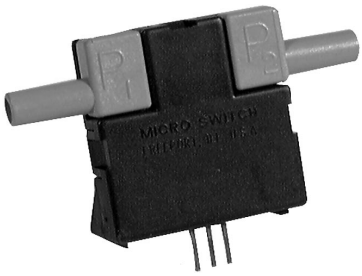
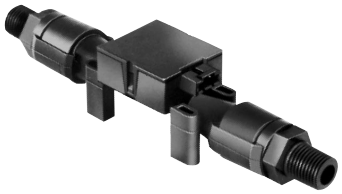
Airflow Sensors
Microbridge Mass Airflow



AWM 1000/2000/3000 Series

AWM 40000 Series



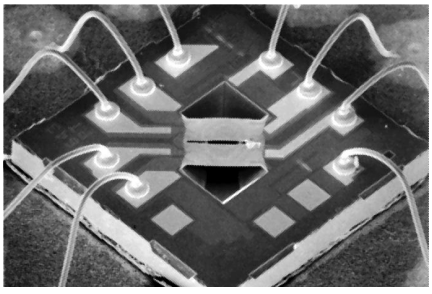
AWM 5000 Series

FEATURES
- State-of-the-art silicon micromachining
- Sensitive to low flows – 0.1 sccm to 20 SLPM
- Adaptable for use with higher flows (See Application Note 2 page 128.)
- Fast response time
- Analog output
- Low power consumption
- Repeatable response
- Laser-trimmed interchangeability
- Accurate, cost effective flow sensing
- In-line printed circuit board terminals
- Standard 0.100″ (2,54mm) mounting centers
- Accurate sensing of low pressure 0.001″ to 4.0″ H_2O (.003 to 10mBar)

APPLICATIONS
- Damper control for heating, ventilation, and air conditioning systems
- Gas analyzers
- Low vacuum control
- Process control
- Medical respirators and ventilators
- Oxygen concentrators
- Leak detection equipment
- Vent hoods
- Anesthesia control
- Gas metering
- Gas chromatography

OPERATION
The microbridge mass airflow sensor operates on the theory of heat transfer. Mass airflow is directed across the surface of the sensing elements. Output voltage varies in proportion to the mass air or other gas flow through the inlet and outlet ports of the package. The specially designed housing precisely directs and controls the airflow across the microstructure sense element. Mechanical design of the package allows it to be easily mounted to printed circuit boards.

The microbridge mass airflow sensor has a unique silicon chip based on advanced microstructure technology. It consists of a thin-film, thermally isolated bridge structure containing heater and temperature sensing elements. The bridge structure provides a sensitive and fast response to the flow of air or other gas over the chip. Dual sensing elements positioned on both sides of a central heating element indicate flow direction as well as flow rate. Laser trimmed thick film and thin film resistors provide consistent interchangeability from one device to the next.



The microbridge mass airflow sensor uses temperature-sensitive resistors deposited within a thin film of silicon nitride. They are suspended in the form of two bridges over an etched cavity in the silicon, shown below. The chip is located in a precisely dimensioned airflow channel to provide a repeatable flow response. Highly effective thermal isolation for the heater and sensing resistors is attained by etching the cavity space beneath the flow sensor bridges. The small size and thermal isolation of the microbridge mass airflow sensor are responsible for the extremely fast response and high sensitivity to flows.

Dual Wheatstone bridges control airflow measurement — one provides closed loop heater control, the other contains the dual sensing elements. The heater circuit minimizes shift due to ambient temperature changes by providing an output proportional to mass flow. The circuit keeps the heater temperature at a constant differential (160°C) above ambient air temperature which is sensed by a heat-sunk resistor on the chip. The ratiometric voltage output of the device corresponds to the differential voltage across the Wheatstone bridge circuit.

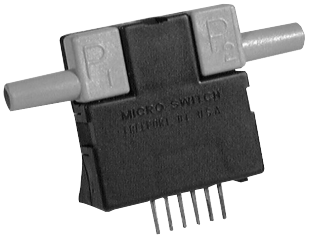
NOTICE
Dust contamination may be possible in some applications, the effects of which can be minimized. By design, dust particles that may be present in the air stream will flow past the chip parallel to the chip surface. In addition, the microstructure chip produces a thermophoretic effect, which repels micrometer-sized dust particles away from the bridge structure.

Dust adherence to chip edges and channel surfaces can be prevented using a simple filter. A disposable five-micron filter used in series on the upstream side of the airflow device will provide adequate filtering in most applications. For a list of possible filter sources, see Filter Manufacturers, page 126.

CAUTION
PRODUCT DAMAGE

AWM Series Microbridge Mass Airflow Sensors are **NOT** designed to sense liquid flow and will be damaged by liquid flow through the sensor.

Microbridge Mass Airflow/Unamplified



FEATURES
- Cost-effective microbridge technology
- Accurate, repeatable airflow sensing
- Bi-directional sensing capability
- Low differential pressure sensing

Take advantage of microbridge mass flow sensor technology. The AWM1000 series mass flow sensor provides all of the outstanding performance benefits of the standard AWM2000 series in a more cost-effective sensor platform. This device provides accurate, repeatable flow sensing. Sensor to sensor interchangeability specifications are approximately twice as large as compared to the AWM2000 series.

The heater control circuit in Figure 1 and the sensing bridge supply circuit in Figure 2 are both required for operation per specification. These two circuits are **NOT** on board the sensor and must be supplied in the application. The differential amplifier circuitry in Figure 3 may be useful in providing output gain and/or introducing voltage offsets to the sensor output (Ref. Equation 1).

NOTE: For applications involving sensing hydrogen (H_2) gas or helium (He) gas, see Application Note 3, page 131.

Figure 1
Heater Control Circuit

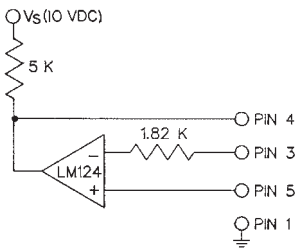


Figure 2
Sensing Bridge Supply Circuit

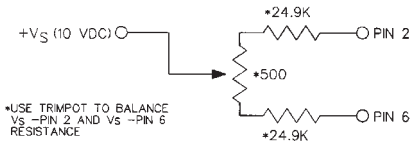
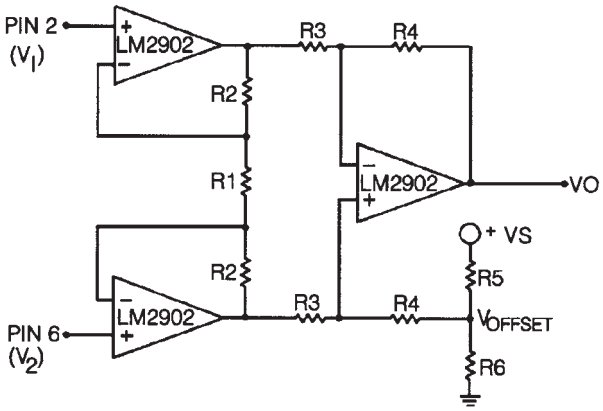


Figure 3
Differential Instrumentation Amplifier Circuit



Equation 1:

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

$$\text{where } V\ \text{offset} = V_s\left(\frac{R_6}{R_6+R_5}\right)$$

Airflow

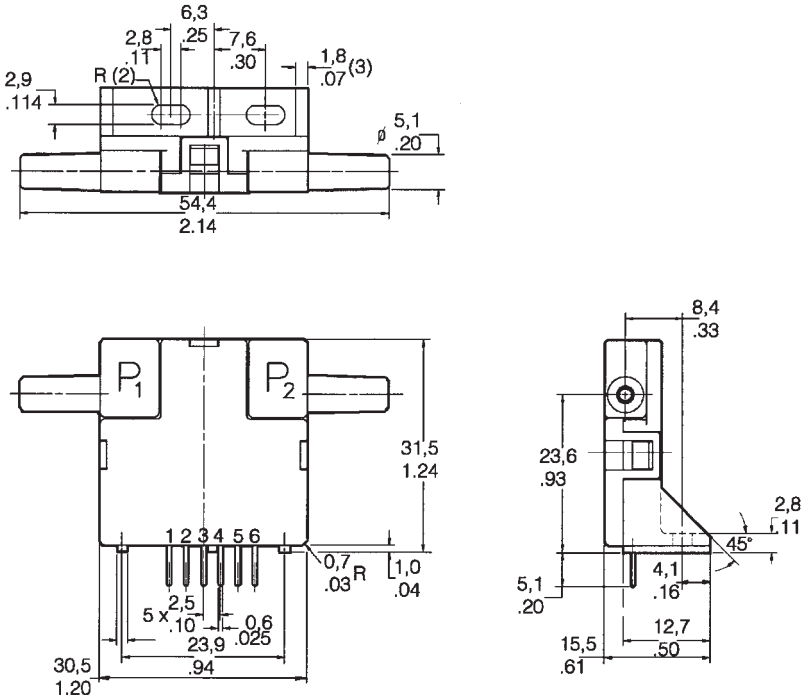
Microbridge Mass Airflow/Unamplified

AWM1000 SERIES ORDER GUIDE (Performance Characteristics @ 10.0 ±0.01 VDC, 25°C)

Catalog Listings	AWM1100V	AWM1200V	AWM1300V
Flow Range (Full Scale)	±200 sccm		+1000 sccm to −600 sccm
Pressure Range (See Application Note #1)		±4.0″ H_2O (10 mBar)	
Output Voltage @ Trim Point	30 mV @ 100 sccm	20 mV @ 2.0″ H_2O	50 mV @ 650 sccm
Null Voltage Shift, Typ. +25 to −25°C, +25 to 85°C	±0.7 mV (max.)	±0.7 mV (max.)	±0.7 mV (max.)
Output Voltage Shift, Max. +25 to −25°C +25 to +85°C	±4% Full Scale ±4% Full Scale	+22% Reading (Note 2) −22% Reading	±4% Full Scale ±4% Full Scale
Repeatability & Hysteresis, Max.	±1% Full Scale	±1% Full Scale	±1% Full Scale
	Min.	**Typ.**	**Max.**
Excitation (VDC) (Note 1)	8.0	10±0.01	15
Power Consumption (mW)	—	30	50
Null Voltage (mV)	−1.0	0.0	+1.0
Response Time (msec)	—	1.0	3.0
Common Mode Pressure (psi)	—	—	25
Sensor Resistance (kΩ) Pin 2-Pin 1, Pin 6-Pin 1	—	5	—
Sensor Current (mA) Pin 2-Pin 1, Pin 6-Pin 1	—	0.3	0.6
Temperature Range	Operating: −25° to +85°C (−13° to +185°F); Storage: −40° to +90°C (−40° to +194°F)		
Termination	2,54 mm (.100″) centers, 0,635 mm (0.025″) square		
Weight (grams)	10.8		
Shock Rating	100 g peak (5 drops, 6 axes)		

Notes:
1. Output Voltage is ratiometric to supply voltage.
2. Temperature shifts when sensing differential pressure correlates to the density change of the gas over temperature. See Application Note 1.
3. Maximum allowable rate of flow change to prevent damage: 5 SLPM/1.0 sec.

MOUNTING DIMENSIONS (for reference only)



NOTE: Positive 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). Do not exert a force greater than 4.54 kg (10 lbs.) in any direction.

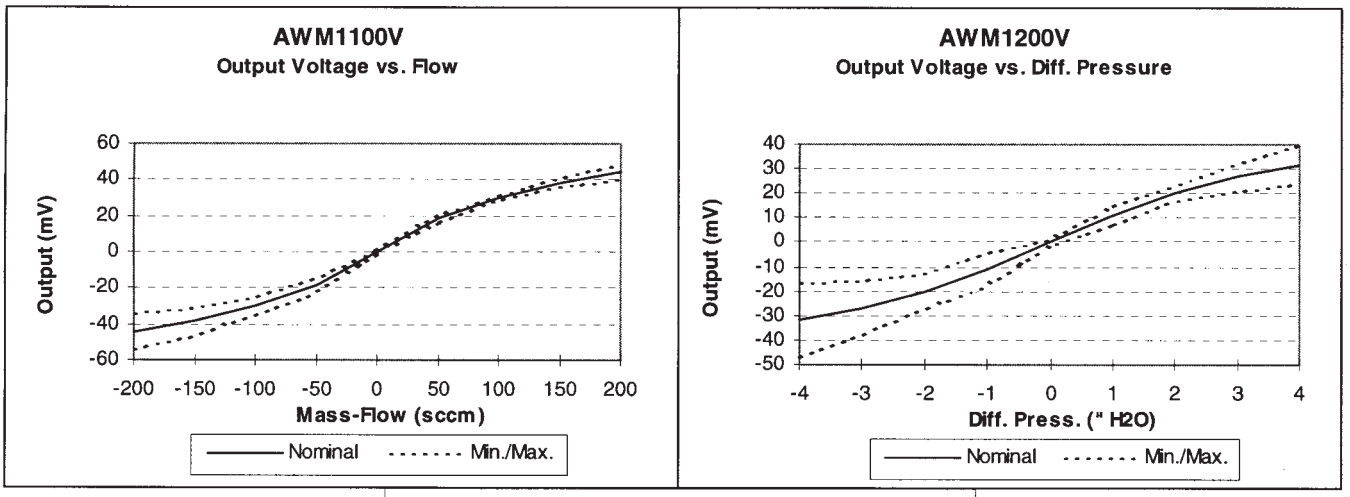
Microbridge Mass Airflow/Unamplified

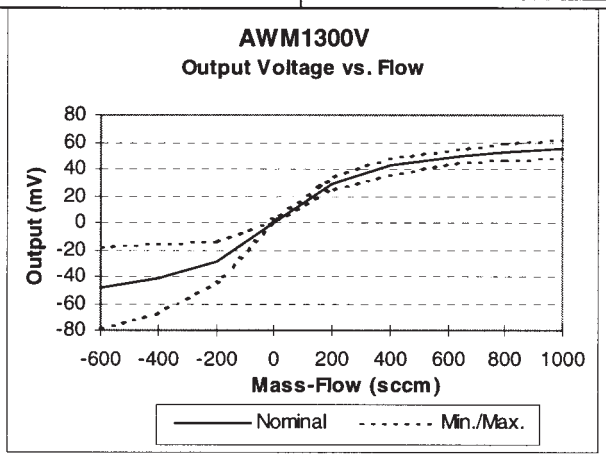
OUTPUT FLOW VS INTERCHANGEABILITY (Note 1) **Performance Characteristics @ 10.0 ±0.01 VDC, 25°C**

AWM1100V				AWM1200V (Note 2)				AWM1300V			
Press mBar	**Flow sccm**	**Nom. mV**	**Tol. ±mV**	Flow sccm	**Press. ″ H_2O**	**Nom. mV**	**Tol. ±mV**	Press mBar	**Flow sccm**	**Nom. mV**	**Tol. ±mV**
0.49	**200**	44.25	4.25	120	**4.00**	31.75	8.0	3.4	**1000**	55.50	7.0
0.35	**150**	38.75	3.00	90	**3.00**	26.75	6.0	2.4	**800**	52.90	6.0
0.21	**100**	30.00	1.00	60	**2.00**	20.00	3.0	1.8	**650**	50.00	5.0
0.09	**50**	18.40	2.00	30	**1.00**	11.20	4.0	0.83	**400**	42.50	6.0
0	**0**	0.00	1.00	0	**0.00**	0.00	1.0	0.31	**200**	29.20	5.0
−0.09	**−50**	−18.40	3.90	−30	**−1.00**	−11.20	7.0	0	**0**	0.00	1.5
−0.21	**−100**	−30.00	5.00	−60	**−2.00**	−20.00	7.0	−0.31	**−200**	−28.90	15.0
−0.35	**−150**	−38.75	7.65	−90	**−3.00**	−26.75	11.0	−0.83	**−400**	−41.20	26.0
−0.49	**−200**	−44.25	9.75	−120	**−4.00**	−31.75	15.0	−1.6	**−600**	−48.20	30.0

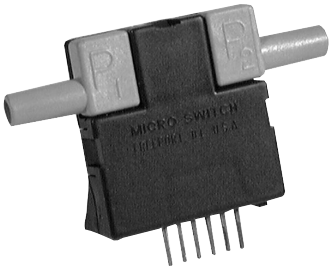
Notes:
1. Numbers in **BOLD** type indicate calibration type, mass flow or differential pressure. Tolerance values apply to calibration type only.
2. Differential pressure calibrated devices are not recommended for flow measurement. Use flow calibrated devices for flow measurement.

OUTPUT CURVES





Microbridge Mass Airflow/Unamplified



FEATURES
- Bidirectional sensing capability
- Actual mass air flow sensing
- Low differential pressure sensing

The AWM2000 Series microbridge mass airflow sensor is a passive device comprised of two Wheatstone bridges. The heater control circuit in Figure 1 is required for operation per specifications. The sensing bridge supply circuit in Figure 2 is also required for operation per specifications. These two circuits are **not on board** the package and must be supplied in the application. The differential amplifier in Figure 3 is a useful interface for the sensing bridge. It can be used to introduce the gain and to introduce voltage offsets to the sensor output as referenced in Equation 1.

Note: For applications sensing hydrogen or helium, see Application Note 3, page 131.

Figure 1
Heater Control Circuit

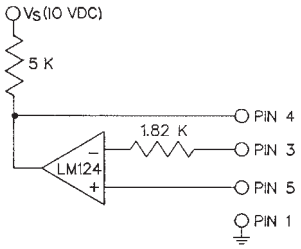


Figure 2
Sensing Bridge Supply Circuit

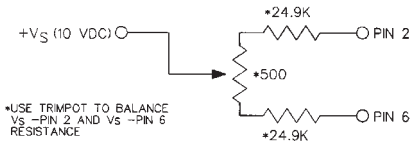
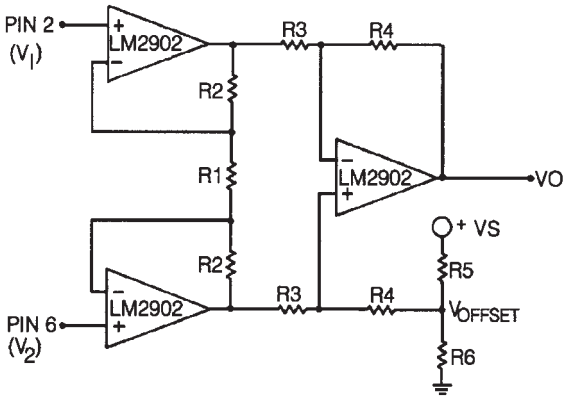


Figure 3
Differential Instrumentation Amplifier Circuit



Equation 1:

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

$$\text{where } V\ \text{offset} = V_s\left(\frac{R_6}{R_6+R_5}\right)$$

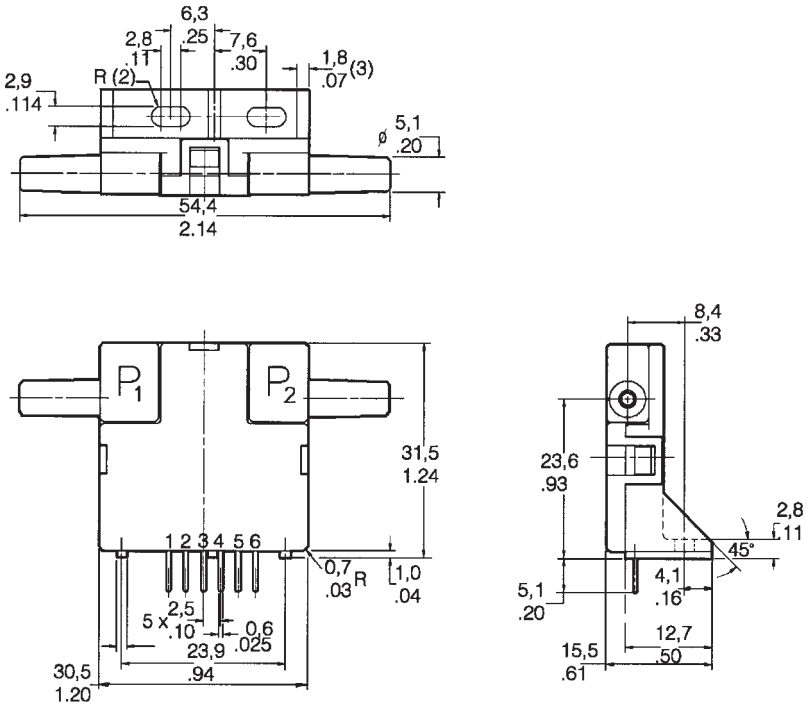
Microbridge Mass Airflow/Unamplified

AWM2000 SERIES ORDER GUIDE (Performance Characteristics @ 10.01 ±0.01 VDC, 25°C)

Catalog Listings	AWM2100V	AWM2150V	AWM2200V	AWM2300V
Flow Range (Full Scale)	±200 sccm	±30 sccm		±1000 sccm
Pressure Range (See Application Note #1)			±4.0″ H_2O (10 mBar)	
Output Voltage @ Trim Point	30 mV @ 100 sccm	11.8 mV @ 25 sccm	20 mV @ 2″ H_2O	50 mV @ 650 sccm
Null Voltage Shift, Typ. +25° to −25°C, +25° to 85°C	±0.20 mV	±0.20 mV	±0.20 mV	±0.20 mV
Output Voltage Shift, Max. +25° to −25°C +25° to +85°C	+2.5% Reading −2.5% Reading	+5% Reading −5% Reading	+22% Reading (Note 2) −22% Reading	+5% Reading −5% Reading
Repeatability & Hysteresis, Max.	±0.35% Reading	±0.35% Reading	±0.35% Reading	±1% Reading
	Min.	**Typ.**	**Max.**	
Excitation (VDC) (Note 1)	8.0	10±0.01	15	
Power Consumption (mW)	—	30	50	
Null Voltage (mV)	−1.0	0.0	+1.0	
Response Time (msec)	—	1.0	3.0	
Common Mode Pressure (psi)	—	—	25	
Sensor Resistance (kΩ) Pin 2-Pin 1, Pin 6-Pin 1	—	5	—	
Sensor Current (mA) Pin 2-Pin 1, Pin 6-Pin 1	—	—	0.6	
Temperature Range	Operating: −25° to +85°C (−13° to +185°F); Storage: −40° to +90°C (−40° to +194°F)			
Termination	2,54 mm (.100″) centers, 0,635 mm (0.025″) square			
Weight (grams)	10.8			
Shock Rating	100 g peak (5 drops, 6 axes)			

Notes:
1. Output Voltage is ratiometric to supply voltage.
2. Temperature shifts when sensing differential pressure correlates to the density change of the gas over temperature. See Application Note 1.
3. Maximum allowable rate of flow change to prevent damage: 5.0 SLPM/1.0 sec.

MOUNTING DIMENSIONS (for reference only)



NOTE: Positive 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). Do not exert a force greater than 4.54 kg (10 lbs.) in any direction.

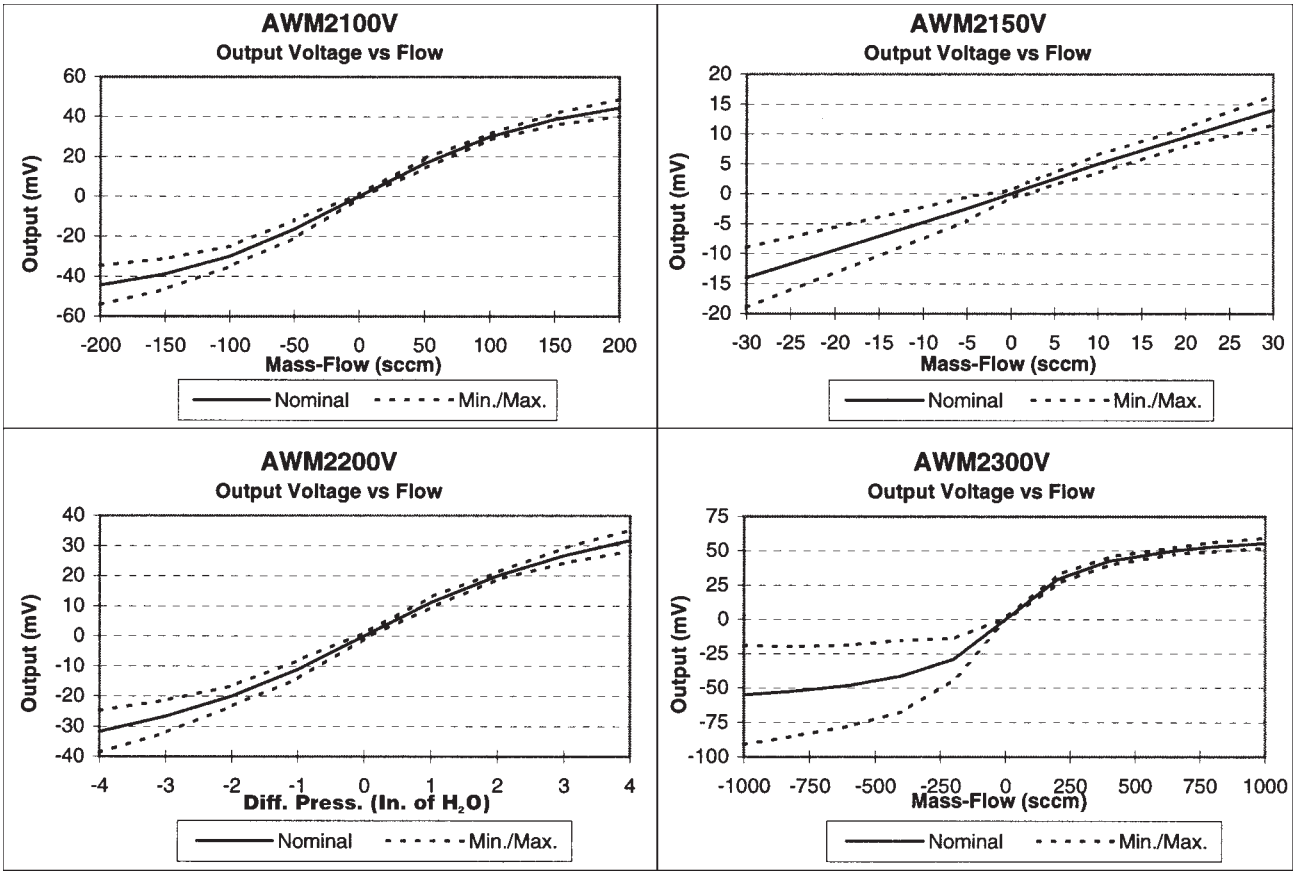
Microbridge Mass Airflow/Unamplified

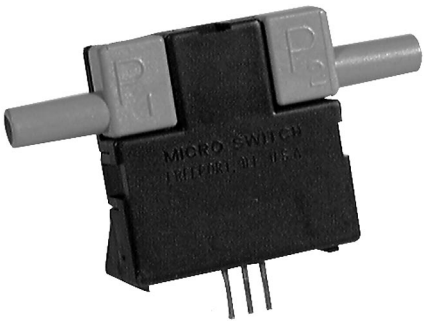
OUTPUT FLOW VS INTERCHANGEABILITY (Note 1) **Performance Characteristics @ 10.0 ±0.01 VDC, 25°C**

AWM2100V				AWM2150V				AWM2200V (Note 2)				AWM2300V			
Press. mBar	**Flow sccm**	**Nom. mV**	**Tol. ±mV**	Press. µBar	**Flow sccm**	**Nom. mV**	**Tol. ±mV**	Flow sccm	**Press. ″ H_2O**	**Nom. mV**	**Tol. ±mV**	Press. mBar	**Flow sccm**	**Nom. mV**	**Tol. ±mV**
0.49	**200**	44.50	4.25	53	**30**	14.0	2.5	120	**4.00**	31.75	3.50	3.4	**1000**	55.50	3.70
0.35	**150**	38.75	3.00	36	**20**	9.5	1.5	90	**3.00**	26.75	2.50	2.4	**800**	52.90	3.50
0.21	**100**	30.00	1.50	17	**10**	5.0	1.5	60	**2.00**	20.00	1.20	1.8	**650**	50.00	2.50
0.09	**50**	16.50	2.50	9.8	**5**	2.5	1.0	30	**1.00**	11.20	1.80	0.83	**400**	42.50	3.00
0.00	**0**	0.00	1.00	7.4	**4**	2.0	1.0	0	**0.00**	0.00	1.00	0.31	**200**	29.20	3.20
−0.09	**−50**	−16.50	4.50	6.2	**3**	1.5	1.0	−30	**−1.00**	−11.20	3.00	0	**0**	0.00	1.00
−0.21	**−100**	−30.00	5.00	5	**2**	1.0	1.0	−60	**−2.00**	−20.00	3.30	−0.31	**−200**	−28.90	15.00
−0.35	**−150**	−38.80	7.65	2.5	**1**	0.5	0.8	−90	**−3.00**	−26.75	5.30	−0.83	**−400**	−41.20	26.00
−0.49	**−200**	−44.50	9.75	0	**0**	0.0	0.6	−120	**−4.00**	−31.75	7.00	−1.6	**−600**	−48.20	29.50
				−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

Notes:
1. Numbers in **BOLD** type indicate calibration type, mass flow or differential pressure. Tolerance values apply to calibration type only.
2. Differential pressure calibrated devices are not recommended for flow measurement. Use flow calibrated devices for flow measurement.

OUTPUT CURVES





FEATURES
- Laser trimmed for improved sensor interchangeability
- Flow sensing up to 1.0 SLPM
- Low differential pressure sensing

Like the AWM2000 Series, the dual Wheatstone bridges control airflow measurement. The AWM3000 Series is amplified; therefore, it can be used to increase the gain and to introduce voltage offsets to the sensor output. The schematic in Figure 3 depicts the amplification circuitry on board the sensor. Also, the heater control circuit (see Figure 1) and the sensing bridge supply circuit (see Figure 2) are on board the package.

Figure 1
Heater control circuit

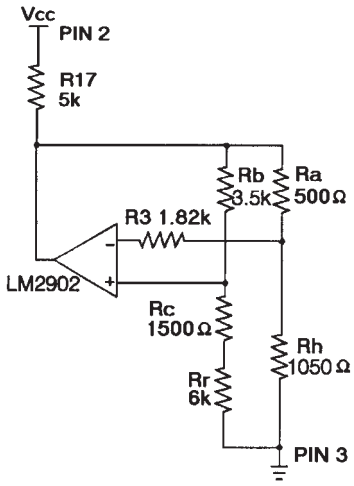


Figure 2
Sensing bridge supply circuit

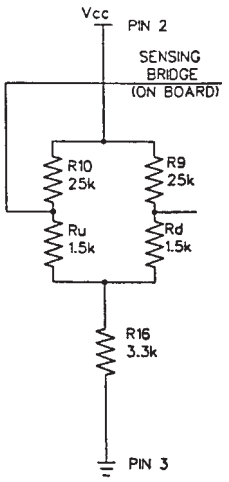
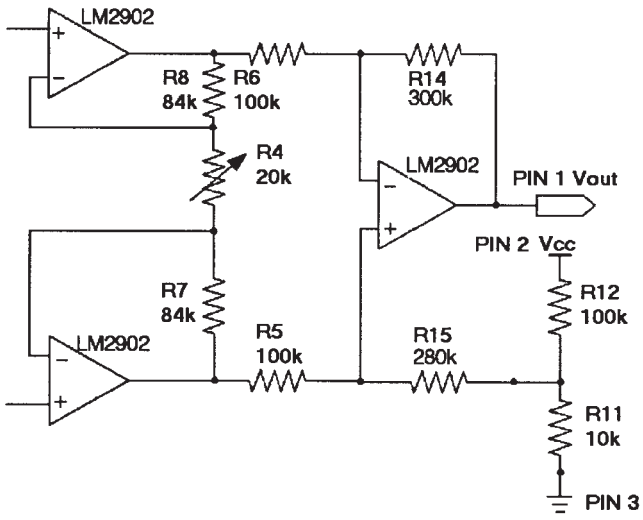


Figure 3
Differential instrumentation amplifier circuit



Airflow

Microbridge Mass Airflow/Amplified

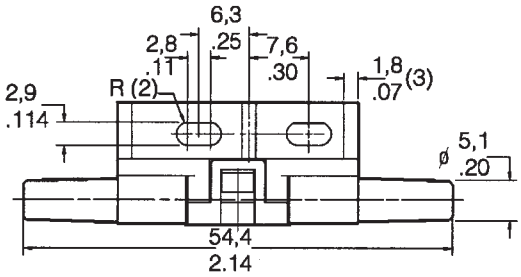
AWM3000 SERIES ORDER GUIDE (Performance Characteristics @ 10.01 ±0.01 VDC, 25°C)

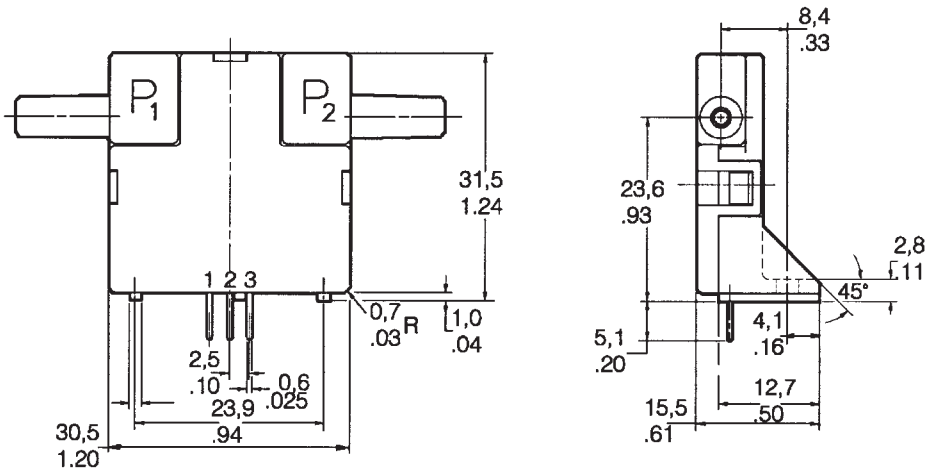
Catalog Listings	AWM3100V	AWM3150V	AWM3200V	AWM3300V
Flow Range (Full Scale)	+200 sccm	+30 sccm		+1000 sccm
Pressure Range (See Application Note 1)			+2.0″ H_2O (5 mBar)	
Output Voltage @ Trim Point	5 VDC @ 200 sccm	3.4 VDC @ 25 sccm	5 VDC @ 2″ H_2O	5 VDC @ 1000 sccm
Null Voltage	1.00 ±0.05 VDC	1.00 ±0.10 VDC	1.00 ±0.08 VDC	1.00 ±0.10 VDC
Null Voltage Shift, Typ. +25° to −25°C, 25° to +85°C	±25 mV	±100 mV	±25 mV	±25 mV
Output Voltage Shift, Max. +25° to −25°C +25° to +85°C	−4% Reading +4% Reading	±5% Reading ±5% Reading	+24% Reading (Note 3) −24% Reading	−5% Reading +5% Reading
Repeatability & Hysteresis, Max.	±0.50% Reading	±1% Reading	±0.50% Reading	±1% Reading

	Min.	Typ.	Max.
Excitation VDC (Note 2)	8.0	10±0.01	15
Power Consumption (mW)	—	50	60
Response Time (msec) (Note 1)	—	1.0	3.0
Common Mode Pressure (psi)	—	—	25
Temperature Range	Operating: −25° to +85°C (−13° to +185°F); Storage: −40° to +90°C (−40° to +194°F)		
Termination	2,54 mm (.100″) centers, 0,635 mm (0.025″) square		
Weight (grams)	10.8		
Shock Rating	100 g peak (5 drops, 6 axes)		

Notes:
1. Initial warm-up time for signal conditioned circuitry is 1 minute max.
2. Output Voltage is ratiometric to supply voltage.
3. Temperature shifts when sensing differential pressure correlates to the density change of the gas over temperature. (See Application Note 1.)
4. Maximum allowable rate of flow change to prevent damage: 5 SLPM/1 sec.

MOUNTING DIMENSIONS (for reference only)





Note: Positive flow direction is defined as proceeding from Port 1 (P1) to Port 2 (P2) and results in positive output. Do not exert a force greater than 4.54kg (10 lbs.) in any direction.

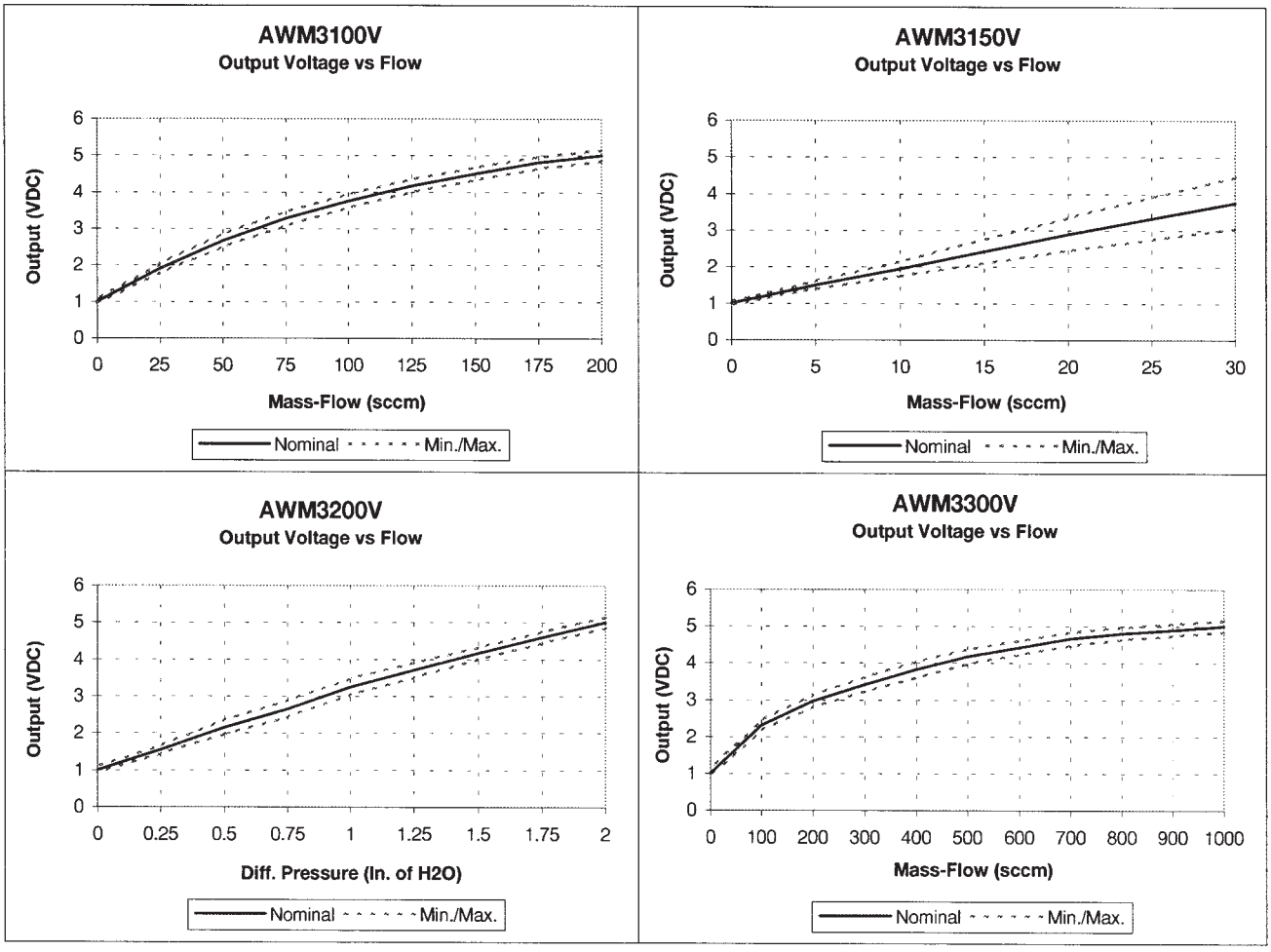
Microbridge Mass Airflow/Amplified

OUTPUT FLOW VS INTERCHANGEABILITY (Note 1) **Performance Characteristics @ 10.0 ±0.01 VDC, 25 C**

AWM3100V				AWM3150V				AWM3200V (Note 2)				AWM3300V			
Press. mBar	**Flow sccm**	**Nom. VDC**	**Tol. ± VDC**	Press mBar	**Flow sccm**	**Nom. VDC**	**Tol. ± VDC**	Flow sccm	**Press ″ H_2O**	**Nom. VDC**	**Tol. ± VDC**	Press. mBar	**Flow sccm**	**Nom. VDC**	**Tol. ± VDC**
0.49	**200**	5.00	0.15	2.50	**30**	3.75	0.70	60.0	**2.00**	5.00	0.15	3.40	**1000**	5.00	0.15
0.42	**175**	4.80	0.16	1.70	**20**	2.90	0.45	53.0	**1.75**	4.59	0.15	2.90	**900**	4.90	0.16
0.35	**150**	4.50	0.17	0.84	**10**	1.95	0.20	46.0	**1.50**	4.16	0.16	2.40	**800**	4.80	0.17
0.28	**125**	4.17	0.18	0.42	**5**	1.50	0.10	38.0	**1.25**	3.70	0.20	2.00	**700**	4.66	0.18
0.21	**100**	3.75	0.19	0.34	**4**	1.40	0.08	30.0	**1.00**	3.25	0.22	1.60	**600**	4.42	0.19
0.14	**75**	3.27	0.19	0.26	**3**	1.30	0.08	23.0	**0.75**	2.65	0.22	1.20	**500**	4.18	0.20
0.09	**50**	2.67	0.17	0.17	**2**	1.20	0.07	16.0	**0.50**	2.15	0.19	0.80	**400**	3.82	0.21
0.04	**20**	1.90	0.13	0.08	**1**	1.10	0.06	8.0	**0.25**	1.55	0.11	0.54	**300**	3.41	0.19
0.00	**0**	1.00	0.05	0.00	**0**	1.00	0.05	0.0	**0.00**	1.00	0.08	0.31	**200**	2.96	0.17
												0.12	**100**	2.30	0.14
												0.00	**0**	1.00	0.10

Notes:
1. Numbers in **BOLD** type indicate calibration type, mass flow or differential pressure. Tolerance values apply to calibration type only.
2. Differential pressure calibrated devices are not recommended for flow measurement. Use flow calibrated devices for flow measurement.

OUTPUT CURVES



Airflow

Microbridge Mass Airflow/Amplified

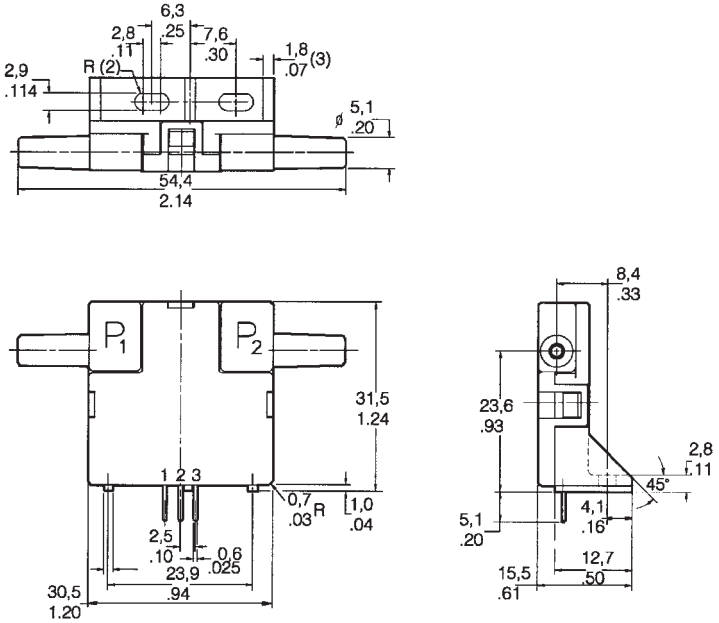
AWM3000 SERIES ORDER GUIDE (Performance Characteristics @ 10.01 ±0.01 VDC, 25°C)

Catalog Listings	AWM3200CR*	AWM3201CR*	AWM3303V
Flow Range (Full Scale)			±1000 sccm (1 SLPM)
Differential Pressure Range	0 - 2″ H_2O (5 mBar)	0 - 0.5″ H_2O (1.25 mBar)	
Output Type	4 - 20 mA DC (linear)	4 - 20 mA DC (linear)	1 - 5 VDC (Note 2)
Output @ Trim Point	20.0 ±1 mA DC @ 2″ H_2O	20.0 ±1 mA DC @ .05″ H_2O	5.00 ±0.150 VDC
Null Output	4.00 ±0.3 mA DC	4.00 ±0.4 mA DC	3.00 ±0.050 VDC
Null Shift +25° to −25°C, +25° to +85°C	±2 mA DC (max.)	±2 mA DC (max.)	±.050 VDC (max.)
Output Shift +25° to −25°C +25° to +85°C	 +24% Reading −31% Reading (Note 3)	 +32% Reading −32% Reading (Note 3)	 −5% Reading +5% Reading
Linearity Error	±5% Reading	±5% Reading	N/A
External Output Load	100 - 300 Ω (Note 4)	100 - 300 Ω (Note 4)	N/A
Response Time (Note 1)	60 msec (max.)	60 msec (max.)	3 msec (max.)
Repeatability & Hysteresis, Max.	±0.50% Reading	±0.50% Reading	±1% Reading
Excitation VDC	10 ±0.01	10±0.01	8-15
Power Consumption (mW)	—	50	100
Common Mode Pressure (psi)	—	—	25
Calibration Gas	Nitrogen		
Temperature Range	Operating: −25° to +85°C (−13° to +185°F); Storage: −40° to +90°C (−40° to +194°F)		
Termination	2,54 mm (.100″) centers, 0,635 mm (0.025″) square		
Weight (grams)	10.8		
Shock Rating	100 g peak (5 drops, 6 axes)		

Notes:
1. Initial warm-up time for signal conditioned circuitry is 1 minute max.
2. Output Voltage is ratiometric to supply voltage.
3. Temperature shifts when sensing differential pressure correlates to the density change of the gas over temperature.
4. Output load connected from V_{OUT} to GND (current sinking).
5. Maximum allowable rate of flow change to prevent damage: 5.0 SLPM/1.0 sec.

* A 5 micron filter must be used on differential pressure sensors.

MOUNTING DIMENSIONS (for reference only)



Note: Positive flow direction is defined as proceeding from Port 1 (P1) to Port 2 (P2) and results in positive output. Do not exert a force greater than 4.54kg (10 lbs.) in any direction.

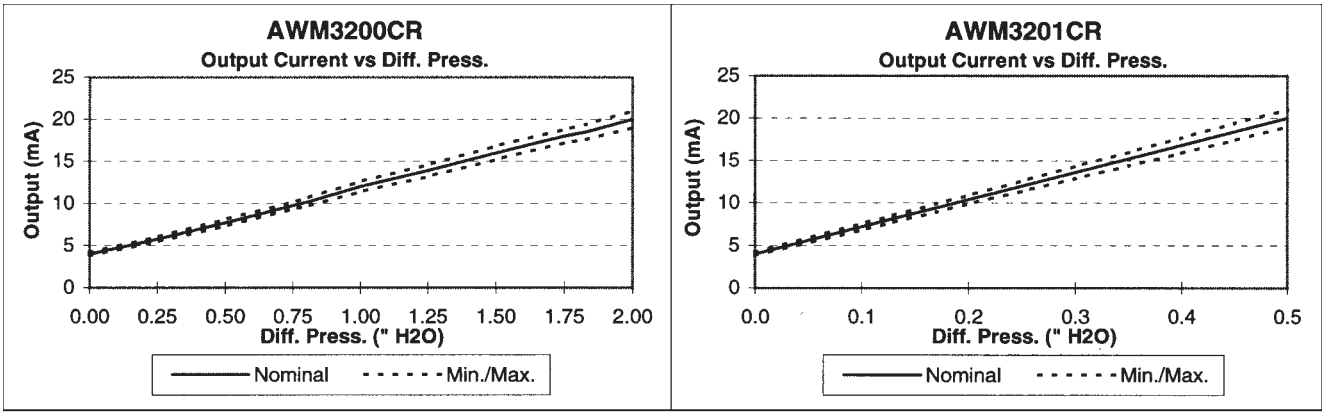
Microbridge Mass Airflow/Amplified

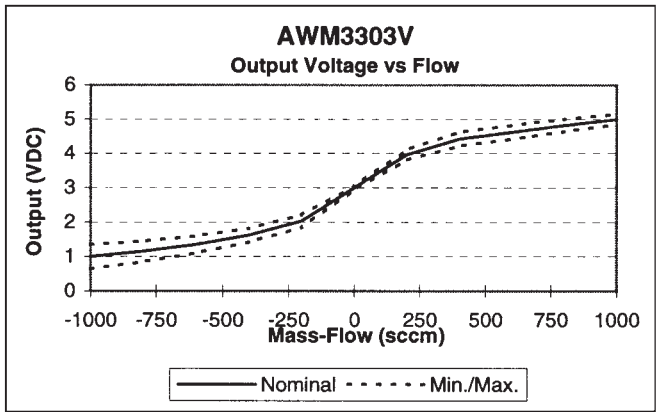
OUTPUT FLOW VS INTERCHANGEABILITY (Note 1) **Performance Characteristics @ 10.0 ± 0.01 VDC, 25 C**

AWM3200CR (Note 2)				AWM3201CR (Note 2)				AWM3303V			
Flow sccm	**Press. ″ H_2O**	**Nom. mA DC**	**Tol. ± mA DC**	Flow sccm	**Press. ″ H_2O**	**Nom. mA DC**	**Tol. ± mA DC**	Press mBar	**Flow sccm**	**Nom. VDC**	**Tol. ± VDC**
0	**0.00**	4.00	0.3	0	**0.00**	4.0	0.4	3.49	**1000**	5.00	0.15
7	**0.25**	5.75	0.3	35	**0.10**	7.2	0.4	2.42	**800**	4.82	0.18
15	**0.50**	7.70	0.4	42	**0.13**	8.0	0.4	1.59	**650**	4.67	0.20
22	**0.75**	9.75	0.4	53	**0.17**	9.4	0.5	0.83	**400**	4.42	0.20
25	**0.81**	10.21	0.5	61	**0.20**	10.4	0.5	0.31	**200**	3.96	0.15
30	**1.00**	12.00	0.6	71	**0.25**	12.0	0.6	0.00	**0**	3.00	0.05
37	**1.25**	13.90	0.7	81	**0.30**	13.6	0.7	-0.31	**-200**	2.03	0.18
45	**1.50**	16.00	0.8	87	**0.35**	15.2	0.8	-0.83	**-400**	1.62	0.20
52	**1.75**	18.00	0.8	97	**0.40**	16.8	0.9	-1.59	**-600**	1.35	0.25
55	**1.83**	18.50	0.9	105	**0.45**	18.4	1.0	-2.42	**-800**	1.15	0.30
60	**2.00**	20.00	1.0	113	**0.50**	20.0	1.0	-3.44	**-1000**	1.00	0.35

Notes:
1. Numbers in **BOLD** type indicate calibration type, mass flow or differential pressure. Tolerance values apply to calibration type only.
2. Differential pressure calibrated devices are not recommended for flow measurement. Use flow calibrated devices for flow measurement.

OUTPUT CURVES





Airflow

Microbridge Mass Airflow/Unamplified and Amplified

FEATURES

- Manifold mount/o-ring sealed
- Ceramic flow-tube (non-outgassing), 0-1000 sccm
- Plastic flow tube, 0-6 SLPM
- High common mode pressure (150 psi ceramic flow-tube only)
- Operating temperature up to 125°C (unamplified only)
- High stability at null and full-scale

The AWM40000 Series mass flow sensor family is based on proven microbridge technology and includes both amplified signal conditioned devices and unamplified sensor only devices.

When using the unamplified devices (AWM42150VH and AWM42300V), the heater control circuit in Figure 1 and the sensing bridge supply circuit in Figure 2 are both required for operation per specification. These two circuits are **NOT** on board the sensor and must be supplied in the application. The differential amplifier circuitry in Figure 3 may be useful in providing output gain and/or introducing voltage offsets to the sensor output (Ref. Equation 1).

The amplified devices (AWM43300V and AWM43600V) can be used to increase output gain and introduce voltage offsets. The differential instrumentation amplifier circuitry, heater control circuitry and sensing bridge supply circuitry are all provided onboard the amplified sensors.

Figure 1
Heater Control Circuit

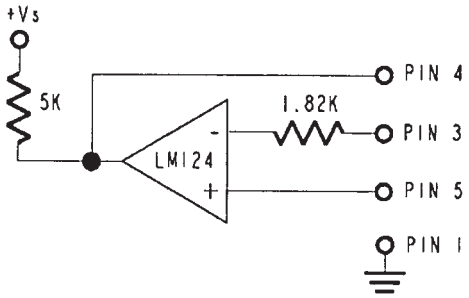


Figure 2
Sensing Bridge Supply Circuit

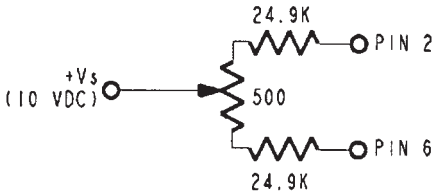
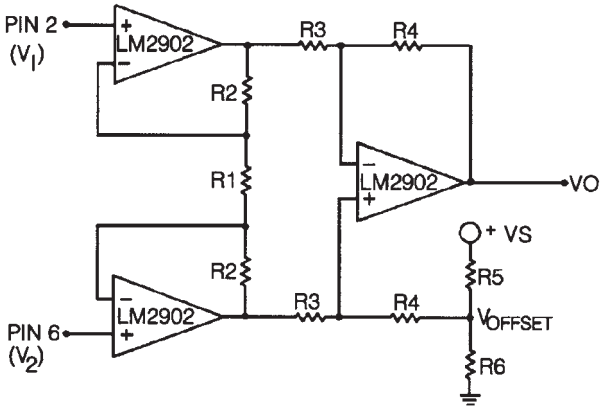


Figure 3
Differential Instrumentation Amplifier Circuit



Equation 1:

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

$$\text{where } V\ \text{offset} = V_S\left(\frac{R_6}{R_6+R_5}\right)$$

Microbridge Mass Airflow/Unamplified and Amplified

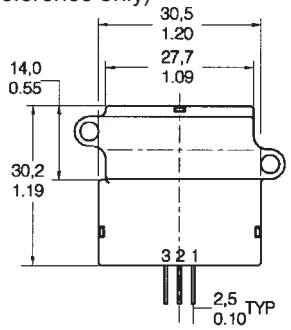
AWM40000 SERIES ORDER GUIDE (Performance Characteristics @ 10.01 ±0.01 VDC, 25°C)

Catalog Listings	AWM42150VH	AWM42300V	AWM43300V	AWM43600V
Flow Range (Full Scale)	±25 sccm	±1000 sccm	+1000 sccm	+6 SLPM
Output Voltage @ Trim Point	8.5 mV ±1.5 mV @ 25 sccm	54.7 mV ±3.7 mV DC @ 1000 sccm	5 V ±0.15 VDC @ 1000 sccm	5 V ±0.15 VDC @ 6 SLPM
Null Voltage	0.0 ±1.0 mVDC	0.0 ±1.5 mVDC	1.0 ±0.05 VDC	1.0 ±0.05 VDC
Null Voltage Shift +25° to −25°C, +25° to +85°C	±0.20 mVDC	±0.20 mVDC	±0.025 VDC	±0.025 VDC
Output Voltage Shift +25° to −25°C +25° to +85°C	+2.5% Reading typ. −2.5% Reading typ.	+2.5% Reading max. −2.5% Reading max.	−5.0% Reading max. +6.0% Reading max.	−6.0% Reading max. +6.0% Reading max.
Power Consumption (mW)	60 (Max.)	60 (Max.)	60 (Max.)	75 (Max.)
Repeatability & Hysteresis	±0.35% Reading (3)	±0.50% Reading	±0.50% Reading	±1.00% Reading
Pressure Drop @ Full Scale (in H_2O)	0.008″ H_2O (Typ.)	1.02 (Typ.)	1.02 (Typ.)	8.00 (Typ.)
	Min.	**Typ.**	**Max.**	
Excitation VDC	8.0	10±0.01	15	
Response Time (msec)	—	1.0	3.0 (Note 1)	
Common Mode Pressure (psi) (max.)	—	—	150 psi (10 Bar)	25 psi (1.7 Bar)
Output Load	NPN (Sinking): 10 mA PNP (Sourcing): 20 mA			
Temperature Range	Operating: −40° to +125°C (−40° to +251°F) Storage: −40° to +125°C (−40° to +251°F)		Operating: −25° to +85°C (−13° to +185°F) Storage: −40° to +90°C (−40° to +194°F)	
Calibration Gas	Nitrogen			
Ratiometricity Error	±0.30% Reading			
Weight (grams)	14 g			11 g
Shock Rating	100 g peak (5 drops, 6 axes)			
Termination	2,54 mm (.100″) centers, 0,635 cm (0.025″) square			

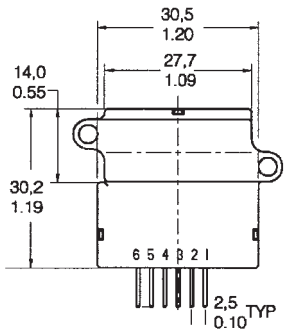
Notes:
1. Response time is typically 1 msec from 10 to 90%.
2. Repeatability & Hysteresis tolerances reflect inherent inaccuracies of the measurement equipment.
3. Maximum allowable rate of flow change to prevent damage: 5.0 SLPM/1.0 sec.

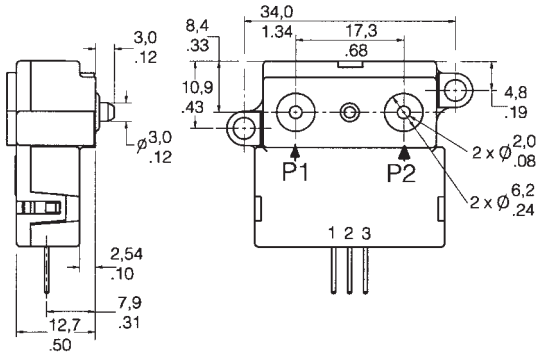
MOUNTING DIMENSIONS (for reference only)

Amplified Sensors



Unamplified Sensors





Note: Positive flow direction is defined as proceeding from Port 1 (P1) to Port 2 (P2), and results in positive output.

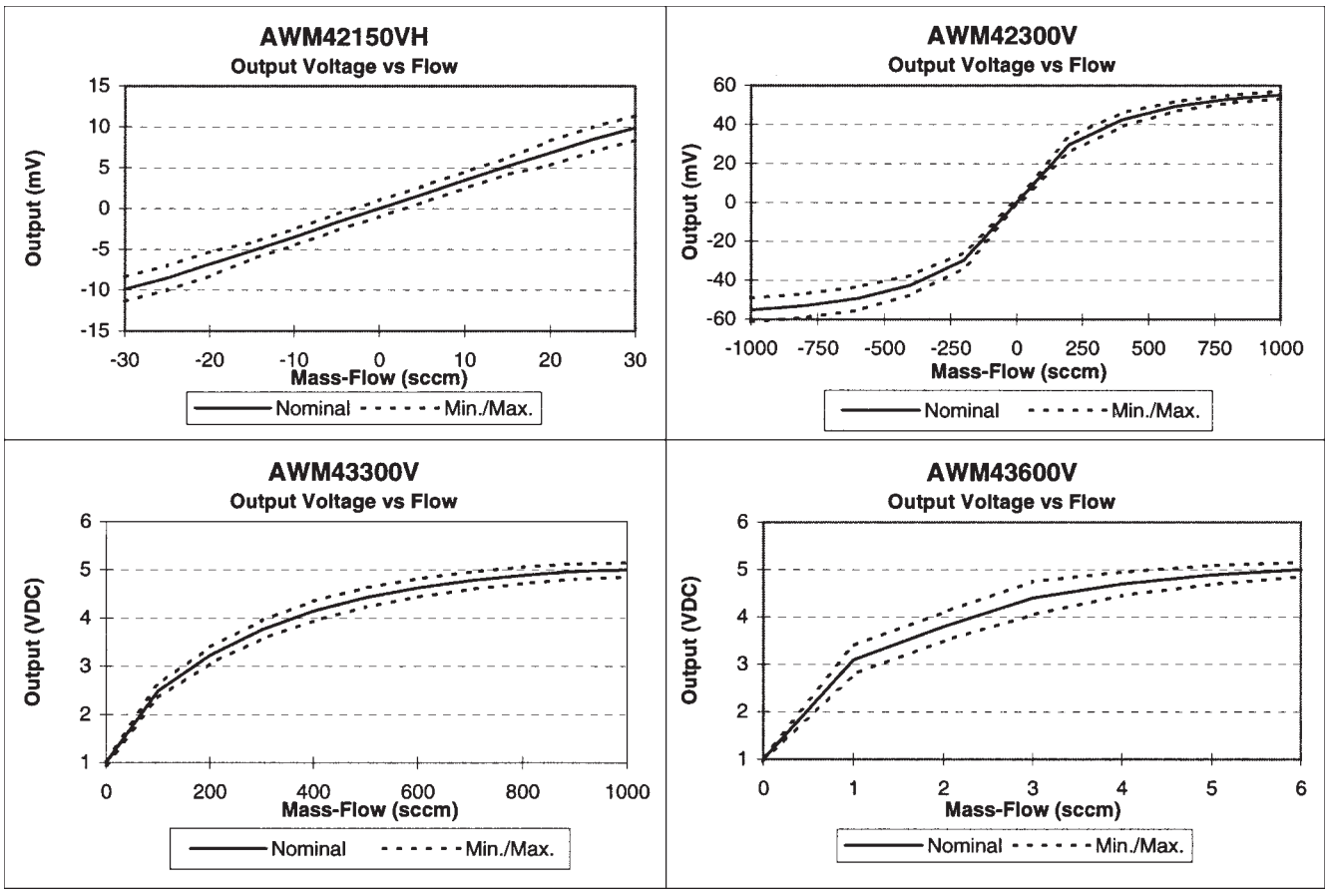
Airflow

Microbridge Mass Airflow/Unamplified and Amplified

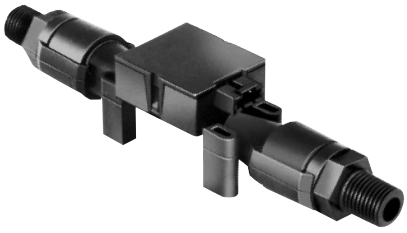
OUTPUT FLOW VS INTERCHANGEABILITY (Note 1) **Performance Characteristics @ 10.0 ± 0.01 VDC, 25°C**

AWM42150VH				AWM42300V				AWM43300V				AWM43600V			
Press μBar	**Flow sccm**	**Nom. mV**	**Tol. ± mV**	Press. mBar	**Flow sccm**	**Nom. mV**	**Tol. ± mV**	Press. mBar	**Flow sccm**	**Nom. VDC**	**Tol. ± VDC**	Press. mBar	**Flow SLPM**	**Nom. VDC**	**Tol. ± VDC**
20	**30**	9.9	1.5	2.23	**1000**	54.7	2.00	2.23	**1000**	5.00	0.15	20.0	**6**	5.00	0.15
17	**25**	8.5	1.5	1.52	**800**	53.0	2.0	1.87	**900**	4.97	0.16	14.7	**5**	4.89	0.20
14	**20**	6.8	1.5	0.94	**600**	49.3	2.5	1.52	**800**	4.89	0.17	9.07	**4**	4.70	0.25
10	**15**	5.2	1.0	0.49	**400**	42.5	3.5	1.16	**700**	4.78	0.18	6.40	**3**	4.40	0.35
7	**10**	3.5	1.0	0.19	**200**	29.8	4.0	0.94	**600**	4.63	0.19	3.35	**2**	3.80	0.30
3	**5**	1.7	1.0	0.00	**0**	0.0	1.5	0.71	**500**	4.43	0.20	1.17	**1**	3.10	0.30
0	**0**	0.0	1.0	-0.19	**-200**	-29.8	4.0	0.50	**400**	4.15	0.21	0.00	**0**	1.00	0.05
				-0.49	**-400**	-42.5	5.0	0.33	**300**	3.76	0.19				
				-0.94	**-600**	-49.3	6.0	0.19	**200**	3.23	0.17				
				-1.52	**-800**	-53.0	6.0	0.08	**100**	2.49	0.14				
				-2.23	**-1000**	-55.2	6.0	0.00	**0**	1.00	0.05				

Notes:
1. Numbers in **BOLD** type indicate calibration type, mass flow or differential pressure.
   Tolerance values apply to calibration type only.



High Flow Mass Airflow/Amplified



FEATURES
- Linear voltage output
- Venturi design
- Remote mounting capability
- Active laser trimming improves interchange ability
- Separate gas calibration types:
  – Ar (argon)
  – N_2 (nitrogen) or
  – CO_2 (carbon dioxide)

In-Line Flow Measurement
AWM5000 Series Microbridge Mass Airflow Sensors feature a venturi type flow housing. They measure flow as high as 20 standard liters per minute (SLPM) while inducing a maximum pressure drop of 2.25″ H_2O. The microbridge chip is in direct contact with the flow stream, greatly reducing error possibilities due to orifice or bypass channel clogging.

Rugged, Versatile Package
The rugged plastic package has been designed to withstand common mode pressures up to 50 psi, and the small sensing element allows 100 gs of shock without compromising performance. The included ''AMP'' compatible connector provides reliable connection in demanding applications.

On-board Signal Conditioning
Each AWM5000 sensor contains circuitry which performs amplification, linearization, temperature compensation, and gas calibration. Figure 1 (Heater Control Circuit) and Figure 2 (Sensor Bridge Circuit and Amplification Linearization Circuit) illustrate the on-board electrical circuitry for the AWM5000 Series. A 1 to 5 VDC linear output is possible for all listings regardless of flow range (5, 10, 15, or 20 SLPM) or calibration gas (nitrogen, carbon dioxide, nitrous oxide, or argon). All calibration is performed by active laser trimming.

Figure 1

Heater Control Circuit

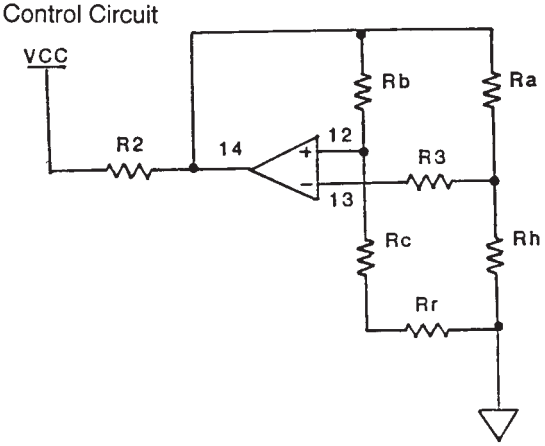
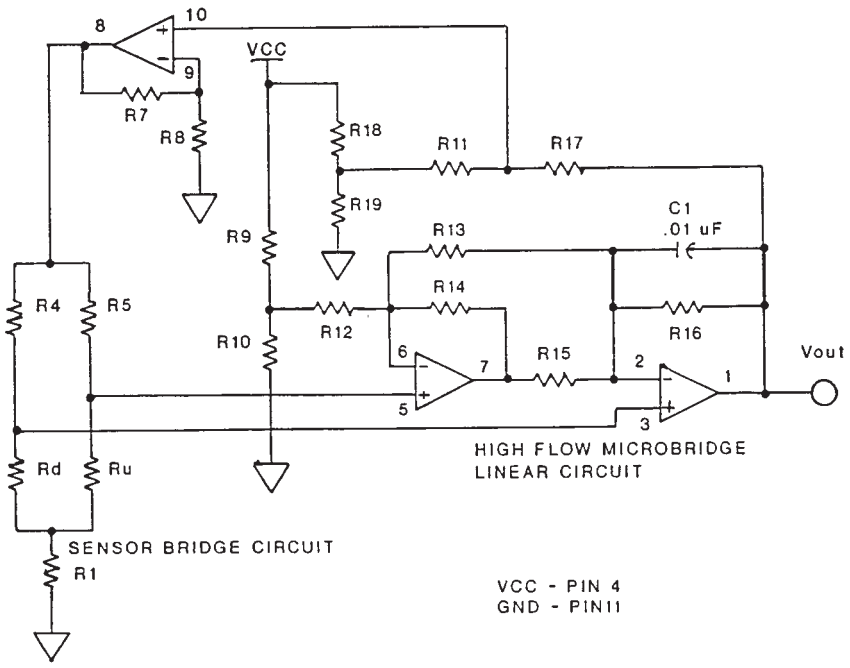


Figure 2

Sensor Bridge Circuit and Amplification Linearization Circuit



Airflow

Highflow Mass Airflow/Amplified

SPECIFICATIONS (Performance Characteristics @ 10.0 ±0.01 VDC, 25°C)

	AWM5101	AWM5102	AWM5103	AWM5104
Flow Range (Note 3)	0-5 SLPM	0-10 SLPM	0-15 SLPM	0-20 SLPM
Suffix - Calibration gas	**VA** - Argon (Ar)		**VC** - Carbon dioxide (CO_2)	**VN** - Nitrogen (N_2)
	Min.	**Typ.**		**Max.**
Excitation VDC	8	10±0.01		15
Power consumption (mW)	—	—		100
Response time (msec)	—	—		60
Null output VDC	0.95	1		1.05
Null output shift −20° to 70°C	—	±0.050 VDC		±.200 VDC
Common Mode Pressure (psi)	—	—		50
Temperature range	−20° to +70°C, (−4° to 158°F)			
Weight	60 grams (2.12 oz.)			
Shock ratings	100 g peak, 6 msec half-sine (3 drops, each direction of 3 axes)			
Output @ laser trim point	5 VDC @ Full Scale Flow			
Output voltage shift +20° to −25°C, +20° to 70°C	Suffix VA or VN ±7.0% Reading, Suffix VC ±10.0% Reading			
Linearity error (2)	±3.0% Reading (max.)			
Repeatability & Hysteresis	±0.5% Reading (max.)			
Connector (Included) —Four pin receptacle	MICRO SWITCH (SS12143)/AMP (103956-3)			
Leak rate, max	0.1 psi/min. at static condition, (Note 2)			

Notes:
1. Linearity specification applies from 2 to 100% full scale of gas flow range, and does not apply to null output at 0 SLPM.
2. The AWM5000 series product has a leakage spec of less than 0.1 psi per minute at 50 psi common mode pressure. If during installation, the end adapters are twisted with respect to the flowtube, this may compromise the seal between the o-ring and the flowtube and may cause a temporary leak. This leak might be as high as 1 psi or might remain in specification. It will self-reseal as the o-ring takes a new set. Approximately 85% of the leakage will dissipate in 24 hours. Within 48 hours, complete recovery will take place.
3. SLPM denotes standard liters per minute, which is a flow measurement referenced to standard conditions of 0°C/1 bar (sea level), 50% RH.

