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Notes on the nulling of strain gauge bridges

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Notes on the nulling of strain gauge bridges

(*Note: This is written for a 95HPD but the techniques apply to all our instruments*)

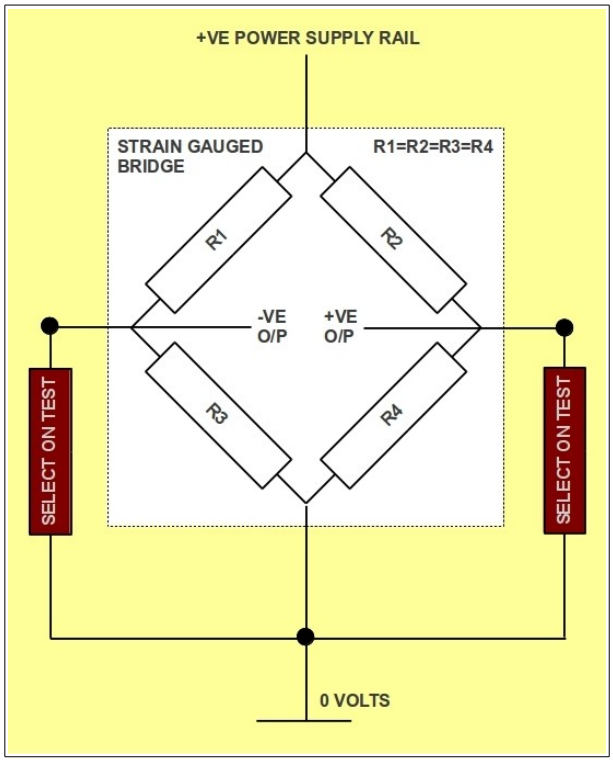
There are a number of strain gauged transducers in the probe. Occasionally the output of a transducer needs to be nulled, that is, set to a particular output for a given state. This may be because a transducer has been replaced, or because a gradual change in output over time has taken the circuit beyond an acceptable limit.

The analogue to digital (A-to-D) converter in the electronics of the probe can only output a number between ± 3.2767 volts. To make the most of this restriction while still leaving something in reserve, the displacement followers (the 'arms') of the 95mm HPD have an output that lies between ± 2 volts over their working range of 0 to 25 mm. Therefore the nulled or zero position should be approximately -2 volts - anywhere between -1.3 and -2.3 is acceptable.

The condition for the pressure transducers is different. For TPC A, the nulled or zero output is set to be close to 0 volts sensitivities.

There are no variable potentiometer devices anywhere in the probe for nulling the transducers. This is because no variable device can be made with the necessary electrical performance and mechanical reliability. In order to null the transducer fixed resistors must be soldered into place.

The figure below shows the circuit of a typical transducer. This might well be a strain arm. The two shaded resistors must be chosen by the user. Terminal posts are provided in the instrument where these resistors must be soldered.



A supply of suitable resistors must be available. These must be metal film resistors (MF25 series) and a comprehensive range is required of preferred values between 100 ohms and 10 meg ohms.

To null a circuit, arrange that the transducer is in a known condition (ambient pressure for a pressure cell, arm fixed to the body of the instrument for a strain arm).

Remove any existing resistors.

Note the output of the transducer. It will be either positive or negative from the desired value. If positive, the first resistor to be used will go into the negative pair of soldering posts, and vice versa.

With practice, a user can hold a resistor between the soldering posts long enough and reliably enough to determine if it is the optimum value. The optimum value is either:

- The resistor that brings the reading sufficiently close to the desired output or
- The resistor that is just large enough to change the sign of the output. That is, if the output was initially too positive, the optimum resistor is that which is just sufficient to take it negative.

Having found the first resistor and soldered it in place, another resistor can now be chosen to go into the other side of the circuit. This can be visualised as the first resistor having too great an effect, and something is now required to swing the output back the other way.

Provided that the user is operating with a complete set of resistors using the standard intervals the second resistor will be about 10 times the value of the first.

The usual cautions should be taken:

- Turn the power off when soldering in the new resistor.
- The resistor will be affected by the heat of the soldering procedure, so allow it to cool before taking a reading.
- Make sure that the joint is sound and no trailing wires can touch other parts of the system.
- It is advisable to leave a small tail on the resistor to aid in its removal at a subsequent date.

Some users unpracticed in the handling of electrical components use a resistor decade box to find out what value of resistor to install. Such a box has a pair of wires which can be connected between the soldering posts. Switches on the box are then configured until the optimum value of resistance is discovered. The box is then removed and the resistor is then obtained and soldered in place.

Although nulling is the usual reason for changing the value of the fixed resistors, sometimes it is necessary to set the gain of the circuit. In this instance, the output of the circuit must be found, and then reduced to the desired range by soldering a resistor across the output of the bridge. It will probably be necessary to tack the resistor in place to determine first if it is the optimum value before soldering it properly.