Mass Flow Meters, Controllers and Manifolds

High performance gas flow control for OEMs!

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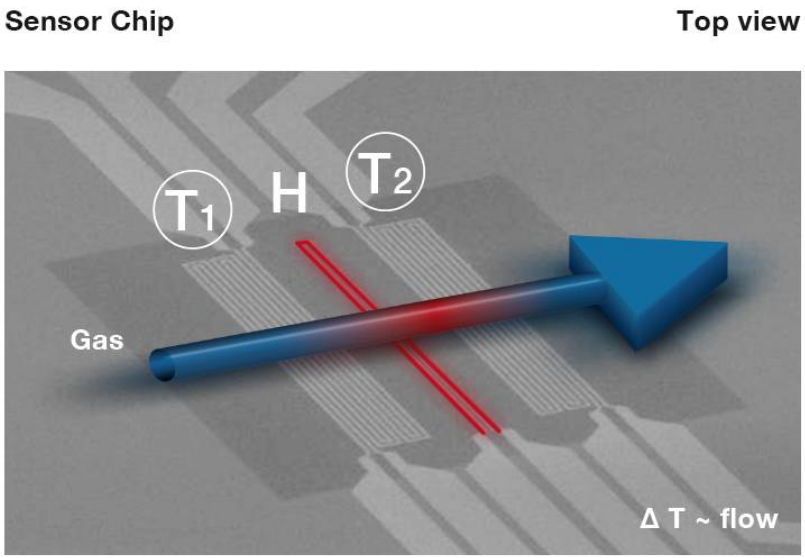
Mass Flow Sensor Technology Comparison

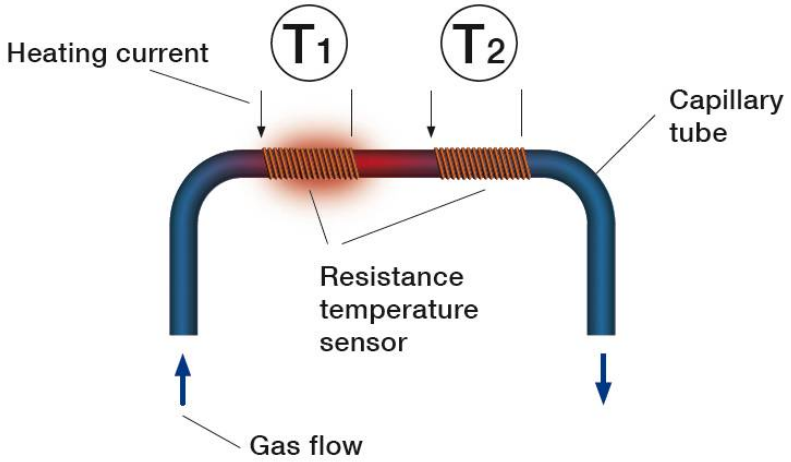
MEMS based design



Advantage

- Speed – Reaction Time
- Accuracy
- Repeatability
- Small size
- Long term stability

Conventional design



Advantage

- Compatible with aggressive gases

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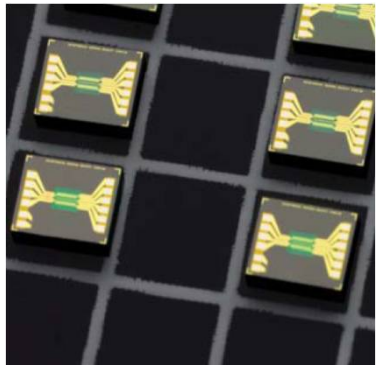
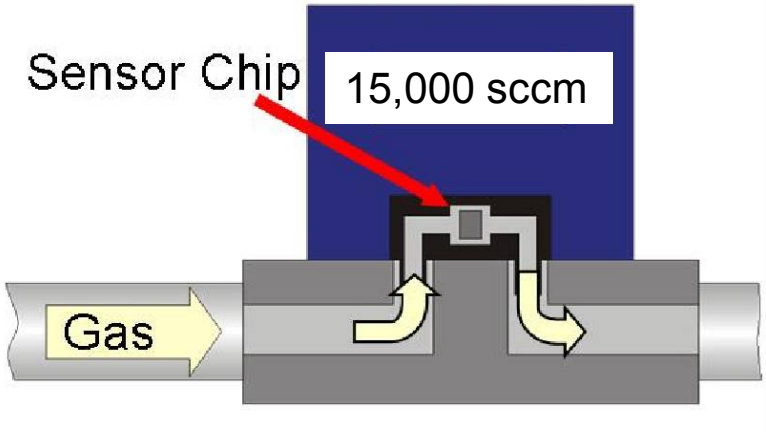
Axetris' Mass Flow Sensor

Total quality control (from chip to controller)

- Axetris' specific mass flow chip design
- Produced in Axetris' cleanroom in Switzerland
- Complete manufacturing in Switzerland
- Full testing and strict quality control





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Specifications

- **Gases**
  N_2, Air, O_2, Ar, CO_2, He, H_2
- **Flow Range (F.S.)**
  0…20 to 15,000 sccm
- **Minimum flow** (25°C, N_2,1 bar)
  0.04 sccm
- **Minimum resolution** (25°C, N_2,1 bar)
  0.002 sccm (@ 20 sccm F.S.)
- **Repeatability**
  $\leq \pm$ 0.015 % F.S. / $\leq \pm$ 0.15 %
  whichever is greater
- **Settling time**
  < 150 ms
- **Accuracy** (25°C, N_2,1 bar)
  $<\pm$ 0.2 % F.S / $\pm$ 1 % O.R.
  whichever is greater
- **Pressure coefficient**
  +/- 0.2 % O.R. /bar
- **Long term stability**
  $\leq \pm$ 0.25 % F.S./year
- **Dynamic Range**
  Better than 1000:1

Typical specified values only; for details, consult product datasheet

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Product Range

	Flow Meter	Flow Controller	Mixer / Splitter
Stand alone			
OEM Module			

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Why customers chose Axetris

Advantage: Ultra Compact Size

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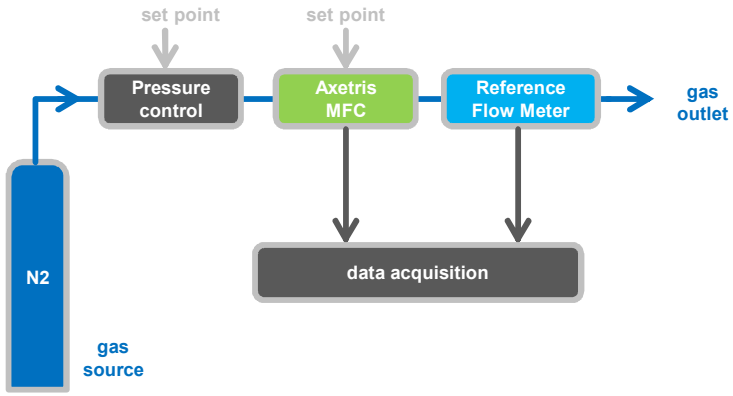
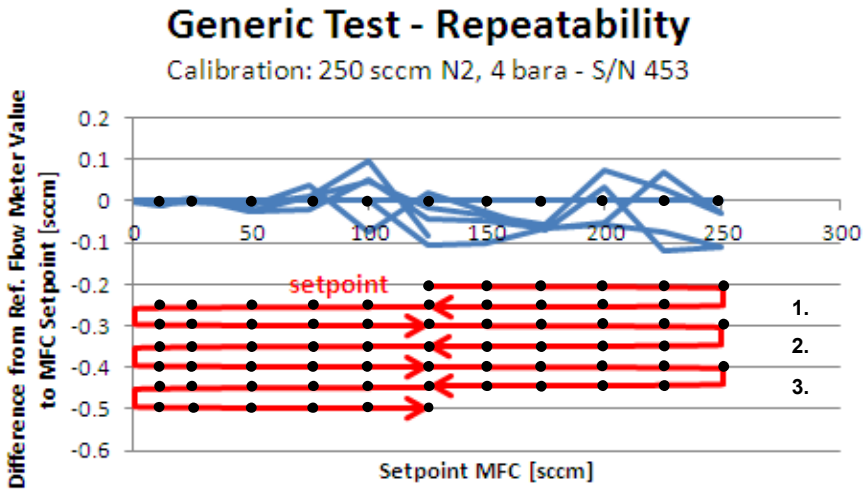
Advantage: Repeatability

- Meter: below 0.01 % F.S.
  Controller: below 0.015 % F.S.



