DEM ABPM KIT
All Band Power Meter

Assembly Notes and Pictures

Paul Wade W1GHZ   w1ghz@arrl.net

Down East Microwave has kindly agreed to make kits available for my All Band Power Meter (Note: I receive no remuneration from these kits – I'm just happy that DEMI makes them available). The assembly instructions are good, but photographs can help to clarify things, so I put together a kit from DEMI, taking pictures and notes along the way. These are intended to supplement the assembly instructions.

Step one of the assembly is the tricky bit – parts that work at 10 GHz are small! Once you get U1 installed, there are a handful of surface-mount components, then the rest are ordinary components with leads to stick through the holes and solder.

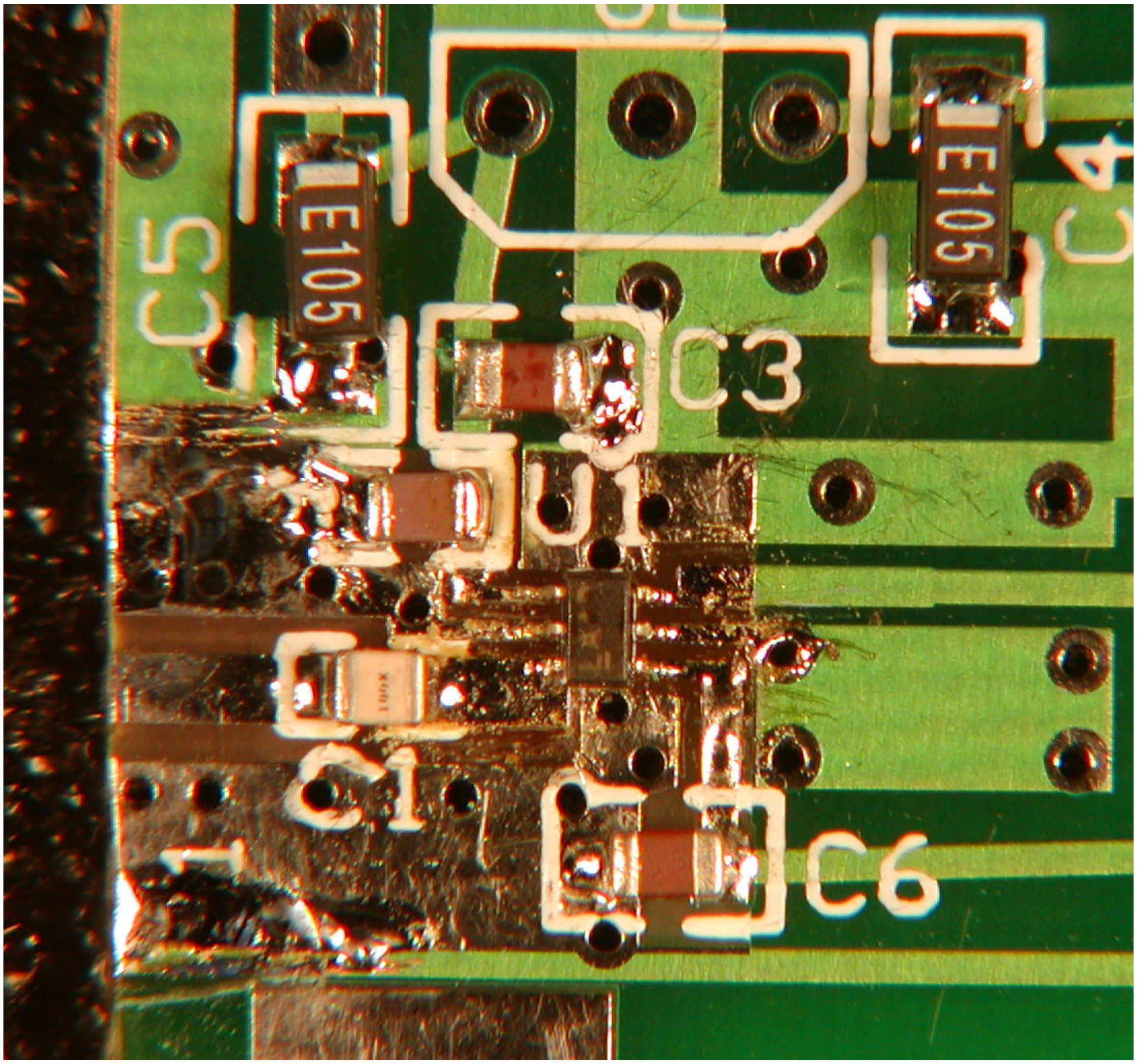
For U1 and the other surface-mount components, use a magnifying lens or microscope and a pair of tweezers. A temperature-controlled soldering iron with a fine tip is recommended, and the solder should be small diameter – I use 0.022" diameter no-clean solder, like Multicore X39B.

