Doug Demaw, W1FB

Build an Active Antenna

You have heard many times the term "active antenna." Perhaps you have wondered "exactly what is this antenna and how might it be used?"

Let's start by defining the word "active." This does not suggest physical activity on the part of an electronic device. Rather, it tells us that the circuit is active in terms of voltage and current. A passive device, on the other hand, is a circuit that requires no operating voltage. It will exhibit some power loss as a signal is passed through it. Examples of passive devices are diode mixers, filters that use inductance and capacitance (LC filters) and all manner of wire antennas, etc.

An active mixer, on the other hand, uses a transistor or an IC, and operating voltage is applied to it. The mixer draws current and can cause a signal increase from the input to the output terminals. This is known as "conversion gain." Active antennas contain RF amplifiers that require an operating voltage. Some active circuits may be designed to provide gain, while others may have unity gain (1) or a negative gain (signal loss). The nature of the active circuit depends upon its particular application.

Filters may be made active or passive. An active filter is often used to increase receiver selectivity at audio frequencies. This type of filter has no coils or inductors. Instead, it uses resistors, capacitors and ICs. An active filter may be designed for unity gain, or it may have a gain of 2 or 3, typically.

Active Antennas

What is an active antenna and why might we wish to build one? Active antennas are physically short, and they cover a wide spectrum of frequency. For example, an active antenna may perform uniformly from, say, 550 kHz to 50 MHz if it is designed well. This means that no antenna tuning or matching circuits are needed.

This type of antenna would be quite lossy if it did not include an RF amplifier section. In other words, if you connected a 6-foot whip antenna to your SW receiver and measured a 6.7-MHz signal at S3, that same signal might register 10 dB over S9 on your S meter if you switched to a full size dipole that was cut for 6.7 MHz. However, if we add an RF amplifier to the 6-foot whip before the signal is routed to the receiver, the S meter will indicate a similar reading to that when the dipole is used.

Why Use an Active Antenna?

Active antennas provide an alternative to no antenna at all if you are an apartment dweller or live in an urban area where external antennas are prohibited. These small active antennas are desirable for those who conduct business travel and find it necessary to stay in hotels or motels while on the road. The SWL need not be without an antenna if he is willing to build an active one.

