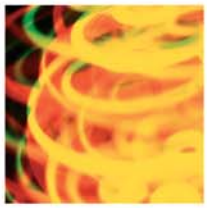

Analogue and Digital Mass Flow Meters and Controllers for Gases

MASS-STREAM™

По вопросам продаж и поддержки обращайтесь:

Волгоград +7 (8442) 45-94-42
Екатеринбург +7 (343) 302-14-75
Ижевск +7 (3412) 20-90-75
Казань +7 (843) 207-19-05
Краснодар +7 (861) 238-86-59
Красноярск +7 (391) 989-82-67
Москва +7 (499) 404-24-72
Ниж.Новгород +7 (831) 200-34-65
Новосибирск +7 (383) 235-95-48
Омск +7 (381) 299-16-70
Пермь +7 (342) 233-81-65
Ростов-на-Дону +7 (863) 309-14-65
Самара +7 (846) 219-28-25
Санкт-Петербург +7 (812) 660-57-09
Саратов +7 (845) 239-86-35
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сайт: bronkhorst.pro-solution.ru | эл. почта: brk@pro-solution.ru
телефон: 8 800 511 88 70

M+W Instruments™
Your partner

Key Facts

M+W Instruments™ was founded in 1988 and has always specialised in thermal mass flow meters and controllers for gases. Our instruments work on the basis of bypass measurement (model series D-51xx) and direct through-flow measurement following the constant temperature anemometer principle (model series D-62xx).

Since 1997 we are a subsidiary of Bronkhorst High-Tech and nowadays we cooperate with more than 30 distributors worldwide. Please visit our website www.mw-instruments.com/contact for the contact data of your local distributor. Our instruments are suitable for use in the chemical and pharmaceutical industries, in mechanical engineering and semi-industrial applications, as well as in gas production, food and beverage industries.

We are committed to a long lasting cooperation with our customers and our quality standards are specifically aimed at this.

You benefit from our well-trained and highly motivated team as well as from our standardised product range, which guarantees short delivery times. Of course we are also your competent contact for special solutions.

Content

Principle of Through-Flow Measurement

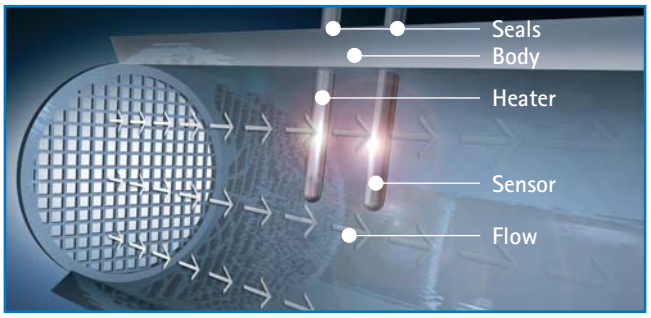
The mass flow meters and controllers consist of a metal base plate with a straight through-flow path. Two sensors are encased with stainless steel and protrude inside this bore; one is designed as a heater and the other one is designed as a temperature probe. A constant difference in temperature (ΔT) is created between the two sensors. The energy required to maintain this ΔT is dependent on the mass flow.

Both values are proportional. That means the higher the flow, the more energy is required to maintain the chosen ΔT.

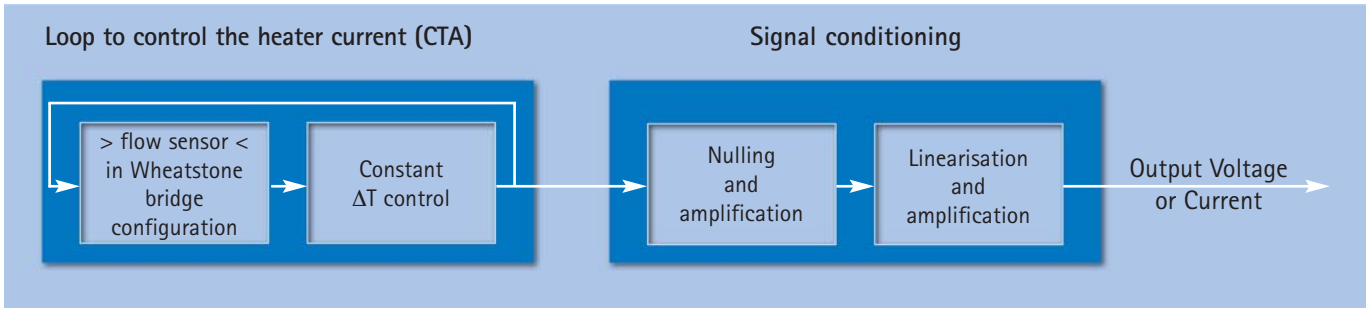
The working principle is based on King's law of the ratio between the mass flow and the heater energy:

$$P = P_0 + C\emptyset_m^{\,n}$$

P = total heater power
P_0 = heater power offset at zero flow
C = constant
$\emptyset_m$ = mass flow
n = dimensionless number (typ. 0.5)



