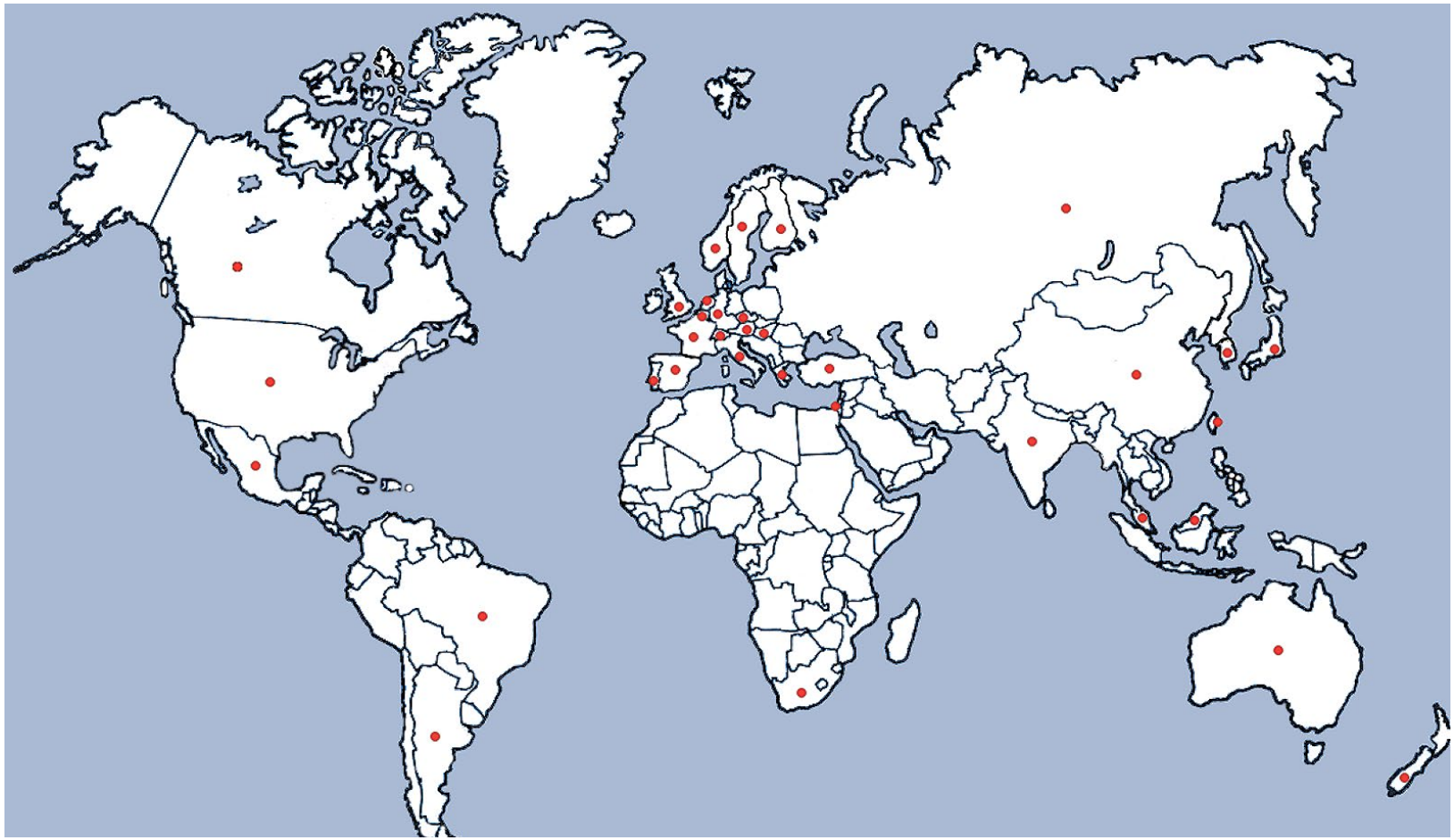
Digital and Analog Flow Meters and Controllers

AALBORG®



Worldwide Distribution



Visit our web site at: www.aalborg.com

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About the Company

Founded in 1972, Aalborg is well-known throughout the world as a primary manufacturer of precision instrumentation for flow measurement and control.

We operate two divisions:

The Electronics Division produces analog and digital mass flow meters and controllers, as well as a diverse line of wafer and insertion type vortex flow meters for steam, liquid or gases. In addition a line of peristaltic pumps, stepping motor driven valves made in this department are highly useful in processing and OEM applications.

The Variable Area Division manufactures a complete line of glass tube rotameters. These flow meters are available with aluminum, brass, stainless steel or PTFE wetted components. Aalborg also manufactures a unique line of PFA tube meters for ultrapure or corrosive applications. Precision barstock stainless steel or brass needle valves, as well as PTFE valves, are also manufactured in this division.

NIST Traceability

All equipment used for flow calibrations are traceable to NIST.

Accredited Calibration Services

AALFA-KAL Metrology Laboratory, division of Aalborg Instruments & Controls is accredited by A2LA in conformance to ISO17025/2005 and to Z540-1/1994. Gas flow calibrations up to 50L/min are performed according Scope of Accreditation - Certificate Number: 3989.01.

Technical Assistance

Technical Assistance is readily available. Customers are invited to contact the company or our distributors to discuss individual requirements. OEM applications are welcome.

ISO9001/2015 Certification

Aalborg has been ISO 9001 certified since April of 1995. We are very proud of the design features and the exceptionally high quality for which our products which have been known since 1972. It is our policy that through strict enforcement of exacting manufacturing standards the Aalborg brand name continues to be associated with a reputation of high quality and reliability. Our products are backed by meticulous innovative engineering combined with efficient manufacturing practices and a highly skilled work force guaranteeing total customer satisfaction.

Our Mission

It is the policy of Aalborg to develop, produce and deliver products and services which consistently conform to or exceed customer requirements.

Our commitment is to provide cutting-edge technology combined with a sincere desire to serve our customers and produce the highest quality products attainable.

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NIST Traceable Calibrations

Our laboratories are fully equipped to perform NIST traceable flow calibrations for Rotameters, Mass Flow Meters and Mass Flow Controllers.

We offer calibration services on meters and controllers of other manufacturers' products as well.

AALFA-KAL laboratory is equipped to calibrate Molboxes. Our technicians are trained and certified by the manufacturer of Molboxes and Moblocs.

For fast cost effective service please contact our customer service department.

A2LA Accredited Calibrations

AALFA-KAL Metrology Laboratory, division of Aalborg Instruments & Controls is accredited by A2LA in conformance to ISO17025/2005 and to Z540-1/1994. Gas flow calibrations up to 50L/min are performed according to Scope of Accreditation - Certificate Number: 3989.01.

Compliance Qualifications

Extensive set of Molbox/Molblocs ensure conveniently overlapping calibration ranges.

- ANSI/NCSL Z540-1-1994
- ISO9001/2015 CERTIFIED
- MIL-STD-456624A
- ISO17025 Accredited

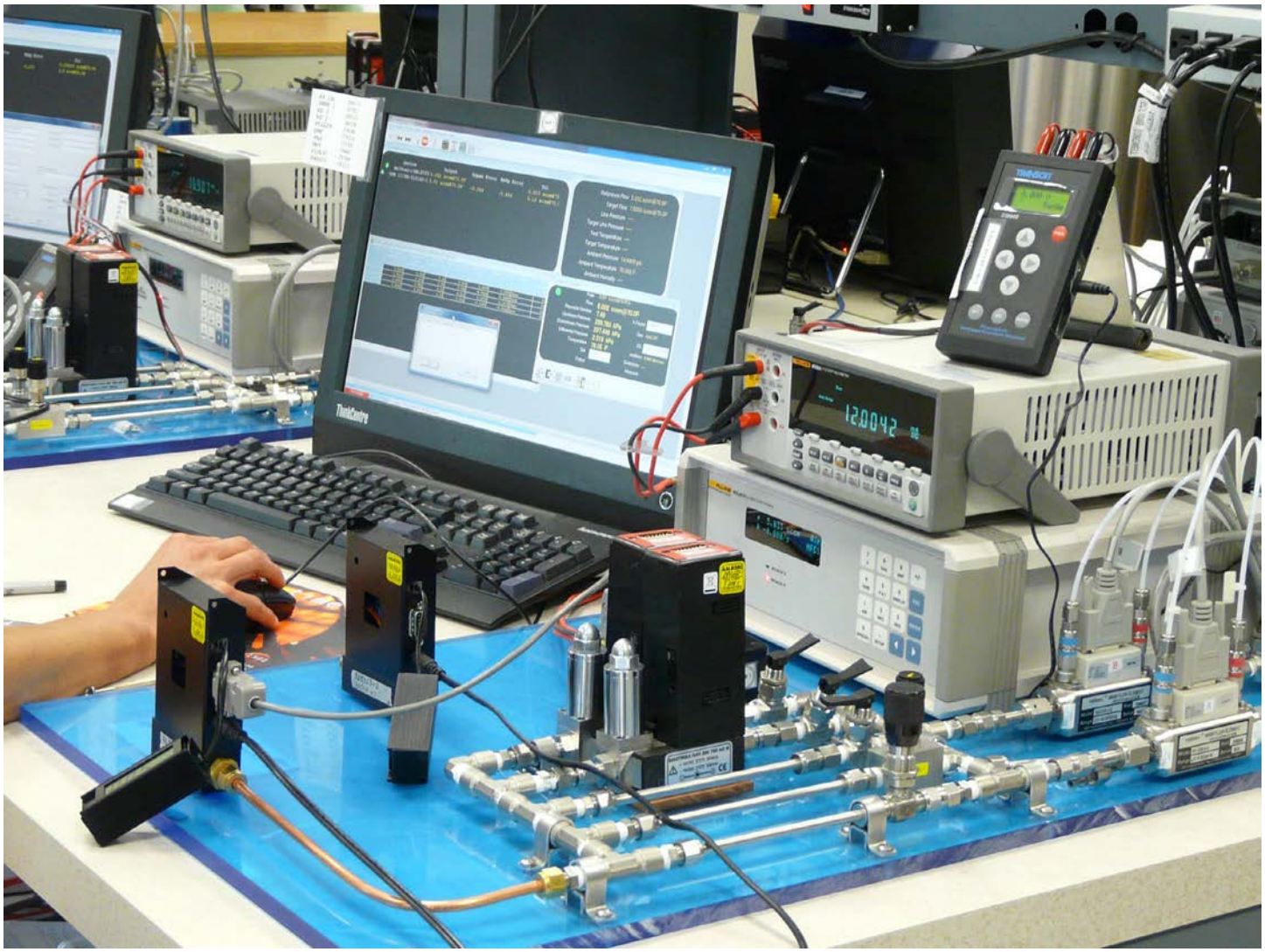
Partial view of the gas calibration laboratory.



Technicians calibrating Flow Controllers using Bell Provers and Molbox/Molblocs technology.

ACCREDITED
Certificate 3989.01

Close-up view of Molbox/Molblocs equipment supported by COMPASS software for calibrating GFM flow meters.



Link for an explanation how to use Molbox/Molblocs method of calibrations of Flow Meters and Controllers.

http://www.youtube.com/watch?v=FVDqrW5y70A

Pressure Limits Of Calibrations

Up to 500 PSIG for routine gases (Air, N_2, He and Ar) with a maximum flow of 250 L/min. Up to 80 PSIG for Air, with a maximum flow of 1000 L/min.

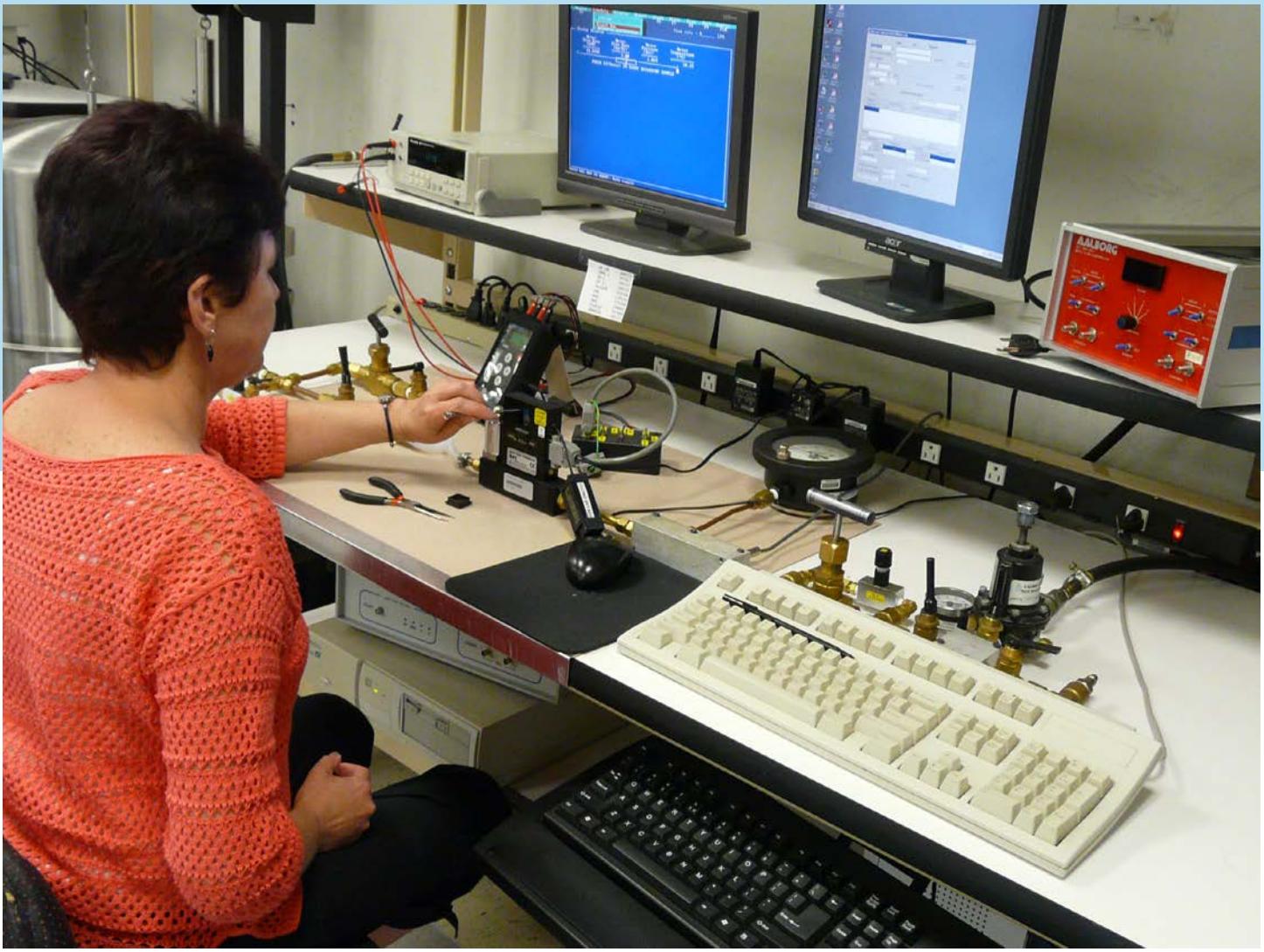
Customer calibrations are represented by primary SI flow units.

- Gas calibrations for up to 1000 L/min and water calibrations up to 4 L/min available.
- Calibrated to NIST traceable standards.



Bell prover used by technician in calibrating high flow capacity flow meter.

ilac-MRA A2LA ACCREDITED Certificate 3989.01



Terminal shown for low-flow Flow Controller calibration supported by Aalborg SDPROC software.

Piston Gauge, model 7601 with gas operated, gas lubricated piston-cylinder module. It supports definition of pressure against a vacuum reference.



OPERATING MODES: Gauge, Absolute and Differential.

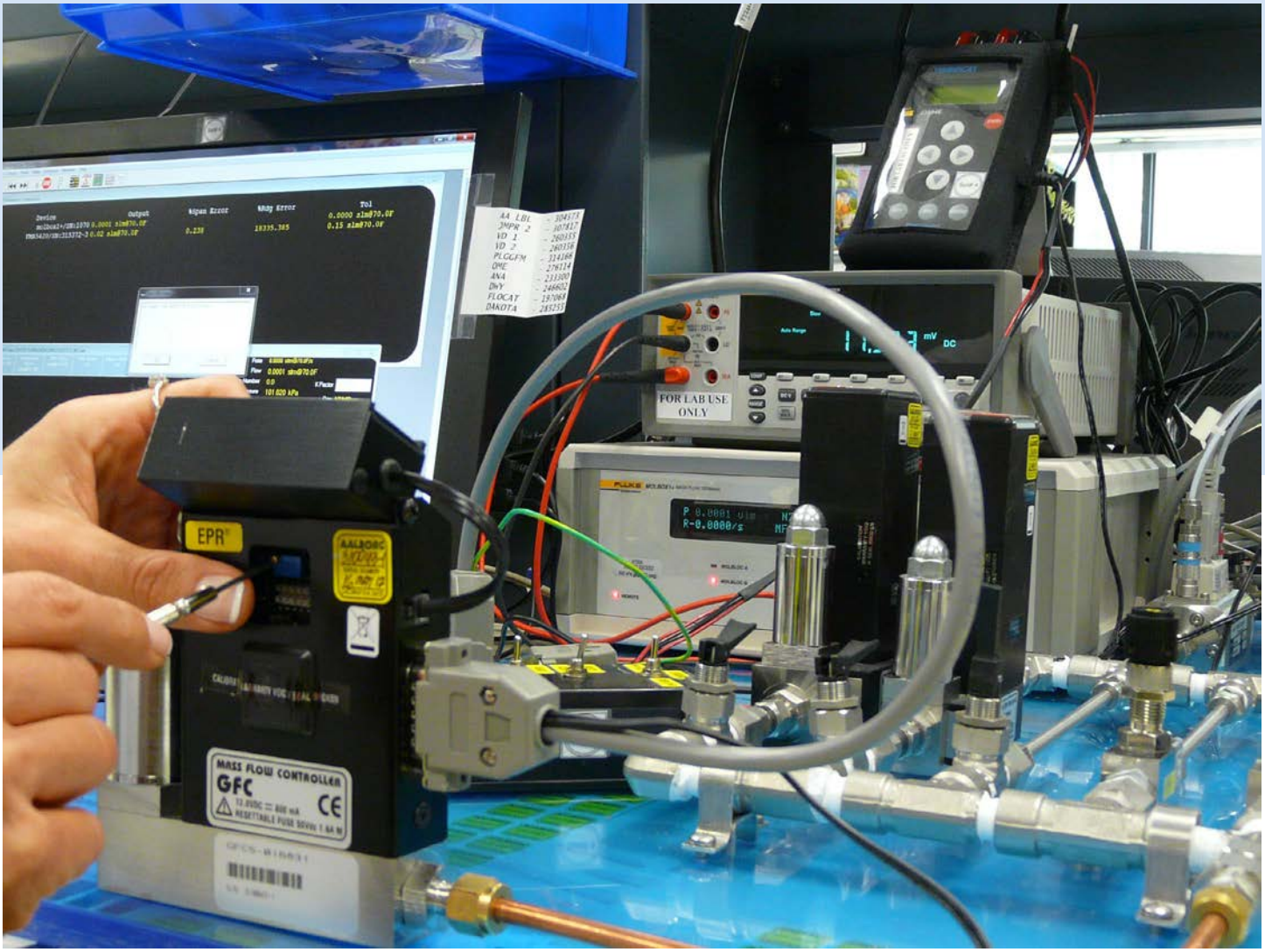
OVERALL SPECIFICATION FOR PRESSURE MEASUREMENT:

Sensitivity: 0.02Pa +0.5 ppm
Reproducibility: +/-4 ppm
Measurement Uncertainty (k=2): +/-(0.5Pa + 20 ppm)

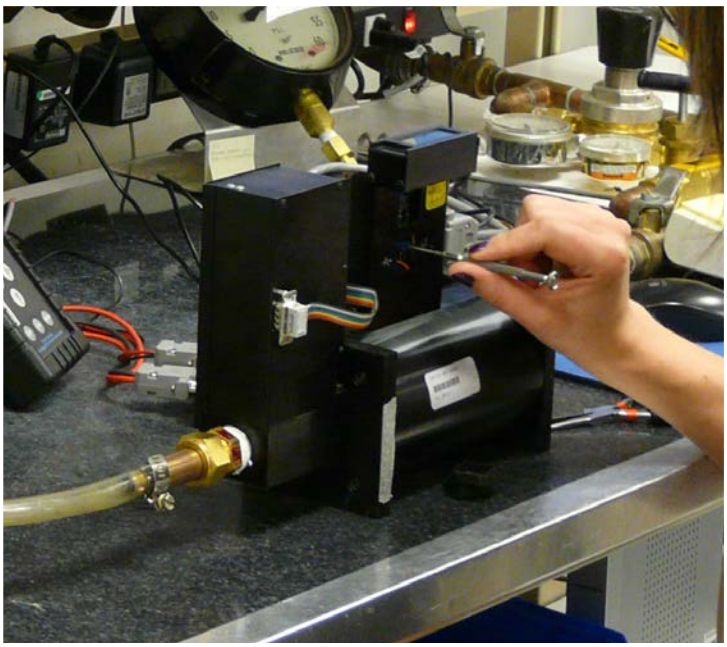
Suitable for Molbox 1+ A350/A700

ilac-MRA A2LA ACCREDITED Certificate 3989.01

Our gas calibration laboratory has NIST traceable approved in-house equipment to certify our calibration devices. Molbox/Molblocs based calibration for GFC Flow Controller.



Our technicians are trained and certified and our Laboratory is equipped to calibrate Molboxes. In addition, our laboratory can calibrate NIST traceable approved "In-House" equipment to certify our primary calibration devices. We also calibrate and certify customers' Molboxes. For fast cost effective service please contact our customer service department.



Gas flow calibration laboratory is capable of performing calibrations from 1 mL/min to 1000 L/min at 21.1 °C /101.325 kPa (70 °F, 14.69 PSI abs).

According to "state of the art" calibrating practices, calibrations are performed based on 4 to 1 uncertainty ratio.

ilac-MRA

A2LA ACCREDITED
Certificate 3989.01



Specialized software applied to calibration of Flow Meter.

EUROPEAN SERVICE FACILITY

Authorized Repair and Service Facility
for Aalborg Thermal Mass Flow Systems

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ASIAN SERVICE FACILITY

Authorized Repair and Service Facility
for Aalborg Thermal Mass Flow Systems

AALBORG -Beijing Comity MEASURE & CONTROL CO.

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Xisanqi, Hai Dian District, Beijing, China

Phone: 86-10-6295-0464, 86-10-6295-0465
Fax: 86-10-6295-0466
Website: http://www.comity-tec.com

ilac-MRA A2LA ACCREDITED Certificate 3989.01



Typical Bell Prover used for NIST traceable calibrations


Vendor Qualification Program
Biomira Inc.
This is to certify that
Aalborg Instruments and Controls Inc.
is now recognized as an
Approved Vendor
for the oxygen gas calibration of variable
Quality Assurance


FLUKE
Calibration
Certificate of Training
has successfully completed a specialized course of study in:
Precision Pressure Calibration
conducted 2012 May 07 to May 11 in Phoenix, AZ USA
Presented 2012 May 11 by
Fluke Calibration
Matt Daniels, PAS, Pressure and Flow
Jollien O Bryant, Training Coordinator


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FLUKE
Calibration
Certificate of Training
Fluke Calibration hereby certifies that
has successfully completed training in topics of
"How to" in Electrical, Pressure, Flow, and Temperature Calibration
on November 17, 2011 in Albany, NY
Fluke Calibration Representative


FLUKE
Calibration
Certificate of Training
has successfully completed a specialized course of study in:
Startup and Training on
PG7601™ Gas Piston-Gauge Calibration System
Presented 2012 April 4th by
Fluke Calibration
Martin Girard
General Manager - Fluke Calibration


BOMBARDIER
Certificate of Approval
Approved For: Bombardier Maintenance, Repair, & Overhaul Organizations
The Quality Management System of
Aalborg Instruments & Controls, Inc.
Located at:
20 Corporate Drive
Orangeburg, NY 10962
Is hereby granted approval to provide materials, parts, and/or services as defined by contract and/or purchase order.
This certificate is valid and remains in effect until otherwise rescinded. This approval is contingent upon your continued compliance to regulatory ratings, capability listings, quality system accreditations, and/or consistent conformity to the standard of quality and reliability.
Manager, Quality Assurance & Aerospace Services
Bombardier Aerospace
1255 E. Aero Park Blvd.
Tucson, AZ 85756
August 17, 2009
Date of Approval



ilac-MRA A2LA

Accredited Laboratory

A2LA has accredited

AALFA - KAL METROLOGY LABORATORY,
DIVISION of AALBORG INSTRUMENTS & CONTROLS, INC
Orangeburg, NY

for technical competence in the field of

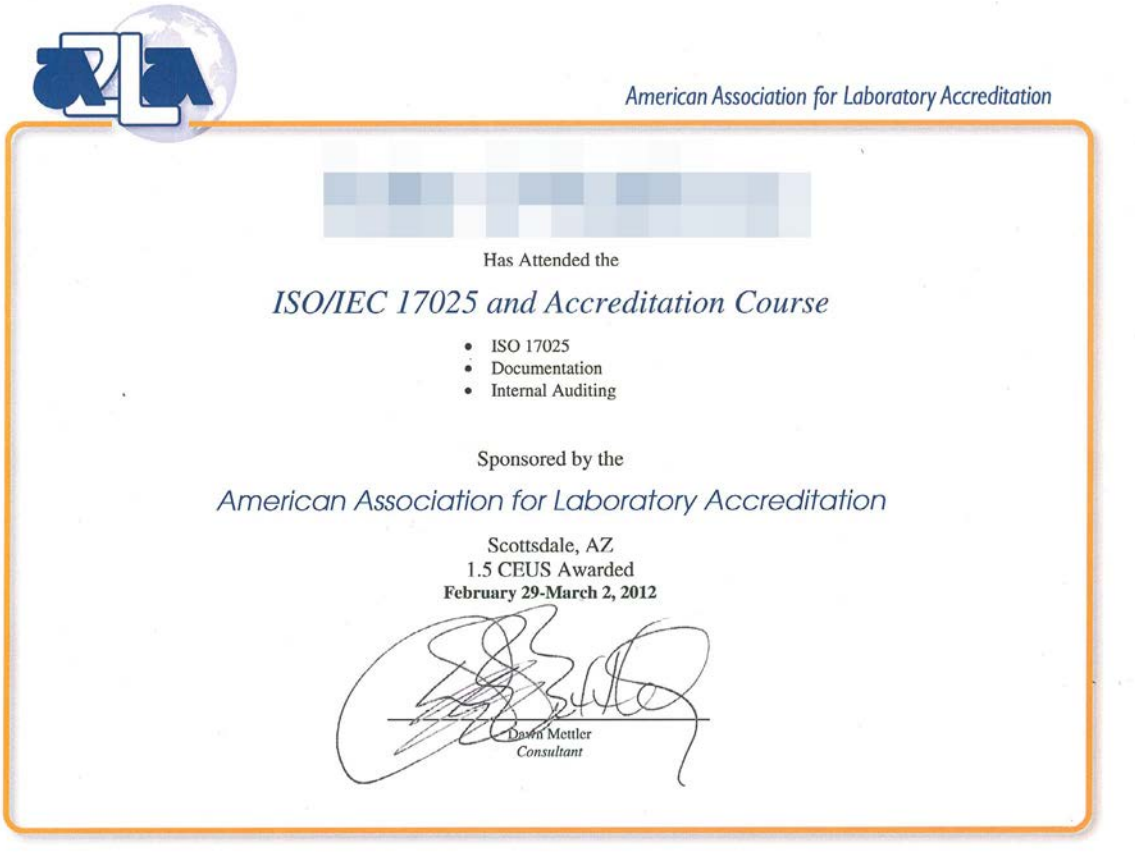
Calibration

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This laboratory also meets the requirements of ANSI/NCSL Z540-1-1994 and R205 – Specific Requirements: Calibration Laboratory Accreditation Program. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 26th day of February 2026.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3989.01
Valid to April 30, 2028

For the calibrations to which this accreditation applies, please refer to the laboratory's Calibration Scope of Accreditation.



A2LA

American Association for Laboratory Accreditation

Has Attended the

ISO/IEC 17025 and Accreditation Course

- ISO 17025
- Documentation
- Internal Auditing

Sponsored by the

American Association for Laboratory Accreditation

Scottsdale, AZ
1.5 CEUS Awarded
February 29-March 2, 2012

Dawn Mettler
Consultant

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017
& ANSI/NCSL Z540-1-1994

AALFA - KAL METROLOGY LABORATORY,
DIVISION of AALBORG INSTRUMENTS & CONTROLS, INC.
20 Corporate Dr.
Orangeburg, NY 10962
Agnieszka Malolepszy Phone: 845 770 3000

CALIBRATION

Valid To: April 30, 2028 Certificate Number: 3989.01

In recognition of the successful completion of the A2LA evaluation process (including an assessment of the organization's compliance with R205 – A2LA's Calibration Program Requirements), accreditation is granted to this laboratory to perform the following calibrations[1, 4]:

I. Fluid Quantities

Parameter	Range	CMC[2, 3, 5] (±)	Comments
Volumetric Flow – Measuring Equipment	Up to 20 SCCM (8 to 100) SCCM (16 to 200) SCCM (32 to 400) SCCM (80 to 1000) SCCM (160 to 2000) SCCM (800 to 10 000) SCCM (1600 to 20 000) SCCM (4000 to 50 000) SCCM	0.22 % 0.24 % 0.34 % 0.37 % 0.23 % 0.27 % 0.24 % 0.23 % 0.26 %	DHI Molbox-1 (Air, He, Arg, CO_2, O_2, N_2)

[1] This laboratory offers commercial calibration services.

[2] Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[3] In the statement of CMC, percentages represent the percent of reading unless otherwise noted.

[4] This scope meets A2LA's *P112 Flexible Scope Policy*.

[5] The type of instrument or material being calibrated is defined by the parameter. This indicates the laboratory is capable of calibrating instruments that measure or generate the values in the ranges indicated for the listed measurement parameter.

5202 Presidents Court, Suite 220 | Frederick, MD 21703-8398 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

Design Features

- Rigid metallic construction.
- Maximum pressure of 1000 psig (70 bars).
- Leak integrity 1 x 10^{-9} of helium.
- NIST traceable certification.
- Built-in tiltable LCD readout.
- 0-5 Vdc and 4-20 mA signals.
- Circuit protection.
- Can be used as a portable device.
- Engineering units or 0 to 100% displays.
- TIO Totalizer option.



