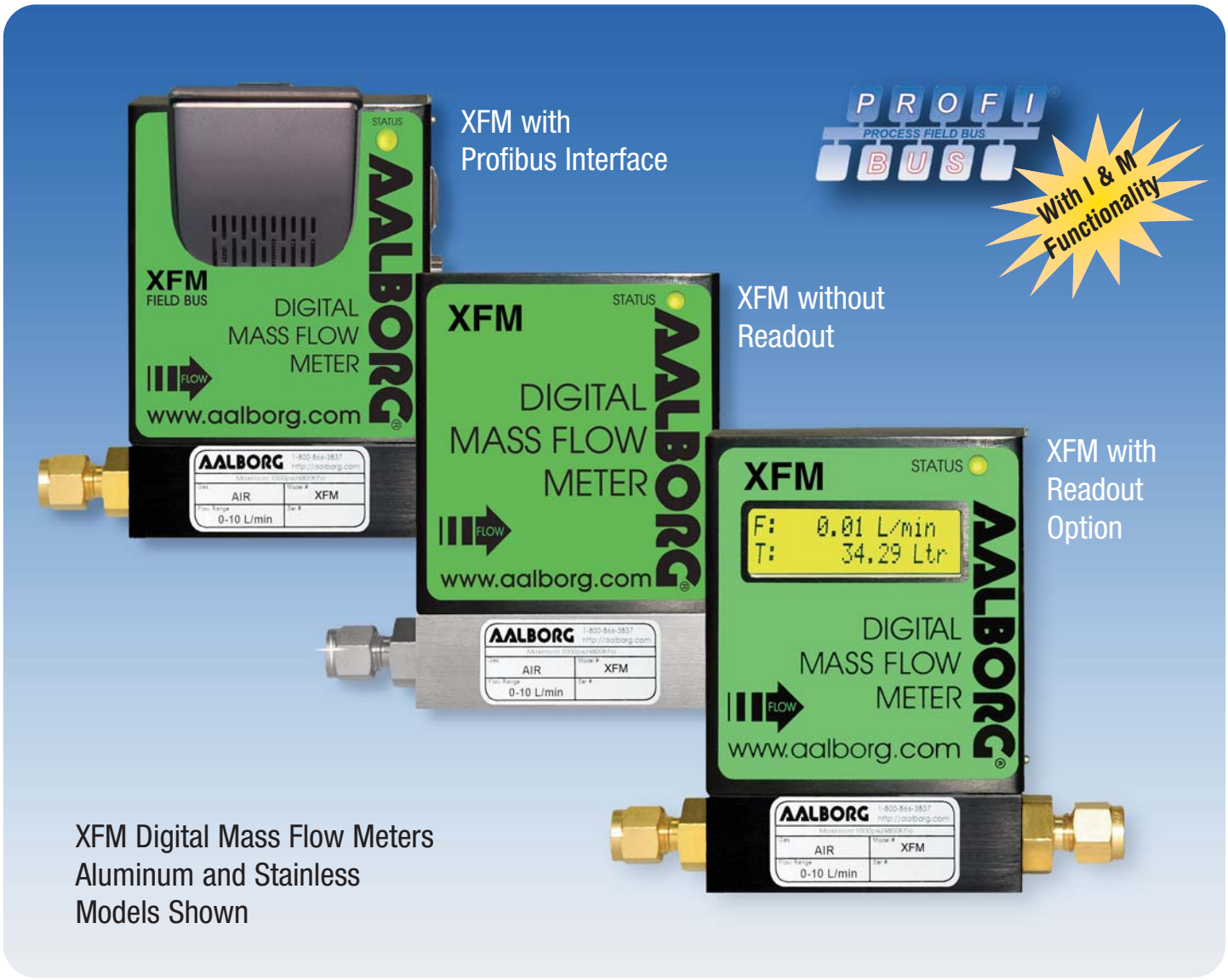
Design Features

- Supports up to 23 Engineering Units (including User Defined).
- Stores calibration data for up to 10 gases.
- Programmable Totalizer indicates total gas quantity.
- High and low gas flow Alarm limits with preset delay interval.
- Two sets of user-programmable electromechanical SPDT relays with latch option.
- User-selectable analog 0-5 Vdc or 4-20mA outputs.
- Internal Conversion factors for up to 32 gases.
- Digital Interface (RS-232 / RS-485, Profibus DP available).
- Multi-Drop Capability of up to 256 units (RS-485 option).
- Optional Profibus DP interface with I&M functionality.
- Automatic sensor zero offset adjustment (via digital interface or local push button).
- Self-Diagnostic Tests.
- Local 2 x 16 characters LCD display* with adjustable back light (optional).



