

**azbil**



# Compact Digital Mass Flow Controller

Model F4H



Compact × Quality

# A New Standard

The standard for mass flow controllers has just been raised. Azbil Corporation has added a new series of compact, easy-to-use products to its lineup of digital mass flow controllers equipped with the Micro Flow sensor, the sensor that achieves 0.3 s high-speed controllability.



Compact  $\times$  Quality



## Ease of use **1** Compact Design Saves Space

Compact but equipped with the essential functions. These products help to save space.

## Ease of use **2** All Models Have Communication Functions

All models have communications functions for IoT compatibility.  
RS-485 (CPL) / Modbus RTU

## Ease of use **3** High Noise Tolerance

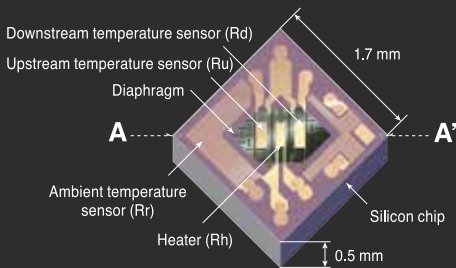
With isolation of the power supply from the signal circuit, power supply noise can't affect analog signals. Additionally, highly noise-resistant 4 to 20 mA signals can be used.

## Ease of use **4** Reduction in Overall Cost

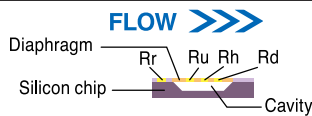
Overall cost is lower for reasons such as: communication functions eliminate the need for an analog I/O module; 24 Vdc operation eliminates the need for a dedicated power supply; and multi-gas/multi-range capability allows reduction of inventory.

### The Micro Flow Sensor

**Structure** High-sensitivity, high-speed response mass flow sensor using a platinum thin-film circuit on a silicon chip.

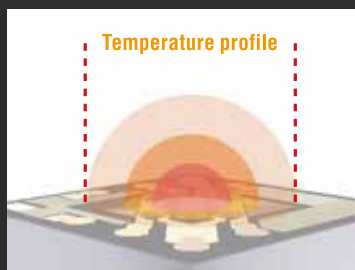


**Section A-A'**

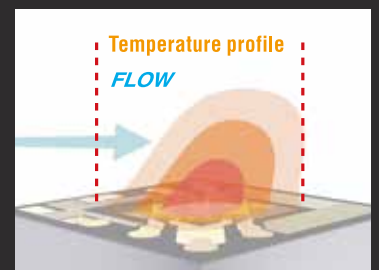


### Principle of measurement

When there is no gas flow, the temperature distribution around the heater is symmetrical. When gas flows from Ru to Rd, the symmetry in temperature is distorted toward the Rd (downstream) side. The temperature difference between Ru and Rd is used to calculate the flow rate.



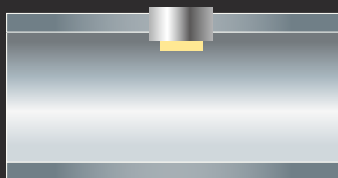
When there is no flow



When gas is flowing

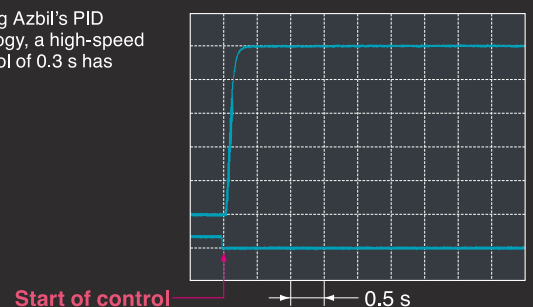
### Structure of Micro Flow Products

Because the Micro Flow sensor, whose constituents have extremely low heat capacity, is in direct contact with the process gas, flow rate fluctuations can be detected instantly as changes in temperature.



By incorporating Azbil's PID control technology, a high-speed response control of 0.3 s has been achieved.

