Installation & Operation Manual

GP200 Series
Mass Flow Controllers & Meters

BROOKS® INSTRUMENT

Beyond Measure

Essential Instructions
Read before proceeding!

Brooks Instrument designs, manufactures and tests its products to meet many national and international standards. These products must be properly installed, operated and maintained to ensure they continue to operate within their normal specifications. The following instructions must be adhered toand integrated into your safety program when installing, operating and maintaining Brooks Instrument products.

- To ensure proper performance, use qualified personnel to install, operate, update, program and maintain the product.
- 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.

⚠ **WARNING: Do not operate this instrument in excess of the specifications listed in the Instruction and Operation Manual. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.**

- 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.

⚠ **WARNING: Prior to installation ensure this instrument has the required approval ratings to meet local and national codes. Failure to heed this warning can result in serious personal injury and / or damage to the equipment.**

- 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.
- Operation: (1) Slowly initiate flow into the system. Open process valves slowly to avoid flow surges. (2) Check for leaks around the flow meter inlet and outlet connections. If no leaks are present, bring the system up to the operating pressure.
- Please make sure that the process line pressure is removed prior to service. 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 to prevent electrical shock and personal injury, except when maintenance is being performed by qualified persons.

⚠ **WARNING: For liquid flow devices, if the inlet and outlet valves adjacent to the devices are to be closed for any reason, the devices must be completely drained. Failure to do so may result in thermal expansion of the liquid that can rupture the device and may cause personal injury.**

European 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 Specifications Section of this manual contains instructions related to the PED directive.
- Products described in this manual are in compliance with EN directive 2014/34/EU.
- All Brooks Instrument Flowmeters fall under fluid group 1.
- Products larger than 25mm or 1" (inch) are in compliance with PED category I, II or III.
- Products of 25mm or 1" (inch) or smaller are Sound Engineering Practice (SEP).

European Electromagnetic Compatibility (EMC)

The Brooks Instrument (electric/electronic) equipment bearing the CE mark has been successfully tested to the regulations of the Electro Magnetic Compatibility (EMC) directive 2014/30/EU.

Special attention, however, is required when selecting the signal cable to be used with the CE marked equipment, as well as grounding of the equipment.

Grounding Signal Wires & Power Lines

- Brooks Instrument supplies high quality cable(s) that 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", "Circular" or "RJ45" type connectors used should be shielded with a metal shield.
- If applicable, metal cable glands must be used to provide 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 an 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 an earth ground.
- For twisted pair connections (e.g. RJ45), to avoid electrical interference and to meet the Electro Magnetic Compatibility (EMC directive) requirements, use individually shielded twisted pair cable, either in single pair or multi-pair varieties.
- For pin configuration: Please refer to the enclosed Instruction Manual.

Grounding the Device

- Ground the device to earth using a low-impedance conductive connection path, such as a grounded substrate or the pipeline plumbing (if the joints are ground-bonded). Improper grounding can cause measurement error or damage to the device.

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Section 2 Installation

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Introduction

The GP200 Series is the first fully (both inlet and outlet) pressure insensitive P-MFC, designed specifically for semiconductor applications. The GP200's unique differential pressure technology, coupled with its downstream valve architecture, removes the current limitations of pressure-based mass flow controllers, enabling the most precise process gas delivery over the widest range of operating conditions in the industry.

As the inventor and market leader in gas and flow range programmable Mass Flow Controllers, Brooks sophisticated and proprietary MultiFlo™ gas model is now embedded within each GP200 device enabling on-the-fly gas & range reconfiguration for maximum process flexibility.

The GP200's ultra-fast, highly repeatable Matched Transient Response and dynamic cross-talk insensitivity enable tighter process control, handling extreme supply pressure variations while maintaining precise mass flow control to the chamber. The GP200 platform supports a broad range of process conditions which enables drop-in replacement and upgrade of many traditional pressure-based mass flow controllers.

How to Use This Manual

This manual is intended to provide the user with all the information necessary to install, operate, troubleshoot, and maintain these pressure-based mass flow devices. The manual is organized in the following sections:

- Section 1 Introduction
- Section 2 Installation
- Section 3 Operation
- Section 4 Maintenance and Troubleshooting
- Section 5 Product Description Code
- Section 6 Appendix

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

Product Support References

Refer to www.BrooksInstrument.com for Brooks sales and service locations and to obtain other documents that support the GP200 Series. Those documents include:

- Brooks Expert Support Tool (BEST)
- Brooks GP200 Series Datasheet

Notice and Caution Statements

Warning, caution, and notice statements are located throughout this manual in the ANSI format. A WARNING statement indicates a potentially hazardous situation which, if not avoided, COULD result in death or serious injury. A CAUTION statement indicates a potentially hazardous situation which, if not avoided, MAY result in minor or moderate injury. It may also be used to alert against unsafe practices. A NOTICE statement describes specific information that requires special attention.

Product Warranty

Product warranty information can be found on the Brooks website at www.BrooksInstrument.com. This information provides general warranty information, limitations, disclaimers, and applicable warranty periods according to product group.

Industry Standard References

Table 1-1 Industry Standard References

Reference Number	Reference Description
MIL-STD-810	Method 514.4, Category 1, Transportation Requirement Method 516.4, Procedure 1, Functional Shock Test Requirement
SEMI E12	Standard temperature and pressure
SEMI E16	Guideline for determining and describing MFC leak rates
SEMI E17	Guideline for MFC transient characteristics tests
SEMI E18	Guideline for temperature specifications of the MFC
SEMI E27	Standard for MFC and MFM linearity
SEMI E28	Guideline for pressure specifications for the MFC
SEMI E52	Practice for referencing gases used in digital MFCs
SEMI E54	Sensor actuator network connections for DeviceNet
SEMI E56	Test method for determining accuracy, linearity, repeatability, short-term reproducibility, hysteresis of thermal MFCs
SEMI E66	Test method for determining particle contribution by MFCs
SEMI E67	Test method for determining reliability of MFCs
SEMI E68	Test method for determining warm-up time of MFCs
SEMI E69	Test method for reproducibility and zero drift for thermal MFCs
SEMI E80	Test method for determining attitude sensitivity of MFCs
SEMI E16-90	Guidelines for determining and describing mass flow controllers leak rates
SEMI F19	Specification for the finish of the wetted surface of electro polished 216L stainless steel components
SEMI F20	Specifications for 316L stainless steel bar, extruded shapes, plate, and investment castings for components used in ultra-high purity semi manufacturing applications
SEMI F36	Guide for dimensions and connections of gas distribution components
SEMI F37	Method for determination of surface roughness parameters for gas distribution system components
SEMI F44	Guideline for standardization of machined stainless steel weld fittings
SEMI F45	Guideline for standardization of machined stainless steel reducing fittings
SEMI F47	Specifications for semiconductor processing equipment voltage sag immunity
SEMI S2	Environmental, Health and Safety Guidelines
SEMI S9	Dielectric testing
SEMI S10	Risk assessment
SEMI S12	Decontamination of fielded products
ETG.1000.2	Physical Layer service definition and protocol specification
ETG.1000.3	Data Link Layer service definition
ETG.1000.4	Data Link Layer protocol specification
ETG.1000.5	Application Layer service definition
ETG.1000.6	Application layer protocol specification
ETG.1020	EtherCAT Protocol Enhancements
ETG.2000	EtherCAT Slave Information
ETG.5001.1	Modular Device Profile - Part 1: General MDP Device Model
ETG.5003.1	Semiconductor Device profile - Part 1: Common Device Profile (CDP)
ETG.5003.2020	Specific Device Profile: Enhanced Mass Flow Controller
ETG.5003.2021	Specific Device Profile: Mass Flow Controller
ETG.5003.2022	Specific Device Profile: Mass Flow Meter
ETG.5003.2023	Specific Device Profile: Enhanced Mass Flow Meter

Glossary of Terms and Acronyms

Table 1-2 Terms and Acronyms

Term or Acronym	Definition
CSR	Customer Special Requirement
CVD	Chemical Vapor Deposition
DeviceNet	A 5-wire local network I/O communication device that employs a command/response communication protocol
DSP	Digital Signal Processor
EPI Epitaxy (EPI)	A process technology where a pure silicon crystalline structure is deposited or “grown” on a bare wafer, enabling a high-purity starting point for building the semiconductor device.
HBD	Horizontal Base Down
GP200 Series	Pressure Based Mass Flow Controller
F.S.	Full Scale
LED	Light Emitting Diode
MFC	Mass Flow Controller
MultiFlo Technology	A physics-based calibration methodology that enables gas and flow range configuration within a defined standard configuration
P-MFC	Pressure-Based Mass Flow Controller
PID	Proportional Integral Derivative Controller
PSIA	Pounds per Square Inch Absolute
PSID	Pounds per Square Inch Differential
PSIG	Pounds per Square Inch Gauge
PTI	Pressure Transient Insensitive. Reduces the effect of pressure fluctuations in gas flow.
ROR	As pressure increases, flow increases at a pressure rate of rise, or ROR.
S.P.	Setpoint
VIU	Vertical mounting attitude with inlet side facing up

Product Description

The GP200 Series is the first fully (both inlet and outlet) pressure insensitive P-MFC, designed specifically for semiconductor applications. The GP200's unique differential pressure technology, coupled with its downstream valve architecture, removes the current limitations of pressure-based mass flow controllers, enabling the most precise process gas delivery over the widest range of operating conditions in the industry.

As the inventor and market leader in gas and flow range programmable Mass Flow Controllers, Brooks sophisticated and proprietary MultiFlo™ gas model is now embedded within each GP200 device enabling on-the-fly gas & range reconfiguration for maximum process flexibility.

The GP200's ultra-fast, highly repeatable Matched Transient Response and dynamic cross-talk insensitivity enable tighter process control, handling extreme supply pressure variations while maintaining precise mass flow control to the chamber. The GP200 platform supports a broad range of process conditions which enables drop-in replacement and upgrade of many traditional pressure-based mass flow controllers.

True Differential Pressure Measurement

By removing the requirement to match and compensate two separate pressure transducers, the GP200 differential pressure technology reduces measurement uncertainty for enhanced accuracy, repeatability, and drift performance.

Lower Inlet Pressure Operation

Safer fab operation at lower inlet pressures is now achievable with a P-MFC due to the GP200's differential pressure sensor that is specifically optimized for low differential pressure measurement.