** LCD display is not available for Profibus DP interface option.*

XFM Digital Mass Flow Meters

The flow rate can be displayed in 23 different volumetric flow or mass flow engineering units including user specific. Flow meters can be programmed remotely via RS-232 /RS-485 or optional Profibus DP interface.

XFM flow meters support various functions including: programmable flow totalizer, high and low flow alarm, automatic zero adjustment, 2 relay outputs, jumper selectable 0-5 Vdc or 4-20 mA analog outputs, status LED diagnostic, capable to store calibration for up to 10 different gases, internal or user-specific K-factors. Optional local 2 x 16 characters LCD display* with adjustable back light provides Flow, Total and diagnostic reading simultaneously.

Principle Of Operation

The stream of gas entering the Mass Flow transducer is split by shunting a small portion of the flow through a capillary stainless steel sensor tube. The remainder of the gas flows through the primary flow conduit. The geometry of the primary conduit and the sensor tube are designed to ensure laminar flow in each branch. According to principles of fluid dynamics, the flow rates of a gas in the two laminar flow conduits are proportional to one another. Therefore, the flow rates measured in the sensor tube are directly proportional to the total flow through the transducer. In order to sense the flow in the sensor tube, heat flux is introduced at two sections of the sensor tube by means of precision-wound heater sensor coils. Heat is transferred through the thin wall of the sensor tube to the gas flowing inside. As gas flow takes place, heat is carried by the gas stream from the upstream coil to the downstream coil windings.

The resultant temperature dependent resistance differential is detected by the electronic control circuit. The measured temperature gradient at the sensor windings is linearly proportional to the instantaneous rate of flow taking place. An output signal is generated that is a function of the amount of heat carried by the gases to indicate mass molecular based flow rates. Additionally, the XFM model Mass Flow Meter incorporates a Precision Analog Microcontroller (ARM7TDMI® MCU) and non-volatile memory that stores all hardware specific variables and up to 10 different calibration tables.

** LCD display is not available for Profibus DP interface option.*

Interface

The digital RS485 or RS-232 interface (optional Profibus DP interface is available) provides access to applicable internal data including: flow, CPU temperature, auto zero, totalizer and alarms settings, gas table, conversion factors and engineering units selection, dynamic response compensation and linearization table adjustment. The analog interface provides 0 to 5Vdc or 4 to 20 mA (jumper selectable) outputs for flow reading.

Auto Zero

The XFM supports automatic sensor zero offset adjustment which can be activated locally via the maintenance push button or remotely via digital interface. The auto zero feature necessitates a condition of absolutely no flow through the meter during the adjustment process. Provisions are made to either start, read, or save the current auto zero value via digital commands.

Totalizer

The total volume of the gas is calculated by integrating the actual gas flow rate as a function of time.

THE DIGITAL INTERFACE COMMANDS ARE PROVIDED TO:

- SET THE TOTALIZER TO ZERO.
- START THE TOTALIZER AT A PRESET FLOW.
- ASSIGN ACTION AT A PRESET TOTAL VOLUME.
- START/STOP TOTALIZING THE FLOW.
- READ TOTALIZER.

Totalizer conditions become true when the totalizer reading and the “Stop at Total” volumes are equal. In addition, the provision is made to automatically disable Totalizer during sensor warm up period.

Flow Alarm

High and Low gas flow ALARM limits can be preprogrammed via digital interface. ALARM conditions become true when the current flow reading is equal or higher/lower than corresponding values of high and low alarm levels. Alarm action can be assigned with preset delay interval (0-3600 seconds) to activate the contact closer (separate for High and Low alarm). Latch Mode control feature allows each relay to be latched on or follow the corresponding alarm status.

