ASAIR®

Differential Pressure Sensor

ADP1108-R

Datasheet ADP1108-R

Low Differential Pressure Sensor
with fast response time

- For medical ventilators (ICU and home care)
- High sensitivity below 10 Pa to measure small volume flow (neonatal)
- Fast response time for efficient trigger function
- Offset and hysteresis free
- Fully calibrated and temperature compensated
- Not sensitive to the mounting orientation and vibrations

ADP1108-R Product Summary

The response time of the ADP1108-R has been optimized for medical ventilation applications.

Mounted in a rugged, chemically inert PPS housing the ADP1108-R differential pressure sensors feature a unique dynamic range, zero offset and unsurpassed **long term stability**. This makes it an ideal fit for demanding yet cost sensitive OEM applications in medical and HVAC equipment.

The ADP1108-R is supplied with **5.0 V** and provides a **0.25~4.0 V output**. Although the output of the sensor is analog, the internal linearization and **temperature compensation** is performed digitally. This results in a superior accuracy, outstanding resolution (up to 0.05 Pa), and lowest temperature dependence.

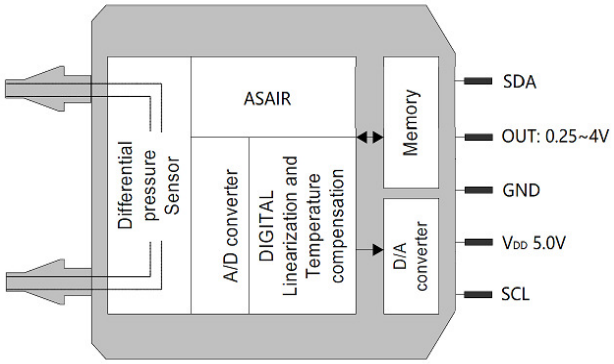
Its leading performance is based on ASAIR proprietary ASAIR® sensor technology. The differential pressure is measured by a thermal sensing element. In contrast to other thermal differential pressure sensors only a very small amount of air is required. This leads to a reliable operation even under harsh conditions. In comparison to membrane and piezo-resistive based sensors the ADP1108-R differential pressure sensors show an extended measurement range, better **offset stability** and improved reproducibility even at lowest pressure ranges. In addition the ADP1108-R is robust against pressure bursts and shows no sensitivity to the mounting orientation.

Applications

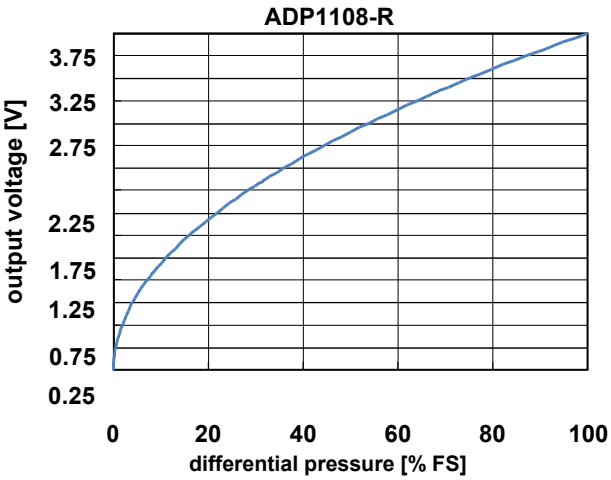
Medical applications:

- Homecare ventilation
- Intensive care ventilation (ICU)

Block Diagram



1 Sensor Output Characteristics[1]



The ADP1108-R provides a fully calibrated voltage output. To enhance the sensitivity at very low differential pressures, the ADP1108-R comes with a root-square output characteristic.

$$\text{Diff.Press.}[Pa] = \left(\frac{Output\_Voltage - 0.25V}{3.75V} \right)^2 \cdot 500$$

Use this formula to convert the sensor output into physical value.

[1]Calibration conditions apply unless otherwise noted: 23°C and $p_{absolute}$ = 966 mbar, dry air, V_{DD} = 5.000 V.

