Digging Deeper:

Modification Details for A Low-Cost, Easy-to-Make, Dual Band QRP "Afterburner"

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Part 1 of this article described the reasoning behind the author's goal of building a two-band amplifier for his QRP rig using a Ramsey 20-watt amplifier kit, along with a description of some recommended modifications to the basic amp. Construction details follow. – ed.

Modification Details

1. *Fixing the heat problem*: First, the supplied case is plastic. A metal, or partly metal, case connected to the two transistor heat sinks with an insulated copper buss would dissipate heat better, but there is an easier way. By adding another small U-shaped heat sink vane — either from an actual "official" sink or cut from a thin piece of copper or aluminum flashing — to the top of the transistor, some of the issue is resolved. Not critical, it just adds a little more surface area. Also, you will mount a tiny $8 or so silver-dollar size microprocessor type 12-VDC, low drain fan over a small 1-inch or so hole (matched to fan size) in the soft plastic case above the heat sink and drill a few 3/8-inch holes in the bottom of the case. See **Photo F** for a typical fan, plus **Photos G** and **H** for placement of the vent holes. The heat problem is now completely solved. I have run it over a minute key down at 14 watts out and it stayed cool.

2. *Stability Fix*: As mentioned, there is a stability issue with some of these amps. After studying the issues reported and that I myself experienced, I found that, due (I believe) to variations in FET gain from the time this unit was designed, and (ironically) the lower-loss, higher-quality, glass epoxy board used in newer units, they can be prone to self oscillation. The manual alludes to this as well, in case of antenna mismatch.

Briefly, a 6.8-ohm, 1/2-watt resistor and a small type-43 ferrite bead are inserted between the board and each FET's gate. This cures any tendency to oscillate. It reduces gain slightly at 40 and 20 meters, but very much at VHF (where the oscillations appeared). The resistor/bead assembly goes into the intended FET gate lead hole and the gate lead is soldered to the top of the resistor lead above the bead. I also used an 8.1-ohm resistor with success. It must not be wire wound, but carbon or film type; 1/2-watt is fine. *(**SEE: Figures 3** and **4**. Step-by-step instructions are below for this and each of the following mods.)*

3. *The impedance fix*: By removing a couple of turns from the broadband input transformer (or not putting them in while building the amp, in your case.) plus adding a small (2- or 3-dB) attenuator on the input, SWR was brought

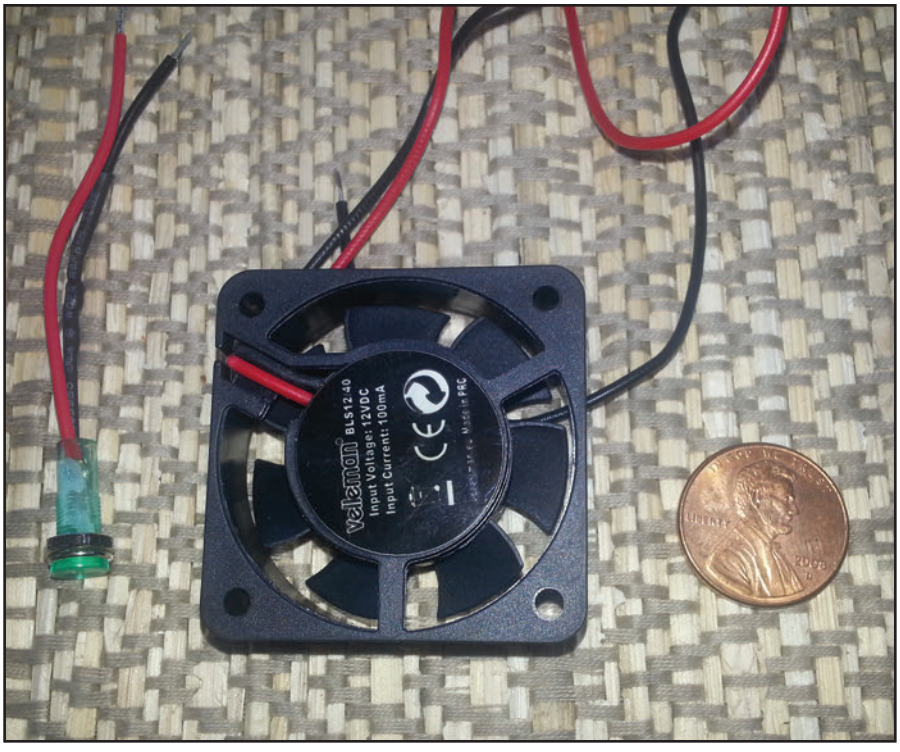

***Photo F.** A small microprocessor fan helps to add sufficient ventilation so a one-minute key down doesn't bother the final transistors with overheating.*

