

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 transmitter or HART

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FlowMeters.com



TABLE OF CONTENTS

.....	1
PROPRIETARY NOTICE.....	4
QUICK SET UP.....	5
MAXIMUM Dimensions	7
INSTALLATION.....	8
GENERAL SPECIFICATIONS	9
Introduction to hart ®field device specifications	11
Scope.....	11
Purpose	11
Who should use this document?	11
Abbreviations and definitions.....	11
References	12
Device Identification	12
Product Overview	12
Product Interfaces.....	13
Process Interface.....	13
Magnetic Sensors.....	13
Host interface	13
Analog Output 1: Process Flow	13
Local Interfaces, Jumpers and Switches.....	14
Device Variables.....	14
Dynamic Variables	15
Status Information	15

Device Status.....	15
Extended Device Status.....	16
Additional Device Status (Command #48)	17
Universal Commands	18
Common-Practice Commands	18
Supported Commands	18
Burst Mode	19
Catch Device Variable	19
Device-Specific Commands	19
Command #128: Read Alarm Setpoints	19
Command #129: Write Low Alarm Setpoint	21
Command #130: Write High Alarm Setpoint	22
Command #131: Reset Totalizer	23
Tables	24
Flow Unit Codes	24
Unit Conversion	24
Performance	25
Sampling Rates.....	25
Power-Up	25
Reset	25
Self-Test	25
Command Response Times.....	25
Busy and Delayed-Response	26
Long Messages.....	26
Non-Volatile Memory	26
Modes	26

Write Protection	26
Damping.....	26
Annex A. Capability Checklist	27
Annex B. Default Configuration.....	28
Annex C. Revision History	29
RMA NOTICE RETURN MERCHANDISE AUTHORIZATION	29
RMA FORM	31
WARRANTY INFORMATION	32

PROPRIETARY NOTICE

The information contained in this publication is derived in part from proprietary and patented data and been prepared for the express purpose of assisting in installation, operation, and maintenance of the instruments described herein. Publication of this information does not convey any rights of use or reproduction other than in connection with the installation, operation and maintenance of the equipment described herein. Universal Flow Monitors, Inc. reserves the right to change the information contained in this publication at any time and without prior notice.

QUICK SET UP

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 (-).

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.



PIPING: Screw pipe into meter with flow going into port marked "IN". Teflon tape or pipe dope discouraged

WIRING:



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

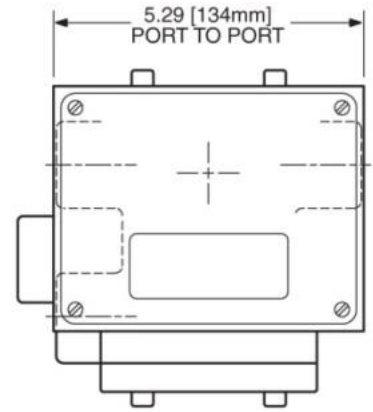
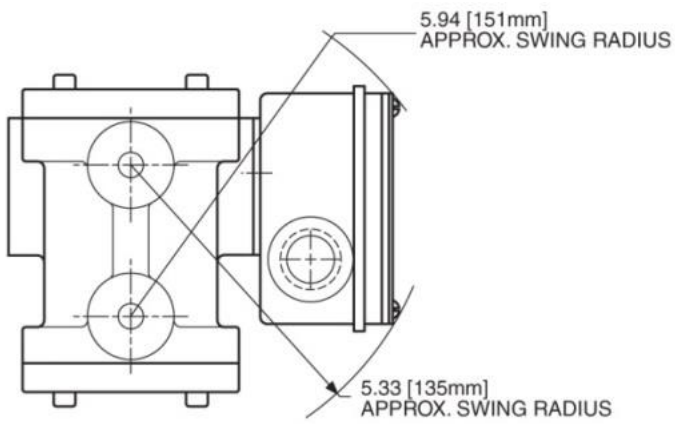


Pour se protéger des chocs électriques en cas de défaut à la terre, brancher une mise à la terre externe sur les vis ou cosses de mise à la terre fournies à l'intérieur de cet instrument. De tels points de fixation sont identifiés à l'aide d'une étiquette ou d'un label adjacent à la vis ou à la cosse de mise à la terre avec le symbole.