TABLE 6 - SPECIFICATIONS

FLOW MEDIUM:	Please note that XFM Mass Flow Meters are designed to work only with clean gases. **Never** try to measure flow rates of liquids with any XFM.	
CALIBRATIONS:	Performed at standard conditions [14.7 psia (101.4 kPa) and 70 °F (21.1°C)] unless otherwise requested.	
ENVIRONMENTAL (PER IEC 664):	Installation Level II; Pollution Degree II.	
FLOW ACCURACY	±1% of FS at calibration temperature and pressure.	
REPEATABILITY:	±0.15% of full scale.	
FLOW TEMPERATURE COEFFICIENT:	0.15% of full scale/ °C or better.	
FLOW PRESSURE COEFFICIENT:	0.01% of full scale/psi (6.895 kPa) or better.	
FLOW RESPONSE TIME:	600ms time constant; approximately 2 seconds to within ±2% of set flow rate for 25% to 100% of full scale flow.	
MAXIMUM GAS PRESSURE:	500 psig (3447 kPa gauge).	
MAXIMUM PRESSURE DROP:	0.18 PSID (at 10 L/min flow). 4 psi (at 50 L/min flow). See Table 9 for pressure drops associated with various models and flow rates.	
GAS AND AMBIENT TEMPERATURE:	32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.	
RELATIVE GAS HUMIDITY:	Up to 70%.	
LEAK INTEGRITY:	1 x 10^{-9} smL/sec He maximum to the outside environment.	
ATTITUDE SENSITIVITY:	Deviation of up to 1% from stated accuracy, after re-zeroing.	
OUTPUT SIGNALS:	Linear 0-5 Vdc (3000 ohms min load impedance); Linear 4-20 mA (500 ohms maximum loop resistance). Maximum noise 20mV peak to peak (for 0-5 Vdc output).	
CONNECTIONS:	**XFM 17 and 37**: 1/4" compression fittings. **Optional:** 6mm compression, 1/4" VCR®, 3/8" or 1/8" compression fittings.	
	XFM 47: 3/8" compression fittings.	
TRANSDUCER INPUT POWER:	11 to 26 Vdc, 100 mV maximum peak to peak output noise. POWER CONSUMPTION: +12Vdc (200 mA maximum); +24Vdc (100 mA maximum); Circuit board have built-in polarity reversal protection, 300mA resettable fuse provide power input protection.	
WETTED MATERIALS:	Aluminum Models:	Anodized aluminum, brass, 316 stainless steel, Viton® O-rings.
	Stainless Steel Models:	316 stainless steel, Viton® O-rings.
	Optional O-ring Materials:	Buna-N®, EPR® (Ethylene Propylene), or Kalrez®.
CAUTION:	Aalborg makes no expressed or implied guarantees of corrosion resistance of mass flow meters as pertains to different flow media reacting with components of meters. It is the customers' sole responsibility to select the model suitable for a particular gas based on the fluid contacting (wetted) materials offered in the different models.	
DISPLAY:	*Optional local 2x16 characters LCD with adjustable backlight (2 lines of text).	
CALIBRATION OPTIONS:	Standard is one 10 points NIST traceable calibration. Optional, up to 9 additional calibrations may be ordered at additional charge.	
CE COMPLIANCE:	EMC Compliance with 89/336/EEC as amended. Emission Standard: EN 55011:1991, Group 1, Class A Immunity Standard: EN 55082-1:1992.	

** LCD display is not available for Profibus DP interface option.*

Multi-Gas Calibration

The XFM is capable of storing primary calibration data for up to 10 gases. This feature allows the same XFM to be calibrated for multiple gases while maintaining the rated accuracy on each.

Conversion Factors

Conversion factors for up to 32 gases are stored in the XFM. In addition, provision is made for a user-defined conversion factor. Conversion factors may be applied to any of the ten gas calibrations via digital interface commands.

Contact Closure

Two sets of electromechanical SPDT relay outputs are provided to actuate user-supplied equipment.

These are programmable via digital interface such that the relays can be made to switch when a specified event occurs (e.g. when a low or high flow alarm limit is exceeded or when the totalizer reaches a specified value) or may be directly controlled by user.

TABLE 7 - STANDARD FLOW CAPACITIES FOR XFM

XFM 17		XFM 37	XFM 47
mL/min [N_2]	L/min [N_2]	L/min [N_2]	L/min [N_2]
10	1	20	60
20	2	30	80
50	5	40	100
100	10	50	
200			
500			

Leak Integrity

1 x 10^{-9} smL/sec of Helium maximum to the outside environment.

