

Model 47 and Model 48 Magnetic Flow Transmitters



The Models 47 and 48 Magnetic Flow Transmitters, together with a Model 4700S Sanitary Magnetic Flowtube, combine to form an easy-to-use, versatile Sanitary Magnetic Flowmeter. This flowmeter is an economical, exceptionally accurate, microprocessor-based magnetic flow system for use with most common everyday conductive liquids used in sanitary process applications. The transmitter converts the low level, high impedance signal from lined flowtubes to a standard scaled transmission signal, either 4 to 20 mA, 0 to 20 mA, digital, or pulse output, that is proportional to volumetric flow rate. Refer to PSS 1-6G2 A for flowtube specifications.

FEATURES

- ▶ Simple Installation, Setup, and Operation
- ▶ High Resolution A/D Converter provides a Wide Dynamic Range
- ▶ Transmitter Remote or Mounted to Flowtube
- ▶ 4 to 20 mA and HART Communications
- ▶ Flowtube Characteristics stored in DATA PROM, ensures Accuracy and allows instant Upload to Transmitter
- ▶ Three Line, Backlit Indicator with Keypad
- ▶ Two Totalizers for Forward, Reverse, or Net Flow
- ▶ Automatic Empty Tube Zero, and Programmable Low-Flow Cutoff
- ▶ Integral Batch Counter with Model 48 Transmitter
- ▶ IEC IP67/NEMA 6 Enclosure Construction
- ▶ Complies with Electromagnetic Compatibility Requirements of European EMC Directive 89/336/EEC by Conforming to the following IEC Standards: EN 50081-1, -2; EN 50082-1, -2; and EN 60730.
- ▶ Conforms to Applicable European Union Directives (Product Marked with “CE” Logo)

AN INTELLIGENT PATH TO SANITARY MAGNETIC FLOW SYSTEMS

Merging the latest flowtube technology with this microprocessor-based transmitter provides the food, beverage, and pharmaceutical industries a significant advancement in sanitary liquid flow measurement.

This flowmeter is a natural path to the future: high or low rate pulse output and a 4 to 20 mA dc signal for today's systems; and the 4 to 20 mA dc signal software configurable to full digital communications with the I/A Series® System using HART Communication Protocol.

SUPERIOR REPUTATION FOR DEPENDABILITY AND QUALITY

Magnetic flow measurement systems were introduced to the process industries in 1954 and has demonstrated the broadest and most time-proven application expertise with tens of thousands of successful installations.

A SELECTION OF OUTPUT SIGNALS

The transmitter provides analog, digital, and pulse output signals.

The Analog Output Signal is 4 to 20 mA or 0 to 20 mA and can be configured to operate in either unidirectional or bidirectional flow applications. The analog output can be either internally or externally powered, and is independently isolated.

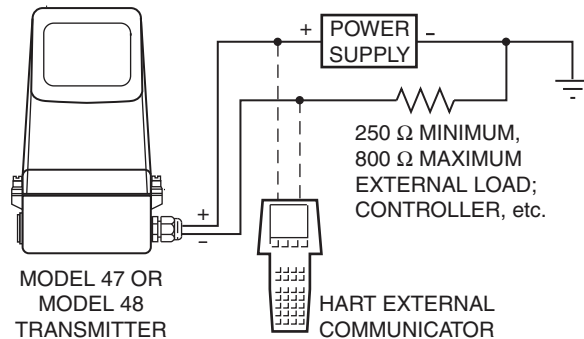
The Digital Output Signal utilizes HART communications protocol. The digital signal allows remote communications/configuration of the transmitter. The digital output signal can be superimposed on the analog output signal, or kept separate. The HART signal has a 1200 baud transmission rate and allows communications with the HART Communicator. See Figure 1.

The Pulse Output can be configured for frequency mode or scaled pulse mode. It is independently isolated from fluid ground and can be internally or externally powered. Frequency mode would be selected (for example) to drive an external rate meter. Maximum output frequency is selectable between 500 and 10 000 Hz. Scaled mode would be selected (for example) to drive an external totalizer.

CONTACT (RELAY) OUTPUT

A relay output is provided and can be used for batch control, error indication and alarms, and flow direction and limits.