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Photo G. *Holes on the bottom of the Ramsey amplifier's enclosure allow air to flow through the cabinet interior, helping to keep the final RF transistors cool.*

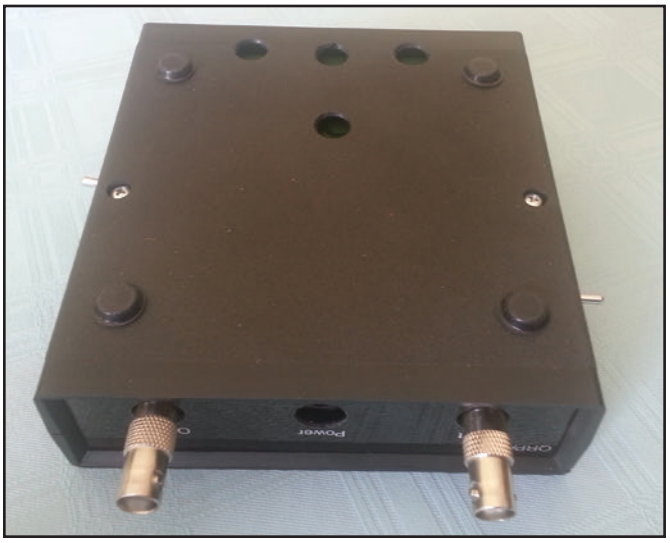


Photo H. *This view of the amplifier's underside shows the coaxial adapters in place.*

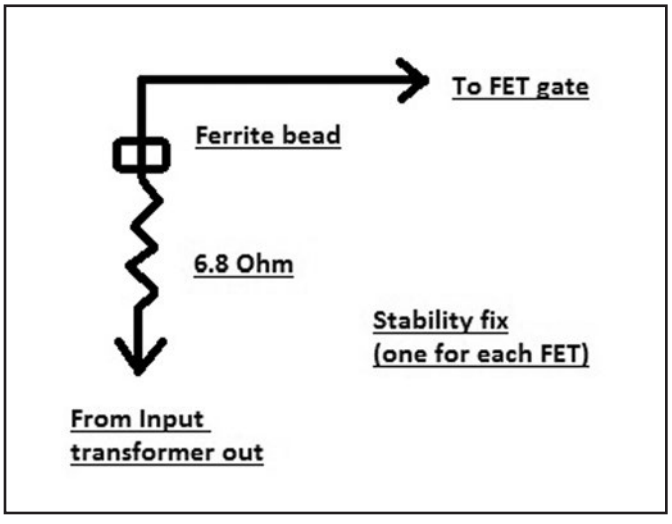


Figure 3. *To improve stability, this simple modification was made for each of the RF output transistors.*

within tolerance. Depending on your QRP rig's output power, a 3-dB pad may be better. It is happiest at 1 to 2 watts drive. I give values for an exact 3-dB pad that gives 1.1:1 SWR to your driver rig in **Figure 5**. The bias pot sets the exact output level, together with this pad. I advise a 12- to 14-watt output for about 6- to 10-dB gain.

4. *Power On Light*: A very easy mod is a pre-wired RadioShack red or green 12-volt LED (with a series resistor included) connected to the switched A+ pin on top of the power switch, to remind you that power is on (saves battery drain when you remember to turn it off in the field). A good spot is seen in the lead photo (**Photo A** in Part I).

I will list the parts needed and some sources at the end of this article, with the steps needed to add in the mods and fixes, which result in a nice and low-cost, little amp when QRP needs a little help.