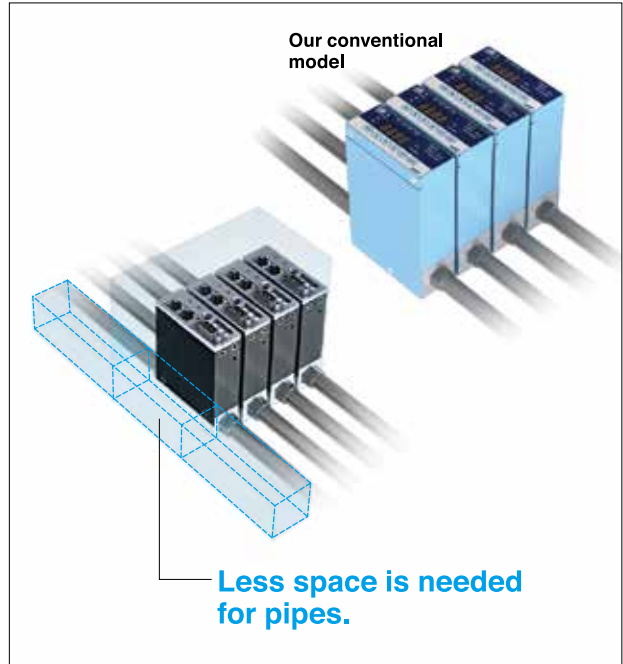
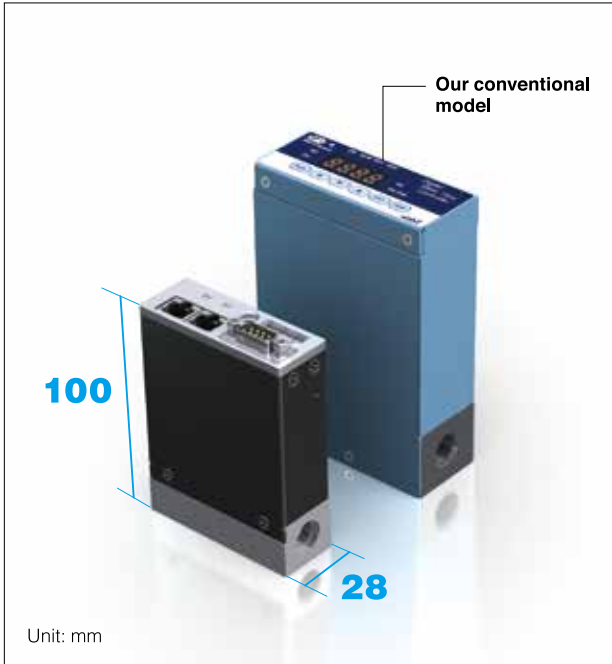
### Control Characteristics



# Ease of use **1** Compact Design Saves Space

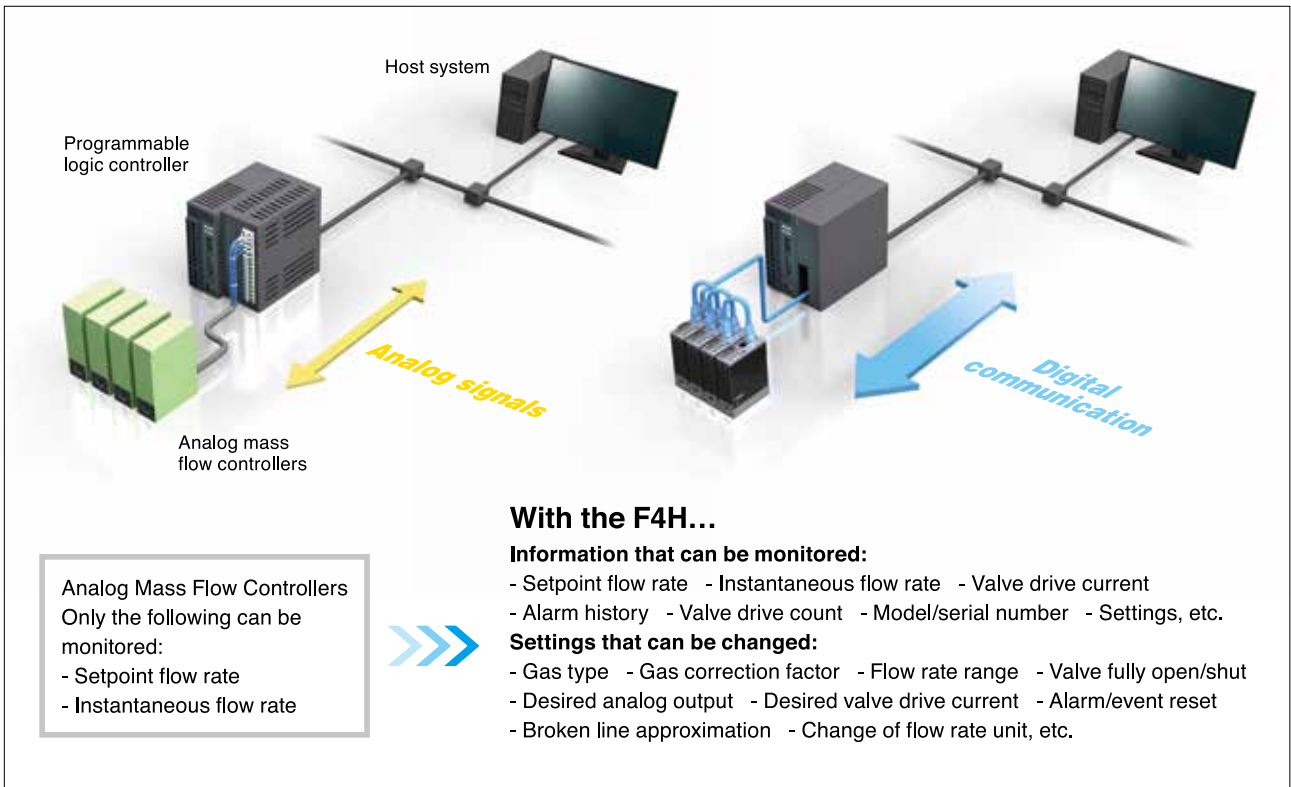
The new products are 50 % smaller than our conventional models.

