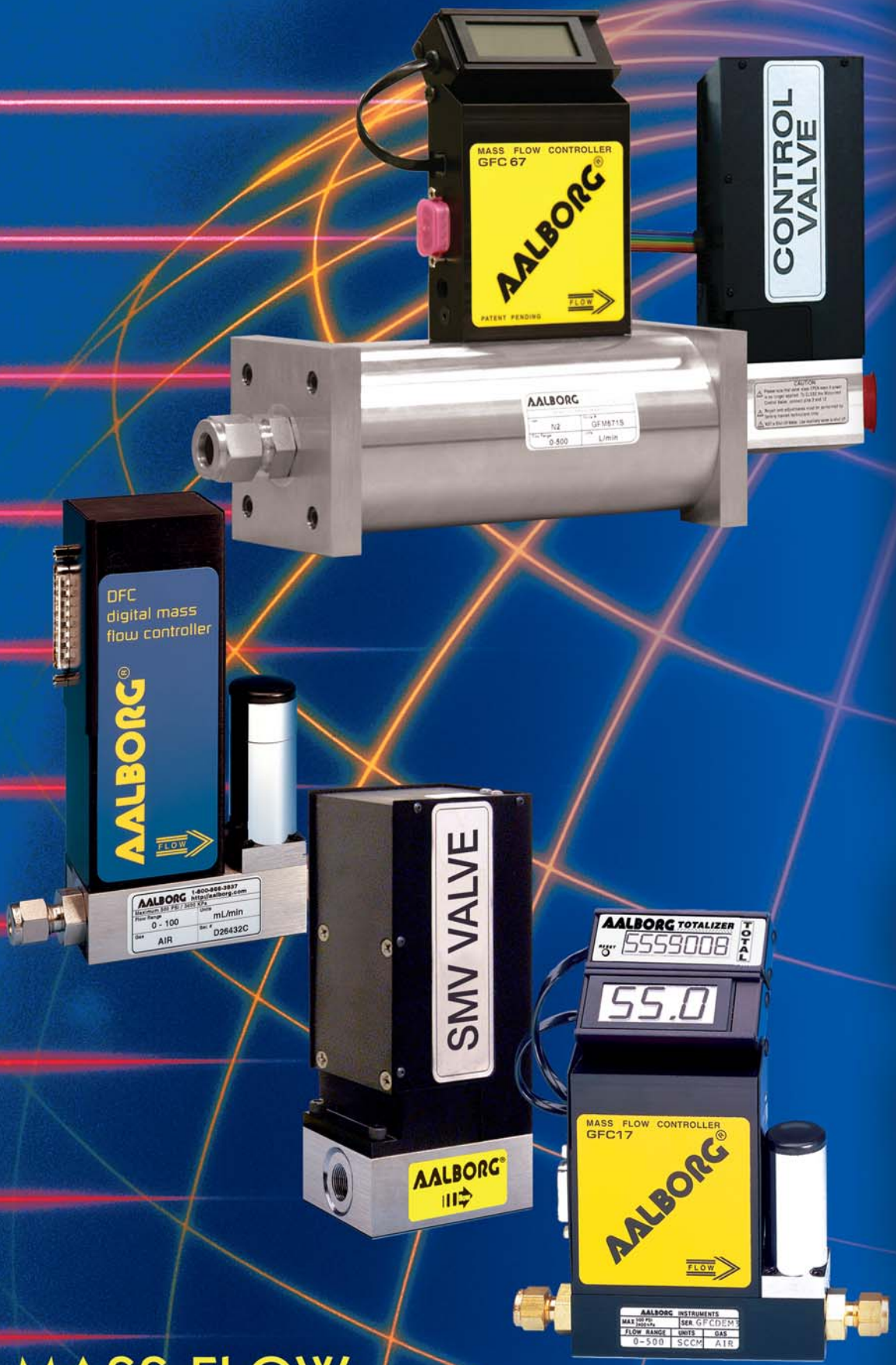


AALBORG®

MASS FLOW METERS AND CONTROLLERS

Worldwide Distribution

Visit our web site at: aalborg.com

About the Company

Founded in 1972 Aalborg Instruments & Controls, Inc. is well known throughout the world as a primary manufacturer of precision instrumentation for flow measurement and control. We operate two divisions. The Variable Area Division manufactures a diversified line of rotameter flow meters and needle valves. Constructed of aluminum, brass, stainless steel, PTFE or PFA, variable area flow meters range from microflow to industrial size flow meters. The Electronics Division produces state of the art thermal mass flow meters and mass flow controllers for gases and proportionating valves for liquids and gases.

NIST Traceable

NIST traceable calibrations are performed in our well equipped laboratories.

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

ISO 9001 Certification

Aalborg Instruments 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 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 Instruments & Controls, Inc. 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.

Table of Contents

20 Corporate Drive, Orangeburg, NY 10962 USA toll free: 1.800.866.3837 Phone: 845.770.3000 Fax: 845.770.3010
e-mail us at: info@aalborg.com web site: http://aalborg.com

Table of Contents

AALBORG®

20 Corporate Drive, Orangeburg, NY 10962 USA toll free: 1.800.866.3837 Phone: 845.770.3000 Fax: 845.770.3010
e-mail us at: info@aalborg.com web site: http://aalborg.com

NIST Calibrations

Our laboratories are fully equipped to perform NIST traceable flow calibrations for Mass Flow and variable area instruments, and many other flow products. We can also offer calibration service on equipment and instrumentation produced by other manufacturers, comparable to those manufactured by Aalborg.

- Calibrations are performed at standard (STP) conditions (70° F/21.1° C and 14.7 psia/1 atm abs).
- NIST traceable gas calibrations for up to 2000 sL/min and water calibrations up to 2 L/min available.
- Calibrated to either a primary NIST standard or to an NIST traceable instrument.
- State of the art Precision Glass - Piston, and Bell Prover type calibration.

*SGS ISO9001 Certification is not applicable.

Typical calibrators used for Low flow rates

Typical Bell Prover used for NIST traceable calibrations

Low Cost Mass Flow Meters

GFM

http://aalborg.com

A low cost solution to thermal mass flow metering for gases is presented by Aalborg in introducing the model GFM mass flow meter line.

The GFM design combines the convenience and accuracy of conventional mass flow devices with low costs previously unattainable.

Each of these meters incorporate an advanced straight tube sensor in conjunction with flow passage elements constructed of aluminum and brass for non-corrosive gases or 316 stainless steel for corrosive applications.

Typical Aluminum GFM Mass Flow Meter

Design Features

- Rigid metallic construction.
- Maximum pressure of 500 psig(34.5 bars).
- Leak integrity 1 x 10^{-7} 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.
- 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.

Low Cost Mass Flow Meters

http://aalborg.com

GFM 77 Aluminum Mass Flow Meter

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 control.

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. Transducers without LCD readout are offered for OEM applications.

GFM mass flow meters are available with flow ranges from 10 sccm to 1000 sL/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 controllers may be used as benchtop units or mounted by means of screws in the base.

Transducer power supply ports are fuse and polarity protected.

Leak Integrity

1 x 10^{-7} smL/sec of helium max to outside environment.

Specifications

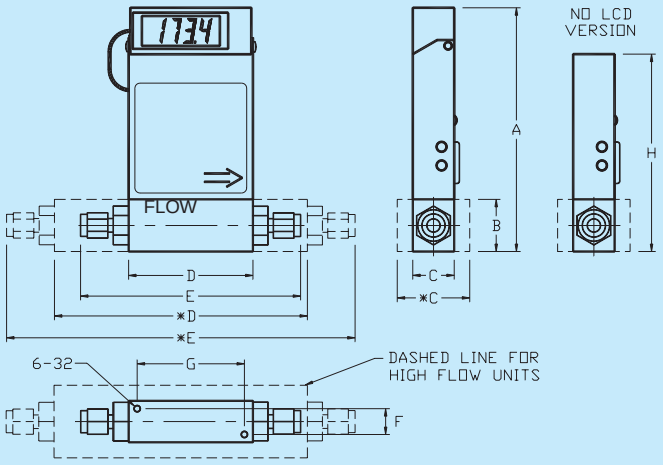
Accuracy : (including linearity)	±1.5% of full scale, including linearity for gas temperatures of 59°F to 77°F (15°C to 25°C) and pressures of 5 to 60 psia (0.4 to 4.1 bars); optional ±1% of full scale (certified calibration accuracy) associated with a given set of temperature and pressure values. ±3% of full scale including linearity for gas temperatures of 32°F to 122°F (0 to 50°C) and 1 to 500 psia (0.07 to 34 bars).
Repeatability :	±0.5% of full scale.
Response Time :	Generally 2 seconds to within ±2% of actual flowrate over 25 to 100% of full scale.
Temp. Coefficient :	0.15% of full scale / °C.
Pressure Coefficient :	0.01% of full scale / psi (0.07 bar)
Max Pressure Drop : [cm H2O]	up to 10 std. sL/min. - 2.5cm of H_20; 15 std. l/min. -10 cm of H_20
Gas & Ambient Temp :	41°F to 122°F (0 to 50°C)
Output Signals :	Linear 0-5 Vdc. 1000 ohms min. load impedance and 4 - 20 mA 0 - 250 ohms loop resistance
Transducer Input Power :	+12 Vdc; 200 mA of maximum. +24 Vdc optional.
Time Constant :	800 ms.
Gas Pressure :	500 psig (34.5 bars) maximum. 20 psig (1.4 bars) optimum.
Materials In Fluid Contact :	a. Aluminum models GFM Series: anodized aluminum, 316 stainless steel, brass and Viton® O-rings. b. Stainless Steel models GFM17S, 37S, 47S, 57S, 67S and 77S: 316 stainless steel and Viton® O-rings. Optional O-rings Neoprene® and Kalrez®.
Connections :	GFM 17 and 37 -1/4" compression fittings. GFM 47 -3/8" compression fittings. Optional VCR®s or 1/8", 3/8"compression fittings. GFM 57 - 3/8" compression fittings. GFM 67 - 1/2" compression fittings. GFM 77 - 3/4" FNPT fittings. Optional VCR®s 3/4" compression fittings (GFM77).
CE Compliant :	EN 55011 class 1, class B; EN50082-1