Cross-Talk Insensitive

Maintains tight process control under dynamic process conditions the accuracy of the GP200 P-MFC will stay within ≤ ± 1% of S.P. during extreme pressure supply disruptions up to 40 psi/sec.

Matched Transient Response

Ultra-fast, highly repeatable ascending and descending flow stabilization time enables tighter process control in advanced high cycle Deposition and Etch processes.

Downstream Valve Architecture

The GP200's downstream valve architecture ensures that accuracy is independent of downstream pressure, enabling flow delivery into pressures as high as 1200 Torr. The GP200's fast closing valve addresses non-productive recipe wait times, or "tail effects", that are seen in upstream MFC valve designs that require additional time to bleed down their internal volume of gas.

Zero Leak-by Control Valve

100X improvement in valve shut-down addresses the long standing "first wafer effect" where the accumulation of unmetered gas (between the MFC control valve & downstream isolation valve) contributes to non-uniformities and Critical Dimension (CD) defects on the first wafer of a process.

High Flow Rate Capability

10 sccm to 50 slm F.S. N2 equivalent P-MFC supports all process flow needs with just nine (9) standard bin configurations for maximum flexibility.

Specifications for GP200 Series Devices

⚠ 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.

⚠ 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.

Table 1-3 Specifications for GP200 Series

PERFORMANCE		
Full Scale Flow Range	3 sccm to 50,000 sccm F.S. N2 Equivalent	
Process Gas Flow Accuracy[1]	**Zero Leak Valve:** < ± 1% S.P. (5 – 100% F.S.) < ± 0.05% F.S. (0.5 - 5% F.S.)	**Metal Seal Valve:** < ± 1% S.P. (5-100% F.S.) < ± 0.05% F.S. (2-5% F.S.)
Control Range	0.5– 100% F.S.	2– 100% F.S.
Repeatability & Reproducibility	< ± 0.15% S.P.	
Transient Response & Flow Settling Time	280 ± 20 ms Matched Transient Response, for any ascending or descending non-zero setpoint (Fast Response Option available via Customer Special Request.)	
Valve Leak-by	**Zero Leak Valve:** <0.005% of F.S. of the bin (Bins 42-46) <0.02% of F.S. of the bin (Bins 40-41) (@ 45 psia to VAC)	**Metal Seal Valve:** <0.15% of F.S. of the bin (@ 45 psia to VAC)
Supply Pressure Insensitivity/Cross-Talk	< ± 1% S.P. up to 40 psi/sec inlet pressure spike	
Steady State Back Pressure Insensitivity	Insensitive to steady state back pressure	
Dynamic Back Pressure Insensitivity	Maintains accuracy during disturbance from vacuum to 1200 Torr over a period of 1 sec	
Zero Stability	< ± 0.15% F.S. per year	
Temperature Coefficient	Zero: 0.005% F.S. per °C Span: 0.05% S.P. per °C	
Number of Standard Configurations	Nine (9) standard bin ranges	
Dynamic Gas and Range Programmability	Device may be configured via single tool command in less than 1 second or via BEST Software with independent USB diagnostic port	
Attitude Insensitivity [1] For Analog control, adder of < ± 0.05% F.S. applies	Insensitive to device orientation after re-zeroing	

RATINGS	
Operating Temperature Range[2]	10 – 60 ° C
Operating Inlet Pressure[3]	< 15 psia for Low Pressure (LP) bins, configurable based on application 15 to 30 psia 25 to 40 psia 35 to 50 psia 45 to 60 psia
Operating Outlet Pressure[3]	Vacuum to Atmosphere Up to 1200 Torr for some applications
Differential Pressure Range	Min: 7 psid typical Max: up to 50 psid
External Leak Integrity	1 x 10-10 atm cc/sec He
Proof Pressure	100 psia, Standard Gases 70 psia, Helium and Helium Mixtures 45 psia, Low Pressure Gases
Design Pressure	150 psia
Burst Pressure	1000 psia

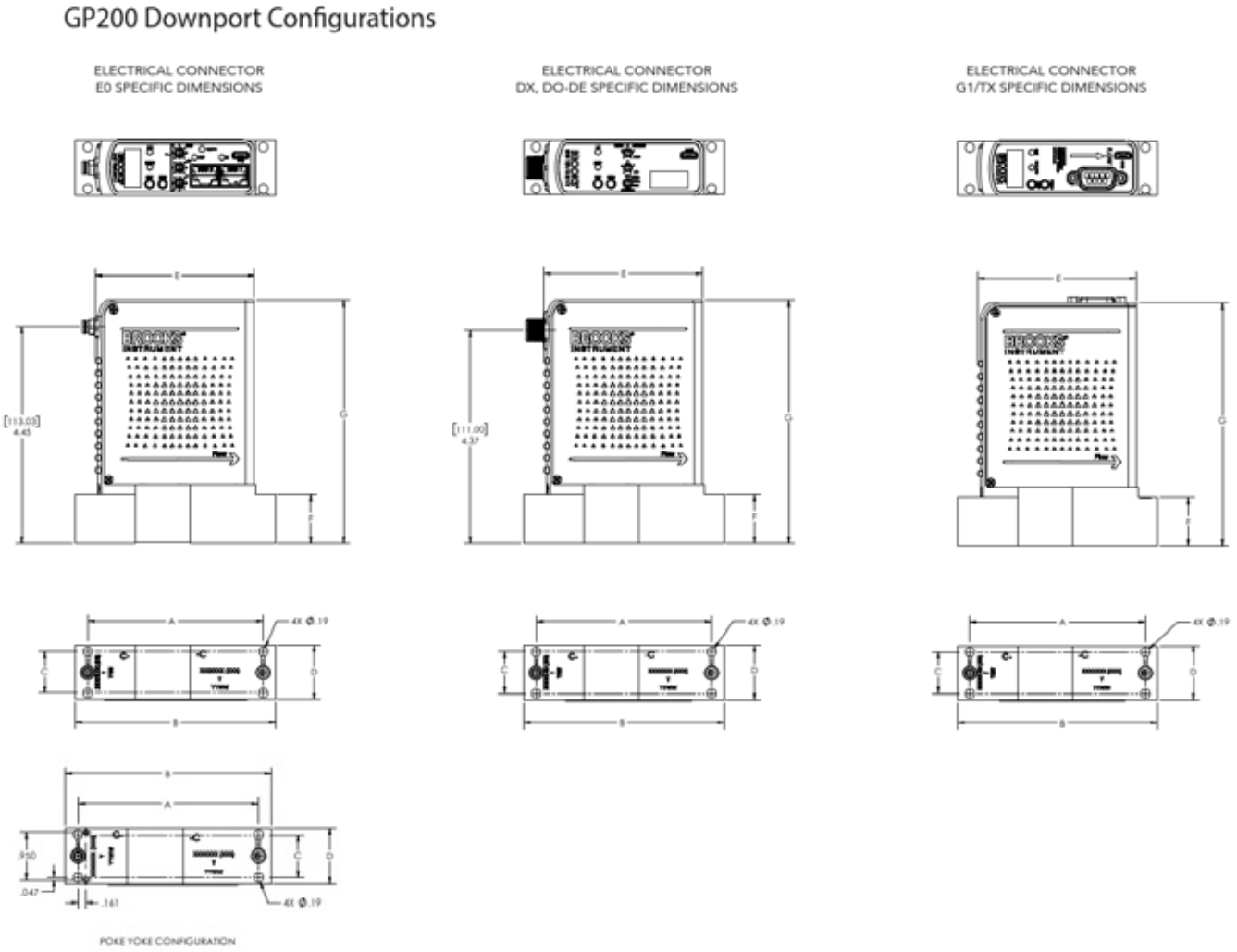
MECHANICAL	
Valve Type	Normally Closed
Primary Wetted Materials	316L, Hastelloy C-22, 316/316L Stainless Steel, 304 Stainless Steel, KM-45, PCTFE
Surface Finish	5µ inch Ra avg.

[2] Device should be zeroed at ambient operating temperature per Brooks Instrument recommended procedure
[3] Consult Brooks Configurator for specific Product Sizing Options

DIAGNOSTICS & DISPLAY	
Status Lights	DeviceNet: MFC Health, Network Status EtherCAT: Run, Error, Power, Network Status, Analog/RS485: Network Status
Alarms[4]	Process Control Deviations, Flow High/Low, Temperature High/Low, Pressure High/ Low, Voltage Input High/Low, Communication Alarms, Hardware Failures, Page Create Errors, Warmup Alarm (alarms are model specific)
Display Type	Top Mount Integrated LCD
Viewing Angle/Viewing Distance	Rotatable / 10 ft
Units Displayed/Resolution	Flow (%), Temp. (°C), Pressure (psia, kPa) / 0.1 (unit)

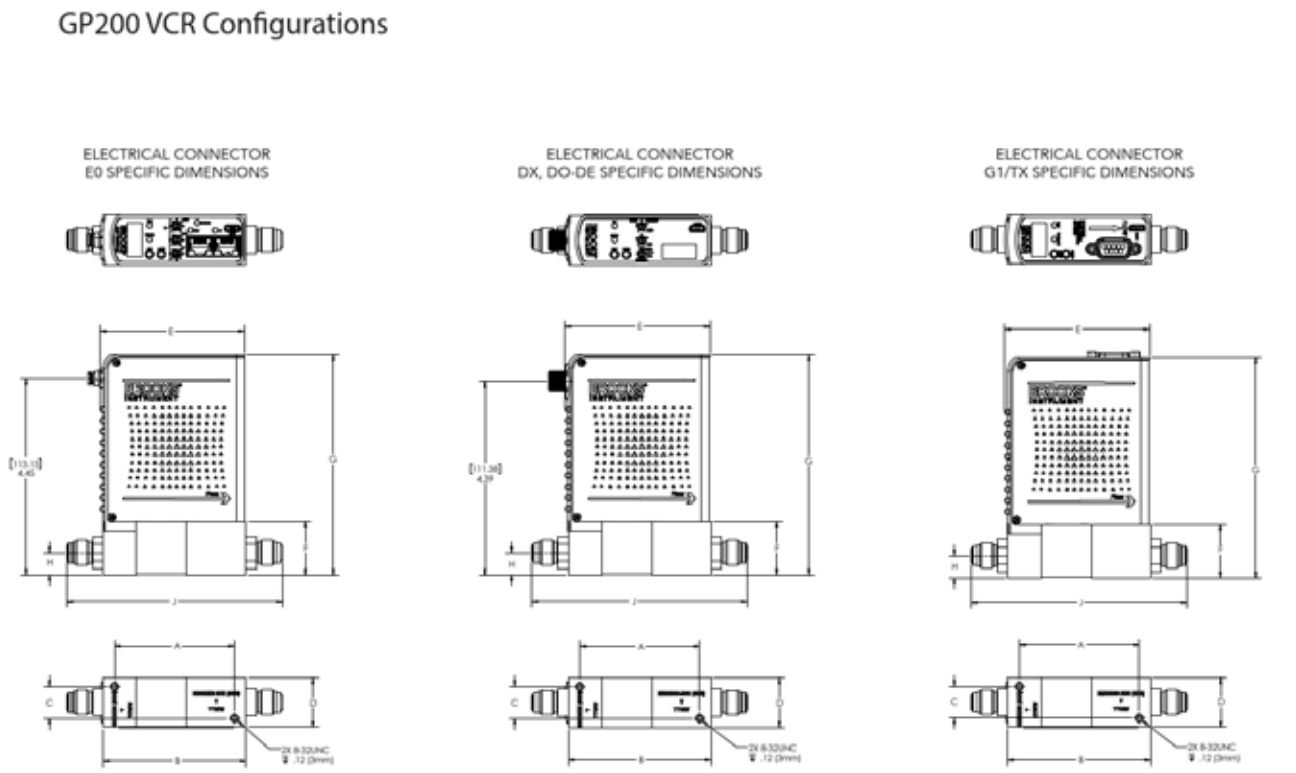
[4] For full list of alarms available consult GP200 Supplemental Communication Manuals at www.BrooksInstrument.com

