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USER'S GUIDE

Series SN/SM/SH, MN/MM/MH, LN/LE, XHF

STANDARD VANE IN-LINE VARIABLE AREA FLOWMETER CONTROL BOXES WITH TRANSMITTERS

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Table of Contents

1 General Vane Piston Switch Manual

Installation and Operation Manual for series: LL, LP, LH, SN, SM, SH, MN, MM ,MH, SX and MX for A, L or Z control boxes with 0, 1 or 2 switches.

1.1 NAMEPLATES AND PRODUCT ID

This manual applies to all vane/piston meters that have one of the designators in the model codes shown in the table shown below. This can be seen on the name plate example.

Table 1: Model code designations for zero, one, two switches

A0	L0	Z0
A1	L1	Z1
A1B	L1B	Z1B
A3	L3	Z3
A61	L61	Z61
A71	L71	Z71
A3	L3	Z3
A4	L4	Z4
A62	L62	Z62
A72	L72	Z72
A2	L2	Z2

Figure 1: Name Plate Example

Wire directly to the switch terminal screws.

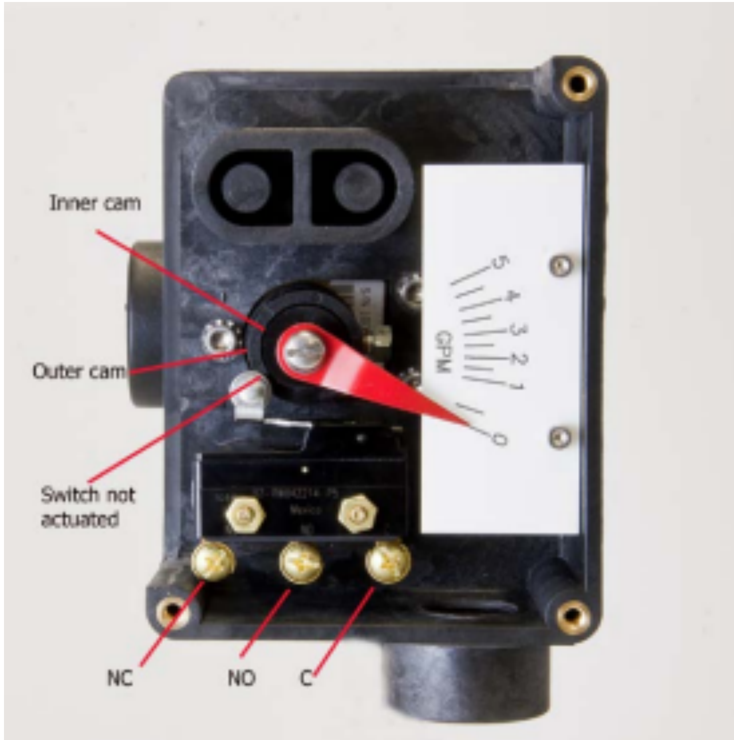


Figure 2: Device overview

In one switch units, the cam is easily adjusted by depressing the outer ring and turning it to the desired position

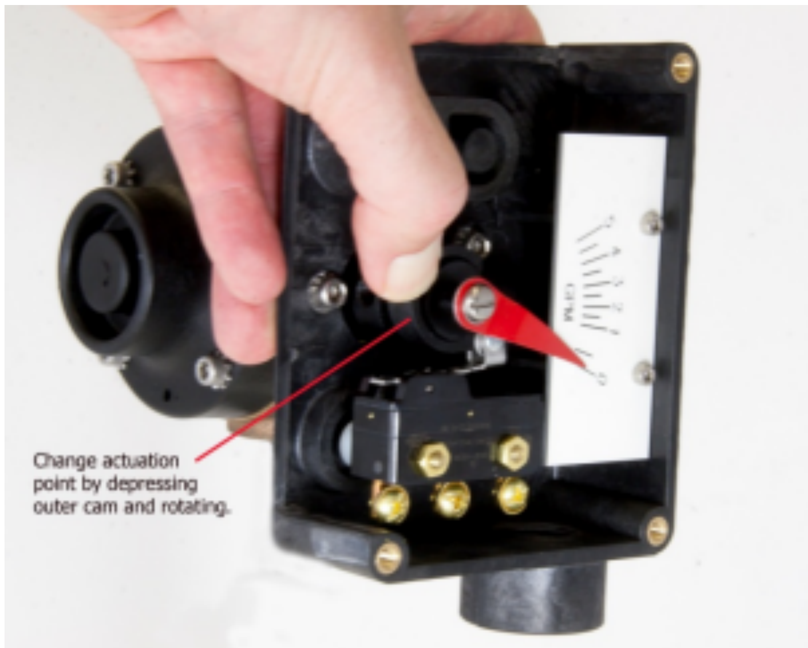


Figure 3: Cam adjustment

WARNING: This instrument was made for the specific use stated at the time of order. Any other use may cause injury. Read instructions before using the device.

Supply Connections—Wire Sizes: Wire used to connect any Switches included must be in accordance with all local and national codes. Wire size and insulation ratings should support actual loads. See also Switch Ratings below. In all cases, wire must be, as a minimum, 20 AWG Teflon insulated rated at 600V and 200°C. It is recommended to include a disconnect switch or circuit breaker near this equipment.

Electrical Switch Ratings:

Table 2: Electrical Switch Ratings

Switch Identification	Switch Description	Electrical Ratings
Model Code Designator: 1 or 2	SPDT – (3 wire) (1 or 2 switches may be provided)	15A – 125VAC, 250VAC, 480VAC; ⅛HP – 125VAC, ¼HP – 250VAC
Model Code Designator: 1B or 2B	SPDT – (3 wire) High Vibration	20A – 125VAC, 250VAC, 480VAC; ½A – 125VDC, ¼A -250VDC; 1HP – 125VAC, 2HP – 250VAC
Model Code Designator: 61 or 62	SPDT – High Temperature	15A – 125VAC, 250VAC, 480VAC; ½A – 125VDC, ¼A -250VDC; ⅛HP – 125VAC, ¼HP – 250VAC
Model Code Designator: 71 or 72	SPDT – Gold Contact	15A – 125VAC, 250VAC, 480VAC; ⅛HP – 125VAC, ¼HP – 250VAC
Model Code Designator: 3 or 4	SPDT – (4 wire) Single-Break Form Z	15A – 125VAC, 250VAC, 480VAC; 1A – 125VDC, ½A -250VDC; ¼HP – 125VAC, ½HP – 250VAC

1.2 Installation

For best results, the meters may be installed in any position as long as proper piping installation requirements are observed. This includes sufficient support of adjacent piping to minimize the system's inherent vibration. Unions of the same pipe size and full port isolation ball valves may be installed for ease of removal and servicing of equipment, if necessary.

If Teflon® tape or pipe sealant is used, the user must ensure that no loose parts become wrapped around the bluff or the flow sensor when the flow starts.

2 Vane/Piston AX/H

Installation and Operation Manual Series: LL, LP, LH, SN, SM, SH, MN, MM, MH, SX and MX Used with control boxes: A, L, or Z with 4-20 mA

2.1 Maximum Dimensions

Figure 4: LL, LP, and LH dimensions

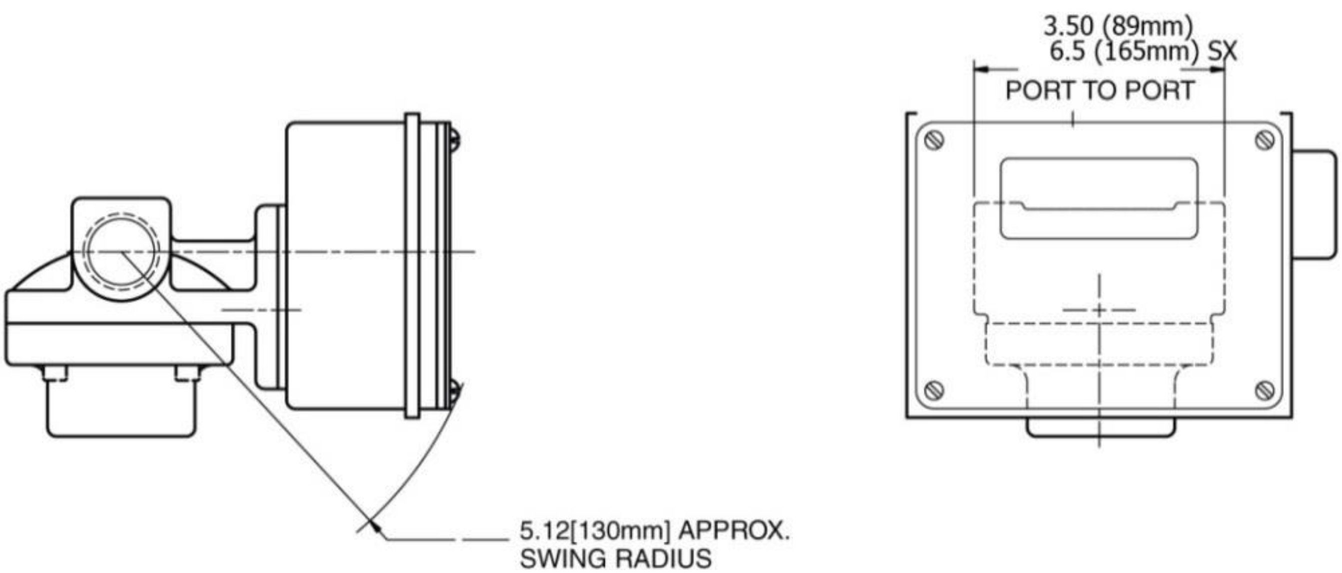


Figure 5: SX, SN, SM, and SH dimensions

2.2 Quick Set Up

2.2.1 Wiring Using Pre-Installed Wires:

Complete the loop circuit using the 2 pre-installed 18", 22AWG wires provided.

IMPORTANT: Observe polarity—The red wire is positive (+), and the black wire is negative (-).