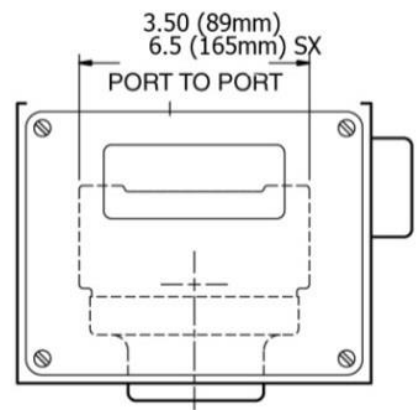
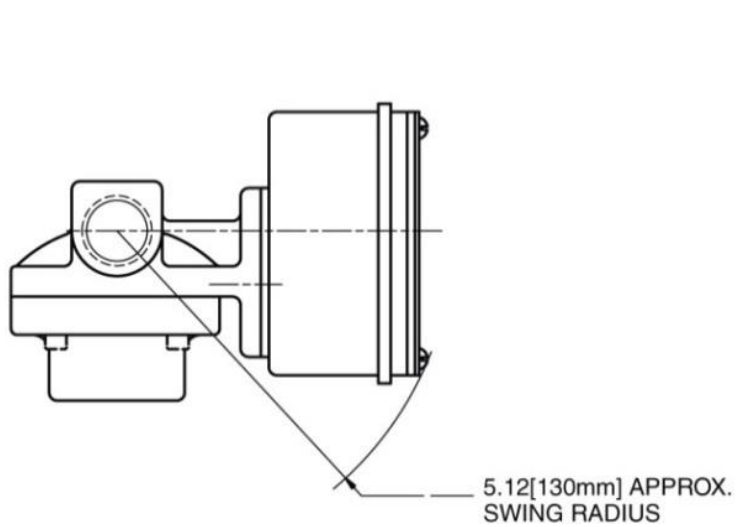
WARNING: This instrument was made for the specific use stated at the time of order. Any other use may cause injury.
Read instructions before using.

MAXIMUM DIMENSIONS

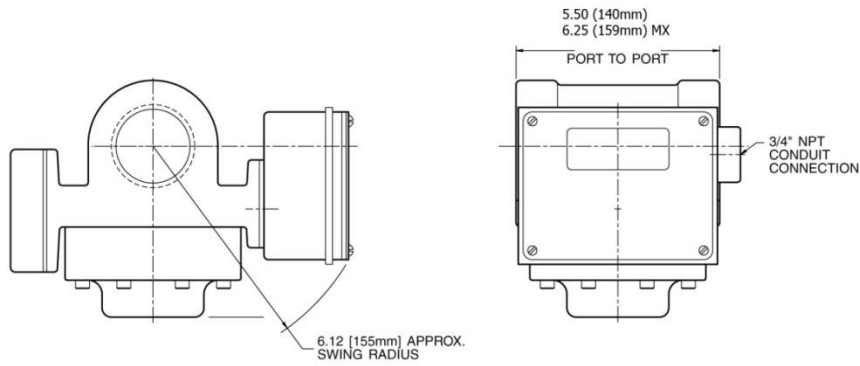
LL, LP and LH



SX, SN, SM and SH




MN, MM, MH and MX



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.