Figure 1. 4 to 20 mA Output Functional Block Diagram with HART Communicator



REMOTE OR INTEGRAL MOUNTING

The Models 47 or 48 Transmitters are not only used as remote mounted units, but can also be mounted directly onto a Model 4700S Series Flowtube as an integral and complete magnetic flow system.

POWER SUPPLY SELECTION

Two different types of power supply are available:

- ▶ 115 to 230 V ac, 50 or 60 Hz
- ▶ 11 to 30 V dc, or 11 to 24 V ac

LOW POWER CONSUMPTION

All Flowmeter configurations are designed to consume less than 6 W (dc) or 9 VA (ac) of power at reference voltage and frequency.

WEATHERPROOF CONSTRUCTION

The enclosure is weatherproof as defined by IEC IP67, and provides the environmental protection of NEMA Type 6.

LOW NOISE - WIDE DYNAMIC RANGE

A Signal Processor converts the analog flow signal to a digital signal and suppresses electrode noise through a digital filter. Inaccuracies in the transmitter caused by long-term and temperature drift are monitored and continuously corrected by a self-monitoring circuit. The A-to-D conversion takes place in an ultra low noise input circuit. This eliminates the need for range switching.

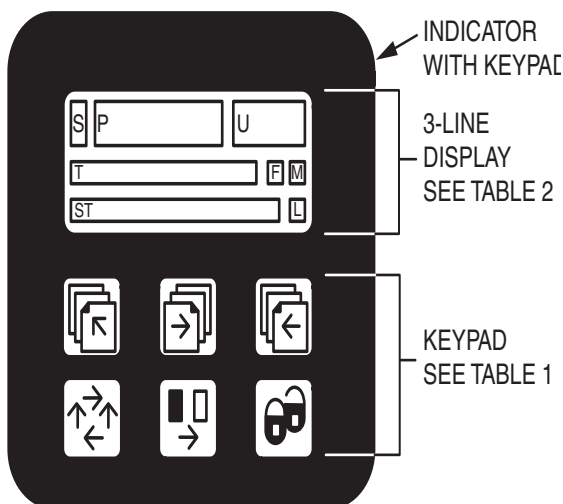
LOW FLUID CONDUCTIVITIES MEASURED

An Input Circuit amplifies the proportional flow signal from the electrodes. The input impedance is extremely high: $>10^{14}$ ohms, which allows flow measurements on fluids with conductivities as low as $5 \mu\text{S/cm}$. Measuring errors due to cable capacitance are eliminated by active cable shielding.

INDICATOR WITH KEYPAD

Three line, backlit, with alphanumeric display. Characters are $3 \times 20 \text{ mm}$ ($0.12 \times 0.8 \text{ in}$) and indicate flow values, flowmeter settings, and error messages. Keypad provides for configuration and operation. See Figure 2 and Tables 1 and 2.

Figure 2. Indicator with Keypad



SENSOR DATA PROM MEMORY UNIT

The flowtube features a unique PROM memory unit which stores flowtube calibration data and factory settings for the life of the product. In addition, customer-specified settings are downloaded to the PROM unit. If the transmitter is replaced, the new transmitter uploads all previous settings and resumes measurement without any need for reprogramming. Alternatively, the user can enter calibration data using the transmitter keypad.

ERROR DETECTION

A Coil Current Module generates a pulsating magnetizing current that drives the coils in the flowtube. The current is continuously monitored and corrected. Errors or cable faults are detected by the self-monitoring circuit.

GALVANIC ISOLATION

An Output Module converts flow data to an analog, a digital, and a relay output. The outputs are galvanically isolated and can be individually set to suit a particular application.

CE COMPLIANCE

The Models 47 and 48 Series Transmitters display the "CE" designation (logo) on the data plate indicating conformance to the appropriate European Community Standards for immunity to sources of electromagnetic interference. This compliance also includes conformance to radio frequency emission limits.

Table 1. Keypad Key Descriptions







Description	Designation	Function
Top Up Key		This key is used to switch between operator and setup menus. In the transmitter setup menu, a short press causes a return to the previous menu.
Forward Key		This key is used to step forward through the menus.
Backward Key		This key is used to step backward through the menus.
Change Key		This key changes the settings, numerical values, or position of the decimal point.
Select Key		This key selects the characters to be changed.
Lock and Unlock Key		This key allows the operator to change settings and provides access to submenus.