Basic structure of the Mass-Stream™-inline flow sensor



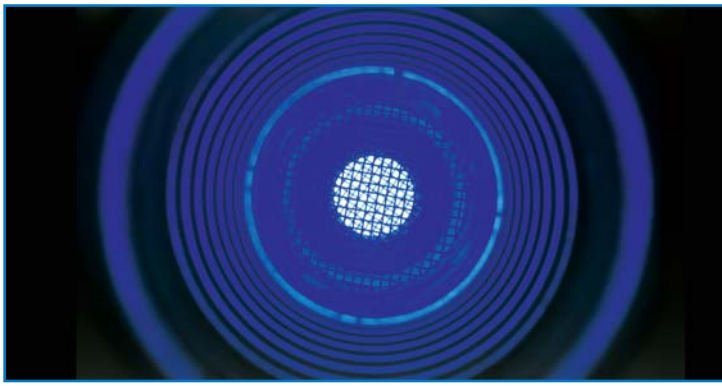
"MASS-STREAM™"
Features and Applications

Worth knowing

MASS-STREAM™ offers a new measuring principle for the mass flow of gases, relatively independent from pressure and temperature.

Smallest standard range	Highest standard range
0.005...0.1 l_n/min (Air)	300...6,000 l_n/min (Air)

Within the above mentioned borders intermediate calibrations with a 1 : 20 turn down ratio are also possible. In addition Bronkhorst High-Tech supplies instruments with smaller and higher flow ranges.



Features

- Mass flow measurement and control for a wide scope of applications
- Compact design, easily installed in virtually any position. The D-62xx series does not require inlet pipes
- Metal base plates available in Aluminium and stainless steel (AISI 316) for corrosive gases
- Direct inline measurement principle (D-62xx model series)
  - Low sensitivity to dirt
  - Low sensitivity to humidity
- Electronic alternative to VA meters (variable area meters)
- Measurement without moving parts

Applications

- Measurement and control technology
- Gas monitoring systems
- Gas consumption measurement
- Paint-spray lines
- Coating plants
- Analytical instruments
- Exhaust gas measurement
- Mechanical engineering
- N2/O2 – generators
- Burner controls
- And much more

Options

- "Low ΔP"-version
- Integrated actual display
- Totalisation with display
- Integrated set point potentiometer
- Readout systems
- Further options on request

Mass Flow Meters (MFM)
- analogue design -

Principle of Operation

Mass-Stream™ mass flow meters are cost-efficient and reliable. They are suitable for all kinds of applications where VA meters have been used so far, e. g. in industrial and medical applications or in laboratory equipment. Basically they are available with or without integrated 3 1/2 digit display or 8 digit summary.

Our model series D-62x0, where the through-flow measurement principle is applied, work within measurement ranges of 10 l_n/min Air up to 6,000 l_n/min Air (full scale range).

For smaller flow ranges our model series D-51xx with the bypass measurement principle is applied.

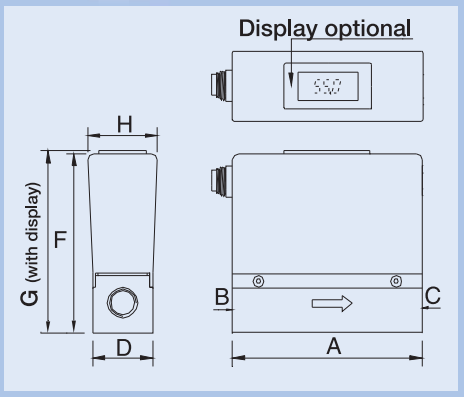
Mass-Stream™ mass flow meters have no moving parts in contrast to VA meters and a small pressure drop. The design of our instruments is very straightforward and allows the installation in almost any position. While using VA meters, where a volumetric measurement principle is applied, any alteration of the conditions can result in measurement errors.