GENERAL SPECIFICATIONS

MAXIMUM OPERATING PRESSURE:	100 PSI for SX or MX with PVC or Tefzel bodies 200 PSI with polysulfone bodies 150 PSI for LL series with polysulfone cap material 300 PSI for LL, SN, MN, LN and XHF 500 PSI for LP, SM and MM 1000 PSI for LE 1500 PSI for LH and SH 2000 PSI for SH and MH
MAX FLUID TEMPERATURE:	200°F (93°C) for SN, MN, LL, LN, LE, XHF, SX PSU, SX Tefzel, MX PSU and MX Tefzel 100°F (38°C) for SX PVC, MX PVC
OPTIONAL MAX FLUID TEMP:	300°F (149°C) for SN, MN, LN, LE, XHF and LL
MIN AND MAX AMBIENT TEMPERATURE:	35°F (1.5°C) to 150°F (65°C) for SN, MN and LL 35°F (1.5°C) 130°F (55°C) for SX PVC, SX PSU, SX Tefzel, MX PVC, MX PSU and MX Tefzel
MAXIMUM FLOW:	Meters may occasionally be over-ranged up to 125% of capacity without damaging the meter.
TURNDOWN RATIO (MAX TO MIN FLOW):	10:1 standard.
PROCESS CONNECTIONS:	Female NPT or BSPP or BSPT or Flanged optional
DISPLAY:	Pointer and scale
TRANSMITTER INPUT POWER:	4-20mA @ 30 Vdc Max.  (24 VDC Max. for Intrinsically Safe on X transmitter) Note: this meter is designed to be Intrinsically Safe if and only if used with approved barriers. See chart below for Maximum Load Resistance vs. Supply Voltage.
ENVIRONMENTAL CONDITIONS	This device has been designed for use in Installation Category 2, pollution degree 4, at altitudes up to 2000 meters (6560 ft.), either indoors or outdoors as defined in CSA Standard C22.2 No. 61010-1-12
ENCLOSURE TYPE RATING	The "A" Style enclosure is rated for type 4X.

ACCURACY: 5% full scale (max reading) LL, LP, LH, SN, SM , SH and SX
 2% full scale MN, MM, MH and MX

OUTPUT: 4-20 mA proportional to flow or HART

REPEATABILITY: .25% of indicated

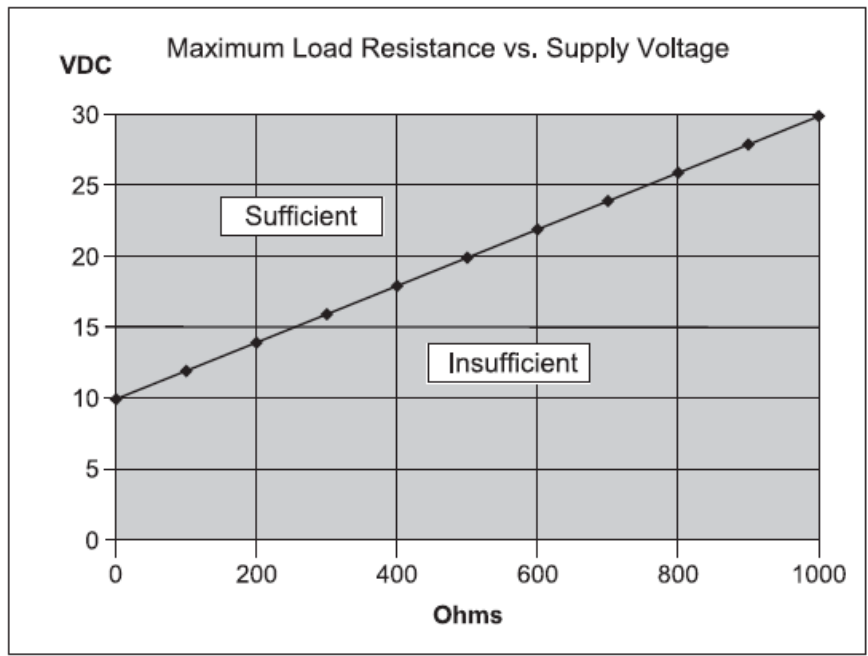
PRESSURE DROP: 2-8 PSI

RESPONSE TIME: 250 Milliseconds

CLEANING: These meters do not require any special cleaning of the external surfaces. If cleaning is deemed necessary, strong solvents, detergents, or chemicals should not be used. A damp cloth may be used to wipe off dirt or debris.

