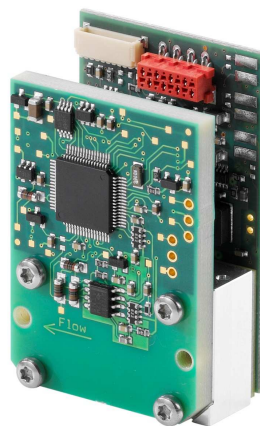


## Product Datasheet

# Mass Flow Meter modules MFM 2000 and MFM 2200 series



**Figure 1** Meter modules with RS-232 TTL Interface  
MFM 2020 and MFM 2021 (with PID controller output)



**Figure 2** Meter modules with RS-232 EIA and RS-485 Interface. MFM 2222 RS-232, MFM 2240 RS-485 half duplex, MFM 2250 RS-485 full duplex

## 1 General description

**Axetris** is offering OEM Mass Flow Meter Modules (MFM) for gases with outstanding value to the customer. The Platinum based MEMS chip technology guarantees excellent stability and repeatability over the whole flow range.

The high speed of the MEMS technology combined with smart software processing along with rigid and robust packaging makes the MFM 2000 and 2200 series an ideal choice for demanding applications.

The meter modules cover flow ranges from full scale ranges as low as 10 up to 3000 sccm, N<sub>2</sub> equivalent.

Portable applications benefit from the ultra-compact size, low weight and economical power consumption.

All MFM 2000 and 2200 modules support digital communication for configuration, to read flow and temperature and for set-point adjustment. If required, you can select another calibration curve or set the valve to fully

open/closed position (or any value in between).

The Axetris mass flow technology is already used by many major companies in the field of Gas chromatography, Leak testing, Thermo analytics, Mass spectroscopy, Thin film deposition, Plasma Engineering and more.

## Key Features

- Platinum based MEMS technology
- High accuracy and stability
- Excellent zero point stability
- Ultra-fast response time
- Excellent repeatability and reproducibility
- Ultra compact size
- Robust packaging with metal flow channel
- High dynamic range
- Flow range zooming (optional)

## Additional features

- Exceptional long term behavior
- Digitally calibrated
- Full temperature compensation (0 to 50°C)
- Multi-gas/range capability, up to 8 calibration curves
- Anemometric measurement principle
- High Precision PID controller (MFM 2021)
- Various digital and analog I/O provided
- Various optional flow interfaces
- RoHS 2011/65/EU compliant
- NIST traceable calibration

## Main Applications

- Gas chromatography
- Thermal analysis
- Mass spectroscopy
- Leak testing
- Thin-Film process control
- Plasma engineering
- Gas blender/Gas splitter
- CO<sub>2</sub> laser gas control
- Bioreactor control
- Medical applications
- Fuel cells

## 2 Type Overview

The MFM 2000 and 2200 series of mass flow meter is available with four different electronic interfaces (Table 1.) The MFM 2020 is the most economical solution and is recommended for direct connection to microprocessors with typical wiring lengths below 30 cm.

As a variant the MFM 2021 includes a PID controller. With an additional driver circuit the MFM 2021 can directly control a proportional valve or a pump.

For medium wiring distances the MFM 2222 is recommended and if you need to address several devices on a single line the MFM 2242 or MFM 2252 is the best choice. This types support also the longest connection length because of the differential mode supported by RS-485.

Type	Analog	Digital	Recommended application
MFM 2020	0...5 V	RS-232 TTL	Digital communication - short electrical connection lines below 30 cm, direct communication with microprocessor systems
MFM 2021	0...5 V	RS-232 TTL	Same as MFM 2020 but with an additional integrated PID controller
MFM 2220	0...5 V	RS-232 EIA	Digital communication single point system – medium line distances up to 15 m (EIA level), buffered, low offset analog output
MFM 2240	None	RS-485 EIA half duplex (HD)	Digital communication multi point system (up to 32 participants) - long electrical line distances (differential mode)
MFM 2250	None	RS-485 EIA full duplex (FD)	