Standard Measurement Ranges

Mass Flow Meters Model		Flow capacitiy (Air) (intermediate ranges available)	
D-5110 - ◆◆◆ - BB - ◆◆ -	12 - ◆ - ◆ - ◆	0.005...0.1	l_n/min Air
	22	0.010...0.2	l_n/min Air
	52	0.025...0.5	l_n/min Air
	13	0.05...1.0	l_n/min Air
	23	0.1...2.0	l_n/min Air
	53	0.25...5.0	l_n/min Air
	14	0.5...10.0	l_n/min Air
D-6210 - ◆◆◆ - BB - ◆◆ -	14 - ◆ - ◆ - ◆	0.5...10	l_n/min Air
	24	1.0...20	l_n/min Air
D-6230 - ◆◆◆ - BB - ◆◆ -	24 - ◆ - ◆ - ◆	1.0...20	l_n/min Air
	54	2.5...50	l_n/min Air
	15	5.0...100	l_n/min Air
D-6250 - ◆◆◆ - CC - ◆◆ -	15 - ◆ - ◆ - ◆	5.0...100	l_n/min Air
	25	10...200	l_n/min Air
	45	20...400	l_n/min Air
D-6270 - ◆◆◆ - CC - ◆◆ -	45 - ◆ - ◆ - ◆	20...400	l_n/min Air
	16	50...1,000	l_n/min Air
	26	100...2,000	l_n/min Air
D-6280 - ◆◆◆ - DD - ◆◆ -	26 - ◆ - ◆ - ◆	100...2,000	l_n/min Air
	46	200...4,000	l_n/min Air
	56	250...5,000	l_n/min Air
D-6290 - ◆◆◆ - DD - ◆◆ -	56 - ◆ - ◆ - ◆	250...5,000	l_n/min Air
	66	300...6,000	l_n/min Air

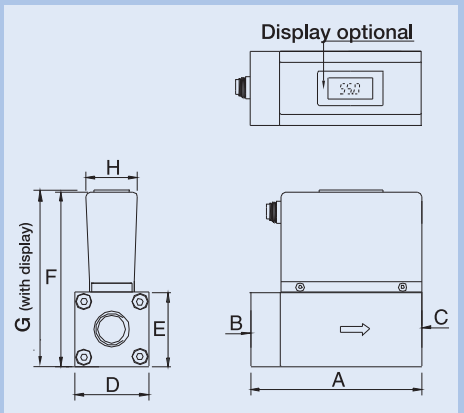
Other gas connections on request.

Model D-6210 MFM



Model	A	B	C	D	F	G	H
D-5110	95	G1/4"	G1/4"	30	94,5	95,5	35
D-6210	95	G1/4"	G1/4"	30	94,5	95,5	35
D-6230	95	G1/4"	G1/4"	30	94,5	95,5	35
D-6250	95	G1/2"	G1/2"	30	98,5	99,5	35

Model D-6270 MFM with LCD display



Model	A	B	C	D	E	F	G	H
D-6270	116	G1/2"	G1/2"	50	50	122,5	123,5	35
D-6280	130	G1"	G1"	70	70	142,5	143,5	35
D-6290	160	G1"	G1"	99,5	99,5	172	173	35

Technical changes and alterations in construction are reserved.

Mass Flow Controllers (MFC)
- analogue design -

Principle of Operation

Based on the concepts of our mass flow meters compact MASS-STREAM™ mass flow controllers are also available.

Up to flows of 400 l_n/min Air equivalent the modular constructed solenoid valve is integrated onto the metal base plate. For higher flows external valves are applied.

The following kv-values are available as a standard: 6.6 x 10^{-2}; 0.3; 1.0.

The control of higher gas flows is possible by using separate valves with kv-values of 2.8; 3.4 and 4.4. (Additional special valves and combinations on request.)

Features

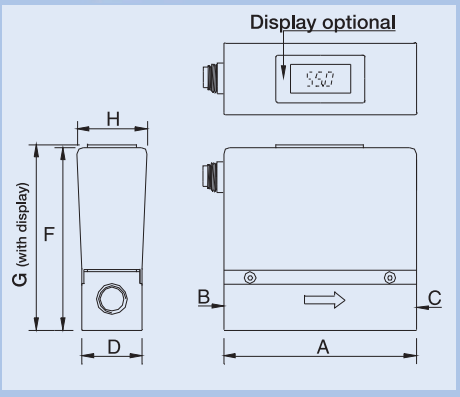
- Usable for virtually every kind of gas or gas-mix
- No moving parts
- Good response times
- Sensor made of stainless steel
- Installable in virtually any position
- No inlet pipes needed (model series D-62xx)
- Optional with integrated flow display or totalisation display
- Maintenance-free
- Two base plate materials on stock (others on request)

