Data Sheet	PSA071040

General Description

The PSA071040 is a MEMS pressure transducer that uses a piezoresistive Wheatstone bridge structure that responds to variations in atmospheric pressure. The pressure sensitive structure uses an elastic film into which four resistors are integrated. Pressure applied to the elastic film causes variation in the bridge's resistance, which generates a voltage that in linearly proportional to the applied pressure.

Suggested applications include biomedicine, automotive, bold pressure monitors, oxygen generators, tire pressure gauges, massage chairs, and coffee machines.

Features

- Pressure range: -40kPa to 40kPa
- 3.3V_{DC} nominal power supply voltage
- 6mm long air nozzle

Applications

- Blood Pressure Monitor
- Oxygen Generator
- Tire Pressure Gauge
- Massage Chair
- Coffee Machines
- Water Pumps

Electrical Characteristics

Absolute Maximum Ratings (T_A = 25°C, unless otherwise specified.)

Parameter	Conditions	Minimum	Typical	Maximum	Unit
V_{DD}		-0.3		15	Volts
Output Pins		-0.3		V_{DD}+0.3	Volts
Burst Pressure				400	kPa
ESD Class	Human Body Model	-2000		2000	Volts
Storage Temperature		-40		125	°C

Performance Characteristics (V_{DD} = 5.0V±0.005, T_A = 25±1°C, RH = 50±10%)

Parameters	Conditions	Minimum	Typical	Maximum	Unit
V_{DD}		4.7	5.0	5.3	Volts
I_{DD}			1.0	2.0	mA
Operating Temperature		-20		85	°C
Pressure Characteristics					
Pressure Range		-40		40	kPa
Full-Scale Output Voltage		105	135	165	mV
Linearity	-40°C ≤ T_A ≤ 85°C	-0.3	±0.1	0.3	%FS
Hysteresis[1]		-0.2		0.2	%FS
Repeatability[2]		-0.3	±0.15	0.3	%FS
Overload Pressure	Maximum continuous applied pressure			80	kPa
Output Offset[3]	Gauge Pressure = 0Pa	-20		20	mV
Output Offset Temperature Coefficient[4]		-0.08		0.08	%FS/°C
Full-Scale Pressure Temperature Drift Coefficient[5]	0°C ≤ T_A ≤50°C	-0.03		0.03	%FS/°C
	-20°C ≤ T_A ≤ 85°C	-0.27	-0.22	-0.17	

Note 1: Operating conditions include a 5V power supply voltage and 25°C ambient temperature applied for 60 minutes. The pressure is then changed. The sensor's output is observed for 30 minutes. Hysteresis is the difference between the maximum and the minimum value divided by the full-scale output.

