



# FBO Series

## Mass flow sensors for gases

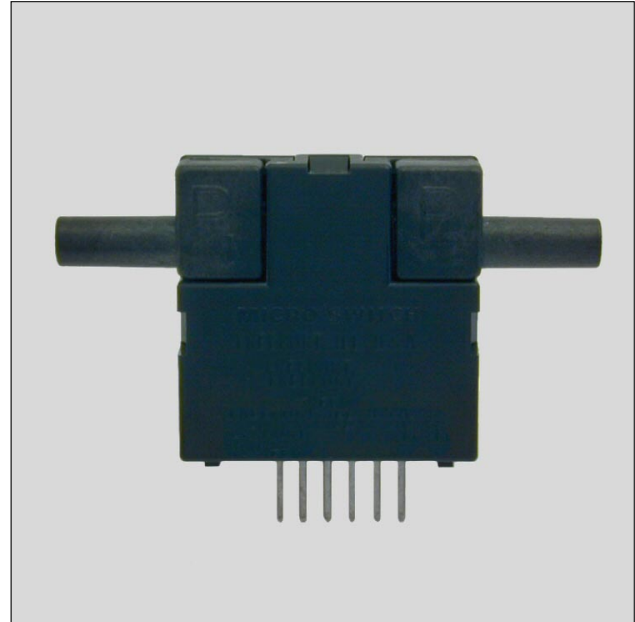
### FEATURES

- Ranges 0...±30 to 0...±1000 or -600...1000 sccm<sup>1</sup>
- Bidirectional sensing
- Actual mass flow sensing
- Sensortech PRO services

### MEDIA COMPATIBILITY

To be used with dry gases only

The FBO series is NOT designed for liquid flow and will be damaged by liquid flow through the sensor



### SPECIFICATIONS

#### Maximum ratings

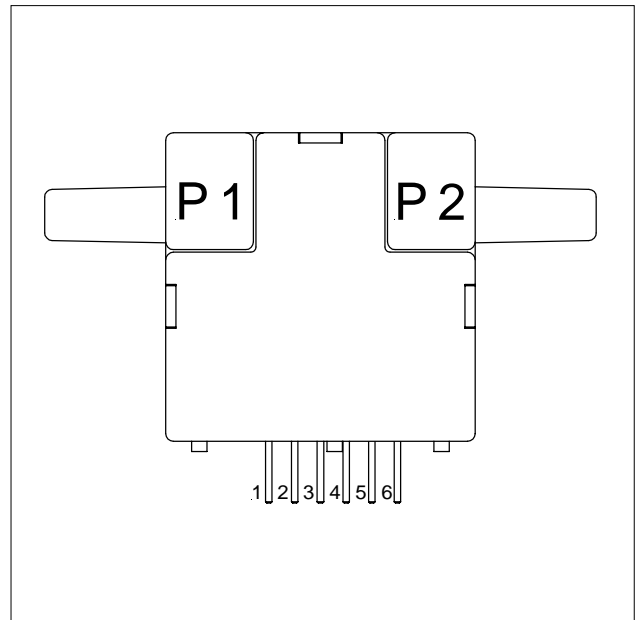
Supply voltage <sup>2</sup>	8 to 15 V typ. 10 ±0.01 V
Power consumption	max. 50 mW typ. 30 mW
Temperature limits	
Operating	-25 to 85°C
Storage	-40 to 90°C
Mechanical shock	100 g (5 drops, 6 axes)

Note:

<sup>1</sup> sccm denotes standard cubic centimeters per minute

<sup>2</sup> Output voltage is ratiometric to supply voltage

### ELECTRICAL CONNECTION





### FLOW SENSOR CHARACTERISTICS<sup>3</sup>

( $V_s = 10 \pm 0.01$  V,  $T_A = 25^\circ\text{C}$ )