MOUNTING: Flow Meters with the Style "A" enclosures may be mounted in any orientation which best suits the user's needs, especially as it pertains to readability of an engraved scale, if so provided

APPROVALS: CSA C22.2 No. 61010-1-12, CE (EMC EN 61000-6-4: 2007, EN 61000-6-2: 2005). Compliance with EMC standards requires a cable length of 30 feet (9 m) or less.



INTRODUCTION TO HART[®] FIELD DEVICE SPECIFICATIONS

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.

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

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.

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

[®] HART is a registered trademark of the HART Communication Foundation

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.

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		

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.

PRODUCT INTERFACES

PROCESS INTERFACE

MAGNETIC SENSORS

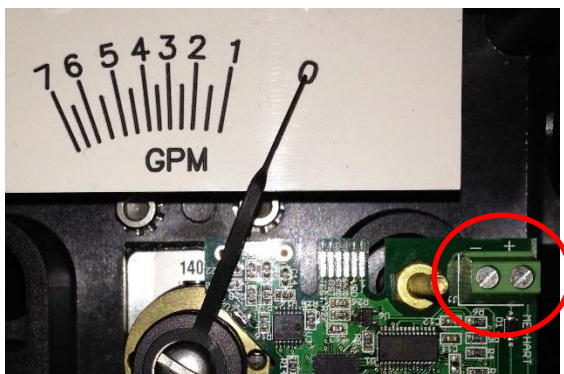
There are two built-in hall-effect sensors measuring the rotation of a permanent magnet that is mounted onto the flowmeter shaft. As the shaft rotates with flow, the sensors provide analog readings that are in turn converted to a digital value by an A/D converter. The digital values are then processed 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.

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.



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. Device malfunction can be indicated by the up-scale current of 24mA. Current values are shown in the table below.

	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

LOCAL INTERFACES, JUMPERS AND SWITCHES

This device has no local controls. The HART version of the ME Transmitter is a blind unit fully controlled through HART commands.

DEVICE VARIABLES

Device Variable Number	Name	Description	Units	HART Class Code
0,246	Primary Variable	Flow	GPM,CMH,LPM	66
1,247	Secondary Variable	Totalizer	Follows PV Units	66
244	Percent Range	Output % of FS	None	66

245	Loop Current	Current Output	mA	66
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DYNAMIC VARIABLES

Two Dynamic Variables are implemented.

	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.

STATUS INFORMATION

DEVICE STATUS

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.

EXTENDED DEVICE STATUS

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

ADDITIONAL DEVICE STATUS (COMMAND #48)

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

Device Specific Status Byte 0

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

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.

UNIVERSAL COMMANDS

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

COMMON-PRACTICE COMMANDS

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.

BURST MODE

This Field Device does not support Burst Mode.

CATCH DEVICE VARIABLE

This Field Device does not support Catch Device Variable.

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

COMMAND #128: READ ALARM SETPOINTS

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

REQUEST DATA BYTES

Byte	Format	Description
None		

RESPONSE DATA BYTES

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

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

COMMAND #129: WRITE LOW ALARM SETPOINT

Writes the setpoint for the Low Alarm

REQUEST DATA BYTES

Byte	Format	Description
0-3	Float	Low Alarm Setpoint

RESPONSE DATA BYTES

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

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

COMMAND #130: WRITE HIGH ALARM SETPOINT

Writes the setpoint for the High Alarm

REQUEST DATA BYTES

Byte	Format	Description
0-3	Float	High Alarm Setpoint

RESPONSE DATA BYTES

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

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

COMMAND #131: RESET TOTALIZER

Resets the totalizer to zero.

REQUEST DATA BYTES

Byte	Format	Description
None		

RESPONSE DATA BYTES

Byte	Format	Description
None		

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

TABLES

FLOW UNIT CODES

(Subset of HART Common Table 2, Unit Codes)

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

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:

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

PERFORMANCE

SAMPLING RATES

Typical sampling rates are shown in the following table.

