Compact Digital Mass Flow Controller
Model F4H

Overview
The F4H compact digital mass flow controller incorporates a high-sensitivity thermal micro-flow sensor developed by Azbil Corporation and features high-speed controllability of 0.3 s.
Its compact design allows flexibility of installation in equipment. The F4H sets a new standard for mass flow controllers.

Features
- Compact design
  The F4H is 50 % smaller than our conventional models.
- Utilization of digital communication
  All F4H models have a digital communication function and can send a wide variety of information useful for failure diagnosis to a host device.
- High noise tolerance
  The power circuit and signal circuit are isolated, so electromagnetic noise on the power line does not affect signals.
- Reduction in overall cost
  The ability to communicate digitally with programmable logic controllers, instead of by analog signal transmission, eliminates the need for an analog I/O module.

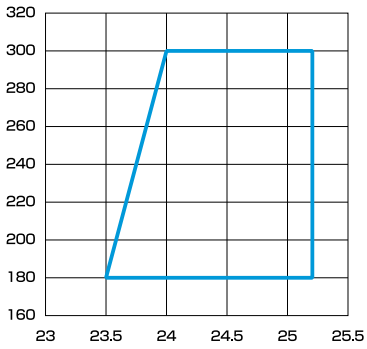
Specifications

Model No.		F4H9050	F4H9200	F4H9500	F4H0002	F4H0005	F4H0020
Valve operation		Normally closed (N.C.) when not powered					
Full scale flow rate (air)*1		50.00 mL/min	200.0 mL/min	500.0 mL/min	2.000 L/min	5.000 L/min	20.00 L/min
Gas type*2		Air/nitrogen model: air/nitrogen, argon, carbon dioxide, hydrogen, helium. (selectable by setting) Oxygen model: oxygen, air/nitrogen, argon, carbon dioxide, hydrogen, helium (selectable by setting) Semi-standard gas model: acetylene, ammonia, air/nitrogen, argon, carbon dioxide, hydrogen, helium (selectable by setting) If you wish to use this device for a gas that is not listed above, please contact us.					
Control	Repeatability	±0.2 % FS ± 1 digit					
	Accuracy (under standard conditions)*3	(1) ±2 % SP (50 % FS < Q ≤ 100 % FS) (2) ±1 % FS (0 % FS ≤ Q ≤ 50 % FS)	(1) ±1 % SP (50 % FS < Q ≤ 100 % FS) (2) ±0.5 % FS (0 % FS ≤ Q ≤ 50 % FS)				
	PV offset from set point	±0.1 % FS ± 1 digit max.					
	Responsiveness (at standard differential pressure)	Time required to go from a flow rate of 0 to a stable flow at the set amount ±2 % FS: 0.3 s (typ.)*10					