With a width of 28 mm, the product's slim design allows closer spacing of pipes, saving more space.



# Ease of use **2** All Models Have Communication Functions

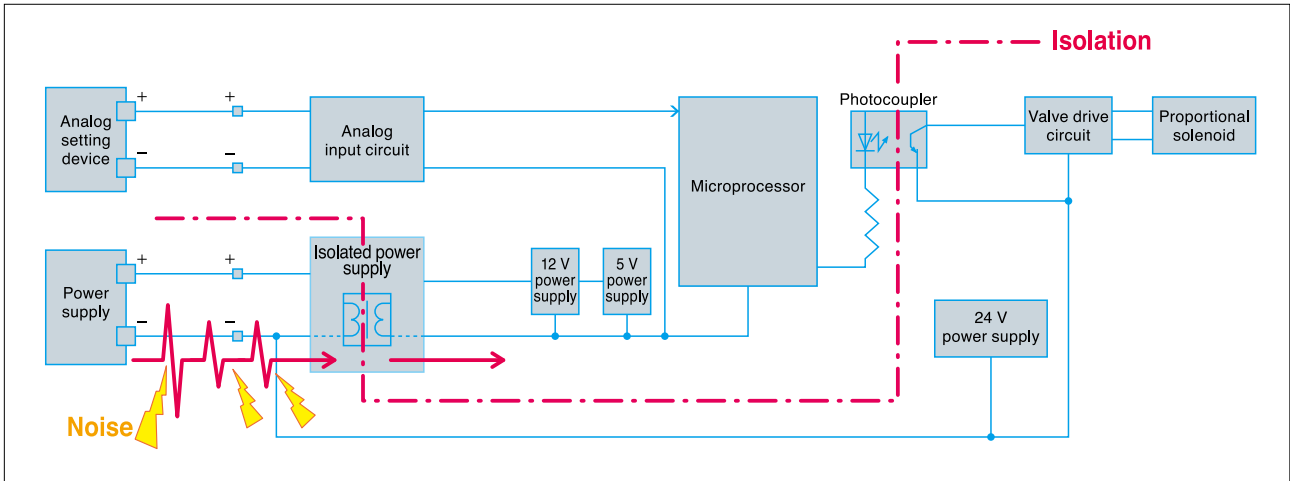
The large amount of data stored in the digital mass flow controller can be uploaded using the communication functions. This feature can be used not only to diagnose the mass flow controller, but also to diagnose the system that is using the mass flow controller. **RS-485 (CPL) / Modbus RTU**



## Ease of use **3** High Noise Tolerance

### ① Isolation of the power supply from the signal circuit

By isolating the valve drive circuit from other circuits, power supply circuit and analog circuit isolation (patent No. 5132617) is achieved, even with a small-capacity isolated power supply. Thanks to this feature, noise from power wiring has no effect on signals.



### ② Highly noise-tolerant 4–20 mA signals can be used.

Choose analog I/O signals from 0 to 5 Vdc, 1 to 5 Vdc, 4 to 20 mA.

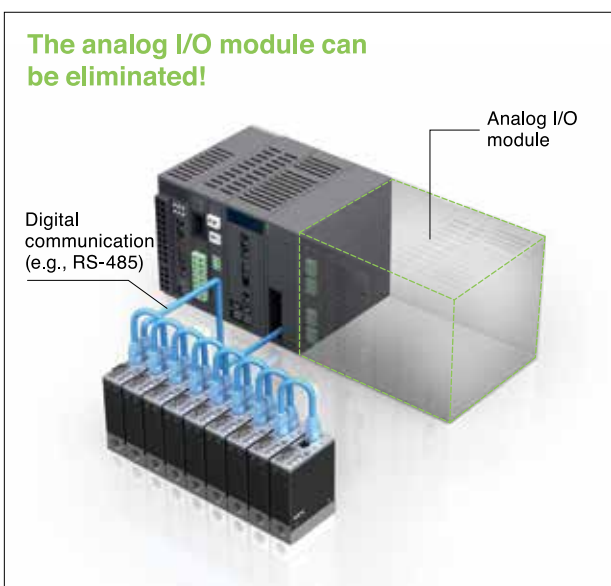
### ③ All models have digital communication capability

Using digital communication eliminates the effect of noise on analog signals.

## Ease of use **4** Reduction in Overall Cost

### Point ①

By switching from an analog to a digital connection with the PLC, the analog I/O module can be eliminated.



The analog I/O module can be eliminated!

