A Sensitive Field Strength Meter for Fox Hunting

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In 2001, an article appeared in QST that introduced me to a nifty integrated circuit from Analog Devices. Their AD8307 is an eight pin DIP that does wonders. Basically, it is a logarithmic amplifier/detector that works from DC to 500 MHz. It produces a dc output proportional to the logarithm of RF power input (to a 50 ohm load). With a little circuitry, it can be connected to a (calibrated) meter to make a decent log power meter. With over 80 dB of range, it seems to work as well as my old lab-grade power meter.

FYI: zero dBm is one milliwatt into a 50 ohm load. For example, -10 dBm would be 10 dB down from one milliwatt - or - 0.001 milliwatts.

The meter I built has a digital readout and works into the –80 dBm range. The maximum input level (across 50 ohms) is +12 dBm, *near* 15 mw (mental math ;).

The QST article, "Simple RF Power Measurement" by Les, W7ZOI and Bob, W7PUA, can be found (by ARRL members) at:

http://www.arrl.org/members-only/tis/info/pdf/0106038.pdf

My article is not really about the above power meter, but a very similar unit. To be safe, I purchased two AD8307 chips (just in case!) The first build of the power meter (above) worked and the spare chip has been languishing in the junque boxe since. With talk of "fox hunts" in the future, I decided to put the spare chip to work. It can be the heart of a very simple, yet very sophisticated field strength meter (FSM). My digital meter would have worked, but trends on digital readouts are hard to follow compared to an analog meter. Besides, I had to do something with that chip!

The FSM alone, would never replace a "real" receiver in a fox hunt, but could be a useful tool to have. I have been in a number of fox hunts over the years where I was very close to the hidden transmitter, but could not find it. In spite of good attenuators, the poorly shielded HT receiver would saturate. There is no way to get a fix on the transmitter when this happens. Extra shielding around the HT can help, but is not very convenient and often the shielding is not good enough. That is where a sensitive, wide dynamic range, field strength meter can take over.

A caveat. Be aware that the FSM "front end" is wide open. Though not quite flat (unlike the frequency compensated digital power meter), it provides no selectivity. Any RF energy will register, up to about 500 MHz. This can be a plus when used as a general purpose FSM, but could be a bit confusing when used for fox hunting. Signals other than the hidden transmitter may come and go. A narrow bandwidth antenna will provide some selectivity and you could always put a bandpass filter between the antenna and the

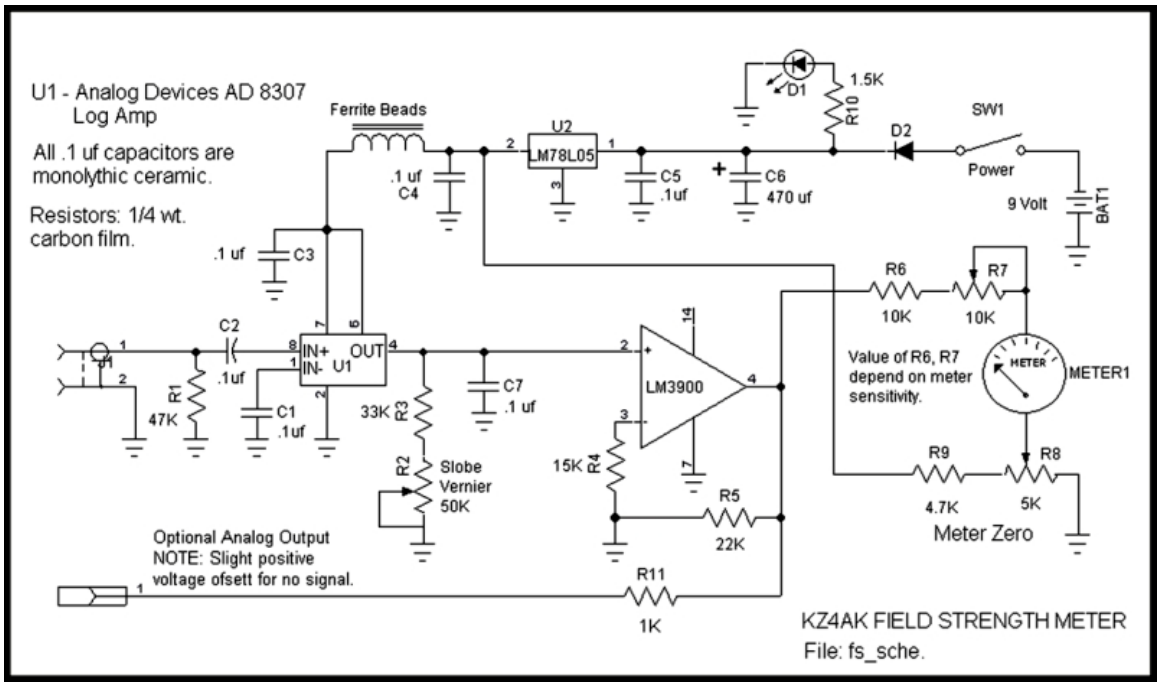
FSM A bandpass filter can be built with only some wire, a few 15 pf variable capacitors (for VHF), a pair of connectors (RCA/BNC/etc.), and a little circuit board. The F.S.M. can even be used to tune-up the filter! Perhaps I can detail this in a later article.