Principles of Operation

Metered gases are divided into two laminar flow paths, one through the primary flow conduit, and the other through a capillary sensor tube. Both flow conduits are designed to ensure laminar flows and therefore the ratio of their flow rates is constant.

Two precision temperature sensing windings on the sensor tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

A Wheatstone bridge design is used to monitor the temperature dependent resistance gradient on the sensor windings which is linearly proportional to the instantaneous rate of flow.

Output signals of 0 to 5Vdc and 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas.

Flow rates are unaffected by temperature and pressure variations within stated limitations.

General Description

Compact, self-contained GFM mass flow meters are designed to read flow rates of gases. The rugged design coupled with instrumentation grade accuracy provides versatile and economical means of flow measurement.

Aluminum or stainless steel models with readout options of either engineering units (standard) or 0 to 100 percent displays are available.

The mechanical layout of the design includes an LCD readout built into the top of the transducer. This readout module is tiltable over 90 degrees to provide optimal reading comfort. It is connected to the transducer by a standard modular plug, and is also readily removable for remote reading installations.

GFM 57, 67 and 77
High Flow Mass Flow Meters



TABLE 1 - SPECIFICATIONS FOR GFM	
ACCURACY:	**GFM 17, 37 and 47:** ±1.0% of full scale.
	GFM 57, 67 and 77: ±1.5% of full scale. OPTIONAL ENHANCED ACCURACY: ±1.0% of full scale.
CALIBRATIONS:	Performed at standard temperature of 70 °F (21.1 °C) only, and at 14.7 psia (101.4 kPa) unless otherwise requested.
REPEATABILITY:	±0.25% of full scale.
RESPONSE TIME:	Generally 2 seconds to within ±2% of actual flow rate over 25 to 100% of full scale.
TEMPERATURE COEFFICIENT:	0.15% of full scale / °C.
PRESSURE COEFFICIENT:	0.01% of full scale / psi (0.07 bar).
MAXIMUM PRESSURE DROP:	See Table 3.
GAS AND AMBIENT TEMP.:	**Gas:** 32 °F to 122 °F (0 °C to 50 °C). **Ambient:** 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.
OUTPUT SIGNALS:	Linear 0-5 Vdc. 1000 ohms min. load impedance and 4-20 mA 0-500 Ohms loop resistance.
TRANSDUCER INPUT POWER:	Universal +12 to +26 Vdc, 200 mA maximum.
TIME CONSTANT:	800 ms.
GAS PRESSURE:	1000 psig (70 bars) maximum GFM 17, 37, 47. 20 psig (1.4 bars) optimum. 500 psig (34.5 bars) GFM 57, 67, 77. 20 psig (1.4 bars) optimum.
**** MATERIALS IN FLUID CONTACT:**	**a.** Aluminum models GFM Series: anodized aluminum, 316 stainless steel, brass and FKM O-rings.
	b. Stainless steel models GFM17S, 37S,47S, 57S, 67S and 77S: 316 stainless steel and FKM O-rings. Optional O-rings: Buna® , EPR and FFKM.
ATTITUDE SENSITIVITY:	No greater than +15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.
CONNECTIONS:	**GFM 17:** 1/4" compression fittings. Optional: 6mm, 3/8" and 1/8" compression fittings or 1/4" VCR® .
	GFM 37: 1/4" compression fittings. Optional: 6mm and 3/8" compression fittings or 1/4" VCR® .
	GFM 47: 3/8" compression fittings.
	GFM 57: 3/8" compression fittings.
	GFM 67: 1/2" compression fittings.
	GFM 77: 3/4" FNPT fittings or 3/4" compression fittings.
LEAK INTEGRITY:	1 x 10^{-9} smL/sec of helium maximum to the outside environment.
CE COMPLIANT:	EN 55011 class 1, class B; EN50082-1.

*** The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

Transducers without LCD readout are offered for OEM applications.

GFM mass flow meters are available with flow ranges from 10 mL/min to 1000 L/min N_2. Gases are connected by means of 1/4" ,3/8" ,1/2" compression fittings and 3/4" FNPT fittings. Optional fittings are available. These meters may be used as bench top units or mounted by means of screws in the base.

Transducer power supply ports are fuse and polarity protected.

TABLE 2 - FLOW RANGES FOR GFM

GFM 17 LOW FLOW MASS FLOW METERS	
CODE	**mL/min [N_2]**
01	0 to 10
02	0 to 20
03	0 to 50
04	0 to 100
05	0 to 200
06	0 to 500
CODE	**L/min [N_2]**
07	0 to 1
08	0 to 2
09	0 to 5
10	0 to 10
GFM 37 MEDIUM FLOW MASS FLOW METERS	
11	0 to 15
30	0 to 20
31	0 to 30
32	0 to 40
33	0 to 50
GFM 47 HIGH FLOW MASS FLOW METERS	
40	0 to 60
41	0 to 80
42	0 to 100
GFM 57 HIGH FLOW MASS FLOW METERS	
50	0 to 200
GFM 67 HIGH FLOW MASS FLOW METERS	
60	0 to 500
GFM 77 HIGH FLOW MASS FLOW METERS	
70	0 to 1000

Leak Integrity

1 x 10^{-9} smL/sec of helium max to outside environment.

TABLE 3 - MAXIMUM PRESSURE DROP FOR GFM

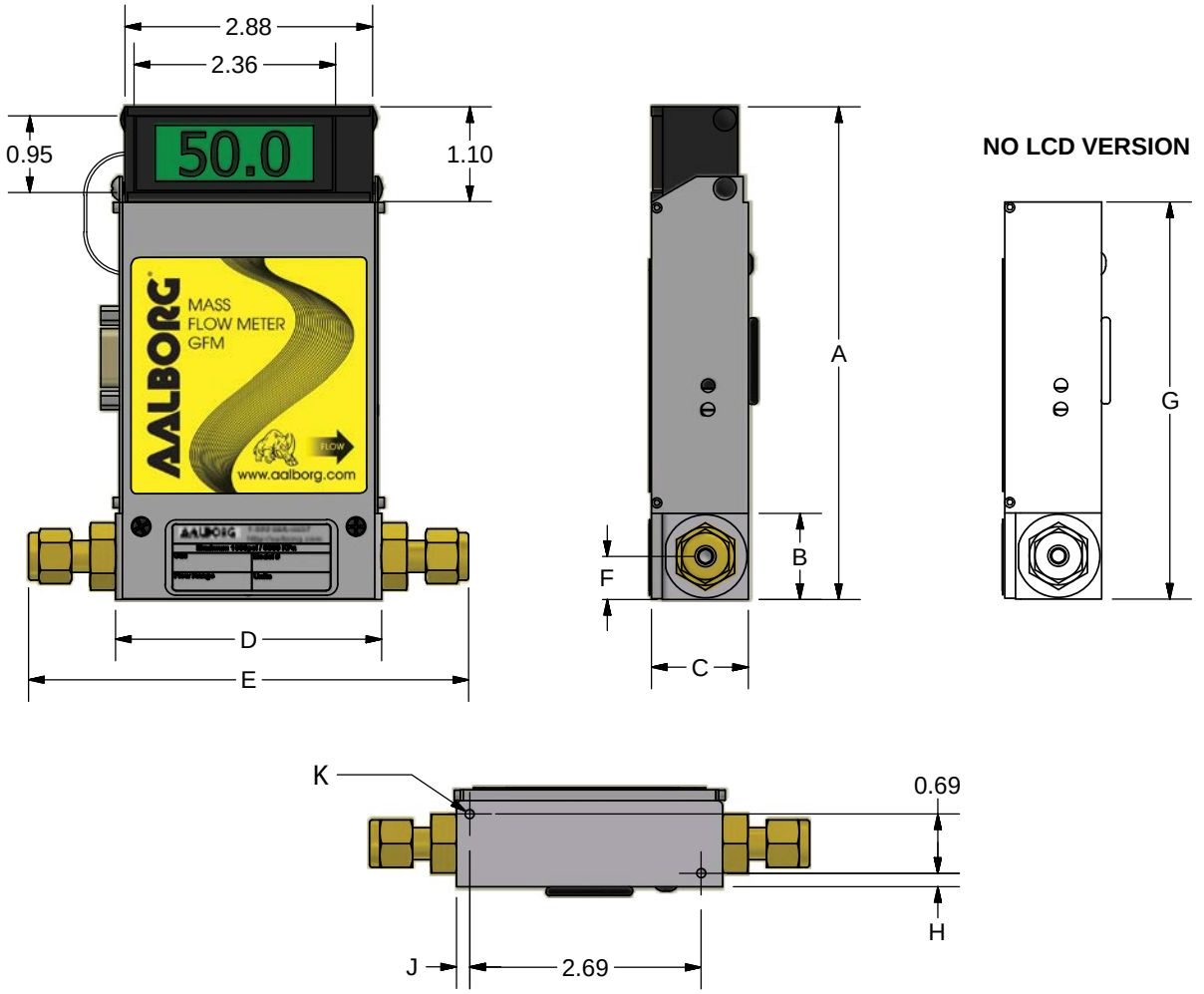
MODEL	FLOW RATE [N_2] [liters/min]	MAXIMUM PRESSURE DROP		
		[mm H_2O]	[psid]	[mbar]
GFM 17	up to 10	25	0.04	2.5
GFM 37	20	300	0.44	30
	30	800	1.18	81
	40	1480	2.18	150
	50	2200	3.23	223
	60	3100	4.56	314
GFM 47	80	4422	6.5	448
	100	5500	8.08	557
GFM 57	200	2720	4.0	280
GFM 67	500	3400	5.0	340
GFM 77	1000	6120	9.0	620

TABLE 4 - ACCESSORIES FOR GFM

POWER SUPPLY - BATTERY PACK - CABLES	
PS-GFM-110NA-2	Power Supply, 110 V / 12 Vdc /North America
PS-GFM-110NA-4	Power Supply, 110 V / 24 Vdc /North America
PS-GFM-230EU-2	Power Supply, 220 V / 12 Vdc /Europe
PS-GFM-230EU-4	Power Supply, 220 V / 24Vdc /Europe
PS-GFM-240UK-2	Power Supply 240 V / 12 Vdc /United Kingdom
PS-GFM-240UK-4	Power Supply 240 V / 24 Vdc /United Kingdom
PS-GFM-240AU-2	Power Supply 240 V / 12 Vdc /Australia
PS-GFM-240AU-4	Power Supply 240 V / 24 Vdc /Australia
BP110	Battery Pack, 110 V (includes case)
BP220	Battery Pack, 220 V (includes case)
CBL-D4	Cable with 9-pin D-connector, (4 - 20 mA)
CBL-D5	Cable with 9-pin D-connector, (0 to 5 Vdc)
17/3RC	17/3RC Remote cable, 3 ft long
17/R	17/R Remote LCD readout with 3 ft long cable
TIO-LAA2	Totalizer I/O Monitor, RS-232 Digital Interface
TIO-LAA5	Totalizer I/O Monitor, RS-485 Digital Interface
KIT-TM-DD	GFM Flow Meter Mounting Kit with Two 9 Pin D-Connectors

For Totalizer Input/ Output Flow Monitor/ Controller options see page 56.

GFM 17, 37 and 47 Mass Flow Meters



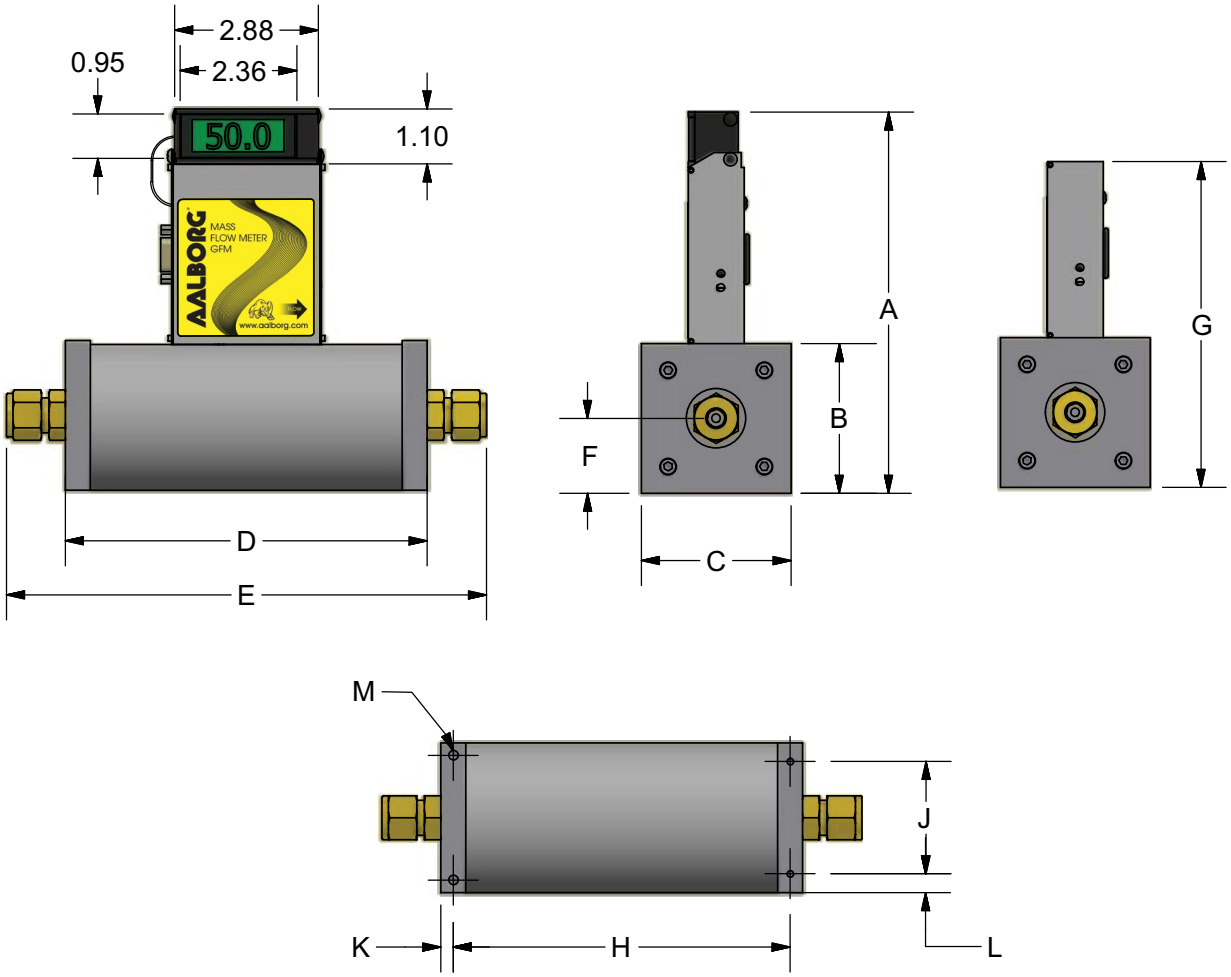
NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

TABLE 5 - DIMENSIONS FOR GFM 17, 37 AND 47 MODELS

MODEL	CONNECTION COMPRESSION FITTING	DIMENSION INCH (MM)									
		LCD VERSION						NO LCD	MOUNTING HOLE		
		A	B	C	D	E	F	G	H	J	K
GFM 17	1/4" Tube O Diameter	5.72 (145.3)	1.00 (25.4)	1.13 (28.6)	3.09 (78.6)	5.10 (129.6)	0.5 (12.7)	4.61 (117.1)	0.16 (4.0)	0.16 (4.0)	6-32 x 0.13
GFM 37	1/4" Tube O Diameter	6.10 (154.9)	1.38 (34.9)	1.25 (31.8)	4.13 (104.8)	6.13 (155.8)	0.63 (15.9)	4.99 (126.7)	0.28 (7.1)	1.08 (27.3)	6-32 x 0.10
GFM 47	3/8" Tube O Diameter	6.10 (154.9)	1.38 (34.9)	1.25 (31.8)	4.13 (104.8)	6.25 (158.7)	0.63 (15.9)	4.99 (126.7)	0.28 (7.1)	1.08 (27.3)	6-32 x 0.10

For Specific Flow Ranges Contact Aalborg Customer Service Department.

GFM 57, 67 and 77 Mass Flow Meters



NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

TABLE 6 - DIMENSIONS FOR GFM 57, 67 AND 77 MODELS

MODEL	CONNECTION COMPRESSION FITTING (except model GFM 77)	DIMENSION (INCH)											
		LCD VERSION						NO LCD	MOUNTING HOLE				
		A	B	C	D	E	F	G	H	J	K	L	M
GFM 57	3/8" Tube O Diameter	6.73 (170.8)	2.00 (80.8)	1.75 (44.5)	6.69 (169.8)	8.81 (223.7)	0.88 (22.2)	5.62 (142.6)	4.69 (119.0)	1.39 (35.3)	1.00 (25.4)	0.18 (4.6)	10-24 x 0.25
GFM 67	1/2" Tube O Diameter	7.64 (194.0)	3.00 (76.2)	3.00 (76.2)	7.25 (184.2)	9.65 (245.1)	1.5 (38.1)	6.53 (165.8)	6.75 (171.5)	2.25 (57.2)	0.25 (6.4)	0.38 (9.5)	1/4-20 x 0.35
GFM 77	3/4" NPT Female	8.66 (220.0)	4.00 (101.6)	4.00 (101.6)	7.30 (185.4)	-	2.00 (50.8)	7.55 (191.8)	6.75 (171.5)	3.00 (76.2)	0.25 (6.4)	0.50 (12.7)	1/4-20 x 0.35

For Specific Flow Ranges Contact Aalborg Customer Service Department.

Configure and Order Online: GFM Mass Flow Meter

GFM	MODEL

MAX FLOW (N_2)	
17	10 L/min
37	50 L/min
47	100 L/min
57	200 L/min
67	500 L/min
77	1000 L/min

MATERIAL	
A	Aluminum
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	FFKM

FITTINGS		MODEL
A	1/4" Compression	GFM 17, 37
B	1/8" Compression	GFM 17
C	1/4" VCR®	GFM 17, 37
D	3/8" Compression	GFM 17, 37, 47, 57
E	1/2" Compression	GFM 67
F	3/4" FNPT	GFM 77
G	3/4" Compression	GFM 77
H	6mm Compression	GFM 17, 37

DISPLAY	
N	No Display
L	LCD Readout

POWER	
6	Universal +12 to +26 Vdc

OUTPUT SIGNAL	
A	0-5 Vdc
B	4-20 mA

DIGITAL INTERFACE	
0	None

GFM	17	S	—	V	A	L	6	—	A	0

EXAMPLE: GFM17S-VAL6-A0 5 L/min [N2] 20 psig

SPECIFY: Flow Range, Gas and Pressure

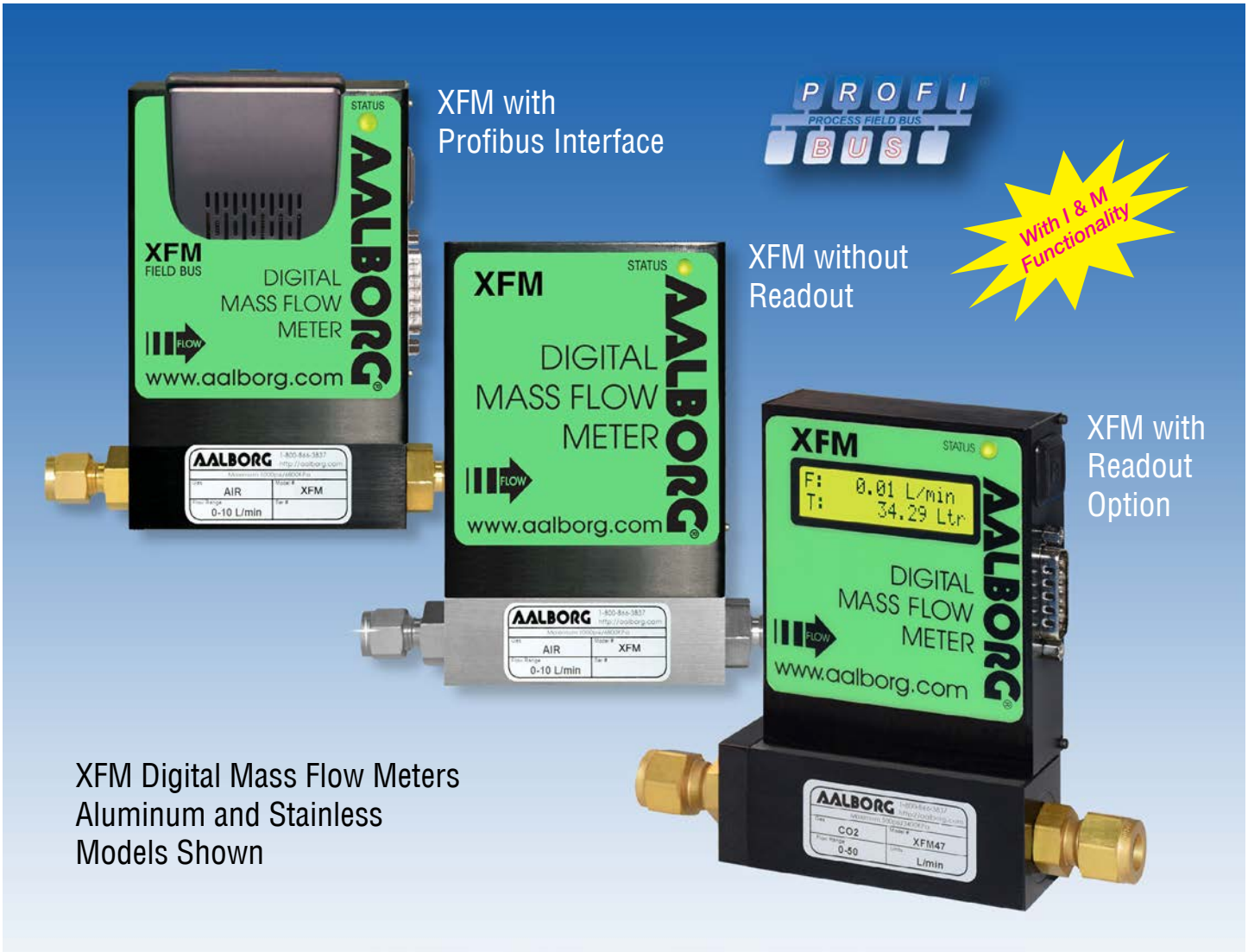
**n.a. = not applicable.*

GFM17 stainless steel, FKM seals, 1/4" compression fittings, display, 12 to 26 Vdc power, 0-5 Vdc, output signal, no digital interface.

XFM DIGITAL MASS FLOW METER

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 7 - 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 temperature of 70 °F (21.1 °C) only, and at 14.7 psia (101.4 kPa) 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:	XFM07/17/37/47: 1000 psig (6894 kPa gage) XFM57/67/77: 500 psig (3447 kPa gage)
MAXIMUM PRESSURE DROP:	0.18 PSID (at 10 L/min flow). 4 psi (at 50 L/min flow). See Table 10 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 07:** 1/8" compression fittings. Optional: 1/4" compression fittings. **XFM 17:** 1/4" compression fittings. Optional: 1/8", 3/8", 6 mm compression fittings, 1/4" VCR. **XFM 37:** 1/4" compression fittings. Optional: 3/8", 6 mm compression fittings, 1/4" VCR. **XFM 47:** 3/8" compression fittings. **XFM 57:** 3/8" compression fittings. **XFM 67:** 1/2" compression fittings. **XFM 77:** 3/4" FNPT. Optional: 3/4" 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.
**** FLUID CONTACT:**	Aluminum Models: Anodized aluminum, brass, 316 stainless steel, FKM O-rings.
	Stainless Steel Models: 316 stainless steel, FKM O-rings.
	Optional O-ring Materials: Buna-N®, EPR® (Ethylene Propylene), or FFKM.
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.*

***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

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 8 - STANDARD FLOW CAPACITIES FOR XFM

XFM 07	XFM 17	XFM 37	XFM 47	XFM 57	XFM 67	XFM 77
mL/min [N_2]	L/min [N_2]	L/min [N_2]	L/min [N_2]	L/min [N_2]	L/min [N_2]	L/min [N_2]
5	1	20	60	200	500	1000
10	2	30	80			
20	5	40	100			
50	10	50				
100						
200						
500						

TABLE 9 - MAXIMUM PRESSURE DROP FOR XFM

MODEL	FLOW RATE [liters/min]	MAXIMUM PRESSURE DROP		
		[mm H_2O]	[psid]	[kPa]
XFM 07	up to 0.5	130	0.18	1.275
XFM 17	up to 10	130	0.18	1.275
XFM 37	up to 50	2722	3.8	26.2
XFM 47	up to 100	1974	11.8	81.4
XFM 57	up to 200	2720	4.0	27.6
XFM 67	up to 500	3400	5.0	34.5
XFM 77	up to 1000	6120	9.0	62.0

Leak Integrity

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

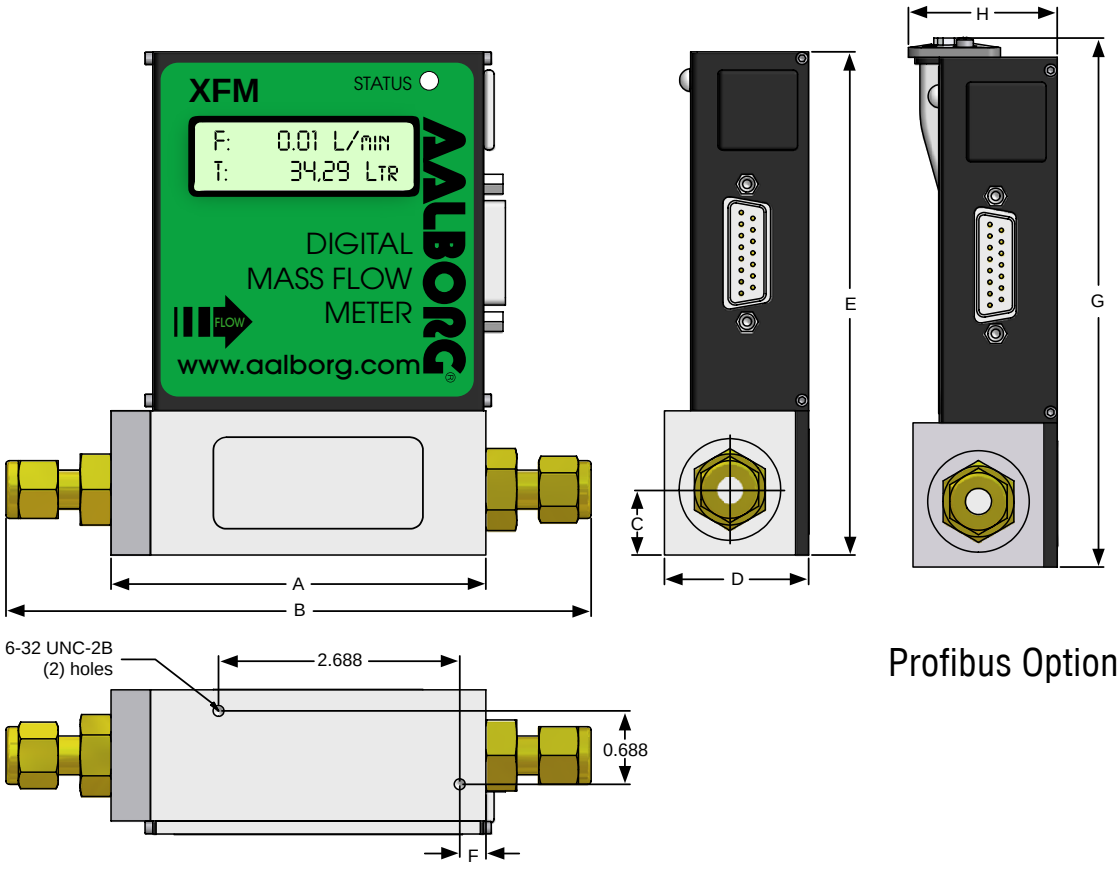
Engineering Units

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 10 - 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	m3/sec	m3	Cubic meter per second
9	8	m3/ min	m3	Cubic meter per minute
10	9	m3/hr	m3	Cubic meter per hour
11	10	ft3/sec	f3	Cubic feet per second
12	11	ft3/min	f3	Cubic feet per minute
13	12	ft3/hr	f3	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



Profibus Option

NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

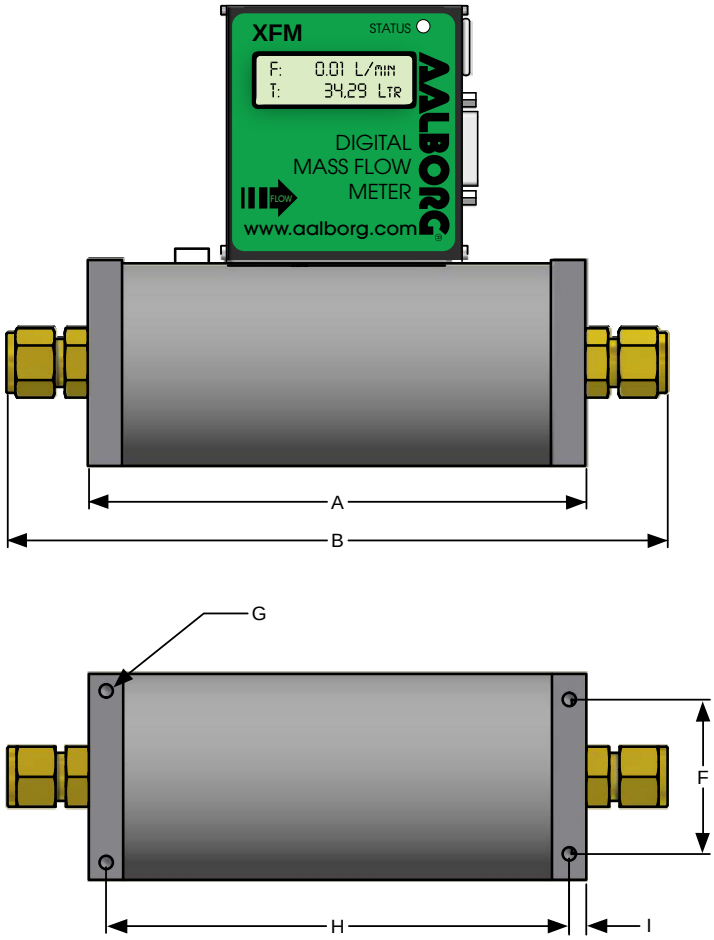
TABLE 11 - DIMENSIONS FOR XFM [INCH]

MODEL	*CONNECTION Compression Fitting (tube OD)	LCD and NO LCD VERSIONS						PROFIBUS CAPABILITY	
		A	B	C	D	E	F	H	I
XFM 07	1/4"	3.09	5.11	0.50	1.13	4.99	0.16	1.41	5.22
XFM 17	1/4"	3.09	5.11	0.50	1.13	4.99	0.16	1.41	5.22
XFM 37	1/4"	4.13	6.14	0.63	1.25	5.36	0.36	1.45	5.60
XFM 47	3/8"	4.13	6.25	0.63	1.25	5.36	0.36	1.45	5.60

TABLE 12 - DIMENSIONS FOR XFM [MM]

MODEL	*CONNECTION Compression Fitting (tube OD)	LCD and NO LCD VERSIONS						PROFIBUS CAPABILITY	
		A	B	C	D	E	F	H	I
XFM 07	1/4"	78.6	129.7	12.7	28.6	126.6	4.0	35.9	132.6
XFM 17	1/4"	78.6	129.7	12.7	28.6	126.6	4.0	35.9	132.6
XFM 37	1/4"	104.8	156.0	15.9	31.8	142.4	9.2	38.6	142.4
XFM 47	3/8"	104.8	158.8	15.9	31.8	142.4	9.2	38.6	142.4

For optional fittings see ordering information.



NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

TABLE 13 - DIMENSIONS FOR XFM [INCH]

MODEL	*CONNECTION Compression Fitting (tube OD)	LCD and NO LCD VERSIONS								TABLE MOUNTING HOLES
		A	B	C	D	E	F	H	I	
XFM 57	3/8"	6.69	8.81	0.88	1.75	5.99	1.39	4.69	1.00	10-24 UNC
XFM 67	1/2"	7.25	9.62	1.50	3.00	6.90	2.25	6.75	0.25	1/4-20 UNC
XFM 77	3/4"	7.25	-	2.00	4.00	7.92	3.00	6.75	0.25	1/4-20 UNC

TABLE 14 - DIMENSIONS FOR XFM [MM]

MODEL	*CONNECTION Compression Fitting (tube OD)	LCD and NO LCD VERSIONS								TABLE MOUNTING HOLES
		A	B	C	D	E	F	H	I	
XFM 57	3/8"	169.8	223.7	22.2	44.5	152.0	35.3	119.0	25.4	10-24 UNC
XFM 67	1/2"	184.2	244.3	38.1	76.2	175.2	57.2	171.4	6.4	1/4-20 UNC
XFM 77	3/4"	184.2	-	50.8	101.6	201.2	76.2	171.4	6.4	1/4-20 UNC

TABLE 15 - XFM ACCESSORIES	
CBL-XFM	D-SUB F 15 pins connector with two 6 feet long branches with stripped ends for user supplied power supply and digital communication interface (no support for analog interface and relays). This cable is included with each instrument.
CBL-DGS	D-SUB F 15 pins connector with 6 feet long shielded cable (stripped ends). Can be used with user supplied power supply, allows access to all XFM peripherals. (Optional).
PS-XFM-110NA-2	Power Supply / cable assembly 110VAC NA PLUG 12Vdc with 6 feet long communication interface branch stripped ends (no support for analog interface and relays output). (Optional).
PS-XFM-110NA-2-A	Power Supply / cable assembly 110VAC NA PLUG 12Vdc with 6 feet long communication interface branch stripped ends with support for analog interface and relays output. (Optional).
PS-XFM-230EU-2	Power Supply / cable assembly 230VAC EU PLUG 12Vdc with 6 feet long communication interface branch stripped ends (no support for analog interface and relays output). (Optional).
PS-XFM-230EU-2-A	Power Supply / cable assembly 230VAC EU PLUG 12Vdc with 6 feet long communication interface branch stripped ends with support for analog interface and relays output. (Optional).
PS-XFM-240AU-2	Power Supply / cable assembly 240VAC AU PLUG 12Vdc with 6 feet long communication interface branch stripped ends (no support for analog interface and relays output). (Optional).
PS-XFM-240AU-2-A	Power Supply / cable assembly 240VAC AU PLUG 12Vdc with 6 feet long communication interface branch stripped ends with support for analog interface and relays output. (Optional).
PS-XFM-240UK-2	Power Supply / cable assembly 240VAC UK PLUG 12Vdc with 6 feet long communication interface branch stripped ends (no support for analog interface and relays output). (Optional).
PS-XFM-240UK-2-A	Power Supply / cable assembly 240VAC UK PLUG 12Vdc with 6 feet long communication interface branch stripped ends with support for analog interface and relays output. (Optional).

Configure and Order Online: XFM Mass Flow Meter

XFM	MODEL

MAX FLOW (N_2)	
07	0.5 L/min
17	10 L/min
37	50 L/min
47	100 L/min
57	200 L/min
67	500 L/min
77	1000 L/min

MATERIAL	
A	Aluminum
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	PTFE / FFKM

FITTINGS		MODEL
A	1/4" Compression	XFM 07, 17, 37
B	1/8" Compression	XFM 07, 17
C	1/4" VCR®	XFM 17, 37
D	3/8" Compression	XFM 17, 37, 47, 57
E	1/2" Compression	XFM 67
F	3/4" FNPT	XFM 77
G	3/4" Compression	XFM 77
H	6mm Compression	XFM 07, 17, 37

DISPLAY	
N	NO Display
L	LCD Readout

POWER	
6	Universal 11 to 26 Vdc

OUTPUT SIGNAL	
A	0-5Vdc
B	4-20mA

DIGITAL INTERFACE	
2	RS232
5	RS485
9	PROFIBUS

XFM	17	S	–	V	A	L	6	–	A	2

EXAMPLE: XFM17S-VAL6-A2 5 L/min [N_2] 20 psig

SPECIFY: Flow Range, Gas and Pressure

**n.a. = not applicable*

XFM17 stainless steel, FKM seals, 1/4" compression fittings with LCD readout, 11 to 26 Vdc, 0-5 Vdc output signal with RS232 digital interface.


ZFM
ZFM
Intelligent
Mass Flow Meter
M 65.8
mL/min
NITROGEN
T1:
2338 mL
Esc
flow
AALBORG
1-800-866-3837
http://aalborg.com
Maximum 1000psi/6800KPa
Model # ZFM17
Gas N2
Units mL/min
Flow Range 0-1000

Design Features

- Multi-gas/Multi-range functionality up to 8 bar (currently for 6 gases).
- Full scale covered flow ranges from 3.125 sml/min to 10 sL/min are available in seven models.
- Standard accuracy ± (0.5% RD + 0.2% FS) based on actual calibration.
- Universal 14-24 Vdc power supply input.
- Supports up to 46 Engineering Units (including User-defined).
- Stores additional user- calibration table data for up to 10 gases.
- Two programmable Totalizers indicate total gas quantity.
- User-programmable Pulse Output (via SSR).
- High and low gas flow Alarm limits with preset delay interval.
- One user-programmable solid-state relays with latch option.
- User-selectable analog 0-5 Vdc, 0-10 Vdc, or 4-20mA outputs.
- Internal conversion factors for up to 26 gases.
- Digital interface (RS-232 or RS-485) test/configuration port, optional Modbus RTU with Isolated RS-485 transceiver).
- Multi-Drop capability of up to 247 units (RS-485 option).
- Optional Modbus RTU network interface with Isolated RS-485 transceiver.
- Automatic sensor zero offset adjustment (via digital interface or local push button).
- Extensive Self- diagnostic with status LED or OLED (optional) indication.
- Local 128 x 64 high contrast OLED (optional) graphic display with joystick control.
- Free, easy-to-use configuration and calibration software (RS-232/RS-485).

User Features

- ZFM Meters, with the new “Multi-Gas/ Multi-Range (MGMR) features, cover flow ranges from 0-3.125 sml/min to 0-10 sL/min are available in seven standard configurations and maintain their high accuracy with turndown ranges up to 133.3 to 1.
- OEM users can significantly reduce the number of instruments kept in stock, storage space, and cost of ownership.
- ZFM users can rescale their instruments to the desired gas and full scale range on site saving time and money.
- Save on considerable installation costs, instrument removal from the factory floor, and recalibration service which are no longer applicable.
- Aalborg provides each ZFM meter with free and easy-to-use “ZFM Configuration Utility Software”. By connecting the instrument to the RS232 port of a PC or lap-top and running this configuration utility, the user can select different gas types and flow ranges within a few minutes without removing the instrument from the installation.
- Each instrument comes with the standard user-selectable (0-5Vdc, 0-10 Vdc, or 4-20 mA) analog output signals and the RS232 or RS-485 digital interface. Optional Modbus interface is also available.

TABLE 16 - FLOW RANGES FOR ZFM

ZFM LOW FLOW MASS METERS		
CODE	Nominal Flow Range sL/min [N_2]	Reconfigurable Full Scale Flow Ranges [Min – Max] sL/min (N_2)
01	0.0125	0.003125 – 0.0125
03	0.05	0.0125 – 0.05
05	0.2	0.05 – 0.2
06	0.8	0.2 – 0.8
08	2.0	0.5 – 2.0
09	6.0	1.5 – 6.0
10	10.0	2.5 – 10.0

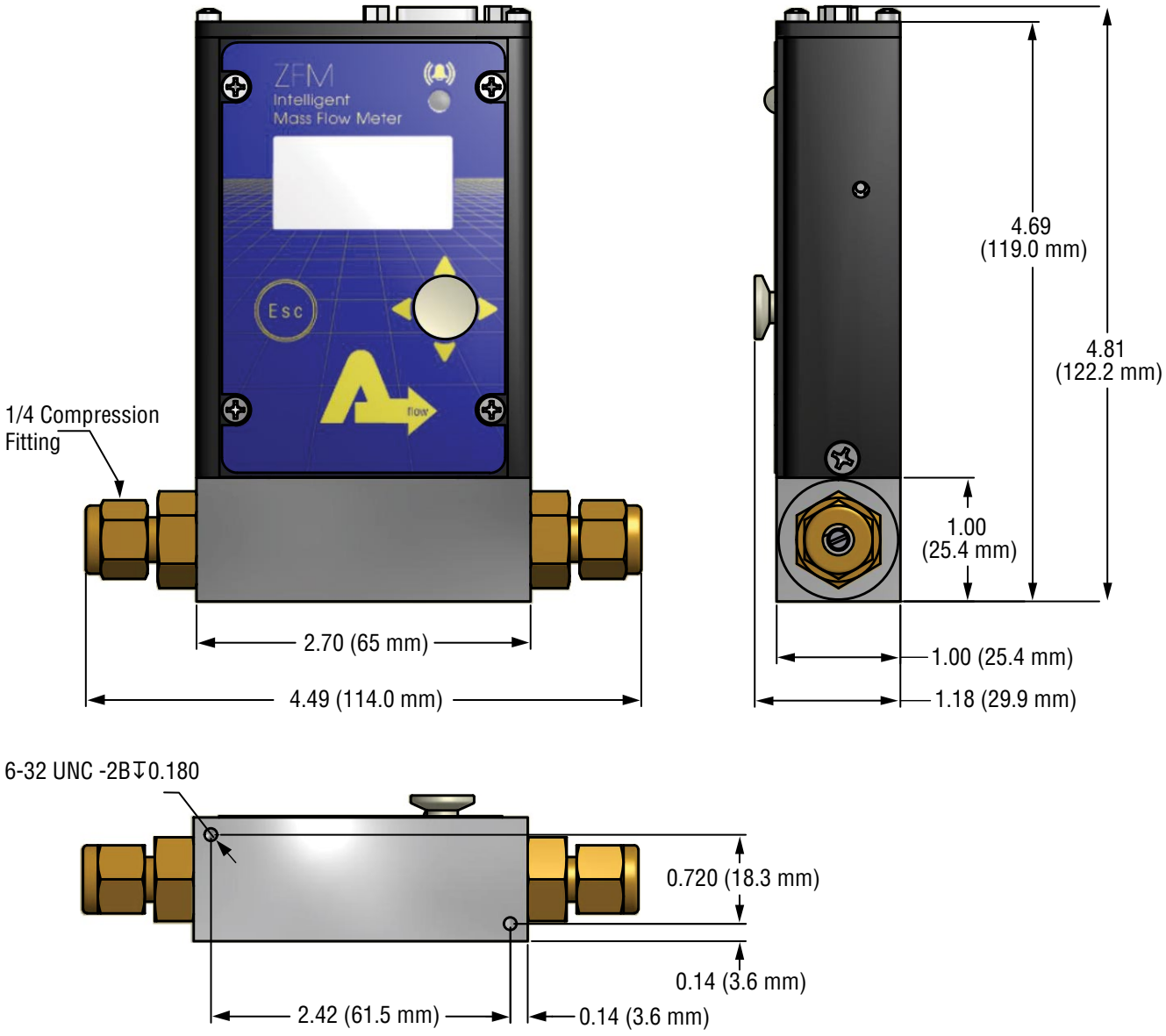
ZFM DIGITAL MASS FLOW METER

TABLE 17 - ZFM SPECIFICATIONS	
FLOW MEDIUM:	Please note that ZFM Mass Flow Meters are designed to work only with clean gases. Never try to measure flow rates of liquids with any ZFM.
CALIBRATIONS:	Performed at standard temperature of 70 °F (21.1 °C) only, and at 14.7 psia (101.4 kPa) unless otherwise requested.
ENVIRONMENTAL (PER IEC 664):	Installation Level II; Pollution Degree II.
FLOW ACCURACY (INCLUDING LINEARITY):	±(0.5% RD + 0.2% FS) based on actual calibration (at calibration temperature and pressure).
REPEATABILITY:	±0.15% of full scale.
FLOW TEMPERATURE COEFFICIENT:	0.05% of full scale/ °C or better.
FLOW PRESSURE COEFFICIENT:	0.01% of full scale/psi (6.895 kPa) or better.
FLOW RESPONSE TIME:	1000ms time constant; approximately 2 seconds to within ±2% of set flow rate for 0% to 100% of full scale flow.
MAXIMUM PRESSURE:	1000 PSIG (6894 kPa gauge).
MAXIMUM PRESSURE DROP:	About 0.8 psi at 10 L/min flow (TBD).
GAS AND AMBIENT TEMPERATURE:	32 °F to 122 °F (0 °C to 50 °C).
RELATIVE GAS HUMIDITY:	Up to 70%.
LEAK INTEGRITY:	1 x 10^{-9} sccs He maximum to the outside environment.
ATTITUDE SENSITIVITY:	Incremental deviation of up to 0.5% FS from stated accuracy, after re-zeroing.
OUTPUT SIGNALS:	Linear 0-5 Vdc (3000 ohms min load impedance); Linear 0-10 Vdc (5000 ohms min load impedance); Linear 4-20 mA (500 ohms maximum loop resistance). Maximum noise 10mV peak to peak (for 0-5 Vdc output).
METER INPUT POWER:	14 to 26 Vdc, 100 mV maximum peak to peak noise. Power consumption: maximum 100 mA @ 24Vdc; Circuit board have built-in polarity reversal protection, 300mA resettable fuse provide power input protection.
****MATERIALS FLUID CONTACT:**	Aluminum Models: Anodized aluminum, brass, 316 stainless steel, FKM O-rings. Stainless Steel Models: 316 stainless steel, FKM O-rings. Optional O-ring Materials: Buna-N® , EPR® (Ethylene Propylene), or FFKM.

⚠ 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

CONNECTIONS:	Model ZFM 17 standard 1/4" compression fittings. Optional 6mm, 1/8" or 3/8" compression fittings and 1/4" VCR fittings are available.
DISPLAY:	Optional local 128x64 graphic yellow OLED with Esc button and Joystick interface.
CALIBRATION OPTIONS:	Build-in support based on empirical K-Factors for additional 5 gases (Air, CO2, O2, Argon, and Helium) included.
	NOTE: Calibration certificate by default provided for Nitrogen only. If Calibration certificate required for other gases optional "as found" calibration must be ordered.
	Optional, up to 10 additional custom calibrations (with calibration certificate) may be ordered at additional charge.
CE COMPLIANCE:	EMC Compliance with 2004/108/EC as amended. CISPR 11. Emission Standard: IEC 61000-6-3. Immunity Standard: IEC 61000-6-1.

***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*



NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

TABLE 18 - ZFM ACCESSORY'S	
MODEL NO.	**DESCRIPTION**
	POWER SUPPLIES
PS-ZFM-110NA-4	ZFM power supply 110VAC North America plug 24 vdc with DC jack power adapter.
PS-ZFM-230EU-4	ZFM power supply 230VAC Europe plug 24Vdc with DC jack power adapter.
PS-ZFM-240UK-4	ZFM power supply 240VAC U.K. plug 24Vdc with DC jack power adapter.
PS-ZFM-240AU-4	ZFM power supply 240VAC Australia plug 24Vdc with DC jack power adapter.
	CABLES
ZFM-APW-BX	Adapter for ZFM DC Power DB9 M/F 2.1 mm DC jack in the box (for user supplied power supply).
CSM9MF-5	Shielded cable D-Sub M/F 9 pins 5.0 feet long.
CSM9MF-10	Shielded cable D-Sub M/F 9 pins 10.0 feet long.
CSM9MF-15	Shielded cable D-Sub M/F 9 pins 15.0 feet long (recommended for 4-20 mA analog output option only).
CSM9MF-25	Shielded cable D-Sub M/F 9 pins 25.0 feet long (recommended for 4-20 mA analog output option only).
CSM9MF-50	Shielded cable D-Sub M/F 9 pins 50.0 feet long (recommended for 4-20 mA analog output option only).
KIT-ZFM-2.5FT	ZFM Electrical Connection Kit: 2.5 feet M/F shielded cable and screw terminal with cover for field termination (included with each ZFM).
CBL-A232	Communication Cable for ZFM with RS-232 Interface 6 FT 3.5mm stereo audio con. with 3-wire to 9 pins female D-connector (included with each ZFM equipped with RS-232 port).
CBL-A485	Communication Cable for ZFM with RS-485 Interface 6 FT 3.5mm stereo audio con. with 3-wire to stripped ends (included with each ZFM equipped with RS-485 port).
	COMMUNICATION PORT ACCESSORIES
USB-RS232	USB to RS232 converter.
USB-RS485	USB to RS485 converter.
RBA098F	Adapter RJ45 TO DB9 female (8X8) for ZFM Modbus interface cable to usb/rs485 converter (USB-RS485).
	MODBUS INTERFACE ACCESSORIES
ECS803-1	RJ45 shielded Y-adapter (Passive TAP).
TDG1026-8C	RJ45 Modular Coupler.
MOD27T	RJ45 Line Terminator (100 Ohm 0.25 W).
JMOD4S-1	RJ45 Splitter fully shielded (5xRJ45, 1 input 4 outputs).
TRD815BL-2	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 2.0 feet.
TRD815BL-10	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 10.0 feet.
TRD815BL-25	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 25.0 feet.

Configure and Order Online: ZFM Mass Flow Meter

ZFM	MODEL

MAX FLOW (N_2)	
17	10 L/min

MATERIAL	
A	Aluminum
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	PTFE / FFKM

FITTINGS		MODEL
A	1/4" Compression	ZFM 17
B	1/8" Compression	ZFM 17
C	1/4" VCR®	ZFM 17
H	6mm Compression	ZFM 17

DISPLAY	
N	NO Display
L	LCD Readout

POWER	
6	Universal 11 to 26 Vdc

OUTPUT SIGNAL	
A	0-5Vdc
B	4-20mA
M	0-10 Vdc

DIGITAL INTERFACE	
2	RS232
5	RS485
3	RS232 with MODBUS

ZFM	17	S	—	V	A	L	6	—	A	2

EXAMPLE: ZFM17S-VAL6-A2 5 L/min [N_2] 20 psig

SPECIFY: Flow Range, Gas and Pressure

**n.a. = not applicable.*

ZFM17 stainless steel, FKM seals, 1/4" compression fittings with LCD readout, 14 to 26 Vdc, 0-5 Vdc output signal with RS232 digital interface.

DPM


AALBORG
DPM
Intelligent
Mass Flow Meter
14.71 PSIA
22.4 C
0.00 SmL/min
T1: 540553.6 SmL
Esc
FLOW

Design Features

- Multi-Parameter functionality: Mass Flow, Volumetric Flow, Gas Pressure and Temperature.
- Multi-Gas functionality: support for 90 different gases and gas mixes.
- Available with corrosion-resistant wetted materials (DPM/08/18/38/48/58/68/78 Series) and low pressure drop (BREEZE™ DPM04/14/24/34/44/54 Series).
- "User Defined Mixture" functionality allows to create and store up 20 custom gas mixes with up to 5 different gases each.
- Quick (< 20ms) response time.
- Standard accuracy ± (0.5% RD + 0.2% FS).
- 200 to 1 turndown ratio.
- Two programmable mass flow rate totalizers.
- High, Low or In Range Alarms with preset action delay for Mass Flow, Temperature and Pressure.
- User programmable mass flow rate Pulse Output (via SSR).
- Extensive Self Diagnostics with status LED or OLED indication.
- All 3 user selectable analog output interfaces are standard: 0-5Vdc, 0-10Vdc, 4-20mA.
- Two user selectable digital communication interfaces (RS-232 and RS-485) are standard.
- Optional Modbus RTU network interface with isolated RS485 transceiver.
- User programmable solid state relay with latch option.
- Universal 9-26 Vdc power supply input.
- Local high contrast OLED (optional) graphic display with joystick control.
- Free, easy-to-use configuration and calibration software (RS-232/RS-485).

General Description

Aalborg Instruments' DPM series digital multi-parameter mass flow meter provides accurate measurements of mass flow rate, volumetric flow rate, pressure and temperature of process gases. It can be used in a variety of industries: scientific and analytical applications, bioreactors and surface depositions, gas sampling, manufacturing and metrology activities.

DPM series digital mass flow meters incorporate multi-parameter multi-gas functionality which allows users on site to select up to 30 different gases locally via optional OLED/Joystick interface, remotely via the RS232/RS485 interface or optional Modbus RTU interface. Standard acuracy is +/- (0.5% RDG + 0.2% FS). Turn down ratio is 200:1. Response time is 10-20 ms.

DPM flow meters support various functions including: two programmable flow totalizers, low, high or range flow, temperature and pressure alarms, automatic zero adjustment (activated via local or communication interface), programmable SSR relay, programmable 0-5 Vdc, 0-10 Vdc or 4-20 mA analog outputs, user-programmable pulse output (via SSR), and extensive self-diagnostics functionality.

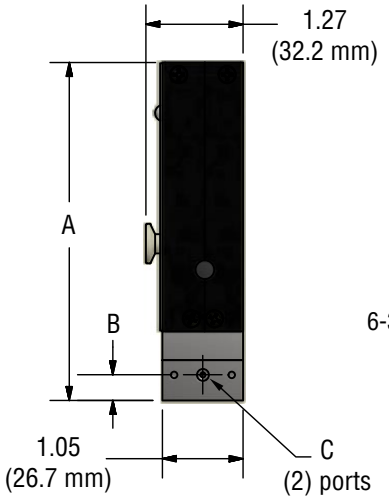
Significant savings become apparent when comparing the cost of a single DPM meter embodying these features, with that of acquiring and installing multiple, application-specific devices.

Principles of Operation

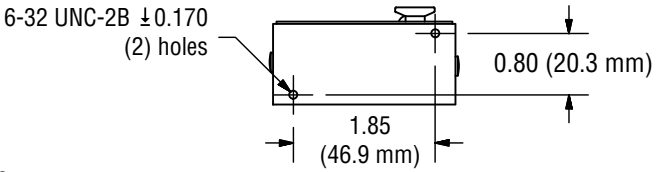
Operation of DPM flow meters is based on the measurement of the differential pressure across specially designed restrictor flow elements. The restrictor flow element is designed to establish laminar flow across the entire range of the instrument's operation from 0 to 133% of full scale range.

A high accuracy and high resolution **differential** pressure sensor is utilized to measure pressure drop across a laminar flow channel, which is linearly proportional to volumetric flow rate. To convert volumetric flow into mass flow, high accuracy and high resolution **absolute** pressure and temperature sensors are utilized. Based on data from the sensors and gas properties from the built-in data base of the instrument, the microcontroller calculates volumetric and mass flow, which along with pressure and temperature parameters are available on the instrument display or via digital interfaces. In addition, the mass flow reading is accessible via the instrument analog interface which can be set by user to 0-5, 0-10 Vdc or 4-20mA mode.





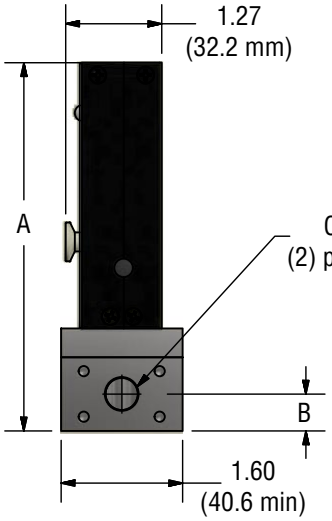
Low Flow Meter Dimensions



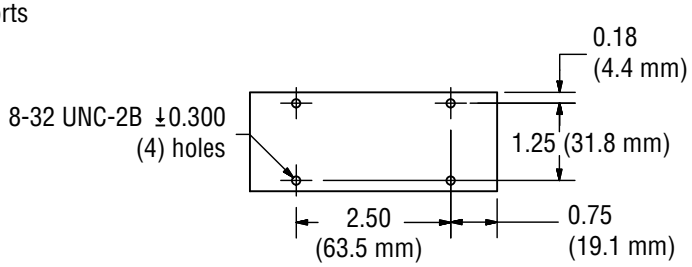
	A (non- corrosive)	A (corrosive resistant)	B	C
DPM04* / DPM07 /DPM08**	4.40 (111.8 mm)	5.03 (127.7 mm)	0.34 (8.5 mm)	10-32 UNF-2B
DPM14* / DPM17 / DPM18**	4.58 (116.2 mm)	5.13 (130.4 mm)	0.35 (8.9 mm)	1/8-27 NPT
DPM24*	5.0 (127.0 mm)		0.35 (8.9 mm)	1/4-18 NPT

* Breeze Models
** Corrosive Resistance Models





Medium and High Flow Meter Dimensions



	A (non- corrosive)	A (corrosive resistant)	B	C
DPM34*/DPM37 /DPM38**	4.85 (123.2 mm)	5.65 (143.5 mm)	0.49 (12.3 mm)	1/4"-18 NPT
DPM4 7/DPM48**	4.85 (132.2 mm)	5.65 (143.5 mm)	0.49 (12.3 mm)	1/4"-18 NPT
DPM44*/DPM57 /DPM58**	5.48 (139.1 mm)	6.28 (159.5 mm)	0.80 (20.3 mm)	1/2"-14 NPT
DPM54*/DPM67 /DPM68**	5.48 (139.1 mm)	6.28 (159.5 mm)	0.80 (20.3 mm)	3/4"-14 NPT
DPM77 /DPM78**	5.48 (139.1 mm)	6.28 (159.5 mm)	0.80 (20.3 mm)	3/4"-14 NPT

* Breeze Models
** Corrosive Resistance Models

NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.



TABLE 19 - DPM FLOW RANGES			
MODEL NO.	**FULL SCALE MASS FLOW RATE**	**PRESSURE DROP AT FULL SCALE FLOW (PSID)**	**PROCESS CONNECTION**
STANDARD PRESSURE DROP [AIR]			
DPM07	0.5 to 50 smL/min	1.0	10-32 Female Thread
DPM17	51 smL/min to 20 sL/min	1.0	1/8" NPT Female
DPM37	21 sL/min to 50 sL/min	2.0	1/4" NPT Female
DPM47	51 sL/min to 100 sL/min	2.5	1/4" NPT Female
DPM57	101 sL/min to 250 sL/min	5.5	1/2" NPT Female
DPM67	251 sL/min 500 sL/min	5.5	3/4" NPT Female
DPM77	501 sL/min to 1000 sL/min	7.0	3/4" NPT Female
CORROSION-RESISTANT PRESSURE DROP [AIR]			
DPM08	0.5 to 50 smL/min	1.0	10-32 Female Thread
DPM18	51 smL/min to 20 sL/min	1.0	1/8" NPT Female
DPM38	21 sL/min to 50 sL/min	2.0	1/4" NPT Female
DPM48	51 sL/min to 100 sL/min	2.5	1/4" NPT Female
DPM58	101 sL/min to 250 sL/min	5.5	1/2" NPT Female
DPM68	251 sL/min 500 sL/min	5.5	3/4" NPT Female
DPM78	501 sL/min to 1000 sL/min	7.0	3/4" NPT Female
DPM (BREEZE™) LOW PRESSURE DROP [AIR]			
DPM04	0.5 smL/min to 20 smL/min	0.06	10-32 Female Thread
DPM14	21 smL/min to 2 sL/min	0.07	1/8" NPT Female
DPM24	2.1 sL/min to 10 sL/min	0.085	1/4" NPT Female
DPM34	10.1 sL/min to 20 sL/min	0.3	1/4" NPT Female
DPM44	20.1 sL/min to 40 sL/min	0.15	1/2" NPT Female
DPM54	40.1 sL/min to 100 sL/min	0.25	3/4" NPT Female

TABLE 20 - DPM ACCESSORY'S		
FITTINGS		
MODEL NO.	**FITTING CODE**	**DESCRIPTION**
DPM07 / 08 / 04	F1C5	10-32 Thread, 1/8" Tubing, Compression, 316 ss.
DPM07 / 04	F2C5	10-32 Thread, 1/8" Tubing, Compression, Nickel Plated Brass.
DPM17 / 18 / 14	F2C2	1/8" NPT Thread, 1/8" tubing, Compression, 316 ss.
DPM17 / 18 / 14	F2C4	1/8" NPT Thread, 1/4" tubing, Compression, 316 ss.
DPM37 / 38 / 34	F4C4	1/4" NPT Thread, 1/4" tubing, Compression, 316 ss.
DPM24 / 34 / 48 / 47	F4C6	1/4" NPT Thread, 3/8" tubing, Compression, 316 ss.
DPM44 / 57 / 58	F8C6	1/2" NPT Thread, 3/8" tubing, Compression, 316 ss.
DPM54 / 67 / 68	1210-1-12-316	3/4" NPT Thread 3/4" tubing, Compression, 300 series ss.
DPM54 / 77 / 78	1210-1-12-316	3/4" NPT Thread 3/4" tubing, Compression, 300 series ss.
POWER SUPPLIES		
PS-GFM-110NA-2	Power Supply, 110 V / 12 Vdc / North America.	
PS-GFM-110NA-4	Power Supply, 110 V / 24 Vdc / North America.	
PS-GFM-230EU-2	Power Supply, 220 V / 12 Vdc / Europe.	
PS-GFM-230EU-4	Power Supply, 220 V / 24Vdc / Europe.	
PS-GFM-240UK-2	Power Supply 240 V / 12 Vdc / United Kingdom.	
CABLES		
CBL-RS232	Communication Cable for DPM with RS232 Interface 1.5 FT 3.5mm stereo audio con. with 3-wire to 9 pins female D-connector (included with each DPM ordered with RS-232 interface).	
CBL-RS485DP	Communication Cable for DPM with RS485 Interface 3 FT 3.5 mm stereo audio con. with 3-wire to stripped ends. (included with each DPM ordered with RS-485 interface).	
CBL-8MINIDIN-3	Shielded cable 8 pins MinDin with stripped ends 3 feet long.	
CBL-8MINIDIN-12	Shielded cable 8 pins MinDin with stripped ends 12 feet long.	
COMMUNICATION PORT ACCESSORIES		
USB-RS232	USB to RS232 converter.	
USB-RS485	USB to RS485 converter.	
MODBUS INTERFACE ACCESSORIES		
ECS803-1	RJ45 shielded Y-adapter (Passive TAP).	
TDG1026-8C	RJ45 Modular Coupler.	
MOD27T	RJ45 Line Terminator (100 Ohm 0.25 W).	
JMOD4S-1	RJ45 Splitter fully shielded (5xRJ45, 1 input 4 outputs).	
TRD815BL-2	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 2.0 feet.	
TRD815BL-10	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 10.0 feet.	
TRD815BL-25	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 25.0 feet.	