Setup and data analysis according SEMI E56-0309



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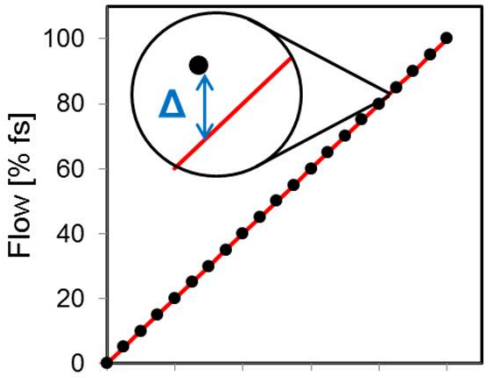
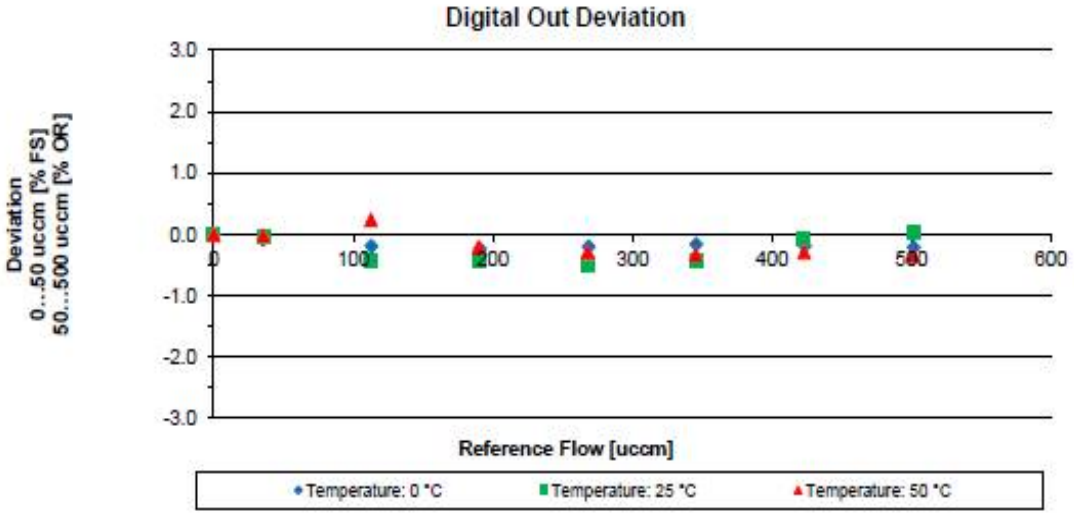
Advantage: Absolute accuracy

- <± 0.2 % F.S / ± 1 % O.R.
  whichever is greater





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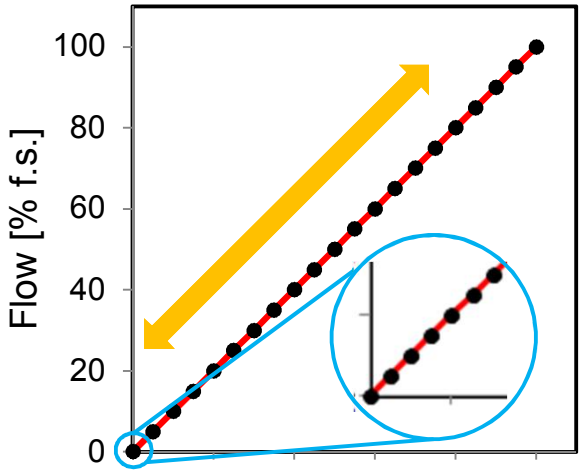
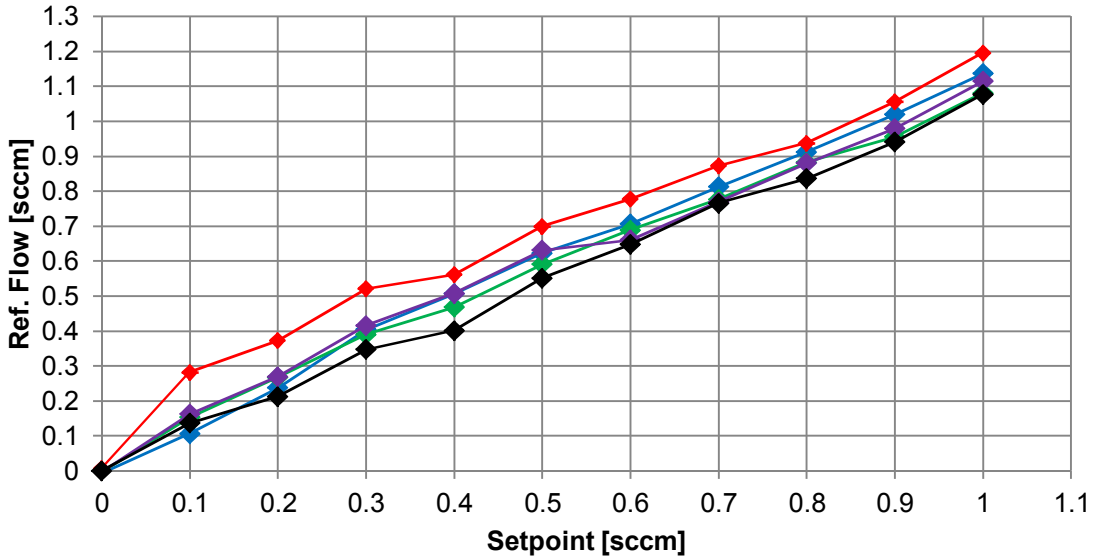
Advantage: Unmatched Dynamic Range

- Better than 1000:1
  - Example: measure at < 1 sccm is possible with F.S. of 1000 sccm
  - Can be further improved with additional gas and range calibrations





