

Brooks® SLA5850, SLA5851, SLA5853 Mass Flow Controllers Models and Models SLA5860, SLA5861, SLA5863 Mass Flow Meters



Essential Instructions

Read this page before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. Because these instruments are sophisticated technical products, you must properly install, use and maintain them to ensure they continue to operate within their normal specifications. The following instructions must be adhered to and integrated into your safety program when installing, using and maintaining Brooks Products.

- Read all instructions prior to installing, operating and servicing the product. If this instruction manual is not the correct manual, please see back cover for local sales office contact information. Save this instruction manual for future reference.
- If you do not understand any of the instructions, contact your Brooks Instrument representative for clarification.
- Follow all warnings, cautions and instructions marked on and supplied with the product.
- Inform and educate your personnel in the proper installation, operation and maintenance of the product.
- Install your equipment as specified in the installation instructions of the appropriate instruction manual and per applicable local and national codes. Connect all products to the proper electrical and pressure sources.
- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- When replacement parts are required, ensure that qualified people use replacement parts specified by Brooks Instrument. Unauthorized parts and procedures can affect the product's performance and place the safe operation of your process at risk. Look-alike substitutions may result in fire, electrical hazards or improper operation.
- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified persons, to prevent electrical shock and personal injury.

Pressure Equipment Directive (PED)

All pressure equipment with an internal pressure greater than 0.5 bar (g) and a size larger than 25mm or 1" (inch) falls under the Pressure Equipment Directive (PED). The Directive is applicable within the European Economic Area (EU plus Norway, Iceland and Liechtenstein). Pressure equipment can be traded freely within this area once the PED has been complied with.

- Section 1 of this manual contains important safety and operating instructions related to the PED directive.
- Meters described in this manual are in compliance with EN directive 97/23/EC module H *Conformity Assessment*.
- All Brooks Instrument Flowmeters fall under fluid group 1.
- Meters larger than 25mm or 1" (inch) are in compliance with category I, II, III of PED.
- Meters of 25mm or 1" (inch) or smaller are Sound Engineering Practice (SEP).

ESD (Electrostatic Discharge)

CAUTION

This instrument contains electronic components that are susceptible to damage by static electricity. Proper handling procedures must be observed during the removal, installation or other handling of circuit boards or devices.

Handling Procedure:

1. Power to unit must be removed.
2. Personnel must be grounded, via a wrist strap or other safe, suitable means before any printed circuit card or other internal device is installed, removed or adjusted.
3. Printed circuit cards must be transported in a conductive container. Boards must not be removed from protective enclosure until immediately before installation. Removed boards must immediately be placed in protective container for transport, storage or return to factory.

Comments

This instrument is not unique in its content of ESD (electrostatic discharge) sensitive components. Most modern electronic designs contain components that utilize metal oxide technology (NMOS, SMOS, etc.). Experience has proven that even small amounts of static electricity can damage or destroy these devices. Damaged components, even though they appear to function properly, exhibit early failure.

Installation and Operation Manual

X-TMF-SLA5800-MFC-eng

Part Number: 541B027AAG

June, 2010

Brooks® Digital MFC's & MFM's

Dear Customer,

We appreciate this opportunity to service your flow measurement and control requirements with a Brooks Instrument device. Every day, flow customers all over the world turn to Brooks Instrument for solutions to their gas and liquid low-flow applications. Brooks provides an array of flow measurement and control products for various industries from biopharmaceuticals, oil and gas, fuel cell research and chemicals, to medical devices, analytical instrumentation, semiconductor manufacturing, and more.

The Brooks product you have just received is of the highest quality available, offering superior performance, reliability and value to the user. It is designed with the ever changing process conditions, accuracy requirements and hostile process environments in mind to provide you with a lifetime of dependable service.

We recommend that you read this manual in its entirety. Should you require any additional information concerning Brooks products and services, please contact your local Brooks Sales and Service Office listed on the back cover of this manual or visit www.BrooksInstrument.com

Yours sincerely,

Brooks Instrument

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<u>Paragraph Number</u>		<u>Page Number</u>
Section 1 Introduction		
1-1	Scope	1-1
1-2	Purpose	1-1
1-3	Description	1-1
1-4	Specifications	1-2
Section 2 Installation		
2-1	General	2-1
2-2	Receipt of Equipment	2-1
2-3	Recommended Storage Practice	2-1
2-4	Return Shipment	2-2
2-5	Transit Precaution	2-2
2-6	Removal from Storage	2-2
2-7	Gas Connections	2-2
2-8	In-Line Filter	2-3
2-9	Installation	2-3
2-10	Electrical Interface	2-5
2-11	Operation Check Procedure (Analog I/O)	2-8
2-12	Digital I/O: DeviceNet or FOUNDATION Fieldbus	2-9
2-13	DeviceNet I/O Assemblies	2-9
Section 3 Operation		
3-1	Overview	3-1
3-2	Theory of Operation for Flow Measurement	3-1
3-3	Features	3-2
3-4	Analog I/O Mode of Operation	3-4
3-5	Communications Features	3-6
3-5-1	RS-485 Communications Features (Analog versions only)	3-6
3-5-2	RS-485 DeviceNet Communications Features	3-7
3-5-3	RS-485 FOUNDATION Fieldbus Communications Features	3-7
3-6	Alarms and Warnings (Analog versions only)	3-8
3-6-1	Alarms and Warnings (Analog versions only)	3-8
3-6-2	Diagnostic Alarms (Analog versions only)	3-10
3-6-3	General Alarms and Warnings (Analog versions only)	3-11
3-7	Calibration/Configuration Sets	3-12
3-8	Special Features	3-13
3-8-1	Setpoint Ramping	3-13
3-8-2	Low Setpoint Command Cutoff	3-13
3-8-3	Low Flow Output Cutoff	3-13
3-8-4	Flow Output Damping	3-13
3-8-5	Adaptive Control	3-13
3-8-6	Flow Totalizer	3-13
3-8-7	Flow Output Conditioning	3-13
3-8-8	Flow Signal Lock-in	3-14
3-9	PC-based Support Tools	3-14

Brooks® Digital MFC's & MFM's

Section 4 Maintenance & Troubleshooting

4-1	Maintenance and Troubleshooting	4-1
4-1-1	Troubleshooting Analog or DeviceNet version	4-2
4-1-2	System Checks	4-4
4-1-3	Cleaning Procedures	4-6
4-1-4	Calibration Procedure	4-6

Section A CE Certificate

CE Certificate of Mass Flow Equipment	A-1
---------------------------------------------	-----

Warranty, Local Sales/Service Contact Information	Back Cover
----------------------------------------------------------------	------------

Figures

<u>Figure Number</u>	<u>Page Number</u>	
1-1	Open Collector Alarm Output.	1-6
1-2	General Wiring	1-6
1-3	Response Performance of Brooks Digital MFC	1-7
1-4	Linear Ramp-up and/or Ramp-down from 200% Per Second Down to 0.5% Per Second Setpoint Change	1-7
1-5	Model SLA5850D Digital I/O DeviceNet MFC	1-11
1-6	Model SLA5850S Analog I/O MFC with RS-485 Elastomer Downport Connections	1-11
1-7	Model SLA5850F Digital I/O FOUNDATION Fieldbus MFC with Coplanar Valve	1-12
1-8	Model SLA5851D Digital I/O FOUNDATION Fieldbus MFC	1-12
1-9	Model SLA5853F Digital I/O DeviceNet MFC and Flanged Connections	1-13
1-10	Model SLA5853 Analog I/O MFC with Flanged Connections	1-13
1-11	Model SLA5860S Analog I/O MFM with RS-485	1-14
1-12	Model SLA5861F Digital I/O FOUNDATION Fieldbus MFM	1-14
1-13	Model SLA5863D Digital I/O DeviceNet MFM	1-15
1-14	Model SLA5863 Analog I/O MFM with Flanges	1-15
2-1	D-Connector Shielded Cable Hookup Diagram, Voltage I/O Version	2-6
2-2	Common Electrical Hookups, Voltage I/O Version	2-6
2-3	Recommended Wiring Configuration for Current Signals (Non-Isolated Power Supply)	2-7
2-4	Recommended Wiring Configuration for Current Signals (Isolated Power Supply)	2-7
3-1	Flow Sensor Operational Diagram (VCR™ End Connections Shown)	3-3
3-2	Externally Accessible Adjustment for all Meters/Controllers	3-3
4-1	Bench Troubleshooting Circuit	4-2

Tables

<u>Table Number</u>	<u>Page Number</u>	
1-1	Flow Ranges and Pressure Ratings	1-3
1-2	Calibration Select Signal	1-8
1-3	Analog I/O Pin Connections	1-8
2-1	Recommended Filter Size	2-3
3-1	Typical Resistor Values for Calibration Selection	3-5
4-1	Sensor Troubleshooting	4-4
4-2	Troubleshooting	4-7

1-1 Scope

Thank you for purchasing a Brooks Instrument Mass Flow Product. This manual, X-TMF-SLA5800-MFC-eng is an installation and operation manual for your instrument.

If you have purchased a Brooks® Digital Mass Flow Product with DeviceNet Communications, a separate DeviceNet Instruction Manual shall also be provided as part of the operating documentation.

1-2 Purpose

The Brooks Digital Products are mass flow measurement devices designed for accurately measuring (MFM's) and rapidly controlling (MFC's) flows of gases. This instruction manual is intended to provide the user with all the information necessary to install, operate and maintain the Brooks MFC and MFM. This manual is organized into the following sections.

Section 1	Introduction
Section 2	Installation
Section 3	Operation
Section 4	Maintenance
Section A	CE Certification
Back Cover	Warranty, Local Sales/Service Contact Information

It is recommended that this manual be read in its entirety before attempting to operate or repair these Brooks Digital products.

1-3 Description

Brooks Instrument's SLA5800 Series is an elastomer sealed digital thermal mass flow measurement and control instrument, which offers unparalleled flexibility and performance. The SLA5800 Series MFC is designed for use in advanced gas handling systems. The result is the most accurate, repeatable, and responsive MFC on the market today!

Wide Flow Range

The SLA5800 Series covers an extremely broad range of flowrates. Model SLA5850 can have a full scale flow as low as 3 ccm. With a high turndown ratio of 50:1, accurate gas flow can be measured or controlled down to 0.06 ccm! Model SLA5853 can meter or control gas flow up to 2500 lpm.

Fast Response Performance

The all-digital electronics and superior mechanical configuration in the SLA5800 series provide for ultra fast response characteristics. Settling times are specified as less than one second, but Brooks' Adaptive Valve Control can achieve response times of 0.2 sec.

Broad Array of Communication Options

Brooks® offers traditional 0-5 volt and 4-20mA analog options as well as RS-485 digital communications ("S-protocol", based on HART). Brooks also offers control interface via digital network protocols like DeviceNet, a high-speed (up to 500k baud) digital communication network, or FOUNDATION® Fieldbus. Brooks' communication capabilities and device-profiles have been certified by the ODVA (Open DeviceNet Vendor's Association) and the ITK Interoperability Test Kit. Other network protocols are in development. Talk to your Brooks representative about your specific needs.

Brooks® Digital MFC's & MFM's

Reduced Cost of Ownership

The SLA5800 Series allows multi-gas and multi-range capabilities to reduce customer inventory. Storage and pre-programming of up to 10 gas calibrations easily permits users to switch between different gases and ranges on a single device.

1-4 Specifications**⚠ WARNING**

Do not operate this instrument in excess of the specifications listed below. Failure to heed this warning can result in serious personal injury and/or damage to the equipment.

PERFORMANCE CHARACTERISTICS:**Flow Ranges**

Models SLA5850/SLA5860 - Any FS range from 0-3 ccm to 0-50 lpm (N₂ eq.)

Models SLA5851/SLA5861 - Any FS range from 20-100 lpm (N₂ eq.)

Up to 200 lpm H₂ flows possible

Models SLA5853/SLA5863 - Any FS range from 100-2500 lpm (N₂ eq.)

Control Range

Turndown: 50:1

Turndown: 100:1 with Coplanar valve option

(for any FS range from 1-50 lpm (N₂eq.)

Accuracy (N₂ eq. at calibration conditions)

±1.0% of rate (20% - 100% FS)

±0.2% FS (below 20% FS) up to 1200 lpm

(Optional: ±0.7% of rate ±0.2% FS ("S-Series") up to

1200 lpm

Flow ranges above 1200 lpm and up to 2500 lpm: ±1.0% of full scale

Repeatability

±0.20% of rate

Settling Time/Response Time

< 1 second to within ±2% FS of final value for a

0-100% command step (better on request)

for flow rates up to 100 lpm N₂ Eq.

< 3 seconds to within ±2% FS of final value for a

0-100% command step (better on request)

for flow rates greater than 100 lpm (N₂ eq.) up to 2500 lpm (N₂ eq.)

Sensitivity to Mounting Attitude

< 0.2% FS maximum deviation from specified accuracy, after rezeroing.

RATINGS:**Temperature Sensitivity**

Zero: less than 0.05% FS per °C

Span: less than 0.1% of rate per °C

Pressure Sensitivity

± 0.03% per psi up to 200 psig (N₂ eq.)

Maximum Operating Pressure

See Table 1-1 below:

Optional 4500 psig (300 bar) For 50,60 and 61 Series body only.

All devices pressure tested without fittings.

 WARNING
When using ANSI/ISA SP-76 downport process connections, refer to substrate manufacturer's operating pressure limits (some substrates are rated lower than 70 bar / 1000 psi).

Pressure Equipment Directive (PED) 97/23/EC

See Table 1-1:

Table 1-1 Flow Ranges and Pressure Ratings

Mass Flow Controller	Mass Flow Meter		Flow Ranges N ₂ Eq.Ratings	Pressure Unit	PED Module H Category
Model:	Model:	Min. f.s.	Max. f.s.	Bar/psi	
SLA5850 ⁽¹⁾		0.003	50 lpm	100bar/1500 psi	SEP
	SLA5860	0.003	50 slpm	300bar/4500 psi	SEP
SLA5851	SLA5861 ⁽¹⁾	20	100 lpm	100bar/1500 psi ⁽³⁾	SEP
SLA5853 ⁽²⁾	SLA5863	100	2500 lpm	70 bar/1000 psi	1 for all 150 lbs flanges 2 for all other connections

(1) 300 bar (4500 psi) version optional.
 (2) Max. Delta P for 5853 is 20 bar (300 psi).
 (3) 70 bar / 1000 psi for UL Certification.

Pressure Differential Range (Controllers)

Minimum:

Model SLA5850

5 psi (0.35 bar) up to 50 lpm (N₂ eq.)

Model SLA5851

10 psi (0.69 bar) from 30 lpm to 100 lpm (N₂ eq.)

Model SLA5853

7.5 psi (0.52 bar) at 500 lpm (N₂ eq.)

14.5 psi (1.00 bar) at 1000 lpm (N₂ eq.)

35.0 psi (2.41 bar) at 2500 lpm (N₂ eq.)

High DP valve 30 psi (2.07 bar) to 290 psi (20 bar max.)

Low DP valve 7.5 psi (0.52 bar) to 30 psi (2.07 bar max.)

Minimum pressure drop depends on gas and FS flow rate (consult factory)

Leak Integrity

Inboard to Outboard: 1x10⁻⁹ atm scc/sec Helium max.

Helium leak test performed without fittings.

Ambient Temperature Limits

Operating: 0°C to 65°C (32°F to 149°F)

Non-Operating: -25°C to 100°C (-13°F to 212°F)

Fluid Temperature Limits

0°C to 65°C (32°F to 149°F)

Brooks® Digital MFC's & MFM's

PHYSICAL:**⚠ CAUTION**

It is the user's responsibility to select and approve all materials of construction. Careful attention to metallurgy, engineered materials and elastomeric materials is critical to safe operation.

Materials of Construction

Wetted parts - stainless steel with Viton® fluoroelastomers

Optional: Buna-N, Kalrez®, Teflon®/Kalrez and EPDM

Outline Dimensions

Refer to Figures 1-5 thru 1-13

Process Connections

Refer to Figures 1-5 thru 1-13

Reference Conditions

Due to effects of pressure and temperature on the compressibility of gases, specific reference conditions must be used when reporting volumetric flow rates in mass flow terms. For example, the unit of measure SCCM (standard cubic centimeters per minute) refers to a volumetric gas flow at a standard reference condition, NOT the actual volumetric gas flow at the actual operating pressure and temperature. The key point is that the MASS FLOW of the gas is fixed, but the reference volumetric flow can be reported differently based upon the standard reference condition used in the calculation.

Throughout the world, there are differences in terminology when describing reference conditions for gases. The words "normal conditions" and "standard conditions" are sometimes used interchangeably to describe the reference STP (Standard Temperature and Pressure) for gases. Further note that temperature and pressure values for standard or normal reference conditions vary in countries and industries worldwide. For example, the Semiconductor Equipment Manufacturing Industry (SEMI) defines standard temperature and pressure conditions as 273.15 K (0 °C) and 101,325 Pa (760 torr). The main concern is that no matter what words are used for descriptive purposes, a gas mass flow rate must have a defined standard pressure and temperature reference condition when performing a volumetric conversion.

ELECTRICAL CHARACTERISTICS:

Analog/RS-485 version: 15-pin D-Connector, male

Digital I/O:

DeviceNet: 5-pin Micro-Connector, male

FOUNDATION Fieldbus: 4-pin Micro-Connector, male

Power Supply Voltage

Analog option: 13.5-27 Vdc,

Digital I/O:

DeviceNet I/O: 11-25 Vdc

FOUNDATION Fieldbus I/O: 14-27 Vdc

SLA5851S Model: 22-27 Vdc

Power Requirements:	Watts, typical	Watts, max.
Analog I/O option, no valve:	1.6	1.8
Analog I/O option, with valve:	3.6	4.0
Digital I/O option, n.v.:	3.6	4.0
Digital I/O option, w.v.:	6.9	7.6

Command/Setpoint Input (Analog I/O capabilities)

Voltage and Current type inputs (but not both simultaneously) are

supported.

Setpoint input types are software selectable as follows:

- 0 - 5 Vdc
- 1 - 5 Vdc
- 0 - 20 mA
- 4 - 20 mA

Voltage Setpoint Input Specifications

- Nominal Range: 0 - 5 Vdc
- Full Range: 0 - 5.5 Vdc
- Absolute Max.: 20 V
(Without Damage)
- Input Impedance: >990 k Ω
- Calibrated Accuracy: $\pm 0.1\%$ of F.S.

Current Setpoint Input Specifications

- Nominal Range: 4 - 20 mA or 0 - 20 mA
- Full Range: 0 - 22 mA
- Absolute Max.: 25 mA
(Without Damage)
- Input Impedance: 125 Ω
- Calibrated Accuracy: $\pm 0.1\%$ of F.S.

Flow Output (Analog I/O version only)

Voltage and current type outputs (but not both simultaneously) are supported. Flow output types are selectable as follows.

- 0 - 5 Vdc
- 1 - 5 Vdc
- 0 - 20 mA
- 4 - 20 mA

Flow Output (Voltage) Specifications

- Nominal Range: 0 - 5 Vdc, 1 - 5 Vdc
- Calibrated Accuracy: $+0.1\%$ of F.S.
- Full Range: -0.5 - 5.5 Vdc (@ 0-5 Vdc); 0.6 - 5.5 Vdc (@ 1-5 Vdc)
- Min. Load Resistance: 2 kW

Flow Output (Current) Specifications

- Nominal Range: 4 - 20 mA or 0 - 20 mA
- Calibrated Accuracy: $\pm 0.1\%$ of F.S.
- Full Range: 0-22 mA (@ 0-20 mA); 3.8-22 mA (@ 4-20 mA)
- Max. Load: 380 Ω (for supply voltage < 16 Vdc)
580 Ω (for supply voltage \geq 16 Vdc)

Valve Override Signal (Analog I/O version only)

The Valve Override Signal (VOR) is implemented as an analog input which measures the voltage at the input and controls the valve based upon the measured reading as follows:

Valve Override Signal Drive Settings (Analog I/O Versions only)

- Floating / Unconnected: Instrument controls valve to command setpoint
- VOR < 0.3 Vdc: Valve Closed
- VOR > 4.8 Vdc: Valve Open

0.3 Vdc ≥ VOR ≥ 4.8 Vdc: Undefined

Valve Override Signal Specifications (Analog I/O Versions only)

Input Impedence: 800 kΩ
 Absolute Max. Input: -25 Vdc > VOR ≥ 25 Vdc
 (without damage)

5 Volt Reference Signal (Analog I/O versions only)

A 5 Vdc reference output is provided to the customer for use in generating a setpoint and/or Valve Override signal. The current drive of this output is very limited and must be used with care.