Model No.			F4H9050	F4H9200	F4H9500	F4H0002	F4H0005	F4H0020
Pressure	Operating differential pressure*4	Ambient temperature: −10 ≤ t ≤ 40 °C	20–200 kPa	50–300 kPa	100–300 kPa	50–300 kPa	100–300 kPa*11	180–300 kPa *11 *12
		Ambient temperature: 40 ≤ t ≤ 50 °C	20–200 kPa	100–300 kPa	150–300 kPa*6	100–300 kPa	150–300 kPa*11	Not available
	Standard differential pressure*5 (outlet pressure = 0 kPa (gauge))		100 kPa	200 kPa				
	Allowable inlet pressure		0.5 MPa (gauge) max.					
	Pressure resistance		1 MPa (gauge)					
	Effect of pressure (per 100 kPa with controller mounted horizontally)		±1.0 % FS max.	±0.5 % FS max.	±0.2 % FS max.	±0.2 % FS max.	±0.2 % FS max.	±0.2 % FS max.
Temperature	Allowable operating temperature		−10 to +50 °C					−10 to +40 °C
	Allowable storage temperature		−20 to +70 °C					
	Effect of temperature		±0.2 % FS max. per 1 °C	±0.1 % FS max. per 1 °C				
Humidity	Allowable operating humidity		10–90 % RH (without condensation)					
	Allowable storage humidity		10–90 % RH (without condensation)					
External leakage	Helium leakage rate		1×10^{-8} Pa· m^3/s					
Analog input for flow rate setting	Setting resolution		3,000					
	Input range		0–5 V DC (default) 1–5 V DC or 4–20 mA can be specified through host communication or by using the dedicated PC loader					
	Input impedance		1 MΩ ±10 % for voltage input, 250 Ω ±10 % for current input					
Instantaneous flow rate analog output	Output range		0–5 V DC (default) 1–5 V DC or 4–20 mA can be specified through host communication or by using the dedicated PC loader					
	Maximum output		110 % min. (120 % max.)					
	External load resistance		250 kΩ min. for voltage output, 300 Ω max. for current output					
External contact input	Number of inputs / use		1. This input is used to specify “Valve forced fully open,” “Valve forced fully closed,” “Flow rate zero point adjustment,” or “Alarm reset” (selectable by setting).					
	Required circuit type		Non-voltage contacts or open collector					
	Terminal voltage with contacts OFF		4.5 ± 1 V					
	Terminal current with contacts ON		Approx. 0.5 mA					
	Allowable ON residual voltage		0.8 V max.					
	Allowable OFF leakage current		50 μA max.					
Digital output	Number of outputs		1					
	Output rating		30 V DC, 30 mA max. (open collector non-isolated output)					
	Leakage current when OFF		0 5 μA max. (Vcc = 30 V 25 °C)					
	Residual voltage when ON		1 V max.					
Communication specifications	Number of connectable devices		31					
	Communication system		RS485 (3-wire system)					
	Protocol		CPL communication, Modbus RTU (select one by the model No. when ordering)					
	Transmission speed		9600, 19200, 38400 bps					
	Connection		RJ45 × 2					
Power supply	Rating		24 V DC, current consumption: 300 mA max.					
	Allowable voltage range		22.8–25.2 V DC (ripple: 5 % max.)					
	Isolation		The power supply circuit and I/O circuit are isolated.					
Connection method			9/16-18 UNF, Rc ¼, ¼ Swagelok or equivalent, ¼ VCR or equivalent					
Mounting orientation			Horizontally only	Horizontally (the top panel should not face downward) or vertically*7 *8				
Main gas-contacting materials			Standard gas models and oxygen models: SUS316, fluororesin, fluororubber Semi-standard gas models: SUS316, fluorine resin, ethylene-propylene rubber					
Mass			Approx. 700 g (excluding fittings)					
Standards and regulations compliance			EN 61326-1:2013, EN 61326-2-3:2013*9					

*1. mL/min and L/min indicate the volumetric flow rate per minute converted to conditions of 0 °C and 101.325 kPa (1 atm). The controllable flow rate range varies depending on the gas type.
*2. The gas must be dry and not contain corrosive components (chlorine, sulfur, acid, etc.).
Also, it must be clean, without dust or oil mist.
*3. Instrument error under standard conditions according to our equipment.
*4. Operation is possible below the minimum operating differential pressure, but the controllable flow rate range narrows.
*5. This is the differential pressure during calibration.
*6. The supply voltage must be kept at 23.5 V DC or above.
*7. Measurement error occurs if the device is vertically mounted.
To avoid this, specify the mounting orientation for function code C-34, the piping orientation setting, and set the actual pressure for the parameter code P-23, the inlet pressure setting.
*8. Model F4H9050 cannot be mounted vertically.
*9. During EMC testing, the reading or output may fluctuate by the equivalent of ±5 % FS.
*10. F4H0020: when C-36, the operating differential pressure setting, is set to “0” (low differential pressure).
*11. To be used with a supply voltage from 23.5 to 25.2 V.
*12. The maximum operating differential pressure varies according to the supply voltage. See the graph below. The operating differential pressure for argon is 250–300 kPa.

Applied voltage and maximum differential pressure for F4H0020



< Standard conditions >
● Fluid: air.
● Fluid pressure: standard differential pressure ±5 %.
● Ambient temperature: 23 ±3 °C.
● Power voltage: 24 V DC ±2 %.
● Warm-up time: leave at ambient temperature for 2 hours or more and wait at least 30 minutes after power-on.
● Vibration: 0 m/s^2.
● Mounting orientation: the top panel must face upward.
● Straight pipe length: 50 mm or more for upstream straight pipe, 25 mm or more for downstream straight pipe.
● Piping: use fittings that are standard for our products (Rc, Swagelok or equivalent, VCR or equivalent)
To use an Rc fitting, the inner diameter of the straight pipe must be 4 mm or more.
● Gas temperature: ambient air temperature ±1 °C.
● Gas dew point temperature: −18 °C or below

