

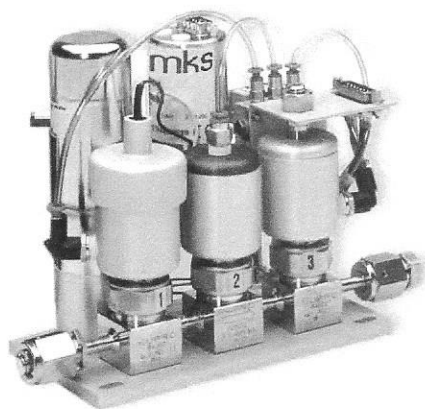


**Flow
Solutions**

WWW.MKSINSTR.COM

GBROR

GAS BOX RATE-OF-RISE IN SITU FLOW VERIFIER



Description

Shutting down a process tool to open a gas line to replace a suspect flow controller not only wastes valuable production time, but increases the risk of gas line contamination. More often than not, no trouble is found with the flow controller — the actual problem is determined to be elsewhere. Tool cost of ownership is improved by having a way to validate the integrity of the MFC on the tool in situ, eliminating loss of valuable process time.

Some process tools provide ways to validate MFC performance either by the use of a "golden MFC", or a rate-of-rise technique that requires using the process chamber itself. Each method has its drawback. Since the "golden MFC" is also a thermal MFC, it is subject to the same performance characteristics as process MFCs. A process chamber rate-of-rise technique requires the tool to be off-line, which compromises actual process throughput. In addition, repeatable results demand a fixed chamber volume condition (free of deposition build-up), as well as uniform chamber temperature, and leak-tight integrity.

A better, overall solution is a dedicated MKS GBROR In Situ Flow Verifier. The MKS GBROR saves time, money, and improves product throughput by allowing accurate and timely diagnosis with verification of MFC performance during process "down" situations, or during routine tool maintenance activity. Processes that benefit from the use of the GBROR include CVD, Etch, and other processes that require tight control of critical gas flow rates in the range of 2 sccm to 2 slm. Other processes may be

covered by the 100 sccm to 20 slm version or 100 sccm to 50 slm versions.

Compared with an "in the chamber" rate-of-rise, which often shows large variations due to uncontrolled temperature and surface conditions, the GBROR is a dedicated instrument providing a high level of confidence and reproducibility. Other advantages include the following:

- **Independence of gas type for MFC calibration** — Actual process gases and gas mixtures can be used to maximize accuracy of MFCs (or) inert purge gases can be used in a "fingerprint" technique to maximize tool process time.

- **Insensitive to contamination** — A typical location of the GBROR gas stick is downstream from the gas mixing manifold to the dump to exhaust (see installation diagram on page 4). This in situ location eliminates risk of contamination since the gas line does not need to be opened to verify mass flow controller performance.

- **Flexibility of installation** — The GBROR is available in two configurations; model GBR1B has no enclosure and is meant to be installed inside a gas box; the GBR2B includes an enclosure with exhaust port for installation outside of the gas box.

Features & Benefits

Cost Effective

- Provides MFC diagnostic capability avoiding unnecessary removal of "good" MFC
- Fast in situ verification of flow rate
- Small measurement volume consumes low quantity of gas, and allows quick purge/pumpdown cycle times
- Measures total pressure directly, independent of gas composition