Min. Load Resistance: 2 kΩ (2.5 mA maximum)
 Accuracy: ±1.0%

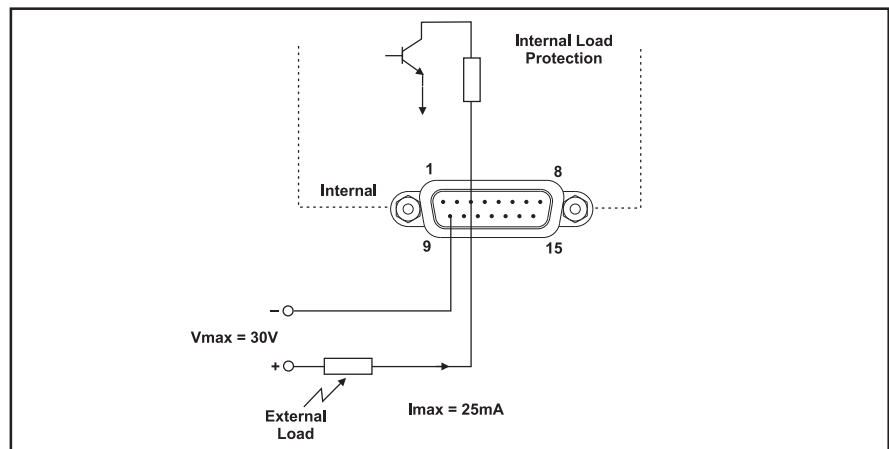


Figure 1-1 Open Collector Alarm Output

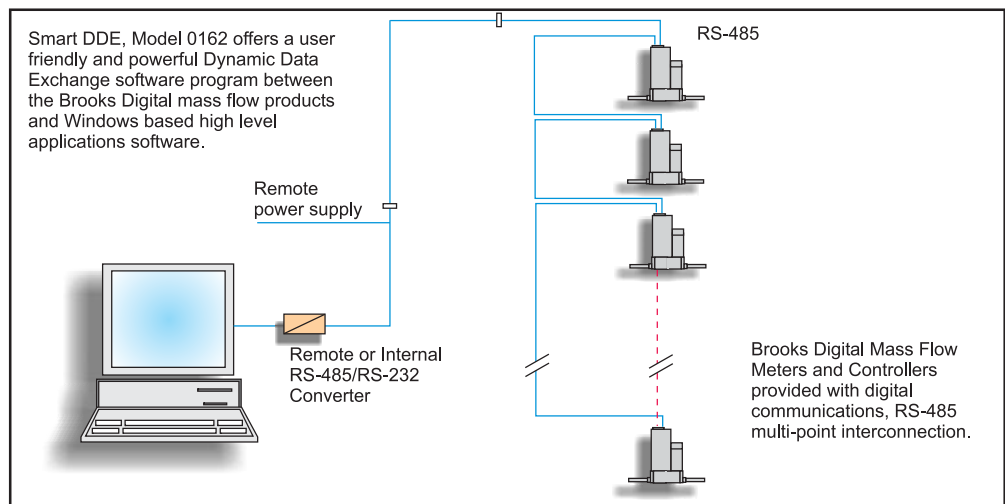


Figure 1-2 General Wiring

Alarm Output (Analog I/O versions only)

The Alarm Output is an open collector or "contact" type that is CLOSED (on) whenever an alarm is active. The Alarm Output may be set to indicate any one of various alarm conditions. Reference Section 3-6-2 for more information on alarms.

Type: Open Collector
 Max Closed (ON) Current: 25 mA
 Max Open (OFF) Leakage: 1 μA
 Max Open (OFF) Voltage: 30 Vdc

Fast Response Performance

The curves in Figure 1-3 depict the MFC output signal and actual transitional flow to steady-state when gas flow enters into process chamber, under a step response command condition.

Brooks devices also feature adaptive (optimized) PID control, including fast response. and linear ramp-up and/or ramp-down control characteristics.

Calibration Curve Selection (Analog I/O versions only)

Select one of ten gases and select PID tuning settings in analog mode. Requires external connection of resistors between Pin # 13 and Pin # 9. (Reference Tables 1-2 and 1-3.)

Selectable Soft Start

Processes requiring injection of gases can be adversely affected by excessive initial gas flow. This abrupt injection of gas can result in process damage from explosion or initial pressure impact. These problems are virtually eliminated with the soft start feature.

Traditional soft start or linear ramp-up and/or ramp-down (See Figure 1-4) can be factory selected or are available via the Brooks Service Suite™.

Linear ramp-up is adjustable at 200% per second down to 0.5% per second setpoint change.

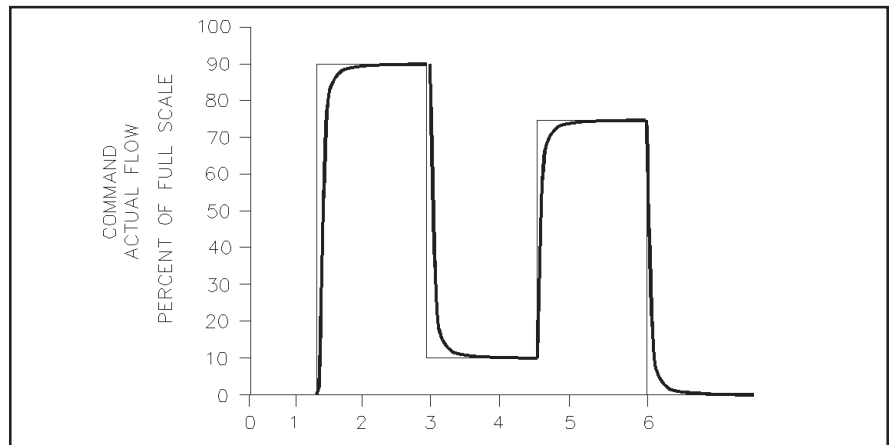


Figure 1-3 Response Performance of Brooks Digital MFC

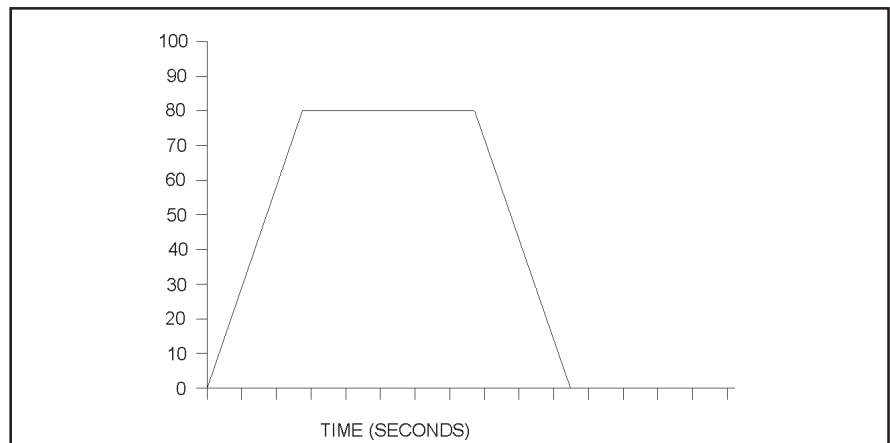


Figure 1-4 Linear Ramp-up and/or Ramp-down from 200% Per Second Down to 0.5 % Per Second Setpoint Change

Table 1-2 Calibration Select Signal.

DEFAULT = CAL# 1 (External resistor not installed)			
CAL	Resistor Value (k ohms)	CAL	Resistor Value (k ohms)
1	Not Installed	6	124
2	Shorted	7	80.6
3	665	8	52.3
4	324	9	30.9
5	191	10	15

Table 1-3 Analog I/O Pin Connections:

Function	PIN
Setpoint , Command Input (-)	1
Flow Signal , 0(1) -5 volt, Output (+)	2
TTL Alarm , open collector, Output (+)	3
Flow Signal , 0(4)-20 mA, Output (+)	4
Power Supply , +13.5 Vdc to +27 Vdc(+)	5
Not Connected	6
Setpoint , 0(4)-20 mA, Input (+)	7
Setpoint , 0(1)-5 Vdc, Input (+)	8
Power Supply , Common (-)	9
Flow Signal , Common, Output, (-)	10
Reference , +5 Vdc, Output (+)	11
Valve Override , Input	12
Calibration Select Input	13
RS-485 Common B (-)	14
RS-485 Common A (+)	15

RS-485 Communications

The Brooks Digital Series is equipped with RS-485 communication capability. Refer to Table 1-3 (Analog I/O pin connections), that enables the device to communicate via a personal computer for process control.

Baud rate selections for the Brooks Digital Series related to RS-485 are: 1200, 2400, 4800, 9600, 19200 and 38400 baud and can be selected via the Brooks service Suite™.

The RS-485 is essentially a multidrop connection. It allows a maximum of 32 devices to be connected to a computer system. IBM-compatible PC's are not equipped with RS-485 ports as standard. An RS-232 to RS-485 converter or RS-485 interface board is therefore required to connect an RS-485 network to a standard pc. The RS-485 bus, a daisy chain network, meaning that the wires are connected at the units as in Figure 1-2.

DeviceNet Communications

The Brooks SLA5800 Digital Series is also available with DeviceNet™ communication capability. DeviceNet is an open digital protocol capable of high speeds and easy system connectivity. Brooks Instrument has several of its devices available on this popular networking standard, and is a member of ODVA™ (Open DeviceNet Vendors Association), the governing standard body for DeviceNet.

DeviceNet is similar to the RS485 standard in that it is a multi-drop connection that allows a maximum of 64 devices to be connected on the same network. Baud rate selections for DeviceNet products are 125K, 250K and 500K and can be selected via MAC ID switches mounted on the device.

The DeviceNet communication link also provides access to many of the Brooks SLAMf Digital Series functions for “control and monitor” operations, including:

- Accurate setpoint adjustment and flow output measurement (including units of measure selection)
- PID Settings (controller only)
- Valve Override (controller only)
- Calibration Gas Select
- Soft Start Control (controller only)

FOUNDATION® Fieldbus Communications:

The Brooks SLA5800 Digital Series is supporting FOUNDATION® Fieldbus communication protocol. FOUNDATION® Fieldbus is a digital network allowing usage of existing 4-20mA cables, avoiding costly re-wiring. Fully certified by passing ITK, this device has passed several Interoperability requirements over a broad range of hosts. When combined with DeltaV and using the power of PlantWeb, those devices provide intelligent alerts allowing accurate device maintenance and service.

- Value Range check - Part of the standard function blocks
- Temperature sensor connection - Check sensor connection
- Firmware checksum - Check for Internal firmware integrity
- Non-volatile memory - Check for non-volatile memory integrity
- RAM - Check for RAM integrity
- Zero Drift/Valve Leak-by - Check for flow leak-by or sensor zero drift
- Device Overhaul due - Preventive Maintenance
- Calibration Due - Preventive Maintenance
- Valve spring life - Preventive Maintenance
- No Flow - No flow detected when setpoint requested
- Reverse Flow - Reverse flow detected
- Flow Totalizer - Informed when a user define amount of fluid has been delivered
- Time Totalizer - Informed when a user define amount of time has expired

Device type dependant function block are available representing the different device functions:

- Current Flow Value (Mass Flow device only)
- Current Pressure Value (Pressure device only)
- Current Device Temperature (Mass Flow device only)
- Current Valve position (Controller Only)
- Setpoint Control (Controller Only)
- Direct Valve Control (Controller Only)
- Actuator Override (Controller Only)
- Ultra-fast (8ms) PID function block for Cascade control (all devices)

Brooks® Digital MFC's & MFM's

Certifications:**EMC Directive 89/336/EEC:**

per EN 61326

Hazardous Location Classification

Enclosure: Type 1/IP40

Ambient Temperature: 0°F ≥ Tamb ≤ 150°F (0°C ≥ Tamb ≤ 65°C)

United States and Canada

UL Recognized: E73889 Volume 3, Section 4

Non-Incendive,
Class 1, Division 2
Groups A, B, C & D; T4*Per UL 1604 and CSA-213*

Class 1, Zone 2, AEx nA II T4

Per ANSI/ISA 12.12.02 - 2003 and ANSI/UL 60079-15

Ex nA II T4

Per CSA - E79 - 15

Europe - ATEX Directive 94/9/EC

KEMA 04ATEX1118X



II 3 G Ex nA II T4

Per EN 60079-15: 2003

The product shall be installed in a suitable enclosure providing a degree of protection of at least IP54 according to EN60529, taking into account the environmental conditions under which the equipment will be used.

Pressure Equipment Directive (97/23/EC):

See Table 1-1 for further pressure information

PC-based Support Tools

Brooks Instrument offers a variety of PC-based process control and service tools to meet the needs of our customers. SmartDDE may be used with any unit supporting RS-485 in a multidrop configuration, thus allowing users to control and monitor their Brooks devices. The Brooks Service Tool™ (BST) may be used to monitor, diagnose, tune and calibrate Brooks devices equipped with DeviceNet or FOUNDATION Fieldbus communications. The Brooks Service Tool™ interfaces with Brooks products via a special service port.

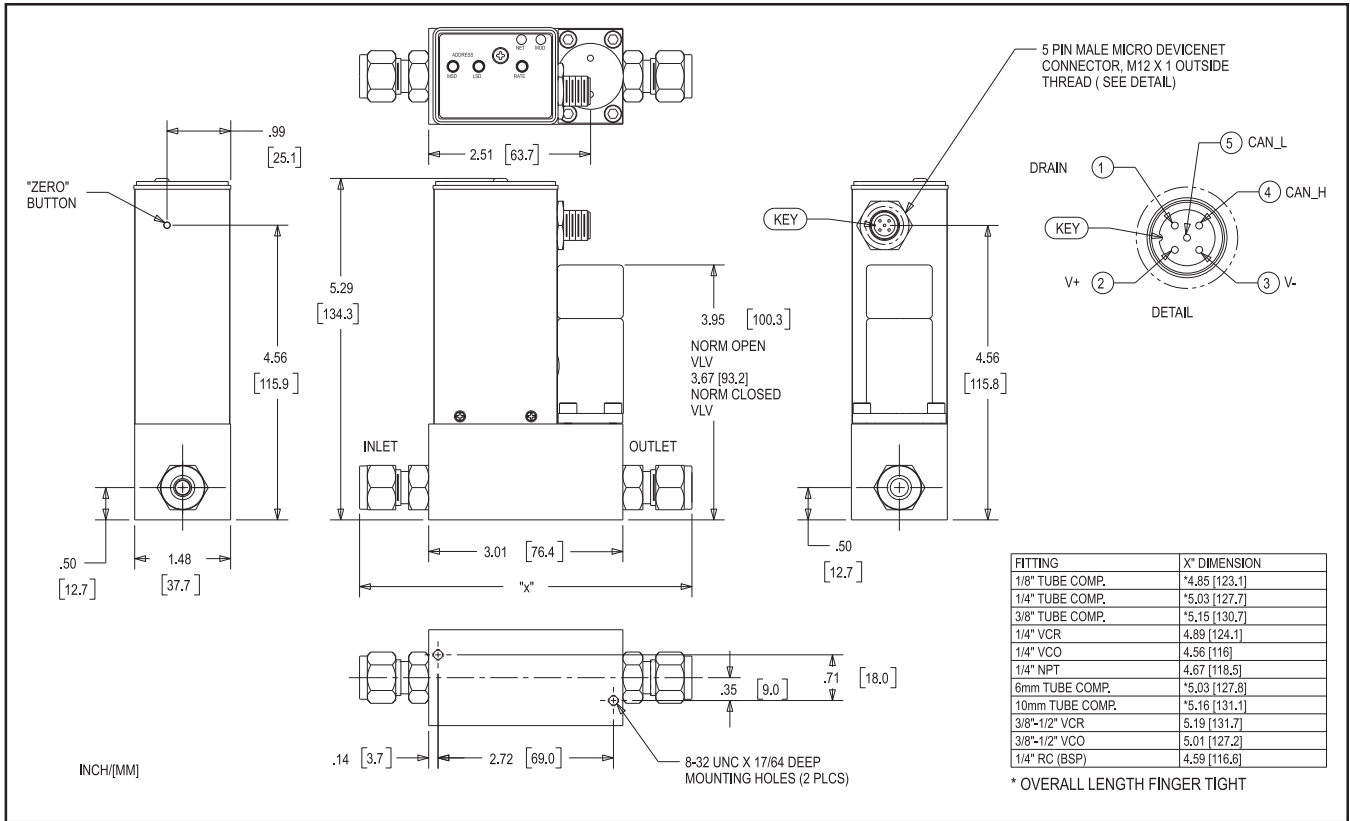


Figure 1-5 Model SLA5850D Digital I/O Devicenet MFC

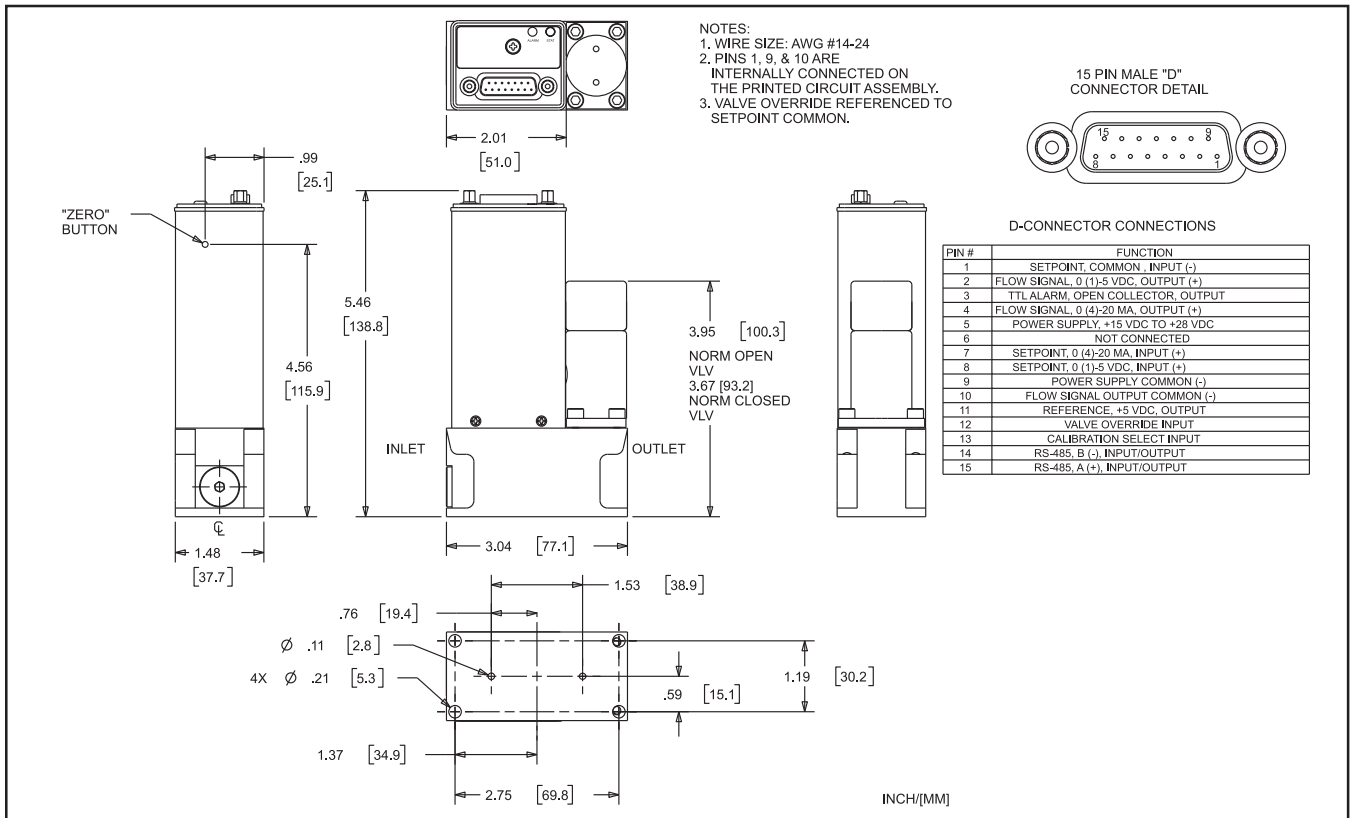


Figure 1-6 Model SLA5850S Analog I/O MFC with RS-485 Elastomer Downport Connections