ELECTRICAL	
Digital Communication	DeviceNet™, EtherCAT®, RS485 (model specific)
Electrical Connection	DeviceNet™ via 5-Pin M12 connector EtherCAT® via RJ45 jacks, Power via 5-pin M8 connector 0-5V Analog/RS485 (L-Protocol) via 9-pin D-Connector
Independent Diagnostics Service Port	RS485 via micro-USB
DeviceNet Power Supply/Consumption	545mA max. @ +11-25 Vdc, 250mA max. @ 24 Vdc (under typical operating conditions)
EtherCAT Power Supply/Consumption	360mA max @ 18-30 Vdc, 270mA max @ 24 Vdc (under typical operating conditions)
Analog/RS485 Power Supply/Consumption	6 Watts max @ ± 15 Vdc (± 10%) or +24Vdc (± 10%) (under typical operating conditions)
COMPLIANCE	
EMC	2014/30/EU EMC Directive EN:61326-1: 2013
Environmental Compliance	2011/65/EU & 2015/863/EU RoHS Directive EC 1907/2006 REACH Directive



FITTING OPTION CODE	SEAL TYPE	A	B	C	D	E	F	G
CX	C-SEAL	3.62 in [92mm]	4.13 in [105mm]	0.86 in [22mm]	1.12 in [28mm]	3.25 in [83mm]	1.00 in [25mm]	5.00 in [127mm]
LX	C-SEAL	3.62 in [92mm]	4.13 in [105mm]	0.86 in [22mm]	1.12 in [28mm]	3.25 in [83mm]	1.00 in [25mm]	5.00 in [127mm]
WX	W-SEAL	3.62 in [92mm]	4.13 in [105mm]	0.86 in [22mm]	1.12 in [28mm]	3.25 in [83mm]	1.00 in [25mm]	5.00 in [127mm]

Figure 1-1 Dimensions of GP200 Series Downport Configurations



FITTING OPTION CODE	VCR	A	B	C	D	E	F	G	H	J
VS	1/4"	2.72in [69mm]	3.24in [82mm]	0.72in [18mm]	1.12in [28.4mm]	3.28in [83mm]	1.21in [31mm]	5.00in [127mm]	0.50in [13mm]	4.88in [124mm]

Figure 1-2 Dimensions of GP200 Series VCR Configurations

General

This section provides installation instructions for the Brooks GP200 Series Pressure-Based Mass Flow Devices. The installation process consists of purging the gas supply line prior to installation, unpacking, inspecting the device, connecting the device to the gas supply line, and testing for leaks.

Receipt of Equipment

When the equipment 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 the nearest Brooks Instrument location listed on the Global Service Network page on our website:

BrooksInstrument.com/GlobalSupportCenters

This device has been assembled, calibrated, and double-vacuum bagged in a Class 100 clean room. In your semi-clean area, remove the outer bag only. Pass the device into your clean area. Remove the second clean room compatible bag only when the device is ready to be tested and/or installed in your clean system.

Recommended Storage Practice

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

- Within the original shipping container.
- Ambient temperature 21°C (70°F) nominal, 32°C (90°F) maximum, 7°C (45°F) minimum.
- Relative humidity 45% nominal, 60% maximum, 25% minimum.

Return Shipment

Prior to returning any instrument to the factory for any reason, visit our website for instructions on how to obtain a Return Materials Authorization Number (RMA #) and complete a Decontamination Statement to accompany it:

BrooksInstrument.com/Service

All instruments returned to Brooks also require a Safety Data Sheet

(SDS) for the fluid(s) used in the instrument. Failure to provide this information will delay processing of the instrument. Instrument must have been purged in accordance with the following:

⚠ WARNING

Before returning the device, purge thoroughly with a dry inert gas such as Nitrogen before disconnecting process connections. Failure to correctly purge the instrument could result in fire, explosion or death. Corrosion or contamination may occur upon exposure to air.

Transit Precautions

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

Removal from Storage

Upon removal of the device from storage, a visual inspection should be conducted to verify its "as-received" condition. If the device has been subject to storage conditions more than those recommended (refer to "Recommended Storage Practice"), it should be subjected to a pneumatic pressure test in accordance with applicable vessel codes. To maintain a device's ultra-clean integrity, this service should be performed by the factory or one of the certified service centers.

Gas Connections

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

In-Line Filter

It is recommended that an in-line filter be installed upstream from the device to prevent the possibility of any foreign material entering the flow sensor or control valve. The filtering element should be replaced periodically or ultrasonically cleaned.

Mechanical 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 the time of installation.

The recommended installation procedure guidelines are as follows:

- The device should be in a clean, dry atmosphere relatively free from shock and vibration.
- Leave sufficient room for access to the user interface, display and MAC ID and baud rate switches (if equipped) at the top of the device.
- Install the device in such a manner that permits easy purge and removal if the device 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 N_2 before use.

Flow Controller Installation Arrangement

Typical gas supply arrangements are shown below. GP200s are often arranged inside a gas panel. With the gas model now embedded in each GP200 device, on-the-fly gas & range reconfiguration is made possible for maximum process flexibility. The GP200 P-MFC can be reconfigured for a variety of pure gases and mixtures, enabling the user to reduce unique inventory requirements.

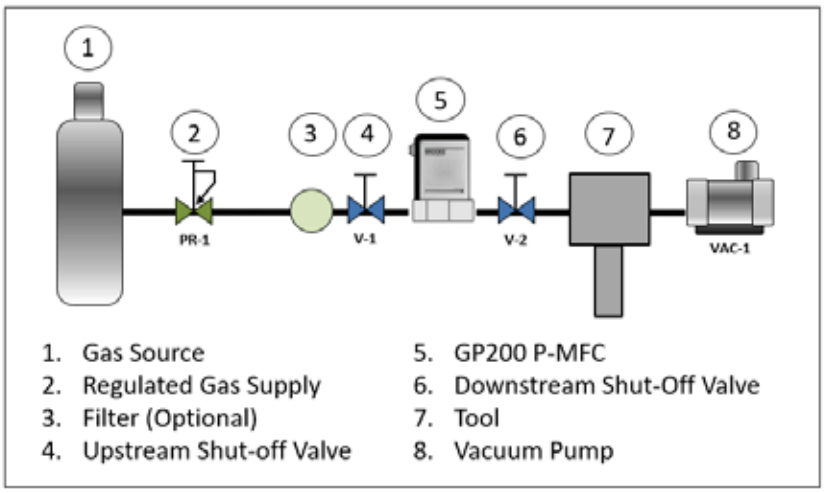


Figure 2-1 Typical Gas Supply Arrangement

Purge the Gas Supply Line Before GP200 Series Installation

⚠ CAUTION

For additional safety, it is recommended to close the two valves between the charged gas line and the GP200 Series to be installed. See Figure above for more details.

⚠ NOTICE

It is recommended to archive service and calibration documentation for the GP200 Series to determine the contamination state of each gas line and to assist service personnel.

⚠ CAUTION

DO NOT remove the shipping caps covering the inlet/outlet for VCR fittings, or DO NOT remove the blue tape on the bottom of the device for downport fittings before the GP200 Series is being installed. Failure to comply will introduce contaminants into the GP200 Series.

Before operating the GP200 Series, the gas supply line must be completely purged with nitrogen or argon to ensure the line is free from toxic or flammable gases, contaminants, moisture, and oxygen. The purge gas must be free of moisture and oxygen to less than 100 ppb. Purge the gas lines as follows or in accordance to prescribed company and safety procedures.

1. Shut off the process gas supply valve(s) upstream of the GP200 Series. If such a valve is not available, shut the valve on the gas panel. Tag the valve at this point to prevent accidental re-exposure of the process gas to the gas line.

2. Cycle purge the gas line with dry nitrogen or argon to fully flush out the process gas. Cycle purging consists of evacuating to a low pressure adequate to induce out-gassing and then purging to remove adhered moisture and oxygen. If a toxic or reactive gas is present and a clogged GP200 Series is suspected, then proceed with caution. Pump down and purge the GP200 Series from both downstream and upstream lines. If check valves are present in the gas line, both pumping down and purging are required. Pumping down without purging is inadequate. If a good vacuum source is not available, the GP200 Series can be de-contaminated by purge only.

3. Repeat the purge cycle several times within 2-4 hours to complete the cleaning. For toxic and corrosive gasses, it is recommended to use 100-120 cycles.

Position and Mount the GP200 Series

Position the GP200 Series so that the gas flow is pointed in the same direction as the flow arrow shown on the GP200 Series rear label and outer can. The various mounting positions are described in the figure below.

The standard orientation for the GP200 Series is Horizontal Base Down (HBD). The accelerometer in the GP200 automatically determines the orientation of the device and proprietary algorithms compensate for any potential orientation effects. It is recommended that the MFC is re-zeroed with process gas following the recommended Brooks procedure after a change in device mounting orientation.