Standard Measurement Ranges

Mass Flow Controllers Model		Flow capacitiy (Air) (intermediate ranges available)	
D-5111	- ◆◆◆ - BB - ◆◆ -12 - ◆ - ◆ - ◆	0.005...0.1	l_n/min Air
	22	0.010...0.2	l_n/min Air
	52	0.025...0.5	l_n/min Air
	13	0.05...1.0	l_n/min Air
	23	0.1...2.0	l_n/min Air
	53	0.25...5.0	l_n/min Air
	14	0.5...10.0	l_n/min Air
D-5121	- ◆◆◆ - CB - ◆◆ -14 - ◆ - ◆ - ◆	0.5...10	l_n/min Air
	24	1.0...20	l_n/min Air
	54	2.5...50	l_n/min Air
D-6211	- ◆◆◆ - BB - ◆◆ -14 - ◆ - ◆ - ◆	0.5...10	l_n/min Air
	24	1.0...20	l_n/min Air
D-6231	- ◆◆◆ - BB - ◆◆ -24 - ◆ - ◆ - ◆	1.0...20	l_n/min Air
	54	2.5...50	l_n/min Air
	15	5.0...100	l_n/min Air
D-6251	- ◆◆◆ - CC - ◆◆ -15 - ◆ - ◆ - ◆	5.0...100	l_n/min Air
	25	10...200	l_n/min Air
	45	20...400	l_n/min Air
D-6271/004	- ◆◆◆ - CC - ◆◆ -45 - ◆ - ◆ - ◆	20...400	l_n/min Air
	16	50...1,000	l_n/min Air

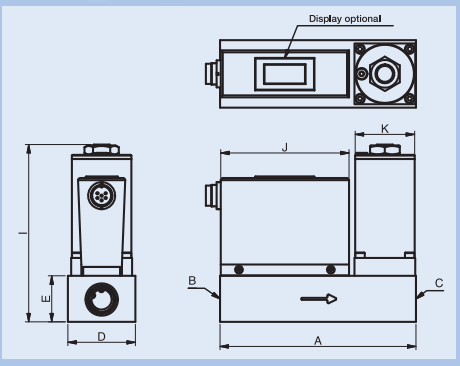
Other gas connections on request.

Model D-5121 MFC with LCD display



Model	A	B	C	D	F	G	H
D-5111	95	G1/4"	G1/4"	30	94,5	95,5	35
D-5121	95	G1/2"	G1/4"	30	97	98	35
D-6211	95	G1/4"	G1/4"	30	94,5	95,5	35
D-6231	95	G1/4"	G1/4"	30	94,5	95,5	35

Model D-6251 MFC



Model	A	B	C	D	E	I	J	K
D-6251	145	G1/2"	G1/2"	50	34	131	95	44
D-6271	Dimensions on request							
D-6281	Dimensions on request							
D-6291	Dimensions on request							

Technical changes and alterations in construction are reserved.

Mass Flow Meters (MFM)
- digital design -

Principle of Operation

All Mass-Stream™ mass flow meters and controllers are also available in a digital design. The Mass-Stream™ digital model series is operated with a digital pc-board with all functions for the flow measurement and control. Due to the modular construction commonly used analogue input / output signals and a RS232 interface are supplied as well as the additional interfaces Profibus-DP®, DeviceNet™, Flow-Bus or MODBUS protocols.

The Mass-Stream™ digital model series is characterised by a high degree of signal integrity and up to 8 calibration curves of different gases can be memorised in the instrument.

For the instrument adaption to a wide range of different process conditions our customers are offered the possibility to adjust, to optimise and to evaluate the parameters and control characteristics remote on site. The referring software is a basic part of our scope of supply of digital mass flow meters and controllers, as well as the calibration certificate, the 8-pin connector for the electrical connection and the software and documentation on CD.

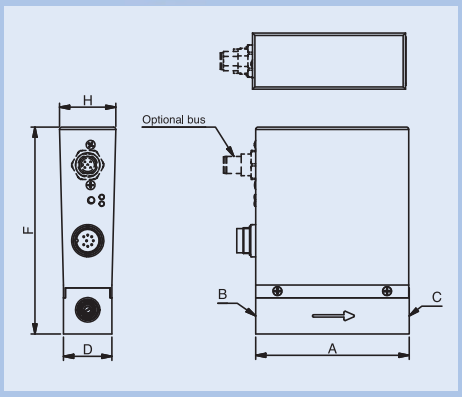
When ordering a digital instrument please forward the required specification of the preferred presetting (analogue or digital input / output signals).