Before any assembly, slip the two coax connectors in place and look where the grounding legs will be soldered. I left the green soldermask too close around them, so scrape it away with your X-Acto knife so that clean copper is available for soldering, then tin it lightly.

Here is how I install U1: first I put a miniscule amount of flux in the PCB pads, by dipping the lead of a ¼ watt resistor in rosin paste flux (Kester SP-44), the touching the pads with that lead. Then I wet the pad connected to the input connecter (U1 pin6) with a tiny dab of solder. I hold U1 (triple-check orientation) in place with the tweezers and reflow the solder on that pad so that pin 6 is soldered in place. If the leads don't all line up, I reflow again and shift the part until they do. [An alternative here is to put a tiny dab of temporary adhesive, like Blu-tac or Elmer's Tac 'N Stick, under the part to hold it while soldering.] Once the part is in place with the leads aligned, I solder the leads one at a time by putting the iron on the PCB pad next to the lead, then touch the iron with solder and let it flow up the pad onto the lead. If it won't flow or I bridge two leads, then I come back after all the leads are done once and put solder-wick across all three leads on one side of the part and heat the solder-wick with the iron. The flux in the solder-wick will cause the solder to flow properly, and any excess solder will be soaked up by the solder-wick. I've never had a bad assembly using this technique, but it leaves a lot of flux residue to clean off.

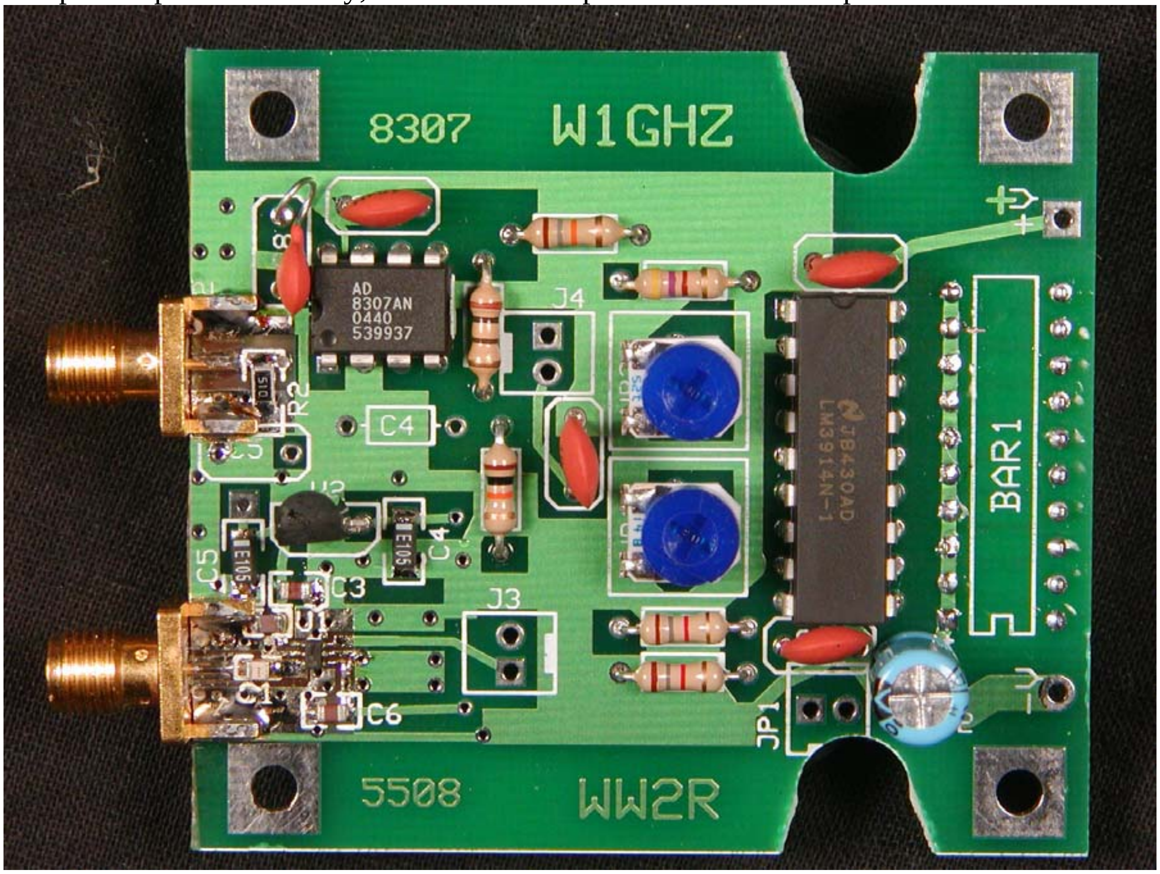
At this point, you are either saying: “Sounds like I could do that” or “No way.” If you find task daunting, enlist a friend or give Steve a call.