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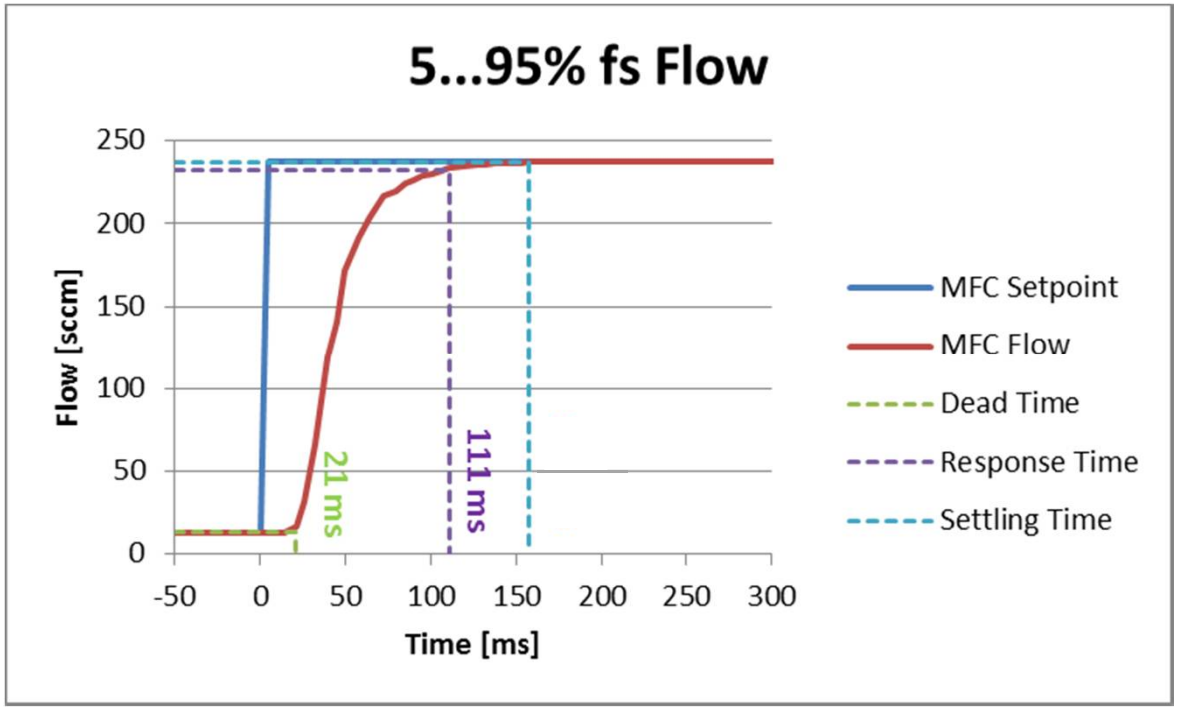
Advantage: Speed and reaction time

- Set point reached in 150 ms



Dead Time:	Flow value out of specifications of set point 1
Response Time:	Flow value within specifications of set point 2 (± 2% OR)
Settling Time:	Flow value within set point 2 (± 0.2% OR)

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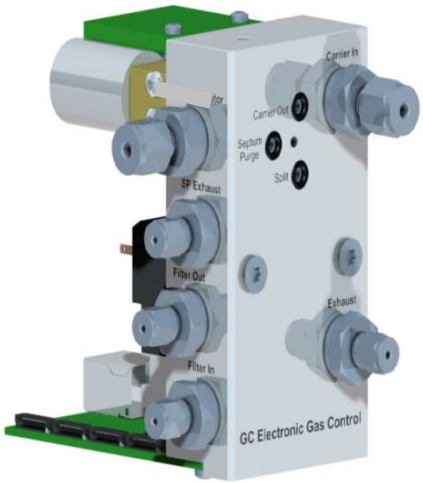
Advantage: Flexibility

….from meter OEM modules up to complete manifolds…and customized solutions



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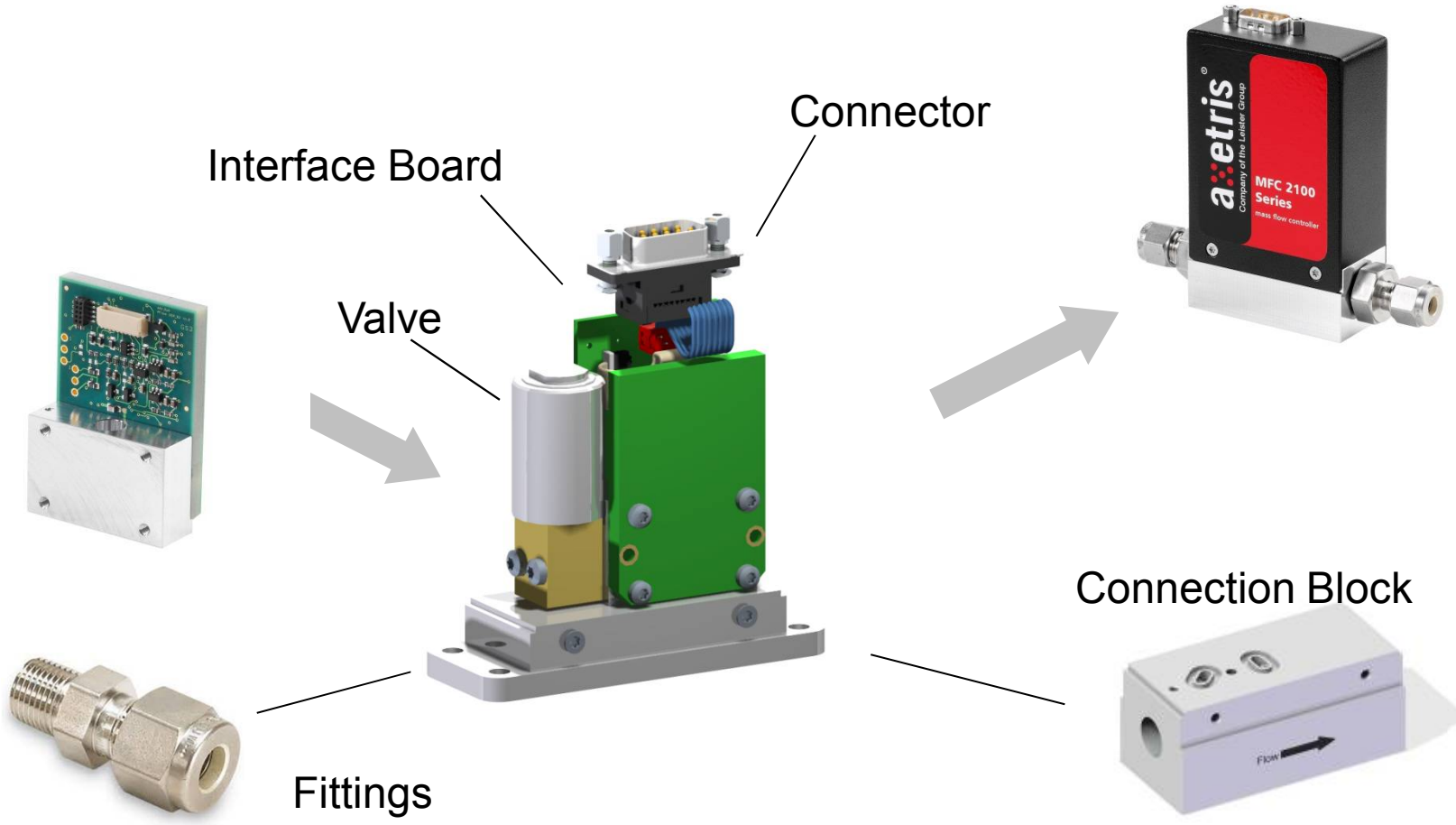
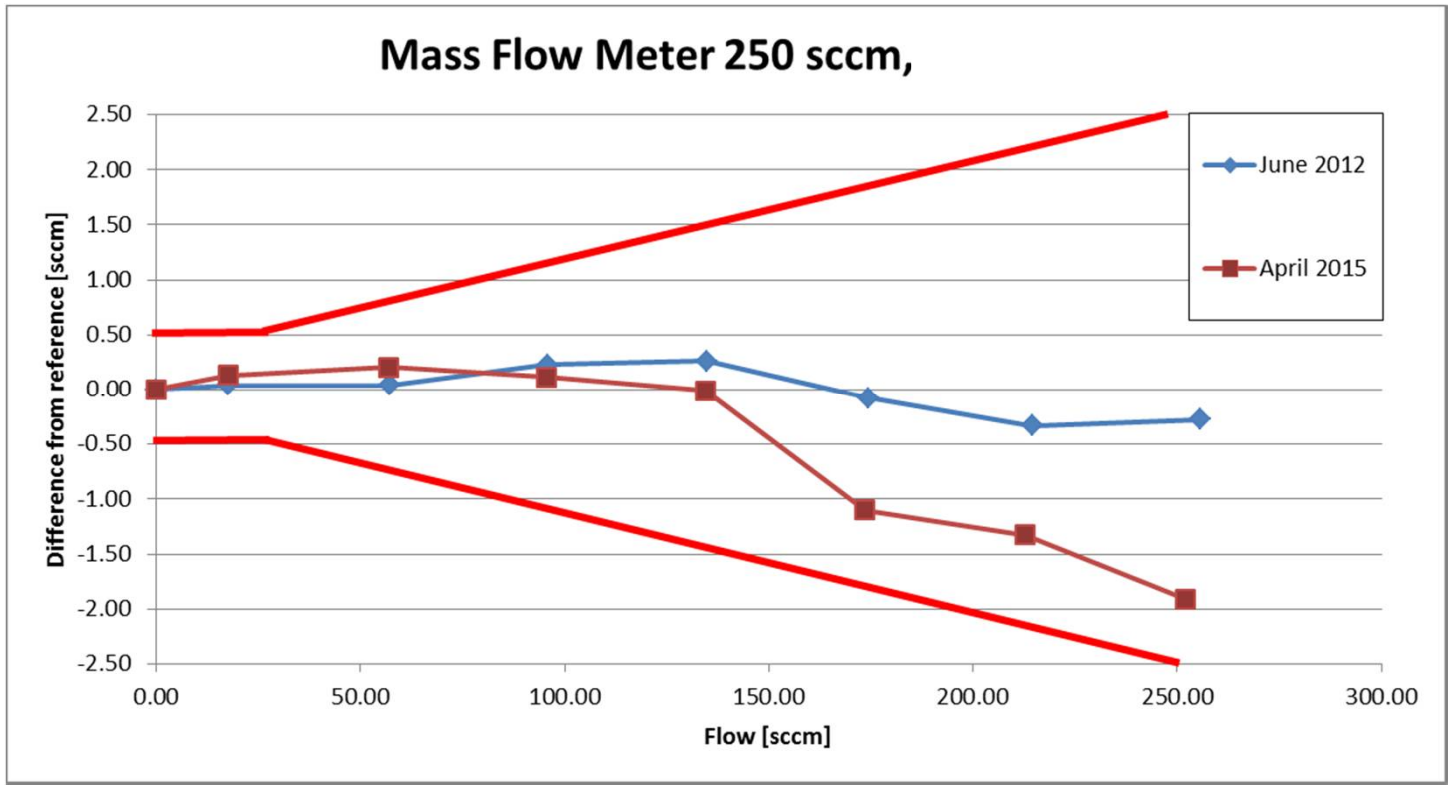
Advantage: Modularity and Flexibility