Detailed Mod Instructions and Hints

While the actual mods are not difficult, working with care, planning and attention to detail are, as always, important. A clean, well-lighted space, a decent soldering iron, and small tools will make the project easier. Read through the manual and this article before you begin. Write in red any changes in instructions into a *copy* of the manual's step-by-step guide to incorporate the mods in the right places. Refer to the photos and drawings in **Figures 6** and **7** and **Photos I**, **J**, and **K** for guidance on layout, wiring and parts placement. Let's get started…

1. First obtain needed materials for the mods.

a. Ramsey can supply the extra toroid cores (IND15, yellow) and caps. The toroids are $0.42 each, plus postage.

b. Note that while the ceramic caps are OK, small silver micas in the *exact* values as shown are better but hard to find. I found that they are sold by Allied, which has the following: 180 pf SM = part #70189491, 330 pf = 70189462, 50 pf = 70190147. Cost about $6 for all three. Also, the ferrite bead, type 43 ferrite, 0.185 dia. is p/n 70154328 at 17 cents.

c. Get white heat sink paste (a few bucks at "the Shack") to put on the FETs (between heat sinks and FET tab).

d. RadioShack or local computer stores will have suitable tiny microprocessor fans and daughter boards.

e. The added 6.8-ohm resistors *may* be found at RS, or at several other distributors.

f. You will need 3 each of 1/2-watt resistors for the PI type input pad. For my situation, two 330-ohm and one 10-ohm (on top) in a pi arrangement did the job. For a 4- or 5-watt exciter, I suggest 180 ohms on the input side, 10-ohm series resistor (on top) and a 330-ohm on the amp side for 3 dB and 53-ohm impedance. I did find these at RadioShack.

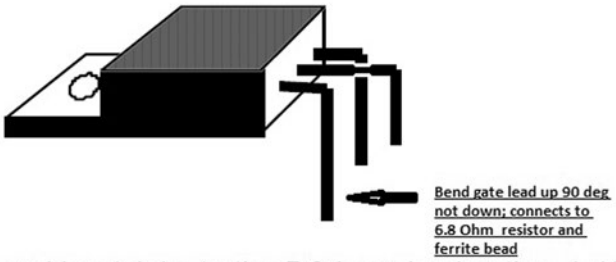
2. Wind the toroids per your kit instruction, for the regular band, but use the turns for the new/second band according to the table below.

3. Mount the harmonic filter caps on the main board per the manual, and the second band parts on the small (about 2x1 inch) daughter board.

4. Make a ground bus of the cap wires and solder on a heavy (# 14 or 16) ground wire from the ground side of the four caps to the main board where the RCA antenna jack is grounded.

5. The board will be supported by a short standoff with an appropriate hole in the daughter board. See the photos. The metal standoff substitutes for one of the main board mounting screws near the left rear. RS has these in several styles.

insertion into the PC board. Bend down the two outside leads about 1/8" from the transistor body and the center lead about 3/16" from the body.



❒ 40. Mount the transistors and heatsinks to the PC board using the 4-40 screws and nuts. Solder all transistor leads. Note that the heatsinks may look slightly different from the ones shown.

Figure 4. *By bending the MOSFET's Gate lead up, the transistor can accept the 6.8-ohm resistor and ferrite bead shown in Figure 3.*

6. Install a small ceramic or quality plastic 1-pin standoff terminal a quarter inch from the T1 hot lead.

7. Lift the hot output wire from T1 (PA output transformer) from the circuit board (at junction of C4 and L1) if you already wired it in, or just connect it to the standoff after it is wound. If "unwiring" any wire from the board, use a solder sucker (non-static type) or solder wick. You will solder this wire to the standoff terminal in step #4 above.

8. Install a 2-position, 2-pole toggle switch *close by* the existing filters (2 inches max). This will be on side of lower case. See photos for guidance on location.

9. Solder armature (center) of pole 1 of switch to the T1 output hot wire at the standoff in step 7.

10. Solder an insulated #16 or #18 wire from one side of pole 1 of the band switch to the junction of C4 and L1 on main board (the original band).

11. Solder a wire from the remaining pole 1 switch terminal to the new filter board input (C4a and L1a junction).

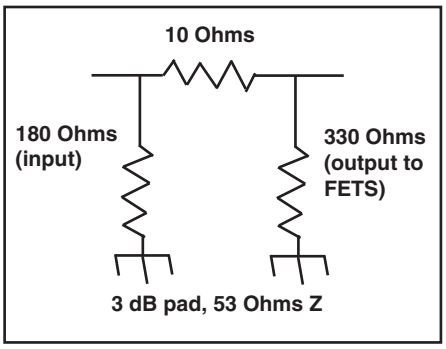


Figure 5. *For a better input match, these values were determined for a 3-dB pad to accommodate drive of more than 2 watts.*

Output from the output transformer can now be switched to the input of each filter. Note which switch position is for which band.

