Build an SWR/Wattmeter

BY WILLIAM WINTER, Jr.
WB8JCQ/LU1AKO

Putting some meaningful scales on your homebrew meter.

Doug DeMaw, W1FB, wrote a very good article on wattmeters that appeared in the December, 1969, issue of *QST*.[1] This instrument has appeared in subsequent editions of the ARRL *Radio Amateur's Handbook*. This is a basic design used by many manufacturers, as DeMaw states.

Some time back, I built a wattmeter using that article as a guide. I used point-to-point wiring because printed circuit board construction is impractical for a one-of-a-kind unit. It worked very well, except for the fact that, because I had available only a linear meter movement, the calibration did not follow the dial markings. I used it this way for many years, as a relative-output indicator. I thought that someday I would have the means to calibrate it more satisfactorily.

One day, I noticed a meter advertised (catalog No. TM21K401) in the "This Month" flyer from Herbach & Rademan, Inc., 401 East Erie Ave., Philadelphia, Pennsylvania 19134. This meter has the following scales: SWR, 0-10, 0-25, 0-500 watts, 0-100 per cent modulation, and 0-10 linear scale. The meter movement is a 100-microampere, full-scale unit. Their price was $5, so I purchased one. These are brand new, high quality units, probably intended for a multi-use instrument.

The only difficulty I encountered in mounting the new meter to replace the old surplus unit was the mounting bolts. These bolts have metric threads, and no nuts were supplied; but I found the required nuts in my junk box. I made a few component changes in the original DeMaw circuit. The diagram, **Fig. 1**, shows the circuit I used. The original DeMaw circuit used two switches: one to switch from low to high power and the other to switch from forward to reverse. Because it is not advisable to read SWR at high power (the transmitter could be damaged if operated at high-power under conditions of excessive SWR), I changed the switching arrangement. Only one single-pole, four-position switch is needed, but, because I already had two switches mounted, I retained that arrangement. S1 position one reads SWR at a 25-watt level. Position two reads forward power. S2 selects 25, 500, or 2500-watt scales.

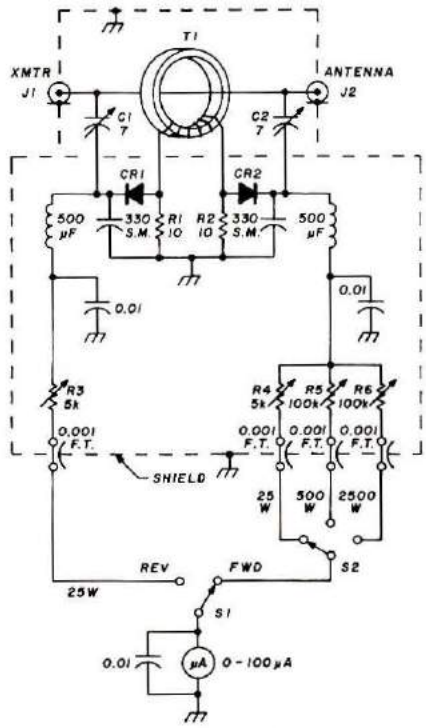

Fig. 1. The schematic of the SWR/wattmeter. T1 is a toroidal transformer consisting of 35 turns of No. 36 (0.13 mm) enameled wire spaced to cover entire core. The core is a Micrometals T-68-2. R1 and R2 are 10-ohm carbon composition resistors, and must be matched for resistance. CR1 and CR2 are matched Germanium diodes.

The series-trimmer values were selected according to this meter movement and the diodes used. The diodes I used were unidentified germanium types, removed from a surplus computer board. I used an ohmmeter to select a matched pair. Different diodes and meter movements may require changes in resistance beyond the range of the trimmers specified.

Balancing the bridge

Connect the transmitter to J1, and a 50-ohm dummy load to J2. Be sure the dummy load is non-inductive; wire wound or metal-film resistors or light bulbs are no good here, as they will cause an impedance mismatch. Also, be sure the restive load can handle the amount of power used.

Apply enough transmitter power for a full scale reading on the lowest forward scale. Switch to reflected power and, using an insulated screwdriver, adjust C2 for a null. It may be necessary to temporarily jumper across R3 and/or increase transmitter power to get enough meter movement for a meaningful null. Remove the jumper.

Reverse the coax connections to J1 and J2. Switch to reflected power and apply enough drive for full-scale reading. Switch to forward 25 watts, and adjust C1 for a null. Here again, it may be necessary to temporarily short R4 and adjust transmitter power for a meaningful null adjustment.

Repeat these steps until no further improvement is achieved.

Calibrating the meter scales

Using a calibrated wattmeter connected between the J1 terminal and the dummy load as a standard, couple enough power to J2 to achieve 25

watts output as read on the calibrated power meter (I used a Bird 43 and Heath Cantenna). Switch to reverse power and adjust R3 for a full-scale (25-watt) reading.

Reverse the coax connections so that the transmitter is connected to J1 and the calibrated wattmeter is between J2 and the dummy load. Switch to forward power and calibrate R4 for 25 watts full scale.

Following the procedure of this last step, adjust R5 and R6 for the full-scale ranges you have chosen (500 watts and 2500 watts, in my case). Be sure to increase the transmitter power output to achieve at least mid-scale or higher reading to get accurate calibration. Be careful not to exceed the dummy load ratings. Use short key-down times; a 10 to 1 ratio for key-up to key-down, for example (5 seconds key down to 50 seconds key up).

Measuring SWR

Standing wave ratio readings are made as follows: Couple enough forward power to the antenna for a 25-watt full scale reading. Next, switch to reverse power, and read SWR directly off the scale.

If the meter specified is no longer available, Herbach & Rademan also list a smaller meter, catalog No. TM21K436. It appears to have only a 0-1 linear scale and SWR scale. This could be useful for SWR applications only, if power readings are not needed. B & F Enterprises, 119 Foster St., Peabody, Massachusetts 01960, advertise a 2½-inch power-meter movement for $3.38, catalog No. 9W0078. It does not appear to have an SWR scale.

These unused, surplus meter movements are apparently from the CB industry: probably discontinued production, parts overstock, etc. Their appearance on the surplus market makes it very attractive to build your own wattmeter. It is now possible to home brew your own and have a unit with performance and appearance equal to that of commercial units, at a fraction of the cost.

Reference

1. Milton F. DeMaw, W1FB, "In-Line RF Power Metering — Some Practical Considerations," *QST*, December, 1969, page 11.

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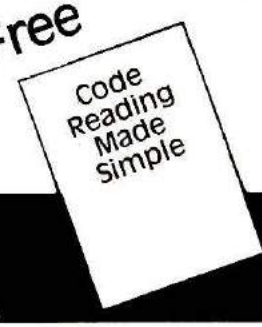

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