NOTICE

AWM5000—Chimney Effect

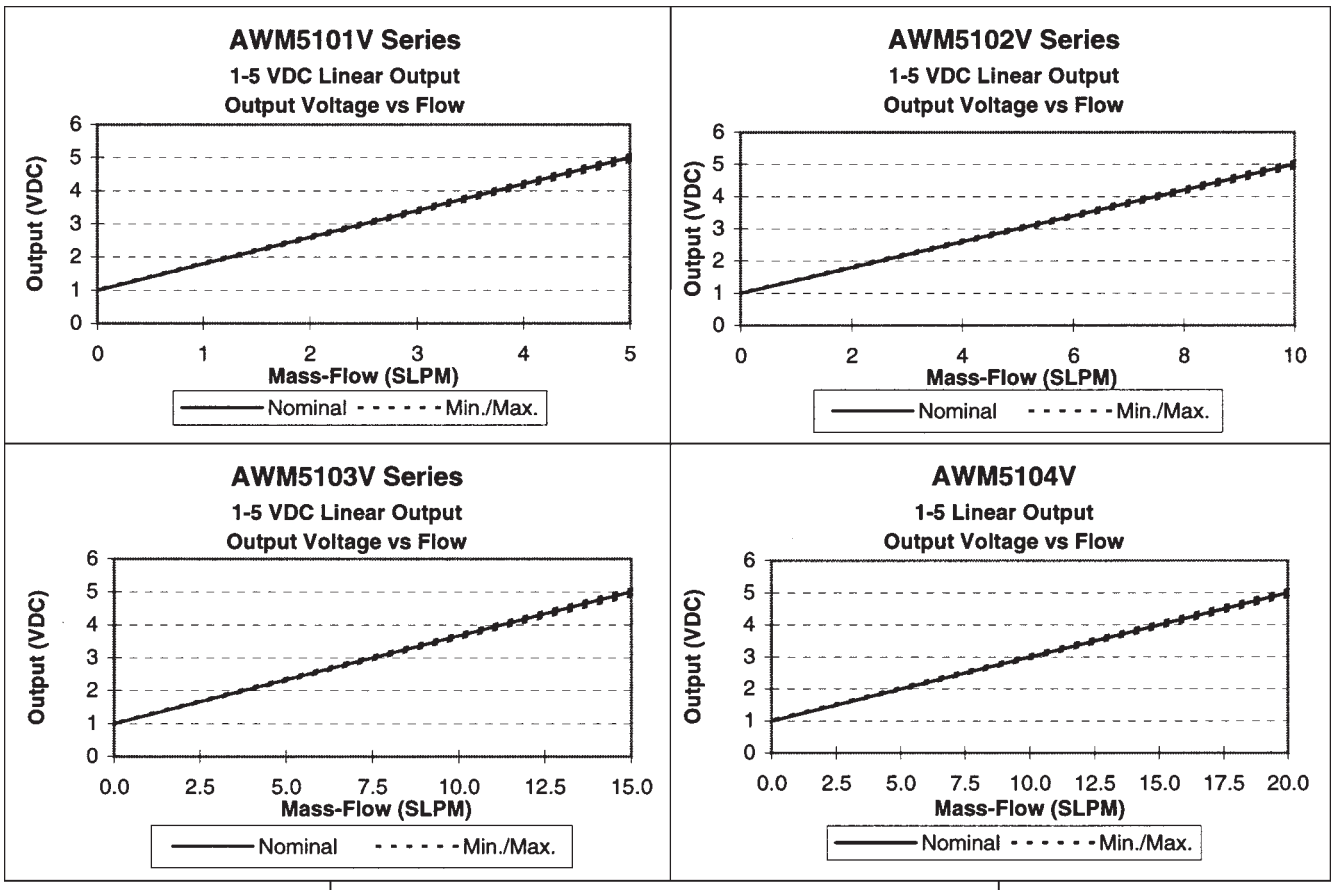
AWM microbridge mass airflow sensors detect mass airflow caused by heat transfer. The thermally isolated microbridge structure consists of a heater resistor positioned between two temperature sensing resistors.

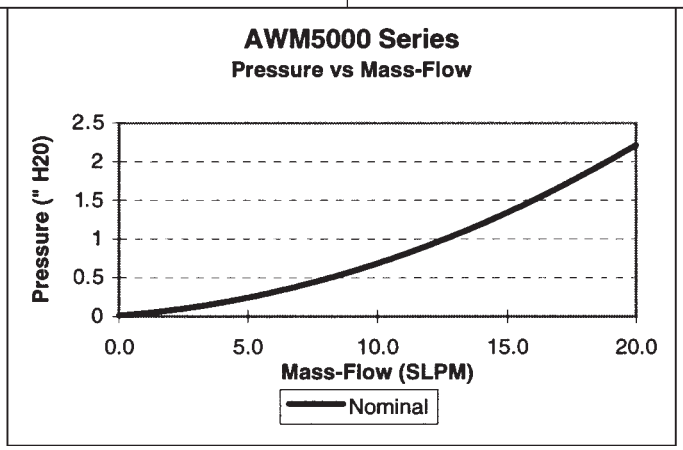
The heater resistor maintains a constant temperature, 160°C above ambient, during sensor operation. Airflow moving past the chip transfers heat from the heater resistor. This airflow warms the downstream resistor and cools the upstream resistor. The temperature change and the resulting change in resistance of the temperature resistors is proportional to the mass airflow across the sensing element.

When the sensor is mounted in a vertical position, under zero flow conditions, the sensor may produce an output that is the result of thermally induced convection current. This occurrence is measurable in the AWM5000 Series, particularly in the 5 SLPM versions. When designing the sensor into applications where null stability is critical, avoid mounting the sensor in a vertical position.

High Flow Mass Airflow/Amplified

OUTPUT CURVES (Performance Characteristics @ 10.0 ±0.01 VDC, 25°C)





Airflow

Highflow Mass Airflow/Amplified

AWM5000 ORDER GUIDE

Catalog Listing	Flow Range
AWM5101VA	5 SLPM, Argon calibration
AWM5101VC	5 SLPM, CO_2 calibration (2)
AWM5101VN	5 SLPM, N_2 calibration (1)
AWM5102VA	10 SLPM, Argon calibration
AWM5102VC	10 SLPM, CO_2 calibration (2)
AWM5102VN	10 SLPM, N_2 calibration (1)
AWM5103VA	15 SLPM, Argon calibration
AWM5103VC	15 SLPM, CO_2 calibration (2)
AWM5103VN	15 SLPM, N_2 calibration (1)
AWM5104VA	20 SLPM, Argon calibration
AWM5104VC	20 SLPM, CO_2 calibration (2)
AWM5104VN	20 SLPM, N_2 calibration (1)

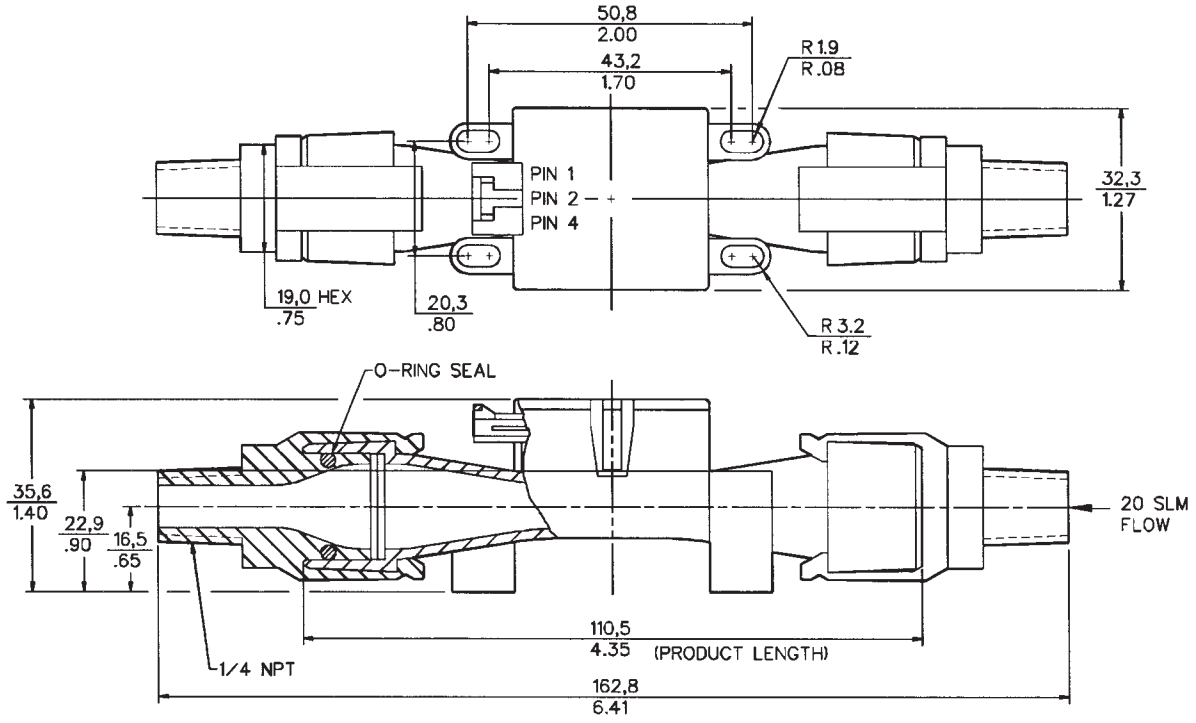
CONNECTOR ORDER GUIDE

Catalog Listing	Description
SS12143	Four pin Electrical connector Connectors use Amp 103956-3

Note: All listings have 1 - 5 VDC linear output with 10 VDC supply over given flow range for a specific calibration gas.
1. N_2 calibration is identical to 0_2 and air calibration.
2. CO_2 calibration is identical to N_2O calibration.
3. For additional gas correction factors, see Application Note 3.

OUTPUT CONNECTIONS
Pin 1 + Supply voltage
Pin 2 Ground
Pin 3 No connection
Pin 4 Output voltage
Arrow on bottom of housing indicates direction of flow.

MOUNTING DIMENSIONS (for reference only)



Honeywell

Mass Airflow Sensors

AWM720P1 Airflow

AWM700 Series

FEATURES

- Flow tubes for ranges up to 200 SLPM
- Highly stable null and full-scale
- Compact package design
- Extremely low hysteresis and repeatability errors, less than 0.35% of reading
- Fast response time, 6 ms typical
- Low power consumption, less than 60 mW

TYPICAL APPLICATIONS

- Oxygen concentrators
- Oxygen conservers
- Respirators and ventilators
- Nebulizers
- Continuous positive airway pressure (CPAP) equipment
- Anesthesia delivery
- Leak detection
- Spectroscopy
- Mass flow controllers
- Telecommunication systems
- Environmental climate controls
- Fuel cell controls

⚠WARNING

PERSONAL INJURY

- DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

AWM700 Series microbridge mass airflow sensors provide in-line flow measurement with a specially designed bypass flow housing. The sensors measure flow as high as 200 standard liters per minute (SLPM) while inducing a pressure drop of 1 inch H_2O, typically. The AWM700 has a high flow range capability in a small package.

The AWM700 has a 6 millisecond response time, requires a 10 Vdc supply, but consumes only 60 mW of power. The compact plastic package withstands overpressures of 25 psi without compromising performance. The snap-in AMP compatible connector provides reliable connection. The sensor is also well suited for use in portable devices and battery-powered applications.

The AWM700 Series provides a combination of time proven reliability, high accuracy, and precision operating characteristics. This inherent accuracy over life reduces need for recalibration. AWM700 sensor circuitry performs amplification and temperature compensation.

The AWM720P1 200 LPM Mass Airflow Sensor, developed primarily for the medical ventilation market, meets the high performance requirements of many medical and analytical instrumentation applications.

⚠WARNING

MISUSE OF DOCUMENTATION

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PERFORMANCE SPECIFICATIONS

Flow Range (Full Scale)		+ 200 SLPM		
	Min.	**Typ.**	**Max.**	**Units**
Excitation (1)	9.990	10.000	10.010	Vdc
Power Supply	8.000	10.000	15.000	Vdc
Power Consumption			60	mW
Output Load				
Sinking		10		mA
Sourcing		20		mA
Calibration gas		Air		
Null Voltage Shift				
+25°C to -25°C, +25°C to +85°C		± .025 typ.		Vdc
Full Scale Output Shift				
+25°C to +10°C		-2.0		% Reading
+25°C to +40°C		+2.0		% Reading
Ratiometricity Error (1)		± 0.30 typ.		% Reading
Repeatability and Hysteresis (2)		± 0.50		% Reading
Response Time		6 typ.		ms
Pressure Drop @ Full Scale		1.0 typ. 2,5 typ.		inch H_2O mBar
Overpressure		25 max.		psi
Temperature Range				
Operating		-25°C to +85°C [-13°F to +185°F]		
Storage		-40°C to +90°C [-40°F to +194°F]		
Weight		34 [1.20 oz]		gram
Connector—4 pin receptacle		AMP 103956-3 (provided with sensor)		

FLOW SPECIFICATIONS

Flow (SLPM)	Nominal (Vdc) Typical	±Tolerance (Vdc)	Pressure Drop (inch H_2O)	(mBar)
0	1.00	0.05	0	0
25	2.99	—	0.04	0.10
50	3.82	0.18	0.13	0.33
75	4.30	—	0.21	0.53
100	4.58	—	0.34	0.85
150	4.86	—	0.65	1.64
200	5.00	0.36	1.09	2.74

Notes: 1. Output voltage is ratiometric to supply voltage.

2. Repeatability and Hysteresis tolerances reflect inherent inaccuracies of the measurement equipment.

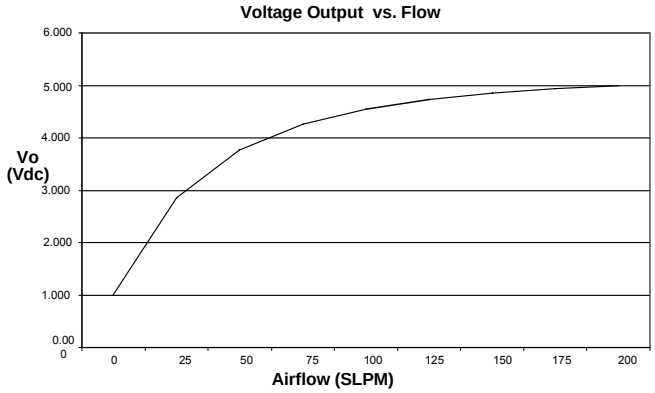


Figure 1. Voltage Output vs. Airflow

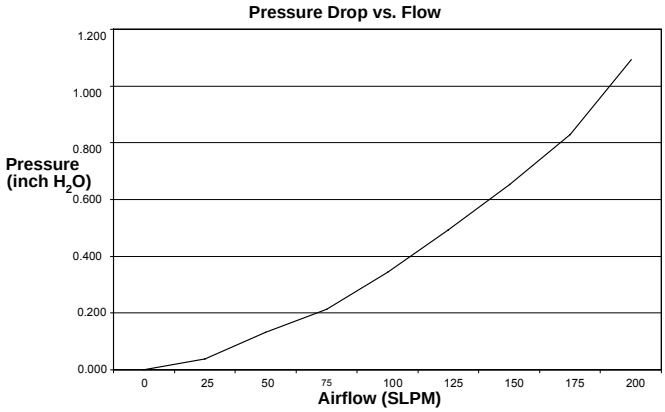


Figure 2. Pressure Drop vs. Airflow

OUTPUT CURVES

Figure 1, Voltage Output vs. Airflow and Figure 2, Pressure Drop vs. Airflow depict performance characteristics for the AWM700 Series sensors at 10.0 ±0.01 Vdc at 25ºC.

NOTICE

LAMINAR FLOW

Due to the fast response time of the sensor, these specifications were generated using laminar flow. Airflow instability or “turbulence” present in the airstream will result in an increase in measurement uncertainty.

The turbulent flow problem can be corrected by either straightening the airflow using flow laminarizing or by slowing the response of the sensor using a simple RC time constant on the output of the sensor. This, of course, slows down the sensor response time. The values needed depend on the amount of turbulence present in the application.

Several techniques for laminarizing the flow include adding hex shaped honeycombs, foam, screen materials or adding constrictors (frits) to the flow stream. There are various commercial laminar flow elements that can be purchased. Unfortunately the greater the efficiency of the laminarizer, the greater the increase in pressure drop in order to establish a given flow rate. Plastic honeycomb material probably gives the most improvement for the least pressure drop. In any test fixture, the avoidance of sharp radii is an absolute requirement.

Failure to comply with these application instructions may result in product failures.

ELECTRICAL CONNECTION

The AWM700 Series accepts a latch detent connector, such as: AMP part number 103956-3. Information on latch detent connectors is available from the AMP Product Information Center, 1-800-522-6752 or the AMP Customer Hotline, 1-800-722-1111.

RELATED AMP LITERATURE

82160	MTE Interconnection System (AMPMODU) Catalog
108-25034	Product Specification (technical performance information)
114-25026	Application Specification (describes product, proper assembly, full tooling information)
IS 6919	Instruction Sheet for assembly procedure

MAKING ELECTRICAL CONNECTIONS

1. Remove (unlatch) the connector from the AWM700.
2. Hand-crimp the interface wire to the appropriate pin on the connector. One possible tool: AMP Hand-Crimp Tool, part number 58342-1.
3. Insert the terminal contacts into the connector housing after carrier strip (lead-frame) is removed.
4. Reconnect (latch) connector to AWM700 device.

MOUNTING INSTRUCTIONS

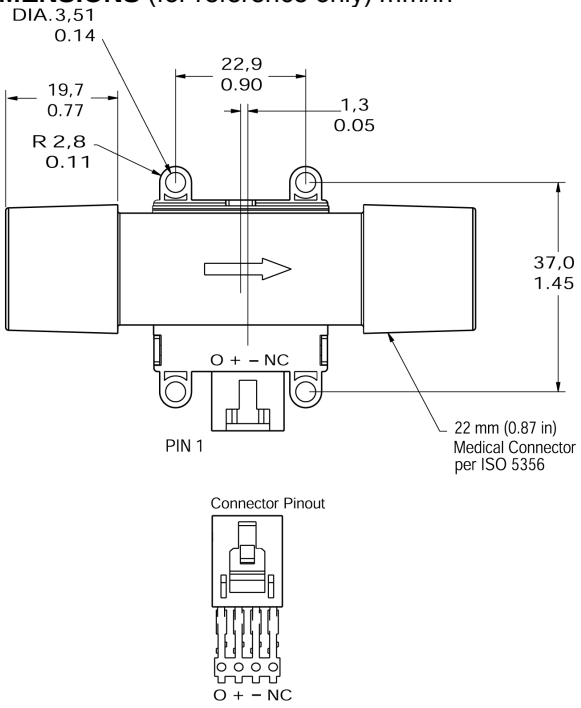
Mount AWM700 Series sensors with 6-32 screws. Honeywell recommends use of washers below screw head. Mounting torque is 0.68 N m [6.0 in lb] max.