GFM

http://aalborg.com

Dimensions* GFM Mass Flow Meters

MODEL	CONNECTION: SWAGELOCK COMPRESSION FITTING EXCEPT MODEL GFM77	DIMENSIONS [INCH] LCD VERSION							NO LCD
		A	B	C/*C	D/*D	E/*E	F	G	H
GFM17	1/4 TUBE ODIA	5.60	1.00	1.00	3.00	5.02	0.69	2.68	4.50
GFM37	1/4 TUBE ODIA	5.98	1.37	1.25	4.00	6.02	0.69	2.68	4.88
GFM47	3/8 TUBE ODIA	5.98	1.37	1.25	4.00	6.14	0.69	2.68	4.88
GFM57	3/8 TUBE ODIA	6.60	2.00	1.75	6.69	8.83	0.99	4.68	5.50
GFM67	1/2 TUBE ODIA	7.35	2.75	2.50	7.25	9.67	1.69	4.68	6.25
GFM77	3/4 NPT FEMALE	8.23	3.63	3.38	7.31	-----	1.69	4.68	7.13



ORDERING INFORMATION FOR GFM

MODEL
GFM

SERIES	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

SEALS	
V	Viton
B	Buna
E	EPR
T	PTFE/ Kalrez

FITTINGS	
A	1/4" Compression
B	1/8" Compression
C	VCR
D	3/8" Compression
E	1/2" Compression
F	3/4" FNPT
G	3/4" Compression
X	Special

CONNECTOR	
D	D Connector

DISPLAY	
N	No display
L	LCD readout

POWER	
2	12 Vdc
4	24 Vdc

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

*n.a. = not applicable

DIGITAL INTERFACE	
0	None

GFM 17 S - V A D L 2 - A 0

EXAMPLE: GFM17S-VADL2-A0 **5 L/min [N_2] 20 psig** PLEASE SPECIFY: Gas, Flow Range and Pressure.

GFM17 stainless, Viton seals, 1/4" compression fittings, D connector with display, 12Vdc, 0-5 Vdc, Output Signal, No Digital Interface.

For Specific Flow Ranges Contact Aalborg Customer Service Department

Table 7 - Totalizer	
TOT-10-0C	Totalizer (5Vdc - 10Vdc signals), calibrated.
TOT-10-0N	Totalizer (5Vdc - 10Vdc signals), uncalibrated.
CBLTOT-10	Cable & splitter, used in conjunction w/ display.
Table 8 - IO Input/Output	
IO-232-C	Input/output to RS232, 0-5Vdc.
IO-232-E	Input/output to RS232, 4-20mA.
IO-485-C	Input/output to RS485, 0-4Vdc.
IO-485-E	Input/output to RS485, 4-20mA.

Table 9 - Accessories for GFM Mass Flow Meters	
PS-GFM-110NA-2	Power Supply, 110 V / 12 Vdc /North America
PS-GFM-230EU-2	Power Supply, 220 V / 12 Vdc /Europe
PS-GFM-240UK-2	Power Supply 240 V / 12 Vdc /United Kingdom
PS-GFM-240AU-2	Power Supply 240 V / 12 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

FLOW RANGES			
Code	Units [Nitrogen]	Code	Units [Nitrogen]
GFM17			
-01	0 to 10 smL/min	-06	0 to 500 smL/min
-02	0 to 20 smL/min	-07	0 to 1 sL/min
-03	0 to 50 smL/min	-08	0 to 2 sL/min
-04	0 to 100 smL/min	-09	0 to 5 sL/min
-05	0 to 200 smL/min	-10	0 to 10 sL/min
GFM37			
-11	0 to 15 sL/min	-32	0 to 40 sL/min
-30	0 to 20 sL/min	-33	0 to 50 sL/min
-31	0 to 30 sL/min		
GFM47			
-40	0 to 60 sL/min	-42	0 to 100 sL/min
-41	0 to 80 sL/min		
GFM57			
-50	0 to 200 sL/min		
GFM67			
-60	0 to 500 sL/min		
GFM77			
-70	0 to 1000 sL/min		

Low Cost Mass Flow Controllers

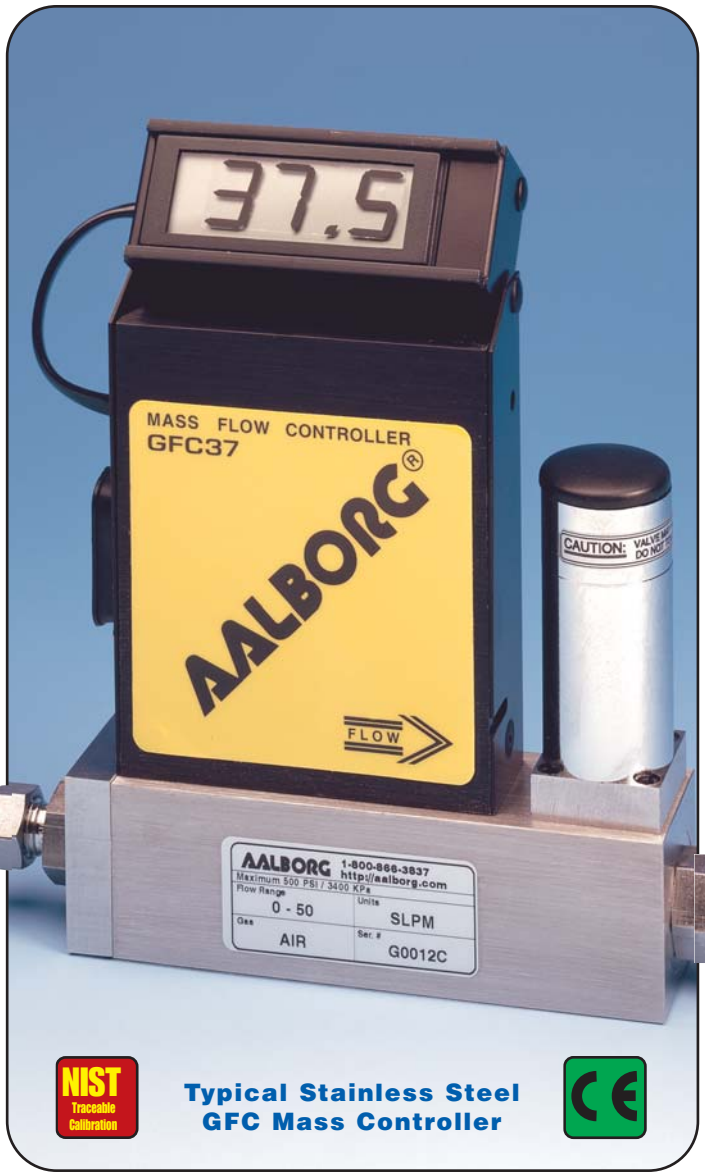
GFC

http://aalborg.com

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 straight 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.



Typical Stainless Steel GFC Mass Controller

Design Features

- Rigid metallic construction.
- Maximum pressure of 500 psig (34.5 bars).
- Leak integrity 1 x 10^{-7} 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.
- 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.

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.

Low Cost Mass Flow Controllers

http://aalborg.com

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. The valve is normally closed as a safety feature to ensure that gas flow is shut off in case of a power outage. Setpoints are controlled either locally or remotely.

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 sccm to 1000 sL/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 benchtop units or mounted by means of screws in the base.

Transducer power supply ports are fuse and polarity protected.

GFC 77 Aluminum Mass Flow Controller

Leak Integrity

1 x 10^{-7} smL/sec of helium maximium to the outside environment.

Specifications

Accuracy (including linearity) :	±1.5% of full scale, including linearity for gas temperatures of 59°F to 77°F (15°C to 25°C) and pressures of 5 to 60 psia (0.4 to 4.1 bars).
Repeatability :	±0.5% of full scale.
Response Time :	Generally 2 seconds to within ±2% of actual flow rate over 25 to 100% of full scale.
Temp. Coefficient :	0.15% of full scale / °C.
Pressure Coefficient :	0.01% of full scale / psi (0.07 bar).
Optimum Gas Pressure :	25 psig (1.73 bars).
Max Gas Pressure :	500 psig (34.5 bars) maximum.
Max Diff. Pressure :	GFC17 & GFC37 50psi (3.4bars), GFC47 40psi (2.7bars)
Gas & Ambient Temp :	41°F to 122°F (5°C to 50°C).
Materials In Fluid Contact :	a. Aluminum models GFC Series: anodized aluminum, 316 stainless steel, brass and Viton® O-rings. b. Stainless Steel models GFC17S, 37S, 47S, 57S, 67S and 77S: 316 stainless steel and Viton® O-rings. Optional O-rings Neoprene® and Kalrez®.
Attitude Sensitivity :	1% shift for a 90° 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 setpoint mode; NPN compatible purge / valve off.
Connections :	GFC 17 and 37 - 1/4"compression fittings. GFC 47 - 3/8" compression fittings. Optional VCR®s or 1/8", 3/8" compression fittings. GFC 57 - 3/8" compression fittings. GFC 67 - 1/2" compression fittings. GFC 77 - 3/4" FNPT fittings. Optional VCR®s 3/4" compression fittings(GFC77).
Transducer Input Power :	+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