- Designed for your needs



Advantage: Long term stability

- Re-calibration not required



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Advantage: multiple-gas & downscaling

- Up to 8 real gas calibrations
- Up to 6 downscaling
  - Downscaling: 2nd calculation for different flow range with same gas

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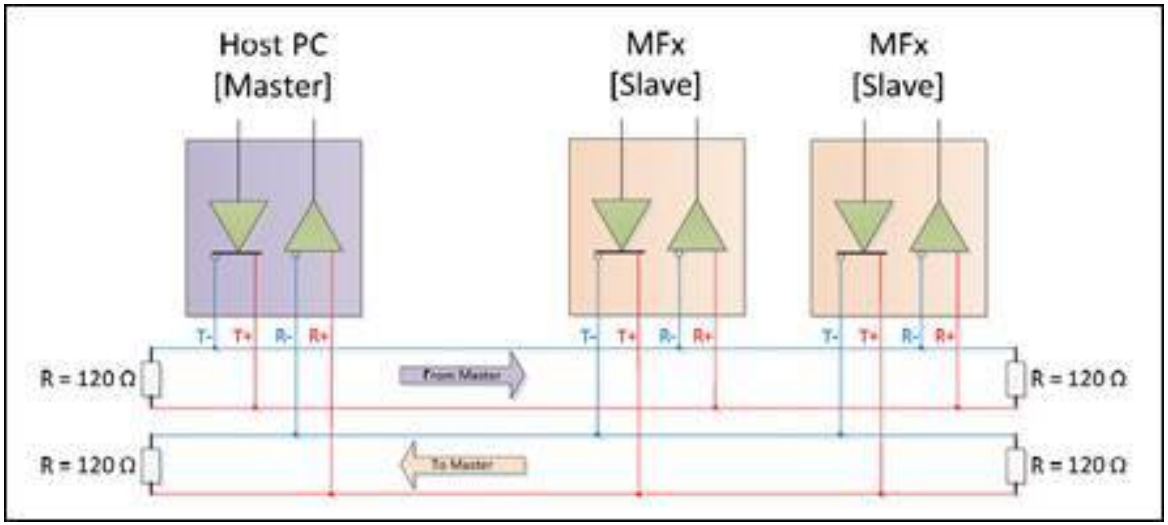
Advantage: Interfaces

- RS-232 TTL or EIA
  - Analog Output 0-5 V or 4-20 mA
- RS-485
  - Half-duplex
  - Full-duplex
- Other interfaces
  - on request



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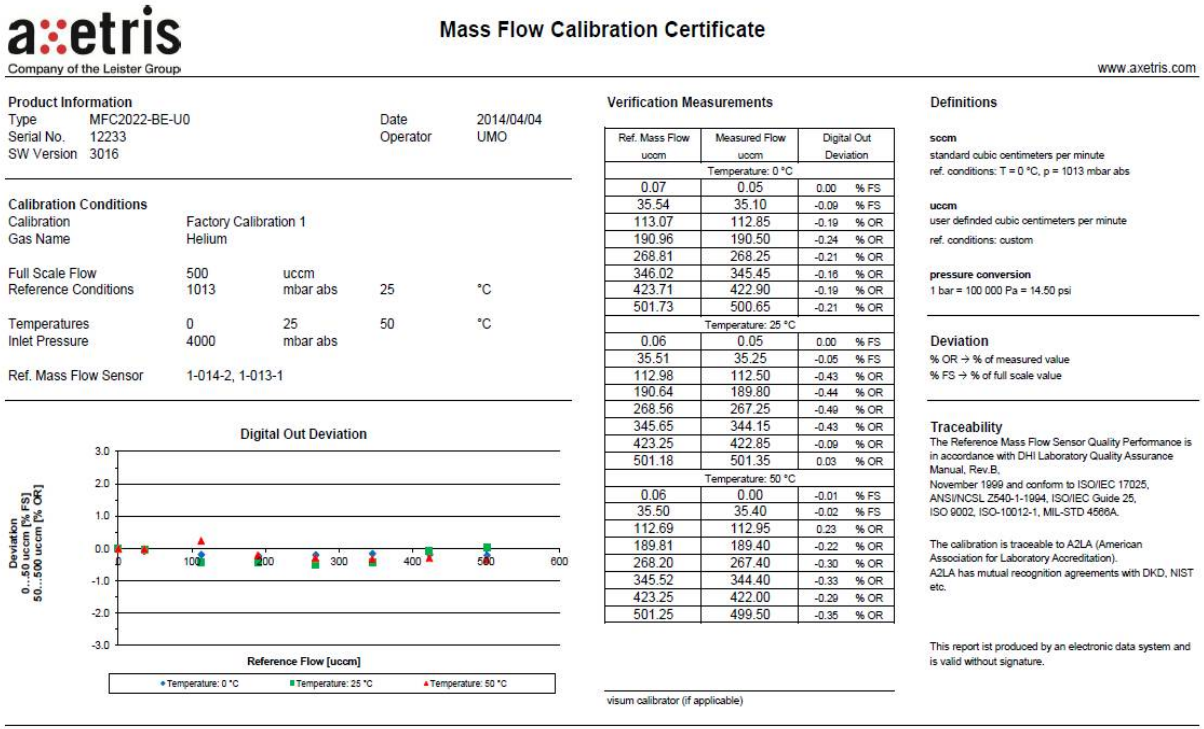
Advantage: calibration certificate

