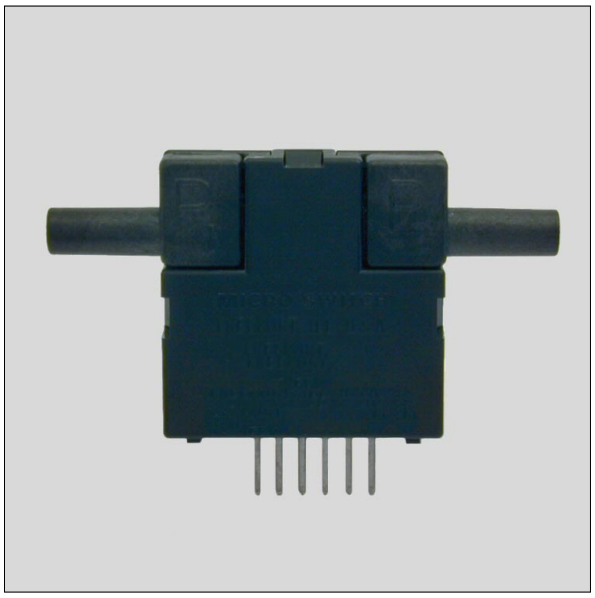
# FBO Series
## Mass flow sensors for gases

### FEATURES

- **Ranges 0...±30 to 0...±1000 or -600...1000 sccm[1]**
- **Bidirectional sensing**
- **Actual mass flow sensing**
- **Sensortechnics 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

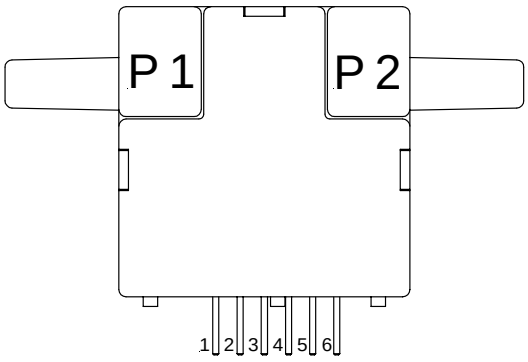
### SPECIFICATIONS

**Maximum ratings**

| | |
|---|---|
| Supply voltage[2] | 8 to 15 V<br>typ. 10 ±0.01 V |
| Power consumption | max. 50 mW<br>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






SENSORTECHNICS

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## FLOW SENSOR CHARACTERISTICS[3]

($V_S$ = 10 ±0.01 V, $T_A$ = 25°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 ±0.01 V, $T_A$ = 25°C)

| Characteristics | | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Zero offset | | | | -1.0 | 0 | 1.0 | mV |
| Repeatability and hysteresis (combined) | | | FBOL001DB<br>all others | | | ±1.0<br>±0.35 | % reading |
| Temperature effects | Offset | -25 to 85 °C[5] | | | ±0.20 | | 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:
[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.

## FLOW SPECIFICATIONS

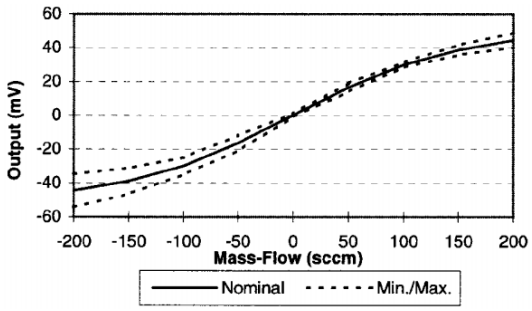
($V_S$ = 10 ±0.01 V, $T_A$ = 25°C)

| FBOM200DB | | | | FBOM030DB | | | | FBOL001DB | | | | FBOL001DBX | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Press. (mbar) | **Flow (sccm)[6]** | Nom. (mV) | Tol. (± mV) | Press. (µbar) | **Flow (sccm)[6]** | Nom. (mV) | Tol. (± mV) | Press. (mbar) | **Flow (sccm)[6]** | Nom. (mV) | Tol. (± mV) | Press. (mbar) | **Flow (sccm)[6]** | Nom. (mV) | Tol. (± 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 | | | | |

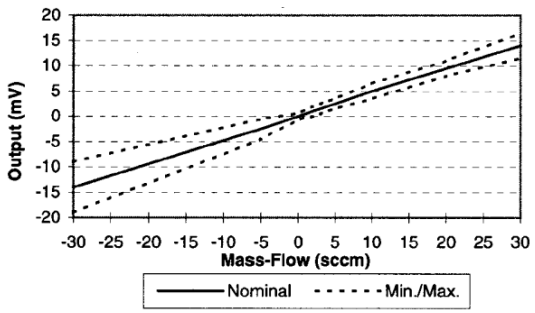
Note: [6] Devices are calibrated in mass flow. Tolerance values apply to calibration type only.