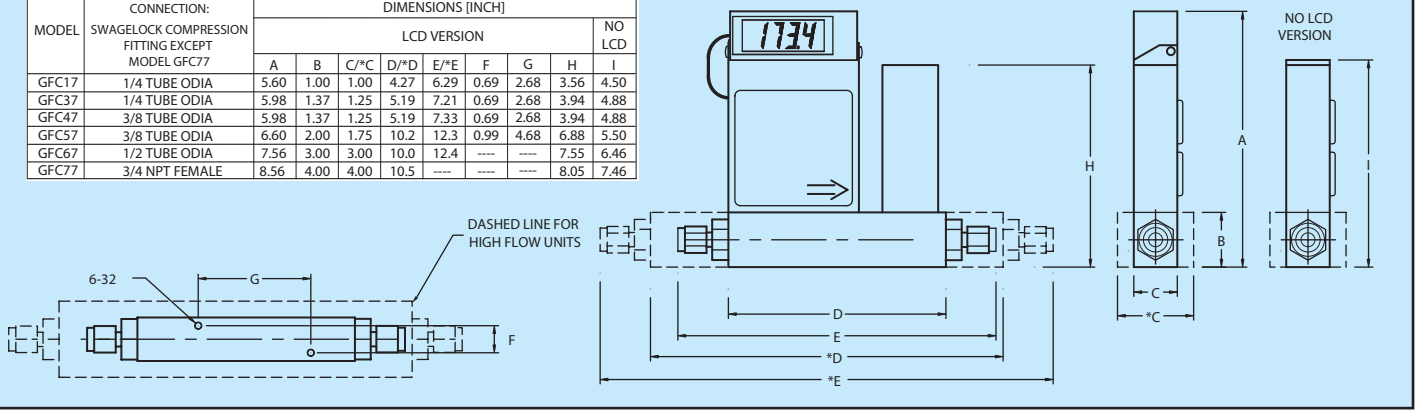
Low Cost Mass Flow Controllers

GFC

http://aalborg.com

Dimensions* GFC Mass Flow Controller

MODEL	CONNECTION: SWAGELOCK COMPRESSION FITTING EXCEPT MODEL GFC77	DIMENSIONS [INCH]								
		LCD VERSION								NO LCD
		A	B	C/*C	D/*D	E/*E	F	G	H	I
GFC17	1/4 TUBE ODIA	5.60	1.00	1.00	4.27	6.29	0.69	2.68	3.56	4.50
GFC37	1/4 TUBE ODIA	5.98	1.37	1.25	5.19	7.21	0.69	2.68	3.94	4.88
GFC47	3/8 TUBE ODIA	5.98	1.37	1.25	5.19	7.33	0.69	2.68	3.94	4.88
GFC57	3/8 TUBE ODIA	6.60	2.00	1.75	10.2	12.3	0.99	4.68	6.88	5.50
GFC67	1/2 TUBE ODIA	7.56	3.00	3.00	10.0	12.4	----	----	7.55	6.46
GFC77	3/4 NPT FEMALE	8.56	4.00	4.00	10.5	----	----	----	8.05	7.46



MODEL	SERIES	MAX. FLOW (N_2)
GFC	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

SEALS	
V	Viton
B	Buna
E	EPR
T	PTFE/ Kalrez

FITTINGS	
A	1/4" Compression
B	1/8" Compression
C	VCR
D	3/8" Compression
E	1/2" Compression
F	3/4" FNPT
G	3/4" Compression
X	Special

CONNECTOR	
D	D Connector

DISPLAY	
N	No display
L	LCD readout

POWER	
2	12 Vdc
4	24 Vdc

INPUT/OUTPUT SIGNAL	
A	*n.a./0-5 Vdc
B	*n.a./4-20mA
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 D L 2 – C 0

EXAMPLE: GFC17S-VADL2-C0 **50 L/min [N_2] 20 psig** PLEASE SPECIFY: Gas, Flow Range and Pressure.

GFC17 stainless, Viton seals, 1/4" compression fittings, D connector with display, 12Vdc, 0-5 Vdc. Out Put Signal, No Digital Interface.

ORDERING INFORMATION FOR GFC

*n.a.= not applicable

NOTE: Only 12Vdc for models GFC 57, 67 and 77.

For Specific Flow Ranges
Contact Aalborg Customer Service Department.

Table 13 - Totalizer	
TOT-10-0C	Totalizer (5Vdc - 10Vdc signals), calibrated.
TOT-10-0N	Totalizer (5Vdc - 10Vdc signals), uncalibrated.
CBLTOT-10	Cable & splitter, used in conjunction w/ display.
Table 14 - IO Input/Output	
IO-232-C	Input/output to RS232, 0-5Vdc.
IO-232-E	Input/output to RS232, 4-20mA.
IO-485-C	Input/output to RS485, 0-4Vdc.
IO-485-E	Input/output to RS485, 4-20mA.

Table 15 - Accessories for GFC Mass Flow Meters	
PS-GFC-110NA-2	Power Supply, 110 V / 12 Vdc /North America
PS-GFC-230EU-2	Power Supply, 220 V / 12 Vdc /Europe
PS-GFC-240UK-2	Power Supply 240 V / 12 Vdc /United Kingdom
PS-GFC-240AU-2	Power Supply 240 V / 12 Vdc /Australia
CBL-DGS	Cable, Sheilded 15-pin D-connector /end terminated
17/3RC	Remote Cable, 3 feet long
17/R	Remote LCD readout with 3 feet long cable

FLOW RANGES			
Code	Units [Nitrogen]	Code	Units [Nitrogen]
GFC17			
-01	0 to 10 smL/min	-06	0 to 500 smL/min
-02	0 to 20 smL/min	-07	0 to 1 sL/min
-03	0 to 50 smL/min	-08	0 to 2 sL/min
-04	0 to 100 smL/min	-09	0 to 5 sL/min
-05	0 to 200 smL/min	-10	0 to 10 sL/min
GFC37			
-11	0 to 15 sL/min	-32	0 to 40 sL/min
-30	0 to 20 sL/min	-33	0 to 50 sL/min
-31	0 to 30 sL/min		
GFC47			
-40	0 to 60 sL/min	-42	0 to 100 sL/min
-41	0 to 80 sL/min		
GFC57			
-50	0 to 200 sL/min		
GFC67			
-60	0 to 500 sL/min		
GFC77			
-70	0 to 1000 sL/min		

Totalizer

This compact totalizer is designed to be used primarily with mass flow meters and mass flow controllers. It can also be used in conjunction with other types of instrumentation with 0-5 Vdc signal outputs.

The totalizer takes analog output flow signals of either 5 to 10 Vdc, from GFM mass flow meters and GFC mass flow controllers, or 0 to 5 Vdc from AFC mass flow controllers, AFM mass flow meters and other compatible products (jumper selectable).

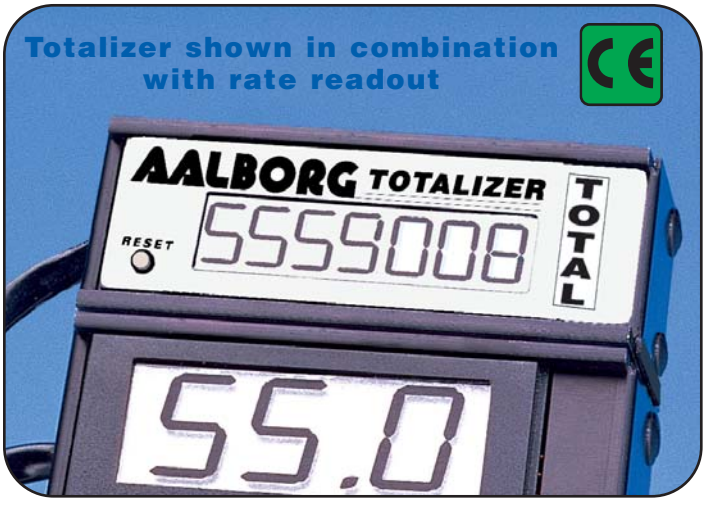
The totalizer integrates and accumulates up to 7 digits of direct engineering units for the given gas and flow rate (i.e. standard liters, standard cubic centimeters, etc.).

In order to reduce low signal (noise) totalizing, provision is made for 1% cut off.

A built-in battery back-up holds the total reading for up to 20 years.

The totalizer can be connected to GFM mass flow meters or GFC mass flow controllers via either a modular jack replacing the LCD display or with an additional connector in parallel with the LCD display.

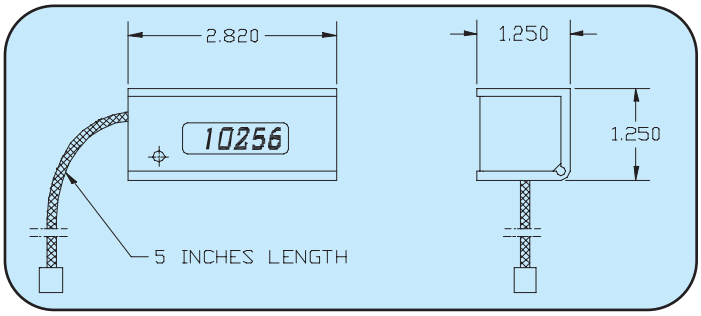
Each totalizer is shipped from the factory with adjustments made for specified flow rates. The totalizer can be re-scaled for a different flow range or engineering unit.



Specification

Input Analog Range :	5 to 10 Vdc/0 to 5 Vdc optional.
Power Consumption :	10 mA at 12 Vdc, less than 0.125 watts.
Accuracy :	±0.5% of full scale.
Temperature Stability :	±200 ppm/°C in the range of 5°C to 50°C.
Display :	7 digit, 8mm figure height.
Reading Backup :	20 years lithium battery, no external power required.
Reset :	push button switch.
Weight :	3.5oz.