From here it gets easier. Step two, install the rest of the topside surface mount components, using the above techniques, but these parts only have two, much bigger, leads. It should look something like this:

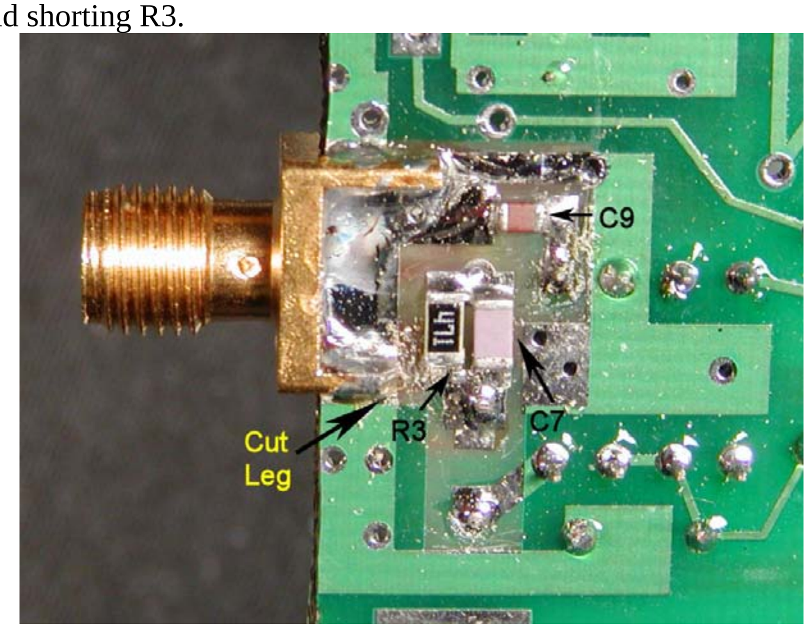


Step three, install U2 through U4. Read the note again about the screening for U2 being backwards – my fault. Make sure you get U3 and U4 correctly aligned also. If you solder one in backwards, you’ll have to cut the leads off, pull them out one-by-one, clean the holes, and call Steve for a replacement. I’ve never had a problem with U1, but did get U4 backwards once.

