



FBO Series

Mass flow sensors for gases

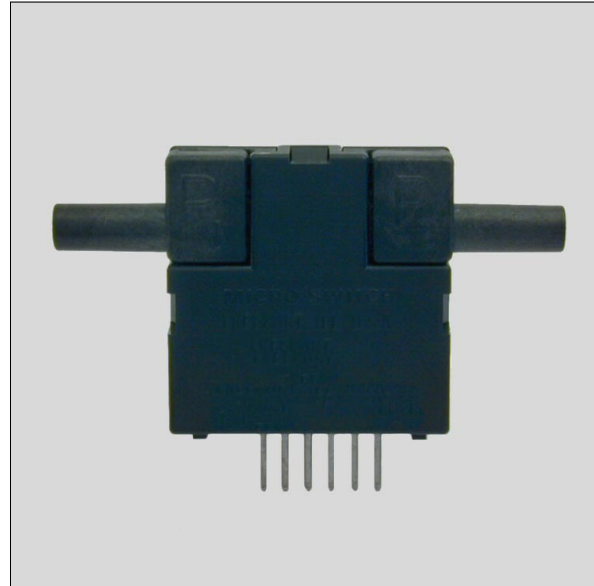
FEATURES

- Ranges 0...±30 to 0...±1000 or -600...1000 sccm¹
- 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

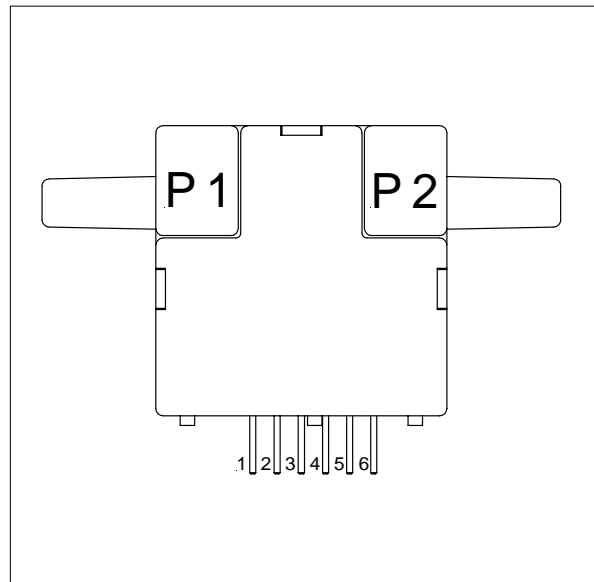
| | |
|-----------------------------|------------------------------|
| Supply voltage ² | 8 to 15 V typ. 10 ±0.01 V |
| Power consumption | max. 50 mW typ. 30 mW |
| Temperature limits | |
| Operating | -25 to 85°C |
| Storage | -40 to 90°C |
| Mechanical shock | 100 g (5 drops, 6 axes) |

Note:

¹ sccm denotes standard cubic centimeters per minute

² Output voltage is ratiometric to supply voltage

ELECTRICAL CONNECTION





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FLOW SENSOR CHARACTERISTICS³

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

| Part no. | Flow range (full scale) | Max. flow change ⁴ | Output voltage @ trim point |
|------------|-------------------------|-------------------------------|-----------------------------|
| FBOM200DB | ± 200 sccm | 5.0 l/sec | 30 mV @ 100 sccm |
| FBOM030DB | ± 30 sccm | 5.0 l/sec | 11.8 mV @ 25 sccm |
| FBOL001DB | ± 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) | | | | ± 1.0 ± 0.35 | % reading | |
| Temperature effects | Offset -25 to 85 °C ⁵ | | ± 0.20 | | mV | |
| | Span -25 to 25 °C | | | 2.5 5.0 5.0 5.0 | % reading | |
| | 25 to 85 °C | | | -2.5 -5.0 -5.0 -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:

³ A 5 micron filter is recommended for all devices.

⁴ Maximum allowable rate of flow change to prevent damage.

⁵ Shift is relative to 25 °C.