Dimensions



Cable Connection

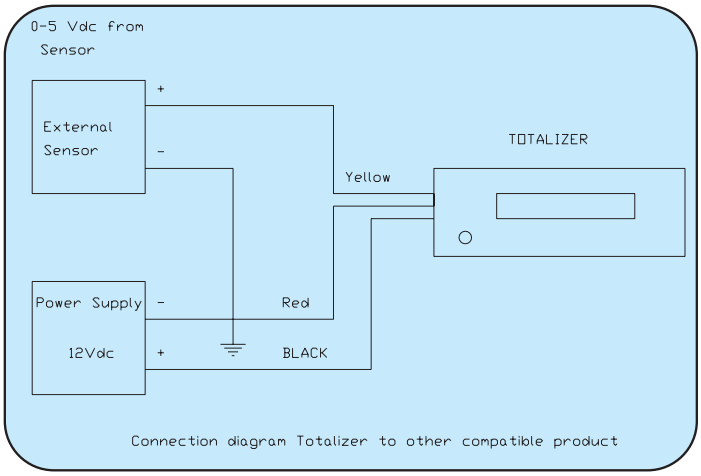


Table 16 - Totalizer	
TOT-10-0C	Totalizer (5Vdc-10Vdc signals) calibrated.
TOT-10-0N	Totalizer (5Vdc-10Vdc signals) uncalibrated.
TOT-5-0C	Totalizer (0Vdc-5Vdc signals) calibrated.
TOT-5-0N	Totalizer (0Vdc-5Vdc signals) uncalibrated.
CBLTOT-10	Cable & splitter, used in conjunction w/ display
CBLTOT-5	Cable with stripped end

Low Cost Input/Output Devices

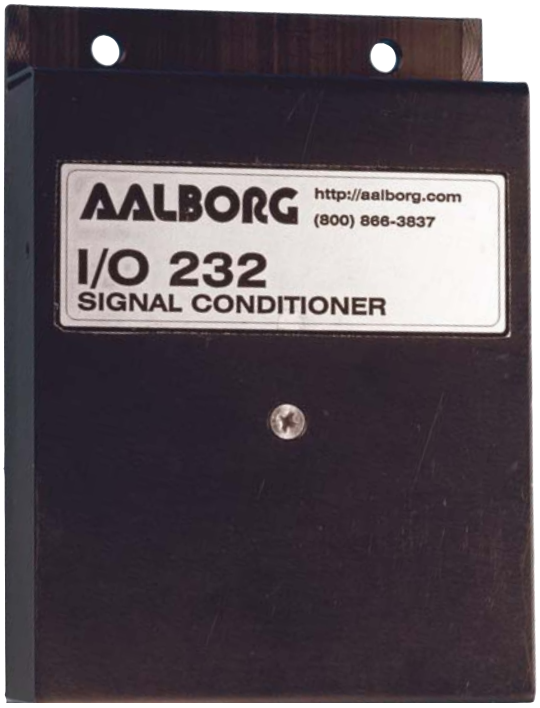
I/O

http://aalborg.com

Microprocessor driven Signal Conditioner allows analog voltage levels to be set and read via its RS-232 or RS-485 serial port.

The simple set of commands is included to perform various functions: an analog output, read an analog input, verify communications link, programming communication parameters and ADC/DAC calibration mode.

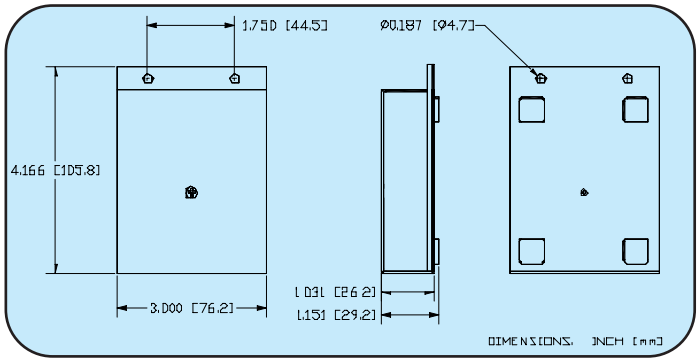
I/O 232 and I/O 485 units may also be used with other instrumentation with analog outputs.



Design Features

- Selectable input and output analog ranges 0-5Vdc or 4-20mA.
- Multi-Drop Capability of up to 64 units (for RS-485 version).
- User selectable data transfer rate from 300 to 9600 baud and CRC error check ON/OFF.
- DAC/ADC 10 bits (0.1%) resolution.
- Free software supports: data recorder, totalizer, hi/low alarm,and custom programming of up to ten steps.

Dimensions



Hook-ups for I/O-232 to GFC

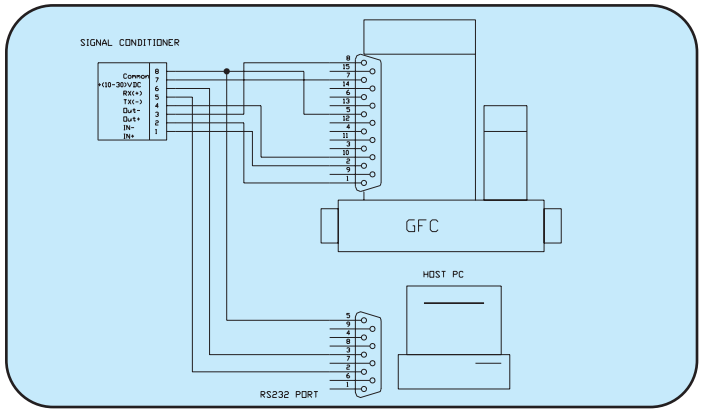


Table 17 - IO Input/Output	
IO-232-C	Input/output to RS232, 0-5Vdc.
IO-232-E	Input/output to RS232, 4-20mA.
IO-485-C	Input/output to RS485, 0-5Vdc.
IO-485-E	Input/output to RS485, 4-20mA.

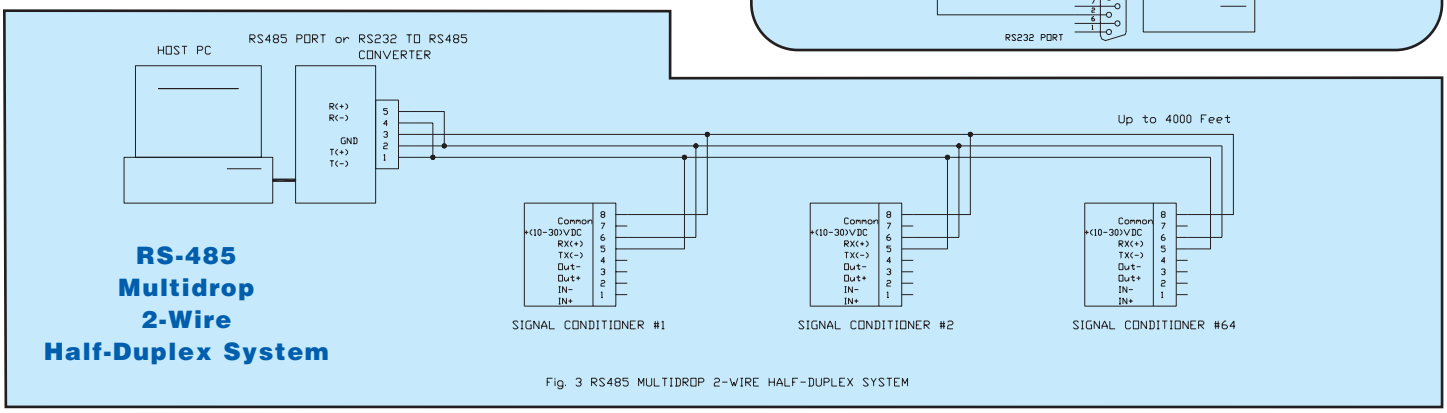


Fig. 3 RS485 MULTIDROP 2-WIRE HALF-DUPLEX SYSTEM

Digital Mass Flow Controllers

DFC

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.

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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.
- Totalizer indicates total gas quantity.
- Alarm limits for high and low gas flow.
- Conversion factors for up to 256 gases.
- Auto Tune function for optimum control response.
- 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 5Vdc or 4 to 20mA are generated indicating mass molecular based flow rates of the metered gas.

Interface

The **digital interface** operates via RS485 (optional RS232) and 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.

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, sL/min, sL/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.

Specifications

Accuracy : (including linearity)	15°C to 25°C and 10 to 60 psia(0.7-4 bars):±1% of FS, 0°C to 50°C and 5 to 150 psia(0.3-10 bars):±2% of FS, ±1% of FS at a specific temperature and pressure with special calibration.
Repeatability :	±0.15% of full scale.
Response Time :	0.6 to 1.0 second to within ±2% of set point over 20% to 100% of full scale.
Temp. Coefficient :	0.05% of full scale/°C or better.
Pressure Coefficient :	0.01% of full scale/psi (0.07 bar) or better.
Optimum Gas Pressure :	25 psig (1.73 bars).
Max Gas Pressure :	500 psig (34.5 bars).
Max Diff. Pressure :	50 psig (3.4 bars) for DFC2600 and DFC3600 40 psig (2.8 bars) for DFC4600
Max Pressure Drop : [cm H2O]	Refer to Table 21
Gas & Ambient Temp :	41°F to 122°F (5°C to 50°C)
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, Viton® O-rings. Neoprene® or Kalrez® O-rings optional.
Connections :	Model DFC2600 standard 1/4" compression fittings, Model DFC3600 standard 1/4" compression fittings, Model DFC4600 standard 3/8" compression fittings, Optional 1/8" or 3/8"compression fittings and 1/4" VCR® fittings available.
Transducer Input Power:	±15Vdc, 450 mA maximum.
Calibration Options :	Standard 10 point NIST 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