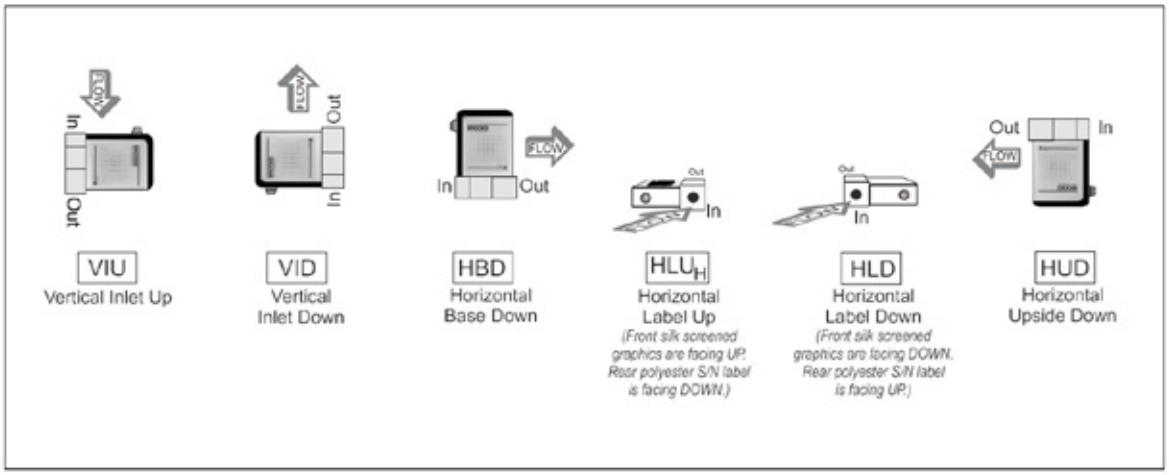


Figure 2-2 GP200 Series Mounting Attitude Positions

If your GP200 Series is configured with downport fittings, follow Steps 1 through 4 below. If your GP200 Series has VCR fittings, proceed to Step 5.

1. Refer to Figure 2-3 GP200 Series Mounted to K1 Series Substrate Blocks Figure 2-3 below. If downported fittings (1) are used, the GP200 Series is mounted to K1 Series substrate blocks (2) with four screws (3). Metal C-seals or W-seals (4) (as provided by integrator) are inserted between the GP200 Series and substrate blocks before the screws are installed. These metal seals must be replaced after each installation.

2. Select the mounting screws noted in Table 2-1 for downported devices. M4 screws are used on 1.125” devices, K1S. M5 screws are used on 1.5” devices, K1R2 and K1H.

3. Refer to Figure 2-3. Insert the two mounting seals (4) over the gas flow path of the K1 block. Carefully align the GP200 Series mounting holes onto the K1 substrate blocks. Using your fingers, install the screws through the GP200 Series fitting and hand tighten.

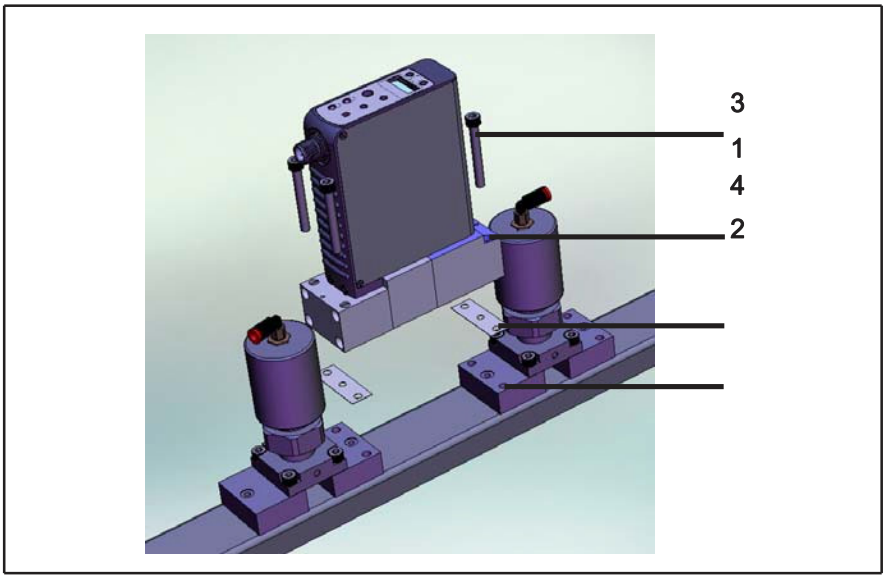


Figure 2-3 GP200 Series Mounted to K1 Series Substrate Blocks

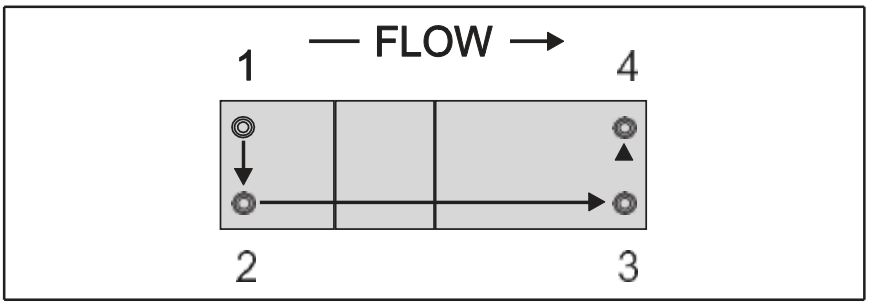


Figure 2-4 Mounting Screws Torque Pattern

Table 2-1 K1 Series Fasteners

Connection	Fastener Size		
	K1S	K1R2	K1H
GP200 to Substrate	M4 x 34mm or M4 x 35mm	M5 x 30mm	M5 x 37mm

Table 2-2 K1 Substrate Torque Data

Connection	Torque Pattern	Torque (Inch-Pounds)		
		K1S	K1R2	K1H
GP200 to Substrate	Use a square pattern as shown in Figure 2-5. Start at 25 inch-pounds and increase in increments of 10 inch-pounds until proper value is obtained.	45	45	45

4. Using a torque wrench and a metric hex key, tighten the screws to the torque value as described in Table 2-2 and Torque Pattern Figure 2-4.

5. If your GP200 Series is configured with ¼" VCR fittings, secure the GP200 Series block to the gas panel with two, 8-32-UNC-2B" screws. Then connect the inlet/ outlet fittings to the gas supply line using two wrenches. Tighten the fittings to manufacturer recommendations.

Perform a Leak Test

⚠WARNING

Before operating the flow controller, ensure all gas connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.

It is critical to leak test the gas supply lines and GP200 Series connections before turning on the process gas supply after any new installation. Check for leaks using a helium leak detector or any other appropriate leak test method. Follow leak test specifications as defined by integrator.

Zeroing Setup Process

When a Mass Flow device is first installed, it is highly recommended to re-zero the device to ensure the best results. Further it is normal to experience a zero drift in a Mass Flow Meter Controller (MFC) during the life of the device.

A zero offset can be a major contributor to flow inaccuracies particularly at lower control setpoints, where the zero offset error becomes a large percentage of the total flow signal. Therefore, the MFC zero should be constantly monitored and when applicable, set correctly and consistently. Note the expected signal output at a zero-flow condition should be 0.0 ±0.1%.

Because the MFC is not intended to be used as a positive shut-off device, it is not guaranteed to be leak tight when its valve is closed. Consequently, setting the MFC zero while there is a pressure differential across the MFC can be a problem because the MFC could be measuring the leakage through the valve, which will result in a calibration error. To minimize flow errors in an MFC, it is suggested that the user follow the instructions outlined below to prepare the device for zeroing.

EtherCAT Zeroing Procedure

Step Number	Step Description	MFC	Upstream Isolation Valve	Downstream Isolation Valve	Criteria	MFC Communication
1	**MFC min Power On Time**	Setpoint 0%	x	x	60 mins	SDO: 0xF9F6; 0x01
2	**MFC Temperature**	Temperature	x	x	+/- 0.1°C	PDO 0x6002; 0x01
3	**Pumpdown** (Line Evacuation)	Setpoint 100%	C	O	Flow is < 0.05% F.S.	"PDO 0x1600:0x01 Setpoint PDO 0x1A00:0x02 Flow"
4	**Pressurize MFC** (For best results, use process gas @ operating pressure; 'Recommended')	Setpoint 100%	O	C	Flow is < 0.05% F.S.	"PDO 0x1600:0x01 Setpoint PDO 0x1A00:0x02 Flow"
5	**Pressurize MFC**	Setpoint 0%	O	C	Flow is < 0.005% F.S.	"PDO 0x1600:0x01 Setpoint PDO 0x1A00:0x02 Flow"
6	**Close Upstream Valve**	Setpoint 0%	C	C	Flow is < 0.05% F.S.	"PDO 0x1600:0x01 Setpoint PDO 0x1A00:0x02 Flow"
7	**Allow system to equilibrate**	Setpoint 0%	C	C	60 seconds	
8	**Zero MFC**	Setpoint 0%	C	C	Readback = FB10:02(255) Running complete (0)	"0xFB10:0x01 Flow Zero Command PDO 0x1A00:0x02 Flow"
9	**Verify**	Setpoint 0%	C	C	Flow is <0.005% F.S.	"PDO 0x1600:0x01 Setpoint PDO 0x1A00:0x02 Flow"
10	**Return to Normal operation**	Setpoint 0%	C	C	Flow is <0.005% F.S.	"PDO 0x1600:0x01 Setpoint PDO 0x1A00:0x02 Flow"

Analog Zeroing Procedure

Step Number	Step Description	MFC	Upstream Isolation Valve	Downstream Isolation Valve	Criteria
1	**MFC min Power On Time**	Setpoint 0%	x	x	60 mins
2	**MFC Temperature**	Temperature	x	x	+/- 0.1°C
3	**Pumpdown** (Line Evacuation)	Setpoint 100%	C	O	Flow is < 0.05% F.S.
4	**Pressurize MFC** (For best results, use process gas @ operating pressure; 'Recommended')	Setpoint 100%	O	C	Flow is < 0.05% F.S.
5	**Pressurize MFC**	Setpoint 0%	O	C	Flow is < 0.005% F.S.
6	**Close Upstream Valve**	Setpoint 0%	C	C	Flow is < 0.05% F.S.
7	**Allow system to equilibrate**	Setpoint 0%	C	C	60 seconds
8	**Read Zero on MFC**	Setpoint 0%	C	C	Read over analog
9	**Set Zero**	Setpoint 0%	C	C	Press button on top of MFC
10	**Verify**	Setpoint 0%	C	C	Flow is <0.005% F.S.
11	**Return to Normal operation**	Setpoint 0%	C	C	Flow is <0.005% F.S.

