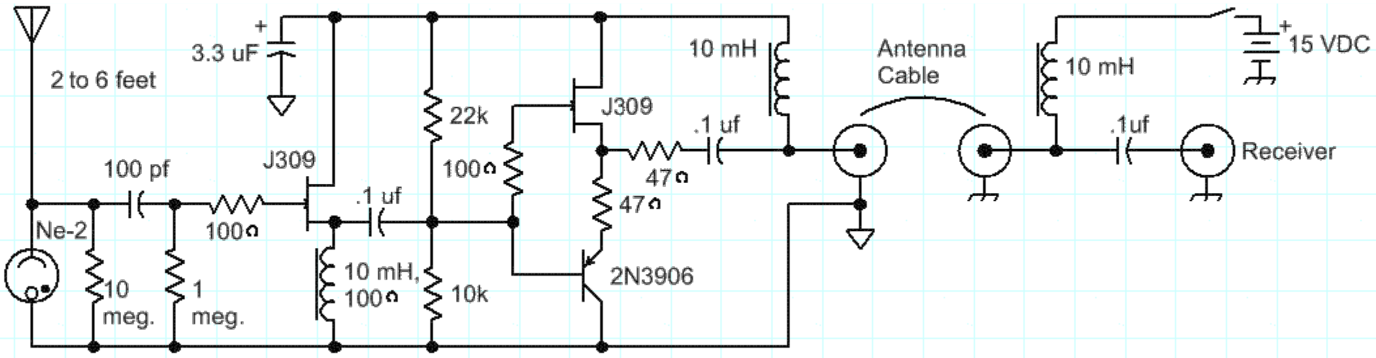


Figure 8: Improved Antenna Buffer.

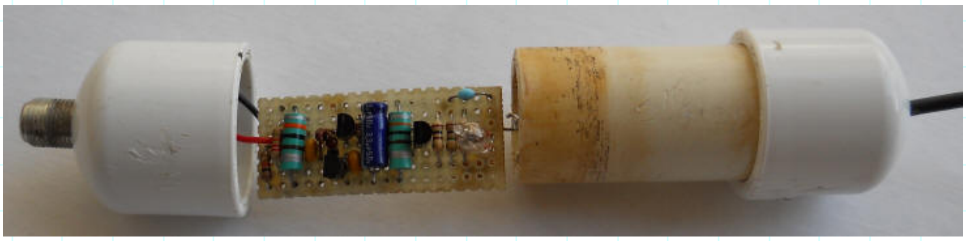
This active antenna buffers an electrically short antenna to give a useful frequency response from a few kHz to over 30 MHz and is usable well over 100 MHz. The circuit is located right at the short antenna and it properly drives coaxial cable. Output resistance was chosen for reasonable VSWR with both 50 and 75 ohm cable. But make sure to terminate the cable at the receiver with the cable's characteristic resistance.

The first 10 mH inductor used in the prototype has about 100 ohms of resistance and that resistance is important in the source of the first J309. If you inductors are significantly lower in resistance, add a series resistor to total around 100 ohms. The other two chokes in the power supply should be below about 100 ohms, but lower resistance is fine. Lower value chokes can be used, but at some point, the low frequency response will suffer. For 100kHz and above, 1 mH is good. Also make sure that the lower value choke exhibits 100 ohms of resistance in the source of the JFET by adding series resistance. The high value choke "unloads" the source making intermodulation performance quite good.

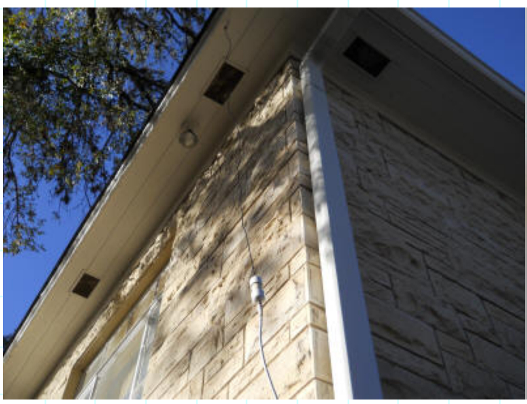
The source inductor and complimentary output stage do give the circuit good large-signal handling capability, but keep the antenna shorter than about 5 or 6 feet to avoid potential overload by strong signals. On several occasions now I've thought the antenna was exhibiting bad intermod performance only to discover that my various receivers were the culprit. Don't forget that receivers can be overloaded, too. Often an appropriate hiigh or low pass filter can help. The circuit exhibits the proper output impedance for driving filters. The power supply is indicated as 15 volts and 12 volts will work, but with slightly less signal handling capability. Higher supply voltage is also fine, up to about 25 volts.

Note: I recently built a two-tone generator for intermodulation tests. The circuit above produces a -65 dBc product at 1 MHz when driven by 4 and 5 MHz, 0 dBm signals. That's pretty decent. However, adjusting the power supply voltage can dramatically improve the performance. At 17.6 VDC, the prototype's distortion dropped below -90 dBc! It becomes a challenge to measure. I suspect the optimum power supply voltage varies from unit to unit. If you have two unusually strong stations tune a receiver to their difference frequency and adjust the power supply for minimum signal. (In most cases strong enough signals to cause noticeable IMD won't be present; one would need two signals well above 1 millivolt each to get a 1 microvolt product from the prototype running on 15 volts.) As a worst-case test I lowered the voltage to 12 volts, used an 8 foot antenna, and looked for the intermod from two strong AM stations, each showing -30 dBm on my HP3586 Selective Level Meter. I could see the noise floor of the measurement at the difference frequency, over 70 dB down. Atmospheric noise obscures any intermod. So, intermod isn't much of a factor in most settings.