2.2.2 Wiring Removing Pre-Installed Wires:

Open cover and remove pre-installed wires. Connect a twisted wire pair (not provided) to the terminals observing the polarity marked on the PC board. The units are shipped with a red wire connected to the positive (+) terminal, and a black wire connected to the negative (-) terminal. The wire may be up to AWG 14 size, but no smaller than AWG22.

Figure 6: Terminals for 4-20 mA loop

2.3 Introduction to HART® Field Device Specifications

2.3.1 Scope

The Universal Flow Monitors water flow transmitter, model ME Transmitter complies with HART Protocol Revision 7.0. This document specifies all the device specific features and documents HART Protocol implementation details (e.g., the Engineering Unit Codes supported). The functionality of this Field Device is described sufficiently to allow its proper application in a process and its complete support in HART capable Host Applications.

2.3.2 Purpose

This specification is designed to complement other documentation (e.g., the installation manuals specific to SN/SM/SH, MN/MM/MH/, LL/LP/LH, LN/LE and XHF model flow meters) by providing a complete, unambiguous description of this Field Device from a HART Communication perspective

2.3.3 Who Should Use this Document?

The specification is designed to be a technical reference for HART capable Host Application Developers, System Integrators and knowledgeable End Users. It also provides functional specifications (e.g., commands, enumerations and performance requirements) used during Field Device development, maintenance and testing. This document assumes the reader is familiar with HART Protocol requirements and terminology.

2.3.4 Abbreviations and Definitions

ADC	Analog to Digital Converter
CPU	Central Processing Unit (of microprocessor)
DAC	Digital to Analog Converter
EEPROM	Electrically-Erasable Read-Only Memory
ROM	Read-Only Memory
PV	Primary Variable
SV	Secondary Variable
HCF	HART Communication Foundation
FSK	Frequency Shift Keying Physical Layer

2.4 Process Interface

2.4.1 Magnetic Sensors

There are two built-in hall-effect sensors measuring the rotation of a permanent magnet that is mounted onto the flowmeter shaft. As the shaft rotates with flow, the sensors provide analog readings that are in turn converted to a digital value by and A/D converter. The digital values are then processed by the microcontroller and linearized, and subsequently converted to a scaled analog output via a D/A converter in the range of 4 to 20 mA.

2.4.2 Host Interface Analog Output 1: Process Flow

The two-wire 4-20mA current loop is connected to two terminals on the transmitter circuit board. Depending on the product used, one of the two configurations are offered for field wiring.

The first option allows the user to directly connect the loop wires to the terminals on the PCB. The correct polarity is shown in the pictures below, where the red wire is connected to the (+) terminal and the black wire is connected to the (–) terminal.

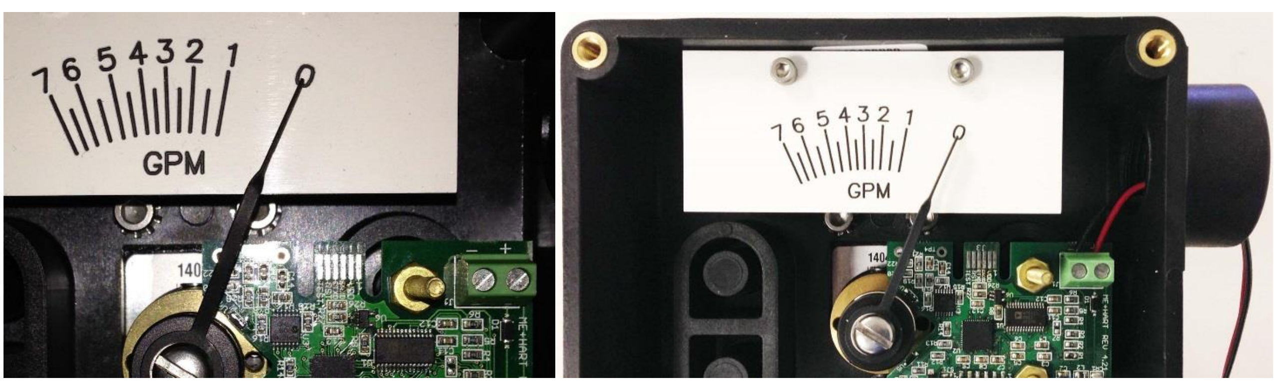


Figure 7: PCB Polarity wiring

2.5 Dynamic Variables

Two Dynamic Variables are implemented.

Table 3: Dynamic Variables table

	Meaning	Units
PV	Volumetric Flow Reading	GPM, CMH, LPM
SV	Totalizer Value based on PV	Follows PV Units

The PV is derived using a calibrated linearization table applied to A/D converter readings of hall-effect sensors.

The SV is based on a 5ms timer and is updated based on the current reading of flow.

Both PV and SV values are smoothed.

2.6 Status Information

Table 4: Device Status table

Bit Mask	Definition	Conditions to set bit
0x80(bit 7)	Device Malfunction	None
0x40(bit 6)	Configuration Changed	Any change in device configuration
0x20(bit 5)	Cold start	Set any time power is cycled
0x10(bit 4)	More Status Available	Triggers when either alarm is active
0x08(bit 3)	Loop Current Fixed	None
0x04(bit 2)	Loop Current Saturated	Occurs when loop current reaches upper limit
0x02(bit 1)	Non-Primary Variable out of limits	None
0x01(bit 0)	Primary Variable Out of limits	Occurs when PV is being limited due to exceeding calibrated limitations

When Bit 4 is set, Host should send Command 48 to determine which alarm is active.

2.6.1 Additional Device Status (Command #48)

Command #48 returns 9 bytes of data, with the following status information:

Table 5: Device Specific Status Byte 0 table

Bit Mask	Description	Conditions
0x80	Undefined	NA
0x40	Undefined	NA
0x20	Undefined	NA
0x10	Undefined	NA
0x08	Undefined	NA
0x04	Undefined	NA
0x02	High Alarm	High Alarm is active if set
0x01	Low Alarm	Low Alarm is active if set

2.6.1 Burst Mode

This Field Device does not support Burst Mode.

2.6.2 Catch Device Variable

This Field Device does not support Catch Device Variable.

2.7 Device-Specific Commands

The following device-specific commands are implemented:

128	Read Alarm Setpoints
129	Write Low Alarm Setpoint
130	Write High Alarm Setpoint
131	Reset Totalizer

2.8 Command #128: Read Alarm Setpoints

Reads the High and Low Alarm Setpoints. If zero, the alarm is disabled.

2.8.1 Request Data Bytes

Table 6: Request Data Bytes table

Byte	Format	Description
None		

2.8.2 Response Data Bytes

Table 7: Response Data Bytes table

Byte	Format	Description
0	Enum	PV Unit value
1-4	Float	High Alarm Setpoint
5-8	Float	Value of High Alarm Setpoint

2.9 Command #129: Write Low Alarm Setpoint

Writes the setpoint for the Low Alarm.

2.9.1 Request Data Bytes

Table 8: Request Data Bytes table

Byte	Format	Description
0-3	Float	Low Alarm Setpoint

2.9.2 Response Data Bytes

Table 9: Response Data Bytes table

Byte	Format	Description
0	Enum	PV Unit value
1-4	Float	Low Alarm Setpoint

2.9.3 Command-Specific Response Codes

Table 10: Command-Specific Response Codes table

Code	Class	Description
0	Success	No Command-Specific Errors
1-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

2.10 Command #131: Reset Totalizer

Resets the totalizer to zero.

2.10.1 Request Data Bytes

Table 11: Request Data Bytes table

Byte	Format	Description
None		

2.10.2 Response Data Bytes

Table 12: Response Data Bytes table

Byte	Format	Description
None		

2.10.3 Command-Specific Response Codes

Table 13: Command-Specific Response Codes table

Code	Class	Description
0	Success	No Command-Specific Errors
1-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

2.11 Performance

2.11.1 Sampling Rates

Typical sampling rates are shown in the following table.

Table 14: Sampling Rates table

PV digital value calculation	10 per second
SV digital value calculation	10 per second
Analog output update	10 per second

2.11.2 Power-Up

The device is typically ready within 1 second of power-up. Totalizer is initialized to zero.

2.11.3 Reset

Command 42 ("Device Reset") causes the device to reset its microcontroller. The resulting restart is identical to the normal power up sequence.

2.11.4 Self-Test

Self-Test is not supported.

2.11.5 Command Response Times

Table 15: Command Response Times table

Minimum	20ms
Typical	50ms
Maximum	100ms

2.1 Annex A: Capability Checklist

Table 16: Capability Checklist table

Manufacturer, model and revision	Universal Flow, ME Transmitter, Rev1
Device type	Transmitter
HART revision	7.0
Device Description available	No
Number and type of sensors	2 internal
Number and type of actuators	0
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	4
Number of Dynamic Variables	2
Mappable Dynamic Variables?	No
Number of common-practice commands	5
Number of device-specific commands	4
Bits of additional device status	2
Alternative operating modes?	No
Burst mode?	No
Write-protection?	No

3 Vane/Piston AXØ

Installation and Operation Manual Series: LL, LP, LH, SN, SM, SH, MN, MM ,MH, SX and MX for A, L or Z control boxes with transmitter.