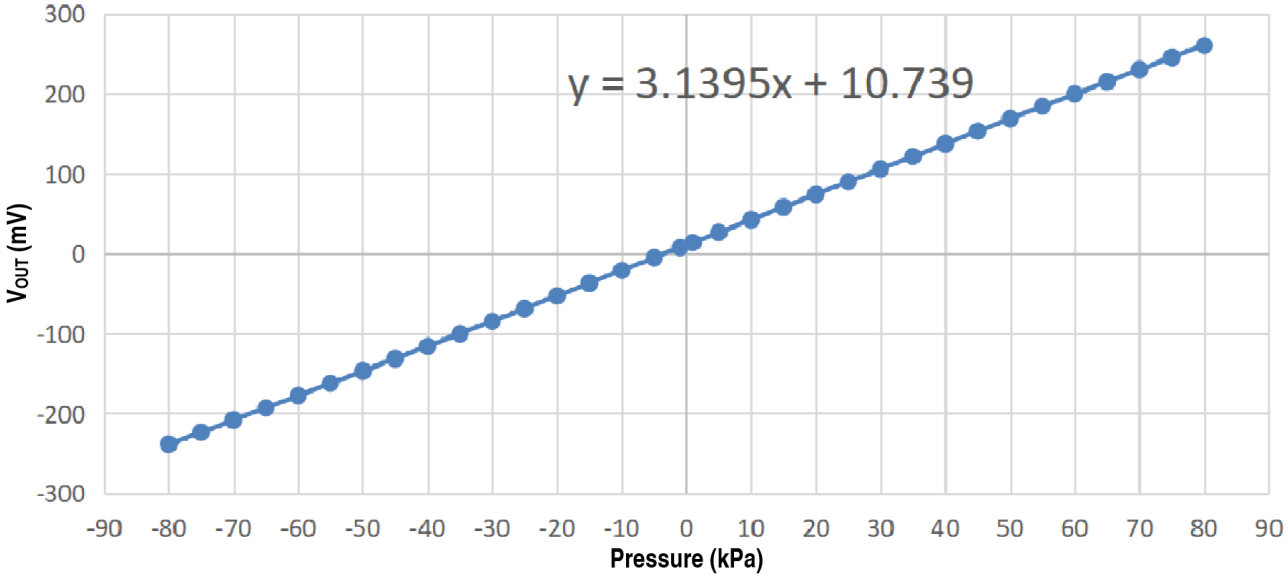
Note 2: An original pressure is applied, and the output voltage value is measured. The pressure is changed to a different value and the output voltage is measured. The pressure applied is returned to the original value and the output voltage is measured. The difference in the output voltage when evaluating the original pressure is the Repeatability.

Note 3: This refers to the gauge pressure 0Pa, the immediate atmospheric pressure value present around the PSA071040.

Note 4: The Output Offset varies with temperature. With V_{DD} = 5.0V±0.005, assign ten pressures evenly throughout the PSA071040 input pressure range. At each pressure, measure the output voltage at each of the following temperatures: -20°C, 0°C, 25°C, 45°C, 65°C, 85°C. Log the voltage and resistance for each pressure and temperature combination. Calculate the sensitivity, the linearity, and the output offset.

Note 5: Use a constant voltage supply source, V_{DD} = 5.0V±0.005. The current drawn in adaptive.

Typical Output Voltage vs. Pressure (V_{DD} = 5.0V±0.005, T_A = 25±1*C, RH = 50±10%)



Pressure Performance Curve

With respect to the curve titled "Typical Output Voltage vs. Pressure," the following is an explanation of how the output can be a negative voltage while operating on a single supply referenced to ground when a negative pressure (partial vacuum) is applied. Referring to Figure 1, the power supply voltage is applied to Pin 3, Pins 1 and 6 are connected to ground, Pin 2 is the positive output, and Pin 5 is the negative output. When a positive pressure is applied to the sensor, the output voltage at Pin 2 (V_{OUT+}) is higher than the voltage present at Pin 5 (V_{OUT-}) and the differential voltage [V_{OUT+} - V_{OUT-}] is greater than 0V. Conversely, a negative pressure input creates a higher voltage at Pin 5 that is higher than the voltage at Pin 2 and the differential voltage is less than 0V.