Standard Measurement Ranges

Mass Flow Meters Model		Flow capacitiy (Air) (intermediate ranges available)	
D-5110 - ◆◆◆ - BB - ◆◆ -	12 - ◆ - ◆ - D◆	0.005...0.1	l_n/min Air
	22	0.010...0.2	l_n/min Air
	52	0.025...0.5	l_n/min Air
	13	0.05...1.0	l_n/min Air
	23	0.1...2.0	l_n/min Air
	53	0.25...5.0	l_n/min Air
	14	0.5...10.0	l_n/min Air
D-6210 - ◆◆◆ - BB - ◆◆ -	14 - ◆ - ◆ - D◆	0.5...10	l_n/min Air
	24	1.0...20	l_n/min Air
D-6230 - ◆◆◆ - BB - ◆◆ -	24 - ◆ - ◆ - D◆	1.0...20	l_n/min Air
	54	2.5...50	l_n/min Air
	15	5.0...100	l_n/min Air
D-6250 - ◆◆◆ - CC - ◆◆ -	15 - ◆ - ◆ - D◆	5.0...100	l_n/min Air
	25	10...200	l_n/min Air
	45	20...400	l_n/min Air
D-6270 - ◆◆◆ - CC - ◆◆ -	45 - ◆ - ◆ - D◆	20...400	l_n/min Air
	16	50...1,000	l_n/min Air
	26	100...2,000	l_n/min Air
D-6280 - ◆◆◆ - DD - ◆◆ -	26 - ◆ - ◆ - D◆	100...2,000	l_n/min Air
	46	200...4,000	l_n/min Air
	56	250...5,000	l_n/min Air
D-6290 - ◆◆◆ - DD - ◆◆ -	56 - ◆ - ◆ - D◆	250...5,000	l_n/min Air
	66	300...6,000	l_n/min Air

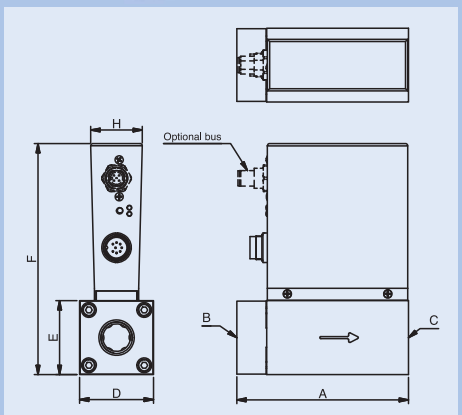
Other gas connections on request.

Model D-5110 MFM digital



Model	A	B	C	D	F	H
D-5110	95	G1/4"	G1/4"	30	128,5	35
D-6210	95	G1/4"	G1/4"	30	128,5	35
D-6230	95	G1/4"	G1/4"	30	128,5	35
D-6250	95	G1/2"	G1/2"	30	132,5	35

Model D-6270 MFM digital



Model	A	B	C	D	E	F	H
D-6270	116	G1/2"	G1/2"	50	50	156,5	35
D-6280	130	G1"	G1"	70	70	176,5	35
D-6290	160	G1"	G1"	99,5	99,5	206	35

Technical changes and alterations in construction are reserved.

Mass Flow Controllers (MFC)
- digital design -

Principle of Operation

Comparable to our analogue model series compact control units for our MASS-STREAM™ digital series are also available.

Up to flows of 400 l_n/min Air equivalent the modular constructed solenoid valve is integrated onto the metal base plate. For higher flows external valves are applied.

The following kv-values are available as a standard: 6.6 x 10^{-2}; 0.3; 1.0.

The control of higher gas flows is possible by using separate valves with kv-values of 2.8; 3.4 and 4.4. (Additional special valves and combinations on request.)

Features

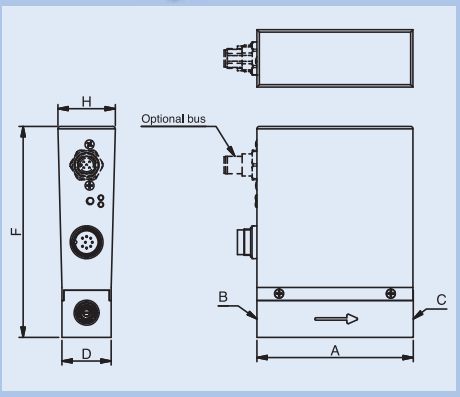
- Usable for virtually every kind of gas or gas-mix
- No moving parts
- Good response times
- Sensor made of stainless steel
- Installable in virtually any position
- No inlet pipes needed (model series D-62xx)
- Maintenance-free
- Two base plate materials on stock (others on request)