3.1 Maximum Dimensions

Figure 8: Figure 9: LL, LP, and LH dimensions

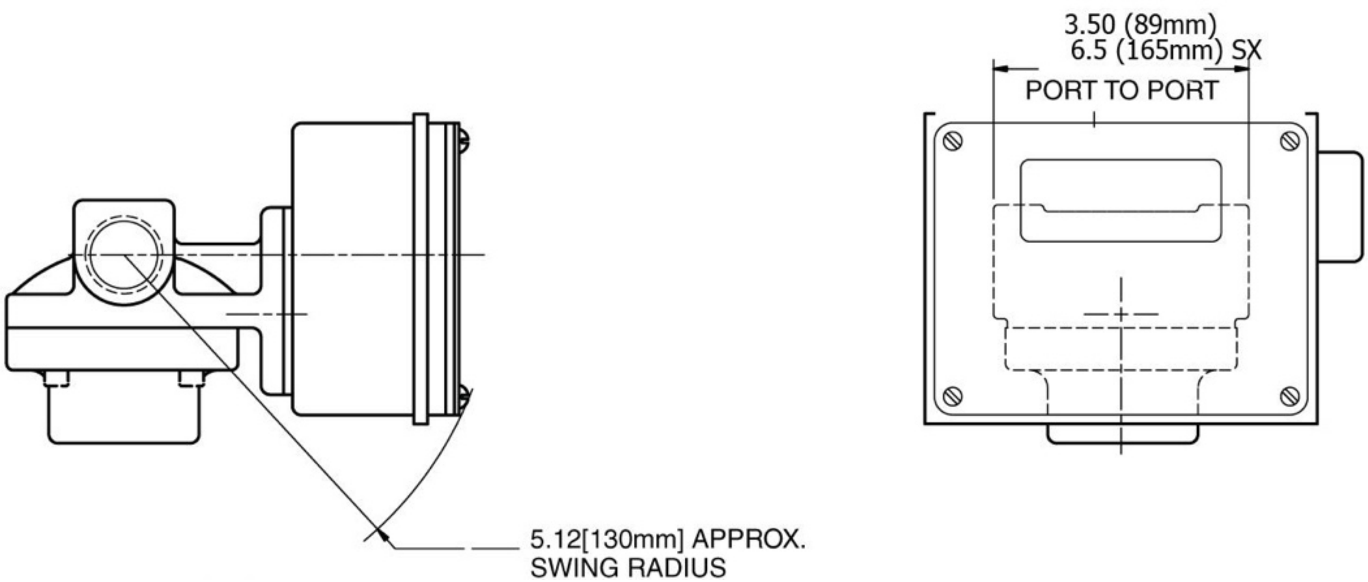


Figure 10: SX, SN, SM, and SH dimensions

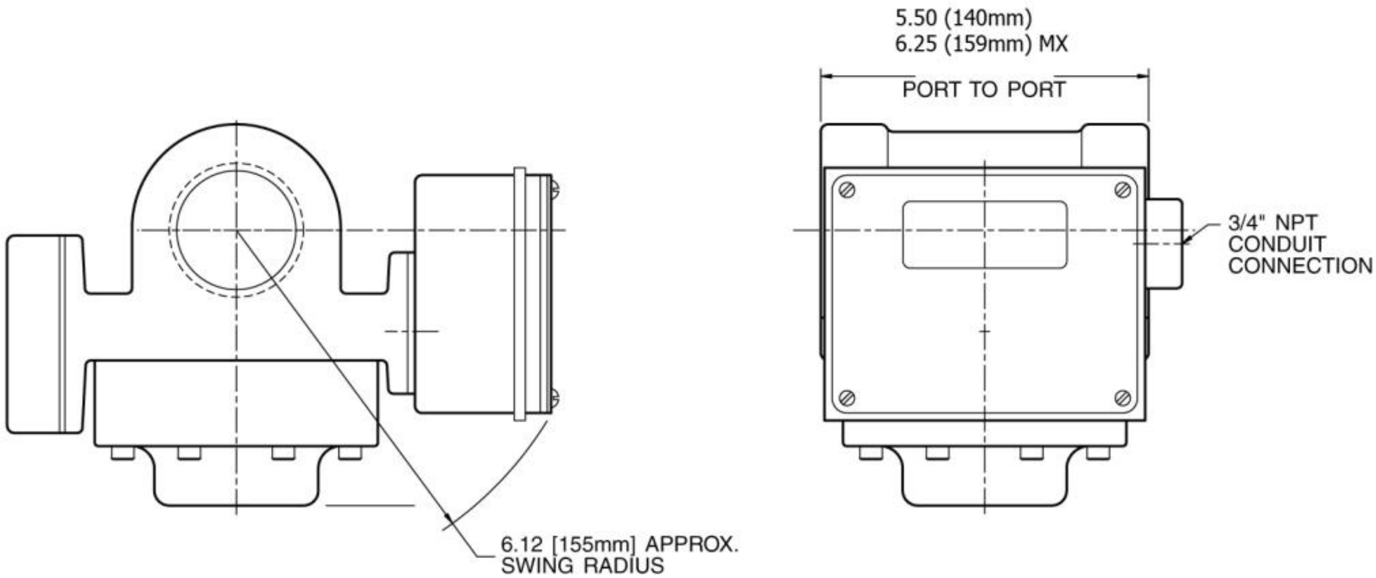


Figure 11: MN, MM, MH, and MX

3.2 **Nameplates and Product ID**

This manual applies to all vane/piston meters that have the designator “AX0”, “LX0” or “ZX0” in the model code. This can be seen on the name plate as shown below.

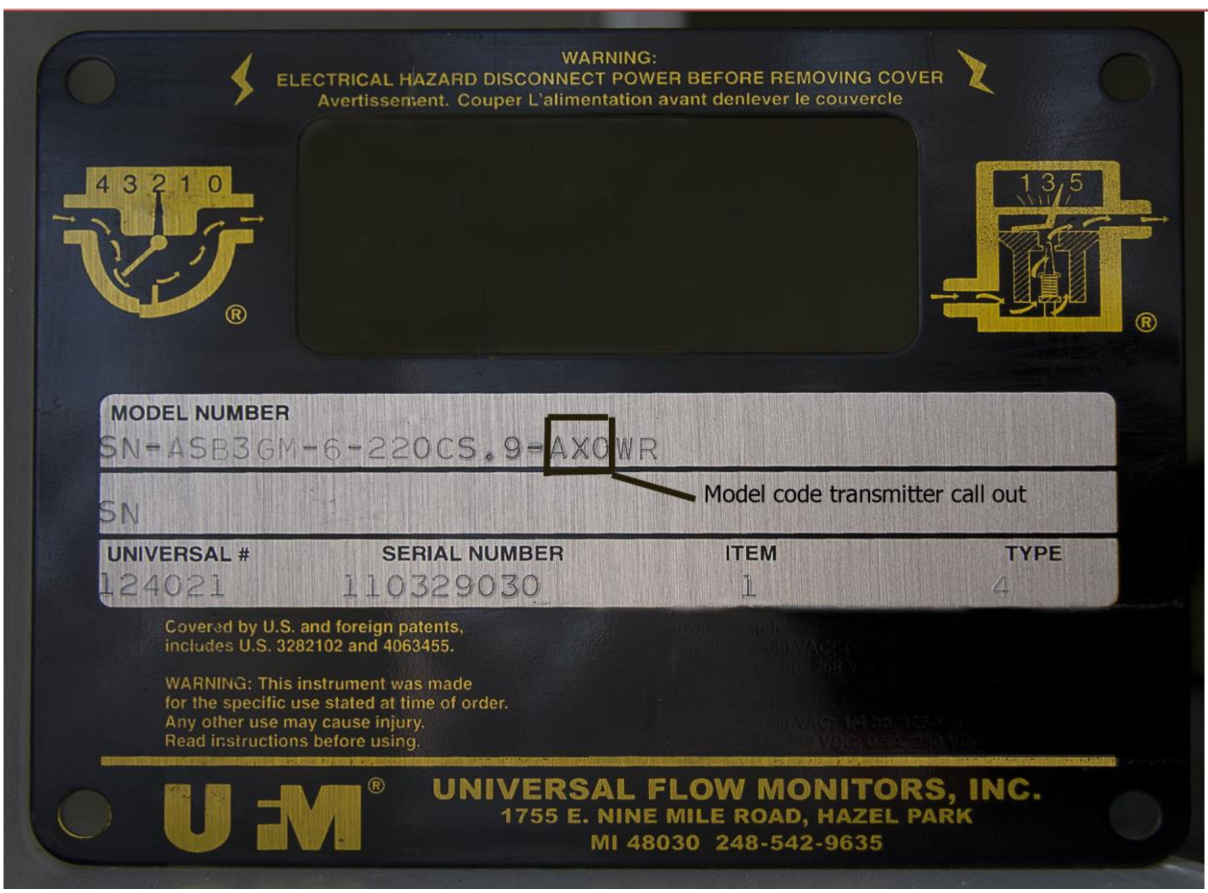


Figure 12: Nameplate and Product ID

4 Vane/Piston RX/H

Installation and Operation Manual Series: LL, LP, LH, SN, SM, SH, MN, MM, MH, SX, MX, LN, LE and XHF Used with R control boxes with 4-20 mA transmitter or HART and optional mechanical switches.