Functions

Function	Description
Analog signal type selection	Analog input/output can be selected from 0–5 V DC, 1–5 V DC, and 4–20 mA DC.
Operation at alarm/event occurrence	Control when an alarm or event occurs can be selected from (1) continues control, (2) valve forced fully closed, or (3) valve forced fully open
External contact input function	The external contact input function can be selected from (1) valve forced fully closed, (2) valve forced fully open, or (3) Alarm reset
Flow rate range change function	The range can be reduced to 99 to 10 % of the standard range.
Gas type selection	The following gases can be used by changing the setting. Air models: air/nitrogen, argon, carbon dioxide, hydrogen, helium Oxygen models: oxygen, air/nitrogen, argon, carbon dioxide, hydrogen, helium
Flow rate standard condition	The conversion reference temperature setting for displaying measurements in volumetric flow rate can be changed.
PV filter	The instantaneous flow rate can be averaged.
Settings for vertical piping	Drift caused by vertical piping can be adjusted.
Setup using the PC loader	A port for loader communication is provided as a standard feature. Using the dedicated loader, which runs on a PC, you can change parameter settings and monitor data.
SP ramp control function	To prevent a rapid change in the flow rate, this function sets a maximum rate of change for the set point (SP) flow rate when control starts or when the flow rate setting is changed.
Valve drive current event setting	This function generates an event if the valve drive current deviates from the specified range.
Multipoint flow rate correction	This function corrects the flow rate measurement at four points for each flow rate range. It is used to adjust the flow rate after flow rate calibration.
Manual output of flow rate signal	This function forces output of flow rate signals. It is used for loop checking after wiring.
Optional analog scaling function	The flow rate corresponding to 100 % analog input/output can be freely set to any value.
Control optimization	The optimal control parameters can be selected according to the operating differential pressure.
Flow rate display unit change function	The flow rate unit can be selected from (1) L/min or mL/min, (2) m^3/h or L/h, or (3) g/min or mg/min.
Manual setting of valve drive current	This function fixes the valve drive current at a certain value, providing an effective means of determining whether the cause of unstable flow rate control is a control error by this product or an external factor.
Storing of alarm history	Alarm history is saved in order of occurrence.
Valve drive count	The number of times the valve closes fully is saved. This count is used as a guideline for determining when the device needs to be replaced.

Standard gases: gas types and control ranges

Model No. / Gas type	F4H9050		F4H9200		F4H9500	
	Control range (mL/min)	Setting resolution (mL/min)*	Control range (mL/min)	Setting resolution (mL/min)*	Control range (mL/min)	Setting resolution (mL/min)*
Air/nitrogen	1.00–50.00	0.05	2.0–200.0	0.2	5.0–500.0	0.5
Oxygen	1.00–50.00	0.05	2.0–200.0	0.2	5.0–500.0	0.5
Argon	1.00–50.00	0.05	2.0–200.0	0.2	5.0–500.0	0.5
Carbon dioxide	0.60–30.00	0.05	1.2–120.0	0.2	3.0–300.0	0.5
Hydrogen	4.0–200.0	0.2	8.0–800.0	0.5	20–2000	2
Helium	4.0–120.0	0.2	8.0–800.0	0.5	20–1200	2
Acetylene	0.55–28.00	0.05	1.2–112.0	0.2	3.0–280.0	0.5
Ammonia	0.75–38.00	0.05	1.6–152.0	0.2	4.0–380.0	0.5

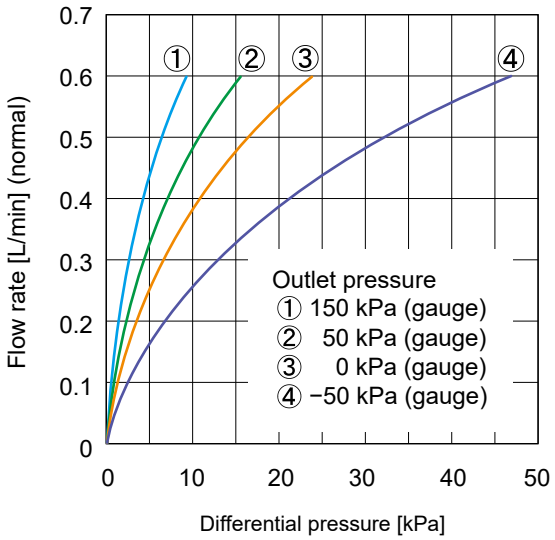
Model No. / Gas type	F4H0002		F4H0005		F4H0020	
	Control range (L/min)	Setting resolution (L/min)*	Control range (L/min)	Setting resolution (L/min)*	Control range (L/min)	Setting resolution (L/min)*
Air/nitrogen	0.020–2.000	0.002	0.050–5.000	0.005	0.20–20.00	0.02
Oxygen	0.020–2.000	0.002	0.050–5.000	0.005	0.20–20.00	0.02
Argon	0.020–2.000	0.002	0.050–5.000	0.005	0.20–20.00	0.02
Carbon dioxide	0.012–1.200	0.002	0.030–3.000	0.005	0.12–12.00	0.02
Hydrogen	0.080–8.000	0.005	0.20–20.00	0.02	0.80–60.00	0.05
Helium	0.080–8.000	0.005	0.20–12.00	0.02	0.80–50.00	0.05
Acetylene	0.012–1.220	0.002	0.030–3.050	0.005	0.12–12.20	0.02
Ammonia	0.016–1.540	0.002	0.040–3.850	0.005	0.16–15.40	0.02