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

POWER-UP

The device is typically ready within 1 second of power-up.

Totalizer is initialized to zero.

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 0.)

SELF-TEST

Self-Test is not supported.

COMMAND RESPONSE TIMES

Minimum	20ms
Typical	50ms
Maximum	100ms

BUSY AND DELAYED-RESPONSE

Device busy is not used.

Delayed-response is not used.

LONG MESSAGES

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

NON-VOLATILE MEMORY

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

MODES

Fixed current mode is not implemented.

WRITE PROTECTION

Write-protection is not implemented.

DAMPING

Damping is not implemented.

ANNEX A. CAPABILITY CHECKLIST

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

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

RMA NOTICE RETURN MERCHANDISE AUTHORIZATION

Please read the following UFM policy information carefully. By following the guidelines outlined below you will assist in providing a timely evaluation and response regarding the status of your flow meter. UFM evaluates all AUTHORIZED RETURNED MATERIALS in a timely manner and will promptly provide notification regarding the status of the related materials and/or a written quotation indicating the total charges and description of the necessary repairs.

- 1 All returns must have a RMA form completed by the customer.
- 2 Any meter returned that was previously in service must have the OSHA requirements completed and a MSDS included where applicable.
- 3 An RMA number will only be issued when UFM has received a copy of the completed RMA form and any applicable MSDS.
- 4 A "Return Goods" shipping label (located in the back of the Instruction Manual) must be used for returning materials to UFM.
- 5 Returned goods must be shipped prepaid or they will be rejected.

REPAIRABLE MATERIAL

Written or verbal authorization to proceed with the repair under an assigned Purchase Order, must be received within 30 days of repair quotation. If the unit(s) are repaired, the \$90.00 evaluation charge will be applied to the quoted repair costs. If no repairs are authorized within this 30 day period, the customer will be billed \$90.00 plus shipping charges and the materials will be returned to the customer.

NON-REPAIRABLE MATERIAL

If materials are found not repairable, a written notice that the material is not repairable will be provided to the customer by UFM. If no disposition to scrap or return the material is received from the customer within 30 days, un-repairable material will be scrapped and the customer will be billed the \$90.00 evaluation charge. If a UFM replacement unit is purchased within 30 days of non-repairable condition notice, the \$90.00 evaluation fee will be waived. The return of non-repairable materials may be ordered by customer Purchase Order providing for shipping and handling charges.

RETURN FOR RESTOCK - All goods returned for restock adjustment must be:

- A. New and unused.
- B. Returned to the factory within ONE YEAR of date of original shipment.
- C. Returned through the distributor where the goods were originally purchased. This material will also be subject to an evaluation charge of \$90.00.

The customer will be advised of the restocking adjustment for all restockable goods. Upon acceptance of the restocking adjustment, by the customer, the \$90.00 evaluation fee will be waived and a credit issued by UFM. The customer will be advised of any non-restockable goods and will be charged the \$90.00 evaluation fee plus

any shipping charges if returned to the customer.

If no disposition is received by UFM within 30 days, the goods will be scrapped and the \$90.00 evaluation fee will be billed.

WARRANTY RETURNS

Warranty returns must be shipped prepaid to UFM. UFM will review the goods and advise the customer of the evaluation and validity of the warranty claim. Valid warranty claims will be repaired or replaced at no charge. No evaluation fee will be charged for repairs made under warranty. Return shipping costs will be prepaid by UFM. Should UFM determine the returned material is not defective under the provisions of UFM's standard warranty, the customer will be advised of needed repairs and associated costs. All materials returned for warranty repair that are determined to not have a valid warranty claim will be subject to the "Repairable Material" policy outlined above