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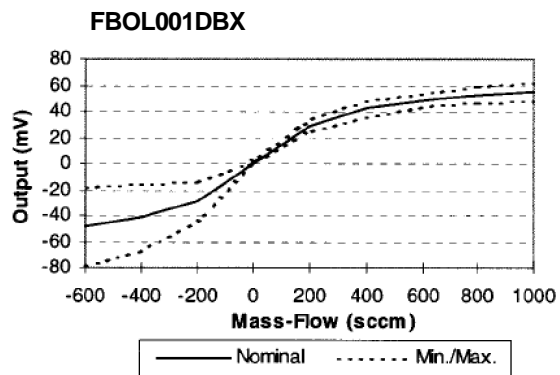
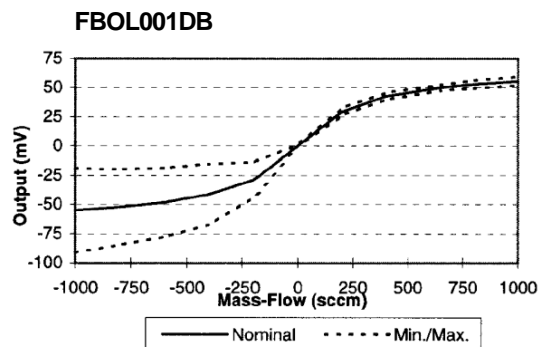
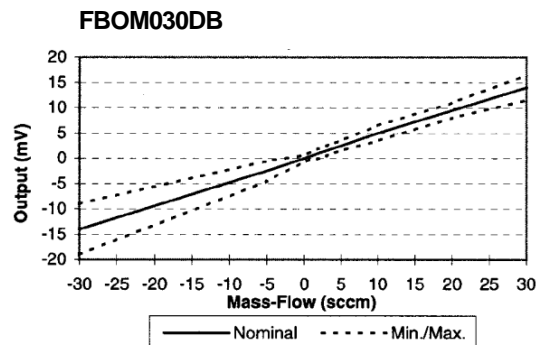
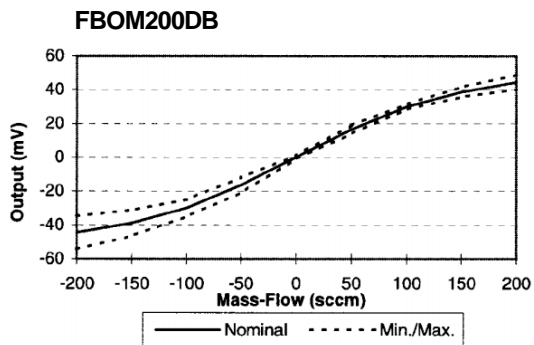
FLOW SPECIFICATIONS

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

| FBOM200DB | | | | FBOM030DB | | | | FBOL001DB | | | | FBOL001DBX | | | |
|---------------|--------------------------|-----------|------------------|---------------------|--------------------------|-----------|------------------|---------------|--------------------------|-----------|------------------|---------------|--------------------------|-----------|------------------|
| Press. (mbar) | Flow (sccm) ⁶ | Nom. (mV) | Tol. (\pm mV) | Press. (μ bar) | Flow (sccm) ⁶ | Nom. (mV) | Tol. (\pm mV) | Press. (mbar) | Flow (sccm) ⁶ | Nom. (mV) | Tol. (\pm mV) | Press. (mbar) | Flow (sccm) ⁶ | 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 | | | | |

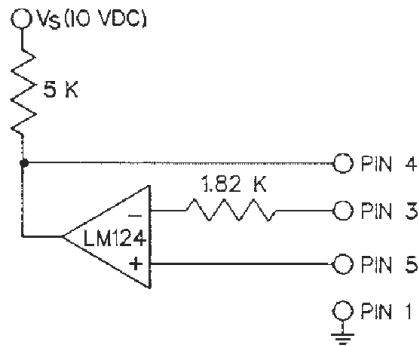
Note: ⁶ Devices are calibrated in mass flow. Tolerance values apply to calibration type only.

OUTPUT VS. FLOW CURVES

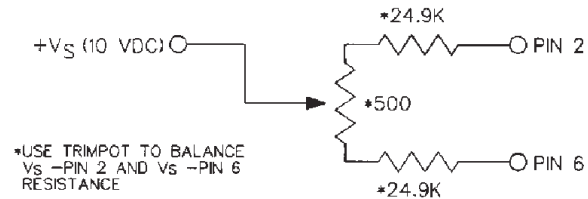




HEATER CONTROL CIRCUIT



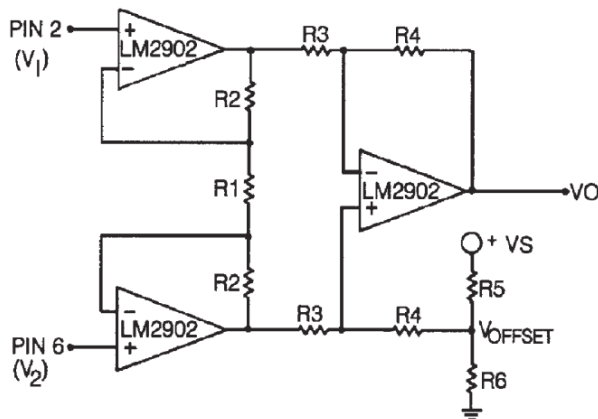
SENSING BRIDGE SUPPLY CIRCUIT



Note:

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

DIFFERENTIAL INSTRUMENTATION AMPLIFIER CIRCUIT (optional)