Brooks® Digital MFC's & MFM's

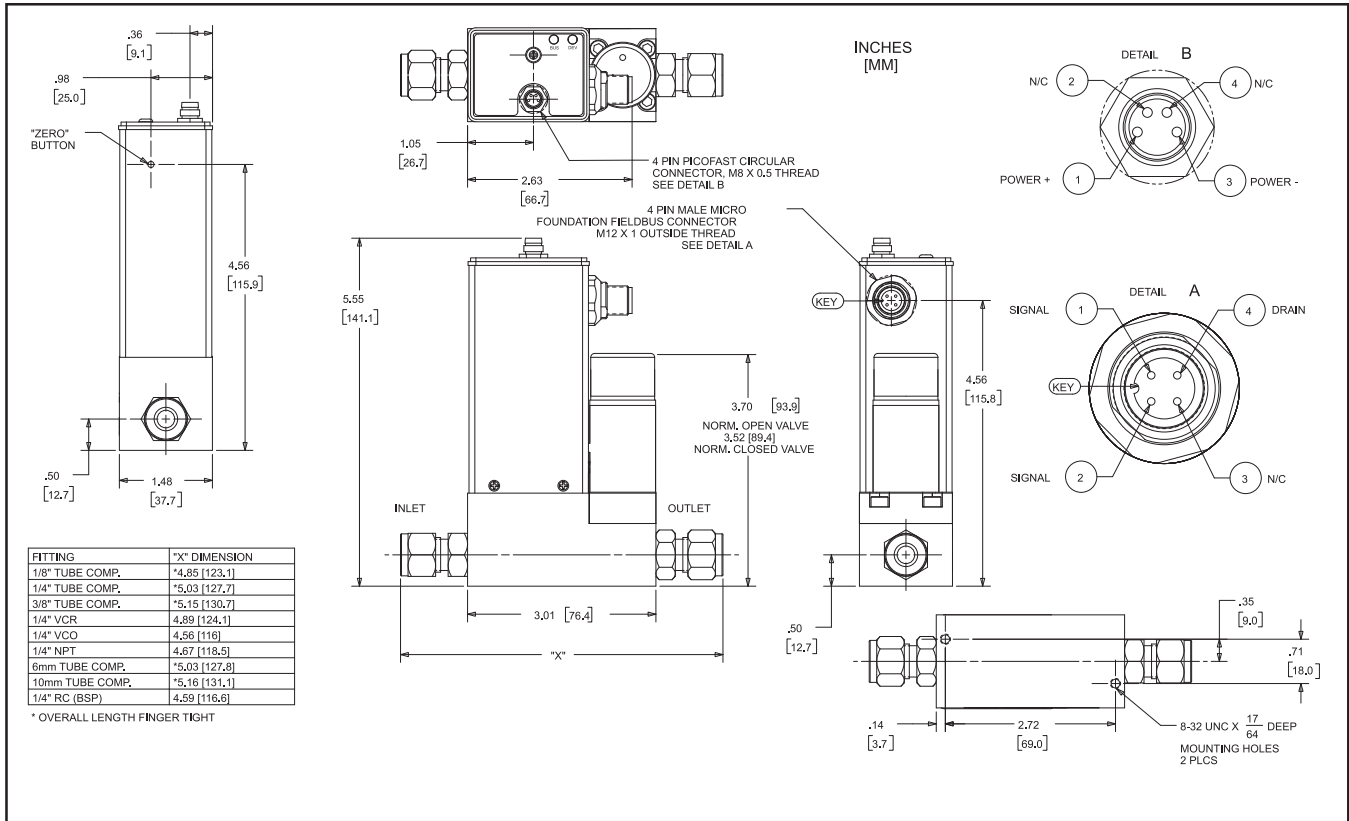


Figure 1-7 Model SLA5850F Digital I/O FOUNDATION Fieldbus MFC with Coplanar Valve