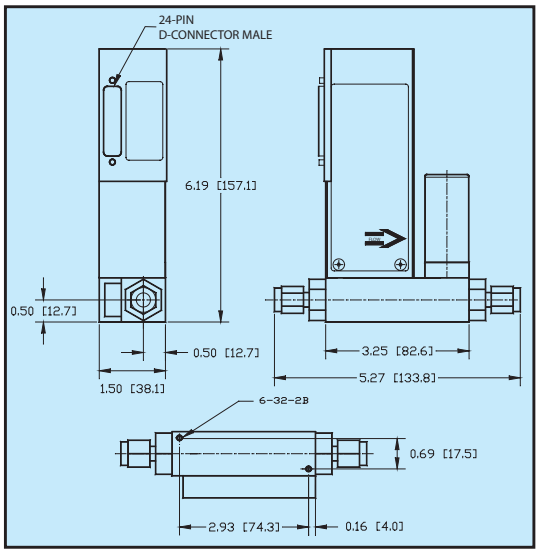
Dimensions - Digital Mass Flow Controllers

DFC

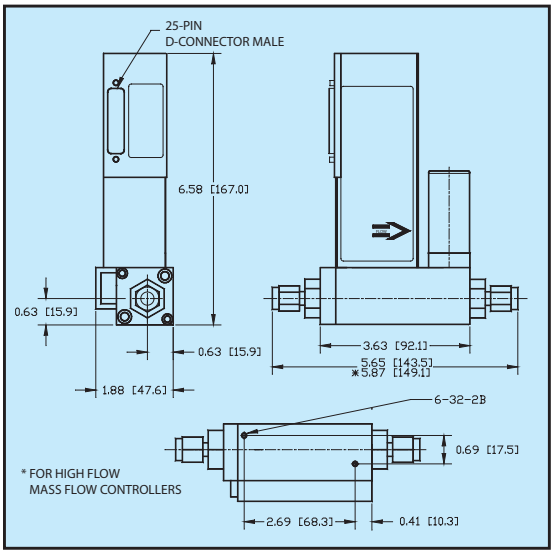
http://aalborg.com

Dimensions*

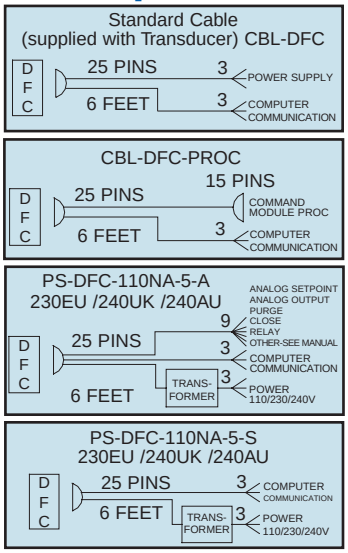
DFC26 Mass Flow Controller



DFC36/46 Mass Flow Controller



Cable Options



Flow Ranges			
Code	**Units [Nitrogen]**	**Code**	**Units [Nitrogen]**
DFC2600 LOW FLOW CONTROLLERS			
-01	0 to 10 smL/min	**-06**	0 to 500 smL/min
-02	0 to 20 smL/min	**-07**	0 to 1 sL/min
-03	0 to 50 smL/min	**-08**	0 to 2 sL/min
-04	0 to 100 smL/min	**-09**	0 to 5 sL/min
-05	0 to 200 smL/min	**-10**	0 to 10 sL/min
DFC3600 MEDIUM FLOW CONTROLLERS			
-11	0 to 15 sL/min	**-32**	0 to 40 sL/min
-30	0 to 20 sL/min	**-33**	0 to 50 sL/min
-31	0 to 30 sL/min		
DFC4600 HIGH FLOW CONTROLLERS			
-40	0 to 60 sL/min	**-42**	0 to 100 sL/min
-41	0 to 80 sL/min		

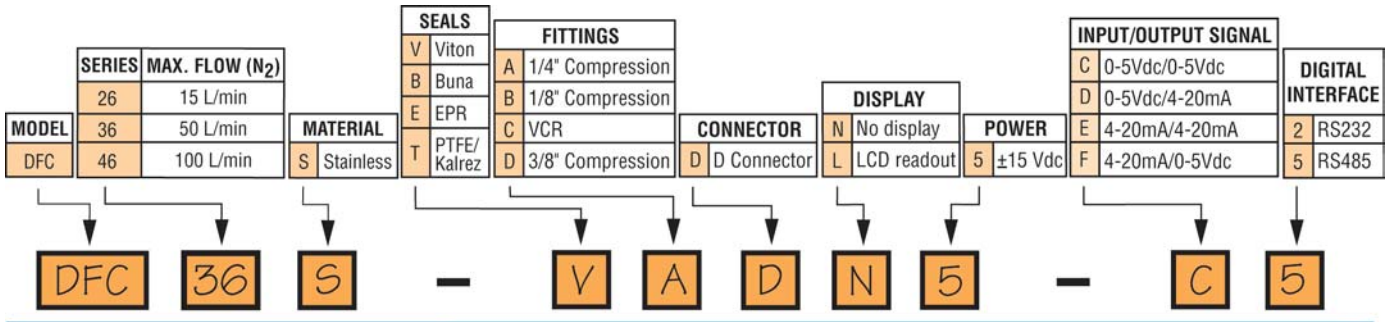
Table 21 - Maximum Pressure Drop For DFC's

Model No.	Flow Rate [sL/min]	Maximum Pressure Drop	
		[psid]	[bars]
DFC26	15	1.06	0.072
DFC26	20	3.87	0.26
DFC36	3	2.0	0.136
DFC36	0	3.5	0.238
DFC36	40	5.5	0.374
DFC36	50	8	0.544
DFC46	100	18.9	1.302

Table 22 - Accessories

CBL-DFC	25 pin D-connector with 6 ft. wire to computer port stripped, Branch 6ft. wire to customers power supply
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-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-240AU-5-S	Power supply with 25 pin female D-connector 240/vac (±15Vdc.) Branch 6ft wire to computer port stripped /Australia

DFC DISPLAY READOUT ACCESSORIES	
BCKUPEG-DFC	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)



EXAMPLE: DFC36S-VADN5-C5 **50 L/min N_2 20 psig** PLEASE SPECIFY: Gas, Flow Range and Pressure

DFC36 Stainless, Viton seals, 1/4" Compression Fittings, D Connector, No Display, +15 Vdc Power, 0-5 Vdc/0-5Vdc Input Output Signal, RS485 Digital Interface.

ORDERING INFORMATION FOR DFC

Mass Flow Meters and Controllers

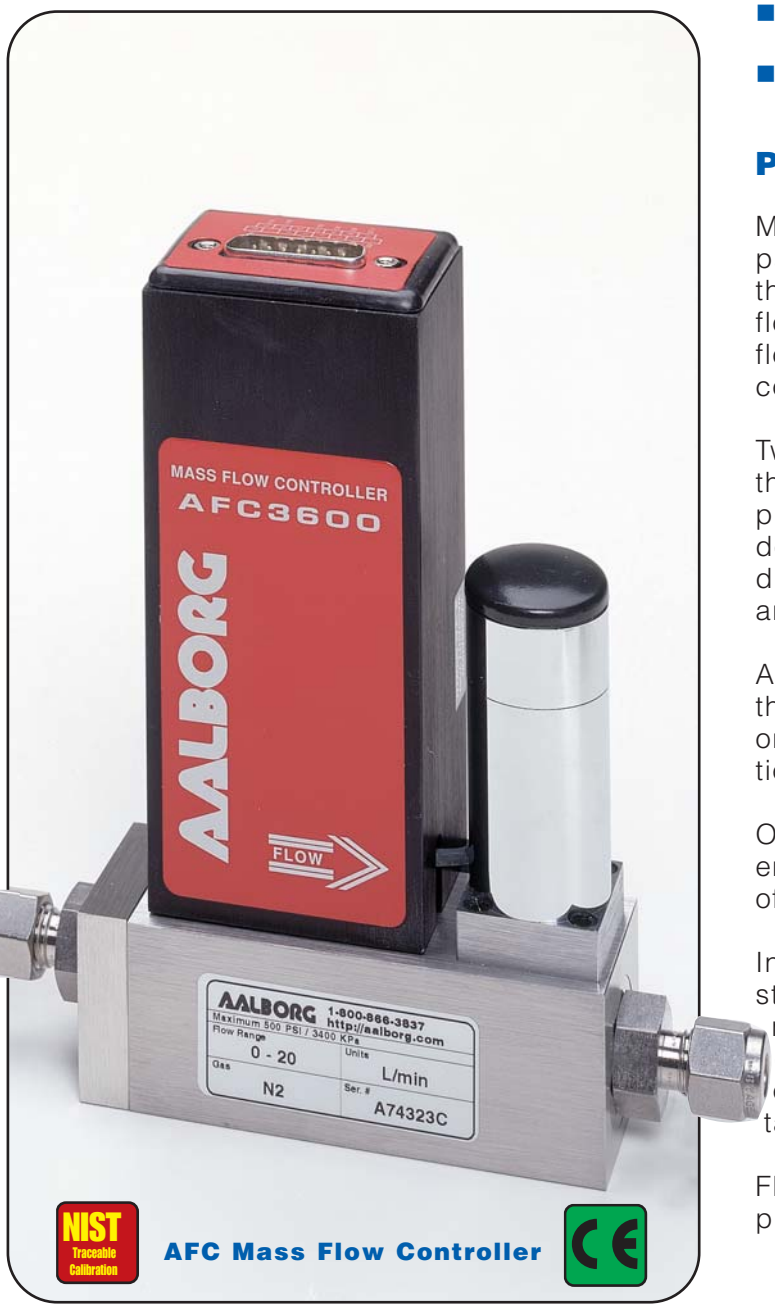
AFC AFM

http://aalborg.com

Model AF mass flow meters and 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.

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



AFC Mass Flow Controller

Design Features

- Rigid metallic construction.
- Maximum pressure of 500 psig (34.5 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.

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.

Mass Flow Meters and Controllers

AFC AFM

http://aalborg.com

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.