TABLE 21 - DPM SPECIFICATIONS		
FLOW MEDIUM:	Please note that DPM04/07/14/17/24/37/44/47/54/57/67/77 mass flow meters are designed to work only with clean, non-corrosive gases. The DPM08/18/38/48/58/68/78 mass flow meters are also compatible with corrosive gases listed in the instrument's operating manual. Never try to measure flow rates of liquids with any DPM.	
CALIBRATIONS:	Perform at standard conditions [14.7 psia (101.4 kPa) and 70 °F (21.1 °C)]	
ENVIRONMENTAL (PER IEC 664):	Installation Level II; Pollution Degree II.	
FLOW ACCURACY (INCLUDING LINEARITY):	±(0.5% RD + 0.2% FS) at calibration temperature and pressure.	
REPEATABILITY:	±0.15% of full scale.	
FLOW TEMPERATURE COEFFICIENT:	0.05% of full scale/ °C or better.	
FLOW PRESSURE COEFFICIENT:	0.01% of full scale/psi (6.895 kPa) or better.	
FLOW RESPONSE TIME:	Default 10 ms (adjustable by user).	
INSTRUMENT WARM-UP TIME:	< 5 seconds.	
MAXIMUM MEASURABLE FLOW RANGE:	133% Full Scale.	
OPERATING RANGE / TURNDOWN RATIO:	0.5% to 100% Full Scale / 200:1.	
MASS REFERENCE CONDITIONS (STP):	70 °F & 14.696 PSIA (other available on request).	
MAXIMUM INTERNAL GAS PRESSURE (STATIC):	DPM07/17/37/47/57/67/77	120 PSIG
	DPM04/14/24/34/44/54	50 PSIG
	DPM08/18/38/48/58/68/78	150 PSIG
MAXIMUM INSTANTANEOUS DIFFERENTIAL PRESSURE ACROSS INLET AND OUTLET:	DPM07/17/37/47/57/67/77	12 PSID
	DPM04/14/24/34/44/54	9.75 PSID
	DPM08/18/38/48/58/68/78	10 PSID
PROOF PRESSURE:	DPM07/17/37/47/57/67/77	145 PSIG
	DPM04 /14 /24 /34 /44 /54	50 PSIG
	DPM08 /18 /38 /48 /58 /68 /78	175 PSIA
OPERATING TEMPERATURE:	-10 to +60 °C (14 to 140 °F).	
MOUNTING ATTITUDE SENSITIVITY:	DPM07/17/37/47/57/67/77: None	
	DPM08/18/38/48/58/68/78: None after differential pressure sensor Tare procedure.	
RELATIVE GAS HUMIDITY RANGE:	0 to 100% (Non-Condensing).	
INGRESS PROTECTION:	IP40.	
OUTPUT SIGNALS:	Linear 0-5 Vdc (3000 ohms min. load impedance);	
	Linear 0-10 Vdc (5000 ohms min. load impedance); with power supply >= 12Vdc.	
	Linear 4-20 mA (550 ohms maximum loop resistance) with power supply >= 12Vdc.	
	Maximum noise 10mV peak to peak (for 0-5/0-10 Vdc output).	
TRANSDUCER INPUT POWER:	9 to 26 Vdc, 150 mV maximum peak to peak output noise. Power consumption: 100 mA maximum. Circuit board has built-in polarity reversal protection, 300mA resettable fuse provide power input protection.	
DIGITAL OUTPUT SIGNALS:	Standard RS-232 or RS-485 (user selectable). Optional Modbus over isolated RS-485 transceiver.	
**** WETTED MATERIALS:**	DPM04/07/14/17/24/34/37/44/47/54/57/67/77: 300 Series Stainless steel, FKM O-rings, high-temperature polyamide, alumina ceramic, epoxy, silicone, glass, gold.	
	DPM08/ 18 /38 /48 /58 /68 /78: 316 Stainless steel, FKM or FFKM O-rings.	

*** The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

Configure and Order Online: DPM Mass Flow Meter

DPM	MODEL

MAX FLOW (Air)		
Standard Pressure Drop	07	0.5 sml/min to 50 sml/min
	17	51 sml/min to 20 sL/min
	37	21 sL/min to 50 sL/min
	47	51 sL/min to 100 sL/min
	57	250 sL/min
	67	500 sL/min
	77	1000 sL/min
Corrosion-Resistant	08	0.5 to 50 smL/min
	18	51 smL/min to 20 sL/min
	38	21 sL/min to 50 sL/min
	48	51 sL/min to 100 sL/min
	58	101 sL/min to 250 sL/min
	68	251 sL/min 500 sL/min
	78	501 sL/min to 1000 sL/min
Breeze™ Low Pressure Drop	04	0.5 smL/min to 20 smL/min
	14	21 smL/min to 2 sL/min
	24	2.1 sL/min to 10 sL/min
	34	10.1 sL/min to 20 sL/min
	44	20.1 sL/min to 40 sL/min
	54	40.1 sL/min to 100 sL/min

MATERIAL	
S	Stainless Steel

SEALS	
V	FKM
T	FFKM

CONNECTIONS	
0	Not Included (Optional Accessory)

OLED READOUT	
N	NO Display
L	OLED Readout

POWER	
6	Universal 9 to 26 Vdc

OUTPUT SIGNAL	
A	0-5 Vdc
B	4-20 mA
M	0-10 Vdc

DIGITAL INTERFACE	
2	RS232
5	RS485
3	RS232 with Modbus
4	RS485 with Modbus

DPM	17	S	—	V	0	L	6	—	A	3

EXAMPLE: DPM17S-V0L6-A3

SPECIFY: Flow Range, Gas and Pressure **n.a. = not applicable.*

DPM17, 316 stainless steel, FKM seals, with OLED readout 9-26 Vdc, 0-5 Vdc output signal,RS 232 with Modbus

Model GFC thermal Mass Flow Controllers are designed to indicate and control set flow rates of gases.

The GFC combines the characteristics and accuracy of conventional mass flow devices into a unique compact design at low costs previously unattainable.

Each of these controllers incorporates an advanced U shape tube sensor in conjunction with flow passage elements constructed of aluminum and brass for non-corrosive gases or 316 stainless steel for corrosive applications. Zero and span adjustments are accessible from the outside of transmitters.

Principles of Operation

Metered gases are divided into two laminar flow paths, one through the primary flow conduit, and the other through a capillary sensor tube. Both flow conduits are designed to ensure laminar flows and therefore the ratio of their flow rates is constant.

Two precision temperature sensing windings on the sensor tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

A Wheatstone bridge design is used to monitor the temperature dependent resistance gradient on the sensor windings which is linearly proportional to the instantaneous rate of flow.

Output signals of 0 to 5Vdc and 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas. The combined gas streams flow through a proportionating electromagnetic valve with an appropriately selected orifice. The closed loop control circuit continuously monitors the mass flow output and maintains it at the set flow rate.

Flow rates are unaffected by temperature and pressure variations within stated limitations.

Design Features

- Rigid metallic construction.
- Maximum pressure of 1000 psig (70 bars).
- Leak integrity 1 x 10^{-9} smL/sec of helium.
- NIST traceable certification.
- Built-in tiltable LCD readout.
- Local or remote setpoint control.
- 0-5 Vdc and 4-20 mA signals.
- Circuit protection.
- TIO Totalizer option.

General Description

Compact, self-contained GFC mass flow controllers are designed to indicate and control flow rates of gases. The rugged design coupled with instrumentation grade accuracy provides versatile and economical means of flow control. Aluminum or stainless steel models with readout options of either engineering units (standard) or 0 to 100 percent displays are available. The built-in electromagnetic valve allows the flow to be set to any desired flow rate within the range of the particular model.



Typical Stainless Steel GFC Mass Flow Controller

Setpoints are controlled either locally or remotely. The valve is normally closed as a safety feature to ensure that gas flow is shut off in case of a power outage. The LCD readout built into the top of the transducer is tiltable over 90 degrees to provide optimal reading comfort. It is connected to the transducer by a standard modular plug, and is readily removable for remote reading installations. Transducers without LCD readout are offered for OEM applications. GFC mass flow controllers are available with flow ranges from 10 mL/min to 1000 L/min N_2. Gases are connected by means of 1/4", 3/8", or optional 1/8" compression fittings and 3/4" FNPT fittings. Optional fittings are available. These controllers may be used as bench top units or mounted by means of screws in the base. Transducer power supply ports are fuse and polarity protected.

Leak Integrity

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

TABLE 22 - SPECIFICATIONS

ACCURACY:	**ACCURACY %FS**				**OPTIONAL ENHANCED ACCURACY %FS**			
	MODEL:	GFC 17, 37, 47	GFC 57, 67, 77		**MODEL:**	GFC 57, 67, 77		
	FLOW RANGE:	0-100%	20-100%	0-20%	**FLOW RANGE:**	20-100%	0-20%	
	ACCURACY:	±1.0%	±1.5%	±3%	**ACCURACY:**	±1%	±1.0%	REF DATA with ±1%
CALIBRATIONS:	Performed at standard temperature of 70 °F (21.1 °C) only, and at 14.7 psia (101.4 kPa) unless otherwise requested.							
REPEATABILITY:	±0.5% of full scale.							
RESPONSE TIME:	**GFC17:** 300ms time constant; approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow.							
	GFC 37/47: 600ms time constant; approximately 2 seconds to within ±2% of set flow rate for 25% to 100% of full scale flow.							
	GFC 57/67/77: 1800ms time constant; approximately 5 seconds to within ± 2% of set flow rate for 25% to 100% of full scale flow.							
TEMPERATURE COEFFICIENT:	0.15% of full scale / °C.							
PRESSURE COEFFICIENT:	0.01% of full scale / psi (0.07 bar).							
PRESSURE DROP:	See Table 24.							
OPTIMUM GAS PRESSURE:	25 psig (1.73 bars).							
MAX. GAS PRESSURE:	1000 psig (70 bars) maximum GFC 17, 37, 47. 500 psig (34.5 bars) GFC 57, 67, 77.							
TURN DOWN RATIO:	40:1.							
MAX. DIFF. PRESSURE:	50 psi for GFC 17/37/57/67 and 77 (3.4 bars), 40 psi for 47 (2.7 bars).							
GAS AND AMBIENT TEMP:	32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.							
****MATERIALS IN FLUID CONTACT:**	**a.** Aluminum models GFC Series: anodized aluminum, 316 stainless steel, brass and FKM O-rings.							
	b. Stainless steel models GFC17S, 37S, 47S, 57S, 67S and 77S: 316 stainless steel and FKM O-rings. Optional O-rings: Buna® EPR and FFKM.							
ATTITUDE SENSITIVITY:	No greater than +15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.							
OUTPUT SIGNALS:	Linear 0-5 Vdc. (1000 ohms min. load impedance); 4-20 mA (0-500 ohms loop resistance) Max noise ±20mV.							
COMMAND SIGNALS:	Analog 0-5 Vdc or 4-20 mA for remote set point mode; NPN compatible purge /valve off.							
CONNECTIONS:	**GFC 17:** 1/4" compression fittings. Optional: 6mm, 3/8" and 1/8" compression fittings or 1/4" VCR® .							
	GFC 37: 1/4" compression fittings. Optional: 6mm and 3/8" compression fittings or 1/4" VCR® .							
	GFC 47: 3/8" compression fittings.							
	GFC 57: 3/8" compression fittings.							
	GFC 67: 1/2" compression fittings.							
	GFC 77: 3/4" FNPT fittings. Optional: 3/4" compression fittings.							
LEAK INTEGRITY:	1 x 10^{-9} smL/sec of helium maximum to the outside environment.							
TRANSDUCER INPUT POWER:	**GFC 17, 37 and 47:** Universal +12 Vdc to 26 Vdc, 650 mA maximum. **GFC 57, 67 and 77:** +12 Vdc, 800 mA; +24 Vdc, 650 mA optional.							
CIRCUIT PROTECTION:	Circuit boards have built-in polarity reversal protection. Resettable fuses provide power input protection.							
DISPLAY:	3-1/2 digit LCD, 0.5" high characters.							
CE COMPLIANT:	EN 55011 class 1, class B; EN50082-1.							

***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

TABLE 23 - FLOW RANGES FOR GFC	
GFC 17 LOW FLOW MASS FLOW CONTROLLER	
CODE	**mL / min [N_2]**
01	0 to 10
02	0 to 20
03	0 to 50
04	0 to 100
05	0 to 200
06	0 to 500
CODE	**L / min [N_2]**
07	0 to 1
08	0 to 2
09	0 to 5
10	0 to 10
GFC 37 MEDIUM FLOW MASS FLOW CONTROLLER	
11	0 to 15
30	0 to 20
31	0 to 30
32	0 to 40
33	0 to 50
GFC 47 /57 /67 /77 HIGH FLOW MASS FLOW CONTROLLER	
40	0 to 60
41	0 to 80
42	0 to 100
50	0 to 200
60	0 to 500
70	0 to 1000

TABLE 24 - MAXIMUM PRESSURE DROP FOR GFC

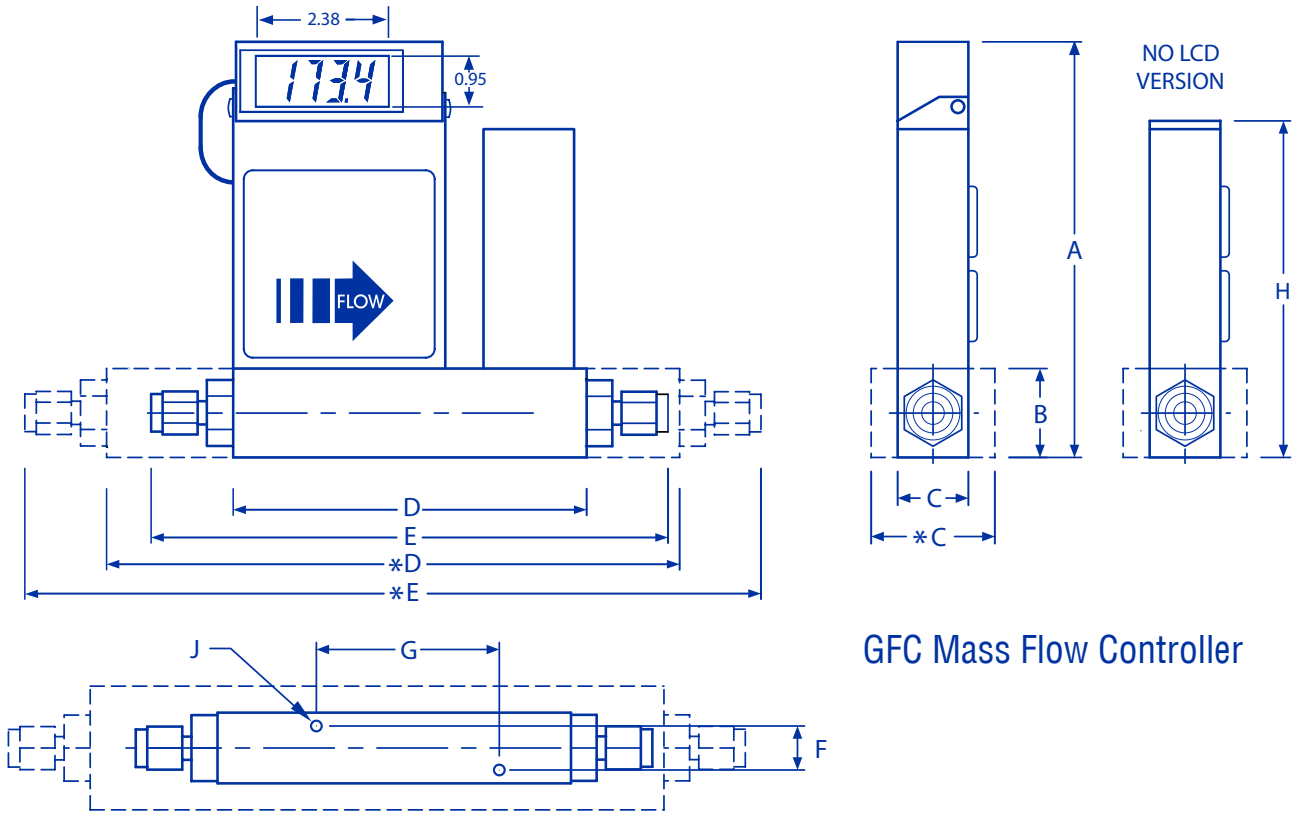
MODEL	FLOW RATE (N_2) [liters/min]	MAXIMUM PRESSURE DROP		
		[mm H_2O]	[psid]	[mbar]
GFC 17	up to 10	720	1.06	75
GFC 37	15	2630	3.87	266
	20	1360	2.00	138
	30	2380	3.50	241
	40	3740	5.50	379
	50	5440	8.00	551
GFC 47	60	7480	11.00	758
	100	12850	18.89	1302
GFC 57	200	7031	10.00	690
GFC 67	500	8437	12.00	827
GFC 77	1000	10547	15.00	1034

GFC 57, 67 and 77 Series Aluminum and Stainless Mass Flow Controllers



TABLE 25 - ACCESSORIES FOR GFC	
POWER SUPPLY - BATTERY PACK - CABLES	
PS-GFC-110NA-2	Power Supply, 110 V/12 Vdc /North America
PS-GFC-110NA-4	Power Supply, 110 V/24 Vdc /North America
PS-GFC-230EU-2	Power Supply, 220 V/12 Vdc /Europe
PS-GFC-230EU-4	Power Supply, 220 V/24 Vdc /Europe
PS-GFC-240UK-2	Power Supply 240 V/12 Vdc /United Kingdom
PS-GFC-240UK-4	Power Supply 240 V/24 Vdc /United Kingdom
PS-GFC-240AU-2	Power Supply 240 V/12 Vdc /Australia
PS-GFC-240AU-4	Power Supply 240 V/24 Vdc /Australia
CBL-DGS	Cable, Shielded 15-pin D-connector /end terminated
17/ 3RC	Remote Cable, 3 feet long
17/ R	Remote LCD readout with 3 feet long cable

For Totalizer Input/Output Flow Monitor/ Controller options see page 56.



GFC Mass Flow Controller

NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

TABLE 26 - DIMENSION FOR GFC

MODEL	CONNECTION COMPRESSION FITTING (except model GFC 77)	DIMENSION (INCH)								
		LCD VERSION							NO LCD	MOUNTING HOLE
		A	B	C/*C	D/*D	E/*E	F	G	H	J
GFC 17	1/4" Tube O Diameter	5.72	1.00	1.00	4.27	6.29	0.69	2.69	4.61	6-32 x 0.13
				*C	*D	*E				
GFC 37	1/4" Tube O Diameter	6.10	1.37	1.25	5.19	7.21	0.69	2.69	4.99	6-32 x 0.10
GFC 47	3/8" Tube O Diameter	6.10	1.37	1.25	5.19	7.33	0.69	2.69	4.99	6-32 x 0.10
GFC 57	3/8" Tube O Diameter	6.73	2.00	1.75	10.2	12.3	1.39	4.69	5.62	10-24 x 0.25
GFC 67	1/2" Tube O Diameter	7.55	3.00	3.00	10.24	12.4	2.5	6.80	6.53	1/4-20 x 0.35
GFC 77	3/4" NPT Female	8.66	4.00	4.00	10.5	—	3.0	6.80	7.55	1/4-20 x 0.35

For Specific Flow Ranges Contact Aalborg Customer Service Department.

Configure and Order Online: GFC Mass Flow Controller

GFC	MODEL

MAX. FLOW (N_2)	
17	10 L/min
37	50 L/min
47	100 L/min
57	200 L/min
67	500 L/min
77	1000 L/min

MATERIAL	
A	Aluminum
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	FFKM

FITTINGS		MODEL
A	1/4" Compression	GFC 17, 37
B	1/8" Compression	GFC 17
C	1/4" VCR®	GFC 17, 37
D	3/8" Compression	GFC 17, 37, 47, 57
E	1/2" Compression	GFC 67
F	3/4" FNPT	GFC 77
G	3/4" Compression	GFC 77
H	6mm Compression	GFC 17, 37

DISPLAY	
N	No display
L	LCD readout

POWER		MODEL
6	Universal +12 Vdc to 26 Vdc	GFC 17, 37 and 47
2	12 Vdc	GFC 57, 67 and 77
4	24 Vdc	GFC 57, 67 and 77

INPUT/OUTPUT SIGNAL	
A	Local 0-5 Vdc
B	Local 4-20 mA
C	0-5Vdc/0-5Vdc
D	0-5Vdc/4-20mA
E	4-20mA/4-20mA
F	4-20mA/0-5Vdc

DIGITAL INTERFACE	
0	None

GFC	17	S	—	V	A	L	2	—	C	0

EXAMPLE: GFC17S-VAL2-C0 10 L/min [N_2] 20 psig

SPECIFY: Flow Range, Gas and Pressure **n.a. = not applicable.*

GFC17 stainless steel, FKM seals, 1/4" compression fittings with display, 12Vdc, 0-5 Vdc. Out put signal, No digital interface

DPC04, DPC08, DPC14, DPC18, DPC37 and DPC47



DPC57, DPC67 and DPC77



Design Features

- Available with corrosion-resistant wetted materials (DPC/08/18/38/48/58/68/78 Series) and low pressure drop (BREEZE™ DPC04/14).
- Simultaneously displays Mass Flow, Volumetric Flow, Pressure and Temperature.
- Multi-Gas functionality: support for 90 different gases and gas mixes.
- "User Defined Mixture" functionality allows to create and store up 20 custom gas mixes with up to 5 different gases each.
- Quick (100-150 ms) response time.[1]
- Standard accuracy ± (0.5% RD + 0.2% FS).
- 200 to 1 turn-down ratio.
- Two programmable mass flow rate totalizers.
- High, Low or In Range Alarms with preset action delay for Mass Flow, Temperature and Pressure.
- User programmable mass flow rate Pulse Output (via SSR).
- Extensive Self Diagnostics with status LED or OLED indication.
- All 3 user selectable analog input and output interfaces are standard: 0-5Vdc, 0-10Vdc, 4-20mA.
- Two user selectable digital communication interfaces (RS-232 and RS-485) are standard.
- Optional Modbus RTU network interface with isolated RS485 transceiver.
- User programmable solid state relay with latch option.
- Universal 12-26 Vdc power supply input (for DPC07/17/37/47). For DPC57/67/77 24-26Vdc.
- Local high contrast OLED (optional) graphic display with joystick control.
- Free, easy-to-use configuration and calibration software (RS-232/RS-485).
- Programmable set point table with ramping up/down capability up to 16 steps.

DPC PRECISION DIGITAL MASS FLOW CONTROLLER WITH MULTI-GAS FUNCTIONALITY

General Description

Aalborg Instruments' DPC series precision digital mass flow controller provides accurate and stable control of mass flow rates, of process gases. With simultaneous displays of Mass Flow, Volumetric Flow, Pressure and Temperature parameters it can be used in a variety of industries: scientific and analytical applications, bioreactors and surface depositions, gas sampling, manufacturing and metrology activities.

DPC flow controllers support various functions including: user selectable local, analog, digital or program set point control, two programmable flow totalizers, low, high or range flow, temperature and pressure alarms, automatic zero adjustment (activated via local or communication interface), programmable SSR relay, programmable 0-5 Vdc, 0-10 Vdc or 4-20 mA analog inputs and outputs, user-programmable pulse output (via SSR), and extensive self-diagnostics functionalities.

DPC differential pressure mass flow controllers feature totalizers with batch processing mode (0.5% RD + 0.2%FS) standard accuracy, 200:1 turn-down ratio and less than 150 ms response time.

Significant savings are apparent, comparing to the cost of a single DPC embodying these features, with that of acquiring and installing mulitple, appliation-specific devices.

Principles of Operation

Operation of DPC flow controllers is based on the measurement of the differential pressure across specially designed restrictor flow elements. The restrictor flow element is designed to establish laminar flow across the entire range of the instrument's operation from 0 to 133% of full scale range.

A high accuracy and high resolution **differential** pressure sensor is utilized to measure pressure drop across a laminar flow channel, which is linearly proportional to volumetric flow rate. To convert volumetric flow into mass flow, high accuracy and high resolution **absolute** pressure and temperature sensors are utilized. Based on data from the sensors and gas properties from the built-in data base of the instrument, the micro-controller calculates volumetric and mass flow, which along with pressure and temperature parameters are available on the instrument display or via digital interfaces. In addition, the mass flow reading is accessible via the instrument analog interface which can be set by user to 0-5, 0-10 Vdc or 4-20mA mode.

1. *For DPC with full scale 20 sml/min and lower the response time may be slightly longer.*
2. *Digital Signal provide access to Mass Flow, Volumetric Flow, Pressure, Temperature, Totalizers, Alarms.*

TABLE 27 - DPC FLOW RANGES

MODEL NO.	FULL SCALE MASS FLOW RATE	PRESSURE DROP AT FULL SCALE FLOW (PSID)	PROCESS CONNECTION
DPC04 (Low DP, BREEZE)	0.5 sml/min to 20 smL/min	0.08	10-32 Female Thread
DPC07	0.5 to 50 sml/min	1.0	10-32 Female Thread
DPC08 (Corrosive-resistant)			
DPC14 (Low DP, BREEZE)	21 smL/min to 2 sL/min	0.19	1/8" NPT Female
DPC17	51 sml/min to 20 sL/min	1.0 - 20.0	1/8" NPT Female
DPC18 (Corrosive-resistant)			
DPC37	21 sL/min to 50 sL/min	5.0 - 8.5	1/4" NPT Female
DPC47	51 sL/min to 100 sL/min	10.0 - 20.0	1/4" NPT Female
DPC57	250 sL/min	2.5	1/2" NPT Female
DPC67	500 sL/min	6.9	3/4" NPT Female
DPC77	1000 sL/min	15.0	3/4" NPT Female

TABLE 28 - DPC ACCESSORY'S

MODEL NO.	FITTING CODE	DESCRIPTION
FITTINGS		
DPC04 / 07 / 08	F1C5	10-32 Thread, 1/8" Tubing, Compression, 316 ss.
DPC04 / 07	F2C5	10-32 Thread, 1/8" Tubing, Compression, Nickel Plated Brass.
DPC14/ 17 / 18	F2C2	1/8" NPT Thread, 1/8" tubing, Compression, 316 ss.
DPC14/ 17 / 18	F2C4	1/8" NPT Thread, 1/4" tubing, Compression, 316 ss.
DPC37	F4C4	1/4" NPT Thread, 1/4" tubing, Compression, 316 ss.
DPC47	F4C6	1/4" NPT Thread, 3/8" tubing, Compression, 316 ss.
DPC57	F8C6	1/2" NPT Thread, 3/8" tubing, Compression, 300 series ss.
DPC57	F8C8	1/2" NPT Thread, 1/2" tubing, Compression, 300 series ss.
DPC67 / 77	1210-1-12-316	3/4" NPT Thread, 3/4" tubing, Compression, 300 series ss.
POWER SUPPLIES		
PS-GFM-110NA-2	Power Supply, 110 V / 12 Vdc / North America.	
PS-GFM-110NA-4	Power Supply, 110 V / 24 Vdc / North America.	
PS-GFM-230EU-2	Power Supply, 220 V / 12 Vdc / Europe.	
PS-GFM-230EU-4	Power Supply, 220 V / 24Vdc / Europe.	
PS-GFM-240UK-2	Power Supply, 240 V / 12 Vdc / United Kingdom.	
CABLES		
CBL-A232	Communication Cable for DPC with RS-232 Interface 1.5 FT 3.5 mm stereo audio con. with 3-wire to 9 pins female D-connector (included with each DPC).	
CBL-A485DP	Communication Cable for DPC with RS-485 Interface 3 FT 3.5mm stereo audio con. with 3-wire to stripped ends.	
CBL-8MINIDIN-3	Shielded cable 8 pins MinDin with stripped ends 3 feet long.	
CBL-8MINIDIN-12	Shielded cable 8 pins MinDin with stripped ends 12 feet long.	
COMMUNICATION PORT ACCESSORIES		
USB-RS232	USB to RS232 converter.	
USB-RS485	USB to RS485 converter.	
MODBUS INTERFACE ACCESSORIES		
ECS803-1	RJ45 shielded Y-adapter (Passive TAP).	
TDG1026-8C	RJ45 Modular Coupler.	
MOD27T	RJ45 Line Terminator (100 Ohm 0.25 W).	
JMOD4S-1	RJ45 Splitter fully shielded (5xRJ45, 1 input 4 outputs).	
TRD815BL-2	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 2.0 feet.	
TRD815BL-10	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 10.0 feet.	
TRD815BL-25	Category 5E Patch Twisted Pair Cable, RJ45 / RJ45, Blue 25.0 feet.	

