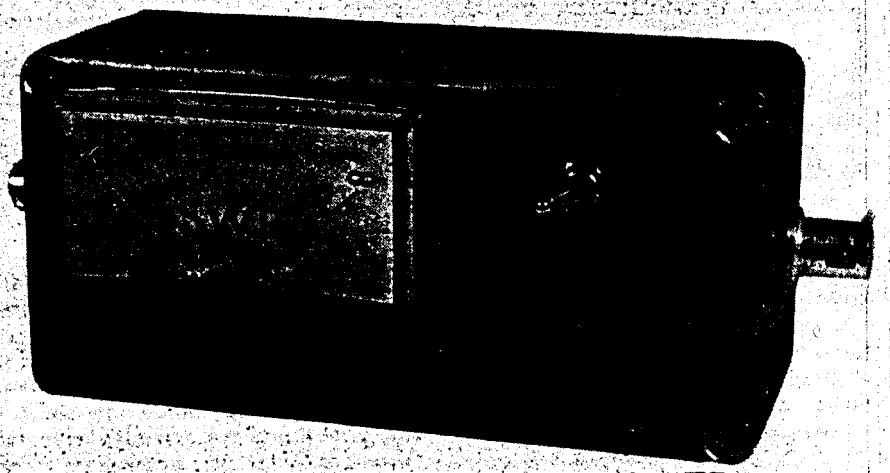
A 2 metre VSWR Bridge



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Introduction

Matching the aerial to the transmitter, in order to obtain maximum radiated power, is an important consideration for any radio amateur hoping to obtain the best results from his equipment: this can be achieved by using some form of standing wave meter in the tuning-up procedure. The standing wave ratio (s.w.r.) is a measure of the efficiency of an aerial system: the closer the s.w.r. is to unity, the greater the proportion of transmitter power actually radiated. Although the s.w.r. only approaches unity under ideal conditions, in practical situations its measurement will provide a very useful evaluation of the system's performance.

The instrument described is an s.w.r. bridge which will provide a constant, on-the-air reading whilst allowing meaningful measurements to be made on the relative merits of different aerials and aerial sites. It is suitable for use in the feeders of v.h.f. transmitters having outputs of between 1W and 100W.

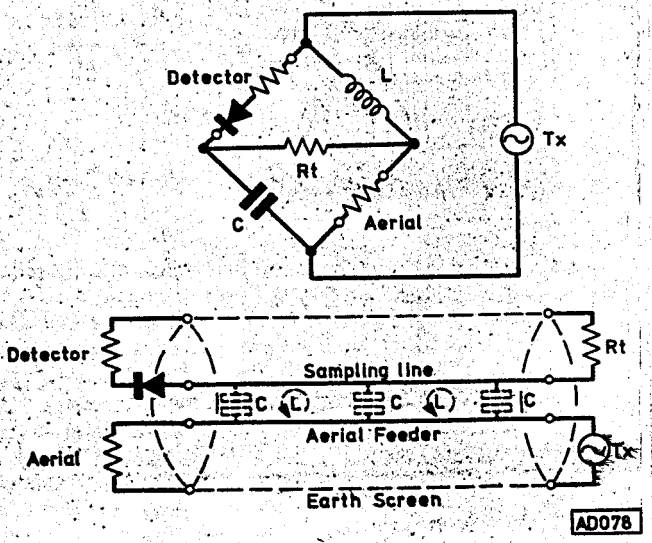

Fig. 1: Theoretical diagram of the Maxwell Bridge transmission line coupler

Circuit Description

An s.w.r. bridge works by sampling the amount of power flowing in each direction along the aerial feeder. This is achieved by the use of a Maxwell bridge transmission line coupler, as shown in Fig. 1. The reactive arms of the bridge are formed by the distributed capacitance and mutual inductance of the coupled lines. The two sampling lines L1 and L2, shown in the circuit diagram of Fig. 2, are coupled to the main aerial feeder and respectively terminated at opposite ends by R1 and R2, thus providing two outputs which are proportional to the forward and reflected signals present. Diodes D1, D2 and capacitors C1, C2 convert the sampled signals to d.c. for measurement on a conventional meter M1. Potentiometer VR1 adjusts the sensitivity of the circuit and ferrite beads prevent stray r.f. pick-up in the wiring.

In practice, the bridge can be used either way round due to the symmetry of the circuit, but for convenience, SK1 is assigned to the transmitter and SK2 to the load; this allows S1 to be designated "forward" and "reflected."

