NOVA SENSOR

Application Note

NPP-301

Frequently Asked Questions

Here is a list of the most frequently asked questions regarding the NPP-301. We hope this FAQ sheet will help you to get to know and use the NPP-301 pressure sensor.

1. Can the NPP-301 measure gage pressure?

In order to measure gage pressure, two NPP-301 sensors would be required. One sensor would measure the applied pressure, while the second sensor would measure the ambient pressure. The gage pressure would be the difference in the two pressure readings.

The NPP-301 is an absolute pressure sensor. At sea level, even when a gage sensor measures 0 psig, the NPP-301 measures 14.7 psia. It measures the difference between the exposed air pressure and its internal vacuum reference. Like all absolute sensors, if the altitude changes, so does the ambient pressure.

If a car tire measures 30 psig at sea level, then the NPP-301 will measure 44.7 psia, which is the tire pressure plus the ambient pressure of 14.7 psia. If the same car tire travelled to 10,000 feet, the NPP-301 would still measure 44.7 psia, but a tire gauge will read 34.6 psig (44.7-10.1), because the ambient pressure is only 10.1 psia. Therefore, the NPP-301 can measure tire pressure, barometric pressure, altitude changes and closed vessels. If you have a question on which sensor to choose for your application, please contact Amphenol Advanced Sensors for applications assistance.

2. Can the NPP-301 be used as a weight sensor?

The NPP-301 is not a load cell. The NPP-301 does not measure weight or a load. The load needs to be converted to an air pressure. If a weight was placed on a balloon or air bladder, then as the balloon is squeezed the air pressure increases inside the balloon. If the NPP-301 was placed inside the balloon, then the sensor can measure the pressure change and the weight of the object acting on the balloon.

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3. How do I hook up the NPP-301?

A basic test circuit is shown in Figure 1 below. Pin 1 can be found by having the top cover's beveled edge facing you and the port on the left-hand side. Pin 1 would be the first pin on the left.

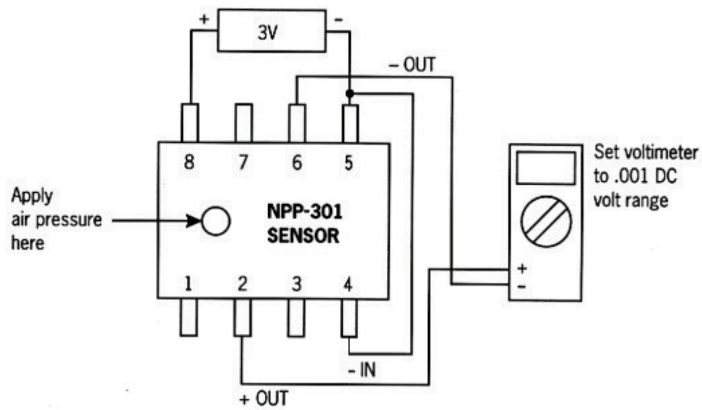

Figure 1 - Simple Test Circuit

Apply a voltage (VDC) to the sensor by connecting the positive voltage (+) to pin 8 and the negative voltage (-) to pins 4 and 5. The voltage can be two or three batteries or a DC power supply. DO NOT switch the (+) and the (-) on the power supply or drive the sensor with AC voltage. You could possible damage the sensor if the polarity of the power is reversed. Connect the positive lead of a voltmeter to pin 2 and the negative lead to pin 6. Set the voltmeter to read DC voltages with a resolution of 1 mV or 0.001 volts. At sea level, and with 3 volts powering the sensor, the NPP-301A-100A (15 psia, 100 kPa) will read approximately 0.06 volts. The NPP-301A-200A (30 psia, 200 kPa) will read 0.03 volts under the same conditions. The NPP-301A-700A will read 0.009 volts at sea level. There will be some variations between each sensor due to different offset voltages and pressure sensitivities.