4.1 Maximum Dimensions

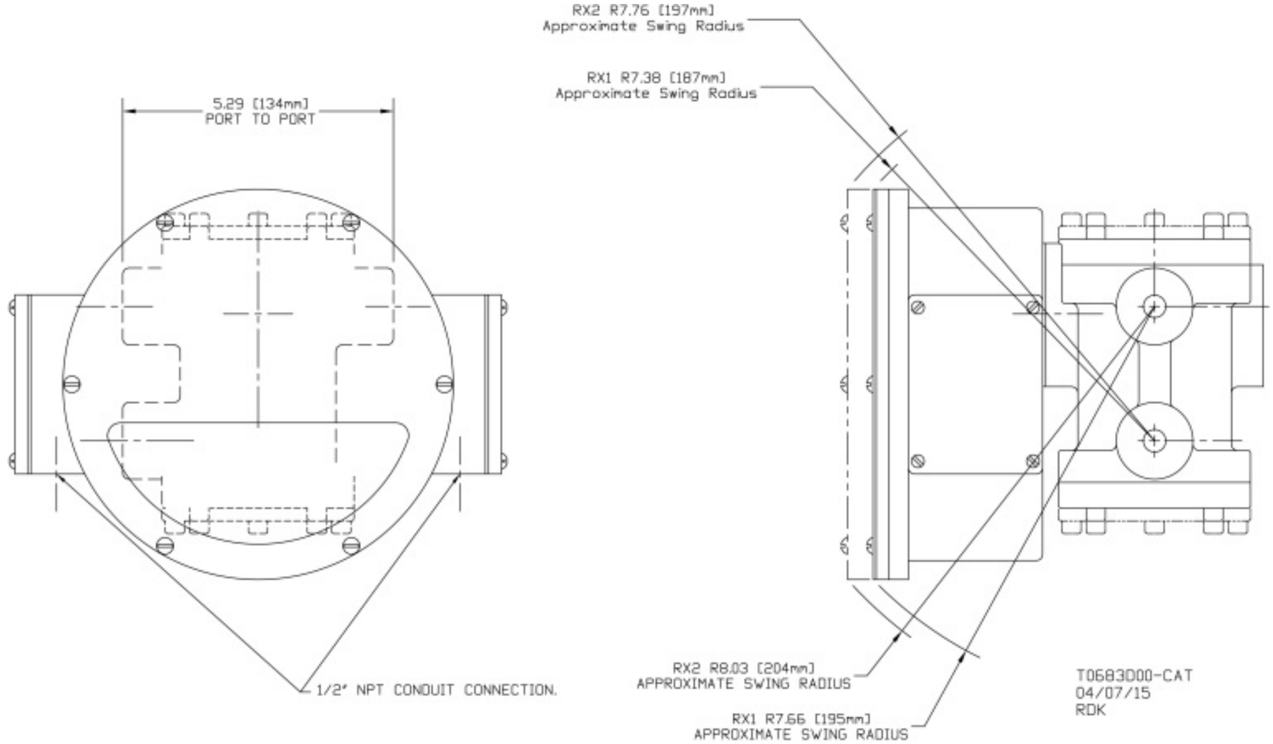


Figure 13: LL, LP, and LH Dimensions

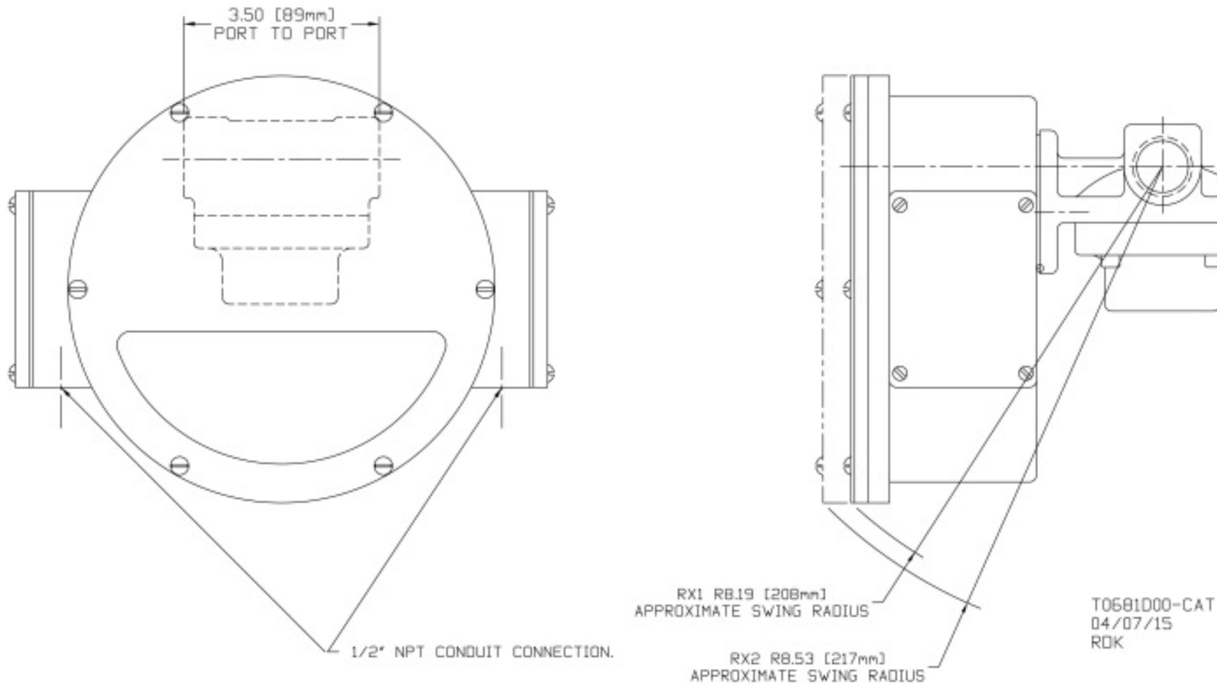
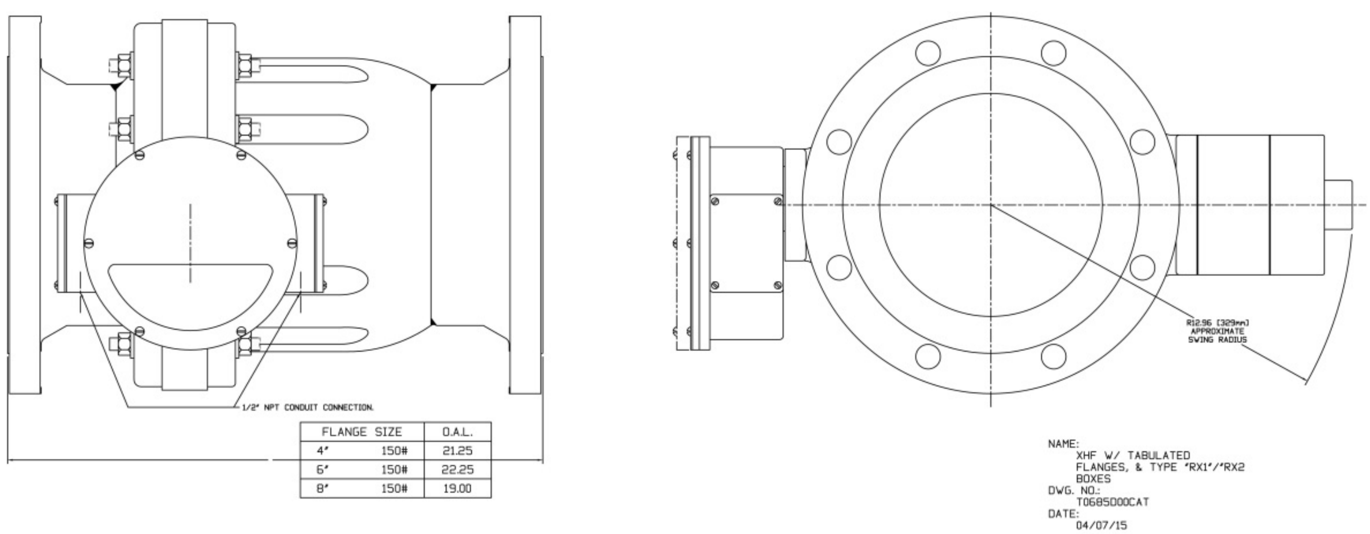


Figure 14: SX, SN, SM, and SH Dimensions



FLANGE SIZE		O.A.L.
4"	150#	21.25
6"	150#	22.25
8"	150#	19.00

Figure 15: XHF Dimensions

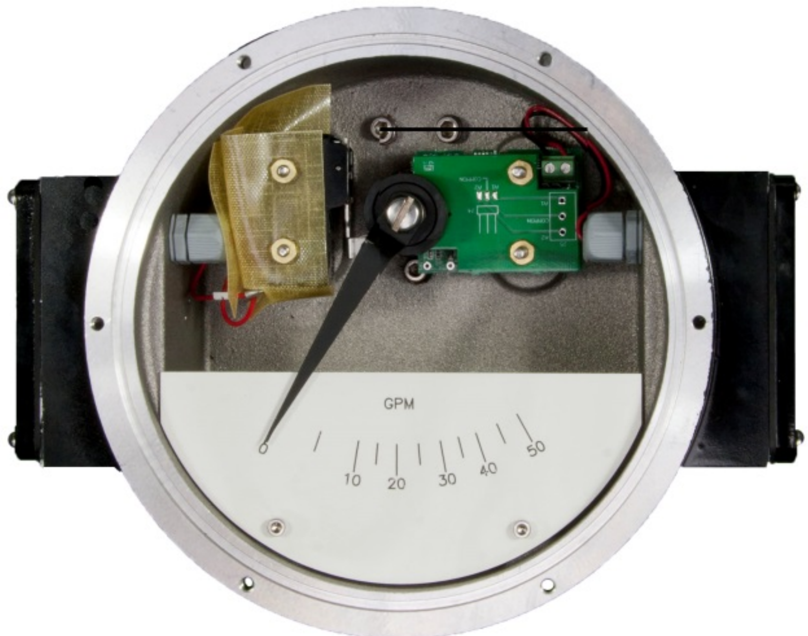


Figure 16: R Box shown open with optional mechanical switch

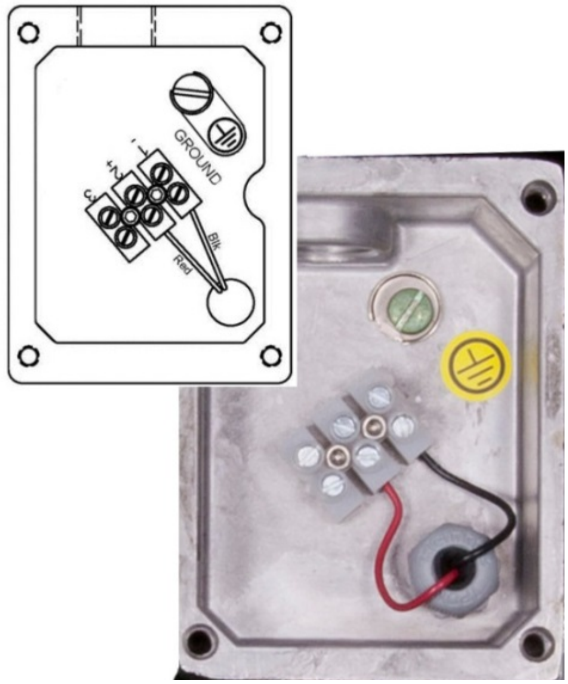


Figure 17: Transmitter Wiring with or without HART

Figure 18: Mechanical (Optional) Switch Wiring

4.2 Installation

For best results, the meters may be installed in any position as long as proper piping installation requirements are observed. This includes sufficient support of adjacent piping to minimize the system's inherent vibration. Unions of the same pipe size and full port isolation ball valves may be installed for ease of removal and servicing of equipment, if necessary.