- Every MFM/MFC gets specific certificate
  - Serial number
  - Calibration date
  - Calibration curve
  - Operator ID
  - On request by pdf



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Mass Flow Calibration Certificate

www.axetris.com

Product Information

Type	MFC2022-BE-U0	Date	2014/04/04
Serial No.	12233	Operator	UMO
SW Version	3016		

Calibration Conditions

Calibration	Factory Calibration 1			
Gas Name	Helium			
Full Scale Flow	500	uccm		
Reference Conditions	1013	mbar abs	25	°C
Temperatures	0		25	50 °C
Inlet Pressure	4000	mbar abs		
Ref. Mass Flow Sensor	1-014-2, 1-013-1			

Digital Out Deviation

Verification Measurements

Ref. Mass Flow uccm	Measured Flow uccm	Digital Out Deviation	
Temperature: 0 °C			
0.07	0.05	0.00	% FS
35.54	35.10	-0.09	% FS
113.07	112.85	-0.19	% OR
190.96	190.50	-0.24	% OR
268.81	268.25	-0.21	% OR
346.02	345.45	-0.16	% OR
423.71	422.90	-0.19	% OR
501.73	500.65	-0.21	% OR
Temperature: 25 °C			
0.06	0.05	0.00	% FS
35.51	35.25	-0.05	% FS
112.98	112.50	-0.43	% OR
190.64	189.80	-0.44	% OR
268.56	267.25	-0.49	% OR
345.65	344.15	-0.43	% OR
423.25	422.85	-0.09	% OR
501.18	501.35	0.03	% OR
Temperature: 50 °C			
0.06	0.00	-0.01	% FS
35.50	35.40	-0.02	% FS
112.69	112.95	0.23	% OR
189.81	189.40	-0.22	% OR
268.20	267.40	-0.30	% OR
345.52	344.40	-0.33	% OR
423.25	422.00	-0.29	% OR
501.25	499.50	-0.35	% OR

visum calibrator (if applicable)

Definitions

sccm
standard cubic centimeters per minute
ref. conditions: T = 0 °C, p = 1013 mbar abs

uccm
user definded cubic centimeters per minute
ref. conditions: custom

pressure conversion
1 bar = 100 000 Pa = 14.50 psi

Deviation
% OR → % of measured value
% FS → % of full scale value

Traceability
The Reference Mass Flow Sensor Quality Performance is in accordance with DHI Laboratory Quality Assurance Manual, Rev.B, November 1999 and conform to ISO/IEC 17025, ANSI/NCSL Z540-1-1994, ISO/IEC Guide 25, ISO 9002, ISO-10012-1, MIL-STD 4566A.

The calibration is traceable to A2LA (American Association for Laboratory Accreditation). A2LA has mutual recognition agreements with DKD, NIST etc.

This report ist produced by an electronic data system and is valid without signature.

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Axetris Mass Flow Manifolds

OEM mass flow manifolds for specific customer needs

Advantages:

- Compact Systems to Save Space
- Easy “Plug-and-Play” Integration
- Single electronic interface to reduce integration complexity (Optional)
- Fewer interfaces to increase production yield
- Complete Solution to lower procurement costs

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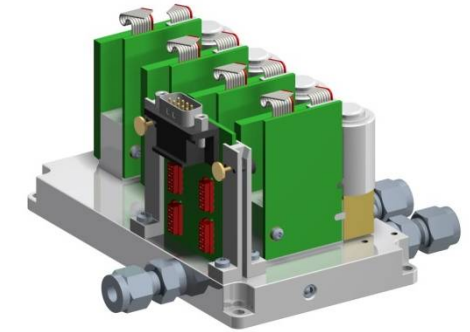
Standard Platform

Multi-Channel Manifold with up to 4 MFCs



Configuration at a Glance:

- Channels: up to 4 MFCs
- Common Electronic Interface Board
- Interface Options: RS 485 / RS 232
- Connector: Common D-Sub 9
- Configuration: Mixer or Splitter
- Thread: G1/8”, Optional Fittings

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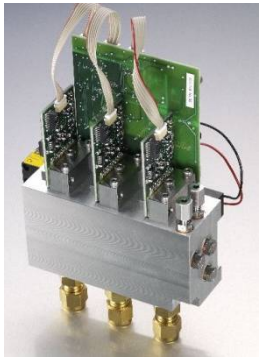
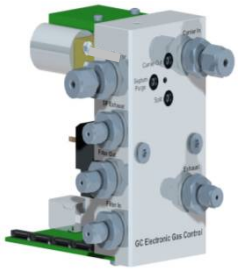
Custom Mass Flow Manifolds

Examples



Gas Mixer for Analytical Instruments
"…fast control, insensitivity against pressure pulses, high reliability"

Gas Mixer in Enclosure
"…compact size, high turn down ratio, pulsed mode available, configurable, multi gas calibration"



Electronic Pressure and Flow Control for Gas Chromatography
"…low flow control for He, H_2 and N_2, high stability and repeatability"

Mass flow controller for industrial thin film production
"…small size, very robust and reliable design"

Mass Flow Meters in 6x6 Configuration
"…compact solution, available with upto 6 flow-through channels, takes the complexity out of integration.."

Discuss your requirements with our application experts!

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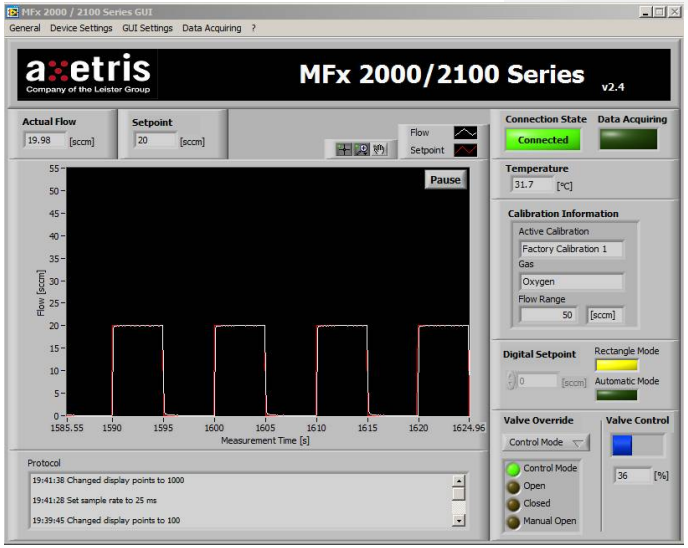
Labkit – for an easy start

- Easy creation of custom flow sequences
- Reading of the complete device
  - Type Code
  - Art. No, Config ID
  - Serial No
  - Calibration Parameters Gas
  - Range
- Protocol window
- Automatic-mode
- Delivered in one box
  - Entire controller
  - All connections
  - Software
  - Documentation



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Analytical Applications (selection)

Thermal analysis

Application
A common analytical method to study the properties of materials as they change with temperature. Gases are used as *reactive gas*, *flush gas* or *protection gas*

Requirements
Flow Range: 0..200 sccm
Gas: Air, Ar, CO_2, He, N_2, O_2, 4% H_2 in Ar.