<p style="text-align: center;">UNIVERSAL U-M ROCON LLC FLOW MONITORS</p>	<p>RETURN MATERIAL AUTHORIZATION E-MAIL: ufm@flowmeters.com 1755 E. Nine Mile Rd., Hazel Park MI 48030 PH: (248) 542-9635 Fax: (248) 398-4274</p>
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IMPORTANT: This form must be filled out completely and faxed to the Repair Department prior to issuing a RMA # (UFM) / NRA # (ROCON)

Customer: _____	Product Information _____	Qty: _____
_____	Model Code: _____	_____
_____	S/N: _____	_____
_____	Sales Order: _____	_____
Contact Name: _____	_____	
Phone # _____	_____	
FAX # _____	Are before (as found) and after readings required?	
E-mail: _____	_____ Yes _____ No	
Reason for return: (Please be detailed as possible. Lack of information may increase labor charges.)		
<p>Mechanical</p> <input type="checkbox"/> Leaks <input type="checkbox"/> Sticks <input type="checkbox"/> Calibration Off <input type="checkbox"/> Switch does not work <input type="checkbox"/> Other (describe below)	<p>Electronics</p> <input type="checkbox"/> No signal <input type="checkbox"/> Inaccurate signal <input type="checkbox"/> No Display <input type="checkbox"/> Other (describe below)	
Details: _____		

<p>Note: There will be a minimum evaluation charge of \$90.00 for all units returned (excluding units covered under warranty). Units WILL NOT be accepted without a valid Return Material Authorization Number (RMA#). A Material Safety Data Sheet on the process fluid must be received, when applicable, prior to the RMA# being issued.</p>		
* OSHA Requirements: (to be filled out by customer) NO EXCEPTIONS!!		
Process Fluid: _____		
Meter must be flushed to remove all process fluids.		
I hereby certify that the material being returned has been properly flushed and cleaned of all hazardous materials and does not require any special handling.		
Print or Type Name _____	Signature: _____	
Title _____	Date: _____	

<p>Distributor Information <i>INTERNAL USE ONLY</i></p> Company Name _____ Contact Name _____ PO # _____ Phone # _____ FAX # _____	<p># _____</p> <p>Authorized by _____</p> <p>Date _____</p>
---	---

WARRANTY INFORMATION

1) **ACCEPTANCE AND INTEGRATION CLAUSE:** This Sales Order Acknowledgment and the sales order information that Universal Flow Monitors, Inc. ("Universal") attaches to or associates with it (herein "Acknowledgment"), constitutes an acceptance by Universal of an offer by the buyer upon the conditions and terms and at the prices stated in this Acknowledgment. The Acknowledgment contains the entire understanding of Universal and the buyer regarding the subject matter of said Acknowledgment. This Acknowledgment may only be modified by a written agreement signed by the party against whom enforcement is sought.

2) **WAIVER:** Waiver by Universal of any default(s) by the buyer shall not constitute waiver by Universal of any of the conditions of the agreement between Universal and the buyer as set forth hereunder with respect to any further or subsequent default by the buyer.

3) **FORCE MAJEURE:** Universal shall not be responsible for failure or delays in deliveries due to fire, strikes, breakdowns, acts of God, failure of carriers, inability to secure required materials, or other causes beyond Universal's control. Buyer waives any claims for damage arising by virtue of delay in delivery of material by Universal.

4) **LIMITED WARRANTY:**

(a) **Warranty.** For a period of one year from the date of manufacture, Universal warrants that each product covered by this Acknowledgment will be free from defects in material and workmanship. In order to qualify for any remedy provided in this Acknowledgment, buyer must give notice to Universal within the one-year period, return the product to Universal freight paid and intact with Material Safety Data Sheets covering all substances passing through the product or that form a residue on the product.