Part no.	Flow range (full scale)	Max. flow change <sup>4</sup>	Output voltage @ trim point
FBOM200DB	$\pm 200$ sccm	5.0 l/sec	30 mV @ 100 sccm
FBOM030DB	$\pm 30$ sccm	5.0 l/sec	11.8 mV @ 25 sccm
FBOL001DB	$\pm 1000$ sccm	5.0 l/sec	50 mV @ 650 sccm
FBOL001DBX	-600...1000 sccm	5.0 l/sec	50 mV @ 650 sccm

### PERFORMANCE CHARACTERISTICS

( $V_s = 10 \pm 0.01$  V,  $T_A = 25^\circ\text{C}$ )

Characteristics		Min.	Typ.	Max.	Unit	
Zero offset		-1.0	0	1.0	mV	
Repeatability and hysteresis (combined)				$\pm 1.0$ $\pm 0.35$	% reading	
Temperature effects	Offset	-25 to 85 °C <sup>5</sup>			mV	
	Span	-25 to 25 °C	FBOM200DB		2.5	% reading
			FBOM030DB		5.0	
			FBOL001DB		5.0	
			FBOL001DBX		5.0	
		25 to 85 °C	FBOM200DB		-2.5	
			FBOM030DB		-5.0	
			FBOL001DB		-5.0	
FBOL001DBX				-5.0		
Sensor resistance (Pin 2 - Pin 1, Pin 6 - Pin 1)			5		kOhm	
Sensor current (Pin 2 - Pin 1, Pin 6 - Pin 1)				0.6	mA	
Response time			1.0	3.0	ms	
Common mode pressure				25	psi	

**Notes:**

<sup>3</sup> A 5 micron filter is recommended for all devices.

<sup>4</sup> Maximum allowable rate of flow change to prevent damage.

<sup>5</sup> Shift is relative to 25 °C.



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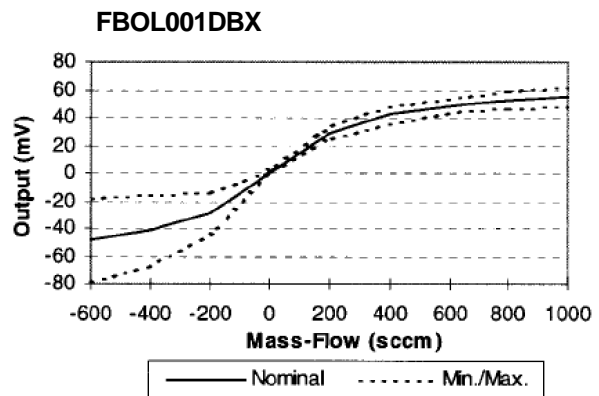
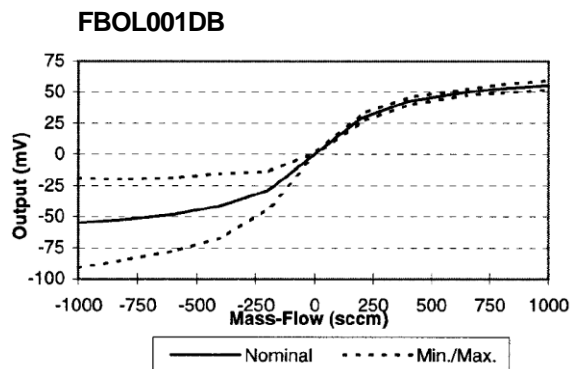
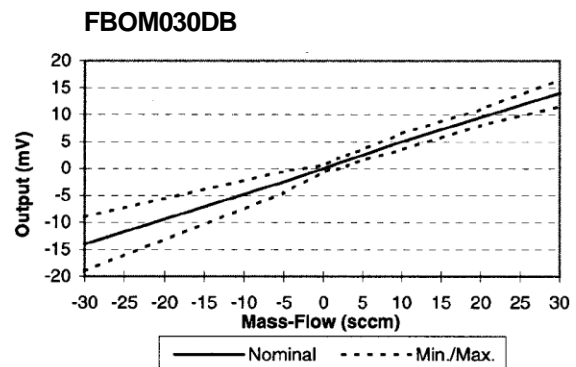
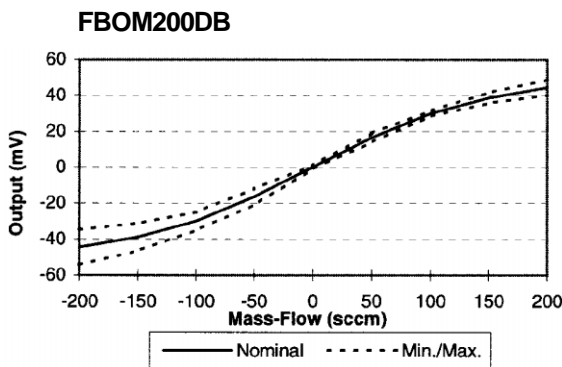
### FLOW SPECIFICATIONS