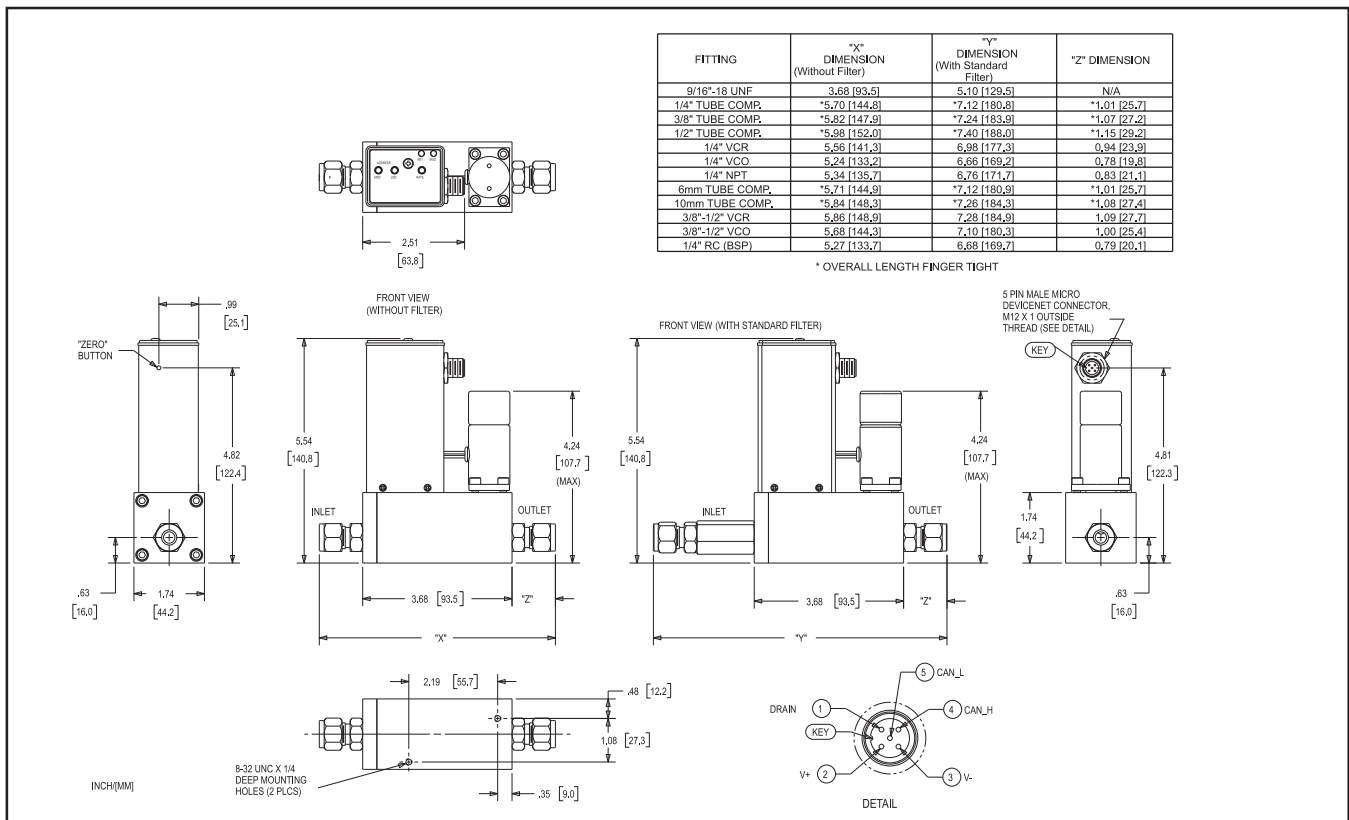


Figure 1-8 Model SLA5851D Digital I/O DeviceNet MFC

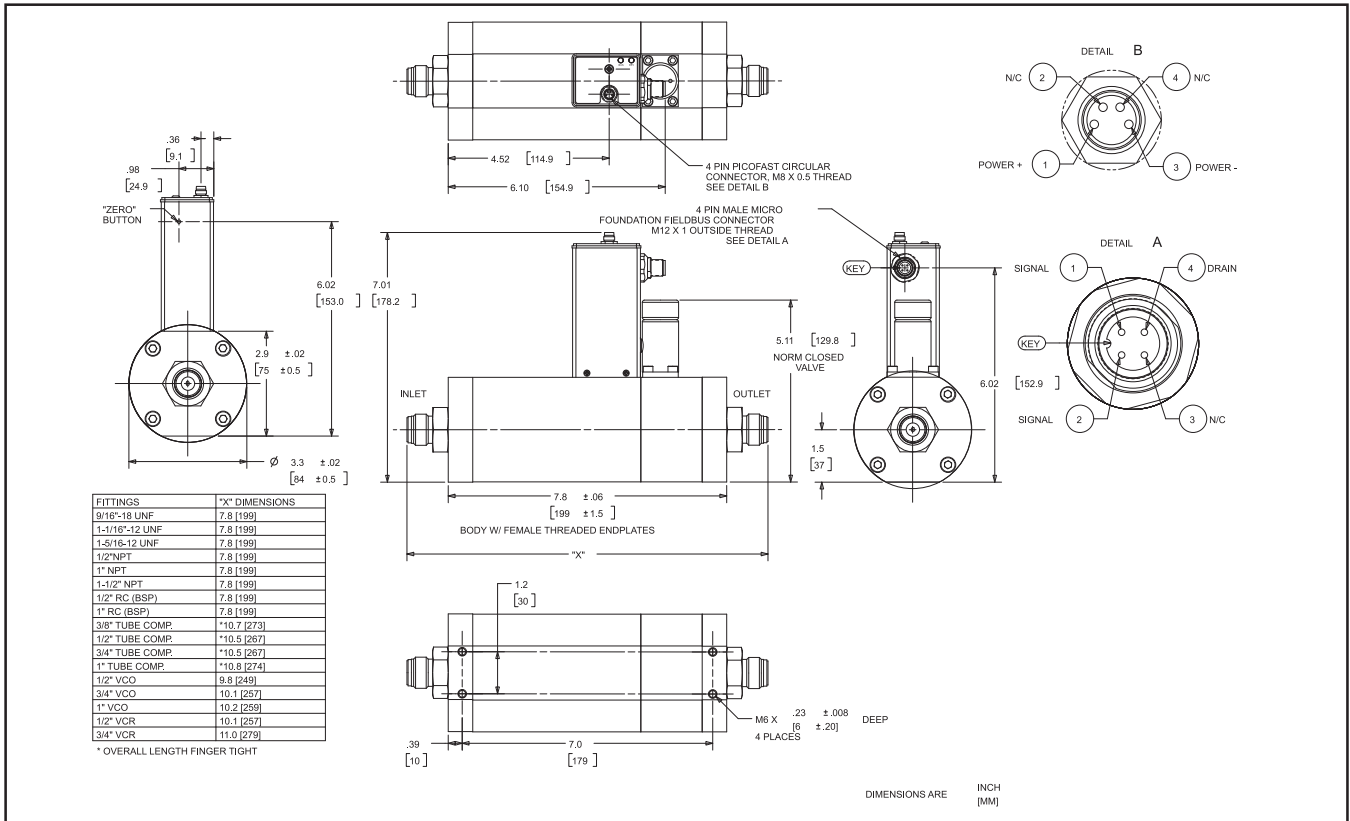


Figure 1-9 Model SLA5853F Digital I/O FOUNDATION Fieldbus MFC

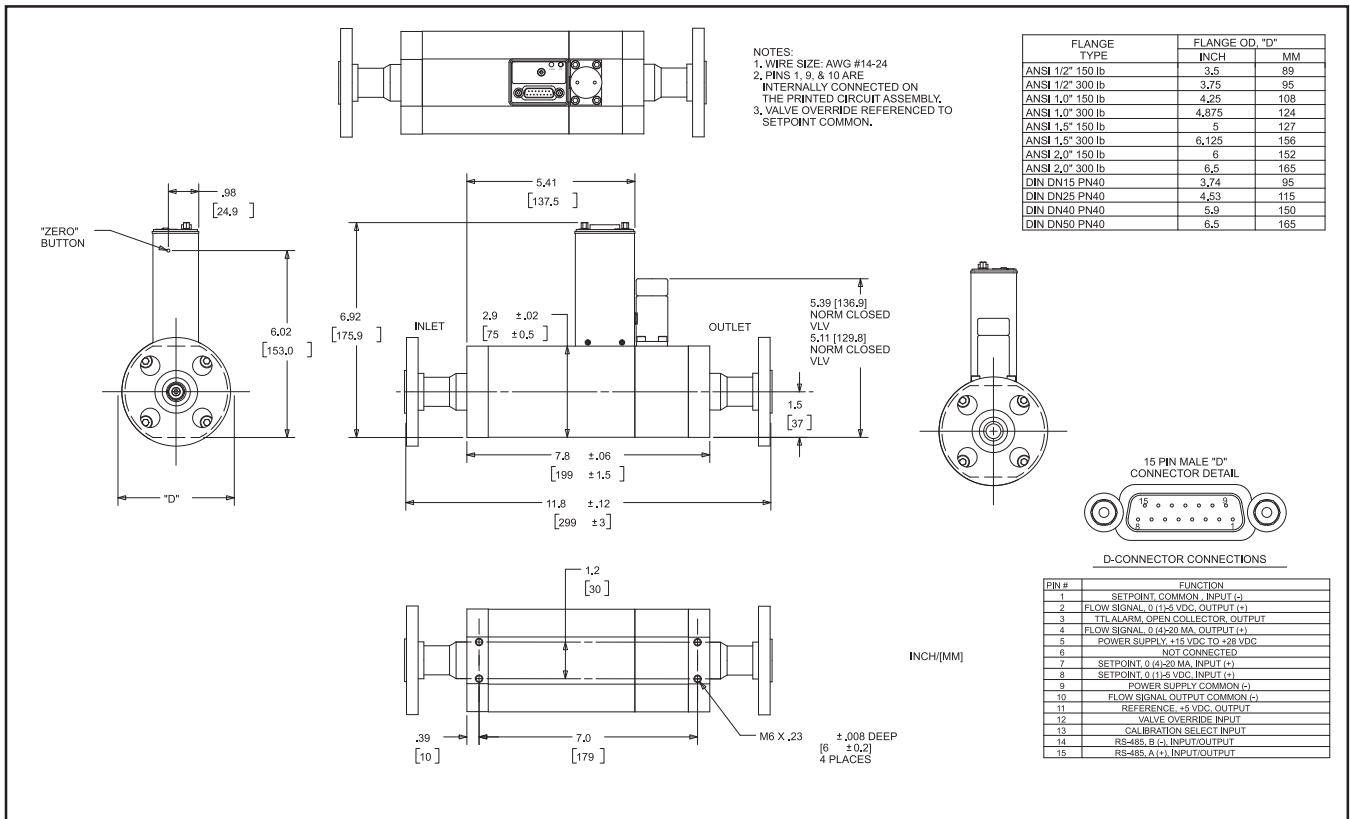


Figure 1-10 Model SLA5853S Analog I/O MFC with Flanged Connections

Brooks® Digital MFC's & MFM's

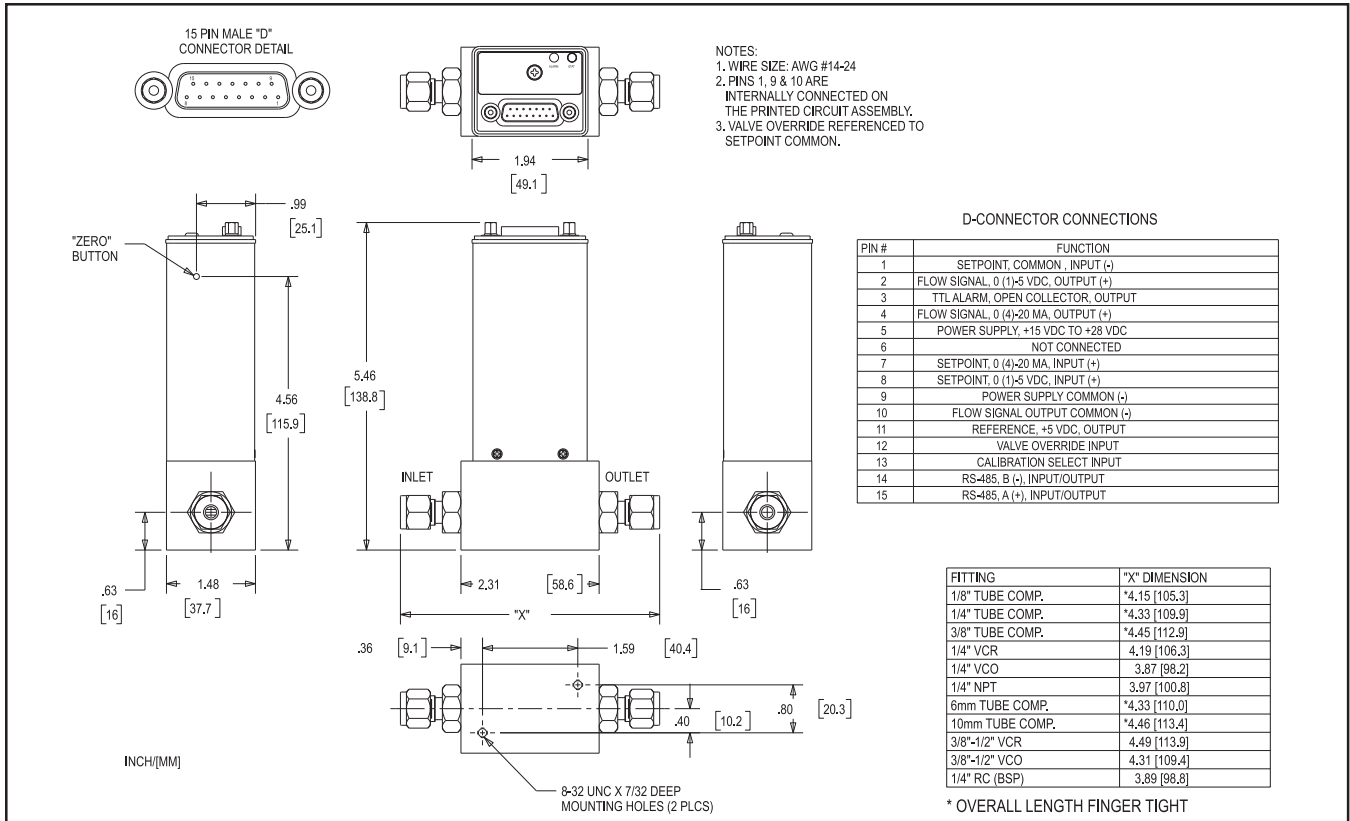


Figure 1-11 Model SLA5860S Analog I/O MFM with RS-485

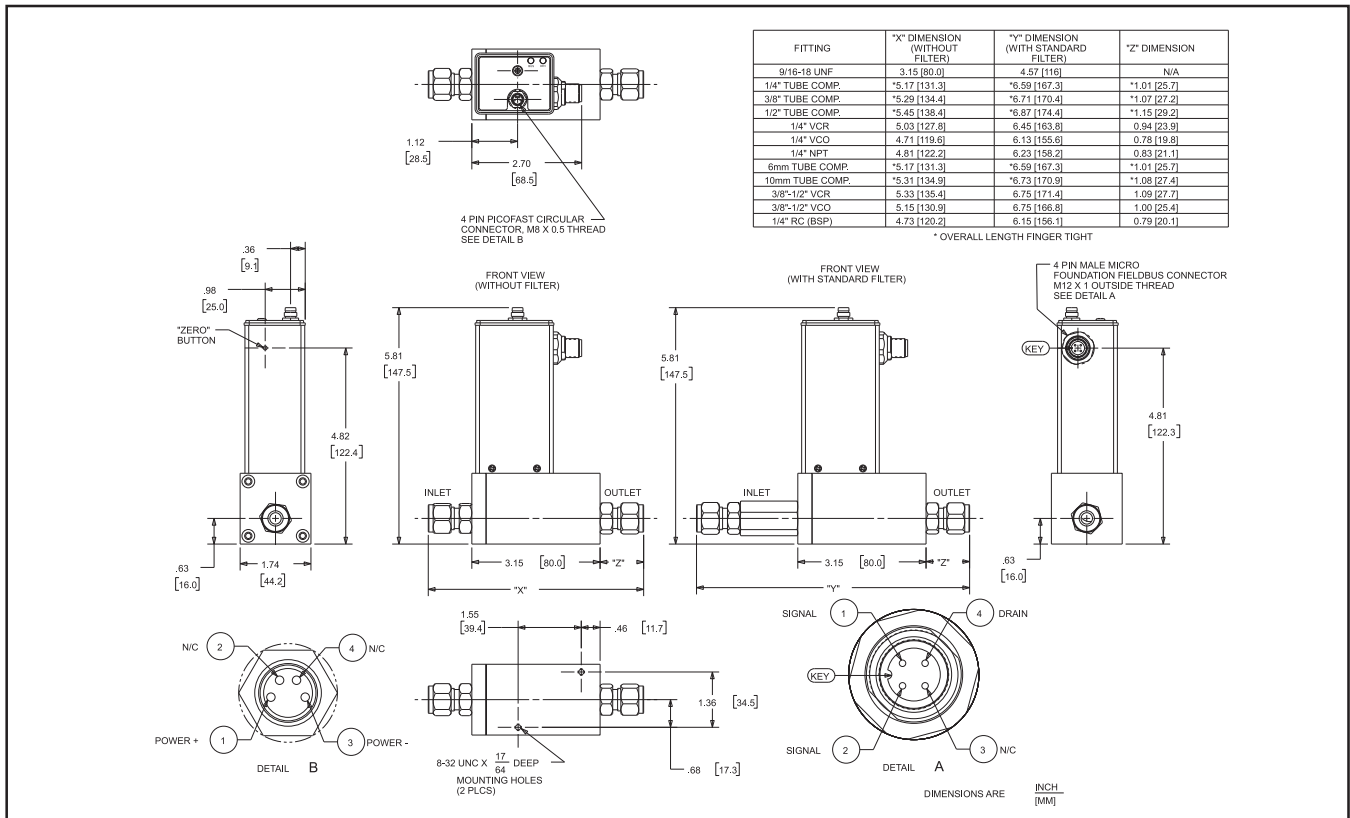


Figure 1-12 Model SLA5861F Digital I/O FOUNDATION Fieldbus MFM

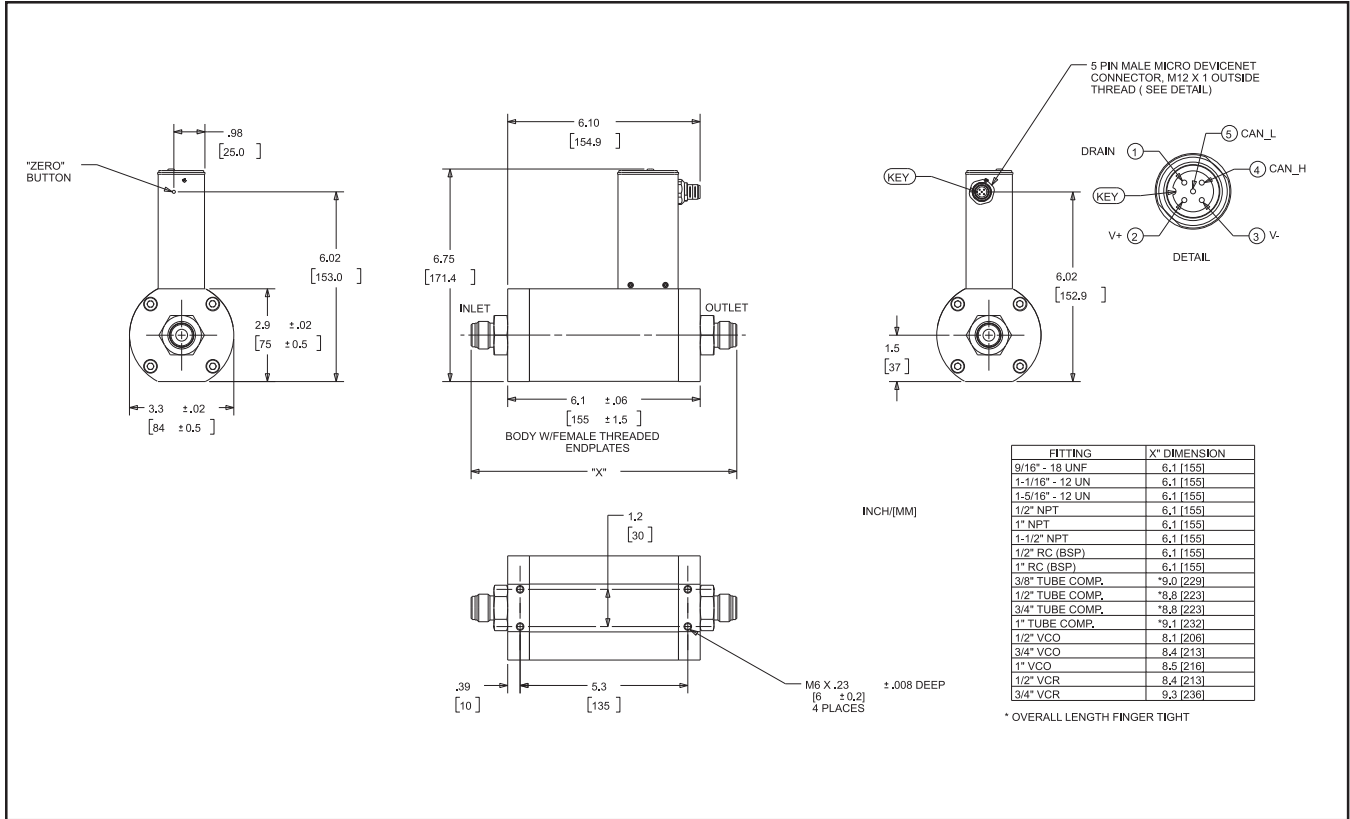


Figure 1-13 Model SLA5863D Digital I/O Devicenet MFM

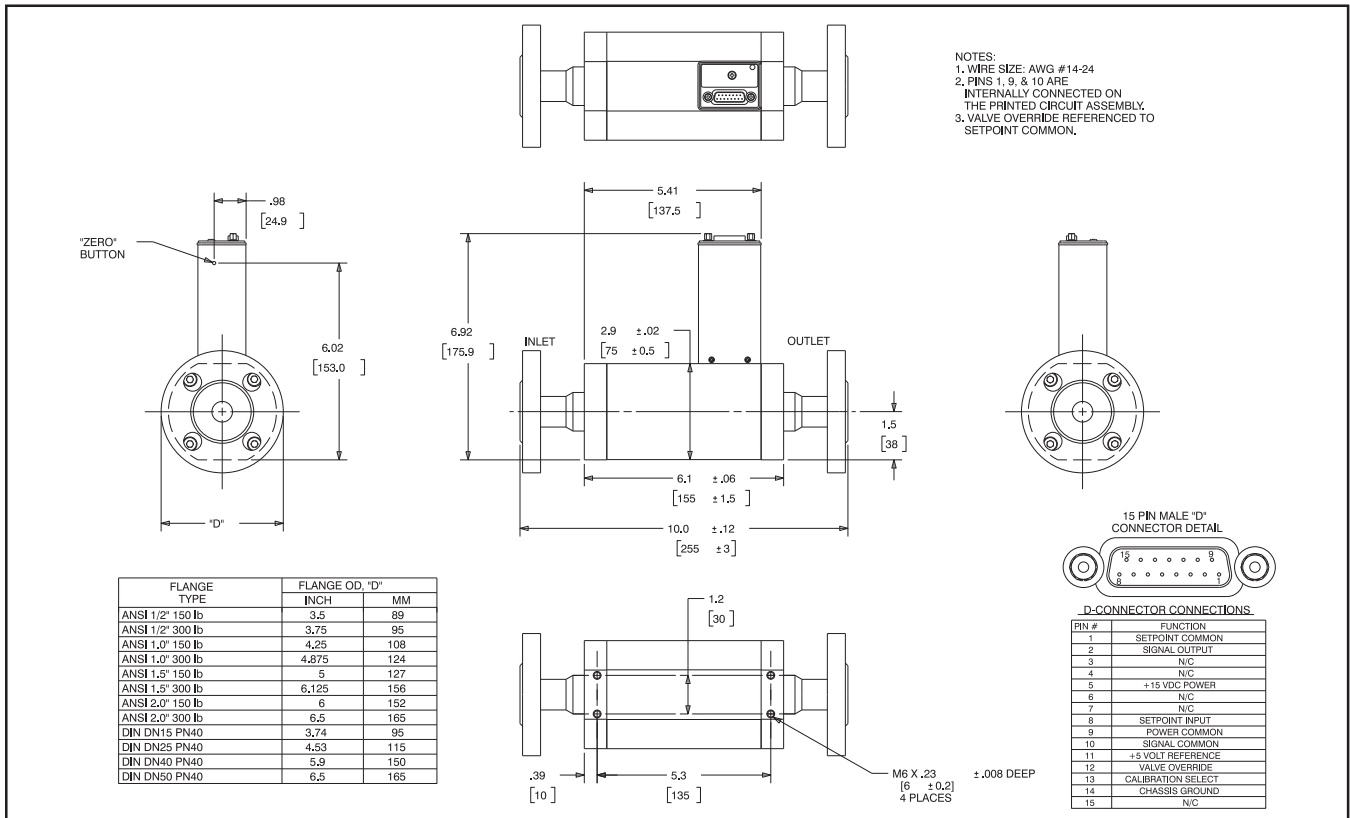


Figure 1-14 Model SLA5863 Analog I/O MFM with Flanges

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2-1 General

This section provides installation instructions for the Brooks® Digital MFC's and MFM's. Section 1, Figures 1-5 thru 1-12 show the dimensions and electrical connections.

2-2 Receipt of Equipment

When the instrument is received, the outside packing case should be checked for damage incurred during shipment. If the packing case is damaged, the local carrier should be notified at once regarding his liability. A report should be submitted to your nearest Product Service Department.

Brooks Instrument

407 W. Vine Street
P.O. Box 903
Hatfield, PA 19440 USA
Toll Free (888) 554 FLOW (3569)
Tel (215) 362 3700
Fax (215) 362 3745
E-mail: BrooksAm@BrooksInstrument.com
www.BrooksInstrument.com

Brooks Instrument

Neonstraat 3
6718 WX Ede, Netherlands
P.O. Box 428
6710 BK Ede, Netherlands
Tel +31 (0) 318 549 300
Fax +31 (0) 318 549 309
E-mail: BrooksEu@BrooksInstrument.com

Brooks Instrument

1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel +81 (0) 3 5633 7100
Fax +81 (0) 3 5633 7101
Email: BrooksAs@BrooksInstrument.com

Remove the envelope containing the packing list. Carefully remove the instrument from the packing case. Make sure spare parts are not discarded with the packing materials. Inspect for damaged or missing parts.

2-3 Recommended Storage Practice

If intermediate or long-term storage of equipment is required, it is recommended that the equipment be stored in accordance with the following:

- a. Within the original shipping container.
- b. Stored in a sheltered area, preferably a warm, dry, heated warehouse.
- c. 32°C (90°F) maximum, 45°F (7°C) minimum.
- d. Relative humidity 45% nominal, 60% maximum, 25% minimum.
Upon removal from storage a visual inspection should be conducted to verify the condition of equipment is "as received".

Brooks® Digital MFC's & MFM's

2-4 Return Shipment

Prior to returning any instrument to the factory, contact your nearest Brooks location for a Return Materials Authorization Number (RMA#). This can be obtained from one of the following locations:

Brooks Instrument

407 W. Vine Street
P.O. Box 903
Hatfield, PA 19440 USA
Toll Free (888) 554 FLOW (3569)
Tel (215) 362 3700
Fax (215) 362 3745
E-mail: BrooksAm@BrooksInstrument.com
www.BrooksInstrument.com

Brooks Instrument

Neonstraat 3
6718 WX Ede, Netherlands
P.O. Box 428
6710 BK Ede, Netherlands
Tel +31 (0) 318 549 300
Fax +31 (0) 318 549 309
E-mail: BrooksEu@BrooksInstrument.com

Brooks Instrument

1-4-4 Kitasuna Koto-Ku
Tokyo, 136-0073 Japan
Tel +81 (0) 3 5633 7100
Fax +81 (0) 3 5633 7101
Email: BrooksAs@BrooksInstrument.com

Any instrument returned to Brooks requires completion of Form RPR003-1, Brooks Instrument Decontamination Statement, as well as, a Material Safety Data Sheet (MSDS) for the fluid(s) used in the instrument. This is required before any Brooks Personnel can begin processing. Copies of the form can be obtained from any Brooks Instrument location listed above.

2-5 Transit Precautions

To safeguard against damage during transit, transport the instrument to the installation site in the same container used for transportation from the factory if circumstances permit.

2-6 Removal from Storage

Upon removal from storage, a visual inspection should be conducted to verify the condition of the equipment is "as received." If the equipment has been in storage in conditions in excess of those recommended (See Section 2-3), the device should be subjected to a pneumatic pressure test in accordance with applicable vessel codes.

2-7 Gas Connections

Prior to installation ensure all piping is clean and free from obstructions. Install piping in such a manner that permits easy access to the instrument if removal becomes necessary.

2-8 In-Line Filter

Unless an integrated (internal) filter is already installed, it is recommended that an in-line filter be installed upstream from the mass flow controller or meter to prevent the possibility of any foreign material entering the flow sensor or control valve MFC. The filtering element should be replaced periodically or ultrasonically cleaned.

Table 2-1 Recommended Filter Size

Models	Maximum Flow Rate	Recommended Filter
SLA5850/60	100 ccm	2 micron
SLA5850/60	500 ccm	2 micron
SLA5850/60	1 to 5 lpm	10 micron
SLA5850/60	10 to 100 lpm	40 micron
SLA5851/61	10 to 30 lpm	40 micron
SLA5853/63	> 100 lpm	Consult factory

Note: Brooks provides many filter options. For those not listed here, please contact factory.

2-9 Installation

⚠ CAUTION

When installing the Mass Flow Controller or Meter, care should be taken that no foreign materials enter the inlet or outlet of the instrument. Do not remove the protective end caps until time of installation.

⚠ CAUTION

Any sudden change in system pressure may cause mechanical damage to elastomer materials. Damage can occur when there is a rapid expansion of fluid that has permeated elastomer materials. The user must take the necessary precautions to avoid such conditions.

Recommended installation procedures:

- a. The Brooks Digital MFC or MFM should be located in a clean, dry atmosphere relatively free from shock and vibration.
- b. Leave sufficient room for access to Self-zero function push-button.
- c. Install in such a manner that permits easy removal if the instrument requires servicing.

⚠ CAUTION

When used with a reactive (sometimes toxic) gas, contamination or corrosion may occur as a result of plumbing leaks or improper purging. Plumbing should be checked carefully for leaks and the instrument purged with clean, dry N₂ before use.

- d. The Brooks Digital MFC or MFM can be installed in any position. However, mounting in orientations other than the original factory calibration(see calibration data sheet supplied with the instrument) can result in a $\pm 0.2\%$ maximum full scale shift after re-zeroing.

- e. When installing a mass flow controller or meter with full scale flow rates of 10 lpm or greater, be aware that sharp, abrupt angles in the system piping directly upstream of the controller may cause a small shift in accuracy. If possible, have at least ten pipe diameters of straight tubing upstream of the mass flow controller or meter. This is not required for meters with an integrated filter.

⚠ CAUTION

Since the Model SLA5800 control valve may not provide positive shut-off, a separate shut-off valve may be installed downstream for that purpose. It should be noted that a small amount of gas may be trapped between the downstream side of the mass flow controller and the shut-off valve which will result in a surge upon accuation of the shut-off valve. This surge can be reduced in magnitude either by locating the controller and the shut-off valve close together or by moving the shut-off valve upstream of the controller.

Special considerations to be taken when installing the SLA5853 MFC:

The Model SLA5853 has a valve design that is different from the standard low flow Brooks TMFC's. The SLA5853 consists of a dual stage, pilot operated valve. The pilot valve (located on the top of the MFC) controls a differential pressure across the main valve which, in turn controls the flow through the device. The main valve is a pressure operated valve that utilizes a bellows spring and diaphragm to control flow. This bellows and diaphragm assembly can be susceptible to damage by pressure spikes or surges. For this reason, it is recommended that process line startups are handled with care.

The bellows spring is offered in two levels. A low force for low differential pressures ($\Delta P < 30$ psig), and a high force ($\Delta P > 30$ and < 300 psig).

The selection of the bellows spring is mainly determined by the differential pressure as specified on the customer order. This should reflect your actual process conditions. The low force bellows consists of a softer bellows spring which is required to allow flow control at lower differential pressures.

During startup conditions, when a process line is being pressurized, the pressure and/or pressure differentials that the SLA5853 is exposed to may be different from the final process conditions. For higher pressure applications, and especially those with the low force bellows, it is important to bring the pressure up in a controlled manner in order to prevent a possible pressure spike to the bellows spring and main valve diaphragm. A pressure spike could deform the bellows, damage the diaphragm or blow out the bellows O-ring seal. This typically results in a failure to shutoff (leakby at zero setpoint).

One method to assure successful startups is to set a 100% setpoint command or valve override open command and then gently ramp the pressure up to operating conditions. This will allow you to bring your process pressures up to normal process conditions and the SLA5853 will then function as specified.

Another method is to utilize a bypass valve to allow pressure around the device while ramping up pressure to proper operating conditions.

The main point is to not instantly open a ball valve and allow a high upstream pressure or high back pressure surge into the SLA5853 main valve.

Proper process line venting is also important. If operating at pressures greater than 50 psig, be sure to perform a controlled pressure release from inlet and back pressure simultaneously in order to prevent bellows damage from excessive back pressure.

Following careful startup and venting procedures will contribute to a long problem free life of your SLA5853 controller.

Stable Operating Conditions:

As stated above, the SLA5853 model utilizes a pressure operated main valve. Valve performance is dependant on stable system pressures. Oscillating or unstable upstream or downstream pressures are likely to cause the device flow control to become unstable. For the best performance, it is important to create a stable pressure environment by utilizing quality inlet and back pressure regulators in your process design. In many cases, the addition of a back pressure regulator will isolate the SLA5853 from the unstable downstream pressures inherent in many process designs.

For more information, please contact the Brooks Technical Service group.

2-10 Electrical Interface

The setpoint signal is supplied as a 0(1) to 5 Vdc or 0(4)-20 mA analog signal. All signals are supplied via the 15-pin D-Connector. For an analog unit the minimum set of connections which must be made to the MFC and MFM includes +13.5 - 27 Vdc, supply common, and a setpoint signal.

The Brooks Digital electrical interface is designed to facilitate low-loss, quiet signal connections. Separate returns (commons) are supplied for the analog setpoint, analog flow signal, and the power supply. These commons are electrically connected together on the PC board.

Analog I/O Versions

- Signal Common
- Signal Output (Voltage or Current)
- +13.5 - 27 Vdc Supply
- Setpoint Input (Voltage or Current)
- Setpoint Common
- Supply Common
- Chassis Ground (via unit body)

Refer to Table 1-3 for pin connections

Refer to Figures 2-2, 2-3 and 2-4 for electrical I/O connections

(The Brook's MFC acts as a current sink to a setpoint input signal. The 0/4-20 mA setpoint signal should be "driven" into the MFC input by a controlled current source. Reference Brook's device specifications for the setpoint input impedance.)

(The Brook's MFC acts as the current source when providing a 0/4-20 mA output signal to the load. The output signal is "driven" by the MFC into the customer load. Reference Brook's device specifications for maximum load capacity.)

Brooks® Digital MFC's & MFM's

For a DeviceNet unit, 11-25 Vdc power and communication I/O are supplied via the standard 5-pin Circular Micro-Connector.