12. The small filter daughter board should now be secured to the main board above the existing filters, on the metal standoff as above, being careful not to short anything. Use your own judgment, as I can't know the details of your particular chosen board.

13. Check all for clearance and shorts.

14. Now the filter output side will be wired.

15. Lift the lead going from the PTT relay out to the junction of L3 and C7 (this means *carefully cutting the printed circuit trace* from the relay to that junction, leaving a 1/16-inch gap). This is so the antenna relay input can be switched between the outputs of the two filters. See the drawing in **Figure 7** showing this cut.

16. One side of the band switch's Pole 2 goes to the original filter output at the L3 and C7 junction. Be sure it matches the Pole 1 wiring so the original band is connected at both ends! The center/armature of Pole 2 goes to the antenna PTT relay trace from which the old filter was just disconnected. A tiny

Photo I*. This photograph shows the new heat sinks installed and the ferrite bead-resistor combinations added to the gate of each of the RF output transistors, as shown in* ***Figure 3*** *and* ***4****.*

Daughter Board/2nd Output Filter Values

Choose from the following table to select values for the band to be added:

Part #	40 Meters	30 Meters	20 Meters
C4	330 pF	330 pF	180 pF
C5	560 pF	560 pF	330 pF
C6	560 pF	560 pF	330 pF
C7	330 pF	330 pF	180 pF
L1	19 T	15 T	12 T
L2	22 T	16 T	14 T
L3	19 T	15 T	12 T

Note: These values are taken from the Ramsey manuals. However, the 40-meter caps in the manual were possibly reversed through a typo and are corrected here. This is based on standard filter designs and calculations. Ramsey engineering has been advised.

hole for the wire must be drilled in the trace near the relay. RadioShack has a neat set of printed circuit board size mini-drills that works well for this.

17. The last connection goes to the new filter output at the junction of L3a and C7a.

18. Check wiring, shorts, etc. and see that the switch connects the old filter in one position and the new one in the other, and that you did not crisscross them.

19. Label the switch for the bands you choose.

20. This completes the dual band portion of the mods.

21. Stability fix:

a. *Before* soldering in the FETS, lift the gate lead of each FET *up* carefully, and only once (they don't bend back and forth without breaking).

b. Where the lead would have gone, solder in a 6.8-ohm resistor (as much as 9.1 ohms will work if you can't find a 6.8). It goes in vertically.

c. Slip a small ferrite bead (type 43) over the upper lead of each resistor, then tie/solder the lead above the bead to the FET gate lead and neatly trim the leads.

22. Impedance fix:

a. When winding the input transformer (the smaller one), reduce the turns indicated by two.

b. Make a triangle of a 10-ohm and two 330-ohm 1/2-watt resistors. If using more than 2 watts drive, use the 3-dB values in the table. The bottom end of the two 330-ohm resistors are wrapped and soldered together, with one lead cut short and the other longer to connect to ground. The 10-ohm goes across the other ends, leaving the leads long. The 330/10/330 set gives 2.5 dB at 60 ohms in.

c. Solder the lead from one side of the 10 ohm to the hole in the PC board where the hot lead of the transformer input would have gone.

d. The other end goes to the lead from the transformer (the other lead of the transformer is connected to ground). Solder the bottom of the triangle to ground by the transformer. This is a Pi pad, but as both 330-ohm resistors (or the 180 and 330 for the 3-dB version) are grounded, it looks like a triangle.

23. LED light:

a. Select a red or green LED light with integral mount and resistor for 12-volt DC. RadioShack and other outlets have these.

b. Drill a small matching hole just to the left of the power switch.

c. Mount the LED, trim the leads and connect the + lead to the switched lead upper 12-volt pin of the power switch; the negative lead goes to any nearby ground. It is correct when it lights when power is on. This is a good place to get +12 volts for the fan too. The fan will run whenever power is on. If you are super concerned about battery drain, it is a low-power device.

24. Check all wiring, using a VOM to check shorts and continuity. Then, with the power cable connected, check voltages and see that the LED and fan are operating when switched on.