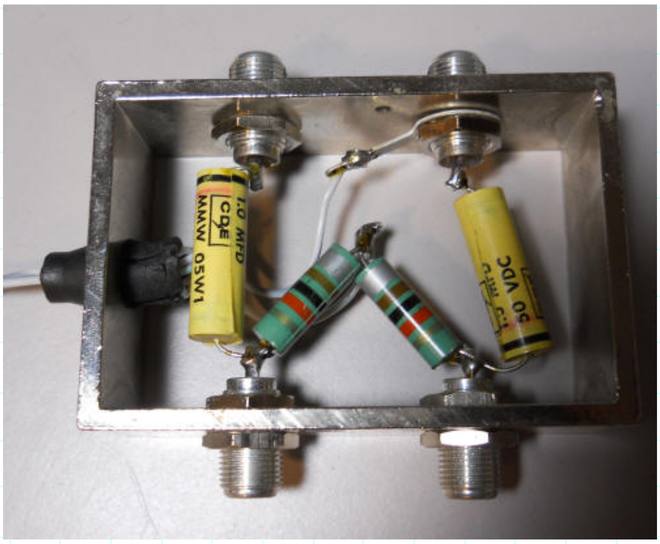
The circuitry was built into a short piece of PVC pipe with end caps:



The RF connector and antenna wire were sealed with a little epoxy in each cap. The antenna wire is heavy insulated copper wire like that used in house wiring. The antenna is simply hung from a hook or string and the end could be pulled into the air by tossing a string over the branch of a tree. :



The box below distributes power to two antennas, including this one. Power comes in on the left from a regulated 12 volt molded power supply. The two inductors pass the power to the two antenna connectors at the bottom. 1 uF capacitors couple the antennas to the receiver connectors at the top. Even more active antennas could be accommodated by adding the appropriate parts.



This antenna significantly improves my weather radio reception at 160 MHz. It also improves the sensitivity of my Sferics Detector, operating below 100 kHz. For that, I just connected a clip lead from the output of the amplifier and wrapped it around the antenna of the Sferics Detector to lightly couple it. Here's a little video showing it in action. Notice the wire just loosely wrapped around the antenna.

Note: this antenna has great signal-to-noise but there's no gain. Some receivers will benefit from additional gain but watch out for itermods generated by any amplifier you add. A passive filter in front of the amplifier can make a huge difference.

For higher frequencies, a resonant antenna becomes feasible. For example, Fig. 8 shows a simple vertical ground-plane antenna which connects directly to 50 ohm coaxial cable without a loading coil or matching network.

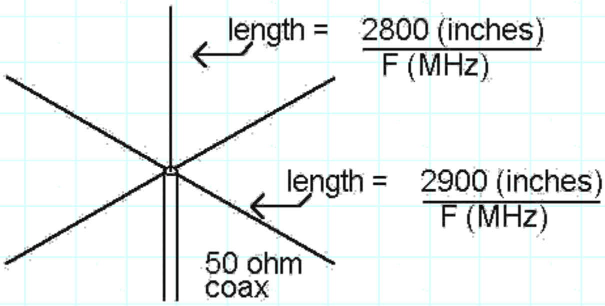


Figure 8: Vertical ground-plane schematic.

Using the equations shown, a 49 MHz antenna would have a vertical element 57 inches long and ground elements 59 inches long. The vertical element simply connects to the center conductor of the coax and the ground elements connect to the coax braid. The elements may be mounted on a small square of phenolic, fiberglass, or other weatherproof board material. Try not to let dissimilar metals come in contact or, if they must, coat the contact area with silicone rubber. One simple approach is to make the whole affair from PVC pipe with copper wire or tubing on the inside. It is often desirable to have a fixed-frequency antenna with directionality for monitoring a particular station or for installing on an antenna rotator. For example, if you live within a mile or two of a fast food restaurant you can probably pick up the little wireless microphones they use to take orders. You are probably wondering why anyone would want to pick up those signals (which are around 33 MHz). Hmmm. Well, it would be a challenge. Or, how about building a dedicated antenna to receive a distant weather transmitter instead. Or the police in a neighboring town, or a remote airport. Those sound a little better. (When my kids were small I thought of making a tricycle "drive-up" window with real audio from the local fast-food restaurant - never got around to it...) The point is that a directional antenna will give greatly improved performance for any of the signals on your scanner. Multi-element yagi antennas are a good choice for single frequency reception and log-periodic antennas give excellent multi-band reception. The construction of these antennas can prove difficult and purchasing a factory assembled unit is usually a preferable approach. A three-element yagi is not overly difficult for the more experienced hobbyist and several design references are easily found on the internet. A search using "3-element yagi" turned up nearly 600 hits including excellent design articles and commercial sources.