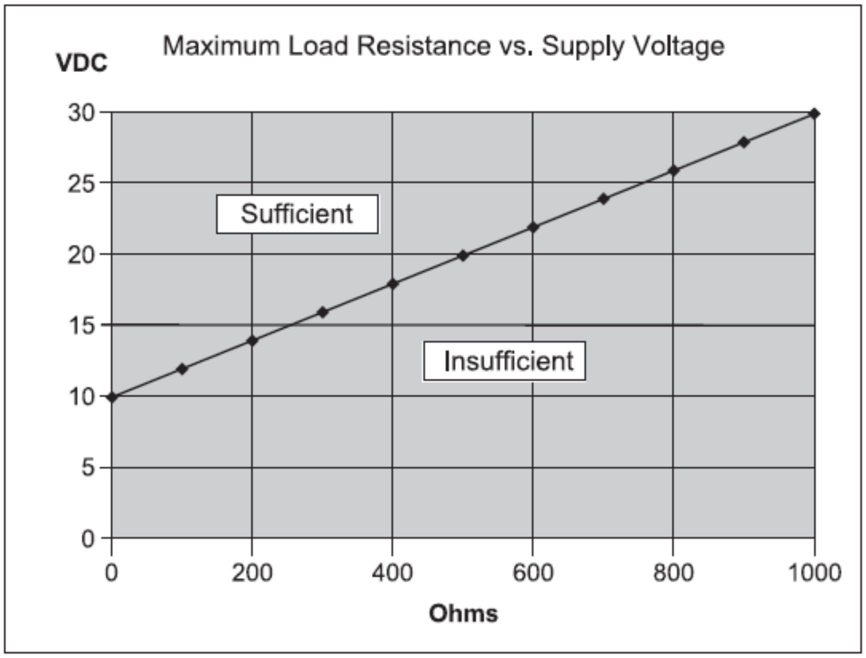


Figure 19: Maximum Load vs. Supply Voltage table

4.3 References

HART Smart Communications Protocol Specification. HCF_SPEC-12. Available from the HCF.
Installation manuals specific to SN/SM/SH, MN/MM/MH/LL/LP/LH,LN/LE and XHF model flow meters as manufactured by Universal Flow Monitors, Inc.

4.4 Device Identification

Manufacturer Name:	Universal Flow	**Model Name(s):**	ME Transmitter
Manufacture ID Code:	24692 (6074 Hex)	**Device Type Code:**	230 (E1EF Hex)
HART Protocol Revision	7.0	**Device Revision:**	1
Number of Device Variables	4		
Physical Layers Supported	FSK		
Physical Device Category	Transmitter, Non-DC-isolated Bus Device		

Figure 20: Device Identification

4.5 Product Overview

The ME Transmitter is a two-wire loop-powered flow transmitter, with a 4-to-20mA output. This transmitter uses a non-contact magnetic encoder for measuring the displacement of the shaft/pointer on standard UFM flowmeters. It is an add-on feature to SN/SM/SH,MN/MM/MH,LL/LP/LH,LN/LE and XHF model flow meters as manufactured by Universal Flow Monitors, Inc. The ME Transmitter replaces the earlier models Digital Transmitters that utilized a potentiometer, providing improved accuracy while maintaining 100% compatibility. The analog output of this device is linear with flow over the working range of all supported flowmeters.

4.6 Process Interface

4.6.1 Magnetic Sensors

There are two built-in hall-effect sensors measuring the rotation of a permanent magnet that is mounted onto the flowmeter shaft. As the shaft rotates with flow, the sensors provide analog readings that are in turn converted to a digital value by and A/D converter. The digital values are then processed by the microcontroller and linearized, and subsequently converted to a scaled analog output via a D/A converter in the range of 4 to 20 mA.

4.6.2 Host Interface: Process Flow

The two-wire 4-20mA current loop is connected to two terminals on the transmitter circuit board. Depending on the product used, one of the two configurations are offered for field wiring.

A secondary terminal strip away from the PCB (mounted in a separate compartment of the flowmeter) and is marked L+ and L-. The red wire connects the (+) terminal on the PCB to L+ and the black wire connects the (–) terminal on the PCB to L-.

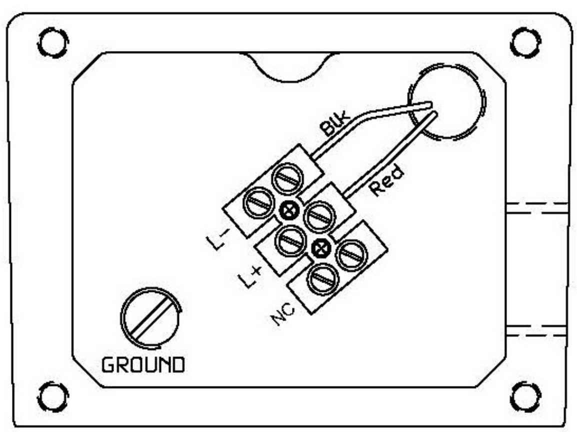


Figure 21: PCB Wiring

This is the only output from this transmitter, representing the process flow measurement, linearized and scaled according to the configured range of the instrument. This output corresponds to the Primary Variable. HART Communication is supported on this loop.

A guaranteed linear over-range is provided. The up-scale current of 24mA can indicate device malfunction. Current values are shown in the table below.

Table 17: Current Values table

	Direction	Values (percent of range)	Values (mA or V)
Linear over-range	Down	0% ± 0.5%	3.92 to 4.08 mA
	Up	+106.25% ± 0.1%	20.84 mA to 21.16 mA
Device malfunction indication	Down	N/A	N/A
	Up	+125.0% ± 0.1%	23.98 mA to 24.02 mA
Maximum current		+106.25% ± 1%	20.84 mA to 21.16 mA
Multi-Drop current draw			4.0 mA
Lift-off voltage			10.5 V

4.7 Status Information

Table 18: Device Status table

Bit Mask	Definition	Conditions to set bit
0x80(bit 7)	Device Malfunction	None
0x40(bit 6)	Configuration Changed	Any change in device configuration
0x20(bit 5)	Cold start	Set any time power is cycled
0x10(bit 4)	More Status Available	Triggers when either alarm is active
0x08(bit 3)	Loop Current Fixed	None
0x04(bit 2)	Loop Current Saturated	Occurs when loop current reaches upper limit
0x02(bit 1)	Non-Primary Variable out of limits	None
0x01(bit 0)	Primary Variable Out of limits	Occurs when PV is being limited due to exceeding calibrated limitations

When Bit 4 is set, Host should send Command 48 to determine which alarm is active.

4.7.1 Extended Device Status

The Field Device cannot predict, in advance, when the maintenance will be required. Extended Device Status is unused.

Table 19: Command 48-Byte Data

Byte	Description	Data
0-5	Device Specific Status	Only Byte 0 is used
6	Extended Device Status	Bit 1 will be set when an alarm condition is active.
7	Device Operating Mode	0
8	Standard Status 0	Not used

"Not used" bits are always set to 0.

Device does not support extended device status, all device status activity is included in the device status byte.

4.8 Universal Commands

All Universal Commands are supported as specified in the HART Universal Command Specification.

4.9 Common-Practice Supported Commands

The following common-practice commands are implemented:

33 Read Device Variables

35 Write Range Values

42 Perform Master Reset

44 Write PV Units

54 Read Device Variable Information

In command 54 the acquisition period is unused. Values are typically updated every 100ms.

4.9.1 Command-Specific Response Codes

Table 20: Command-Specific Response Codes

Code	Class	Description
0	Success	No Command-Specific Errors
1-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

4.10 Command #130: Write High Alarm Setpoint

Writes the setpoint for the High Alarm.

4.10.1 Request Data Bytes

Table 21: Request Data Bytes table

Byte	Format	Description
0-3	Float	High Alarm Setpoint

4.10.2 Response Data Bytes

Table 22: Response Data Bytes table

Byte	Format	Description
0	Enum	PV Unit value
1-4	Float	High Alarm Setpoint

4.10.3 Command-Specific Response Codes

Table 23: Command-Specific Response Codes table

Code	Class	Description
0	Success	No Command-Specific Errors
1-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

4.11 Tables

4.11.1 Flow Unit Codes

Subset of HART Common Unit Codes

Table 24: Flow Unit Codes table

16	Gallons Per Minute (GPM)
17	Liters Per Minute (LPM)
19	Cubic Meters Per Hour (CMH)

4.11.2 Unit Conversion

Internally, the transmitter uses Gallons per Minute. Conversions are made using a floating point factor. Values are directly converted from GPM when possible, however Alarm values changed between units are converted from stored unit value:

Table 25: Unit Conversion table

New Unit	Previous Unit	Factor
GPM	LPM	0.2642
	CMH	4.403
LPM	GPM	3.785
	CMH	16.666
CMH	GPM	0.2271
	LPM	0.06

4.12 Performance

4.12.1 Busy and Delayed-Response

Device busy is not used. Delayed-response is not used.

4.12.2 Long Messages

The largest data field used is in the response to Command 21: 34 bytes including the two status bytes.

4.12.3 Non-Volatile Memory

EEPROM is used to hold the device's configuration parameters. New data is written within 100ms of command receipt.

4.12.4 Modes

Fixed current mode is not implemented.

4.12.5 Write Protection

Write-protection is not implemented.

4.12.6 Damping

Damping is not implemented.

4.13 Annex b. Default Configuration

Default configuration is based on a unit-by-unit basis.