( $V_s = 10 \pm 0.01$  V,  $T_A = 25^\circ\text{C}$ )

FBOM200DB				FBOM030DB				FBOL001DB				FBOL001DBX			
Press. (mbar)	Flow (sccm) <sup>6</sup>	Nom. (mV)	Tol. ( $\pm$ mV)	Press. ( $\mu$ bar)	Flow (sccm) <sup>6</sup>	Nom. (mV)	Tol. ( $\pm$ mV)	Press. (mbar)	Flow (sccm) <sup>6</sup>	Nom. (mV)	Tol. ( $\pm$ mV)	Press. (mbar)	Flow (sccm) <sup>6</sup>	Nom. (mV)	Tol. ( $\pm$ mV)
0.49	200	44.50	4.25	53	30	14.0	2.5	3.4	1000	55.50	3.70	3.4	1000	55.50	7.0
0.35	150	38.75	3.00	36	20	9.5	1.5	2.4	800	52.90	3.50	2.4	800	52.90	6.0
0.21	100	30.00	1.50	17	10	5.0	1.5	1.8	650	50.00	2.50	1.8	650	50.00	5.0
0.09	50	16.50	2.50	9.8	5	2.5	1.0	0.83	400	42.50	3.00	0.83	400	42.50	6.0
0.00	0	0.00	1.00	7.4	4	2.0	1.0	0.31	200	29.20	3.20	0.31	200	29.20	5.0
0.00	50	16.50	4.50	6.2	3	1.5	1.0	0	0	0.00	1.00	0	0	0.00	1.5
-0.21	-100	-30.00	5.00	5	2	1.0	1.0	-0.31	-200	-28.90	15.00	-0.31	-200	-28.90	15.0
-0.35	-150	-38.80	7.65	2.5	1	0.5	0.8	-0.83	-400	-41.20	26.00	-0.83	-400	-41.20	26.0
-0.49	-200	-44.50	9.75	0	0	0.0	0.6	-1.6	-600	-48.20	29.50	-1.6	-600	-48.20	30.0
				-9.8	-5	-2.5	2.0	-2.4	-800	-52.20	32.50				
				-53	-30	-14.0	5.0	-3.4	-1000	-55.00	36.00				

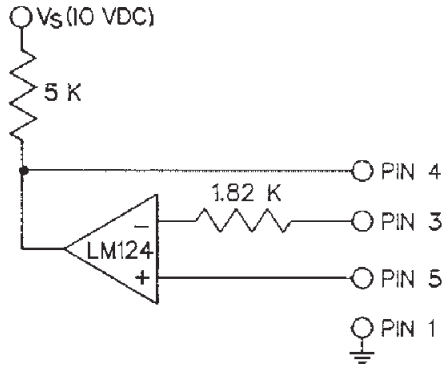
Note: <sup>6</sup> Devices are calibrated in mass flow. Tolerance values apply to calibration type only.