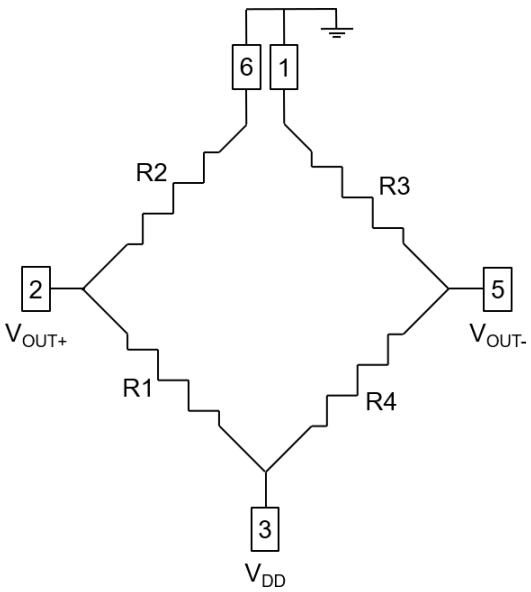


Figure 1. Simplified PSA071040 resistor bridge circuit diagram

Application Circuit

The circuit shown in Figure 2 is a PSA071040 bridge pressure sensor circuit whose output voltage is conditioned and amplified. To facilitate remote sensing, a current mode bridge drive is used. A four-wire shielded cable is used to connect to the remotely located bridge to the conditioning circuit. The OP177 precision operational amplifier servos the bridge current to 1.67mA, driven by a 1.235V AD589 reference voltage. A PNP transistor buffers the drive current supplied by the OP177 operational amplifier. This further ensures the lowest operational amplifier self-heating, and highest gain linearity.