### Point ②

Since these products run on 24 Vdc, a dedicated  $\pm 15$  V power supply is not required. Also, since the power supply is isolated from the signal circuits, supplying power from a single source to multiple F4H units will not create a cyclic circuit.



The same power supply can be used for multiple mass flow controllers!

### Point ③

Multi-gas/multi-range capabilities allow fewer models and less inventory.

## Functions

Function	Description
Selection of analog signal type	Analog input/output can be selected from 0 to 5 Vdc, 1 to 5 Vdc, and 4 to 20 mAcd.
Selection of alarm/event response	Control in the event of an alarm or event can be selected from: (1) Continue, (2) Force valve fully closed, and (3) Force valve fully open.
Assignment of external contact input	The external contact input function can be selected from: (1) Force valve fully closed, (2) Force valve fully open, and (3) Reset alarm.
Setup of flow rate control range	The flow rate control range can be set down to one tenth of the standard range.
Gas type setup	Changing the settings allows use with the following gas types. Air model: air/nitrogen, argon, carbon dioxide, hydrogen, and helium Oxygen model: oxygen, air/nitrogen, argon, carbon dioxide, hydrogen, and helium
Selection of flow rate reference conditions	The conversion reference temperature setting for displaying measurements in terms of the volumetric flow rate can be changed.
PV filter	This function can be used to average the instantaneous flow rate.
Settings for vertical piping	This function adjusts any drift caused by installation on a vertical pipe.
Setup from PC (loader function)	A port for connecting a PC loader is provided as a standard feature. Using the dedicated PC loader, you can change settings or monitor internal data from a computer.
SP ramp control function	To prevent a rapid change in the flow rate, this function sets a maximum rate of change for the setpoint flow rate (SP) when control starts or when the flow rate setting is changed.
Valve drive current event settings	This function generates an event if the valve drive current deviates from a set range.
PV broken line correction	This function corrects the flow rate measurement at four points for each flow rate region. 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 output signals. It is used for loop checking after the wiring has been completed.
Analog scaling function	Any flow rate can be set within the full-scale analog input/output range.
Control optimization	The optimal control parameters can be selected according to the operating differential pressure.
Change of flow rate unit	The flow rate unit can be selected from: (1) L/min or mL/min, (2) m <sup>3</sup> /h or L/h, and (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 alarm occurrence.
Valve drive count	The number of times the valve closes fully is saved. This count is used as a guide for determining when the device needs to be replaced.

## Control Flow Rate Range by Gas Type

	F4H9050		F4H9200		F4H9500	
	Control range (mL/min)	Set resolution (mL/min)	Control range (mL/min)	Set resolution (mL/min)	Control range (mL/min)	Set resolution (mL/min)
Air / Nitrogen	2.00 to 50.00	0.05	4.0 to 200.0	0.2	10.0 to 500.0	0.5
Oxygen	2.00 to 50.00	0.05	4.0 to 200.0	0.2	10.0 to 500.0	0.5
Argon	2.00 to 50.00	0.05	4.0 to 200.0	0.2	10.0 to 500.0	0.5
Carbon dioxide	1.20 to 30.00	0.05	2.4 to 120.0	0.2	6.0 to 300.0	0.5
Hydrogen	8.0 to 200.0	0.2	16.0 to 800.0	0.5	40 to 2000	2
Helium	8.0 to 120.0	0.2	16.0 to 800.0	0.5	40 to 1200	2

	F4H0002		F4H0005		F4H0020	
	Control range (L/min)	Set resolution (L/min)	Control range (L/min)	Set resolution (L/min)	Control range (L/min)	Set resolution (L/min)
Air / Nitrogen	0.040 to 2.000	0.002	0.100 to 5.000	0.005	0.40 to 20.0	0.02
Oxygen	0.040 to 2.000	0.002	0.100 to 5.000	0.005	0.40 to 20.0	0.02
Argon	0.040 to 2.000	0.002	0.100 to 5.000	0.005	0.40 to 20.0	0.02
Carbon dioxide	0.024 to 1.200	0.002	0.060 to 3.000	0.005	0.24 to 12.00	0.02
Hydrogen	0.160 to 8.000	0.005	0.40 to 20.00	0.02	1.60 to 60.00	0.05
Helium	0.160 to 8.000	0.005	0.40 to 12.00	0.02	1.60 to 50.00	0.05

Note: Set a flow rate within the control ranges shown above.



## Model Selection Guide

Basic model No.			Control flow rate				Flow path	Pipe connection	Gas type	Conn. type	O-ring	Gas type (default)	Option 1	Option 2	Option 3	Appended No.	Remarks		
F	4	H																	
			9	0	5	0											2.00 to 50.00 mL/min *1		
			9	2	0	0											4.0 to 200.0 mL/min *1		
			9	5	0	0											10.0 to 500.0 mL/min *1		
			0	0	0	2											0.040 to 2.000 L/min *1		
			0	0	0	5											0.100 to 5.000 L/min *1		
			0	0	2	0											0.40 to 20.00 L/min *1		
							6										SUS316 (degreased for 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		
										2							RS-485 CPL model		
										3							RS-485 Modbus model		
											0						O-ring material: fluororubber		
												N					Factory setting: air/nitrogen *2		
												S					Factory setting: oxygen *3		
													0				None		
														0			None		
															0		None		
																D	With an inspection report		
																	Y	With traceability certificate	
																		0	Product version

\*1. Flow rate setting range for air, nitrogen, argon, and oxygen. For other gases, see the control flow rate range by gas type in the preceding section.