**Table 1** Type overview MFM 2000 and 2200 mass flow meter series

### 3 Block Diagrams

#### 3.1 MFM 2020 and MFM 2200 series

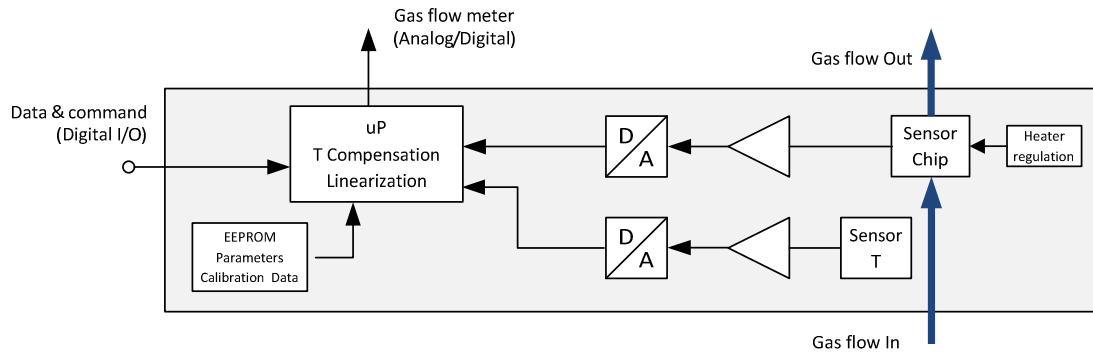


Figure 3 Block diagram of the MFM 2020 and the MFM 2200 series

#### 3.2 MFM 2021

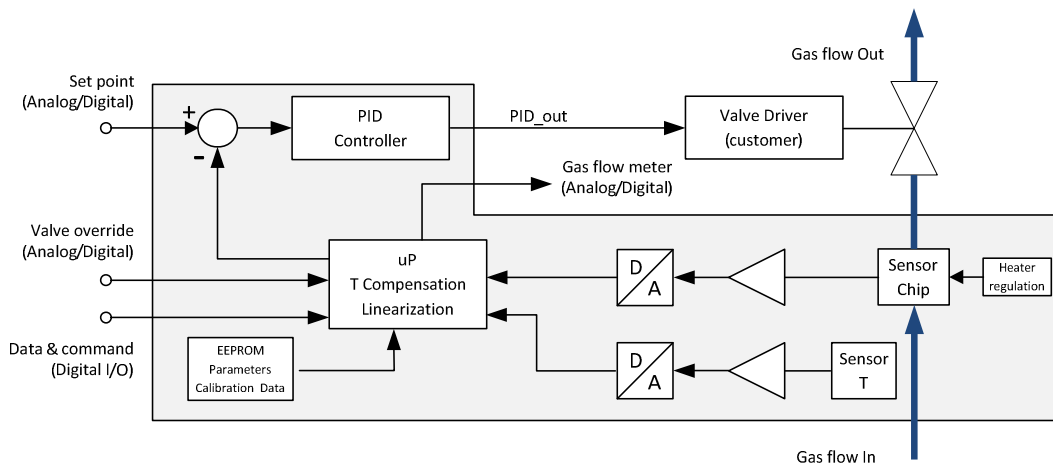


Figure 4 Block diagram of the MFM 2021

## 4 Hardware specifications

**Important:** The specification applies for the MFM calibrated with Nitrogen N<sub>2</sub> 250 sccm. Conditions: Temperature 25 °C, input pressure Pin 1 bara (absolute), vertical mounting position, digital output. For other gases and conditions or higher accuracy contact Axetris.

### 4.1 Gas flow

Parameter	Unit	Value / Range
Flow range	sccm <sup>1</sup>	0 – 50 / 0 – 250 / 0 – 3000 (N <sub>2</sub> equivalent)
Gases	-	N <sub>2</sub> , Air, O <sub>2</sub> , CO <sub>2</sub> , Ar, He, H <sub>2</sub> Clean, dry, non-corrosive gases, other gases upon request
Flow accuracy		
250 sccm F.S.	% F.S. <sup>2</sup>	± 0.2 for range 0-10% F.S.
25°C, 1 bara	% O.R. <sup>3</sup>	± 1.0 for range 10-100% F.S.
Other temperature	% F.S.	± 0.5 for range 0-10% F.S.
0...50 °C, 1 bara	% O.R.	± 2.0 for range 10-100% F.S.
Other range		
50 & 3000 sccm F.S.	-	Contact Axetris for accuracy information
Temperature coefficient	-	Temperature effects included in the accuracy spec.
Resolution	% F.S.	< 0.02
Sensor response time	ms	4
Repeatability	% F.S.	± 0.1 for range 0 - 10% F.S.
	% O.R.	± 0.1 for range 10 - 100% F.S.
Long term stability	%F.S./year	< ± 0.25
Pressure operating range	bar <sup>3</sup>	0...9
Pressure coefficient	% O.R. / bar	± 0.2
Maximum allowed flow		
up to 50 sccm F.S.	sccm	1000
250 sccm F.S.	sccm	2000
3000 sccm F.S.	sccm	10000
Pressure drop		typical values (for N <sub>2</sub> ): Other flow range upon request
250 sccm F.S.	Pa	15 at 100 sccm, 25 at 150 sccm 45 at 200 sccm, 65 at 250 sccm
Leak tightness external	mbar l/s	< 1x10 <sup>-9</sup> He
External offset zeroing <sup>4</sup>	%	< ±2 of the F.S. value
Position sensitivity	-	Standard calibration position is vertical. Other position can generate offset, see mounting instructions Figure 8