Mass spectrometry and Atomic spectroscopy

Application
is an analytical chemistry technique that helps identify the amount and type of chemicals present in a sample

Requirements
Flow range: low flow for ICP-MS (< 20 sccm)
High range: for MS
Gas: H_2, N_2, Ar

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Analytical Applications (selection)

Gas chromatography (GC)

Application
The most common instrumental analytical technique for food, environmental, petrochemical, forensic clinical toxicology and diagnostics doping control

Requirements
Flow Range: ~ 20…250 sccm
GC carrier gas: He, H_2, N_2

Bioreactors

Application
Bioreactors / Fermentors are used to grow (controlled) micro-organisms, animal/human cells.

Requirements
Flow Range: high flow
Gas: Air, O_2, N_2, CO_2
Low Pressure

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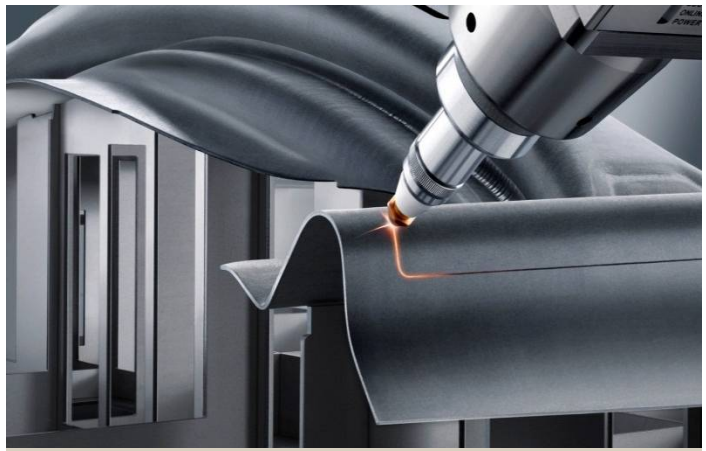
Industrial applications (selection)

Leak Tester

Application
Quality control in industrial manufacturing.
Products and systems for leak testing of automotive parts, valves, medical products etc.

Requirements
Flow range: < 100 sccm or > 5’000 sccm
Gas: Air
Insensitivity against pressure & flow pulses



CO_2 Laser

Application
CO_2, He, N_2 Gas mixer for CO_2 gas laser.
Mostly used in 2D, 3D cutting and welding machine. Main usage 2D cutting.

Requirements
Flow Range: 10 to 2’000 sccm
Most important is the accurate mix of all gases – otherwise efficiency will be lower

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Industrial Applications (selection)

Thin Film Coating

Application
in this application the mass flow controller is used to build a plasma in vacuum chamber.

Requirements
Flow Range: up to 2000 sccm
Gas: N_2, O_2, Ar
Output pressure is 0 bara (vacuum), repeatability

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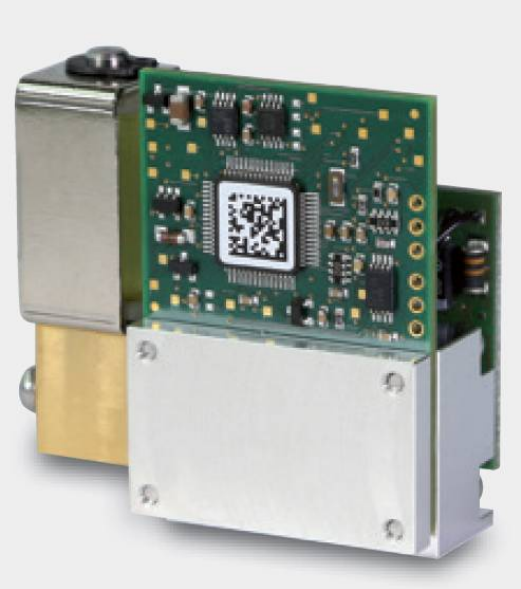
MFD Plus – Product Launch in May 2016

Full Scale Flow extended to 15,000 sccm

- Unmatched Dynamic Range
- Excellent Repeatability
- Miniature Size
- Designed for OEMs



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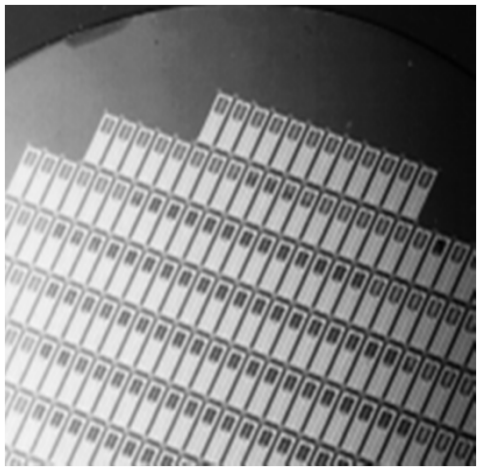
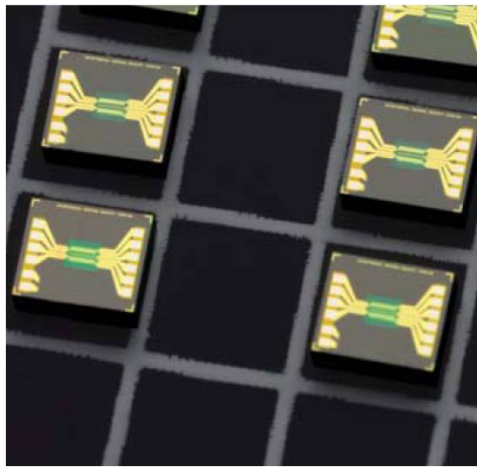
Mass flow meters, controllers and manifolds

- Key points
  - Highest repeatability and accuracy
  - Unmatched dynamic range (Better than 1000:1)
  - Compact and modular design
  - Low flow control





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Back up slides

Advantage Axetris Mass Flow Controller

Product Specification	Reference	Axetris	*Advantage Customer*
Compatible Gases	N2, Air, CO2, Ar	**N2, Air, CO2, Ar, He, H2**	*All common non-corrosive gases are supported*
Turn-Down Ratio	25:1 *(Termed Rangeability)*	**Typically 1000:1** ***(depends on gas and calibration range)***	*Excellent resolution and low flow control*
Response Time	1 sec (to within +/- 2% FS)	**<150 msec**	*Fast Control*
Repeatability	+/- 1% FS	**+/- 0.15% FS**	*Unmatched Repeatability*
Accuracy	+/- 2% FS	**+/- 0.2% FS** ***(0-10% FS)***	*Unmatched Accuracy*
Temperature Coefficient	+/- 0.1% FS/deg C	**Temperature Coefficient included in accuracy spec**	*Almost no loss of accuracy with varying temperature*
Pressure Coefficient (N2)	0.7% – 2% FS/bar	**0.2% O.R./bar**	*Almost no loss of accuracy with varying pressure*
Resolution	0.01 L	**<0.02 %FS**	*Excellent Low Flow Control*