25. Heat Fix:

a. First cut a small hole (1.5 to 2 inches, depending upon the fan you buy) in the top case, over the FETs. If you don't have a hole-cutter, measure the inside opening of the fan and draw a circle that size above the two FETs. Of course, the top and bottom halves of the case must be removed from the board before drilling! Be sure you check locations — twice — and mark with tape what is front, top, left, etc. of covers. Then *you* won't have an extra hole like my "carefully engineered" extra vent hole!

b. Drill a series of small holes

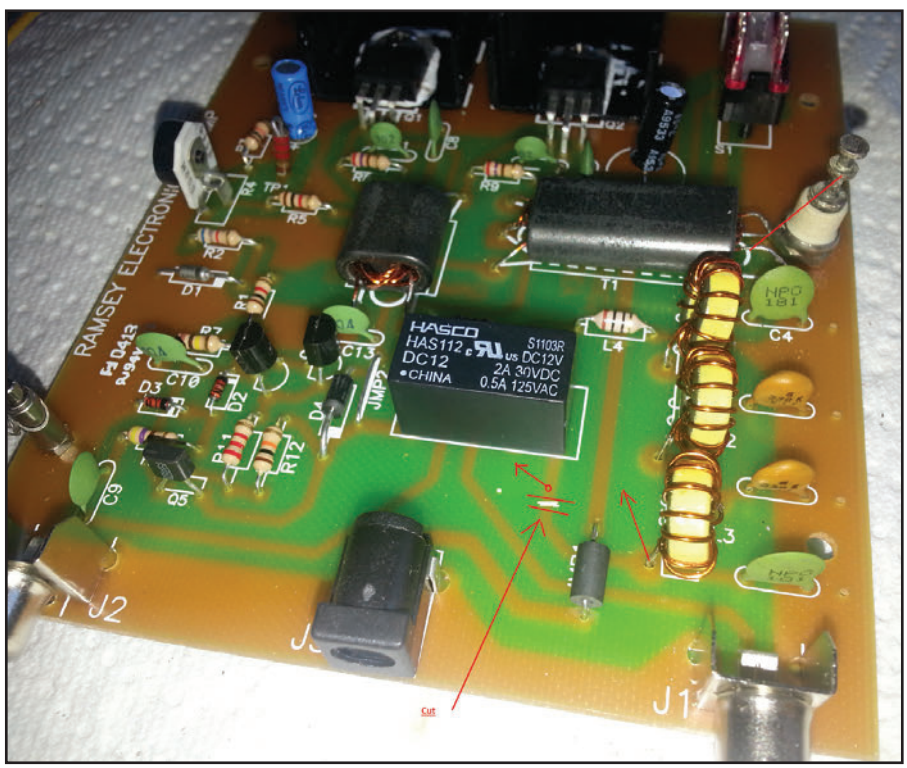


Photo J. *Red arrows point the way to make modifications to the printed circuit board and where wiring is needed for two-band operation.*

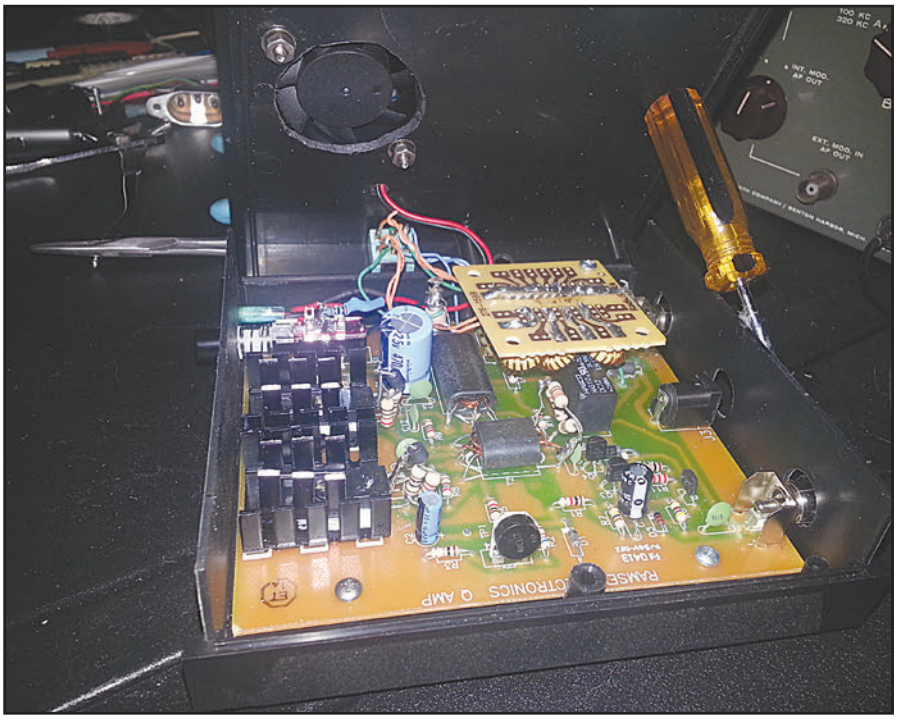


Photo K. *Here is the Ramsey RF Amplifier board, complete with modifications for two-band flexibility, comfortable drive levels and cool and collected final RF transistors operation.*