## OUTPUT VS. FLOW CURVES

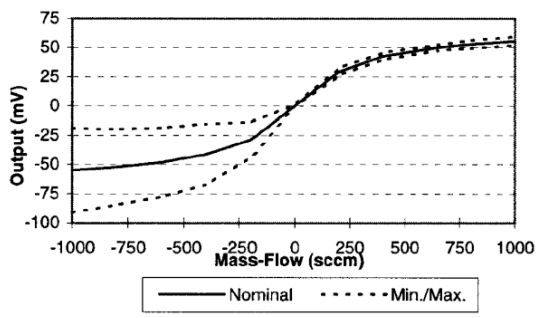
**FBOM200DB**



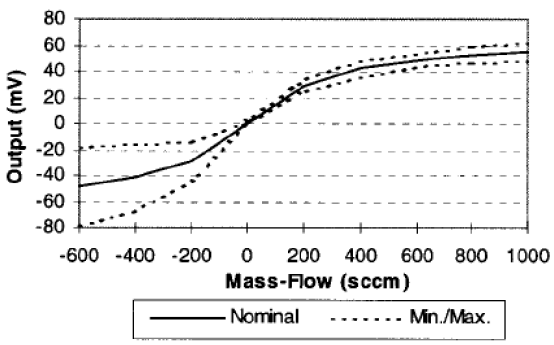

**FBOM030DB**



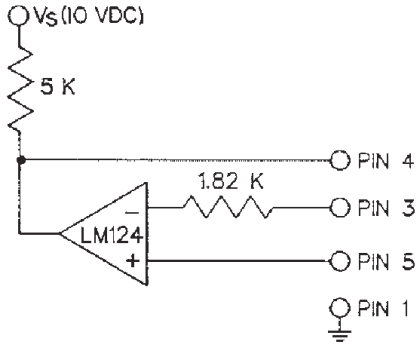

**FBOL001DB**



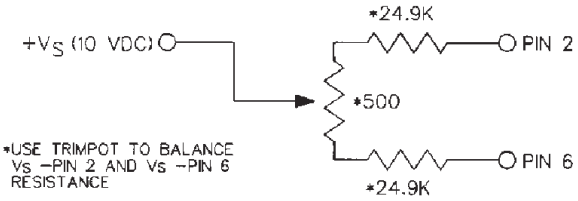

**FBOL001DBX**



## HEATER CONTROL CIRCUIT

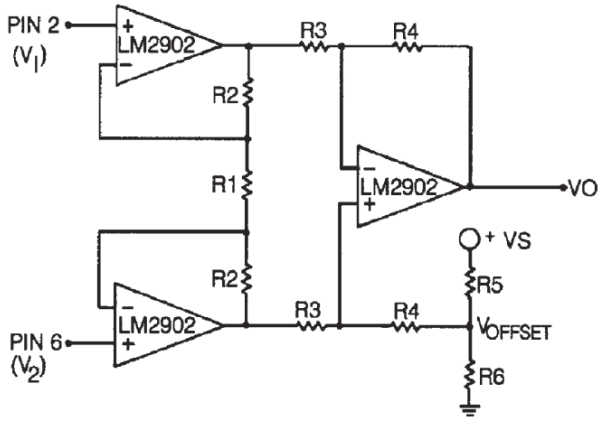



## SENSING BRIDGE SUPPLY CIRCUIT




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

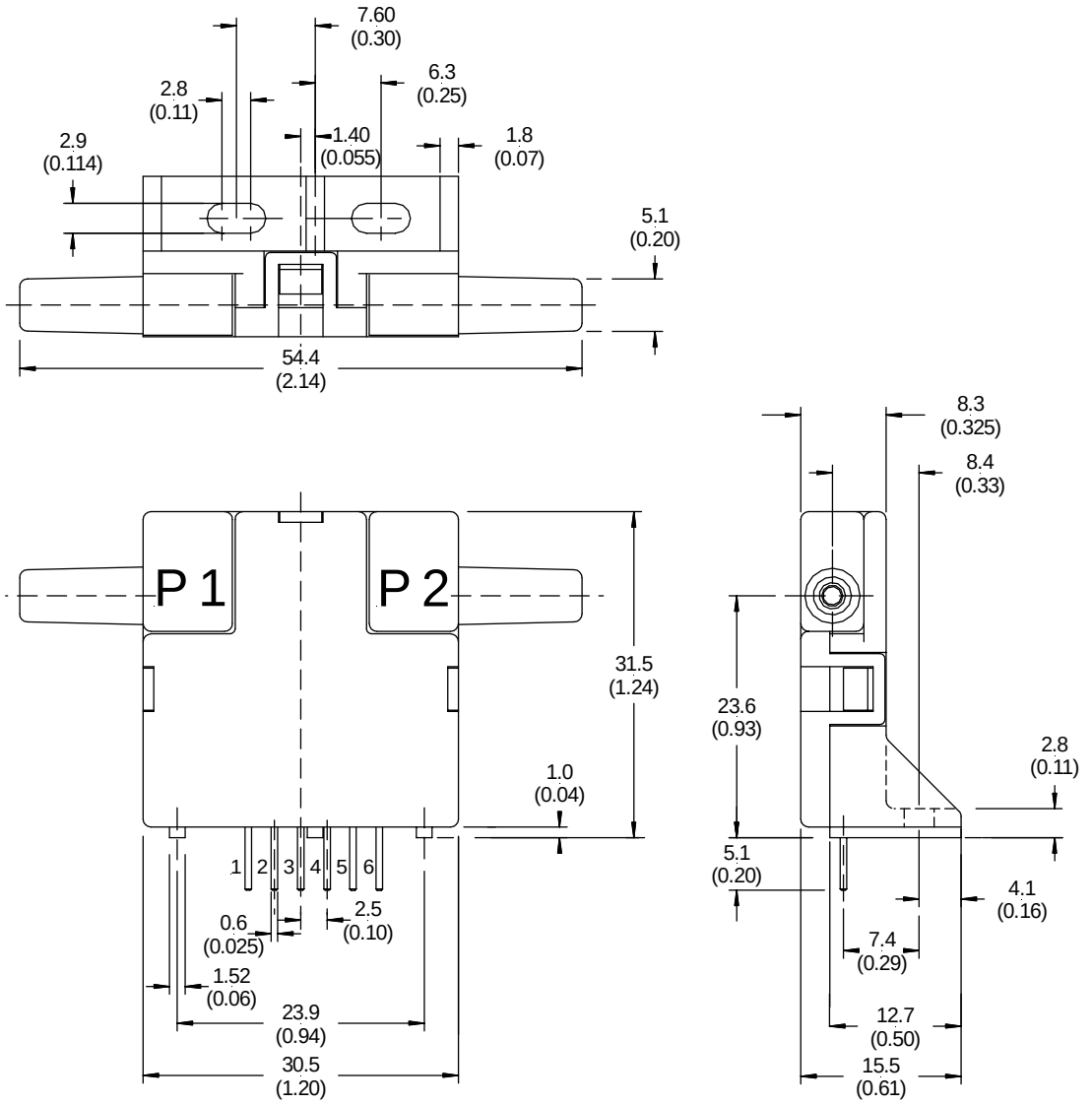
## DIFFERENTIAL INSTRUMENTATION AMPLIFIER CIRCUIT (optional)




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

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

## 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[7]

| 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 ($N_2O$) | 1.35 |
| Nitrogen dioxide ($NO_2$) | 1.35 |
| Carbon dioxide ($CO_2$) | 1.35 |

Notes:
[7] Gas correction factors are referenced to nitrogen ($N_2$) 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 ($H_2$) 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 ($H_2$) 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 | --- |

**Sensortechnics PRO services:**

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... plus other services on request