Accurate

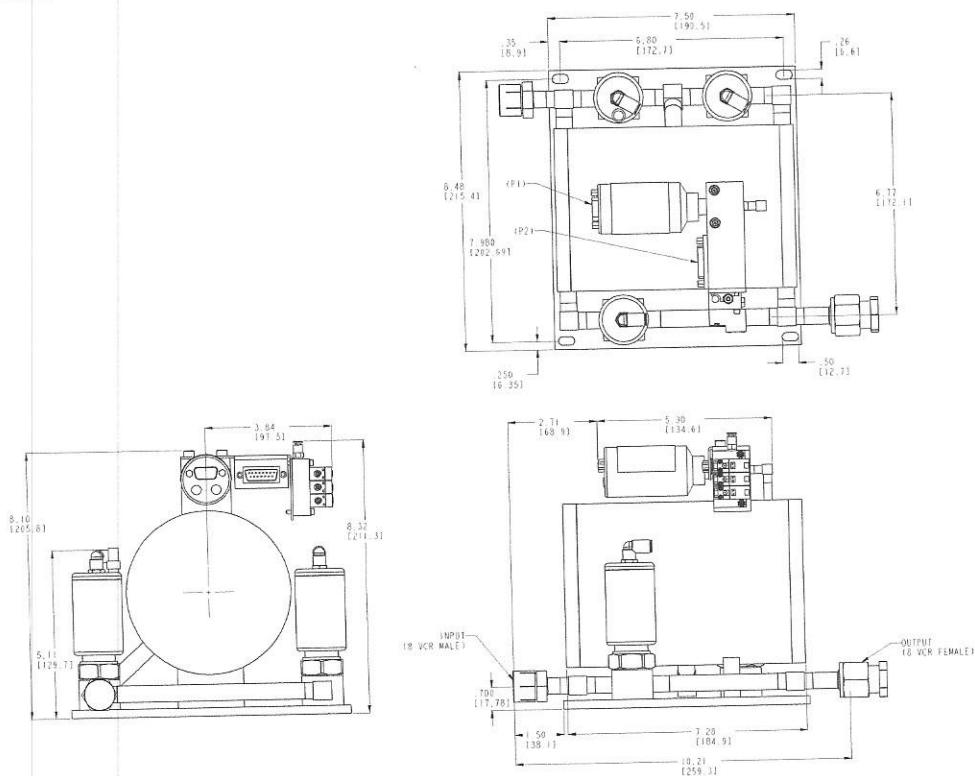
- Verifies mass flow controller accuracy and repeatability, enabling "copy exact" (run-to-run/tool-to-tool) performance from the gas box
- Based on proven Baratron® capacitance manometer stability and accuracy
- Pressure rate-of-rise technique is independent of gas species (user choice)
- Verifies critical/more common MFC flow rates of 2 sccm to 2 slm or 100 sccm to 20 slm or 100 sccm to 50 slm

Compatible

- Permanent installation of the gas stick reduces the number of gas line atmospheric exposures
- Corrosion resistant materials of construction with 10µin Ra surface finish
- CE Compliant—meets requirements for European Union



Dimensional Drawing



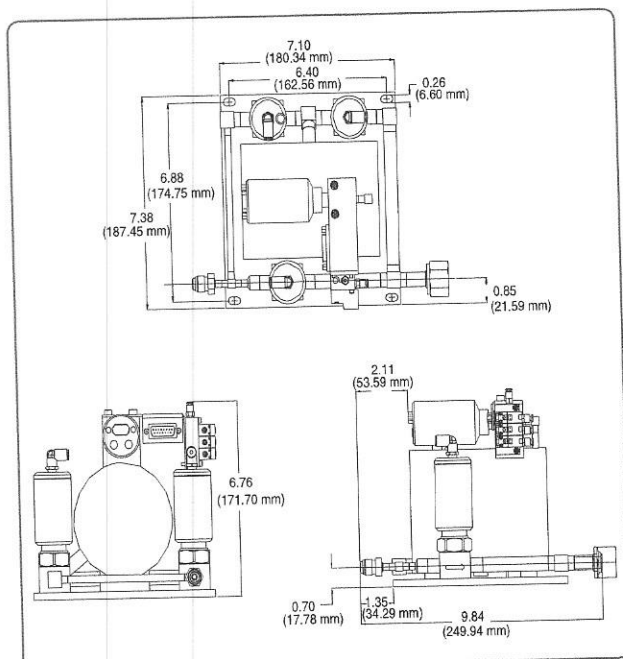
Dimensional Drawing — GBRIB (50 slm F.S.)

Note: Unless otherwise specified, dimensions are nominal values in inches (mm referenced).