TABLE 29 - DPC SPECIFICATIONS

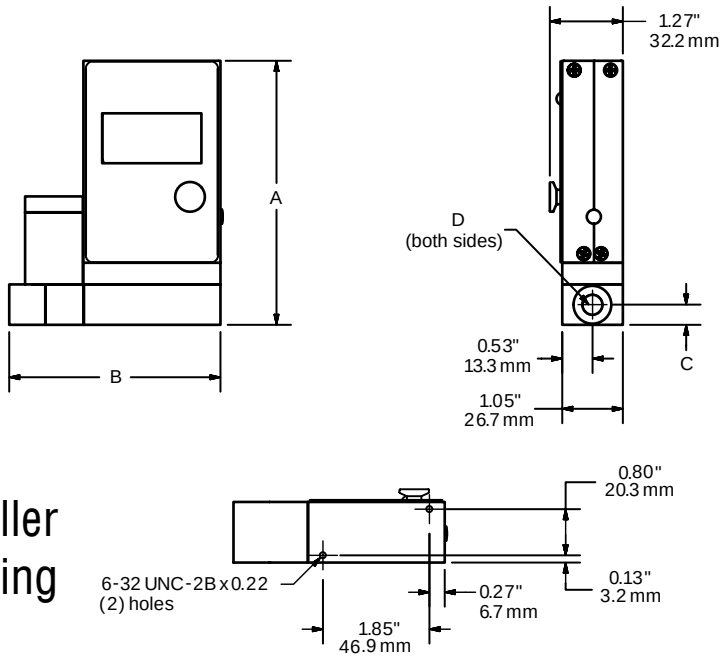
FLOW MEDIUM:	Please note that DPC04/07/14/17/37/47/57/67/77 mass flow controllers are designed to work only with clean, non-corrosive gases. The DPC08/18/38/48/58/68/78 mass flow controllers are also compatible with corrosive gases listed in the instrument's operating manual. Never try to control flow rates of liquids with any DPC.
CALIBRATIONS:	Performed at standard conditions [14.7 psia (101.4 kPa) and 70 °F (21.1 °C)].
ENVIRONMENTAL (PER IEC 664):	Installation Level II; Pollution Degree II.
FLOW ACCURACY (INCLUDING LINEARITY):	±(0.5% RD + 0.2% FS) at calibration temperature and pressure conditions after tare.
REPEATABILITY:	±0.2% of full scale.
FLOW TEMPERATURE COEFFICIENT:	0.05% of full scale/ °C or better.
FLOW PRESSURE COEFFICIENT:	0.01% of full scale/psi (6.895 kPa) or better.
TYPICAL FLOW RESPONSE TIME:	Default 150 ms (adjustable).[1]
INSTRUMENT WARM-UP TIME:	< 5 seconds.
MAXIMUM CONTROLLABLE FLOW RANGE:	125% Full Scale.
OPERATING RANGE / TURNDOWN RATIO:	0.5% to 100% Full Scale / 200:1.
MASS REFERENCE CONDITIONS STP:	70 °F & 14.696 PSIA (other available on request).
MAXIMUM INTERNAL GAS PRESSURE (STATIC):	DPC07/17/37/47/57/67/77: 120 PSIG DPC04/14: 50 PSIG DPC08/18/38/48/58/68/78 150 PSIG
MAXIMUM INSTANTANEOUS DIFFERENTIAL PRESSURE ACROSS DIFFERENTIAL SENSOR:	DPC07/17/37/47/57/67/77: 12 PSID DPC04/14: 9.75 PSID DPC08/18/38/48/58/68/78 10 PSID
PROOF PRESSURE:	DPC07/17/37/47/57/67/77: 145 PSIG DPC04/14: 50 PSIG DPC08/18/38/48/58/68/78 175 PSIG
VALVE TYPE:	Normally Closed.
VALVE MAXIMUM OPERATING PRESSURE (WITH UPSTREAM CONFIGURATION)	DPC04/07/08/14/18: (<2 sL/min) - 150 PSIG DPC17/18: (2 ÷ 5 sL/min) - 100 PSIG DPC17/18: (5 ÷ 20 sL/min) - 50 PSIG DPC37/38/47/48: 50 PSIG DPC57/58/67/68/77/78: 50 PSIG
OPERATING TEMPERATURE:	-10 to +60 ˚C (14 to 140 ˚F).
MOUNTING ATTITUDE SENSITIVITY:	DPC04/07/14/17/37/47: None. DPC57/58/67/68/77/78: Mount with valve cylinder vertical and upright position. DPC08/18/38/48: None after differential pressure sensor Tare procedure.
RELATIVE GAS HUMIDITY RANGE:	0 to 100% (Non -Condensing).
INGRESS PROTECTION:	IP40.
LEAK INTEGRITY:	1 x 10^{-9} sccs He max to the outside environment.
ANALOG OUTPUT SIGNALS:	Linear 0-5 Vdc (3000 ohms min. load impedance);
	Linear 0-10 Vdc (5000 ohms min. load impedance);
	Linear 4-20 mA (550 ohms maximum loop resistance) with power supply >= 14Vdc.
	Maximum noise 10mV peak to peak (for 0-5/0-10 Vdc output).
ANALOG SET POINT INPUT SIGNALS	Linear 0-5 Vdc, 0-10Vdc (100K input impedance).
	Linear 4-20mA (250 Ohm input impedance).
TRANSDUCER INPUT POWER:	12 to 26 Vdc, 150 mV maximum peak to peak output noise. Power consumption: 250 mA maximum for DPC04/07/14/17, 300mA maximum for DPC37/47. 24 to 26 Vdc for DPC57/67/77 (Power consumption: 650 mA maximum) circuit board have built-in polarity reversal protection, 300mA (750mA for DPC57/67/77) resettable fuse provide power input protection.
DIGITAL OUTPUT SIGNALS [2]:	Standard RS-232 or RS-485 (user selectable). Optional Modbus over isolated RS-485 transceiver.
**** WETTED MATERIALS:**	DPC04/07/14/17/37/47: 300 Series SS, 430 SS, FKM O-rings, high temperature polyamide, alumina ceramic, epoxy, silicone, glass, gold, C360 HT brass.
	DPC57/67/77: 300 Series SS, FKM O-rings, high temperature polyamide, alumina ceramic, epoxy, silicone, glass, gold.
	DPC08/18/38: 301SS, 302 SS, 316 SS, 430 SS, FKM or FFKM O-rings.

1. For DPC with full scale 20 sml/min and lower the response time may be slightly longer.

2. Digital Signal provide access to Mass Flow, Volumetric Flow, Pressure, Temperature, Totalizers, Alarms.

***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

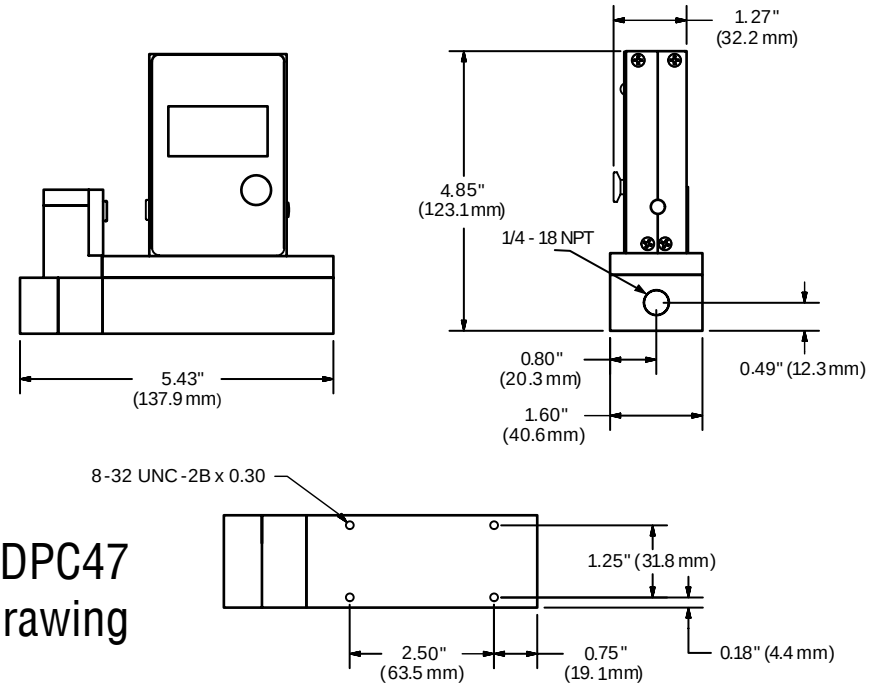
Low Flow Controller Dimensional Drawing



	A (non- corrosive)	A (corrosive resistant)	B	C	D
DPC04*/ DPC07/ DPC08**	3.68" (93.4 mm)	4.98 (126.5 mm)	4.58" (116.2 mm)	0.34" (8.5 mm)	10-32 UNF
DPC14*	3.85" (97.7 mm)		4.84" (122.8 mm)	0.42" (10.7 mm)	1/4 NPT
DPC17/DPC18**	3.66" (92.9 mm)	5.13 (130.4 mm)	4.40" (111.8 mm)	0.35" (8.9 mm)	1/8 NPT

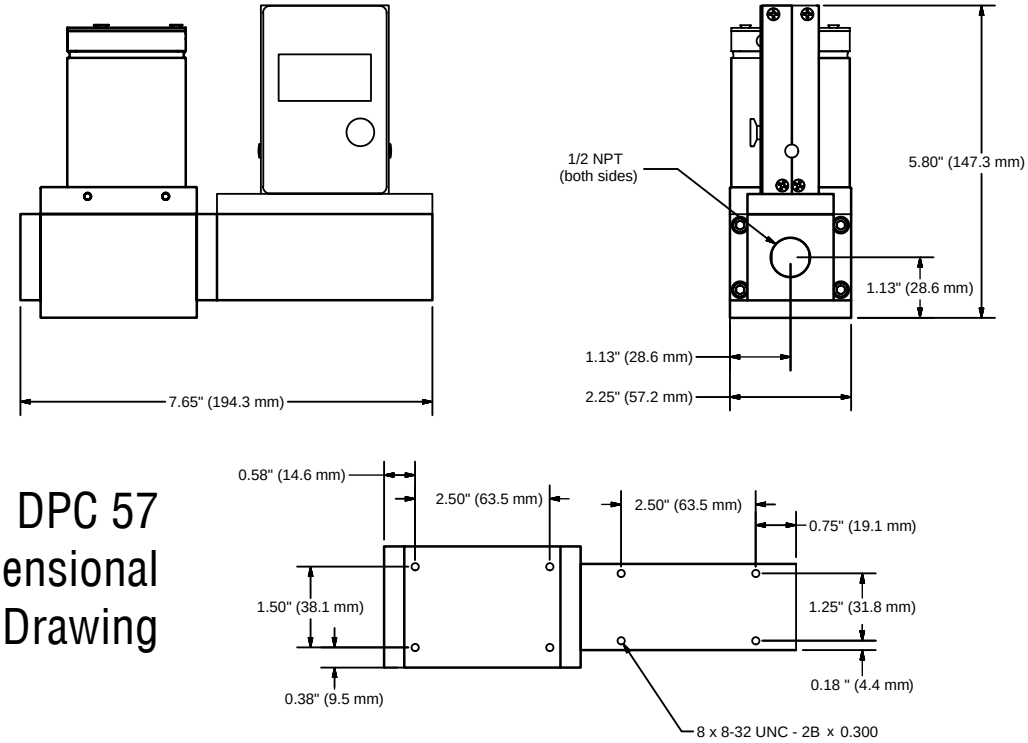
* **Breeze Models**
** **Corrosive Resistance Models**

DPC37 and DPC47 Dimensional Drawing

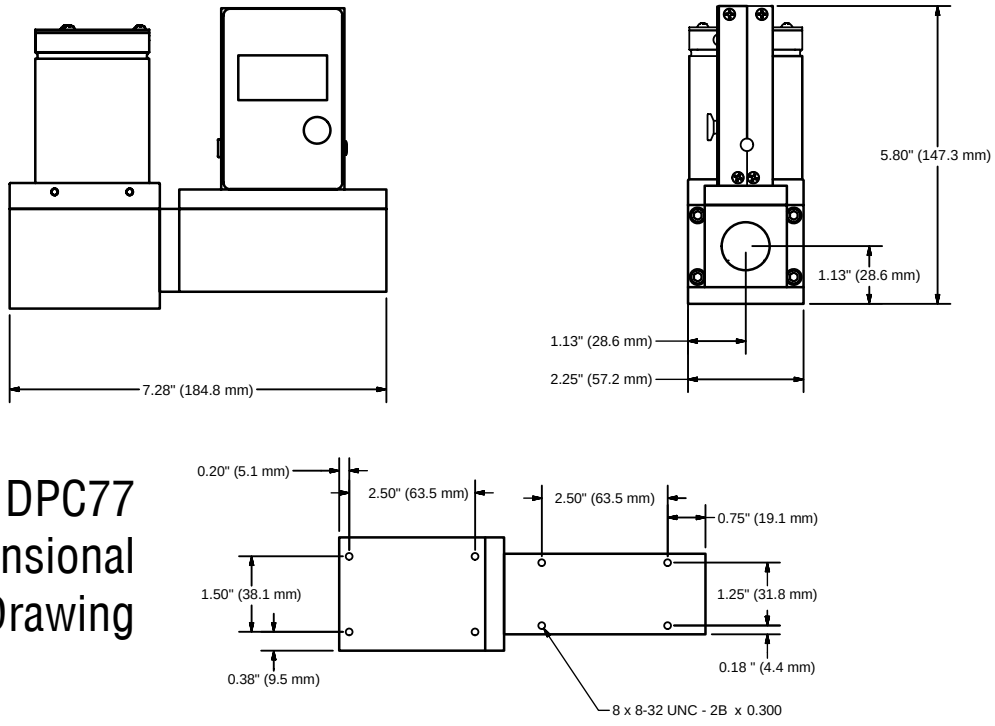


NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice.
For certified dimensions please contact Aalborg®.

DPC 57 Dimensional Drawing



DPC67 and DPC77 Dimensional Drawing



NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

Configure and Order Online: DPC Mass Flow Controller

DPC	MODEL

MAX FLOW (Air)		
Standard Pressure Drop	07	0.5 smL/min to 50 smL/min
	17	51 smL/min to 20 sL/min
	37	21 sL/min to 50 sL/min
	47	51 sL/min to 100 sL/min
	57	250 sL/min
	67	500 sL/min
	77	1000 sL/min
Corrosion-Resistant	08	0.5 smL/min to 50 smL/min
	18	51 smL/min to 20 sL/min
Breeze™ Low Pressure Drop	04	0.5 smL/min to 20 smL/min
	14	21 smL/min to 2 sL/min

MATERIAL	
S	Stainless Steel

SEALS	
V	FKM
T	FFKM

CONNECTIONS	
0	Not Included (Optional Accessory)

OLED READOUT	
N	NO Display
L	OLED Readout

POWER	
6	Universal 12 to 26 Vdc (24-26 Vdc for DPC57/67/77)

SET POINT ANALOG INPUT SIGNAL	
A	0-5 Vdc
B	4-20 mA
M	0-10 Vdc

OUTPUT SIGNAL	
A	0-5 Vdc
B	4-20 mA
M	0-10 Vdc

DIGITAL INTERFACE	
2	RS232
5	RS485
3	RS232 with Modbus
4	RS485 with Modbus

DPC	—	17	S	—	V	0	L	6	—	A	A	3

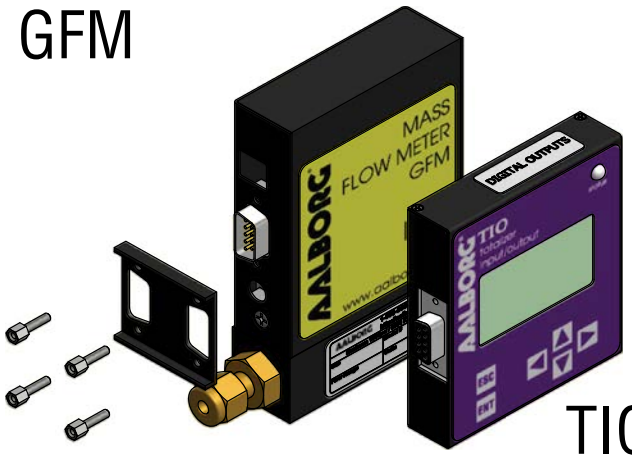
EXAMPLE: DPC17S-V0L6-AA3

SPECIFY: Flow Range, Gas and Pressure **n.a. = not applicable.*

DPC17, 316 stainless steel, FKM seals, with OLED readout 12-26 Vdc, 0-5 Vdc input signal ,0-5 Vdc output signal,RS 232 with Modbus

TIO TOTALIZER INPUT/OUTPUT FLOW MONITOR/CONTROLLER

GFM

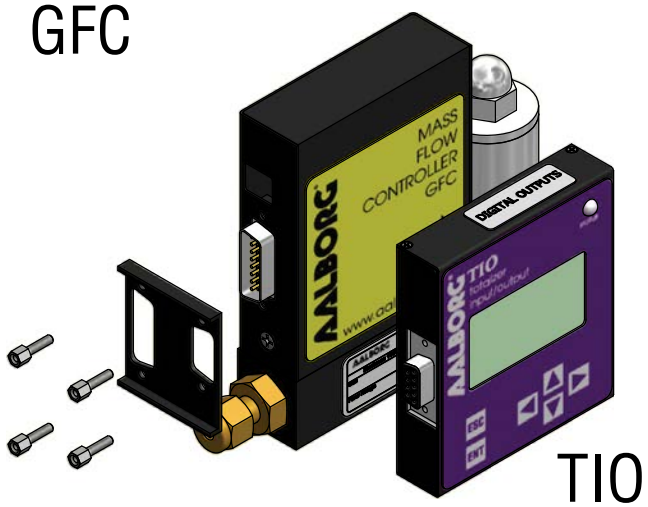


TIO



GFM with TIO Mounted

GFC



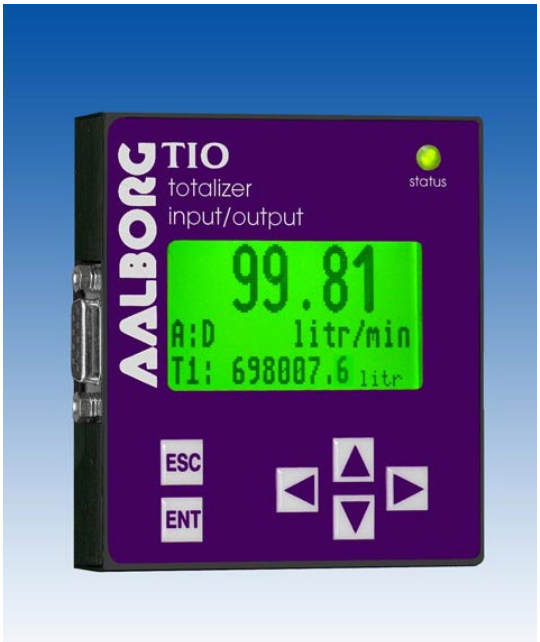
TIO



GFC with TIO Mounted

Design Features

- Displays instantaneous, total and accumulated flow rates.
- Built-in Flow Linearizer (10 point linearization of the flow curve).
- Up to 47 different volumetric and mass flow engineering units.
- Large 13mm (0.51") digits for flow rate and 5.5mm (0.21") for Total.
- Digital RS-232 or RS-485 interface (multi-drop capability of up to 64 devices.)
- Compact design for unit mount, panel mount, wall mount or field mount applications.
- User-programmable, optically-isolated pulse output.
- Two programmable, optically-isolated, digital outputs.
- Flow controllers, set point command control via local LCD or digital interface.
- Programmable set point table with ramping up/down capability up to 16 steps.
- Free Configuration and Monitoring Utility software.



Applications

For flow meters and controllers with analog 0-5 (5-10) (0-10)Vdc, 4-20mA input output interface, where flow indications / control and totalizers or alarm functions are required. Also when re-transmission of the flow rate and/or totalizer functions via optically-isolated pulse output or serial communication is desired. Local or programmable set point control for flow controllers (no host PC presence required). Activation of user-supplied equipment via programmable optically-isolated digital outputs when flow alarms or totalizers events are active.

Display

The graphical LCD display has large 13mm (0.51") digits for flow rate and 5.5mm (0.21") for total and can be set by user to simultaneously show different combination of the flow parameters: flow rate, totalizers, flow alarms, and diagnostic events . All configuration parameter settings are easily accessed via a simple user-interface menu driven by a 6 button keypad which can be password-protected.

Design Features

- 0-5 Vdc (Input/Output)
- 5-10 Vdc (Output only)
- 0-10 Vdc (Input/Output)
- 4-20 mA (Input/Output)

For flow meters and / or flow controllers, TIO provides jumpers selectable for 0-5 Vdc or 4-20 mA analog set point control signals. The flow rate set point can be adjusted locally via keypad, remotely via host PC using digital communication interface, or programmed in advance using built-in 16 steps batch table with ramping up/down support.

Programmable Pulse Output

The programmable flow pulse output is operating independently from totalizers and based on configuration settings can provide pulse frequency proportional to instantaneous fluid flow rate.

The LCD/keypad and digital communication interface commands are provided to:

- Enable/Disable Pulse Output.
- Configure Pulse Output start flow rate (in % of full scale).
- Configure the Unit/Pulse value (in current volumetric or mass flow units).
- Configure Pulse Active On Time (10 - 6550 ms).

Programmable Totalizers

TIO provides two independent programmable flow totalizers. Both totalizers are updated every 100 ms and can be set to activate different events. Main totalizer accumulated total is backed-up in EEPROM memory every second.

The LCD/keypad and digital communication interface commands are provided to:

- Enable/Disable totalizing the flow.
- Start the totalizer at a preset flow rate (in % of full scale).
- Assign action at a preset total volume (Event Volume).
- Configure power on delay (in seconds).
- Configure Auto Reset at preset volume.
- Configure Auto Reset delay (in seconds).
- Reset the totalizer to ZERO.

TIO TOTALIZER INPUT/OUTPUT FLOW MONITOR/CONTROLLER

Programmable Alarms

TIO provides the user with a flexible alarm/warning system that monitors the fluid flow for conditions that fall outside configurable limits as well as visual feedback for the user via the LCD or via an optically-isolated output. The flow alarm has several attributes which can be configured by the user via LCD/Keypad or digital communication interface:

- Enable/Disable flow alarm.
- Low flow alarm settings (in % of full scale).
- High flow alarm settings (in % of full scale).
- Flow alarm action delay.
- Flow alarm action latch mode.

Digital Communication

All process data and settings can be read and modified manually via local LCD Keypad or through the digital RS-232 or RS-485 communication interface. Proprietary ASCII software interface command set and free Communication Utility software are provided.

TABLE 30 - SPECIFICATIONS	
ADC/DAC RESOLUTION:	12 bit.
ANALOG INPUTS	0-5 Vdc, 4-20 mA, 5-10 Vdc (jumper-selectable), 0-10 Vdc (special order)
ANALOG OUTPUTS:	0-5 Vdc, 4-20 mA (jumper-selectable)
LCD:	128x64 graphic LCD with instantaneous Flow reading and Total volume indication. Adjustable LCD contrast and back light.
KEYPAD:	Local 6 tactical push buttons.
PULSE OUTPUT:	User-programmable, optically-isolated, with preset active low time interval (10 – 6550 ms).
DIGITAL OUTPUT:	Two programmable, optically-isolated, UCE @ 40Vdc, ICE @ 150 mA (Voltage Isolation: 250 Vrms).
DIGITAL INTERFACE: **PROTOCOL:** **SPEED:** **CONFIGURATION:** **ADDRESSING:** **TYPE:**	RS-232 or RS-485 (mult-idrop capability up to 64 devices) Proprietary ASCII software interface command set. 1200 - 2400 - 4800 - 9600 -19200 – 38400 – 57600 – 115200 baud (user selectable). **Stop bit:** 1 **Data bits:** 8 **Parity:** None **Flow Control:** None Maximum 255 addresses (for RS-485 option only). RS232 or RS485 2-wire. RS232 or RS485 2-wire.
POWER REQUIREMENTS:	12 – 26 Vdc (up to 60 mA maximum).
INTERFACE CONNECTORS:	Process I/O signals and Digital RS-232/RS-485 interface – miniature 9 pin female D-SUB connector. Digital optically-isolated outputs: TERM BLOCK HEADER 4POS 3.5MM Male Pins, Shrouded.
ENVIRONMENT:	Installation Level II, Pollution Degree II, (Per IEC 664).
ELECTROMAGNETIC COMPATIBILITY:	Compliant ref. 89/336/EEC as amended. Emission Standard: EN 55011:1991, Group 1, Class A Immunity Standard: EN 55082- 1:1992
OPERATING TEMPERATURE:	-10 °C to +70 °C (14°F to +158 °F).
DIMENSIONS:	86.4 x 76.2 x 19.1 mm (3.4" x 3.0" x 0.75") - W x H x D.
WEIGHT:	Appr. 125g / 0.3 lbs.

TABLE 31 - TIO ACCESSORY'S

PART NUMBER	DESCRIPTION	WHEN REQUIRED
KIT-TM-DD	GFM flow meter mounting kit, shielded cable with two 9 pins D-connectors for process signals and communication branch.	GFM + digital communication with Host PC or PLC.
KIT-TM-RD	GFM flow meter mounting kit, 4 wire cable between GFM RJ11 and TIO 9 pin D-connector.	GFM (12 Vdc power option only), 5-10 Vdc input, no digital communication.
KIT-TM-FD	GFM flow meter mounting kit, flat wire cable between GFM and TIO 9 pin D-connectors.	GFM, 0-5Vdc input no digital communication.
KIT-TC-110NA-2C	GFC flow controller mounting kit, shielded cable with North America plug 110 Vac to 12 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, North America 12 Vdc power supply, digital communication.
KIT-TC-110NA-2N	GFC flow controller mounting kit, shielded cable with North America plug 110 Vac to 12 Vdc power supply.	GFC, 0-5 Vdc input, North America 12 Vdc power supply.
KIT-TC-110NA-4C	GFC flow controller mounting kit, shielded cable with North America plug 110 Vac to 24 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, North America 24 Vdc power supply, digital communication.
KIT-TC-110NA-4N	GFC flow controller mounting kit, shielded cable with North America plug 110 Vac to 24 Vdc power supply.	GFC, 0-5 Vdc input, Europe 12 Vdc power supply.
KIT-TC-230EU-2C	GFC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 12 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, Europe 12 Vdc power supply, digital communication.
KIT-TC-230EU -2N	GFC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 12 Vdc power supply.	GFC, 0-5 Vdc input, Europe 24 Vdc power supply.
KIT-TC-230EU -4C	GFC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 24 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, Europe 24 Vdc power supply, digital communication.
KIT-TC-230EU -4N	GFC flow controller mounting kit, shielded cable with EUROPE plug 230 Vac to 24 Vdc power supply.	GFC, 0-5 Vdc input, Australia 12 Vdc power supply.
KIT-TC-240AU-2C	GFC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 12 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, Australia 12 Vdc power supply digital communication.
KIT-TC-240AU-2N	GFC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 12 Vdc power supply.	GFC, 0-5 Vdc input, Australia 24 Vdc power supply.
KIT-TC-240AU-4C	GFC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 24 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, Australia 24 Vdc power supply digital communication.
KIT-TC-240AU-4N	GFC flow controller mounting kit, shielded cable with AUSTRALIA plug 240 Vac to 12 Vdc power supply.	GFC, 0-5 Vdc input, UK 12 Vdc power supply.
KIT-TC-240UK-2C	GFC flow controller mounting kit, shielded cable with UK plug 240 Vac to 12 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, UK 12 Vdc power supply digital communication.
KIT-TC-240UK -2N	GFC flow controller mounting kit, shielded cable with UK plug 240 Vac to 12 Vdc power supply.	GFC, 0-5 Vdc input, UK 24 Vdc power supply.
KIT-TC-240UK -4C	GFC flow controller mounting kit, shielded cable with UK plug 240 Vac to 24 Vdc power supply, communication branch.	GFC, 0-5 Vdc input, UK 24 Vdc power supply digital communication.
KIT-TC-240UK-4N	GFC flow controller mounting kit, shielded cable with UK plug 240 Vac to 24 Vdc power supply.	GFC, 0-5 Vdc input, UK 24 Vdc power supply.
KIT-TC-240UK-2AC	GFC flow controller mounting kit, shielded cable with UK plug 240 Vac to 12 Vdc power supply, communication branch, analog 4-20 mA output branch from GFC.	GFC, 0-5 Vdc input, UK 12 Vdc power supply, digital communication, analog 4-20 mA output branch from GFC.
KIT-TC-240UK-4AC	GFC flow controller mounting kit, shielded cable with UK plug 240 Vac to 24 Vdc power supply, communication branch, analog 4-20 mA output branch from GFC.	GFC, 0-5 Vdc input, UK 24 Vdc power supply, digital communication, analog 4-20 mA output branch from GFC.
KIT-TM	GFM flow meter mounting kit, no cables.	GFM, user-supplied custom cables.
KIT-TC	GFC flow controller mounting kit, no cables.	GFC, user-supplied custom cables.
CBL-DA9-X	9 conductor round shielded cable consisting of a 9 pin Female "D" Sub-Connector (plug) on one end, and loose wires on the other end.	For TIO stand alone option, user-supplied power supply.

Note: X – represent the length of the cable in feet.

Configure and Order Online: TIO Accessory Totalizer Input/Output

TIO	MODEL

DISPLAY / KEYPAD	
N	No Display / No Keypad
L	LCD / Keypad

INPUT SIGNAL	
A	0-5 Vdc
B	4-20 mA
C	0-10 Vdc
D	5-10 Vdc

OUTPUT SIGNAL	
A	0-5 Vdc
B	4-20 mA
C	0-10 Vdc

DIGITAL INTERFACE	
2	RS-232
5	RS-485

TIO	—	L	A	A	2

EXAMPLE: TIO-LAA2

Totalizer I/O Flow Monitor / Controller with LCD Keypad, 0-5 Vdc Input, 0-5 Vdc Output and RS-232 Digital Interface.

Programmable Mass Flow Controller with Digital Signal Processing

Microprocessor driven **digital** flow controllers allow one to program, record, and analyze flow rates of various gases with a computer via an RS-485 interface. Optional RS-232 is available.

Controllers can be programmed for various control functions including flow set point, totalizer, stop totalizer, read totalizer, totalizer from preset flow, stop at preset total, auto zero, and more.