Table 2. Three-line Display Descriptions

Designation	Location	Description
S	1st Line	Sign field
P	1st Line	Primary field for numerical values
U	1st Line	Units field
T	2nd Line	Title line provides information that varies according to the selected operator or setup menu
F	2nd Line	The alarm field. Two flashing triangles appear on a fault condition.
M	2nd Line	Mode field. See instruction manual for description of the numerous symbols that are displayed.
ST	3rd Line	Subtitle line either adds information to the “T” line or keeps individual information independent of the “T” line.
L	3rd Line	A Lock field symbol indicates function of the Lock key. See Instruction Manual.

OPERATING CONDITIONS

Influence	Reference Operating Conditions(b)	Normal Operating Condition Limits	
		Transmitter Only - Flowtube Remote	Transmitter Integrally Mounted to Flowtube(c)
Ambient Temperature with Indicator(a)	20 ±2°C (68 ±3°F)	-20 and +50°C (-4 and +122°F)	-20 and +50°C (-4 and +122°F)
Ambient Temperature without Indicator(a)	20 ±2°C (68 ±3°F)	-20 and +60°C (-4 and +140°F)	-20 and +50°C (-4 and +122°F)
Relative Humidity	50 ±10%	5 and 95%	5 and 95%
Supply Voltage ▶ ac Voltage ▶ dc Voltage	▶ 115 or 230 V ac, ±1% 18 V ac, ±1% ▶ 12 or 24 V dc, ±1%	▶ 115 V ac, -15%, +10%; or 230 V ac, -15%, +10% 11 and 24 V ac ▶ 11 and 30 V dc	
Supply Frequency	50 or 60 Hz, ±1%	50 and 60 Hz, -3 Hz, +3 Hz	
Vibration	Negligible	0 to 32 m/s ² (0 to 3.2 "g") from 18 to 1000 Hz in all directions	

- (a) During transportation/storage, ambient temperatures of -40 to +70°C (-40 to +158°F) at a relative humidity to 95% are allowed.
- (b) Reference Operating Conditions assumes the liquid is water in a fully developed flow profile, a 30-minute warm-up period, and that there is a straight pipe upstream (ten pipe diameters minimum), and a straight pipe downstream (five pipe diameters minimum).
- (c) For integrally mounted configurations, the ambient temperature limit of 50°C (122°F) must be reduced depending on the process temperature of the liquid. Refer to PSS 1-6G2 A for flowtube specifications.

PERFORMANCE SPECIFICATIONS

(Performance stated under Reference Operating Conditions and is for the Magnetic Flow System - Transmitter with Flowtube)

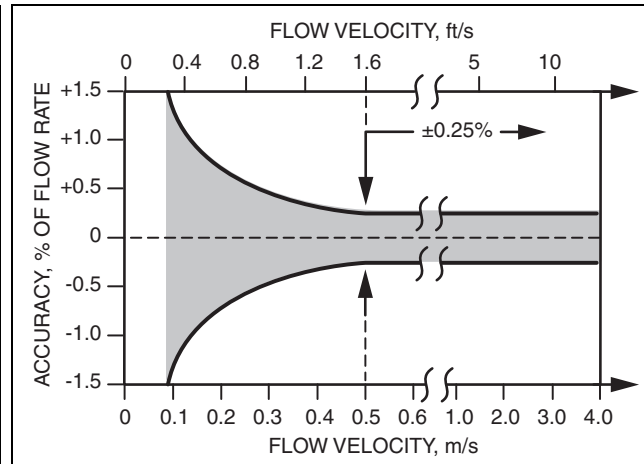
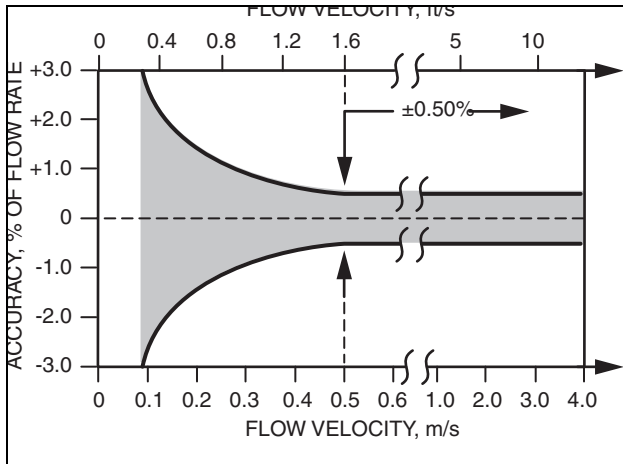
Accuracy - Digital and Pulse Outputs