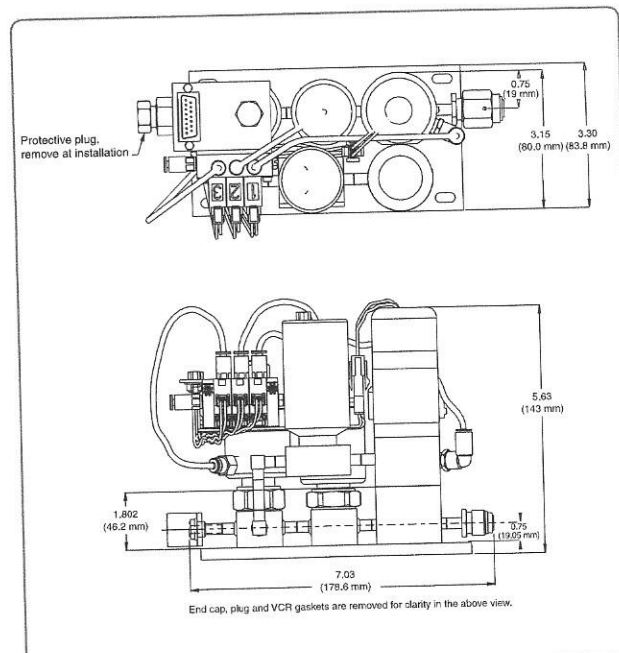
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The Electronic Controller

The GBROR half-rack controller can be operated locally using the buttons on the faceplate or can be completely operated by a host controller through the RS-232 communications interface. Local faceplate controls can also be locked out using a key switch to prohibit changes after initial setup.

This controller has software/firmware to support the pressure and temperature measurements, operate the pneumatic shut-off valves, and the following operation controls:

Verify Flow Rate — reports the gas flow in sccm of actual gas used.

External Volume Calculation — measures the volume in the line between the MFC and the GBROR for use in flow calculations. There is also the option to input stray volume, such as the volume between the MFC and a shut-off valve.

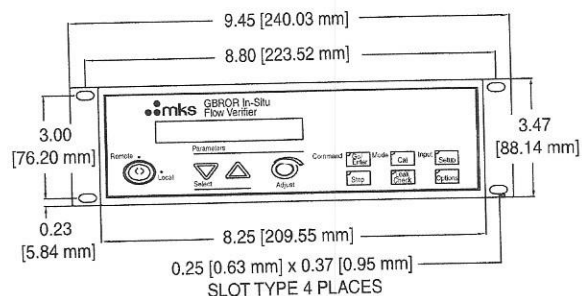
Precondition Purge — sequences valves to cycle-purge the chamber to minimize the potential of cross contamination. The minimum and maximum pressures and number of cycles are user-selectable.

Connected Leak Check — reports the leak integrity of the gas stick plus the connected upstream plumbing. If the upstream plumbing includes a direct connection to the MFC, the controller will report the leak rate through the MFC.

Isolated Leak Check — verifies leak-tight integrity of the GBROR stick.

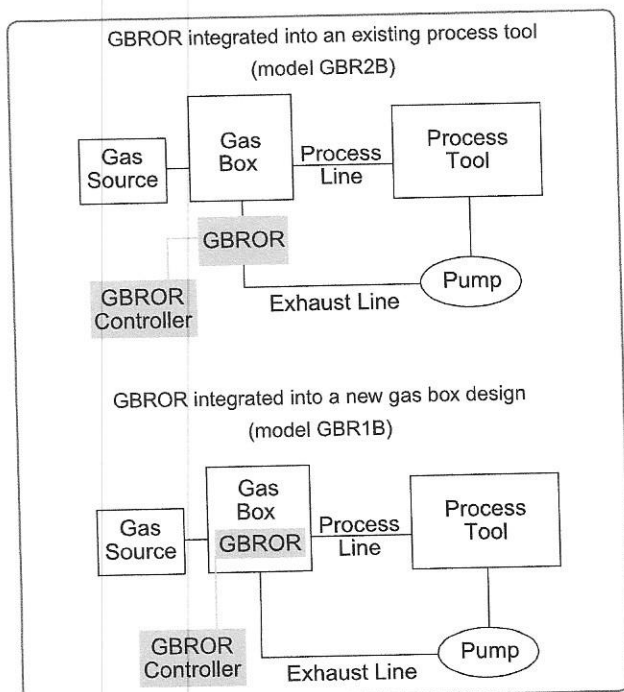


GBROR Controller —
For models GBR1B and GBR2B



GBROR Controller Dimensional Drawing —

Note: Unless otherwise specified, dimensions are nominal values in inches (mm referenced). The controller is a standard half-rack size.