NIST Traceable Calibration · CE · PROG · RS485

Design Features

- Digital and Analog modes operate simultaneously.
- Programmable Flow Configurations.
- Multi-Drop Capability of up to 256 units.
- Stores calibration data for up to 10 gases.
- Auto Tune function for optimum control response.
- Free PC Software with Gas Blending and Programmable Flow functions.
- Totalizer indicates total gas quantity.
- Alarm limits for high and low gas flow.
- Conversion factors for up to 256 gases.
- Self-Diagnostic Tests.

Principles of Operation

Metered gases are divided into two laminar flow paths, one through the primary flow conduit, and the other through a capillary sensor tube. Both flow conduits are designed to ensure laminar flows and therefore the ratio of their flow rates is constant.

Two precision temperature sensing windings on the sensor tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

A Wheatstone bridge design is used to monitor the temperature dependent resistance gradient on the sensor windings which is linearly proportional to the instantaneous rate of flow. The output of the Wheatstone bridge is converted to digital format with a 12 Bit ADC (analog to digital converter).

An on-board microprocessor and non-volatile memory store all calibration factors and directly control a proportionating electromagnetic valve. The digital closed loop control system continuously compares the mass flow output with the selected flow rate.

Deviations from the set point are corrected by compensating valve adjustments, with PID algorithm thus maintaining the desired flow parameters with a high degree of accuracy. Output signals of 0 to 10Vdc, 0 to 5Vdc or 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas.

Interface

The digital RS-485 (optional RS-232) interface provides access to applicable internal data including **FLOW SET POINT, ACTUAL FLOW, ZERO ADJUSTMENTS, and LINEARIZATION TABLE ADJUSTMENTS.**

The analog interface provides 0 to 5Vdc, 0 to 10Vdc and 4 to 20 mA inputs and outputs.

Auto Zero

The DFC automatically nulls the sensor zero offset whenever the flow set point is below 2% of full scale. To accommodate this feature the control valve must fully close under that condition. Provisions are made to either disable, force or store the current auto zero via digital commands.

Totalizer

The firmware for the DFC provides functions to register total gas quantity. The total mass of gas is calculated by integrating the actual gas flow rate with respect to time.

Digital interface commands are provided to:

- **Set the totalizer to zero.**
- **Start /stop totalizing the flow.**
- **Read the totalizer.**
- **Start the totalizer at a preset flow.**
- **Stop the flow at a preset total.**

Multi-Gas Calibration

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

Conversion Factors

Conversion factors for up to 256 gases are stored in the DFC. Conversion factors may be applied to any of the ten gas calibrations via digital interface commands.

Flow Alarms

High and Low gas flow ALARM limits are programmed using the digital interface. Alarm conditions are reported via the digital interface or can activate the contact closure outputs.

Gas Blending Feature

Aalborg free software allows controlling flow of the Gas mixture of up to eight different gases (for RS-485 bus with 8 DFC controllers) with preset values of the ratio in % for each channel. The flow rate of the Gas Mixture can be incremented or decremented within allowable range (based on Full Scale range of all DFC controllers in the mixture system) by changing the Gas Mixture set point settings. The software will automatically adjust individual set point for each device according to set ratios.

Programmable Flow

Aalborg software supports programmable flow modes, allowing execution of custom programming of up to ten steps. Various flow configurations include ramping, linearized increasing and decreasing modes.

Auto Tune

The AUTO TUNE function allows the DFC to automatically optimize control response for the gas under actual process conditions. During the AUTO TUNE process, the instrument adjusts PID gains for optimum step response and determine key control valve characteristics (only available on units with less than 80 L/min maximum flow).

Contact Closure

Two sets of dry contact relay outputs are provided to actuate user supplied equipment. These are programmable via the 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).

Valve Override

Means are provided to force the control valve fully open (purge) or fully closed via either the analog or digital interfaces.

Self-Diagnostics

Whenever power is first applied, the DFC runs a series of SELF-DIAGNOSTIC TESTS to ensure that it is in optimum working condition.

Engineering Units

The flow set point, measured gas flow and associated totalizer data is scaled directly in engineering units via digital interface commands. The following units of measure are supported:% of FS, mL/min, mL/hr, scfm, scfh, L/min, L/hr, lbs/hr, lbs/min, and one user defined unit of measure.

Leak Integrity

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

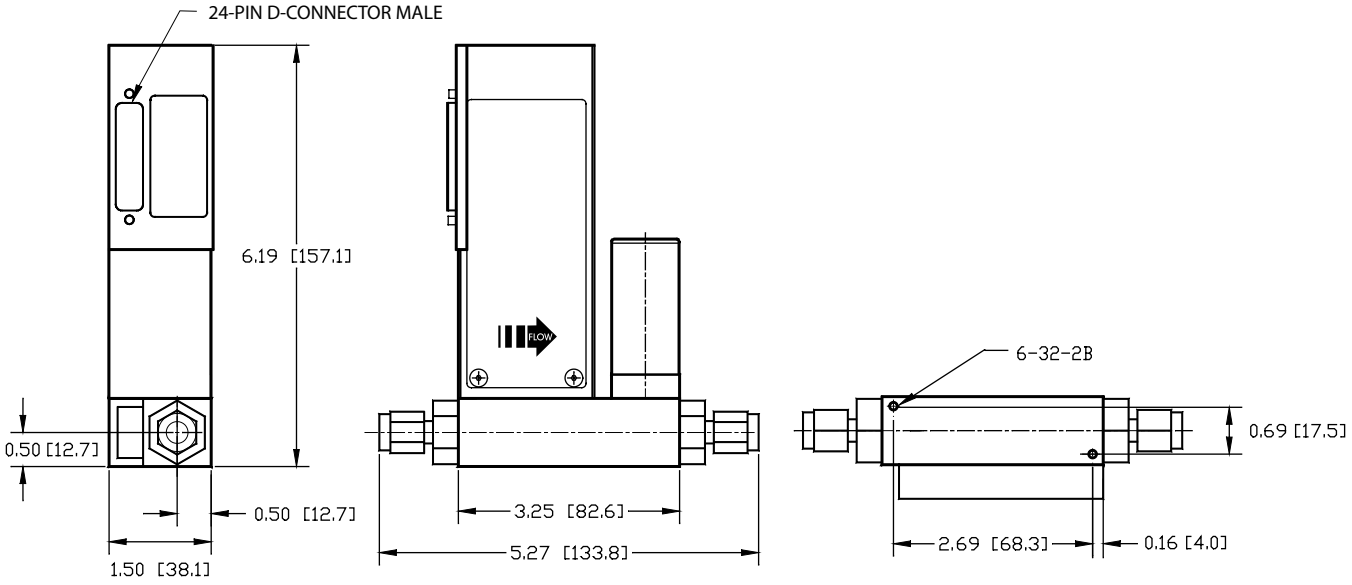
Balanced Power Supply

The DFC operates on ±15Vdc. The current requirements for the positive and negative power supplies are balanced such that the current in the power supply common connection is minimized. Maximum power consumption is 13.5 watts at ±15Vdc.

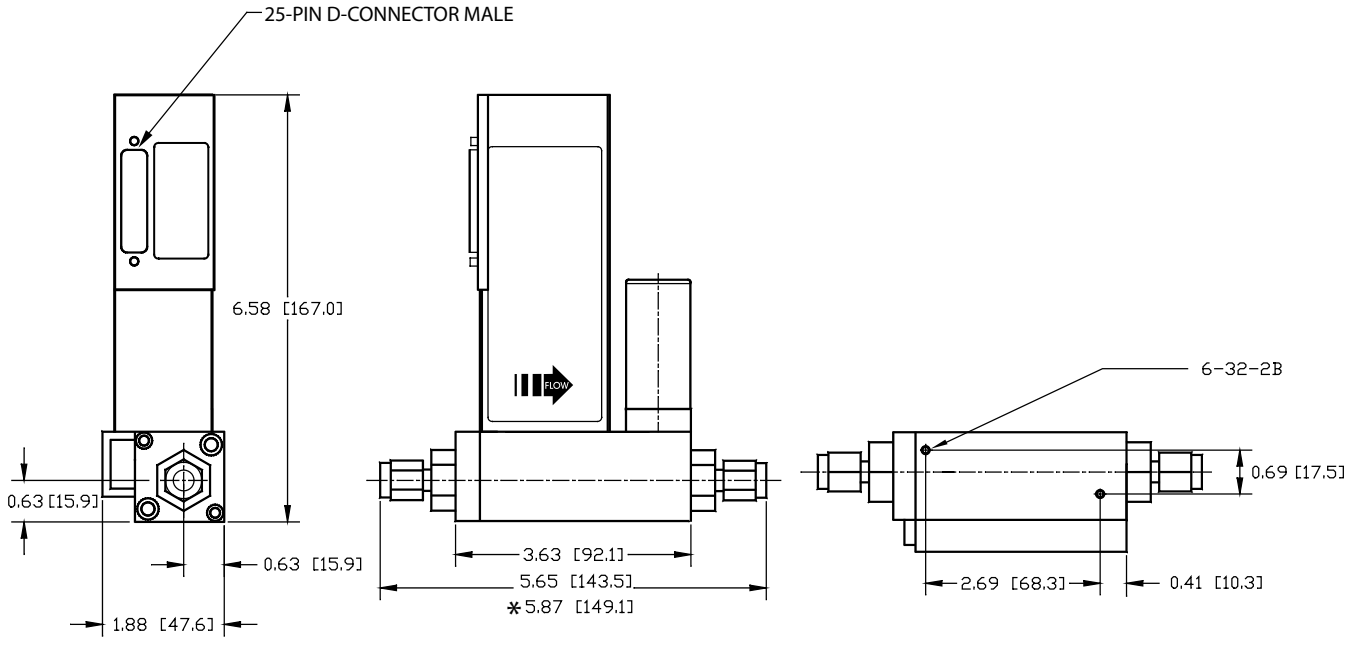
TABLE 32 - SPECIFICATIONS	
ACCURACY:	±1% of FS at calibration temperature and pressure.
CALIBRATIONS:	Performed at standard temperature of 70 °F (21.1 °C) only, and at 14.7 psia (101.4 kPa) unless otherwise requested.
REPEATABILITY:	±0.15% of full scale.
RESPONSE TIME:	1.0 to 2.0 second to within ±2% of set point over 20% to 100% of full scale.
TEMPERATURE COEFFICIENT:	0.05% of full scale/ °F or better.
PRESSURE COEFFICIENT:	0.01% of full scale /psi (0.07 bar) or better.
OPTIMUM GAS PRESSURE:	25 psig (1.73 bars).
MAXIMUM GAS PRESSURE:	1000 psig (70 bars).
MAXIMUM DIFFERENTIAL PRESSURE:	50 psig (3.4 bars) for DFC 26 and DFC 36 40 psig (2.8 bars) for DFC 46
MAX PRESSURE DROP:	Refer to Table 35.
GAS AND AMBIENT TEMP:	32 °F to 122 °F (0 °C to 50 °C). 14 °F to 122 °F (-10 °C to 50 °C) - Dry gases only.
COMMUNICATION INTERFACE:	RS485 - Standard. RS232 - Optional.
OUTPUT SIGNALS:	Linear 0-5 Vdc (2000 ohms min load impedance); 0-10Vdc (4000 ohms min impedance); 4-20 mA optional (0-500 ohms\ loop resistance). Maximum noise 20mV peak to peak.
CIRCUIT PROTECTION:	Circuit boards have built-in polarity reversal protection. Resettable fuses provide power input protection.
****MATERIALS IN FLUID CONTACT:**	316 stainless steel, 416 stainless steel, FKM O-rings. Optional O-rings: Buna® , EPR and FFKM.
ATTITUDE SENSITIVITY:	No greater than +15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.
CONNECTIONS:	**Model DFC 26/36:** Standard 1/4" compression fittings. **Optional:** 6mm compression fittings or 3/8" compression fittings or 1/4" VCR® or 1/8" compression fittings (DFC 26).
	Model DFC 46: standard 3/8" compression fittings.
LEAK INTEGRITY:	1 x 10^{-9} smL/sec of helium maximum to the outside environment.
TRANSDUCER INPUT POWER:	+15Vdc, 450 mA maximum.
CALIBRATION OPTIONS:	Standard 10 point NIST traceable calibration. Optional up to 9 additional 10 point calibrations may be ordered for an additional charge.
CE COMPLIANCE:	EN 55011 class 1, class B; EN50082-1.

***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

DFC 26 Mass Flow Controller



DFC 36/46 Mass Flow Controller



* FOR HIGH FLOW MASS FLOW CONTROLLERS

NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

DFC DIGITAL MASS FLOW CONTROLLERS

TABLE 33 - FLOW RANGES FOR DFC

DFC 26 LOW FLOW CONTROLLERS		DFC 36 MEDIUM FLOW CONTROLLERS		DFC 46 HIGH FLOW CONTROLLERS	
CODE	Units [Nitrogen]	CODE	L/min [N_2]	CODE	L/min [N_2]
01	0 to 10 mL/min	11	0 to 15 L/min	40	0 to 60 L/min
02	0 to 20 mL/min	30	0 to 20 L/min	41	0 to 80 L/min
03	0 to 50 mL/min	31	0 to 30 L/min	42	0 to 100 L/min
04	0 to 100 mL/min	32	0 to 40 L/min		
05	0 to 200 mL/min	33	0 to 50 L/min		
06	0 to 500 mL/min				
07	0 to 1 L/min				
08	0 to 2 L/min				
09	0 to 5 L/min				
10	0 to 10 L/min				

TABLE 35 - MAXIMUM PRESSURE DROP FOR DFC

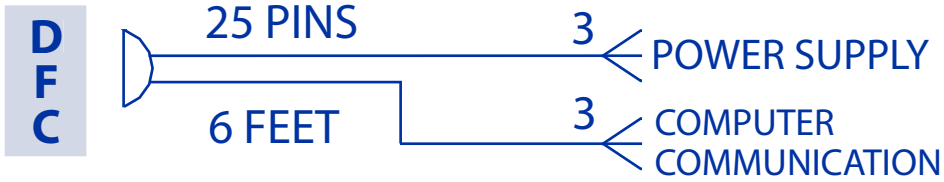
MODEL NO.	MAX. FLOW (N_2)	MAXIMUM PRESSURE DROP		
		[mm H_2O]	[psid]	[mbar]
DFC 26	up to 10	720	1.06	75
DFC 36	15	2630	3.87	266
	20	1360	2.00	138
	30	2380	3.50	241
	40	3740	5.50	379
	50	5440	8.00	551
DFC 46	60	7480	11.00	758
	100	12850	18.89	1302

TABLE 34 - ACCESSORIES AND READOUTS FOR DFC

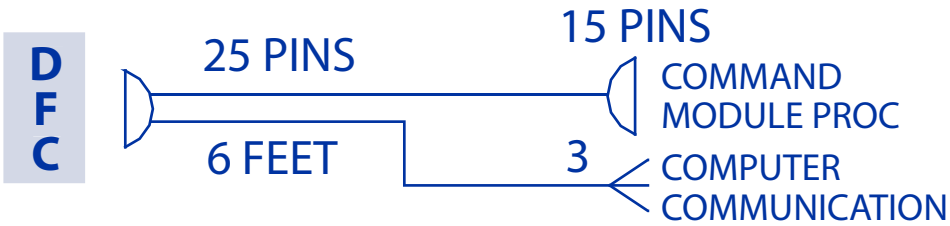
CBL-DFC	25 pin D-connector with 6 ft. wire to computer port stripped, Branch 6ft. wire to customers power supply.
CBL-DFC-DPM-AI	Cable stripped for DFC w/LCD jack and analog input for set point only.
CBL-DFC-DPM-AIO	Cable stripped for DFC with LCD jack and analog input/output.
CBLDFC-PROC	25 pin D-connector with 6ft. wire to 15 pin DM, Branch 6ft. wire to computer port stripped.
PS-DFC-110NA-5-S	Power supply with 25 pin female D-connector 110/vac (±15Vdc.) Branch 6ft wire to computer port stripped /North America.
PS-DFC-110NA-5-A	Power supply with 25 pin D-connector, analog interface 110/vac (+ - 15Vdc.) (North America).
PS-DFC-230EU-5-S	Power supply with 25 pin female D-connector 230/vac (±15Vdc.) Branch 6ft wire to computer port stripped /Europe.
PS-DFC-230EU-5-A	Power supply, 25 pin D-connector, analog interface 230/vac (+ - 15Vdc.) (Europe).
PS-DFC-240AU-5-S	Power supply with 25 pin female D-connector 240/vac (±15Vdc.) Branch 6ft wire to computer port stripped /Australia.
PS-DFC-240AU-5-A	Power supply, 25 pin D-connector, analog interface 240/vac (+ - 15Vdc.) (Australia).
PS-DFC-240UK-5-S	Power supply with 25 pin female D-connector 240/vac (±15Vdc.) Branch 6ft wire to computer port stripped /United Kingdom.
PS-DFC-240UK-5-A	Power supply, 25 pin D-connector, analog interface 240/vac (+ - 15Vdc.) (U.K).
BCKUPDFC	Digital panel meter / led backlight.
PS-DFC-110NA-5-S-D	Power supply DFC 110/Vac ±15Vdc standard interface and LCD jack. (United States).
PS-DFC-110NA-5-A-D	Power supply DFC 110/Vac ±15Vdc analog interface and LCD jack. (United States).
PS-DFC-230EU-5-S-D	Power supply DFC 230/vac +/-15Vdc standard interface and LCD jack. (Europe).
PS-DFC-230EU-5-A-D	Power supply DFC 230/vac +/-15Vdc analog interface and LCD jack. (Europe).
PS-DFC-240AU-5-S-D	Power supply DFC 240/vac +/15Vdc standard interface and LCD jack. (Australia).
PS-DFC-240AU-5-A-D	Power supply DFC 240/vac +/-15Vdc analog interface and LCD jack. (Australia).
PS-DFC-240UK-5-S-D	Power supply DFC 240/vac +/-15Vdc standard interface and LCD jack. (United Kingdom).
PS-DFC-240UK-5-A-D	Power supply DFC 240/vac +/-15 Vdc analog interface and LCD jack. (United Kingdom).

Cable Options

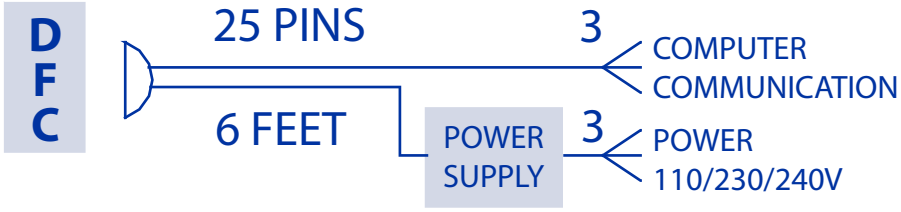
Standard Cable (supplied with Transducer) CBL-DFC



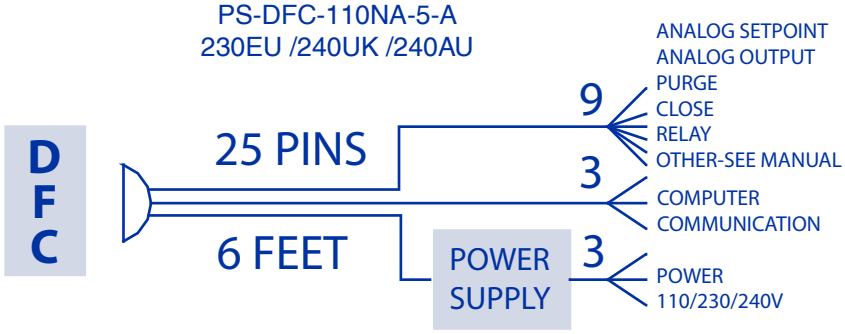
CBL-DFC-SDPROC



PS-DFC-110NA-5-S 230EU /240UK /240AU



PS-DFC-110NA-5-A
230EU /240UK /240AU



Configure and Order Online: DFC Mass Flow Controller

DFC	MODEL

MAX. FLOW (N_2)	
26	10 L/min
36	50 L/min
46	100 L/min

MATERIAL	
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	PTFE / FFKM

FITTINGS		MODEL
A	1/4" Compression	DFC 26, 36
B	1/8" Compression	DFC 26
C	1/4" VCR®	DFC 26, 36
D	3/8" Compression	DFC 26, 36, 46
H	6mm Compression	DFC 26, 36

DISPLAY	
N	No Display
L	LCD Readout (Special interface cable is required).

POWER	
5	+15 Vdc

INPUT / OUTPUT SIGNAL	
C	0-5Vdc/ 0-5Vdc
D	0-5Vdc/ 4-20mA
E	4-20mA/ 4-20mA
F	4-20mA/ 0-5Vdc
H	0-5 Vdc/ 0-10Vdc
I	0-10Vdc/ 0-5 Vdc
J	0-10Vdc/ 0-10 Vdc
K	4-20 mA/ 0-10 Vdc
L	0-10 Vdc/ 4-20 mA

DIGITAL INTERFACE	
2	RS232
5	RS485

DFC	36	S	—	V	A	N	5	—	C	5

EXAMPLE: DFC36S-VAN5-C5 50 L/min [N_2] 20 psig

SPECIFY: Flow Range, Gas and Pressure

DFC 36 stainless steel, FKM seals, 1/4" compression fittings, No display, +15 Vdc power, 0-5 Vdc/0-5 Vdc input output signal, RS485 digital interface.

Model **AF** mass flow controllers are designed to indicate flow rates and control set flow rates of gases.

Each of these units incorporates an advanced straight tube sensor in conjunction with flow passage elements constructed of stainless steel.

LCD readouts of command modules are supplied with 0 to 100 percent calibrations. Zero and span adjustments are conveniently accessible from outside of the transmitters.

Design Features

- Rigid metallic construction.
- Maximum pressure of 1000 psig (70 bars).
- 0-5 Vdc or 4-20mA signals.
- Leak integrity 1 x 10^{-9} smL/sec of helium.
- Accuracy of ±1% F.S.
- Totalizer option.
- Circuit protection.

Principles of Operation

Metered gases are divided into two laminar flow paths -one through the primary flow conduit and the other through a capillary sensor tube.

Both flow conduits are designed to ensure laminar flows and therefore the ratio of their flow rates is constant.

Two precision temperature sensing windings on the sensor tube are heated, and when flow takes place, gas carries heat from the upstream to the downstream windings. The resultant temperature differential is proportional to the change in resistance of the sensor windings.

A Wheatstone bridge design is used to monitor the temperature dependent resistance gradient on the sensor windings which is linearly proportional to the instantaneous rate of flow.

Output signals of 0 to 5Vdc or 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas.

SDPROC and AFC Analog Mass Flow Controller



In AFC mass flow controllers the combined gas streams flow through a proportionating electromagnetic valve with an appropriately selected orifice. The closed loop control circuit continuously monitors the mass flow output and maintains it at the set flow rate.

Flow rates are unaffected by temperature and pressure variations within stated limitations.

Transducer power supply ports are fuse and polarity protected.

AFC mass flow controllers include an electromagnetic control valve that allows the flow to be set to any desired flow rate within the range of the particular model. The valve is normally closed as a safety feature to ensure that gas flow is shut off in case of a power outage.

AFC mass flow controllers are designed to meter and control flow rates of gases.

AFC mass flow controllers are available with flow ranges from 10 mL/min to 100LPM [N_2]. Gases are connected by means of 1/4", 3/8", or optional 1/8" compression fittings.

These controllers may be used as bench top units or mounted by means of screws in the base.

TABLE 36 - SPECIFICATIONS		
ACCURACY:	±1% of FS at calibration temperature and pressure.	
CALIBRATIONS:	Performed at standard temperature of 70 °F (21.1 °C) only, and at 14.7 psia (101.4 kPa) unless otherwise requested.	
REPEATABILITY:	±0.25% of full scale.	
TIME CONSTANT:	**AFC26:** (Qmax = 10 L/min): 300 ms. **AFC36:** (Qmax = 50 L/min): 600 ms. **AFC46:** (Qmax = 100 L/min): 600 ms.	
RESPONSE TIME:	**AFC26:** (Qmax = 10 L/min): Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. **AFC36:** (Qmax = 50 L/min) and AFC46: (Qmax=100 L/min): Approximately 2 second to within ±2% of set flow rate or 25% to 100% of full scale flow.	
TEMPERATURE COEFFICIENT:	0.1% of full scale/ °C.	
PRESSURE COEFFICIENT:	0.01% of full scale/psi (0.07 bar).	
OPTIMUM GAS PRESSURE:	25 psig (1.73 bars).	
MAXIMUM GAS PRESSURE:	1000 psig (70 bars) maximum. Standard calibration is at 20 psig (1.4 bars) inlet pressure.	
MAX. PRESSURE DROP: (at full scale flow)	Refer to Table 38.	
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.	
LEAK INTEGRITY:	1 x 10^{-9} smL/sec of helium maximum, to the outside environment.	
****MATERIALS IN FLUID CONTACT:**	316 stainless steel, 416 stainless steel, FKM O-rings. Optional O-rings: Buna®, EPR and FFKM.	
ATTITUDE SENSITIVITY:	No greater than +15 degree rotation from horizontal to vertical; standard calibration is in horizontal position.	
OUTPUT SIGNALS:	Linear 0-5 Vdc (2000 W min. load impedance); 4 - 20 mA optional (0 - 500 W loop resistance); maximum noise 20 mV peak to peak.	
CONNECTIONS:	**AFC26:**	1/4" compression fittings. Optional: 6mm, 3/8" and 1/8" compression fittings or 1/4" VCR®.
	AFC36:	1/4" compression fittings. Optional: 6mm and 3/8" compression fittings or 1/4" VCR®.
	AFC 46:	3/8" compression fittings.
TRANSDUCER INPUT POWER:	**AFC 26:**	+15 ±5% Vdc, 80 mA max, 1.2W; -15 ± 5% Vdc, 200 mA max, 3W;
	AFC 36 /AFC 46:	+15 ±5% Vdc, 220 mA max, 3.3W; -15 ±5% Vdc, 600 mA max, 9W.
CIRCUIT PROTECTION:	Circuit boards have built-in polarity reversal protection. Replaceable fuses provide power input protection.	

***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

Leak Integrity

1 x 10^{-9} smL/sec of helium max to outside environment.

Mass Flow Systems

Complete Mass Flow Systems include Command Modules, transducers and cables. Command modules contain appropriate power supplies, 24x2 alpha-numeric dot matrix display readout, and four panel buttons which provide complete control over all the various functions necessary to measure and/or control flow.

Optional built in Ethernet interface allows accessing any Internet-connected SDPROC from a browser on your work station, PC, or laptop computer.

