

In-Line Flow Measurement

AWM5000 Series Microbridge Mass Air-flow 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" H₂O. 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.

FEATURES

- Linear voltage output
- Venturi design
- Remote mounting capability
- Active laser trimming improves interchange ability
- Separate gas calibration types:
 - Ar (argon)
 - N₂ (nitrogen) or
 - CO₂ (carbon dioxide)

Figure 1

Heater Control Circuit

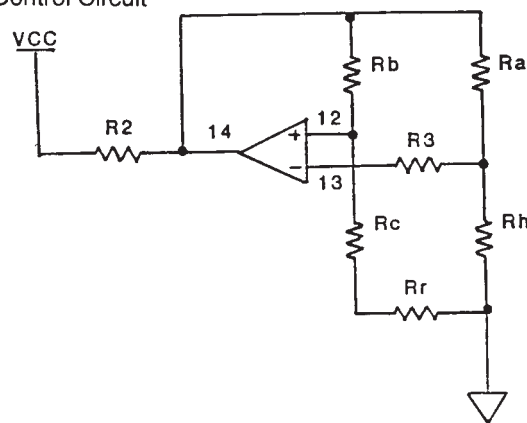
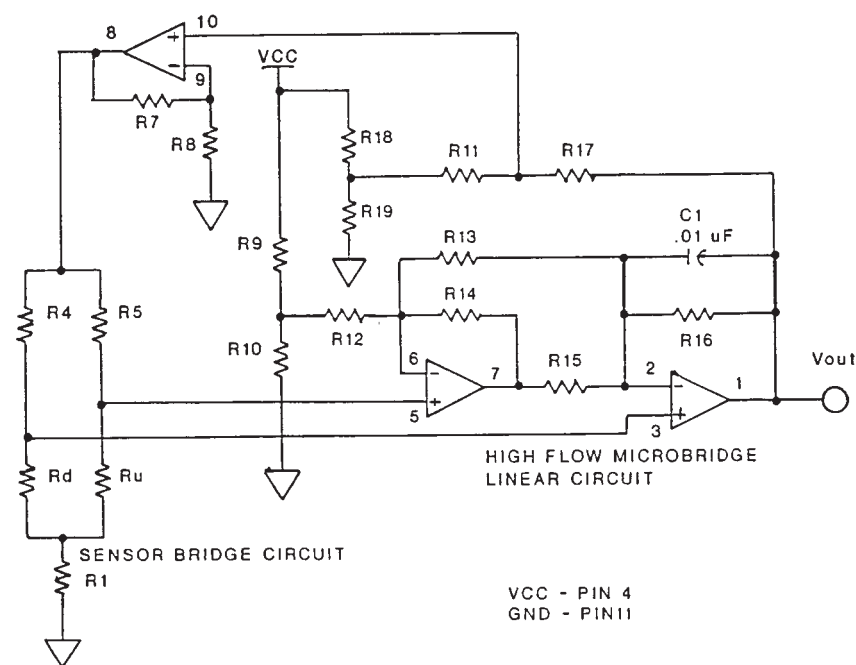


Figure 2

Sensor Bridge Circuit and Amplification Linearization Circuit



Airflow

Airflow Sensors

Highflow Mass Airflow/Amplified

AWM5000 Series

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.