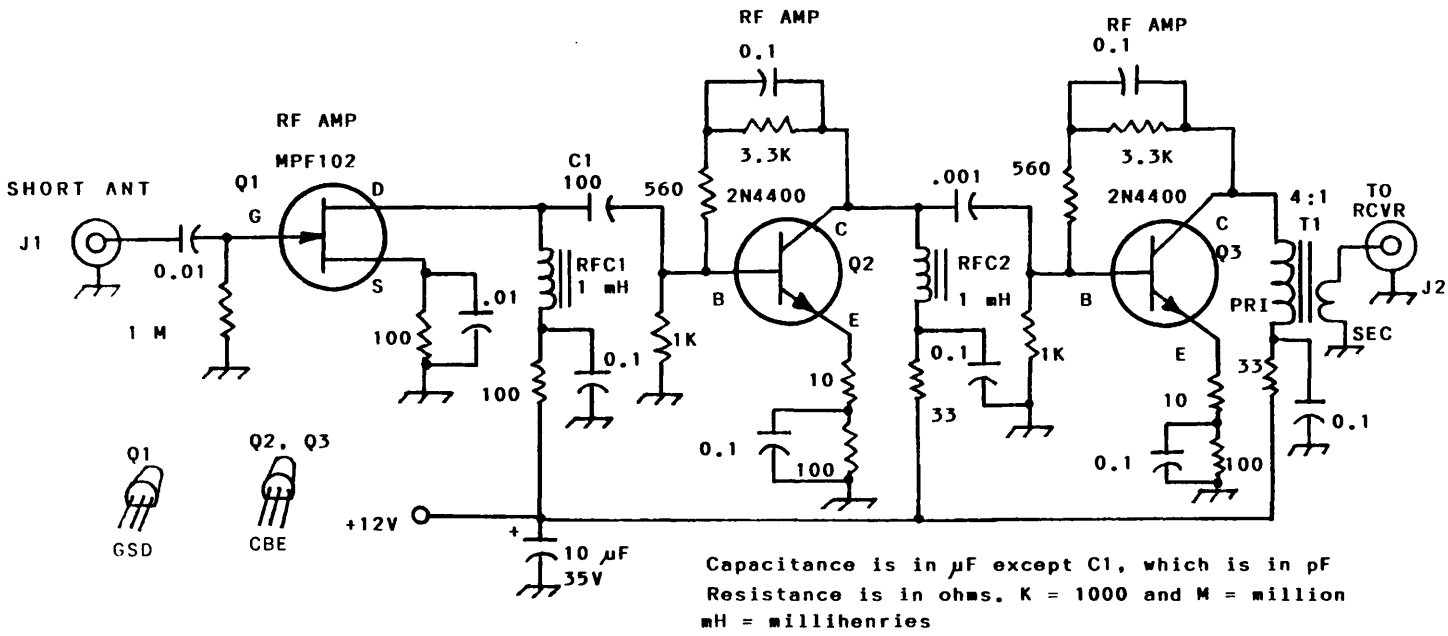

Figure 1: Schematic diagram of the active antenna amplifier. Capacitors without polarity marked are disc ceramic, 50 volts or greater. Resistors are 1/4 watt carbon composition or carbon film. RFC 1 and RFC 2 are miniature iron-core RF chokes (see text). Jl and J2 are jacks of the builder's choice. Tl has 12 turns of no. 26 enam. wire (primary winding) on an Amidon Assoc. or FairRite FT-50-43 ferrite toroid core (850 mu). The secondary winding has six turns of no. 26 enam. wire wound uniformly over the primary winding. Overall amplifier gain is approx. 30 dB.

A Simple but Practical Active Antenna

Figure 1 contains a schematic diagram for an active antenna. The parts are inexpensive and easy to obtain. You can tack this circuit together in an evening. It may be constructed on a piece of perf board or a breadboard of your choice. The leads should be kept as short as practicable in order to ensure wide frequency coverage and the prevention of unwanted self-oscillations.

Q1 is a junction field-effect transistor (JFET). It has an input impedance of 1 megohm when wired as shown. This is an ideal situation when we attach a short antenna at J1. You may use a long telescoping whip antenna, or a short hank of wire may be used. Any length from 6 to 10 feet is okay. Longer pieces of wire may be desirable for reception below 20 MHz. Don't be afraid to experiment.

Q2 further amplifies the incoming signal (10 dB) and Q3 performs the same function, adding another 10 dB of gain. The gain of Q2 and Q3 may be as great as 15 dB per stage, depending upon the beta of the particular transistor plugged into the circuit. Q2 and Q3 operate as linear broadband amplifiers that use shunt and degenerative feedback. These two stages can be replaced by a single CA3028A or MC1350P IC, should you wish to do your own thing.

The output of Q3 is approximately 200 ohms. A 4:1 broadband step-down transformer (T1) converts the 200-ohm output to 50 ohms. This makes it suitable for use with most shortwave and amateur receivers.

Although the circuit calls for a 12-V power supply, it will work well at 9V, should you wish to use a battery. Total current drain is on the order of 13 mA at 12 V, and it drops to 8 mA when the supply voltage is lowered to 9.

This circuit works well from 1.6 to 35 MHz. Operation at lower frequencies may be had by changing RCF1 and RFC2 to 10-mH units.

Using the Active Antenna

Connect a short antenna at J1. Vertical polarization will result if the wire or whip is vertical. Moving the antenna to a horizontal position will favor horizontally polarized signals. Be sure to experiment with the orientation of the antenna when monitoring different bands.

In an ideal situation the active antenna and its electronics would be located out of doors (on a balcony, deck or whatever). This will keep it away from electrical house wiring and steel frameworks if you live in an apartment. These man-made objects not only absorb signals but they may radiate noise. You may use RG-58 coaxial cable between the active antenna (T1) and your receiver. Any convenient length is suitable.

If you live near a powerful commercial broadcast station, a CBer with illegal power or an amateur radio station, you may find that the active antenna will overload and cause spurious signals across the tuning range of your receiver. This is a price that must be paid when a broadband circuit is used. Tuned circuits create needed selectivity for eliminating interference from nearby stations with strong signals. Active antennas do not contain tuned circuits.

Build the circuit in a metal box so that it is shielded. You should route the circuit ground to the metal box and ground the box to a cold water pipe or an earth ground. This is not an essential action on your part, but it will help to improve the active antenna's overall performance.

You may substitute 2N4416 FETs for the MPF102 shown at Q1 of Figure 1. Similarly, you may use 2N4400, 2N4401 or 2N5179 transistors at Q2 and Q3. The 1-mH RF chokes are available from Oak Hills Electronics in Big Rapids, MI 49307 or from Mouser Electronics in TX. The core for T1 is available from Amidon Assoc., Inc., 2216 E. Gladwick St., Dominguez Hills, CA 90220. Catalogs are available from all three companies.

MT

Itching to Write?

Any hobbyist with some enthusiasm and experience, has something to share. Write the Editor, P.O. Box 98, Brasstown, NC 28902.