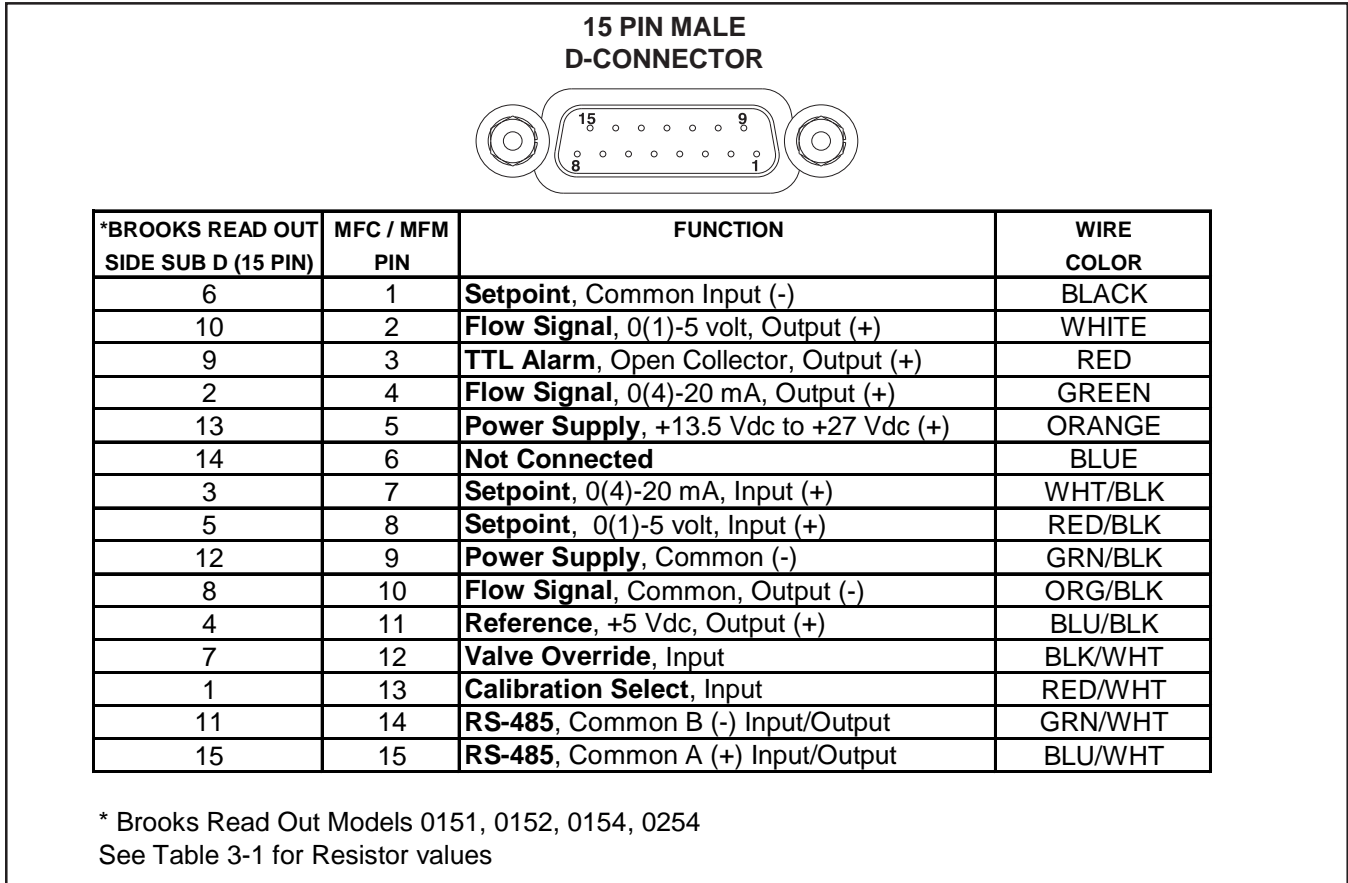


Figure 2-1 D-Connector Shielded Cable Hookup Diagram, Voltage I/O Version

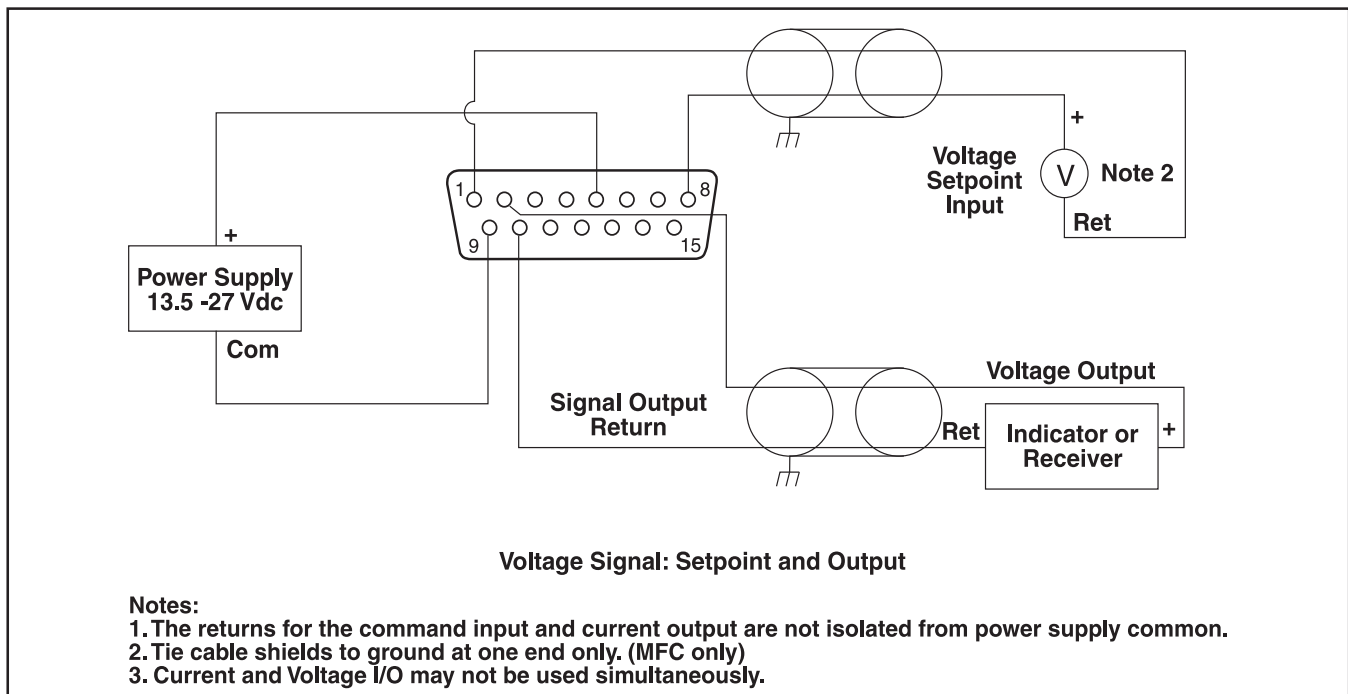


Figure 2-2 Common Electrical Hookups, Voltage I/O Version

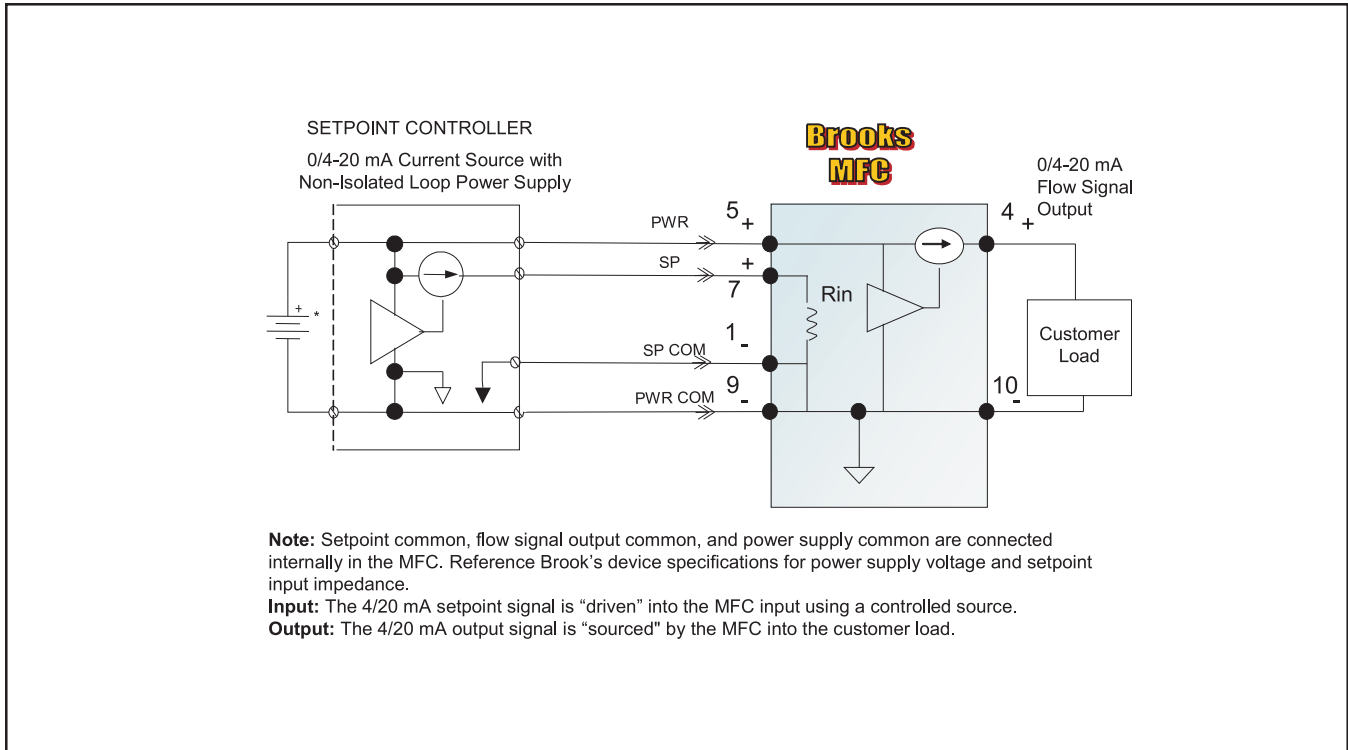


Figure 2-3 Recommended I/O Wiring Configuration for Current Signals (Non-Isolated Power Supply)

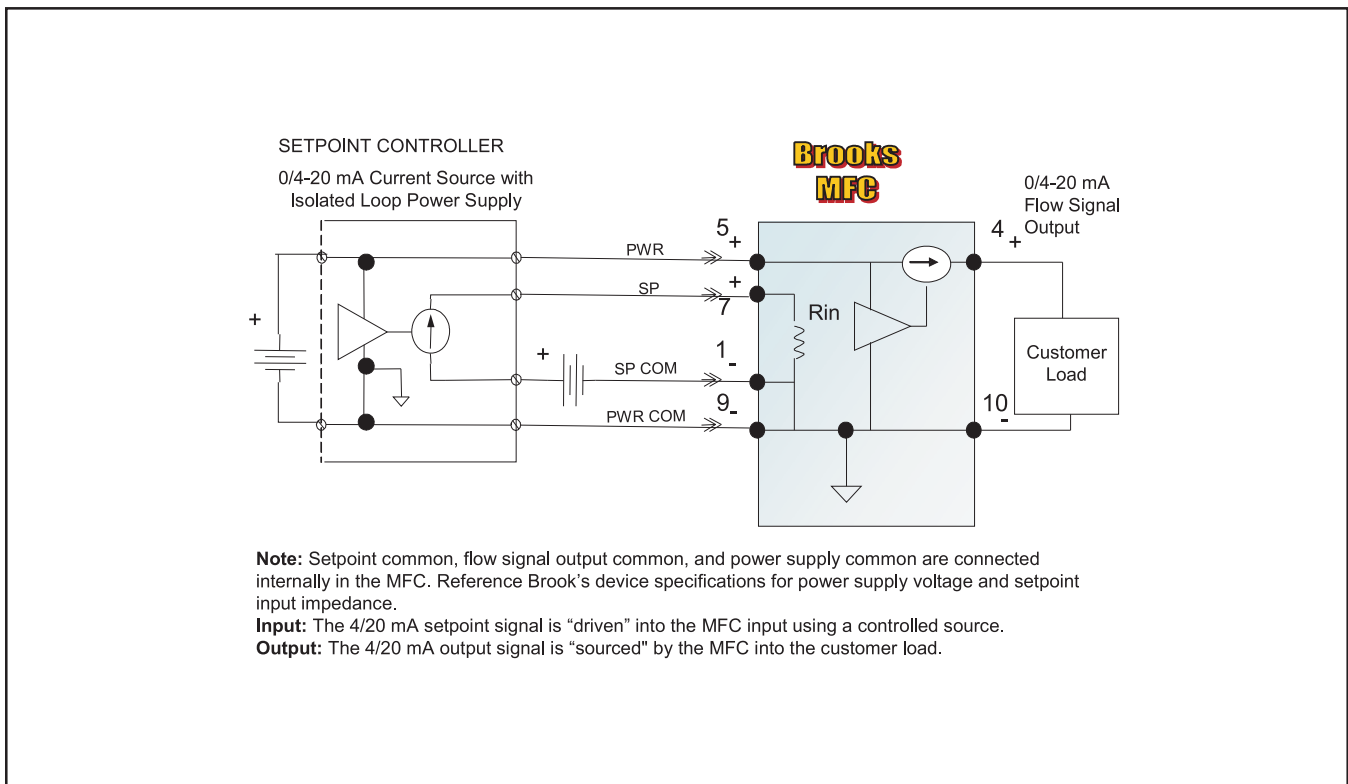


Figure 2-4 Recommended I/O Wiring Configuration for Current Signals (Isolated Power Supply)

Brooks® Digital MFC's & MFM's

2-11 Operation Check Procedure (Analog I/O)

- a. Mount the MFC/MFM in its final orientation.
- b. Apply power to the MFC/MFM and allow approximately 45 minutes for the instrument to completely warm up and stabilize its temperature.
- c. Do NOT supply gas to the MFC/MFM. Ensure that the differential pressure across the MFC/MFM is zero.
- d. Apply a setpoint of:
 - 0.000 Vdc \pm 10 mV (0 - 5 Vdc setpoint)
 - 1.000 Vdc \pm 10 mV (1 - 5 Vdc setpoint)
 - 0.000 mA \pm 100 μ A (0 - 20 mA setpoint)
 - 4.000 mA \pm 100 μ A (4 - 20 mA setpoint)
- e. If the zero exceeds one of these limits, follow the re-zeroing procedure in Section 3-4. The analog output signal should be:
 - 0.000 Vdc \pm 10 mV (0 - 5 Vdc output)
 - 1.000 Vdc \pm 10 mV (1 - 5 Vdc output)
 - 0.000 mA \pm 40 μ A (0 - 20 mA output)
 - 4.000 mA \pm 40 μ A (4 - 20 mA output)
- f. Turn on the gas supply. A positive flow signal may be present due to slight valve leak-thru (MFC only).
- g. Supply a setpoint signal between:
 - 0 to 5 Vdc (0 - 5 Vdc setpoint)
 - 1 to 5 Vdc (1 - 5 Vdc setpoint)
 - 0 to 20 mA (0 - 20 mA setpoint)
 - 4 to 20 mA (4 - 20 mA setpoint)
- h. Check the analog output signal. The output signal should match the setpoint signal in accordance with the accuracy specifications provided in Section 1-4 of this document.
- i. If flow output signal does not match the setpoint, and pressure settings are correct, this could indicate a problem in the MFC. A secondary issue could be the gas type. When checking with a surrogate gas, ensure that there is enough pressure to the MFC in order to flow the correct amount of the surrogate gas.

Example:

Checking an MFC calibrated for 100 ccm SF₆ (sulfur hexafluoride). The sensor factor N₂ (nitrogen) is 0.27, therefore the equivalent N₂ needed is $100/0.27 = 370.4$ ccm. This may require a pressure increase to make this flow rate.

2-12 Digital I/O: DeviceNet or FOUNDATION Fieldbus

- a. Mount the MFC/MFM in its final orientation.
- b. Apply power to the MFC/MFM and allow approximately 45 minutes for the instrument to completely warm up and stabilize its temperature.
- c. Turn on the gas supply. A positive flow signal may be present due to slight valve leak-thru (MFC only).
- d. Provide the proper UOM setpoint between 20% and 100% FS to the MFC via the digital network controller.
- e. Check the MFC Flow value. It should match the setpoint UOM. Value within $\pm 0.2\%$ FS in less than 10 seconds after setpoint change.
- f. If flow output signal does not match the setpoint, and pressure settings are correct, this could indicate a problem in the MFC. A secondary issue could be the gas type. When checking with a surrogate gas, ensure that there is enough pressure to the MFC in order to flow the correct amount of the surrogate gas.

Example:

Checking an MFC calibrated for 100 ccm SF₆ (sulfur hexafluoride).

The sensor factor N₂ (nitrogen) is 0.27, therefore the equivalent N₂ needed is $100/0.27 = 370.4$ ccm. This may require a pressure increase to make this flow rate.

2-13 DeviceNet I/O Assemblies

Other problems that may occur in an operational checkout of a DeviceNet MFC could be due to data mismatches of Input/Output I/O assemblies. For proper communication over the DeviceNet network, the MFC must be set up with the same I/O Assembly as the network master. The DeviceNet specification defines Input and Output relative to the network (i.e. the data being PRODUCED from the device (MFC) as an INPUT into the network or the data is being CONSUMED by the device (MFC) is an OUTPUT from the network). The Brooks MFC supports 12 instances of Input Assemblies and 4 instances of Output Assemblies.

NOTE: This information and all other detailed DeviceNet information is available in the Brooks DeviceNet Supplement Instruction Manual.

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3-1 Overview

This section contains the following information:

- Theory of Operation
- Features

3-2 Theory of Operation for Flow Measurement

The thermal mass flow measurement system consists of two components: the restrictor and the flow sensor. Figure 3-1 contains a diagram of the flow stream through the MFC/MFM with an enlarged view of the flow sensor. Gas flow entering the MFC/MFM is separated into two paths; one straight through the restrictor and the other through the flow sensor. This is represented in Figure 3-1 where the total flow A+B enters the MFC/MFM and is separated into streams A and B. The streams are joined again at the far side of the restrictor.

The separation of the flow streams is caused by the restrictor. During flow conditions there will be a pressure differential across the restrictor which forces gas to flow in the sensor.

The pressure difference caused by the restrictor varies linearly with total flow rate. The sensor has the same linear pressure difference versus flow relationship. The ratio of sensor flow to the flow through the restrictor remains constant over the range of the MFC/MFM ($A/B = \text{constant}$). The full scale flow rate of the MFC/MFM is established by selecting a restrictor with the correct pressure differential for the desired flow.

The flow sensor is a very narrow, thin-walled stainless steel tube. Onto this tube are built upstream and downstream temperature sensing elements on either side of a heating element. Constant power is applied to the heater element, which is located at the midpoint of the sensor tube. During no-flow conditions, the amount of heat reaching each temperature sensor is equal, so temperatures T_1 and T_2 (Fig. 3-1) are equal. Gas flowing through the tube carries heat away from the upstream temperature sensor and toward the downstream sensor. The temperature difference, $T_2 - T_1$, is directly proportional to the gas mass flow. The equation is:

$$DT = A \times P \times C_p \times m$$

Where,

DT = Temperature difference $T_2 - T_1$ ($^{\circ}\text{K}$)

A = Constant of proportionality ($\text{s}^2 \cdot ^{\circ}\text{K}^2 / \text{kJ}^2$)

P = Heater Power (kJ/s)

C_p = specific heat of the gas at constant pressure ($\text{kJ/kg} \cdot ^{\circ}\text{K}$)

m = Mass Flow (kg/s)

A bridge circuit and a differential amplifier interpret the temperature difference and generate an electrical signal directly proportional to the gas mass flow rate.

Brooks® Digital MFC's & MFM's

3-3 Features

Note: All Brooks Digital Series mass flow meters are configured at the factory according to customer order and do not require adjustment. Not all features are available on all instruments.