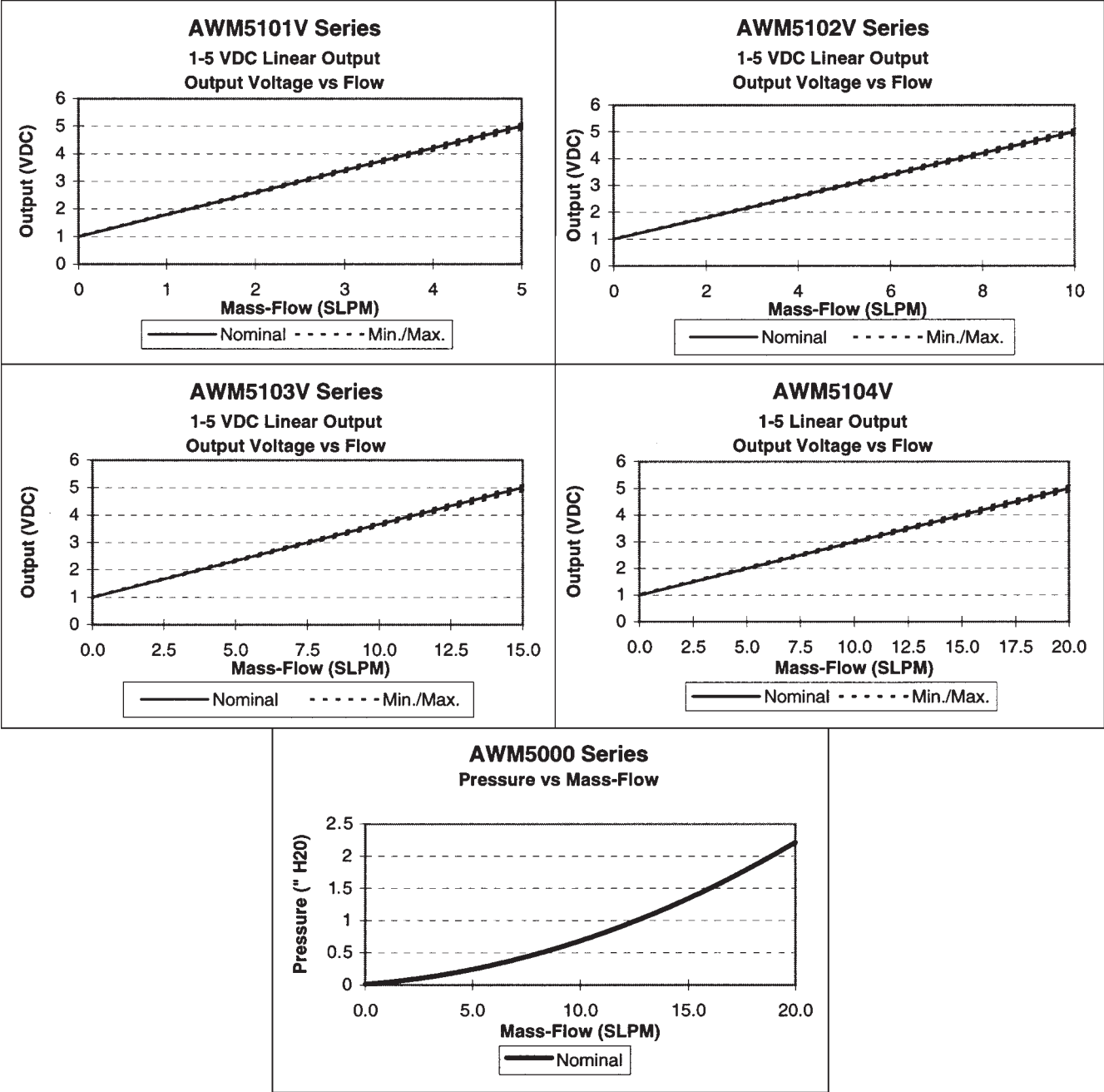
When the sensor is mounted in a vertical position, under zero flow conditions, the sensor may produce an output that is the result of thermally induced convection current. This occurrence is measurable in the AWM5000 Series, particularly in the 5 SLPM versions. When designing the sensor into applications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

Airflow Sensors

High Flow Mass Airflow/Amplified

AWM5000 Series

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



Airflow

Airflow Sensors

Highflow Mass Airflow/Amplified

AWM5000 Series

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.

