

Intelligent Vortex Flowmeters



Model 84C with Modbus Communication

Master Instruction

MI 019-224

Release date February 25, 2020



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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.

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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 and a pulse signal that is proportional to the volumetric flow rate. These signals can be mapped to a variety of measurements.

All flowmeters, except Sanitary, are 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), NPT male threaded (84CN), or sanitary (84CS) 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 a Modbus RTU host.

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)

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	<p>The model code defines the options associated with a product.</p> <p>Figure 1 - Sample Model Code</p> <p>84CF010-MPRF1STFTJFD</p> <p>FD: FM Explosionproof 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 M: Modbus Electronics 010: 1 inch (DN25, 25 mm) Nominal Line Size F: Flanged Body Style</p>

Communication Parameters

The flowmeter uses the Modbus RTU (Remote Terminal Unit) mode over a 2-wire RS-485 multidrop serial connection for communication. The flowmeter functions as a Modbus server (slave) device.

Table 1 - Modbus Communication Parameters

Communication Rate	4800, 9600 (default), or 19200 baud
Measurement Update Rate	4800 baud: 19 times/s 9600 baud: 38 times/s 19200 baud: 76 times/s
Parity	none (default) even odd
Station Addressing	Stations use Device Address 1 through 247: <ul style="list-style-type: none"> • 99 is the default • 0 is used for broadcast commands

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)
With Neobee® M20 fill (Sensor Fill, Temperature Range and Material selection C) (Only available for sanitary flowmeter body)	-20 and +177°C (0 and 350°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	9 and 30Vdc

Functional Specifications

Response Time (Without Damping)

Table 3 - Flowmeter Response Times

Flowmeter Output	Response Time (Without Damping)
Digital Mode	0.5 second or the vortex shedding period for frequencies less than 2 Hz.
Pulse Output	<ul style="list-style-type: none"> Raw mode: Vortex shedding frequency Frequency or Pulse mode: 0.25 second or the vortex shedding period for frequencies less than 2Hz.

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

Outputs

Table 4 - Flowmeter Outputs

Flowmeter Output	Response Time (Without Damping)
Digital	Digital information is conveyed using the Modbus RTU protocol over an RS-485 interface communicating at a baud rate of up to 19200. See <i>Modbus Communication Parameters, page 10</i> .
Pulse Output	<p>The pulse output can be configured with the electronics module in one of the following modes:</p> <ul style="list-style-type: none"> • 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 10,000Hz, 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 requires two power and three 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: 20mA dc
- Reverse polarity protected
- Short circuit protected
- Connectable to pull-up and pull-down counters

Power Supply Requirements

Supply Current:

- 10mA dc nominal
- Pulse Output: 20mA dc maximum

Supply Voltage:

- 9 and 30Vdc depending on electrical safety approvals and certifications.

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.

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 ³		High Temperature Range ⁴	
	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 21*).

3. Applies to flanged, wafer, NPT, and sanitary body styles.

4. Applies to flanged, wafer, and NPT body styles.

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: 3750psig (258.6bar, 25855kPa) or that imposed by flange rating
- Wafer Body: 1500psig (103.4bar, 10340kPa) 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
- Sanitary Body as imposed by process piping:
 - Line size DN50 (2 in): 1,725 kPa (250 psi)
 - Line size DN80 (3 in): 1,035 kPa (150 psi)

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 24 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 - 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 6 - 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 7 - Density Units

Unit	Description	Fluid Restriction
g/cm ³	grams per cubic centimeter	No restriction
kg/l	kilograms per liter	No restriction
kg/m ³	kilograms per cubic meter	No restriction
lb/ft ³	pounds per cubic foot	No restriction
lb/gal	pounds per US gallon	No restriction
lb/Yd ³	pounds per cubic yard	No restriction
LT/Yd ³	long tons per cubic yard	No restriction
oz/in ³	ounces per cubic inch	No restriction
ST/Yd ³	short tons per cubic yard	No restriction

Table 8 - 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

Table 8 - Mass Rate Units (Continued)

Unit	Description	Fluid Restriction
LTon/h	long tons (2240 lb) per hour	No 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 9 - 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
bb13/d	barrels (31.5 US gallons) per day	Liquids only
bb13/h	barrels (31.5 US gallons) per hour	Liquids only
bb13/m	barrels (31.5 US gallons) per minute	Liquids only
bb13/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
lgal/d	imperial gallons per day	Liquids only
lgal/h	imperial gallons per hour	Liquids only
lgal/m	imperial gallons per minute	Liquids only
lgal/s	imperial gallons per second	Liquids only
l/d	liters per day	Not for vapor

Table 9 - Volume Rate Units (Continued)

Unit	Description	Fluid Restriction
l/h	liters per hour	Not for vapor
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
mcf/d	thousands of cubic feet per day	No restriction
Mgal/d	millions of US gallons per day	Liquids only
MI/d	millions of liters per day	Not for vapor
MI/h	millions of liters per hour	Not for vapor
mmcf/d	millions of cubic feet per day	No restriction

Table 10 - 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 11 - 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
NI/d	normal liters per day (MKS System)	Not for vapor
NI/h	normal liters per hour (MKS System)	Not for vapor
NI/m	normal liters per minute (MKS System)	Not for vapor
NI/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 12 - 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 13 - Volume Units

Unit	Description	Fluid Restriction
bbbl	liquid barrels (42 US gallons)	No restriction
bbbl3	liquid barrels (31.5 US gallons)	No restriction
ft3	cubic feet	No restriction
gal	gallons	No restriction
lgal	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
MI	millions of liters	No restriction
mmcft	millions of cubic feet	No restriction

Table 14 - 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 15 - Normal Volume Units

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

Table 16 - 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 17 - Absolute Viscosity Units

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

Table 18 - 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 19 - Energy Units

Unit	Description	Fluid Restriction
BTU	British thermal units ⁵	No restriction
J	joules	No restriction
MCal	megacalories ⁶	No restriction
MJ	megajoules	No restriction

Table 20 - Heat Flow Units

Unit	Description	Fluid Restriction
BTU/h	British thermal units per hour ⁵	No restriction
J/s	joules per second	No restriction
MCal/h	megacalories per hour ⁶	No restriction
MJ/h	megajoules per hour	No restriction

Table 21 - K-Factor Units

Unit	Description	Fluid Restriction
m ³ /p	cubic meters per pulse	No restriction
p/ft ³	pulses per cubic foot	No restriction
p/l	pulses per liter	No restriction

Table 22 - 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

5. 1 BTU = 0.2519958 kcal.

6. 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 (Flanged)	84CW (Wafer)	84CN (NPT)	84CS (Sanitary)
Body and Shedder Bar	Cast 316 ss (CF8M) or 304 ss	Cast 316 ss (CF8M) or nickel alloy ⁷ (CW2M)	Cast 316 ss (CF8M)	Tube: 316/316L ss Shedder Bar: 316L ss (ASTM 276)
End Connection	316 ss or 304 ss	N/A	cast 316 ss (CF8M)	316 ss
Sensor Seals	316 ss, 316 ss/grafoil, nickel alloy ⁷ (CW2M), or nickel alloy ⁷ (CW2M)/grafoil			N/A
Detector Diaphragm	316 ss or nickel alloy ⁸			316 ss

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

8. Equivalent to Hastelloy®.

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.

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 H₂S 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 193 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 23 - 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

Table 23 - Approximate Mass of Model 84C Flanged Flowmeters (Continued)

Nominal Line Size		Flange Specifications		Mass	
Model Code	Size	Type	Material	kg	lb
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
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 24 - Approximate Mass for Model 84C Wafer Flowmeters with 316 ss Body Material

Model Code	Nominal Line Size		Mass	
	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 25 - 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

Table 26 - Approximate Mass for Model 84C Sanitary Flowmeters

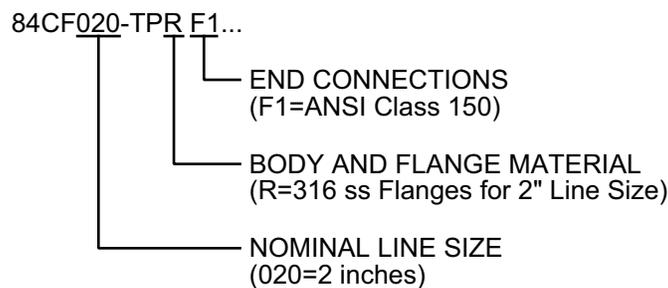
Nominal Line Size			Flowmeter Description	Weight with Connections C0, M0, R0, T0, and U0 ⁹	
Model Code	mm	in		kg	lb
020	DN50	2	Body and Cable	0.7	1.6
			Housing and Bracket	4.1	6.5
			Total	4.8	8.1
030	DN80	3	Body and Cable	1.1	2.5
			Housing and Bracket	4.1	6.5
			Total	5.2	9.0

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):



Refer to *Model Code*, page 193 for an explanation of these codes.

9. See Model Code table for sanitary body.

Figure 2 - 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

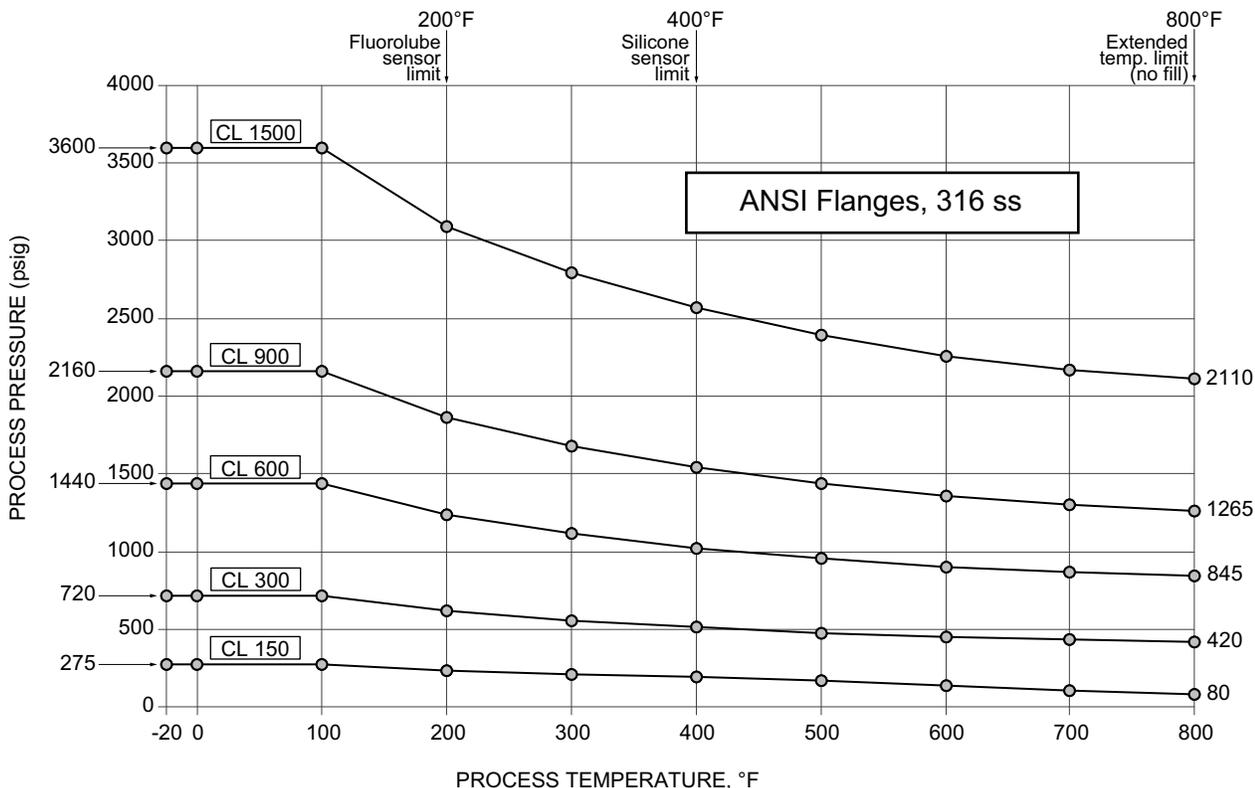


Figure 3 - Pressure Ratings for Welded 304 ss ANSI Flanges, Line Sizes 060 to 120 (6 to 12 inches), per ASME B16.5, Group 2.1 Materials

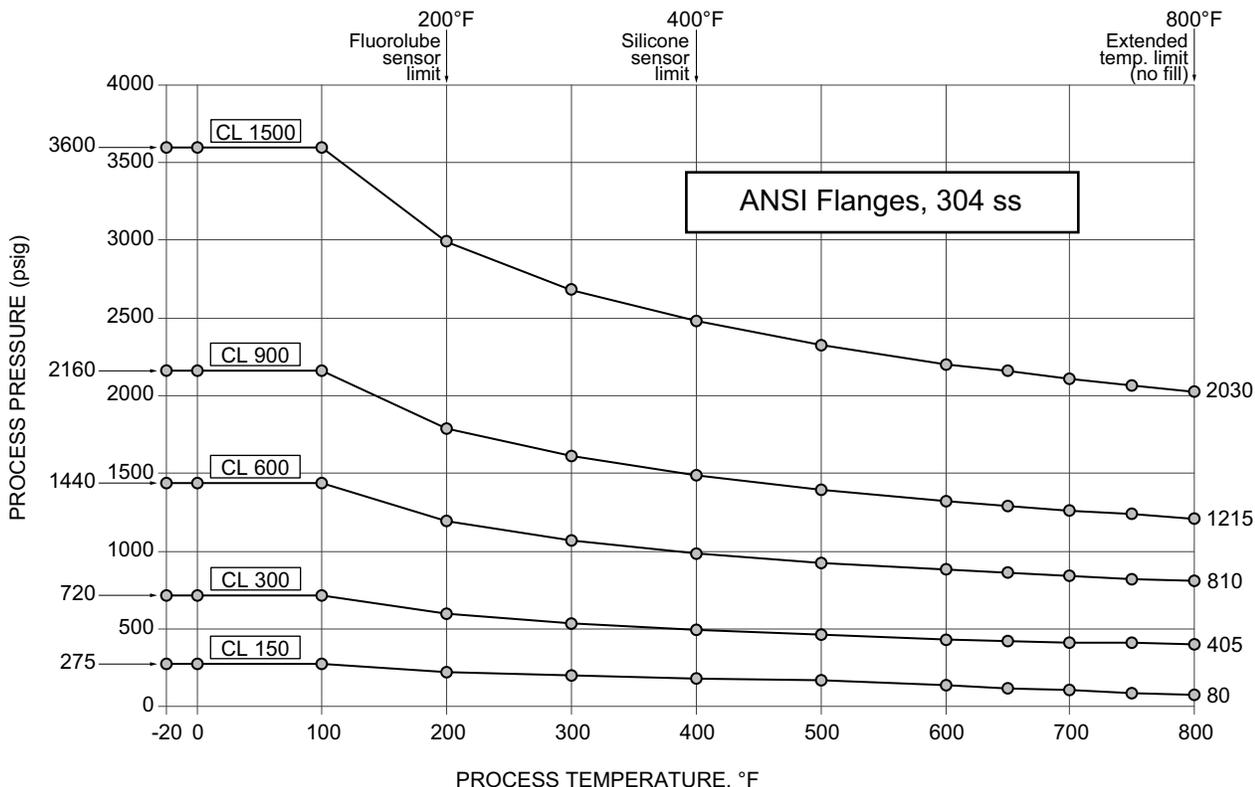


Figure 4 - Pressure Ratings for Welded 316 ss Metric Flanges, Line Sizes 008 to 040 (DN15 to DN100), per EN 1092-1, Material Group 14E0

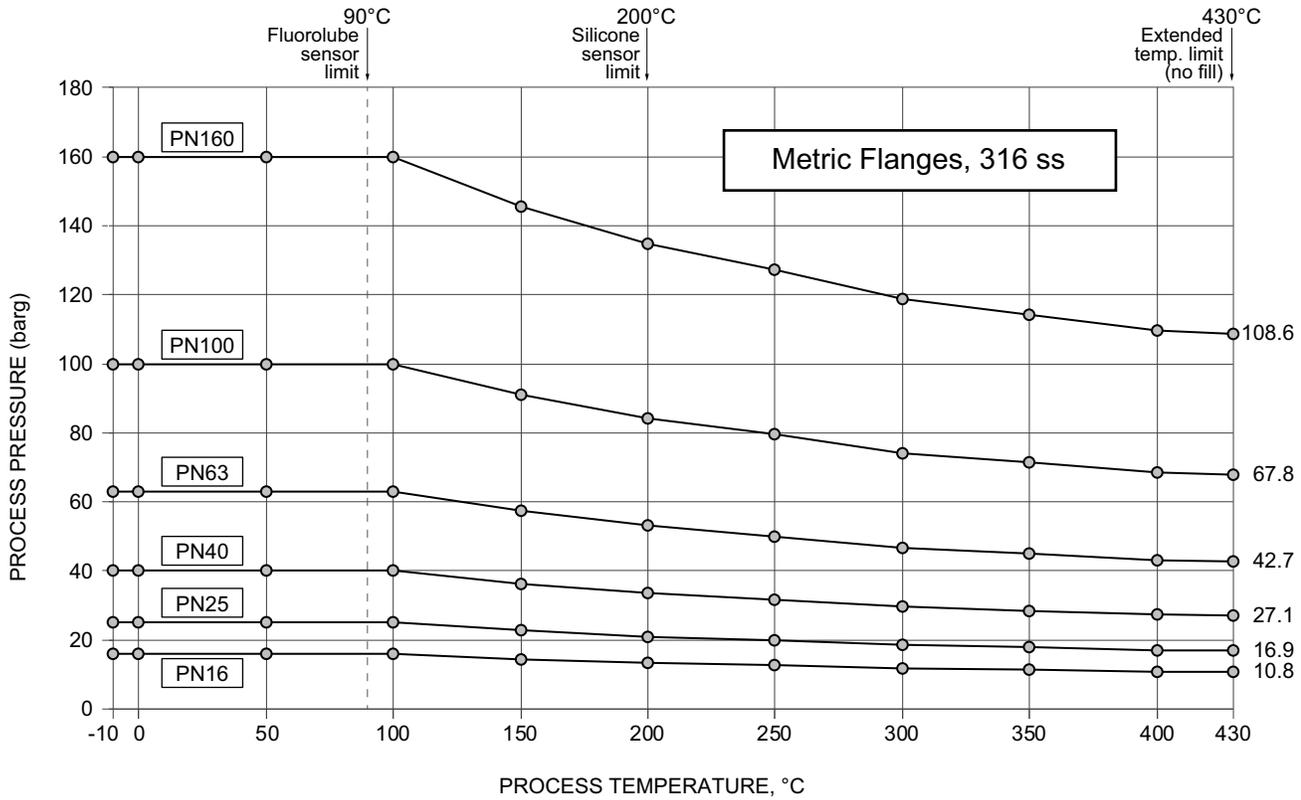
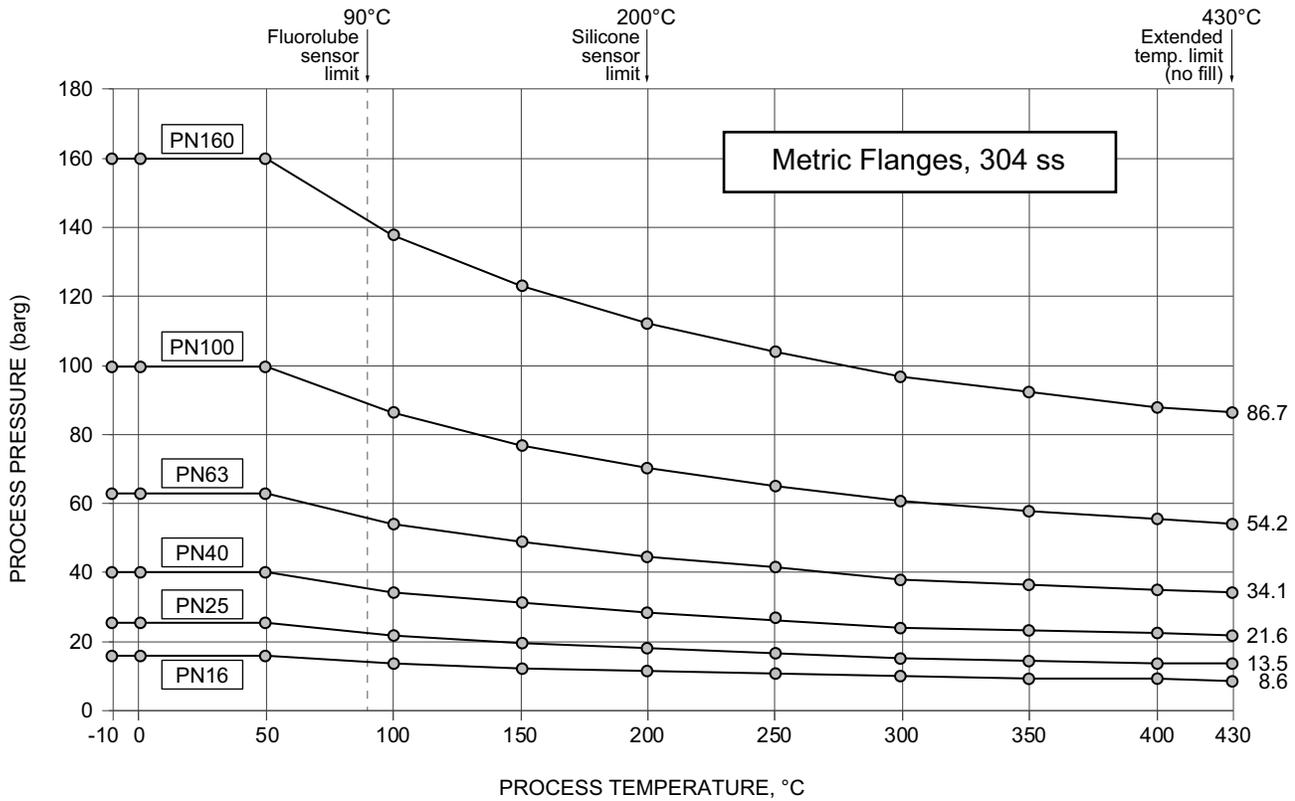


Figure 5 - Pressure Ratings for Welded 304 ss Metric Flanges, Line Sizes 060 to 120 (DN150 to DN300), per EN 1092-1, Material Group 10E0



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.

Sanitary Body Flowmeter

Sanitary Body as imposed by process piping:

- Line size DN50 (2 in): 1,725 kPa (250 psi) at 37.8°C (100°F)
- Line size DN80 (3 in): 1,035 kPa (150 psi) at 37.8°C (100°F)

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.

Table 27 - Electrical Certifications

Agency Certification, Types of Protection, and Area Classification	Application Conditions	Model Code Option
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
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
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 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
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 30* 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 30*) shows the Model Code and electrical safety data. For interpretation of the Model Code, see *Model Code, page 193*.

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 6 - Sample Flowmeter Dataplate

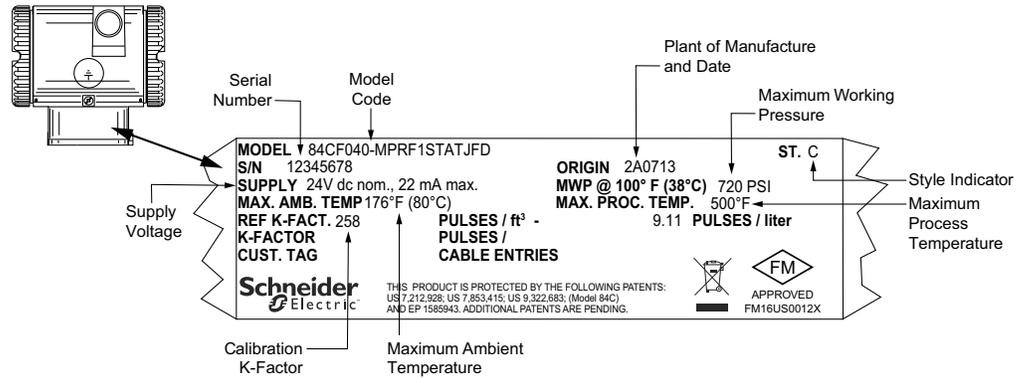
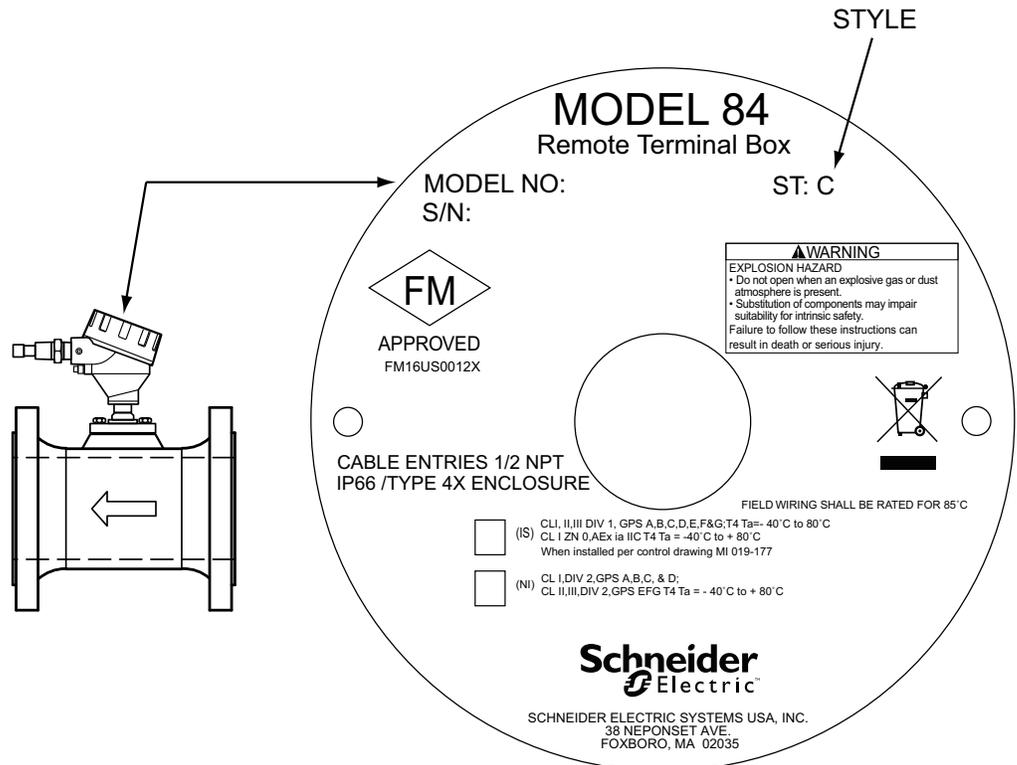


Figure 7 - Sample Junction Box Data Plate



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 (see *Typical Piping Configuration, page 38*). For those installations where this upstream requirement is not met, the type of disturbance must be selected from a pick list during transmitter 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 39*), 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

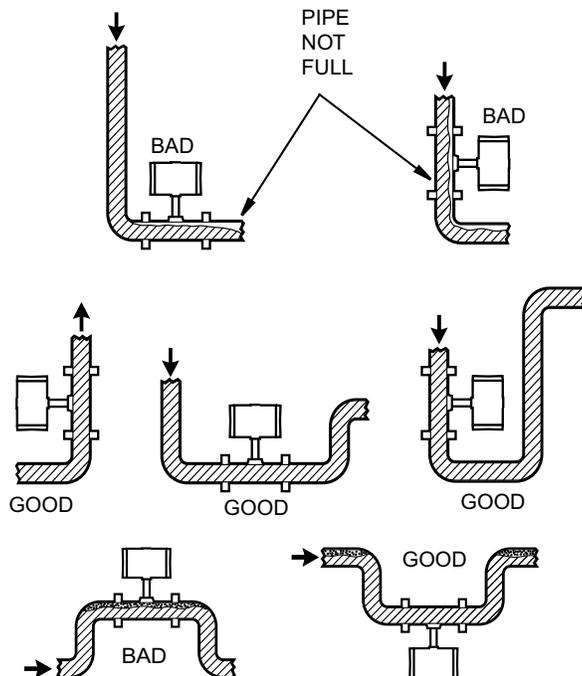
For optimal performance, consider the mounting locations of the sensor and integral electronics relative to the piping. Factors that influence this decision include process fluid type, ambient temperature, and vibration. Mount the meter in accordance with the installation guidelines for process fluids described in *Process Fluids*, page 32. Also see *Recommended Mounting Arrangements*, page 37.

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 8 - Piping Arrangements¹⁰

- 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.

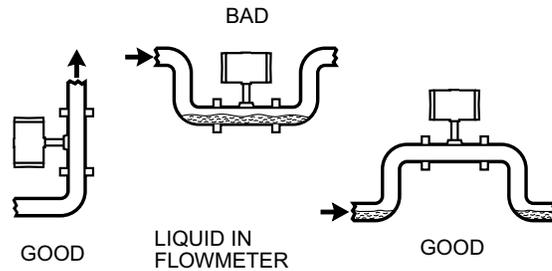
When the flow is more stable, the flowmeter can be mounted a minimum of five (5) pipe diameters upstream of the control valve. Pressure fluctuations often are lower on the upstream side of a control valve flow than on the downstream side. This is recommended when a pressure sensor is used with a flowmeter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

10. Not drawn to scale.

NOTICE
<p>WATER HAMMER FROM TRAPPED CONDENSATE</p> <p>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.</p> <p>Failure to follow these instructions can result in equipment damage.</p>

Figure 9 - Piping for Gas Applications¹¹



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.

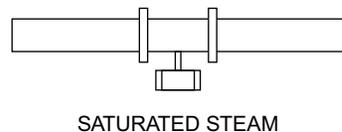
NOTICE
<p>WATER HAMMER FROM TRAPPED CONDENSATE</p> <p>Trapped condensate can cause a “water hammer” during startup. If you cannot drain the condensate, open the valve slowly, allowing any trapped condensate to travel downstream through the flowmeter at low velocity so that no damage occurs.</p> <p>Failure to follow these instructions can result in equipment damage.</p>

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 35.

Figure 10 - Piping for Saturated Steam Application



11. Not drawn to scale.

Superheated Steam

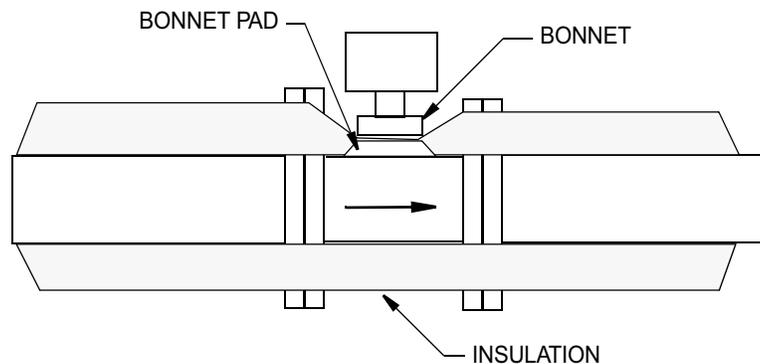
When the process fluid is superheated steam, the electronics housing can be either above or below the flowmeter body. The flowmeter should be insulated to maintain superheated conditions inside the flowmeter as well as insulating the electronics from heat. Assure that the electronics temperature does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

Insulate your meter as described in *Insulation*, page 35.

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.

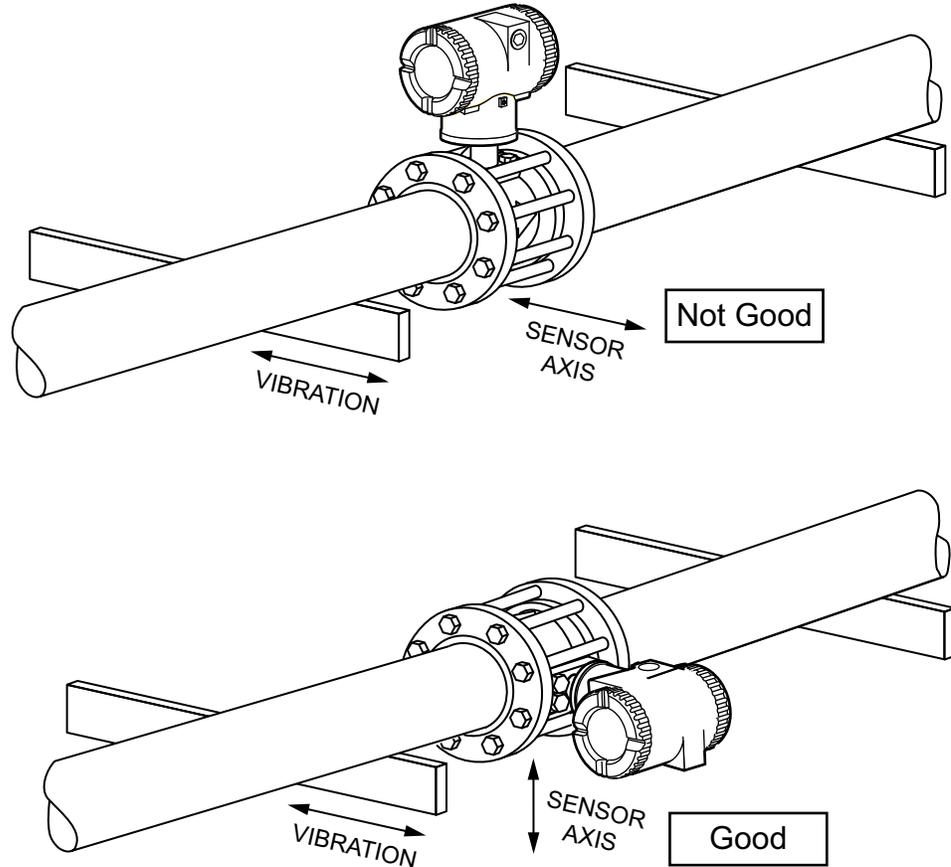
Figure 11 - Insulation



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 12 - Sensor Mounting to Minimize the Effect of Vibration



Ambient Temperature Limitations and Considerations

The temperature limits of the electronics housing are -20 and $+80^{\circ}\text{C}$ (0 and 176°F) with an optional display, or -40 and $+80^{\circ}\text{C}$ (-40 and $+176^{\circ}\text{F}$) 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

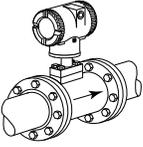
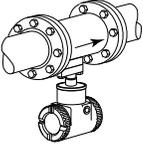
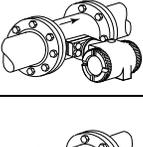
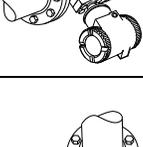
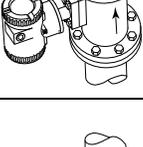
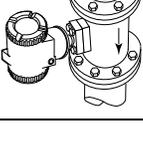
In installations where these agency certifications do not apply and ambient temperature limitations are not achievable, remotely mounting the electronics in a lower temperature area is recommended. In this configuration, only the preamplifier — which is rated for a maximum temperature of 105°C (221°F) — is near the flowmeter.

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

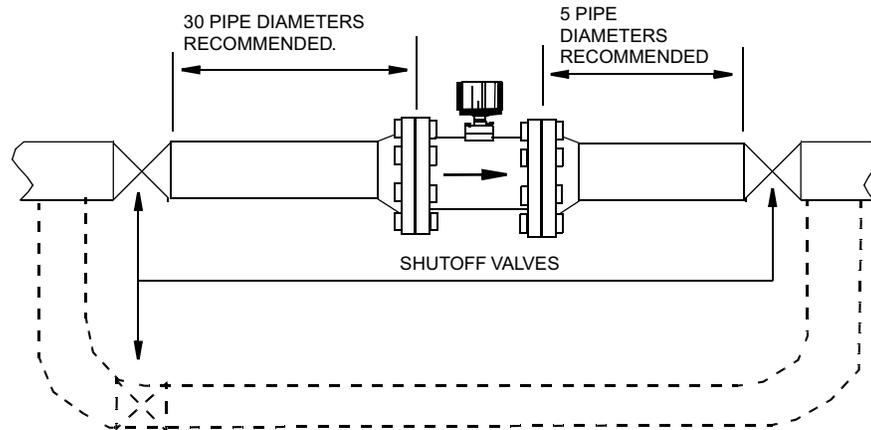
13. Possibility of temporary startup error due to trapped air.
 14. Requires adequate insulation.
 15. Best choice when errors due to startup cannot be tolerated.
 16. Recommended only for clean fluids.
 17. Not preferred; must maintain full pipe with no voids in fluid.

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 figure).

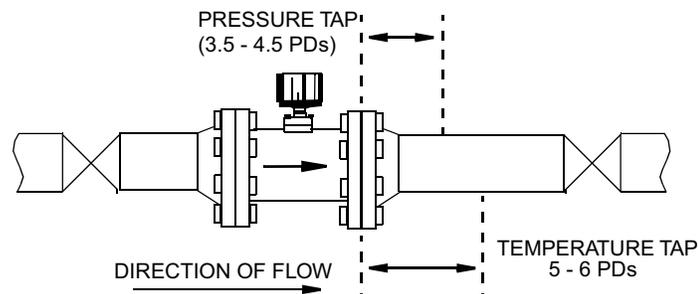
Figure 13 - Typical Piping Configuration



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 14 - 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 38.

- 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 38.

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

Installing the Flowmeter Body

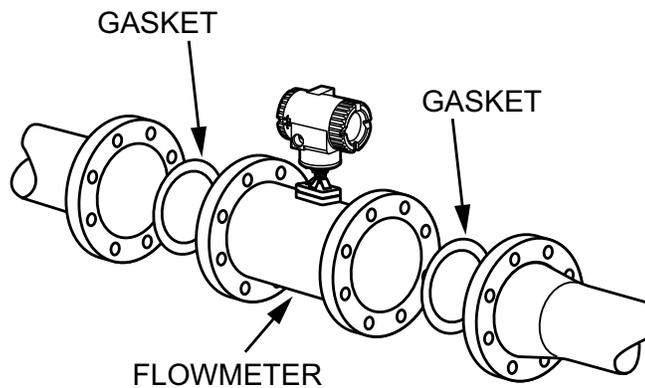
If the electronics are mounted remotely, mount the flowmeter body so that the junction box is serviceable.

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 15 - Flanged Flowmeter Installation



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.

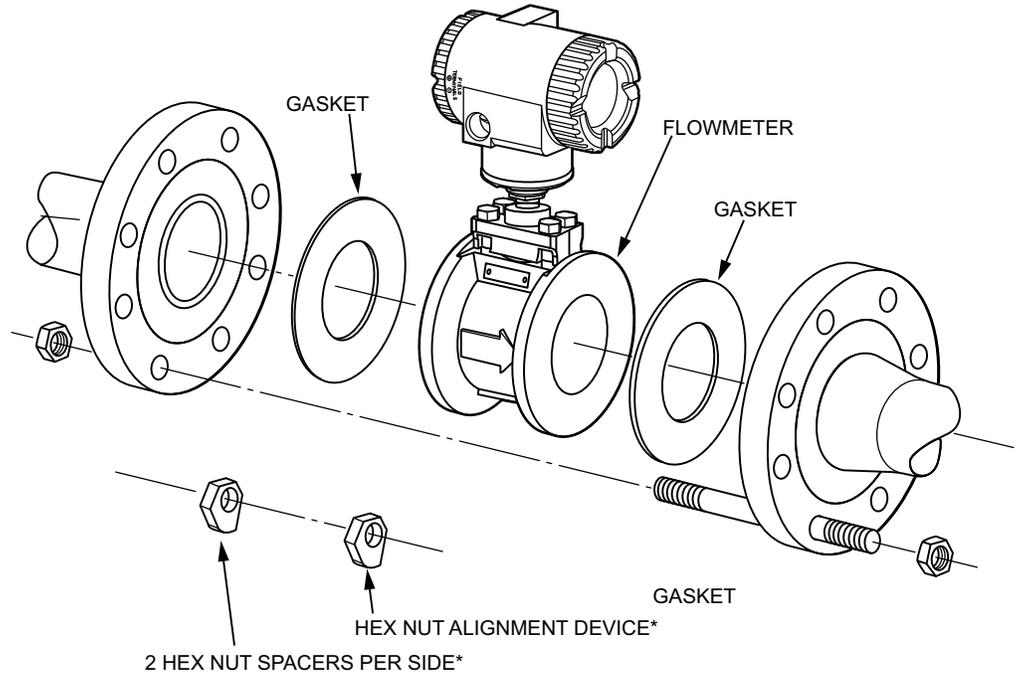
2. Visually inspect the centering and alignment of the mating flanges.
3. Install the bolts. Tighten in accordance with conventional flange bolt tightening practice (that is, incremental and alternate tightening of bolts).

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 16 - 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 41. 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.

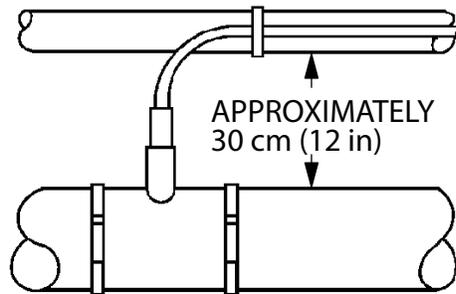
Sanitary Body (84CS)

Piping Considerations for Sanitary Flowmeters

NOTE:

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

Figure 17 - Flowmeter Body Cable Support



Effects of Piping on Sanitary Flowmeter Performance

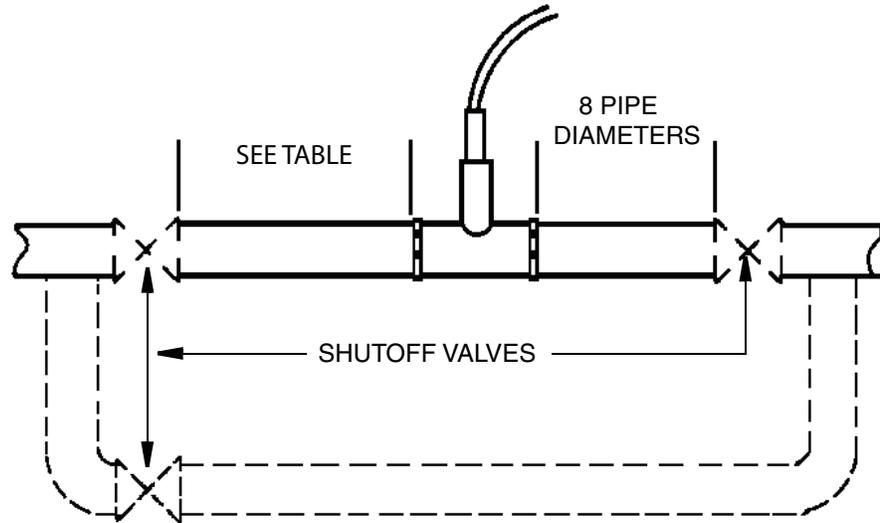
- The vortex shedder axis can be oriented to reduce, or in some cases eliminate, vibration influence. Positioning the flowmeter body so that vibrations are parallel to the sensor diaphragms minimizes the effects of vibrations.
- To help ensure that your flowmeter performs to its fullest capabilities, it should be mounted in a straight, unobstructed pipe. The recommended minimum amount of straight pipe upstream is shown in the table. There should be a minimum of eight diameters of straight pipe downstreams. See the figure.

Table 29 - Typical Piping Configurations

Upstream Configuration	Recommended Upstream Pipe Diameters
90° Elbow	30
Two elbows in different planes with the closet elbow in the same plane as the shedder element. ¹⁸	45
Two elbows in different planes with the closest elbow perpendicular to the plane of the shedder. ¹⁸	35
15:1 reduction in piping diameter.	35
Butterfly valve (wide open)	30

18. Shedder is located in bore of flowmeter.

Figure 18 - Bypass Piping



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

Bypass Piping

It is sometimes desirable to provide bypass piping if the flow cannot be interrupted for servicing the flowmeter. see *Bypass Piping, page 44*.

▲ WARNING

RISK OF HIGH PRESSURE

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

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

Installing the Flowmeter with Sanitary End Connections

The 84C with a sanitary body has six different end connection possibilities:

- 3-A I-Line Fitting Mates With (Cherry-Burrell 15 WI or equivalent) (Code C0)
- ANSI 150# (Code F0)
- Metric (DIN 11851) Coupling (Code M0)

- RJT (BS 1864) Coupling (Code R0)
- 3-A Fitting Mates With (Tri-Clover or equivalent) (Code T0)
- ISS (ISO 2853) Coupling (Code U0)

The end connections on your flowmeter body were specified as part of your order. All end connections are welded to the flowmeter body. You supply the mating end connections, gaskets, and clamps.

▲ WARNING

RISK OF HIGH PRESSURE

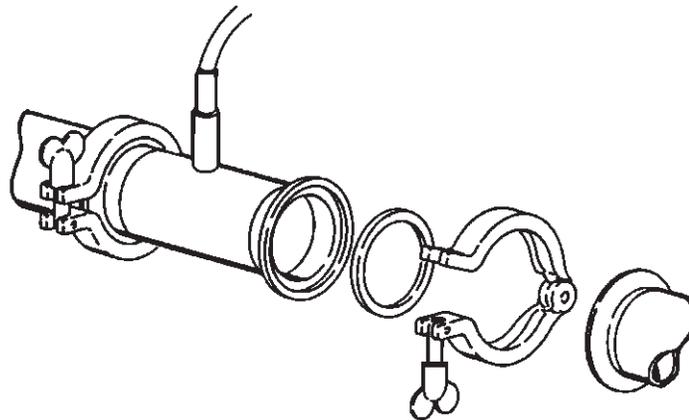
The maximum pressure limit of the flowmeter is 1.9 MPa (275 psig) or the limit of the end connection used, whichever is less.

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

3-A I-Line Fitting Mates With (Cherry-Burrell 15 WI or equivalent) (Code C0)

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

Figure 19 - 3-A I-Line Fitting

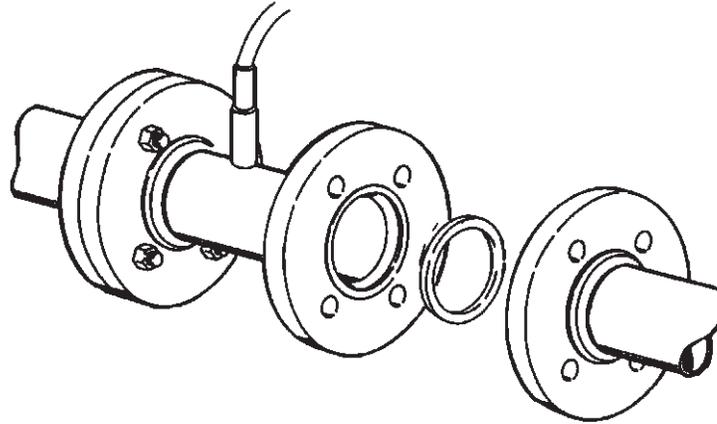


1. Insert the seals into the flowmeter body ends.
2. Insert the mating pipe ends and tighten the clamps securely.

ANSI 150# (Code F0)

The ANSI 150# is a crevice-free design for general sanitary service.

Figure 20 - ANSI 150#



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

▲ CAUTION

EQUIPMENT OPERATION HAZARD

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

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

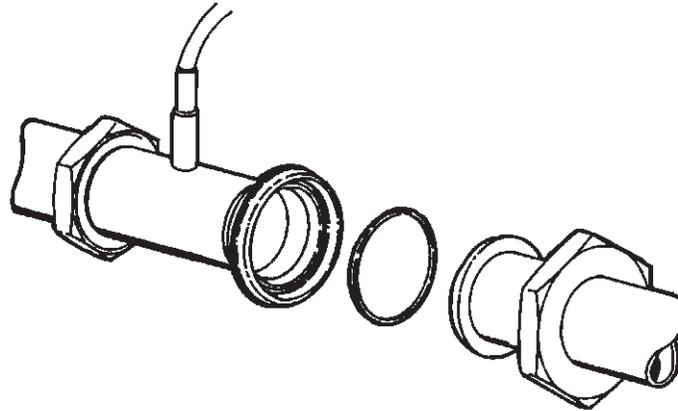
NOTE: If welding of the flanges to the process piping is required, protect the inside diameter of the flowmeter from weld splatter. Failure to do this may adversely affect flowmeter accuracy.

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

Metric (DIN 11851) Coupling (Code M0)

The Metric (DIN 11851) coupling with an external knuckle thread is per DIN 405.

Figure 21 - Metric (DIN 11851) Coupling

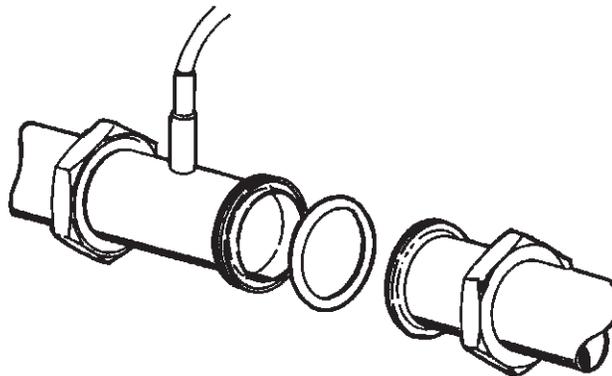


1. Insert the seals into the grooves in the flowmeter body ends.
2. Tighten the nuts securely.

RJT (BS 1864) Coupling (Code R0)

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

Figure 22 - RJT Coupling

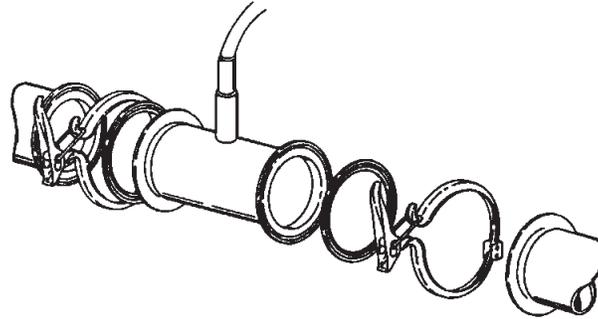


1. Insert the seals into the cavity in the flowmeter body ends.
2. Tighten the nuts securely.

3-A Fitting Mates With (Tri-Clover or equivalent) (Code T0)

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

Figure 23 - 3-A Fitting Tri-Clamp

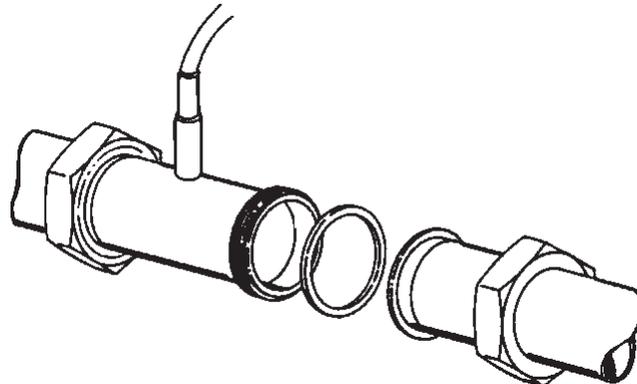


1. Insert the seal into the flowmeter body ends.
2. Make full face contact between the pipe and flowmeter body ends prior to installing and tightening the clamps.

ISS (ISO 2853) Coupling (Code U0)

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

Figure 24 - ISS Coupling



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

Mounting the Remote Electronics Housing

The remote electronics housing allows for separation of the flowmeter body from the electronics. All flowmeters can be remotely mounted. The sanitary flowmeter is only available with a remote mounted electronics housing with a 4.5 m (15 ft) cable.

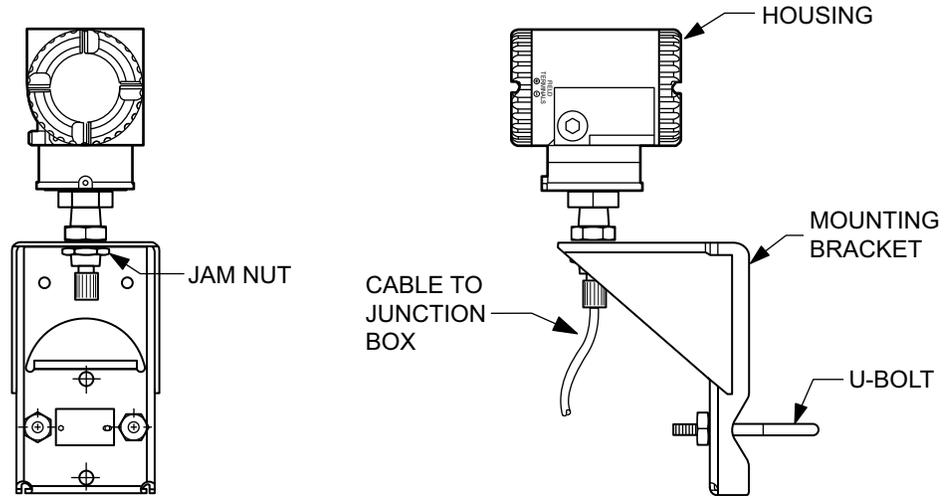
A flowmeter with remote electronics consists of:

- 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 25 - 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:

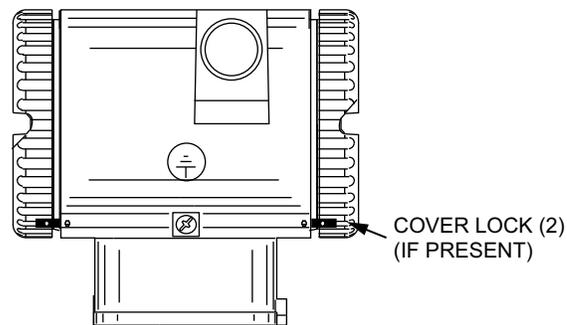
1. Remove the jam nut under the bracket.
2. Raise the housing until you can slide the cable through the cutout in the bracket.
3. Lay the housing aside and secure the mounting bracket to the wall.
4. Place the housing in the bracket.
5. Tighten the jam nut under the bracket.

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 26 - 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 96.

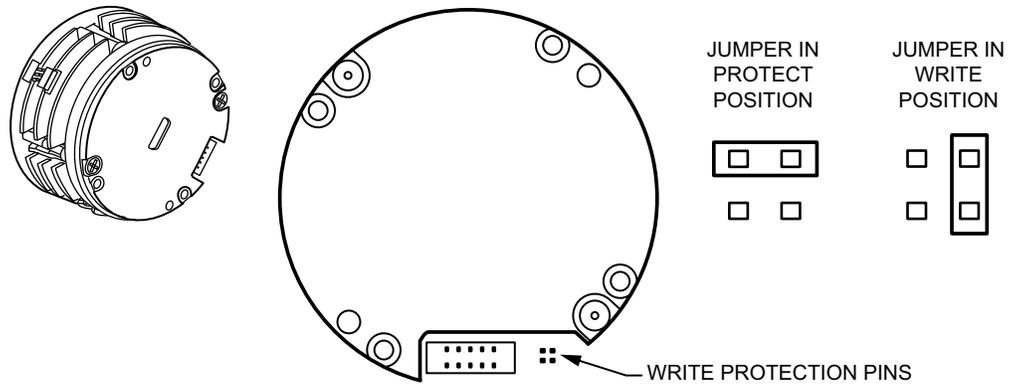
To activate write protection:

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.

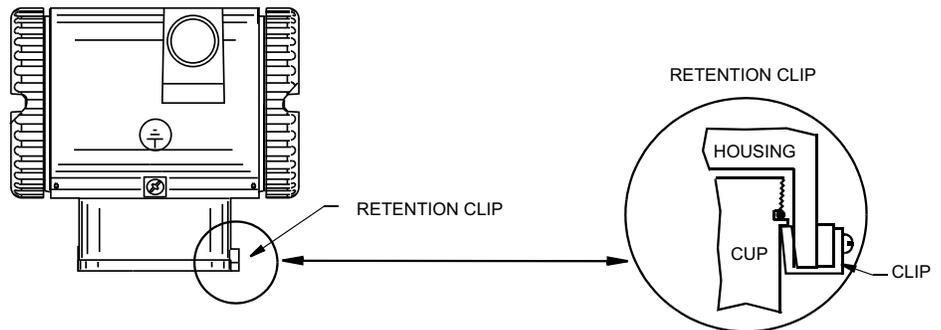
Figure 27 - Write Protect Jumper



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 28 - 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 193.

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
<p>EXPLOSION HAZARD</p> <p>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.</p> <p>Failure to follow these instructions can result in death or serious injury.</p>

Accessing Flowmeter Field Terminals

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

Figure 29 - Accessing Field Terminals

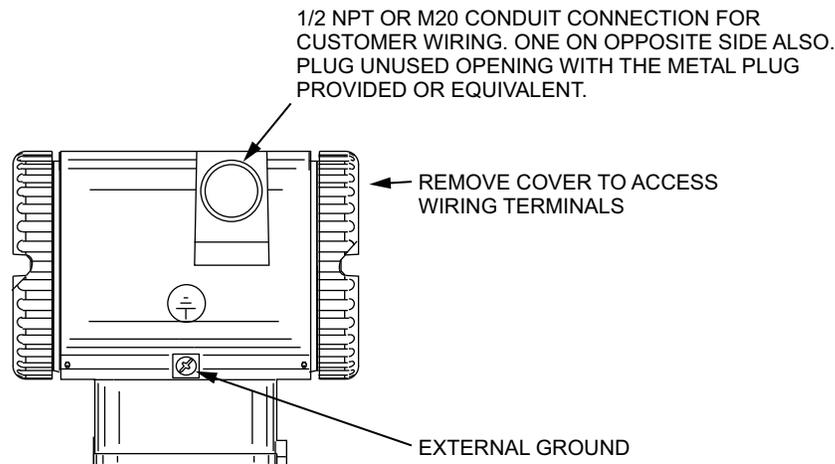
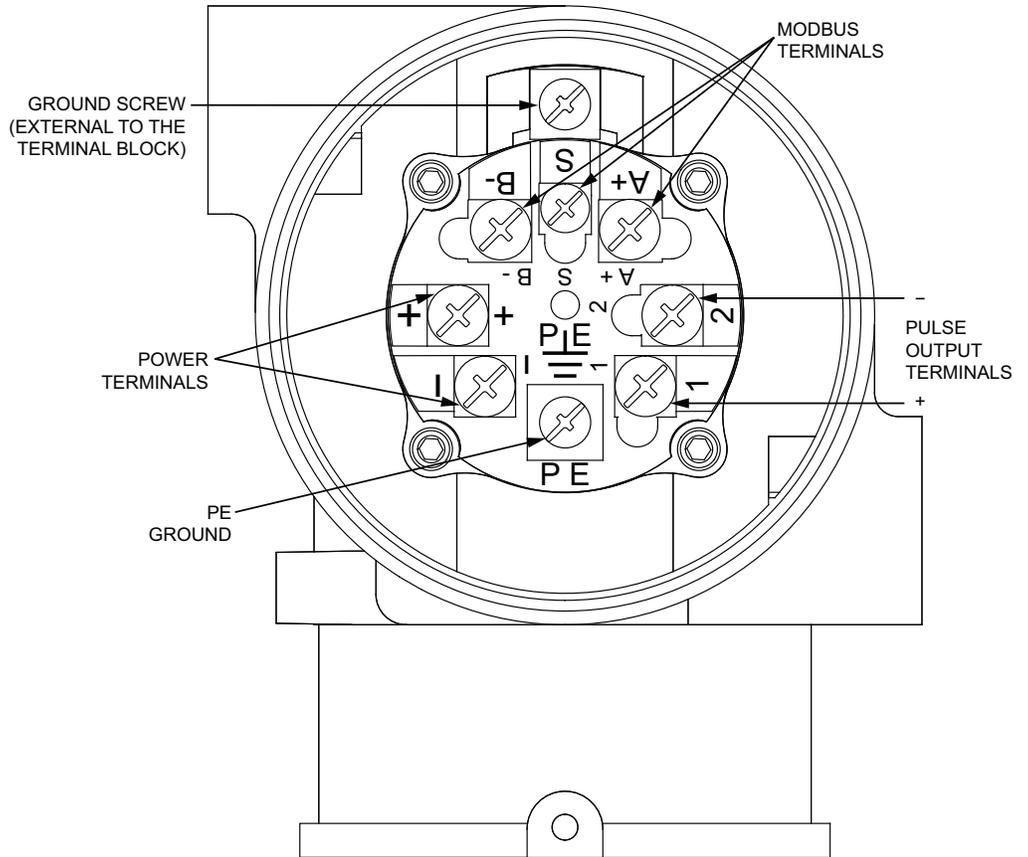


Figure 30 - Identification of Field Terminals



Remotely Mounted Electronics

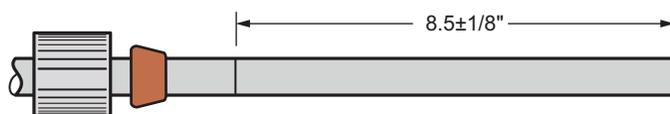
To use the flowmeter as shipped with the cable attached at both ends, mount the electronics housing and flowmeter body within the limits of the cable length.

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."

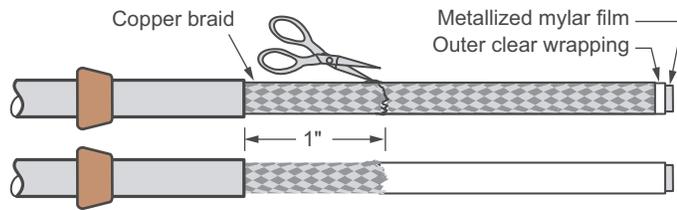
Preparing the Remote Signal Cable

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

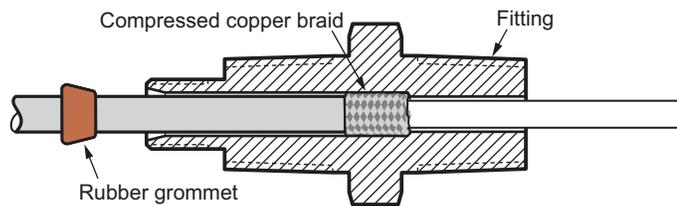
1. Insert the cable into the knurled nut and rubber grommet. Then remove the outer insulation to the dimension shown. Do not damage the copper braid.



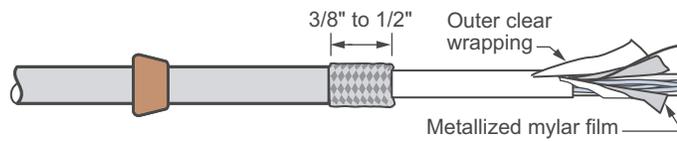
- Cut the copper braid one inch from the end of the outer insulation.



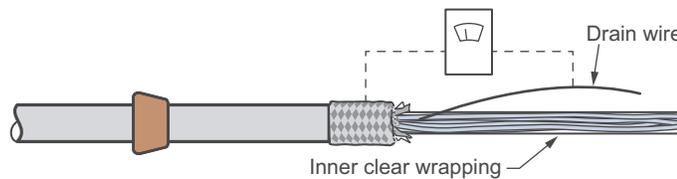
- Insert the cable into the fitting until the cable is bottomed out inside the fitting. Rotate the fitting one or two turns to pack the braid into place. Remove the cable and examine the packed braid. If there are still strands of braid that have not packed, push them back by hand and reinsert the cable 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.



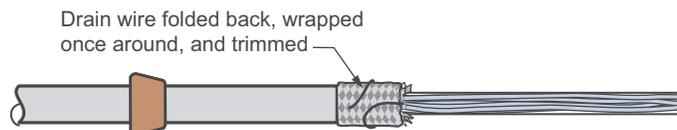
- Remove the outer clear wrapping and the metallized mylar film to the end of the packed braid. This exposes the inner drain wire. The inner clear wrapping and filler material are still in place.



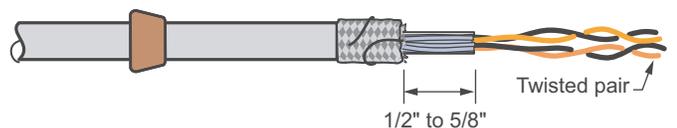
- Make sure that the drain wire is not in contact with the outer braid, then use an ohm meter to verify that there is no electrical connection between the drain wire and the braid over the entire length of the cable. This step also verifies that the electronics end of the cable has been properly dressed, and that there is no damage or other issue with the cable.



- 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.

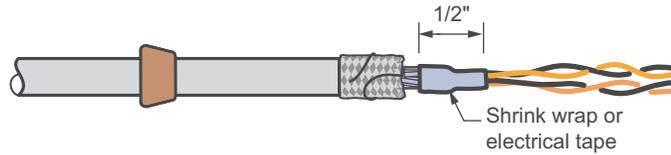


- Cut back the inner clear wrapping and the filler to 1/2 to 5/8 inch from the end of the outer insulation.

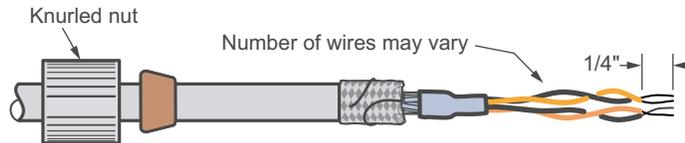


- Cut a half-inch long piece of shrink wrap. Position it so that half the wrap covers the inner clear wrapping/filler, and half covers the exposed twisted wires. Apply heat to the shrink wrap.

NOTE: You can use a half-inch piece of electrical tape in place of the shrink wrap.



- Strip 1/4 inch from the ends of the wires.

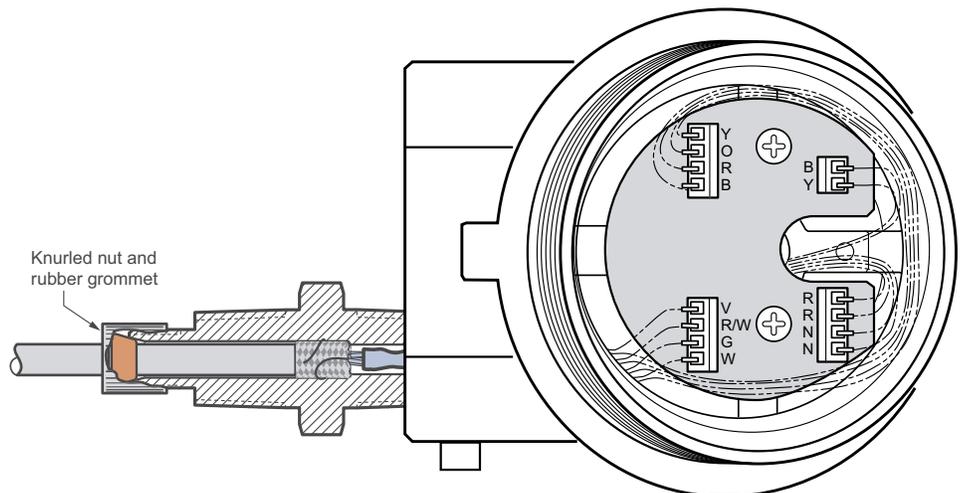


Connecting the Remote Signal Cable

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

- Insert the cable into the fitting, making sure that the cable has bottomed out in the fitting.
- Slide the rubber grommet into the fitting.
- Screw the knurled nut into place, clamping the rubber grommet against the assembly. Hand tighten with moderate force to assure a water tight connection.
- Dress the wires in the junction box as shown in the diagram.

Figure 31 - 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.

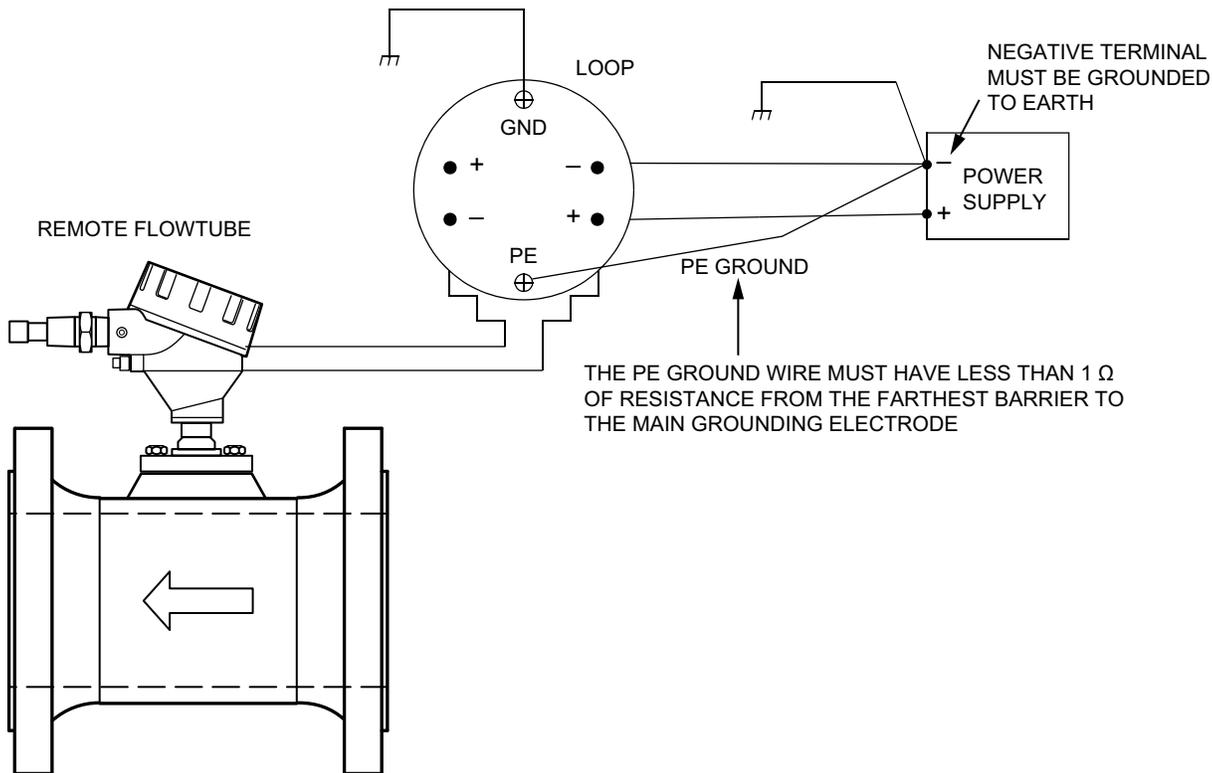
- Disconnect the cable at the flowmeter (junction box) end.

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



Loop Wiring

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 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.

- Plug unused conduit openings.

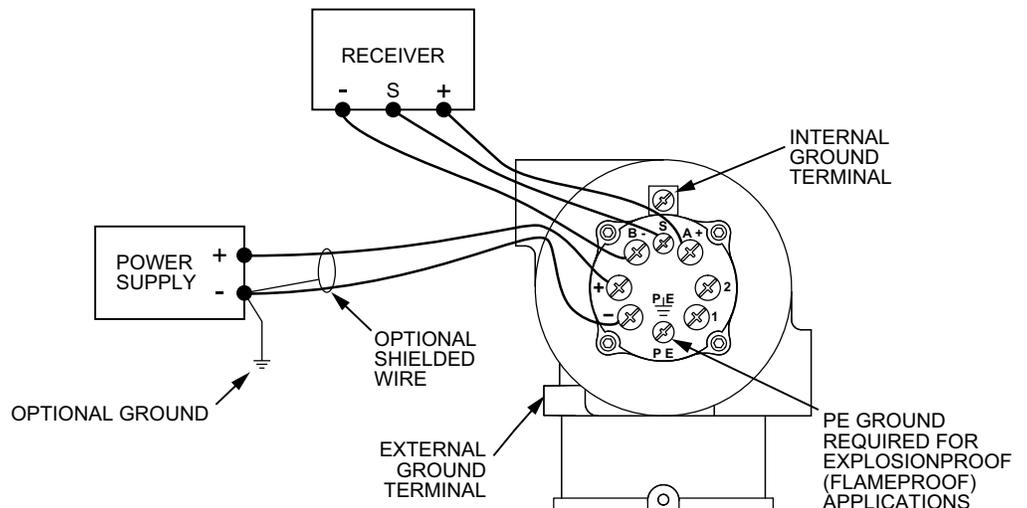
⚠ ⚠ WARNING
EXPLOSION HAZARD
To help prevent explosions and to maintain flameproof, explosionproof, and dust-ignitionproof protection, observe applicable wiring practices. Plug the unused conduit openings with approved conduit plugs. Both plug and conduit must engage a minimum of five full threads for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

- 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.

- Connect the power supply loop wires to the “+” and “-” terminals.
- Connect receivers (such as controllers, recorders, or indicators) to the A(+), S (shield), and B(-) terminals.
- 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 49*.
- To wire additional flowmeters to the same power supply, repeat these steps for each flowmeter.

Figure 33 - Wiring the Flowmeter to a Power Supply



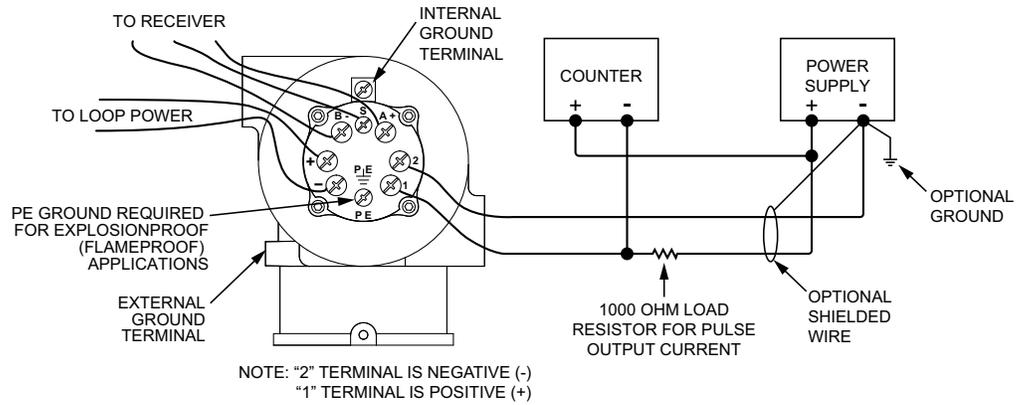
Wiring a Flowmeter with a Pulse Output

See *Wiring the Flowmeter to a Power Supply*, page 56 for an overview of wiring, grounding, voltage, and resistance requirements.

An additional, separate loop is required when using the pulse output. 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 34 - Wiring a Flowmeter with Pulse Output



Operating the Flowmeter

You can operate the flowmeter with the optional local display, Modbus host software, 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 95)
- Using the flowmeter with Modbus Commands (see *Modbus RTU Operation*, page 142)
- Using the flowmeter with a PC-based configurator (see the manual for the PC-based configurator and MI 019-276, *Advanced DTM Library - Operation Using MODBUS 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 Modbus 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 Modbus command.

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

gal/m	gallons per minute
bb/h	barrels per hour
bb/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 30 - 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 30 - 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		
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 96.)
- **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 103* for the menu on the local display for the General and Steam personalities and see the *Status Menu Diagram, page 133* for the menu on the local display for the Oil & Gas personality.

The status values associated with the diagnostic messages are shown in *Messages, page 92*.

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 96*.

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 64*.

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 Modbus commands, 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 96*.

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 31 - Measurement Properties

Local Display	Register ¹⁹	Description
EGU	See <i>Unit Code Registers, page 148</i> .	Engineering units (EGUs): Select an appropriate engineering unit for each fluid measurement type. Refer to <i>Units, page 15</i> .
EGUTYP	N/A	EGU Type: (For Base Volumetric Flow and the General personality only) Choose to use the standard or normalized volume for the Base Volume Rate (BVolate) measurement parameter.
LRV	See <i>Lower Limit Registers, page 147</i> .	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	See <i>Upper Limit Registers, page 146</i> .	Upper Range Value: Enter the upper range value for the measurement type.
Default	See <i>User Default Registers, page 145</i>	Default: Enter the default value to which the flowmeter will set the measurement value if an error occurs.
AlertSt	See <i>Alert Strategy Registers, page 151</i> .	<p>Alert Strategy: This property allows you to configure how the flowmeter will react to an alert with regard to the measurement you are configuring.</p> <ul style="list-style-type: none"> • 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. • On Alert Use the Default (AlertDef): On an alert, the flowmeter continues to run, but the measurement is set to a user-defined default. <p>NOTE:</p> <ul style="list-style-type: none"> • Pulse output only supports On Alert Use the Default (AlertDef).

19. See *Registers, page 144*.

Table 31 - Measurement Properties (Continued)

Local Display	Register ²⁰	Description
CMethod	See <i>Calculation Method Registers</i> , page 152.	<p>Calculation Method: This property describes how the particular measurement is calculated:</p> <ul style="list-style-type: none"> 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 <i>Fluid Parameters</i>, page 69. <p>NOTE: Pressure does not support the UserOn calculation method.</p> <ul style="list-style-type: none"> By Remote: The measurement is transmitted by remote communications.
4 Damp	See <i>Damping Registers</i> , page 146.	<p>Damping: This property allows you to set damping for fluid configuration parameters. Possible settings are:</p> <ul style="list-style-type: none"> None, 0.25, 0.5, 1, 2, 4, 8, 16, 32

Recommended Setup Procedure

Configure your flowmeter in the following sequence:

- 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.
- 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.
- Configure the required settings in the order listed below:
 - Fluid type
 - Measurement properties
 - Flowmeter's output
- Configure the optional settings in the order listed below:
 - Configure the Low Flow Cut-In (LFCI).
 - Map the totalizers.
 - Configure the piping parameters.
 - Configure the reference K-factor.
 - Configure passwords, if applicable.
 - Turn totalizers on.

For a detailed example of how to achieve a pulse output for Mass Flow, and how to display Total Mass using the local display, see *Configuration Example*, page 100.

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.

20. See *Registers*, page 144.

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 65*). 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 32 - 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	15°C	159°F
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 ²¹	0 Joules/kg	0 BTU/lb

Table 33 - 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	178°C	352.4°F
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 ²²	0 Joules/kg	0 BTU/lb

Table 34 - 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	
Measurement Units	Same as present configuration ²³	
Flowing Temperature	20°C	68°F
Flowing Density	1.20 kg/m ³	0.08 lb/ft ³
Absolute Viscosity	0.18 cP	
Upper Range Value	Upper Range Limit for Flowmeter Size	
Pressure	101.00 kPaa	14.65 psia
Heat Content ²⁴	0 Joules/kg	0 BTU/lb

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

Table 35 - 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 ²⁵	
Flowing Temperature	178°C	352.4°F
Flowing Density	4.94kg/m ³	0.31 lb/ft ³
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 36 - 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 ²⁵	
Flowing Temperature	178°C	352.4°F
Flowing Density	4.94kg/m ³	0.31 lb/ft ³
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:

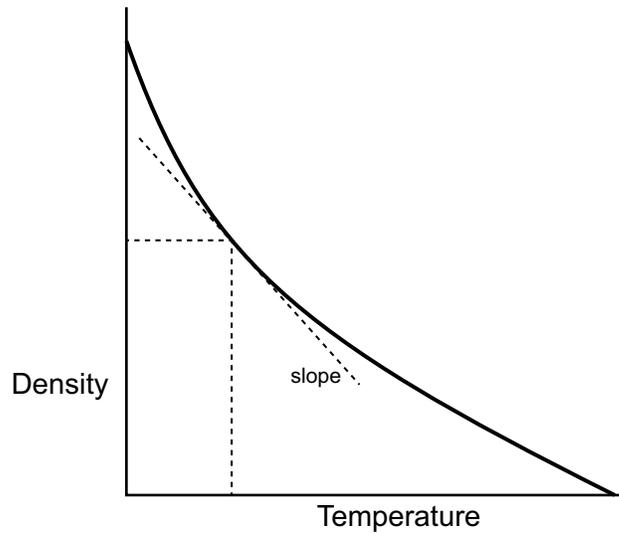
ThRefTD (Reference Temperature)	ThRefD (Reference Density of the Liquid)	ThCoefD (Δ Density/ Δ Temperature)	Density
75 °F	49.0172 lbs/ft ³	-0.034529561 lbs/ft ³ /°F	49.0172 lbs/ft ³

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

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

Refer to the diagram.

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

Figure 35 - Calculating Density Values

$$\text{Density} = \text{ThRefD} + (\text{Current Temperature} - \text{ThRefTD}) \times \text{slope}$$

where $\text{slope} = \text{ThCoefD} = \Delta \text{Density} / \Delta \text{Temperature}$

For a detailed example of how to achieve a pulse output for Mass Flow and how to display Total Mass using the local display, see *Configuration Example, page 100*.

Updating Fluid Parameters

To update fluid parameters:

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

See the *Fluid Menu Diagram, page 107* for the menu on the local display for the General or Steam personalities. The Fluid menu is not available for the Oil & Gas personality.

2. For the Flow Temperature, Density, Pressure and Viscosity parameters listed below, configure the properties in *Measurement Properties, page 63*. 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 37 - Fluid Parameters

Local Display	Register ²⁶	Factory Default	Description
3 Fluid	6900	(Default value varies based on the personality selected.)	<p>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 <i>Default Configuration Databases</i>, page 65. User Liquid, User Vapor, and SselectionUser Gas are user configurable fluid types, while SaturatedSteam and SuperHeatedSteam are predefined.</p> <p>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.</p>
3 Name	6902	Default Water	Fluid Name: Enter a name for this fluid (optional).
3 Config FlwTmp	EGU: 3306 LRV: 2402 URV: 2308 Default: 1000 AlertSt: 5007 CMethod: 5504 Damp: 2004	EGU: degF LRV: N/A URV: N/A Default: 59 4AlertSt: N/A CMethod: N/A Damp: None	<p>Flow Temperature: Configure the measurement properties associated with the flow temperature.</p> <p>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.</p> <p>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.</p>
3 BasTmp	7502	59	Base Temperature: Enter the base temperature in the temperature unit specified.
3 Config Densty	EGU: 3310 LRV: 2408 URV: 2316 Default: 1004 AlertSt: 5011 CMethod: 5508 Damp: 2008	EGU: lb/ft ³ LRV: N/A URV: N/A Default: 62.372 4AlertSt: N/A CMethod: N/A Damp: None	<p>Density: Configure the measurement properties associated with the density of the fluid.</p> <p>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).</p> <p>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.</p>
3 BasDen	7500	62.372	Base Density: Enter the base density in the density unit specified.
3 Config Press	EGU: 3309 LRV: 2406 URV: 2314 Default: 1002 AlertSt: 5010 CMethod: 5507 Damp: 2006	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.
3 BasPrs	7504	100.1010	Base Pressure: Enter the base pressure in the unit specified.
3 Config Visc	EGU: 3311 Default: 1006 AlertSt: 5012 CMethod: 5509	EGU: cPoise Default: 1.1219 4AlertSt: N/A CMethod: N/A	<p>Viscosity: Configure the measurement properties associated with the viscosity of the fluid.</p> <p>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).</p>

26. See Registers, page 144.

Table 37 - Fluid Parameters (Continued)

Local Display	Register ²⁷	Factory Default	Description
3ThCoefD	7000	-0.0191111	<p>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).</p> <p>The Vortex Model 84C Flowmeter uses the following thermo-coefficient equation to apply temperature correction for density (for liquids only):</p> <p>Density = ThRefD + (Current Temperature - ThRefTD) * ThCoefD</p> <p>See <i>Calculating Density Values, page 68</i>.</p> <p>where:</p> <ul style="list-style-type: none"> ThRefD is the reference density of the liquid ThRefTD is the reference temperature ThCoefD = Δ Density / Δ Temperature
3ThRefTD	7002	58.99996	
3 ThRefD	7004	62.37183	
3ThCoefV	7100	-0.006316	<p>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).</p> <p>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 <i>Setting Tuning Parameters, page 70</i>.</p> <p>The flowmeter uses the following thermo-coefficient equation to apply temperature correction for viscosity (for liquids only):</p> <p>Viscosity = ThRefV + (Current Temperature - ThRefTV) * ThCoefV</p> <p>where:</p> <ul style="list-style-type: none"> ThRefV is the reference viscosity of the liquid ThRefTV is the reference temperature ThCoefV = Δ Viscosity / Δ Temperature
3ThRefTV	7102	59.99990	
3 ThRefV	7104	1.121900	

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).²⁸

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

See the *Tuning Menu Diagram, page 112* for the menu on the local display for the General and Steam personalities and see the *Tuning Menu Diagram, page 136* for the menu on the local display for the Oil & Gas personality.

Table 38 - Tuning Parameters

Local Display	Register ²⁹	Factory Default	Description
3 Rd Corr (General and Steam personalities only)	Coil 103 (See <i>Coils, page 160</i> .)	Off	Reynolds number correction: Set the Reynolds number correction to On or Off.
3MaxRate (Oil & Gas personality only)	2302–2303	The Liquid upper range value for the flow meter. (line size dependent)	Maximum Flow Rate, same as upper range value.

27. See *Registers, page 144*.

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

29. See *Registers, page 144* and *Coils, page 160*.

Table 38 - Tuning Parameters (Continued)

Local Display	Register ³⁰	Factory Default	Description
3MxRt Hz (Oil & Gas personality only)	13504–13505	Line size dependent.	Pulse output frequency that corresponds to the Max Rate flowing rate (3MaxRate).
3 LFCI > 4 FlowEGU	10501	gal/m (for General and Steam personalities) and bbl/d (for Oil & Gas personality)	LFCI Flow Units: Set the flow units associated with the LFCI.
3 LFCI > 4Setting	See <i>LFCI Registers</i> , page 159.	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)	13031–13032	1.0000000	LFCI User Factor per Model 84C Special Flowtube Configurator.
3 FlwDmp (Oil & Gas personality only)	2002–2003	None	Flow Damping Time: Select the damping factor. Choose 0 to 32 seconds.
3 Filter (Oil & Gas personality only)	13501	FixGas	Filter Mode: Choices are: <ul style="list-style-type: none"> • 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 88.

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) 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.

30. See *Registers*, page 144 and *Coils*, page 160.

2. Configure the other measurement parameters below from the **1 Setup > 2Measure > 3MeasCfg** menu selection (local display).

See the *Measurement Configuration Menu Diagram, page 113* for the menu on the local display for the General or Steam personality and see the *Oil Gas Main Menu, page 135* for the menus on the local display for the Oil and Gas personality.

For each parameter listed below, configure the properties provided in *Measurement Properties, page 63*. 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 39 - Measurement Parameters

Local Display	Register ³¹	Factory Default	Description
4 Config FlwVol	EGU: 3303 URV: 2302 AlertSt: 5004	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)	EGU: 3304 URV: 2304 AlertSt: 5005	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	EGU: 3309 LRV: 2406 URV: 2314 Default: 1002 AlertSt: 5010 CMethod: 5507 Damp: 2006	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.
4 Config FlwTmp	EGU: 3306 LRV: 2402 URV: 2308 Default: 1000 AlertSt: 5007 CMethod: 5504 Damp: 2004	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.

31. See *Registers, page 144*.

Table 39 - Measurement Parameters (Continued)

Local Display	Register ³²	Factory Default	Description
4 Config Densty	EGU: 3310 LRV: 2408 URV: 2316 Default: 1004 AlertSt: 5011 CMethod: 5508 Damp: 2008	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.
4 Config FlwMas	EGU: 3305 URV: 2306 AlertSt: 5006	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	EGU: 3307 URV: 2310 AlertSt: 5008	EGU: ft/s URV: N/A 4AlertSt: N/A	Velocity: Configure the measurement properties associated with the velocity.
4 Config Visc	EGU: 3311 Default: 1006 AlertSt: 5012 CMethod: 5509	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	N/A N/A	EGU: Hz URV: N/A	Raw Vortex Frequency: Configure the measurement properties associated with the raw vortex frequency.
4 Config EleTemp	EGU: 3313 LRV: 2412 URV: 2320 Default: 1010 AlertSt: 5018 Damp: 2012	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	EGU: 3312 LRV: 2410 URV: 2318 Default: 1008 AlertSt: 5013 CMethod: 5510	EGU: degF LRV: N/A URV: N/A Default: Fluid based (0 for custom fluids) 4AlertSt: N/A CMethod: N/A	Heat Content: ³³ Configure the measurement properties associated with the heat content.

32. See *Registers*, page 144.

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

Table 39 - Measurement Parameters (Continued)

Local Display	Register ³⁴	Factory Default	Description
4 Config HtFlow	EGU: 3308 LRV: 2404 URV: 2312 AlertSt: 5009 CMethod: 5506	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.)	3303	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 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.

34. See *Registers*, page 144.

- 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.

See *Totalizer/Pulse Control Registers*, page 155 and *Totalizer Configuration Registers*, page 156.

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 50.

For information on controlling totalizer access using passwords on the local display, see *Totalizer Access Restrictions*, page 98.

Totalizer Display Options

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

- XXXXXXXX
- 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.

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.

See *Measurement Registers*, page 145 and *Status Registers*, page 148.

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).

See the *Totalizer Configuration Menu Diagram, page 123* for the menu on the local display for the General or Steam personalities. The Totalizer Configuration menu is not available for the Oil & Gas personality.

Table 40 - Totalizer Parameters (for Totalizer 1, Totalizer 2, and Totalizer 3)

Local Display	Register ³⁵	Factory Default	Description
4 Map	See <i>Pulse Total Configuration Registers, page 156</i>	Volume	<p>Map Totalizer: Allows you to map each totalizer to a measurement. Choose Volume, BVolume, Mass, Vor Cnt, or Energy.</p> <p>When mapping a totalizer, consider the following guidelines:</p> <ul style="list-style-type: none"> • 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	See <i>Unit Code Registers, page 148</i>	gal	<p>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 volumetric flow EGU is configured to cubic feet per second, the totalizer's EGU is set to cubic feet by default.</p> <p>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).</p> <p>For example, The slope for a custom unit of a 42 gallon barrel would be 6.2898 because 6.2898 bbl = 1 m³.</p>

35. See *Registers, page 144*.

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 50*.
 - b. For information on configuring passwords (local display only), see *Using Passwords, page 96*.
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, pulse output, and display parameters.

Setting Communication Parameters

Configure the communication parameters from the **1 Setup > 2 Output > 3 Coms** menu selection (local display).

See the *Modbus Communication Menu Diagram, page 124* for the menu on the local display for the General and Steam personalities and see *Output Menus - Modbus Communication Menu Diagram, page 137* for the menu on the local display for the Oil & Gas personality.

For more information on the registers, see *Modbus Communications Registers, page 153*.

Table 41 - Communication Parameters

Local Display	Register ³⁶	Factory Default	Description
4 Station	6600	99	Station Address: Enter the Modbus address of the flowmeter between 1 and 247.
4 Baud	6601	9600	Baud Rate: Set the Baud Rate for the Modbus communications. Select, 4800, 9600, or 19200.
4 Parity	6602	NoParity	Parity: Set the parity for the Modbus communication. Select NoParity, Odd, or Even.
4 StopBit	6603	OneBit	Stop Bit: Select the stop bit for the Modbus communication. Select OneBit or TwoBits.
4FltSwap	6604	Full	<p>Float Swap: Enter the byte-swapping format to be used. Choose:</p> <ul style="list-style-type: none"> • Full (Full swap) • Word (Word swap) • WordByte (Word and byte swap) • None (No swap) <p>See <i>32-Bit Register Byte Format, page 77</i> for definitions of the byte-swapping formats.</p>

Table 42 - 32-Bit Register Byte Format

Option	Example	Result ³⁷
Full	ABCD → DCBA	Big-endian format (default)
Word	ABCD → CDAB	Big-endian format, with words swapped
WordByte	ABCD → BADC	Little-endian format, with words swapped
None	ABCD → ABCD	Little-endian format

36. See *Registers, page 144*.

37. Although the Modbus protocol defines the big-endian format, the flowmeter uses the little-endian format natively.

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 43 - 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), 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 91. To turn Pulse mode on using registers, see *Totalizer/Pulse Control Registers*, page 155.

- 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: $1/(2 \times 0.05 \text{ s}) = 10 \text{ Hz}$

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%.

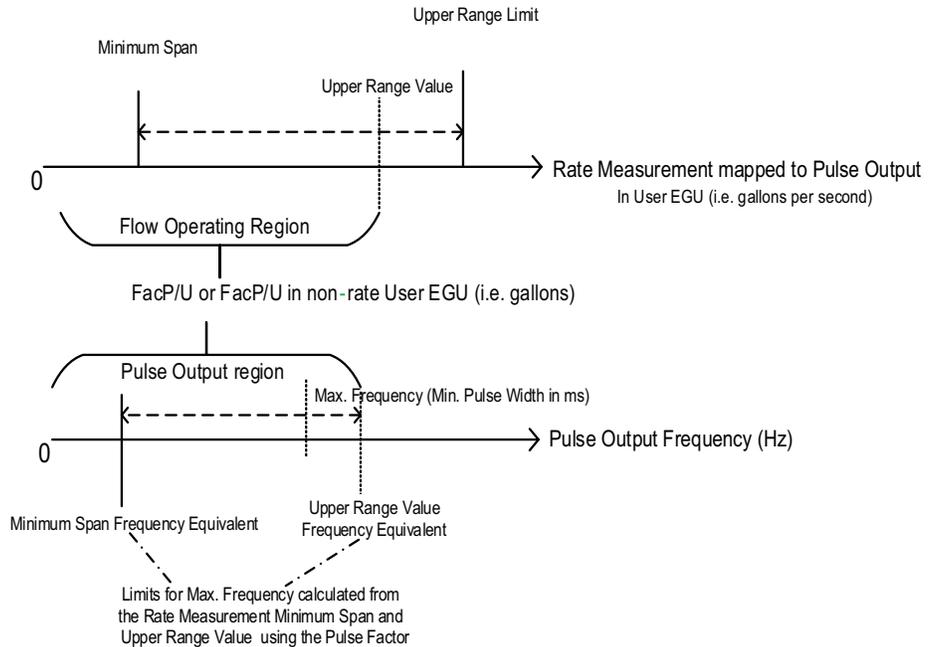
Table 44 - Minimum Pulse Widths and Maximum Frequency Equivalents

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 36 - 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).

See the *Pulse Output, Pulse Mode Configuration Menu Diagram, page 125* 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 & Gas personality.

Table 45 - Pulse Output, Pulse Mode Parameters

Local Display	Register ³⁸	Factory Default	Description
4 Pulse	8200	Freq	Pulse Mode: Select Pulse to configure the Pulse Output to pulse mode.
4MapPul	8301	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	8304	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 <i>Minimum Pulse Widths and Maximum Frequency Equivalents</i> , page 79.
4FacEGU	8300	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 EGU's. 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	8302	1	<p>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).</p> <ul style="list-style-type: none"> 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	8306	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 $\geq 150\%$ of the pulse URV.
 - A status is set.
 - A diagnostic alert will be set by the source of the alert.

38. See *Registers*, page 144.

- 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).

See *Pulse Output, Frequency Mode Configuration Menu Diagram, page 126* 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 135*).

Table 46 - Pulse Output, Frequency Mode Parameters

Local Display	Register ³⁹	Factory Default	Description
4 Pulse	8200	Freq	Pulse Mode: Select Freq or Frequency to configure the Pulse Output to pulse frequency.
4MapFreq	8400	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	8401	0	Lower Range Value: LRV should be 0, indicating a no flow condition.
4 URV	8403	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	8405	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	2000	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.)	8306	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), and select **None**.

To turn Pulse mode on or off using registers, see *Totalizer/Pulse Control Registers, page 155*.

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.

39. See *Registers, page 144*.

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
- 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
XXXXXXXXX	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).

See *Display Configuration Menu Diagram (1 of 2)*, page 127 for the menus on the local display for the General and Steam personalities; see *Output Menus - Display Configuration Menu Diagram (1 of 2)*, page 137 for the menus on the local display for the Oil & Gas personality.

Table 47 - Home Screen Parameters

Local Display	Register	Factory Default	Description
4CfgShow > 5 Select 4 CfgShow > 5 Select > 6 Show 4 CfgShow > 5 Select > 6 Format	N/A	FlwVol: On/AutoFmt The remaining measurements are set to Off/ AutoFmt: FlwBvo, FlwMas, Velcty, Tot1, Tot2, Tot3, Densy, Visc, Press, FlwTmp, 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	N/A	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	N/A	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).

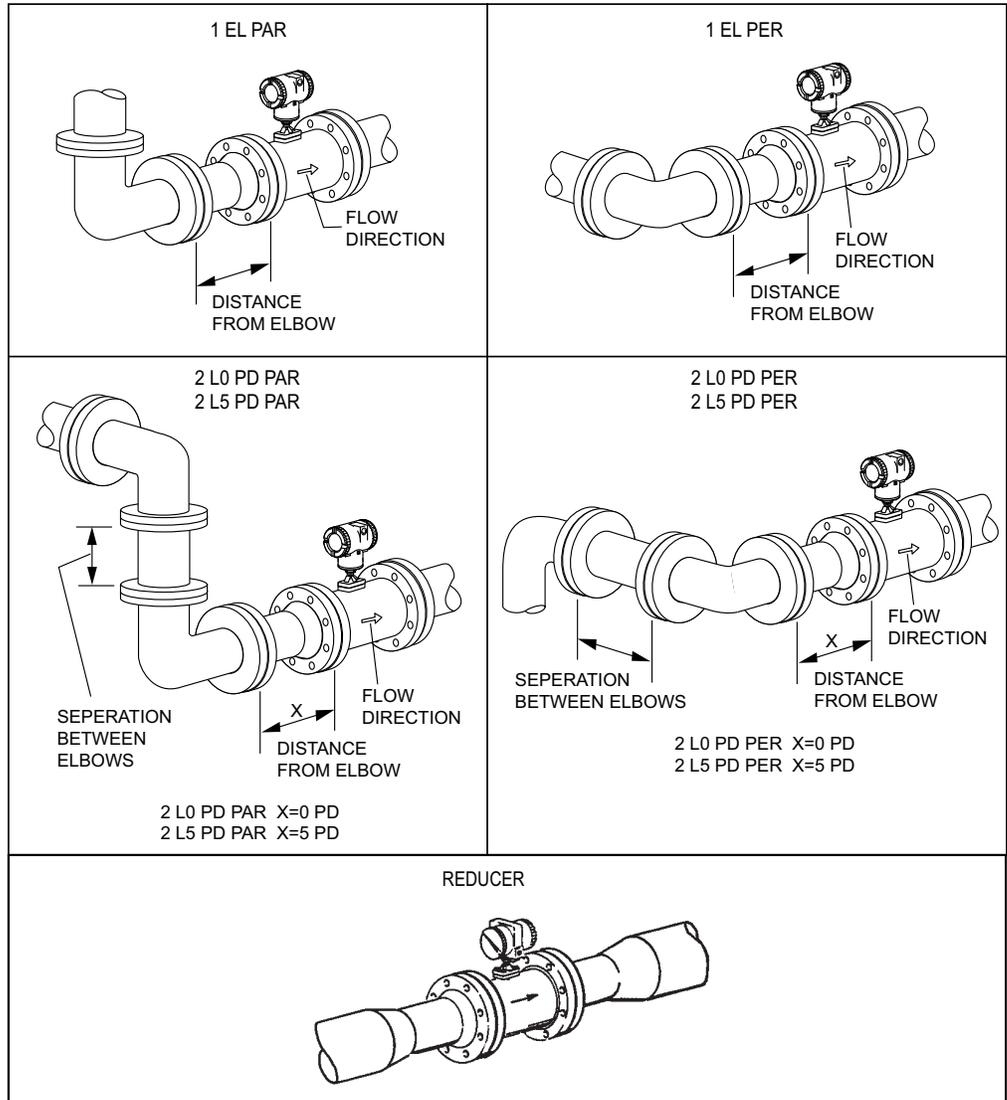
See the *Pipe Configuration Menu Diagram, page 130* for the menu on the local display for the General and Steam personalities and see the *Pipe Configuration Menu Diagram, page 139* for the menu on local display for the Oil & Gas personality.

Table 48 - Piping Parameters

Local Display	Register ⁴⁰	Factory Default	Description
3 Piping > 4 Config	11055	Straight	<p>Upstream Piping Configuration: Select the upstream piping configuration from the following:</p> <ul style="list-style-type: none"> • 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 <p>See <i>Piping Configurations</i>, page 86.</p>
3 Piping > 4 UpDist	11050	0	<p>Upstream Distance: Enter the distance to the first upstream flow disturbance in pipe diameters.</p>
3BoreSch	11054	Sched 40	<p>Bore Schedule: Select the pipe bore. Choose from Sched 10, Sched 40 Sched 80, PN16, PN40, PN64, PN100, or Sanitary.</p>
3 Custom	11052	0	<p>Custom Kref Bias: Input the Kref Bias in percent (%). For example, to change Kref by 2%, enter 2.0000.</p>

40. See *Registers*, page 144.

Figure 37 - 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).

See the *NewMod Configuration Menu Diagram, page 131* for the menu on the local display for the General and Steam personalities and see the *NewMod Configuration Menu Diagram, page 140* for the menu on the local display for the Oil & Gas personality.

Table 49 - Flowmeter Parameters

Local Display	Register ⁴¹	Factory Default	Description
3 Model	6500	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	11000	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	3314	p/ft ³	K Reference Units: Select the unit for the reference K-factor. See <i>Units, page 15</i> .
3 K Ref > 4 K Ref	11500	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).

See the *Advanced Options Menu Diagram, page 131* for the menu on the local display for the General and Steam personalities and see the *Advanced Options Menu Diagram, page 140* for the menu on the local display for the Oil & Gas personality.

Table 50 - Advanced Option Parameters

Local Display	Register ⁴²	Factory Default	Description
3 Per Sel	10000	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 ⁴³	N/A	N/A	Advanced Options: The selections provide a additional options for configuring custom flowtubes. Contact Global Customer Support for information and assistance.
3SetMode	N/A	Normal	Menu Mode: Select the menu mode to be used. Select Normal (the default), ViewOnly, or ShowAll. <ul style="list-style-type: none"> • Normal: Only the appropriate configuration-specific menu items are visible in the menu system. • 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.

41. See *Registers, page 144*.

42. See *Registers, page 144* and *Coils, page 160*.

43. This menu is reserved for advanced options.

Table 50 - Advanced Option Parameters (Continued)

Local Display	Register ⁴⁴	Factory Default	Description
3NoiseRd	Coil 101 (On=Method1, Off=Basic)	Method1	<p>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:</p> <ul style="list-style-type: none"> 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 <i>Measurement Properties</i>, page 63). 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 <i>Measurement Properties</i>, page 63). 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.
3ClrRTU	N/A	N/A	<p>Clear RTU: The RTU can be used to set the measurements that display on the local display. The ClrRTU selection allows you to clear the fields set from the RTU and return to using the measurement fields configured from the Setup menu on the local display.</p>

Resetting the Database

To reset the flowmeter to its factory default values:

1. Navigate to the **1 Setup > 2 SetDef** menu selection (local display).

See the *Resetting the Database Menu Diagram*, page 131 for the menu on the local display for the General and Steam personalities and see the *Oil Gas Main Menu*, page 135 for the menu on the local display for the Oil & Gas personality.

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 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

44. See *Registers*, page 144 and *Coils*, page 160.

See the *Calibration/Test Menu Diagram, page 132* for the menu on local display for the General and Steam personalities and see the *Calibration/Test Menu Diagram, page 141* for the menu for the Oil & Gas personality.

Calibration

You can set the automatic LFCI, calibrate the process temperature (if your flowmeter has an optional temperature sensor), and clear the Time in Service meter 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 70*. 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 set the LFCI from registers using Coil 107. (For more information on Coil 107, see *Auto LFCI Procedure, page 162*.)

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 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).
2. Select **5RtdEgu** (local display). Note the engineering units used by the temperature sensor.
3. Select **5CurTmp** (local display). Enter the current temperature in the selected engineering units.
4. Save your changes.

To calibrate the temperature sensor (RTD) using registers, use Coil 104. See *RTD Calibration Procedure*, page 161.

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).
The message **Applying** appears on the display.
2. Save your changes.

To restore the factory calibration on the temperature sensor (RTD) using registers, use Coil 105. See *RTD Calibration Procedure*, page 161.

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.

To clear the Time in Service meter using registers, use Coil 100. See *Coils*, page 160.

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

To test the loop:

1. Navigate to **1 Cal/Tst > 2 Test** (local display) and select the calibration source:
 - Frequency pulse output (applies to Pulse Frequency Mode): **3 Set Hz** (local display)

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 start self test from registers using Coil 106. For more information on Coil 106, see the *User Self Test Procedure*, page 161.

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 78.

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 128 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. To turn Pulse mode on or off using registers, see *Totalizer/Pulse Control Registers*, page 155.

1. On the local display, press **ENTER** to stop the display of measurements and select **ENTER** at the **1 Pulse** menu.
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 74*.

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 is off.
- **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 129* for the menu on the local display for the General and Steam personalities and see the *Totalizer Actions Top Level Menu Diagram, page 141* for the menu on local display for the Oil & Gas personality. To turn Totalizers on or off using registers, see *Totalizer/Pulse Control Registers, page 155*.

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).
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 51 - 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. Check the raw frequency to determine if it is out of limits for the flowmeter size.
B: Input	Bad Input: An input to a specific measurement or calculation has exceeded the soft limit. This adversely affects all measurements.	
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 <i>Totalizer Actions</i> , 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 52 - 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 <i>Setting the Write Protect Jumper</i> , page 50.
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.
- Out-of-Service status (**O:**) messages usually mean that the measurement is not supported by the available hardware.

Table 53 - 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 54 - 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 55 - 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 56 - Out-of-Service Status Messages

Message	Description
O:UsrOf	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:FacOf	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.

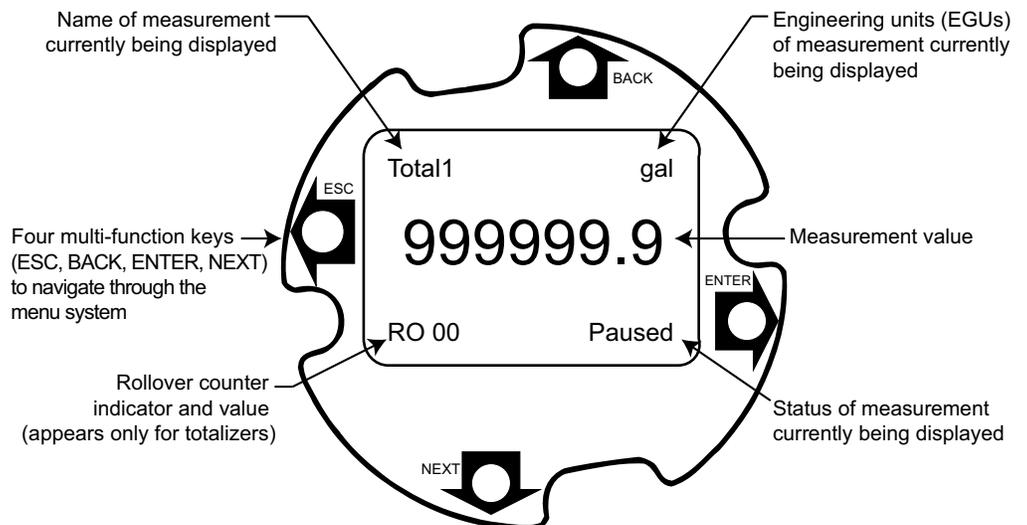
Local Display and Home Screen

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 95*). 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, 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 38 - Local Display and Home Screen



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

Key	Function
Left Arrow (ESC)	<ul style="list-style-type: none"> 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 entry⁴⁵ Answers No to prompts
Right Arrow (ENTER)	<ul style="list-style-type: none"> 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 entry⁴⁵ 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)	<ul style="list-style-type: none"> Moves upward in the menu structure, a pick list menu, or list of characters
Down Arrow (NEXT)	<ul style="list-style-type: none"> 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.

45. 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 redisplay 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 132* for the menu on the local display for the General or Steam personality and see the *Password Configuration Menu Diagram, page 141* for the menu on the local display for the Oil and Gas personality.
 - 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 132* for the menu on the local display for the General or Steam personality and see the *Password Configuration Menu Diagram, page 141* for the menu on the local display for the Oil and Gas personality.
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 57 - Totalizer Access Restrictions

Write Protection	Hi and Lo Passwords Configured	Access Restriction for Totalizer Actions					
		Totalizer 1 Operations		Totalizer 2 Operations		Totalizer 3 Operations	
		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 96*.

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**).

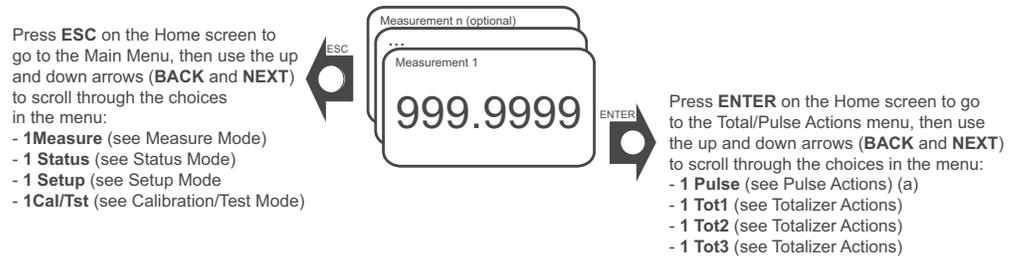
Picking from a List

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 as shown in *Accessing the Top Level Menus from the Home Screen, page 100*.

Figure 39 - Accessing the Top Level Menus from the Home Screen



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

Configuration Example

This example demonstrates how to achieve 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 Pulse Output for Mass Flow
3. 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 68*.

1. Select **1 Setup > 2 Fluid > 3 Fluid** 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 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** menu 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 **4 FacEGU 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 76 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 Ib** 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 59.

Menus for the General and Steam Personalities

Figure 40 - Status Menu Diagram

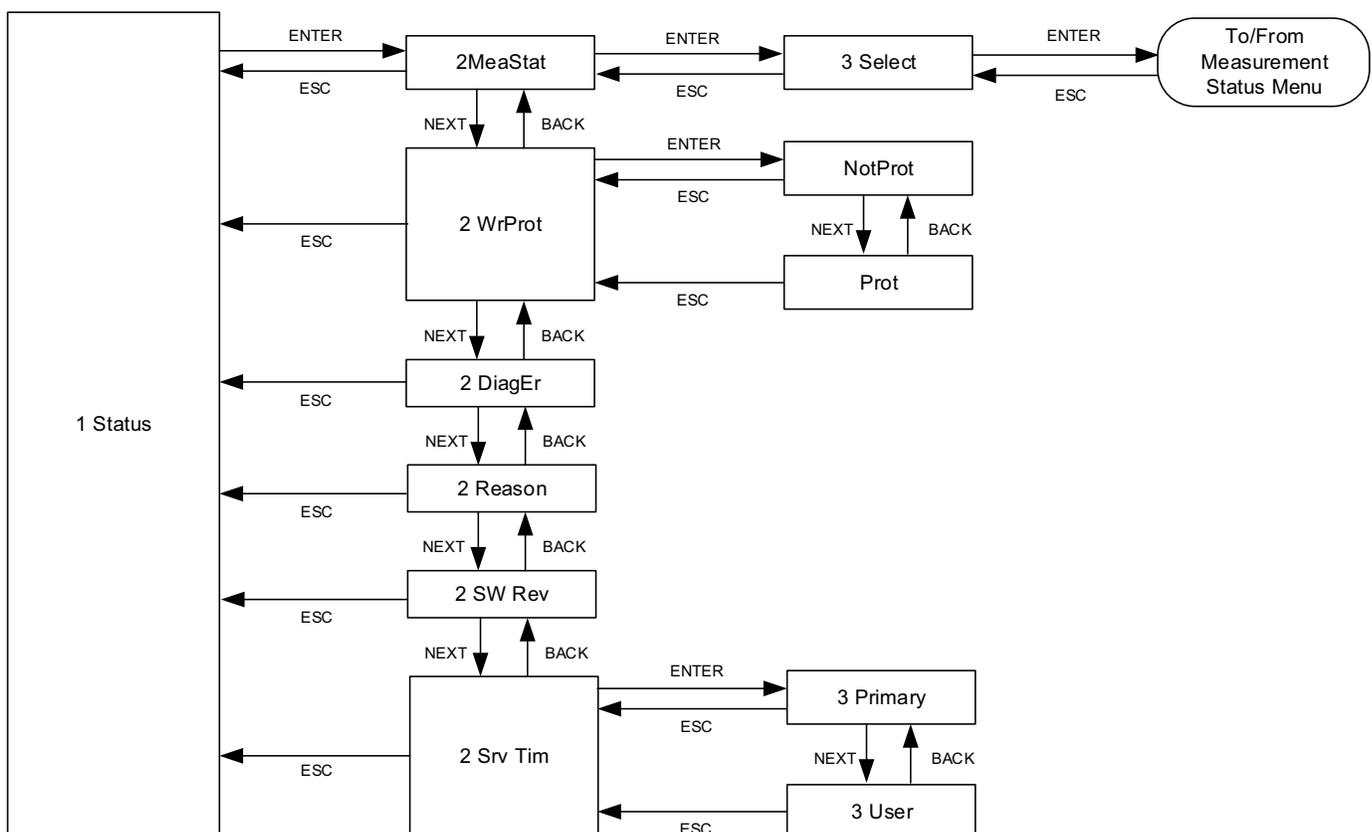


Figure 41 - Measurement Status Menu Diagram (1 of 2)

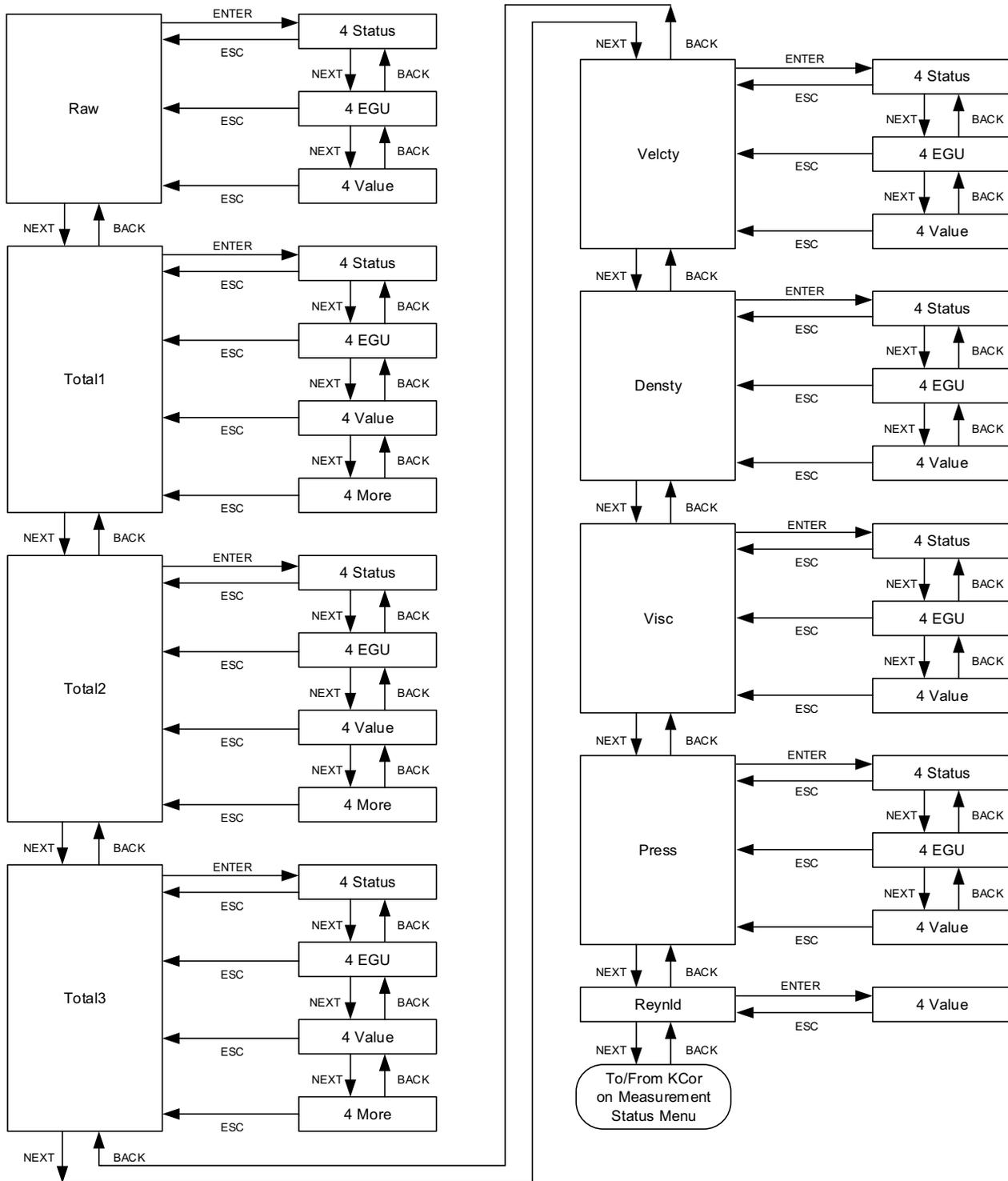


Figure 42 - Measurement Status Menu Diagram (2 of 2)

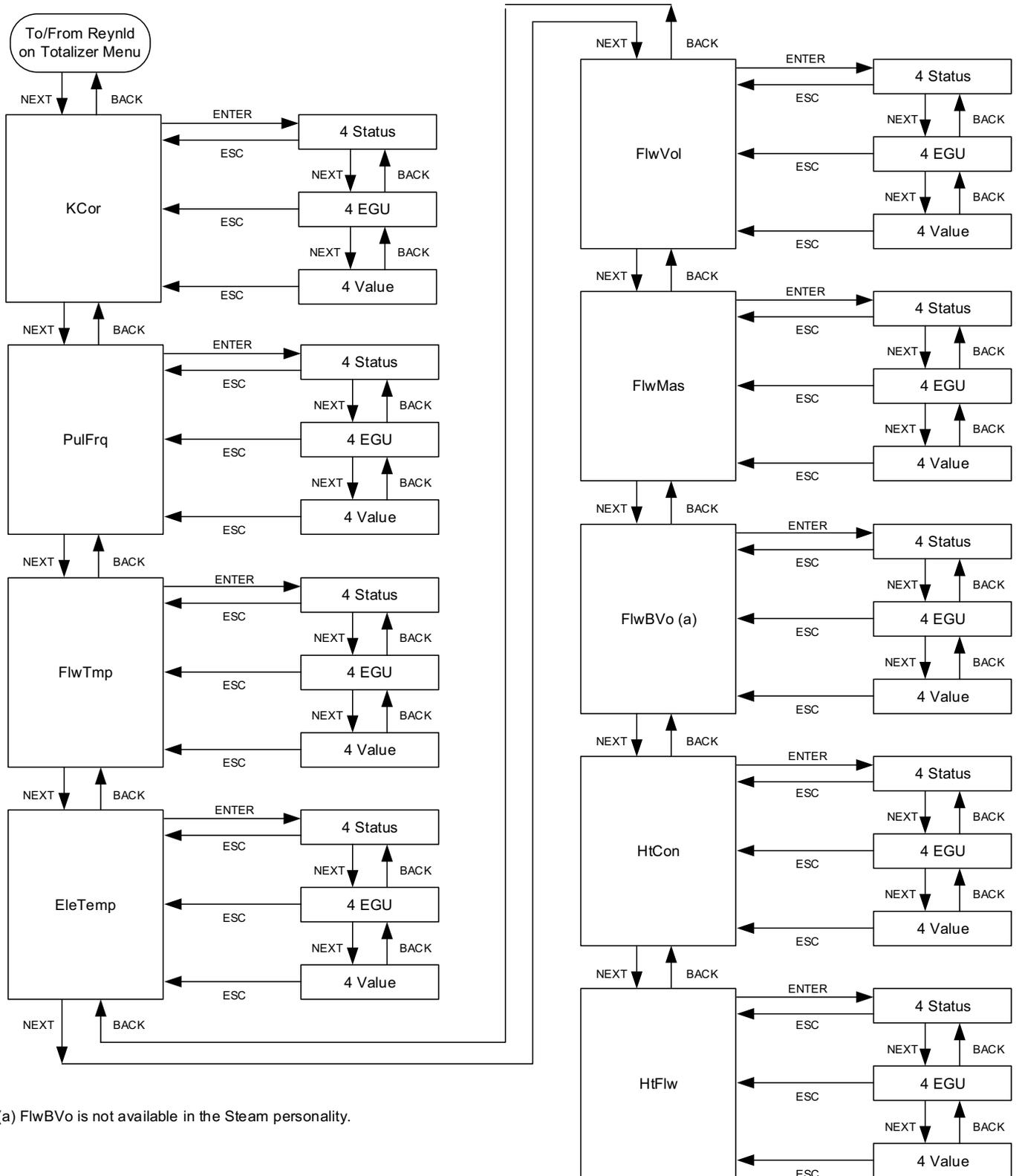


Figure 43 - Setup Main Menu

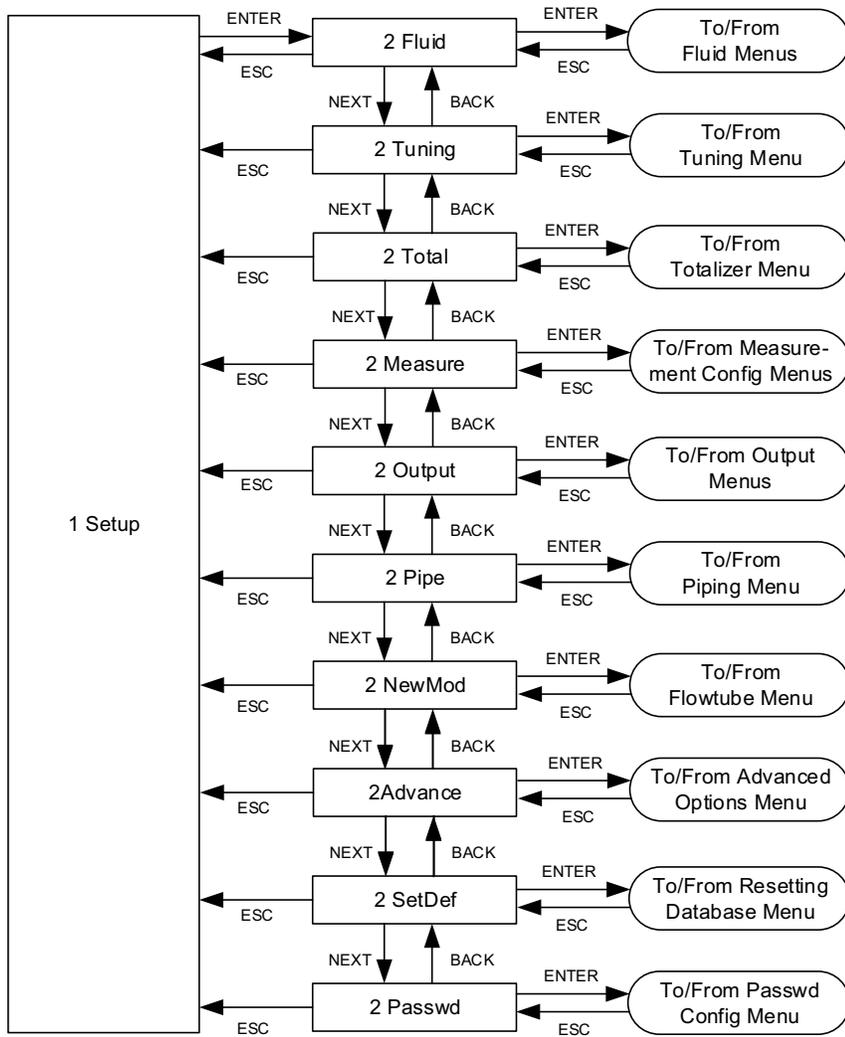
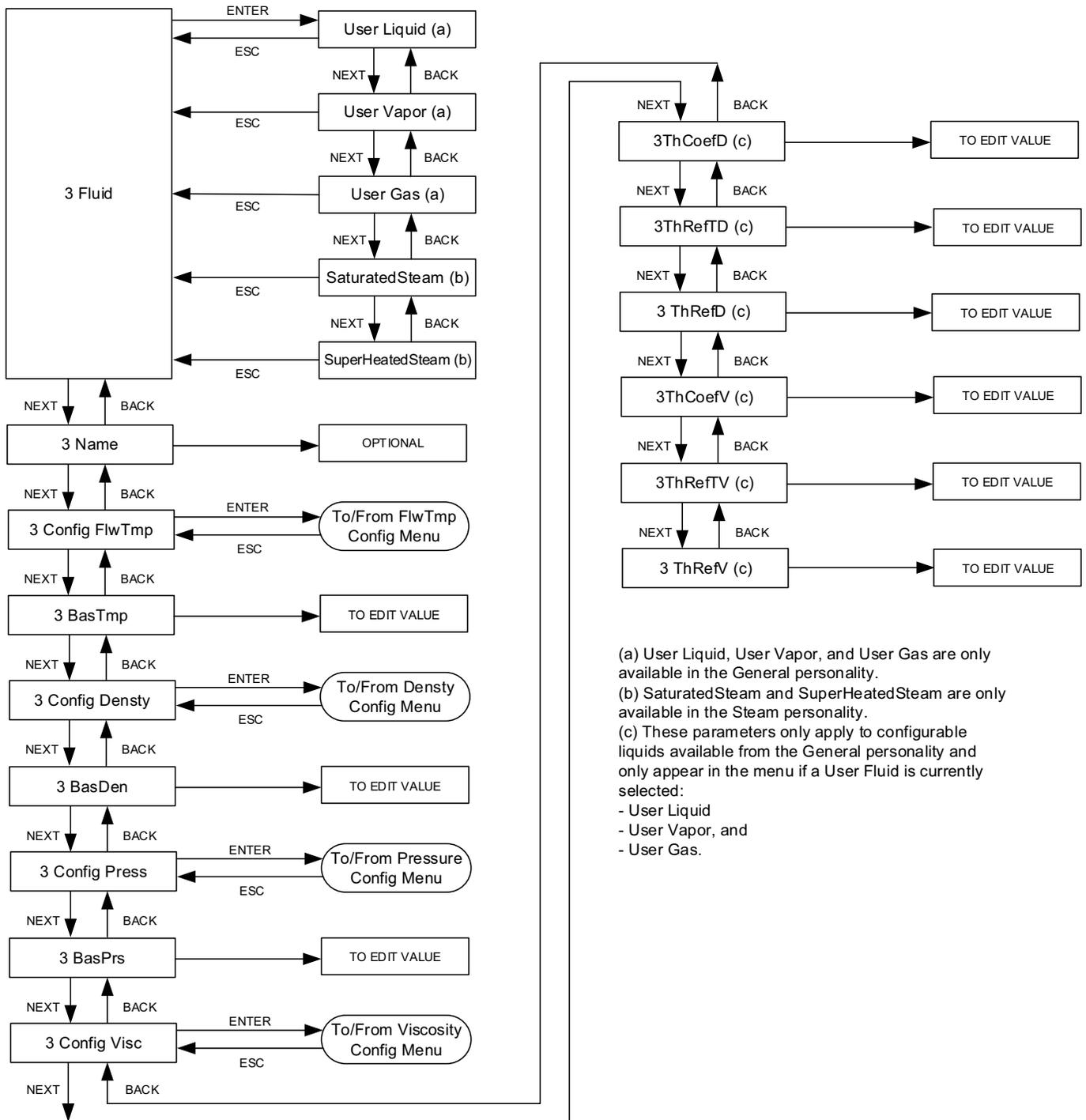


Figure 44 - Fluid Menu Diagram



(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 45 - Process Temperature (FlwTmp) Configuration Menu Diagram

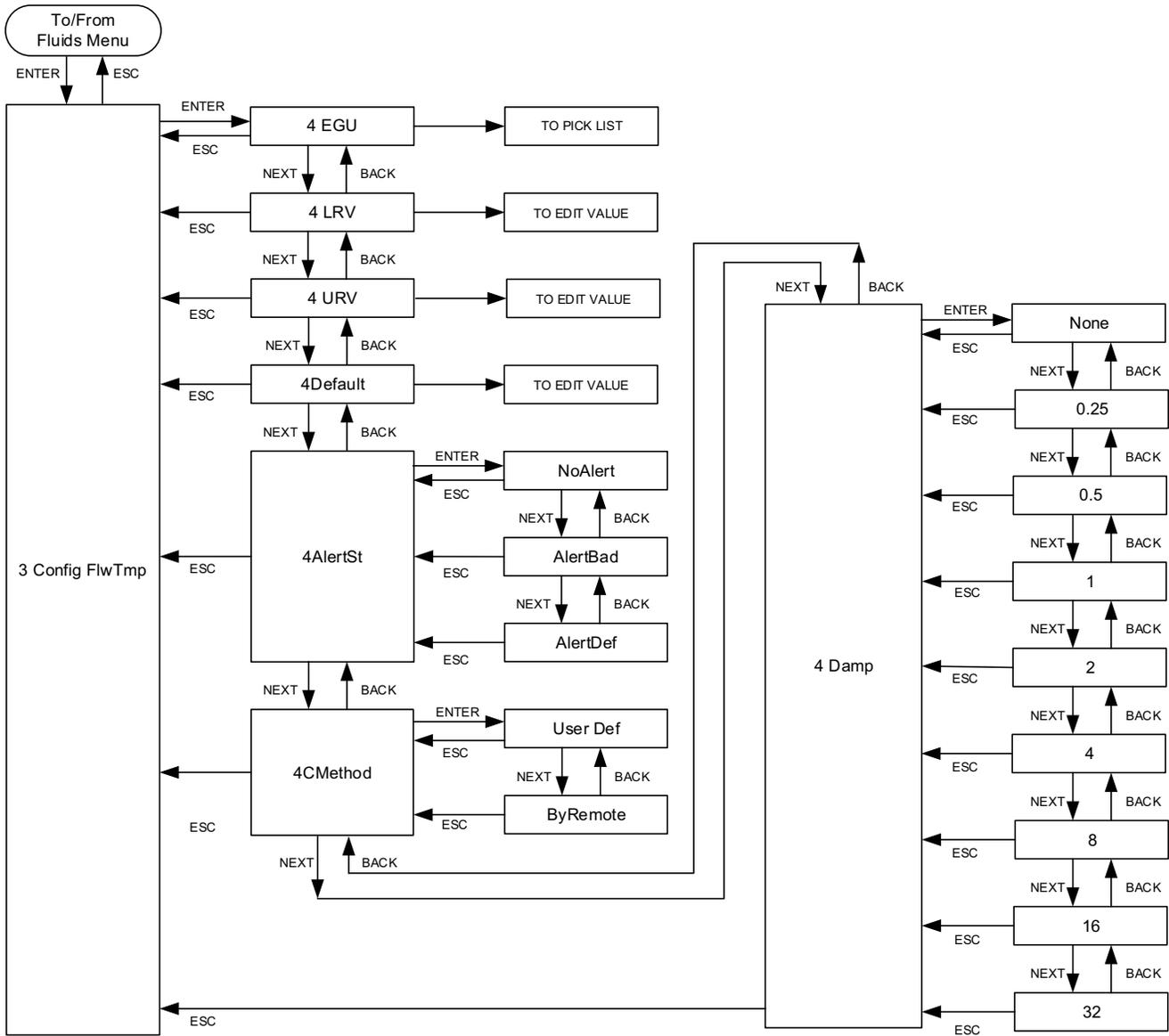


Figure 46 - Density Configuration Menu Diagram

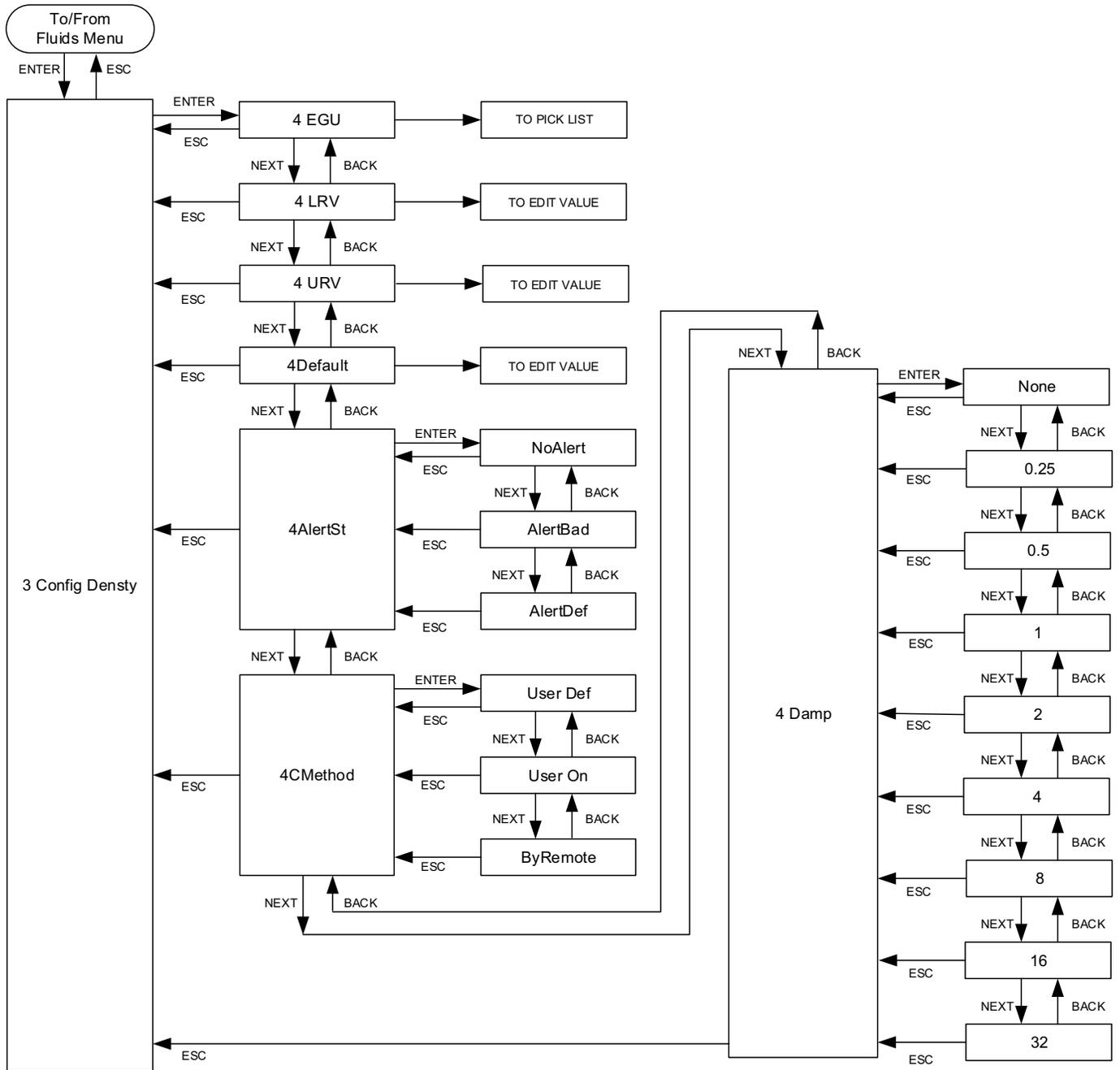


Figure 47 - Pressure Configuration Menu Diagram

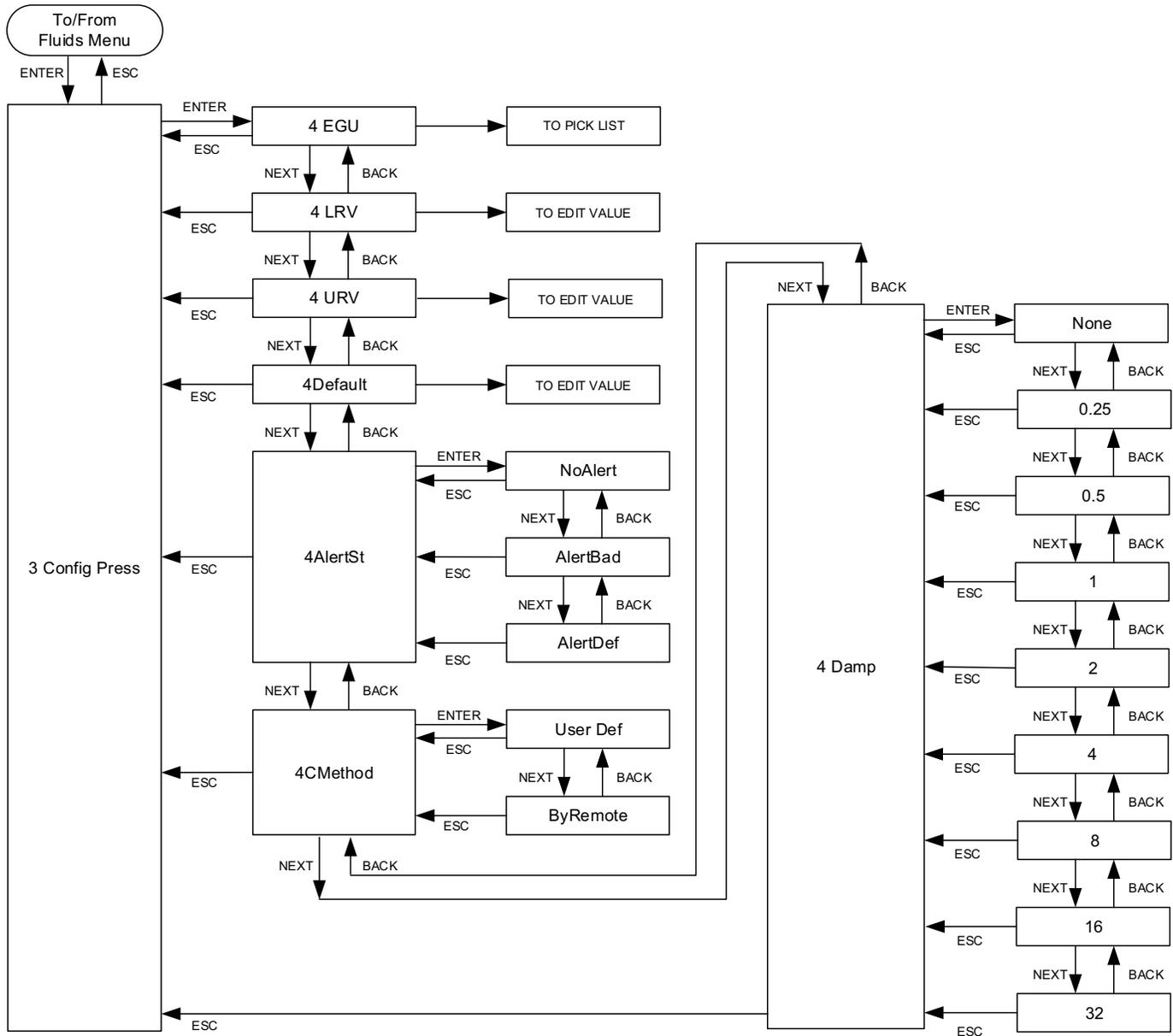


Figure 48 - Viscosity Configuration Menu Diagram

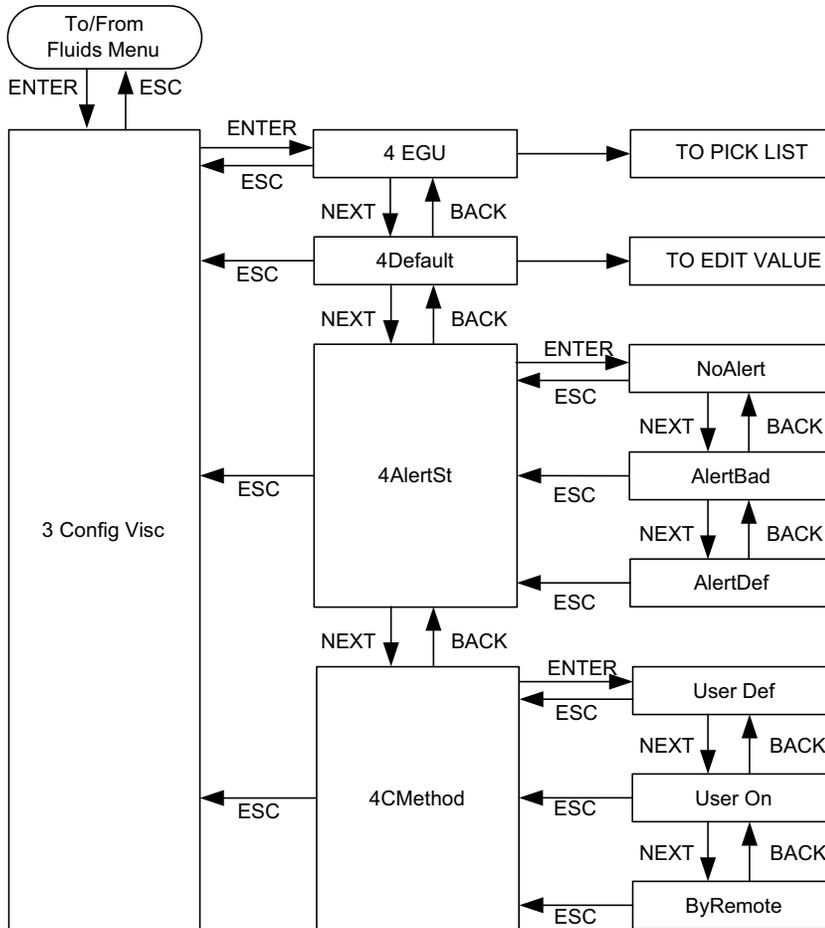


Figure 49 - Tuning Menu Diagram

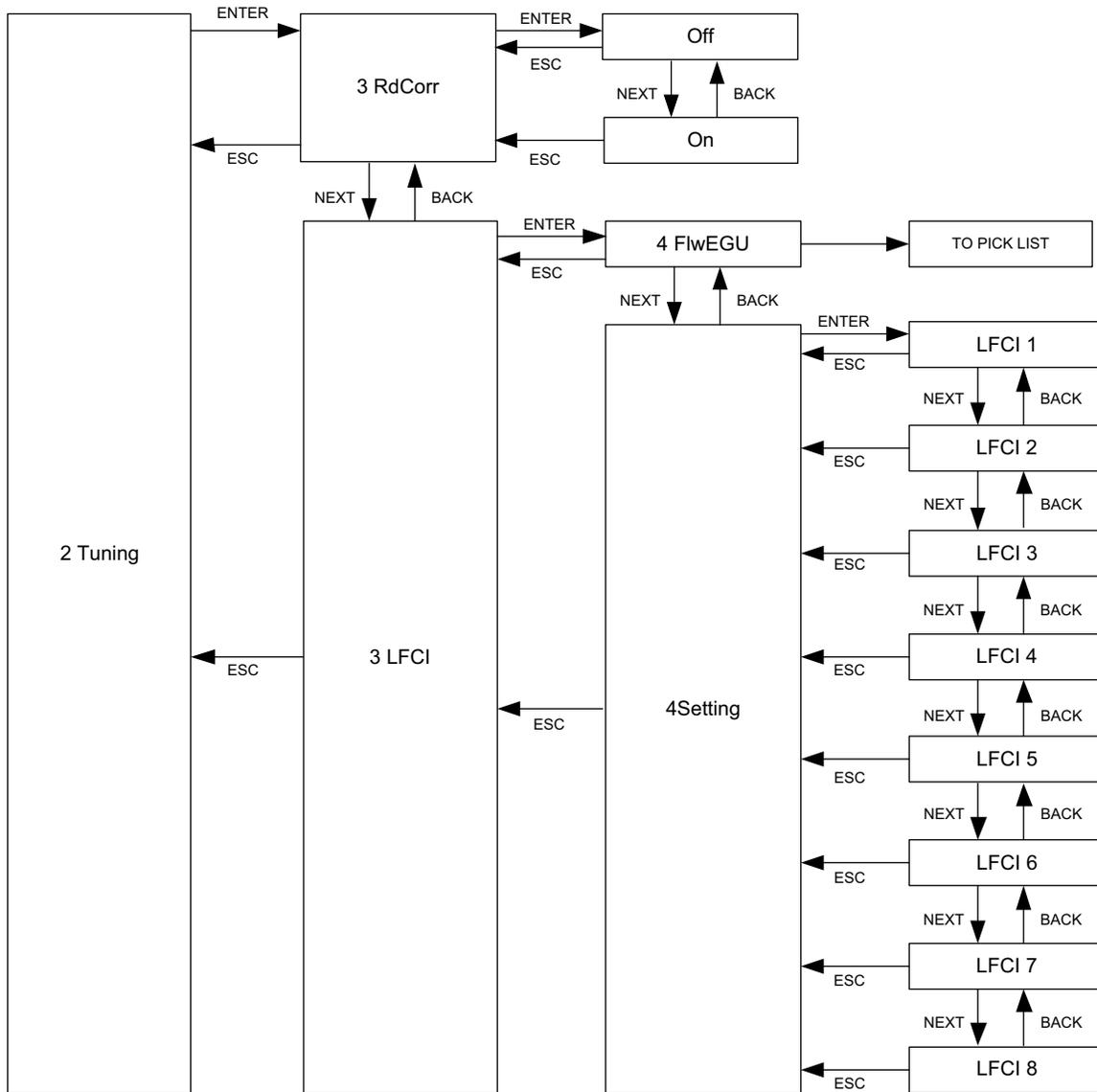


Figure 50 - Measurement Configuration Menu Diagram

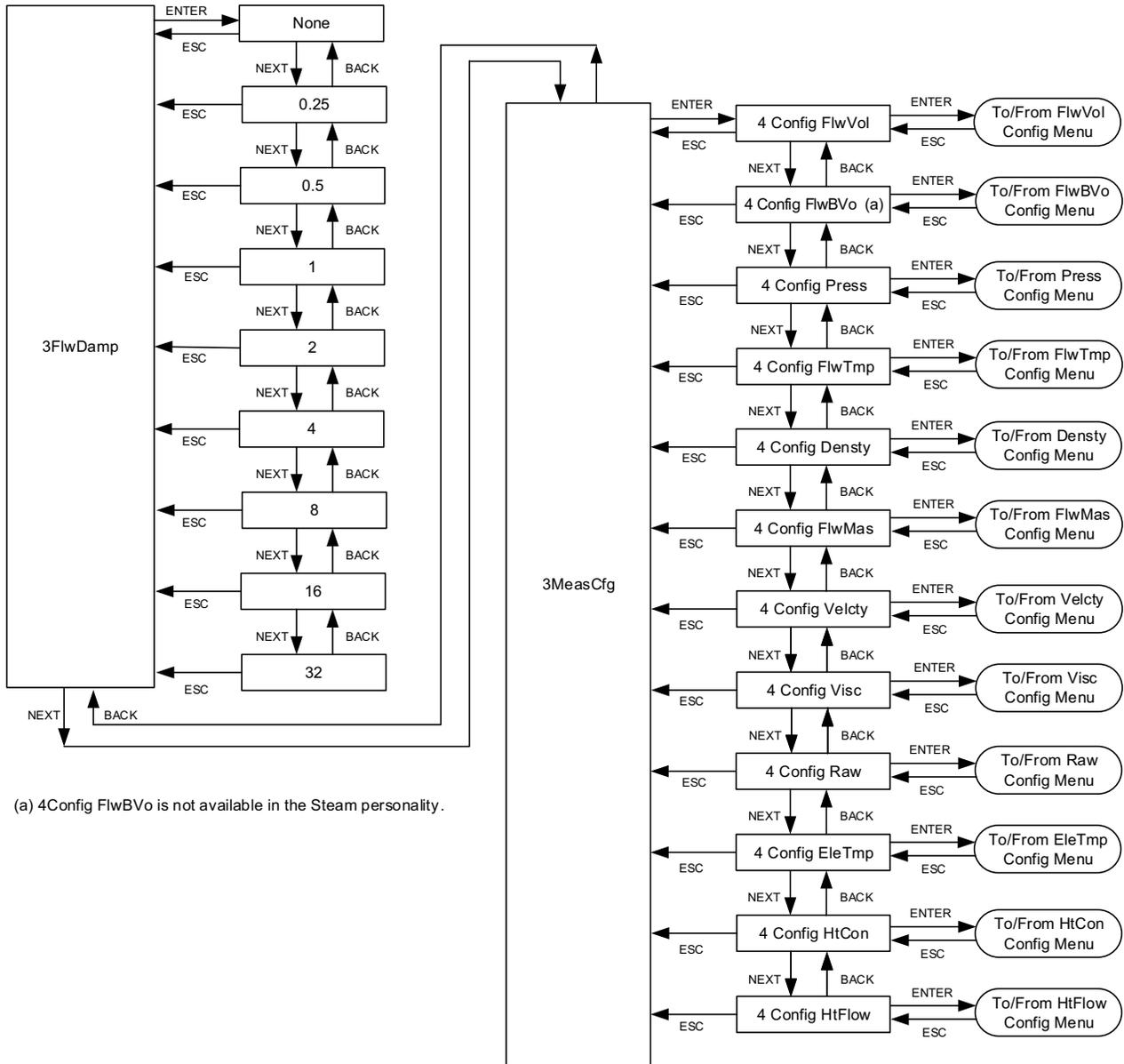


Figure 51 - Volumetric Flow (FlwVol) Configuration Menu Diagram

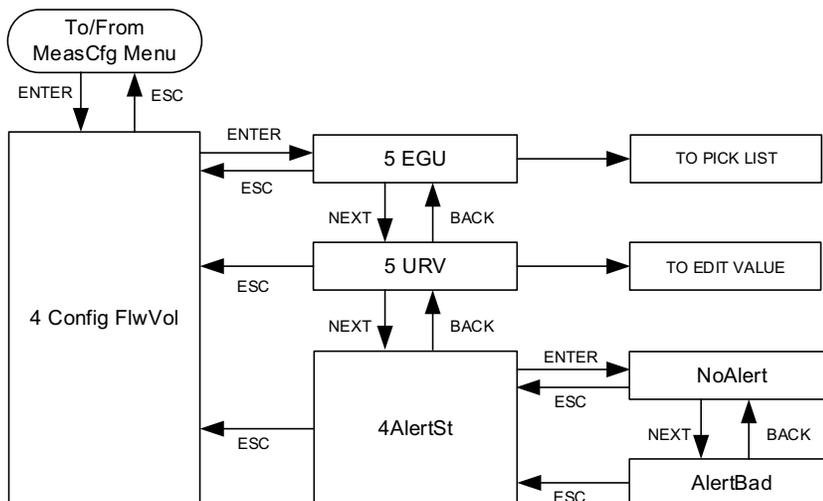
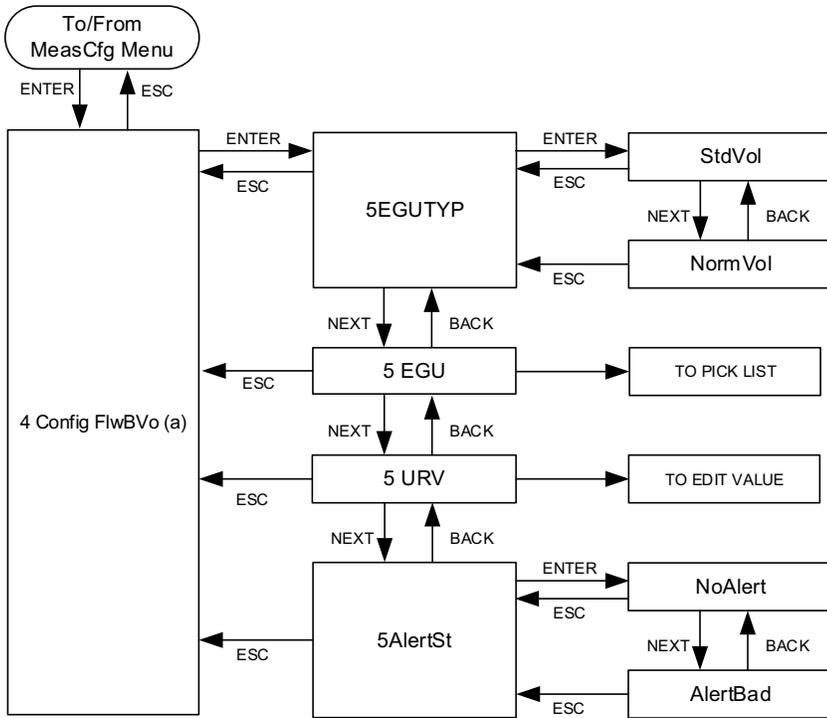


Figure 52 - Base Volumetric Flow (FlwBVo) Configuration Menu Diagram



(a) The Config FlwBVo menu is not available in the Steam personality.

Figure 53 - Pressure Configuration Menu Diagram

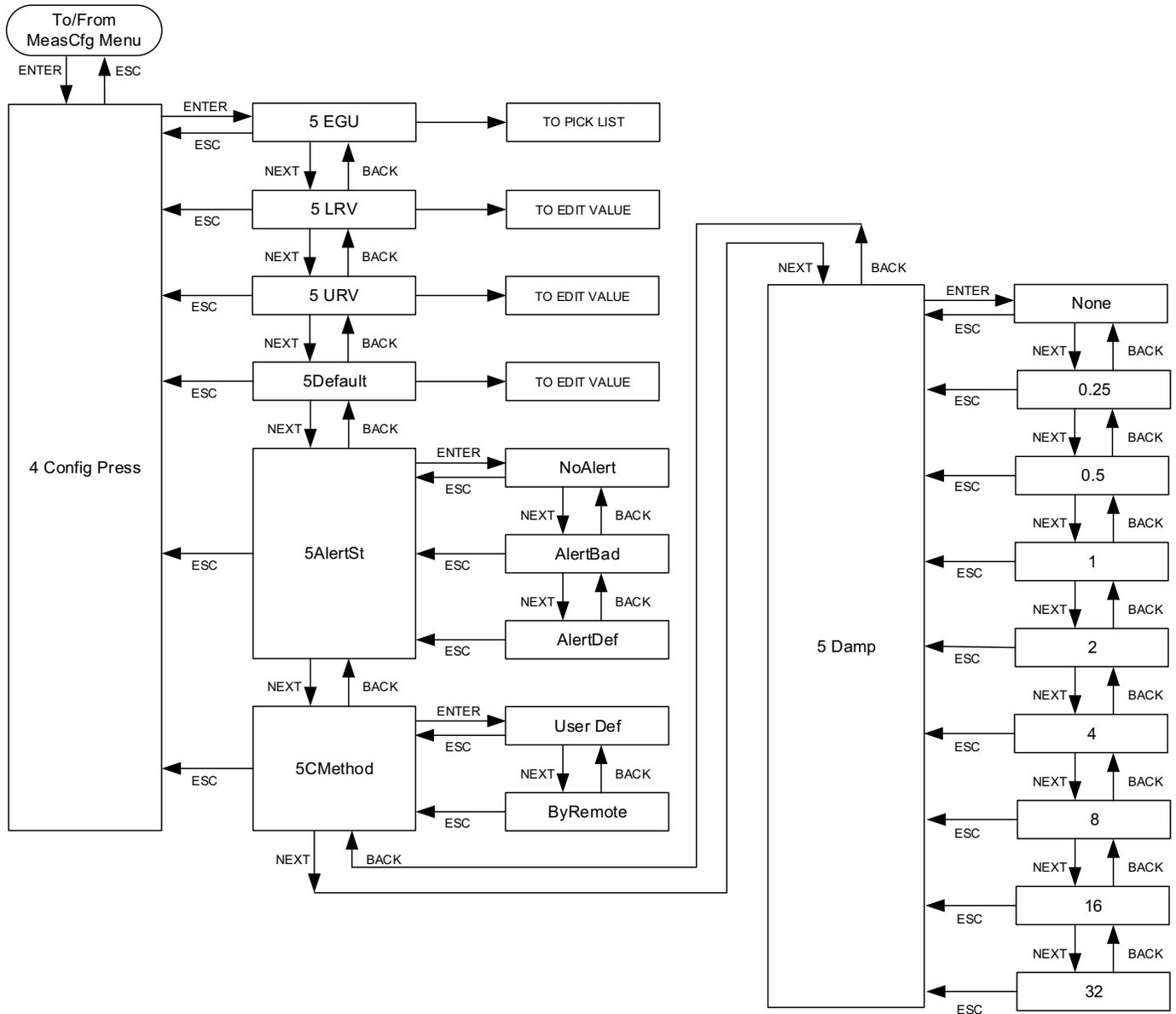


Figure 54 - Process Temperature Configuration Menu Diagram

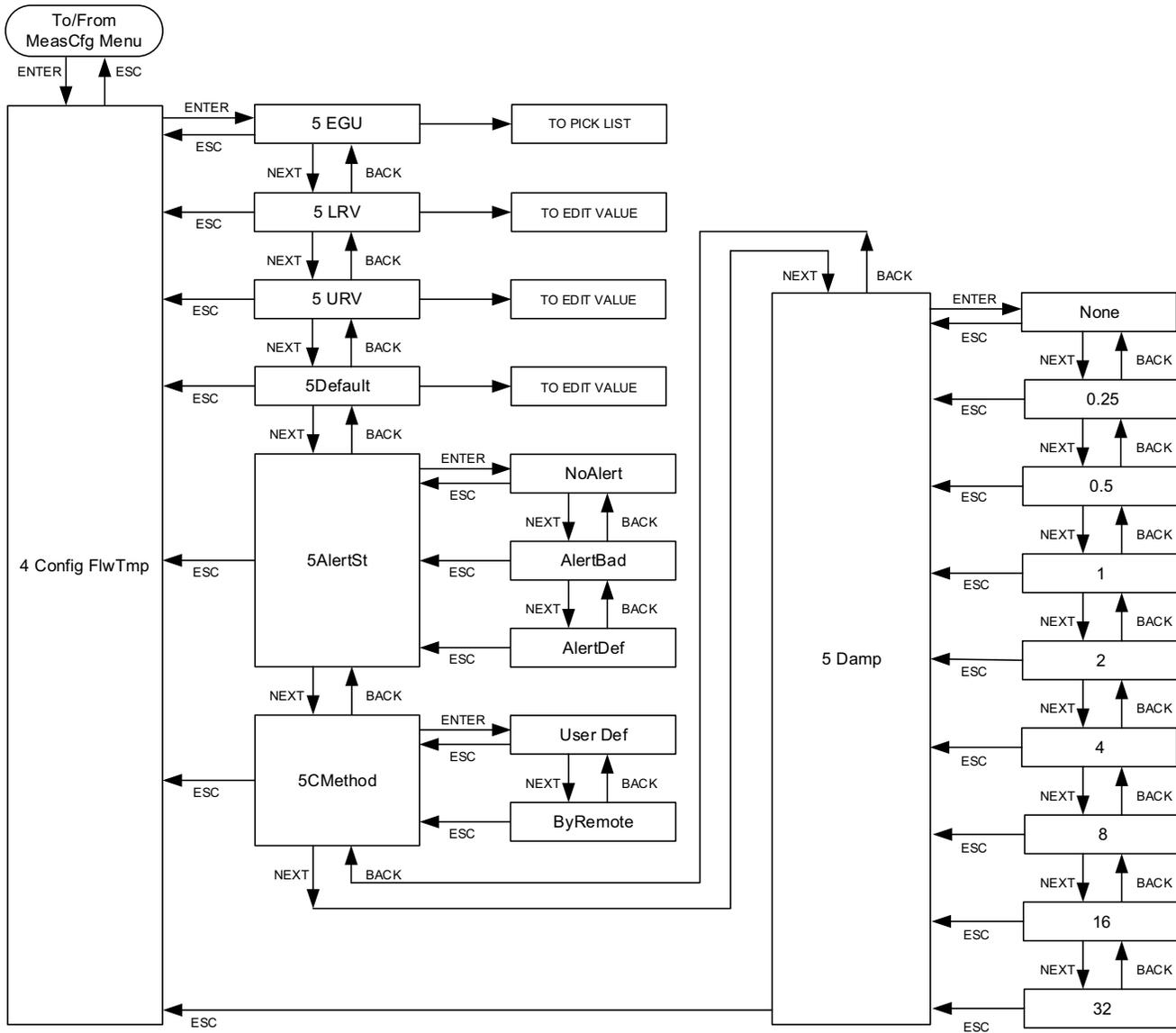


Figure 55 - Density Configuration Menu Diagram

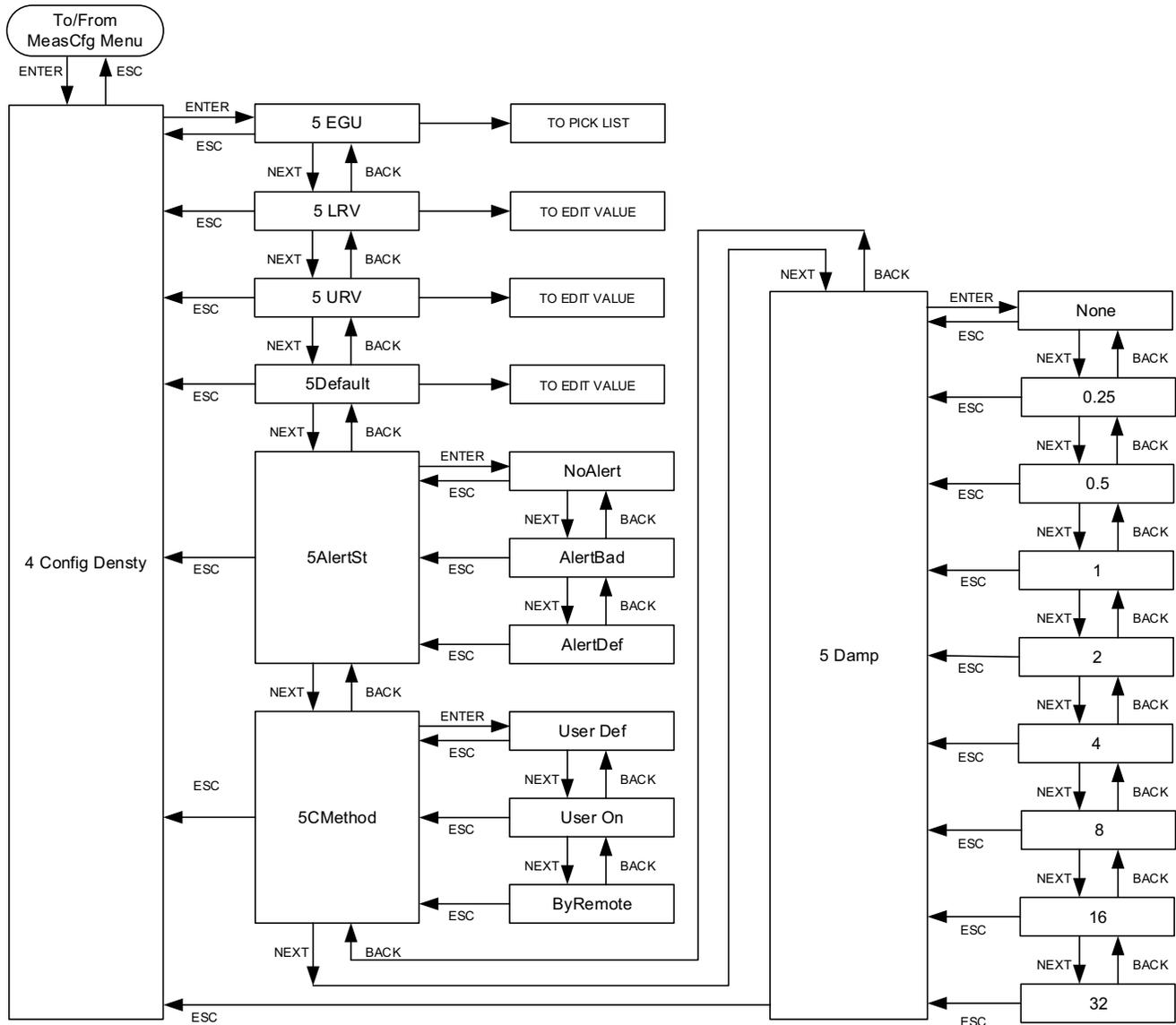


Figure 56 - Mass Flow (FlwMas) Configuration Menu Diagram

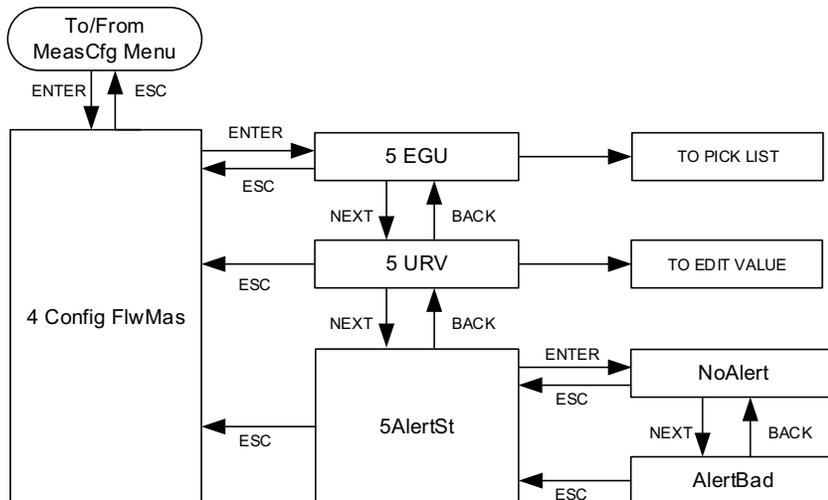


Figure 57 - Velocity (Velcty) Configuration Menu Diagram

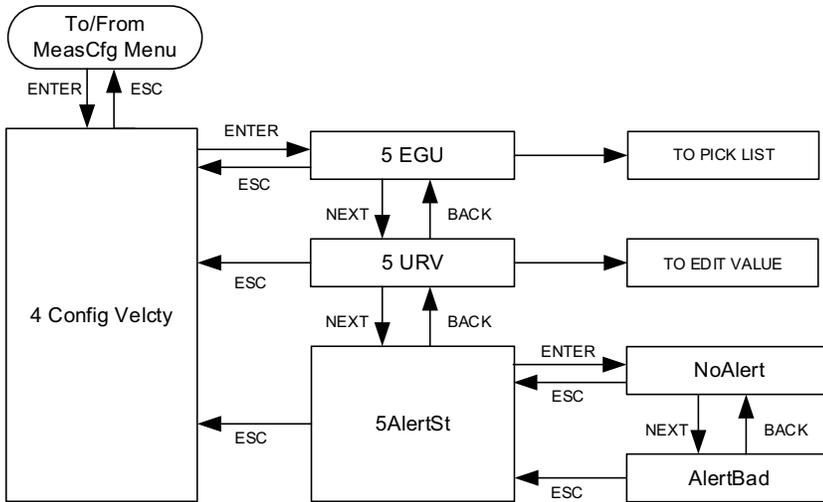


Figure 58 - Viscosity (Visc) Configuration Menu Diagram

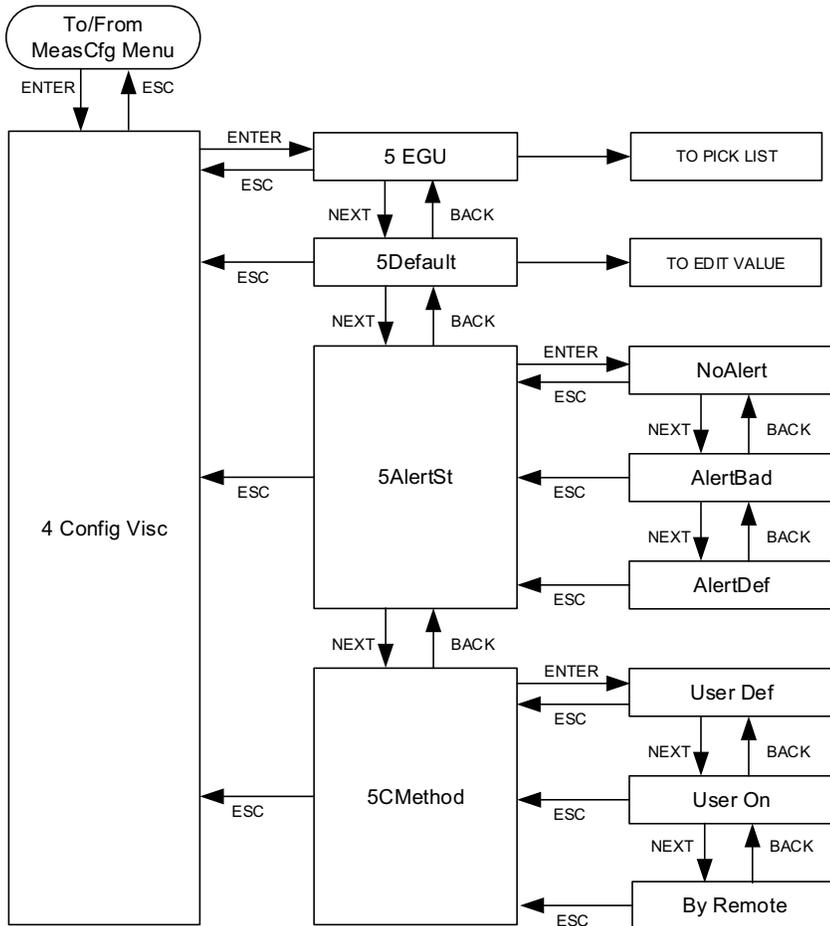


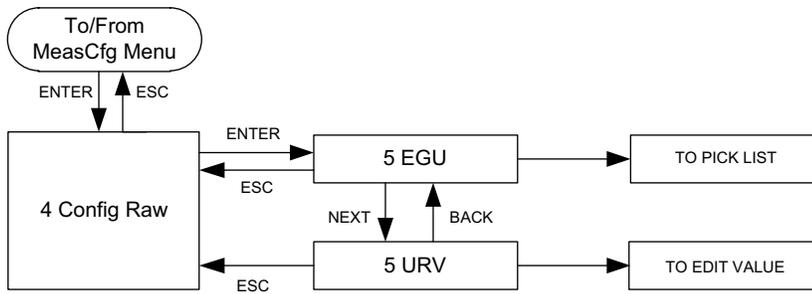
Figure 59 - Raw Vortex Frequency (Raw) Configuration Menu Diagram

Figure 60 - Electronic Temperature (EleTemp) Configuration Menu Diagram

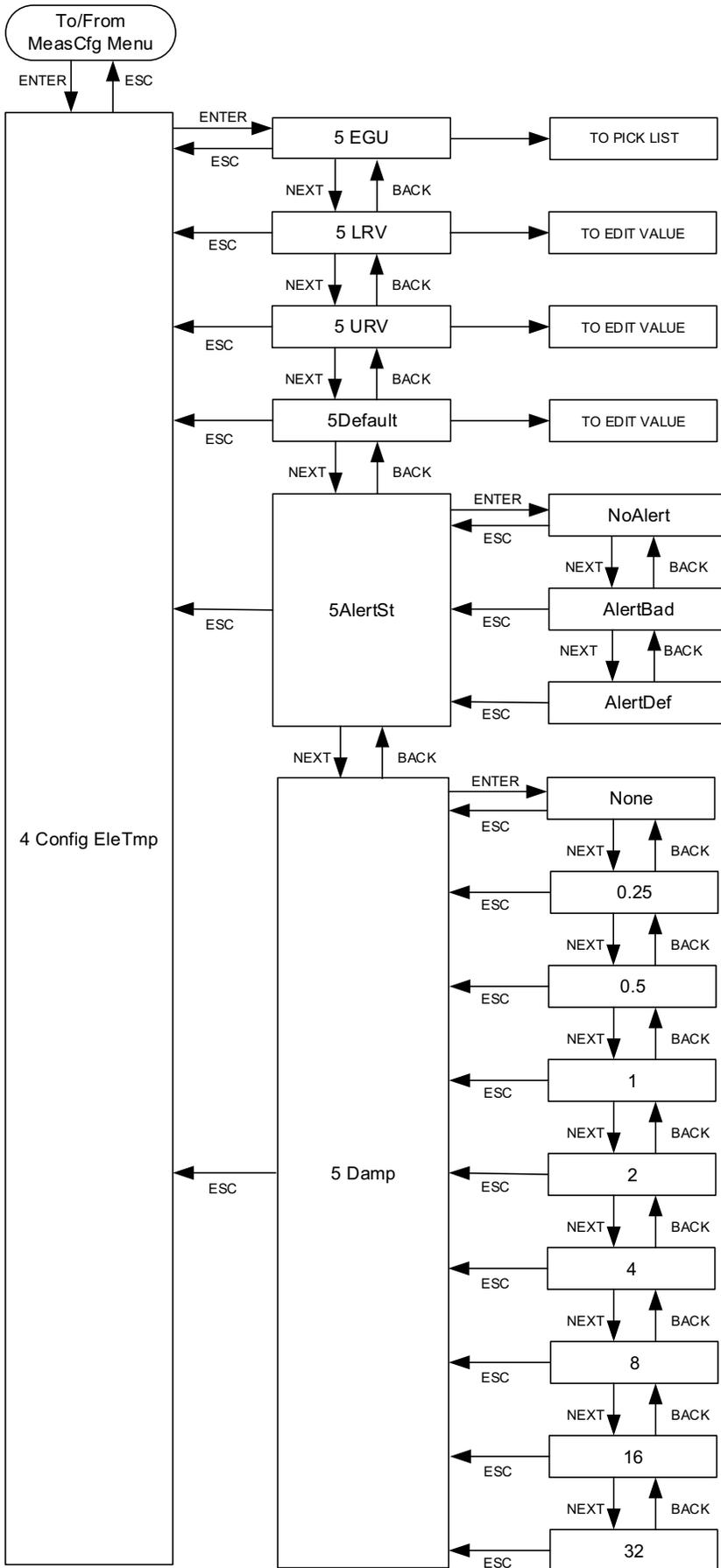


Figure 61 - Heat Content (HtCon) Configuration Menu Diagram

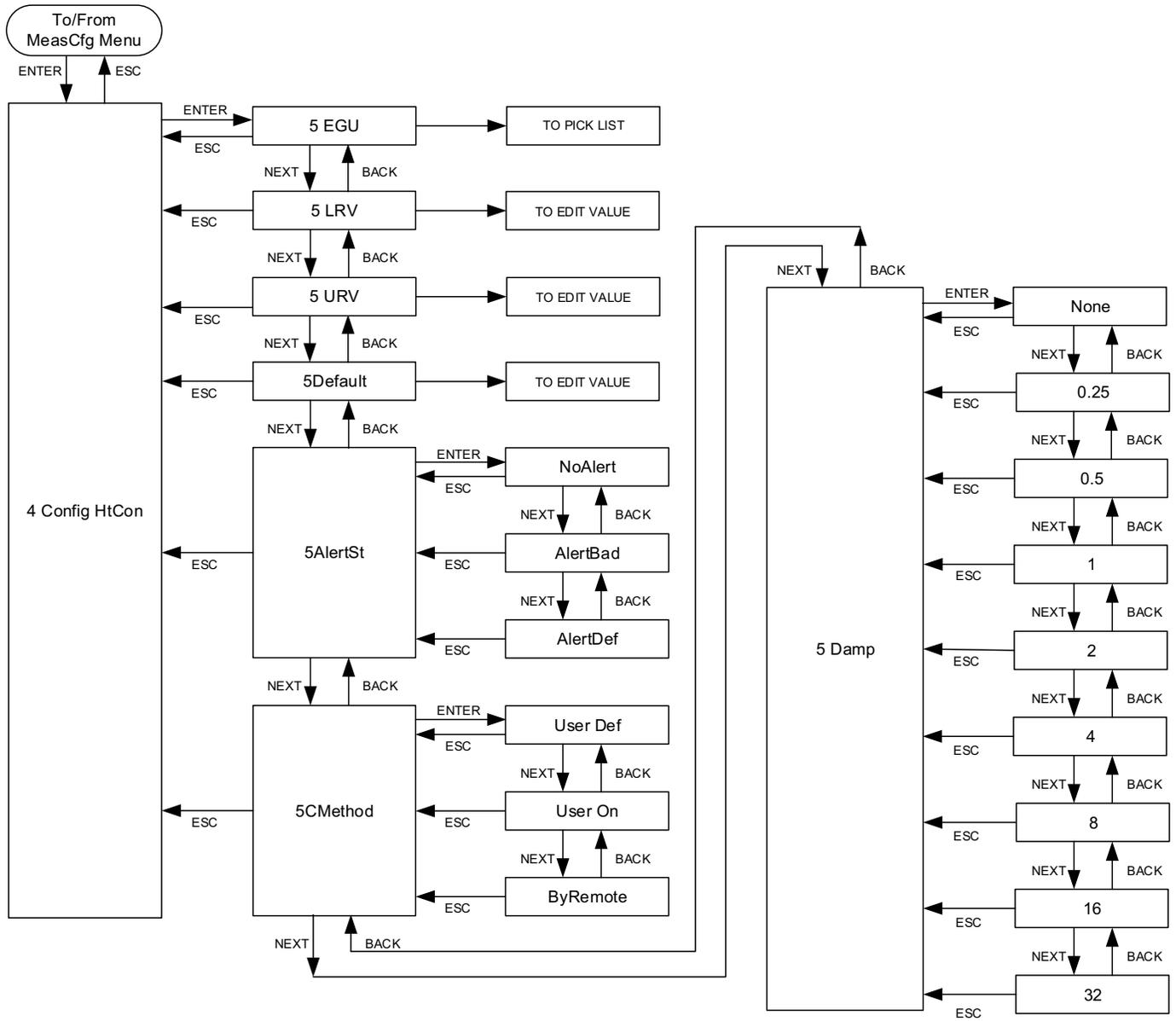


Figure 62 - Heat Flow (HtFlow) Configuration Menu Diagram

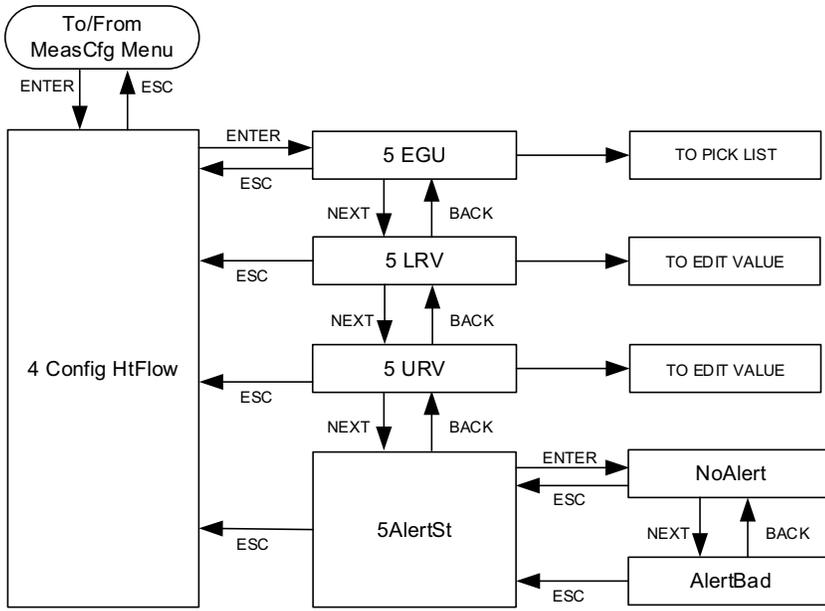
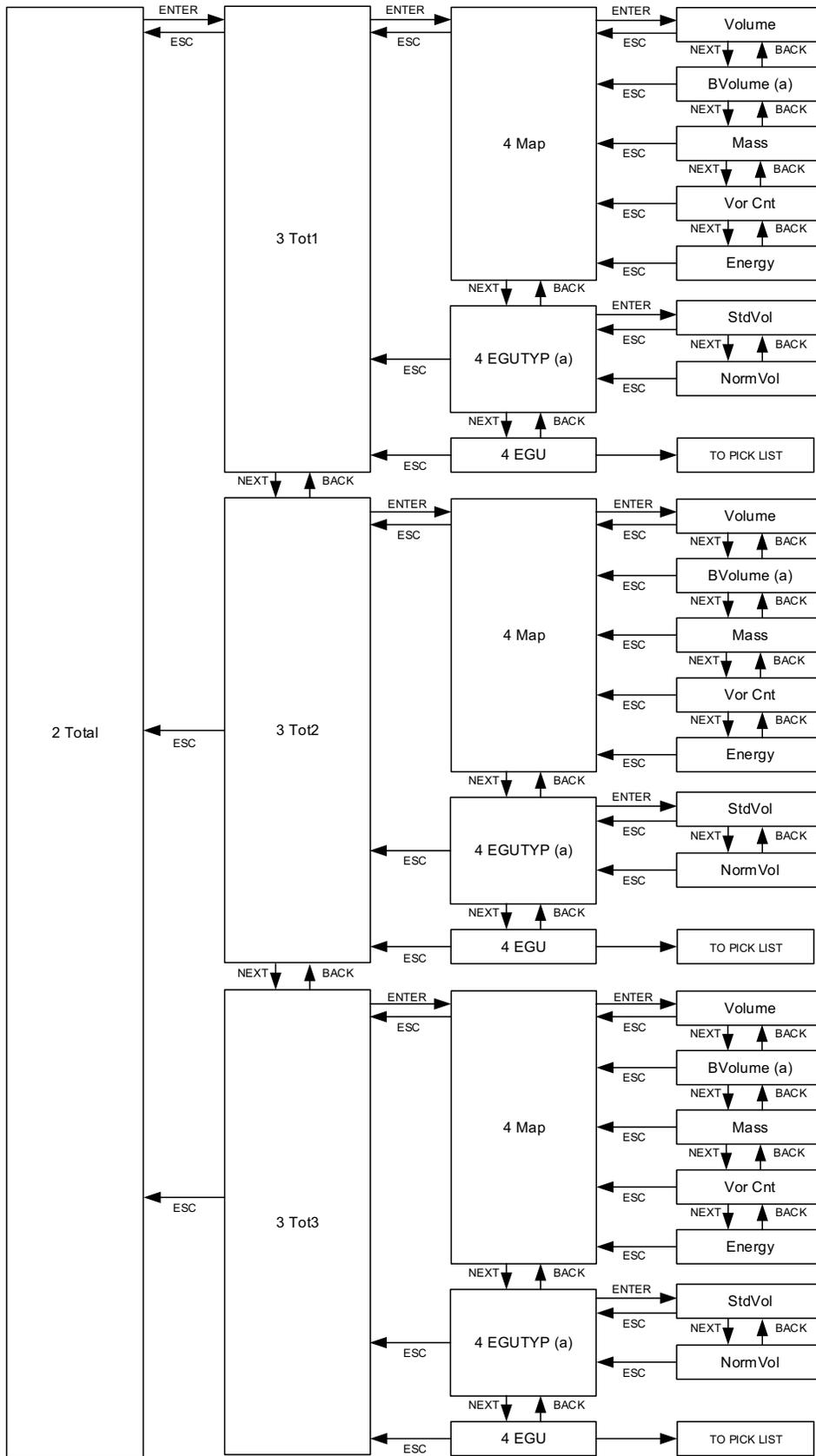


Figure 63 - Totalizer Configuration Menu Diagram



(a) BVolume and 4 EGUTYP are not available in the Steam personality.

Figure 64 - Modbus Communication Menu Diagram

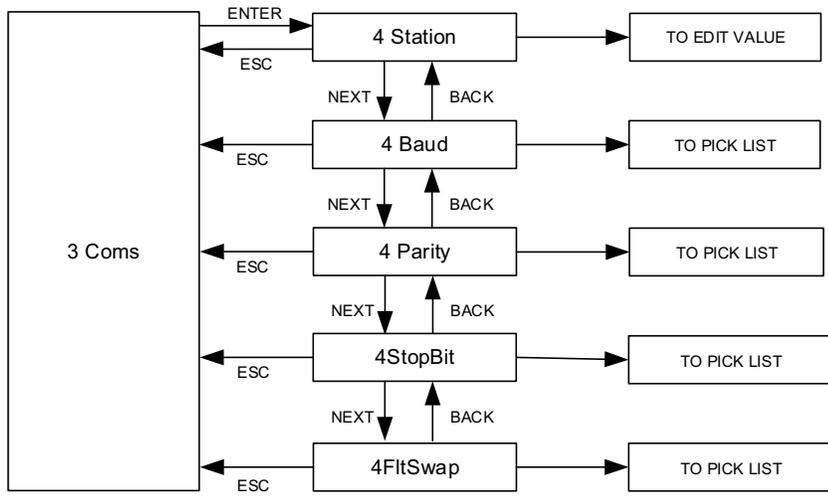
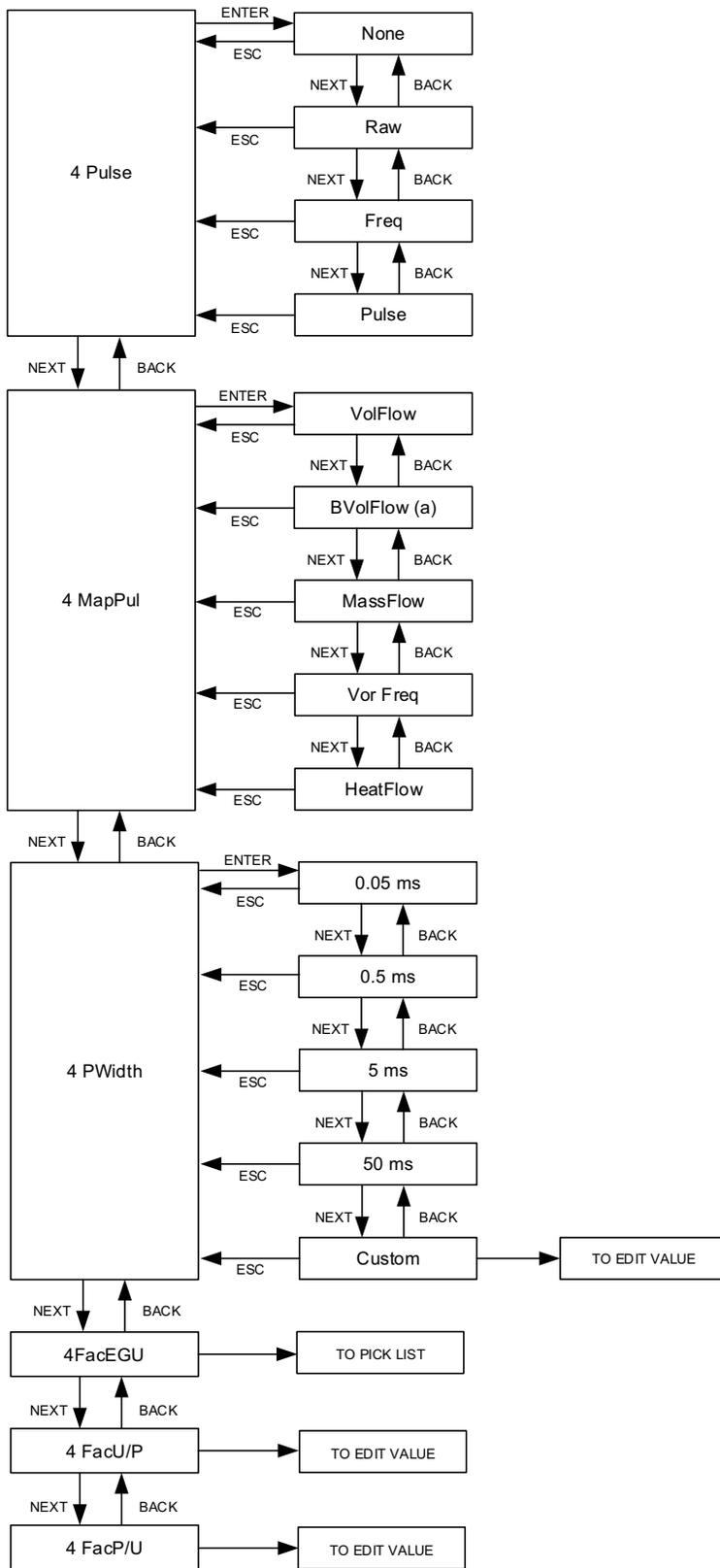
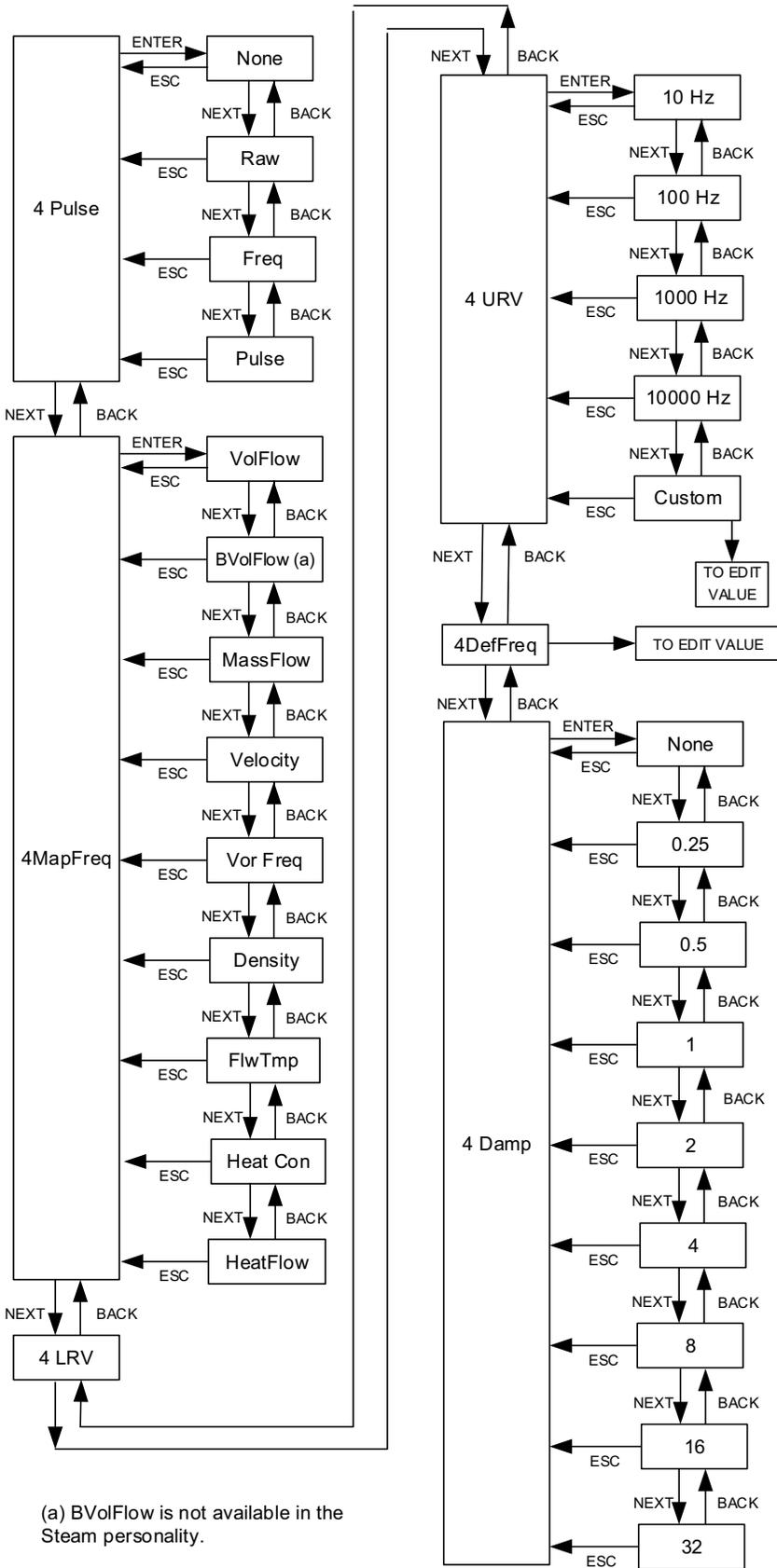


Figure 65 - Pulse Output, Pulse Mode Configuration Menu Diagram



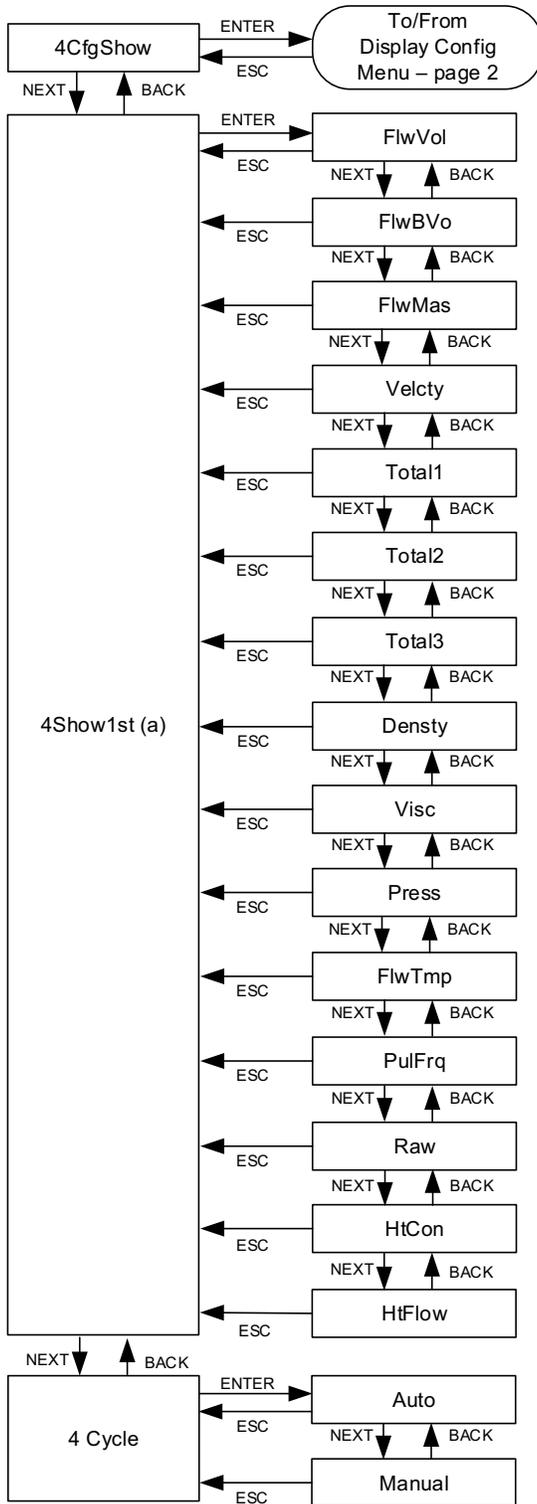
(a) BVolFlow is not available in the Steam personality.

Figure 66 - Pulse Output, Frequency Mode Configuration Menu Diagram



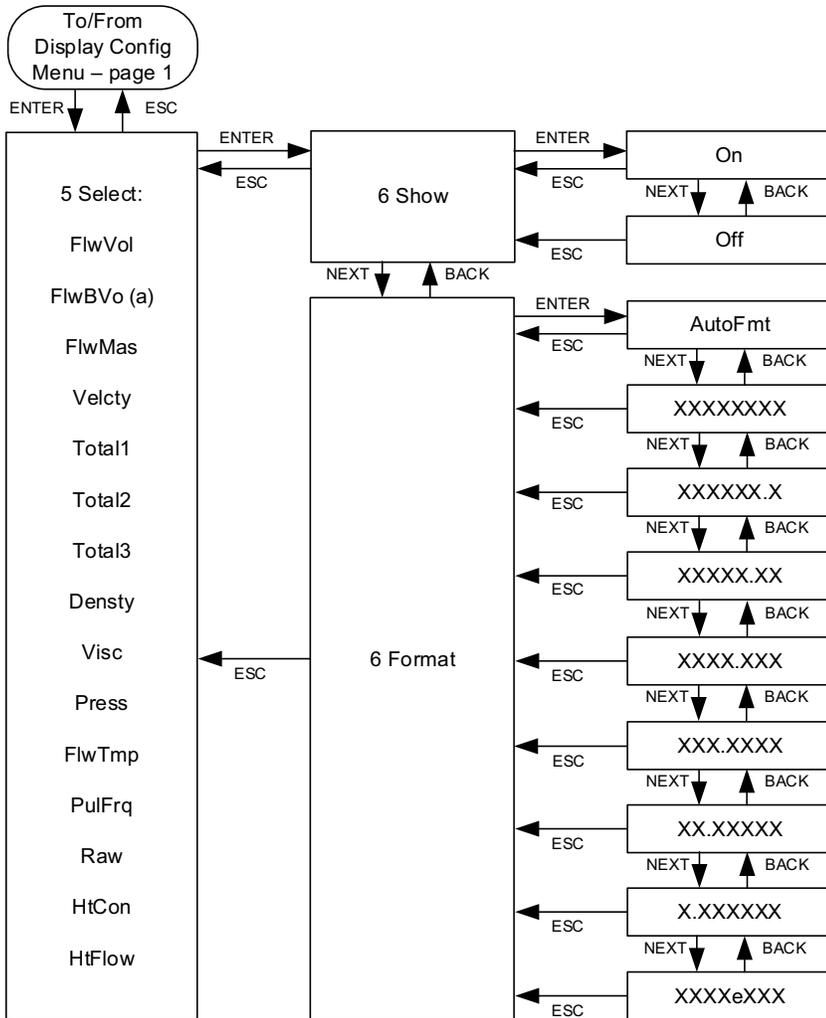
(a) BVolFlow is not available in the Steam personality.

Figure 67 - Display Configuration Menu Diagram (1 of 2)



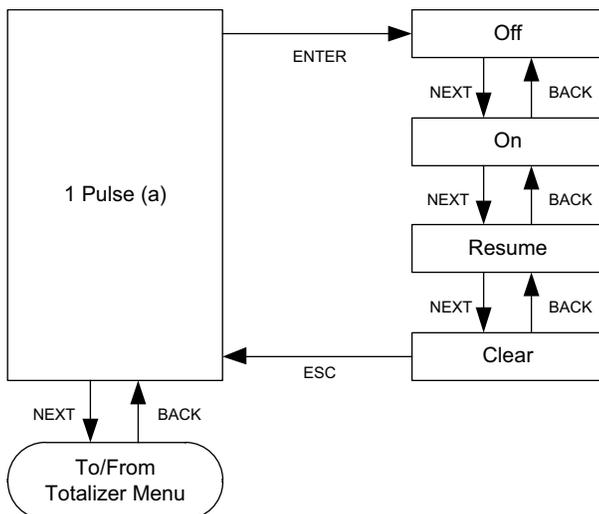
(a) If **Show** is set to **Off** for a particular measurement, that measurement does not appear in the **4Show1st** menu. **4Show1st** only shows those measurements that are configured to appear on the Home screen.

Figure 68 - Display Configuration Menu Diagram (2 of 2)



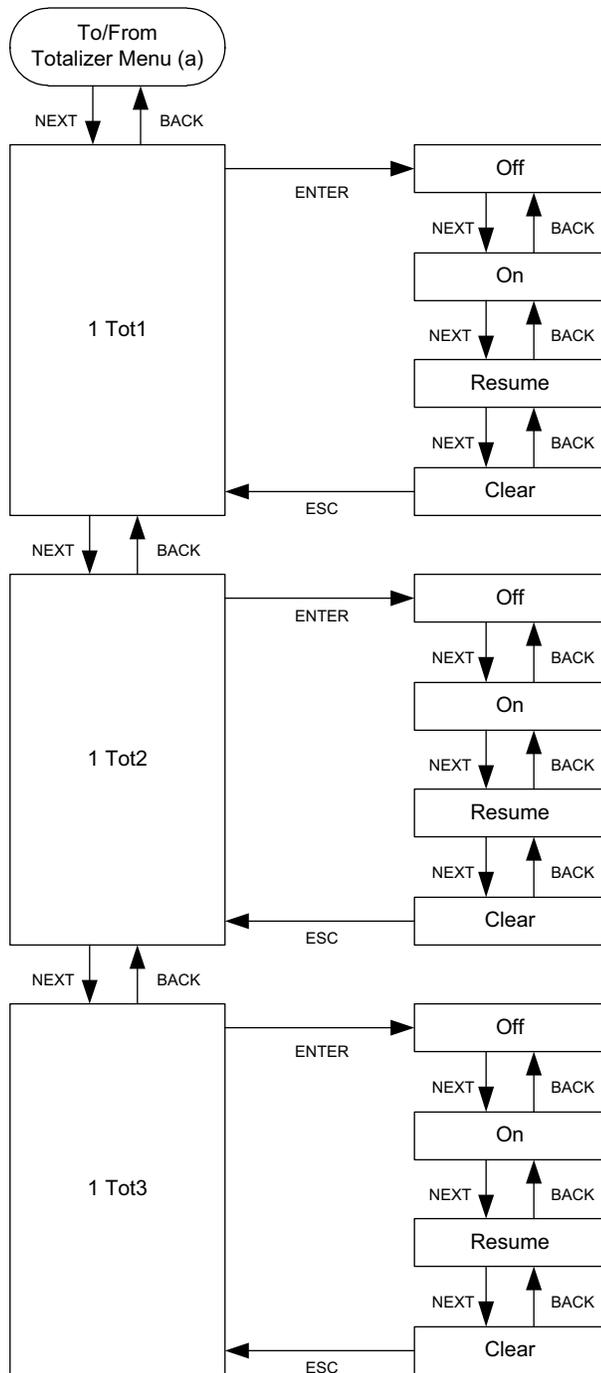
(a) FlwBVo is not available in the Steam personality.

Figure 69 - Pulse Actions Top Level Menu Diagram



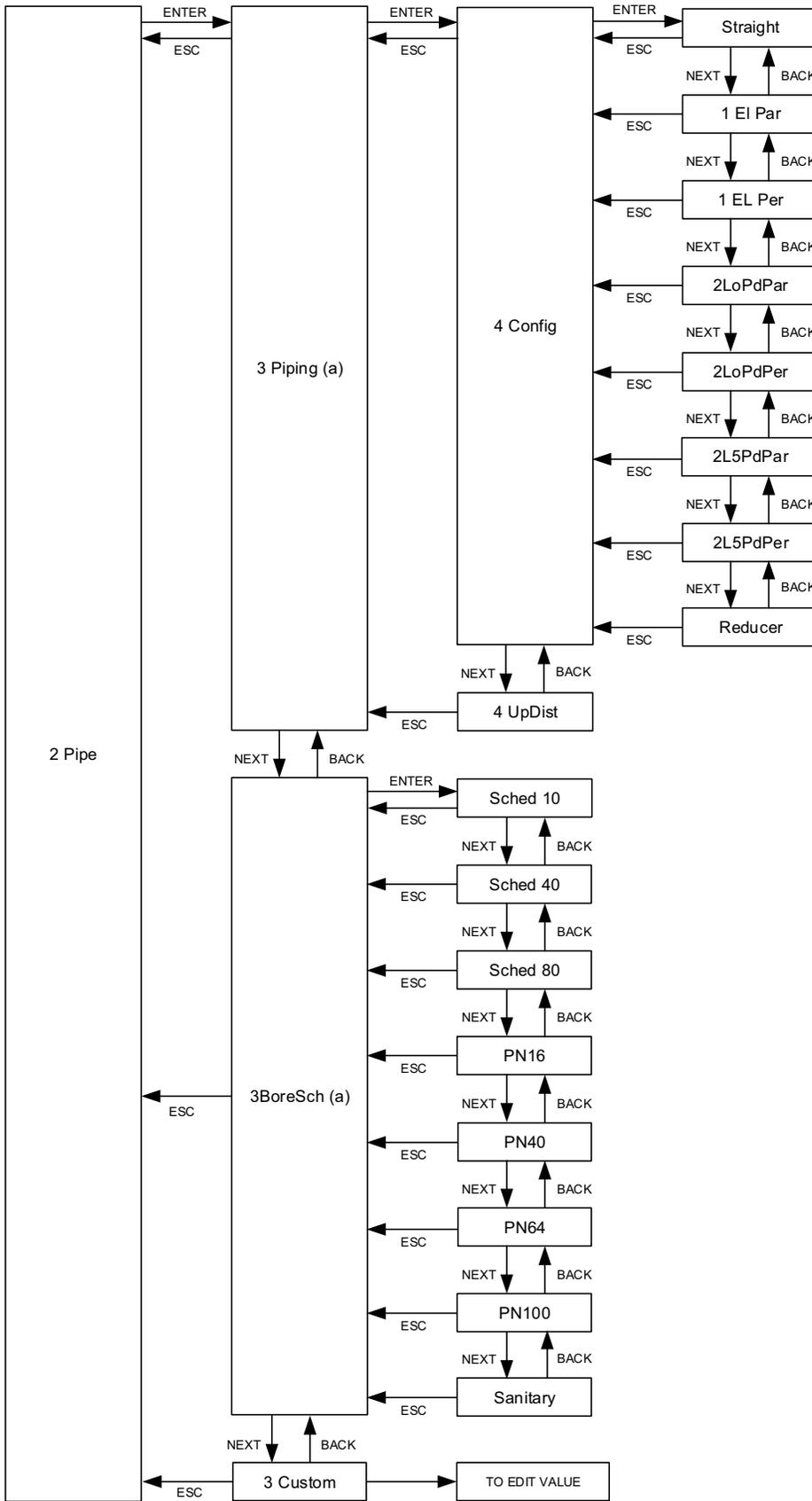
(a) Only available when Pulse Output is configured in Pulse mode.

Figure 70 - Totalizer Actions Top Level Menu Diagram



(a) Goes back to the **1 Pulse** menu only when Pulse Output is configured to Pulse Mode..

Figure 71 - Pipe Configuration Menu Diagram



(a) Not available for all model codes.

Figure 72 - NewMod Configuration Menu Diagram

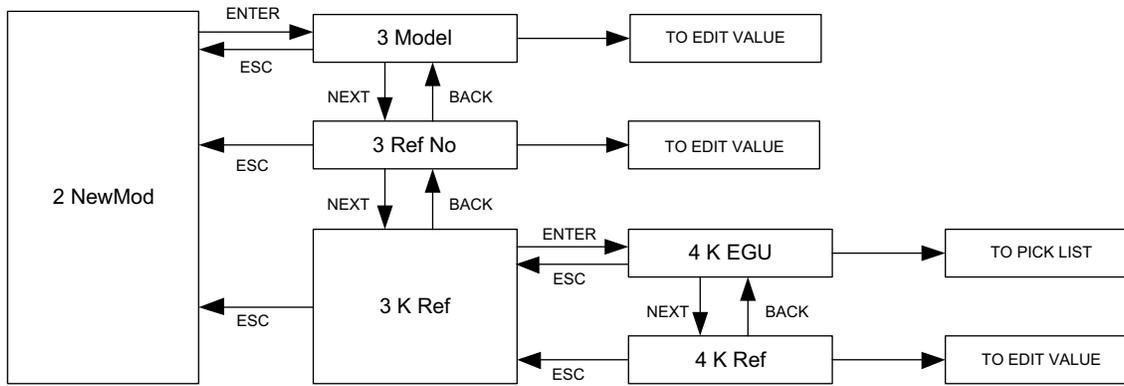
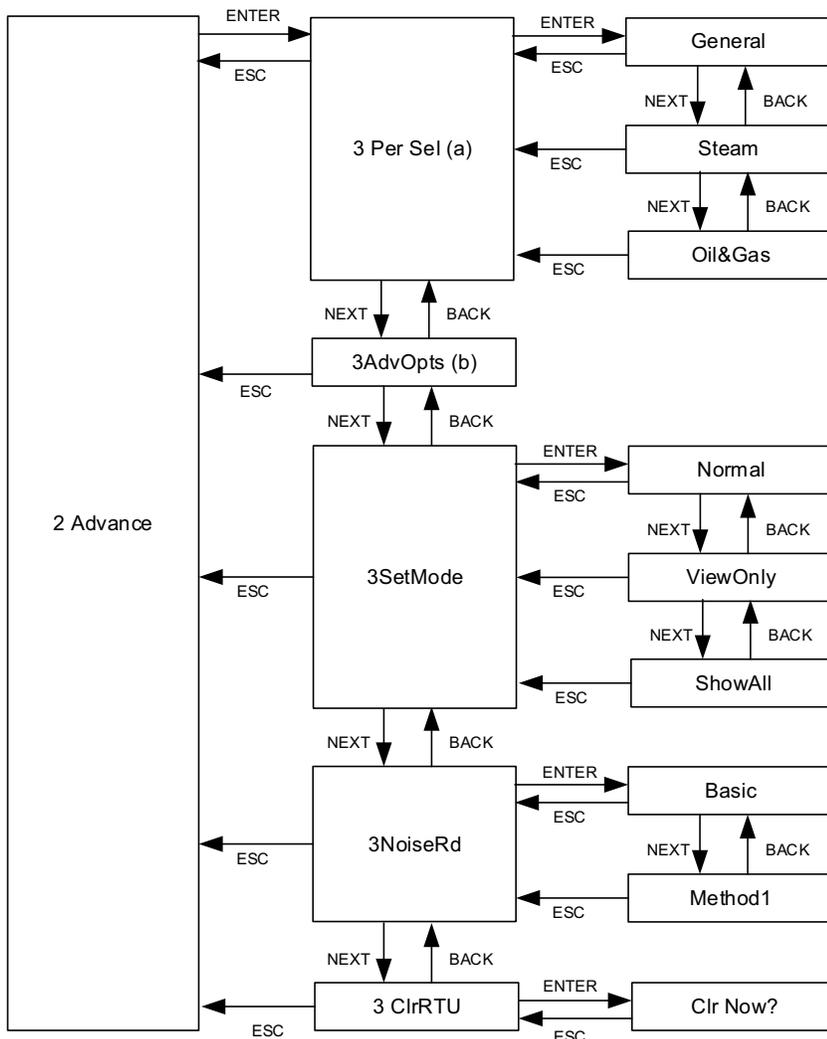


Figure 73 - Advanced Options Menu Diagram



- (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 74 - Resetting the Database Menu Diagram



Figure 75 - Password Configuration Menu Diagram

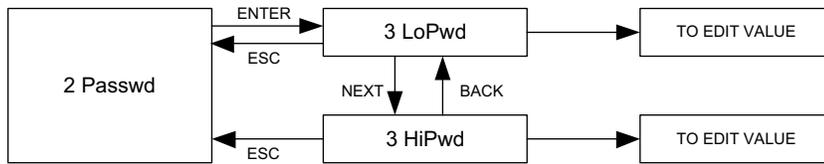
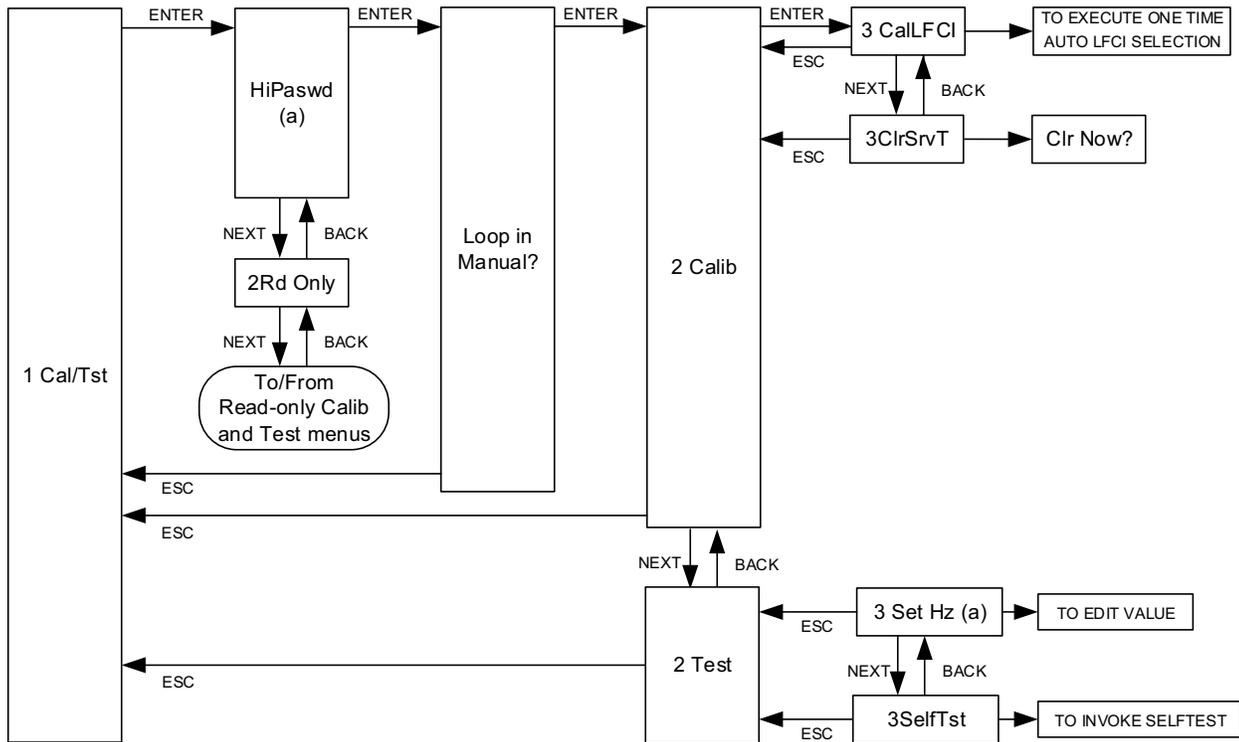


Figure 76 - Calibration/Test Menu Diagram



(a) Applies to Pulse Frequency Mode only.

Menus for the Oil & Gas Personality

Figure 77 - Status Menu Diagram

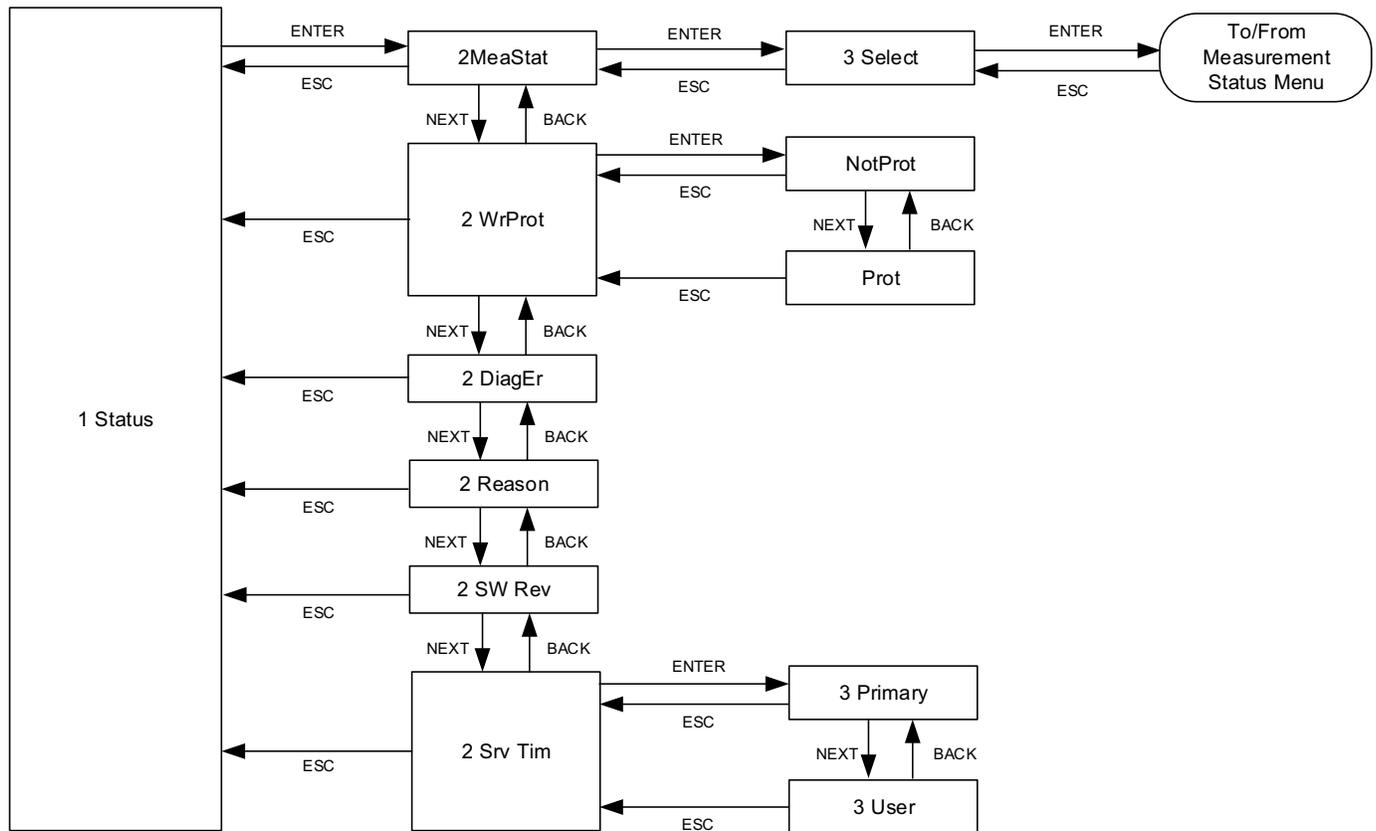


Figure 78 - Measurement Status Menu Diagram

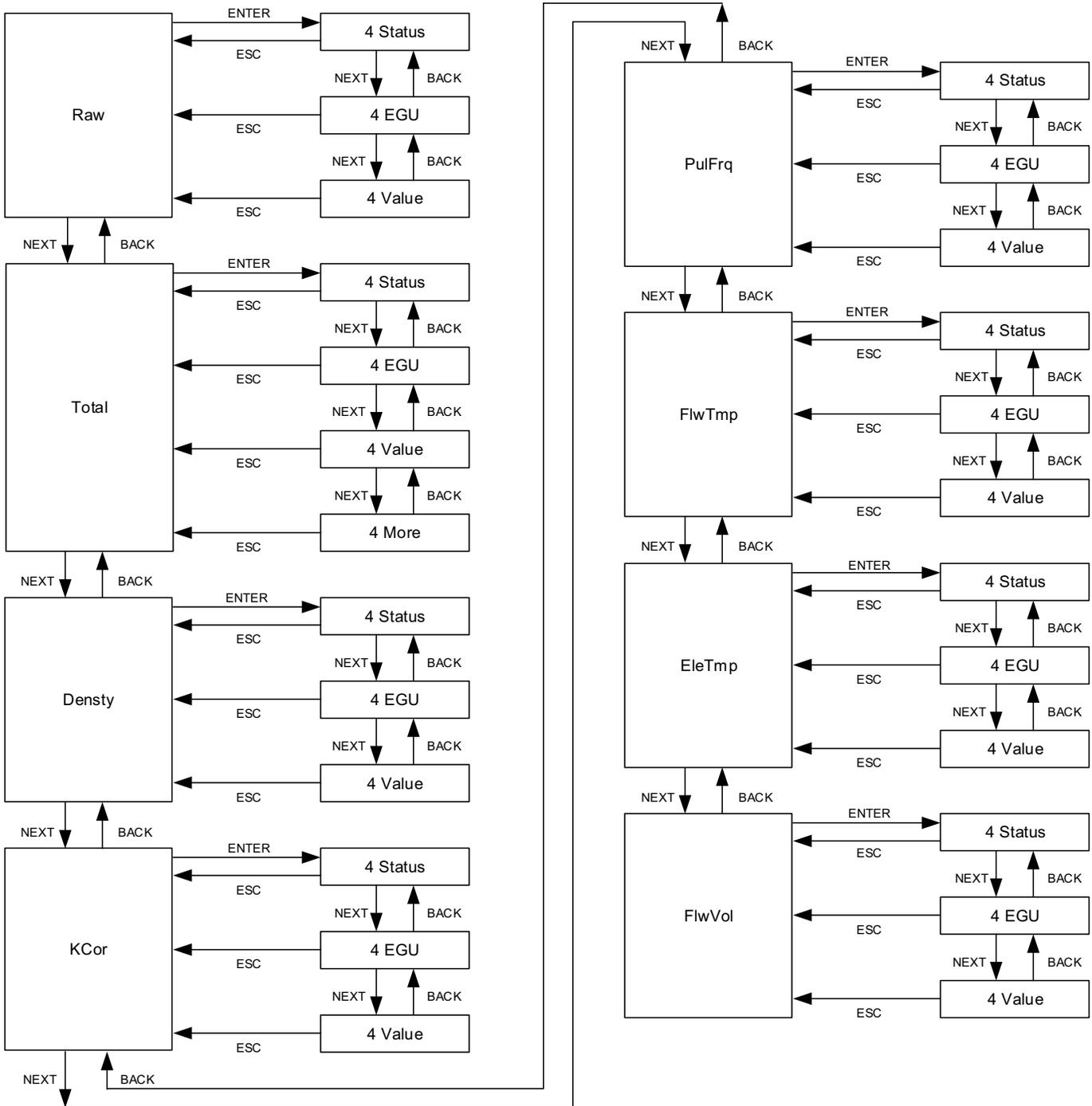


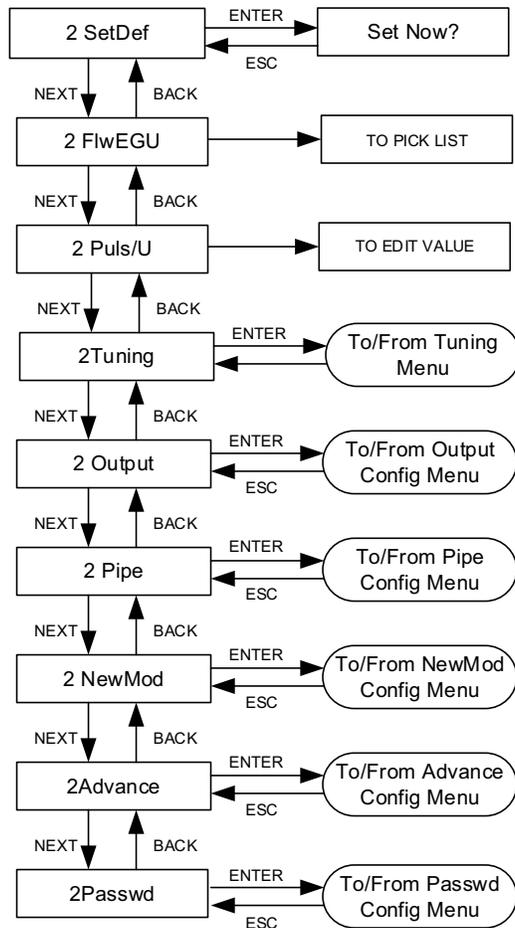
Figure 79 - Oil Gas Main Menu

Figure 80 - Tuning Menu Diagram

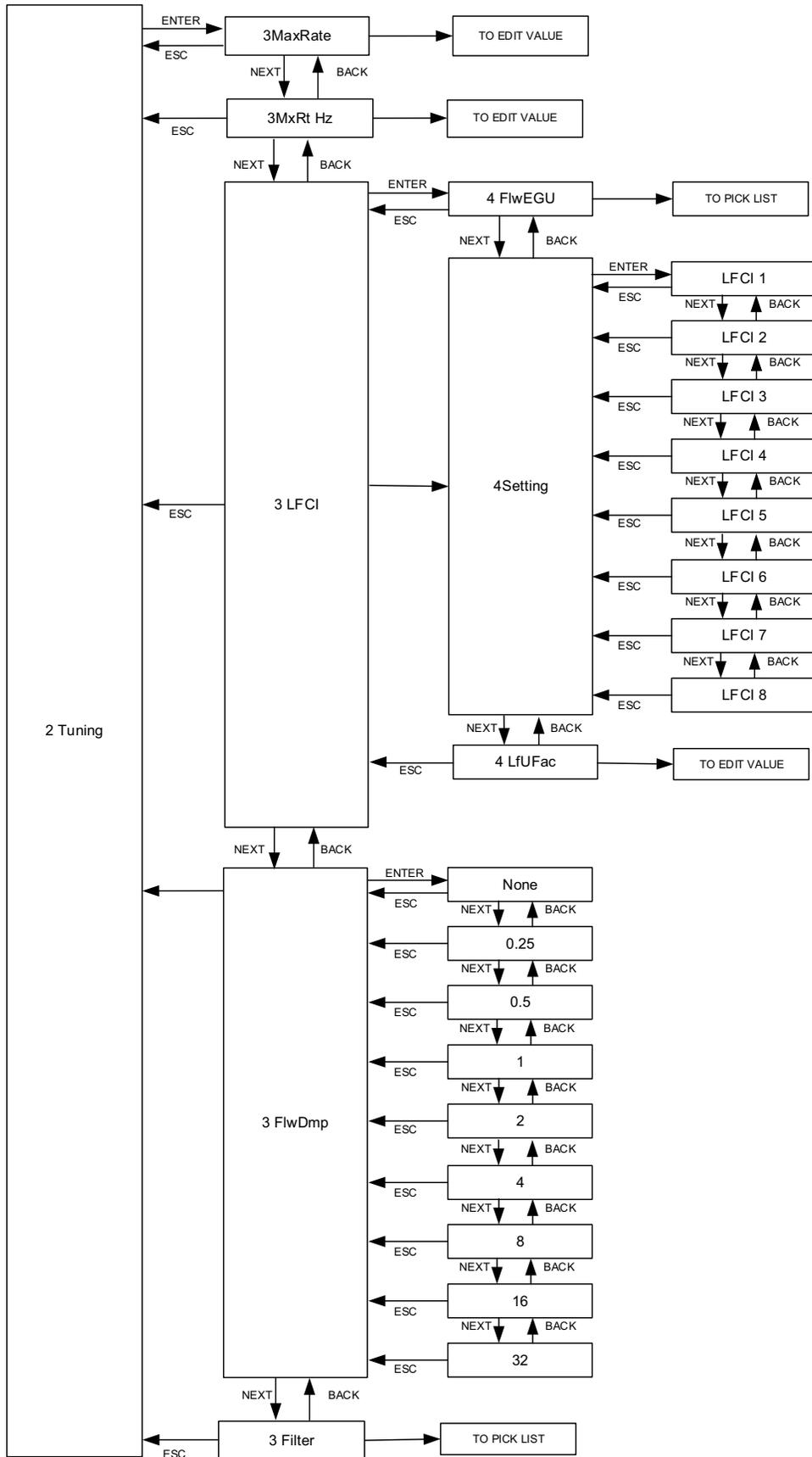


Figure 81 - Output Menus - Modbus Communication Menu Diagram

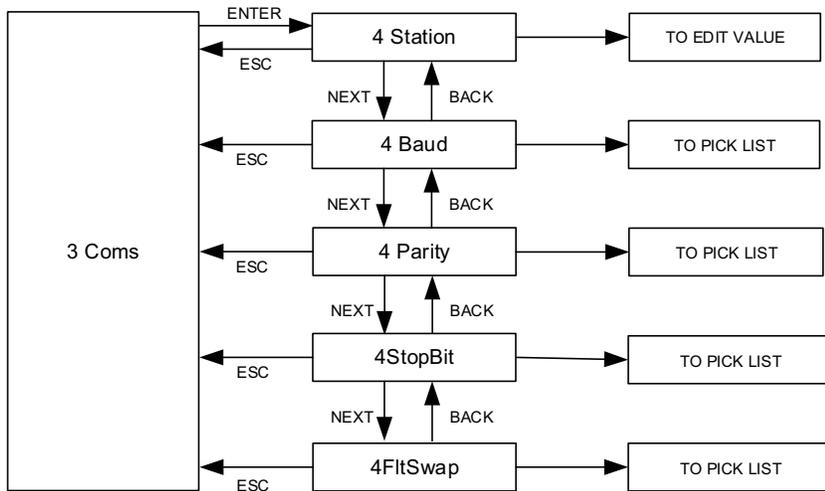
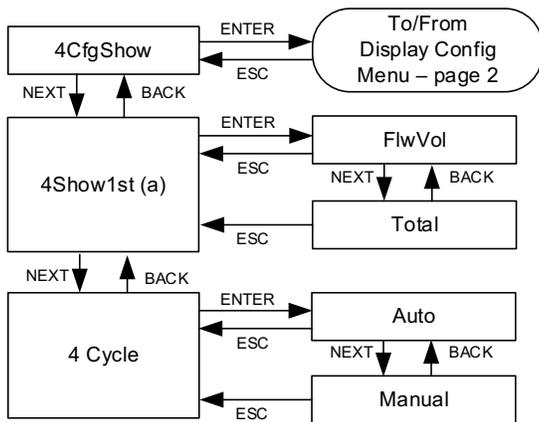


Figure 82 - Output Menus - Display Configuration Menu Diagram (1 of 2)



(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 83 - Output Menus - Display Configuration Menu Diagram (2 of 2)

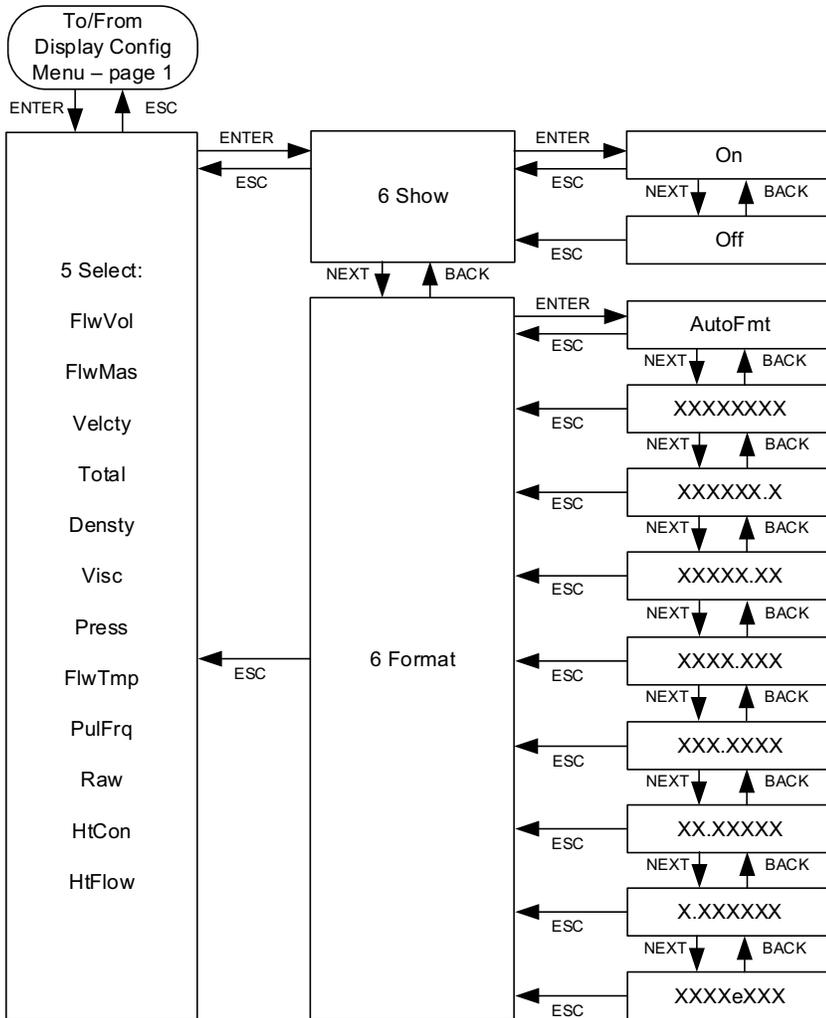
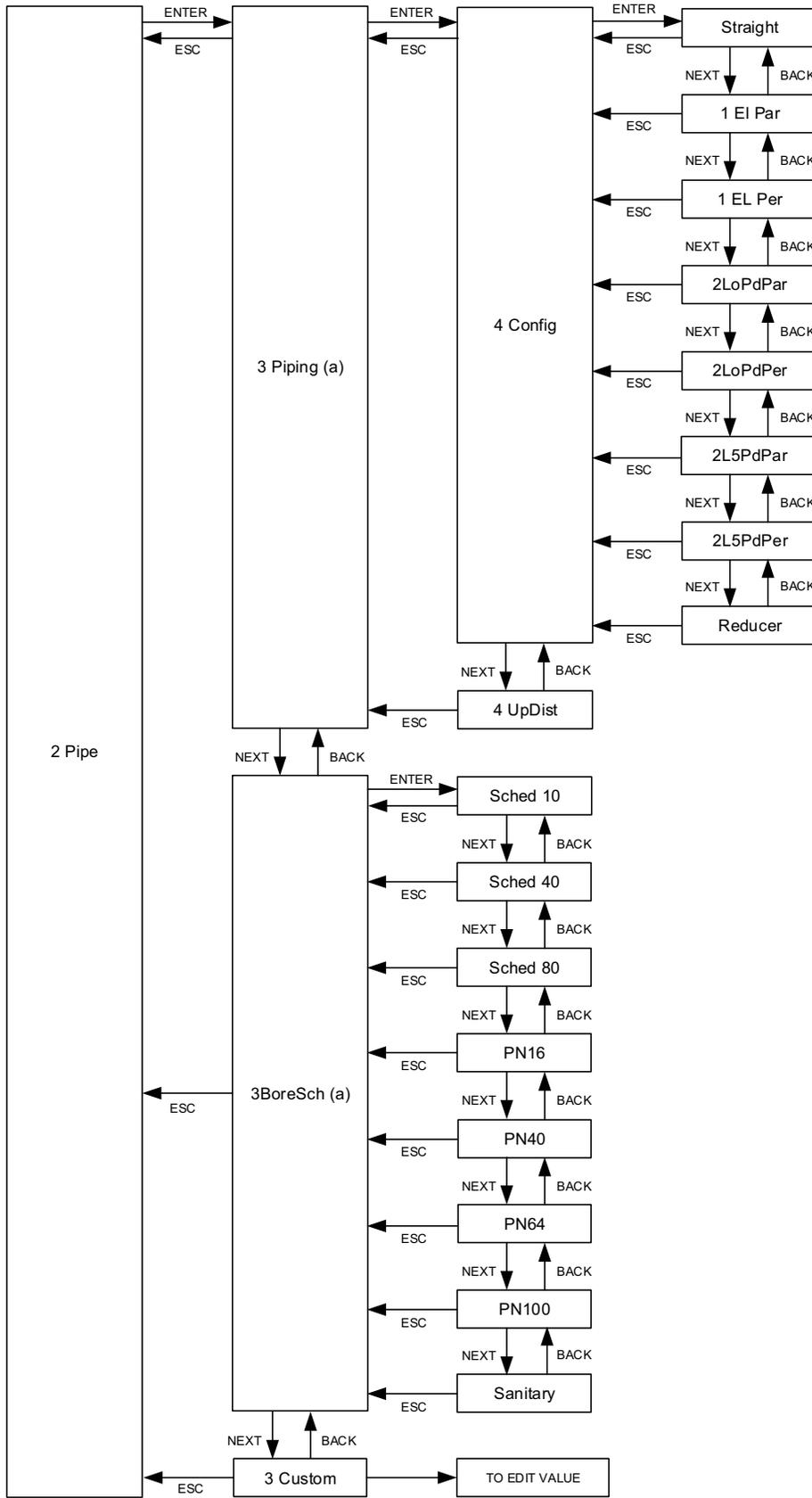


Figure 84 - Pipe Configuration Menu Diagram



(a) Not available for all model codes.

Figure 85 - NewMod Configuration Menu Diagram

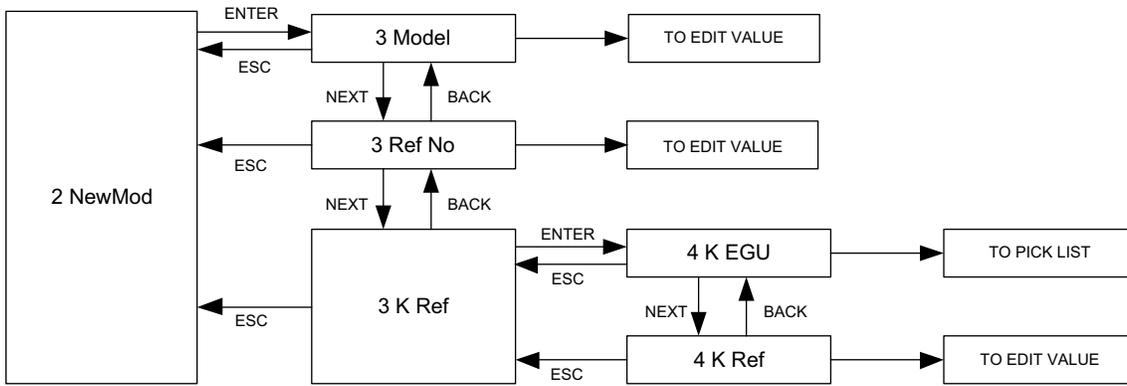
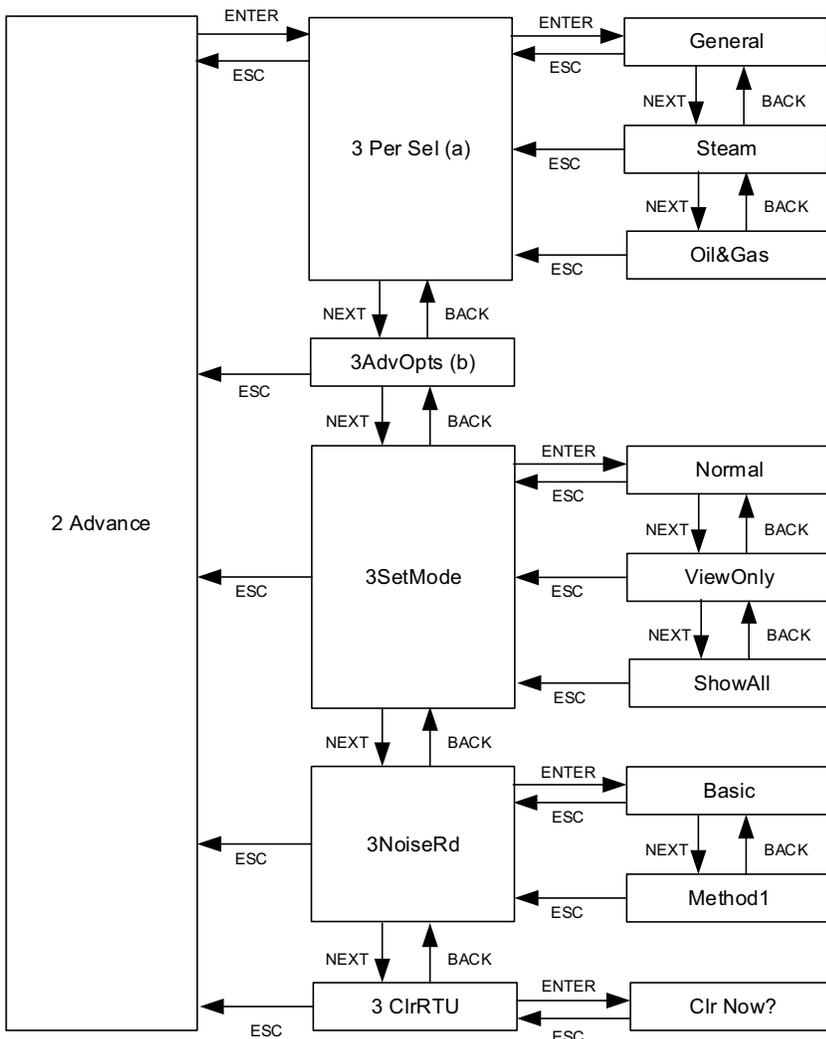


Figure 86 - Advanced Options Menu Diagram



- (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 87 - Password Configuration Menu Diagram

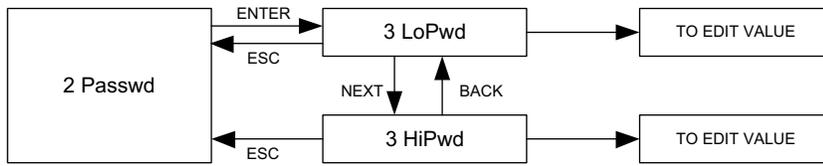
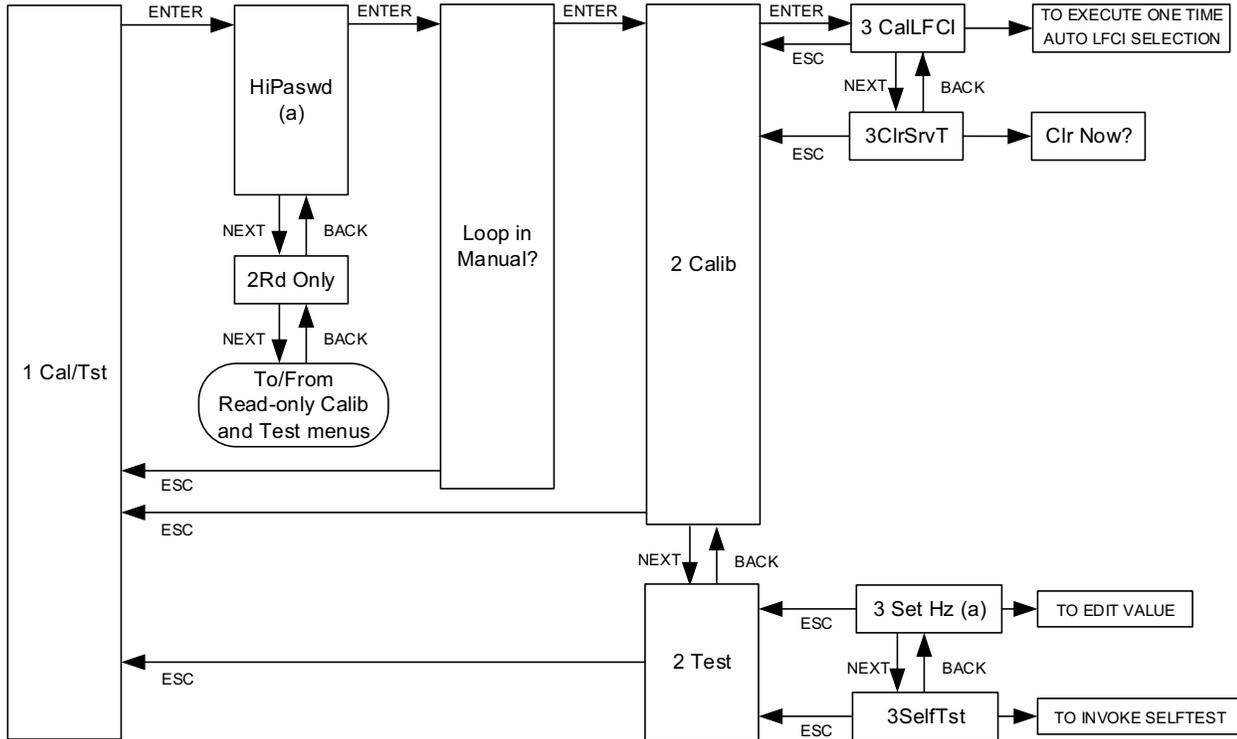
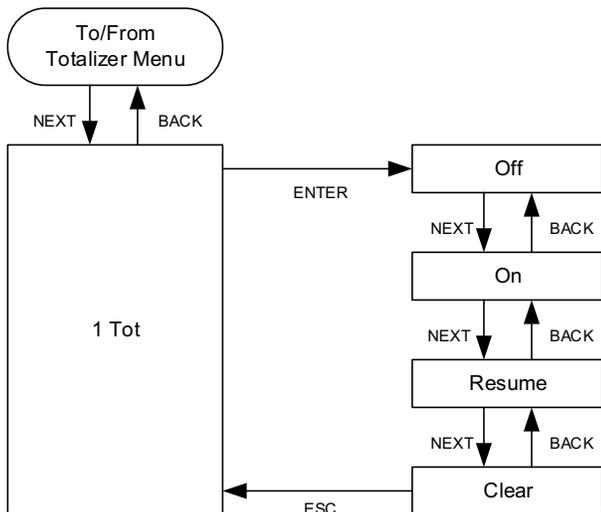


Figure 88 - Calibration/Test Menu Diagram



(a) Applies to Pulse Frequency Mode only.

Figure 89 - Totalizer Actions Top Level Menu Diagram



Modbus RTU Operation

Modbus RTU is a serial protocol that can be used in point-to-point or multidrop RS-485 networks. Modbus commands are used to read from and write to registers containing data.

Implementation of the Modbus RTU protocol in this product is based on the following documents:

- PI-MBUS-300 Rev B: Modicon/Gould Modbus Protocol Reference Guide
- Modbus Over Serial Line Specification and Implementation Guide V1.02
- Modbus Application Protocol Specification V1.1b3 at <http://www.modbus.org>

Modbus Commands

Table 58 - Command Function Codes

Command Function Code	Command Function	Description
1	Read coils	Read multiple coils.
3	Read registers	Read the contents of multiple registers. ⁴⁶
4		
5	Write a single coil	Set a single coil On or Off.
6	Write a single register	Change the contents of a single register.
8	Diagnostics	Perform diagnostic tests and return communication status information. Refer to <i>Diagnostic Command Options, page 142</i> .
15	Write multiple coils	Set multiple coils On or Off.
16	Write multiple registers	Change the contents of multiple registers.
17	Report server ID	Read device-specific identification.

- Modbus commands and responses are limited to a total of 256 bytes.
- Read/write registers consist of two bytes of data in MSB-LSB (most significant byte-least significant byte) order.
- A Modbus command to read multiple registers can access a contiguous block of registers (up to 125) in a single transaction.
- A Modbus command to write multiple registers can write a contiguous block of registers (up to 123) in a single transaction.
- For both read and write commands, the maximum register count is reduced by 1 when accessing floating point values.

Table 59 - Diagnostic Command Options

Diagnostic Option Code	Diagnostic Option	Description ⁴⁷
0	Return query data	Heartbeat; forces the server device to loopback this command as sent.
1	Restart communications	Performs a complete reset of the communication interface in the server device.

46. Although the Modbus specification distinguishes between commands 3 and 4, both commands are identical to the flowmeter.

47. All counts begin when power is cycled, communication is restarted (option 1), or diagnostic counters are cleared (option 10).

Table 59 - Diagnostic Command Options (Continued)

Diagnostic Option Code	Diagnostic Option	Description ⁴⁸
4	Force Listen Only mode	Server device ignores all messages sent to it until a restart communications command (option 1) is received. This can be used to take a problem device off the communications bus. Refer to <i>Listen Only Mode</i> , page 144.
10	Clear diagnostic counters	Sets all communication status counters to 0.
11	Return bus message count	Returns the number of Modbus messages read on the communications bus.
12	Return bus communication error count	Returns the number of CRC errors encountered by the server device.
13	Return bus exception count	Returns the number of exception responses returned by the server device. Refer to <i>Modbus Exception Codes</i> ⁴⁹ , page 143.
14	Return server message count	Returns the number of Modbus messages addressed to the server device.
15	Return server no response count	Returns the number of instances when the server device did not respond.
17	Return server busy count	Returns the number of instances when the server device could not perform the requested action because it was busy.
18	Return bus character overrun count	Returns the number of bytes lost by the server device.

Table 60 - Modbus Exception Codes⁵⁰

Code	Name	Description
01	Illegal function	The function code in the query is not supported by the server device.
02	Illegal data address	The data address in the query is not allowed for the server device.
03	Illegal data value	A data value in the query is not allowed for the server device.
04	Device failure	An error was detected while the server device was attempting to perform the requested action.

Modbus status registers are available to the communication host. These registers contain detailed information if the server device returns an exception code. See *Modbus Status Registers*, page 157.

Broadcast Messages

Station ID 0 is reserved for broadcast messages.

Server devices do not respond to broadcast messages. However, server devices do act on broadcast write requests.

48. All counts begin when power is cycled, communication is restarted (option 1), or diagnostic counters are cleared (option 10).

49. Modbus exception codes are defined by the Modbus RTU protocol. For more information about the Modbus RTU protocol, visit <http://www.modbus.org>. See for additional references.

50. Modbus exception codes are defined by the Modbus RTU protocol. For more information about the Modbus RTU protocol, visit <http://www.modbus.org>. See *Modbus RTU Operation*, page 142 for additional references.

Listen Only Mode

In Listen Only mode, the transmitter does not act upon nor respond to any command it receives except for the Restart Communications command.

To enter Listen Only mode, use command code 8 (Diagnostics), diagnostic function option 4 (Force Listen Only Mode).

To exit Listen Only mode, do any of the following:

- Use command code 8 (Diagnostics), diagnostic function option 1 (Restart Communications). This command brings the transmitter back to normal operation on the Modbus network.
- Cycle power to the transmitter.
- Restart communications with a restart/reset. The transmitter attempts to reinitialize the communication channel.

Registers

Table 61 - Data Formats

Type	Registers Required	Description								
Char	1	Two ASCII characters per register								
UInt16	1	One unsigned 16-bit integer in the range 0 to 65535								
Float	2	<p>Floating point numbers are in the IEEE 754 format. Numbers are made up of one sign bit (S), eight exponent bits (E), and 23 mantissa bits (M). A number consists of four bytes as shown below:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Byte A</th> <th>Byte B</th> <th>Byte C</th> <th>Byte D</th> </tr> </thead> <tbody> <tr> <td>SEEE EEEE</td> <td>EMMM MMMM</td> <td>MMMM MMMM</td> <td>MMMM MMMM</td> </tr> </tbody> </table> <p>Floating-point values are stored in two consecutive registers. Both registers must be read or written in the same Modbus command. Not doing so results in an exception response.</p> <p>The flowmeter uses the little endian format for floating point values. The transmission of the floating point value begins with the least significant byte and ends with the most significant byte.</p>	Byte A	Byte B	Byte C	Byte D	SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM
Byte A	Byte B	Byte C	Byte D							
SEEE EEEE	EMMM MMMM	MMMM MMMM	MMMM MMMM							

Host-specific formatting notes:

- These Modbus register addresses are “1-based.” Modbus host software that follows this convention automatically subtracts 1 from any register address before sending it in a command to a remote device. If your host software does not perform this function, subtract 1 from the register addresses before you use them.
- Some host systems require that the register addresses be entered in a specific format, such as 3xxxx for read-only, and 4xxxx for read/write or write-only.

Measurement Registers

Table 62 - Registers for Measurements

Name	Address	Type	Registers	Read/Write ⁵¹
Totalizer 1	500	Float	2	RO
Totalizer 1 Rollover	502	Float	2	RO
Totalizer 2	504	Float	2	RO
Totalizer 2 Rollover	506	Float	2	RO
Totalizer 3	508	Float	2	RO
Totalizer 3 Rollover	510	Float	2	RO
Pulse Output	512	Float	2	RO
Volume Rate	514	Float	2	RO
Volume Base Rate	516	Float	2	RO
Mass Rate	518	Float	2	RO
Process Temperature	520	Float	2	RO
Velocity	522	Float	2	RO
Power	524	Float	2	RO
Pressure	526	Float	2	RO
Density	528	Float	2	RO
Viscosity	530	Float	2	RO
Enthalpy	532	Float	2	RO
Reynolds	534	Float	2	RO
Electronics Temperature	536	Float	2	RO
K Corrected	538	Float	2	RO

User Default Registers

These are the default values to which the flowmeter sets the fluid measurement value if there is an alert condition.

Table 63 - Registers for User Defaults

Name	Address	Type	Registers	Read/Write ⁵¹
Process Temperature Default	1000	Float	2	RW
Pressure Default	1002	Float	2	RW
Density Default	1004	Float	2	RW
Viscosity Default	1006	Float	2	RW
Enthalpy Default	1008	Float	2	RW
Electronics Temperature Default	1010	Float	2	RW

51. RO=Read Only; WO=Write Only; RW=Read/Write.

Remote Measurement Input Registers

Table 64 - Registers for Remote Measurement Input

Name	Address	Type	Registers	Read/Write ⁵²
Process Temperature Remote Value	1500	Float	2	RW
Pressure Remote Value	1502	Float	2	RW
Density Remote Value	1504	Float	2	RW
Viscosity Remote Value	1506	Float	2	RW
Enthalpy Remote Value	1508	Float	2	RW

Damping Registers

Table 65 - Registers for Dampings

Name	Address	Type	Registers	Read/Write ⁵²
Pulse Frequency Damping	2000	Float	2	RW
Volume Rate Damping	2002	Float	2	RW
Process Temperature Damping	2004	Float	2	RW
Pressure Damping	2006	Float	2	RW
Density Damping	2008	Float	2	RW
Enthalpy Damping	2010	Float	2	RW
Electronics Temperature Damping	2012	Float	2	RW

Upper Limit Registers

Table 66 - Registers for Upper Limits

Name	Address	Type	Registers	Read/Write ⁵²
Pulse Frequency URV	2300	Float	2	RW
Volume Rate URV	2302	Float	2	RW
Volume Base Rate URV	2304	Float	2	RW
Mass Rate URV	2306	Float	2	RW
Process Temperature URV	2308	Float	2	RW
Velocity URV	2310	Float	2	RW
Power URV	2312	Float	2	RW
Pressure URV	2314	Float	2	RW
Density URV	2316	Float	2	RW
Enthalpy URV	2318	Float	2	RW
Electronics Temperature URV	2320	Float	2	RW

52. RO=Read Only; WO=Write Only; RW=Read/Write.

Lower Limit Registers

Table 67 - Registers for Lower Limits

Name	Address	Type	Registers	Read/Write ⁵³
Pulse Frequency LRV	2400	Float	2	RW
Process Temperature LRV	2402	Float	2	RW
Power LRV	2404	Float	2	RW
Pressure LRV	2406	Float	2	RW
Density LRV	2408	Float	2	RW
Enthalpy LRV	2410	Float	2	RW
Electronics Temperature LRV	2412	Float	2	RW

Unit Text Registers

Table 68 - Registers for Unit Text

Name	Address	Type	Registers	Read/Write ⁵³
Pulse Factor Units	3000	Char	4	RO
Totalizer 1 Units	3004	Char	4	RO
Totalizer 2 Units	3008	Char	4	RO
Totalizer 3 Units	3012	Char	4	RO
Pulse Output Units	3016	Char	4	RO
Volume Rate Units	3020	Char	4	RO
Volume Base Rate Units	3024	Char	4	RO
Mass Rate Units	3028	Char	4	RO
Process Temperature Units	3032	Char	4	RO
Velocity Units	3036	Char	4	RO
Power Units	3040	Char	4	RO
Pressure Units	3044	Char	4	RO
Density Units	3048	Char	4	RO
Viscosity Units	3052	Char	4	RO
Enthalpy Units	3056	Char	4	RO
Electronics Temperature Units	3060	Char	4	RO
K Corrected Units	3064	Char	4	RO

53. RO=Read Only; WO=Write Only; RW=Read/Write.

Unit Code Registers

Refer to *Measurement Unit (EGU) Codes*, page 162 for enumerations.

Table 69 - Registers for Unit Code

Name	Address	Type	Registers	Read/Write ⁵⁴
Totalizer 1 Unit Code	3300	UInt16	1	RW
Totalizer 2 Unit Code	3301	UInt16	1	RW
Totalizer 3 Unit Code	3302	UInt16	1	RW
Volume Rate Unit Code	3303	UInt16	1	RW
Volume Base Rate Unit Code	3304	UInt16	1	RW
Mass Rate Unit Code	3305	UInt16	1	RW
Process Temperature Unit Code	3306	UInt16	1	RW
Velocity Unit Code	3307	UInt16	1	RW
Power Unit Code	3308	UInt16	1	RW
Pressure Unit Code	3309	UInt16	1	RW
Density Unit Code	3310	UInt16	1	RW
Viscosity Unit Code	3311	UInt16	1	RW
Enthalpy Unit Code	3312	UInt16	1	RW
Electronics Temperature Unit Code	3313	UInt16	1	RW
K Corrected Unit Code	3314	UInt16	1	RW

Status Registers

See *Status*, page 62 for more information.

Table 70 - Registers for Status

Name	Address	Type	Registers	Read/Write ⁵⁴
Totalizer 1 Status	3500	UInt16	1	RO
Totalizer 2 Status	3501	UInt16	1	RO
Totalizer 3 Status	3502	UInt16	1	RO
Pulse Output Status	3503	UInt16	1	RO
Volume Rate Status	3504	UInt16	1	RO
Volume Base Rate Status	3505	UInt16	1	RO
Mass Rate Status	3506	UInt16	1	RO
Process Temperature Status	3507	UInt16	1	RO
Velocity Status	3508	UInt16	1	RO
Power Status	3509	UInt16	1	RO
Pressure Status	3510	UInt16	1	RO
Density Status	3511	UInt16	1	RO
Viscosity Status	3512	UInt16	1	RO
Enthalpy Status	3513	UInt16	1	RO

54. RO=Read Only; WO=Write Only; RW=Read/Write.

Table 70 - Registers for Status (Continued)

Name	Address	Type	Registers	Read/Write ⁵⁵
Reynolds Status	3514	UInt16	1	RO
Electronics Temperature Status	3515	UInt16	1	RO
K Corrected Status	3516	UInt16	1	RO
S1 Vortex Signal Status	3517	UInt16	1	RO
S4 RTD Ohms Status	3518	UInt16	1	RO
S5 Electronics Temperature Status	3519	UInt16	1	RO

Table 71 - Enumerations for Status

Code	Description
0x60	OK
0x61	Input Fixed
0x62	Paused
0x63	Overridden
0x64	Default
0x65	Input Overridden
0x80	Under Soft Lower
0x81	Over Soft Upper
0x82	Input Issue
0x83	Pulse and totals stopped due to a configuration change
0x84	RTD is shorted
0x85	RTD is open
0x86	Override is outside the soft limits
0x87	Offline and Pulse and Totals are stopped
0x88	Using Default Value
0x90	Alert Under Hard Lower
0x91	Alert Over Hard Upper
0x92	Alert Input Bad
0x93	Alert Input turned off by USER
0x94	Alert Input turned off by FACTORY
0x95	Alert Internal Error
0x96	Alert RTD is shorted
0x97	Alert RTD is open
0x98	Alert Override is outside the hard limits
0x99	Alert Measurement not ready

55. RO=Read Only; WO=Write Only; RW=Read/Write.

Custom Units Name Registers

Table 72 - Registers for Custom Units Name

Name	Address	Type	Registers	Read/Write ⁵⁶
Totalizer 1 Custom Unit Name	4500	Char	4	RW
Totalizer 2 Custom Unit Name	4504	Char	4	RW
Totalizer 3 Custom Unit Name	4508	Char	4	RW
Pulse Total Custom Unit Name	4512	Char	4	RW
Volume Rate Custom Unit Name	4516	Char	4	RW
Volume Base Rate Custom Unit Name	4520	Char	4	RW
Mass Rate Custom Unit Name	4524	Char	4	RW
Pressure Custom Unit Name	4528	Char	4	RW
Density Custom Unit Name	4532	Char	4	RW

Custom Units Slope Registers

Table 73 - Registers for Custom Units Slope

Name	Address	Type	Registers	Read/Write ⁵⁶
Totalizer 1 Custom Unit Slope	4600	Float	2	RW
Totalizer 2 Custom Unit Slope	4602	Float	2	RW
Totalizer 3 Custom Unit Slope	4604	Float	2	RW
Pulse Total Custom Unit Slope	4606	Float	2	RW
Volume Rate Custom Unit Slope	4608	Float	2	RW
Volume Base Rate Custom Unit Slope	4610	Float	2	RW
Mass Rate Custom Unit Slope	4612	Float	2	RW
Pressure Custom Unit Slope	4614	Float	2	RW
Density Custom Unit Slope	4616	Float	2	RW

Custom Units Offset Registers

Table 74 - Registers for Custom Units Offset

Name	Address	Type	Registers	Read/Write ⁵⁶
Totalizer 1 Custom Unit Offset	4700	Float	2	RW
Totalizer 2 Custom Unit Offset	4702	Float	2	RW
Totalizer 3 Custom Unit Offset	4704	Float	2	RW
Pulse Total Custom Unit Offset	4706	Float	2	RW
Volume Rate Custom Unit Offset	4708	Float	2	RW
Volume Base Rate Custom Unit Offset	4710	Float	2	RW
Mass Rate Custom Unit Offset	4712	Float	2	RW

56. RO=Read Only; WO=Write Only; RW=Read/Write.

Table 74 - Registers for Custom Units Offset (Continued)

Name	Address	Type	Registers	Read/Write ⁵⁷
Pressure Custom Unit Offset	4714	Float	2	RW
Density Custom Unit Offset	4716	Float	2	RW

Alert Strategy Registers

See *Measurement Properties*, page 63 for more information.

Table 75 - Registers for Alert Strategy

Name	Address	Type	Registers	Read/Write ⁵⁷
Totalizer 1 Alert Strategy	5000	UInt16	1	RW
Totalizer 2 Alert Strategy	5001	UInt16	1	RW
Totalizer 3 Alert Strategy	5002	UInt16	1	RW
Pulse Output Alert Strategy	5003	UInt16	1	RW
Volume Rate Alert Strategy	5004	UInt16	1	RW
Volume Base Rate Alert Strategy	5005	UInt16	1	RW
Mass Rate Alert Strategy	5006	UInt16	1	RW
Process Temperature Alert Strategy	5007	UInt16	1	RW
Velocity Alert Strategy	5008	UInt16	1	RW
Power Alert Strategy	5009	UInt16	1	RW
Pressure Alert Strategy	5010	UInt16	1	RW
Density Alert Strategy	5011	UInt16	1	RW
Viscosity Alert Strategy	5012	UInt16	1	RW
Enthalpy Alert Strategy	5013	UInt16	1	RW
Reynolds Alert Strategy	5014	UInt16	1	RW
Electronics Temperature Alert Strategy	5015	UInt16	1	RW
S1 Vortex Signal Alert Strategy	5016	UInt16	1	RW
S4 RTD Ohms Alert Strategy	5017	UInt16	1	RW
S5 Electronics Temperature Alert Strategy	5018	UInt16	1	RW
K Corrected Alert Strategy	5019	UInt16	1	RW

Table 76 - Enumerations for Alert Strategy

Code	Description
0x00	On Alert Continue
0x01	On Alert Bad
0x02	On Alert use Default

57. RO=Read Only; WO=Write Only; RW=Read/Write.

Calculation Method Registers

See *Measurement Properties*, page 63 for more information.

Table 77 - Registers for Calculation Method

Name	Address	Type	Registers	Read/Write ⁵⁸
Pulse Output Calc Method	5500	UInt16	1	RW
Volume Rate Calc Method	5501	UInt16	1	RW
Volume Base Rate Calc Method	5502	UInt16	1	RW
Mass Rate Calc Method	5503	UInt16	1	RW
Process Temperature Calc Method	5504	UInt16	1	RW
Velocity Calc Method	5505	UInt16	1	RW
Power Calc Method	5506	UInt16	1	RW
Pressure Calc Method	5507	UInt16	1	RW
Density Calc Method	5508	UInt16	1	RW
Viscosity Calc Method	5509	UInt16	1	RW
Enthalpy Calc Method	5510	UInt16	1	RW
Reynolds Calc Method	5511	UInt16	1	RW
Electronics Temperature Calc Method	5512	UInt16	1	RW
S4 RTD Ohms Calc Method	5513	UInt16	1	RW
S5 Electronics Temperature Calc Method	5514	UInt16	1	RW
K Corrected Calc Method	5515	UInt16	1	RW
S1 Vortex Signal Calc Method	5516	UInt16	1	RW

Table 78 - Enumerations for Calculation Method

Code	Description
0x03	Override
0x04	User Default
0x05	User Off
0x06	User On
0x07	By Remote

Override Registers

Perform only one override at a time. Reset or write a NAN (Not a Number) to clear all overrides.

Table 79 - Registers for Override

Name	Address	Type	Registers	Read/Write ⁵⁸
Totalizer 1 Override	6000	Float	2	WO
Totalizer 2 Override	6002	Float	2	WO
Totalizer 3 Override	6004	Float	2	WO

58. RO=Read Only; WO=Write Only; RW=Read/Write.

Table 79 - Registers for Override (Continued)

Name	Address	Type	Registers	Read/Write ⁵⁹
Pulse Output Override	6006	Float	2	WO
Volume Rate Override	6008	Float	2	WO
Mass Rate Override	6012	Float	2	WO
Process Temperature Override	6014	Float	2	WO
Pressure Override	6020	Float	2	WO
Density Override	6022	Float	2	WO

Device Control Registers

Change to this parameter does not take effect until the device is reset.

Table 80 - Registers for Device Control

Name	Address	Type	Registers	Read/Write ⁵⁹
Warm Restart	6513	UInt16	1	WO

Modbus Communications Registers

Changes to these parameters do not take effect until the device is reset.

Table 81 - Registers for Modbus Communications

Name	Address	Type	Registers	Read/Write ⁵⁹
Station Id	6600	UInt16	1	RW
Baud Rate	6601	UInt16	1	RW
Parity	6602	UInt16	1	RW
Stop Bits	6603	UInt16	1	RW
Byte Format	6604	UInt16	1	RW
Test Register	6605	Float	2	RO

- This read/write register contains the enumeration for the currently configured 32-bit register byte-swapping format. There are four options:

Option	Example	Result
0: Full swap	ABCD → DCBA	Big-endian format (default)
1: Word swap	ABCD → CDAB	Big-endian format, with words swapped
2: Word and byte swap	ABCD → BADC	Little-endian format, with words swapped
3: No swap	ABCD → ABCD	Little-endian format

- Test Register, Address 6605

This 4-byte, floating-point register displays the test value **1234.0** when the byte format of the Modbus master matches that of the device. The master can use this to verify that the byte-swapping format is set accordingly in the device.

59. RO=Read Only; WO=Write Only; RW=Read/Write.

Fluid Configuration Registers

Table 82 - Registers for Fluid Configuration

Name	Address	Type	Registers	Read/Write ⁶⁰
Set Fluid Defaults	6900	UInt16	1	WO
Current Fluid Id	6901	UInt16	1	RO
Current Fluid Name	6902	Char	8	RW

Changing the fluid type in the **Set Fluid Defaults** register stops all totalizers and pulse output in Pulse/Total Mode. When pulse output in Pulse/Total Mode is stopped, a **PulseStopped** alert is returned.

Table 83 - Fluid IDs

Code	Description
0x8000	User Liquid
0x8001	User Gas
0x8002	User Vapor
0x8004	Saturated Steam
0x8005	Superheated Steam

Density Thermal Compensation Registers

See *Fluid Parameters, page 69* for more information.

Table 84 - Registers for Density Thermal Compensation

Name	Address	Type	Registers	Read/Write ⁶⁰
Density Thermo Coefficient	7000	Float	2	RW
Density Thermo Offset Temp	7002	Float	2	RW
Density Thermo Offset	7004	Float	2	RW

Viscosity Thermal Compensation Registers

See *Fluid Parameters, page 69* for more information.

Table 85 - Registers for Viscosity Thermal Compensation

Name	Address	Type	Registers	Read/Write ⁶⁰
Viscosity Thermo Coefficient	7100	Float	2	RW
Viscosity Thermo Offset Temp	7102	Float	2	RW
Viscosity Thermo Offset	7104	Float	2	RW

60. RO=Read Only; WO=Write Only; RW=Read/Write.

Base Parameters Registers

See *Fluid Parameters*, page 69 for more information.

Table 86 - Registers for Base Parameters

Name	Address	Type	Registers	Read/Write ⁶¹
Base Density	7500	Float	2	RW
Base Temperature	7502	Float	2	RW
Base Pressure	7504	Float	2	RW

Totalizer/Pulse Control Registers

Table 87 - Registers for Totalizer/Pulse Control

Name	Address	Type	Registers	Read/Write ⁶¹
Totalizer 1 Action	8000	UInt16	1	RW
Totalizer 2 Action	8001	UInt16	1	RW
Totalizer 3 Action	8002	UInt16	1	RW
Pulse Output Control	8003	UInt16	1	RW

Table 88 - Totalizer/Pulse Actions

Code	Description
0x00	Off
0x01	On
0x02	Resume
0x03	Reset

Pulse Output Mode Configuration Registers

Table 89 - Registers for Pulse Output Mode

Name	Address	Type	Registers	Read/Write ⁶¹
Pulse Output Mode	8200	UInt16	1	RW

Table 90 - Enumerations for Pulse Output Mode

Code	Description
0x00	None
0x01	Raw
0x03	Frequency
0x04	Pulse

61. RO=Read Only; WO=Write Only; RW=Read/Write.

Totalizer Configuration Registers

See *Setting Totalizer Parameters*, page 74 for more information.

Configure only one totalizer at a time. If you attempt to set multiple mappings at the same time, the command does not execute successfully.

Table 91 - Registers for Totalizer Configuration

Name	Address	Type	Registers	Read/Write ⁶²
Totalizer 1 Map	8100	UInt16	1	RW
Totalizer 2 Map	8101	UInt16	1	RW
Totalizer 3 Map	8102	UInt16	1	RW

Table 92 - Enumerations for Totalizer/Pulse Mapping

Code	Description
0x01	Volume
0x02	Base Volume
0x07	Mass
0x41	Vortex Count
0x0D	Energy

Pulse Total Configuration Registers

See *Configuring Pulse Output*, page 78 for more information.

See *Enumerations for Totalizer/Pulse Mapping*, page 156.

Changing the source map for pulse output, pulse/total mode in the **Pulse Total Output Map** register returns a **SetToNearest** alert if the existing **Pulse Total Min Width** or **Pulse Total Factor** are adjusted in order to achieve a valid configuration.

Table 93 - Registers for Pulse Total Configuration

Name	Address	Type	Registers	Read/Write ⁶²
Pulse Factor Unit Code	8300	UInt16	1	RW
Pulse Total Output Map	8301	UInt16	1	RW
Pulse Total Factor UP	8302	Float	2	RW
Pulse Total Min Width	8304	Float	2	RW
Pulse Total Factor PU	8306	Float	2	RW

62. RO=Read Only; WO=Write Only; RW=Read/Write.

Pulse Frequency Configuration Registers

See *Configuring Pulse Output*, page 78 for more information.

See *Enumerations for Totalizer/Pulse Mapping*, page 156.

Table 94 - Registers for Pulse Frequency Configuration

Name	Address	Type	Registers	Read/Write ⁶³
Pulse Frequency Output Map	8400	UInt16	1	RW
Pulse Frequency Min Freq	8401	Float	2	RW
Pulse Frequency Max Freq	8403	Float	2	RW
Pulse Frequency Offline Freq	8405	Float	2	RW

Self Test Registers

Table 95 - Registers for Self Test

Name	Address	Type	Registers	Read/Write ⁶³
SelfTestResult	8501	UInt16	1	RW

Calibration Registers

Table 96 - Registers for Calibration

Name	Address	Type	Registers	Read/Write ⁶³
RTD Calibration Value	9000	Float	2	WO
Primary Time In Service	9002	UInt16	1	RO
User Time In Service	9003	UInt16	1	RO

Modbus Status Registers

Table 97 - Registers for Modbus Status

Name	Address	Type	Registers	Read/Write ⁶³
Configuration Change Counter	9500	UInt16	1	RO
Last Configuration Access Return Code	9501	UInt16	1	RO
Detailed Return Code	9502	UInt16	1	RO
Configuration Access Specific Info	9503	UInt16	1	RO
Malfunction Code	9504	UInt16	1	RO

63. RO=Read Only; WO=Write Only; RW=Read/Write.

For return codes not listed in the next table, contact Global Customer Support.

Table 98 - Detailed Return Codes for Register 9502

Code	Description
0x60	OK
0x62	Bad Data Size
0x66	Invalid Partial Value
0x6D	Engineering Units Code Not Found
0x6E	Engineering Units Code Not Allowed
0x6F	Set To Nearest Value
0x70	Below Soft Limit
0x71	Above Soft Limit
0x74	Device Is Busy
0x75	Invalid Selection
0x76	Write Protected
0x77	LRV Equals URV
0x78	URV Too Low
0x79	URV Too High
0x7A	LRV Too Low
0x7B	LRV Too High
0x7C	Both (URV and LRV) Out Of Range
0x7D	Bad Mode
0x7E	Value Too Big
0x7F	Value Too Small
0x80	Invalid Measurement Block; Invalid Measurement
0x81	Access Restricted
0x86	Span Too Small
0x87	Invalid Date Code Detected
0x88	Invalid Mode Selection
0x89	Invalid Pulse Frequency
0x91	Heartbeat Frequency Is Too Small
0x92	Heartbeat Frequency Has Been Changed
0x93	New Pulses Seen
0x98	Changes Not Allowed When Pulse Or Total Is On
0x9A	Invalid Device Variable Number
0x9B	Invalid Measurement Calculation Method
0x9C	Invalid Measurement Error Strategy
0xA1	Pulse Output Frequency Span Too Small
0xA2	Pulse Output Maximum Frequency Too Big
0xA3	Pulse Output Maximum Frequency Too Big
0xA4	Pulse Output Maximum Frequency Too Big
0xA5	Pulse Output Maximum Frequency Too Big

Table 98 - Detailed Return Codes for Register 9502 (Continued)

Code	Description
0xA6	Pulse Output Pulse Factor Set To Nearest Value
0xA8	Block Not Available
0xA9	URV > URL Caused Rerange
0xAA	Changes Not Allowed While Measurement Is Mapped To Pulse Output Or Totalizer
0xAB	Current Conditions Indicate Liquid Water Is Present

LFCI Registers

Table 99 - Registers for LFCI

Name	Address	Type	Registers	Read/Write ⁶⁴
Auto LFCI Status	10500	UInt16	1	RO
Unit Code	10501	UInt16	1	RW
LFCI Level	10502	UInt16	1	RW
LFCI1 Value	10503	Float	2	RO
LFCI2 Value	10505	Float	2	RO
LFCI3 Value	10507	Float	2	RO
LFCI4 Value	10509	Float	2	RO
LFCI5 Value	10511	Float	2	RO
LFCI6 Value	10513	Float	2	RO
LFCI7 Value	10515	Float	2	RO
LFCI8 Value	10517	Float	2	RO

Tube Serial Number Registers

Table 100 - Registers for Tube Serial Number

Name	Address	Type	Registers	Read/Write ⁶⁴
Tube Serial Number	11000	Char	8	RW

K Reference Registers

Table 101 - Registers for K Reference

Name	Address	Type	Registers	Read/Write ⁶⁴
K Reference Write	11500	Float	2	WO
K Reference Read	11502	Float	2	RO

64. RO=Read Only; WO=Write Only; RW=Read/Write.

Information Registers

Table 102 - Registers for Info

Name	Address	Type	Registers	Read/Write ⁶⁵
Long Tag	12000	Char	16	RW

Coils

Coils are available for controlling options, synchronous functions, and asynchronous tasks.

Use the addresses in this table with Modbus commands 1 (Read Coils) and 5 (Write Single Coil).

Table 103 - Coil Registers

Name	Address	Read/Write ⁶⁵	Type	Description
User Time In Service Clear	100	RW	Synchronous	Write On to clear
Noise Reduction	101	RW	Sync. On/Off	On/Off
Adaptive Filtering	102	RW	Sync. On/Off	On/Off
Reynolds Correction	103	RW	Sync. On/Off	On/Off
Run RTD Calibration	104	RW	Synchronous	See <i>RTD Calibration Procedure, page 161</i>
Restore Factory RTD Calibration	105	RW	Synchronous	Write On to restore
User Self Test	106	RW	Asynchronous	See <i>User Self Test Procedure, page 161</i>
Perform Auto LFCI	107	RW	Asynchronous	See <i>Auto LFCI Procedure, page 162</i>

Examples

Where xx = station ID and yyy = coil address:

- Write Single Coil On (command 5): xx0500yyyFF00
- Write Single Coil Off (command 5): xx0500yyy0000
- Read Coil (command 1): xx0100yyy0001

Synchronous On/Off Option Coils

Reads from these coils return the current option state:

- Read with setting On, Coil=1 (On)
- Read with setting Off, Coil=0 (Off)

Writes to these coils set the option state:

- Write **ON** sets Coil=1, Option=On
- Write **OFF** sets Coil=0, Option=Off

If the setting is not allowed, the coil write does not change the coil state, and the write returns as unsuccessful. The return code and information field are stored in the Modbus status.

65. RO=Read Only; WO=Write Only; RW=Read/Write.

If the option is set successfully, the coil is set to reflect the option state, and the write is successful.

Synchronous Function Coils

Reads from these coils return the last written state: 0=Off, 1=On.

Writes to these coils control the function:

- Write **On** sets Coil=1, run function
- Write **Off** sets Coil=0, no other action

If not allowed, writing **On** causes the coil state to be set to Off, and the write returns as unsuccessful. The return code and information field are stored in the Modbus status.

If the function runs successfully, the coil is set to On, and the write is successful.

Asynchronous Task Coils

Asynchronous task coils control a specific asynchronous task. Reads from these coils return the current state of the task.

- Read with function inactive, Coil=0 (Off)
- Read with function active, Coil=1 (On)

Writes to these coils invoke the task as follows:

- Write **On** with coil Off, start function and set Coil=On
- Write **Off** with coil Off, no effect (Coil remains Off)
- Write **On** or **Off** with coil On, no effect (Coil remains On)

Reading one of these coils returns the current status (Active=1, Inactive=0). Each self-test coil reports Active if any self-test is active.

Writing one of these coils attempts to start the task. If the task is already active or is unable to start, the coil write leaves the coil state unchanged, the task does not start, and the write returns as unsuccessful. The return code and information field are stored in the Modbus status.

If the task starts successfully, the coil write state changes from Off to On, and the write is successful.

RTD Calibration Procedure

1. Place a known temperature value in register **RTD Calibration Value**.
2. Write **On** to the coil.

User Self Test Procedure

1. Write **On** to start.
2. The display reads **On** while in progress.
3. The display reads **Off** when finished.
4. Check the **Self Test Result** register to verify the result:
0=Unsuccessful or not run; 1=Run and passed.

Auto LFCI Procedure

1. Write **On** to start.
2. The display reads **On** while in progress.
3. The display reads **Off** when finished.
4. Check the **Auto LFCI Status** register to verify the result: 0x93=Unsuccessful; 0x60=OK.