### OUTPUT VS. FLOW CURVES

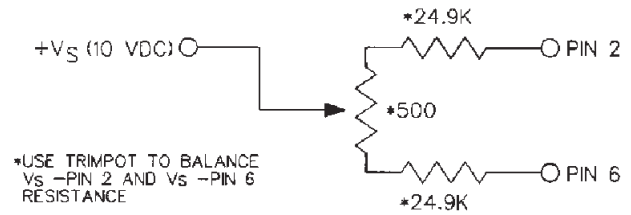




### HEATER CONTROL CIRCUIT

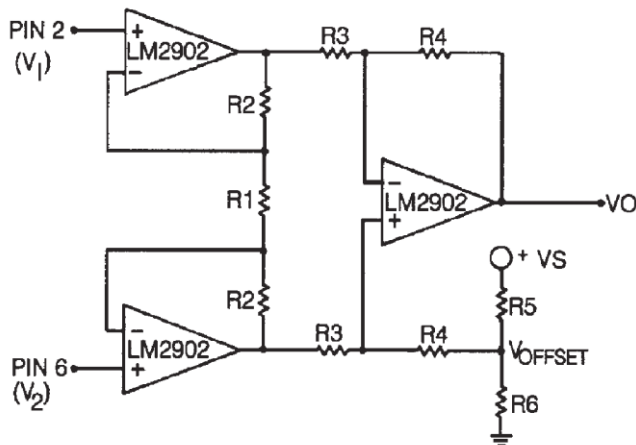


### SENSING BRIDGE SUPPLY CIRCUIT



**Note:**  
 These circuits are required for operation per specifications. Circuits are not on board the sensor.

### DIFFERENTIAL INSTRUMENTATION AMPLIFIER CIRCUIT (optional)



$$V_O = \left( \frac{2R_2 + R_1}{R_1} \right) \left( \frac{R_4}{R_3} \right) (V_2 - V_1) + V_{Offset}$$

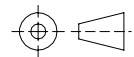
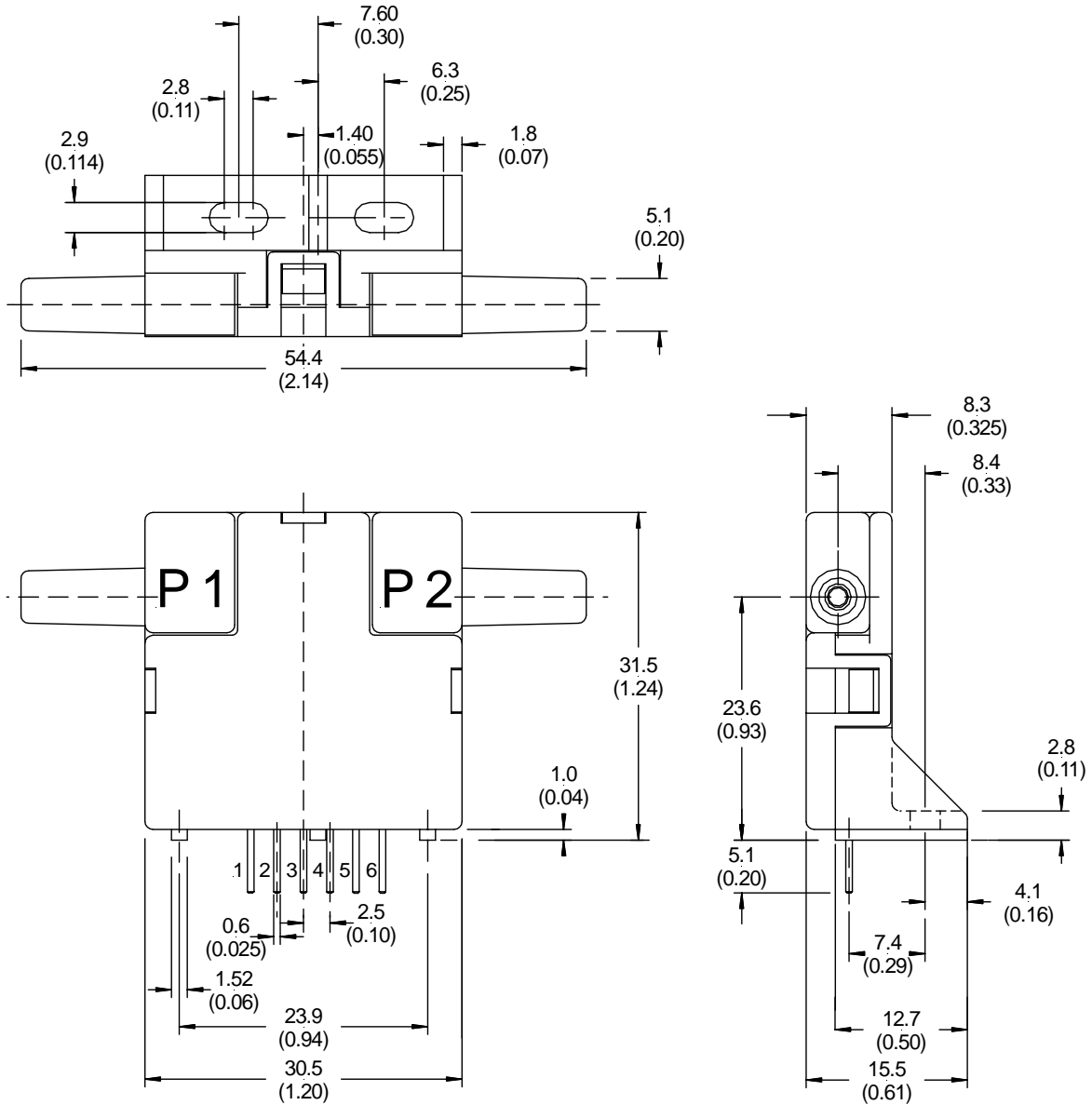
where  $V_{Offset} = V_S \left( \frac{R_6}{R_6 + R_5} \right)$



