

## SENSITIVITY ADJUSTMENT ON CERAMIC PRESSURE SENSORS

### Principle of operation

For some industrial applications, it is necessary to normalize the output signal of the sensors, in order to make them interchangeable without having to adjust the gain of the related electronic amplifier.

A realistic interchangeability can be set-up at  $\pm 1\%$  in an economic way.

The best solution for that is to reduce the actual sensitivity of all sensors, down to a fixed value, by simply adding a resistor in parallel with the output of the sensor.

Let's consider a strain gage bridge assembly which exhibits a measured output resistance  $R_{out}$  and a measured Full Scale Output Voltage  $V_{out}$  (Figure 1). A parallel resistor  $R_{//}$  is connected to the output of the bridge. The electronic equivalent schematic diagram is represented on figure 2.

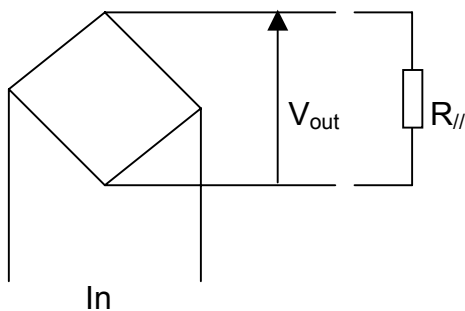


Figure 1

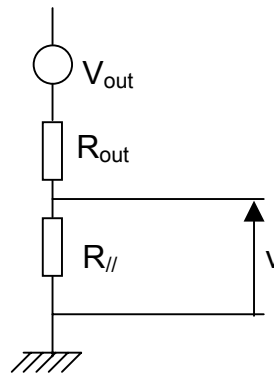


Figure 2

Thus, as a result of the potentiometric divider represented on Figure 2, it comes :

$$v = V_{out} \times R_{//} / (R_{out} + R_{//})$$

Formula #1

From this expression, we can deduct :

$$R_{//} = R_{out} \times v / (V_{out} - v)$$

Formula #2



Technical Note # TN07 (continued)

**SENSITIVITY ADJUSTMENT ON CERAMIC PRESSURE SENSORS**

In order to make sure that all sensors can be normalized at the same output voltage level, it is necessary to consider the overall spread of sensitivity inside a given manufacturing batch and the inter-batch spread as well.

Considering that the inter-batch sensitivity spread could reach  $\pm 20\%$  in the worst case, the calculation of the  $R_{//}$  resistor has to be made with a  $\pm 25\%$  sensitivity loss.

In practice, and only on the  $\varnothing 34\text{mm}$  sensors, the  $R_{//}$  resistor is Thick Film Screen Printed on the ceramic substrate, by means of the same kind of special conductive ink used for making the strain gages, so that the Temperature Coefficient is the same, in order to avoid any additional Zero Drift versus temperature.

The  $R_{//}$  resistor is then Laser trimmed in order to reach the desired output signal under a given Pressure.

Another technique consists in placing a chip resistor as  $R_{//}$ . In that case, the tolerance on the  $R_{//}$  resistor, resulting from the formula #2, must be around  $10^{-3}$ .

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX