

**Model 84S I/A Series® Intelligent Vortex Flowmeters for Sanitary Flow Applications with HART® Communication Protocol**



The Foxboro® brand Model 84S is part of a family of intelligent, high performance sanitary vortex flowmeters designed for food and pharmaceutical sanitary liquid service, and CIP systems. They transmit a 4 to 20 mA, digital, and pulse output signal, as applicable, using HART® communication protocol for remote configuration, calibration, and monitoring. An on-board LCD indicator/configurator is also offered for local configuration.

**FEATURES**

- ▶ Liquid, gas, or steam applications.
- ▶ Complies with 3-A sanitary standards.
- ▶ Best in class accuracy:
  - $\pm 0.5\%$  of reading in liquids
  - $\pm 1.0\%$  of reading in gas and steam.
- ▶ Widest rangeability in class.
- ▶ ActiveTuning™ algorithm:
  - Real time Reynolds number ( $R_D$ ) low flow correction down to  $R_D$  of 5000.
  - Compensation for piping effects.
  - Adaptive filtering and signal conditioning.
  - Tunable for specific operating conditions.
- ▶ HART communication protocol.
- ▶ Pulse output provides raw or scaled frequency, or total.
- ▶ Low power versions available for battery or solar power installations.
- ▶ 316L stainless steel flowtube with 25RA finish. Also a complete line of sanitary end connections.
- ▶ Invensys has a free-to-use flow sizing program on the Internet at [www.FlowExpertPro.com](http://www.FlowExpertPro.com).

## **SANITARY AND CIP/SIP DESIGN**

The 84S Sanitary Vortex Flowmeter is 3-A compliant. The meter is a crevice-free design with no moving parts. The process-wetted parts are 316 ss and 316L ss and finished to 25 microinch sanitary standards. The design allows for in-line cleaning (CIP) using various combinations of cleaning solutions, air purging, or saturated steam (SIP) at temperatures to 177°C (350°F).

## **WIDE VARIETY OF APPLICATIONS**

This flowmeter is offered in 2 and 3 in (DN 50 and DN 80) sizes, with a large selection of common sanitary end connections. For users who do not require 3-A compliance, a Class 150 RF flange end connection is also offered. It is ideally suited for the pharmaceutical, food, and dairy industries. Difficult fluids, such as some slurries, can also be measured. It can also be configured, for example, to measure the flow of liquids in a batch process without measuring the inert gas following the batch, thus providing an accurate measurement of the liquid only.

The low power versions of the Vortex Flowmeter differ from the standard versions in that the supply current is fixed at a constant 10 mA, and remains in operation down to a minimum voltage of 10 V dc. The low power versions are intended for use with battery power with any form of recharging technology, such as solar arrays or alternators.

## **“CE” COMPLIANCE**

These flowmeters comply with applicable European Community Standards for immunity to EMI emissions, and pressure equipment directive (PED) 97/23/EC.

## **SIMPLE DESIGN FOR BEST PERFORMANCE AND RELIABILITY**

This patented family of vortex flowmeters has the high accuracy and rangeability of positive displacement and turbine flowmeters without the mechanical complexity and high cost. They provide flow rate accuracy of  $\pm 0.5\%$  in liquids and  $\pm 1.0\%$  in gas and steam. It utilizes patented *DirectSense*<sup>™</sup> technology to eliminate routine problems encountered with other vortex meters.

*DirectSense* technology measures pressure pulses from vortex shedding directly, without clumsy mechanical linkages. The benefits of *DirectSense* technology include:

- ▶ Provides best performance in class.
- ▶ Increased measurement sensitivity for wider rangeability.
- ▶ Greater immunity to pipe vibration.

Because these vortex flowmeters have no moving parts, they are very durable and reliable. This simplicity of design ensures low initial cost, low operating and maintenance costs, which contribute to an overall low cost of ownership.

## **SIMPLIFIED FLOW START-UP**

No primary device calculations or mechanical calibrations are required. The flowmeter is easily installed and configured. Simply wire it to a proper power source, an I/O module, or controller, and it is ready to measure flow.

Invensys will preconfigure the flowmeter with user-supplied flow data. Generically configured flowmeters can be used as shipped, but for more precise application, the flowmeter should be configured to specific process usage. The configurators allow selection of the fluid type (liquid, gas, or steam) that provides general default configurations when process conditions are not available.

## ACTIVETUNING ALGORITHM

- ▶ Reynolds Number: Patented algorithm improves accuracy performance down to an  $R_D$  of 5000.
- ▶ Compensations for Piping Effects: When it is not possible to provide the recommended pipe diameters of unobstructed straight pipe upstream of the flowmeter, the Model 84S can be configured to compensate for most of the common non-ideal upstream conditions, such as elbows and reducers. Straight runs as short as 5-pipe diameters can be configured to achieve full accuracy.
- ▶ Adaptive Filtering and Signal Conditioning: A patented, adaptive filtering algorithm provides real-time, dynamic frequency filters that follow the vortex shedding frequency. This results in unsurpassed low-flow measurement capability and vibration immunity. This is incorporated with a digital smoothing algorithm that conditions the raw vortex signal to virtually eliminate dropped or added pulses, further enhancing low-flow performance.
- ▶ Tunable for Specific Operating Conditions: Configurable parameters for Low Flow Cut-in and damping allow tuning for specific flow conditions.

## COMPACT, EFFICIENT, DURABLE DESIGN

The Model 84S is offered in the most common sanitary line sizes, and has the same electronics housing as the Model 84F (flanged body) and Model 84W (wafer body) flowmeters. The electronics housing is of durable construction and provides environmental protection to the enclosed parts, such as the environmentally protected amplifier, local digital display/ configurator, and terminal block. The plug-in amplifier can be calibrated in place and can be replaced without interrupting the flow in the pipe.

## USABLE IN HAZARDOUS AREA LOCATIONS

These flowmeters meet numerous agency requirements for hazardous locations.

## MEASUREMENT INTEGRATION

These flowmeters provide efficient integration of measurements into HART process control schemes. They operate by using a bidirectional digital signal superimposed on the 4 to 20 mA current signal (standard power -T and -U versions), or on the fixed 10 mA supply current (low power -L and -M versions). They are also offered with or without a pulse output. Remote communication of digital values plus status and configuration information can be achieved via HART communication protocol.

Configurators used with the HART versions are:

- ▶ The HART Communicator. Users having a HART Communicator for other devices can have them upgraded with Invensys software to accommodate these flowmeters.
- ▶ The local digital indicator/configurator.
- ▶ A PC-based configurator.

With HART, digital multidropping is permitted. This is the connection of several transmitters to a single communications line. Up to fifteen transmitters can be connected on a single twisted pair of wires or over leased telephone lines.

## REMOTE MOUNTED ELECTRONICS HOUSING

The remote housing is supported by a bracket, which mounts to a surface or nominal DN 50 or 2-in pipe. This housing can be located up to a cable length of 50 ft (15.2 m) from the flowtube without loss of low level signal.

## LOCAL DIGITAL INDICATOR/CONFIGURATOR

This is a full feature, 16-character digital indicator and configurator. Total flow and/or the instantaneous flow rate may be displayed in user-selected flow units. The display may be configured for either flow or total, or to toggle between them. Four pushbuttons on the indicator are used to configure the flowmeter.

### FLOWEXPERTPRO™ PROGRAM

The FlowExpertPro program is used primarily to size Foxboro brand flowmeters. It also ensures that the user has selected the proper flowmeter type for the application. Invensys provides this meter selection tool as a free website to all users, without the need for registration. In addition to flowmeter selection and sizing, the FlowExpertPro program includes the following features:

- ▶ Incorporates a large library of the physical properties of typical process fluids.
- ▶ Displays results in tabular or graphic format.
- ▶ Allows user to save, print, or E-mail results.
- ▶ Provides reference to applicable flowmeter PSS and other related flowmeter documentation.

The program calculates minimum and maximum flow rates, rangeability, pressure loss, and  $R_D$ , using established flow equations. It also allows for material and flange selection. You are invited to visit [www.FlowExpertPro.com](http://www.FlowExpertPro.com) to access this program, or contact Invensys for further information.

### OPERATING CONDITIONS

Influence	Factory Calibration Conditions (a)	Operating Limits (b)
Process Fluid	Clear Water	Liquid, Gas, and Steam
Process Temperature	20 to 30°C (70 to 85°F)	-18 and +177°C (0 and +350°F)
Ambient Temperature (Housing)		
▶ with Indicator/Configurator	▶ 20 to 30°C (70 to 85°F)	▶ -18 and +80°C (0 and +176°F) (c)
▶ without Indicator/Configurator	▶ 20 to 30°C (70 to 85°F)	▶ -40 and +80°C (-40 and +176°F) (c)
Relative Humidity	50 to 90%	0 and 100%
Supply Voltage - mA Output	24 ±0.5 V dc	15.5 and 42 V dc (see Figure 2) 10 and 42 V dc for Low Power version (d)

- (a) Assumes ANSI Schedule 40 process piping; flanges bored to interfacing pipe I.D.; piping and flowmeter body bores aligned to within 2% of meter bore; gaskets to be 3.18 mm (0.125 in) thick and not protruding into pipeline; a minimum of thirty pipe diameters of straight pipe upstream and five pipe diameters downstream of flowmeter; clear water is free from air or particles.
- (b) Limits are based on nonflashing, noncavitating conditions. A minimum positive back pressure is required for proper operation to avoid these effects.
- (c) Refer to Electrical Safety Specifications table further in the document for ambient temperature limits with certain electrical certifications.
- (d) Supply current is fixed at a constant 10 mA and remains in operation down to a minimum terminal voltage of 10 V dc. See Power Supply Requirements (Low Power Versions) note in the Functional Specifications section.

PERFORMANCE SPECIFICATIONS

Specifications are under calibrated operating conditions unless otherwise stated

Factory Calibrated Flow Ranges

Nominal Meter Size	Nominal Mean K-Factor Pulses/L (Pulses/USg) (a)	Factory-Calibrated Flow Range for Water (b)		
		L/s Range	USgpm Range	RD Range
DN 50 (2 in)	9.96 (37.9)	0.684 to 10.8	10.8 to 171	100,000 to 380,000
DN 80 (3 in)	2.75 (10.4)	1.61 to 25.4	25.5 to 403	38,000 to 570,000

- (a) The K-factor is the relationship between input (volumetric flow rate) and the output (pulse rate). Reference K-factor is the arithmetic mean value of K-factor over a designated flow rate range (reference conditions). The mean K-factor is derived as:  

$$\text{Mean K-factor} = (K_{MAX} + K_{MIN}) / 2$$
 where KMAX is the maximum K-factor and KMIN is the minimum K-factor over the calibrated flow range.
- (b) Factory calibrated Reynolds Number range applies to standard temperature sensor. Other sensor selections and manifold selections may alter the calibration range. See FlowExpertPro.com for specific calibration ranges.

Accuracy for Liquids

Accuracy within the calibrated range is as follows (also see Figure 1):

DN 50 (2 in) Flowmeter

- ▶ Above 100,000  $R_D$ ;  $\pm 0.5\%$
- ▶ Between 20,000 and 100,000  $R_D$ ;  $\pm 1.0\%$
- ▶ Between 5,000 and 20,000  $R_D$ ;  $\pm 2.0\%$

DN 80 (3 in) Flowmeter

- ▶ Above 38,000  $R_D$ ;  $\pm 0.5\%$
- ▶ Between 20,000 and 38,000  $R_D$ ;  $\pm 1.0\%$
- ▶ Between 5,000 and 20,000  $R_D$ ;  $\pm 2.0\%$

Accuracy for Gases and Steam

Accuracy within the calibrated range is as follows:

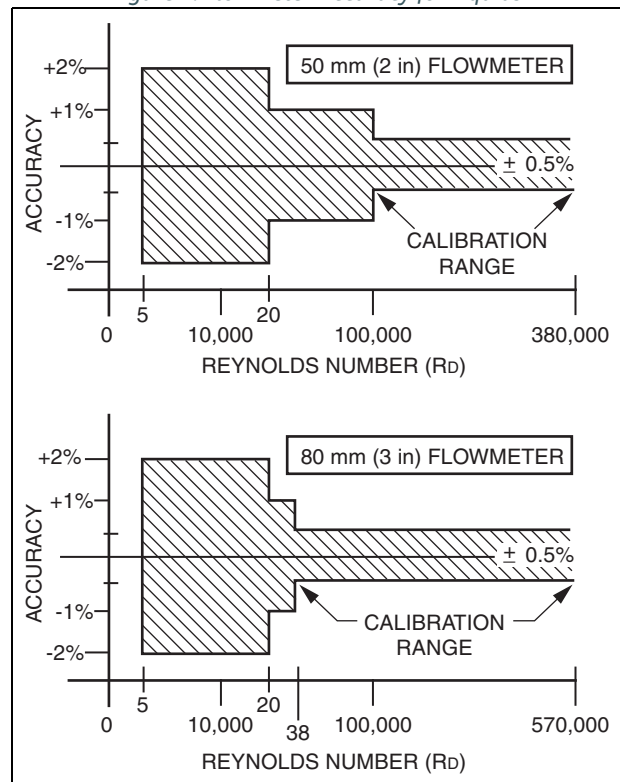
DN 50 and DN 80 (2 in and 3 in) Flowmeters

- ▶ Above 20,000  $R_D$ ;  $\pm 1.0\%$
- ▶ Between 5,000 and 20,000  $R_D$ ;  $\pm 2.0\%$

NOTE

To achieve the liquid, gas, and steam accuracy stated above, the flowing density and viscosity must be entered in the database configuration. Also refer to FlowExpertPro.com to determine the accuracy for specific applications.

Figure 1. Flowmeter Accuracy for Liquids



**Ambient Temperature Effect (Amplifier only)****With Pulse Output**

±0.01% of reading from  
-40° to +80°C (-40° to +176°F)<sup>(1)</sup>

**With Analog Output**

For 28°C (or 50°F) change in ambient  
temperature within operative limits.

*Zero (4 mA)*

±0.02% of span maximum

*Span (16 mA)*

±0.1% of span maximum

**With Digital Output**

±0.01% of reading from  
-40° to +80°C (-40° to +176°F)

**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 for a 55°C (or 100°F) increase in temperature. This flowmeter will automatically recompute a flowing K-factor when process temperature is entered in the database fluid definition.

**Relative Humidity Effect**

No effect if covers and conduit seals are properly installed.

**Electromagnetic Emission (EMI) and Radio Frequency Interference (RFI) Effects**

The flowmeters meet the EMI and RFI requirements of EN 61326.

**Position Effect (Filled Pipe Conditions)**

For most applications, the flowmeter can be mounted in a pipeline which may run in any direction from the vertical (flow in upward direction) to the horizontal. Measurement of liquid and gas streams is not affected by the pipeline orientation or the flowmeter orientation in the pipeline. For steam measurement, the recommended flowmeter position is in a horizontal pipe.

---

(1) The 80°C (176°F) temperature may be extended to 85°C (185°F). Refer to Electrical Safety Specification table further in the document.

FUNCTIONAL SPECIFICATIONS

**Direct Connectivity to I/A Series® Open Industrial System**

The Model 84S can be connected directly to the I/A Series System using I/A Series fieldbus modules (FBMs). Invensys can provide the FBM applicable to your installation.

**Remote Communication/Configuration**

Refer to Table 1 for remote configurators or communicators used with these flowmeters.

**Local Communication/Configuration**

In addition to remote communications, a local digital indicator/configurator with pushbuttons is also available for local interrogation and configuration.

**Write Protect Jumper**

A write protect jumper provides additional security by allowing the user to prevent the local indicator/configurator and remote configurator from writing to the electronics. This write protection capability meets the security requirements of ISA-584.01-1986.

**Password Protection**

This is provided in the local display/configurator mode to assure operating security. A second level of protection is provided for configuration security.

**Communication Format**

Digital communications is provided in both the analog (4 to 20 mA) and digital modes based upon the FSK (Frequency Shift Keying) technique. See Table 1 for communication parameters.

**On-Line Diagnostics**

Flowmeter uses many internal diagnostic functions including hardware checks, and internal code and database validation. Error checking and diagnostic codes are also embedded in the communications protocol. These diagnostics are performed at startup and as continuous background checks.

**Offline Diagnostics (Self-Test)**

The configurators allow self-tests to be initiated to validate the transmitter electronics. This test uses an internally generated frequency signal.

**Table 1. Remote Communication Parameters**

Parameter	HART Analog or Digital Multidrop Mode
Remote Configurator/Communicator	HART Communicator or PC-Based Configurator
Communication Rate	1200 baud
Communication Distance (Rated)	1800 m (6000 ft)
Flow/Total Measurement Update	5 times/s
Raw Pulse Measurement Update	Vortex Shedding Frequency

**Power Supply Requirements (Standard Power Versions)**

**Supply Current**

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

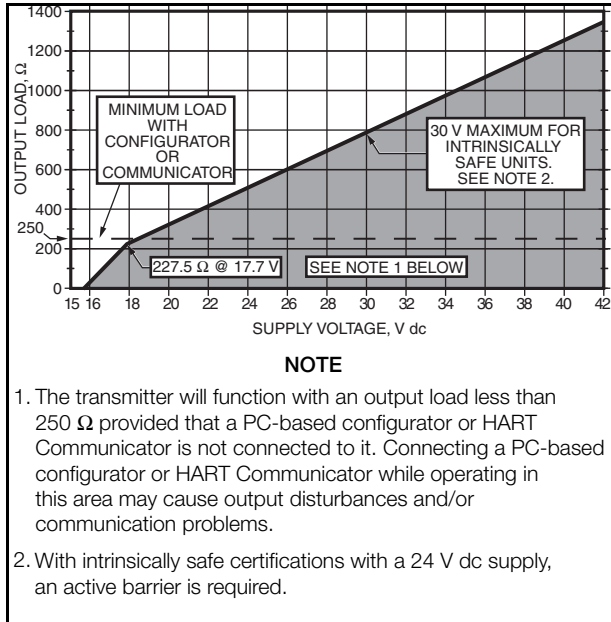
**Supply Voltage**

15.5 to 42 V dc, depending on electrical safety approvals and certifications. Refer to Figure 2.

**NOTE**

When operating at ambient temperatures below -29°C (-20°F), it is important to maintain a minimum loop voltage of 15.75 V dc to maintain remote configurator communications capability.

Figure 2. Supply Voltage vs Output Load for 4 to 20 mA Output



**Power Supply Requirements (Low Power Versions)**

**Supply Current**

10 mA dc nominal

**Supply Voltage Limits**

10 and 42 V dc

**NOTE**

For proper operation, 10 V dc must be maintained at the flowmeter terminals. For HART communications, a 250 Ω load resistor must be included in the power supply loop and a supply voltage of 12.5 V dc must be maintained. See installation MI for typical installation topologies.

**Output Damping**

Damping smooths the flow rate output, and optimizes the flowmeter’s response time to the control system. Damping is an exponential filter with a selectable time constant; it can be set between 0 and 32 seconds. An eight second damping factor will pass 64% of the step change in this time period. Damping applies to all outputs except the Raw Pulse Output where no damping is applied to the direct vortex shedding frequency.

**Response Time (Without Damping)**

**Analog Mode**

0.5 second or the vortex shedding period for frequencies less than 2 Hz.

**Digital Mode**

0.5 second or the vortex shedding period for frequencies less than 2 Hz.

**Pulse Output**

- ▶ Raw Pulse: Vortex shedding frequency
- ▶ Rate or Total Pulse: 0.25 s or the vortex shedding period for frequencies less than 2 Hz.

**Nominal Flow Velocity Limits**

These limits can be calculated using Table 2. In the table,  $\rho_f$  is the fluid density at flowing conditions in kg/m<sup>3</sup> or lb/ft<sup>3</sup>, as applicable. The specifications apply for most applications, but can deviate slightly for some combinations of density and line size. Also refer to FlowExpertPro.com.

**Table 2. Nominal Flow Velocity Limits**

Range Limit	Flow Velocity Limit	
	m/s	ft/s
Lower	$4.8/\sqrt{\rho_f}$	$4.0/\sqrt{\rho_f}$
Upper	$240/\sqrt{\rho_f}$	$200/\sqrt{\rho_f}$



## Outputs

These flowmeters with full-featured electronics can support the following outputs:

- ▶ HART Version -T: Digital and 4 to 20 mA output, with a pulse output
- ▶ HART Version -U: Digital and 4 to 20 mA output
- ▶ HART Version -L: Digital output with a pulse output
- ▶ HART Version -M: Digital output without a pulse output

### 4 to 20 mA Output

Flow rate available as a 4 to 20 mA signal with the 20 mA value being set by the configured full range flow rate.

### Digital Output

Digital information is superimposed on a 4 to 20 mA signal (standard power versions) or the power supply loop (low power versions) at 1200 baud (see Table 1). For low power versions, output is fixed at 10 mA.

### Pulse Output

The pulse output can be configured with the full-function electronics: raw pulse, rate pulse, and total pulse.

- ▶ Raw Pulse: This is the vortex shedding frequency directly passed through providing an instantaneous, nondampened frequency output.
- ▶ Rate Pulse: The frequency of this output is a 50% duty cycle pulse output with a frequency range of 0 to 10, 0 to 100, or 0 to 1000 Hz, proportional to zero flow to the full range flow rate/upper range value (URV).
- ▶ Total Pulse: 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.

## 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 any one of three types of pulse outputs: raw pulse, rate pulse, and total pulse. The following specifications apply to all three types of outputs:

- ▶ Isolated 2-Wire Transistor Switch
- ▶ Applied Voltage: 5 to 30 V dc
- ▶ Maximum "ON" State Voltage Drop: 1.0 V dc
- ▶ Maximum "ON" State Current: 20 mA
- ▶ Reverse polarity protected
- ▶ Short circuit protected
- ▶ Configurable to pull up or pull down counters.

### Output Combinations (4 to 20 mA Outputs)

Flowmeter wired as a 2-wire device without pulse output, and as a 4-wire device with pulse output.

### 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 applicable to gas, liquid, or steam applications.

### 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 Correction

The flowmeter computes a corrected K-factor at the specific process temperature entered by the user.

### K-Factor Bias

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

### Static Pressure Limits

#### Minimum Static Pressure

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

#### Maximum Static Pressure

DN 50 or 2 in Size: 1,725 kPa (250 psi) at 38°C (100°F), or that imposed by process piping.

DN 80 or 3 in Size: 1,035 kPa (150 psi) at 38°C (100°F), or that imposed by process piping.

### Flowmeter Ranges

Flowmeter is shipped with flow range specified in the sales order or with a default flow range equal to the meter capacity. It can be reranged by the user keeping the same flow rate units, choosing new flowrate units from a built-in menu-selectable list, or entering custom flow rate units. Also refer to FlowExpertPro.com.

### Approximate Pressure Loss (Pressure Drop)

The maximum pressure loss at maximum flow for any fluid is 55 kPa (8 psi). For many flow conditions, however, the actual pressure loss is much less than 55 kPa (8 psi). Use the FlowExpertPro sizing program to determine actual pressure loss for a given set of flow conditions.

### Minimum Back Pressure (Volatile Liquids or Low Pressure Conditions)

Any condition that tends to contribute to the release of vapor from the liquid (flashing, which may also induce cavitation) shall be avoided by proper system design and operation of the flowmeter within the rated flow rate range. Location of flowmeter should consider the need for using a back-pressure valve, or for increasing inlet pressure. To avoid flashing and to ensure 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

$\Delta P$  = Pressure loss in kPa or psi; see "Approximate Pressure Loss (Pressure Drop)" on page 10

$p_v$  = Vapor pressure at line conditions in kPa or psi absolute

$p_{atm}$  = Atmospheric pressure in kPa or psi absolute

**Functional Block Diagrams**

Refer to Figure 3 and Figure 4.

Figure 3. HART 4 to 20 mA Topology

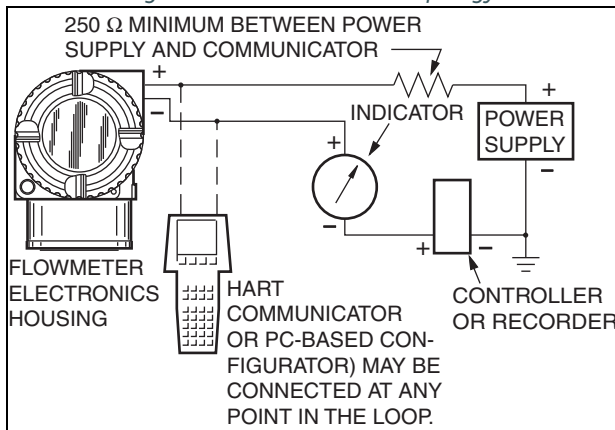
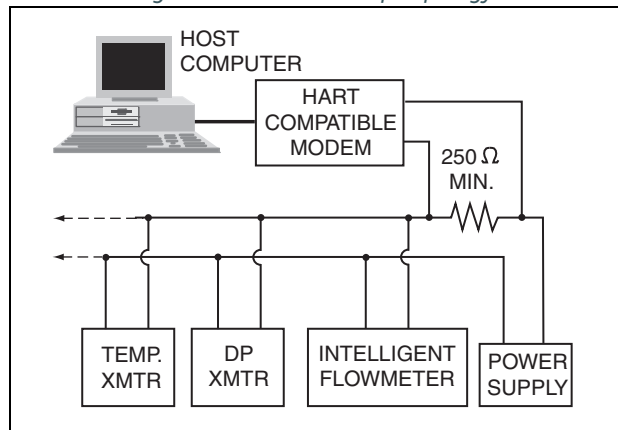


Figure 4. HART Multidrop Topology



**PHYSICAL SPECIFICATIONS**

**Process-Wetted Parts**

- ▶ Flowmeter Body: 316 ss tube
- ▶ Shedding Bar: 316L ss per ASTM 276
- ▶ Detector Diaphragm: 316L ss
- ▶ End Connections: 316 ss

**Detector Capsule Fill Material**

Food grade silicone oil. Volume is 0.262 cm<sup>3</sup> (0.016 in<sup>3</sup>).

**Electronics Module**

Printed wiring assemblies (PWAs) are conformally coated for moisture and dust protection.

**Electronics Housing and Housing Covers**

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

**Mounting Configuration**

The flowtube can be located in pipeline which may run in any direction from the vertical (flow in upward direction) to the horizontal. The electronics housing is mounted to a bracket, which in turn is attached to a surface in a remote location, or to a nominal DN 50 or 2 in pipe. The body and housing are electrically connected by a 4.5 m (15 ft) cable. The cable is an integral part of the flowmeter body assembly. During operation, the flow line must remain full.

**Electrical Connections**

Field wires enter through M20 or 1/2 NPT conduit threaded entrances on either side of the electronics housing. Wires terminate under screw terminals and washers on terminal block (see Figure 5) in the field terminal compartment. Unused entrance is plugged to ensure moisture and RFI/EMI protection.

**Environmental Protection**

Electronics housing is dusttight and weatherproof per IEC IP66 and provides the environmental and corrosion resistant protection of NEMA Type 4X.

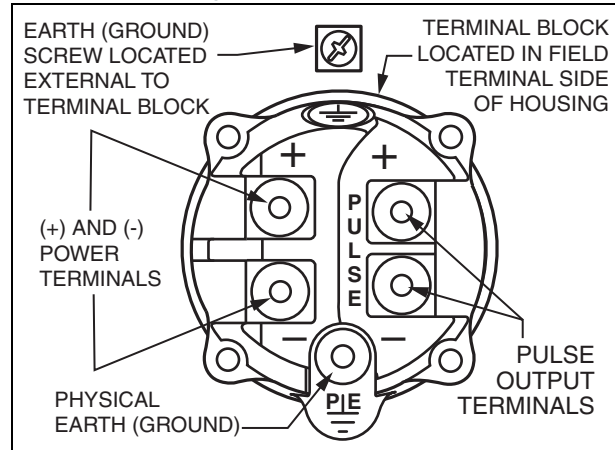
**Data Plate**

Stainless steel data plate encircles and is secured to the lower part of the electronics housing. Includes conventional Model and operating data, including the factory calibration factor (K-factor). If additional tag data space is required, an optional Stainless Steel Customer Tag is offered.

**Dimensions - Nominal**

Refer to Dimensions - Nominal section for general outline data. For more details, refer to Dimensional Print DP 019-123.

Figure 5. Terminal Block



**Approximate Weight**

Nominal Line Size		Flowmeter Description	Approximate Weight with Connections C, M, R, T, U (a)	
mm	in		kg	lb
DN 50	2	Body and Cable	0.72	1.6
		Housing and Bracket	4.1	6.5
		Total	4.8	8.1
DN 80	3	Body and Cable	1.1	2.5
		Housing and Bracket	4.1	6.5
		Total	5.2	9.0

(a) Connections C, M, R, T, and U are fittings, couplings, and Tri-clamp type connections. See Model Code.

**PRODUCT SAFETY SPECIFICATIONS**

**Electrical Safety Specifications**

Refer to table below.

**Pressure Safety**

Refer to Maximum Static Pressure paragraph in FUNCTIONAL SPECIFICATIONS section for pressure-temperature limits with each flowtube size.

**Personnel and Electrical Fire Safety**

This device is designed to be a minimum fire hazard by using low energy power and adequate insulation and separation of electrical circuits. The required standards of worldwide testing agencies such as FM, CSA, ATEX, IEC, and OSHA have been fulfilled.

## ELECTRICAL SAFETY SPECIFICATIONS

The Model 84 has been designed to meet the electrical safety descriptions listed below. For detailed information, or status of the testing laboratory approval/certification, contact Invensys.

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

Refer to MI 019-177 for FM and CSA Connection Diagrams; refer to MI 019-179 for ATEX and IECEx Safety Information.

Agency, Types of Protection, and Area Classification	Application Conditions	Elect. Safety Design Code
<b>ATEX</b> Intrinsically safe: II 1G; II 2D; Ex ia IIC T4 Ga Ex tb IIIC T103°C Db	Sira 06ATEX2067X Integrally mounted or remote mounted (electronics and junction box). Temperature Class T4; Ta = -40° to +80°C	E
<b>ATEX</b> Flameproof: II 2/1 (1) G; II 2D Ex d [ia Ga] ia IIC T4 Gb; Ex tb IIIC T85°C Db	Sira 06ATEX2067X Integrally mounted electronics. Temperature Class T4; Ta = -20° to +80°C	H
<b>ATEX</b> Flameproof: II 2/1 (1) G; II 2D Ex d [ia Ga] IIC T4 Gb; Ex tb IIIC T85°C Db	Sira 06ATEX2067X Electronics housing of remote mounted version. Temperature Class T4; Ta = -20° to +80°C	H
<b>CSA</b> Intrinsically safe: Class I, II, III, Div. 1, Groups A, B, C, D, E, F, and G. Ex ia IIC T4	Temperature Class T4; Ta = -40° to +80°C	C
<b>CSA</b> Explosionproof with Intrinsically Safe sensor connections: Class I, Div. 1, Groups A, B, C, and D; Class II, Div 1, Groups E, F, and G; Class III; [Ex ia]; T5; Ex d [ia] IIC T5 Dust-ignitionproof for Class II, Div. 1, Groups E, F, and G; Class III, Div. 1 Also Zone certified Ex d [ia] IIC.	Temperature Class T5; Ta = 60°C  Temperature Class T5; Ta = -40° to +80°C	D
<b>CSA</b> Class I, Division 2: Class I, Div. 2, Groups A, B, C, and D; Class II, Div. 2, Groups E, F and G; Class III.	Temperature Class T4; Ta = 80°C	M
<b>FM</b> Intrinsically safe: Class I, II, III, Div. 1, Groups A, B, C, D, E, F, G; T4 Class I Zone 0 AEx ia IIC T4	Temperature Class T4; Ta = 80°C	F
<b>FM</b> Explosionproof with Intrinsically Safe sensor connection: Class I, II, III, Div.1, Groups B, C, and D; T5 Dust-ignitionproof for Class II, III, Div. 1, Groups E, F, and G	Temperature Class T5; Ta = 85°C	G
<b>FM</b> Nonincendive: Class I, II, Div. 2, Groups A, B, C, and D; T4 Class II, III, Div. 2, Groups F and G	Temperature Class T4; Ta = 80°C	K
<b>IECEx</b> Intrinsically safe: Ex ia IIC T4 Ga; Ex tb IIIC T103°C Db	IECEx SIR 06.0020X Temperature Class T4; Ta = -40° to +80°C	L

Agency, Types of Protection, and Area Classification	Application Conditions	Elect. Safety Design Code
<b>IECEX</b> Flameproof: Ex d [ia Ga] ia IIC T4 Gb Ex tb IIC T85°C Db	IECEX SIR 06.0020X Integrally mounted electronics. Temperature Class T4; Ta = -20° to +80°C	B
<b>IECEX</b> Flameproof: Ex d [ia Ga] IIC T4 Gb Ex tb IIC T85°C Db	IECEX SIR 06.0020X Electronic housing of remote mounted version. Temperature Class T4; Ta = -20° to +80°C	B
<b>NEPSI</b> Intrinsically safe, Zone 0, Ex ia IIC	Temperature Class T4; Ta = -40° to +80°C	R
<b>NEPSI</b> Flameproof, Zone 1, Ex d IIC (except acetylene)	Temperature Class T5; Ta = -40° to +85°C	S
Unit with CE mark and PED controls and records		Y
Unit does not have CE mark; not to be installed in European Union (EU) countries		Z

**OPTIONAL SELECTIONS AND ACCESSORIES**

**Option -N: Calibration Certificate**

A calibration and pressure test sheet come standard with each flowmeter. A certified flow calibrated K-factor and pressure test certificate is available by selecting Option -N.

**Options -L and -M: Foxboro Certificates of Conformance and Compliance**

Two material certificates are offered:

- ▶ Option -L is a certificate of compliance to the specifications of the Invensys/Foxboro Quality System, which conforms to ISO 9001.

- ▶ Option -M is a material certificate for process wetted metal (meets BS EN 10204 3.1).

**AS Code MTS: Stainless Steel Customer Tag Accessory**

This tag adds 40 x 90 mm (1.5 x 3.5 in) of space for customer data that does not fit on the standard data plate. It is attached to transmitter with stainless steel wire. There can be a maximum of 10 lines of data with 40 characters and spaces per line. Tag will also show the K-factor specific to customer application (information with flowing conditions being submitted with the purchase order). Specify AS Code MTS.

## MODEL CODE

## MODEL CODE

<u>Description</u>	<u>Model</u>
Intelligent Sanitary Vortex Flowmeter	84S
<b>Electronics Type</b>	
Intelligent Electronics, HART Communication Protocol, with Pulse Output	-T
Intelligent Electronics, HART Communication Protocol, without Pulse Output	-U
Intelligent Electronics, LOW POWER, HART Communication Protocol, with Pulse Output (a)	-L
Intelligent Electronics, LOW POWER, HART Communication Protocol, without Pulse Output (a)	-M
<b>Nominal Line Size</b>	
2 in (DN 50), Stainless Steel Tubing	02
3 in (DN 80), Stainless Steel Tubing	03
<b>End Connection Type (Welded to Flowmeter Body) (b)</b>	
3-A I-Line Fitting, Mates with Cherry Burrell 15 WI or Equivalent	C
ANSI Class 150 RF Flange (c)	F
Metric (DIN 11851) Coupling with External Knuckle Thread, per DIN 405, Part 1	M
RJT Coupling per BS 1864, with External Whitworth Thread, 6 TPI	R
3-A Tri-Clamp Type Quick-Disconnect Ferrule, Mates with Tri-Clover 14 WMP, or equivalent	T
ISS (ISO 2853) Coupling with External Trapezoidal Thread, 8 TP	U
<b>Local Digital Indicator/Configurator</b>	
No Digital Indicator/Configurator	N
Full Function Digital Indicator/Configurator	J
<b>Electronics Housing Material and Conduit Connections</b>	
Remote Mounted; Aluminum Housing; 1/2 NPT Conduit Connections	R
Remote Mounted; Aluminum Housing; M20 Conduit Connections	W
<b>Electrical Safety (refer to Electrical Safety Specifications section for details)</b>	
ATEX intrinsically Safe	E
ATEX flameproof	H
CSA intrinsically safe	C
CSA Division 2	M
CSA explosionproof	D
FM intrinsically safe	F
FM nonincendive	K
FM explosionproof	G
IECEX intrinsically safe	L
IECEX flameproof	B
NEPSI intrinsically safe	R
NEPSI flameproof	S
No Agency Electrical Certifications; with CE mark, PED Controls and Records	Y
No Agency Certifications; no CE mark; Units not to be installed in European Union (EU) countries	Z
<b>Optional Selections</b>	
<b>Foxboro Certificates of Compliance/Conformance</b>	
Standard Certificate of Compliance	-L
Material Certification of Process Wetted Metal (Conforms to BS EN 10204 3.1)	-M
<b>Foxboro Calibration Certificate</b>	
Calibration and Pressure Test Certification	-N
<b>Instruction Manual</b>	
Detailed Instruction Manual in place of Universal MI 019-145	-C
Example: 84S-T02CJRF-LN	

(a) The LOW POWER Vortex Flowmeter is not available with a 4 to 20 mA output.

(b) Mating end connections, gaskets, and clamps to be supplied by the user.

(c) The ANSI Class 150 RF flange is not available if 3-A compliance is required.

### SUGGESTED RFQ SPECIFICATIONS

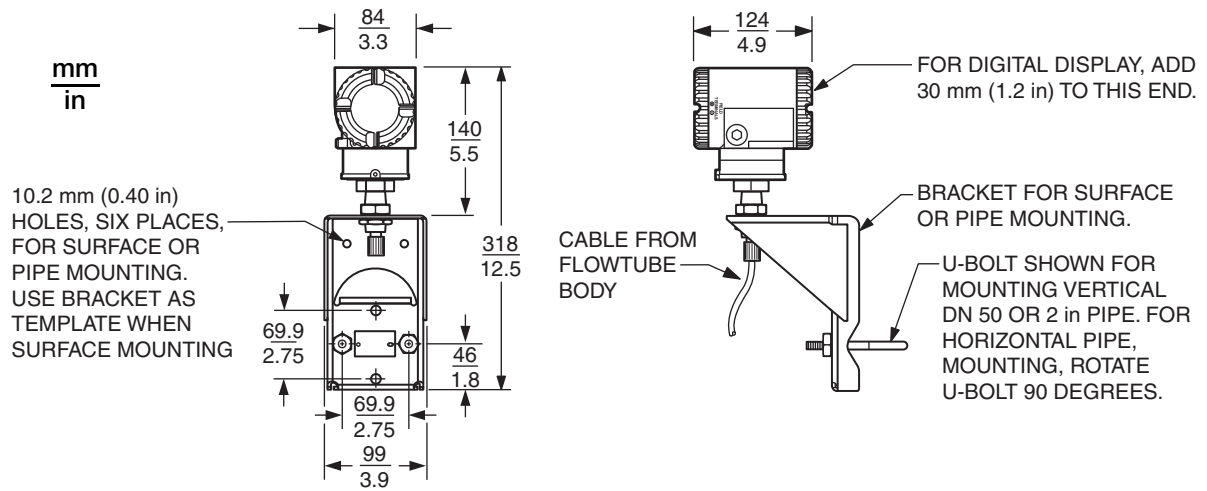
The manufacturer shall provide field-mounted sanitary vortex flowmeters (3-A compliant) featuring digital signal processing techniques capable of accurately measuring liquid, gas, or steam flows. The specifications for these meters are as follows:

<b>Communication Protocol:</b>	HART
<b>Outputs:</b>	Analog (4 to 20 mA) and digital, with or without pulse output.
<b>Remote Communications:</b>	Direct digital with HART Multidrop.
<b>Configuration:</b>	Can be configured from the LCD indicator, HART communicator, or PC-based configurator.
<b>Accuracy:</b>	0.5% of reading in liquids, 1.0% of reading in gas and steam.
<b>Internal Flow Totalizer:</b>	Standard.
<b>EMI and RFI:</b>	Meets the EMI and RFI requirements for EN 61326-1
<b>Voltage Supply:</b>	2-wire 24 V dc loop powered.
<b>Power Supply:</b>	10 to 42 V dc
<b>Supply Current:</b>	10 mA dc nominal
<b>Electronics Housing:</b>	Remote mounted housing (with epoxy finish); integral 4.5 m (15 ft) cable from flowtube to housing.
<b>Electronics:</b>	Enclosed in a NEMA 4X (IEC IP66) housing sealed with O-rings for protection against moisture or other contaminants, optional integral LCD indicator with on- board configuration pushbuttons.
<b>Body and Shedder Bar Materials:</b>	316 ss tube and 316L ss shedder bar.
<b>Flowmeter Sizing:</b>	Sizing tools with free web site access at <a href="http://www.FlowExpertPro.com">www.FlowExpertPro.com</a> .
<b>Electrical Classification:</b>	Refer to Electrical Safety Specifications table.
<b>Model Code:</b>	Model 84S Intelligent Vortex Flowmeter for Sanitary Flow Applications, or equivalent.

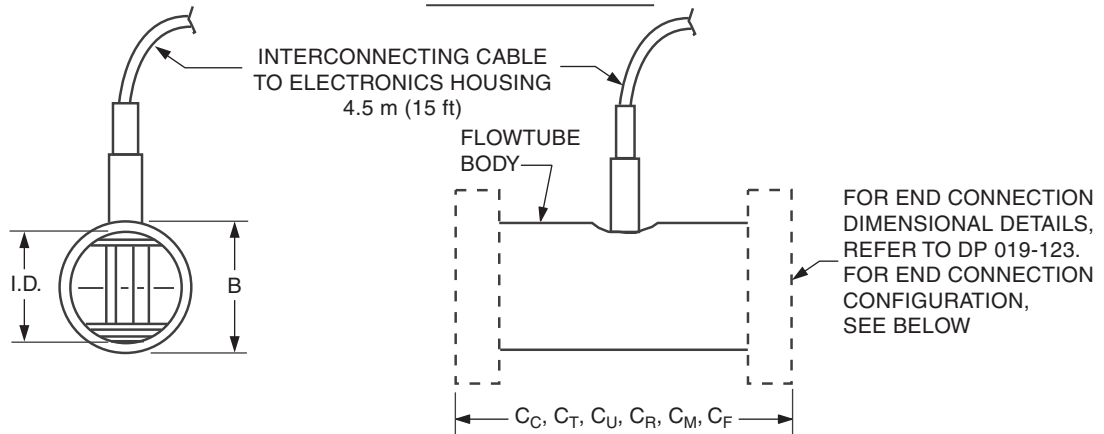


DIMENSIONS – NOMINAL

84S FLOWMETER WITH REMOTE MOUNTED ELECTRONICS HOUSING

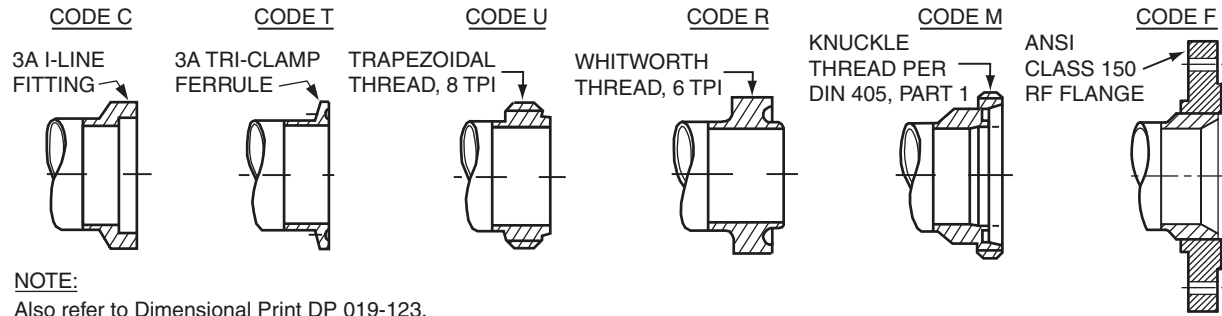


FLOWTUBE BODY



Line Size		I.D.	B	Face-to-Face Dimensions					
mm	in			$C_C$	$C_T$	$C_U$	$C_R$	$C_M$	$C_F$
DN 50	2	$\frac{47.50}{1.870}$	$\frac{50.8}{2.00}$	$\frac{155}{6.1}$	$\frac{127}{5.0}$	$\frac{145}{5.7}$	$\frac{160}{6.3}$	$\frac{173}{6.8}$	$\frac{254}{10.0}$
DN 80	3	$\frac{72.90}{2.870}$	$\frac{76.2}{3.00}$	$\frac{213}{8.4}$	$\frac{178}{7.0}$	$\frac{196}{7.7}$	$\frac{211}{8.3}$	$\frac{334}{9.2}$	$\frac{251}{9.9}$

END CONNECTION CONFIGURATIONS



NOTES

## ORDERING INSTRUCTIONS

1. Model Number.
2. Flow Data:
  - a. Maximum, minimum, and normal flow rate (must be provided for Analog Output).
  - b. Fluid composition and viscosity at operating temperatures.
  - c. Fluid density or relative density (specific gravity).
  - d. Maximum, minimum, and normal operating temperatures.
  - e. Maximum, minimum, and normal operating pressures.
  - f. Mating pipe schedule.
  - g. Type and location (distance) of upstream disturbances.
3. Calibration Information (analog output only); maximum flow rate at 20 mA output. If meter is not to be calibrated, add Note: "Calibration Not Required".
4. Optional Selections and Accessories;  
Select from Model Code or "Optional Selections and Accessories" section
5. Customer Tag Data.
6. If meter is to be used in the European countries, then meter must have P.E.D. certification.

## OTHER M&I PRODUCTS

Invensys provides a broad range of measurement and instrument products, including solutions for pressure, flow, analytical, positioners, temperature, controlling and recording. For a listing of these offerings, visit the Invensys Operations Management web site at:

[www.iom.invensys.com](http://www.iom.invensys.com)

Invensys Operations Management  
5601 Granite Parkway Suite 1000  
Plano, TX 75024  
United States of America  
<http://iom.invensys.com>

Global Customer Support  
Inside U.S.: 1-866-746-6477  
Outside U.S.: 1-508-549-2424 or contact  
your local Invensys representative.  
Website: <http://support.ips.invensys.com>

Invensys, Foxboro, I/A Series, ActiveTuning,  
*DirectSense*, and FlowExpertPro are trademarks of  
Invensys plc, its subsidiaries, and affiliates.  
All other brand names may be trademarks of their  
respective owners.

Copyright 2006-2013 Invensys Systems, Inc.  
All rights reserved