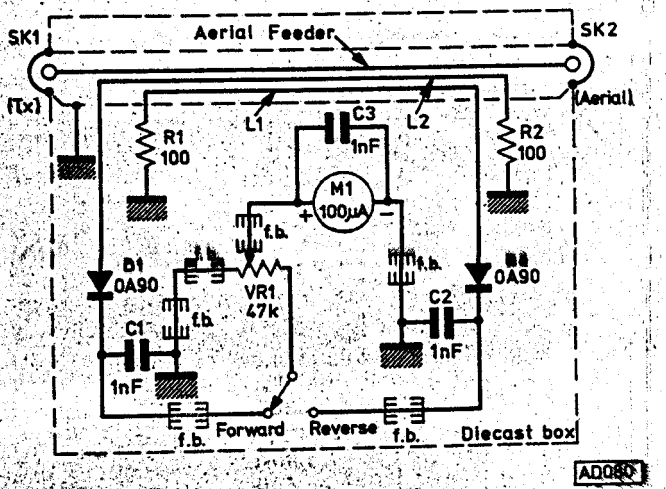

Fig. 2: Complete circuit diagram of the 2m VSWR bridge

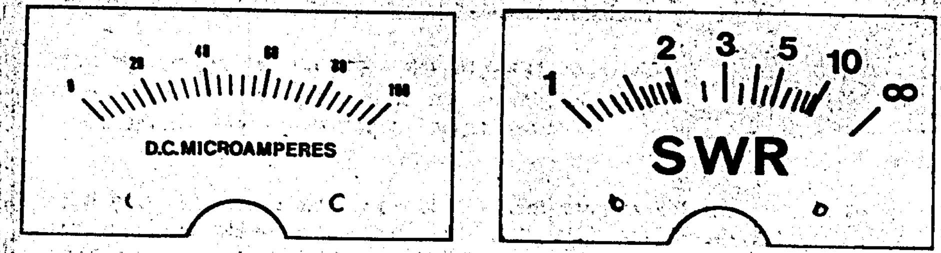

Fig. 5: Meter calibration scale for use with Maplin type '2 in PAN' meter. The original 100μA meter scale (left). Replacement scale for s.w.r. measurement (right). Both shown actual size

Calibration

Using the recommended meter movement the instrument may be calibrated simply by copying the scale shown full size in Fig. 5. For alternative types of movement a table of calibration points is given. The new meter scale is best marked with the scale plate detached from the movement, using a fine pen and drawing ink, pencil or dry transfers.

S.W.R.	Reverse Reading (μA)	S.W.R.	Reverse Reading (μA)
1:1	0	2·5:1	43
1·1:1	5	3:1	50
1·2:1	9	3·5:1	56
1·3:1	13	4:1	60
1·4:1	17	4·5:1	64
1·5:1	20	5:1	67
1·6:1	23	6:1	71
1·7:1	26	7:1	75
1·8:1	29	8:1	78
1·9:1	31	9:1	80
2:1	33	10:1	82

★ components

Capacitors
C1 1nF disc ceramic
C2 1nF disc ceramic
C3 1nF disc ceramic

Resistors
R1 100 ohms ¼W 2%
R2 100 ohms ¼W 2%
VR1 47kΩ linear carbon

Diodes
D1 OA90
D2 OA90 (See text)

Sockets
SK1 50Ω BNC
SK2 50Ω BNC

Lines
L1 250mm 26 s.w.g. enamelled copper wire
L2 250mm 26 s.w.g. enamelled copper wire
140mm low-loss 50Ω coaxial cable of capacitance 56pF/m (UR202)

Miscellaneous
Diecast box approximately 120mm [illegible]
100μA 2in panel [illegible]
Miniature single [illegible]
knob with [illegible]
tag strip. [illegible]
quired [illegible]
Leaswood, [illegible]

Using the S.W.R. Bridge

Attach the output of the v.h.f. transmitter to SK1 and the aerial system or some other form of load to SK2, using matched feeder. Set S1 to read forward power and turn VR1 fully anticlockwise for minimum meter sensitivity. Apply r.f. power from the transmitter and adjust VR1 for a full-scale meter reading. Leaving the setting of VR1 unchanged, set S1 to read reverse power: the meter will now indicate s.w.r. directly.

It should be noted that continuous high-power operation of the s.w.r. bridge without a load may cause the 100 ohm resistors and the diodes to be destroyed. The bridge may be left permanently inline with the feeder between transmitter and aerial, as it introduces no significant signal degradation in either direction. Constructors should be wary of placing too much importance on absolute s.w.r. readings; the real value of the bridge lies in its ability to indicate relative forward and reverse power levels. It will be found invaluable as a general aid in the adjustment of transmitters and aerials. ●