Engineering Units

The measured gas flow and associated totalizer data are scaled directly in engineering units via the digital interface.

THE FOLLOWING 23 UNITS OF MEASURE ARE SUPPORTED:

TABLE 8 - UNITS OF MEASURE FOR XFM

NUMBER	INDEX	FLOW RATE ENGINEERING UNITS	TOTALIZER ENGINEERING UNITS	DESCRIPTION
1	0	%	%s	Percent of full scale
2	1	mL/sec	mL	Milliliter per second
3	2	mL/min	mL	Milliliter per minute
4	3	mL/hr	mL	Milliliter per hour
5	4	L/sec	Ltr	Liter per second
6	5	L/ min	Ltr	Liter per minute
7	6	L/hr	Ltr	Liter per hour
8	7	m^3/sec	m^3	Cubic meter per second
9	8	m^3/ min	m^3	Cubic meter per minute
10	9	m^3/hr	m^3	Cubic meter per hour
11	10	ft^3/sec	f^3	Cubic feet per second
12	11	ft^3/min	f^3	Cubic feet per minute
13	12	ft^3/hr	f^3	Cubic feet per hour
14	13	g/sec	g	Grams per second
15	14	g/min	g	Grams per minute
16	15	g/hr	g	Grams per hour
17	16	kg/sec	kg	Kilograms per second
18	17	kg/min	kg	Kilograms per minute
19	18	kg/hr	kg	Kilograms per hour
20	19	Lb/sec	Lb	Pounds per second
21	20	Lb/min	Lb	Pounds per minute
22	21	Lb/hr	Lb	Pounds per hour
23	22	User	UD	User defined

TABLE 9 - MAXIMUM PRESSURE DROP FOR XFM

MODEL	FLOW RATE [liters/min]	MAXIMUM PRESSURE DROP		
		[mm H_2O]	[psid]	[kPa]
XFM 17	up to 10	130	0.18	1.275
XFM 37	up to 50	2722	4	27.58
XFM 47	up to 100	1974	2.9	20

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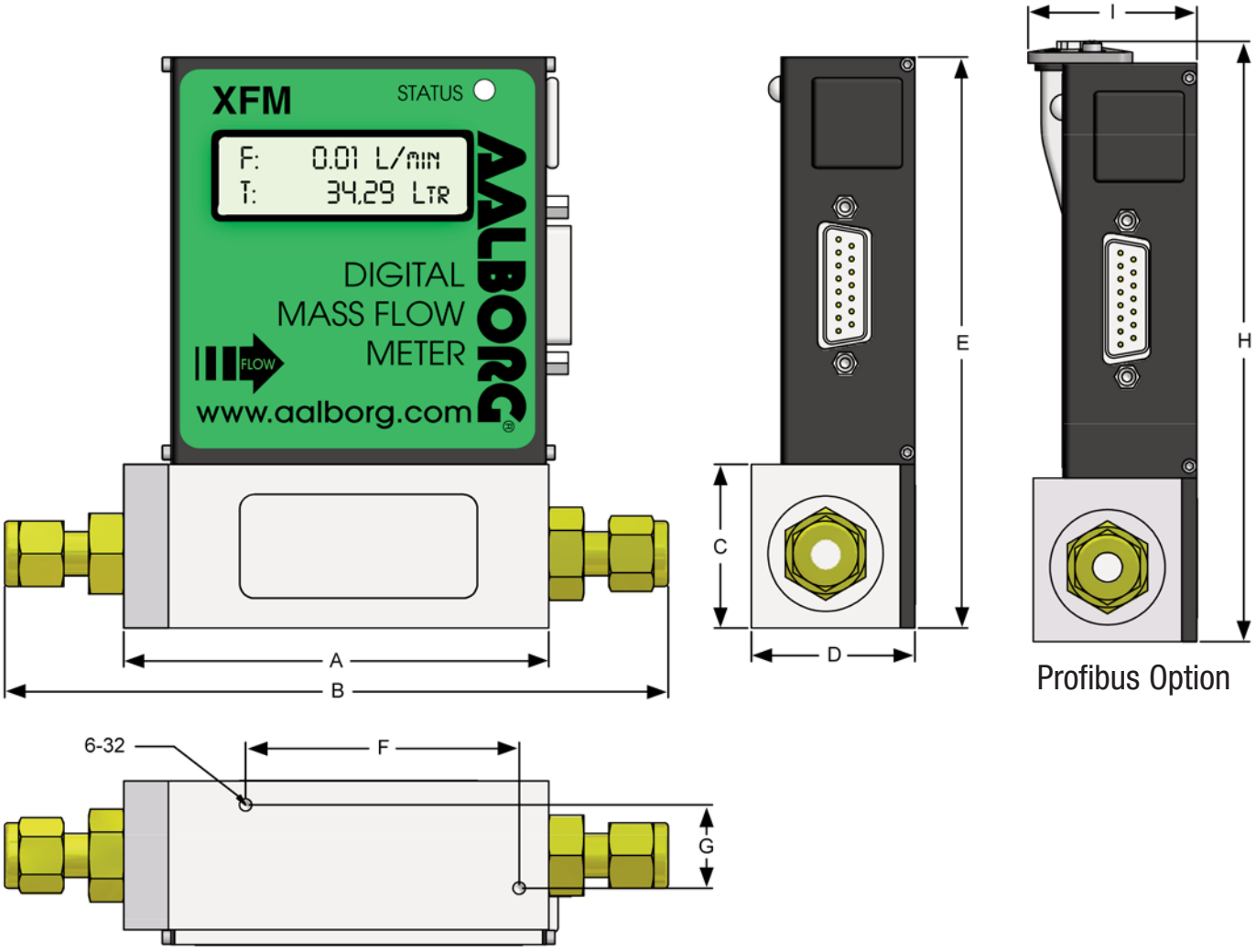