TABLE 37 - FLOW RANGES FOR AFC

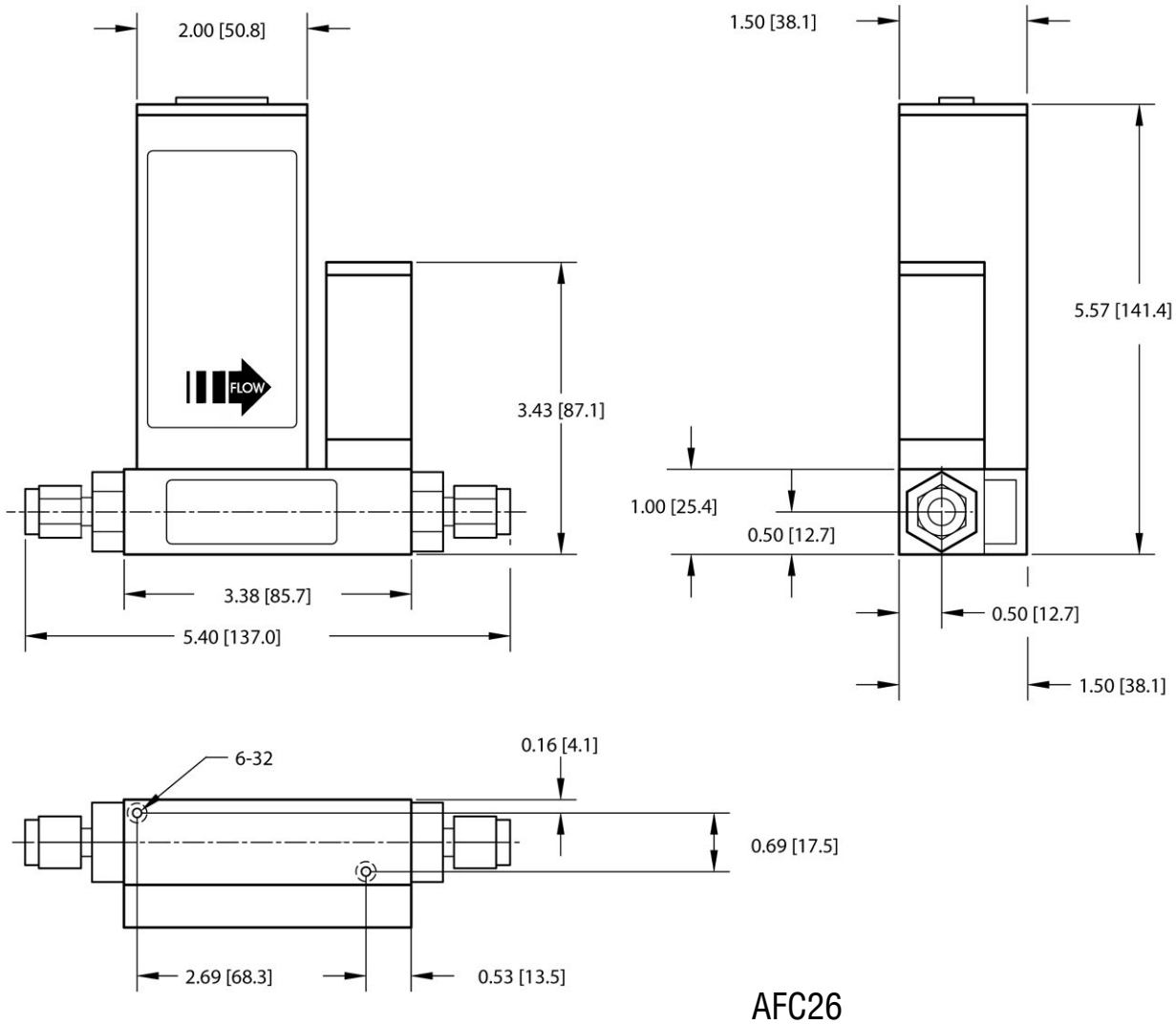
CODE	UNITS [Nitrogen]
AFC 26	
01	0 to 10 mL/min
02	0 to 20 mL/min
03	0 to 50 mL/min
04	0 to 100 mL/min
05	0 to 200 mL/min
06	0 to 500 mL/min
07	0 to 1 L/min
08	0 to 2 L/min
09	0 to 5 L/min
10	0 to 10 L/min
AFC 36	
11	0 to 15 L/min
30	0 to 20 L/min
31	0 to 30 L/min
32	0 to 40 L/min
33	0 to 50 L/min
AFC 46	
40	0 to 60 L/min
41	0 to 80 L/min
42	0 to 100 L/min

TABLE 38 - MAXIMUM PRESSURE DROP FOR AFC

FLOW RATE [liters/min]	AFC SERIES	
	[psid]	[bars]
up to 10	1.06	0.072
up to 15	3.87	0.26
up to 20	2.0	0.136
up to 30	3.5	0.238
up to 40	5.5	0.374
up to 50	8	0.544
up to 100	18.9	1.302

SDPROC and AFC Analog Mass Flow Controller

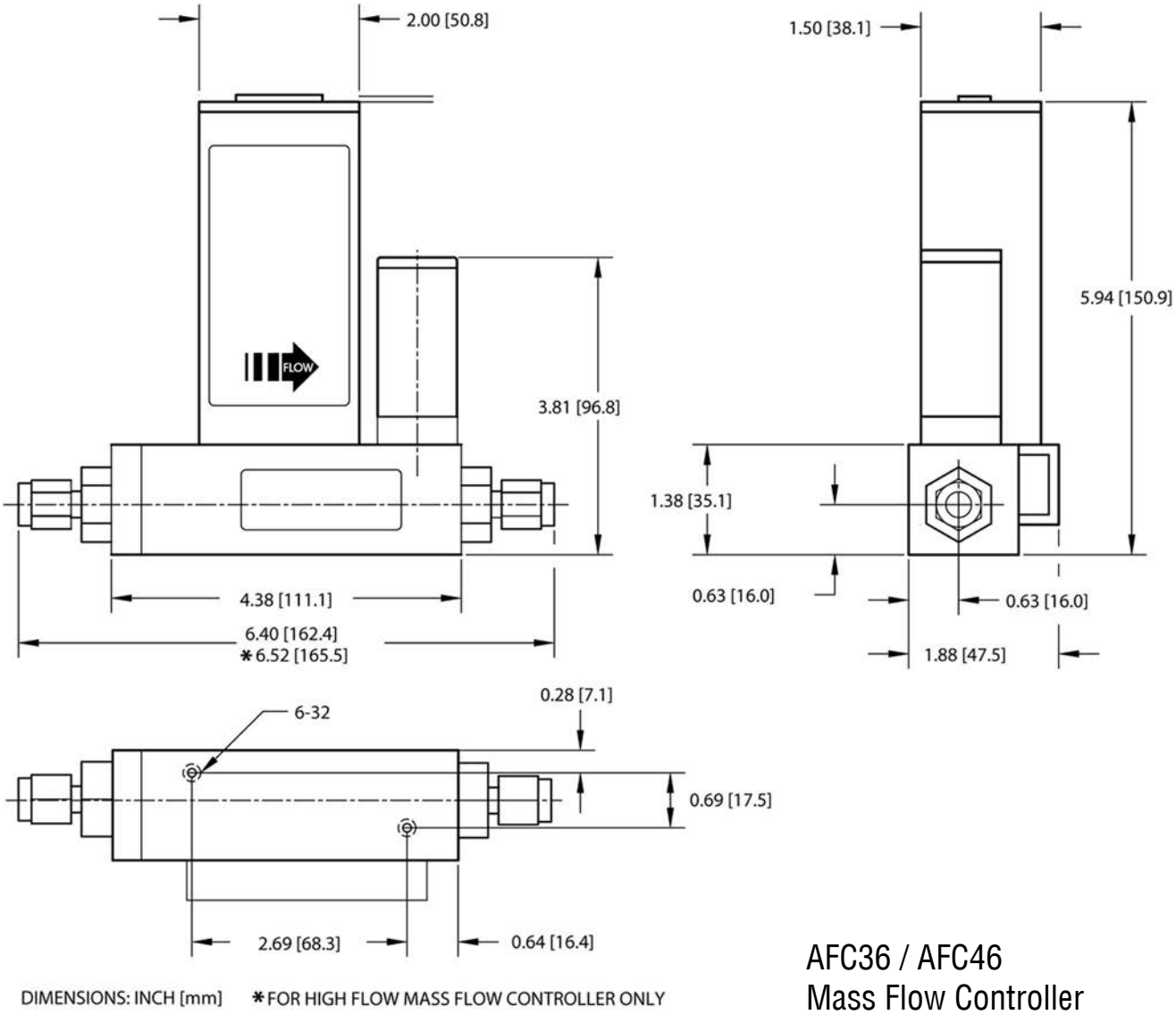




DIMENSIONS: INCH [mm]

AFC26
Analog Mass Flow Controller

NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.



DIMENSIONS: INCH [mm] *FOR HIGH FLOW MASS FLOW CONTROLLER ONLY

AFC36 / AFC46
Mass Flow Controller

NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

Configure and Order Online: AFC Mass Flow Controller

AFC	MODEL

MAX FLOW (N_2)	
26	10 L/min
36	50 L/min
46	100 L/min

MATERIAL	
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	PTFE / FFKM

FITTINGS		MODEL
A	1/4" Compression	AFC 26, 36
B	1/8" Compression	AFC 26, 36
C	1/4" VCR®	AFC 26, 36
D	3/8" Compression	AFC 26, 36, 46
H	6mm Compression	AFC 26, 36

DISPLAY	
N	NO Display

POWER	
5	+15 Vdc

INPUT / OUTPUT SIGNAL	
C	0-5Vdc / 0-5Vdc
D	0-5Vdc / 4-20mA

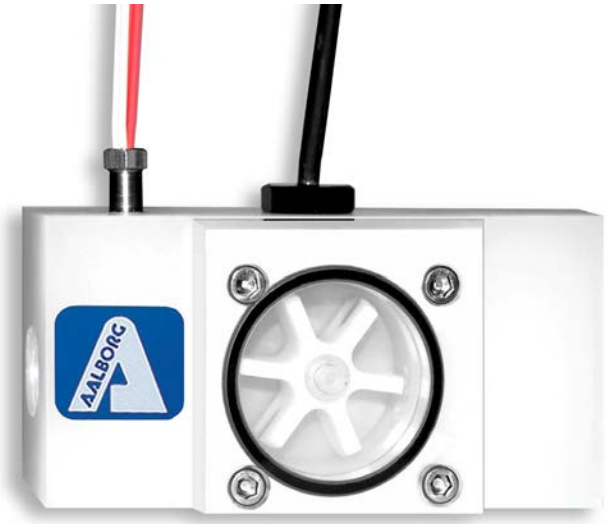
DIGITAL INTERFACE	
0	NONE

AFC	36	S	—	V	A	N	5	—	C	0

EXAMPLE: AFC36S-VAN5-A0 50 L/min [N_2] 20 psig

SPECIFY: Flow Range, Gas and Pressure **n.a. = not applicable*

AFC36 stainless steel, FKM seals with 1/4" compression fittings, without a display, ±15 Vdc, 0-5Vdc input/output signal, and no digital interface.



Design Features

- Flow meters for liquid flow applications.
- Jewel bearings allow for very low minimum flow rates.
- Easy to install and operate.
- Mounted horizontally or vertically.
- Only one moving part.
- Flow indication via transparent acrylic cover.
- Versatile square wave flow output signal.
- Female NPT ports.
- Multi-Parameter: Flow and temperature *outputs.
- Four wires platinum RTD option.
- Polypropylene and chemically resistant.
- PVDF models.

FOR LIQUIDS ONLY

* *PWM provides only raw pulse output signals. In order to get actual flow and temperature readings, user has to implement additional signal processing.*

Principles of Operation

Fluid flowing through the unit causes the paddle wheel to spin. As the magnets embedded in the paddle spin past the sensor, electrical pulses are produced in which frequency is proportional to the flow rate. The number of pulses per desired time interval and the K-factor (number of pulses/gallon) make it possible to calculate the flow rate and volume passing through the unit.

Configure and Order Online: PWM Paddle-Wheel Flow Meter

TABLE 39 - FLOW RATE FOR PWM

Meter Sizes	Flow Rate H_2O		Inlet/Outlet Ports Female NPT	Max Pressure Drop	
	[L/min]	[gal/min]		Bar	PSI
PWM04	0.15-18.9	0.04-5	3/8"	1	15
PWM06	0.3-37.6	0.08-10	1/2"	1.4	20
PWM08	0.6-64.4	0.15-17	3/4"	1.4	20
PWM10	1.3-132.5	0.35-35	1"	1.4	20

TABLE 40 - SPECIFICATIONS

ACCURACY	±1% FS.
MAX TEMPERATURE	60 °C (140 °F).
MAX PRESSURE	10 barg (150 psig).
POWER	5 to 24 Vdc @ 2 mA.
OUTPUT SIGNAL	NPN open collector (load 30 mA max).
DIMENSIONS	56H x 108L x 53D [mm] (2.2 x 4.25 x 2.2") Without RTD and flow sensors.
CABLE	Flow signal 1.8 m (6') or optional 3.7m (12') [ft.] RTD 12 [in.] long cable.
RTD	Platinum 0.00385 TCR, meets EN 60751, Class B.

TABLE 41 - PADDLE WHEEL MODEL NUMBERS

Polypropylene	Polypropylene with RTD	PVDF	PVDF with RTD
PWM04P	PWM04PR	PWM04T	PWM04TR
PWM06P	PWM06PR	PWM06T	PWM06TR
PWM08P	PWM08PR	PWM08T	PWM08TR
PWM10P	PWM10PR	PWM10T	PWM10TR

TABLE 42 - MATERIALS FLUID CONTACT:

	POLYPROPYLENE MODELS	PVDF UNITS MODELS
BODY	Polypropylene	PVDF
LID	Acrylic	PVDF
PADDLE WHEEL	PVDF	PVDF
SHAFT	Nickel Tungsten Carbide	Zirconia Ceramic
BEARINGS	Sapphire Jewels	Sapphire Jewels
O-RINGS	EPDM	PTFE
PLATINUM RTD	316 ss casing	316 ss casing

PWE DIGITAL PADDLE WHEEL FLOW METER

FOR LIQUIDS ONLY



PLEASE NOTE:
POWER CORD WITH MALE PLUG IS NOT INCLUDED.
ORDER SEPARATELY: CAT NO. CBL-PWE

Design Features

- Jewel bearings allow for very low minimum flow rates.
- Multi-Parameter: Flow and optional temperature measurements.
- Polypropylene and chemically resistant PVDF models.
- Supports up to 29 Engineering Units (including User Defined).
- Two programmable Totalizers and Flow Pulse output (3.3Vdc CMOS).
- Programmable High/Low Flow and optional Temperature Alarms with preset action delay interval.
- Two sets of user-programmable optically isolated outputs.
- User-selectable (via jumpers) analog 0-5 Vdc or 4-20mA flow and optional temperature outputs.
- RS-232 or RS-485 Digital Interface with Multi-Drop Capability of up to 256 units (RS-485 option).
- Local keypad and 2x16 characters LCD display with adjustable back light (optional).
- Enclosure weather tight to IP65 standards.
- Free communication software with temperature and flow data log-in capability.

General Description

PWE flow meters support various functions including: two independently programmable flow totalizers, user programmable low, high or range flow and temperature alarm, two sets of user programmable optically isolated outputs, self diagnostic alarm, flow pulse output.

The flow rate can be displayed in 29 different volumetric or mass flow engineering units. Flow meter parameters and functions can be programmed locally via optional keypad and LCD † or remotely via the RS-232/RS-485 interface.

Optional local 2x16 LCD† readout with adjustable back light provides flow rate, temperature† , total volume reading in currently selected engineering units, diagnostic events indication and feature a password protected access to the process parameters to ensure against tampering or resetting.

(† - optional feature)

Principles of Operation

Liquid flowing through the unit causes the paddle wheel to spin. As the magnets embedded in the paddle spin past the sensor, electrical pulses are produced in which frequency is proportional to the flow rate. The number of pulses per desired time interval and the K-factor (number of pulses/gallon) make it is possible to calculate the flow rate and volume passing through the unit.

On board CPU and signal conditioner circuitry perform accurate flow and total computation, digital communication and analog 0-5 Vdc or 4-20 mA output signals. Non-volatile memory stores all hardware specific and user programmable variables, including flow linearization table.

Totalizer

The total volume of the liquid is calculated by integrating the actual liquid flow rate with respect to time. The optional LCD/keypad and 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. Main Totalizer reading is stored in the non volatile memory (EEPROM). The pilot Totalizer reading is stored in volatile memory (SRAM) and will be lost if flow meter is powered down.

Engineering Units

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

THE FOLLOWING 29 UNITS OF MEASURE ARE SUPPORTED:

TABLE 43 - UNITS OF MEASURE

NUMBER	INDEX	FLOW RATE ENGINEERING UNITS	TOTALIZER ENGINEERING UNITS	DESCRIPTION
1	0	%	%s	percent of full scale
2	1	mL/s	mL	milliliter per second
3	2	mL/min	mL	milliliter per minute
4	3	mL/h	mL	milliliter per hour
5	4	l/s	ltr	liter per second
6	5	l/min	ltr	liter per minute
7	6	l/h	ltr	liter per hour
8	7	m3/s	m3	cubic meter per second
9	8	m3/min	m3	cubic meter per minute
10	9	m3/h	m3	cubic meter per hour
11	10	ft3/s	ft3	cubic feet per second
12	11	ft3/min	ft3	cubic feet per minute
13	12	ft3/h	ft3	cubic feet per hour
14	13	gal/s	gal	gal per second
15	14	gal/min	gal	gal per minute
16	15	gal/h	gal	gal per hour
17	16	g/s	g	grams per second
18	17	g/min	g	grams per minute
19	18	g/h	g	grams per hour
20	19	kg/s	kg	kilograms per second
21	20	kg/min	kg	kilograms per minute
22	21	kg/h	kg	kilograms per hour
23	22	lb/s	lb	pounds per second
24	23	lb/min	lb	pounds per minute
25	24	lb/h	lb	pounds per hour
26	25	t/s	ton	ton (metric) per sec
27	26	t/min	ton	ton (metric) per minute
28	27	t/h	ton	ton (metric) per hour
29	28	User	UD	user defined

PWE DIGITAL PADDLE WHEEL FLOW METER

Flow and Temperature† Alarms

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

(†- optional feature)

Optically Isolated Outputs

Two sets of optically isolated outputs are provided to actuate user supplied equipment. These are programmable via digital interface or optional LCD/Keypad such that the outputs 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 44 - FLOW RATE FOR PWE

Meter Sizes	Flow Rate H_2O		Inlet/Outlet Ports Female NPT	Max Pressure Drop	
	[L/min]	[gal/min]		Bar	PSI
PWE4	0.15-18.9	0.04-5	3/8"	1	15
PWE6	0.3-37.6	0.08-10	1/2"	1.4	20
PWE8	0.6-64.4	0.15-17	3/4"	1.4	20
PWE10	1.3-132.5	0.35-35	1"	1.4	20

TABLE 45 - **MATERIALS IN FLUID CONTACT

	POLYPROPYLENE MODELS	PVDF MODELS
BODY	Polypropylene	PVDF
LID	Acrylic	PVDF
PADDLE WHEEL	PVDF	PVDF
SHAFT	Nickel Tungsten Carbide	Zirconia Ceramic
BEARINGS	Sapphire Jewels	Sapphire Jewels
O-RINGS	EPDM	PTFE
PLATINUM RTD	316 stainless steel casing	316 stainless steel casing

***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

TABLE 46 - DIGITAL PADDLE WHEEL FLOW METER ACCESSORIES

MODEL NO.	DESCRIPTION
CBL-PWE	Cable 12 Pins stripped end 6 foot shielded
PS-PWE-110NA-2	Power Supply PWE 110 Vac North American Plug
PS-PWE-230EU-2	Power Supply PWE 230 Vac Continental Plug
PS-PWE-240AU-2	Power Supply PWE 240 Vac Australian Plug
PS-PWE-240UK-2	Power Supply PWE 240 Vac UK Plug

TABLE 47 - DIGITAL PADDLE WHEEL METER FEATURES FOR POLYPROPYLENE MODELS

NO KEYPAD & LCD - NO RTD	WITH RTD - NO KEYPAD & LCD	KEYPAD & LCD - NO RTD	KEYPAD & LCD - RTD
PWE04P(*)NN	PWE04P(*)NR	PWE04P(*)LN	PWE04P(*)LR
PWE06P(*)NN	PWE06P(*)NR	PWE06P(*)LN	PWE06P(*)LR
PWE08P(*)NN	PWE08P(*)NR	PWE08P(*)LN	PWE08P(*)LR
PWE10P(*)NN	PWE10P(*)NR	PWE10P(*)LN	PWE10P(*)LR

TABLE 48 - DIGITAL PADDLE WHEEL METER FEATURES FOR PVDF MODELS

NO KEYPAD & LCD - NO RTD	WITH RTD - NO KEYPAD & LCD	KEYPAD & LCD - NO RTD	KEYPAD & LCD - RTD
PWE04T(*)NN	PWE04T(*)NR	PWE04T(*)LN	PWE04T(*)LR
PWE06T(*)NN	PWE06T(*)NR	PWE06T(*)LN	PWE06T(*)LR
PWE08T(*)NN	PWE08T(*)NR	PWE08T(*)LN	PWE08T(*)LR
PWE10T(*)NN	PWE10T(*)NR	PWE10T(*)LN	PWE10T(*)LR

(*) FOR COMPLETE MODEL NUMBERS SEE PAGE 81.

TABLE 49 - SPECIFICATIONS FOR PWE	
FLOW MEDIUM:	Please note that PWE Flow Meters are designed to work only with liquids. Never try to measure flow rates of dry gas.
CALIBRATIONS:	Performed at standard temperature of 70 °F (21.1 °C) only, and at 14.7 psia (101.4 kPa) unless otherwise requested.
VISCOSITY:	Calibrated to 1 cSt (water) meters with display can be used for liquids up to 50 cSt with field calibration (maximum flow range may be affected).
ENVIRONMENTAL (PER IEC 664):	Installation Level II; Pollution Degree II.
FLOW ACCURACY (INCLUDING LINEARITY):	±1% of FS.
REPEATABILITY:	±0.25% of full scale.
LIQUID TEMPERATURE MEASUREMENT RANGE† :	34 °F to 140 °F (1 °C to 60 °C).
TEMPERATURE ACCURACY (INCLUDING LINEARITY)† :	±0.5 °C.
FLOW RESPONSE TIME:	Approximately 1 seconds (above 10% of full scale flow), approximately 2 seconds (below 10% of full scale flow).
MAXIMUM PRESSURE:	10 barg (150 psig).
MAXIMUM PRESSURE DROP:	1.4 bar (20 psi) at 132.5 L/min flow. See table for pressure drops associated with various models and flow rates.
AMBIENT TEMPERATURE RANGE:	14 °F to 140 °F (-10 °C to 60 °C).
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).
FLOW PULSE OUTPUT:	3.3 Vdc amplitude (3000 ohms min load impedance).
OPTICALLY ISOLATED OUTPUTS:	UCE ≤ 40Vdc, ICE ≤ 150 mA.
FLOW METER INPUT POWER:	11 to 26 Vdc, 100 mV maximum peak to peak output noise.
	Power consumption: +12Vdc (150 mA maximum); +24Vdc (100 mA maximum);
	Circuit board have built-in polarity reversal protection, 300mA resettable fuse provide power input protection.
COMMUNICATIONS PARAMETERS (RS-232/RS-485):	Baud rate: ..... 9600 baud. Stop bit: ..... 1. Data bits: ..... 8. Parity: ..... None. Flow Control: ..... None.
ELECTRICAL CONNECTIONS:	Built-in female 12 pin M16, IP67 connector. To be mated with 12 pin M16 male EMI shielded IP67 connector. (Binder-USA P/N: 99-5629-15-12) not included. Optional cable available. Cable including male connector available.
DISPLAY:	Optional local 2x16 characters LCD with adjustable backlight (2 lines of text).
KEYPAD:	Optional 4 push button keypad.
CE COMPLIANT:	EMC Compliance with 89/336/EEC as amended. Emission Standard: EN 55011:1991, Group 1, Class A Immunity Standard: EN 55082-1:1992.

(† - optional feature)

Configure and Order Online: PWE Paddle-Wheel Flow Meter

PWE	MODEL

ORIFICE SIZE (Maximum Flow Range)	
04	5 gal / min (0.15 - 18.9 L/min)
06	10 gal / min (0.3 - 37.6 L/min)
08	17 gal / min (0.6 - 64.4 L/min)
10	35 gal / min (1.3 - 132.5 L/min)

MATERIAL LOWER BLOCK	
P	Polypropylene
T	PVDF

SEALS	
E	EPDM
T	PTFE
B	Buna®
V	FKM

DISPLAY / KEYPAD	
N	No Display / No Keypad
L	LCD / Keypad

RTD OPTION	
N	No RTD
R	RTD

OUTPUT SIGNAL	
A	0-5 Vdc
B	4-20 mA

DIGITAL INTERFACE	
2	RS-232
5	RS-485

PWE	04	P	—	E	L	N	—	A	2

EXAMPLE: PWE04P-ELN-A2

Digital Paddle Wheel Meter, Maximum Flow 5 Gal. per minute, Polypropylene Lower Block, EPDM Seals, LCD Keypad, No RTD, 0-5 Output Signal with RS-232 Digital Interface.



PSV Proportionating Electromagnetic Valve

PSV Proportionating Electromagnetic Valves are designed to respond to variable power inputs to proportionately regulate the flow of liquids and gases.

For added safety PSV valves are normally closed (NC) when de-energized. They can also serve as "ON-OFF" valves. For control functions see the PSV-D Driver Module.

Flow is controlled by increasing or decreasing the voltage applied to the coil. This causes a magnetic force which raises the core and allows gas to flow.

PSV valves, constructed of stainless steel are available in five different sizes covering flow ranges from 3.5 L/min - 100 L/min air and 125 mL/min - 2.85 L/min H_2O.

Design Features

- **Leak Integrity 1 x 10^{-9} mL/sec.**
- **Rigid metallic construction.**
- **Gas and liquids.**
- **Max pressure of 1000 psig (68.9 bars).**

Principle of Operation

A variable stroke electromagnetic valve featuring a valve seat design which permits increasing or decreasing flow rates of liquids or gases through it in proportion to variable input power.

Regulator Systems

Complete flow regulating systems include a PSV electromagnetic valve connected to a pulse width modulated PSV-D Driver Module. For details see Driver Module description.

TABLE 50 - MAX FLOW RATES AND CV VALUES FOR PSV

MODEL NUMBER	ORIFICE SIZE		Cv	*MAXIMUM FLOW [mL/min]	
	[in]	[mm]		AIR	WATER
PSV1S-VA	0.02	0.51	0.009	3500	125
PSV2S-VA	0.04	1.02	0.033	13000	400
PSV3S-VA	0.055	1.4	0.055	21500	700
PSV4S-VA	0.063	1.6	0.068	25000	850
PSV5S-VA	0.125	3.18	0.24	100000	2850

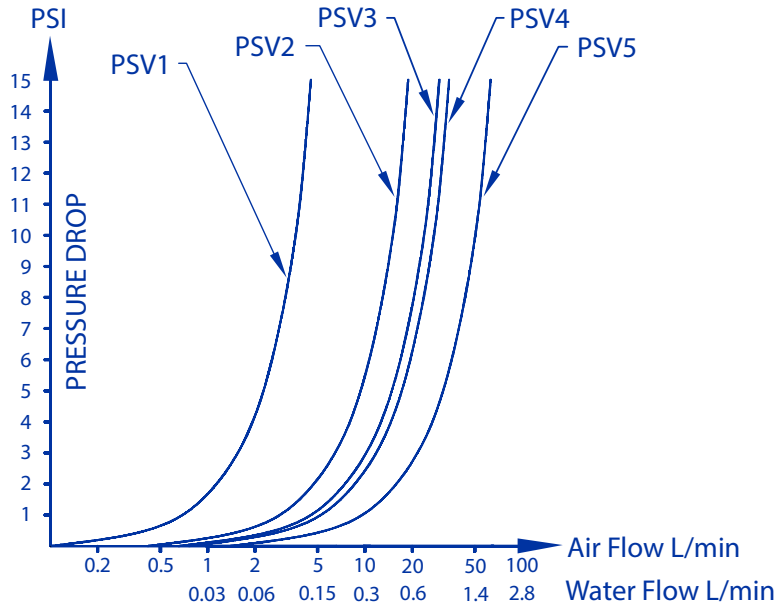
** Based on 10 psig (690 mbar) differential pressure for sizes 1-4 20 PSIG 1380 mBar for size 5.*

TABLE 51 - SPECIFICATIONS

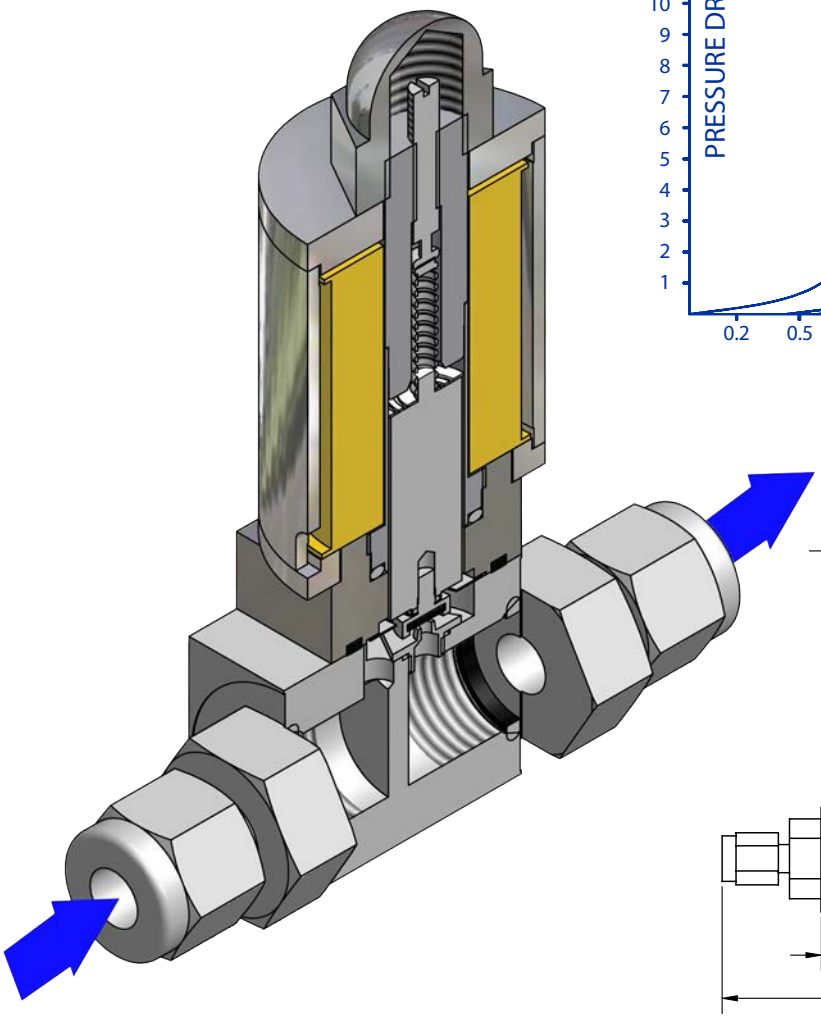
POWER INPUT:	0-30Vdc.
MAXIMUM POWER REQUIRED:	400 mA.
TYPE OF OPERATION:	Normally closed (NC) when de-energized.
CONNECTIONS:	1/4" Compression fittings optional 3/8" (1/8" with PSV1, 2 or 3).
**** MATERIALS IN FLUID CONTACT:**	Types 316 and 416 stainless steel, FKM O-rings. Optional O-rings: Buna®, EPR and FFKM.
MAXIMUM PRESSURE:	1000 psig (6897 kPa).
MAXIMUM DIFFERENTIAL PRESSURE:	50 psid (345 kPa).
LEAK INTEGRITY:	1 X 10^{-9} smL/sec Helium individually tested.
FLUID TEMPERATURE:	14 °F to 122 °F (-10 °C to 50 °C).
MAXIMUM TEMPERATURE (typical):	174 °F (79 °C) inside, 130 °F (54 °C) outside surface at 24Vdc.

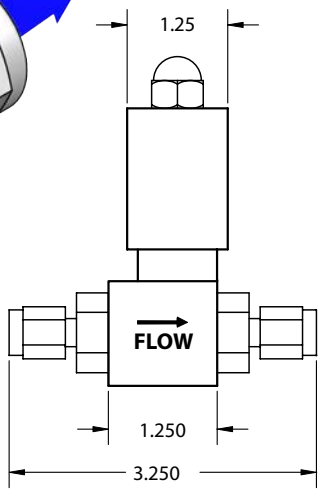
***The selection of materials of construction, is the responsibility of the customer. The company accepts no liability.*

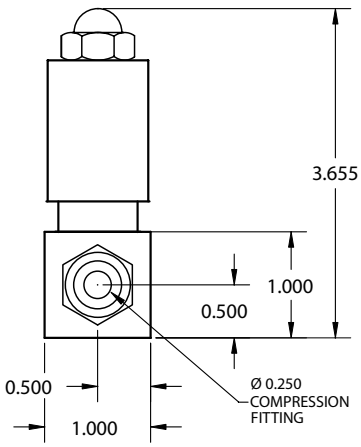
Pressure Drops Across PSV Valves



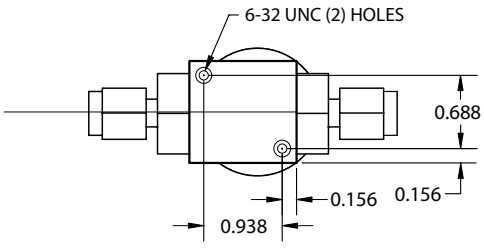
Cross Sectional View PSV Valve







PSV Proportionating Electromagnetic Valves



NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.

Configure and Order Online: PSV Proportional Solenoid Valve

PSV	MODEL

SERIES	
1	
2	
3	
4	
5	

MATERIAL	
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	PTFE / FFKM

FITTINGS	
A	1/4" Compression
B	1/8" Compression (1/8" with PSV1, 2 or 3)
D	3/8" Compression

PSV	4	S	–	V	A

EXAMPLE: PSV4S-VA

PSV4 stainless steel, FKM seals with 1/4" compression fittings.