Sanitary Flowtube Model and Liner Used	Magnetic Flow System Accuracy with:	
	Model 47 Transmitter	Model 48 Transmitter
4700S with Ceramic Liner	±0.5% of Flow Rate(a)	±0.25% of Flow Rate(b)
4700S with PFA Liner	±0.5% of Flow Rate(a)	±0.50% of Flow Rate(a)

(a) See Figure 3 for curve of accuracy vs. flow velocity.
(b) See Figure 4 for curve of accuracy vs. flow velocity.

*Figure 3. Accuracy vs. Flow Velocity
Model 47 Transmitter with Ceramic or PFA Flowtubes; or
Model 48 Transmitter with PFA Flowtube*

*Figure 4. Accuracy vs. Flow Velocity
Model 48 Transmitter with Ceramic Flowtube*



Accuracy - 4 to 20 mA Output (or 0 to 20 mA)

Same as Digital/Pulse Output accuracy, but add
±(0.1% of flow rate + 0.05% of Span)

Repeatability

±0.1% of Flow Rate for velocities ≥0.5 m/s (1.6 ft/s)

Supply Voltage Effect

<0.005% of measured value for 1% voltage change

Ambient Temperature Effect

CURRENT OUTPUT

<±0.005%/°C

PULSE/FREQUENCY OUTPUT

<±0.003%/°C

INDICATOR DISPLAY

<±0.003%/°C

Electromagnetic Compatibility

The Models 47 and 48 Transmitters, together with the Model 4700S Sanitary Magnetic Flowtube, comply with European EMC Directives 89/336/EEC and 72/23/EEC relating to electromagnetic compatibility and low voltage, as follows:

- ▶ EN 50081-1: 1992, EMC - General Emission

Standard, Part 1

- ▶ EN 50082-1: 1992, EMC - General Immunity Standard, Part 1
- ▶ EN 50081-2: 1993, EMC - General Emission Standard, Part 2
- ▶ EN 50082-2: 1995, EMC - General Immunity Standard, Part 2
- ▶ EN 60730, Automatic Electrical Controls

FUNCTIONAL SPECIFICATIONS

Flowtube Specifications

Refer to PSS 1-6G2 A

Electrical Output Signals

Three electrical output signals are available – current, pulse/frequency, and contact (relay):

CURRENT OUTPUT SIGNAL

Output

4 to 20 mA, or 0 to 20 mA

Load

<800 ohms

Damping

0.1 to 30 seconds, adjustable

PULSE/FREQUENCY OUTPUT SIGNAL

Output

0 to 10 000 Hz, 50% duty cycle

Damping

0.1 to 30 seconds, adjustable

Active

24 V dc, 30 mA, Load >1000 Ω and <10 000 Ω

Passive

3 to 30 V dc, 110 mA, Load >200 Ω and <10 000 Ω

CONTACT (RELAY) OUTPUT SIGNAL

- ▶ Changeover relay
- ▶ 42 V ac/2 A; 24 V dc/1 A

Digital Input Signal (HART)

INPUT

11 to 30 V dc, R = 4400 Ω

ACTIVATION TIME

50 ms

CURRENT

2.5 mA at 11 V dc

7 mA at 30 V dc

Supply Voltage and Power Consumption

115 to 230 V ac: 9 VA

11 to 24 V ac: 9 W

24 V dc: 6 W

12 V dc: 5 W

Flowtube Excitation Frequency

WHEN USED WITH MODEL 47 TRANSMITTER

3-1/8 Hz pulsating dc current (±125 mA)

WHEN USED WITH MODEL 48 TRANSMITTER

3-1/8, 6-1/4, or 12-1/2 Hz pulsating dc current (±125 mA)

Communications

MODEL 47 TRANSMITTER

HART Communication Protocol can be incorporated in the electronics provided.