5 Vane/Piston TX/H

Installation and Operation Manual Series: LL, LP, LH, SN, SM, SH, MN, MM, MH, SX, MX, LN, LE and XHF
Used with T control boxes with 4-20 mA transmitter or HART and optional mechanical switches.

5.1 Maximum Dimensions

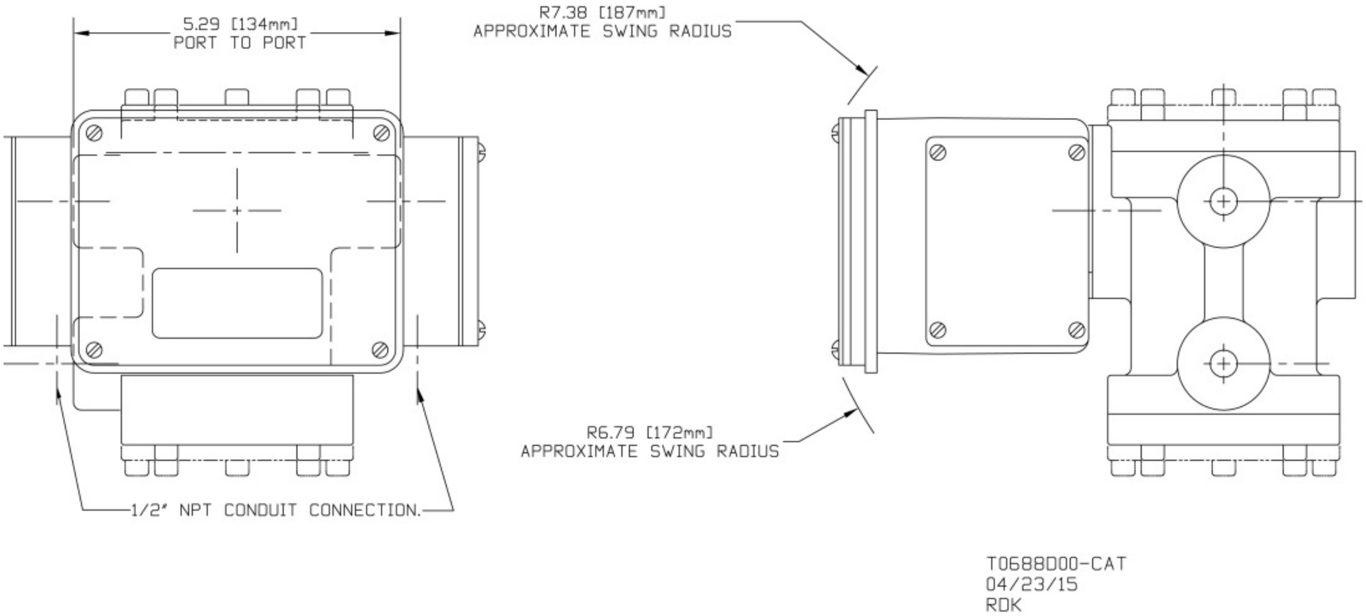


Figure 22: LL, LP, and LH dimensions

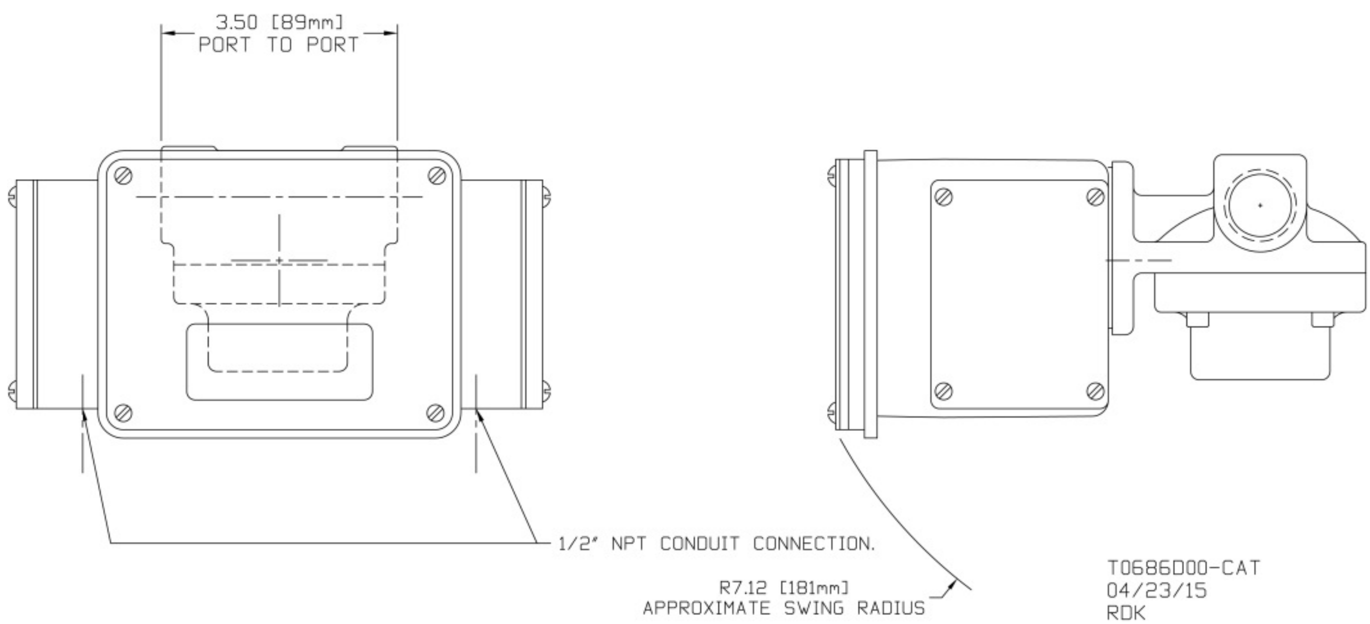


Figure 23: SX, SN, SM, and SH dimensions

XHF

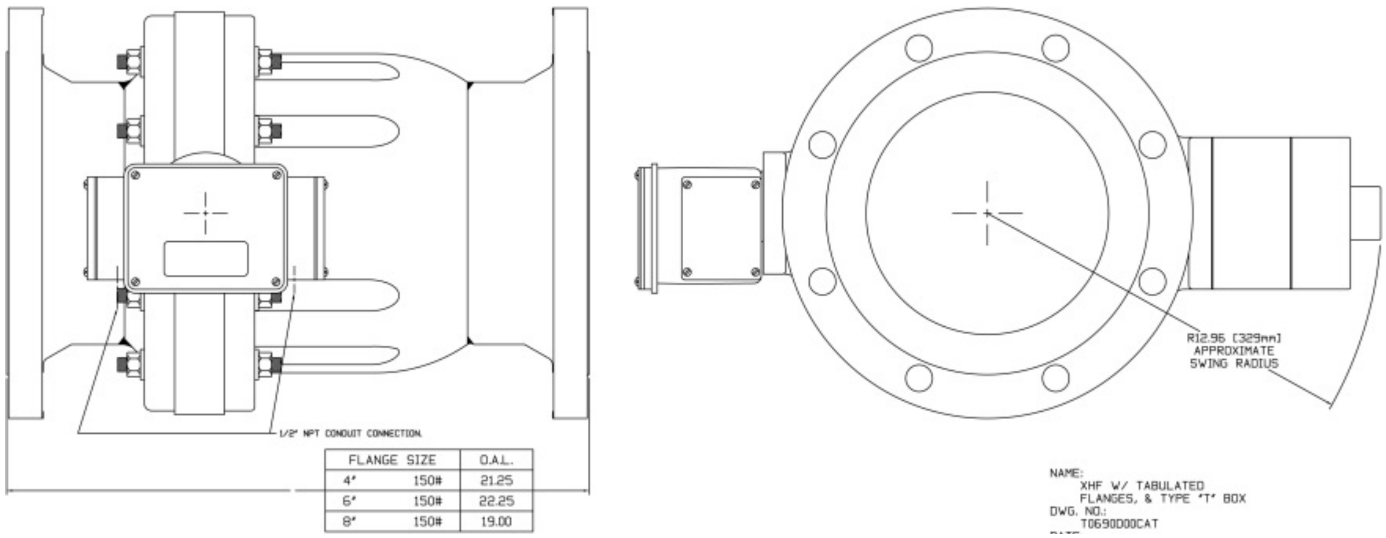


Figure 24: XHF dimensions

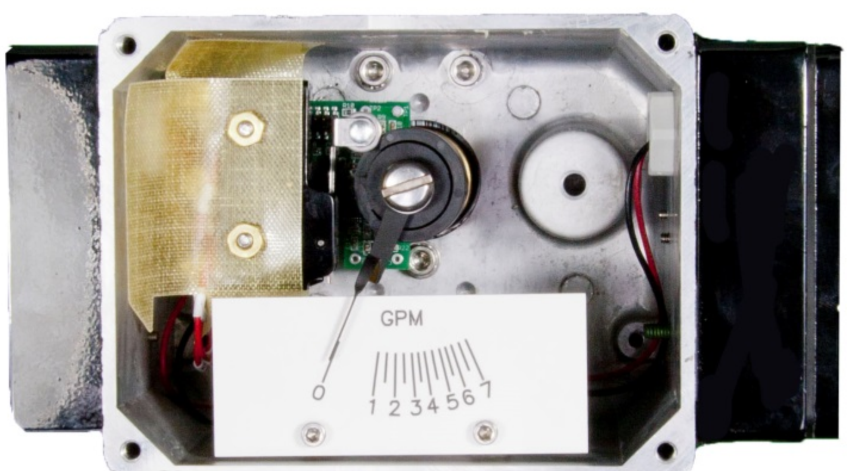


Figure 25: T Box with Optional Switch and Transmitter

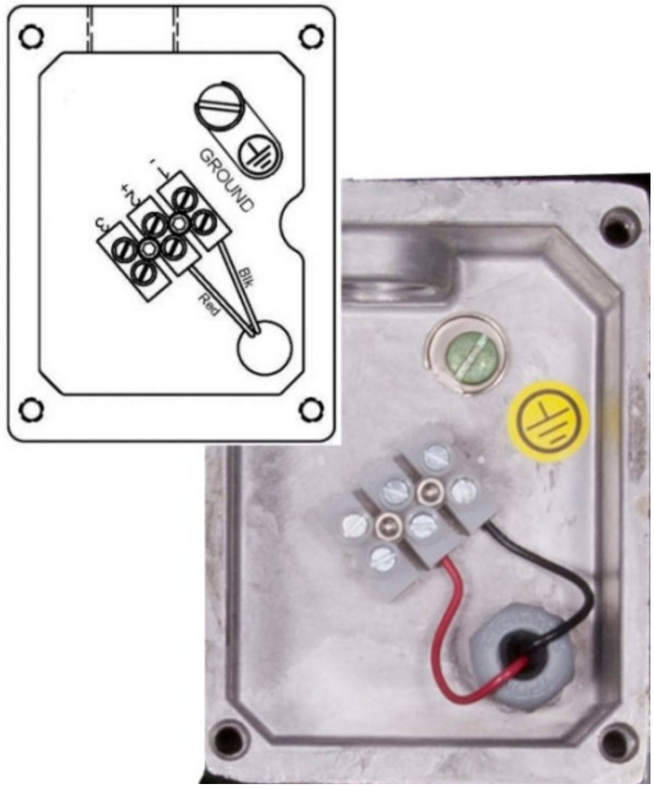


Figure 26: Transmitter Wiring with or without HART

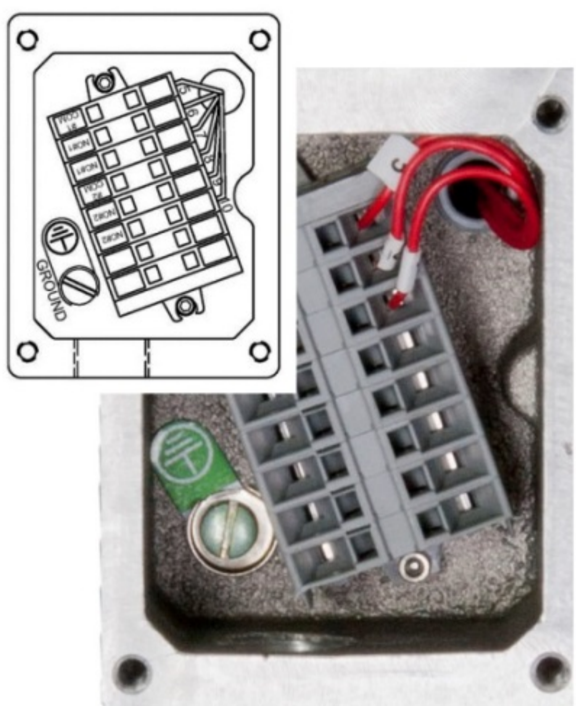


Figure 27: Mechanical (Optional) Switch Wiring

5.2 Installation

For best results, the meters may be installed in any position as long as proper piping installation requirements are observed. This includes sufficient support of adjacent piping to minimize the system's inherent vibration. Unions of the same pipe size and full port isolation ball valves may be installed for ease of removal and servicing of equipment, if necessary.

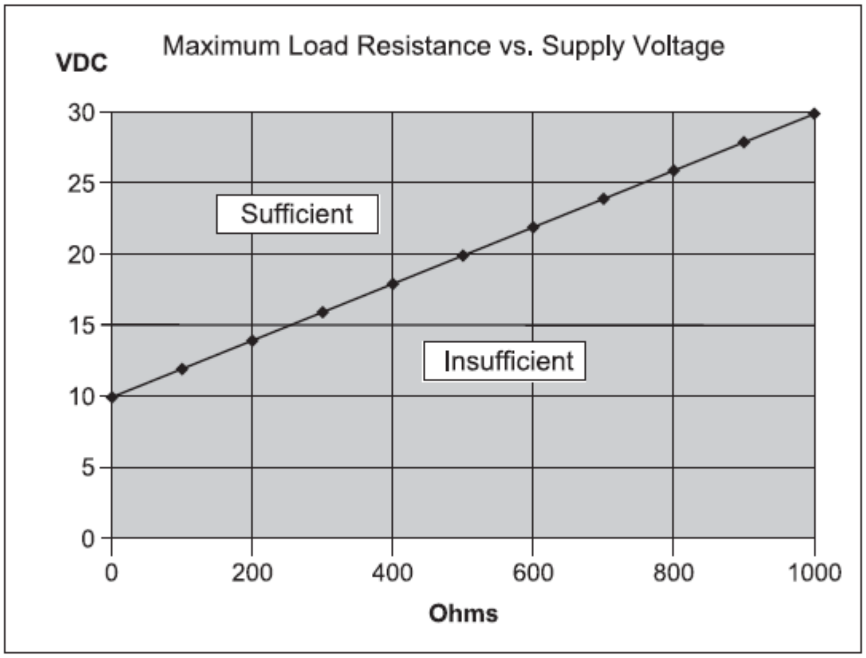


Figure 28: Maximum Load Resistance vs. Supply Voltage

5.3 Device Identification

Manufacturer Name:	Universal Flow	**Model Name(s):**	ME Transmitter
Manufacture ID Code:	24692 (6074 Hex)	**Device Type Code:**	230 (E1EF Hex)
HART Protocol Revision	7.0	**Device Revision:**	1
Number of Device Variables	4		
Physical Layers Supported	FSK		
Physical Device Category	Transmitter, Non-DC-isolated Bus Device		

Figure 29: Device Identification

5.4 Product Overview

The ME Transmitter is a two-wire loop-powered flow transmitter, with a 4-to-20mA output. This transmitter uses a non-contact magnetic encoder for measuring the displacement of the shaft/pointer on standard UFM flowmeters. It is an add-on feature to SN/SM/SH,MN/MM/MH,LL/LP/LH,LN/LE and XHF model flow meters as manufactured by Universal Flow Monitors, Inc. The ME Transmitter replaces the earlier models Digital Transmitters that utilized a potentiometer, providing improved accuracy while maintaining 100% compatibility. The analog output of this device is linear with flow over the working range of all supported flowmeters.

5.5 Process Interface

5.5.1 Magnetic Sensors

There are two built-in hall-effect sensors measuring the rotation of a permanent magnet that is mounted onto the flowmeter shaft. As the shaft rotates with flow, the sensors provide analog readings that are in turn converted to a digital value by and A/D converter. The digital values are then processed by the microcontroller and linearized, and subsequently converted to a scaled analog output via a D/A converter in the range of 4 to 20 mA.