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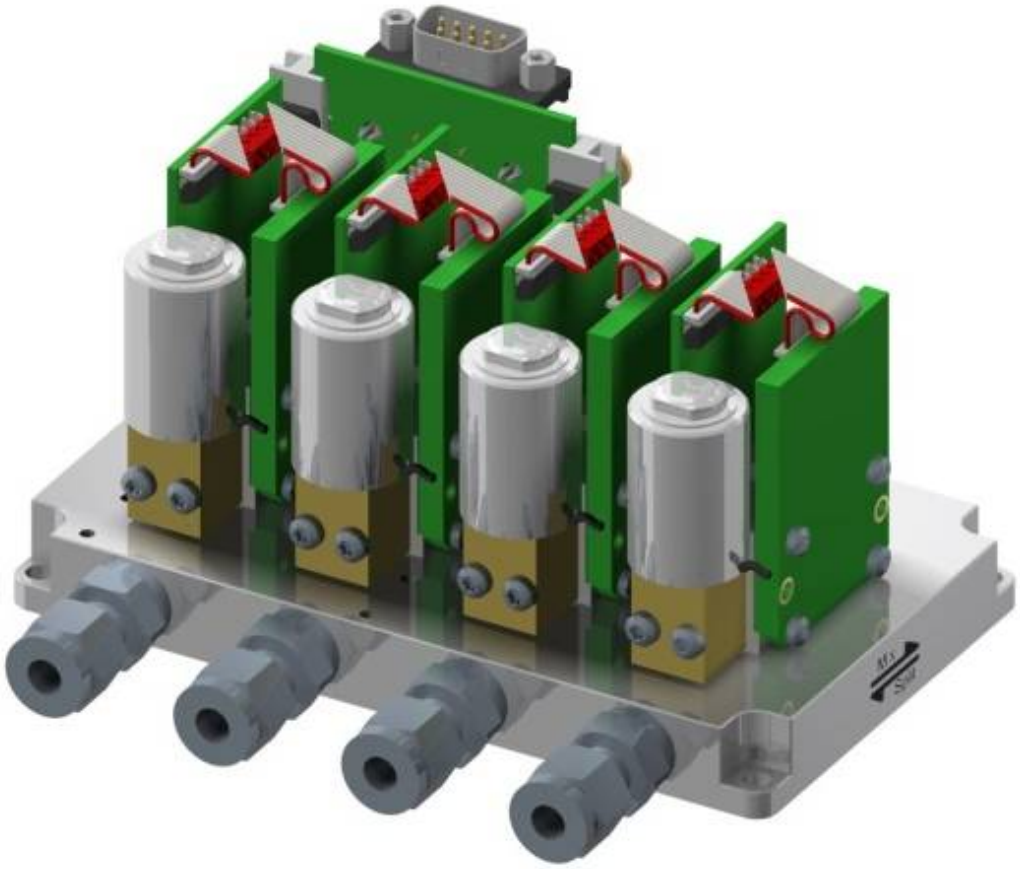
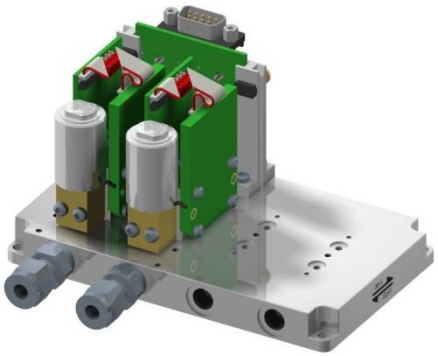
Advantage of the Axetris Gas Control System

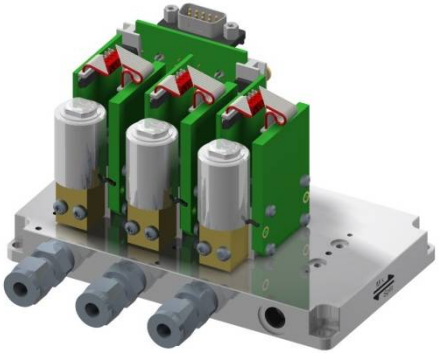
Advantage	Customer Benefit
Compact	Occupies only a small space in the customers systems. Allows to build very compact instruments or add additional functionality into existing designs. E.g. support for additional gases
Digital configuration	Saves time during installation and commissioning. Easy configuration of addresses, selection of calibration. Writing of set points and reading of measured values
Less tube connections	Higher reliability
Helium leak tested	Higher reliability
One integrated solution	Single source (less supplier)
Less fluid interfaces	Saves manufacturing and test time
Less electronic interfaces	Saves manufacturing and test time
Flexible configuration	• The same system can be ordered with 2 to 4 channels. Beside mixer-, also splitter- and direct configurations are available • If required the customer can configure the gas control system on his assembly line, by choosing the amount and the type of modules. This is specially useful if the customers end product is manufactured in multiple configurations. For example by using a 2:1 or a 4:1 mixer

Gas Control Systems: 4- channel platform





2- channel assembly option



3- channel assembly option

Remark: Typical picture only

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Appendix – Some Definitions / Remarks

Official Name:

- Mass Flow Manifolds

Configurations Available

- Mixer
- Splitter
- Direct / Flow-Through
- Customized

Axetris Type Key: MFY 20000 or 21000

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Standard Types of the 4- channel platform

Standard Types
Digital interface: RS-485 FD, one common mainboard with D-Sub 9 connector
Fluid interface: G1/8” threads

Function	Type	Electr. Inter-face		Fluid System Class		Fluid System Identifier		Electronic mainboard
Splitter	MFX 20	501	-	1440	-	AAAx	-	BBY1
Mixer	MFY 20	501	-	1440	-	AAAx	-	BBY1
Direct	MFZ 20	501	-	1440	-	AAAx	-	BBY1

Further information: see type code manifold systems

Assembly options
4: 4 MFC installed
3: 3 MFC installed
2: 2 MFC installed
Empty position closed with dummy flow channel

x: Fitting selectable

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Range Overview Modules

			Input/ Output					Supply Voltage
			Analog		Digital			
			0…5 V	4…20 mA	RS-232 TTL	RS-232	RS-485	
Meter		MFM 2020	●		●			12 V
		MFM 2021	●		●			12 V
		MFM 2220	●			●		24 V
		MFM 2240					●HD	24 V
		MFM 2250					●FD	24 V
Controller		MFC 2022	●		●			24 V
		MFC 2222	●			●		24 V
		MFC 2242					●HD	24 V
		MFC 2252					●FD	24 V

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Range Overview Stand Alone Types

			Input/ Output					Supply Voltage
			Analog		Digital			
			0…5 V	4…20 mA	RS-232 TTL	RS-232	RS-485	
Meter		MFM 2120	●			●		24 V
		MFM 2130		●		●		24 V
		MFM 2140					●HD	24 V
		MFM 2150					●FD	24 V
Controller		MFC 2122	●			●		24 V
		MFC 2132		●		●		24 V
		MFC 2142					●HD	24 V
		MFC 2152					●FD	24 V