<sup>1</sup> sccm: standard cubic centimeter per minute (reference conditions: 0 °C and 1013 mbar absolute).

<sup>2</sup> % F.S.: Percent Full Scale. % O.R.: Percent Of Rate.

<sup>3</sup> Relative pressure in bar.

<sup>4</sup> Due to the extreme sensitivity of the device, be sure no flow occurs when zeroing. External zeroing is characterized for N<sub>2</sub> and Air, 25 °C, 1 bara (absolute) inlet pressure. For other gases and conditions contact Axetris. For detailed communication zeroing protocol see Axetris MFM/MFC Data Communication Specifications.

## 4.2 Environmental conditions

Parameter	Unit	Value / Range
Operating temperature	°C	0...50
Humidity	%RH	0...95, non-condensing conditions
Storage temperature	°C	-20...80

## 4.3 Electrical characteristics

Parameter	Unit	Value / Range
Voltage supply DC		
Nominal	V	12 ± 10% (MFM 2020 / 2021)
Ripple	mV	≤ 50
Current supply DC, typical	mA	< 50
Start-up time	s	3
Warm-up time		
Deviation < ±0.1% F.S.	s	15
For optimum accuracy	min	15
Analog output		
Resistive loads	kΩ	> 2
Capacitive loads	pF	< 200 (MFM 2020 / 2021)
	nF	< 100 (MFM 2220 / 2240 / 2250)
Overload protection		
Valve override, set point input	-	DC protected up to supply voltage / ESD protected
PID and gas flow output	-	ESD protected

#### 4.4 Communication interface

Parameter	Unit	Value / Range
Communication interface hardware		
MFM 2020/ MFM 2021		RS-232 TTL
MFM 2220		RS-232 EIA
MFM 2240		RS-485 half-duplex
MFM 2250		RS-485 full-duplex
Digital input		
Set point	dig.	0...65535
Valve override <sup>1</sup>	dig.	0...4095
Channel selection	dig.	1...8 <sup>2</sup>
External offset zeroing	-	Specific protocol <sup>3</sup>
Digital output		
Gas flow	dig.	0...10000 <sub>dec</sub> (0 to 100% F.S.)
Temperature	dig.	0...65535 <sup>4</sup>
Device number	-	Individual traceability, Serial number
<i>MFM 2021 only</i>		
Analog Input		
Set-point	V	0...5
Valve override <sup>1</sup>	V	0 / 5 (close / fully open in purge mode)
Cut off limit	V	1% F.S. (active on request at factory level)
<i>MFM 2020, MFM 2021, MFM 2220 only</i>		
Analog Output		
Gas flow	V	0...5
PID_Out	V	0...5 (MFM 2021)

<sup>1</sup> The digital valve override command data must be within the range (0...4095)<sub>dec</sub> to allow direct control of the external valve (PID control is off). Digital value out of this range makes the device returning in selected mode; analog or digital set point with PID control on. For details on the communication interface see Axetris MFM/MFC Data Communication Specifications.

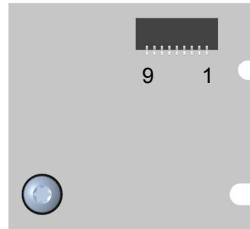
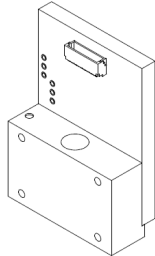
<sup>2</sup> Standard calibration is N<sub>2</sub> gas, 1013 mbar absolute, 25 °C, vertical position, one range. Multi-gas/range is available upon request.