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

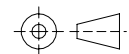
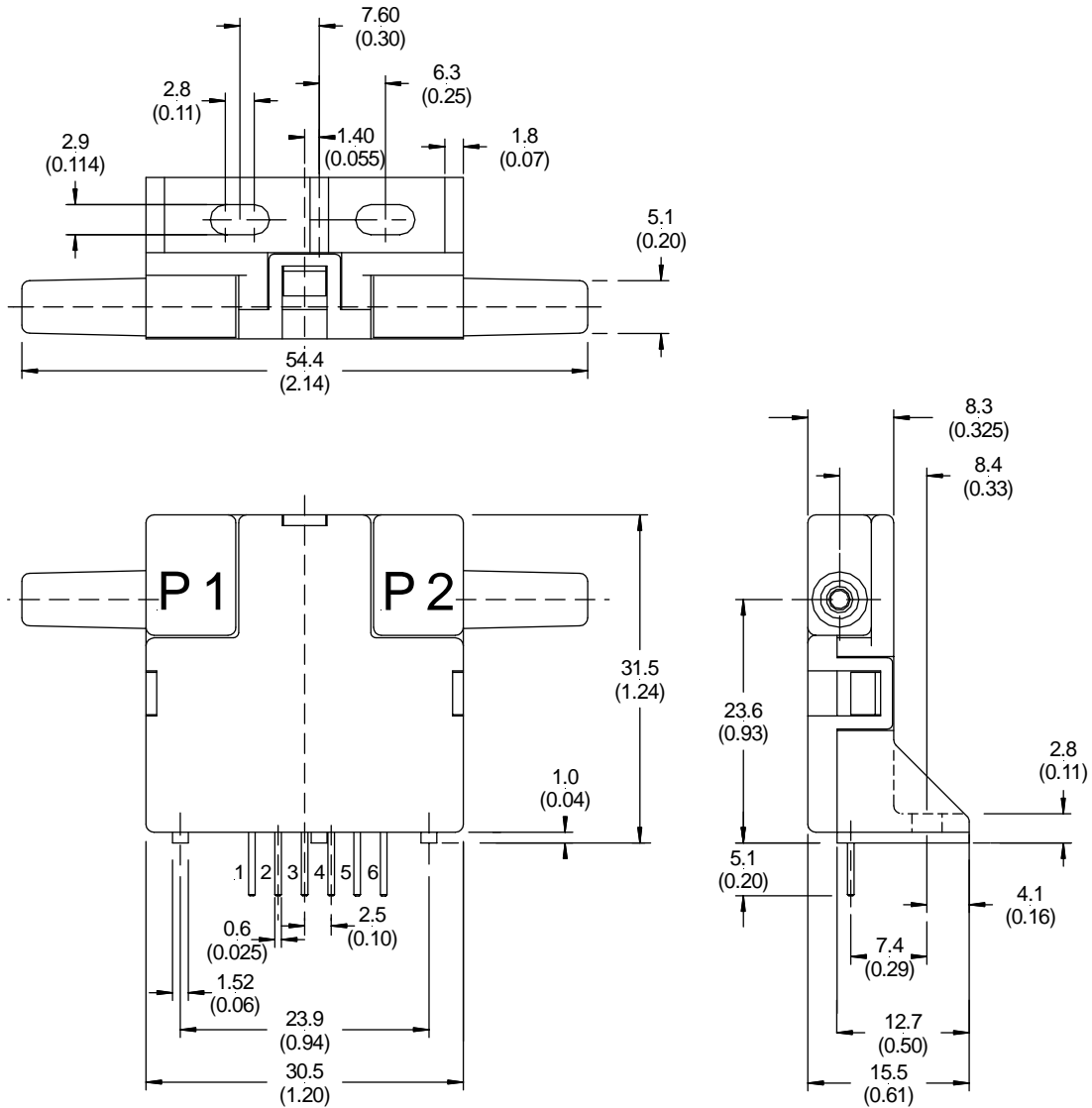
where $V_{Offset} = V_s \left(\frac{R_6}{R_6 + R_5} \right)$



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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 FACTORS⁷

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

Notes:

⁷ Gas correction factors are referenced to nitrogen (N₂) 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.

⁸ When sensing Hydrogen (H₂) 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

⁹ Hydrogen (H₂) 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 ⁹ |
|------------------|------------|---------------------------|
| ±30 sccm | FBOM030DB | --- |
| ±200 sccm | FBOM200DB | FBOM200HB |
| ±1000 sccm | FBOL001DB | FBOL001HB |
| -600...1000 sccm | FBOL001DBX | --- |

Sensortech PRO services:

- Extended guarantee period of 2 years
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- Advanced logistics models for supply inventory and short delivery times
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- Fastest possible technical response for design and QA engineers
- ... plus other services on request

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