MODEL 48 TRANSMITTER

HART Communication Protocol can be provided using an “add-on” module which is easily inserted in the transmitter’s bottom surface compartment. This can be done in the factory or in the field, as specified. This “add-on” feature allows other communication protocol modules to be easily used in the future by simply replacing the communications module.

Functions

Flow rate, two totalizers, low flow cutoff, flow direction, and diagnostics. Additionally, the Model 48 Transmitter provides a batch function.

Galvanic Isolation

All inputs and outputs are galvanically isolated.

Low Flow Cutoff - Programmable

- ▶ 0 to 9.9% of maximum flow rate
- ▶ Detection of empty pipe (special cable required - see Signal and Coil Driver section)

Totalizer

Two 8-digit totalizers for forward, net, and reverse flow. Reverse flow is indicated by a negative sign (-).

Empty Tube Zero

Automatic empty tube zero adjustment used to drive output signal to “zero flow rate” when the electrodes become uncovered by the conductive liquid.

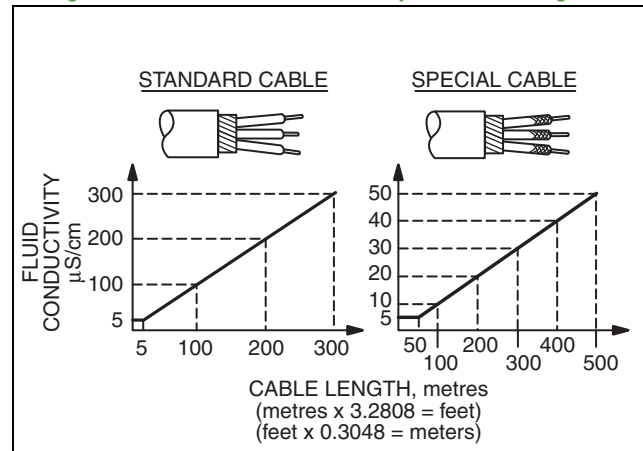
Signal and Coil Driver 3-Conductor Cable

For remote transmitter installations, the maximum allowable cable length is 300 m (985 ft) between flowtube and transmitter when using a standard 3-conductor (with shield) cable. This length can be increased to 500 m (1640 ft) by using a special cable. The special cable is double shielded (screened) and is used with very low conductivity

fluids and in high noise applications. For empty flowtube detection, the minimum conductivity must always be $\geq 20 \mu\text{S/cm}$.

The signal cable can be used in temperatures from -5 to $+70^\circ\text{C}$ (23 to 158°F) in installations requiring cable flexing, and down to -30°C (-32°F) for installations where cable flexing is not required. Refer to Figure 5 for the relationship between fluid conductivity and cable length for both the standard and special cables. Also see Accessories section for ordering instructions.

Figure 5. Process Fluid Conductivity vs. Cable Length



PHYSICAL SPECIFICATIONS

Enclosure Construction (Including Terminal Box)

The overall enclosure construction meets IEC IP67, and provides the environmental protection of NEMA Type 6 (submersion in 1.5 m (5 ft) of water for 72 hours).

Enclosure Material

Fiberglass reinforced polyamide

Enclosure Finish

Gray and blue pigmented polyamide material

Transmitter Mounting

The transmitter is either directly mounted to the flowtube, or can be remotely mounted to a surface or DN 50 (2 in) pipe using a mounting bracket. See Optional Selections and Accessories, and Dimensions - Nominal sections.

Electrical Connections (Terminal Box)

A Terminal box is provided with remote mounted transmitters. The integrally mounted terminal box has four 1/2 NPT or M20 threaded holes for cable conduit connection. See Accessories section for cable glands available if conduit is not used.

Mounting Position

The transmitter can be mounted in any position without degrading performance. The only requirements are that the flowtube be completely full with the process liquid during measurement, and that the electrodes should not be near the top or bottom of the pipeline. Also with either integrally or remote mounted transmitters, the enclosure box can be rotated 90° in either direction to allow selecting the best view of the displays and use of the keypad.