<sup>3</sup> For digital offset zeroing protocol, see Axetris MFM/MFC Data Communication Specifications.

<sup>4</sup> For decoding digital value into degree Celsius [°C], see Axetris MFM/MFC Data Communication Specifications.

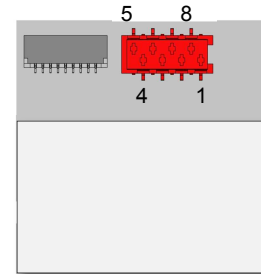
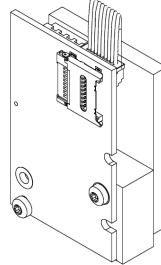
## 5 User interface pin assignment

### MFM 2020/2021 RS-232 TTL / 0...5 V



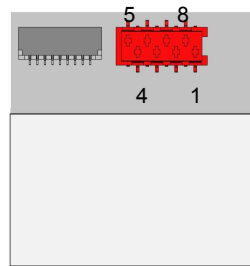
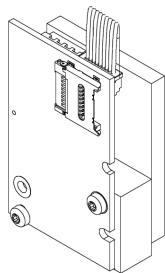
Pin	I/O Type	Description
1	Power	+ 12 V
2	Power	GND (Power)
3	Digital In	RxD_TTL
4	Digital Out	TxD_TTL
5	Analog	GND (Analog)
6	Analog Out	PID_OUT (MFM 2021)
7	Analog Out	Flow value
8	Analog In	Flow Set-point (MFM 2021)
9	Analog In	Valve Override (MFM 2021)

### MFM 2220 RS-232 EIA / 0...5 V



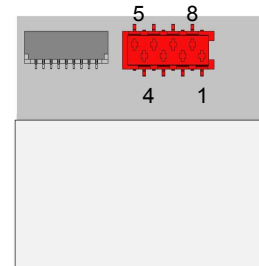
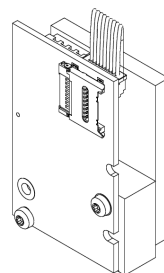
Pin	I/O Type	Description
1	Power	+ 24 V
2	Power	GND (Power)
3	Digital In	RxD
4	Digital Out	TxD
5	Analog	GND (Analog)
6	Analog Out	Flow value
7	nc	
8	nc	

### MFM 2240 RS-485 Half Duplex



Pin	I/O Type	Description
1	Power	+ 24 V
2	Power	GND
3	Digital	Non Inverting Input-Output/ D+
4	Digital	Inverting Input-Output/ D-
5	nc	
6	nc	
7	nc	
8	nc	

### MFM 2250 RS-485 Full Duplex



Pin	I/O Type	Description
1	Power	+ 24 V
2	Power	GND
3	Digital In	Non Inverting Receiver Input/ R+
4	Digital In	Inverting Receiver Input/ R-
5	nc	
6	Digital Out	Inverting Transmitter Output/ T-
7	Digital Out	Non Inverting Transmitter Output/ T+
8	nc	

**Table 2** Pin assignment

MFM 2020 and 2021, connector type JST-SM09B-SR

MFM 2222, MFM 2242, MFM 2252, connector type Micromatch 8-pole

## 6 Mechanical characteristics

### 6.1 Dimensions and weights

Type	Parameter	Unit / Range	Value
MFM 2020, MFM 2021	Size	mm	16.4 x 34 x 48.5
	Weight	g	34
MFM 2220, MFM 2240, MFM 2250	Size	mm	23 x 34 x 55
	Weight	g	47