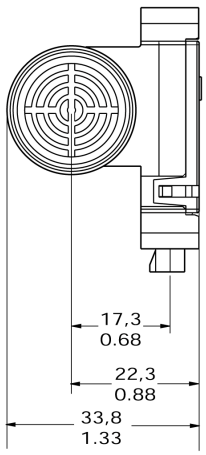
Mass Airflow Sensors

AWM720P1 Airflow

AWM700 Series

MOUNTING DIMENSIONS (for reference only) mm/in





WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Contact your local sales office for warranty information. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace without charge those items it finds defective. The foregoing is Buyer's sole remedy and is **in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose.**

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

For application assistance, current specifications, or name of the nearest Authorized Distributor, check the Honeywell web site or call:
1-800-537-6945 USA
1-800-737-3360 Canada
1-815-235-6847 International
FAX
1-815-235-6545 USA
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www.honeywell.com/sensing
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Honeywell

Mass Airflow Sensors

AWM90000 Airflow

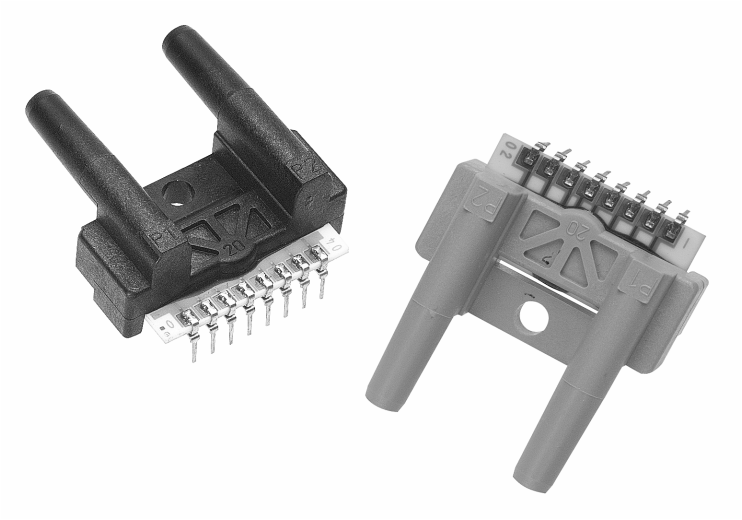
AWM90000 Series

FEATURES

- Mass flow and differential pressure versions
- Bi-directional sensing capability
- Highly stable null and full-scale
- Extremely low pressure drop
- Compact package design
- Extremely low hysteresis and repeatability errors, less than 0.35% of reading
- Fast response time, 1 ms typical
- Low power consumption, 50 mW max.

TYPICAL APPLICATIONS

- Continuous Positive Airway Pressure (CPAP) equipment
- Sleep apnea monitors
- Respirators and ventilators
- Oxygen conservers
- Oxygen concentrators
- Nebulizers
- Spirometers
- Anesthesia delivery
- Variable Air Volume (VAV) – damper control
- Clogged filter detection
- Fuel to air ratio sensing
- Leak detection equipment
- Spectroscopy equipment



AWM90000 Series microbridge mass airflow sensors are available in two versions, Mass Flow and Differential Pressure. The AWM92100V has a flow range of +/- 200 sccm with a pressure drop of only 0.49 mBar, typically. The AWM92200V is a differential pressure version that has a range of +/- 2" H_2O.

The AWM90000 Series sensors have a 1 millisecond response time, operate with a supply voltage from 8.0 Vdc to 15.0 Vdc, while consuming only 50 mW of power. The compact plastic package will withstand a maximum overpressure of 25 psi without compromising performance. The sensor is well suited for use in portable devices and battery-powered applications.

The AWM90000 Series provides customers with a combination of time proven reliability, repeatable flow sensing, and the ability to customize the sensor functions to meet their specific application needs.

⚠WARNING

PERSONAL INJURY

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. **Failure to comply with these instructions could result in death or serious injury.**

⚠WARNING

MISUSE OF DOCUMENTATION

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PERFORMANCE SPECIFICATIONS

Catalog Listings	AWM92100V	AWM92200V
Flow Range (Full Scale)	+/- 200 sccm	
Pressure Range		+/- 2.0 H_2O (5 mBar)
Null Voltage Shift, Typ. -25 °C to 25 °C [-13 °F to 77 °F] 25 °C to 85 °C [77 °F to 185 °F]	 +/- 2.0 mV (1) +/- 2.0 mV (1)	 +/- 2.0 mV (1) +/- 2.0 mV (1)
Output Voltage Shift, Typ. -25 °C to 25 °C [-13 °F to 77 °F] 25 °C to 85 °C [77 °F to 185 °F]	 -3.0% FSO (2) +/-1% FSO (2)	 25% Reading -30% Reading

1. Assumes low TCR Bridge resistance used (pins 2 and 8)
2. Requires recommended RC value of 1K Ohm is used (pins 3 to 7) and typ. Heater control circuit. Maximum current RH.

Specifications	Min.	Typ.	Max.
Excitation (1)	8.0 Vdc	10 ±0.01 Vdc	15.0 Vdc
Power Consumption			50 mW
Calibration Gas	Air		
Ratiometricity Error (1)	± 0.30 typ. % Reading		
Repeatability and Hysteresis (2)	± 0.35% Reading		
Response Time	1 ms typ.		
Pressure Drop @ Full Scale (200 sccm)	 0.49 typ. mBar		
Overpressure	25 psi max.		
Operating Temperature Range	-25 °C to 85 °C [-13 °F to 185 °F]		
Storage Temperature Range	-40 °C to 90 °C [-40 °F to 194 °F]		
Vibration	20 g's, 10 Hz to 2000 Hz		
Shock	100 g, 6 ms		
Weight	5.6 grams		

1. Output voltage is ratiometric to supply voltage.
2. Repeatability and Hysteresis tolerances reflect inherent inaccuracies of the measurement equipment.

AWM92100V FLOW SPECIFICATIONS

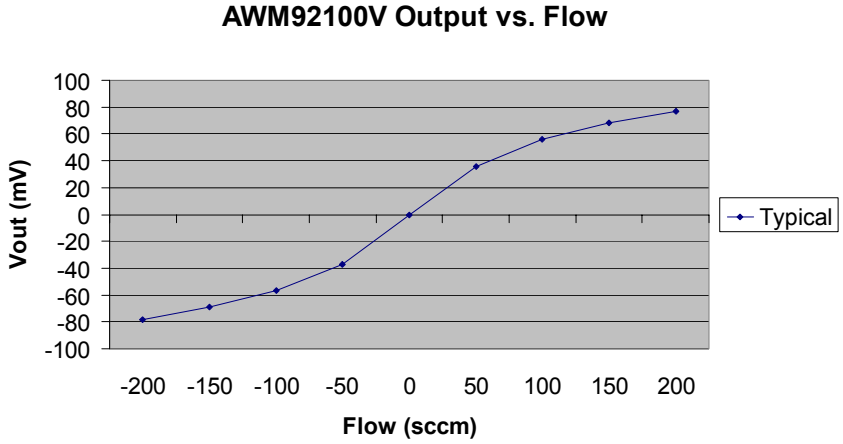
Flow (sccm)	Nominal (mV Typical)	± Tolerance (mV Typical)
200	77	32
150	68	29
100	56	25
50	36	17
0	0	20
-50	-37	18
-100	-57	26
-150	-69	30
-200	-78	33

AWM92200V FLOW SPECIFICATIONS

Pressure (inch H2O)	Nominal (mV) Typical	Typical Min. (mV)	Typical Max. (mV)
2.0	38	22	77
1.5	32	18	66
1.0	23	12	49
.5	12	7	29
0	0	-20	20
-.5	-12	-7	-30
-1.0	-23	-12	-51
-1.5	-32	-18	-68
-2.0	-39	-22	-79

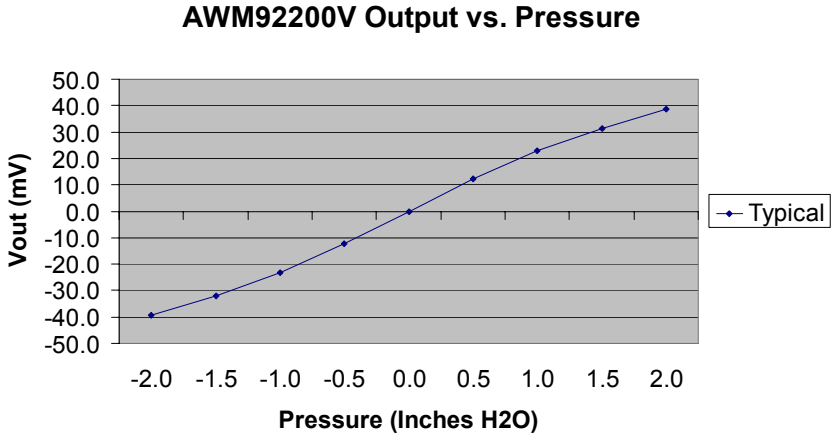
AWM92100V VOLTAGE OUTPUT VS. FLOW CURVE

Depicts performance characteristics for the AWM92100V sensor at 10.0 ±0.01 Vdc at 25 ºC [77 ºF].

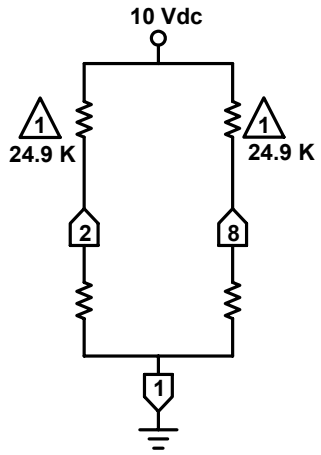
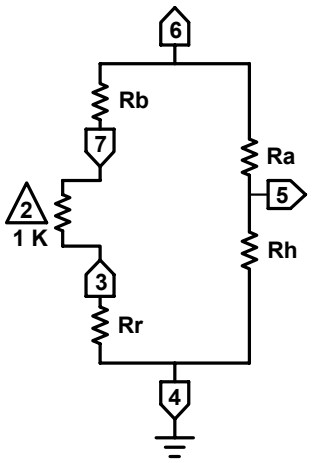
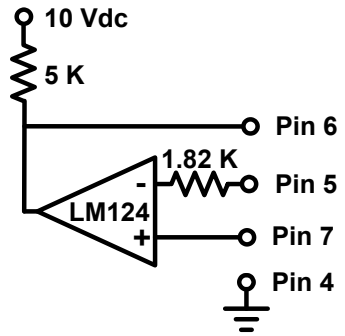


AWM92200V OUTPUT VOLTAGE VS. PRESSURE CURVE

Depicts performance characteristics for the AWM92200V sensor at 10.0 ±0.01 Vdc at 25 °C [77 ºF].

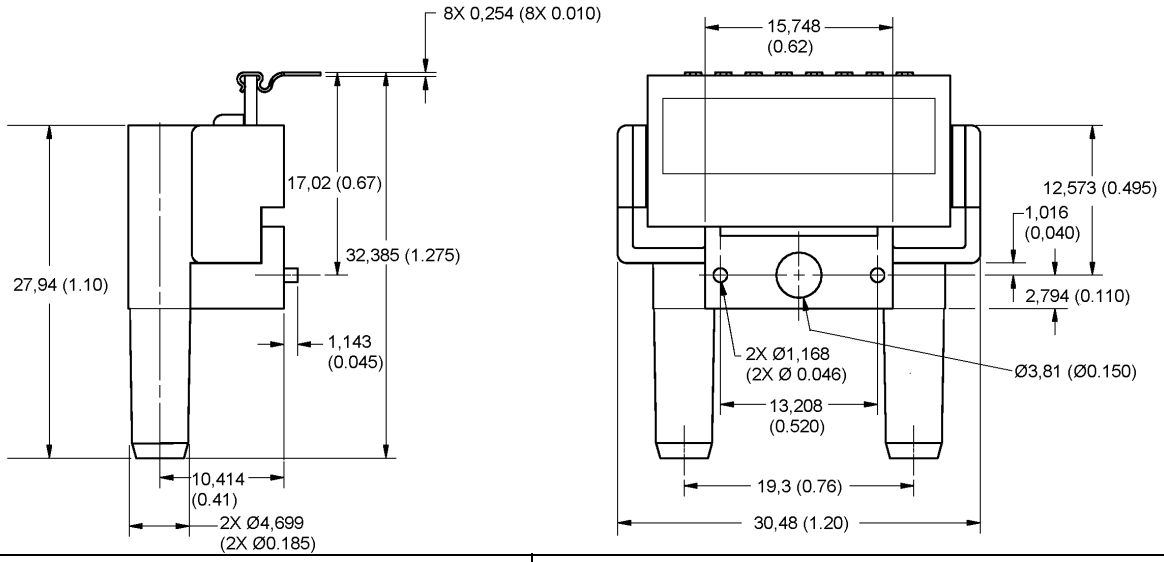


WIRING DIAGRAMS

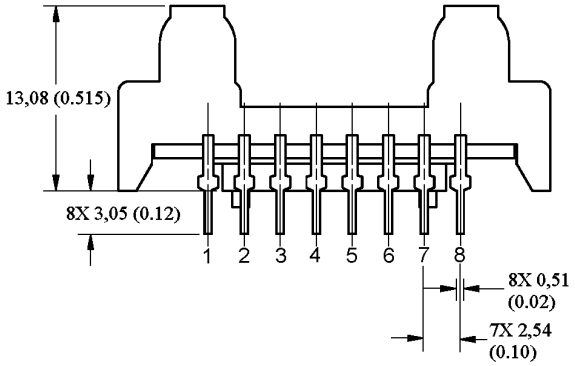
Sensor Bridge Circuit	Used With Heater Control Circuit	Heater Control Circuitry (Suggested)
		

1	Customer supplied 24.9 KΩ matched bridge circuit resistors (affects null output voltage). Output is measured differentially from pins 8 to 2.
2	Customer supplied 1 KΩ resistor (affects temperature compensation and span voltage).

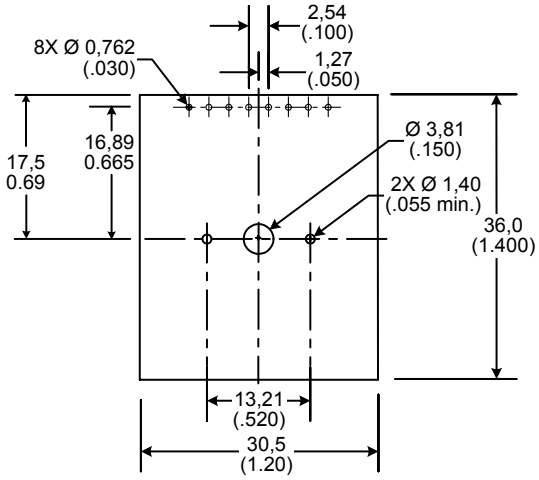
MOUNTING DIMENSIONS (for reference only) mm(in)



Sensor Pinout



PC Board Mounting Dimensions (outer dimensions equal the minimum ciruit board space required.)



Mass Airflow Sensors

AWM90000 Airflow

AWM90000 Series

NOTICE

LAMINAR FLOW

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The turbulent flow problem can be corrected by either straightening the airflow using flow laminarizing or by slowing the response of the sensor using a simple RC time constant on the output of the sensor. This, of course, slows down the sensor response time. The values needed depend on the amount of turbulence present in the application.

Several techniques for laminarizing the flow include adding hex shaped honeycombs, foam, screen materials or adding constrictors (frits) to the flow stream. There are various commercial laminar flow elements that can be purchased. Unfortunately the greater the efficiency of the laminarizer, the greater the increase in pressure drop in order to establish a given flow rate. Plastic honeycomb material probably gives the most improvement for the least pressure drop. In any test fixture, the avoidance of sharp radii is an absolute requirement.

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While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

For application assistance, current specifications, or name of the nearest Authorized Distributor, check the Honeywell web site or call:

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1-800-737-3360 Canada
1-815-235-6847 International

FAX

1-815-235-6545 USA

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info.sc@honeywell.com

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Sensing and Control
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11 West Spring Street
Freeport, Illinois 61032

008080-1-EN IL50 GLO 703 Printed in USA

Honeywell

Honeywell Zephyr™ Analog Airflow Sensors: HAF Series–High Accuracy

DESCRIPTION

Honeywell Zephyr™ Analog Airflow Sensors: HAF Series-High Accuracy, provide an analog interface for reading airflow over the specified full scale flow span and temperature range. Their thermally isolated heater and temperature sensing elements help these sensors provide a fast response to air or gas flow.

Zephyr sensors are designed to measure mass flow of air and other non-corrosive gases. They are available in standard flow ranges and are fully calibrated and temperature compensated with an on-board Application Specific Integrated Circuit (ASIC).

The HAF Series is compensated over the temperature range of 0 °C to 50 °C [32 °F to 122 °F] and operates across a temperature range of -20 °C to 70 °C [-4 °F to 158 °F]. The state-of-the-art ASIC-based compensation provides analog outputs with a response time of 1 ms.

These sensors operate on the heat transfer principle to measure mass airflow. They consist of a microbridge Microelectronic and Microelectromechanical System (MEMS) with temperature-sensitive resistors deposited with thin films of platinum and silicon nitride. The MEMS sensing die is located in a precise and calculated airflow channel to provide repeatable flow response.

Zephyr sensors provide customers with enhanced reliability, analog accuracy, repeatable measurements and the ability to customize sensor options to meet many specific application needs. The combination of rugged housings with a stable substrate makes these products extremely robust. They are designed and manufactured according to ISO 9001 standards.