Sample: Zeroing the GP200 Series from the LCD Display Panel

1. Once all the conditions outlined in the preparation sections have been met and the pressure across the device is at 0 PSID, press the display button until the %F.S. can be seen on the display as shown in Figure 2-5.

Figure 2-5 GP200 Display showing “%F.S.”

2. Hold the zero button until the display flashes. The display will continue flashing while the device is zeroing. When the display stops flashing the zero routine will be complete.

Figure 2-6 Top View of GP200 Series Device

DeviceNet Zeroing Procedure

Step Number	Step Description	MFC	Upstream Isolation Valve	Downstream Isolation Valve	Criteria
1	**MFC min Power On Time**	Setpoint 0%	x	x	60 mins
2	**MFC Temperature**	Temperature	x	x	+/- 0.1°C
3	**Pumpdown** (Line Evacuation)	Setpoint 100%	C	O	Flow is < 0.05% F.S.
4	**Pressurize MFC** (For best results, use process gas @ operating pressure; 'Recommended')	Setpoint 100%	O	C	Flow is < 0.05% F.S.
5	**Pressurize MFC**	Setpoint 0%	O	C	Flow is < 0.005% F.S.
6	**Close Upstream Valve**	Setpoint 0%	C	C	Flow is < 0.05% F.S.
7	**Allow system to equilibrate**	Setpoint 0%	C	C	60 seconds
8	**Read Zero on MFC**	Setpoint 0%	C	C	Readback = 0x0E-0x31-0x01-0x0B
9	**Set Zero**	Setpoint 0%	C	C	0x4B-0x31-0x01
10	**Verify**	Setpoint 0%	C	C	Flow is <0.005% F.S.
11	**Return to Normal operation**	Setpoint 0%	C	C	Flow is <0.005% F.S.

Sample: Zeroing GP200 Series Over DeviceNet

1. Once all the conditions outlined in the preparation sections have been met and the pressure across the device is at 0 PSID, use the tool interface's DeviceNet software to send an Explicit message to the MFC to perform a "ZERO" service as described in the S-Analog Sensor Object (0x31).

2. The tool interface's DeviceNet software should provide a method to route an Explicit message to the S-Analog Sensor Object (0x31).

Typically, the structure of an Explicit message using the DeviceNet software tool is set up as follows; 0x0E-0x31-0x01-0x0B where:

- 0X0E = Read\Get data request
- 0x31 = DeviceNet Object Class (S-Analog Sensor in this case)
- 0x01 = Instance 1
- 0x0B = Attribute number

3. Note that data shown in the syntax 0xNN are in hexadecimal format, therefore in the example shown above, attribute 0x0B = decimal 11 if referencing in the attribute table.

4. To send the Explicit Zero service command to the MFC, the structure would be as follows:

0x4B-0x31-0x01 where:

- 0x4B = Zero Service
- 0x31 = Sensor Object Class
- 0x01 = Instance 1

Note there is no requirement to send an attribute value with the Zero service command 0x4B.

5. The MFC will respond with its appropriate action to zero itself upon receipt of the Zero service command.

For more information, please reference the GP200 DeviceNet

Supplemental Manual found on www.brooksinstrument.com.

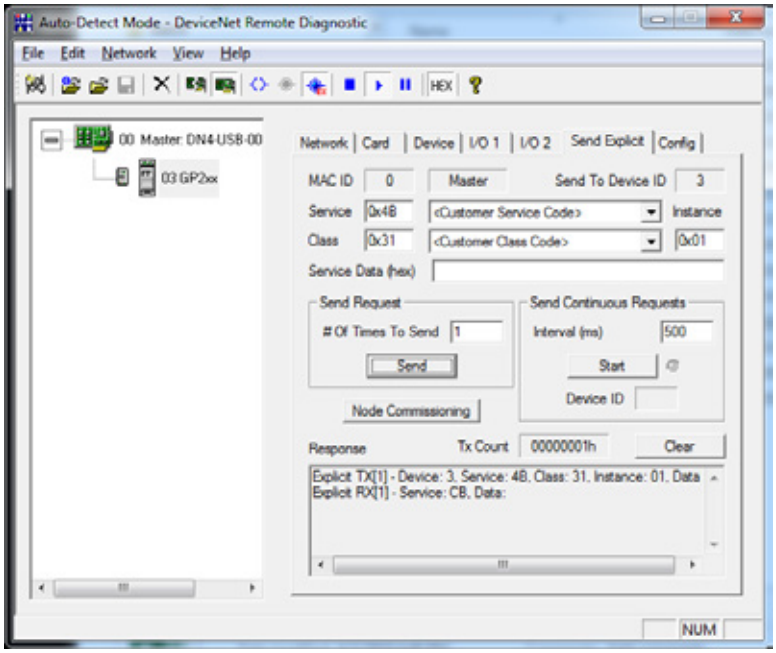


Figure 2-7 DeviceNet Remote Diagnostic Example

Performance Checks

This section describes how to zero and sequence the GP200 Series devices for proper operation.

NOTICE

If the GP200 Series has been in purge mode for a long period of time, wait until the GP200 Series has cooled down before zeroing. The cool down period should be ~30 minutes for purges up to five minutes and at least 60 minutes after purging overnight.

- The GP200 Series must be warmed up for at least 30 minutes.
- The active gas page must be correct.
- The GP200 Series must be correctly zeroed.

Introduction to the Brooks Expert Support Tool

The Brooks' Expert Support Tool is a Windows®-based application that provides expanded monitoring & control of the Brooks' digital thermal mass flow controller/meter, flow controller/meter, pressure controller and remote pressure transducer (RT), and pressure-based flow controller modes for servicing tasks that include setup, configuration, calibration, tuning, control, monitoring, and troubleshooting.

Note that the Brooks Expert Support Tool is meant to be used as a startup and troubleshooting tool. It is not intended to be permanently connected to the device in your system/application.

Using the Brooks Expert Support Tool

The device is connected from its diagnostics port to a computer via the computer's serial port or USB port. Various cable/adapter combinations are available to connect a device to the PC.

The following tools and cables connect a GP200 device's Micro USB diagnostic port the PC's standard USB port:

- Standard USB to Micro USB cable

Figure 2-8 Standard USB to Micro USB Cable

To install the Brooks Expert Support Tool application, download the BEST installer file from the Products/Software section of the Brooks Instrument website (www.brooksinstrument.com).

Please reference the Brooks Expert Support Tool Quick Start Guide for installation and operation details and the Brooks Expert Support Tool Installation and Operation Manual for more in-depth details.

⚠ CAUTION

DO NOT make any connections to unlabeled connector pins. Any failure to comply could damage the GP200 Series and/or the mating electrical device. Before connecting the cable, make sure that all pin connections of the mating cable have the same pin out connections. When installing and removing cables to and from your computer, make sure the power is turned off on your computer. This will prevent damage to your computer and associated equipment.

GP200 Alarms in the Brooks Expert Support Tool

The Alarm Status window shows detailed alarm states for supported devices interfaces/protocols. The exact alarms/warnings shown may vary depending on the protocol type and device type.

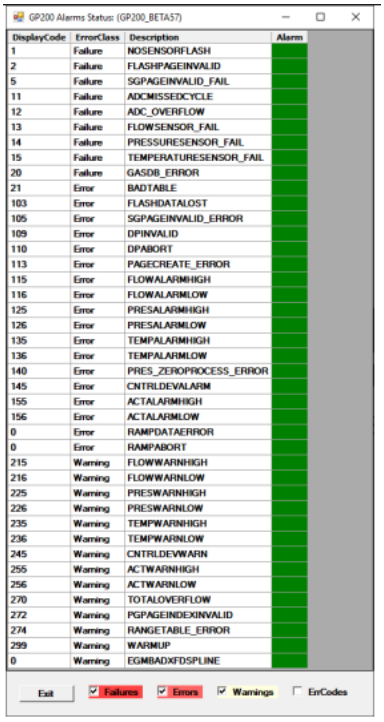


Figure 2-9 GP200 Series Alarm Status Window in BEST

The Alarm Settings window allows a user to change alarm settings for the device.

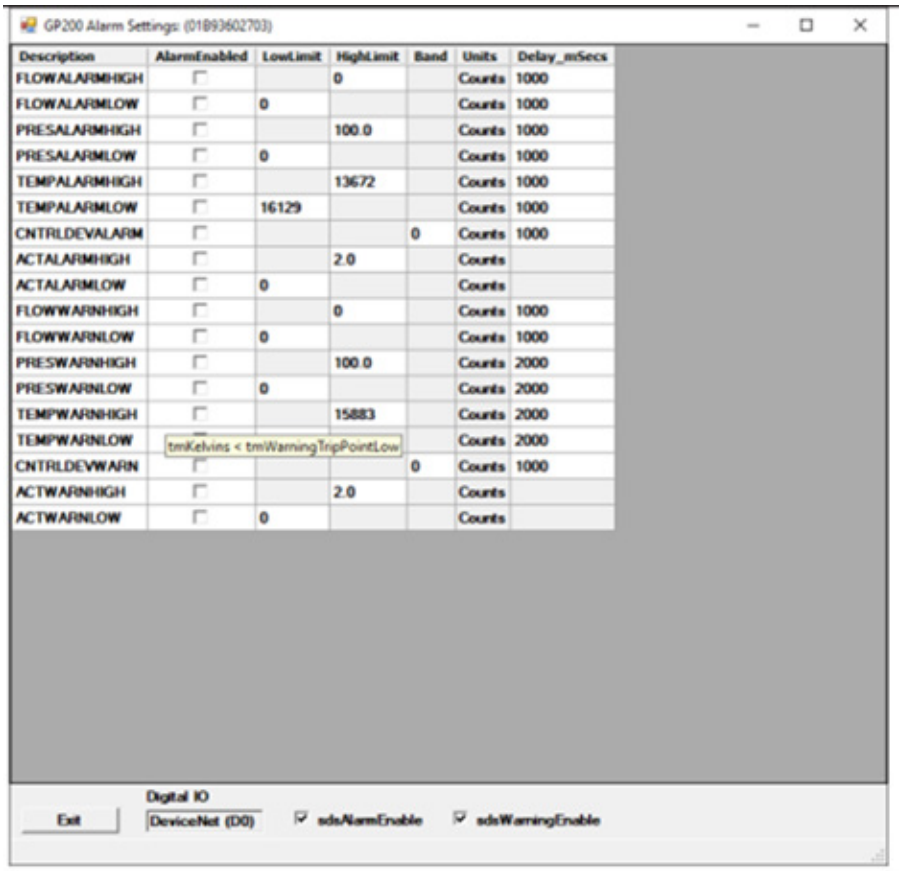


Figure 2-10 GP200 Series Alarm Settings Window in BEST

GP200 Gas Pages in the Brooks Expert Support Tool

Customer gas pages can be changed with the Brooks Expert Support Tool using the Customer Page tab in the Flow Calibration menu. Reference Figure 2-11 below.