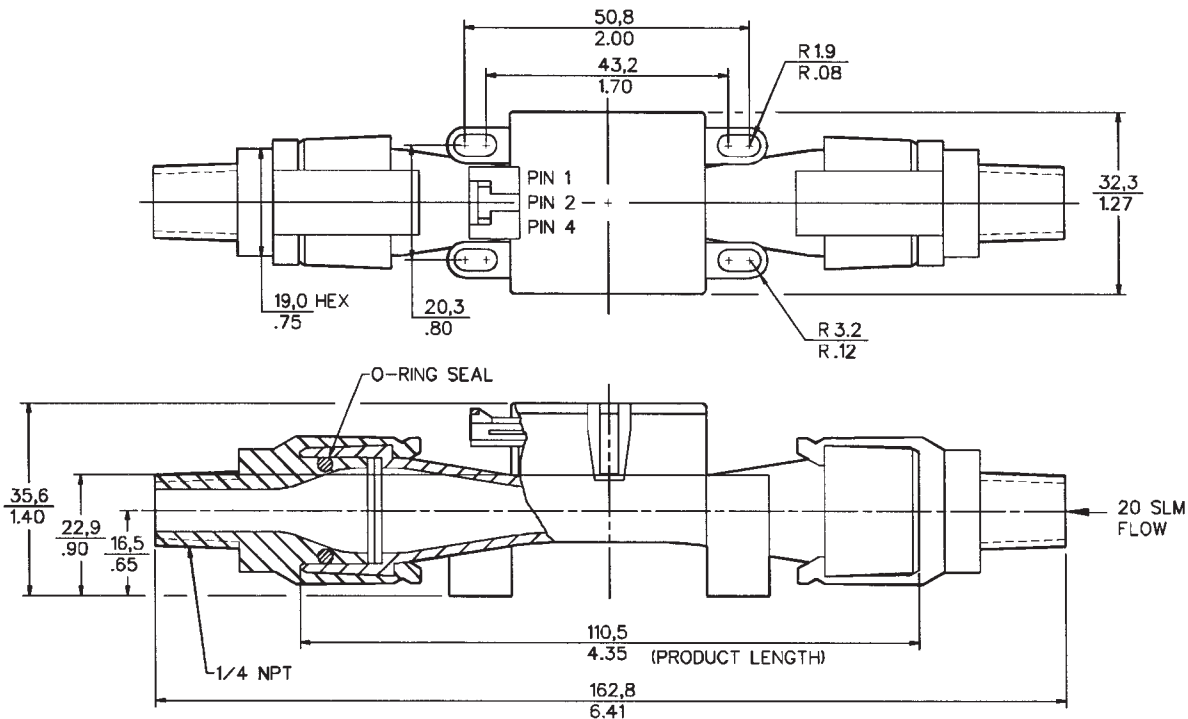
1. N₂ calibration is identical to O₂ and air calibration.
2. CO₂ calibration is identical to N₂O calibration.
3. For additional gas correction factors, see Application Note 3.

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.

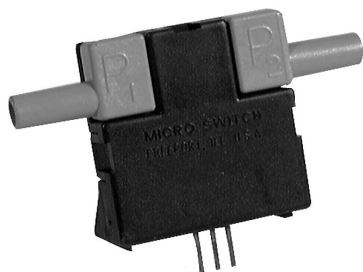
MOUNTING DIMENSIONS (for reference only)



Airflow Sensors

Microbridge Mass Airflow

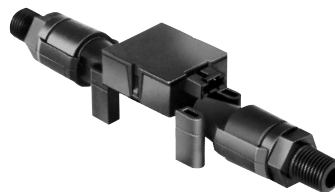
AWM Series



AWM 1000/2000/3000 Series



AWM 40000 Series



AWM 5000 Series

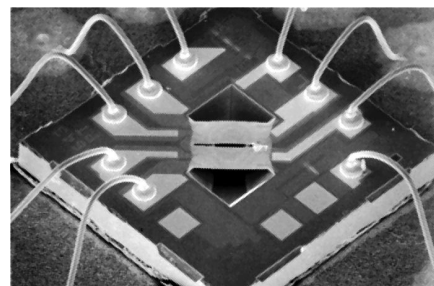
FEATURES

- 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

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.



- 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" H₂O (.003 to 10mBar)

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 ratio-metric voltage output of the device corresponds to the differential voltage across the Wheatstone bridge circuit.

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

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.