\*2. If the gas type is "N", "S" cannot be selected for "Gas type (default)."

\*3. If the gas type is "S", only "S" can be selected for "Gas type (default)."

### Optional Parts

D-SUB 9-pin analog cable assembly	*Available soon	81447655-001
1/4" Rc fitting (set of 2)		81446834-001
1/4" Swagelok fitting or equivalent (set of 2)		81447653-001
1/4" VCR fitting or equivalent (set of 2)		81447654-001
AC adapter		81446957-001
Loader communication cable		81441177-001

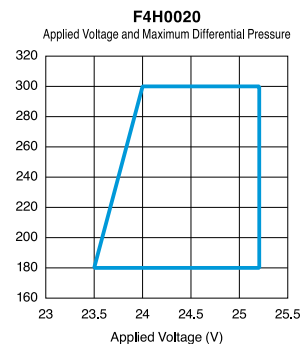
# Specifications

Item	F4H9050	F4H9200	F4H9500	F4H0002	F4H0005	F4H0020		
Valve operation	Normally closed when de-energized (N.C.)							
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 types	*2 Air/nitrogen model: air/nitrogen, argon, carbon dioxide, hydrogen, and helium (switchable by setting) Oxygen model: oxygen, air/nitrogen, argon, carbon dioxide, hydrogen, and helium (switchable by setting)							
Control	Repeatability	± 0.2 % FS ± 1 digit						
	Accuracy (under reference conditions)	*3 ± 2 % FS	± 1 % FS					
	Offset of PV from SP	± 0.1 % FS ± 1 digit max.						
	Response (at standard differential pressure)	Time from zero flow rate setting until statically determinate at ± 2 % FS: 0.3 s (typ.) *10						
Valve output update cycle	1 ms							
Pressure	Operating differential pressure range	*4 Ambient temperature: -10 ≤ t ≤ 40 °C	20 to 200 kPa	50 to 300 kPa	100 to 300 kPa	50 to 300 kPa	100 to 300 kPa *11	180 to 300 kPa *11, *12
		Ambient temperature: 40 < t ≤ 50 °C	20 to 200 kPa	100 to 300 kPa	150 to 300 kPa *6	100 to 300 kPa	150 to 300 kPa *11	Usage prohibited
	Standard differential pressure (outlet pressure = 0 kPa [gauge])	*5 100 kPa	200 kPa					
	Allowable inlet pressure	0.5 MPa (gauge) max.						
	Pressure resistance	1 MPa (gauge)						
Pressure characteristics (horizontal installation, per 100 kPa with air)	±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 range	- 10 to + 50 °C				- 10 to + 40 °C		
	Allowable storage temperature range	- 20 to + 70 °C						
	Temperature characteristics	±0.2 % FS per 1 °C max.	± 0.1 % FS per 1 °C max.					
Humidity	Allowable operating humidity range	10 to 90 % RH (without condensation)						
	Allowable storage humidity range	10 to 90 % RH (without condensation)						
Leakage	Helium external leakage rate	1x10 <sup>-8</sup> Pa · m <sup>3</sup> /s						
Analog input for flow rate setting	Setting resolution	3,000						
	Input range	0 to 5 Vdc (factory setting), can be switched to 1 to 5 Vdc or 4 to 20 mAdc by host communication or PC loader						
	Sampling cycle	5 ms						
	Input impedance	Voltage input type: 1 MΩ ± 10 %. Current input type: 250 Ω ± 10 %						
Analog output for instantaneous flow rate	Output resolution	10,000						
	Output range	0 to 5 Vdc (factory setting), can be changed to 1 to 5 Vdc or 4 to 20 mAdc by host communication or PC loader						
	Output update cycle	5 ms						
	Maximum output	110 % min. (120 % max.)						
	External resistance	Voltage output type: 250 kΩ min., current output type: 300 Ω max.						
External contact input	Number of inputs / use	One input: "Force valve open," "Force valve closed," "Zero flow rate correction," and "Alarm reset" (change by changing the setting)						
	Required circuit type	Non-voltage contacts or open collector						
	Contact OFF terminal voltage	4.5 ± 1 V						
	Contact ON terminal current	Approx. 0.5 mA						
	Allowable ON residual voltage	0.8 V max.						
	Allowable OFF leakage current	50 μA max.						
Digital output	Number of outputs	One output						
	Output rating	30 Vdc, 30 mA max. (non-isolated open collector output)						
	OFF leakage current	0.5 μA max (Vcc = 30 V 25 °C)						
	ON residual voltage	1 V max.						
Communications	Number of units connectable	31 F4H units						
	Communication method	RS485 (3-wire system)						
	Protocol	CPL communication, Modbus RTU (select either by model number when ordering)						
	Communication speed	9600 19200 38400bps						
Power	Connection	RJ45 × 2						
	Rating	24 Vdc, current consumption: 300 mA max.						
	Allowable power voltage range	22.8 to 25.2 Vdc (ripple 5 % max.)						
Isolation	The power circuit is isolated from the input/output circuit.							
Connection method	9/16-18 UNF, 1/4" Rc, 1/4" Swagelok or equivalent							
Mounting orientation	Only horizontal	Horizontal (top panel surface cannot face downward) or vertical				*7, *8		
Material of gas-contacting parts	Standard gas or oxygen model: SUS316, fluorocarbon resin, fluororubber							
Weight	Approx. 700 g (excluding fitting)							
Standards compliance	EN 61326-1:2013, EN 61326-2-3:2013 *9							