Standard Measurement Ranges

Mass Flow Controllers Model		Flow capacitiy (Air) (intermediate ranges available)	
D-5111	- ◆◆◆ - BB - ◆◆ -12 - ◆ - ◆ - D◆	0.005...0.1	l_n/min Air
	22	0.010...0.2	l_n/min Air
	52	0.025...0.5	l_n/min Air
	13	0.05...1.0	l_n/min Air
	23	0.1...2.0	l_n/min Air
	53	0.25...5.0	l_n/min Air
	14	0.5...10.0	l_n/min Air
D-5121	- ◆◆◆ - CB - ◆◆ -14 - ◆ - ◆ - D◆	0.5...10	l_n/min Air
	24	1.0...20	l_n/min Air
	54	2.5...50	l_n/min Air
D-6211	- ◆◆◆ - BB - ◆◆ -14 - ◆ - ◆ - D◆	0.5...10	l_n/min Air
	24	1.0...20	l_n/min Air
D-6231	- ◆◆◆ - BB - ◆◆ -24 - ◆ - ◆ - D◆	1.0...20	l_n/min Air
	54	2.5...50	l_n/min Air
	15	5.0...100	l_n/min Air
D-6251	- ◆◆◆ - CC - ◆◆ -15 - ◆ - ◆ - D◆	5.0...100	l_n/min Air
	25	10...200	l_n/min Air
	45	20...400	l_n/min Air
D-6271/004	- ◆◆◆ - CC - ◆◆ -45 - ◆ - ◆ - D◆	20...400	l_n/min Air
	16	50...1,000	l_n/min Air

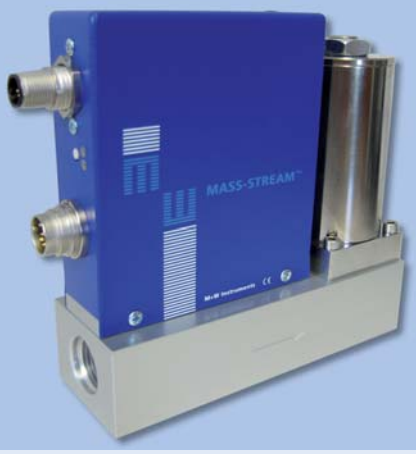
Other gas connections on request.

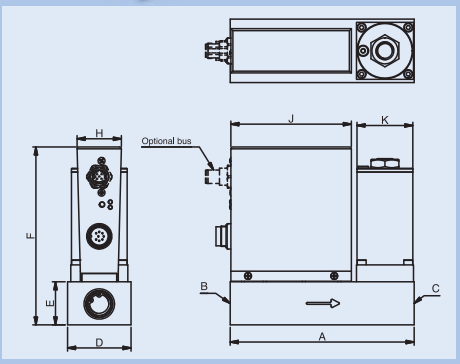
Model D-5121 MFC digital



Model	A	B	C	D	F	H
D-5111	95	G1/4"	G1/4"	30	128,5	35
D-5121	95	G1/2"	G1/4"	30	131	35
D-6211	95	G1/4"	G1/4"	30	128,5	35
D-6231	95	G1/4"	G1/4"	30	128,5	35

Model D-6251 MFC digital





Model	A	B	C	D	E	F	H	J	K
D-6251	145	G1/2"	G1/2"	50	34	140,5	35	95	44
D-6271	Dimensions on request								
D-6281	Dimensions on request								
D-6291	Dimensions on request								

Technical changes and alterations in construction are reserved.

Readout Systems
with integrated Power Supply

General

This standardised series of readout systems can be applied for analogue mass flow meters and controllers. The most commonly used functions are offered in compact single channel table top housings, DIN panel mount cassette and multi channel versions in 1/2 19" or 19" table top or rack housings.

Functions

- Power supply for MFM / MFC
- Indication of actual flow
- Indication of totalisation (counter)
- Set point potentiometer

Electrical Data

- Power supply 100...240 Vac at 50/60 Hz converted into 24 Vdc, 1 A
- Suitable for the connection of instruments with 0...5 Vdc input/output signal and 24 Vdc power supply
- 9-pin sub-D connector for the instrument connections
- Max. load per channel: 0,5 A at +24 Vdc

Model Number Identification

Code		Housing	
D - 11		1/2 19" table housing	42 TE
D - 12		19" table housing	84 TE
D - 13		1/2 19" rack	42 TE
D - 14		19" rack	84 TE
D - 15		Table top cassette	14 TE
D - 16		Panel mount cassette	14 TE
	Code	**Supply voltage**	
	- 00	100...240 Vac	
		Code	**Modules with blank front (14TE)**
		- 00	Rear panel with power supply + protection + mains cable
		- 01	Rear panel with additional power supply and sub-D socket
		- 02	Rear panel with sub-D socket
		- 03	Rear panel blank
		Code	**Modules with actual flow indication (14TE)**
		- 10	Rear panel with power supply + protection + mains cable
		- 11	Rear panel with additional power supply and sub-D socket
		- 12	Rear panel with sub-D socket
		- 13	Rear panel blank
		Code	**Modules with totalised flow indication (14TE)**
		- 20	Rear panel with power supply + protection + mains cable
		- 21	Rear panel with additional power supply and sub-D socket
		- 22	Rear panel with sub-D socket
		- 23	Rear panel blank
		Code	**Modules with actual flow indication and control potentiometer (14TE)**
		- 30	Rear panel with power supply + protection + mains cable
		- 31	Rear panel with additional power supply and sub-D socket
		- 32	Rear panel with sub-D socket
		- 33	Rear panel blank
		Code	**Modules with totalised flow indication and control potentiometer (14TE)**
		- 40	Rear panel with power supply + protection + mains cable
		- 41	Rear panel with additional power supply and sub-D socket
		- 42	Rear panel with sub-D socket
		- 43	Rear panel blank

Model D-15

Model D-11

Model D-14

Technical changes and alterations in construction are reserved.

