Mike Higgins, K6AER

Getting Rid of Slugs

Want to get more mileage from those wattmeter slugs? Mike shows us how.

This is not an article about gardening but like many slang words, it leaves a visual image. I'm not old enough to know how Bird wattmeter coupling units got that name, but for the last 50 years that is what they have been called — slugs.

The Bird model 43 and the various Bird offspring have been around longer than I can remember. Every ham's first serious lab-grade possession was a Bird wattmeter with a stash of slugs. The cost of the wattmeter has remained relatively inexpensive, with new units costing a little above $300. The slugs have ballooned in cost, fetching between $90 and $160 per copy. To cover multi-frequency octave ranges and power levels over 30 dB, you can spend a small fortune buying these beauties.

The frequency coverage of the slugs is determined by precise pickup loop design, but the wattage ranges are determined by plain old series resistance. By changing the slug's series output resistor, we can change the range of the output to the meter to read from 1 to 5000 W or more. The meter range can also be changed by shunting parallel resistance across the meter to make it less sensitive. This is what I have done to make a 500 W slug now read 1000 and 2500 W on the meter or 5/10/25 W, or any level, with the same metering relationship.

Modification

A single SPDT center off switch is used to select calibrated resistances placed across the 30 µA meter movement giving the meter a ×1, ×2 and ×5 reading scale. Selections of components are not critical and all are available from RadioShack for about $12. This method of scalability works on both the CW and peak reading wattmeters. The switch is located in the bottom right corner as viewed from the meter front (Figure 1).

Each trimming potentiometer is soldered to each side of the switch with the wiper connected to the meter along with the center position of the switch. The ×2 position has a resistance of about 2000 Ω and the ×5 position is about 790 Ω. These are starting points and the final calibration will need to be established with a power level from a calibrated meter or source.

Trimpot mounting is accomplished by soldered directly to the rear of the switch as shown in Figure 2. Wires are routed directly to the meter. To avoid confusion, orient the Trimpots to correspond to the ×2 and ×5 positions mirrored on the front of the meter.

The range selection switch is located in the lower left (when viewed from rear) corner of the wattmeter case. The hole is 0.25 inches in diameter and must be carefully drilled to provide room for the switch and Trimpots. The range switch wires can be connected at the meter on the model 43 series or on the circuit board of the peak reading model. As with any modification project, measure twice and drill once.

The schematic of a typical Bird wattmeter is shown in Figure 3, with the modification just ahead of the meter. Modifications are in blue.

Calibration

Calibration can be performed in several ways. Applying power to the wattmeter at the full power level and by setting the power reading at the ×2 level at half meter reading (50% indicated) and

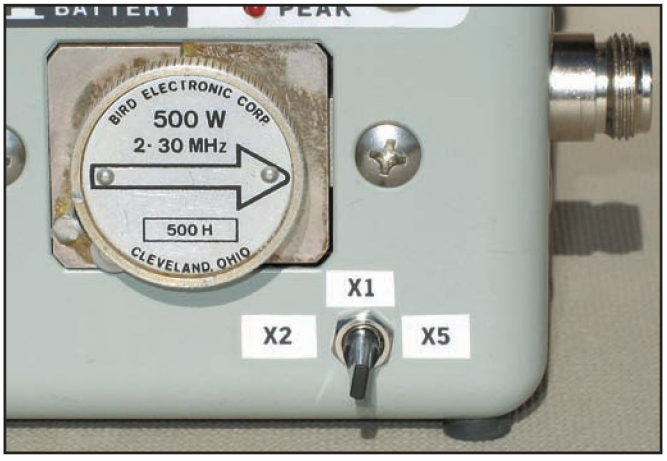

Figure 1 — Close-up of the new front panel range switch.