5.5.2 Host Interface: Process Flow

The two-wire 4-20mA current loop is connected to two terminals on the transmitter circuit board. Depending on the product used, one of the two configurations are offered for field wiring.

A secondary terminal strip away from the PCB (mounted in a separate compartment of the flowmeter) and is marked L+ and L-. The red wire connects the (+) terminal on the PCB to L+ and the black wire connects the (–) terminal on the PCB to L-.

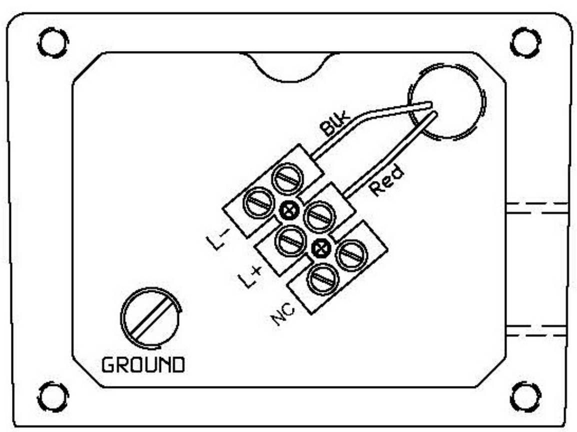


Figure 30: PCB Wiring

This is the only output from this transmitter, representing the process flow measurement, linearized and scaled according to the configured range of the instrument. This output corresponds to the Primary Variable. HART Communication is supported on this loop.

A guaranteed linear over-range is provided. The up-scale current of 24mA can indicate device malfunction. Current values are shown in the table below.

Table 26: Current Values table

<table>
<tr><th></th><th>Direction</th><th>Values (percent of range)</th><th>Values (mA or V)</th></tr>
<tr><td rowspan="2">Linear over-range</td><td>Down</td><td>0% ± 0.5%</td><td>3.92 to 4.08 mA</td></tr>
<tr><td>Up</td><td>+106.25% ± 0.1%</td><td>20.84 mA to 21.16 mA</td></tr>
<tr><td rowspan="2">Device malfunction indication</td><td>Down</td><td>N/A</td><td>N/A</td></tr>
<tr><td>Up</td><td>+125.0% ± 0.1%</td><td>23.98 mA to 24.02 mA</td></tr>
<tr><td colspan="2">Maximum current</td><td>+106.25% ± 1%</td><td>20.84 mA to 21.16 mA</td></tr>
<tr><td colspan="3">Multi-Drop current draw</td><td>4.0 mA</td></tr>
<tr><td colspan="3">Lift-off voltage</td><td>10.5 V</td></tr>
</table>

5.1 Status Information

Table 27: Device Status table

Bit Mask	Definition	Conditions to set bit
0x80(bit 7)	Device Malfunction	None
0x40(bit 6)	Configuration Changed	Any change in device configuration
0x20(bit 5)	Cold start	Set any time power is cycled
0x10(bit 4)	More Status Available	Triggers when either alarm is active
0x08(bit 3)	Loop Current Fixed	None
0x04(bit 2)	Loop Current Saturated	Occurs when loop current reaches upper limit
0x02(bit 1)	Non-Primary Variable out of limits	None
0x01(bit 0)	Primary Variable Out of limits	Occurs when PV is being limited due to exceeding calibrated limitations

When Bit 4 is set, Host should send Command 48 to determine which alarm is active.

5.1.1 Extended Device Status

The Field Device cannot predict, in advance, when the maintenance will be required. Extended Device Status is unused.