Approximate Mass

REMOTE MOUNTED TRANSMITTER

1.65 kg (3.6 lb), includes mounting bracket

TRANSMITTER MOUNTED TO FLOWTUBE

Flowtube Size		Transmitter and Flowtube(a)	
SI (Metric) Units	U.S. Customary Units	kg	lb
DN 10	1/2 in	3.0	6.6
DN 15	3/4 in	3.0	6.6
DN 25	1 in	3.5	7.7
DN 40	1-1/2 in	4.2	9.3
DN 50	2 in	5.0	11.0
DN 65	2-1/2 in	6.3	13.9
DN 80	3 in	7.8	17.2
DN 100	4 in	10.8	23.8

(a) Approximate mass does not include flowtube end connection adapters and clamps.

ACCESSORIES

Conduit Connection Adapter (Terminal Box)

For users who still require the PG 13.5 fittings, a conduit connection adapter can be provided to adapt from 1/2 NPT to PG 13.5. See table below, and contact Global Customer Support for further information.

Description	Part Number (a)
Nickel Plated Brass Conduit Fitting, 1/2 NPT to PG 13.5	X0178LU

(a) Part number specified is for one fitting.

Cable Glands (Terminal Box)

If cable gland cable entry is required, rather than conduit, see table below.

Description	Part Number (a)
Cable Gland, 1/2 NPT to 1/2 NPT	A5E00822501
Cable Gland, M20 to M20	A5E00822490

(a) Part number specified is for two cable glands.

Mounting Bracket

Required for use with remote mounted transmitters. A stainless steel bracket allows mounting of the transmitter to a surface or DN 50 (2 in) pipe. The bracket is first attached to a surface or pipe, and then the flowtube terminal box and transmitter are installed. Mounting instructions are provided to ensure proper installation.

See Dimensions-Nominal section and table below.

Description	Part Number
Wall Mounting Kit with four 1/2 NPT Cable Glands	085B1053
Wall Mounting Kit with four M20 Cable Glands	085B1018

Signal and Coil Driver Cables

- ▶ Standard cable for remote mounted transmitters. Three conductors with PVC cable jacket, and shield (screen) over the three wires.
- ▶ Special cable for remote mounted transmitters. Three conductors with PVC cable jacket, and shield (screen) over the three wires, and also over each individual wire.
- ▶ Cables are offered in lengths from 10 to 500 m (33 to 1640 ft). Specify Part Number(s) required as listed in the table below.

Cable Length		Part Number(a)	
m	ft	Standard	Special
10	33	083F0121	N/A
20	66	083F0210	083F3095
40	131	083F0211	083F3094
60	197	083F0212	083F3093
100	328	083F0213	083F3092
150	492	083F3052	083F3056
200	656	083F3053	083F3057
500	1640	083F3054	083F3058

(a) See Functional Specifications section for specifications relating to the standard and special cables.

MODEL CODE

Model 47 and Model 48 Magnetic Flow Transmitters

Description	Code
Magnetic Flow Transmitter System Accuracy of $\pm 0.5\%$ with Model 4700S Sanitary Flowtubes having Ceramic or PFA Liners	47
Magnetic Flow Transmitter System Accuracy of $\pm 0.25\%$ with Model 4700S Sanitary Flowtubes having a Ceramic Liner, and $\pm 0.50\%$ with Model 4700S Sanitary Flowtubes having a PFA Liner	48
Supply Voltage and Frequency 115 to 230 V ac, 50 to 60 Hz 11 to 24 V ac or 11 to 30 V dc	-A -B
Communication Protocol 4 to 20 mA Current Output Intelligent; Digital, HART and 4 to 20 mA(a)	A T
Indicator with Keypad With Indicator and Keypad Blind; Without Indicator and Keypad(b)	A B
Transmitter Enclosure Fiberglass Reinforced Polyamide Enclosure, Meets IEC IP67 and NEMA Type 6(c)	1
Electrical Safety UL, ULc, CE, C-Tick; For use in General Purpose (Ordinary) Locations	A
EXAMPLES: 47-AAA1A; 48-BTA1A	