Installation Schematics



The Gas Stick

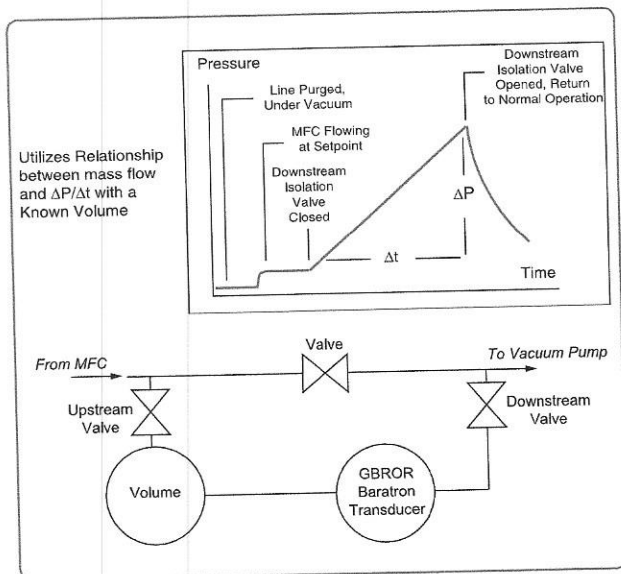
The GBROR gas stick is specially designed with accuracy, cleanliness and compact size in mind.

In addition to having a small gas chamber, solenoid valves and VCR fittings, the GBROR gas stick contains a specially-designed (patent pending) MKS Baratron® capacitance manometer. The Baratron capacitance manometer's proven accuracy and stability enables this ROR measurement to deliver better than 1.0% of reading accuracy.

The all-metal gas stick construction (Kel-F® valve seats) is the key to maintaining low contamination levels. All components of the gas stick module are butt-welded, tested, and calibrated as a unit to maximize performance and process tool integration efficiency.

Because it is so compact, the in situ gas stick can be easily integrated within new gas box designs, or within existing process tools. The capability provided by such a compact, cost-effective method to achieve verified, accurate flows of process gas has immense impact on the overall goal of repeatable, transferable, "copy exact" processes.

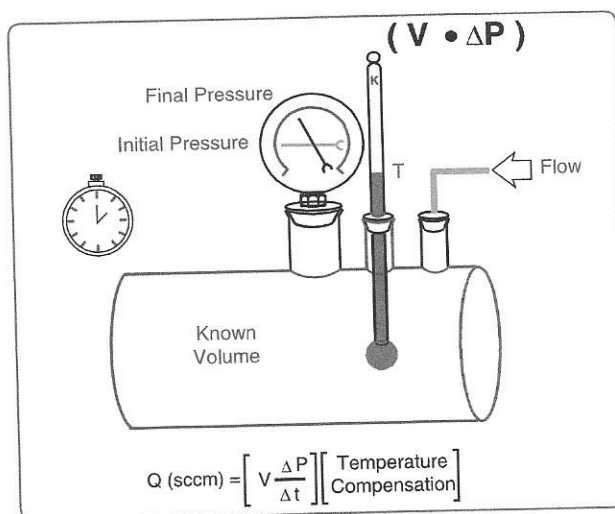
The diagram below shows a simplified GBROR principle of operation. The gas stick contains a specially-designed (patent pending) MKS Baratron® capacitance manometer. The controller can be interfaced to a host computer via RS-232 communications.



GBROR Principle of Operation —

The graph shows how the flow (in sccm) is related to the volume times the slope of the curve. The system compensates for temperature.

The diagram below illustrates the basic principle of the pressure rate-of-rise method. Flow (in units of standard condition volumetric flow such as sccm) can be accurately determined by flowing a gas into a known volume and observing the pressure rise which occurs during an interval of time. Since standard conditions are referenced to a particular temperature (typically 0°C), the prevailing ambient gas temperature is factored into the computation.



Pressure Rate-of-Rise Principle —

As can be seen from the equation, the accuracy of this method depends upon the precision of each factor (volume, pressure increment, time and temperature).



