Resistance Bridges

In electronics, circuits similar to that shown in figure 1, are called bridges. When all the elements of such a circuit are rectifier diodes, we call it a rectifier bridge - which is commonly used in battery eliminators. When all the elements of such a circuit are resistors, we call it a resistance bridge. The circuit of figure 1 is also known as a 'Wheatstone Bridge'.

Now, let us see the functioning of this bridge circuit. Figure 2 shows a practical bridge circuit, drawn in a simplified manner for better understanding. The two branches made up of R_1, R_2, and R_3, R_4 are nothing but voltage dividers. The meter connected between these two branches at the junctions between R_1, R_2 and R_3, R_4 measures the difference between the two junction points.

In the circuit of figure 2, the lift branch R_1, R_2 divides the voltage into 2V on R1 and 3V on R2. The right branch divides the 5V supply voltage into 2.5V and 2.5V across R_3 & R_4.

The difference voltage thus becomes 3V - 2-5 V = 0.5 V which is measured by the meter and indicated.

If we now reduce R1 to 260Ω instead of 400Ω, the voltage across R2 will increase by about 0.5V. This will increase the reading on the meter across the junction points by 0.5V. The meter connected directly across R2 will also show an increase in reading by 0.5V.

A very important fact can be observed here that for a rise of about 17% in the voltage across R2 there has been a rise of 100% in the difference voltage across the junction points of the bridge, which can also be called as the bridge voltage. The above observation shows how sensitive the bridge voltage is, in relation to any change in the individual branch voltages. Even the slightest change in branch voltages will be reflected as a large deviation in the beidge voltage.

When the ratios of the voltage divider branches on left and right are both exactly identical, the bridge voltage in zero.

This condition of the bridge when the voltage divider ratios of both the branches are identical is known as the balanced condition - the bridge is said to be a balanced bridge.

A simple applications of this bridge circuit is shown in figure 3, which works as a light intensity meter. One of the resistors in the left branch of this bridge is an LDR. The Resistance of an LDR in darkness is very high, whereas its resistance in light falls as the intensity of light increases. Thus the voltage across R1 brcomes dependant upon the intensity of light falling on the LDR. the potentiometer P1 can be adjusted to compensate for voltage across R1 so that

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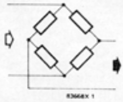

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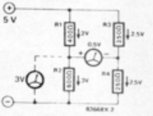

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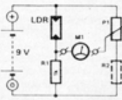

the meter reading becomes zero. If the potentiometer knob is provided with a dial, it can be calibrated to read the light intensity.

This circuit can work even without the resistance R2 (1KΩ) shown in dotted lines, but to protect the LDR from excess current when the potentiometer is in the extreme lower position, R2 should be included in the circuit.

The potentiometer position required, to obtain zero reading on the meter when the LDR is in total darkness, can be marked as zero intensity. The light can then be increased in known steps of intensity level and every time the position of potentiometer can be marked with the known value.

This circuit can be easily assembled on a small SELEX board and calibrated using a standard light intensity meter as a reference.

For a resistance bridge, the individual values of the resistances are not important. The operation depends only on the resistance ratios of the individual branches. When the resistance ratios of the left and right branch become equial, the bridge voltage becomes zero, irrespective of the individual values of resistors and supply voltage.

Figure 1 :

Standard configuration of a bridge circuit. The individual elements can be any type of impedances, or even rectifier diodes.

Figure 2 :

The meter connected across the junction points measures the voltage difference between those two points. The sensitivity of this measurement is much more than that of a meter directly connected across one of the voltage divider resistor.

Figure 3 :

A simple light intensity meter. The potentiometer is used to balance the bridge in such a manner that the voltage across the shunt arm of the bridge in is zero.

Figure 4 :

The circuit of figure 3 can be assembled on a small SELEX PCB.