FEATURES AND BENEFITS (★= competitive differentiator)

- ★High ±2.5% accuracy allows for very precise airflow measurement, often ideal for demanding applications with high accuracy requirements
- Full calibration and temperature compensation typically allow customer to remove additional components associated with signal conditioning from the PCB, reducing PCB size as well as costs often associated with those components (e.g., acquisition, inventory, assembly)
- ★Customizable for specific end-user needs
- ★High sensitivity at very low flows allows a customer's application to detect presence or absence of airflow
- ★High stability reduces errors due to thermal effects and null shift to provide accurate readings over time, often eliminating need for system calibration after PCB mount and periodically over time
- ★Low pressure drop typically improves patient comfort in medical applications, and reduces noise and system wear on other components such as motors and pumps
- ★Linear output provides more intuitive sensor signal than the raw output of basic airflow sensors, which can help reduce production costs, design, and implementation time
- Fast response time allows a customer's application to respond quickly to airflow change, important in critical medical (i.e., anesthesia) and industrial (i.e., fume hood) applications
- 11-bit resolution increases ability to sense small airflow changes, allowing customers to more precisely control their application
- Low 3.3 Vdc operating voltage option and low power consumption allow for use in battery-driven and other portable applications
- Bidirectional flow sensing capability eliminates the need for two airflow sensors, helping to reduce production costs and implementation time
- Insensitivity to mounting orientation allows customer to position sensor in most optimal point in the system, eliminating concern for positional effects
- Insensitivity to altitude eliminates customer-implemented altitude adjustments in the system, easing integration and reducing production costs by not having to purchase additional sensors for altitude adjustments
- Small size occupies less space on PCB, allowing easier fit and potentially reducing production costs; PCB size may also be reduced for easier fit into space-constrained applications
- RoHS-compliant materials meet Directive 2002/95/EC

Honeywell Zephyr™ Analog Airflow Sensors

POTENTIAL APPLICATIONS

Medical
- Anesthesia delivery machines
- Ventricular assist devices (heart pumps)
- Hospital diagnostics (spectrometry, gas chromatography)
- Nebulizers
- Oxygen concentrators
- Patient monitoring systems (respiratory monitoring)
- Sleep apnea machines
- Spirometers
- Ventilators

Industrial
- Air-to-fuel ratio
- Analytical instrumentation (spectrometry, chromatography)
- Fuel cells
- Gas leak detection
- Gas meters
- HVAC filters
- VAV system on HVAC systems
- Meteorolgy

Table 1: Absolute Maximum Ratings[1]

Characteristic	Parameter
Supply voltage	-0.3 Vdc to 6.0 Vdc
Voltage on output pin	-0.3 V to Vsupply
Storage temperature range	-40 °C to 125 °C [-40 °F to 257 °F]
Maximum flow change	5.0 SLPM/s
Maximum common mode pressure	25 psi at 25 °C [77 °F]
Maximum flow	10 SLPM

CAUTION

IMPROPER USE

Do not use these products to sense liquid or fluid flow.

Failure to comply with these instructions may result in product damage.

Note 1: Using the sensor at or beyond the Absolute Maximum Ratings may affect the reliability of the device or cause permanent damage. This is a stress rating only. Using the sensor beyond the operational characteristic ranges may still affect the functional operation of the device.

Table 2: Operating Characteristics

Characteristic	Parameter	Note
Supply voltage	3.3 Vdc ±10%; 5.0 Vdc ±10%	–
Current draw	16 mA max. (no load)	–
Power: 3.3 Vdc 5.0 Vdc	 40 mW typ. (no load) 55 mW typ. (no load)	–
Operating temperature range	-20 °C to 70 °C [-4 °F to 158 °F]	–
Compensated temperature range	0 °C to 50 °C [32 °F to 122 °F]	1
Accuracy: forward flow reverse flow	 ±0.25% FSS or ±2.5% Reading, whichever is greater ±0.25% FSS or ±15% Reading, whichever is greater	2, 4
Total error band: forward flow: reverse flow:	 ±0.25% FSS or ±4.5% Reading, whichever is greater ±0.25% FSS or ±15% Reading, whichever is greater	3, 4
Null accuracy	±0.08 %FSS	4, 8
Response time	1 ms typ.	5
Resolution	11 bit	–
Warm up time	15 ms	6
Calibration media	gaseous nitrogen	7
Null stability	±0.06 FSS max. deviation from null output after 1000 hrs at 25 °C	–
Reverse polarity protection	no	–

Notes:
1. Custom and extended compensated temperature ranges are possible. Contact Honeywell for details.
2. Accuracy is the maximum deviation from the nominal digital output over the compensated flow range at a reference temperature of 25 °C. Errors include offset, span, non-linearity, hysteresis and non-repeatability (see Figure 3 for the Accuracy Error Band vs Flow).
3. Total error band includes all errors over the compensated flow range including all effects due to temperature over the compensated temperature range (see Figure 4 for the Total Error Band).
4. Full Scale Span (FSS) is the algebraic difference between the digital output at the forward Full Scale (FS) flow and the digital output at the reverse FS flow. Forward flow is defined as flow from P1 to P2 as shown in Figure 4. The references to mass flow (SCCM) refer to gas flows at the standard conditions of 0 °C and atmospheric pressure 760 (101.3 kPa).
5. Response time: time to electrically respond to any mass flow change at the microbridge airflow transducer (response time of the transducer may be affected by the pneumatic interface).
6. Warm-up time: time to the first valid flow measurement after power is applied.
7. Default calibration media is dry nitrogen gas. Please contact Honeywell for other calibration options.
8. Null accuracy is the maximum deviation in output at 0 SCCM from the ideal transfer function over the compensated temperature range. This includes offset errors, thermal airflow hysteresis and repeatability errors.

Table 3. Suggested Load

Characteristic	Parameter
Minimum suggested resistance:	
3.3 Vdc	3.3 kOhm
5.0 Vdc	5.0 kOhm
Maximum suggested capacitance:	
3.3 Vdc	10 nF
5.0 Vdc	10 nF

CAUTION

LARGE PARTICULATE DAMAGE

Use a 5-micron filter upstream of the sensor to keep media flow through the sensor free of condensing moisture and particulates. Large, high-velocity particles or conductive particles may damage the sensing element.

Failure to comply with these instructions may result in product damage.

Table 4. Environmental Characteristics

Characteristic	Parameter
Humidity	0% to 95% RH, non-condensing
Shock	100 g, 11 ms
Vibration	15 g at 20 Hz to 2000 Hz
ESD	Class 3B per MIL-STD 883G
Radiated Immunity	Level 3 from (80 MHz to 1000 MHz) per spec IEC61000-4-3

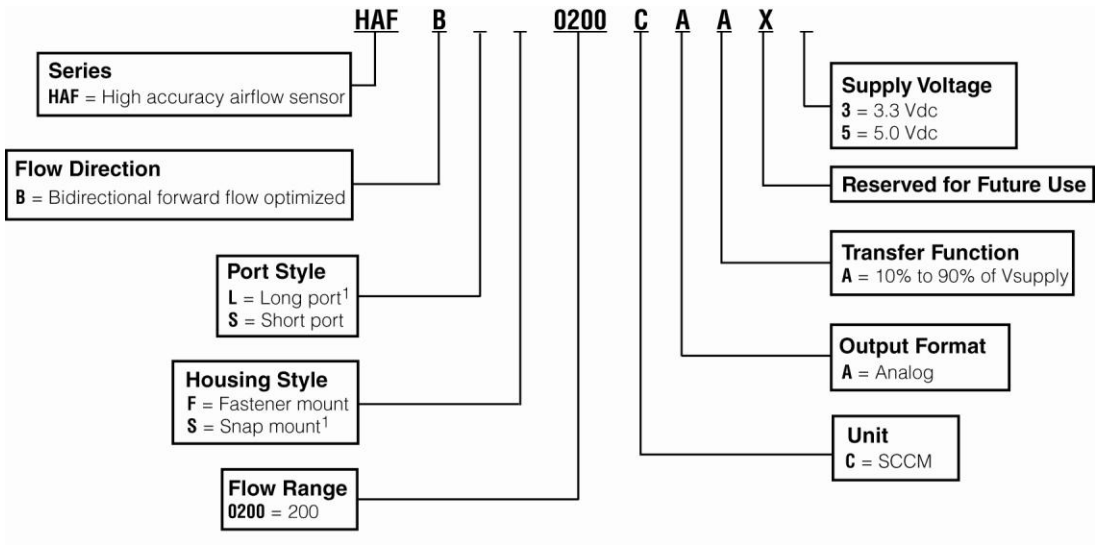
Table 5. Wetted Materials

Characteristic	Parameter
Covers	high temperature polymer
Substrate	PCB
Adhesives	epoxy
Electronic components	silicon, gold
Compliance	RoHS, WEEE

Table 6. Recommended Mounting and Implementation

Characteristic	Parameter
Mounting screw size	5-40
Mounting screw torque	0.68 N m [6 in-lb]
Tubing for long port style	70 durometer, size 0.125 inch inside diameter, 0.250 inch outside diameter silicone tubing
O-ring for short port style	AS568A, Size 7, Silicone, Shore A 70
O-ring for long port style	AS568A, Size 10, Silicone, Shore A 70
Filter recommendation	5-micron filter upstream of the sensor

Figure 1. Nomenclature and Order Guide



Note:

1. The Long Port **Port Style** with the Snap Mount **Housing Style** is not a valid configuration.

Example Catalog Listing

HAFBLS0200CAAX5 = High accuracy airflow sensor, bidirectional forward flow optimized, long port style, snap mount housing, 200 SCCM, analog output, 10% to 90% transfer function, 5.0 Vdc supply voltage.

Customer-specific Requirements

Apart from the general configuration required, other customer-specific requirements are also possible. Please contact Honeywell.

Figure 2. Nominal Analog Output

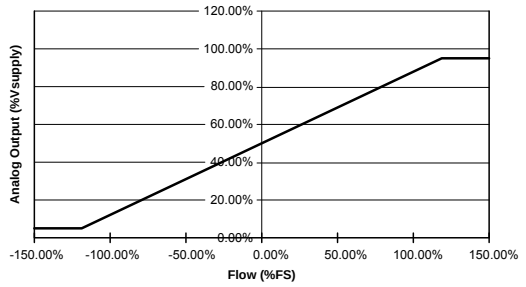


Figure 3. Ideal Transfer Function

$$V_o = V_s\left(0.5 + 0.4\,\frac{F_A}{F_{FS}}\right)$$

$$F_A = \frac{F_{FS}(V_O/V_S - 0.5)}{0.4}$$

Where:
V_O = Output voltage of the device
V_S = Supply voltage measured at the device
F_A = Flow applied across the device
F_{FS} = Full scale flow specified for the device

Figure 4. Accuracy Error Band

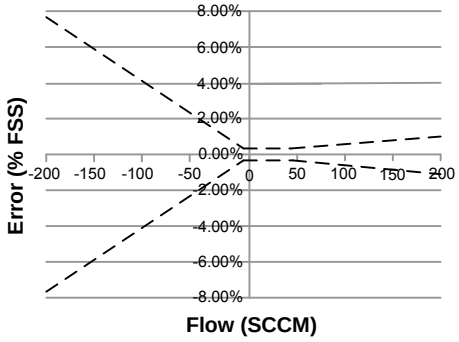


Figure 5. Total Error Band

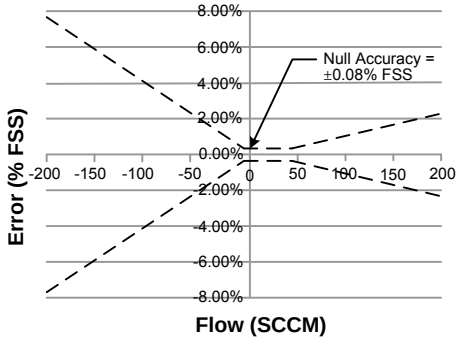
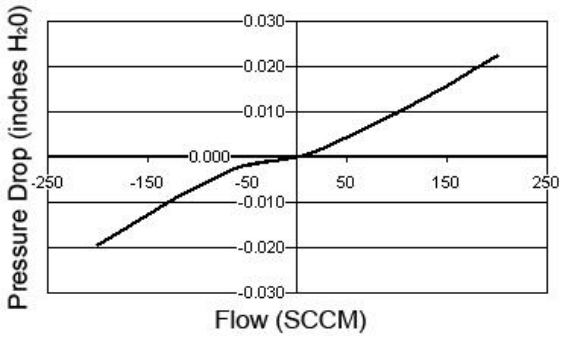
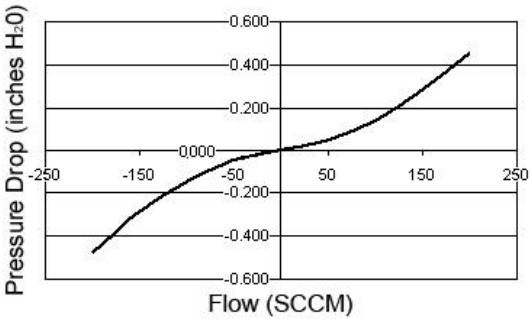


Figure 6. Long Port Style Flow vs Pressure



Flow (SCCM)	Typical Pressure Drop		
	in H_2O	mBar	kPa
-200	-0.019	-0.047	-0.005
-150	-0.013	-0.032	-0.003
-100	-0.007	-0.017	-0.002
-50	-0.001	-0.002	0.000
0	0.000	0.000	0.000
50	0.005	0.012	0.001
100	0.010	0.025	0.002
150	0.016	0.040	0.004
200	0.022	0.055	0.005

Figure .7 Short Port Style Flow vs Pressure



Flow (SCCM)	Typical Pressure Drop		
	in H_2O	mBar	kPa
-200	-0.470	-1.171	-0.117
-150	-0.284	-0.707	-0.071
-100	-0.143	-0.356	-0.036
-50	-0.045	-0.112	-0.011
0	0.000	0.000	0.000
50	0.048	0.120	0.012
100	0.139	0.346	0.035
150	0.287	0.715	0.071
200	0.452	1.126	0.113

Figure 8. Wave Solder Profile

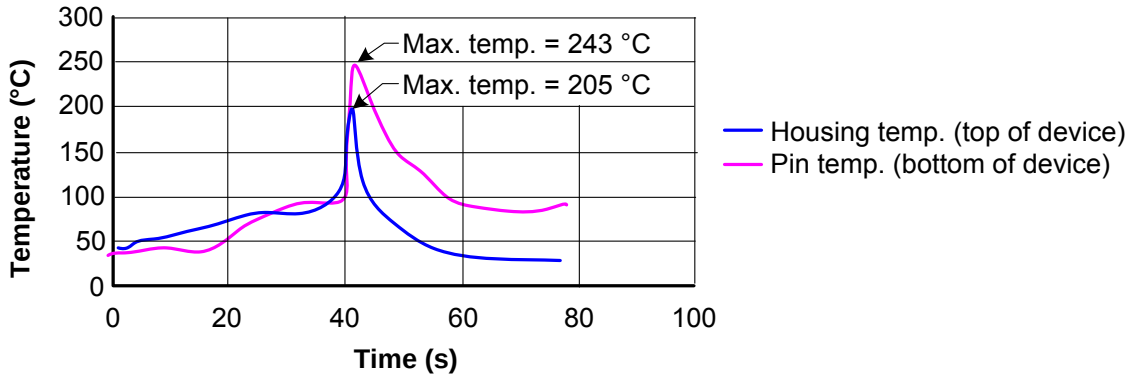
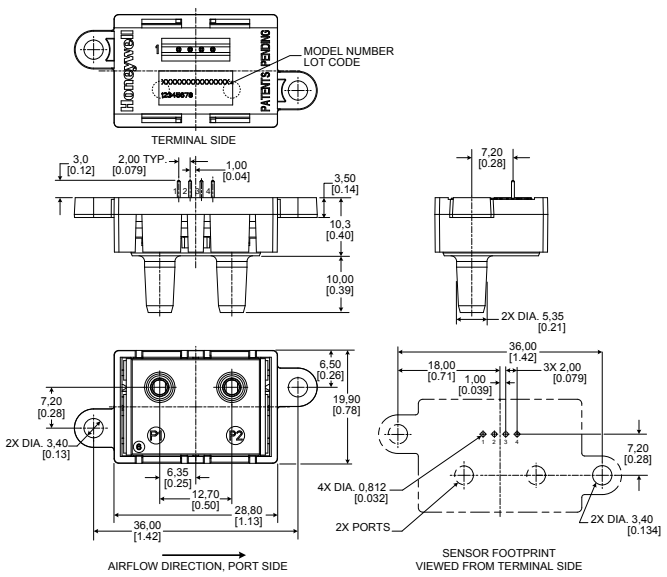
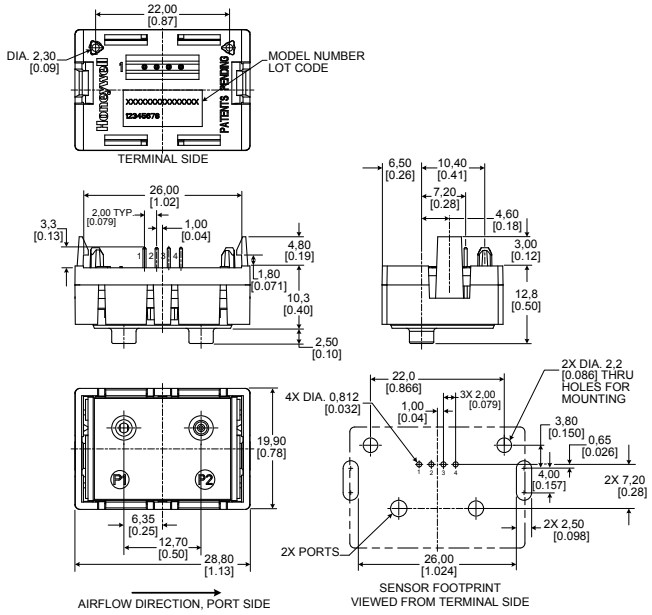


Figure 9. Mounting Dimensions (For reference only: mm [in]). Additional port and housing styles available.

Long Port Style, Fastener Mount



Short Port Style, Snap Mount



Pinout (analog function)	1 = Vout	2 = Vsupply	3 = Ground	4 = NC

⚠ WARNING

PERSONAL INJURY
DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.
Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY
Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

⚠ WARNING

MISUSE OF DOCUMENTATION
- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

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Honeywell Zephyr™ Digital Airflow Sensors: HAF Series–High Accuracy

DESCRIPTION

Honeywell Zephyr™ Digital Airflow Sensors: HAF Series-High Accuracy, provide a digital interface for reading airflow over the specified full scale flow span and temperature range. Their thermally isolated heater and temperature sensing elements help these sensors provide a fast response to air or gas flow.

Zephyr sensors are designed to measure mass flow of air and other non-corrosive gases. They are available in standard flow ranges and are fully calibrated and temperature compensated with an on-board Application Specific Integrated Circuit (ASIC).

The HAF Series is compensated over the temperature range of 0 °C to 50 °C [32 °F to 122 °F] and operates across a temperature range of -20 °C to 70 °C [-4 °F to 158 °F]. The state-of-the-art ASIC-based compensation provides digital (I^2C) outputs with a response time of 1 ms.