Specifications

Range	2 sccm to 2000 sccm 100 sccm to 20 slm 100 sccm to 50 slm
Measurement Accuracy	$\pm < 1\%$ of Rdg.
Time to Verify (typical)	< 1 min.
Power Input	115/230 VAC, 50/60 Hz
I/O Connections	
GBR1B:	Transducer (female) 15-pin Type "D" Solenoid (female) 37-pin Type "D" Communications (male) 9-pin Type "D"
RS232	
GBR2B:	Transducer (female) 15-pin Type "D" Solenoid (female) 37-pin Type "D" Communications (male) 9-pin Type "D"
RS232	
Dimensions	
Electronic Controller	9.0" (228.6 mm) L x 9.45" (240 mm) W x 3.47" (88.1 mm) H
Mechanical Assembly	See outline drawings
Wetted Materials	Inconel®, 316L S.S., Kel-F®, Elgiloy®
Surface Finish (internal)	10 μ inch Ra electropolish
Fittings	
GBR1B:	
Inlet/outlet	1/4" male VCR/1/4" female VCR for 2 to 2000 sccm 1/4" male VCR/1/2" female VCR for 100 sccm to 20 slm 1/2" male VCR/ 1/2" female VCR for 100 sccm to 50 slm
GBR2B:	
Inlet/outlet	1/4" male VCR/1/4" female VCR for 2 to 2000 sccm internal to enclosure (Includes adapter kits for 1/4" weld stubs and 1/2" Swagelok-coaxial connections for both ends) for 2 to 2000 sccm
Operating Air Pressure	80 to 100 psig
Operating Temperature	
Controller	15°C to 40°C
Gas Stick	0°C to 50°C
Leak Integrity	4 \times 10 ⁻⁹ atm-cc/sec
Mounting Options	
GBR1B	Four mounting holes located on the base plate.
GBR2B	
Standard	Mounts on a wall using back mounting holes
Optional	Mounts at the base using standard 1/2" horizontal mounting brackets
Electromagnetic Compatibility	Fully CE compliant to EMC Directive 2004/108/EC when used with an overall metal braided shielded cable, properly grounded at both ends
Product Safety	Fully compliant to Low Voltage Directive 72/23/EEC



Ordering Information

Ordering Code Example: GBR1B23CR1	Code	Configuration
Gas Box Rate-of-Rise without enclosure	GBR1B	GBR1B
Flow Range Full Scale (sccm of N₂)		
2 sccm to 2000 sccm	23C	23C
100 sccm to 20 slm	24C	
100 sccm to 50 slm	54C	
Fittings (inlet/outlet)		
1/4" VCR male/1/4" VCR female (2 sccm to 2000 sccm)	R	R
1/4" VCR male/1/2" VCR female (100 sccm to 20 slm)	R	
1/2" VCR male/1/2" VCR female (100 sccm to 50 slm)	R	
Controller Type		
Half-rack display (2 slm & 20 slm)	1	1
Half-rack display (50 slm)	2	

Cables: (2 required for operation)

When ordering the GBROR, it is necessary to order interface cables.
For cable lengths and connector options, please contact
Applications Engineering.

Standard length, 10 ft. (3.1 m)	CBRORS-3-10 CB700S-1-10
Optional RS-232 Serial Communications 9-pin to 9-pin	CB651-10-10

Ordering Code Example: GBR2B23CR100	Code	Configuration
Gas Box Rate-of-Rise with enclosure	GBR2B	GBR2B
Flow Range Full Scale (sccm of N₂)		
2 sccm to 2000 sccm	23C	23C
Fittings (inlet/outlet)		
1/4" VCR male/1/4" VCR female (2 sccm to 2000 sccm)	R	R
Controller Type		
Half-rack display	1	1
Accessories		
None (standard)	00	00

Cables: (2 required for operation)

When ordering the GBROR, it is necessary to order interface cables.
For cable lengths and connector options, please contact
Applications Engineering.

Standard length, 10 ft. (3.1 m)	CBRORS-3-10 CB700S-1-10
Optional RS-232 Serial Communications 9-pin to 9-pin	CB651-10-10



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