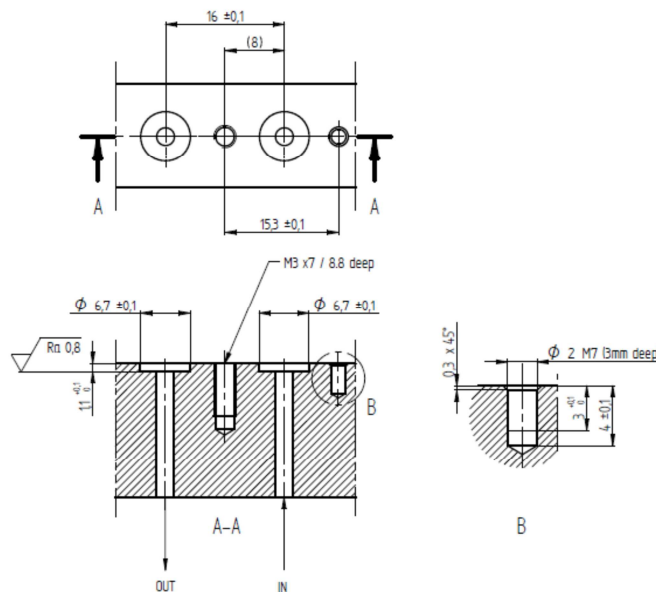
### 6.2 Flow channel and wetted materials

Parameter	Unit	Value / Range
Flow channel	-	Aluminum channel
Wetted materials	-	Aluminum, Silicon, Silicon nitride, Gold, Silicon die-attach, Epoxy, Viton™
Inlet filter	-	None, an external inlet filter (5-200 μm) is recommended
Fluidic connections	-	See mechanical interface

### 6.3 Mechanical interface

For mounting the module to a gas block, Axetris recommends for dry, non-corrosive, non-toxic and non-explosive gases the following components and mechanical interface:

- O-Ring Normatec FKM  $\varnothing_{d1}$  3.5 x  $\varnothing_{d2}$  1.5 [mm] – DIN 3771/ISO 3601/1
- Dowel pin  $\varnothing$  2m6 x 6 [mm] – DIN 6325
- Screw M3 x 20 [mm] – ISO 14583