The PSA071040 produces a typical output of 135mV when exposed to a 40kPa pressure. The signal is amplified by the AD620 in-amp, which is configured for a gain of 75 using an effective RG of 619Ω and the potentiometer set to 46Ω. Full-scale voltage calibration is set by adjusting the 100Ω gain potentiometer such that, for a pressure of -40kPa, the output reads -10.125V; and for 40kPa pressure, the output registers 10.125 V. For applications that require digitization, use an ADC that has a 10 V full-scale input range.

Other design considerations include the 0.1µF capacitor connected across the AD620's inputs. This capacitor, working with the typical bridge component resistance, filters EMI and RFI. The filter's corner frequency is nominally 265Hz.

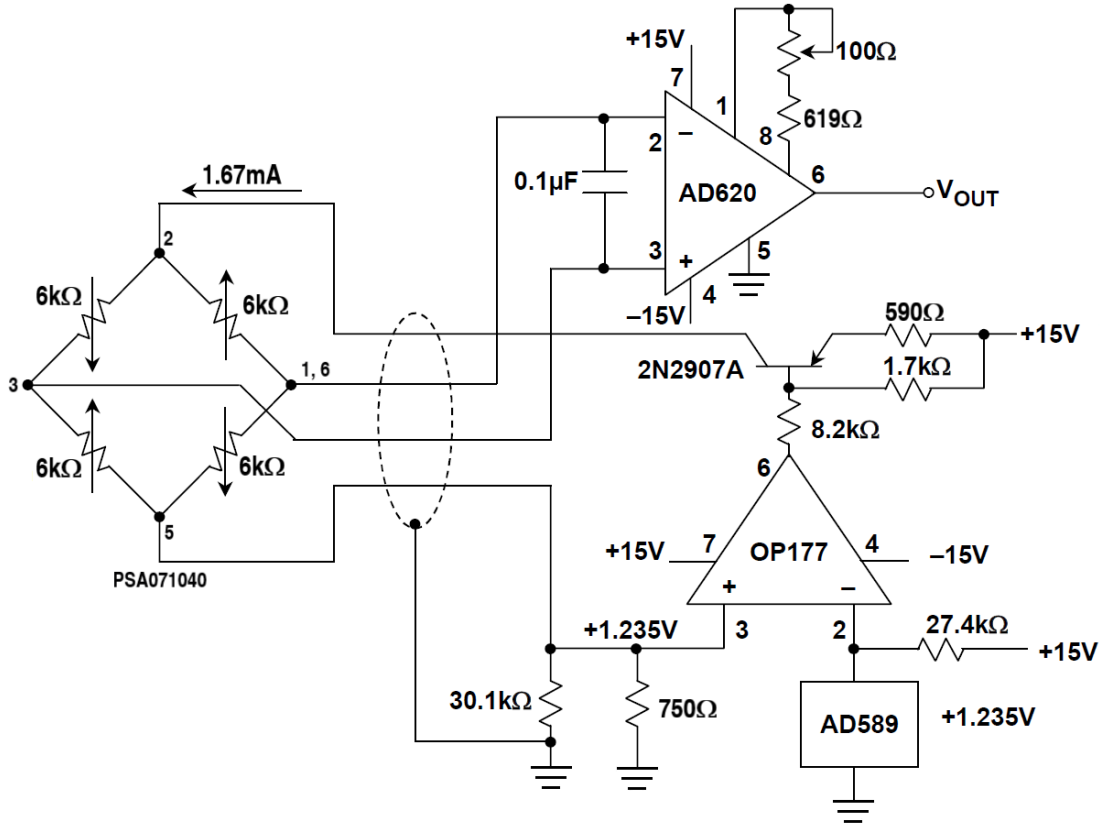
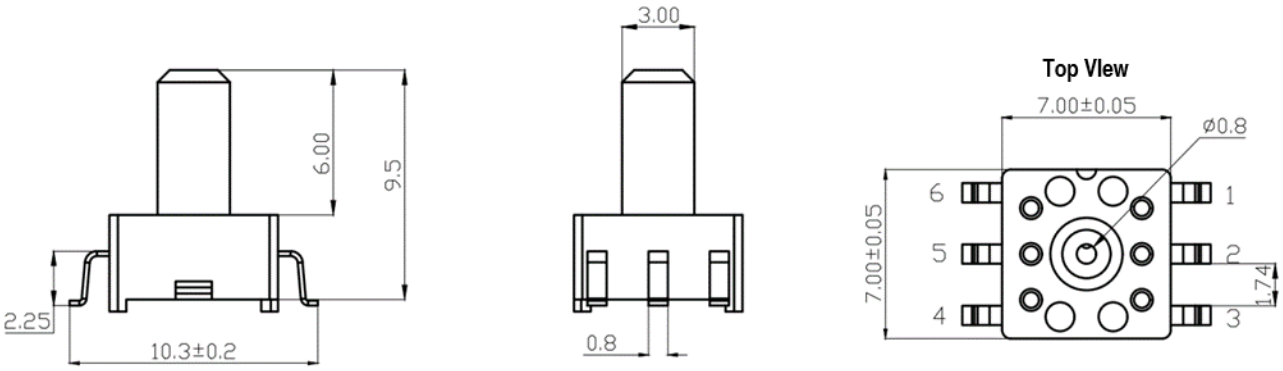