To the right is a picture of my finished FSM. My junque boxe meter happens to be scaled 0-40. With a VHF 'duckie" connected to the rear BNC connector, stray RF around the house registers from 0 to about 3 (with no known transmitters running). It finally reaches full scale with a few watts (2M) just a few feet away. For another point of reference, using a 6" wire in the BNC, a FRS walkie-talkie (0.5 wt/UHF/duckie) will produce over half scale at 40 feet. I can't see the meter beyond that ;)

For a bit more sensitivity, I did not put a 50 ohm termination resistor in the box, at the AD8307. With no termination resistor, the input is 1-2 K ohms. If I want a 50 ohm termination, I add it externally using a BNC "tee" adapter and a BNC 50 ohm terminator. This setup can be seen at the left of the digital power meter picture. Unlike the digital power meter, there is a short run of coax to the chip. If the coax is not properly terminated, the length may affect readings. My coax is short and seems to work fine.

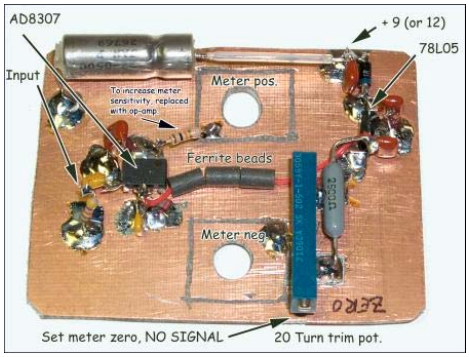
I used a surplus meter, reworking the meter face. (Yet another article? Let me know if you are interested.) The circuit is built on unetched pc board, "dead bug" style. With the right meter (50 microamp) you may not have to use the op-amp buffer, just the right series resistor. The AD8307 output ranges from about +0.2 volts for no signal, to about 2.5 volts at full output. The effective output resistance is 12.5K ohms. My meter was a little current hungry and I used the buffer. With the buffer amp shown, full scale output from the AD8307 will drive the amp output to about 6 volts.

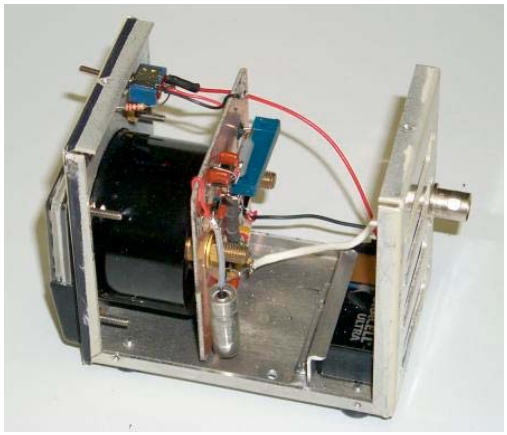
Here is the circuit. R1 is not needed except as a tie point for my construction. For



operation up to UHF, use small monolithic ceramic capacitors and keep all leads very short. Some parts are less critical. Almost any 5 volt regulator can be used. Also, any op-amp with similar characteristics to the LM3900 (rail-rail/single supply) can be substituted. Diode, D2, is a 1N4000, or 1N4001, etc. and serves as reverse battery protection. The LED (D1) and current limiting resistor, R10, remind me the unit is "on" and are mounted to a strip of circuit board held in place by the power switch. Nine volts is supplied by battery and the current drain is about 30 ma total.

My "dead bug" board is at the right. Using a Dremel Tool, isolated pads were cut where the meter studs attach. The buffer amp was added later using a separate board that can be seen in the partial assembly picture below. It is possible to use a conventional (270° carbon) potentiometer in place of the 20 turn precision unit, but ease of setting and stability may suffer.





My recycled homebrew case is not very RF tight and could register output (in very strong fields) that does not originate at the connector – leakage. To minimize this, I plan to build a circuit board shield around the AD8307 circuit.

The almost compete FSU is to the left. The picture, below right, is after the buffer amp board was added. The only reason it is not on the main board is I had already partially assembled the FSU and did not want to undo what was together already.