The Resistance SWR Bridge

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For most pieces of equipment in our hobby, there are many designs. In the case of the well know SWR bridge some are fairly simple, others are complicated. The degree of accuracy depends on the design, and the amount of effort put into the construction and calibration.

The principle behind this type of bridge is simple. A suitable sampling device is used to obtain a small voltage from the line under test, which is then rectified by diodes. By comparing the voltages obtained from the forward and reflected currents in the line, a meter can indicate the Standing Wave Ratio on the line.

The three most popular circuits are the trough type, where a pair of short sampling lines are placed adjacent to a central conductor carrying the RF current, and the voltage induced in each line is used to provide the reference for the measurements; the 'Monimatch' which uses a similar principle, but uses a sampling line threaded down through a piece of coax cable between the outer and inner conductors; and the current transformer type where a toroidal transformer samples the current flowing through the line — the primary of the transformer being a single stretch of wire carrying the RF current and passing through the toroid, with the secondary wound round the toroid itself.

The first two types suffer from frequency consciousness, as the electrical length of the sampling line varies with frequency, hence the readings and sensitivity also vary. Some care in contruction is needed for reliable results. The transformer type is more accurate, but is much more elaborate and complicated to build. It does have the advantage of being frequency independent though.

A simpler bridge

There is a simpler type of SWR bridge which seems to have been given little attention in recent years, but which is ideally suited to the beginner, and is easy to build. It does have the disadvantage of only being suitable for low power, and cannot be left in circuit once the tuning operation is finished. However, it has a minimal parts count, and with a little care in construction gives accurate results. It is ideally suited to QRP work, and could form the basis of a combined QRP antenna matching unit and SWR bridge.

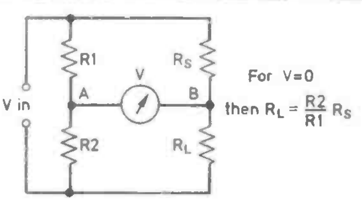

Fig. 1 Theoretical resistance bridge

The resistance bridge

Fig. 1 shows a simple resistance bridge which basically consists of two voltage dividers in parallel placed across a voltage source. Whenever the voltage drop across R1 equals that across R2, then the drops across the other two resistors are also equal. The two junction points of the divider chains are therefore at equal potentials and the meter reads zero, giving a balanced bridge.

If the voltage drops across R1 and 2 are not equal, then the two junction points are at different potentials, the bridge becomes unbalanced, and the meter will read the difference potential.

SWR bridge

If we now make R1 and R2 of equal value, then a balanced condition will exist whenever the other two resistors are equal in value. If R_s is made equal to the characteristic impedance of our transmission line (say 50 ohms), and R_L is replaced by a feeder, then the bridge will be balanced whenever the load impedance is equal to 50 ohms. (See **Fig. 2.**)

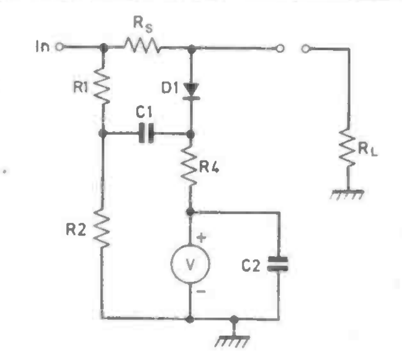

Fig. 2 Theoretical SWR bridge

If the bridge becomes unbalanced then as RF current travelling towards the load only 'sees' the impedance of the line until it reaches the load, the bridge is still balanced for forward current, as it has to pass through R_s en route. The power reflected from the load doesn't see the bridge circuit and hence this registers on the voltmeter.

If we measure the forward voltage at point A (which is equal to half the applied voltage), and compare this with the measured reflected voltage, we can calculate