 205*		
2	Junction Box; see *Junction Box and Remote Mounting, page 208*		
3	B1270KE	A/R	Thread Sealant
4	Bonnet Assembly, Standard or Extended Temperature Range (bonnet for extended temperature range shown); see *Bonnet Assemblies, page 211* for part numbers		
5	X0114AT	A/R	Grease; 14 ounce can

Table 78 - Parts for Bonnet Assembly and Sensor Replacement Kits (Continued)

Item	Part No.	Qty.	Part Name
6	**Below**	—	**Bonnet Bolts (also part of Item 7)**
	X0173SV	4	Standard Temperature, ASTM A193, Grade B7, plated steel. Hexhead (0.625 hex); 0.437-14 x 2
	X0174EY	4	Extended Temperature, ASTM A453, Stainless Steel, grade 660. Hexhead 0.625 hex); 0.437-14 x 2
7	Sensor Replacement Kit, Standard or Extended Temperature Range (extended temperature range sensor shown); items 3, 8, 9, 10, and 11, plus instructions; see *Sensor and Seal Replacement Kits, page 212* for part numbers		
8	n/a		O-Ring
9	n/a		Sensor
10	n/a		Gasket
11	n/a		Flow Dam

Bonnet Assemblies

The bonnet assembly is a pressure containment component. Replacement of this component requires pressure testing. Refer to MI 019-223.

Table 79 - Bonnet Assembly Part Numbers for 84CF and 84CN Flowmeters with Temperature Compensation

Line Size Code	Standard Temperature		Extended Temperature		
	Non-Explosion-proof Certs	Explosion-proof Certs	Non-Explosion-proof Certs	FM/CSA Explosion-proof Certs	ATEX, CSA, IECEx, and NEPSI Flameproof Certs
008 to 030	K0168GM	K0168HR	K0168HK	K0168HJ	K0168HM
040 to 120	K0168HQ	K0168HS	K0168HL	K0168HH	K0168HN

Table 80 - Bonnet Assembly Part Numbers for 84CW Flowmeters with Temperature Compensation

Line Size Code	Standard Temperature		Extended Temperature	
	Non-Explosionproof Certs	Explosionproof Certs	Non-Explosionproof Certs	Explosionproof Certs
008 to 030	K0170AS	K0170AQ	K0170AW	K0170AX
040 to 080	K0170AT	K0170AR	K0170AY	K0170AZ

Table 81 - Bonnet Assembly Part Numbers for 84CF and 84CN Flowmeters without Temperature Compensation

Line Size Code	Standard Temperature		Extended Temperature	
	Non-Explosionproof Certs	Explosionproof Certs	Non-Explosionproof Certs	Explosionproof Certs
008 to 030	K0152TV	K0152TW	K0156JY	K0156JW
040 to 120	K0152TX	K0152TY	K0156JZ	K0156JX

Table 82 - Bonnet Assembly Part Numbers for 84CW Flowmeters without Temperature Compensation

Line Size Code	Standard Temperature		Extended Temperature	
	Non-Explosionproof Certs	Explosionproof Certs	Non-Explosionproof Certs	Explosionproof Certs
008 to 030	K0147GU	K0147GT	K0147GY	K0147GX
040 to 080	K0148SK	K0148SH	K0148TM	K0148TL

Sensor and Seal Replacement Kits

The sensor replacement kits are pressure containment components. Replacement of these components requires pressure testing. Refer to MI 019-223.

NOTICE
POTENTIAL EQUIPMENT DAMAGE
• Do not use these kits for flowmeters that were purchased with the -H oxygen service cleaning option. These require special cleaning. Contact Global Customer Support for assistance.
• Do not use these kits for sanitary flowmeters. Sensors in sanitary flowmeters are not user replaceable. Contact Global Customer Support to return the entire flowmeter for repair or replacement.
• Do not use these kits to replace a gold-plated sensor. Contact Global Customer Support for assistance.
Failure to follow these instructions can result in equipment damage.

Table 83 - Sensor Replacement Kits for 84C Flowmeters with Temperature Compensation

Kit Description		Kit Contents	
Part No.	Sensor Code	Sensor	Seal Kit[80]
K0169AD	D	K0168FT	K0168RJ
K0169AC	F	K0168FR	K0168RJ
K0169AB	R	K0168FP	K0168RJ
K0169AA	S	K0168FM	K0168RJ
K0169AF	A, E	K0168GC	K0168RL
K0169AE	B, G	K0168GB	K0168RK

Table 84 - Seal Kit Contents for 84C Flowmeters with Temperature Compensation

Seal Kit Part No.	Seal Kit Contents			
	O-Ring or Grafoil Seal	Gasket	Flow Dam	Bonnet Bolts (4)
K0168RJ	X0145CM	L0121DT	L0112KT	X0173SV
K0168RL	K0168RD	K0146PT	K0148VB	X0174EY
K0168RK	K0168RD	K0146HL	K0148VA	X0174EY

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80. See the next table for seal kit contents.