Conversion Factor

MASS-STREAM™ mass flow meters and controllers are basically calibrated on air.
If other gases or gas mixtures are used a conversion factor CF has to be applied. This factor is determined by applying a complex formula. For a number of commonly used gases you will find the value in the chart below.

Conversion Factor Table

(L_n: 1013 mbar and 0°C air temperature) - Please also refer to www.fluidat.com

Series / Gas	D-62xx	D-51xx	Series / Gas	D-62xx	D-51xx
Air	1.00	1.00	H_2	-.--	1.01
Ar	2.01	1.40	He	-.--	1.41
CH_4	0.67	0.76	HCL	1.58	0.99
C_2H_2	0.75	0.61	N_2	1.00	1.00
C_2H_4	0.89	0.60	NH_3	0.80	0.77
C_2H_6	0.89	0.60	NO	1.02	0.97
C_3H_8	0.63	0.34	N_2O	1.15	0.71
C_4H_{10}	0.42	0.25	N_2O_2	1.00	1.00
C_5H_{12}	0.25	0.21	O_2	0.98	0.98
CO	1.04	1.00	Xe	6.08	1.38
CO_2	1.20	0.74	Conversion factor for other gases on request.		

Above mentioned values are only regarded as an indication. The exact conversion factors are significantly dependent on the process parameters, like media temperature and operating pressure, and on the physical characteristics of the gas.

The best accuracy can be obtained by calibrating the instrument under operating conditions. The conversion factor causes an additional error in the absolute accuracy. With a conversion factor >1 this error is 2 x CF (in % FS) and with a conversion factor <1 this error is 2/CF (in % FS).

Flow Profile and Sensitivity

In general mass flow measurement is very sensitive to variations of the shape of the flow profile. In comparable instruments, which do not consist of such precautions for these effects of inlet piping conditions, some severe variations in the accuracy might occur.

The MASS-STREAM™ flow meters are designed for a consistent, fully developed flow profile in the metering section and they are thus virtually insensitive to changes of the inlet piping conditions.

Pressure Loss

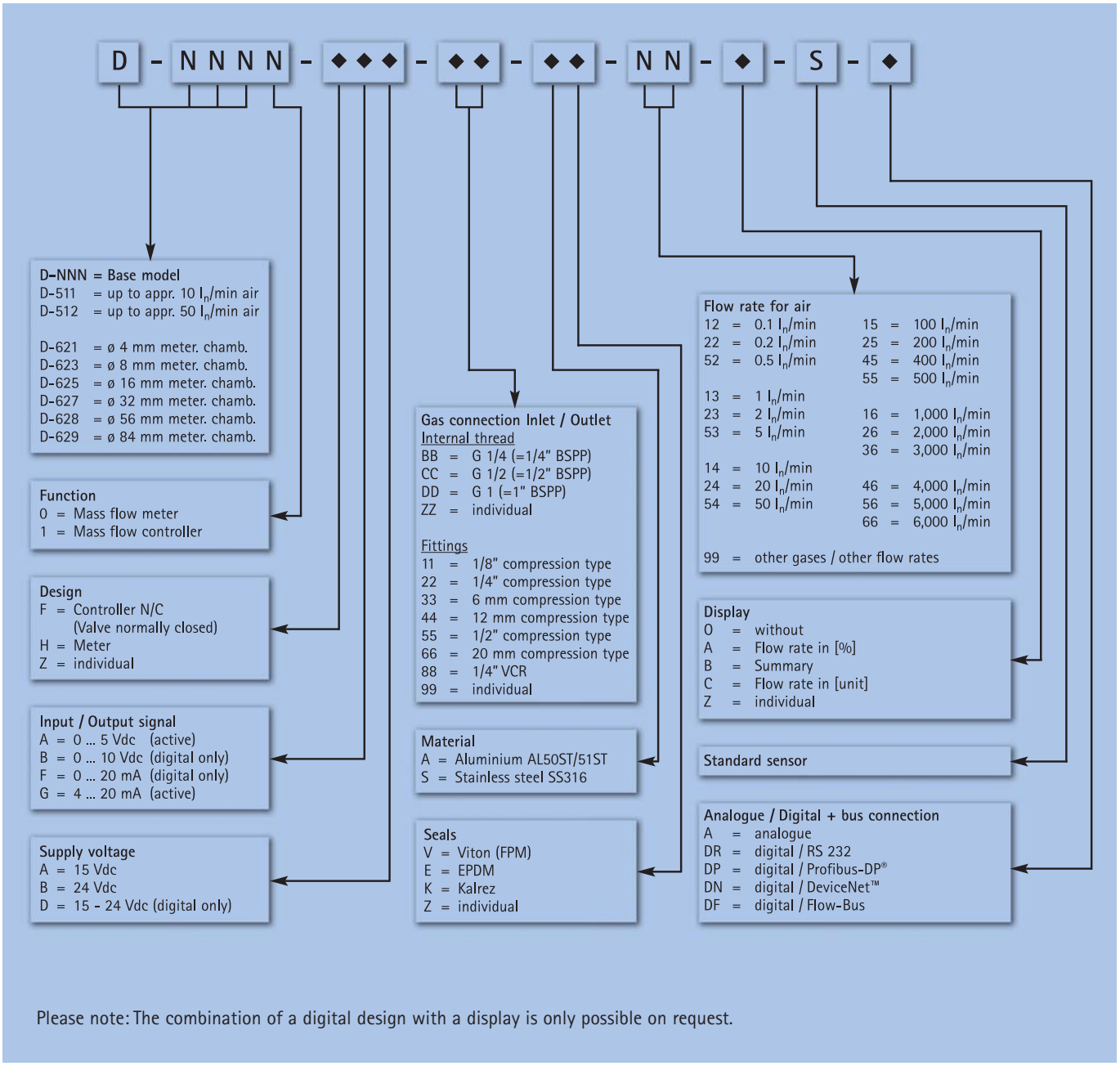
The pressure drop over the instrument's D-62xx measurement chamber is almost comparable to a straight run of pipe of the same diameter and is thus negligible. However, to make the instruments insensitive to upstream piping configurations, a number of mesh screens are required to condition the flow profile. These meshes create a certain pressure drop.