* This is the value when “Display resolution” is set to “1” (high resolution).
Note: Set a flow rate within the control ranges shown above.

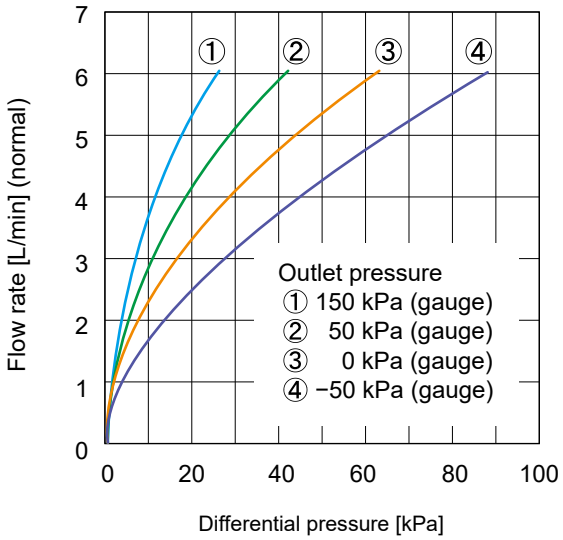
Relationship between differential pressure and flow rate when the valve is fully open (for air)

Note: The following is reference data from our in-house evaluation.

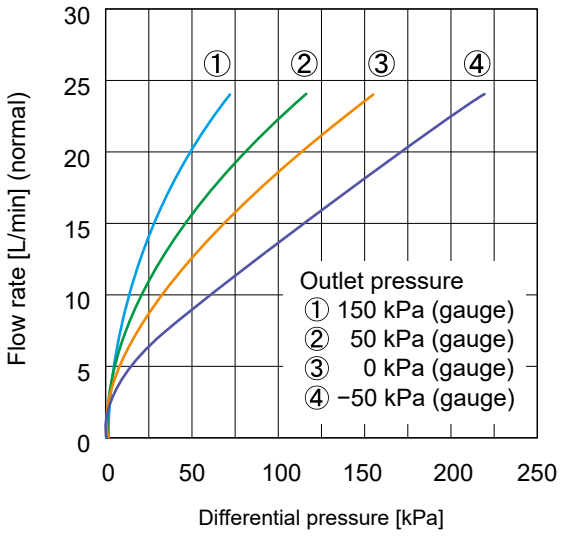
• F4H9050/9200/9500



• F4H0002/0005



• F4H0020



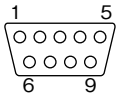
Wiring

■ Connector for external connection

• Connector specifications

D-sub 9-pin (male)

• Pin layout



• Connector pin signal table

Pin No.	Signal	Description	Remarks
1	DI	External contact input (+)	–
2	FLOW RATE OUTPUT	Instantaneous flow rate output (+)	0–5 V, 1–5 V, or 4–20 mA output
3	POWER (24 V)	24 V DC power (+)	–
4	N.C.	–	–
5	POWER (GND)	24 V DC power (−)	–
6	FLOW RATE SP INPUT	Instantaneous flow rate setup input (+)	0–5 V, 1–5 V, or 4–20 mA input
7	A.GND	Instantaneous flow rate output (−) Instantaneous flow rate setup input (−)	Common ground for analog signals
8	D.GND	External contact input (−) Digital output 1 (−)	Common ground for digital signals
9	DO	Digital output (+)	Open collector output

Note: Even though the A.GND and D.GND are connected internally, be sure to ground them separately.