\*1. mL/min and L/min are volumetric flow rate per minute (L/min) converted to conditions of 0 °C and 101.325 kPa (1 atm). The controllable flow rate range varies depending on the gas type. \*2. Dry gas that does not contain chlorine, sulfur, acid, or other corrosive ingredients. Also, clean gas that does not contain dust or oil mist. \*3. Difference between devices when measured using Azbil equipment under the reference conditions \*4. Operation is possible even below the operating differential pressure range, but the controllable flow rate range is narrower. \*5. Differential pressure during product calibration \*6. Make sure that the power is at least 23.5 Vdc. \*7. An measurement error may occur if the flow direction is vertical. Set function code C-34, "Piping orientation setting" according to how the device is mounted, and then change parameter P-23, "Primary pressure specification," according to the pressure used. \*8. Model F4H9050 cannot be mounted vertically.

\*9. During EMC testing, the reading may fluctuate by the equivalent of ±5 % FS, or the output value may fluctuate. \*10. For F4H0020, C-36 (operating differential pressure) is set to "0: Low differential pressure." \*11. Use within a power supply voltage range between 23.5 and 25.2 V.

\*12. The maximum operating differential pressure varies according to the power supply voltage. See the following graph. The operating differential pressure range for argon is from 250 to 300 kPa.



**Reference conditions:**

- Fluid: Air
- Fluid pressure: Standard differential pressure ±5 %
- Ambient temperature: 23 ± 3 °C
- Power supply voltage: 24 Vdc ± 2 %
- Warm-up time: Leave at the ambient temperature for at least 2 hours and then for at least 30 min after turning on the power
- Vibration: 0 m/s<sup>2</sup>
- Mounting direction: Position so that the top panel faces up
- Straight pipe length: 50 mm min. for upstream straight pipe, 25 mm min. for downstream straight pipe
- Piping: Use Azbil's standard pipe coupling (Rc/Swagelok or equivalent, VCR or equivalent). If an Rc pipe coupling is used, the inside diameter of the straight pipe must be 4 mm min.
- Gas temperature: Ambient temperature ±1 °C
- Gas dew point temperature: -18 °C max.