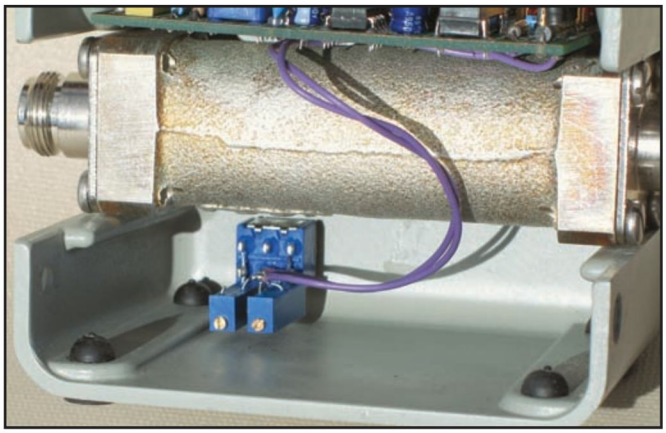

Figure 2 — Rear view of the range switch showing the Trimpot mounting arrangement.

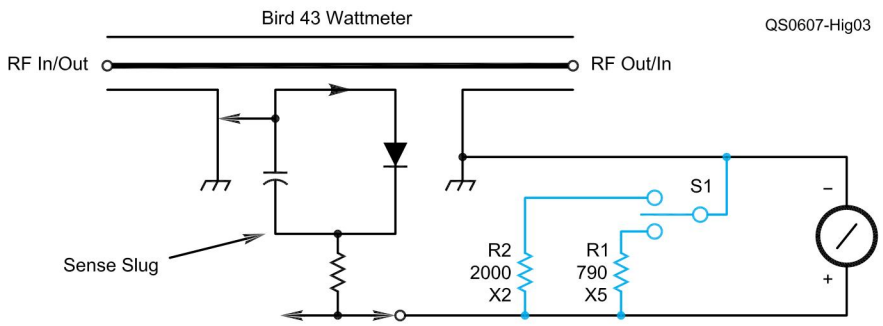

Figure 3 — Schematic diagram of typical Bird wattmeter. The modification is shown in blue. Part numbers are RadioShack parts, www.radioshack.com.
R1 — 1 kΩ, 15 turn trimming potentiometer (RS 271-342).
R2 — 10 kΩ, 15 turn trimming potentiometer (RS 271-343).
S1 — SPDT center off microswitch (RS 275-664).

the ×5 level at the 20% indicated meter reading level. The best calibration is at the full power level reading on each scale. With a 50 W slug you want to set the ×2 level at 100 W and the ×5 level at 250 W. The meter is rated at 5% accuracy at full meter reading and you should calibrate each level at the full power level for the best accuracy. Bird wattmeters are specified as accurate to ±5% at the full power meter reading.

In my case, I calibrated the wattmeter using an Alpha 4510 digital wattmeter in series with the Bird wattmeter. The reference Alpha wattmeter was checked at about 2% accuracy against an HP EPM-441A digital wattmeter. I must stress that when calibrating the meter shunts, it is necessary to use a properly calibrated slug. If you use a slug that's out of calibration, all the shunt readings will be off for other slugs used. You can calibrate against another Bird meter but the calibration will only be as good as your reference. As a reality check, the meter indication will drop to the lower readings by the shunt resistance settings of the ×2 or ×5 switch positions.

I calibrated the meter with an HF slug. When I checked the accuracy with VHF slugs installed, the results were just as good so no compensation was included for other frequency ranges.

Mike Higgins, K6AER, has had his ham license since 1962; he has a BSEE in microwave engineering with 30 years' experience in the aerospace, communications and telecom industries. Currently he is principal engineer for a broadband telecom provider. He lives with his wife in Elizabeth, Colorado on a horse ranch. Repeater, antenna and amplifier design and construction are his favorite technical activities. Mike has built and now maintains several repeaters on the Colorado front range. You can find him on 20 meter SSB. When in Colorado, look for him on Denver's Castle Rock repeater system at 146.67 MHz or contact him at 34575 Morgan Trl, Elizabeth, CO 80107 or **k6aer@arrl.net**.

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