■ Communications connector (RS-485)

• Connector specifications

RJ-45

• Pin layout

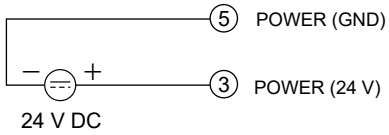
• Connector pin signal table

Pin No.	Signal	Description
1	SG*	RS-485 communication SG
2	SG*	RS-485 communication SG
3	N.C.	---
4	DB	RS-485 communication DB
5	DA	RS-485 communication DA
6	N.C.	---
7	N.C.	---
8	N.C.	---

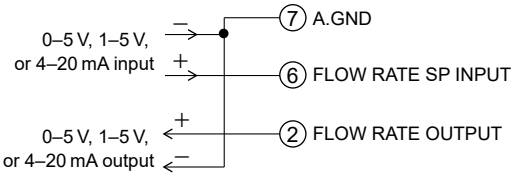
* SG is connected to A.GND and D.GND on the connector for external connection.

■ Wiring

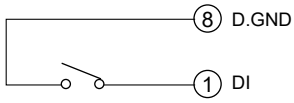
• Power supply



• Analog input/output



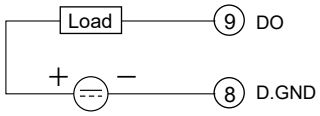
• External contact input



! Handling Precautions

• When switching by using relay contacts, use a relay designed for microcurrents (with gold contacts). Failure to use a relay designed for microcurrents may result in malfunction due to poor contact.

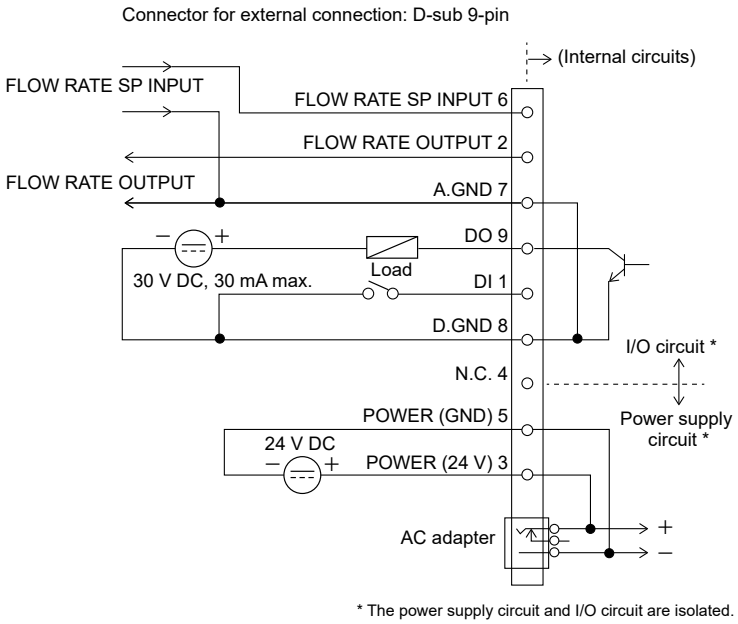
• Digital output



! Handling Precautions

• Be careful not to exceed the rated output of this device.
In addition, when driving a relay, use a relay with built-in diode for absorbing coil surge.

■ Wiring examples



* The power supply circuit and I/O circuit are isolated.

Model selection guide

Basic model No.			Standard flow rate range				Flow path material	Piping connection method	Gas type	Communication type	O-ring material	Default gas type setting	Option 1	Option 2	Option 3	Appended No.	Remarks
F	4	H															
			9	0	5	0											1.00–50.00 mL/min*1
			9	2	0	0											2.0–200.0 mL/min*1
			9	5	0	0											5.0–500.0 mL/min*1
			0	0	0	2											0.020–2.000 L/min*1
			0	0	0	5											0.050–5.000 L/min*1
			0	0	2	0											0.20–20.00 L/min*1
							6										SUS316 (with degreasing of gas-contacting parts)
								U									UNF
								T									Rc fitting
								S									Swagelok fitting or equivalent
								V									VCR fitting or equivalent
									N								Air/nitrogen*2
									S								Oxygen*3
									J								Semi-standard gas*4
										2							RS485 CPL model
										3							RS485 Modbus RTU model
											O						Fluororubber
											E						Ethylene-propylene rubber*4
												N					Default setting: air/nitrogen*2 *4
												S					Default setting: oxygen*3
													0				None
														0			None
															0		None
															D		With inspection report
															Y		With traceability certificate
																0	Product version

*1. The flow rate setting range for air, nitrogen, argon, and oxygen. For other gases, refer to the control flow rate range for each gas type given in “Standard gases: gas types and control ranges.”
*2. For air/nitrogen models, only fluororubber as the O-ring material and air/nitrogen as the default gas type setting can be selected.
*3. For oxygen models, only fluororubber as the O-ring material and oxygen as the default gas type setting can be selected.
*4. For semi-standard gas models, only ethylene-propylene rubber as the O-ring material and air/nitrogen as the default gas type can be selected.