PSV-D

Pulse width modulated PSV-D Driver Modules regulate the power supplied to PSV Regulating valves based on a reference signal.

Set-point signals, 0-5 Vdc or 4-20 mA, input are employed to control the output pulse width modulated voltage at a fixed frequency (»30KHz) and amplitude. Incoming power to the valve coil is applied and discontinued for predetermined periods of time by a low loss solid state switching element.

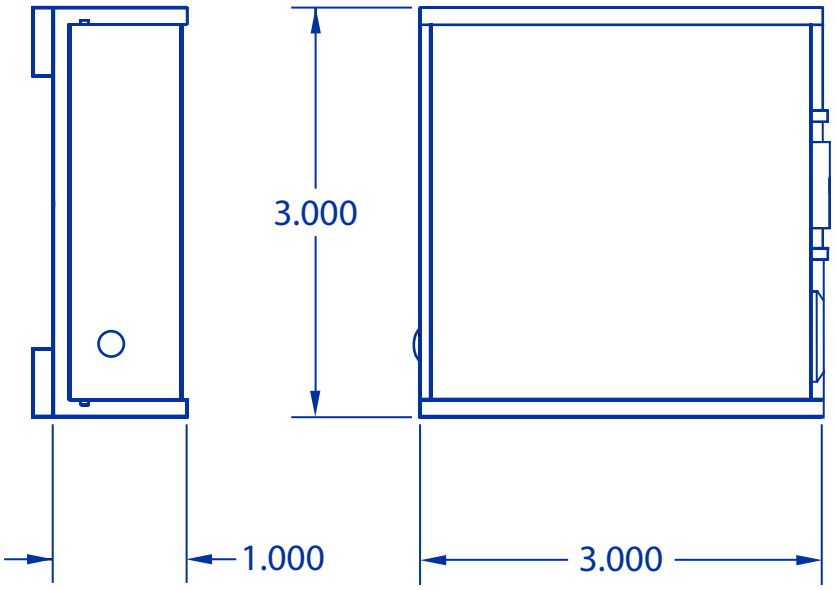
As incoming power is applied, energy in the inductive coils increases and when it is discontinued energy stored in the coil maintains the magnetic flux level required to hold flow at the controlled rate. This cycle takes place many thousands of times per second.

The wide range of power input features conveniently accommodates 12 to 32 Vdc sources.

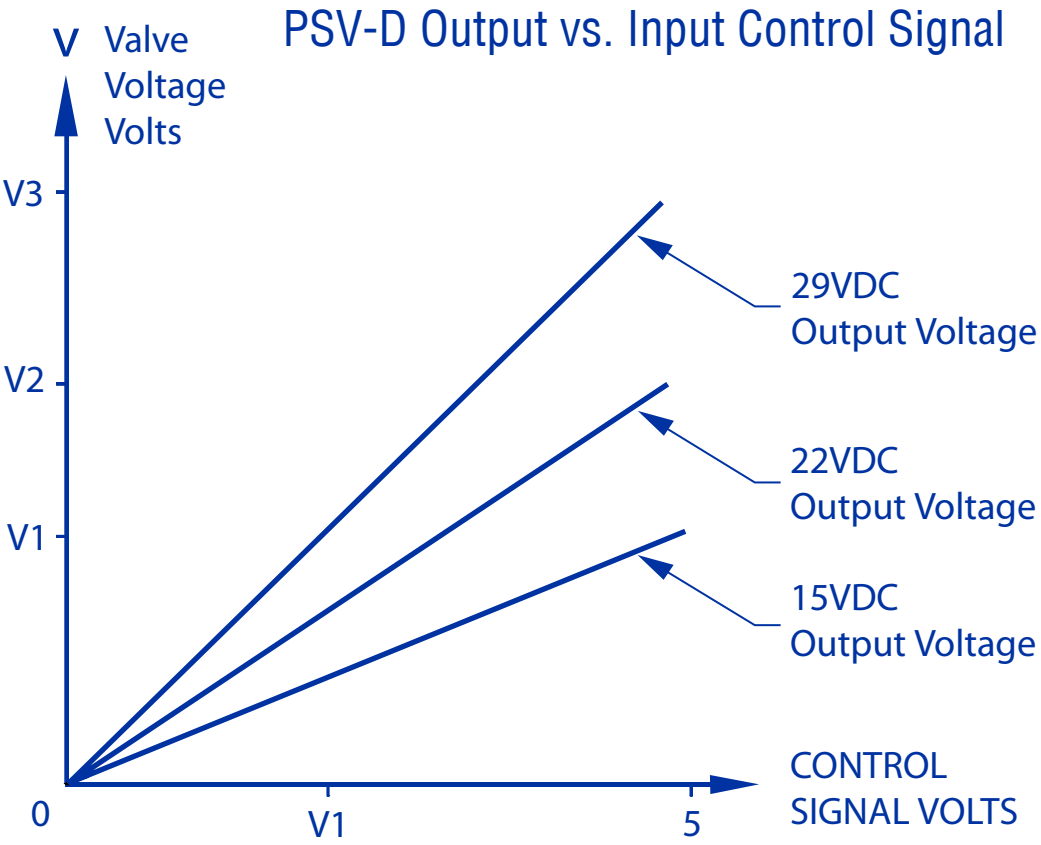
The Auto-Select feature of the Driver Module recognizes the type of reference signal received and defaults to 0 - 5 Vdc if both signals are provided.



Dimensions Pulse Width Modulated Driver Module



NOTE: Aalborg® reserves the right to change designs and dimensions at its sole discretion at any time without notice. For certified dimensions please contact Aalborg®.



Jumper selectable output power allows a choice of dc voltage range for cooler more efficient operation, as a function of flow rates.

Internal resettable fuse protects electronics and rectifier circuits, prevents polarity reversal damage.

The maximum output voltage supplied to the PSV Valve can be set or changed in the field to allow for optimal use of the input reference signal to output voltage based on the specific flow rate and operating pressure applied to the valve.

TABLE 52 - SPECIFICATIONS	
CONNECTION:	9-pin male "D" subconnector for input/output signals.
POWER INPUT REQUIRED:	+12 to 30 Vdc 1A @ 12 Vdc, 0.5A (not supplied) @ 24 Vdc via 9-pin "D"-connector or dc power jack (center positive).
INPUT SIGNAL:	Auto-Select feature allows circuit to recognize which analog input reference (0 to 5 Vdc or 4-20 mA) signal is provided.
TTL ON/OFF:	Jumper selectable LOW (0 Vdc) OFF-HIGH (5 Vdc) on, or reverse, to select valve ON/OFF status.
VALVE OUTPUT POWER:	Jumper selectable to +15, +22, and +29 Vdc with adjacent potentiometer to obtain ±2 Vdc.
FUSE RATING:	An internal resettable 1.6A fuse protects the electronics on the power input.
POLARITY PROTECTION:	Internal rectifier circuit protects from reversed polarity on the power input.
OPERATING TEMPERATURE:	32 °F (0 °C) to 122 °F (50 °C).
DIMENSIONS:	3" (7.62mm) wide x 3" (7.62mm) deep x 1" (25.4mm) high.
CE COMPLIANCE :	EMC Directive 89/336/EEC EN55011:1991 Group 1, Class A EN50082-2:1995.

ORDERING INFORMATION FOR PSV-D	
MODEL	
PSV-D	Proportionating Solenoid Valve Driver

PSV-D

TABLE 53- ACCESSORIES FOR FOR PSVD DRIVER MODULE	
PS-PSV-110NA-4	Power Supply, 110vac/24 Vdc /North America
PS-PSV-230EU-4	Power Supply, 230vac/24 Vdc /Europe
PS-PSV-240AU-4	Power Supply 240vac/24 Vdc /Australia
PS-PSV-240UK-4	Power Supply 240vac/24 Vdc /United Kingdom
CBL-DP9-6	Female 9 pin D-connector with 6 ft.cable

Intelligent Control Valve



Design Features

- Improved high-precision two-way metering valves in aluminum or 316 SS for gas/liquid applications.
- Four different control modes and multiple analog interfaces are supported to accommodate the variety of customer applications.
- Standard digital RS-485 interface implemented using galvanically isolated RS-485 transceiver with high common-mode transient immunity allows direct digital communication with PLC or PC and provides access to all configuration and process variable parameters.
- ASCII commands set, free Communication and Configuration software, and LabVIEW Driver*.
- Eliminates problems associated with solenoid designs, such as coil heating and electromagnetic hysteresis.

General Description

A line of improved electronic two-way metering needle valves is presented. A high-precision linear stepping motor actuator drives the valve spindle. The standard resolution of the stepping motor actuator-driven needles is 0.000125"/step. In micro-stepping mode, the resolution is 0.0000078125"/step.

The valve can be controlled using one of the four modes:

- Analog Interface (0-5Vdc, 1-5 Vdc, 4-20mA, 0-10Vdc* options are supported). The valve opening is linearly proportional to the control analog signal in this mode.
- Digital RS-485 Interface (via optically isolated transceiver using proprietary ASCII commands set). In this mode, the user can control the valve by sending the command with the desired valve opening position expressed in % of valve full opening (0.00 to 100.00% with 0.01% resolution).
- Direction / Speed (legacy SMV valve proprietary mode). In this mode valve is controllable using digital TTL (low active) "Direction" and analog (0-5Vdc, 1-5 Vdc, 4-20mA, 0-10Vdc* options are supported) "Speed" signals.
- Step Clock / Direction. In this mode, the valve is controllable using digital TTL (low-active) "Step" and "Direction" signals. With each falling edge on the "Step Clock" input, the valve needle will move one step to close or open direction based on the logic level applied to the "Direction" input.

Low differential pressure valves may be operated continuously (100% duty cycle). When de-energized, the valves stay in the same position. Advantages over electromagnetic solenoid-operated valves include cool operations, i.e., no control operating problems due to coils heating up, no electromagnetic hysteresis, excellent resolution, and very low differential pressures. The valve control may be overridden with CLOSE and PURGE control signals (TTL low active). To CLOSE the valve, pin 3 on the 9-pin "D"- connector must be connected to GND (pin 2). A GREEN light on the top of the valve will indicate a CLOSED valve condition. To PURGE the valve, pin 7 on the 9-pin "D"-connector has to be connected to GND (pin 2). A RED light on the top of the valve will indicate a fully OPEN valve condition. During regular operation, the valve remains in the last position as it is de-energized.

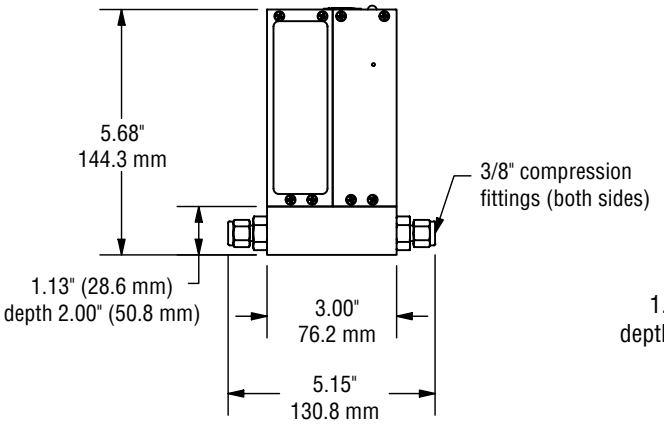
**NOTE: 0-10 Vdc analog input option requires additional jumper installation on the PCB and cannot be selected on the field using the user multi-functional button or via digital RS-485 interface. If the 0-10 Vdc option is required, it must be specified during the order.*

TABLE 54 - FLOW RATE FOR SMVI

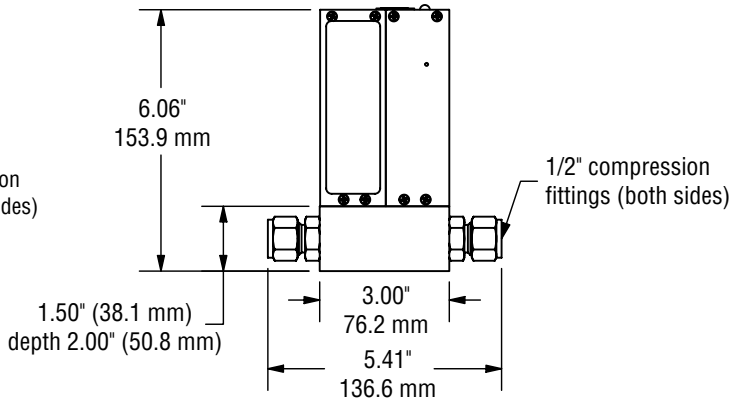
MODEL NUMBERS	MAXIMUM FLOW RATE (at 20 psi differential pressure, 70 °F)				Cv	CONNECTIONS	ORIFICE SIZE
	AIR		H_2O				
	sL/min]	[scfh]	[L/min]	GPM			
SMVI20	200	424	5.6	1.48	0.336	3/8" compression fitting	3/8"
SMVI30	500	1060	14.2	3.75	0.855	3/8" compression fitting	3/8"
SMVI40	1000	2119	28	7.4	0.735	3/4" FNPT	1/2"

TABLE 55 - SMVI SPECIFICATIONS	
MATERIALS OF CONSTRUCTION:	ALUMINUM MODELS CONSTRUCTION AND WETTED MATERIALS: Aluminum lower blocks, PTFE-lined aluminum housing, FKM O-rings, PTFE closing tips. STAINLESS STEEL MODELS CONSTRUCTION AND WETTED MATERIALS: 316 stainless steel lower blocks, PTFE-lined aluminum housings, FKM O-rings, PTFE closing pins. Available SEALS options: FKM, Buna, EPR, FFKM.
MAXIMUM FLOW RATES:	SMVI20 200 sL/min (air), 5.6 L/min (water); SMVI30 500 sL/min (air), 14.2 L/min (water); SMVI40 1000 sL/min (air), 28 L/min (water).
CONNECTIONS:	3/8", 1/2", 3/4" compression and 3/4" FNPT.
ELECTRICAL CONNECTIONS:	9-pin "D" connector located at the side of the valve.
POWER INPUT:	Universal 12 to 24 Vdc @ 800mA (maximum current). Power input is protected by a 900 mA resettable fuse.
DIRECTIONAL AND STEP CLOCK CONTROL SIGNAL:	Digital 5V TTL (10K input impedance). Do not apply more than 5.5 Vdc. Direction Control Input: CLOSE (DOWN): TTL Logic Low (<0.8 Vdc); OPEN (UP): TTL Logic High (> 2 Vdc). Step Clock Control Input: TTL Active Low (Motor performs one step at each falling edge). Valve CLOSE/OPEN override inputs: TTL Active Low (<0.8 Vdc). Do not apply more than 5.5 Vdc.
SUPPORTED ANALOG CONTROL SIGNALS:	Linear 0 to 5 Vdc, 1-5 Vdc, 0-10 Vdc (100K input impedance); Linear 4-20 mA (250 Ω input impedance).
DIGITAL INTERFACE:	Isolated RS-485 transceiver (two wires, half duplex).
RESPONSE TIME:	100ms time constant.
PRESSURE DROP @ 100% FULL-SCALE FLOW:	SMVI30 @ 200 sl/min 5 PSID (350 mbar differential) SMVI30 @ 500 sl/min 7 PSID 490 mbar differential) SMVI40 @ 1000 sl/min 10 PSID (700 mbar differential)
MAXIMUM OPERATING PRESSURE:	500 PSIG (35 bars).
MAXIMUM DIFFERENTIAL PRESSURE:	50 PSIG (3.45 bars).
ENVIRONMENTAL (PER IEC 664):	Installation Level II; Pollution Degree II.
GAS AND AMBIENT TEMPERATURE:	32 °F to 122 °F (0 °C to 50 °C).
INGRESS PROTECTION:	IP40.
EXTERNAL LEAK INTEGRITY:	1 x 10^{-7} sccs He maximum to the outside environment.
INTERNAL LEAK IN CLOSE POSITION:	Up to 0.5% of full-scale range @ 30 PSID.
WETTED MATERIALS:	SMVI20-A/SMVI30-A/SMVI40-A: Anodized aluminum, brass, and 316 stainless steel with FKM O-rings seals; BUNA-N®, EPR, or FFKM O-rings are optional. SMVI20-S/SMVI30-S/SMVI40-S: 316 stainless steel with FKM O-rings seals; BUNA-N®, EPR, or FFKM O-rings are optional.

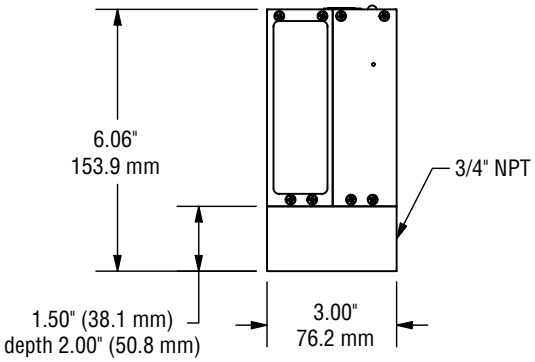
SMVI20



SMVI30



SMVI40



SMVI40C

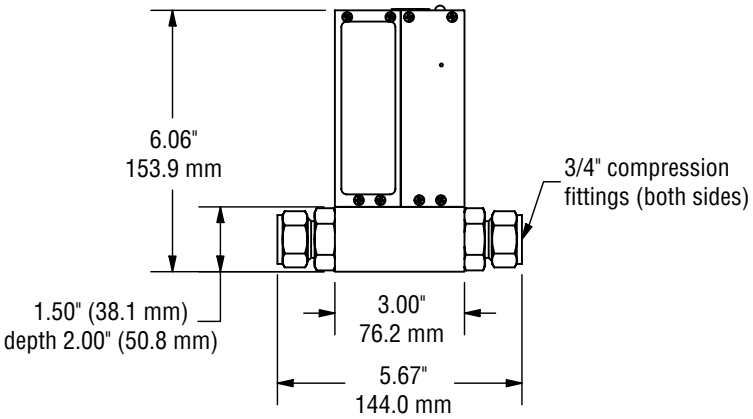
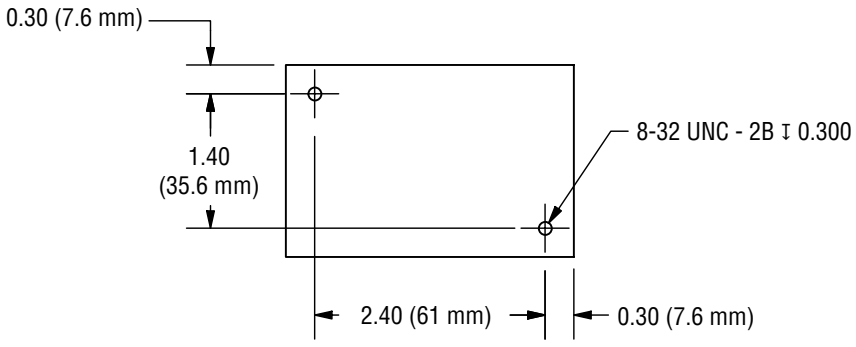


Table Mounting Holes (Typical)



SMVI ORDERING INFORMATION INTELLIGENT CONTROL VALVE

Configure and Order Online: SMVI Intelligent Control Valve

SMVI	MODEL

SERIES	
20	
30	
40	

MATERIAL	
A	Aluminum
S	Stainless Steel

SEALS	
V	FKM
B	Buna®
E	EPR
T	PTFE / FFKM

FITTINGS		MODEL
D	3/8" Compression	SMVI20
E	1/2" Compression	SMVI30
F	3/4" FNPT	SMVI40
G	3/4" Compression	SMVI40

POWER	
6	Universal 12 to 24 Vdc

VALVE OPENING CONTROL MODE	
A	Analog Interface (% of opening)
B	Digital RS-485 Interface (all parameters including % of opening)
C	Direction / Speed (legacy SMV valve proprietary mode)
D	Step Clock / Direction

ANALOG INPUT (applicable only for A and C control modes)	
A	0-5Vdc
B	0-10Vdc * (specify during the order, cannot be changed on the field)
C	1-5Vdc
D	4-20 mA

SMVI	30	–	S	V	E	6	–	A	A

NOTE: 0-10 Vdc analog input option requires additional jumper installation on the PCB and cannot be selected on the field using user multi-functional button or via digital RS-485 interface. If the 0-10 Vdc option is required, it must be specified during the order.

EXAMPLE: SMVI30-SVE6-AA

Stepping Motor Valve Intelligent 500 sl/min, SS, FKM, 1/2" Compression fittings, universal 12 to 24 Vdc power, Analog Interface, 0-5Vdc.

TABLE 56 - CONVERSION FACTORS

MULTIPLY	BY	TO OBTAIN
atm	14.70	lbs/sq. in
atm	1.0333	kg/sq. cm
lbs/sq. in	0.07031	kg/sq. cm
ml/min	0.001	liters/min
ml/min	3.531 X 10^{-5}	cu. ft/min
ml/min	1.585 x 10^{-2}	gal/hr
cu. ft/hr	472	ml/min
gal/min	3785	ml/min
g/ml	62.43	lbs/cu. ft
g/ml	0.03613	lbs/cu. in
cc/min	1	mL/min
cfm (ft3/min)	28.31	L/min
cfm (ft3/min)	1.699	m3/hr
oz/min	29.57	mL/min

TABLE 57 - PRESSURE CONVERSION FACTORS

MULTIPLY	BY	TO OBTAIN
psi	27.71	in. H2O
psi	2.036	in. Hg
psi	703.1	mm/H2O
psi	51.75	mm/Hg
psi	.0703	kg/cm2
psi	.0689	bar
psi	68.95	mbar
psi	6895	Pa
psi	6.895	kPa

TABLE 58 - TEMPERATURE

°F = (1.8 x °C) + 32
°C = (°F - 32) x 0.555
°Kelvin = °C + 273.2

TABLE 59 - LENGTH

MULTIPLY	BY	TO OBTAIN
inch	2.54	cm
inch	12	foot
ft.	0.305	meter
yard	1.914	meter
Angstrom	1010	meter

COMMON EQUIVALENTS AND CONVERSIONS

Approximate Common Equivalents

1 inch	= 25 millimeter
1 foot	= 0.3 meter
1 yard	= 0.9 meter
1 mile	= 1.6 kilometers
1 square inch	= 6.5 sq centimeters
1 square foot	= 0.09 square meter
1 square yard	= 0.8 square meter
1 acre	= 0.4 hectare +
1 cubic inch	= 16 cu centimeters
1 cubic foot	= 0.03 cubic meter
1 cubic yard	= 0.8 cubic meter
1 quart (lq)	= 1 liter +
1 gallon	= 0.004 cubic meter
1 ounce (avdp)	= 28 grams
1 pound (avdp)	= 0.45 kilogram
1 horsepower	= 0.75 kilowatt
1 millimeter	= 0.04 inch
1 meter	= 3.3 feet
1 meter	= 1.1 yards
1 kilometer	= 0.6 mile
1 square centimeter	= 0.16 square inch
1 square meter	= 11 square feet
1 square meter	= 1.2 square yards
1 hectare +	= 2.5 acres
1 cubic centimeter	= 0.06 cubic feet
1 cubic meter	= 35 cubic feet
1 cubic meter	= 1.3 cubic yards
1 liter +	= 1 quart
1 cubic meter	= 250 gallons
1 gram	= 0.035 ounces (avdp)
1 kilogram	= 2.2 pounds (avdp)
1 kilowatt	= 1.3 horsepower

Conversions Accurate to Parts Per Million

inches X 25.4*	= millimeters
feet X 0.3048*	= meters
yards X 0.9144*	= meters
miles X 1.603 34	= kilometers
square inches X 6.4516*	= square centimeters
square feet X 0.92 903 0	= square meters
square yards X 0.836 127	= square meters
acres X 0.404 686	= hectares
cubic inches X 16.3871	= cubic centimeters
cubic feet X 0.028 316.8	= cubic meters
cubic yards X 0.764 555	= cubic meters
quarts (lq) X 0.946 353	= liters
gallons X 0.003 785 41	= cubic meters
ounces (avdp) X 28.3495	= grams
pounds (avdp) X 0.453 592	= kilograms
horsepower X 0.745 700	= kilowatts
millimeters X 0.039 370 1	= inchs
meters X 3.280 84	= feet
meters X 1.093 61	= yards
kilometers X 0.621 371	= miles
sq centimeters X 0.155 000	= square inchs
square meters X 10.7639	= square feet
square meters X 1.195 99	= square yards
hectares X 2.471 05	= acres
cu centimeters X 0.061 623 7	= cubic inches
cubic meters X 35.3147	= cubic feet
cubic meters X 1.307 95	= cubic yards
liters X 1.056 69	= quarts (lq)
cubic meters X 264.172	= gallons
grams 0.035 274 0	= ounces (avdp)
kilograms X 2.204 62	= pounds (avdp)
kilowatts 1.341 02	= horsepower

THESE PREFIXES MAY BE APPLIED TO ALL SI UNITS
Multiples and Submultiples

1 000 000 000 000	= 10^{12}
1 000 000 000	= 10^{9}
1 000 000	= 10^{6}
1000	= 10^{3}
100	= 10^{2}
10	= 10
0.1	= 10^{-1}
0.01	= 10^{-2}
0.001	= 10^{-3}
0.000 001	= 10^{-6}
0.000 000 001	= 10^{-9}
0.000 000 000 001	= 10^{-12}
0.000 000 000 000 001	= 10^{-15}
0.000 000 000 000 000 001	= 10^{-18}

Prefixes	Symbols
tara (ter'a)	T
giga (ji ga)	G
mega (meg'a)	M
kilo (kil o)	k+
hecto (hek'to)	h
deka (dek'a)	da
deci (des'i)	d
centi (sen'ti)	c+
milli (mil'i)	m+
micro (mi' kro)	u+
nano (nan'o)	n
pico (pe'ko)	p
femto (fem'to)	f
atto (at'to)	a

+ common term not used in S1 Source: NBS Special Pub. 304.

TRADEMARKS

Aalborg® -is a registered trademark of Aalborg Instruments & Controls.
Buna-N® -is a registered trademark of DuPont Dow Elastomers.
VCR® -is a registered trademark of Swagelock Marketing Company.

US PATENT NUMBERS
4,862,750 and 5,561,249

Limited Warranty Policy

Warranty Coverage

Aalborg® warrants its products to be free from defects in materials and workmanship for a period of not to exceed (12) months from the date of purchase.

Customer Responsibilities

It is the sole responsibility of the customer to ensure the proper selection of equipment that is compatible with the flow medium and operating conditions in use. Products must be operated by qualified personnel knowledgeable in the equipment's intended application, limitations, and proper usage. Use of the equipment in a manner inconsistent with operational guidelines, including exposure to incompatible gases, liquids, or conditions, voids all warranty coverage.

Limitations and Exclusions

This warranty does not cover:
Product that was used outside of its stated specifications.
Products that, upon examination by Seller, or Seller's authorized service provider, are found to have been mishandled, misused, abused, or damaged by Buyer or any third party.
A product repaired or modified by performed by a party other than Aalborg® or its authorized representatives.
Improperly stored, installed, operated, or maintained in a manner inconsistent with Seller's instructions.
Defects attributed to normal wear and tear or failure to comply with Seller's safety warnings.
Indirect, incidental, consequential, special, punitive, or consequential damages, including lost profits.
Shipping or transportation charges to Aalborg® or its authorized service facility.

Return Authorizations

Goods shall not be returned without Seller's prior authorization.
It is recommended that our service representatives be contacted to rectify product issues remotely, if possible. When not possible, request a Return Authorization Number (RAN) and a SERVICE SAFETY ASSURANCE CERTIFICATE form to be completed and attached for factory evaluation.

If a defect covered by this warranty is discovered, the product will be repaired or replaced at Aalborg's sole discretion, free of charge for parts and labor.
Such repair, replacement, or credit shall be Buyer's sole remedy for defective Goods and Services.

For defective Goods not covered by this warranty, repair or replacement shall not be performed until and unless Buyer issues an Order to Seller authorizing such repair or replacement at Seller's then-current repair or replacement price.
In addition, Seller may charge Buyer for any testing or inspection costs. In no event shall Seller retain or store returned Goods for more than three (3) months.

Disclaimer

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Form nr.: AAL-WP1

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Phone: 86-10-6295-0464, 86-10-6295-0465
Fax: 86-10-6295-0466
Website: http://www.comity-tec.com

Products Manufactured By Aalborg

ELECTRONIC METERS & CONTROLLERS

Low Cost Mass Flow Meters
Aluminum or Stainless ● With or Without LCD Readout
Low Cost Mass Flow Controllers
Aluminum or Stainless ● With or Without LCD Readout
Mass Flow Controllers
Stainless ● One to Four Channel Systems
Digital Mass Flow Controllers
Auto Zero ● Totalizer ● Alarms = Built in RS485
Multi-Parameter Digital Mass Flow Meters
Displays Flow Pressure and Temperature
Paddle Wheel Meters
For Liquids ● Optional Temperature Measurements
Smart Rate / Totalizer / Signal Conditioner
LCD Keypad ● RS232 / 485 ● Pulse Output ● Alarms

ROTAMETERS

Single Tube
Aluminum / Brass / Stainless 1 Interchangeable Glass Flow Tubes ● Optional Valves
Multiple Tube
Two to Six Channels ● Aluminum or Stainless
PTFE Single and Multiple Tube
Chemically Inert ● 1 to 4 Channels ● Interchangeable Glass Flow tubes
PTFE - PFA
Chemically Inert ● Low to Medium Flow of Corrosive Liquids with PFA Flow Tube
Kits
Aluminum / Stainless / PTFE ● Including Five Glass Flow Tubes and a Set of Floats
Gas Proportioners
Aluminum / Stainless ● Used for Blending Two or Three Gases
Medium Range
Glass Safety Shield ● Dual Air and Water Scale
Optical Sensor Switch
Non-Invasive Means for Detection of a High or Low Flow
High Flow Industrial Stainless Steel Flow Meters
Heavy Duty Stainless Steel ● Direct Reading Air and Water Scales

VALVES

Barstock
Brass or Stainless ● Standard or High Precision
PTFE
Chemically Inert ● Needle or Metering
Proportionating Solenoid
Stainless ● For Controlling Gas or Liquid Flow
● Pulse width Modulated
SMV ● Stepping Motor Valve

PERISTALTIC PUMPS

Fixed RPM Pumps
Pump Heads
Tubing Pumps
Variable Speeds
Dispensing Pumps
Flexible Tubings