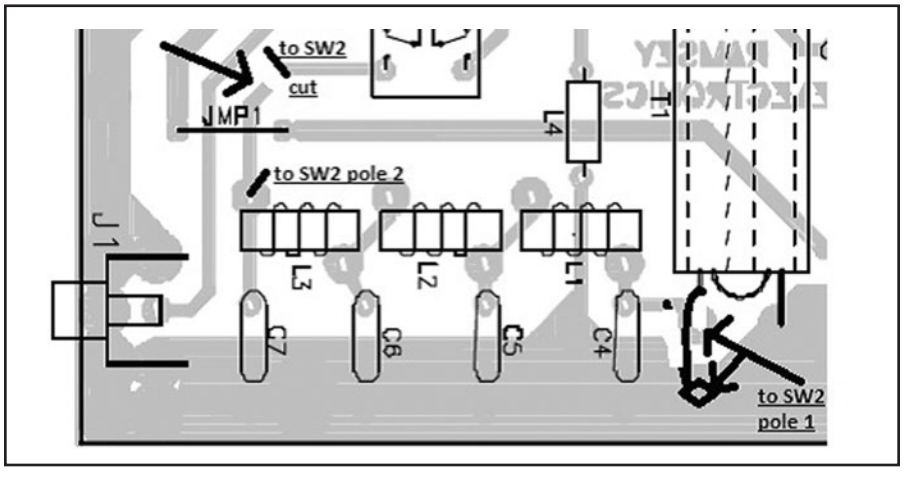


Figure 7. *Modifications are shown in the upper left and lower right of the PC board layout.*

Contacts and Links:

Ramsey Electronics® Customer Service Representative
590 Fishers Station Drive
Victor, NY 14564
phone: (800) 446-2295
e-mail: <col@ramseyelectronics.com>
Web: <http://www.ramseyelectronics.com>

Allied Electronics
<http://www.alliedelec.com>

RadioShack
<http://www.radioshack.com>
Red LED panel Mt for 12 VDC: Model: 276-270(A) Catalog # 276-270

Why Not Three Bands?

Why not three bands, you ask. That, too, is achievable, but not yet tried. If it can fit in the case, it is a workable idea. A larger case is highly recommended should this be attempted. RadioShack and others have small metal cases that can make mods and add-ons easier, with more room. Experiment! Values are given in the table for three band choices. Of course, a 3-position switch would be needed, and lead dressing must be done carefully, with short insulated leads. Keep the expanded daughter board close to the existing output filter. The ground leads to the main board ground need to be kept short; flat tinned ribbon is best.

around the *inside* of the circle. Using a small sharp knife, cut through the holes and smooth the edge with a round file.

c. Place fan over hole and mark screw holes with a sharp pin, then drill the screw holes. Add one more for the red and black power leads, toward the left front. The leads should be twisted together and long enough to reach the front switch with an inch or so of slack. *(**NOTE:** if this were a larger case/project I would have added a second miniature relay to the RF detector to operate the fan only when the key is down, but there is no room here. I did put a small resistor in series with the fan to slightly reduce the current drain. Not essential, but give it a try if you like. You are looking for a slight reduction in speed, but the resistor depends on the model of fan. Less than 18 ohms for sure.)*

d. Solder the black lead to ground near the front, and the red lead to the switched A+. Use care so as not to melt the switch body!

e. Drill 3 or 4 holes in the bottom of the case; about 3/8 inch to dime size. Refer to **Photo G** again.

f. Reassemble case.

26. Apply power. Watch with scope, wattmeter or at least an SWR meter to dummy load or 50 ohm antenna and see that no RF is produced without drive and that RF output drops to zero when drive is removed.

27. Attach your QRP rig and check for output on each band. Adjust bias pot, per the manual, to set output to about 12 watts on your favorite band (of the two). The other band may be different, so pick a midpoint, say 14 watts on 40 meters and 12 watts on 20. Read the manual for operating advice.

28. Enjoy.