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

AF mass flow meters and controllers are available with flow ranges from 10 sccm 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 benchtop 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} 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, digital panel meters with 3-1/2" digit LED readouts and high precision potentiometers.External RS-232 or RS-485 are optional.

Switches in the front panels of Command Modules select LOCAL or REMOTE reference signals, analog outputs are accessible through convenient 9 pin D-connectors.

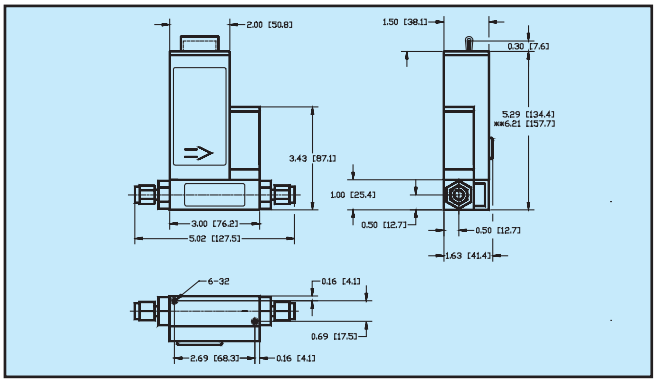
AFC and PROC Mass Flow Controllers

Specifications

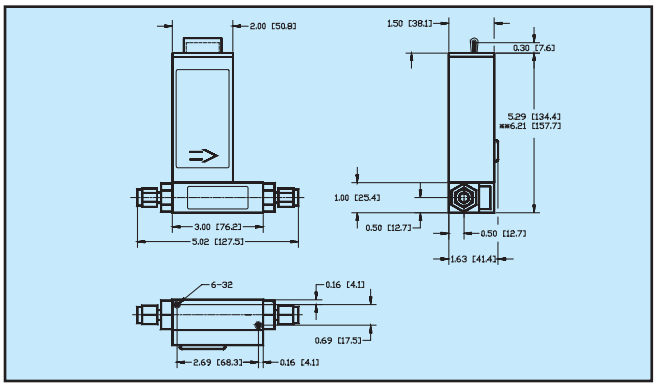
Accuracy :	±1% of full scale, including linearity for gas temperatures ranging from 59°F to 77°F (15°C to 25°C) and pressures of 10 to 60 psia (0.7 to 4.1 bars); ±2% of full scale including linearity ranging from 41°F to 122°F (5°C to 50°C) and pressures of 5 to 150 psia (0.35 to 10.3 bars).
Repeatability :	±0.2% of full scale.
Time Constant :	AFM Series - 300 ms AFC2600 (Qmax = 15 sL/min) - 300 ms AFC3600 (Qmax = 50 sL/min) - 600 ms AFC4600 (Qmax = 100 sL/min) - 600 ms
Response Time :	AFM Series - Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC2600 (Qmax = 15 sL/min) - Approximately 1 second to within ±2% of set flow rate for 25% to 100% of full scale flow. AFC3600 (Qmax = 50 sL/min) and AFC4600 (Qmax = 100 sL/min) - Approximately 2 second to within ±2% of set flow rate for 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 :	500 psig (34.5 bars) maximum. Standard calibration is at 20 psig (1.4 bars) inlet pressure.
Max. Pressure Drop : [cm H2O](at full scale flow)	Refer to Table 4 and Table 5.
Gas and Ambient Temp :	41°F to 122°F (5°C to 50°C).
Leak Integrity :	1 x 10^{-9} smL/sec of helium maximium, to the outside environment.
Materials in Fluid Contact :	316 stainless steel, 416 stainless steel, Viton®, O-rings. Optional o-rings, Neoprene®, or Kalrez®.
Attitude Sensitivity :	1% shift for a 90° rotation from horizontal to vertical; standard calibration is in horizontal position.
Output Signals :	Linear 0 - 5 Vdc (2000Ω min. load impedance); 4 - 20 mA optional (0 - 500Ω loop resistance); maximum noise 20 mV peak to peak.
Connections :	AFM/AFC2600,AFM/AFC3600 -1/4" compression fittings, AFM/AFC4600 - 3/8" compression fittings. Optional - 1/8" or 3/8" compression fittings or 1/4" VCR® fittings.
Transducer Input Power :	AFM/AFC2600 +15 ± 5% Vdc, 80 mA max,1.2W; -15 ± 5% Vdc, 200 mA max, 3W; AFC3600/AFC4600 +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.

Dimensions*

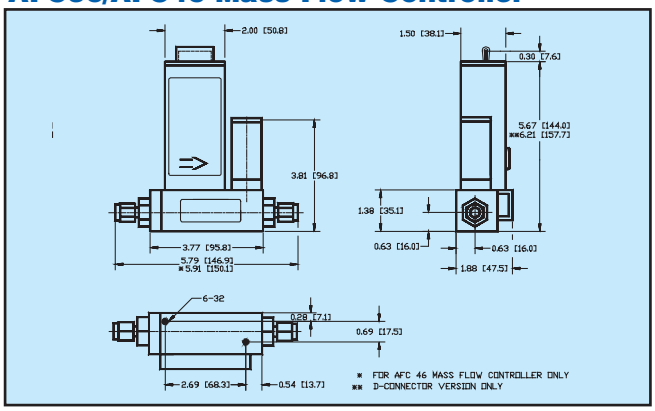
AFC26 Mass Flow Controller



AFM26 Mass Flow Meter



AFC36/AFC46 Mass Flow Controller



AFM36/AFM46 Mass Flow Meter

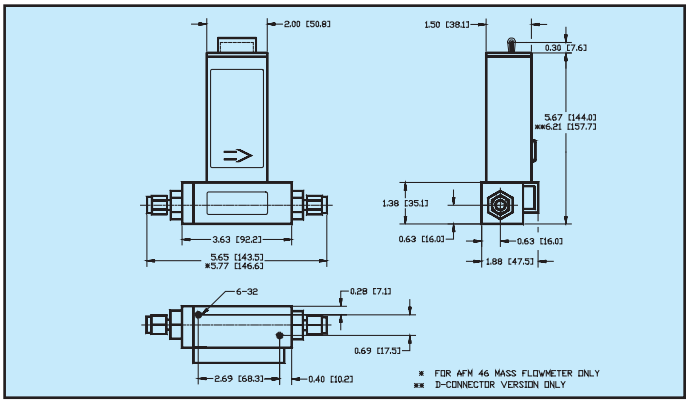


Table 26 - Maximum Pressure Drops

Flow Rate [sL/min]	AFC Series		AFM Series	
	[psid]	[bars]	[psid]	[bars]
up to 10	1.06	0.072	0.04	0.003
up to 15	3.87	0.26	0.09	0.006
up to 20	2.0	0.136	0.44	0.030
up to 30	3.5	0.238	1.18	0.080
up to 40	5.5	0.374	2.18	0.148
up to 50	8	0.544	3.23	0.220
up to 100	18.9	1.302	8.08	0.557

FLOW RANGES			
Code	Units [Nitrogen]	Code	Units [Nitrogen]
AFC2600 / AFM2600			
-01	0 to 10 smL/min	-06	0 to 500 smL/min
-02	0 to 20 smL/min	-07	0 to 1 sL/min
-03	0 to 50 smL/min	-08	0 to 2 sL/min
-04	0 to 100 smL/min	-09	0 to 5 sL/min
-05	0 to 200 smL/min	-10	0 to 10 sL/min
AFC3600 / AFM3600			
-11	0 to 15 sL/min	-32	0 to 40 sL/min
-30	0 to 20 sL/min	-33	0 to 50 sL/min
-31	0 to 30 sL/min		
AFC4600 / AFM4600			
-40	0 to 60 sL/min	-42	0 to 100 sL/min
-41	0 to 80 sL/min		

MODEL	SERIES	MAXIMUM FLOW (N_2)
AFC	26	15 L/min
AFM	36	50 L/min
	46	100 L/min

MATERIAL	
S	Stainless

SEALS	
V	Viton
B	Buna
E	EPR
T	PTFE/ Kalrez

FITTINGS	
A	1/4" Compression
B	1/8" Compression
C	VCR
D	3/8" Compression

CONNECTOR	
D	D Connector

DISPLAY	
N	No display

POWER	
5	±15 Vdc

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

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

*n.a. = not applicable

DIGITAL INTERFACE	
0	None

AFM 36 S – V A D N 5 – A 0

EXAMPLE: AFM36S-VADN5-A0 **50 sL/min [N_2] 20 psig** PLEASE SPECIFY: Gas, Flow Range and Pressure.
AFM36 Stainless, Viton seals with 1/4" compression D connector without a display, +15 Vdc, *n.a./0-5Vdc Input/Output signal, and No Digital Interface

ORDERING INFORMATION FOR AFM AND AFC

Analog Command Modules

PROC

http://aalborg.com

Command Modules used in conjunction with analog or digital mass flow meters and controllers contain appropriate power supplies and digital panel meters with 3-1/2" digit LED readouts. One, two, and four-channel Command Modules are available. A complete mass flow system includes a Command Module, transducers and cables ready to plug in. 0 to 100% calibrations are standard, optional calibrations in direct reading engineering units are available.

Switches provide ON/OFF, and in case of multi-channel modules, CHANNEL display selector functions. Convenient 9 and 15 pin D-connectors are provided for external signal input, computer interfacing and output signal recording.