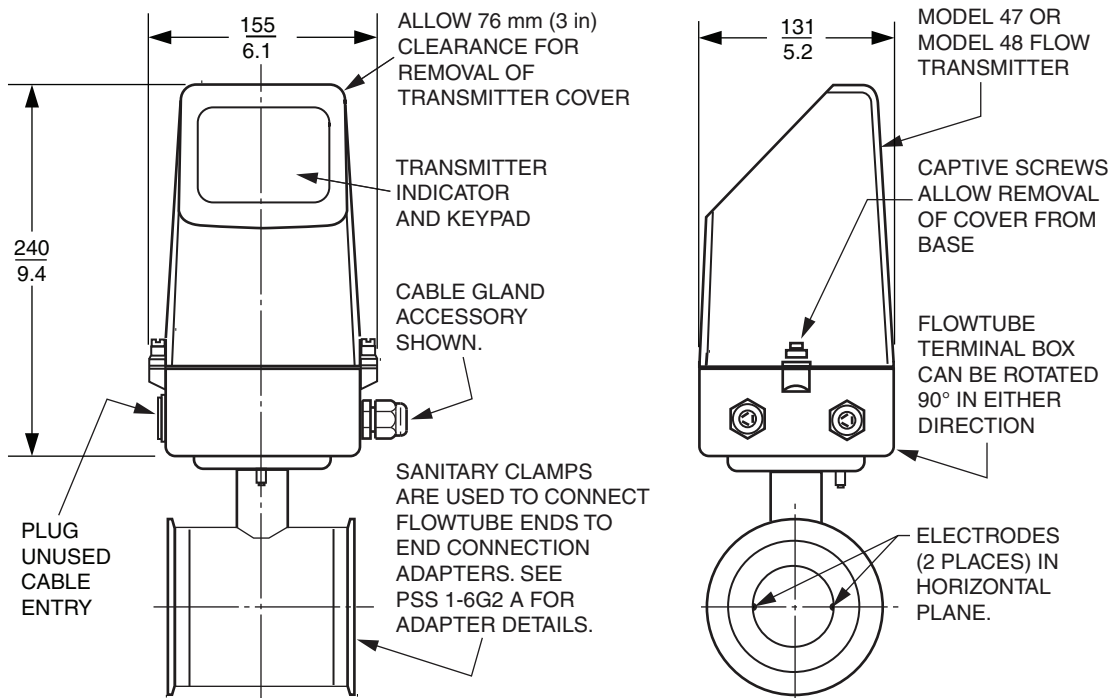
- (a) When HART Communication is specified, included is a waterproof connector for installation in the flowtube terminal box. With the Model 47 Transmitter, HART communications is incorporated in the electronics provided. With the Model 48 Transmitter, HART communications is provided by an "add-on" module (included) in the field or during installation. See "Optional Selections and Accessories" section.
- (b) The "blind" (no indicator or keypad) transmitter is not offered with Communication Protocol Code "A" (4 to 20 mA).
- (c) If transmitter is not directly mounted to a flowtube, then a mounting bracket, and signal and coil driver cable are required. See "Optional Selections and Accessories" section for mounting bracket and cable specifications, and ordering information.

NOTE: For Model 4700S Sanitary Flowtube Model Code, refer to PSS 1-6G2 A.

DIMENSIONS - NOMINAL

mm
in

TRANSMITTER INTEGRALLY MOUNTED TO FLOWTUBE



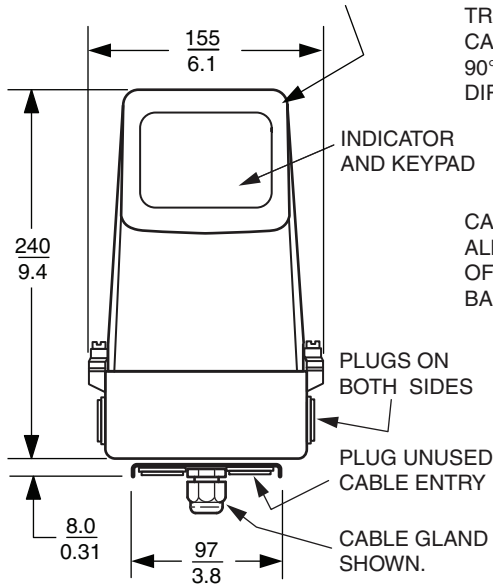
NOTE:

- 1 For overall dimensions of transmitter integrally mounted to the different flowtube sizes, and for the dimensions of each individual flowtube size, refer to Model 4700S Sanitary Magnetic Flowtubes specification document PSS 1-6G2 A.
- 2 The Flowtube terminal box is provided with four threaded holes (1/2 NPT or M20) for conduit connection. For users who prefer a cable gland entry, see Accessories section.