2 Specifications

Table 1: ADP1108-R Sensor specifications[1]

Parameter		ADP1108-R			Unit
		Min	Typ	Max	
Measurement range		0.25	-	4	Volts
		0	-	500	Pa
		0	-	2	Inch water
Accuracy[3]	20% FS to 100% FS	-	1.5	3.0	% Measured Value[4]
	0 to 20% FS	-	0.2	0.4	% Full Span[5]
	zero[2]	-	15 0.01	40 0.06	mV Pa
Repeatability	100 to 500 Pa	-	0.3	1.0	% Measured Value
	0 to 100 Pa	-	0.05	0.2	% Full Span[5]
Null drift per year[6]		-	0	0.1	Pa / year
Additional error over temperature[7] (T ≠ 23°C)	0 to 100 % FS	-	0.03	0.05	% Measured Value[4] / °C
	zero	-	1	2	mV/°C
Response time[(8)]		6.6	8.0	10.1	ms
Cut off frequency of internal filter		17	20	24	Hz

[1] Calibration conditions apply unless otherwise noted: 23°C and $p_{absolute}$ = 966 mbar, dry air, V_{DD} = 5.000 V

[2] Variance between the zero point (offset) of different sensors measured under the same conditions (e.g. same supply voltage, temperature, …)

[3] Include deviations due to linearity, hysteresis, and repeatability

[4] % Measured value = (ADP1108-R output [Pa] - output of reference instrument [Pa]) / output of reference instrument [Pa].

[5] Full span is defined as 3750 mV / 500 Pa for ADP1108-R

[6] Drift over time due to aging, pressure cycles… Test results can be provided.

[7] The additional error due to temperature variation is temporary. Once the sensor is back to the calibration temperature, the shift disappears (no hysteresis).

[8] Tau= 0 to 63%, filter response time = 8ms.

Table 2: Additional sensor specifications.

Parameter			
Media Calibration[1]	Air, N_2 – for other gases contact ASAIR AG.		
Media Compatibility	Air, N_2, O_2		
Operating Conditions[2]: - Temperature - Humidity	 -10 °C ~ +60 °C / 14°F ~ 140 °F non-condensing		
Ambient storage conditions[3]	-40 °C ~ +80 °C / -40°F ~ 176 °F		
Orientation sensitivity	below zero point accuracy		
Admissible overpressure (short term)	1 bar (14.5 PSI)		
Burst Pressure Capability	2 bar (29 PSI)		
Weight	14 g		
Protection Class	IP 20		
Wetted materials	Glass (silicon nitride, silicon oxide), Silicon, PPS (Polyphenylene Sulfide), PEEK (Polyetheretherketone), FR4, Silicone as static sealing, Epoxy, Gold,Pt		
Electromagnetic compatibility	EN 61000-4-2	Air discharge (ESD)	± 2 kV
Lead free	Reach and RoHS compliant.		

[1] Sensors are calibrated for a specific gas, please contact ASAIR when you employ different gases than the specified.

[2] Condensation of liquids or dust on the sensor membrane might lead to sensor offset.

[3] For maximum 2 weeks

2.1 Temperature Compensation

The ADP1108-R differential pressure sensor features a sophisticated built-in temperature compensation circuit. The temperature is measured on the ASAIR® chip by means of a PTAT bandgap reference temperature sensor. Its data is fed into a compensation circuit which is also integrated on the ASAIR® sensor chip. No external temperature compensation is therefore required.

2.2 Altitude Correction

The ADP1108-R differential pressure sensor achieves its unsurpassed performance by using a dynamic measurement principle: An applied differential pressure forces a small air flow through the ADP1108-R, which measures this air flow.
The sensor signal is dependent on the ambient air density. The temperature effect on density is compensated by internal intelligence (see Paragraph 2.1). Effects on density due to a change of ambient pressure, typically a change of altitude above sea level, can be compensated using a correction factor according to the following equation:

$$Dp_{eff} = Dp_{sensor} * P_{cal} / P_{amb}$$

Where Dp_{eff} is the effective differential pressure, Dp_{sensor} the differential pressure indicated by the ADP1108-R, P_{cal} the absolute pressure during calibration (966 mbar) and P_{amb} the actual ambient absolute pressure.