Analog Power Connector: D-SUB 9-pin

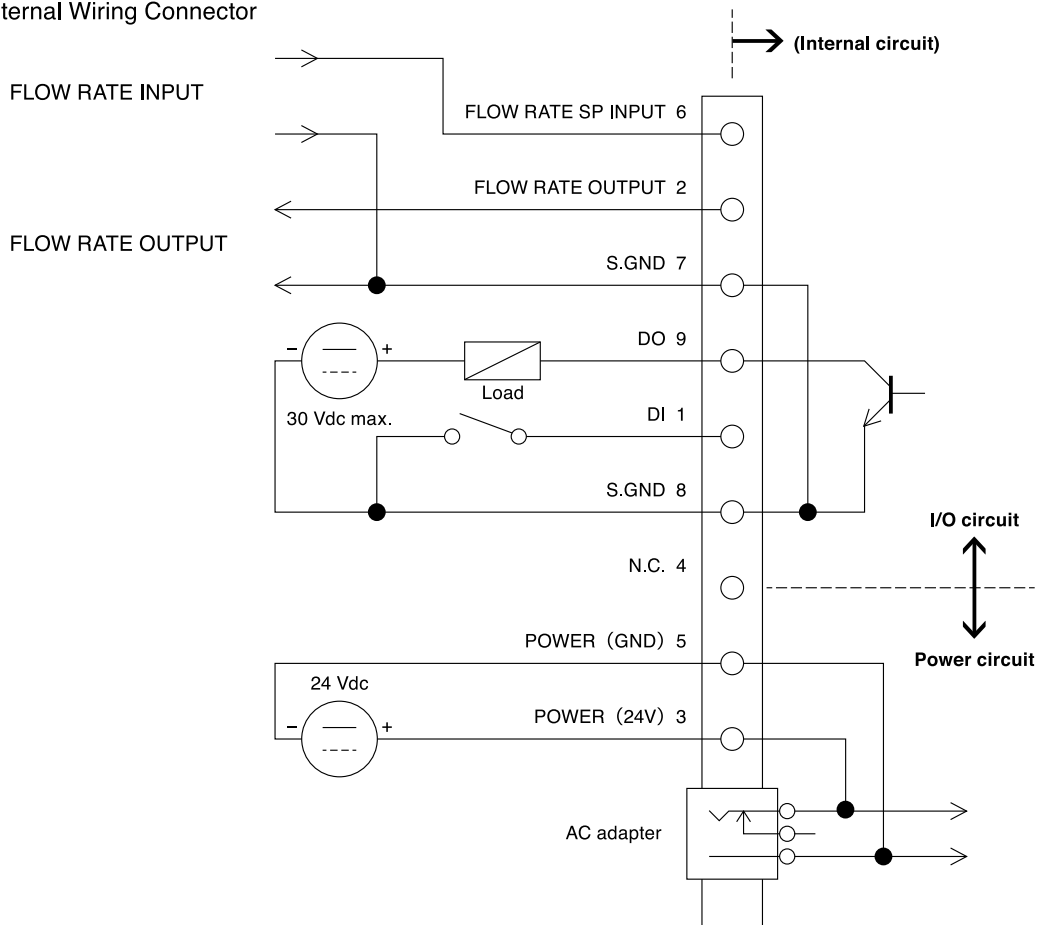
Pin number	Pinout	Description	Remarks
1	DI	Contact input (+)	
2	FLOW RATE OUTPUT +	Flow rate output (+)	0 to 5 Vdc / 1 to 5 Vdc / 4 to 20 mA output
3	POWER (24 V)	24 Vdc power (+)	
4	N.C.	-	
5	POWER (GND)	Power GND	
6	FLOW RATE SP INPUT +	Flow rate setpoint input signal (+)	0 to 5 Vdc / 1 to 5 Vdc / 4 to 20 mA output
7	S.GND	Flow rate output (-)	Any of these can be wired as S.GND
8		Setpoint flow rate input (-)	
9		Contact input (-)	
9	DO	Alarm output (+)	Open collector output

RS-485 Connector: RJ45

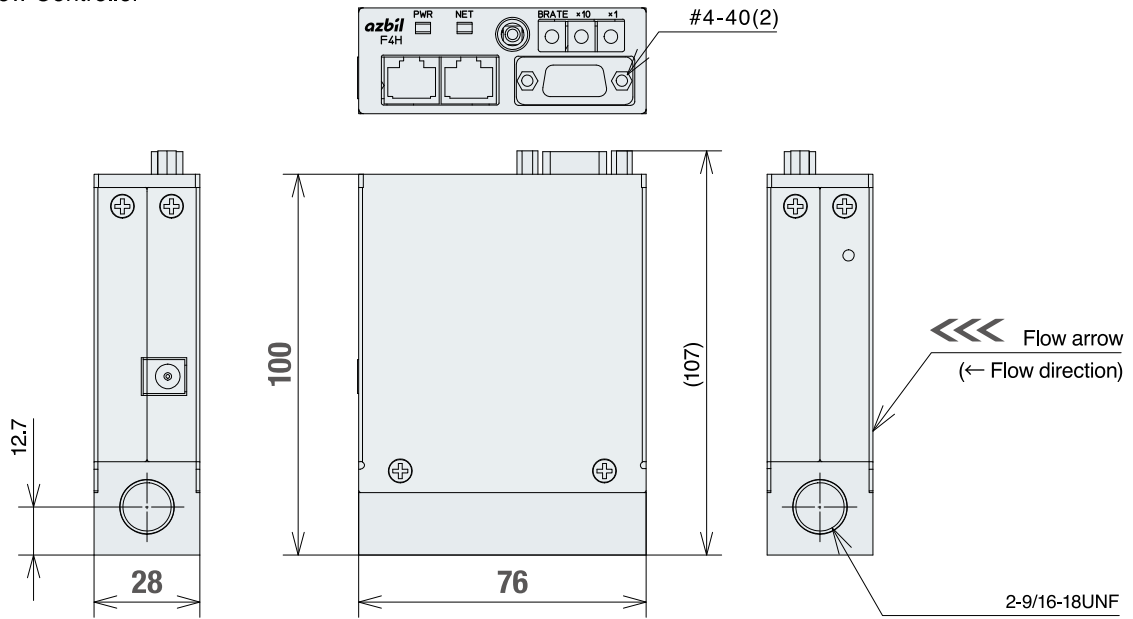
Pin number	Pinout
1	SG
2	SG
3	N.C.
4	DB (D-)
5	DA (D+)
6	N.C.
7	N.C.
8	N.C.