Measurement Unit (EGU) Codes

Table 104 - Absolute Pressure Measurement Unit Codes

Unit	Description	Code
psia	pounds per square inch absolute	0x0300
kPaa	kilopascals absolute	0x0308
Paa	pascals absolute	0x0309
—	Custom	0x03FF

Table 105 - Temperature Measurement Unit Codes

Unit	Description	Code
degC	degrees Celsius	0x0600
K	Kelvins	0x0601
degF	degrees Fahrenheit	0x0602
degR	degrees Rankine	0x0603

Table 106 - Density Measurement Unit Codes

Unit	Description	Code
kg/m3	kilograms per cubic meter	0x0800
g/cm3	grams per cubic centimeter	0x0801
oz/in3	ounces per cubic inch	0x0802
lb/ft3	pounds per cubic foot	0x0803
lb/Yd3	pounds per cubic yard	0x0804
LT/Yd3	long tons per cubic yard	0x0805
ST/Yd3	short tons per cubic yard	0x0806
lb/gal	pounds per US gallon	0x0807
kg/l	kilograms per liter	0x0808
—	Custom	0x08FF

Table 107 - Mass Rate Measurement Unit Codes

Unit	Description	Code
g/s	grams per second	0x0904
g/m	grams per minute	0x0905
g/h	grams per hour	0x0906
g/d	grams per day	0x0907

Table 107 - Mass Rate Measurement Unit Codes (Continued)

Unit	Description	Code
oz/s	ounces per second	0x0912
oz/m	ounces per minute	0x0913
oz/h	ounces per hour	0x0914
oz/d	ounces per day	0x0915
kg/s	kilograms per second	0x0900
kg/m	kilograms per minute	0x0901
kg/h	kilograms per hour	0x0902
kg/d	kilograms per day	0x0903
lb/s	pounds per second	0x0908
lb/m	pounds per minute	0x0909
lb/h	pounds per hour	0x090A
lb/d	pounds per day	0x090B
mTon/s	metric tons per second	0x0916
mTon/m	metric tons per minute	0x0917
mTon/h	metric tons per hour	0x090C
mTon/d	metric tons per day	0x090D
STon/s	short tons (2000 lb) per second	0x090E
STon/m	short tons (2000 lb) per minute	0x090F
STon/h	short tons (2000 lb) per hour	0x0910
STon/d	short tons (2000 lb) per day	0x0911
LTon/m	long tons (2240 lb) per minute	0x0919
LTon/h	long tons (2240 lb) per hour	0x091A
LTon/d	long tons (2240 lb) per day	0x091B
—	Custom	0x09FF

Table 108 - Volume Rate Measurement Unit Codes

Unit	Description	Code
bbbl/s	barrels (42 US gallons) per second	0x0A2A
bbbl/m	barrels (42 US gallons) per minute	0x0A2B
bbbl/h	barrels (42 US gallons) per hour	0x0A2C
bbbl/d	barrels (42 US gallons) per day	0x0A2D
bbbl3/s	barrels (31.5 US gallons) per second	0x0A26
bbbl3/m	barrels (31.5 US gallons) per minute	0x0A27
bbbl3/h	barrels (31.5 US gallons) per hour	0x0A28
bbbl3/d	barrels (31.5 US gallons) per day	0x0A29
ft3/s	cubic feet per second	0x0A22
ft3/m	cubic feet per minute	0x0A23
ft3/h	cubic feet per hour	0x0A24

Table 108 - Volume Rate Measurement Unit Codes (Continued)

Unit	Description	Code
ft ³ /d	cubic feet per day	0x0A25
gal/s	US gallons per second	0x0A16
gal/m	US gallons per minute	0x0A17
gal/h	US gallons per hour	0x0A18
gal/d	US gallons per day	0x0A19
lgal/s	imperial gallons per second	0x0A32
lgal/m	imperial gallons per minute	0x0A33
lgal/h	imperial gallons per hour	0x0A34
lgal/d	imperial gallons per day	0x0A35
l/s	liters per second	0x0A1C
l/m	liters per minute	0x0A1D
l/h	liters per hour	0x0A1E
l/d	liters per day	0x0A1F
m ³ /s	cubic meters per second	0x0A12
m ³ /m	cubic meters per minute	0x0A13
m ³ /h	cubic meters per hour	0x0A14
m ³ /d	cubic meters per day	0x0A15
mcft/d	thousands of cubic feet per day	0x0A4A
mmcft/d	millions of cubic feet per day	0x0A4B
MI/h	millions of liters per hour	0x0A20
MI/d	millions of liters per day	0x0A21
Mgal/d	millions of US gallons per day	0x0A1B
—	Custom	0x0AFF

Table 109 - Standard Volume Rate Measurement Unit Codes

Unit	Description	Code
Sbbl/s	standard barrels (42 US gallons) per second	0x0B3E
Sbbl/m	standard barrels (42 US gallons) per minute	0x0B3F
Sbbl/h	standard barrels (42 US gallons) per hour	0x0B40
Sbbl/d	standard barrels (42 US gallons) per day	0x0B41
Sbl ³ /s	standard barrels (31.5 US gallons) per second	0x0B3A
Sbl ³ /m	standard barrels (31.5 US gallons) per minute	0x0B3B
Sbl ³ /h	standard barrels (31.5 US gallons) per hour	0x0B3C
Sbl ³ /d	standard barrels (31.5 US gallons) per day	0x0B3D
Sft ³ /s	standard cubic feet per second (US system)	0x0B32
Sft ³ /m	standard cubic feet per minute (US system)	0x0B33
Sft ³ /h	standard cubic feet per hour (US system)	0x0B34
Sft ³ /d	standard cubic feet per day (US system)	0x0B35

Table 109 - Standard Volume Rate Measurement Unit Codes (Continued)

Unit	Description	Code
Sgal/s	standard US gallons per second	0x0B36
Sgal/m	standard US gallons per minute	0x0B37
Sgal/h	standard US gallons per hour	0x0B38
Sgal/d	standard US gallons per day	0x0B39
Sm3/s	standard cubic meters per second	0x0B2E
Sm3/m	standard cubic meters per minute	0x0B2F
Sm3/h	standard cubic meters per hour	0x0B30
Sm3/d	standard cubic meters per day	0x0B31
mScft/d	thousands of standard cubic feet per day	0x0B4C
mmScft/d	millions of standard cubic feet per day	0x0B4D
—	Custom	0x0BFF

Table 110 - Normal Volume Rate Measurement Unit Codes

Unit	Description	Code
Ngal/s	normal US gallons per second	0x0C36
Ngal/m	normal US gallons per minute	0x0C37
Ngal/h	normal US gallons per hour	0x0C38
Ngal/d	normal US gallons per day	0x0C39
NI/s	normal liters per second (MKS System)	0x0C42
NI/m	normal liters per minute (MKS System)	0x0C43
NI/h	normal liters per hour (MKS System)	0x0C44
NI/d	normal liters per day (MKS System)	0x0C45
Nm3/s	normal cubic meters per second (MKS System)	0x0C46
Nm3/m	normal cubic meters per minute (MKS System)	0x0C47
Nm3/h	normal cubic meters per hour (MKS System)	0x0C48
Nm3/d	normal cubic meters per day (MKS System)	0x0C49
Nft3/s	normal cubic feet per second	0x0C4A
—	Custom	0x0CFF

Table 111 - Mass Measurement Unit Codes

Unit	Description	Code
kg	kilograms	0x0E00
g	grams	0x0E01
lb	pounds	0x0E02
oz	ounces	0x0E03
mTon	metric tons	0x0E04
STon	short tons (2000 lb)	0x0E05
LTon	long tons (2240 lb)	0x0E06
—	Custom	0x0EFF

Table 112 - Volume Measurement Unit Codes

Unit	Description	Code
m3	cubic meters	0x1000
ft3	cubic feet	0x1002
l	liters	0x1003
MI	millions of liters	0x1004
bbl3	liquid barrels (31.5 US gallons)	0x1005
bbl	liquid barrels (42 US gallons)	0x1006
gal	gallons	0x1007
Mgal	millions of US gallons	0x1008
lgal	imperial gallons	0x100C
mcft	thousands of cubic feet	0x100D
mmcft	millions of cubic feet	0x100E
—	Custom	0x10FF

Table 113 - Standard Volume Measurement Unit Codes

Unit	Description	Code
Sm3	standard cubic meters	0x1100
Sft3	standard cubic feet	0x1101
SBL3	standard liquid barrel (31.5 U.S. gallons)	0x1102
SBBL	standard liquid barrel (42 U.S. gallons)	0x1103
Sgal	standard US gallons	0x1104
mScft	thousands of cubic feet	0x110D
mmScft	millions of cubic feet	0x110E
—	Custom	0x11FF

Table 114 - Normal Volume Measurement Unit Codes

Unit	Description	Code
Nm3	normal cubic meters (MKS System)	0x1200
Nft3	normal cubic feet	0x1201
NI	normal liters (MKS System)	0x1202
Ngal	normal US gallons	0x1203
—	Custom	0x12FF

Table 115 - Velocity Measurement Unit Codes

Unit	Description	Code
m/s	meters per second	0x1400
m/m	meters per minute	0x1401
m/h	meters per hour	0x1402
m/d	meters per day	0x1403
ft/s	feet per second	0x1405
ft/m	feet per minute	0x1406

Table 115 - Velocity Measurement Unit Codes (Continued)

Unit	Description	Code
ft/h	feet per hour	0x1407
ft/d	feet per day	0x1408

Table 116 - Absolute Viscosity Measurement Unit Codes

Unit	Description	Code
PaSec	pascal seconds	0x1500
cPoise	centipoise	0x1501

Table 117 - Heat Content Measurement Unit Codes

Unit	Description	Code
J/kg	joules per kilogram	0x2100
KJ/kg	kilojoules per kilogram	0x2101
BTU/lb	British thermal units per pound	0x2102
MCal/kg	megacalories per kilogram	0x2103

Table 118 - Energy Measurement Unit Codes

Unit	Description	Code
J	joules	0x1B00
MJ	megajoules	0x1B01
BTU	British thermal units	0x1B02
MCal	megacalories	0x1B03

Table 119 - Heat Flow Measurement Unit Codes

Unit	Description	Code
J/s	joules per second	0x1C00
MJ/h	megajoules per hour	0x1C01
BTU/h	British thermal units per hour	0x1C02
MCal/h	megacalories per hour	0x1C03

Table 120 - K-Factor Measurement Unit Codes

Unit	Description	Code
m3/p	cubic meters per pulse	0x1D00
p/l	pulses per liter	0x1D02
p/ft3	pulses per cubic foot	0x1D03

Table 121 - Miscellaneous Measurement Unit Codes

Measurement	Unit	Description	Code
Potential	Volt	volts	0x1900
Resistance	ohms	ohms	0x1A00

Table 121 - Miscellaneous Measurement Unit Codes (Continued)

Measurement	Unit	Description	Code
Frequency	Hz	hertz	0x1F00
Pulse	Pulse	pulses	0x2000

Modbus RTU Display Instructions

Overview

By writing to certain registers, the connected master RTU can send information to the Model 84C Vortex Flowmeter and show it on the local display. There are a maximum of 15 items that can be shown on the local display. An item is a set of three lines of text that are displayed at once.

The top and bottom line of each item can each show 16 characters of text. The middle line can show eight characters of text.

The middle line can display two different types of items. 2 of the 15 items can display 8 characters of ASCII text on the middle line. The remaining 13 items can display a decimal value on the middle line.

Any combination of the 15 items can be enabled or disabled individually (see *RTU Item Enable/Disable*, page 169).

RTU Item Enable/Disable

Use coils 129-143 (see relevant coils below) to enable or disable RTU items 1 through 15. Writing "off" disables the item and "on" enables the item. When all 15 items are off, the RTU display mode is deactivated and the local display behaves normally, showing the measurements being reported by the flowmeter. When at least one of the items are enabled, the local display will be in RTU display mode.

In RTU display mode, the measurement display section of the menu will be replaced with the RTU display items. Depending on whether scan is enabled or not with coil 128, the RTU items will cycle through on the display approximately every 6 seconds or only change when the up/down buttons are pressed.

The enable/disable state of the RTU items, as well as the scan setting, are persistent across power cycles. If the power is cycled, then the text and value need to be rewritten to all the active RTU items or else they will appear in an uninitialized state. A meter in RTU display mode can be reset to the normal measurement display mode from the local display using the ClrRTU option under the **1 Setup > 2 Advance > 3 ClrRTU** selection.

NOTE: Enabling or disabling any RTU item causes a configuration change, and all text and values of the RTU items must be rewritten.

Relevant Coils

Name	Address	Type	Registers	Read	Write
RTU Item 1 Enable	129	bit	Coil	True	True
RTU Item 2 Enable	130	bit	Coil	True	True
RTU Item 3 Enable	131	bit	Coil	True	True
RTU Item 4 Enable	132	bit	Coil	True	True
RTU Item 5 Enable	133	bit	Coil	True	True
RTU Item 6 Enable	134	bit	Coil	True	True
RTU Item 7 Enable	135	bit	Coil	True	True
RTU Item 8 Enable	136	bit	Coil	True	True
RTU Item 9 Enable	137	bit	Coil	True	True
RTU Item 10 Enable	138	bit	Coil	True	True

Name	Address	Type	Registers	Read	Write
RTU Item 11 Enable	139	bit	Coil	True	True
RTU Item 12 Enable	140	bit	Coil	True	True
RTU Item 13 Enable	141	bit	Coil	True	True
RTU Item 14 Enable	142	bit	Coil	True	True
RTU Item 15 Enable	143	bit	Coil	True	True

RTU Item with No Data (Uninitialized State)

An enabled RTU Item with no information contained in the registers will appear on the screen with 3 dots on the top line, 3 dots on the bottom line, and 8 dashes across the middle line.



RTU Scan Enable/Disable

When more than one RTU item is active, there are two ways to show multiple items on the display. This is controlled by coil 128.

- If coil 128 is on, the display cycles through all the active RTU items at a rate of about six seconds.
- If coil 128 is off, you can view the individual items in turn by pressing either the up or down buttons on the front panel.

NOTE: Changing the scan setting causes a configuration change, and all text and values of the RTU items must be rewritten.

Relevant Coil

Name	Address	Type	Registers	Read	Write
RTU Item Scan	128	bit	Coil	True	True

RTU Default Item

Register 6164 is for specifying where to start in the list of 15 items when the RTU display mode is activated. The default value is 1 and corresponds to RTU item 1. If the value of register 6164 is set to 5, and all RTU items are activated at once, RTU item 5 will appear first. If the default item is not active, then the first active RTU item will be displayed first.

For example, if the default value is set to 5 but only RTU items 1, 9 and 12 are active, then item 1 will appear first.

RTU Item Text

There are 15 contiguous blocks of 16 registers each, starting at register 6165. These are for writing the top and bottom lines of an RTU item. The first eight registers are for the top line, and the second eight registers are for the bottom line. All 16 registers

must be written at the same time. The top and bottom lines cannot be changed individually.

The data in these registers do not persist through a power cycle. It is recommended that you periodically rewrite the text. This rate of refresh can and should be much less frequent than updating the values in the middle line, which should be done as often as needed to keep the data current when it is displayed.

For example, if all 15 items are active, a value only needs to be updated about every $6 \times 15 = 90$ seconds to be active when it comes up every time in the scan cycle order.

Relevant Registers

Name	Address	Type	Registers	Read	Write
RTU Item 1 Text	6165	char	16	False	True
RTU Item 2 Text	6181	char	16	False	True
RTU Item 3 Text	6197	char	16	False	True
RTU Item 4 Text	6213	char	16	False	True
RTU Item 5 Text	6229	char	16	False	True
RTU Item 6 Text	6245	char	16	False	True
RTU Item 7 Text	6261	char	16	False	True
RTU Item 8 Text	6277	char	16	False	True
RTU Item 9 Text	6293	char	16	False	True
RTU Item 10 Text	6309	char	16	False	True
RTU Item 11 Text	6325	char	16	False	True
RTU Item 12 Text	6341	char	16	False	True
RTU Item 13 Text	6357	char	16	False	True
RTU Item 14 Text	6373	char	16	False	True
RTU Item 15 Text	6389	char	16	False	True

Example

To set up RTU item 5 so that it displays the word “Example” on top line of the display and “Of RTU Item Text” on the bottom line of the display, write the following hex bytes to the 16 registers, starting at 6229:

Register	Byte	ASCII Chars
6229	0x4578	Ex
6230	0x616d	am
6231	0x706c	pl
6232	0x6520	e (space)
6233	0x2020	(space)(space)
6234	0x2020	(space)(space)
6235	0x2020	(space)(space)
6236	0x2020	(space)(space)
6237	0x4f66	Of
6238	0x2052	(space)R
6239	0x5455	TU

Register	Byte	ASCII Chars
6240	0x2049	(space)l
(6241	0x7465	te
6242	0x6d20	m(space)
6243	0x5465	Te
6244	0x7874	xt

If coil 133 for RTU item 5 is enabled, then the screen appears like this:



NOTE:

- On the top line there is a R in the last character to the right. This always appears on the top line and is an indication that you are viewing an RTU item instead of a measurement from the meter. It also reduces the number of ASCII characters that can display on the top line to 15. The 16th character of the top line is ignored.
- No value was written to registers 6417 and 6418. These are the two registers for the decimal value for RTU item 5. When there is no value to display, the middle line is just eight dashes. This is useful as you can use the decimal RTU items to just display text if you have no need to display a decimal value for the information coming from the RTU. For the ASCII RTU items 1 and 2, the behavior is the same. If no value is written to the middle line registers, the middle line appears as dashes.

Writing an ASCII RTU Item

RTU items 1 and 2 show eight characters of ASCII text on the middle line. The text displayed in the middle line is determined by the four registers starting at 6405 for RTU item 1 and the four registers starting at 6409 for RTU item 2.

Register	Byte	ASCII Chars
6405	0x4578	Ex
6406	0x616d	am
6407	0x706c	pl
6408	0x6520	e (space)

If “Example” is written to the four registers starting at 6405, the middle line appears as below:



Relevant Registers

Name	Address	Type	Registers	Read	Write
RTU Item 1 Value	6405	char	4	False	True
RTU Item 2 Value	6409	char	4	False	True

Writing a Decimal RTU

RTU items 3 through 15 show a decimal value on the middle line. The value displayed is determined by the single precision floating point value written to the two registers.

For example, for RTU item 3, the floating point value is to be written to registers 6413 and 6414. For RTU item 4, it is 6415 and 6416 and so forth, all the way to RTU item 15.

To write “100” to RTU item 3, write the following data to the two registers:

100.0 = 0x42c80000

NOTE: The data is big-endian.

Register	Byte
6413	0x42c8
6414	0x0000

Relevant Registers

Name	Address	Type	Registers	Read	Write
RTU Item 3 Value	6413	float	2	False	True
RTU Item 4 Value	6145	float	2	False	True
RTU Item 5 Value	6417	float	2	False	True
RTU Item 6 Value	6419	float	2	False	True
RTU Item 7 Value	6421	float	2	False	True
RTU Item 8 Value	6423	float	2	False	True
RTU Item 9 Value	6425	float	2	False	True
RTU Item 10 Value	6427	float	2	False	True
RTU Item 11 Value	6429	float	2	False	True
RTU Item 12 Value	6431	float	2	False	True
RTU Item 13 Value	6433	float	2	False	True
RTU Item 14 Value	6435	float	2	False	True
RTU Item 15 Value	6437	float	2	False	True

Display Format

Like the meter-calculated measurement values, the display format of the decimal RTU items can be changed. The 13 registers for controlling this start at 6150.

The following show the enumerations of the display formats:

Byte	Display Format
0x0001	XXXXXXXX
0x0002	XXXXXX.X
0x0003	XXXXX.XX
0x0004	XXXX.XXX
0x0005	XXX.XXXX
0x0006	XX.XXXXX

Byte	Display Format
0x0007	X.XXXXXX
0x0008	XXXXeXXX

NOTE: The AutoFormat display format is not supported for RTU items.

Relevant Registers

Name	Address	Type	Registers	Read	Write
RTU Item 3 Display Format	6150	Unit 16	1	False	True
RTU Item 4 Display Format	6151	Unit 16	1	False	True
RTU Item 5 Display Format	6152	Unit 16	1	False	True
RTU Item 6 Display Format	6153	Unit 16	1	False	True
RTU Item 7 Display Format	6154	Unit 16	1	False	True
RTU Item 8 Display Format	6155	Unit 16	1	False	True
RTU Item 9 Display Format	6156	Unit 16	1	False	True
RTU Item 10 Display Format	6157	Unit 16	1	False	True
RTU Item 11 Display Format	6158	Unit 16	1	False	True
RTU Item 12 Display Format	6159	Unit 16	1	False	True
RTU Item 13 Display Format	6160	Unit 16	1	False	True
RTU Item 14 Display Format	6161	Unit 16	1	False	True
RTU Item 15 Display Format	6152	Unit 16	1	False	True

Additional Information

Because of a limitation of the display, only two lines of text can be written at once. You will see this effect when an RTU item is changed on the display. First, the top and bottom lines are written and then a second or so later, the middle line is written. This will create an inconsistency briefly in the display when changing items. The top and bottom lines of the next item will appear, but the middle line will show the value from the previous item for a moment before updating to the current value.

Because the top and bottom text registers are large (16 registers), you can only write the text for seven RTU items at once.

That is, $7 * 16 \text{ registers} * 2 \text{ bytes} = 224 \text{ bytes}$.

Similarly, eight RTU items would be 256 bytes ($8 * 16 \text{ registers} * 2 \text{ bytes} = 256$) and that is too much data for a single Modbus RTU command.

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
<p>HAZARD OF FLOWMETER CORROSION OR WEAR</p> <p>If the flowrate signal appears to have a calibration shift or goes to zero, check the flowmeter for corrosion or wear.</p> <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p>

NOTICE
<p>POTENTIAL EQUIPMENT DAMAGE</p> <p>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.</p> <p>Failure to follow these instructions can result in equipment damage.</p>

Transmitter Does Not Respond

The transmitter may be in Listen Only Mode. Refer to *Listen Only Mode*, page 144.

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 180.
- 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 21 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 36). 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 53.

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 9 and 30Vdc.
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 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 pulse output default value, if applicable.

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: $+3.0 \pm 0.3$ 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 $\pm 5\%$ 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 53.
 - h. If the flowmeter still has no output, proceed to *Testing the Electronics Module*, page 178.

Testing the Electronics Module

Refer to *Replacing the Electronics Module*, page 184 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.

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 180*.
- 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 180*.
- 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 180*). 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 180*.
- 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.

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 31.

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 sanitary flowmeter sensor is filled with NEOBEE® M-20 fluid for applications with process temperature limits of -18 to +177°C (0 to 350°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 122 - Connectors on the Electronics Module

Number of Pins	Description
2 to terminal block	Pulse Output
6 to potted neck module	Power
	Communication
4 (on side) to potted neck module	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.

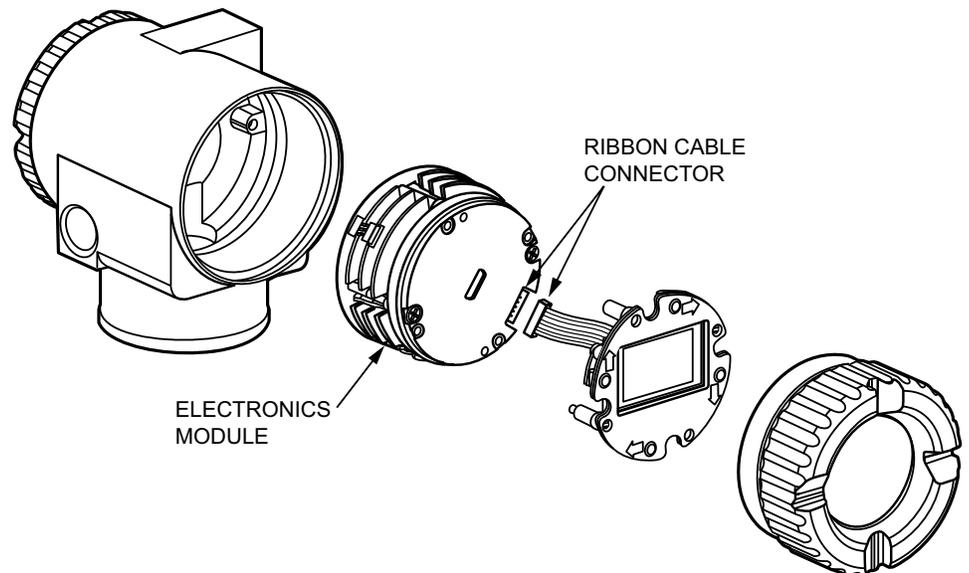
Removing the Electronics Module

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.

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 90 - Optional Display Connection



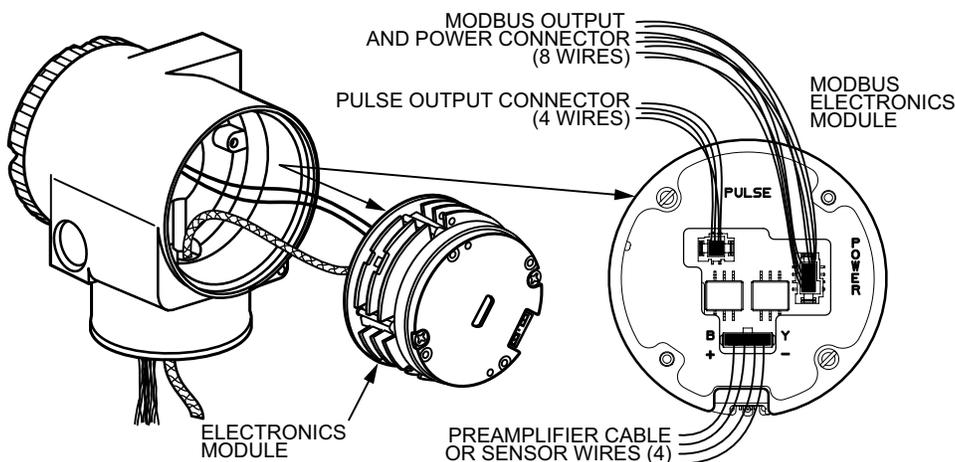
5. Loosen the two captive screws, one on each side of the electronics module.
6. Pull the electronics module out of the housing just far enough to be able to reach the cable connectors on the back of the electronics module.
7. Disconnect the cables from the back (and side, if the flowmeter has a temperature 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 184.
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 91 - 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 185.
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.

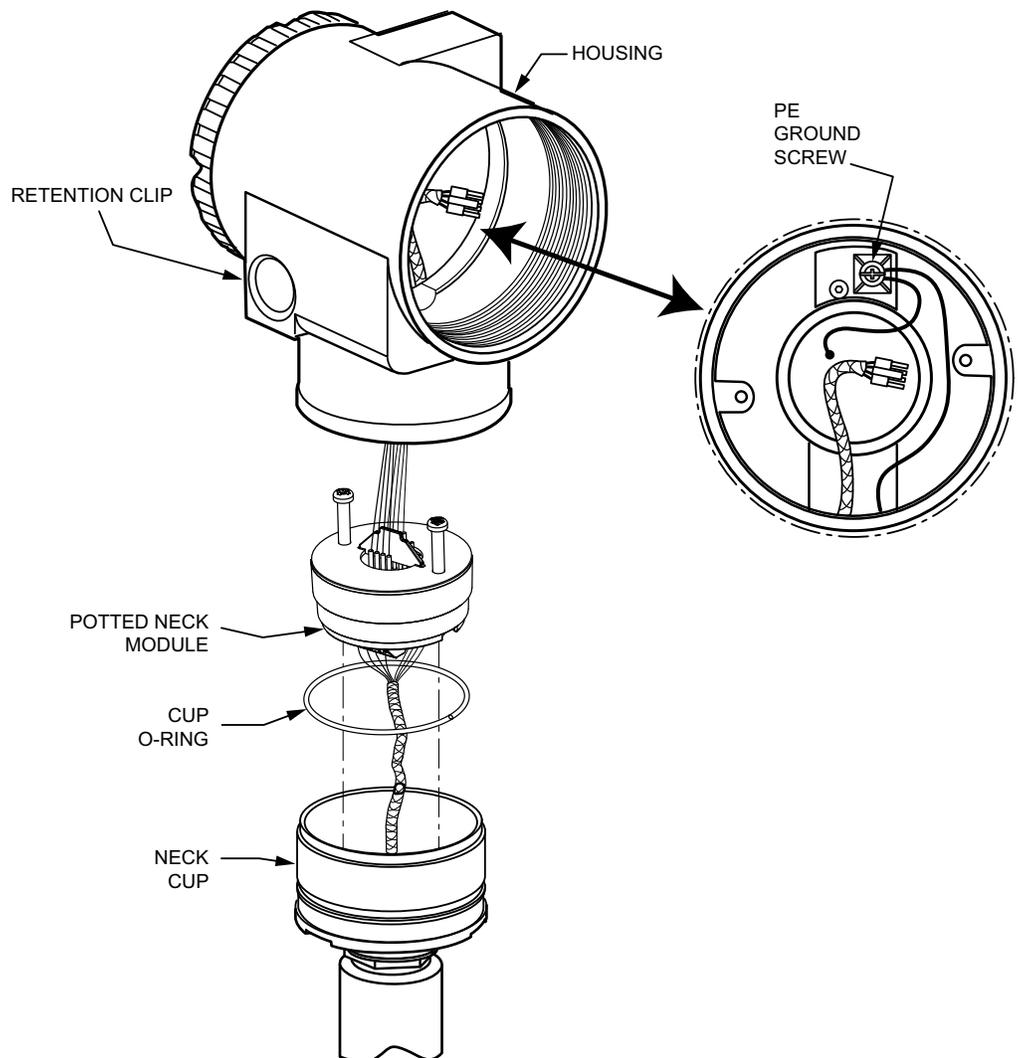
Replacing the Potted Neck Module

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 92 - 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 187.

1. Turn off power to the flowmeter and remove the electronics module. Refer to *Removing the Electronics Module*, page 184. (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 188.
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.

- Inspect the cup o-ring for damage. If the o-ring is damaged, replace it with the appropriate o-ring.

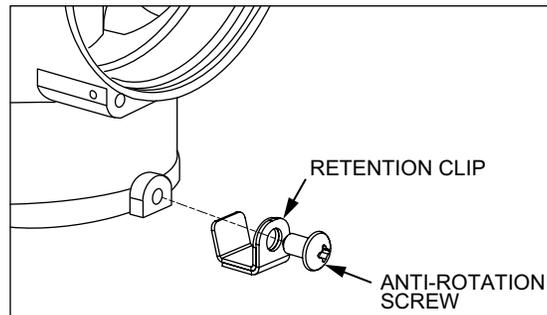
▲ WARNING

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.

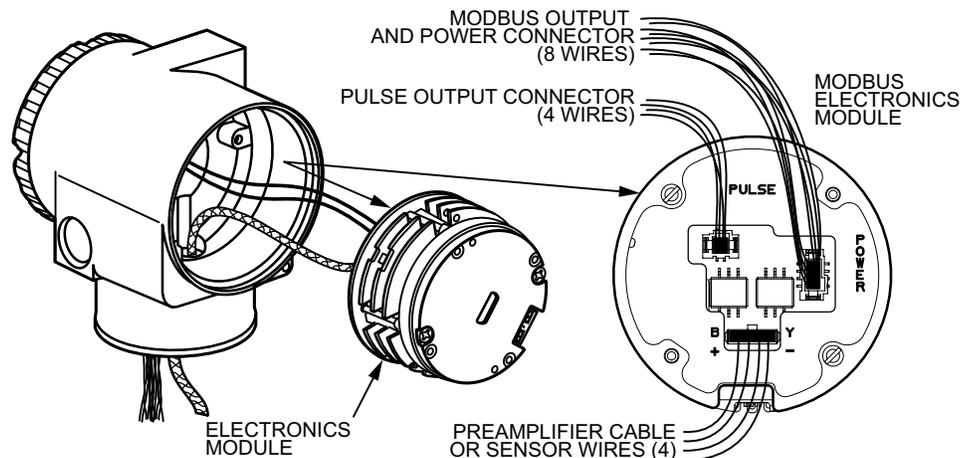
- Lubricate the o-ring with silicone lubricant (part number 0048130 or equivalent). Verify that the o-ring is situated in the groove of the neck.
- Screw the housing onto the cup. Hand-tighten until it bottoms. Do not over-tighten.
- If the flowmeter has explosionproof/flameproof electrical certification, reconnect the two green PE ground wires to the PE ground screw in the electronics housing.
- 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.



- Rotate the housing up to one full turn counterclockwise for optimum access.
- 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).
- 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 93 - 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.

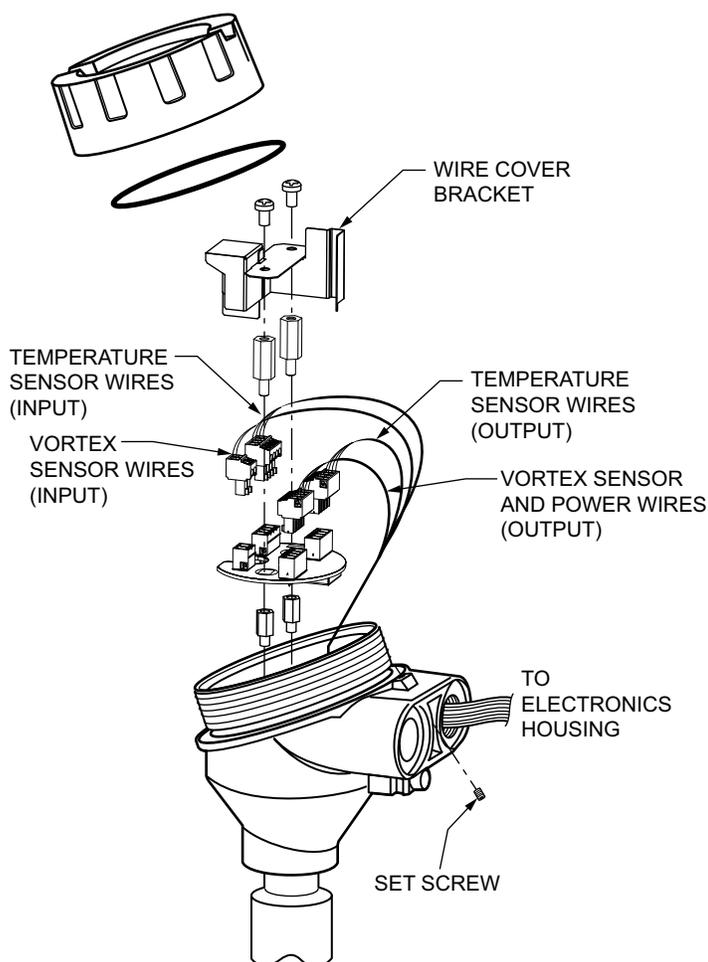
Replacing the Preamplifier

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 187* for instructions.

Integrally mounted flowmeters with standard temperature range do not have a preamplifier.

Figure 94 - 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 190.

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 190.

1. Turn off power to the flowmeter and remove the preamplifier, if you have not done so already. Refer to *Removing the Preamplifier*, page 191.
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.

Replacing or Adding a Digital Display/Configurator

It may be necessary to replace the existing display or you may choose to add a display to a flowmeter that does not have one installed.

Refer to MI 019-198 for instructions on replacing or adding a digital display/configurator to the flowmeter.

- When replacing an existing display, use the M84/84C Replacement Kit (Part number K0149GV).
- When adding a new display to a flowmeter that did not have one, use the M84/84C Conversion Kit (Part number K0149GS).

Model Code

These tables list all of the options, including other electronics versions, for the Model 84C Vortex Flowmeters.

Flanged Body Style

Table 123 - 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) ⁶⁶
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 <ul style="list-style-type: none"> • 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 ⁶⁷ <ul style="list-style-type: none"> • 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

66. For Line Size 080 with End Connection F4, F5, T4, T5, D5, or B5, Optional Welding Certificate -X is included.

67. 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 123 - 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) ⁶⁸
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) ⁶⁹
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) ⁷⁰

68. For Line Sizes 008, 010, and 015, select End Connection D7.

69. For Line Sizes 008, 010, and 015, select End Connection B7.

70. For Multivariable Selection T, pulse output is always enabled.

Table 123 - 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 ⁷¹
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 ⁷¹
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 ^{71 72}
B	Unfilled, 149 to 371°C (300 to 700°F), Cast Stainless Steel CF3M ⁷²
E	Unfilled, 149 to 427°C (300 to 800°F), Cast Nickel Alloy CW2M ^{71 73 74}
G	Unfilled, 149 to 427°C (300 to 800°F), Cast Stainless Steel CF3M ^{73 74}
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 ⁷⁵
W	Aluminum, Remote-Mounted, with M20 Conduit Connections ⁷⁵
Local Digital Indicator/Configurator	
N	No Digital Indicator/Configurator
J	Digital Indicator/Configurator
Electrical Certifications (refer to <i>Electrical Certifications</i>, page 27)⁷⁶	
AA	ATEX Intrinsically Safe ⁷⁷
AD	ATEX Flameproof
BA	INMETRO Intrinsically Safe ⁷⁷
BD	INMETRO Flameproof ⁷⁸
CA	CSA Intrinsically Safe ⁷⁷
CD	CSA Explosionproof
CN	CSA Division 2 ⁷⁷
EA	IECEx Intrinsically Safe ⁷⁷
ED	IECEx Flameproof
FA	FM Intrinsically Safe ⁷⁷
FD	FM Explosionproof
FN	FM Nonincendive ⁷⁷
KD	KOSHA Flameproof

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

72. 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.

73. Not available with temperature compensation (Multivariable Selection T).

74. Includes Optional Welding Certificate -X.

75. For remote mounting, select a cable length with the Cable for Connecting to Remote-Mounted Electronics option.

76. For detailed information or status of testing laboratory approvals/certifications, contact Global Customer Support.

77. Not available with Modbus (Electronics Version -M).

78. Contact Global Customer Support for availability.

Table 123 - Model Code for 84CF Flowmeters (Continued)

Code	Description
NA	NEPSI Intrinsically Safe ⁷⁹
ND	NEPSI Flameproof ⁸⁰
RA	EAC Intrinsically Safe ⁷⁹
RD	EAC Flameproof ⁸⁰
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 ⁸¹
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 ⁸²
-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)

79. Not available with Modbus (Electronics Version -M).

80. Contact Global Customer Support for availability.

81. 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.

82. Available only with sensors that have Fluorolube fill. Not available with unfilled sensors or sensors that have silicone fill.

Wafer Body Style

Table 124 - 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 ⁸³ (Line Sizes 008 to 040)
Mounting and Centering System	
W1	Centering for: <ul style="list-style-type: none"> 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

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

Table 124 - Model Code for 84CW Flowmeters (Continued)

Code	Description
Multivariable Selection	
N	None
T	Temperature Compensation up to 260°C (500°F) ⁸⁴
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 ⁸⁵
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 ⁸⁵
S	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Stainless Steel CF3M
Extended Temperature Range (No Fill Fluid)⁸⁶	
E	Unfilled, 149 to 427°C (300 to 800°F), Cast Nickel Alloy CW2M ⁸⁵
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 ⁸⁷
W	Aluminum, Remote-Mounted, with M20 Conduit Connections ⁸⁷
Local Digital Indicator/Configurator	
N	No Digital Indicator/Configurator
J	Digital Indicator/Configurator
Electrical Certifications (refer to <i>Electrical Certifications, page 27</i>)⁸⁸	
AA	ATEX Intrinsically Safe ⁸⁹
AD	ATEX Flameproof
BA	INMETRO Intrinsically Safe ⁸⁹
BD	INMETRO Flameproof ⁹⁰
CA	CSA Intrinsically Safe ⁸⁹
CD	CSA Explosionproof
CN	CSA Division 2 ⁸⁹
EA	IECEX Intrinsically Safe ⁸⁹
ED	IECEX Flameproof
FA	FM Intrinsically Safe ⁸⁹
FD	FM Explosionproof
FN	FM Nonincendive ⁸⁹

84. For Multivariable Selection T, pulse output is always enabled.

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

86. 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.

87. For remote mounting, select a cable length with the Cable for Connecting to Remote-Mounted Electronics option.

88. For detailed information or status of testing laboratory approvals/certifications, contact Global Customer Support.

89. Not available with Modbus (Electronics Version -M).

90. Contact Global Customer Support for availability.

Table 124 - Model Code for 84CW Flowmeters (Continued)

Code	Description
KD	KOSHA Flameproof
NA	NEPSI Intrinsically Safe ⁹¹
ND	NEPSI Flameproof ⁹²
RA	EAC Intrinsically Safe ⁹¹
RD	EAC Flameproof ⁹²
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 ⁹³
-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)

91. Not available with Modbus (Electronics Version -M).

92. Contact Global Customer Support for availability.

93. Available only with sensors that have Fluorolube fill. Not available with unfilled sensors or sensors that have silicone fill.

NPT (Threaded) Body Style

Table 125 - 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: <ul style="list-style-type: none"> 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) ⁹⁴
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 ⁹⁵
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 ⁹⁵
S	Silicone Fill, -18 to +204°C (0 to 400°F), Cast Stainless Steel CF3M

94. For Multivariable Selection T, pulse output is always enabled.

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

Table 125 - 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 ^{96 97}
B	Unfilled, 149 to 371°C (300 to 700°F), Cast Stainless Steel CF3M ⁹⁷
E	Unfilled, 149 to 427°C (300 to 800°F), Cast Nickel Alloy CW2M ^{96 98}
G	Unfilled, 149 to 427°C (300 to 800°F), Cast Stainless Steel CF3M ⁹⁸
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 ⁹⁹
W	Aluminum, Remote-Mounted, with M20 Conduit Connections ⁹⁹
Local Digital Indicator/Configurator	
N	No Digital Indicator/Configurator
J	Digital Indicator/Configurator
Electrical Certifications (refer to <i>Electrical Certifications, page 27</i>)¹⁰⁰	
AA	ATEX Intrinsically Safe ¹⁰¹
AD	ATEX Flameproof
BA	INMETRO Intrinsically Safe ¹⁰¹
BD	INMETRO Flameproof ¹⁰²
CA	CSA Intrinsically Safe ¹⁰¹
CD	CSA Explosionproof
CN	CSA Division 2 ¹⁰¹
EA	IECEX Intrinsically Safe ¹⁰¹
ED	IECEX Flameproof
FA	FM Intrinsically Safe ¹⁰¹
FD	FM Explosionproof
FN	FM Nonincendive ¹⁰¹
KD	KOSHA Flameproof ¹⁰²
NA	NEPSI Intrinsically Safe ¹⁰¹
ND	NEPSI Flameproof ¹⁰²
RA	EAC Intrinsically Safe ¹⁰¹
RD	EAC Flameproof ¹⁰²
YY	CE mark only; PED controls and records
ZZ	No CE mark; do not install in European Union countries

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

97. 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.

98. Not available with temperature compensation (Multivariable Selection T).

99. For remote mounting, select a cable length with the Cable for Connecting to Remote-Mounted Electronics option.

100. For detailed information or status of testing laboratory approvals/certifications, contact Global Customer Support.

101. Not available with Modbus (Electronics Version -M).

102. Contact Global Customer Support for availability.

Table 125 - 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 ¹⁰³
-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)

103. Available only with sensors that have Fluorolube fill. Not available with unfilled sensors or sensors that have silicone fill.

Sanitary Body Style

Table 126 - Model Code for 84CS Flowmeters

Code	Description
Model	
84C	Vortex Flowmeter
Body Style	
S	Sanitary
Nominal Line Size	
020	DN50; 50 mm (2 in)
030	DN80; 80 mm (3 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	316/316L ss Tubing, 316L ss Shedder
End Connections	
C0	3-A I-Line Fitting Mates With (Cherry-Burrell 15 WI or equivalent)
F0	ANSI 150# ¹⁰⁴
M0	Metric (DIN 11851)
R0	RJT (BS 1864)
T0	3-A Fitting Mates With (Tri-Clover or equivalent)
U0	ISS (ISO 2853)
Single or Dual Measurement; Isolation Manifold	
S	Single Measurement; No Isolation Manifold
Multivariable Selection	
N	None (no temperature compensation)
Sensor Fill, Temperature Range, and Material	
C	Neobee M-20 Fill, -20 to +177°C (0 to 350°F)
Mounting and Conduit Openings for Electronics Housing	
R	Aluminum, Remote-Mounted, with 1/2 NPT Conduit Connections
W	Aluminum, Remote-Mounted, with M20 Conduit Connections
Local Digital Indicator/Configurator	
N	No Digital Indicator/Configurator
J	Digital Indicator/Configurator

104. Does not meet 3-A compliance.

Table 126 - Model Code for 84CS Flowmeters (Continued)

Code	Description
Electrical Certifications (refer to <i>Electrical Certifications</i>, page 27)¹⁰⁵	
AA	ATEX Intrinsically Safe ¹⁰⁶
AD	ATEX Flameproof
BA	INMETRO Intrinsically Safe ¹⁰⁶
BD	INMETRO Flameproof ¹⁰⁷
CA	CSA Intrinsically Safe ¹⁰⁶
CD	CSA Explosionproof
CN	CSA Division 2 ¹⁰⁶
EA	IECEX Intrinsically Safe ¹⁰⁶
ED	IECEX Flameproof
FA	FM Intrinsically Safe ¹⁰⁶
FD	FM Explosionproof
FN	FM Nonincendive ¹⁰⁶
KD	KOSHA Flameproof ¹⁰⁷
NA	NEPSI Intrinsically Safe ¹⁰⁶
ND	NEPSI Flameproof ¹⁰⁷
RA	EAC Intrinsically Safe ¹⁰⁶
RD	EAC Flameproof ¹⁰⁷
YY	CE mark only; PED controls and records
ZZ	No CE mark; do not install in European Union countries
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)
Miscellaneous Optional Selections	
-N	Calibration and Pressure Test Certified Copy

105. For detailed information or status of testing laboratory approvals/certifications, contact Global Customer Support.

106. Not available with Modbus (Electronics Version -M).

107. Contact Global Customer Support for availability.

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 ($\frac{\text{mm}}{\text{in}}$).

Dimensions for 84C Flanged Body Flowmeters

Figure 95 - Flanged Body Flowmeter with Integrally Mounted Electronics Housing

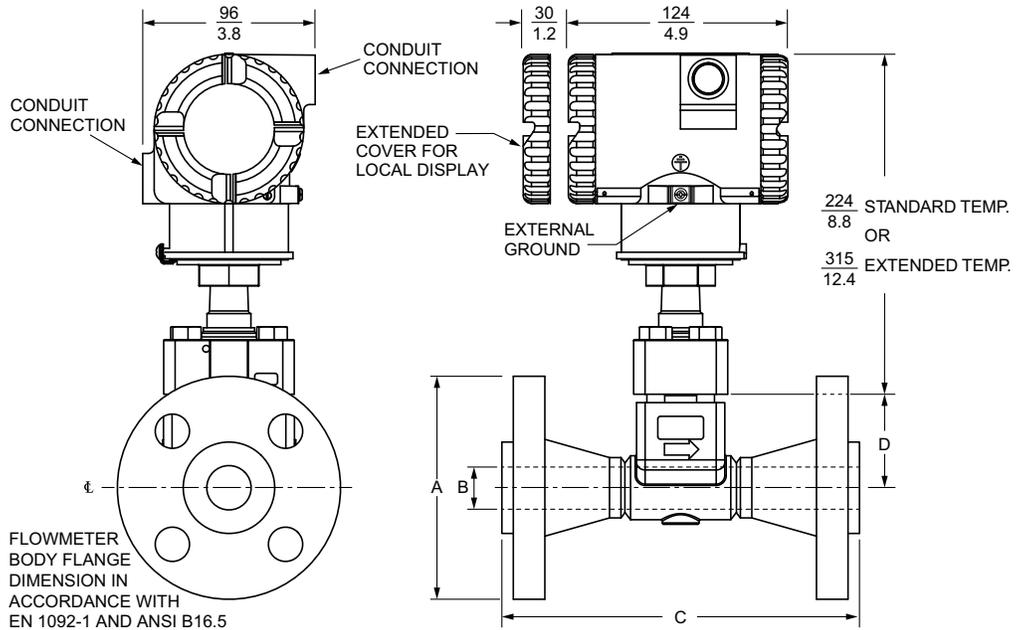


Figure 96 - Flanged Body Flowmeter with Junction Box

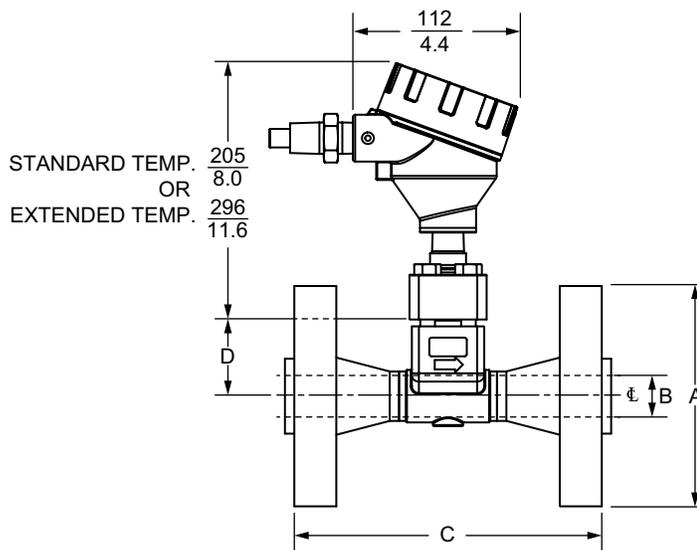


Table 127 - Flanged Body, with ANSI Flanges and Material Code R or E

Nominal Line Size	Flange Type	Dimension A (OD)	Dimension B (ID)	Dimension C ¹⁰⁸		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	

108. For line sizes 008 through 010, the overall length (dimension C) is $\pm 6.4\text{mm}$ ($\pm 0.250\text{in}$). For line size 120, the overall length is $\pm 8.9\text{mm}$ ($\pm 0.350\text{in}$).

**Table 127 - 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 ¹⁰⁹		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 128 - Flanged Body, with DIN Flanges and Material Code R or E

Nominal Line Size	Flange Type	Dimension A (OD)	Dimension B (ID)	Dimension C ¹⁰⁹	Dimension D
008	PN 40 ¹¹⁰	95 mm	19 mm	138 mm	46 mm
	PN 100	105 mm		152 mm	
010	PN 40 ¹¹⁰	115 mm	24.31 mm	142 mm	49 mm
	PN 100	140 mm		178 mm	
	PN 160				
015	PN 40 ¹¹⁰	150 mm	38.10 mm	152 mm	56 mm
	PN 100	170 mm		186 mm	
	PN 160			190 mm	
020	PN 40 ¹¹⁰	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 40 ¹¹⁰	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 40 ¹¹⁰	235 mm	97 mm	222 mm	85 mm
	PN 63	250 mm		248 mm	
	PN 100	265 mm		272 mm	
	PN 160			292 mm	

109. For line sizes 008 through 010, the overall length (dimension C) is $\pm 6.4\text{mm}$ ($\pm 0.250\text{in}$). For line size 120, the overall length is $\pm 8.9\text{mm}$ ($\pm 0.350\text{in}$).