Table 85 - Sensor Replacement Kits for 84C Flowmeters without Temperature Compensation

Kit Description		Kit Contents	
Part No.	Sensor Code	Sensor	Seal Kit[81]
K0161FL	D	K0148JK	K0161EY
K0161FK	F	K0148JJ	
K0161FJ	R	K0148JH	
K0161FH	S	K0148JG	
K0161FN	A, E	K0148KQ	K0161FA
K0161FM	B, G	K0148KN	K0161EZ

Table 86 - Seal Kit Contents for 84C Flowmeters without Temperature Compensation

Seal Kit Part No.	Seal Kit Contents			
	O-Ring	Gasket	Flow Dam	Bonnet Bolts (4)
K0161EY	D0100RP	L0121DT	L0112KT	X0173SV
K0161FA	K0147CC	K0146PT	K0148VB	X0174EY
K0161EZ		K0146HL	K0148VA	

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81. See the next table for seal kit contents.

Optional Cable Selections -P and -R

Cable connector options -P and -R are for use with Electrical Housing Codes T and R (1/2 NPT) only, and are available with Electrical Safety codes YY and ZZ only.

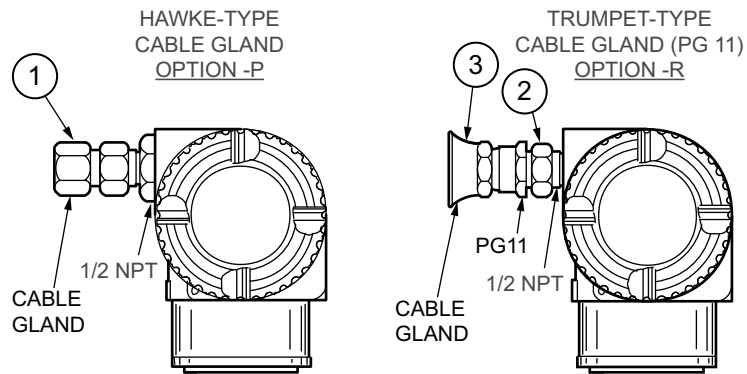**Figure 124 - Optional Cable Selections -P and -R**

Table 87 - Parts for Optional Cable Selections -P and -R

Item	Part No.	Qty.	Part Name
1	N7141HX	1	Hawke-Type Cable Gland (Option -P)
2	N7141KR	1	Adapter, 1/2 NPT to PG 11 (Part of Option -R)[82]
3	N7000AA	1	Trumpet-type Cable Gland — PG 11 (Part of Option -R)[82]

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82. Option -R (Items 2 and 3) should be ordered as a set.

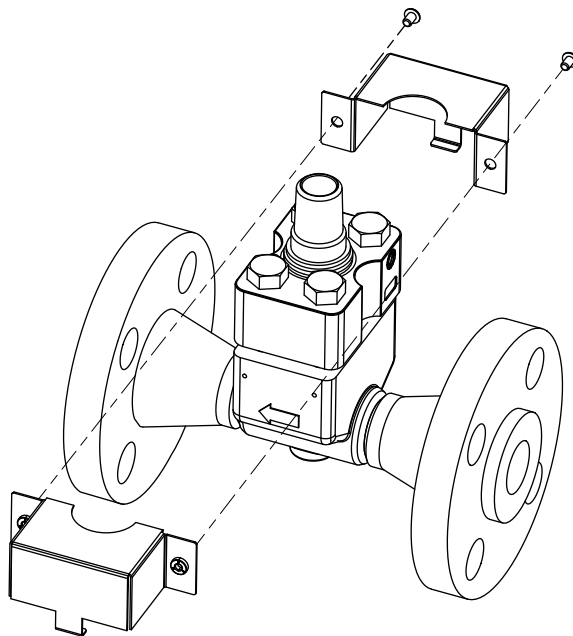# Tamper-Resistant Cover for Bonnet Bolts (Option -S)

Table 88 - Parts for Option -S

Part No.	Part Name
Below	**Bonnet Bolt Cover Kit** Contains a two-piece cover, two screws with custom heads, and a custom wrench
K0171CH	For 84CF and 84CN
K0171CJ	For 84CW with Multivariable Selection T (Temperature Measurement)
K0171CK	For 84CW with Multivariable Selection N

Recommended Spare Parts Summary

Item No.	Part Number	Part Name	Number of Parts Recommended for		
			1 Inst.	5 Inst.	20 Inst.
See *Electronics Housing, page 205*					
4	X0201FC	O-Ring, Cover	2	4	8
5	**Below**	**Electronics Module Assembly**	0	0	1
	K0168GF	HART Communication and 4 to 20 mA Output (Version -T)			
	K0168RS	Low Power with HART Communication; Output Fixed at 10 mA (Version -L)			
	D0219DB	Modbus Communication (Version -M)			
9	K0149GV	Digital Indicator/Configurator Replacement Kit	0	0	1
10	D0162WM	Screw, Cover Lock[83]	2	4	8
12	Potted Cup Assembly Module; see *Potted Cup Assembly Part Numbers, page 207*		1	2	4
13	X0144KW	O-Ring, Housing Neck	1	2	4
See *Junction Box and Remote Mounting, page 208*					
3	**Below**	**Preamplifier Assembly**	0	1	1
	D0159SX	Standard Temperature Remote			
	D0159SZ	Extended Temperature Remote			
6	D0179EG	O-Ring, Cover; for Connection Head Assembly	1	2	4
See *Bonnet Assembly and Sensor Parts, page 210*					
7	Sensor Replacement Kit, Standard or Extended Temperature Range; includes a sensor, seal kit; and instructions; see *Sensor and Seal Replacement Kits, page 212* for part numbers		1	2	4

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83. Two cover lock screws are used with Electrical Safety Codes H, B, and S (ATEX, IECEx, and NEPSI flameproof units).

MI 019-222