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### OUTLINE DRAWING



third angle projection

mass: approx. 10.8 g

dimensions in mm (inches)

**Note:** Positiv flow direction is defined as proceeding from port 1 (P1) to port 2 (P2) and results in positive output (pin 6 > pin 2). Negative flow direction is defined conversely and results in negative output (pin 6 < pin 2).



### GAS CORRECTION FACTORS<sup>7</sup>

Gas type	Correction factor (approx.)
Helium (He)	0.5 <sup>8</sup>
Hydrogen (H <sub>2</sub> )	0.7 <sup>8,9</sup>
Argon (Ar)	0.95
Nitrogen (N <sub>2</sub> )	1.0
Oxygen (O <sub>2</sub> )	1.0
Air	1.0
Nitric oxide (NO)	1.0
Carbon monoxide (CO)	1.0
Methane (CH <sub>4</sub> )	1.1
Ammonia (NH <sub>3</sub> )	1.1
Nitrous oxide (N <sub>2</sub> O)	1.35
Nitrogen dioxide (NO <sub>2</sub> )	1.35
Carbon dioxide (CO <sub>2</sub> )	1.35

Notes:

<sup>7</sup> Gas correction factors are referenced to nitrogen (N<sub>2</sub>) as calibration gas type. Approximate gas correction factors are provided as guidelines only. Individual gas types may perform differently at temperature extremes and varying flow rates.

<sup>8</sup> When sensing Hydrogen (H<sub>2</sub>) or Helium (He) it may be necessary to power the mass flow sensor using increased supply voltage: Hydrogen typ. 12 V, Helium typ. 15 V

<sup>9</sup> Hydrogen (H<sub>2</sub>) flow measurement requires the use of a special sensor. These devices provide normal operation when sensing hydrogen flow and are designated with an "H" at the end of the order number.

### ORDERING INFORMATION - AVAILABLE LISTINGS

**Note:** Preferred listings are highlighted in grey

Flow range	Dry gas	Hydrogen gas <sup>9</sup>
±30 sccm	FBOM030DB	---
±200 sccm	FBOM200DB	FBOM200HB
±1000 sccm	FBOL001DB	FBOL001HB
-600...1000 sccm	FBOL001DBX	---

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