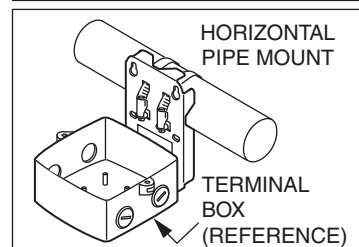
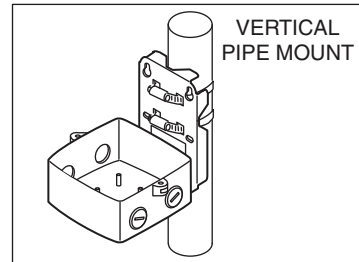
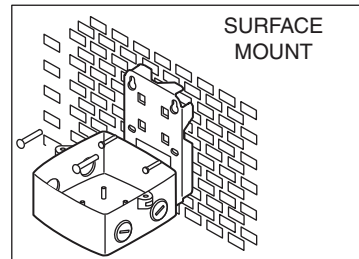
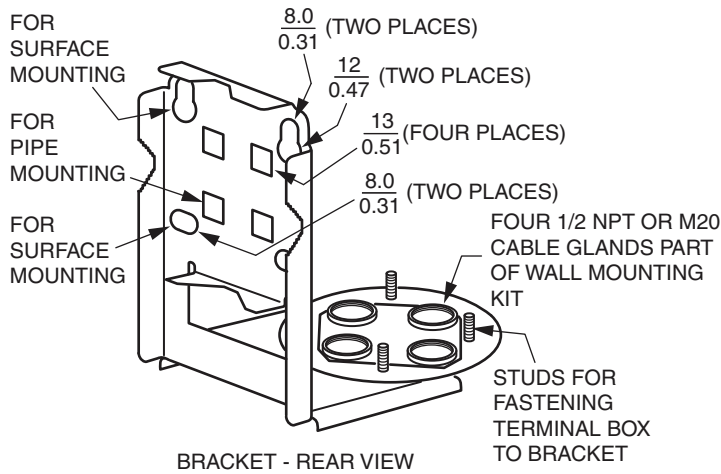
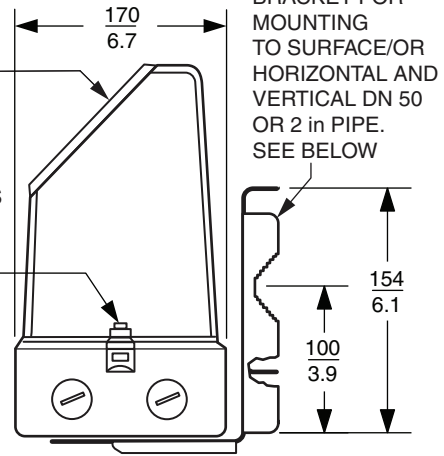
mm
in

TRANSMITTER MOUNTED TO SURFACE OR PIPE
(FLOWTUBE IN REMOTE LOCATION)

ALLOW 76 mm (3 in) CLEARANCE FOR
REMOVAL OF TRANSMITTER COVER



MODEL 47 OR
MODEL 48 FLOW
TRANSMITTER.
CAN BE ROTATED
90° IN EITHER
DIRECTION.



ASSEMBLE TRANSMITTER
TO TERMINAL BOX AFTER
INSTALLING BRACKET

NOTES

ORDERING INSTRUCTIONS

1. Transmitter Model Number
2. Accessories; Specify Part Number and Description

NOTE:

For remote mounting of transmitter, please specify the mounting bracket, and applicable signal and coil driver cable described in the Accessories section.

OTHER FOXBORO PRODUCTS

The Foxboro product lines offer a broad range of measurement and instrument products, including solutions for pressure, flow, analytical, temperature, positioning, controlling, and recording.

For a list of these offerings, visit our web site at:

www.fielddevices.foxboro.com