The Brooks Digital MFC/MFMs are full-featured digital devices. The Brooks Digital MFC/MFMs perform much like traditional analog MFCs, but with improved accuracy, step response and valve control. The analog interface matches that of Brooks' popular analog MFCs so it can be retrofitted into tools using analog MFCs. Other versions of the Delta Class can provide a variety of digital protocols, for example DeviceNet and RS-485.

The Brooks Digital equipment is capable of storing up to 10 different sets of gas calibration data. Each set includes a calibration curve, PID controller settings, valve performance data, and information about the calibration conditions. The Brooks Digital equipment can contain calibrations for different gases or for the same gas at multiple conditions (pressures, full-scale flow rates). Section 3-4 Analog I/O Mode of Operation describes more information about the data contained in the calibration table and how to access the data.

The DeviceNet Instruction Manual describes further details on specific communication features.

Calibrations will appear in the calibration table in the same order as they appeared on the customer order, unless otherwise specified. The first listed gas will appear as calibration #1 the second as calibration #2 and so on. Note that unless specified otherwise on the customer order any unit containing a single calibration will have that calibration stored in calibration position 1.

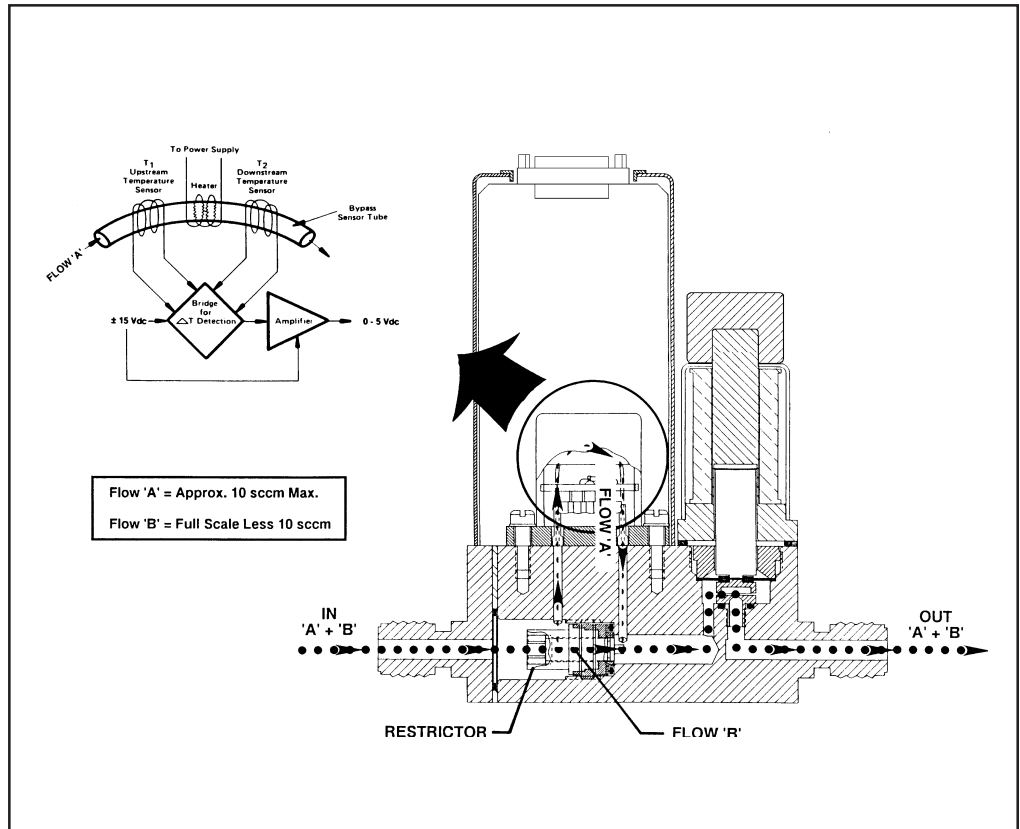


Figure 3-1 Flow Sensor Operational Diagram (VCR™ End Connections Shown)

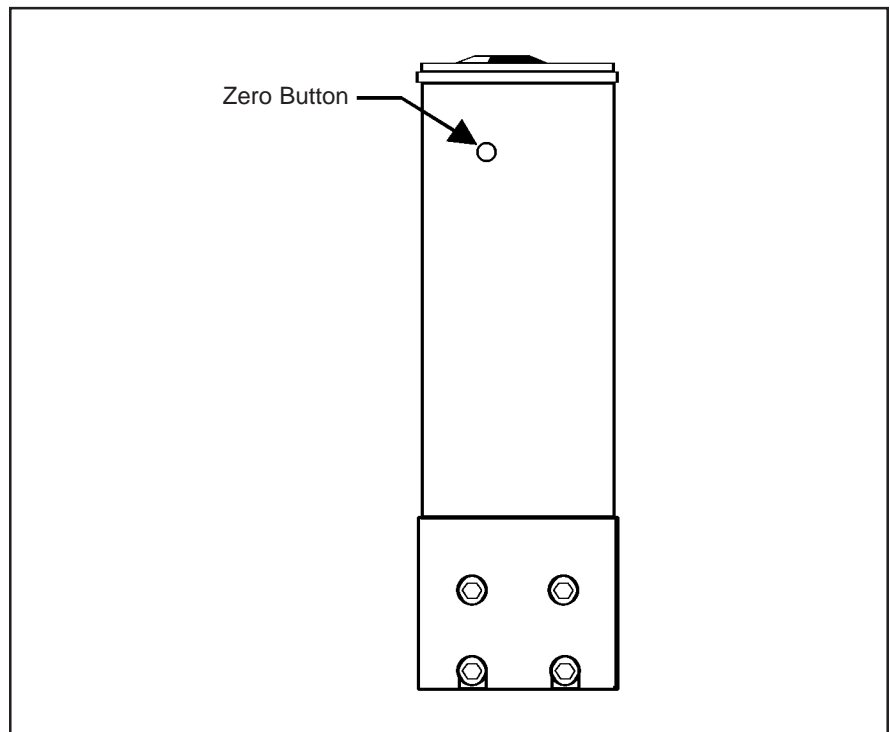


Figure 3-2 Externally Accessible Adjustment for all Meters/Controllers.

Brooks® Digital MFC's & MFM's

3-4 Analog I/O Mode of Operation

The following paragraphs describe the basic features of the Brooks Digital Series Mass Flow Meters/Controllers.

NOTE: Read Section 3-3, Features, before reading this section. See DeviceNet Supplemental Instruction Manual for specific details on communication features.

Functional Description

The analog interface may include any of the following I/O options as specified by the user:

- 0 - 5 Vdc setpoint, 0 - 5 Vdc flow output
- 1 - 5 Vdc setpoint, 1 - 5 Vdc flow Output
- 0 - 20 mA setpoint, 0 - 20 mA flow output
- 4 - 20 mA setpoint, 4 - 20 mA flow output

Also included are the Valve Override input and Calibration Select input pins. All analog signals available are on the 15 pin D-Connector. (See Fig. 2-1 for connections). Note that one formerly unused connector pin, Pin 13, now allows selection of up to ten separate calibrations. The contents of the ten calibrations are determined from the customer order. Only those calibrations ordered will be available in the instrument. Unless otherwise specified, a Brooks Digital MFC/MFM ordered with only one calibration will have that calibration stored in calibration #1.

Before operating the MFC/MFM, apply power and warm-up the instrument for approximately 45 minutes. After warm-up, apply gas pressure then proceed by following the instructions in the following sections.

Analog I/O Setpoint (MFC Only)

This input allows the user to establish the MFC setpoint,. Several input types are available as follows:

Setpoint Signal Type	Full Scale	Minimum Signal	Maximum Signal
0 to 5 Vdc	5 Vdc	0 V	5.5 Vdc = 110%
1 to 5 Vdc	5 Vdc	1 V	5.5 Vdc = 111%
0 to 20 mA	20 mA	0 mA	22 mA = 110%
4 to 20 mA	20 mA	20 mA	22 mA = 111%

Analog I/O Flow Signal

This output is used to indicate the flow signal. A negative flow signal indicates reverse flow through the device, but is NOT calibrated.

Several flow signal types are available:

Analog I/O Type	Full Scale	Minimum Signal	Maximum Signal
0 to 5 Vdc	5 Vdc	-0.5 V	5.5 Vdc = 110%
1 to 5 Vdc	5 Vdc	0.5 V	5.5 Vdc = 111%
0 to 20 mA	20 mA	0 mA	22 mA = 110%
4 to 20 mA	20 mA	3.8 mA	22 mA = 111%

Valve Override (MFC Only)

Connector Pin 12 on the 15 pin D-Connector allows the valve to be forced to its most closed state or its most open state, regardless of setpoint. If this input is not electrically connected, the MFC will operate according to the current values of the other MFC inputs. If this input is held at 0 Vdc or -15 Vdc the valve will be forced to its most closed state. If this input is held at +5 Vdc or greater (max. = 24 Vdc), the valve will be forced to its open state.

Calibration Select Pin

Connector Pin 13, on the 15 pin D-Connector allows selection of one of ten calibrations stored in the device. This pin is designed to accept pull-down resistors referenced to common (Pin 9).

Table 3-1 shows typical resistor values required for selecting calibrations 1 through 10. Note, these resistor values should be within $\pm 1\%$ tolerance. The default condition is with no resistor connected which activates Calibration #1.

When the calibration select pin changes state, the device performs any required processing to change the calibration, then returns to normal operation. If the device determines that the selected calibration is not valid, (where applicable) the valve is driven to the closed state and the flow signal is set to zero. Typical time required to change calibrations is approximately 1.0 second.

NOTE: It is recommended to change calibration curve selection during no-flow conditions.

Table 3-1 Typical Resistor Values for Calibration Selection

CAL#	RESISTOR VALUE (K ohms)
1	Open
2	Shorted
3	665
4	324
5	191
6	124
7	80.6
8	52.3
9	30.9
10	15

Zeroing the MFC (Self-zero)

It may be desirable to re-zero the flow sensor if it is operated at its temperature extremes or if it is positioned in an attitude other than that specified on the customer order.

Note: Before zeroing the instrument, zero pressure differential MUST be established across the device. If there is pressure across the instrument during the zero process, any detected flow through the sensor will be misinterpreted as the zero flow reading. This will result in calibration inaccuracy during normal operation. Once zero differential pressure is established and verified, press the recessed, momentary push-button (self-zero button) located on the side of the device (See Figure 3-2) to start the self-zero function. The zeroing process requires approximately 10 mseconds.

Brooks® Digital MFC's & MFM's

5 Vdc Reference

Connector Pin 11 on the 15 pin D-Connector provides a 5 Vdc reference output signal and is for use in generating a setpoint and/or Valve Override Signal. The current drive capability of this output is limited to 2.5 mA maximum and must be used with care.

3-5 Communications Features

3-5-1 RS-485 Communications Features (Analog versions only)

Digital communication, designed to emulate the Brooks S-series "S-protocol" or pseudo-HART communications is available on the Brooks Digital Series via RS-485. This form of multi-drop capable communication provides access to many of the Brooks Digital Series functions for "control and monitor" operations, including:

- Accurate setpoint adjustment flow output measurement (including units of measure selection)
- Valve Override (controller only)
- Flow Totalizer
- Alarm status and settings
- Soft Start Control (controller only)

RS-485 equipped units support the following baud rates. Please specify the desired baud rate when ordering (default is 19200 baud). Alternately, baud rate may be changed using the Brooks Service Suite™.

Baud Rates: 1200, 2400, 4800, 9600, **19200** and 38400

Reference the Brooks document "S-protocol Communication Command Description for Smart II" for more detail regarding the capabilities of this communication interface.

3-5-2 DeviceNet Communications Features

The Brooks SLA5800 Digital Series is also available with DeviceNet™ communication capability. DeviceNet is an open digital protocol capable of high speeds and easy system connectivity. Brooks Instrument has several of its devices available on this popular networking standard, and is a member of ODVA™ (Open DeviceNet Vendors Association), the governing standard body for DeviceNet.

DeviceNet is similar to the RS485 standard in that it is a multi-drop connection that allows a maximum of 64 devices to be connected on the same network. Baud rate selections for DeviceNet products are 125K, 250K and 500K and can be selected via MAC ID switches mounted on the device.

The DeviceNet communication link also provides access to many of the Brooks SLAMf Digital Series functions for “control and monitor” operations, including:

- Accurate setpoint adjustment and flow output measurement (including units of measure selection)
- PID Settings (controller only)
- Valve Override (controller only)
- Calibration Gas Select
- Soft Start Control (controller only)

3-5-3 FOUNDATION Fieldbus Communications Features

The Brooks SLA5800 Digital Series is supporting FOUNDATION® Fieldbus communication protocol. FOUNDATION® Fieldbus is a digital network allowing usage of existing 4-20mA cables, avoiding costly re-wiring. Fully certified by passing ITK, this device has passed several Interoperability requirements other a broad range of hosts. When combined with DeltaV and using the power of PlantWeb, those devices provide intelligent alerts allowing accurate device maintenance and service.

- Value Range check - Part of the standard function blocks
- Temperature sensor connection - Check sensor connection
- Firmware checksum - Check for Internal firmware integrity
- Non-volatile memory - Check for non-volatile memory integrity
- RAM - Check for RAM integrity
- Zero Drift/Valve Leak-by - Check for flow leak-by or sensor zero drift
- Device Overhaul due - Preventive Maintenance
- Calibration Due - Preventive Maintenance
- Valve spring life - Preventive Maintenance
- No Flow - No flow detected when setpoint requested
- Reverse Flow - Reverse flow detected
- Flow Totalizer - Informed when a user define amount of fluid has been delivered
- Time Totalizer - Informed when a user define amount of time has expired

Brooks® Digital MFC's & MFM's

Device type dependant function block are available representing the different device functions:

- Current Flow Value (Mass Flow device only)
- Current Pressure Value (Pressure device only)
- Current Device Temperature (Mass Flow device only)
- Current Valve position (Controller Only)
- Setpoint Control (Controller Only)
- Direct Valve Control (Controller Only)
- Actuator Override (Controller Only)
- Ultra-fast (8ms) PID function block for Cascade control (all devices)

3-6 Alarms and Warnings (Analog versions only)

This section outlines alarms and warnings associated with the Analog versions of the Brooks Digital Series.

For information describing alarms and warnings for Brooks DeviceNet™ units, reference the Brooks DeviceNet™ Supplemental Manual.

3-6 -1 Alarms and Warnings (Analog versions only)

Connector Pin 3, on the 15 pin D-Connector provides an open collector TTL output that will close depending on the alarm/warning situation and the alarm settings.

Alarms and Warnings are a user configurable feature. This feature may be adjusted via the Service Port using a special software application available from Brooks. Reference the Brooks Service Suite User Manual for more information about the Service Port and Service Tool software applications.

Each alarm has the following common user configurable traits:

Severity - The options are Off, Warning and Alarm. When set to Off, the conditions are not monitored and no actions will be taken. When set to Warning, the Alarm LED will flash Green when the monitored value exceeds the specified conditions. (See Alarm Code attribute). When set to Alarm, the Alarm LED will flash Red and the Analog Outputs will act based on the assigned Output Alarm Behavior when the monitored value exceeds the specified conditions.

Alarm Code - The alarm code specifies the code to be flashed on the LED to indicate that an alarm/warning condition has occurred. When more than one alarm/warning is active, then the LED will indicate the most severe alarm with the highest Alarm Code. An Alarm is more severe than a Warning. Alarm Codes do not have to be unique, i.e., more that one alarm/warning type can use the same alarm code.

Latching Enable - When an alarm/warning is set to non-latching, that means the alarm is indicated only when the monitored value exceeds the specified conditions. When the alarm/warning is set to latching, this means that the alarm/warning will be indicated when the monitored value first exceeds the specified conditions, and will be indicated until the user clears the alarm. If the user clears the alarm while the monitored value still exceeds the specified conditions, then the alarm will be re-latched and continue to be indicated.

Contact Enable - If the alarm condition is detected and the severity is alarm or warning, and the alarm contact is enabled, then the alarm contact is "closed".

Low Limit - The value of the monitored value below which is considered an alarm/warning condition. (This attribute not valid for alarms that monitor a state condition of the device.)

High Limit - The value of the monitored value above which is considered an alarm/warning condition. (This attribute not valid for alarms that monitor a state condition of the device.)

Delay - The time in seconds that the value must remain above the high limit or below the low limit before an alarm/warning condition is indicated.

Alarm Summary

The following table summarizes the parameters for each alarm type and the respective default values.

Alarm	Severity	Alarm Code	Latching Enable	Contact Enable	Low Limit	High Limit	Delay
Diagnostic	Alarm	12	n/a	Off	n/a	n/a	n/a
Flow 1	Off	11	Off	Off	0%	120%	1.0
Flow 2	Off	10	Off	Off	0%	120%	1.0
No Flow Indication	Alarm	9	Off	Off	2%	n/a	1.0
Setpoint Deviation	Alarm	8	Off	Off	-10%	+10%	1.0
Totalizer Overflow	Off	7	n/a	Off	n/a	n/a	n/a
User Power Supply	Alarm	6	Off	Off	13.5	27.0	1.0
Setpoint Input Out of Range	Alarm	5	Off	Off	n/a	n/a	1.0
Flow Output Out of Range	Alarm	4	Off	Off	n/a	n/a	1.0
Flow Output Loop Open	Off	3	Off	Off	n/a	n/a	1.0
Flow Sensor Out of Range	Alarm	1	Off	Off	n/a	n/a	1.0

Brooks® Digital MFC's & MFM's

3-6-2 Diagnostic Alarms (Analog versions only)

A Diagnostic Alarm will be indicated when any of the diagnostics below detect a failure providing a visual indication via the red and/or green LED, and activating the TTL open collector output located on the 15 pin D-Connector. The diagnostic test or tests that have detected a problem and caused the Diagnostic Alarm to occur can be determined only by reading a parameter via the Service Port. When a diagnostic alarm occurs, the device will automatically reset after approximately 5 seconds.

Diagnostic	Failure Description
RAM	Byte by byte test of RAM detects bad memory location
Flash (Program Memory)	8-bit Checksum of the entire Flash not zero.
Non-Volatile Memory	Byte by byte test of Non-Volatile Memory detects bad memory location
Temperature Sensor	Temperature Sensor reports a value outside the designed range of 0° C to 100° C
Power Supply (Internal)	Any internally generated power supply voltage outside operational limits. (3.3 Volt and 7.6 Volt internal supply voltages must be within \pm 5% of nominal value.)

Safe Mode

When the Device is in Safe Mode, the following behavioral characteristics of the device apply:

Flow Output Signal will be set to its defined Safe State for the following output signal types:

0 to 5 Vdc: 0 Vdc

1 to 5 Vdc: 1 Vdc

0 to 20 mA: 0 mA

4 to 20 mA: 0 mA

In the Safe State, the valve will be unpowered. This means that for Normally Closed valves, the valve will stay closed and for Normally Open valves, the valve will stay open.

3-6-3 General Alarms and Warnings (Analog versions only)

Several alarms are available to indicate unexpected process control events as follows:

Flow Alarms

Two flow alarms will be provided. Each will allow the user to set a minimum and maximum flow limit range. Whenever flow is not within the range, the alarm will occur. These two general flow alarms provide more flexibility than having specific low and high flow alarms. These two alarms may be used to create separate low and high flow alarms, or maybe used to provide banding around a flowrate. If the device is a controller, then this alarm is disabled if the setpoint is not within the specified flow limits or if the valve override is active.

User Power Supply Alarm

The User Power Supply Alarm monitors the Power Input to the device for values outside the device specification of 13.5 to 27 Vdc. The user can configure the voltage limits that activate this alarm in order to monitor their supply voltage for a tighter specification than the device requires.

Setpoint Deviation Alarm

The Setpoint Deviation Alarm monitors the difference between Setpoint and Flow and sets the alarm when the difference exceeds the specified limits for more than the specified delay period. The user specifies a minimum and maximum limit in percent of Setpoint. This alarm is disabled if the valve override is active.

No Flow Indication Alarm

The No Flow Indication Alarm will occur when the measurement of flow indicates flow less than a value that can be configured to 0 - 2%. If the device is a controller, setpoint must exceed the configured limit and valve override must not be active for this alarm to occur.