(b) **Exclusive Remedy.** The buyer's EXCLUSIVE REMEDY for failure of any product to conform to any warranty or otherwise for any defect is, at Universal's sole option: (i) repair; (ii) replacement; or (iii) refund of the entire purchase price for the specific product. Without limiting the foregoing, in no case will Universal be liable for de-installation of any defective product or installation of any repaired or replaced product. THIS REMEDY IS THE EXCLUSIVE REMEDY AVAILABLE TO THE BUYER OR ANY OTHER PERSON. UNIVERSAL SHALL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, SPECIAL, PUNITIVE, OR OTHER DAMAGES IN CONNECTION WITH ANY CAUSE OF ACTION, WHETHER IN CONTRACT, TORT, OR OTHERWISE.

(c) **Disclaimer of Other Warranties.** The express warranty in this Acknowledgment is in lieu of any other warranty, express or implied. Without limiting the foregoing, UNIVERSAL DISCLAIMS THE IMPLIED WARRANTY OF MERCHANTABILITY AND ANY IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.

(d) **Special Note About Fitness for a Particular Purpose.** This website and other materials of Universal may place products into, or display products in, categories according to function, size, construction, materials, or other property. This is for organizational purposes only and NO PLACEMENT OF ANY PRODUCT IN ANY CATEGORY OR ANY PRESENTATION OF A PRODUCT IN RELATION TO OTHER PRODUCTS WILL CONSTITUTE A WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE.5) **PROHIBITED USES:** As a condition of the sale of goods or services, buyer will not use, sell, distribute, or otherwise transfer for use, or permit to be used, sold, distributed, or otherwise transferred any product purchased from Universal for any of the following uses:

(a) **Nuclear Energy Applications.** Any application involving, directly or indirectly: (i) exposure of any product to any hazardous properties of nuclear material; (ii) dependence on the proper functioning of the product for the operation of a nuclear facility by any person or organization; (iii) use in or for any equipment or device used for the processing, fabricating or alloying of special nuclear material if, at any time, the total amount of such material on the premises

where such equipment or device is located consists of or contains more than 25 grams of (A) Plutonium (any isotope) or Uranium 233 or any combination thereof; (B) more than 250 grams of Uranium 235; (iv) use in, or for the control of any aspect of, any structure, basin, excavation, premises or place prepared or used for the storage or disposal of waste. The foregoing include, without limitation, any application involving nuclear material contained in spent fuel or waste that is possessed, handled, used, processed, stored, transported or disposed of, any application related to the furnishing of services, materials, parts or equipment in connection with the planning, construction, maintenance, operation or use of any nuclear facility.

(b) Aircraft Applications. Any application involving direct or indirect installation in or on, or use in connection with, any aircraft or aircraft product.

(c) Definitions. As used in this section, the following definitions apply, whether the terms use initial capitals or not.

"Aircraft" includes powered and non-powered winged aircraft, missiles, spacecraft, and other aeronautical craft or mechanisms.

"Aircraft product" includes:

- (1) Any ground support or control equipment used with any aircraft;
- (2) Any article designed for installation in or on aircraft;
- (3) Any ground handling tools or equipment used with aircraft;
- (4) Any aircraft training aids, instructions, manuals, or blueprints; and
- (5) Any engineering, labor or other services involving aircraft.

"Hazardous properties" include radioactive, toxic or explosive properties;

"Nuclear facility" means

- (a) Any nuclear reactor; or
- (b) Any equipment or device designed or used for:
 - (1) Separating the isotopes of uranium or plutonium;
 - (2) Processing or utilizing spent fuel; or
 - (3) Handling, processing or packaging waste.

"Nuclear material" means source material, special material or by-product material;

"Nuclear reactor" means any apparatus designed or used to sustain nuclear fission in a self-supporting chain reaction or to contain a critical mass of fissionable material.

"Property damage" includes all forms of radioactive contamination of property.

"Source material," "special nuclear material," and "by-product material" have the meanings given them in the Atomic Energy Act of 1954 and any regulation promulgated thereunder, as the same may be amended from time to time.

"Spent Fuel" means any fuel element or fuel component, solid or liquid that has been used or exposed to radiation in a nuclear reactor.

"Waste" means any waste material

- (1) containing by-product material and
- (2) resulting from the operation by any person or organization of any nuclear facility.