\*Common to CPL and Modbus RTU

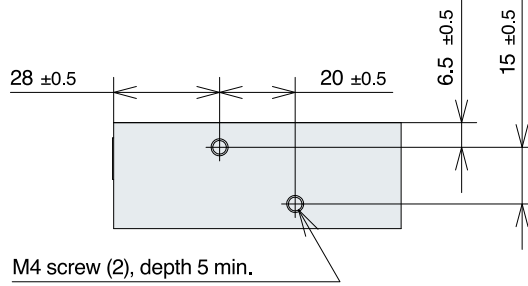
External Wiring Connector



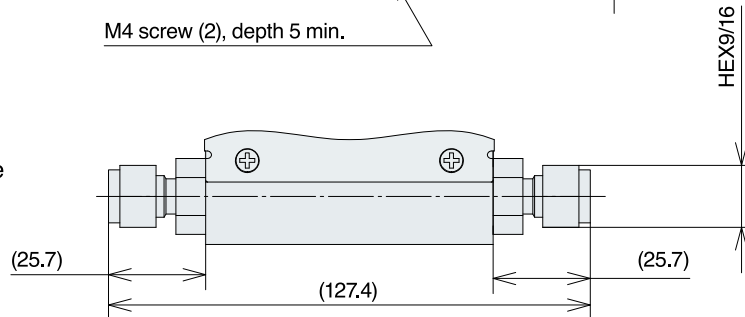
Mass Flow Controller



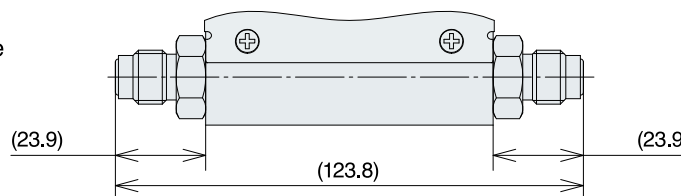
9/16-18 UNF Connection Type



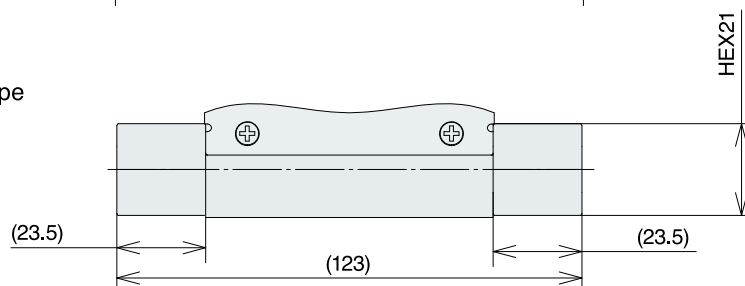
1/4" Swagelok or Equivalent Fitting Type



1/4" VCR or Equivalent Fitting Type



1/4" Rc Connection Type





## Cautions for Flow Controllers

(For installation and use of this device, refer to the warnings and cautions in the user's manual.)

- Never allow gases that are within explosive limits to pass through this device. Doing so might result in an explosion.
- Never use a flow controller for oxygen gas if it is not a special oil-free oxygen gas model. Doing so could cause the gas to ignite.
- Prevent foreign matter from entering the device. Rust, water droplets, oil mist, or dust from the pipes can cause measurement error, control error, or damage to the device. If there is a possibility of foreign matter entering the device, provide an upstream filter, strainer or mist trap capable of eliminating foreign matter 0.1  $\mu\text{m}$  and greater in diameter. Be sure to inspect and replace the filter at regular intervals.
- Use the device within the operating differential pressure range. Failure to do so may cause flow rate hunting to occur. If hunting persists, valve failure may occur. Also, if this device is operated with a differential pressure exceeding the maximum operating differential pressure, the control flow rate may not reach the flow rate setpoint.
- Do not subject this device to pressure beyond its rated pressure resistance. Doing so might result in damage.
- When using a relay for external contact input, always use a relay designed for micro-current use (with gold contacts). Failure to do so could cause faulty contact, resulting in malfunction.
- Do not connect the following in the vicinity of the downstream side of this device: a throttling device or a device that causes a high pressure loss. Doing so may cause flow rate hunting to occur.
- If this device is installed in an environment with large temperature fluctuations, even if the temperature drops when the device is not in use, replace the internal air with gas that is sufficiently dry to prevent condensation. Condensation may cause the device to malfunction.
- Never use this device in a potentially explosive atmosphere or where it will be exposed to a flammable liquid or vapor.
- Use the specified pipe fittings and gaskets and verify that there is no leakage after completion of the piping work. Failure to do so may result in gas leaks.
- The valve on this device cannot completely shut off a flow. If complete shutoff is required, install a separate shutoff valve.



Compact × Quality

Pursuing ease of use  
through built-in functionality

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**Azbil Corporation**  
Advanced Automation Company

*Yamatate Corporation changed its name to Azbil Corporation on April 1, 2012.*

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