This leads to the following correction factors:

Table 3: Altitude correction factors.

Altitude [meter]	Ambient Pressure (P_{amb}) [mbar]	Correction Factor P_{cal} / P_{amb}
0	1013	0.95
250	984	0.98
425	966	1.00
500	958	1.01
750	925	1.04
1500	842	1.15
2250	766	1.26
3000	697	1.38

Example:
The ADP1108-R is used at 750 m above sea level. The output of the ADP1108-R shows 0.5 V, which corresponds to Dp_{sensor} = 33.3 Pa. Taking into account the correction factor P_{cal} / P_{amb} = 1.04 the effective differential pressure Dp_{eff} is 33.3 Pa * 1.04 = 34.6 Pa.

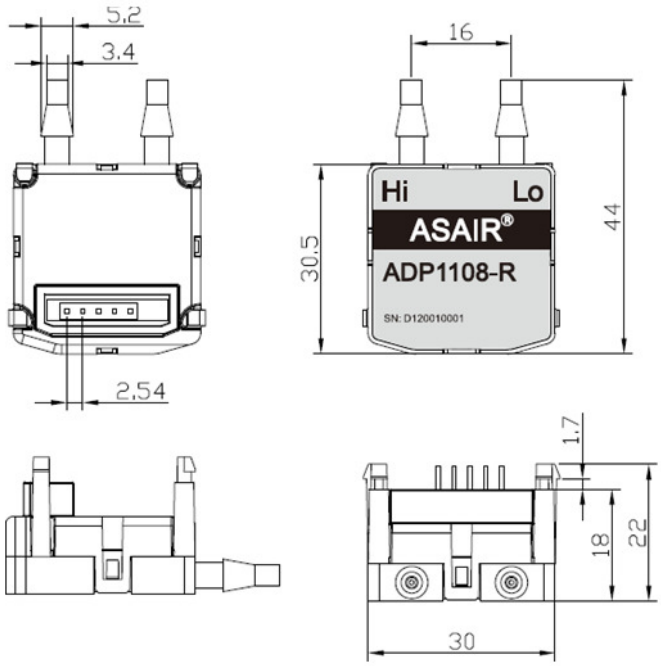
Note:
In many medical and HVAC applications such as filter monitoring, fan/ventilator control or air flow measurement the described effect is actually welcome since at the end the mass flow and not volume flow is the effective value to control.

3 Physical Dimensions and Mounting Information

3.1 Housing

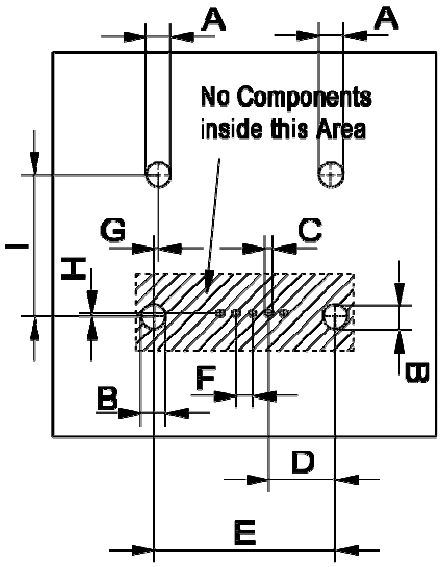
The ADP1108-R differential pressure sensor is mounted in chemically inert PPS housing. The rugged package has been designed to withstand continuous overpressures of at least 1 bar (14.5 PSI). Burst pressure is > 2 bar (29 PSI)

The physical dimensions and mounting information is given in Figure 1 and 2.



Pin#	Function
1	SCL
2	VDD (5 Vdc)
3	Ground
4	OUT (0.25～4 Vdc)
5	SDA

Figure 1: Pin out and physical dimensions in mm (inch). The drawing is not to scale.