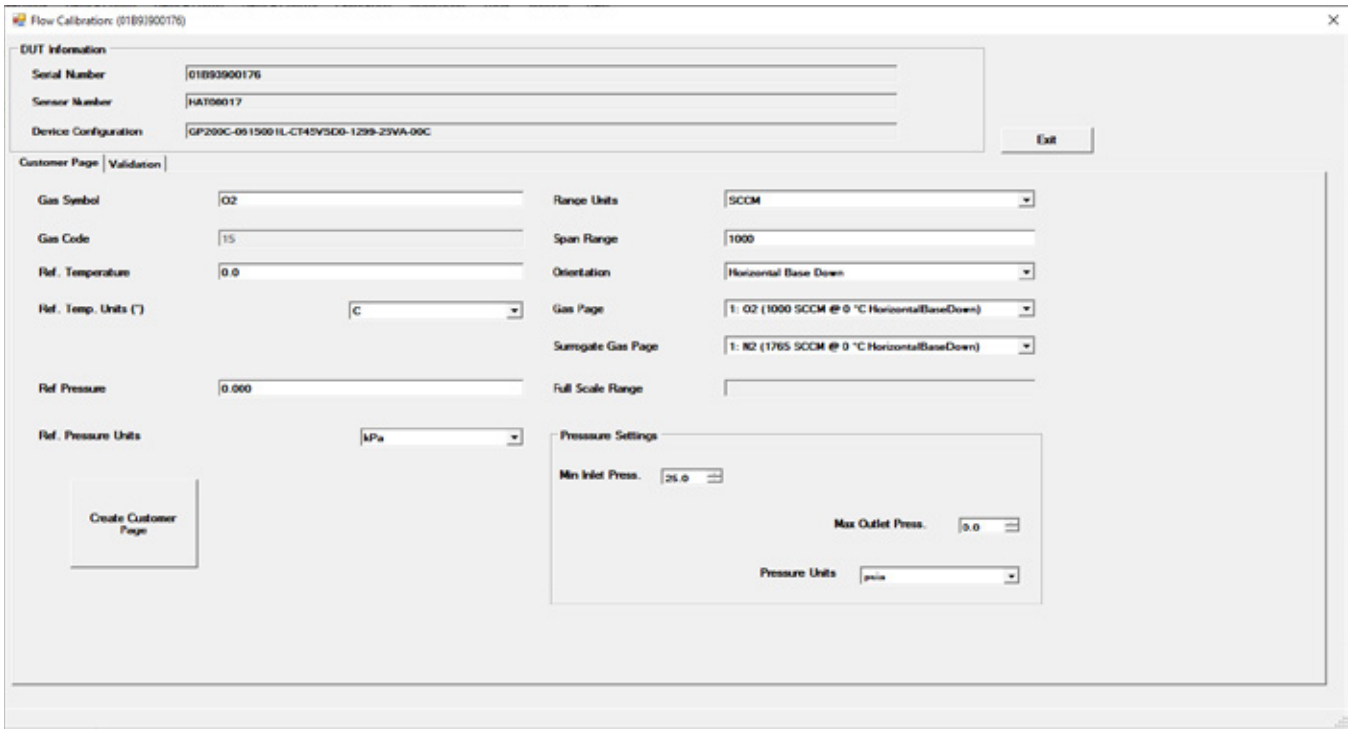


Figure 2-11 Changing Gas Pages using BEST

GP200 Warping in the Brooks Expert Support Tool

For GP200 devices, an adjustment called “Warping” allows a user to adjust the device’s response to match their standard, such as within a certain environment. The user enters performance data of their device as measured in their environment, then the software uses a curve fit to adjust the device’s response accordingly. Warping requires a Brooks Expert Support Tool license. For GP200 devices, a warp adjustment is added to the device’s factory calibration and can be cleared from a flow page without affecting the factory calibration. The same flow page may then be used again without the warp adjustment.

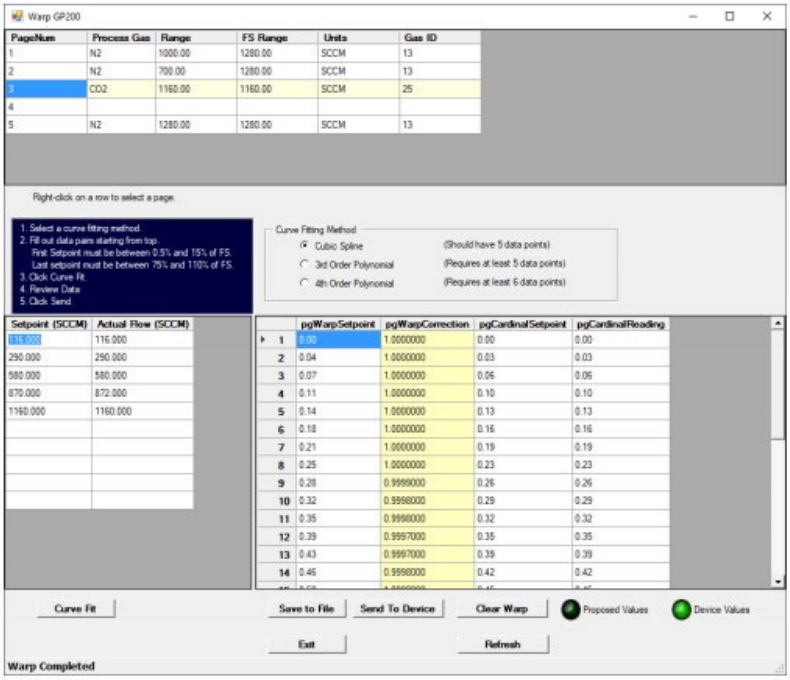
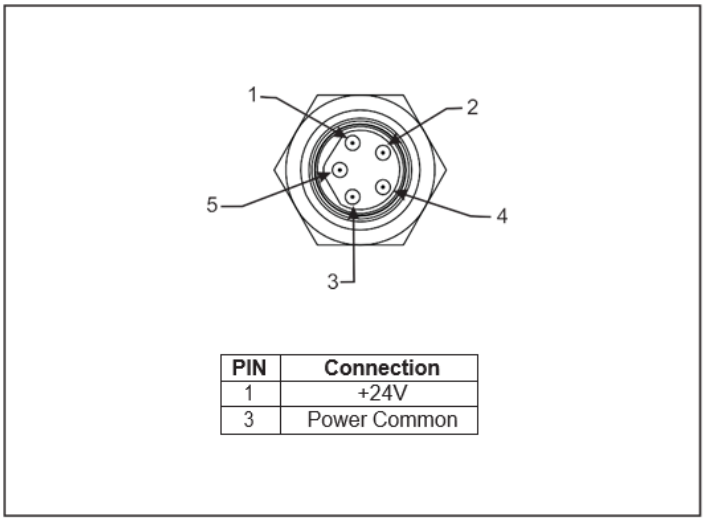


Figure 2-12 GP200 Warping in the Brooks Expert Support Tool

EtherCAT Connections

Power needs to be supplied via the standard male M8 5-pin connector. The M8 connector is located on the upper inlet side of the device.

Figure 2-13 GP200 Series EtherCAT M8 Power Connector



PIN	Connection
1	+24V
3	Power Common

Figure 2-14 EtherCAT Power Connector Drawing

DeviceNet Connections

DeviceNet is a 5-wire local network connection that employs a command-response communication protocol for communicating between a master and slave. Obtain a DeviceNet communication cable (Micro M-12) and fasten it to the 5-pin connector.

Figure 2-15 GP200 Series DeviceNet Pin Connections

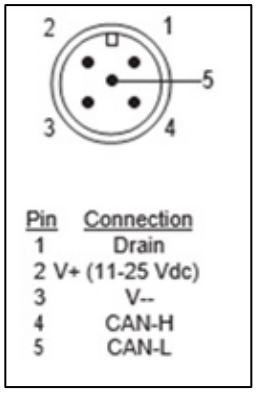


Figure 2-16 DeviceNet Pin Connections

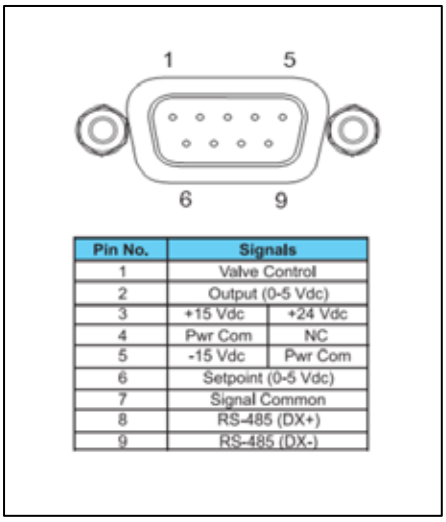
⚠ CAUTION

DO NOT apply more than 10 Inch-Pounds of torque to the cable coupling when connecting the cable to the device or damage may result to the connector.

Analog/RS485 Connections

The GP200 Series devices are available with Analog 9-Pin D-Connectors shown below in Figure 2-16.