Totalizer Overflow Alarm

The Totalizer Overflow Alarm will occur when the Flow Totalizer reaches its maximum value and resets to zero. This alarm is permanently configured as a latching type alarm which requires the user to reset the alarm via the Service Port or the RS-485 interface.

Flow Analog Output Loop Open Alarm

The Flow Analog Output Loop Open Alarm will occur when the device detects that there is no current flowing on the current loop. This alarm could be the fault of an open connection on the analog output current loop.

Setpoint Analog Input Out of Range Alarm

The Setpoint Analog Input Out of Range Alarm will occur when the Voltage Input exceeds the maximum allowable 5.5 V, when the 4 – 20 mA input is less than 3.8 mA or greater than 22 mA, or when the 0 – 20 mA input is greater than 22 mA.

Flow Analog Output Out of Range Alarm

The Flow Analog Output Out of Range Alarm will occur when the measured flow results in an Analog Output which exceeds the specified range for either the Voltage or Current Output. See Section 1.

Flow Sensor Out of Range

The Flow Sensor Out of Range Alarm will occur when the device detects that the signal received from the sensor is not within the allowable tolerance band. This alarm could be the result of a flow sensor failure.

3-7 Calibration/Configuration Sets

All Flow Calibration parameters and some of the device configuration parameters are saved in the device Non-Volatile Memory as “sets”. Up to 10 sets of calibration/configuration sets can be saved in order to have a unit pre-configured for multiple gas calibration, different pressure conditions, multiple scalings of the same gas.

Calibration and configuration data sets may be adjusted by an advanced user via the Service Port using a special software application available from Brooks. Reference the Brooks Service Suite User Manual for more information about the Service Port and Service Tool software applications.

Flow Calibration Options

In addition to the factory calibration polynomial, the following calibration options are provided to modify the factory calibration:

- Gas Correction Factor
- Calibration Scaling
- User Calibration Polynomial

Configuration Options

The following configuration parameters are stored in the Calibration/Configuration Sets:

- P, I, and D
- Valve Offset, Span, and Leaktight Offset
- Pole Compensation and filtering

3-8 Special Features

Special Features may be adjusted by an advanced user via the Service Port using a special software application available from Brooks. Reference the Brooks Service Suite User Manual for more information about the Service Port and Service Tool software applications.

3-8-1 Setpoint Ramping

The following Setpoint Ramping Options are provided:

Off – The device responds immediately to Setpoint changes.

Time – The device will Ramp Flow from the old Setpoint to the new Setpoint in the time specified by the user in seconds.

3-8-2 Low Setpoint Command Cutoff

When the Setpoint is derived from analog input, the Low Setpoint Command Cutoff parameter sets the minimum valid value of Setpoint. If the Setpoint value reported by the analog input is below the Low Setpoint Command Cutoff parameter value, then the Setpoint will be set to zero.

3-8-3 Low Flow Output Cutoff

Whenever the measured flow is below the Low Flow Output Cutoff parameter, the Flow Output will be set to zero.

3-8-4 Flow Output Damping

The Flow Output can be damped from 0 to 10 seconds.

3-8-5 Adaptive Control

Adaptive Valve Control is a means of dynamically adjusting valve offset and span in response to changing process conditions. Options for Adaptive Control are: On/Off, Adjust Offset Only, Adjust Offset and Span.

3-8-6 Flow Totalizer

A Flow Totalizer will be provided and maintained in Non-Volatile Memory. The update rate of the totalizer in Non-Volatile Memory will be 5 seconds.

3-8-7 Flow Output Conditioning

When this feature is enabled and a change in setpoint is detected, the Flow Out signal will equal setpoint for a configurable time period. At the end of the time period, the Flow Out signal will indicate actual flow. A change of setpoint is defined as a change of more than 1% of full scale.

Brooks® Digital MFC's & MFM's


3-8-8 Flow Signal Lock-in

When this feature is enabled, the Flow Out signal will “lock-in” to the setpoint value whenever the error between measured Flow and Setpoint is less than a configurable value.

3-9 PC-based Support Tools

Brooks Instrument offers a variety of PC-based process control and service tools to meet the needs of our customers. SmartDDE may be used with any unit supporting RS-485 in a multidrop configuration, thus allowing users to control and monitor their Brooks devices. The Brooks Service Suite (Analog I/O versions only) may be used to monitor, diagnose, tune and calibrate Brooks devices. The Brooks Service Suite interfaces with Brooks products via a special service port. The Brooks Service Tool (BST) may be used for devices equipped with digital communications to perform many of the same tasks as the Brooks Service Suite.

4-1 Maintenance and Troubleshooting

	<p>⚠ WARNING</p> <p>METER/CONTROLLER SEAL COMPATIBILITY</p>
<p>Products in this manual may contain metal or elastomeric seals, gaskets, O-rings or valve seats. It is the "user's" responsibility to select materials that are compatible with their process and process conditions. Using materials that are not compatible with the process or process conditions could result in the Meter or Controller leaking process fluid outside the pressure boundary of the device, resulting in personnel injury or death.</p> <p>It is recommended that the user check the Meter or Controller on a regular schedule to ensure that it is leak free as both metal and elastomeric seals, gaskets, O-rings and valve seats may change with age, exposure to process fluid, temperature, and /or pressure.</p>	

No routine maintenance is required on the Brooks Digital MFC's and MFM's. If an in-line filter is used, the filtering elements should be periodically replaced or cleaned.

<p>⚠ WARNING</p> <p>If it becomes necessary to remove the MFC/MFM from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the MFC/MFM thoroughly with a dry inert gas such as Nitrogen before disconnecting the gas connections. Failure to correctly purge the MFC/MFM could result in fire, explosion or death. Corrosion or contamination of the MFC/MFM upon exposure to air, may also occur.</p>

<p>⚠ WARNING</p> <p>If it becomes necessary to remove the instrument from the system, power to the device must be disconnected.</p>

<p>⚠ CAUTION</p> <p>It is important that this MFC/MFM only be serviced by properly trained and qualified personnel.</p>

4-1-1 Troubleshooting Analog or DeviceNet version

This section contains suggestions to help diagnose MFC related problems in the gas distribution system and answers commonly asked questions.

Failure of the flow rate or flow signal to achieve setpoint.

1. Insufficient pressure drop across the MFCs (low or no pressure). If there is not enough pressure differential across the MFC, it is impossible for the MFC's orifice to pass the full scale flow rate. To check for this condition, compare the actual inlet/outlet pressure drop with that specified on the order. Increase the pressure if necessary.
2. If pressure settings are correct and flow signal does not match setpoint, a secondary issue could be the gas type. If checking the MFC with a surrogate gas, ensure that there is enough pressure to the MFC in order to flow the correct amount of the surrogate gas.
3. Setpoint is below minimum. MFCs may have a settable low flow cutoff for the setpoint command. If setpoint is below this value, then the MFC will not attempt to control.
4. Clogged sensor tube. If the MFC sensor tube is clogged, the flow signal will be very low or zero while the actual flow will be at the valve's maximum rate.
5. Flow signal matched setpoint but, actual flow is not correct.
Clogged restrictor. If the MFC's restrictor becomes clogged, a much larger flow stream will pass through the sensor rather than going straight through the restrictor. The symptom of this condition is a substantially reduced actual flow with a flow signal which matches the setpoint.
6. Flow rate in excess of 100% at zero setpoint.
Valve Override pin set to open. If Valve Override (VOR) pin is active, the valve will be forced open or closed. Set this pin to its normal level before setting a setpoint.
7. Flow/Flow signal 'Unstable'
Model SL5800 Series MFC performance is tuned during calibration at the conditions specified on the order. If the conditions in use (inlet and outlet pressure, temperature, attitude, gas or mixture type) are different or become different over time, the MFC may not perform as it did when it left the factory.

DeviceNet Version Only

8. Failure of the flow rate or flow signal to achieve setpoint.
Specifically for a DeviceNet MFC, there may be problems associated with the network communication link. One common problem is due to data mismatches of the Input/Output (I/O) Assemblies. For proper communication over the DeviceNet network, the MFC must be set up with the same I/O assembly as the network master. Confirm these I/O settings are correct.

NOTE: This information and all other detailed DeviceNet information is available in the Brooks DeviceNet Supplement Instruction Manual.

Questions Analog Version

Q: What is purpose of the LED on top of the MFC?

A: The LED on top of the MFC should normally be lit GREEN, This signifies the MFC is in proper working mode. If the LED is lit RED, this signifies a critical fault has occurred in the MFC. Please contact the factory for instructions.

Questions DeviceNet Version

Q: What is purpose of the LED on top of the MFC?

A: There are two LEDs on top of a DeviceNet version MFC. The LED labeled 'MOD' is used to indicate module status. This LED should normally be lit GREEN. If the 'MOD' LED is lit RED, this signifies a critical fault has occurred in the MFC. Please contact the factory for instructions. The LED labeled 'NET' is used to indicate NETWORK status. Note the 'NET' LED can have 4 distinct operational states. For more complete details on these LEDs, reference the Brooks DeviceNet Supplement Instruction Manual.

Q: What is purpose of the Rotary Switches on top of the MFC?

A: Two of the rotary switches are labeled 'ADDRESS'. These two switches are used to configure the MAC ID of the MFC when used on the DeviceNet network. MAC ID stands for Media Access Control Identifier and is used to set the unique address of the device on the network. The possible range of addresses is 00 to 63. The out-of-box MAC ID setting is 63. The third rotary switch is labeled 'RATE'. This switch sets the baud rate of the MFC for communicating over the DeviceNet network. The out-of-box default setting is 125K baud. For more complete details on these switches, reference the Brooks DeviceNet Supplement Instruction Manual.

Analog or DeviceNet Version

Q: What is the purpose of the recessed push-button on the side of the MFC?

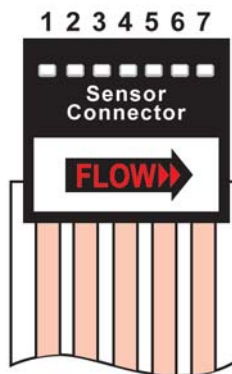
A: This push-button is used to start a self-zero function. DO NOT press this button unless you are performing this function as described in Section 3-5 of this manual.

Table 4-1 Sensor Troubleshooting

SENSOR SCHEMATIC		Sensor Connector	
PIN NO.	FUNCTION	1	2
1	Heater	3	4
2	Upstream Temperature Sensor (Su)	5	6
3	Downstream Temperature Sensor (Sd)	7	
4	Sensor Common		
5	Heater Common		
6	Thermistor		
7	Thermistor		

Remove the sensor connector from the PC Board for this procedure.

OHMMETER CONNECTION	RESULT IF ELECTRICALLY FUNCTIONAL
Pin 1 or 4 to meter body	Open circuit on ohmmeter. If either heater (1) or sensor common (4) are shorted, an ohmmeter reading will be obtained.
Pin 4 to Pin 2	Nominal 1100 ohms reading, depending on temperature and ohmmeter current.
Pin 4 to Pin 3	
Pin 5 to Pin 1	Nominal 1000 ohm reading.
Pin 6 to Pin 7	Nominal 580 ohm reading.



Flex Circuit Wire Numbers

4-1-2 System Checks

The Brooks Digital Series Flowmeters and Controllers are generally used as a component in gas handling systems, which can be complex in nature. It can therefore be very difficult to isolate a malfunction in the system. An inaccurately diagnosed malfunction can cause many hours of unnecessary downtime. If possible, perform the following system checks before removing a suspect Mass Flow Meter or Controller for bench troubleshooting or return to the factory. (especially if the system is new):

1. Verify a low resistance common connection and that the correct power supply voltage and signals are present of the connector of the Smart TMF.

2. Verify that the process gas connections have been made correctly, and that they have been tested for leaks.
3. If the Mass Flow Controller appears to be functioning but cannot achieve Setpoint, verify that there is sufficient inlet pressure and pressure drop at the controller to provide the required flow.

This section contains suggestions to help diagnose simple MFC/MFM related problems in the gas distribution system and answers commonly asked questions.

⚠ WARNING

If it becomes necessary to remove the instrument from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the instrument thoroughly with a dry inert gas such as Nitrogen before disconnecting the gas connections. Failure to correctly purge the instrument could result in fire, explosion or death. Corrosion or contamination of the instrument upon exposure to air, may also occur.

Bench Troubleshooting

1. Establish a proper connection between the Brooks Digital Series Mass Flow Meter or Controller (using Figure 4-1 as a reference) Switch on the power and allow the instrument to warm-up for 45 minutes. In case of a Controller model, adjust the Setpoint to zero. Do not connect the device to a gas source yet. Observe the output signal and, if necessary, perform the zero adjustment procedure (See Section 3-4 zeroing function). If the output signal does not zero properly, please contact Brooks Instrument.
2. Connect the instrument to a source of the same gas used for it's original calibration. Regulate the Setpoint to 100% flow and adjust the inlet and outlet pressures to calibration conditions. Verify that the output signal reaches its full scale value and stabilizes at that value. Vary the command voltage over the 1 to 100% range and verify that the output signal follows the Setpoint If possible, connect a flow measurement device to monitor the actual flow behavior and verify the accuracy of the mass flow instrument. If the mass instrument performs as described above, then it is functioning correctly and the problem may lie elsewhere.

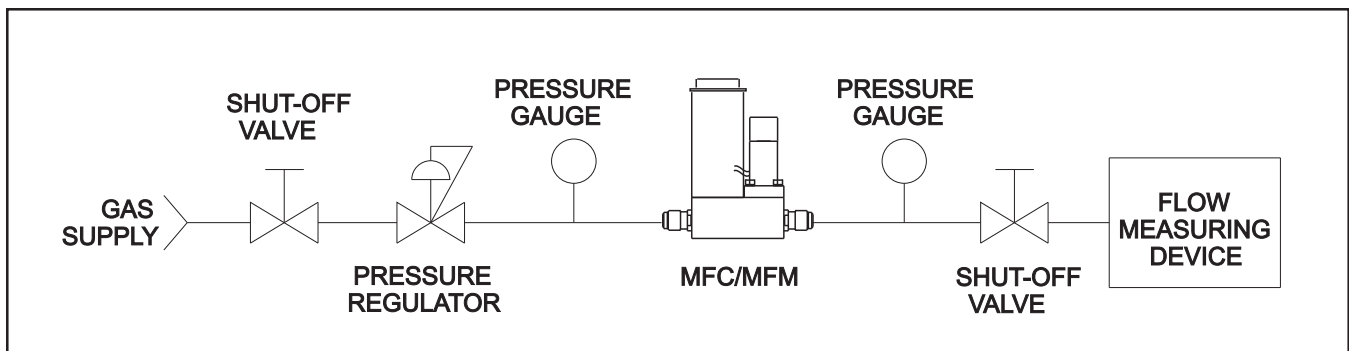


Figure 4-1 Bench Troubleshooting Circuit

Table 4-2 lists possible malfunctions which may be encountered during bench troubleshooting.

For Controller Models Only: Apply +5 Vdc to the +15 Vdc valve override pin (pin 12) and verify that the output exceeds 100%. Connect the valve override pin to earth and verify that the output signal falls below 2%.

4-1-3 Cleaning Procedures

When deposition makes it necessary to clean the Brooks Digital Series Mass Flow Controller or Mass Flow Meter, use the following procedures:

⚠ WARNING

If it becomes necessary to remove the MFC/MFM from the system after exposure to toxic, pyrophoric, flammable or corrosive gas, purge the MFC/MFM thoroughly with a dry inert gas such as Nitrogen before disconnecting the gas connections. Failure to correctly purge the MFC/MFM could result in fire, explosion or death. Corrosion or contamination of the MFC/MFM upon exposure to air, may also occur.

1. Remove the unit from the system.
2. Purge with dry nitrogen gas, which removes virtually all particulate matter from the device. Should contamination persist, subject all wetted¹ components to ultrasonic cleaning. Following this, purge the device thoroughly with dry nitrogen gas once again.
3. If the sensor is contaminated, remove the sensor and use a haemostat or tweezers to push a 0.007" diameter piano wire through the flow-sensor tube to remove any contamination (end closest to the control valve). The sensor tube can then be flushed with a solvent that leaves no residue. This can be accomplished conveniently using a hypodermic needle filled with solvent.

NOTE: Do not soak the sensor assembly in a cleaning solvent. If solvent seeps into the sensor assembly, it will likely damage or significantly alter the sensor's operating characteristics.

4-1-4 Calibration Procedure

The calibration of Brooks Digital Series Mass Flow devices is not described in this manual. Such calibration requires accurate and traceable calibration equipment such as Brooks Vol-U-Meter® equipment, in addition to digital communications.

If your device needs calibration Brooks Instrument can provide this service at one of its service locations. Visit www.BrooksInstrument.com to locate the service location nearest to you. However, if traceable calibration equipment is available at your facility, Brooks service Suite Calibration software, along with training, is available for purchase.

¹ Wetted components include the body, laminar-flow element, and all valve components including the orifice, process adapters and inlet filters (if so equipped).

Table 4-2 Troubleshooting

Trouble	Possible cause	Check/Corrective Action
Output stays at zero (regardless of Setpoint) and there is flow through the meter/controller	Clogged Sensor	Clean sensor. Refer to cleaning procedures (Section 4-1-2).
	Defective electronic board	Contact Brooks Instrument
Flow cannot be achieved regardless of Setpoint. (applicable to MFC)	Clogged Control Valve	Clean the control valve (Section 4-1-2) or return the device to the factory
	Valve override input is grounded	Check the valve override input (Pin 12)
	Defective electronic board	Contact Brooks Instrument.
Output signal stays at approx. 5.5 Vdc or 22 mA (regardless of Setpoint) and there is flow through the meter/controller	Valve leaks or is stuck open (applicable to MFC)	Clean and/or adjust control valve (Section 4-1-2).
	+15 V applied to the valve override input (applicable to MFC)	Check the valve override terminal (Pin 12)
Output signal follows Setpoint at higher Setpoints but will not go below 2%	Defective PC board	Contact Brooks Instrument
	Control valve leaks or is stuck open.	Clean the control valve or return the device to the factory (Section 4-1-2).
Output signal follows Setpoint at lower Setpoints, but does not reach full scale	Insufficient inlet pressure or pressure drop	Adjust pressures, inspect in-line filters and clean/replace as necessary.
	Partially clogged sensor	Clean sensor, see cleaning procedures (Section 4-1-2).
	Partially clogged valve (applicable to MFC)	Clean the control valve (Section 4-1-2) or return the device to the factory, see cleaning procedures
	Valve out of adjustment (applicable to MFC)	Contact Brooks Instrument
Instrument grossly out of calibration. Flow is higher than desired.	Valve guide spring failure (applicable to MFC)	Contact Brooks Instrument
	Partially clogged sensor	Clean sensor, see cleaning procedures (Section 4-1-2).
Instrument grossly out of calibration. Flow is lower than desired.	Partially clogged restrictor	Replace or clean restrictor
Controller oscillates (applicable to MFC)	Pressure drop or inlet pressure deviates from calibrated values	Adjust pressures to original specifications
	Valve out of adjustment	Contact Brooks Instrument
	Unstable inlet pressure	Check external pressure regulator
	Defective PC board	Contact Brooks Instrument

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Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Emne : **Tillæg til instruktions manual.**
Reference : **CE mærkning af Masse Flow udstyr**
Dato : **Januar-1996.**

Brooks Instrument har gennemført CE mærkning af elektronisk udstyr med succes, i henhold til regulativet om elektrisk støj (EMC direktivet 89/336/EEC).

Der skal dog gøres opmærksom på benyttelsen af signalkabler i forbindelse med CE mærkede udstyr.

Kvaliteten af signal kabler og stik:

Brooks lever kabler af høj kvalitet, der imødekommer specifikationerne til CE mærkning.

Hvis der anvendes andre kabel typer skal der benyttes et skærmet kabel med hel skærm med 100% dækning.

Forbindelses stikket type "D" eller "cirkulære", skal være skærmet med metalhus og eventuelle PG-forskrutninger skal enten være af metal eller metal skærmet.

Skærmen skal forbindes, i begge ender, til stikkets metalhus eller PG-forskrutningen og have forbindelse over 360 grader.

Skærmen bør være forbundet til jord.

"Card Edge" stik er standard ikke af metal, der skal derfor ligeledes benyttes et skærmet kabel med hel skærm med 100% dækning.