Dim.	[mm]	[inch]	[mil]
A	3.00	0.118	118
B	3.30	0.130	130
C	1.20	0.047	47
D	10.20	0.402	402
E	28.20	1.110	1110
F	2.54	0.100	100
G	0.60	0.024	24
H	0.50	0.020	20
I	22.70	0.894	894

Figure 2: ADP1108-R PCB footprint. The drawing is not to scale.

3.2 Soldering Instructions

The ADP1108-R differential pressure sensor can be wave soldered. Direct reflow soldering is not recommended since it may affect the accuracy.

If reflow soldering is required ASAIR recommends to use an SMD connector (e.g. type Samtec SSM-103-L- SV) and to mount the ADP1108-R after soldering.

3.3 Connecting Hose

ASAIR recommends a hose with an inner diameter of 3.18 to 3.8mm (1/8 to 3/20 inch). Due to the dynamic measurement principle, a small air flow is required (Figure 3) which leads to a dependence on the length of the hose (Table 4). Tubes up to 1 m show less than 2 % error of the measured value (Table 4).

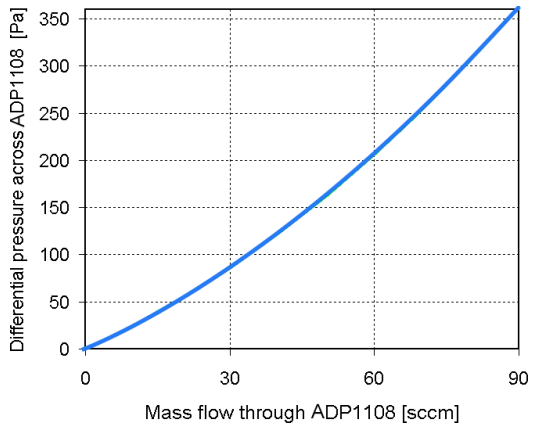


Figure 3: Typical air flow through the ADP1108-R. Please note: 1 scc/min = 1 cm3/min at 0°C and 1013 mbar pressure (1 sccm = 0.001 norm liter).

Table 4: Influence of the length of the connecting hose on the accuracy (using 4 mm inner diameter). Deviation is given in % of the measured value. Example ADP1108-R: a 500 Pa difference pressure is shown as 492.5 Pa when using 1 m tube with 4 mm inner diameter.

Hose length	ADP1108-R	
	@FS	@0.5 FS
0.5 m (20 inch)	-0.75%	-0.95%
1.0 m (40 inch)	-1.5%	-1.9%
2.0 m (80 inch)	-3.0%	-3.8%

Table 5: Maximum flow through the sensor element.

	ADP1108-R
Mass flow through sensor element:	123 sccm (@ 500 Pa)

4 Electrical Specifications

4.1 Power Supply

The ADP1108-R differential pressure sensor requires a stable voltage supply of 5.0 V. The requirements for the electrical supply are specified in Table 6.

4.2 Voltage Output

The ADP1108-R features a voltage output from 0.25 V to 4.0 V. An output voltage below 0.25 V indicates a negative differential pressure (not calibrated).

The resistive load at the output pin should be larger than 20 kOhm. The capacitive load at the output pin must not be larger than 200 pF. If the design shows a larger capacity at the output pin an additional resistor is required in series at the output (e.g. 620 Ohm).

Table 6: ADP1108-R electrical characteristics.

Parameter	Conditions	Min.	Typ.	Max.	Units
Power Supply Voltage V_{DD}		4.75	5.0	5.25	VDC
Operating Current	5 V, no load, zero flow		5.1	6	mA
Output capacitive load C_{load}			20	200	pF
Recommended load R_{load}		20	100	∞	kΩ

5. Important notices

1. Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury (including death). Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product
2. Please consult the datasheet and application notes. Failure to comply with these instructions could result in death or serious injury.
3. Based on the information provided by our suppliers, the materials used in this product and raw materials are harmless to the human body. Aosong has not verified this information through third-party analysis.
4. For any application using this product, expressly reject any and all responsibilities, including but not limited to consequential or incidental compensation.