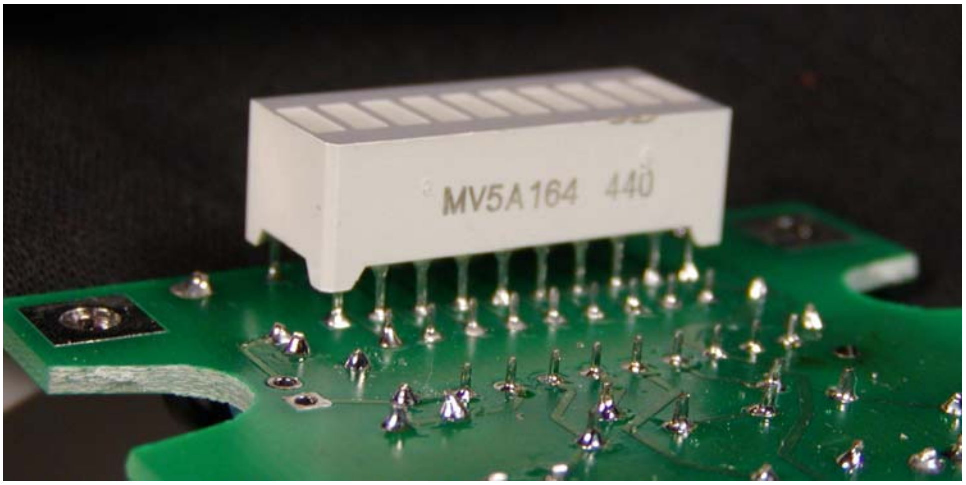
Step four, install C8 with a loop in the lead for L1. You can see it in this picture of the complete top-side assembly, with all the components added in step five.



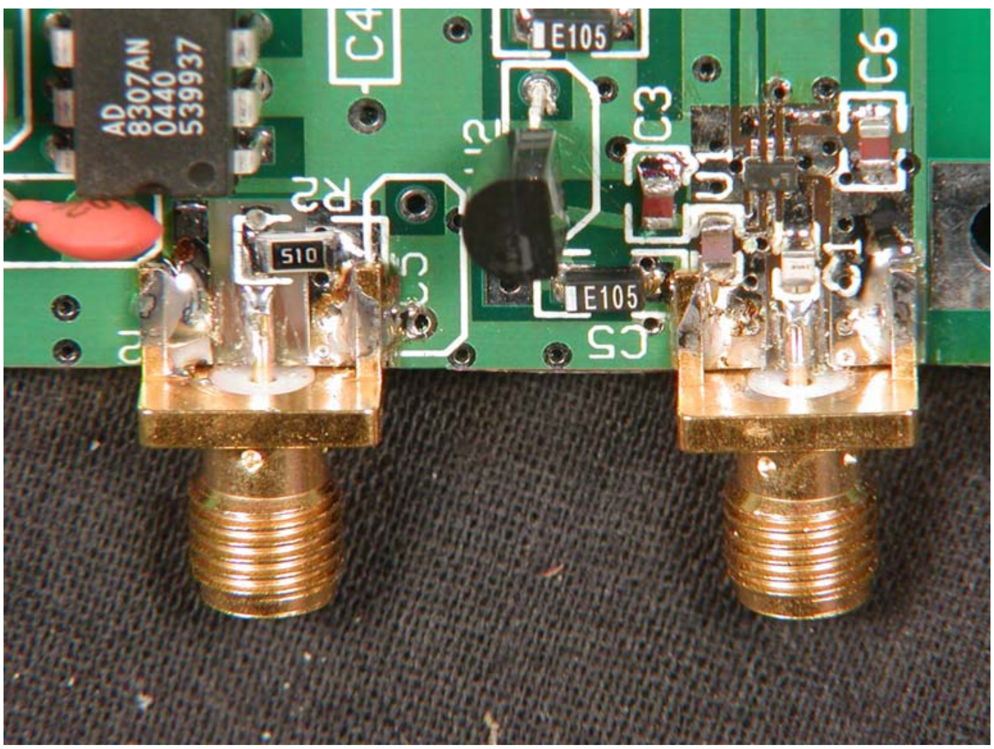
Step six, install the bottom side surface mount components. Since there is no silkscreen on the bottom to guide placement, I've added the designators to this photo. The photo also shows the SMA connector in place, pointing out one grounding lug that must be cut down to avoid shorting R3.