Figure 2-17 GP200 Series Analog 9-Pin Connector



Pin No.	Signals	
1	Valve Control	
2	Output (0-5 Vdc)	
3	+15 Vdc	+24 Vdc
4	Pwr Com	NC
5	-15 Vdc	Pwr Com
6	Setpoint (0-5 Vdc)	
7	Signal Common	
8	RS-485 (DX+)	
9	RS-485 (DX-)	

Figure 2-18 GP200 Series Analog 9-Pin Connector (M)

General

After the device has been properly installed in the process, it is ready for operation. When initiating flow, slowly open any upstream shutoff valve to avoid a flow surge. A bypass is helpful in bringing the flow on smoothly. Avoid starting a pump to supply the device without the use of a valve upstream of the device.

⚠ 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.

⚠ WARNING

Before operating the flow controller, ensure all gas connections have been properly tightened and, where applicable, all electrical connections have been properly terminated.

Theory of Operation for Pressure-Based Flow Measurement

Mass flow controllers (or MFCs) are devices that precisely measure and control the flow rate of gases and they are central elements to any gas delivery system. Most MFC's contain four basic elements- a flow restrictor, flow sensor, integrated electronics, and control valve as shown below in Figure 3-1.

- The flow restrictor, or bypass (1) mechanically sets the maximum flow, conditions the flow to make it more laminar, and creates a pressure drop to divert a precise sample of gas to the sensor (2) to measure the actual mass flow rate through the device.
- The integrated electronics (3) process the data that is received from the flow sensor and compare it to the given setpoint.
- It uses this logic to drive the valve (4) open and closed to allow more flow or less flow.

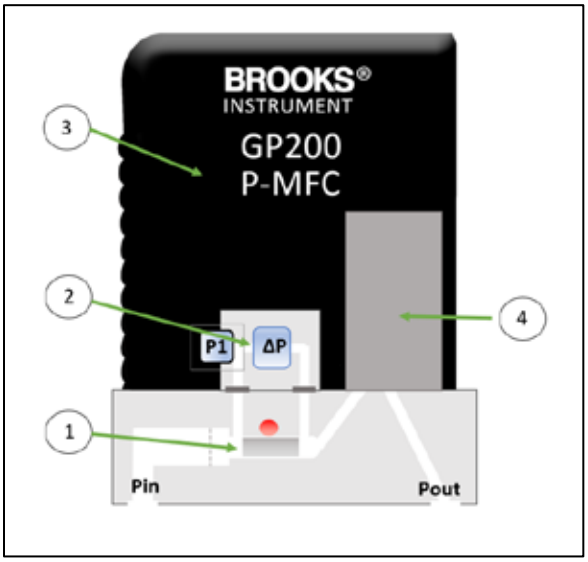


Figure 3-1 GP200 Series MFC Architecture

The valve block is comprised of the electromagnetic valve as well as the jet/orifice. The jet size is based on the maximum flow rate of the device and increases as you increase in device flow rate. The valve controls the flow through the orifice by receiving a current to increase or decrease the space between the plunger and jet.

Pressure-based MFC's are based on the Hagen–Poiseuille equation which is a physical law that gives the pressure-drop in an incompressible fluid in laminar flow flowing through a long cylindrical pipe of constant cross section. By measuring the upstream pressure (P1) and downstream pressure (P2) across a laminar flow element, this equation can be used to relate these measured pressures to the actual mass flow.

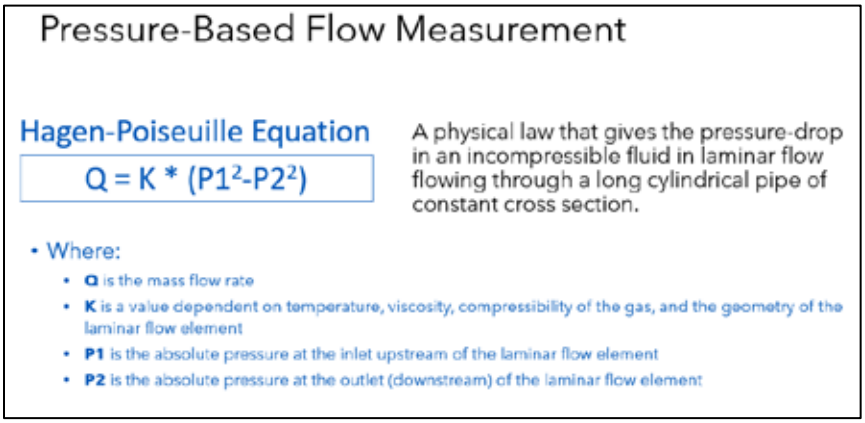


Figure 3-2 Hagen-Poiseuille Equation

This equation can also be re-written to utilize a true differential pressure measurement instead of two individual absolute pressure transducers, as in the GP200. K is a value which is dependent on temperature, viscosity, compressibility of the gas, and the geometry of the laminar flow element. Once R is set with N_2 calibration, only fluid properties are needed and used for other gases.

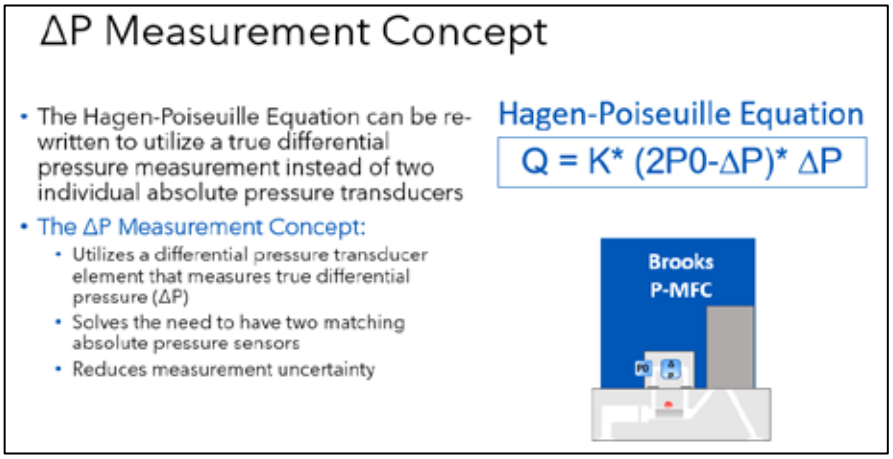


Figure 3-3 GP200 DP Measurement Concept

The gas model is now embedded in the GP200 device and solves the governing fluid mechanics equations in real time at every signal processing cycle (every 2 ms). Fluid Properties are updated for temperature and pressure changes every signal processing cycle, so every 2ms.

This forms the foundation of the GP200 P-MFC. Utilizing a differential pressure transducer element that measures the true differential pressure (ΔP), solves the need to have two matching absolute pressure sensors, and reduces measurement uncertainty for enhanced accuracy and repeatability.

The combination of Brooks' differential pressure approach and downstream valve architecture enable the GP200 to operate at much lower inlet pressures and across a wider range than other pressure-based mass flow controllers that rely on elevated inlet pressures to meet the process' required flow.

Maintenance & Troubleshooting Overview

No routine maintenance is required on the Brooks GP200 Series devices. If an in-line filter is used, the filtering elements should be periodically replaced or cleaned. Any precision unit such as a flow controller requires occasional servicing, especially if it has been operating for an extended period. If reactive gases are being used, it is recommended that you send the device to a Brooks Service Center for cleaning and recalibration. Please follow the instructions for removal, product packaging and product return instructions found in Section 2- Installation—Return Shipment. All active process instrumentation and equipment is subject to aging and wear from their environment. This includes temperature, mechanical stress, component tolerance shift, contaminant buildup, oxidation, and other influences. The effects are gradual, but over time the changes can affect the accuracy of even the best equipment. Therefore, it is recommended to re-zero the device at 12-month intervals. Refer to Section 2-14 and Section 2-15 for re-zeroing instructions.

Maintenance

⚠ WARNING

METER/CONTROLLER SEAL COMPATIBILITY

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.

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.

⚠ WARNING

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

⚠ WARNING

If it becomes necessary to remove the instrument from the system, power to the device must be disconnected.

⚠ CAUTION

It is important that this **MFC/MFM** only be serviced by properly trained and qualified personnel.

⚠ 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 internal circuit boards or devices.

Troubleshooting

This section includes a Troubleshooting Checklist and a GP200 Series Troubleshooting Guide that identifies symptoms, possible causes, and corrective actions.

⚠ NOTICE

OEM tool problems are often caused by something other than the GP200 Series. Therefore, Brooks recommends that you review both the Troubleshooting Checklist and the GP200 Series Troubleshooting Guide before removing the GP200 Series from your system. It is also suggested to contact your Brooks Service representative before removing the GP200 Series from your system.

Troubleshooting Checklist

1. Check environmental factors that could affect changes to GP200 Series performance. The most common environmental factors are listed in Table 4-1 below.
2. Check supply voltage and check for a consistent ground.
3. Ensure OEM tool setpoint matches the setpoint at the GP200 Series. Observe for consistency.
4. Verify isolations valves are open and the gas supply is turned on. Then verify operating pressures are within operating ranges.
5. Check GP200 Series voltage response by moving the setpoint back and forth. Observe for voltage changes.

Table 4-1 Environmental Factors

GP200 Series Performance	Possible Causes
Inaccurate flow.	Temperature shift (steady state or transient). Inlet pressure shift (steady state or transient). Power supply problem. Electrical interference Dirty gas chamber Changes in gas.
Control problems. Cannot reach setpoint. Oscillation.	Differential pressure not within operating range Inlet pressure not stable
Zeroing problems, Indicated zero is not stable.	Temperature shift (steady state or transient). Inlet pressure shift (steady state or transient). Power supply problem. Electrical interference

GP200 Series Troubleshooting Guide

Table 4-2 GP200 Series Troubleshooting Guide

Symptoms & Possible Causes	Corrective Action
1. No gas flow.	
Is the gas supply turned on?	Check shut-off valve and pressure readout. Open the gas supply.
Is the regulator turned on at the correct operating pressure?	Turn off the regulator and reset it to the recommended pressure as described in the Data Sheet.
Are any upstream or downstream shut-off valves closed, either by the system or because of failure?	Verify that the valves are open and operating properly.
Is the MOD LED light on the GP200 Series lit solid green? (DeviceNet Models only)	Observe the LED display panel on top of to verify. If the LED light is not lit, cycle power the to reboot.
Is the commanded setpoint from tool/system at 0.00 Vdc?	Use the tool software to verify.
Has the MFC been commanded off by an active “valve closed” input?	Use the tool software to verify.
2. Flow out of range.	
Is the gas inlet/outlet pressure differential either too high or too low? NOTE: If the differential pressure is too high, voltage will be zero, which is abnormally low for the setpoint. If the differential is too low, voltage will be at its maximum value, which is abnormally high for the set-point.	Verify that the pressure is correct for the gas and range. If required, adjust inlet/outlet pressure to achieve proper pressure reading.
Is the MOD LED light on the GP200 Series lit solid green? (DeviceNet models only)	Observe the LED display panel at top of the device to verify. If the LED light is not lit, cycle power to reboot.
Is the setpoint correct for the required gas flow?	Use the tool software to verify.
Is the GP200 calibrated for the particular gas?	Check the side label. Run a flow check to verify.
Is the zero correct?	Zero the GP200 according to zeroing procedure in Section 2-14. Verify leak check rates are OK.
3. No gas control; flow is at or above maximum.	
Is the gas pressure across the too high?	Verify that the pressure is correct for the gas and range. If required, adjust inlet/outlet pressure to achieve proper pressure reading.
Are system valves open, or is the purge input activated?	Use tool software to verify.
Is the setpoint correct for the required flow?	Use tool software to verify.