4. Can I reflow solder the sensor?

If reflow soldering will be used, a slow ramp-up in temperature is recommended to prevent damage to the sensor. Amphenol Advanced Sensors also recommends that any calibration or temperature compensation not be performed until 8 hours after going through the furnace. This time will allow the sensor to cool evenly and provide a more consistent calibration. In production, Amphenol Advanced Sensors recommends a solder with a no-clean flux. This type of solder will eliminate the need to clean the board and thereby not allow liquids to get into the pressure port of the sensor. If the pc boards must be sprayed to degrease the board, then the pressure port must be covered to prevent any moisture getting into the pressure port.

For evaluation purposes, test clips can be used to connect to the pins. The electrical connection can also be achieved by soldering wires to the appropriate pins. An IC test socket can also be used because the sensor has the same foot print as an SOIC-8 chip. The NPP-301 is taller than most IC packages, so the top cover of the socket will need to be modified to fit the NPP package.

5. How do I apply pressure to the NPP-301?

The NPP-301 was meant to have the entire package exposed to the applied pressure. The top port is not hermetically sealed. For other applications, a vessel or a manifold needs to be used to apply the pressure to the sensor. The NPP-301 does not have a barbed fitting, so an inexpensive way to apply a test pressure would be to glue an pressure port around the entire NPP-301 package. This concept is shown in Figure 2.

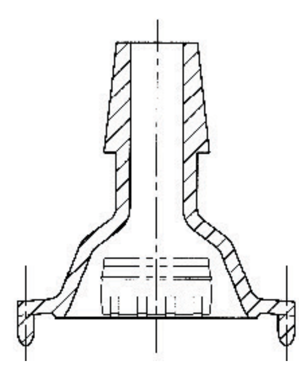

Figure 2 - NPP-301 Pressure Connection

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6. Can I use the NPP-301 to measure water pressure?

Please note that the NPP-301 should only be exposed to air, and not any fluids. There is a thin layer of silicone gel that covers and protects the sensor die from condensation, but not from full immersion underwater.

7. Can a conformal coat be used?

Potting can cover the leads, but it cannot block the vent port. Any material blocking or entering the pressure port will cause errors in the pressure measurement.

8. Why is the full-scale output specification so wide (40-80 mV @ 3 volts)?

The NPP-301 pressure sensor is not calibrated. The sensitivity of the sensor can vary 33% from part to part. Some kind of accurate pressure source must be used to calibrate the NPP-301. Even a mercury manometer can be used to calibrate a barometric sensor. A pressure source can be anything from a bicycle tire pump to a syringe. A syringe can also be used to generate a vacuum. If you do not have a precision pressure source, then a pressure regulator and a calibrated sensor can be used as a reference unit. The applied pressure from the regulator does not need to be accurate, because the data can be normalized using the calibrated sensor. Based upon the output of the reference sensor and the NPP-301, you can adjust the circuit to get the desired output.

Zero adjustment is accomplished by using a 200 ohm potentiometer (pot). The sensitivity adjustment is performed using an amplifier circuit shown in Figure 3. The sensitivity adjustment is performed using a 4.12 Kohm resistor with a 5 Kohm pot for Rg.