TABLE 10 - DIMENSIONS FOR XFM [INCH]

MODEL	*CONNECTION Compression Fitting (tube OD)	LCD and NO LCD VERSIONS							PROFIBUS CAPABILITY	
		A	B	C	D	E	F	G	H	I
XFM 17	1/4"	3.09	5.10	1.00	1.12	4.42	2.81	0.72	4.67	1.42
XFM 37	1/4"	3.57	5.58	1.37	1.37	4.80	2.30	0.70	5.05	1.42
XFM 47	3/8"	3.57	5.68	1.37	1.37	4.80	2.30	0.70	5.05	1.42

TABLE 11 - DIMENSIONS FOR XFM [MM]

MODEL	*CONNECTION Compression Fitting (tube OD)	LCD and NO LCD VERSIONS							PROFIBUS CAPABILITY	
		A	B	C	D	E	F	G	H	I
XFM 17	1/4"	78.5	129.5	25.4	28.6	112.3	71.4	18.3	118.6	36.0
XFM 37	1/4"	90.7	141.7	34.9	34.9	121.9	58.4	17.8	128.3	36.0
XFM 47	3/8"	90.7	144.3	34.9	34.9	121.9	58.4	17.8	128.3	36.0

** For optional fittings see table 6.*

ORDERING INFORMATION FOR DIGITAL MASS FLOW METER

XFM

XFM	MODEL

MAX FLOW (N_2)	
17	10 L/min
37	50 L/min
47	100 L/min

MATERIAL	
A	Aluminum
S	Stainless Steel

SEALS	
V	Viton®
B	Buna®
E	EPR
T	PTFE / Kalrez®

FITTINGS	
A	1/4" Compression
B	1/8" Compression
C	1/4" VCR®
D	3/8" Compression
H	6mm Compression

CONNECTOR	
D	D Connector

DISPLAY	
N	NO Display
L	LCD Readout

POWER	
6	Universal 11-26 VDC

INPUT / OUTPUT SIGNAL	
A	*n.a./0-5 VDC
B	*n.a./4-20 mA

DIGITAL INTERFACE	
2	RS232
5	RS485
9	PROFIBUS

XFM	17	S	–	V	A	D	L	6	–	A	2

EXAMPLE: XFM17S-VADL6-A2 5 L/min [N_2] 20 psig

SPECIFY: *FLOW RANGE, GAS, and PRESSURE* **n.a. = not applicable.*

XFM17 stainless steel, Viton® seals, 1/4" compression fittings, D connector, With LCD readout, 11-26 VDC, 0-5 Vdc output signal with RS232 digital interface.

BULLETIN EM20110I XFM