Also the often used compression type connections cause a significant additional pressure loss.

By reducing the number of mesh screens and using an inlet pipe the pressure loss can be significantly minimised as an option. In addition we recommend the use of fittings with maximum possible diameter.

Model Number Identification

MASS-STREAM™ Model Numbers and Options



Please note: The combination of a digital design with a display is only possible on request.

Enquiry and Order Information

In order to supply the correct instrument for your application please forward the following data:
Type of gas, flow range, operating temperature and pressure (for controllers supply and back pressure), electrical connection, desired output signal, type of gas connections (fittings) and seals.

Based on this information the following calculations and checks will be carried out:

- Conversion of the requested flow to the Air-equivalent flow (the requested flow is divided by the referred conversion factor).
- For mass flow controllers only:
  - Check if the differential pressure over the valve (ΔP) is within the allowed limits.
  - Check if the calculated kv-value is within the specification.

Technical Specifications

Measurement System

Accuracy (based on Air calibration)	± 3 % FS including non-linearity (better accuracy on request)
Repeatability	± 0.5 % FS
Time constant sensor (63.2 %)	$\tau \leq 2$ sec.
Pressure sensitivity	± 0.3 % / bar typical (Air)
Temperature sensitivity	± 0.3 % / °C (Air)
Leak integrity	$< 2 \times 10^{-7}$ mbar l/s He
RFI (Radio Frequency Interference)	According to CE

Operating Limits

Range (Turn-down-Ratio)	5...100 % (1 : 20)
Type of gases	all gases compatible with materials chosen
Temperature	0...50 °C
Pressure rating	max. 10 bar (g); higher on request
Warm up time	within 30 min for optimum accuracy;
	within 30 sec for accuracy ± 4 % FS

Mechanical Parts

Sensor	AISI 316L
Body	AISI 316L or anodised Aluminium
Sieves	Stainless steel
Support rings	Teflon
Protection	IP 40

Electrical Properties

Supply voltage	15 Vdc ±10 % or 24 Vdc ±10 %
	15...24 Vdc ±10 % (digital MFM / MFC only)
Current peak values	
Serie D-51xx...	75 mA max.
Serie D-62xx...	Inrush current 250 mA max.
	No flow 75 mA max.
	100 % flow 175 mA max.
Control valve	+250 mA max.
Output signal	0...5 Vdc or 4...20 mA active
	0...10 Vdc or 0...20 mA active (digital MFM / MFC only)
Connector	6-pin round DIN (analogue MFM / MFC only)
	8-pin round DIN (digital MFM / MFC only)

Technical changes and alterations in construction are reserved.

По вопросам продаж и поддержки обращайтесь:

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