Skærmen bør være forbundet til jord.

Forbindelse af stikket; venligst referer til vedlagte instruktions manual.

Med venlig hilsen,

Deutsch

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Subject : **Nachtrag zur Bedienungsanleitung.**
Referenz : **CE Zertifizierung für Massedurchflußgeräte**
Datum : **Januar-1996.**

Nach erfolgreichen Tests entsprechend den Vorschriften der Elektromagnetischen Verträglichkeit (EMC Richtlinie 89/336/EEC) erhalten die Brooks-Geräte (elektrische/elektronische Komponenten) das CE-Zeichen.

Bei der Auswahl der Verbindungskabel für CE-zertifizierte Geräte sind spezielle Anforderungen zu beachten.

Qualität der Verbindungskabel, Anschlußstecker und der Kabeldurchführungen

Die hochwertigen Qualitätskabel von Brooks entsprechen der Spezifikation der CE-Zertifizierung.

Bei Verwendung eigener Verbindungskabel sollten Sie darauf achten, daß eine

100 %igen Schirmabdeckung des Kabels gewährleistet ist.

"D" oder "Rund" -Verbindungsstecker sollten eine Abschirmung aus Metall besitzen.

Wenn möglich, sollten Kabeldurchführungen mit Anschlußmöglichkeiten für die Kabelabschirmung verwendet werden.

Die Abschirmung des Kabels ist auf beiden Seiten des Steckers oder der Kabeldurchführungen über den vollen Umfang von 360 ° anzuschließen.

Die Abschirmung ist mit dem Erdpotential zu verbinden.

Platinen-Steckverbindungen sind standardmäßige keine metallgeschirmten Verbindungen. Um die Anforderungen der CE-Zertifizierung zu erfüllen, sind Kabel mit einer 100 %igen Schirmabdeckung zu verwenden.

Die Abschirmung ist mit dem Erdpotential zu verbinden.

Die Belegung der Anschlußpins können Sie dem beigelegten Bedienungshandbuch entnehmen.

English

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Subject : **Addendum to the Instruction Manual.**
Reference : **CE certification of Mass Flow Equipment**
Date : **January-1996.**

The Brooks (electric/electronic) equipment bearing the CE mark has been successfully tested to the regulations of the Electro Magnetic Compatibility (EMC directive 89/336/EEC).

Special attention however is required when selecting the signal cable to be used with CE marked equipment.

Quality of the signal cable, cable glands and connectors:

Brooks supplies high quality cable(s) which meets the specifications for CE certification.

If you provide your own signal cable you should use a cable which is overall completely screened with a 100% shield.

"D" or "Circular" type connectors used should be shielded with a metal shield. If applicable, metal cable glands must be used providing cable screen clamping.

The cable screen should be connected to the metal shell or gland and shielded at both ends over 360 Degrees.

The shield should be terminated to a earth ground.

Card Edge Connectors are standard non-metallic. The cables used must be screened with 100% shield to comply with CE certification.

The shield should be terminated to a earth ground.

For pin configuration : Please refer to the enclosed Instruction Manual.

Español

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Asunto : **Addendum al Manual de Instrucciones.**
Referencia : **Certificación CE de los Equipos de Caudal Másico**
Fecha : **Enero-1996.**

Los equipos de Brooks (eléctricos/electrónicos) en relación con la marca CE han pasado satisfactoriamente las pruebas referentes a las regulaciones de Compatibilidad Electro magnética (EMC directiva 89/336/EEC).

Sin embargo se requiere una atención especial en el momento de seleccionar el cable de señal cuando se va a utilizar un equipo con marca CE

Calidad del cable de señal, prensaestopas y conectores:

Brooks suministra cable(s) de alta calidad, que cumple las especificaciones de la certificación CE .

Si usted adquiere su propio cable de señal, debería usar un cable que esté completamente protegido en su conjunto con un apantallamiento del 100%.

Cuando utilice conectores del tipo "D" ó "Circular" deberían estar protegidos con una pantalla metálica. Cuando sea posible, se deberán utilizar prensaestopas metálicos provistos de abrazadera para la pantalla del cable.

La pantalla del cable deberá ser conectada al casquillo metálico ó prensa y protegida en ambos extremos completamente en los 360 Grados.

La pantalla deberá conectarse a tierra.

Los conectores estandar de tipo tarjeta (Card Edge) no son metálicos, los cables utilizados deberán ser protegidos con un apantallamiento del 100% para cumplir con la certificación CE.

La pantalla deberá conectarse a tierra.

Para ver la configuración de los pines: Por favor, consultar Manual de Instrucciones adjunto.

Français

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Sujet : Annexe au Manuel d'Instructions.
Référence : Certification CE des Débitmètres Massiques à Effet Thermique.
Date : Janvier 1996.

Messieurs,

Les équipements Brooks (électriques/électroniques) portant le label CE ont été testés avec succès selon les règles de la Compatibilité Electromagnétique (directive CEM 89/336/EEC).

Cependant, la plus grande attention doit être apportée en ce qui concerne la sélection du câble utilisé pour véhiculer le signal d'un appareil portant le label CE.

Qualité du câble, des presse-étoupes et des connecteurs:

Brooks fournit des câbles de haute qualité répondant aux spécifications de la certification CE.

Si vous approvisionnez vous-même ce câble, vous devez utiliser un câble blindé à 100 %.

Les connecteurs « D » ou de type « circulaire » doivent être reliés à la terre.

Si des presse-étoupes sont nécessaires, ceux ci doivent être métalliques avec mise à la terre.

Le blindage doit être raccordé aux connecteurs métalliques ou aux presse-étoupes sur le pourtour complet du câble, et à chacune de ses extrémités.

Tous les blindages doivent être reliés à la terre.

Les connecteurs de type « card edge » sont non métalliques. Les câbles utilisés doivent être blindés à 100% pour satisfaire à la réglementation CE.

Tous les blindages doivent être reliés à la terre.

Se référer au manuel d'instruction pour le raccordement des contacts.

Greek

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Θέμα : Προσθήκη στο Εγχειρίδιο Οδηγιών.
Σχετικά : Πιστοποίηση CE των Οργάνων Μέτρησης Παροχής Μάζας.
Ημερομηνία : Ιανουάριος - 1996

Κυρίες και Κύριοι,

Τα όργανα (ηλεκτρικά/ηλεκτρονικά) της Brooks τα οποία φέρουν το σήμα CE έχουν επιτυχώς ελεγχθεί σύμφωνα με τους κανονισμούς της Ηλεκτρο-Μαγνητικής Συμβατότητας (EMC ντιρεκτίβα 89/336/EEC).

Οποσδήποτε χρειάζεται ειδική προσοχή κατά την επιλογή του καλωδίου μεταφοράς του σήματος το οποίο (καλώδιο) πρόκειται να χρησιμοποιηθεί με όργανα που φέρουν το σήμα CE.

Ποιότητα του καλωδίου σήματος των στυπιοθλιπτών και των συνδέσμων .

Η Brooks κατά κανόνα προμηθεύει υψηλής ποιότητας καλώδια τα οποία πληρούν τις προδιαγραφές για πιστοποίηση CE.

Εάν η επιλογή του καλωδίου σήματος γίνει από σας πρέπει να χρησιμοποιήσετε καλώδιο το οποίο να φέρει εξωτερικά πλήρες πλέγμα και να παρέχει θωράκιση 100%.

Οι σύνδεσμοι τύπου "D" ή "Κυκλικοί" των καλωδίων, πρέπει να θωρακίζονται με μεταλλική θωράκιση. Εάν είναι εφαρμόσιμο, πρέπει να χρησιμοποιούνται μεταλλικοί στυπιοθλιπτες καλωδίων που να διαθέτουν ακροδέκτη σύνδεσης του πλέγματος του καλωδίου.

Το πλέγμα του καλωδίου πρέπει να συνδέεται στο μεταλλικό περιβλήμα ή στον στυπιοθλιπτή και να θωρακίζεται και στα δύο άκρα κατά 360 μοίρες.

Η θωράκιση πρέπει να καταλήγει σε κάποιο ακροδέκτη γείωσης.

Οι σύνδεσμοι καρτών είναι μη-μεταλλικοί, τα καλώδια που χρησιμοποιούνται πρέπει να φέρουν πλέγμα θωράκισης 100% για να υπακούουν στην πιστοποίηση CE.

Η θωράκιση πρέπει να καταλήγει σε κάποιο ακροδέκτη γείωσης.

Για την διάταξη των ακροδεκτών: Παρακαλούμε αναφερθείτε στο εσώκλειστο Εγχειρίδιο Οδηγιών.

Italiano

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Oggetto : **Addendum al manuale di istruzioni.**
Riferimento : **Certificazione CE dei misuratori termici di portata in massa**
Data : **Gennaio 1996.**

Questa strumentazione (elettrica ed elettronica) prodotta da Brooks Instrument, soggetta a marcatura CE, ha superato con successo le prove richieste dalla direttiva per la Compatibilità Elettromagnetica (Direttiva EMC 89/336/EEC).

E' richiesta comunque una speciale attenzione nella scelta dei cavi di segnale da usarsi con la strumentazione soggetta a marchio CE.

Qualità dei cavi di segnale e dei relativi connettori:

Brooks fornisce cavi di elevata qualità che soddisfano le specifiche richieste dalla certificazione CE. Se l'utente intende usare propri cavi, questi devono possedere una schermatura del 100%.

I connettori sia di tipo "D" che circolari devono possedere un guscio metallico. Se esiste un passacavo esso deve essere metallico e fornito di fissaggio per lo schermo del cavo.

Lo schermo del cavo deve essere collegato al guscio metallico in modo da schermarlo a 360° e questo vale per entrambe le estremità.

Lo schermo deve essere collegato ad un terminale di terra.

I connettori "Card Edge" sono normalmente non metallici. Il cavo impiegato deve comunque avere una schermatura del 100% per soddisfare la certificazione CE.

Lo schermo deve essere collegato ad un terminale di terra.

Per il corretto cablaggio dei terminali occorre fare riferimento agli schemi del manuale di istruzioni dello strumento.

Nederlands

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Onderwerp : **Addendum voor Instructie Handboek**
Referentie: **CE certificering voor Mass Flow Meters & Controllers**
Datum : **Januari 1996**

Dames en heren,

Alle CE gemarkeerde elektrische en elektronische producten van Brooks Instrument zijn met succes getest en voldoen aan de wetgeving voor Electro Magnetische Compatibiliteit (EMC wetgeving volgens 89/336/EEC).

Speciale aandacht is echter vereist wanneer de signaalkabel gekozen wordt voor gebruik met CE gemarkeerde producten.

Kwaliteit van de signaalkabel en kabelansluitingen:

- Brooks levert standaard kabels met een hoge kwaliteit, welke voldoen aan de specificaties voor CE certificering. Indien men voorziet in een eigen signaalkabel, moet er gebruik gemaakt worden van een kabel die volledig is afgeschermd met een bedekkingsgraad van 100%.
- "D" of "ronde" kabelconnectoren moeten afgeschermd zijn met een metalen connector kap. Indien kabelwartels worden toegepast, moeten metalen kabelwartels worden gebruikt die het mogelijk maken het kabelscherm in te klemmen. Het kabelscherm moet aan beide zijden over 360° met de metalen connectorkap, of wartel verbonden worden. Het scherm moet worden verbonden met aarde.
- "Card-edge" connectors zijn standaard niet-metallisch. De gebruikte kabels moeten volledig afgeschermd zijn met een bedekkingsgraad van 100% om te voldoen aan de CE certificering. Het scherm moet worden verbonden met aarde.

Voor pin-configuraties a.u.b. verwijzen wij naar het bijgesloten instructie handboek.

Hoogachtend,

Norsk

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Vedrørende : Vedlegg til håndbok
Referanse : CE sertifisering av utstyr for massestrømsmåling og regulering
Dato : Januar 1996

Til den det angår

Brooks Instrument elektrisk og elektronisk utstyr påført CE-merket har gjennomgått og bestått prøver som beskrevet i EMC forskrift om elektromagnetisk immunitet, direktiv 89/336/EEC.

For å opprettholde denne klassifisering er det av stor viktighet at riktig kabel velges for tilkobling av det måletekniske utstyret.

Utførelse av signalkabel og tilhørende plugger:

- Brooks Instrument tilbyr levert med utstyret egnet kabel som møter de krav som stilles til CE-sertifisering.
 - Dersom kunden selv velger kabel, må kabel med fullstendig, 100% skjerming av lederene benyttes. "D" type og runde plugger og forbindelser må være utført med kappe i metall og kabelnipler må være utført i metall for jordat innfesting av skjermen. Skjermen i kabelen må tilknyttes metallet i pluggen eller nippelen i begge ender over 360°, tilkoblet elektrisk jord.
 - Kort-kantkontakter er normalt utført i kunststoff. De tilhørende flatkabler må være utført med fullstendig, 100% skjerming som kobles til elektrisk jord på riktig pinne i pluggen, for å møte CE sertifiseringskrav.
- For tilkobling av medleverte plugger, vennligst se håndboken som hører til utstyret.
Vennlig hilsen

Português

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Assunto : Adenda ao Manual de Instruções
Referência : Certificação CE do Equipamento de Fluxo de Massa
Data : Janeiro de 1996.

O equipamento (eléctrico/electrónico) Brooks com a marca CE foi testado com êxito nos termos do regulamento da Compatibilidade Electromagnética (directiva CEM 89/336/EEC).

Todavia, ao seleccionar-se o cabo de sinal a utilizar com equipamento contendo a marca CE, será necessário ter uma atenção especial.

Qualidade do cabo de sinal, buchas de cabo e conectores:

A Brooks fornece cabo(s) de qualidade superior que cumprem os requisitos da certificação CE.

Se fornecerem o vosso próprio cabo de sinal, devem utilizar um cabo que, na sua totalidade, seja isolado com uma blindagem de 100%.

Os conectores tipo "D" ou "Circulares" devem ser blindados com uma blindagem metálica. Se tal for necessário, deve utilizar-se buchas metálicas de cabo para o isolamento do aperto do cabo.

O isolamento do cabo deve ser ligado à blindagem ou bucha metálica em ambas as extremidades em 360°.

A blindagem deve terminar com a ligação à massa.

Os conectores "Card Edge" não são, em geral, metálicos e os cabos utilizados devem ter um isolamento com blindagem a 100% nos termos da Certificação CE..

A blindagem deve terminar com ligação à massa.

Relativamente à configuração da cavilha, queiram consultar o Manual de Instruções.

Brooks® Digital MFC's & MFM's

Suomi

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Asia : Lisäys Käyttöohjeisiin
Viite : Massamäärämittareiden CE sertifiointi
Päivämäärä : Tammikuu 1996

Brooksin CE merkillä varustetut sähköiset laitteet ovat läpäissyt EMC testit (direktiivi 89/336/EEC).

Erityistä huomiota on kuitenkin kiinnitettävä signaalikaapelin valintaan.

Signaalikaapelin, kaapelin läpiviennin ja liittimen laatu

Brooks toimittaa korkealaatuisia kaapeleita, jotka täyttävät CE sertifiointivaatimukset. Hankkiessaan signaalikaapelin itse, olisi hankittava 100%:sti suojattu kaapeli.

”D” tai ”Circular” tyyppisen liittimen tulisi olla varustettu metallisuojaalla. Mikäli mahdollista, tulisi käyttää metallisia kaapeliliittimiä kiinnitettäessä suojaa.

Kaapelin suoja tulisi olla liitetty metallisuojaan tai liittimeen molemmissa päissä 360°:n matkalta.

Suojan tulisi olla maadoitettu.

”Card Edge Connector”it ovat standarditoimituksina ei-metallisia. Kaapeleiden täytyy olla 100%:sesti suojattuja jotta ne olisivat CE sertifiointimukaisia.

Suoja on oltava maadoitettu.

Nastojen liittäminen; katso liitteenä oleva manuaali.

Ystävällisin terveisin,

Svensk

Brooks Instrument
407 West Vine St.
Hatfield, PA 19440
U.S.A.

Subject : Addendum to the Instruction Manual
Reference : CE certification of Mass Flow Equipment
Date : January 1996

Brooks (elektriska / elektronik) utrustning, som är CE-märkt, har testats och godkänts enligt gällande regler för elektromagnetisk kompatibilitet (EMC direktiv 89/336/EEC).

Speciell hänsyn måste emellertid tas vid val av signalkabel som ska användas tillsammans med CE-märkt utrustning.

Kvalitet på signalkabel och anslutningskontakter:

Brooks levererar som standard, kablar av hög kvalitet som motsvarar de krav som ställs för CE-godkännande.

Om man använder en annan signalkabel ska kabeln i sin helhet vara skärmad till 100%.

”D” eller ”runda” typer av anslutningskontakter ska vara skärmade. Kabelgenomföringar ska vara av metall alternativt med metalliserad skärmning.

Kabelns skärm ska, i bada ändrar, vara ansluten till kontakternas metallkåpor eller genomföringar med 360 graders skärmning.

Skärmen ska avslutas med en jordförbindelse.

Kortkontakter är som standard ej metalliserade, kablar som används måste vara 100% skärmade för att överensstämma med CE-certifieringen.

Skärmen ska avslutas med en jordförbindelse.

För elektrisk anslutning till kontaktstiften hänvisas till medföljande instruktionsmanual.

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Brooks® Digital MFC's & MFM's

LIMITED WARRANTY

Seller warrants that the Goods manufactured by Seller will be free from defects in materials or workmanship under normal use and service and that the Software will execute the programming instructions provided by Seller until the expiration of the earlier of twelve (12) months from the date of initial installation or eighteen (18) months from the date of shipment by Seller. Products purchased by Seller from a third party for resale to Buyer ("Resale Products") shall carry only the warranty extended by the original manufacturer.

All replacements or repairs necessitated by inadequate preventive maintenance, or by normal wear and usage, or by fault of Buyer, or by unsuitable power sources or by attack or deterioration under unsuitable environmental conditions, or by abuse, accident, alteration, misuse, improper installation, modification, repair, storage or handling, or any other cause not the fault of Seller are not covered by this limited warranty, and shall be at Buyer's expense.

Goods repaired and parts replaced during the warranty period shall be in warranty for the remainder of the original warranty period or ninety (90) days, whichever is longer. This limited warranty is the only warranty made by Seller and can be amended only in a writing signed by an authorized representative of Seller.

BROOKS SERVICE AND SUPPORT

Brooks is committed to assuring all of our customers receive the ideal flow solution for their application, along with outstanding service and support to back it up. We operate first class repair facilities located around the world to provide rapid response and support. Each location utilizes primary standard calibration equipment to ensure accuracy and reliability for repairs and recalibration and is certified by our local Weights and Measures Authorities and traceable to the relevant International Standards.

Visit www.BrooksInstrument.com to locate the service location nearest to you.

START-UP SERVICE AND IN-SITU CALIBRATION

Brooks Instrument can provide start-up service prior to operation when required.

For some process applications, where ISO-9001 Quality Certification is important, it is mandatory to verify and/or (re)calibrate the products periodically. In many cases this service can be provided under in-situ conditions, and the results will be traceable to the relevant international quality standards.

CUSTOMER SEMINARS AND TRAINING

Brooks Instrument can provide customer seminars and dedicated training to engineers, end users and maintenance persons.

Please contact your nearest sales representative for more details.

HELP DESK

In case you need technical assistance:

Americas ☎ 1 888 554 FLOW
 Europe ☎ +31 (0) 318 549 290
 Asia ☎ +81 (0) 3 5633 7100



Due to Brooks Instrument's commitment to continuous improvement of our products, all specifications are subject to change without notice.

TRADEMARKS

Brooks	Brooks Instrument, LLC	ITK	Fieldbus FOUNDATION
Brooks Service Suite	Brooks Instrument, LLC	Kalrez	DuPont Dow Elastomers
Brooks Service Tool	Brooks Instrument, LLC	ODVA	Open DeviceNet Vendors Association, Inc.
DeviceNet	Open DeviceNet Vendors Association, Inc.	Teflon	E.I. DuPont de Nemours & Co.
FOUNDATION Fieldbus	Fieldbus FOUNDATION	VCO	Cajon Co.
HART	HART Communications Foundation	VCR	Cajon Co.
		Viton	DuPont Performance Elastomers

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