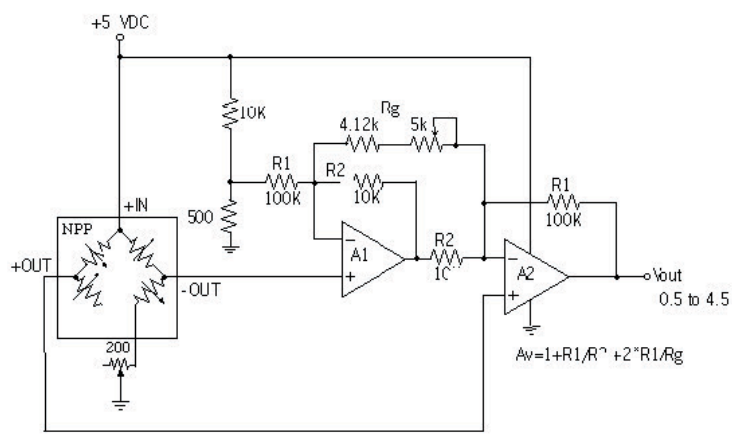

Figure 3 - Amplifier Circuit for NPP-301

9. How do I calibrate the NPP-301 for barometer pressure?

You need the NPP-301-100A that measures 0-15 psia. Let assume that you have a precision sensor that has a 0-5 volt output for a 0-15 psia pressure range. You want an output of 0.5 volts at 0 psia and 4.5 volt output at 15 psia. Connect the NPP-301 and the precision sensor such that they are measuring the same pressure. Attach a syringe or pressure source to the pressure inlet. A manifold or pressure vessel is needed to expose the sensor to the desire pressure. This manifold cannot leak, and yet it must allow the sensor to connect to the power supply and voltmeter.

1. Set the pressure so that the precision sensor reads 4.901 volts (14.7 psia). Adjust the zero adjust on the NPP-301 circuit until the output reads 4.421 volts.
2. Set the pressure so that the precision sensor reads 4.567 volts (13.7 psia). Adjust the sensitivity adjust on the NPP- 301 circuit until the output reads 4.153 volts.
3. Repeat steps 1 and 2 until the output requires no further adjustment.

10. How can I reduce my temperature errors?

Most piezoresistive sensors will change as the temperature changes. There are various techniques to reduce the errors and all techniques have trade-offs with accuracy, time and cost. The circuit in Figure 3 will have a 0.2% sensitivity error for every degree centigrade change in room temperature. For the simplest approach, R5 is set to 9 Kohms as shown in Figure 4. This resistor will help reduce sensitivity errors due to temperature changes. Please note that by adding R5, the overall pressure output has been reduced, because there is less power on the sensor.

Another resistor, R1, helps reduce zero pressure temperature errors. Unlike sensitivity temperature errors, zero temperature errors cannot be predicted as well. So, in order to reduce these errors, the sensor must be tested at two different temperatures. Based upon the change in output, a resistor value, R1 or R2 will be inserted to reduce the zero temperature error.

1. Read the sensor output at room temperature (Vout(t1)).
2. Adjust the temperature of the oven to 10 C warmer than room temperature.
3. Read the output voltage at the warmer temperature (Vout(t2)).
4. Calculate Vout(t2) – Vout(t1)
5. If the difference above is positive, then only R2 is used. If the difference is negative then only R1 is used. If the difference is less than 200 microvolts, you do not need to use either R1 or R2.
6. If you need to use a resistor, then choose a one megohm resistor for either R1 or R2.
7. Retest the sensor (steps 1-5), if the difference change signs then use a two megohm resistor. If the difference is lower, but still greater than 200 or 300 microvolts, then try lower resistor value, like a 750 Kohm resistor, to provide a lower temperature error.

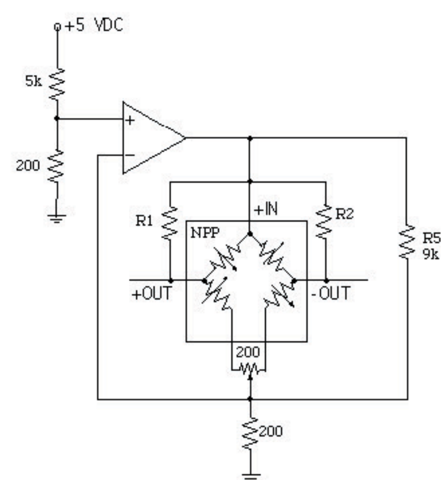

Figure 4 - NPP-301 with Temperature Compensation Resistors

For more accurate temperature compensation techniques, please contact Amphenol Advanced Sensors for applications assistance.

We hope this FAQ sheet has helped you to get started with the NPP-301. If you have questions regarding the NPP-301 or other questions about pressure sensors, please contact Amphenol Advanced Sensors.

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