Optional parts

D-SUB 9-pin analog cable assembly	81447655-001
Rc ¼ fitting (set of 2, O-ring material: fluororubber)	81446834-001
¼ Swagelok fitting or the equivalent (set of 2, O-ring material: fluororubber)	81447653-001
¼ VCR fitting or the equivalent: (set of 2, O-ring material: fluororubber)	81447654-001
Loader communication cable	81441177-001
Smart Device Gateway	NX-SVGN00000

Usable gases according to O-ring material

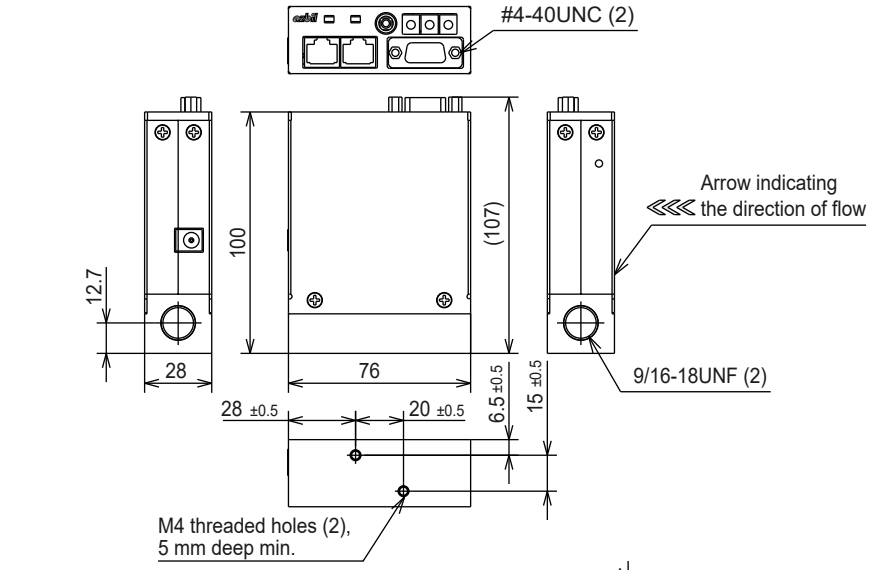
✓: Usable

O-ring material	Gas type*1							
	Air/nitrogen	Oxygen	Argon	Carbon dioxide	Hydrogen	Helium	Acetylene	Ammonia
Fluororubber	✓	✓*2	✓	✓	✓	✓		
Ethylene-propylene rubber	✓		✓	✓	✓	✓	✓	✓

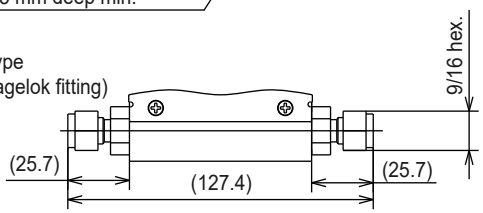
*1. For use with gases other than the above, please contact us.
*2. Select oxygen as the gas type when ordering.

External dimensions

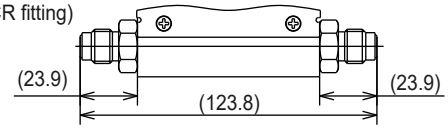
(Unit: mm)



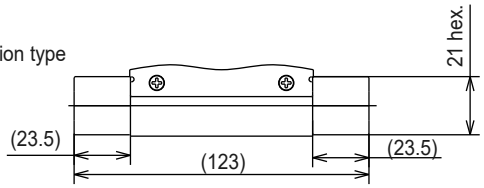
¼ BI-LOK fitting type
(equivalent to Swagelok fitting)



¼ VTF fitting type
(equivalent to VCR fitting)



Rc ¼ connection type



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Please read “Terms and Conditions” from the following URL before ordering and use.

https://www.azbil.com/products/factory/order.html

Specifications are subject to change without notice.

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