**Figure 5** Recommended mechanical and gas interface for the MFM 2000 and MFM 2200 series



## 7 Mounting dimensions

### 7.1 MFM 2020 and MFM 2021

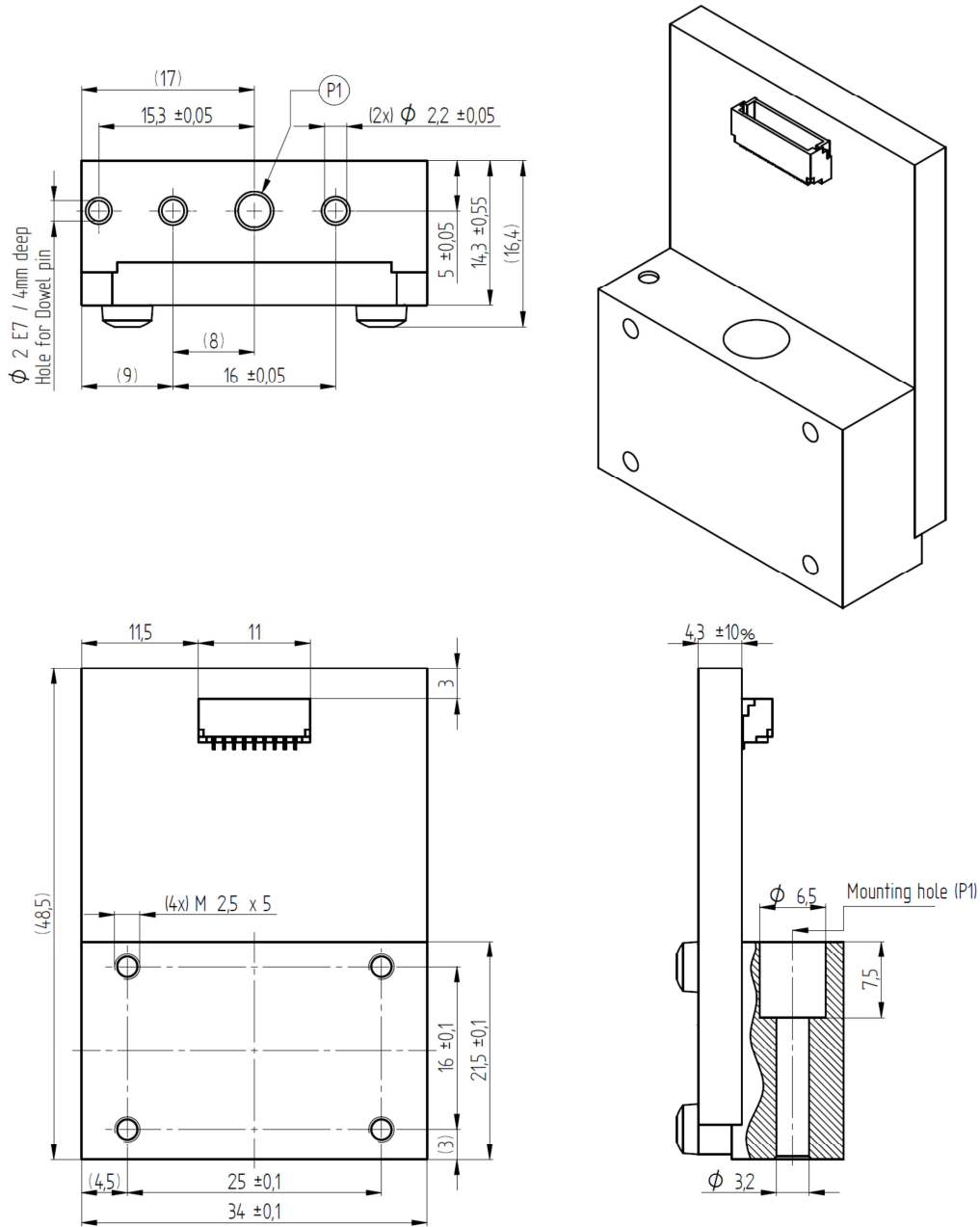
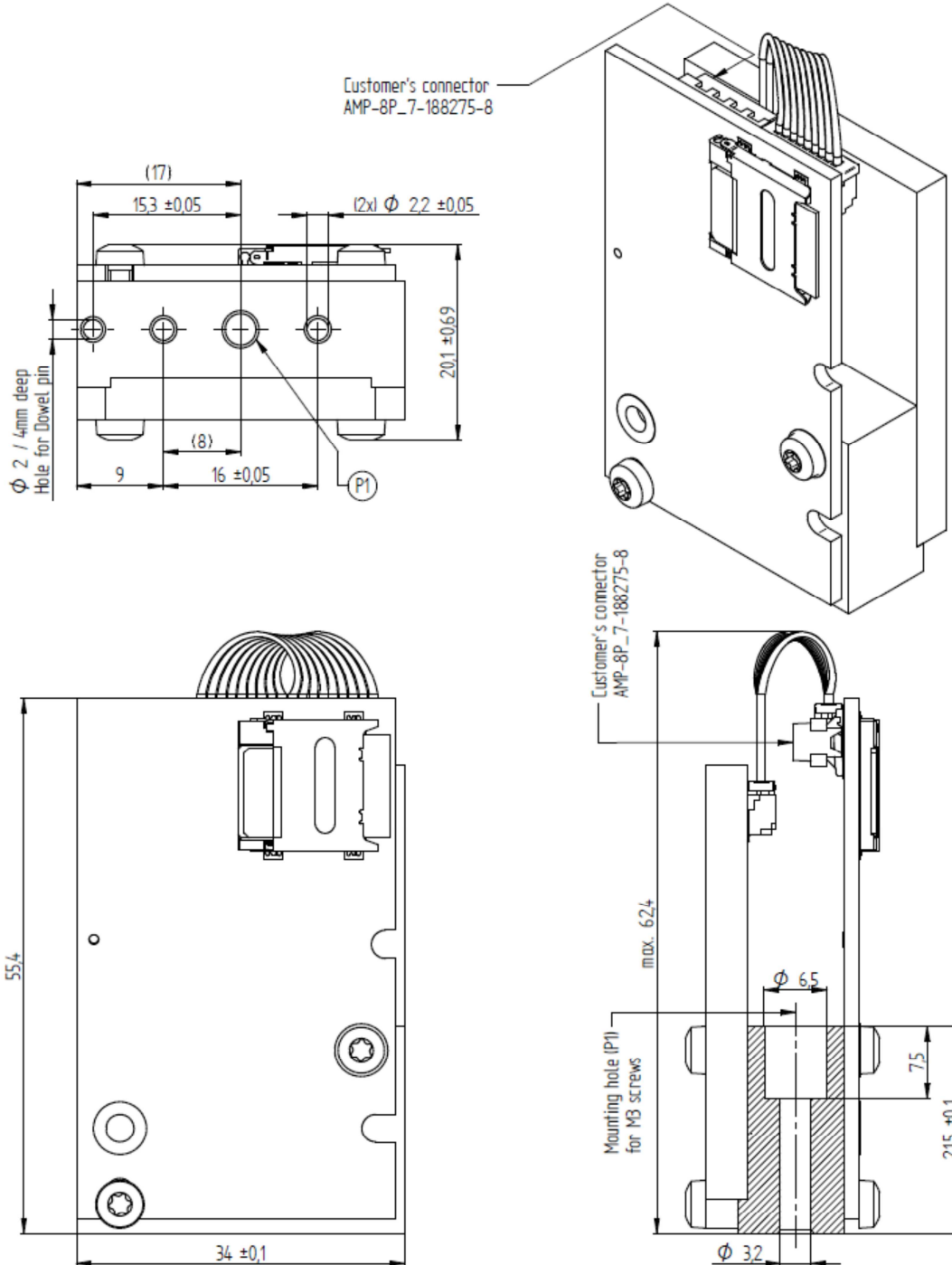