110. May be used with a PN25 mating flange.

Table 128 - 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 ¹¹¹	Dimension D
060	PN 16	285 mm	146 mm	237 mm	112 mm
	PN 40 ¹¹²	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 129 - Flanged Body, with ANSI Flanges and Material Code Y (Backward Compatible with Style A)

Nominal Line Size	Flange Rating ¹¹³	Dimension A (OD)	Dimension B (ID)	Dimension C ¹¹⁴	Dimension D
008	Class 150	3.88 in	0.74 in	6.00 in	1.82 in
	Class 300	4.62 in		6.50 in	
	Class 600				
010	Class 150	4.25 in	0.96 in	6.50 in	1.93 in
	Class 300	4.88 in		7.00 in	
	Class 600				
015	Class 150	4.62 in	1.50 in	7.25 in	2.20 in
	Class 300	6.12 in		7.88 in	
	Class 600				
020	Class 300	6.50 in	1.94 in	7.75 in	2.32 in
	Class 600			8.50 in	

111. 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).

112. May be used with a PN25 mating flange.

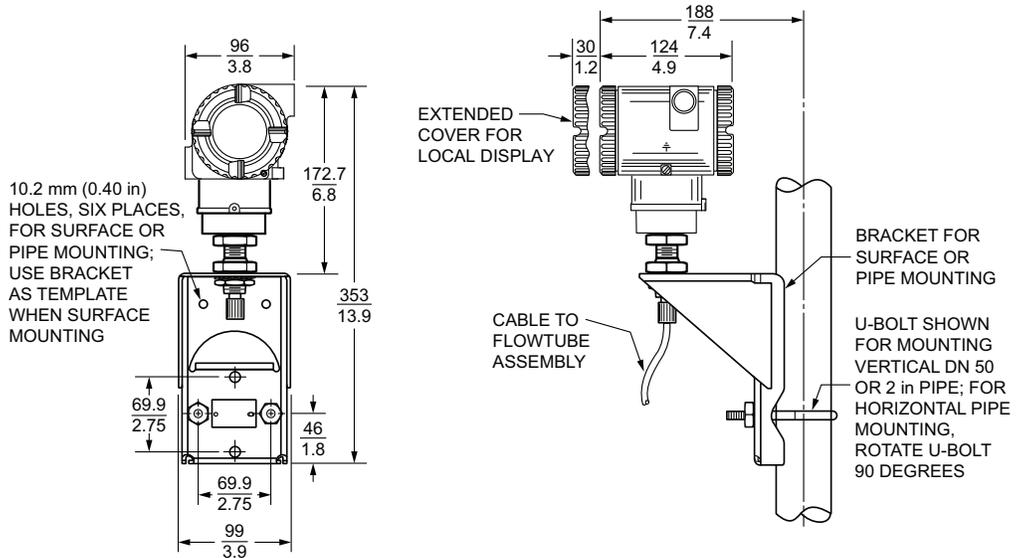
113. For ANSI flanges, material code Y offers face-to-face lengths that are backward compatible with the Style A vortex flowmeters model code selection S. Use material code Y when replacing a Model 84F Style A meter.

114. Overall length (C) is ±0.250 in (±6.4 mm).

Table 129 - Flanged Body, with ANSI Flanges and Material Code Y (Backward Compatible with Style A) (Continued)

Nominal Line Size	Flange Rating ¹¹⁵	Dimension A (OD)	Dimension B (ID)	Dimension C ¹¹⁶	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 97 - 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.

115. 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.

116. Overall length (C) is ± 0.250 in (± 6.4 mm).

Dimensions for 84C Wafer Body Flowmeters

Figure 98 - Wafer Body Flowmeter with Integrally Mounted Electronics Housing

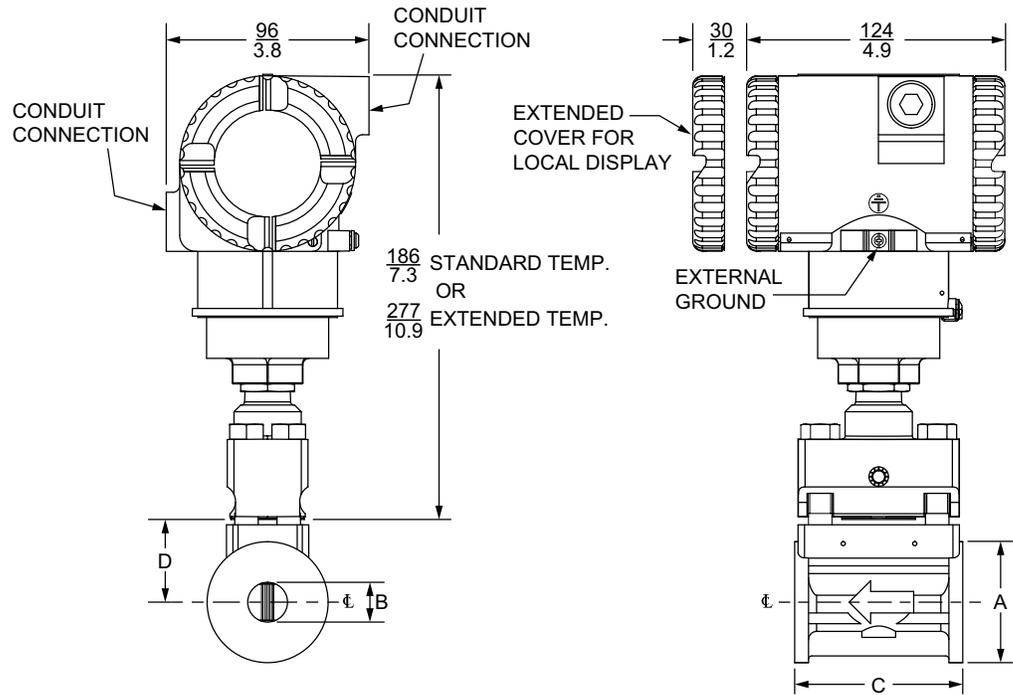


Figure 99 - Wafer Body Flowmeter with Junction Box

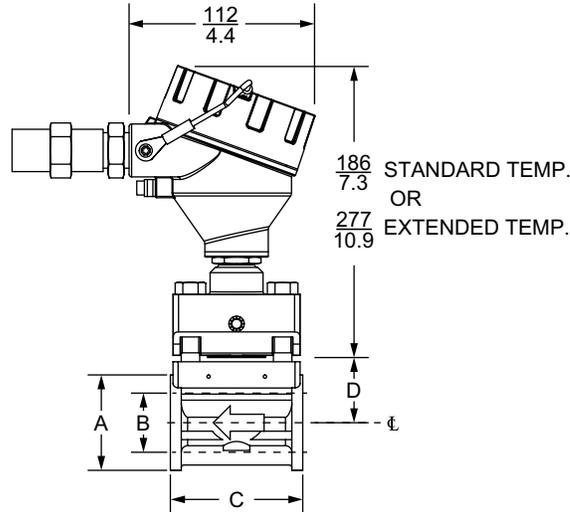


Table 130 - Wafer Body Dimensions

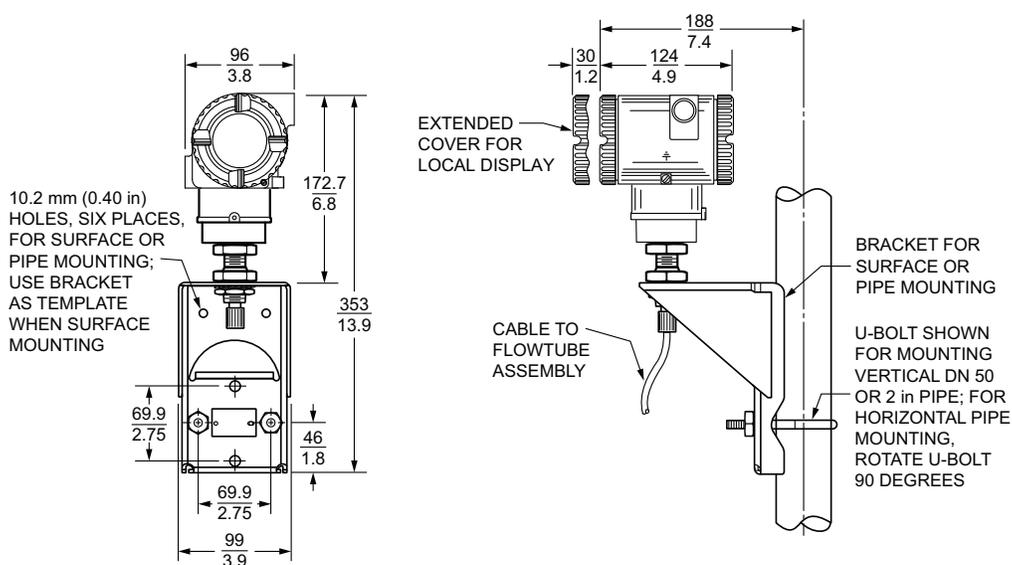
Nominal Line Size ¹¹⁷	Dimension A (OD)	Dimension B (ID) ¹¹⁸	Dimension C	Dimension D
008	57.2 mm (2.25 in)	18.8 mm (0.74 in)	79.5 mm (3.13 in)	36.6 mm (1.44 in)
010	66.8 mm (2.63 in)	24.3 mm (0.96 in)	79.5 mm (3.13 in)	39.4 mm (1.55 in)
015	85.9 mm (3.38 in)	38.1 mm (1.50 in)	79.5 mm (3.13 in)	46.2 mm (1.82 in)

117. Flowmeter body fits between ANSI Class 150, 300, or 600 raised face flanges, or between PN 16, 40, 63, or 100 flanges.

118. Bore equivalent to Schedule 80 pipe.

Table 130 - Wafer Body Dimensions (Continued)

Nominal Line Size ¹¹⁹	Dimension A (OD)	Dimension B (ID) ¹²⁰	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 100 - 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.

119. Flowmeter body fits between ANSI Class 150, 300, or 600 raised face flanges, or between PN 16, 40, 63, or 100 flanges.
120. Bore equivalent to Schedule 80 pipe.

Dimensions for 84C NPT Body Flowmeters

Figure 101 - NPT Body Flowmeter with Integrally Mounted Electronics Housing

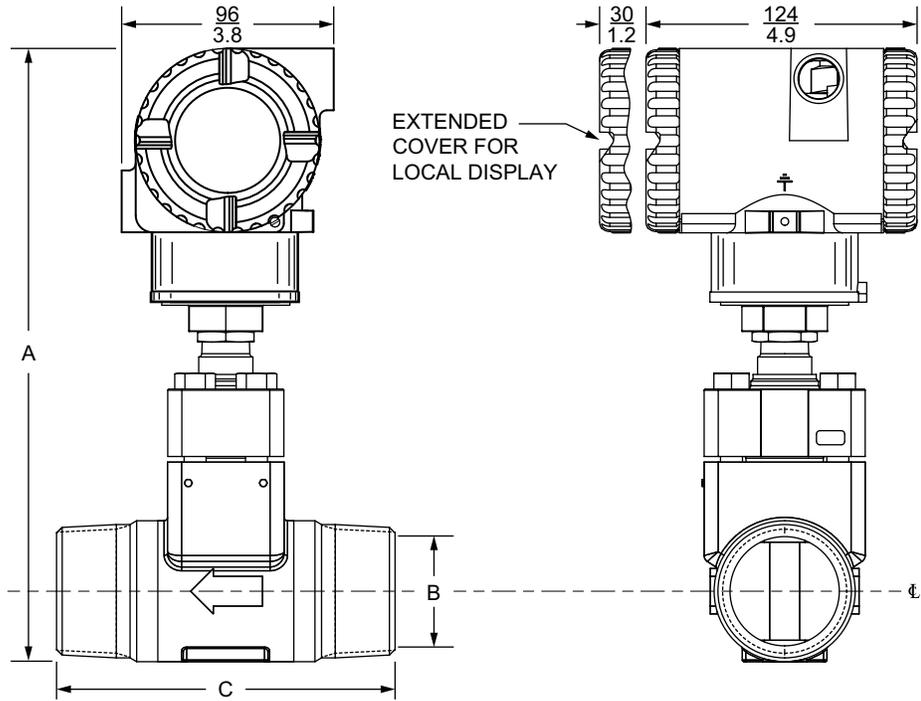


Figure 102 - NPT Body Flowmeter with Junction Box

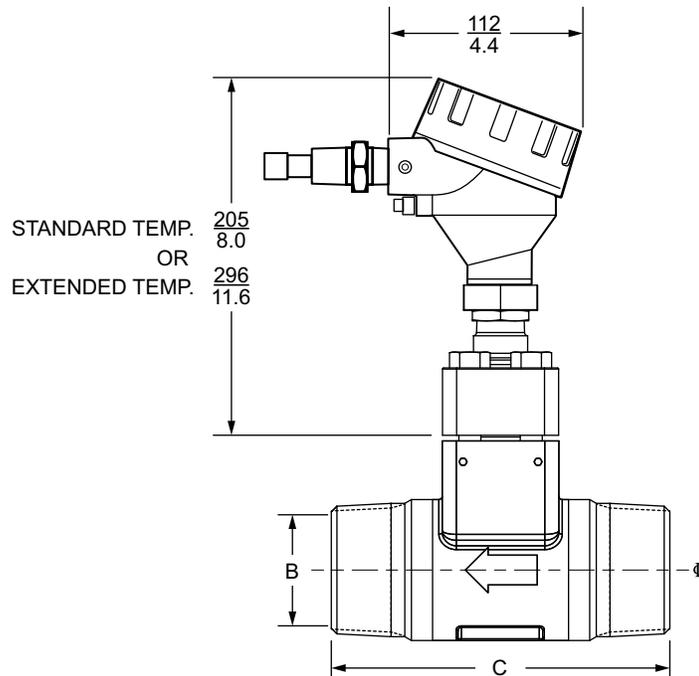
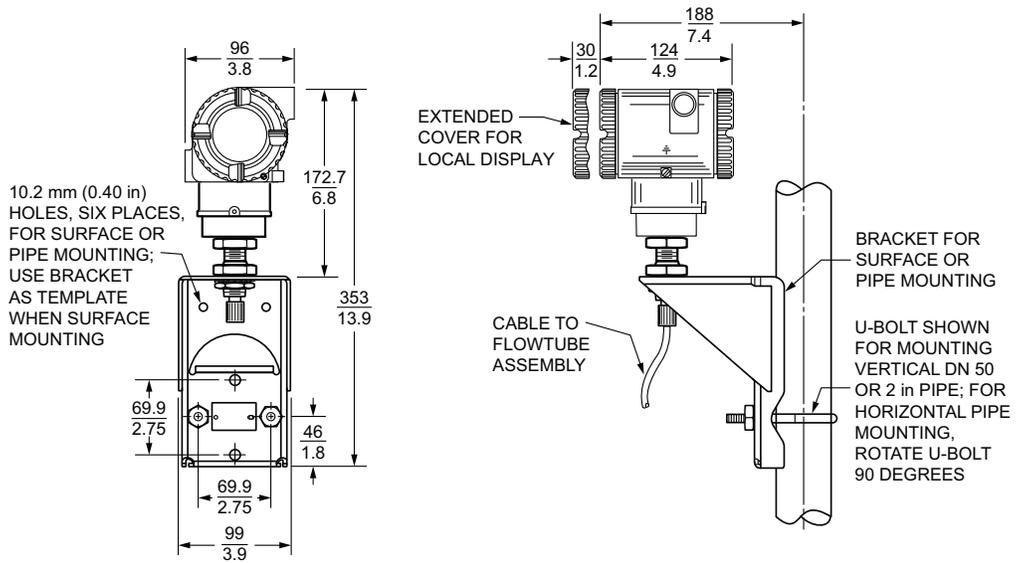


Table 131 - NPT Body Dimensions

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)

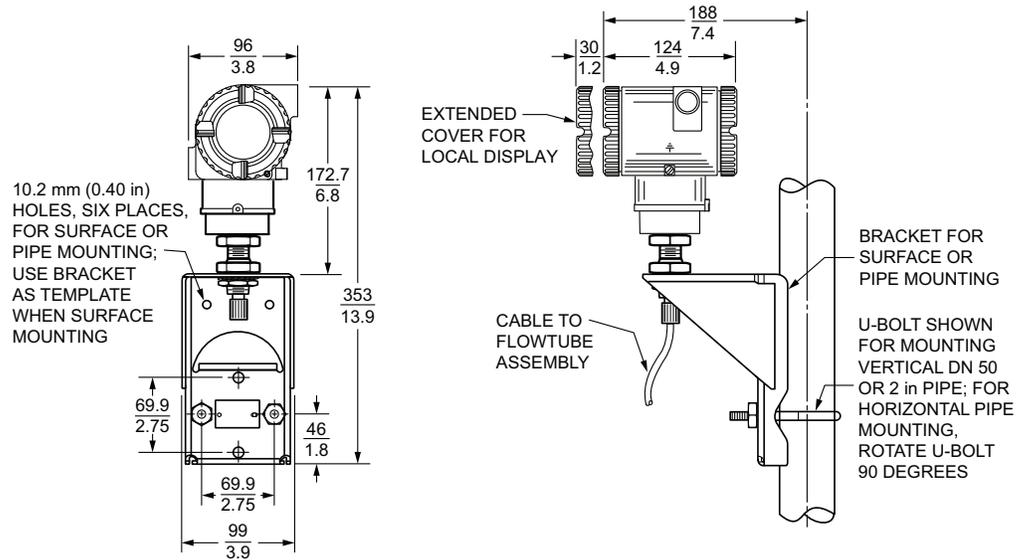
Figure 103 - Remotely Mounted Electronics Housing for 84CN



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.

Dimensions for 84C Sanitary Flowmeters

Figure 104 - Remotely Mounted Electronics Housing for 84CS



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.

Figure 105 - Interconnecting Cable to Electronics Housing for 84CS

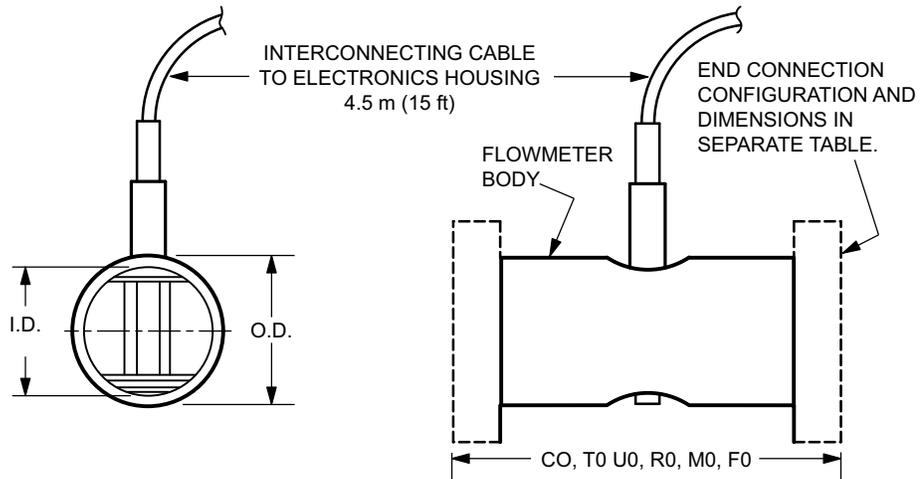


Table 132 - Sanitary Flowmeter Body Dimensions

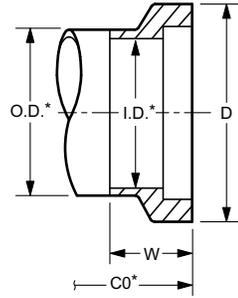
Nominal Line Size	Flowmeter Body Dimensions							
	I.D. ¹²¹	O.D.	End Connections ¹²²					
			C0	T0	U0	R0	M0	F0
020	47.50 mm (1.87 in)	50.8 mm (2.0 in)	155 mm (6.1 in)	127 mm (5.0 in)	145 mm (5.7 in)	160 mm (6.3 in)	173 mm (6.8 in)	254 mm (10.0 in)
030	72.90 mm (2.87 in)	76.2 mm (3.0 in)	213 mm (8.4 in)	178 mm (7.0 in)	196 mm (7.7 in)	211 mm (8.3 in)	334 mm (9.2 in)	251 mm (9.9 in)

121. Equivalent to Schedule 80 pipe.

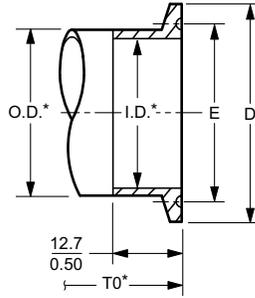
122. Tube length for each end connection.

Figure 106 - End Connection for 84CS

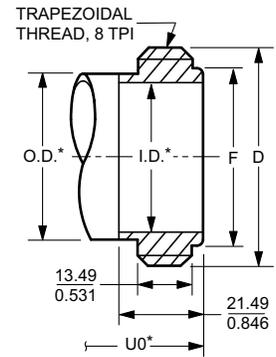
3A I-LINE FITTING (CODE C0)



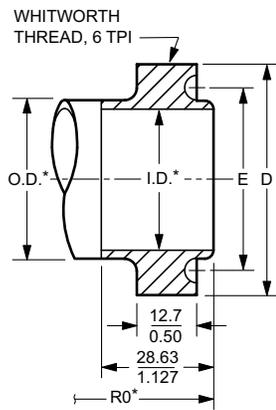
3-A TRI-CLOVER FITTING (CODE T0)



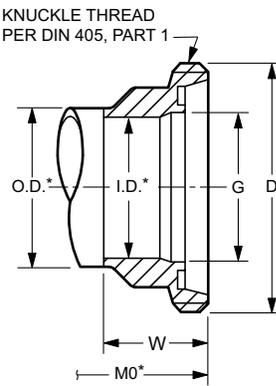
ISS (ISO 2853) (CODE U0)



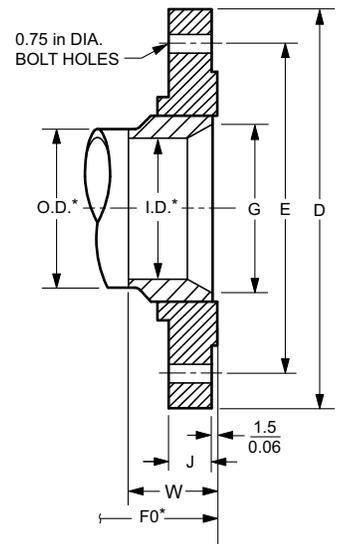
RJT (BS 1864) (CODE R0)



METRIC (DIN 11851) (CODE M0)



ANSI 150 # (CODE F0)



NOTE: Refer to *Sanitary Flowmeter Body Dimensions*, page 214 for values of O.D., I.D., and tube lengths C0, T0, U0, R0, M0, and F0.

Table 133 - Sanitary Flowmeter End Connection Dimensions (C0, T0, U0, and R0)

Nominal Line Size	End Connection Dimensions ¹²³							
	Code C0		Code T0		Code U0		Code R0	
	D	W	D	E	D	F	D	E
020	67.06 mm (2.64 in)	26.19 mm (1.03 in)	64.0 mm (2.52 in)	56.4 mm (2.22 in)	64.08 mm (2.52 in)	56.21 mm (2.21 in)	72.72 mm (2.86 in)	58.67 mm (2.31 in)
030	98.3 mm (3.87 in)	30.96 mm (1.22 in)	90.9 mm (3.58 in)	83.3 mm (3.28 in)	91.11 mm (3.59 in)	82.6 mm (3.25 in)	98.12 mm (3.86 in)	84.07 mm (3.31 in)

123. See the *Sanitary Flowmeter Body Dimensions*, page 214 for dimensions for the O.D., End Connections, and I.D.

Table 134 - Sanitary Flowmeter End Connection Dimensions (M0 and F0)

Nominal Line Size	End Connection Dimensions ¹²⁴							
	Code M0			Code F0				
	D	G	W	D	E	G	J	W
020	78.0 mm (3.10 in)	50.0 mm (2.00 in)	35.0 mm (1.40 in)	152.4 mm (6.0 in)	120.7 mm (4.75 in)	57.02 mm (2.24 in)	17.5 mm (0.69 in)	41.1 mm (1.62 in)
030	110 mm (4.30 in)	81 mm (3.20 in)	40.0 mm (1.60 in)	190.5 mm (7.50 in)	152.4 mm (6.00 in)	84.68 mm (3.33 in)	22.4 mm (0.88 in)	46.0 mm (1.81 in)

124. See the *Sanitary Flowmeter Body Dimensions*, page 214 for dimensions for the O.D., End Connections, and I.D.

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 220 for remote mounting parts and configuration.

Figure 107 - Electronics Housing Assembly

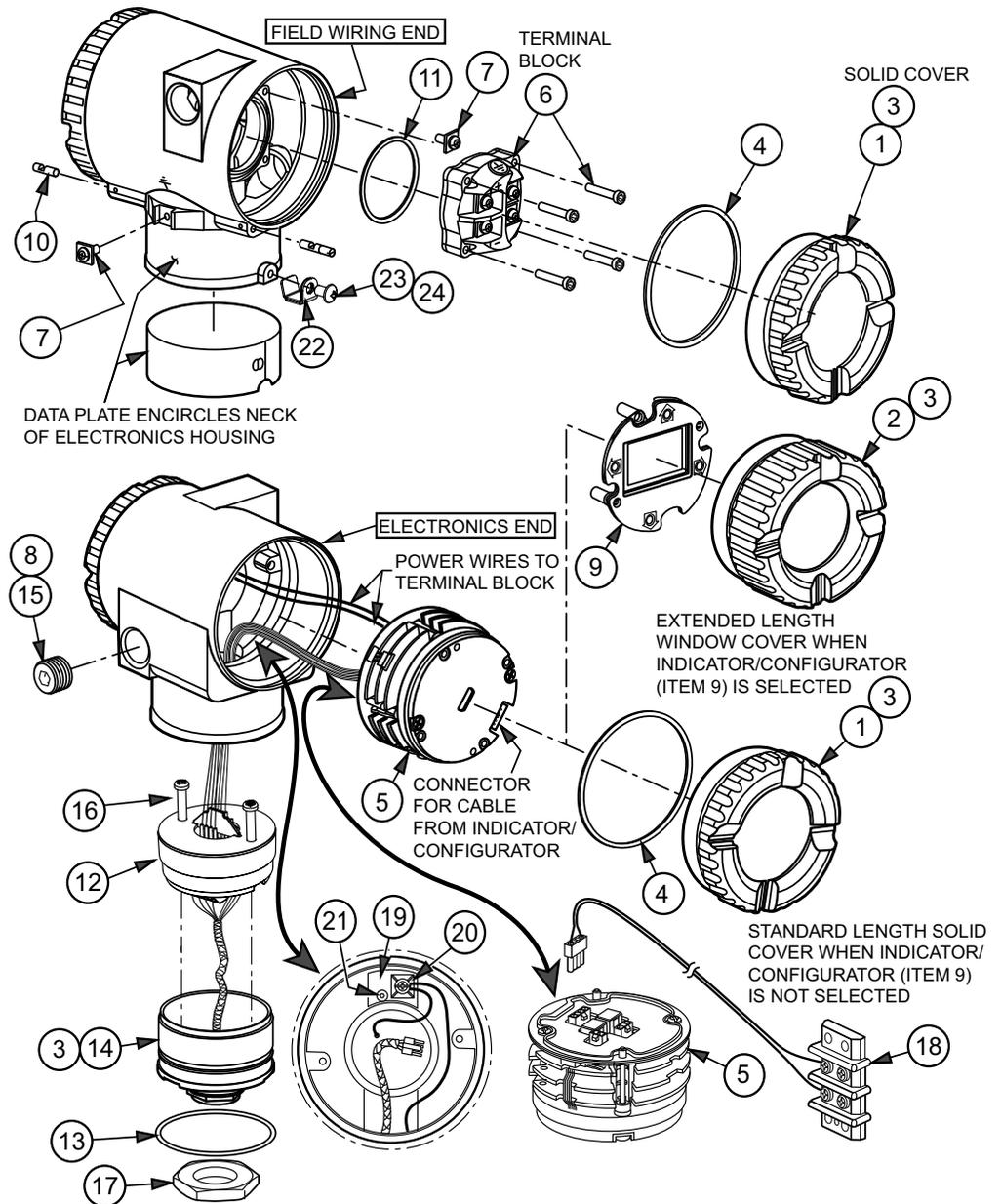


Table 135 - Parts for Electronics Housing Assembly

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, 0.164-32 ¹²⁵
11	X0144KR	1	O-Ring, Terminal Block
12	Potted Cup Assembly Module; see <i>Potted Cup Assembly Part Numbers, page 219</i>		
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
<div style="border: 1px solid black; padding: 10px;"> <p style="text-align: center;">⚠ WARNING</p> <p>RISK OF MOISTURE INGRESS</p> <p>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.</p> <p>Failure to follow these instructions can result in death, serious injury, or equipment damage.</p> </div>			
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

125. 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 135 - Parts for Electronics Housing Assembly (Continued)

Item	Part No.	Qty.	Part Name
18	K0152KU	1	Harness, Test; Accessory ¹²⁶
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 136 - 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 ¹²⁷	K0168MX	K0168MW	K0168MX
	Remotely Mounted	K0171CB		K0168QD	

Table 137 - 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 ¹²⁷	K0168HF	K0168GJ	K0168HF
	Remotely Mounted	K0168QB			

126. The test harness provides a means for inputting a test frequency using a frequency generator, for users who require a test input for validation.
 127. The 84CS (Sanitary) only uses Potted Cup Assembly Part Number K0168MW (with Flameproof/Explosionproof Agency Certification) and K0168GJ (with Non-Flameproof/Explosionproof Agency Certification).

Junction Box and Remote Mounting

Figure 108 - Junction Box and Remote Mounting for Flanged, Wafer, and NPT Body Flowmeter

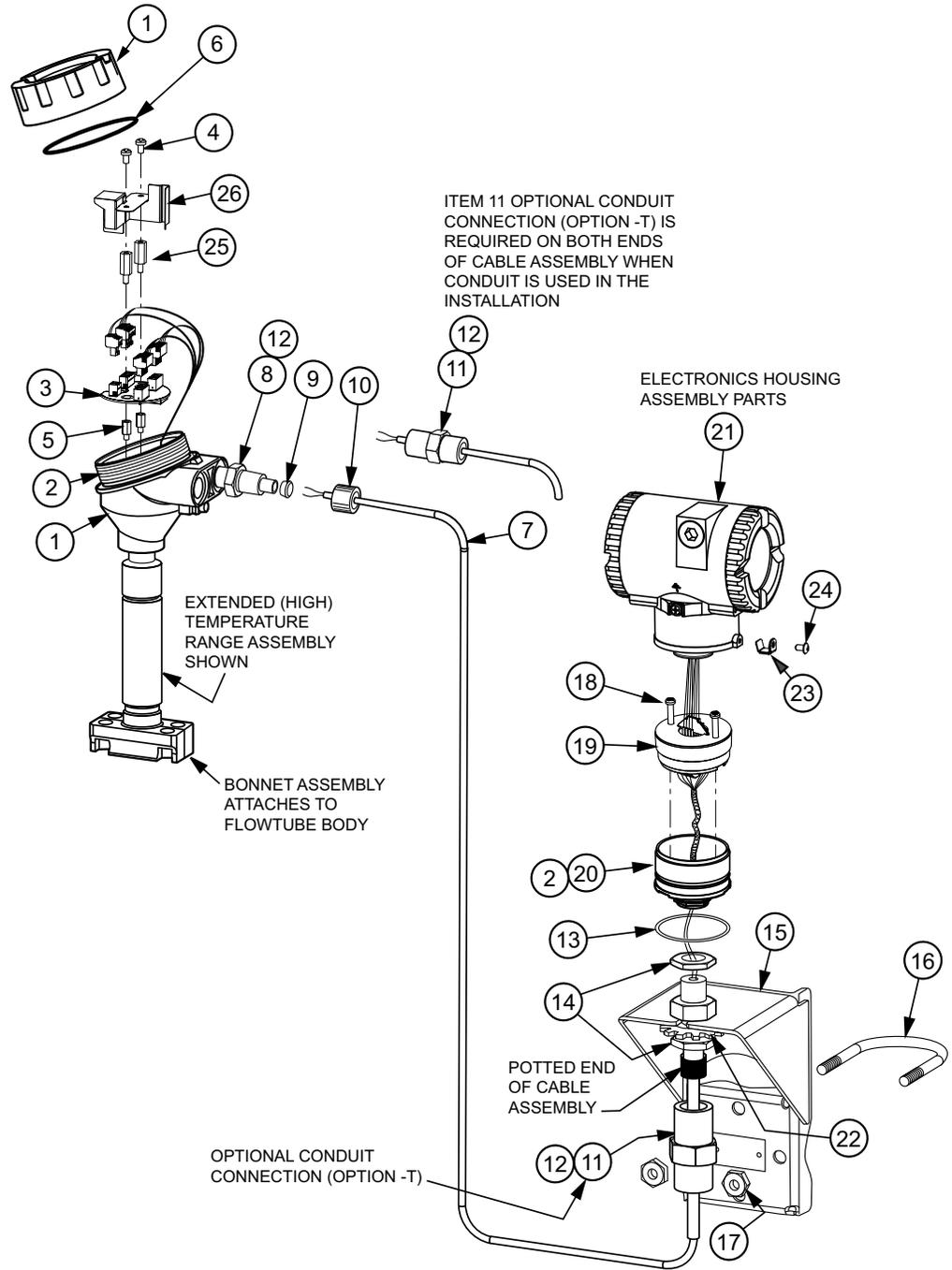


Table 138 - Parts for Junction Box and Remote Mounting

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
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)¹²⁸
	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 <i>Electronics Housing, page 217</i>		
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

128. 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 53*.

Figure 109 - Remote Mounting for Sanitary Body Flowmeter

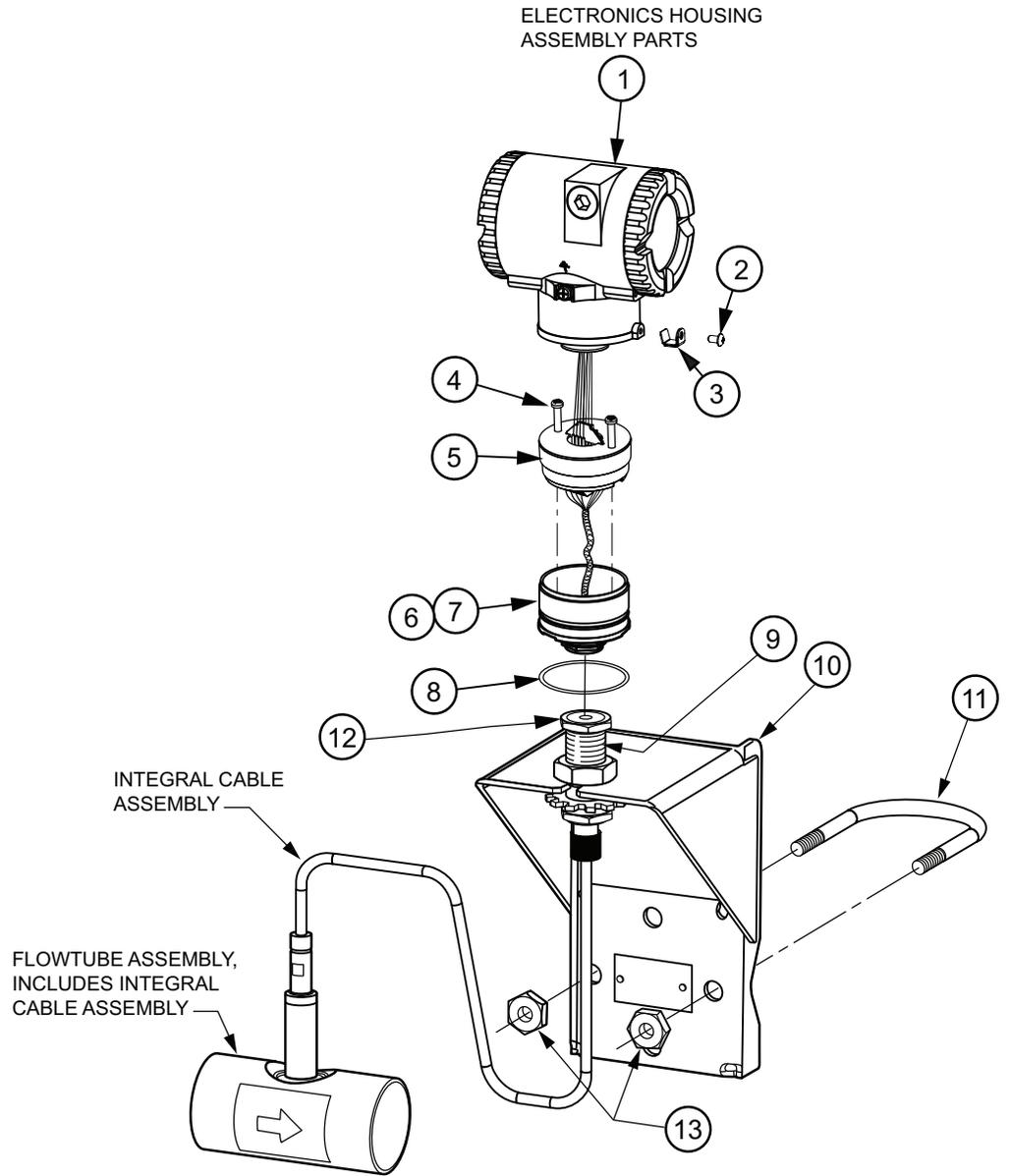


Table 139 - Parts for Remote Mounting (Sanitary Flowmeter only)

Item	Part No.	Qty.	Part Name
1	Below	1	Housing
	K0171BW		Housing, 1/2 NPT, AL
	K0171BV		Housing, M20, AL
2	X0174EK	1	Screw, But hd 8-32 x 0.25
3	D0197PS	1	Anti-Rotation Clip
4	X0174GF	2	Screw, Potting Cup
5	Below	1	Potted Cup Assembly
	K0168GJ		Potted Cup Assembly, I.S.
	K0168MW		Potted Cup Assembly, EX.
6	X0114AT	A/R	Grease
7	K0168GG	1	Neck Cup, Mach
8	X0144KW	1	Neck O-Ring
9	B1270KE	A/R	Thread Sealant
10	K0149HR	1	Remote Bracket
11	D0114SM	1	U-Bolt, Bracket, Remote
12	K0148TQ	1	Jam Nut
13	X0104CT	2	U-Bolt Nuts

Bonnet Assembly and Sensor Parts

Figure 110 - Bonnet Assembly and Sensor Parts

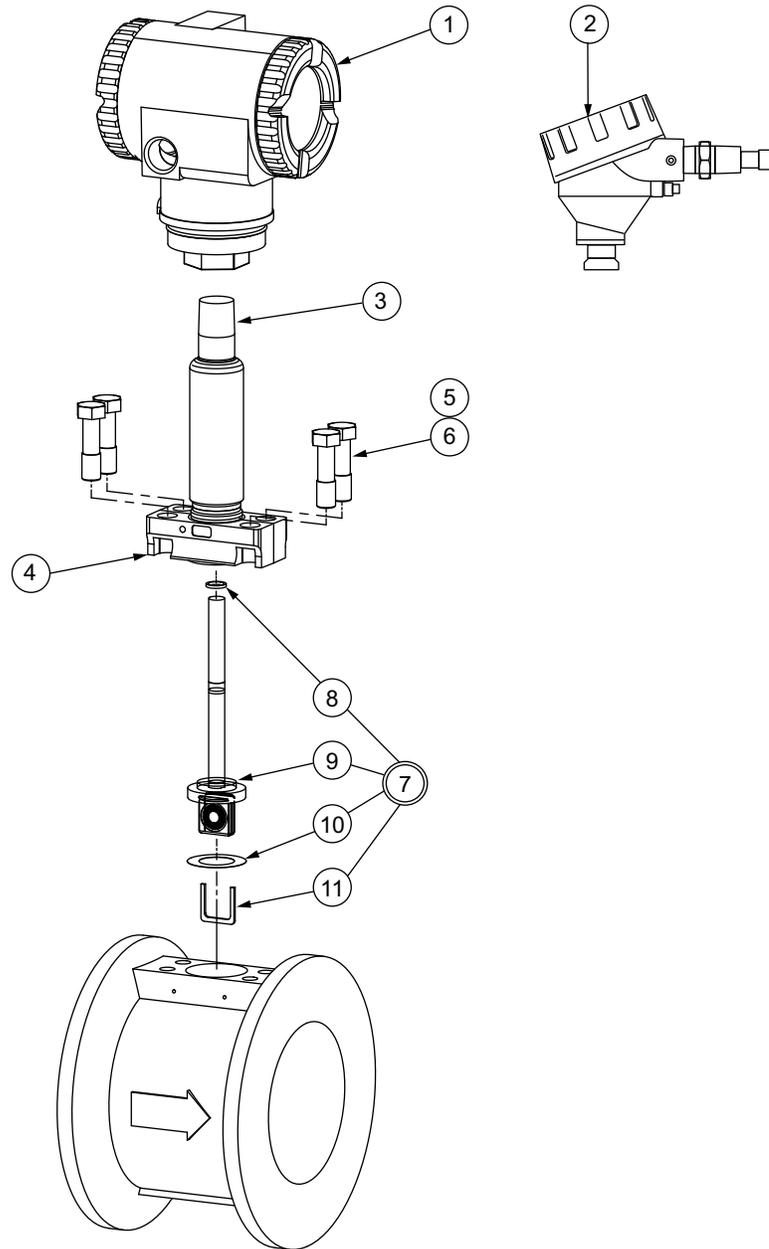


Table 140 - Parts for Bonnet Assembly and Sensor Replacement Kits

Item	Part No.	Qty.	Part Name
1	Housing; see <i>Electronics Housing</i> , page 217		
2	Junction Box; see <i>Junction Box and Remote Mounting</i> , page 220		
3	B1270KE	A/R	Thread Sealant
4	Bonnet Assembly, Standard or Extended Temperature Range (bonnet for extended temperature range shown); see <i>Bonnet Assemblies</i> , page 225 for part numbers		
5	X0114AT	A/R	Grease; 14 ounce can

Table 140 - 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 <i>Sensor and Seal Replacement Kits</i> , page 226 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 141 - 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 142 - 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 143 - 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 144 - 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 145 - Sensor Replacement Kits for 84C Flowmeters with Temperature Compensation

Kit Description		Kit Contents	
Part No.	Sensor Code	Sensor	Seal Kit ¹²⁹
K0169AD	D	K0168FT	K0168RJ
K0169AC	F	K0168FR	
K0169AB	R	K0168FP	
K0169AA	S	K0168FM	
K0169AF	A, E	K0168GC	K0168RL
K0169AE	B, G	K0168GB	K0168RK

Table 146 - 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		K0146HL	K0148VA	

¹²⁹. See the next table for seal kit contents.

Table 147 - Sensor Replacement Kits for 84C Flowmeters without Temperature Compensation

Kit Description		Kit Contents	
Part No.	Sensor Code	Sensor	Seal Kit ¹³⁰
K0161FL	D	K0148JK	K0161EY
K0161FK	F	K0148JJ	
K0161FJ	R	K0148JH	
K0161FH	S	K0148JG	
K0161FN	A, E	K0148KQ	K0161FA
K0161FM	B, G	K0148KN	K0161EZ

Table 148 - 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	

130. 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 111 - Optional Cable Selections -P and -R

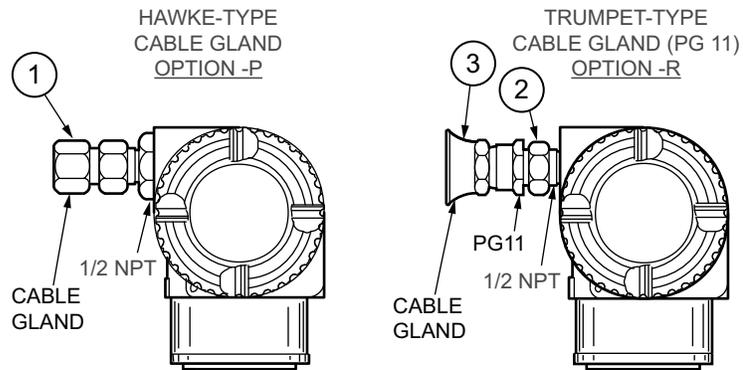


Table 149 - Parts for Optional Cable Selections -P and -R

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) ¹³¹
3	N7000AA	1	Trumpet-type Cable Gland — PG 11 (Part of Option -R) ¹³¹

¹³¹. Option -R (Items 2 and 3) should be ordered as a set.

Tamper-Resistant Cover for Bonnet Bolts (Option -S)

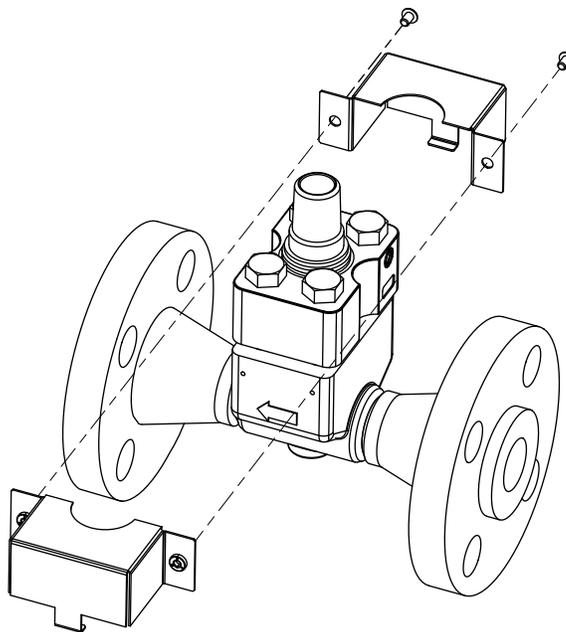


Table 150 - Parts for Option -S

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.
<i>See Electronics Housing, page 217</i>					
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 ¹³²	2	4	8
12	Potted Cup Assembly Module; see <i>Potted Cup Assembly Part Numbers, page 219</i>		1	2	4
13	X0144KW	O-Ring, Housing Neck	1	2	4
<i>See Junction Box and Remote Mounting, page 220</i>					
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
<i>See Bonnet Assembly and Sensor Parts, page 224</i>					
7	Sensor Replacement Kit, Standard or Extended Temperature Range; includes a sensor, seal kit; and instructions; see <i>Sensor and Seal Replacement Kits, page 226</i> for part numbers		1	2	4

132. Two cover lock screws are used with Electrical Safety Codes H, B, and S (ATEX, IECEx, and NEPSI flameproof units).

Schneider Electric Systems USA, Inc.
38 Neponset Avenue
Foxboro, MA 02035
United States of America

1-866-746-6477 inside the U.S.
1-508-549-2424 outside the U.S.

pasupport.schneider-electric.com

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MI 019-224