These sensors operate on the heat transfer principle to measure mass airflow. They consist of a microbridge Microelectronic and Microelectromechanical System (MEMS) with temperature-sensitive resistors deposited with thin films of platinum and silicon nitride. The MEMS sensing die is located in a precise and calculated airflow channel to provide repeatable flow response.

Zephyr sensors provide customers with enhanced reliability, digital accuracy, repeatable measurements and the ability to customize sensor options to meet many specific application needs. The combination of rugged housings with a stable substrate makes these products extremely robust. They are designed and manufactured according to ISO 9001 standards.

FEATURES AND BENEFITS (★= competitive differentiator)

- ★High ±2.5% accuracy allows for very precise airflow measurement, often ideal for demanding applications with high accuracy requirements
- Full calibration and temperature compensation typically allow customer to remove additional components associated with signal conditioning from the PCB, reducing PCB size as well as costs often associated with those components (e.g., acquisition, inventory, assembly)
- ★Customizable for specific end-user needs
- ★High sensitivity at very low flows allows a customer's application to detect presence or absence of airflow
- ★High stability reduces errors due to thermal effects and null shift to provide accurate readings over time, often eliminating need for system calibration after PCB mount and periodically over time
- ★Low pressure drop typically improves patient comfort in medical applications, and reduces noise and system wear on other components such as motors and pumps
- ★Linear output provides more intuitive sensor signal than the raw output of basic airflow sensors, which can help reduce production costs, design, and implementation time
- Fast response time allows a customer's application to respond quickly to airflow change, important in critical medical (i.e., anesthesia) and industrial (i.e., fume hood) applications
- High 12-bit resolution increases ability to sense small airflow changes, allowing customers to more precisely control their application
- Low 3.3 Vdc operating voltage option and low power consumption allow for use in battery-driven and other portable applications
- ASIC-based I^2C digital output compatibility eases integration to microprocessors or microcontrollers, reducing PCB complexity and component count
- Bidirectional flow sensing capability eliminates the need for two airflow sensors, helping to reduce production costs and implementation time
- Insensitivity to mounting orientation allows customer to position sensor in most optimal point in the system, eliminating concern for positional effects
- Insensitivity to altitude eliminates customer-implemented altitude adjustments in the system, easing integration and reducing production costs by not having to purchase additional sensors for altitude adjustments
- Small size occupies less space on PCB, allowing easier fit and potentially reducing production costs; PCB size may also be reduced for easier fit into space-constrained applications
- RoHS-compliant materials meet Directive 2002/95/EC

Honeywell Zephyr™ Digital Airflow Sensors

POTENTIAL APPLICATIONS

Medical
- Anesthesia delivery machines
- Ventricular assist devices (heart pumps)
- Hospital diagnostics (spectrometry, gas chromatography)
- Nebulizers
- Oxygen concentrators
- Patient monitoring systems (respiratory monitoring)
- Sleep apnea machines
- Spirometers
- Ventilators

Industrial
- Air-to-fuel ratio
- Analytical instrumentation (spectrometry, chromatography)
- Fuel cells
- Gas leak detection
- Gas meters
- HVAC filters
- VAV system on HVAC systems
- Meteorolgy

Table 1: Absolute Maximum Ratings[1]

Characteristic	Parameter
Supply voltage	-0.3 Vdc to 6.0 Vdc
Voltage on output pin	-0.3 V to Vsupply
Storage temperature range	-40 °C to 125 °C [-40 °F to 257 °F]
Maximum flow change	5.0 SLPM/s
Maximum common mode pressure	25 psi at 25 °C [77 °F]
Maximum flow	10 SLPM

CAUTION

IMPROPER USE

Do not use these products to sense liquid or fluid flow.

Failure to comply with these instructions may result in product damage.

Note 1: Absolute maximum ratings are the extreme limits that the device will withstand without damage to the device. However, the electrical and mechanical characteristics are not guaranteed as the maximum limits (above recommended operating conditions) are approached, nor will the device necessarily operate at absolute maximum ratings.

Table 2: Operating Characteristics

Characteristic	Parameter	Note
Supply voltage	3.3 Vdc ±10%; 5.0 Vdc ±10%	–
Supply current	16 mA max.	–
Power: 3.3 Vdc 5.0 Vdc	 23 mW typ. 38 mW typ.	–
Operating temperature range	-20 °C to 70 °C [-4 °F to 158 °F]	–
Compensated temperature range	0 °C to 50 °C [32 °F to 122 °F]	1
Accuracy: forward flow reverse flow	 ±0.25% FSS or ±2.5% of reading, whichever is greater ±0.25% FSS or ±9% of reading, whichever is greater	2, 4
Total error band: forward flow: reverse flow:	 ±0.25% FSS or ±4.5% of reading, whichever is greater ±0.25% FSS or ±9% of reading, whichever is greater	3, 4
Null accuracy	±0.02% FSS	4, 10
Response time	1 ms typ.	5
Resolution	12 bit min.	–
Start up time	17 ms	6
Warm up time	30 ms	7
Calibration media	gaseous nitrogen	8
Bus standards	I^2C, fast mode (400 kHz)	9
Null stability	±0.01% FSS maximum deviation from null output after 1000 hours at 25 °C	–
Reverse polarity protection	no	–

Notes:
1. Custom and extended compensated temperature ranges are possible. Contact Honeywell for details.
2. Accuracy is the maximum deviation from the nominal digital output over the compensated flow range at a reference temperature of 25 °C. Errors include offset, span, non-linearity, hysteresis and non-repeatability (see Figure 3 for the Accuracy Error Band vs Flow).
3. Total error band includes all errors over the compensated flow range including all effects due to temperature over the compensated temperature range (see Figure 4 for the Total Error Band).
4. Full Scale Span (FSS) is the algebraic difference between the digital output at the forward Full Scale (FS) flow and the digital output at the reverse FS flow. Forward flow is defined as flow from P1 to P2 as shown in Figure 4. The references to mass flow (SCCM) refer to gas flows at the standard conditions of 0 °C and atmospheric pressure 760 (101.3 kPa).
5. Response time: time to electrically respond to any mass flow change at the microbridge airflow transducer (response time of the transducer may be affected by the pneumatic interface).
6. Start-up time: time to first valid reading of serial number proceeding streaming 14-bit flow measurements.
7. Warm-up time: time to the first valid flow measurement after power is applied.
8. Default calibration media is dry nitrogen gas. Please contact Honeywell for other calibration options.
9. Refer to Honeywell Technical Note for I^2C protocol information.
10. Null accuracy is the maximum deviation in output at 0 SCCM from the ideal transfer function over the compensated temperature range. This includes offset errors, thermal airflow hysteresis and repeatability errors.

Table 3. Environmental Characteristics

Characteristic	Parameter
Humidity	0% to 95% RH, non-condensing
Shock	100 g, 11 ms
Vibration	15 g at 20 Hz to 2000 Hz
ESD	Class 3B per MIL-STD 883G
Radiated immunity	Level 3 from (80 MHz to 1000 MHz) per spec IEC61000-4-3

Table 4. Wetted Materials

Characteristic	Parameter
Covers	high temperature polymer
Substrate	PCB
Adhesives	epoxy
Electronic components	silicon, gold
Compliance	RoHS, WEEE

Table 5. Recommended Mounting and Implementation

Characteristic	Parameter
Mounting screw size	5-40
Mounting screw torque	0.68 N m [6 in-lb]
Tubing for long port style	70 durometer, size 0.125 inch inside diameter, 0.250 inch outside diameter silicone tubing
O-ring for short port style	AS568A, Size 7, Silicone, Shore A 70
O-ring for long port style	AS568A, Size 10, Silicone, Shore A 70
Filter recommendation	5-micron filter upstream of the sensor

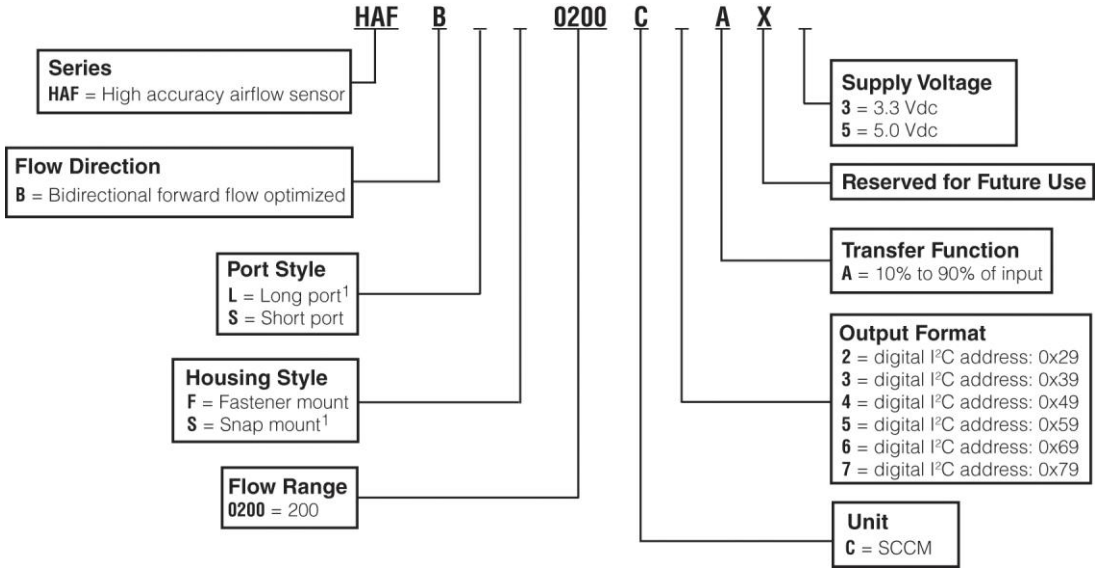
CAUTION

LARGE PARTICULATE DAMAGE

Use a 5-micron filter upstream of the sensor to keep media flow through the sensor free of condensing moisture and particulates. Large, high-velocity particles or conductive particles may damage the sensing element.

Failure to comply with these instructions may result in product damage.

Figure 1. Nomenclature and Order Guide



Note:

1. The Long Port **Port Style** with the Snap Mount **Housing Style** is not a valid configuration.

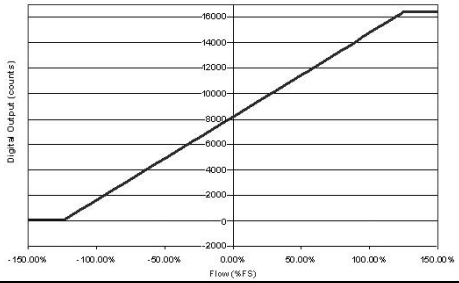
Example Catalog Listing

HAFBLS0200C2AX5 = High accuracy airflow sensor, bidirectional forward flow optimized, long port style, snap mount housing, 200 SCCM, digital I^2C output with 0X29 address, 10% to 90% transfer function, 5.0 Vdc supply voltage.

Customer-specific Requirements

Apart from the general configuration required, other customer-specific requirements are also possible. Please contact Honeywell.

Figure 2. Nominal Digital Output



Ideal Transfer Function

Digital Output Code = 16383 * [0.5 + 0.4 * (Flow Applied/Full Scale Flow)]

Flow Applied = Full Scale Flow * [(Digital Output Code/16383) - 0.5]/0.4

Figure 3. Accuracy Error Band

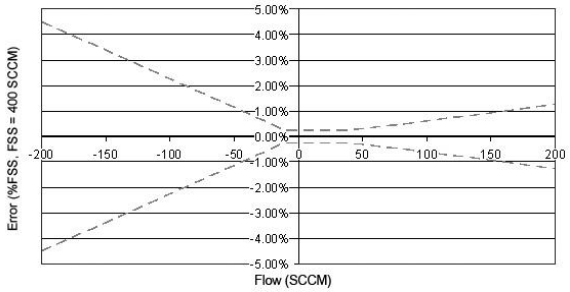


Figure 4. Total Error Band

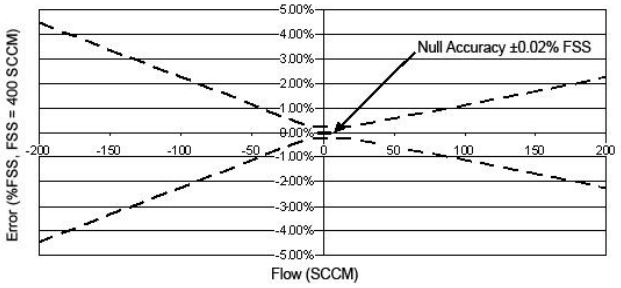
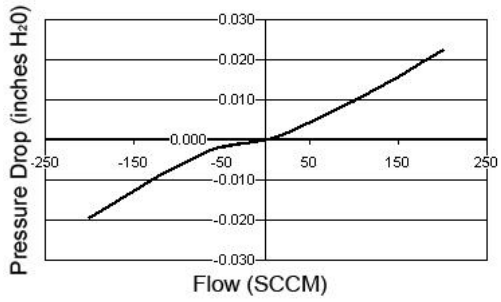
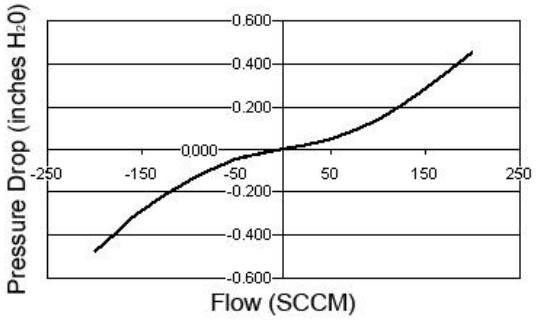


Figure 5. Long Port Style Flow vs Pressure



Flow (SCCM)	Pressure Drop (inches H_2O)
-200	-0.019
-150	-0.013
-100	-0.007
-50	-0.001
0	0.000
50	0.005
100	0.010
150	0.016
200	0.022

Figure 6. Short Port Style Flow vs Pressure



Flow (SCCM)	Pressure Drop (inches H_2O)
-200	-0.470
-150	-0.284
-100	-0.143
-50	-0.045
0	0.000
50	0.048
100	0.139
150	0.287
200	0.452

Figure 7. Wave Solder Profile

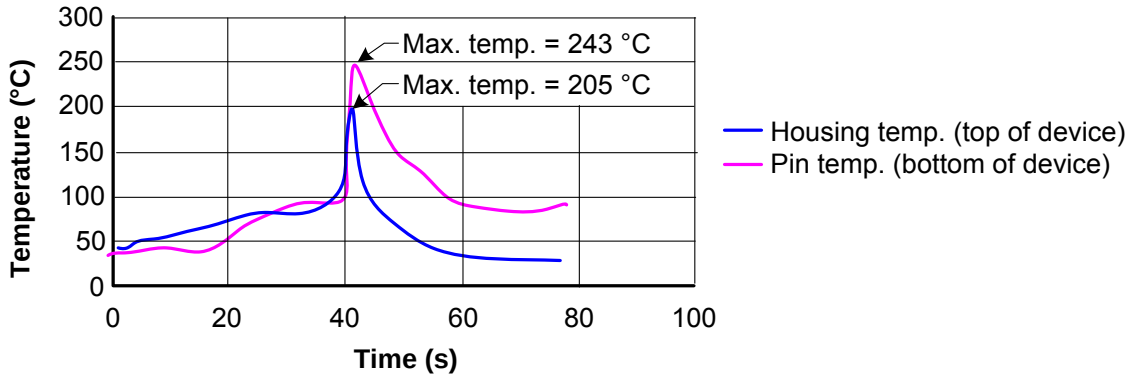
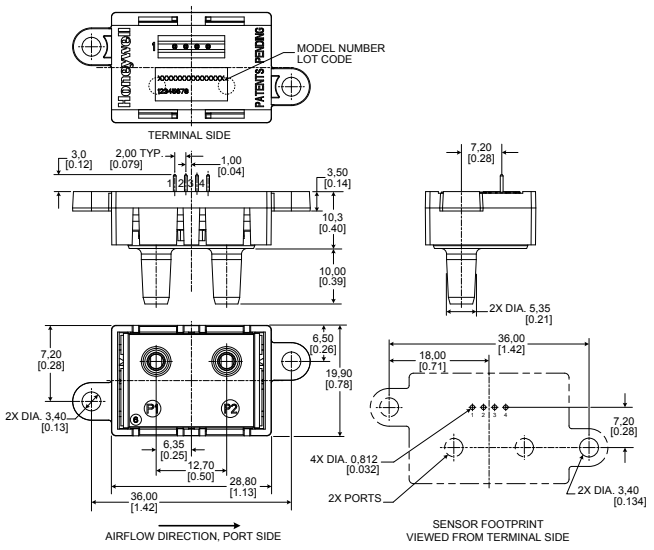
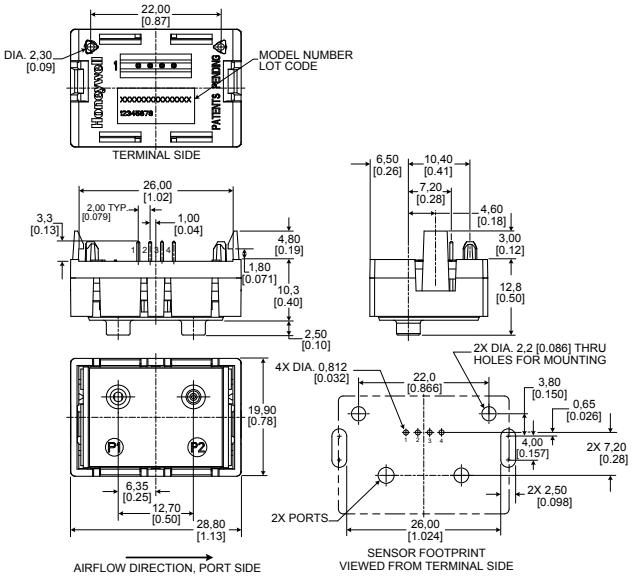


Figure 8. Mounting Dimensions (For reference only: mm [in]). Additional port and housing styles available.

Long Port Style, Fastener Mount



Short Port Style, Snap Mount



Pinout (digital function)	1 = SCL	2 = Vsupply	3 = ground	4 = SDA

⚠ WARNING

PERSONAL INJURY
DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.
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WARRANTY/REMEDY
Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

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