Figure 6 Mounting dimensions MFM 2020 and MFM 2021 mass flow meter modules

## 7.2 MFM 2200 series

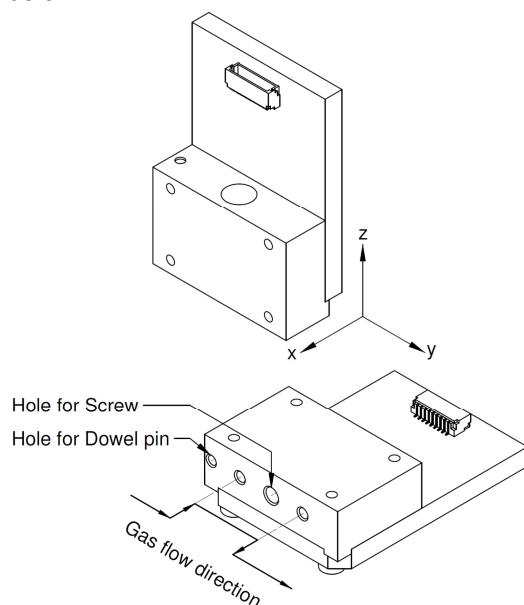


**Figure 7** Mounting dimensions MFM 2200 series

## 8 Installation instruction

The MFM 2000 / 2200 modules are calibrated in vertical position (z). All other positions can cause offset depending on pressure and gas conditions.

The device is not symmetric regarding the direction of the gas flow. Therefore the gas flow direction must be as shown in the drawing below.



**Figure 8** Gas flow direction definition and mounting position (alignment)

## 9 Electromagnetic compatibility

The MFM 2000 and 2200 modules are compact mass-flow meters specially designed for system integration. Due to the wide application and operation range, compliance with the appropriate standards is the responsibility of the equipment manufacturer.

## 10 Caution



### Product damage

- Read all instructions carefully before using the device.
- The MFM anemometric mass flow sensors are not designed to sense liquid flow and damage will result if liquid is passed through the sensor.
- The sensor is not suited for measuring aggressive or corrosive gases. Use only non-corrosive, dry, clean gases. Gas loaded with particulate particle can eventually clog the sensor.

- The appliance must not be used in damp or wet surroundings.
- Use only accessories that are indicated in the instructions for use or are recommended by the manufacturer.
- Failure to comply with these instructions could result in product damage.



### Danger of life

- These sensors employ a heated element.
- The heated element is above the ambient temperature. The sensor must not be used with flammable or explosive gases or mixtures.
- Unprofessional gas handling can cause injury or death. The use of mass flow meters should only be performed by qualified personnel.
- Do not use this product as safety or emergency stop device or in any other application where failure of the product could result in personal injury or death.

## 11 Important notice / Disclaimer

The information furnished by Axetris is believed to be correct and accurate. However, Axetris shall not be held liable to recipient or any third party of any damages, including but not limited to personal injury, property damage, loss of profits, loss of use, interrupt of business or indirect, special incidental or consequential damages, of any kind, in connection with or arising out of the furnishing, performance or use of technical data herein. No obligation or liability to recipient or any third party shall arise or flow out of Axetris rendering of technical or other services.

This technical specification may change without prior notice.

## 12 Certifications

Axetris is an ISO 9001: 2008 certified company. The MFM 2000 / 2200 series is CE and RoHS compliant.



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