Table 28: Command 48-Byte Data

Byte	Description	Data
0-5	Device Specific Status	Only Byte 0 is used
6	Extended Device Status	Bit 1 will be set when an alarm condition is active.
7	Device Operating Mode	0
8	Standard Status 0	Not used

"Not used" bits are always set to 0.

Device does not support extended device status, all device status activity is included in the device status byte.

5.2 Universal Commands

All Universal Commands are supported as specified in the HART Universal Command Specification.

5.3 Common-Practice Supported Commands

The following common-practice commands are implemented:

33 Read Device Variables

35 Write Range Values

42 Perform Master Reset

44 Write PV Units

54 Read Device Variable Information

In command 54 the acquisition period is unused. Values are typically updated every 100ms.

5.3.1 Burst Mode

This Field Device does not support Burst Mode.

5.3.2 Catch Device Variable

This Field Device does not support Catch Device Variable.

5.4 Device-Specific Commands

The following device-specific commands are implemented:

128 Read Alarm Setpoints

129 Write Low Alarm Setpoint

130 Write High Alarm Setpoint

131 Reset Totalizer

5.5 Command #129: Write Low Alarm Setpoint

Writes the Setpoint for the Low Alarm.

5.5.1 Request Data Bytes

Table 29: Request Data Bytes table

Byte	Format	Description
0-3	Float	Low Alarm Setpoint

5.5.2 Response Data Bytes

Table 30: Response Data Bytes table

Byte	Format	Description
0	Enum	PV Unit value
1-4	Float	Low Alarm Setpoint

5.5.3 Command-Specific Response Codes

Table 31: Command-Specific Response Codes table

Code	Class	Description
0	Success	No Command-Specific Errors
1-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

5.6 Command #131: Reset Totalizer

Resets the totalizer to zero.

5.6.1 Request Data Bytes

Table 32: Request Data Bytes table

Byte	Format	Description
None		

5.6.2 Response Data Bytes

Table 33: Response Data Bytes table

Byte	Format	Description
None		

5.6.3 Command-Specific Response Codes

Table 34: Command-Specific Response Codes table

Code	Class	Description
0	Success	No Command-Specific Errors
1-15		Undefined
16	Error	Access Restricted
17-31		Undefined
32	Error	Busy
33-127		Undefined

5.7 Performance

5.7.1 Sampling Rates

Typical sampling rates are shown in the following table.

Table 35: Sampling Rates table

PV digital value calculation	10 per second
SV digital value calculation	10 per second
Analog output update	10 per second

5.7.2 Power-Up

The device is typically ready within 1 second of power-up. Totalizer is initialized to zero.

5.7.3 Reset

Command 42 ("Device Reset") causes the device to reset its microcontroller. The resulting restart is identical to the normal power up sequence. (See Section 5.7.2.)

5.7.4 Self-Test

Self-Test is not supported.

5.7.5 Command Response Times

Table 36: Command Response Times table

Minimum	20ms
Typical	50ms
Maximum	100ms

5.8 Annex A: Capability Checklist

Table 37: Capability Checklist table

Manufacturer, model and revision	Universal Flow, ME Transmitter, Rev1
Device type	Transmitter
HART revision	7.0
Device Description available	No
Number and type of sensors	2 internal
Number and type of actuators	0
Number and type of host side signals	1: 4 - 20mA analog
Number of Device Variables	4
Number of Dynamic Variables	2
Mappable Dynamic Variables?	No
Number of common-practice commands	5
Number of device-specific commands	4
Bits of additional device status	2
Alternative operating modes?	No
Burst mode?	No
Write-protection?	No

6 Vane/Piston TX/TXL

Installation and Operation Manual Series: LL, LP, LH, PI, SN, SM, SH, MN, MM, MH, SX and MX

6.1 Nameplates and Product ID

This manual applies to all vane/piston meters that have the designator “TX0,1,2,3,4 or 61” or “TXL0,1,3, 61” in the model code. This can be seen on the name plate as shown below.

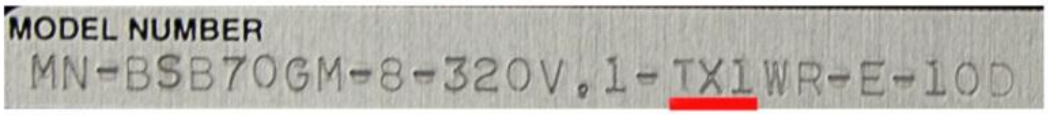


Figure 31: Nameplates and Product ID

Figure 32: Terminal Strip for Power and 4-20 mA Signal

PIPING:	Screw pipe into meter with flow going into port marked "IN". Teflon tape or pipe dope discouraged.
WIRING:	Connect switch wires (for TX1,3 and 61 units) and/or open collector alarm and transmitter wires to the terminal strip as shown. Wire must be in accordance with all local and national codes. Wire size and insulation ratings should support actual loads. In all cases, wire must be, as a minimum, 20 AWG Teflon insulated rated at 600 V and 200 ˚C. It is recommended to include a disconnect switch or circuit breaker near this equipment.
CÂBLAGE	Le câble doit être conforme à tous les codes locaux et nationaux. Le diamètre du câble et ses niveaux d'isolation doivent pouvoir supporter des charges réelles. Dans tous les cas, le câble doit être isolé au minimum en téflon de calibre 20 AWG et d'une capacité nominale de 600 V et de 200°C. Il est recommandé d'inclure un interrupteur général ou un disjoncteur à proximité de cet équipement.
GROUNDING:	For protection against electrical shock in case of a fault, connect an external earth ground to the grounding screws or lugs provided inside this instrument. Such attachment points are identified with a tag or label adjacent to the grounding screw or lug with the symbol.
MISE À LA TERRE	Pour se protéger des chocs électriques en cas de défaut à la terre, brancher une mise à la terre externe sur les vis ou cosses de mise à la terre fournies à l'intérieur de cet instrument. De tels points de fixation sont identifiés à l'aide d'une étiquette ou d'un label adjacent à la vis ou à la cosse de mise à la terre avec le symbole.

A typical 4-20mA wiring diagram is shown below:

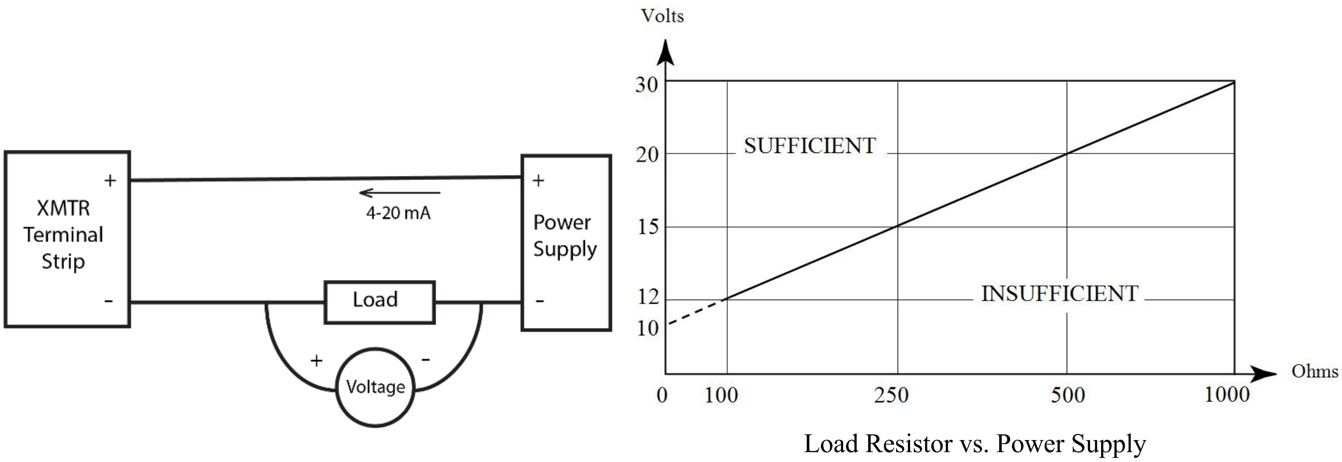


Figure 33: 4-20 mA Wiring Diagram and Load Resistor vs. Power Supply diagram

A guaranteed linear over-range is provided. Device malfunction can be indicated by the up-scale current of 24mA. Current values are shown in the table below.

Table 38: Current Values table

	Direction	Values (percent of range)	Values (mA or V)
Linear over-range	Down	0% ± 0.5%	3.92 to 4.08 mA
	Up	+106.25% ± 0.1%	20.84 mA to 21.16 mA
Device malfunction indication	Down	N/A	N/A
	Up	+125.0% ± 0.1%	23.98 mA to 24.02 mA
Maximum current		+106.25% ± 1%	20.84 mA to 21.16 mA
Multi-Drop current draw			4.0 mA
Lift-off voltage			10.5 V

1. After the last digit is set, continue holding A2 until "SEt" is displayed. If you want to change the first digit again, do not hold A2. Momentarily press and release A2 and the first digit starts blinking again.
2. When finished recording the new setpoint ("SEt" is displayed), release A2.

Figure 34: press and release A2

Note 1: Valid setpoint range is 0-100% of full-scale flow. If the alarm value is set higher than full-scale, it is clamped at full-scale upon exiting this menu.

Note 2: To disable the alarm, set its value to zero.

Note 3: The red ALARM 1 LED comes on when flow exceeds this setpoint. This LED is in series with the drive circuit for the high-alarm open-collector output, meaning that the output transistor is active whenever this LED is on. Some models do not have any external wiring that connects to the alarm transistor (see Model Codes).

In this example, the high alarm had been set for 80.0; therefore, the red LED was activated when flow reached 80.1.

The LED turns off when flow < (setpoint – hysteresis). Hysteresis is 5% of full-scale.

Figure 35: LED activation example

6.2 Set Low Flow Alarm

Figure 36: Set Low Flow Alarm

1. Press A2 until "LFLo" is displayed, then release A2.

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