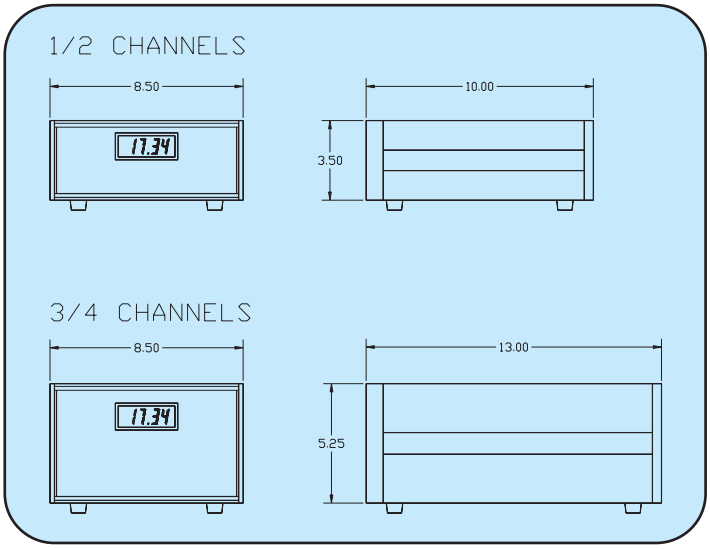
All channels may be simultaneously monitored from output signals to data acquisition or external monitoring devices.

For AFC Mass Flow Controllers, the Set/Run switches and setpoint potentiometers enable desired flow rates to be set for each channel. Open, Auto, and Close mode selector switches for Electromagnetic Valves are on the front panel. A digital display indicates control setpoints or actual flow rates. Front panel switches allow selecting LOCAL or REMOTE reference signals. Analog outputs are accessible through 9 pin D-connectors.

Specifications

AC Input Power :	115 ±10% VAC, 50/60 Hz standard; 230 ±10% VAC 50/60 Hz optional.
Display :	3-1/2" digit LED, 0.5" characters.
Command Module Dimensions :	One or two channels 3.48"(88mm) high x 8.6" (218mm) wide x 10" (254mm) deep. three or four channels 5.22" (142mm) high x 8.6" (218mm) wide x 13" (330mm) deep.

Dimensions



ORDERING INFORMATION PROC COMMAND MODULES

MODEL	CHANNELS	CONFIGURATION	AC INPUT VOLTAGE
PROC	1	A0 AFC / AFM	110NA 110VAC North America
	2	D0 DFC	230EU 230VAC Europe
	3		240UK 240VAC United Kingdom
	4		240AU 240VAC Australia

PROC – 4 A0 – 110NA

EXAMPLE: PROC-4A0-110NA

Analog Command Module, 4-Channel, AFC Configuration, 110VAC, North America Plug

TO ORDER COMPLETE MASS FLOW SYSTEMS:

1. Combine Model designations of appropriate Command Modules with selected Transmitter(s).

EXAMPLE: PROC/AFM2600 describes a single channel Mass Flow Meter System, or 4PROC/AFC3600D depicts a four channel Mass Flow Controller System.

2. Specify line voltage.

Digital Signal Processing Mass Flow Controllers

DPROC

http://aalborg.com

DPROM/DPROC

Microprocessor driven digital Command Modules are used in conjunction with analog mass flow meters or controllers. One, two, three, and four-channel Command Module configurations are available.

Complete mass flow systems include Command Module(s), mass flow transducer(s) and cables ready to plug in. Command Modules contain appropriate power supplies, switch and button controls, and a 24x2 alpha-numeric dot matrix display readout. 0 to 100% calibration readings are standard, optional calibrations in direct engineering units are available.

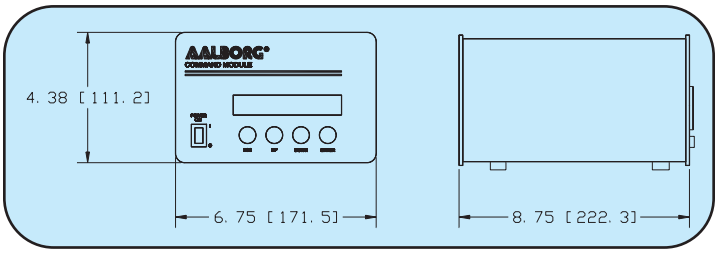
An ON/OFF switch and 4 panel buttons, all on the front of the Command Module provide complete control over all functions necessary to measure and/or control flow. All channels may be simultaneously monitored from output signals to a data aquisitition or external monitoring device.

RS-232 serial communication interface is supported via a standard 9 pin “D” connector on the back panel and standard serial cable (no null modem is required). Communication protocol allows single or continuous data transmission from the DPROC to the PC and setting the desired value of flow for the given channel (DPROC only).

Specifications

Environmental : (per IEC 664)	Installation Level II; Pollution Degree II
Power Supply :	85 to 240 VAC (47 to 440 Hz); 120 to 370 VDC 2A max
Fuse :	2A on input and output power line. When changing, unplug the device from power source. Replace only with fuse 5mm 2A/250V FF.
Display :	24x2 LCD dot matrix with backlight; 24x2 Vacuum Florescent display optional.
Readings :	0 to 100% scale calibrations are standard; optional calibrations in direct engineering units are available.
ADC/DAC Resolution :	12 bits (0.025%)
Communication Standard :	RS-232
Communication Parameters :	8 bits, two stop bits, no parity (8,2,N)
Data Transfer Rate :	9600 baud
Dimensions :	length : 7.75” (19.5cm), width : 6.75” (17cm), height : 4.5” (11cm)
Weight :	4.5lbs (2kg)
Interface Cable :	Flat cable with male 15-pin "D" connector and 20-pin card edge (or female 15-pin "D") connector on the ends is standard. Optional round shielded cable is available with male/female 15-pin "D" connector ends. [Cable length may not exceed 9.5 feet (3 meters)]
Data Port Cable :	Optional shielded cable with male 25-pin "D" connector to connect to command module data port. [Cable length may not exceed 9.5 feet (3 meters)]

Dimensions



TO ORDER COMPLETE MASS FLOW SYSTEMS:

1. Combine Model designations of appropriate Command Modules with selected Transmitter(s).

EXAMPLE: DPROC/AFM2600 describes a single channel Mass Flow Meter System, or 4DPROC/AFC3600D depicts a four channel Mass Flow Controller System.

2. Specify line voltage.

ORDERING INFORMATION DPROC COMMAND MODULES

MODEL	CHANNELS	CONFIGURATION		DIGITAL INTERFACE		AC INPUT VOLTAGE	
DPROC	1	A	AFC / AFM	2	RS232	NA	100-240VAC North America
	2	D	DFC			EU	100-240VAC Europe
	3					AU	100-240VAC Australia
	4					UK	100-240VAC United Kingdom

DPROC – 4 A 2 – NA

EXAMPLE: DPROC-4A2-NA

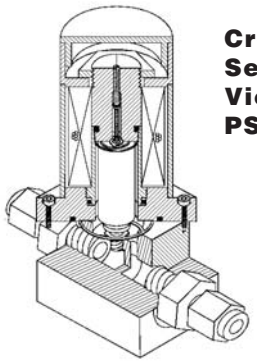
Digital Command Module, 4-Channel, AFC Configuration, RS232, 100-240 VAC North America Plug

Liquids and Gas Flow Regulator

PSV

http://aalborg.com

PSV proportionating Electromagnetic Valve



Cross Sectional View of PSV Valve

Design Features

- Leak Integrity 1 x 10^{-9} sccm.
- Rigid metallic construction.
- Gas and liquids.
- Max pressure of 500psig (34.8 bars).

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

For added safety PSV valves are normally closed (NC) when deenergized. 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 sL/min - 100 sL/min air and 125 mL/min - 2.85 L/min H_2O.

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.

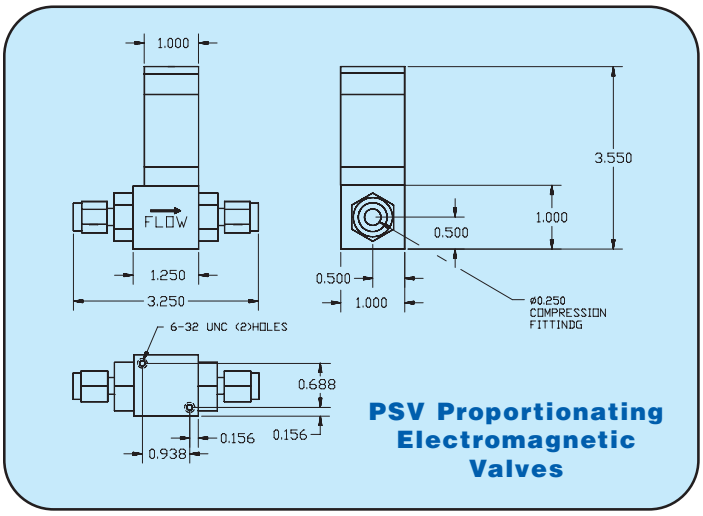
Regulator Systems

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. Optional external RS-232 or RS-485 modules are available. (See page 9).

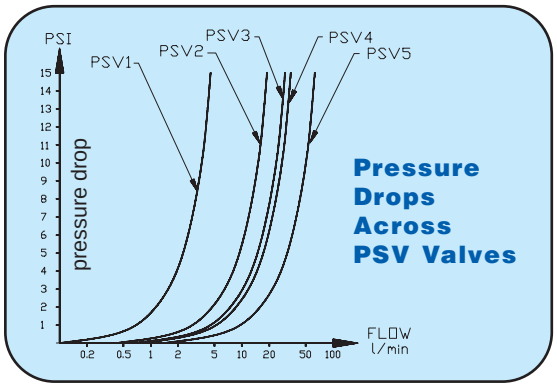
Specifications

Power Input:	0-30Vdc.
Max. Power Required:	400 mA.
Type of Operation:	Normally closed (NC) when deenergized.
Connections:	1/4" Compression fittings optional 1/8" and 3/8".
Dimensions:	3.45" (87.6mm) high x 3.25" (82.6mm) long (including compression fittings) x 1.00" (25.4mm) deep.
Materials in Fluid Contact:	Types 316 and 416 stainless steel, Viton® O-rings.
Max Pressure:	500 psig (3448 kPa).
Max Diff. Pressure:	50 psid (345 kPa).
Leak Integrity:	1 X 10^{-9} smL/sec Helium individually tested.
Max. Temp.(typ.):	174°F (79°C) inside, 130°F (54°C) outside surface at 24Vdc.

Dimensions



PSV Proportionating Electromagnetic Valves

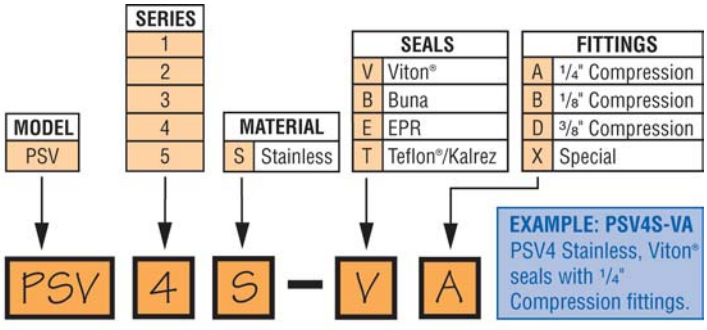


Pressure Drops Across PSV Valves

Table 27 - PSV Valve Max Flow Rates and CV Values

Model Number	Orifice Size		Cv	*Maximum Flow [mL/min]	
	[in]	[mm]		Air	Water
PSV-1	0.02	0.51	0.009	3500	125
PSV-2	0.04	1.02	0.033	13000	400
PSV-3	0.055	1.4	0.055	21500	700
PSV-4	0.063	1.6	0.068	25000	850
PSV-5	0.125	3.18	0.24	100000	2850

*Based on 10 psig (690 mbar) differential pressure



ORDERING INFORMATION FOR PSV VALVES

Pulse Width Modulated Driver Module

PSVD

http://aalborg.com

PSV-D

Pulse width modulated PSV-D Driver Modules regulate the power supplied to PSV Proportional Electromagnetic 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 feature 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.

Pulse width modulated Driver Module

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 flowrate and operating pressure applied to the valve.

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 powerjack (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.

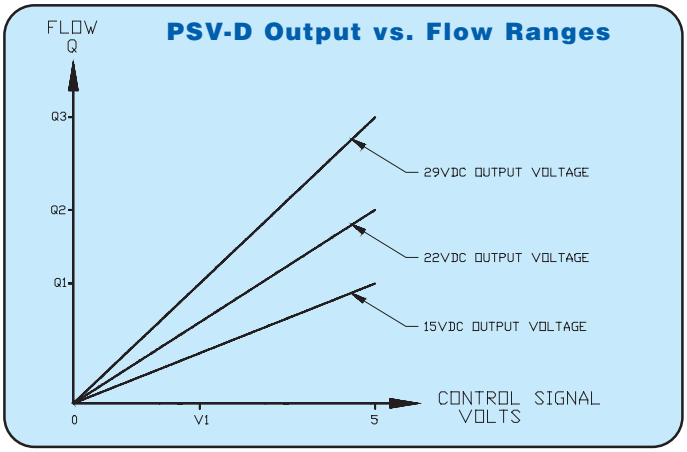
Polarity Protection:
Internal rectifier circuit protects from reversed polarity on the power input.

Operating Temperature:
0°C (32°F) to 50°C (122°F).

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 PSVD	
PSV-D	Proportionating Solenoid Valve Driver
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



Stepping Motor Valves

SMV

http://aalborg.com

Design Features

- High precision two-way metering valves in aluminum or 316 SS for air/water.
- Unparalleled precision and resolution in controlling flow rates (0.0005” per step resolution)
- Operate continuously without overheating. Eliminates coil heating problems associated with solenoid designs.

SMV Stepping Motor Valves

Operation

When the "DIRECTION" is set LOW (GND) the valve spindle travels downward (closes), when it is set HIGH, the valve spindle moves upward (opens). The "SPEED" voltage on pin 4 determines how quickly the valve opens or closes. The signal amplitude for the "SPEED" control signal must remain within the limits of 0 to +5.0 VDC. It may be necessary to override "DIRECTION" and "SPEED" signals with the preset (2.75 Vdc) speed control signal.

This can be accomplished with valve CLOSE and PURGE control signals (open collector NPN compatible). In order to CLOSE the valve, pin 3 on the 9-pin "D" -connector has to be connected to GND (pin 2). A GREEN light on the top of the valve will indicate a CLOSEd valve condition. In order 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 normal operation the valve remains in the last position as it is deenergized. After powering up, the valve will be automatically closed within the first 10 seconds and after that resumes control operation.

Operating power and valve control signals are supplied via the “D”-connector.

General Description

A line of electronic two-way metering needle valves is presented. High precision linear stepping motors drive the valve spindle.

The resolution of the stepping motor driven needles is 0.0005"/step. Low differential pressure valves, may be operated continuously (100% duty cycle).Valves stay in position as when de-energized.

Advantages over solenoid operated valves include cool operations, i.e. there are no control operating problems due to coils heating up, extremely fine resolution, very low differential pressures and high operating pressures. Valves are controllable by TTL compatible logic level and analog 0 to 5 Vdc signals.

Specifications

Aluminum Models:	Aluminum housings and valve blocks, Viton® O-Rings, PFA closing pins.
Stainless/PTFE models:	316 stainless steel valve blocks, PTFE-Teflon® lined Aluminum Housing blocks, Viton® O-Rings, and PFA closing pins.
Maximum Flow rates:	1000 sL/min (air), 28 L/min (H_2O).
Connections:	3/8", 1/2", compression and 3/4" FNPT.
Electrical Connections:	9-pin "D"-connector, located at the side of the valve.
Power input:	+12VDC @ 800 mA. Power input is protected by a 1600mA reset.
Directional control signal:	TTL compatible logic level signal (10K input impedance). (Logic High >= 10 Vdc, Low <= 1.5 Vdc).
Speed control signal:	Analog 0 to 5 Vdc (100K input impedance). TTL ON/OFF override: TTL low level to pins 7 and 3 (10K input impendence).
Response time:	100ms time constant.
Differential Pressures:	700 to 1000 mbars (10 to 15 psid).
Maximum Operating Pressure:	500 psig (35 bars).
Maximum Differential Pressure:	40 psig (2.7 bars).

Model Numbers	Maximum Flow Rate				Cv	Connections	Material
	Air		H_20				
	[sL/min]	[scfh]	[L/min]	GPM			
SMV20-A	200	424	5.6	1.48	0.336	3/8" compression	Aluminum
SMV20-S	200	424	5.6	1.48	0.336	3/8" compression	Stainless Steel
SMV30-A	500	1060	14.2	3.75	0.855	1/2" compression	Aluminum
SMV30-S	500	1060	14.2	3.75	0.855	1/2" compression	Stainless Steel
SMV40-A	1000	2119	28	7.4	1.735	3/4" FNPT	Aluminum
SMV40-S	1000	2119	28	7.4	1.735	3/4" FNPT	Stainless Steel

Table 28 - 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 (ft^3/min)	28.31	L/min
cfm (ft^3/min)	1.699	m^3/hr
oz/min	29.57	mL/min

Table 29 - Pressure Conversion Factors

Multiply	By	To Obtain
psi	27.71	in. H_2O
psi	2.036	in. Hg
psi	703.1	mm/H_2O
psi	51.75	mm/Hg
psi	.0703	kg/cm^2
psi	.0689	bar
psi	68.95	mbar
psi	6895	Pa
psi	6.895	kPa

Table 30 - Temperature

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

Table 31 - Length

Multiply	By	To Obtain
Multiply	2.54	cm
inch	12	inch
ft	0.305	meter
yard	1.094	meter
Angstrom	10^{10}	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^{-4}
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 0001	= 10^{-18}

Prefixes	Symbols
tara (ter'a)	T
giga (ji ga)	G
mega (meg'a)	Ma
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
* exact

Source: NBS Special Pub. 304.

PLEASE NOTE: The company reserves the right to change all dimensions without notice. For certified dimensions please contact Aalborg® Instruments and Controls.

EUROPEAN SERVICE CENTER

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Phone: 49 (0 76 31) 55 45 ● Fax: 49 (0 76 31) - 1 47 40 ● Web: ANALYT-MTC.de ● E-mail: ANALYT_MTC@t-online.de

*SGS ISO9001 Certification is not applicable.

PRODUCTS MANUFACTURED BY AALBORG®

VARIABLE AREA FLOW METERS

SINGLE TUBE
Aluminum/ Brass/ Stainless ● Interchangeable Glass Flow Tubes ● Optional Valves

MULTIPLE TUBE
Two to Six Channels ● Aluminum/ Stainless

PTFE SINGLE AND MULTIPLE TUBE
Chemically Inert ● 1 to 4 Channels ● Interchangeable Glass Flow tubes

GAS PROPORTIONERS
Aluminum/ Stainless ● Used for Blending Two or Three Gases

KITS
Aluminum/ Stainless/ PTFE ● Including Five Glass Flow Tubes and a Set of Floats

PTFE - PFA
Chemically Inert ● Low to Medium Flow of Corrosive Liquids with PFA Flow Tube

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 MAGNUM INDUSTRIAL STAINLESS STEEL FLOW METERS
Heavy Duty Stainless Steel ● Direct Reading Air and Water Scales

VALVES

BARSTOCK
Brass/ 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

ELECTRONIC METERS & CONTROLLERS

LOW COST MASS FLOW METERS
Aluminum/ Stainless ● With or Without LCD Readout

LOW COST MASS FLOW CONTROLLERS
Aluminum/ Stainless ● With or Without LCD Readout

MASS FLOW CONTROLLERS
Stainless ● One to Four Channel Systems

TOTALIZER
Accumulation Up to 7 Digits

DIGITAL MASS FLOW CONTROLLER
Auto Zero ● Totalizer ● Alarms ● Built in RS485

INPUT/OUTPUT DEVICES
RS232/ RS485 - Converts Analog to Digital and Digital to Analog

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