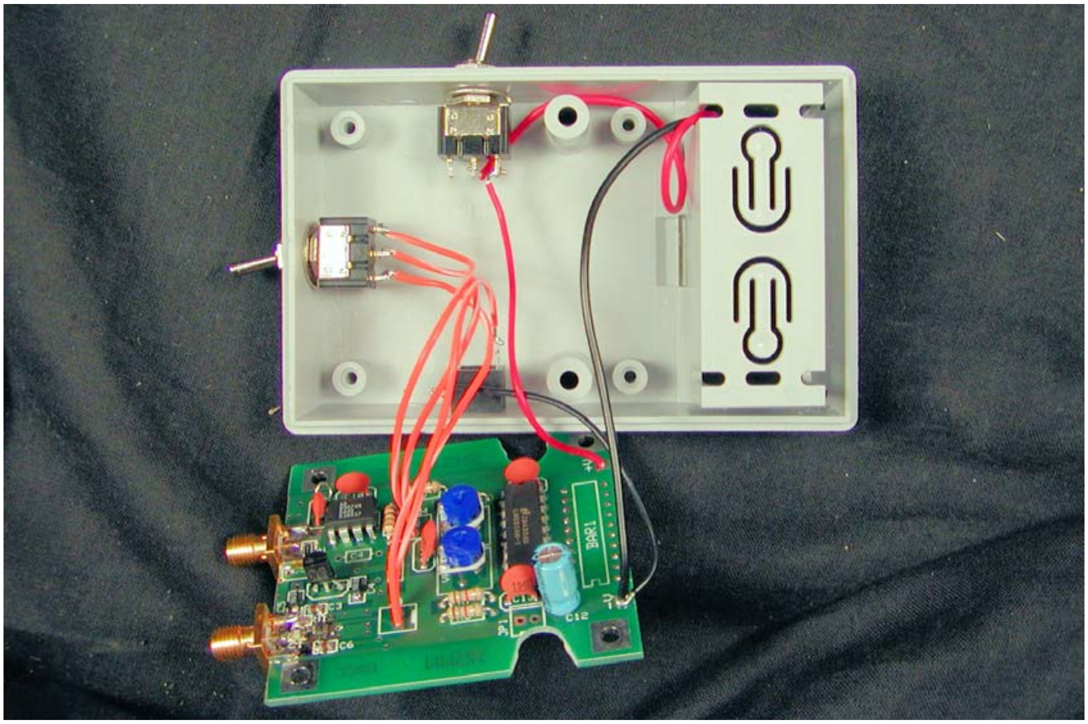
Step seven, install bar graph on bottom side, but don't solder yet. Make sure the pin 1 chamfer is at the proper end, then slip the board into the top half of the plastic case. The bar graph will sit recessed in the cutout. If you want it to sit higher, nearly flush with the case, the leads must be pushed back into the board so it sits higher than the standoffs, as shown in this picture:



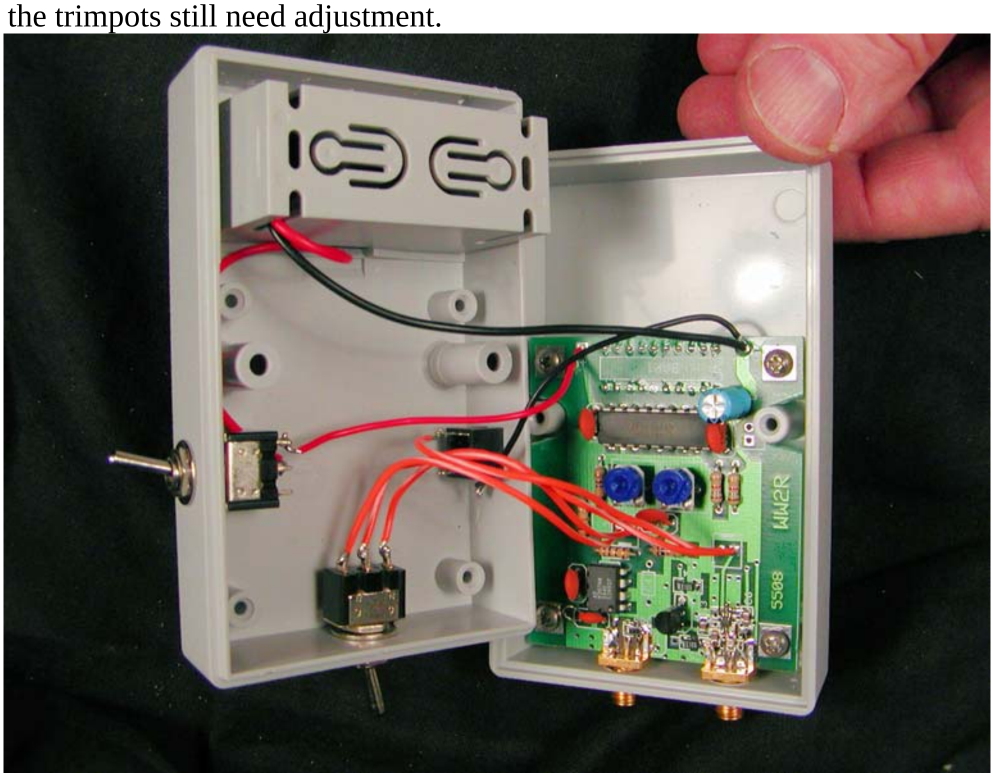
Step eight, fit, trim, and solder the SMA connectors. This photo shows them on topside, and the step six photo shows the bottom side of the VHF connector.



Enclosure assembly: the completed board photo is shown in step four above. Wires are added according to the Wire Assembly Table, ending up with the board wired to the bottom half of the enclosure like this:

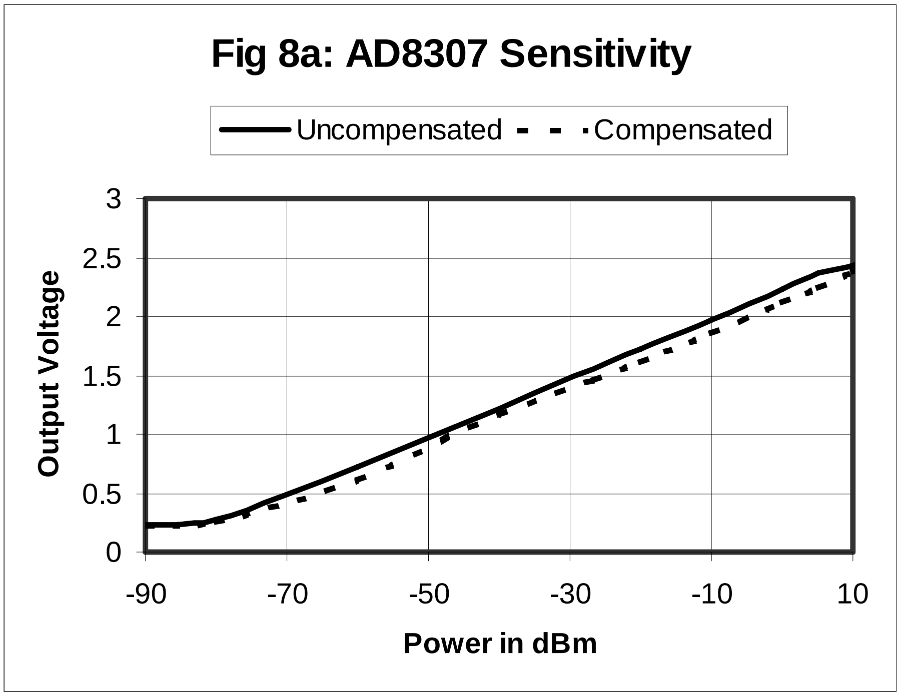


Finally, slip the board into the top half of the enclosure and screw it down. It might look like this last photo. Put the enclosure together, but hold it together with a rubber band for now – the trimpots still need adjustment.