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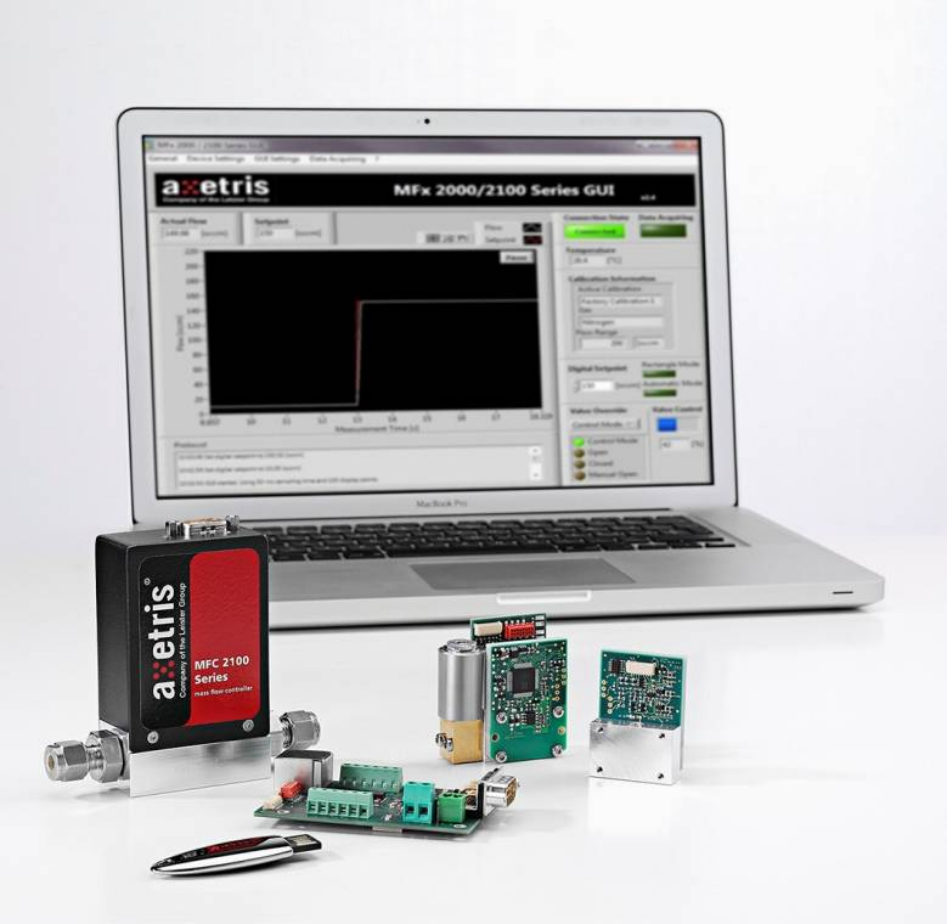
Mass flow meter or controller LabKit



Content

- Interface Board
  Configured for the MFD Device ordered
- Connection Cables
- USB Serial Converter
- LabView based Software
- Documentation
- Power Supply

Kits available for all MFM and MFC modules and stand alone products

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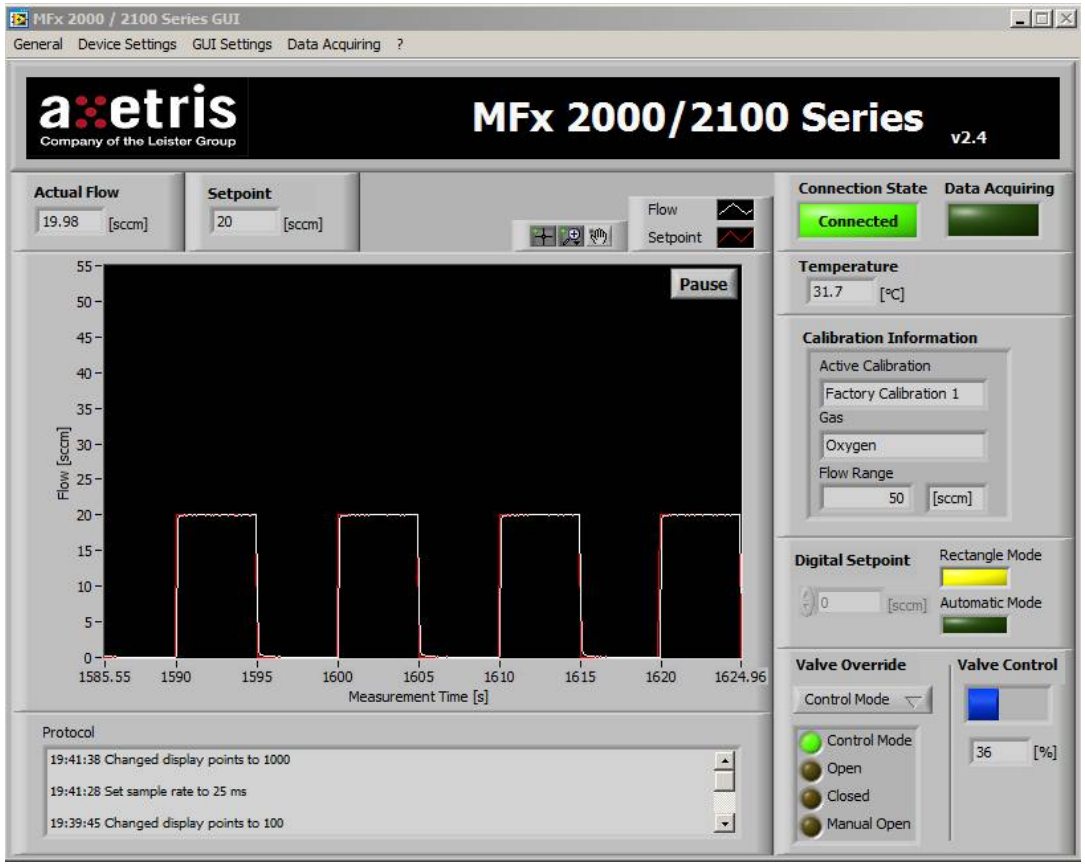
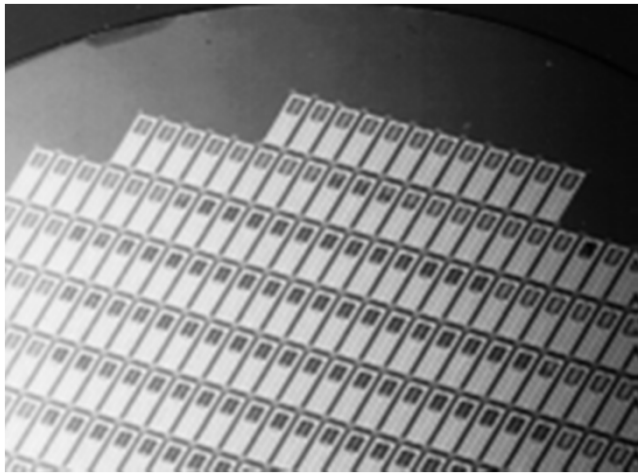
New LabView Software Rev 2.4

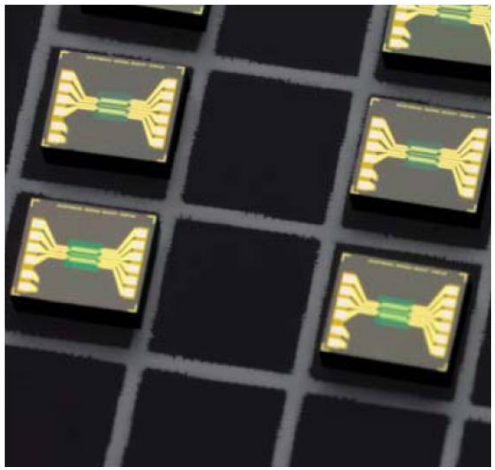


New Features

- Flow editor allows the easy creation of custom flow sequences
- Updated design for better overview and usability
- Better display on small laptop screens
- Valve override allows to set the valve into any arbitrary position
- Reading of the complete device info as: Type Code, Art. No, Config ID, Serial No, Calibration Parameters Gas, Range etc.
- Protocol window
- Many additional data logging functions
- Automatic-mode

Mass Flow Meters, Controllers and Manifolds





axetris