Figure 2. A precision pressure sensor amplifier. It uses a remote current-driven

PSA0701040 pressure sensor, a buffered OP177 precision operational amplifier, and an AD620 precision instrument amplifier set to a gain of 75.

Dimensions (Tolerance: ±0.5mm, unless otherwise specified.)



Pin Definitions

PIN	1	2	3	4	5	6
Pin Definition 1	V_0^-	V_S^+	V_0^+	NC	GND	V_0^-
Pin Definition 2	GND	V_0^+	V_S^+	NC	V_0^-	GND

Signal Definitions

Symbol	V_S^+	GND	V_0^+	V_0^-
Pin Definition	Positive Power Supply Voltage	Power Supply Ground	Positive Analog Output Voltage, Referenced to GND	Analog Output Voltage GND Reference

Assembly Recommendations

Soldering and Assembly

The PSA071040 has a small physical structure, which means that its thermal capacity is limited. Therefore, during the reflow process use only the heat necessary to complete PCB assembly. Excess heat beyond that necessary for proper reflow may cause thermal deformation that can alter and degrade the sensor's performance characteristics. Additionally, ensure that flux or other debris is not allowed to invade the device's interior.

SMT Soldering

The reflow heat profile shown in Figure 2 is recommended.

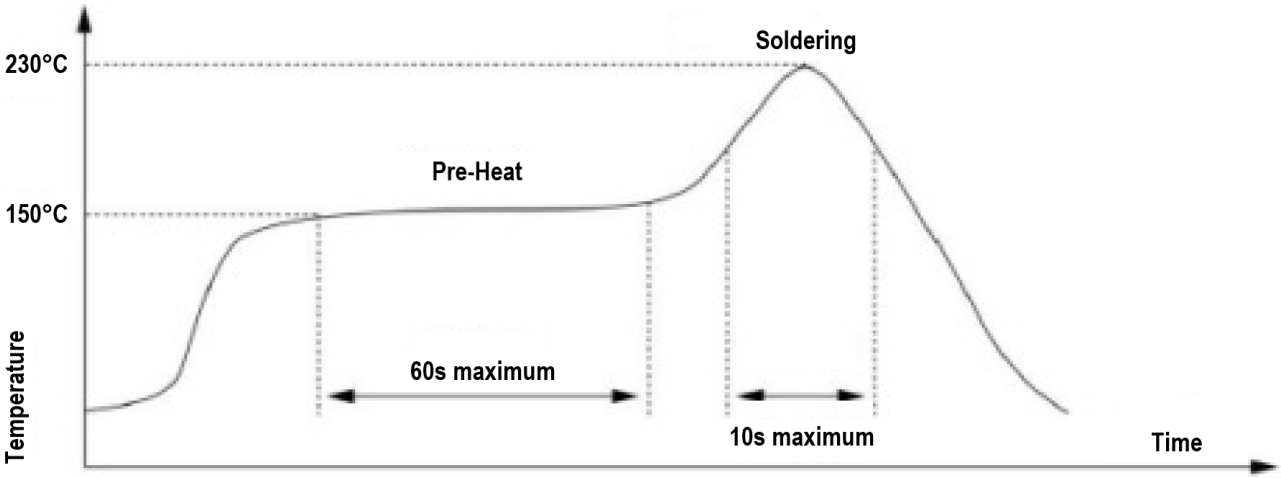


Figure 2. Recommended Solder Reflow Timing and Temperature Profile.

Cleanout

During manufacturing, the PSA071040 is assembled in a dust-free environment. It is recommended that the PCB assembly process is also performed in a dust-free environment (Class 7, ISO14644-1 is suggested). If not possible, use a temporary cover over the sensor during assembly that prevents dust or particles entrance into the device's interior. Post reflow, cleaning increases the risk of damage to the sensor. Therefore, the use of "no-cleaning" solder paste is recommended.

Sensor Port

The sensor is located internally below the device's port. Any foreign object that enters the port can cause damage, rendering the device damaged and leading to errant data or completely inoperable. Therefore, using an acoustically transparent protective membrane is encouraged.

Environment

To avoid the sensitivity and output value changes, avoid exposing the sensor to light sources.

Pressure Range

Ensure that the range of pressure that will be measured is within the range of the sensor. Pressures outside this range can damage the sensor.

ESD Protection

Ensure that when stored prior to assembly onto a PCB that the PSA071040 is stored in an ESD protective container. Please practice proper ESD protocols to prevent ESD damage while handling the device.

Packaging

Container	Qty.
Tube	60pcs per tube
Anti-static bag	20 tubes, 20*60 = 1200pcs
Inner Package	100 tubes, 100*60 = 6000pcs

Note: vacuum package

Specifications Revisions

Revision	Description	Date	Approval
A	Released from Engineering.	10/30/2023	
B	Specification Table Edits; Pressure Performance Curve Edits.	12/04/2023	
C	Corrected mis-spelled word in General Description. Updated pressure range under Features.	12/12/2023	
D	Added "Pressure Performance Curve" applications information and Figure 1. Previous "Figure 1" was revised as "Figure 2."	02/19/2024	KH
E	Revised "Typical Output Voltage vs. Pressure" curve.	02/20/2024	KH

Note:

1. Unless otherwise specified:
    A. All dimensions are in millimeters.
    B. Default tolerances are ±0.5mm and angles are ±3°.
2. Specifications subject to change or withdrawal without notice.