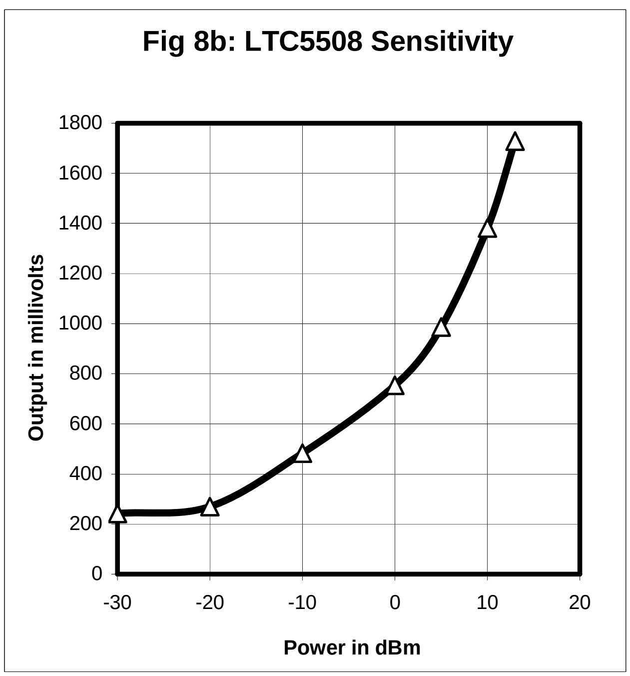


<u>Calibration</u> **(from my previous paper)**

The frequency response of these detector chips is not flat; there is some variation with frequency, so any fine calibration must be at specific frequencies. For most purposes, however, relative calibration within a few dB will suffice.



The two detectors have different sensitivity curves, shown in Figure 8. The AD8307 output is a straight line from about –70 dBm to about +5 dBm, a much greater dynamic range than any commercial power meter.



The straight line response of the AD8307 means that we can read power differences directly, at 25 millivolts per dB. The LTC5508 does not have a linear response, nor is it as sensitive, with a useful range of around –20 dBm to about +13 dBm, comparable to an HP432 meter. So we have a combination of great sensitivity on the lower-frequency side and great frequency response on the higher-frequency side.

The bar graph indicator is handy as a quick, no thinking required, indicator. Many times, that's all you need. Since the sensitivity curves in Figure 8 are so different, some compromise is required for the LED bar graph to make sense for both detectors. The output of the AD8307 may be loaded down, by R5 in the schematic to adjust the slope of the response. I found that an 18K resistor gave similar full-scale readings for both detectors. I set the "ZERO" pot (VR2) so that the first bar on the high-frequency side is lit*, to provide a free pilot light, and set the "FULL SCALE" pot (VR1) to light at +10 dBm. Then I measured the response of both sides at 144 MHz, shown in this Table:

BARS	Low Frequency	High Frequency
1	-70 dBm	—
2	-59	-15 dBm
3	-51	-10
4	-43	-5
5	-35	0
6	-26	+3
7	-18	+6
8	-10	+7
9	-2	+9
10	+5	+10