Table 4-2 GP200 Series Troubleshooting Guide (Continued)

Symptoms & Possible Causes	Corrective Action
4. No gas flow above some set-point.	
NOTE: When the setpoint is increased beyond this point, the GP200 Series signal remains at some value lower than the set-point. Is the gas inlet/outlet differential pressure sufficient? NOTE: If the pressure reading is too low, the valve voltage to the GP200 Series will be at its maximum output. This condition will cause internal valve heating and inability to properly reach desired flow setpoints.	Verify that the pressure is correct for the gas and range. If required, adjust regulator to achieve proper pressure
Is the GP200 Series calibrated for the gas flow?	Check GP200 Series side label. Run a flow check to verify. If flow is incorrect, replace the GP200 Series with a unit that is calibrated properly.
5. No gas flow below some set-point.	
NOTE: When the setpoint is decreased below this point, the GP200 Series signal remains at some value higher than the setpoint. Is the gas inlet/outlet differential pressure too high, or above published setpoints? NOTE: If the differential pressure reading is too high, voltage to the GP200 Series will be at its maximum value when the setpoint is decreased below the point where flow decreases.	Verify that the pressure is correct for this gas and range. If required, adjust regulator to achieve proper pressure
Is the GP200 Series leaking?	Check for contamination. Test the GP200 Series for leak integrity. Replace the GP200 Series if leakage is detected.
6. Gas flow, or GP200 Series pressure reading oscillates.	
Is the GP200 Series calibrated for the gas flowing?	Check the GP200 Series side can label. Run a flow check to verify. If flow is incorrect, replace the GP200 Series.
Is there too much gas pressure across the GP200 Series?	Verify that the pressure is correct for this gas and range. If required, adjust regulator to achieve proper pressure reading.

Table 4-2 GP200 Series Troubleshooting Guide (Continued)

Symptoms & Possible Causes	Corrective Action
7. GP200 Series does not read zero pressure when gas is shut off.	
Is the differential pressure across the GP200 Series really zero?	Verify that the pressure is correct for the gas and range. If the GP200 Series has been contaminated, it may not be able to close, and therefore, will not zero. Equalize the pressure across the GP200 Series by opening it briefly. Set up the GP200 Series for zeroing. Then perform the zeroing procedure in Section 2-14. Use the tool software to verify.
Is the GP200 Series configured properly in the tool software?	Refer to the side can label on the GP200 Series.
Is the GP200 Series mounted to the proper attitude?	The GP200 Series should be calibrated in the attitude it will be operating at.
8. OEM tool does not read correct GP200 Series zero reading.	
Is the differential pressure across the GP200 Series really zero? Is the supply voltage within specified range? Is the GP200 Series mounted in the proper attitude? Is the flow output signal of the GP200 Series really zero?	GP200 Series valve leakage. Incorrect MFC zero.
9. Zero Drift.	
Improper zero of the GP200 Series? Excessive Valve leakage?	GP200 Series aging or sensor stabilization. Zero is not correct.
Symptoms & Possible Causes	Corrective Action
10. Calibration Drift.	
Gas box temperature too high? Is it linear offset?	Zero is not correct.
11. GP200 Series indicates Overshoot.	
	If the tool is idle for an extended period of time, high inlet pressure or contamination will cause overshoot on first use.
12. G200 Series dumps large volume of gas into chamber when setpoint is commanded from the tool.	
	The tool is commanding a setpoint before the pneumatic valves are opened. GP200 Series and pneumatic timing may be offset. GP200 Series overshoots.
13. Tool display output doesn't match GP200 Series flow output.	
Cable resistance causing offset in the tool's display.	Check GP200 Series zero.

Overview

Table 5-1 GP200 Series Model Code

Code Description		Code Option	Option Description
I.	Base Model Code	GP200	Ultra-High Purity Pressure-Based Mass Flow Controllers
II.	Valve Configuration	P	Positive Shut-off/Zero Leak-by Valve[5]
		C	Normally Closed Valve with Metal Valve Seat
III.	Gas and Range[6]	0013 010C	10 sccm F.S. N2 Equivalent, CT40 Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 030C	30 sccm F.S. N2 Equivalent, CT41 Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 100C	100 sccm F.S. N2 Equivalent, CT42 Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 300C	300 sccm F.S. N2 Equivalent, CT43 Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 001L	1,000 sccm F.S. N2 Equivalent, CT44 Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 003L	3,000 sccm F.S. N2 Equivalent, CT45 Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 010L	10,000 sccm F.S. N2 Equivalent, CT46, Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 025L	25,000 sccm F.S. N2 Equivalent, CT47 Standard Bin Configuration at 35 psia inlet, vacuum outlet
		0013 045L	45,000 sccm F.S. N2 Equivalent, CT48 Standard Bin Configuration at 35 psia inlet, vacuum outlet
IV.	Standard Type (CT) Bin		Consult Brooks Configurator or Bin Tables
		CT40	Standard Bin Configuration #40
		CT41	Standard Bin Configuration #41
		CT42	Standard Bin Configuration #42
		CT43	Standard Bin Configuration #43
		CT44	Standard Bin Configuration #44
		CT45	Standard Bin Configuration #45
		CT46	Standard Bin Configuration #46
		CT47	Standard Bin Configuration #47
		CT48	Standard Bin Configuration #48
V.	Low Pressure (LP) Bin	LP40	Low Pressure Bin Configuration #40
		LP41	Low Pressure Bin Configuration #41
		LP42	Low Pressure Bin Configuration #42
		LP43	Low Pressure Bin Configuration #43
		LP44	Low Pressure Bin Configuration #44
		LP45	Low Pressure Bin Configuration #45
		LP46	Low Pressure Bin Configuration #46
VI.	Fittings	CX	1-1/8” body width, 92mm C-Seal
		WX	1-1/8” body width, 92mm W-Seal
		VS	1-1/8" body width, 124mm 1/4" VCR male
		LX	1-1/8” body width, 92mm C-Seal w/Poke Yoke

VII. Communications/Connector

Code Option	I/O	Power On State	Full Scale Setting			Producer	Consumer	Poll IO State Transition	External Baud Rate
D0	DeviceNet	Idle	Count	Integer	6000h	2	7	Executing	500KB
D1	DeviceNet	Idle	Count	Integer	6000h	21	7	Executing	500KB
D2	DeviceNet	Idle	SCCM	Float	7FFFh	13	19	Executing	500KB
D3	DeviceNet	Idle	Count	Integer	6000h	22	7	Executing	500KB
D4	DeviceNet	Executing	Count	Integer	6000h	22	8	Executing	500KB
D5	DeviceNet	Idle	Count	Integer	6000h	6	8	Executing	500KB
D6	DeviceNet	Idle	Count	Integer	7FFFh	3	7	Executing	500KB
D7	DeviceNet	Idle	Count	Integer	7FFFh	6	8	Executing	500KB
D8	DeviceNet	Idle	Count	Integer	6000h	3	7	Executing	500KB
D9	DeviceNet	Executing	Count	Integer	6000h	2	7	Executing	500KB
DA	DeviceNet	Idle	Count	Integer	7FFFh	22	7	Executing	500KB
DB	DeviceNet	Idle	Count	Integer	6000h	22	8	Executing	500KB
DC	DeviceNet	Idle	Count	Integer	7FFFh	3	7	Idle	500KB
DD	DeviceNet	Executing	Count	Integer	7FFFh	22	8	Executing	500KB
DE	DeviceNet	Executing	SCCM	SCCM	6000h	15	19	Executing	500KB
DX	DeviceNet	To Be Defined by Customer Special Request							

- Zero Leak Valve Option not currently available with bins CT47-CT48
- Consult Brooks Configurator or Bin Tables for specific Product Sizing Options

Table 5-1 GP200 Series Model Code (Continued)

Code	Description	Code Option	Option Description
VII.	Communications/Connector	E0	EtherCAT Communication
		G1	9-Pin D-Connector with Analog/RS485 Communication
		TX	9-Pin D-Connector with Analog Only
VIII.	Customer Special Request	XXXX	Customer Special Request (Consult factory for new requests)
IX.	Minimum Inlet Pressure	15	15 psia minimum inlet pressure, ~15-30 psia inlet pressure range
		25	25 psia minimum inlet pressure, ~25-40 psia inlet pressure range
		35	35 psia minimum inlet pressure, ~35-50 psia inlet pressure range
		45	45 psia minimum inlet pressure, ~45-60 psia inlet pressure range
X.	Downstream Condition	V	Vacuum
		A	Atmosphere
		P	Positive Pressure (760 Torr up to 1200 Torr)
XI.	Auto Shut-off	A	Auto Shut Off (Included)
		X	Auto Shut Off (Not Included)
XII.	Reference Temperature	00C	0°C Reference Calibration (Standard)

Example Model Code

I	II	III	IV	V	VI	VII	VIII	IX	X	XI
GP200	C	0013003L	CT45	CX	E0	XXXX	35	V	A	00C

Appendix A: GP200 Series Patents

The GP200 Series is protected by the following US patents and their international filings.

- US 11,073,846 B2 “Mass Flow Controller with Absolute and Differential Pressure Transducer”
- US 10,705,543 B2 “Mass Flow Controller and Controller Algorithm”

LIMITED WARRANTY

Visit www.BrooksInstrument.com for the terms and conditions of our limited warranty.

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.

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.

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

Installation-Manual-GP200-EN/541B230/2025-02

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