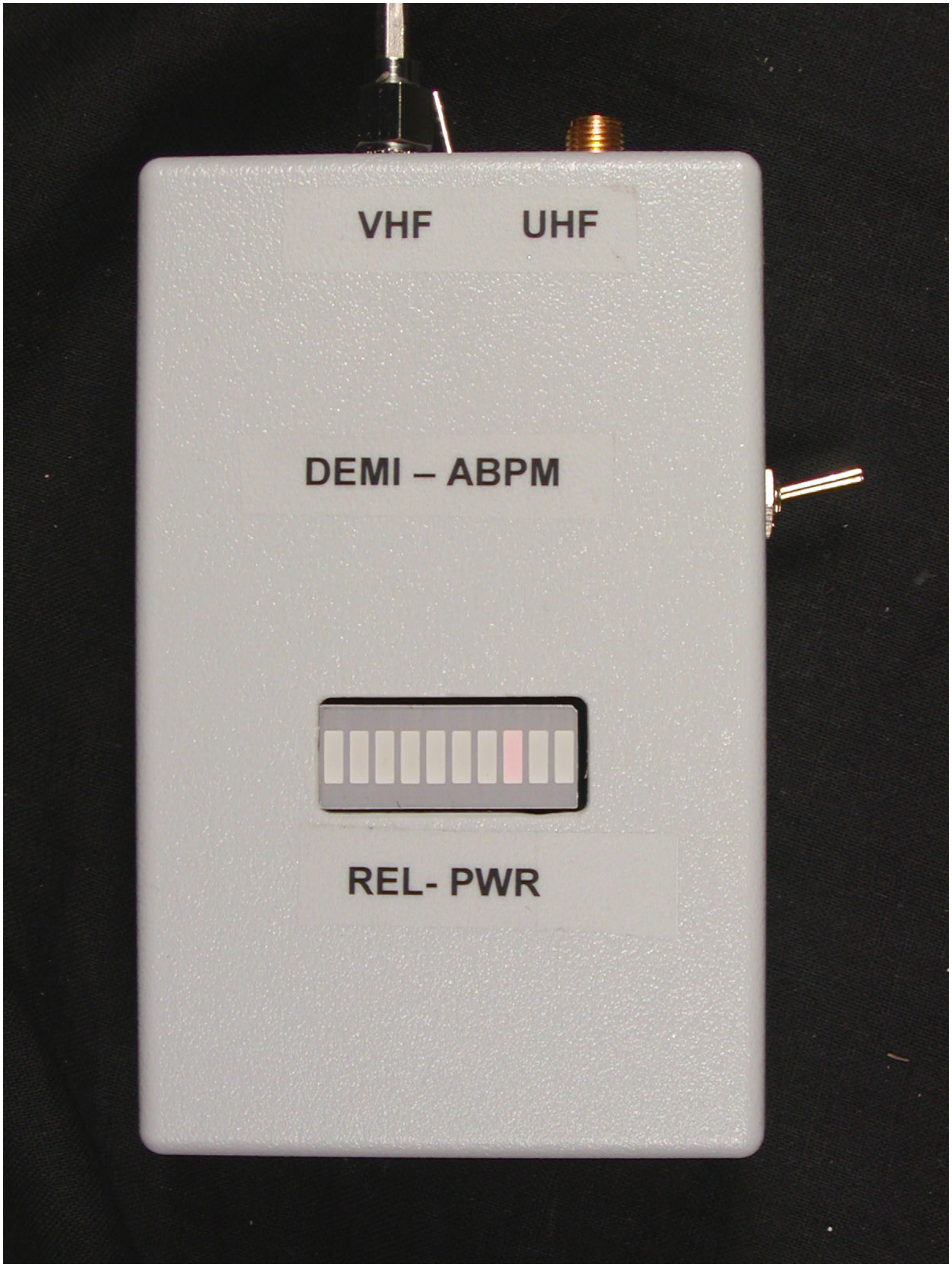
Of course, you are free to adjust the calibration pots however you choose.

The LED indicator may be operated as a bargraph or as a series of dots, with only one LED on at time. Since each LED draws about 20 mA., battery life will be much longer in dot mode. The mode is selected by a jumper, J4, on the board.

When you are satisfied with the adjusments, screw the case together and apply the labels. Then put it to work. One amusing test is how much power leaks through the closed door of a microwave oven.

* In the kit unit, I had to change R6 to 100 ohms to get the first bar to light with no signal.

One final option: if you would prefer higher sensitivity but don't need the full frequency range, an LTC5534 may be substituted at U1. This will provide roughly 60 dB of range, but only up to about 3.5 GHz.


VHF
UHF
DEMI – ABPM
REL- PWR