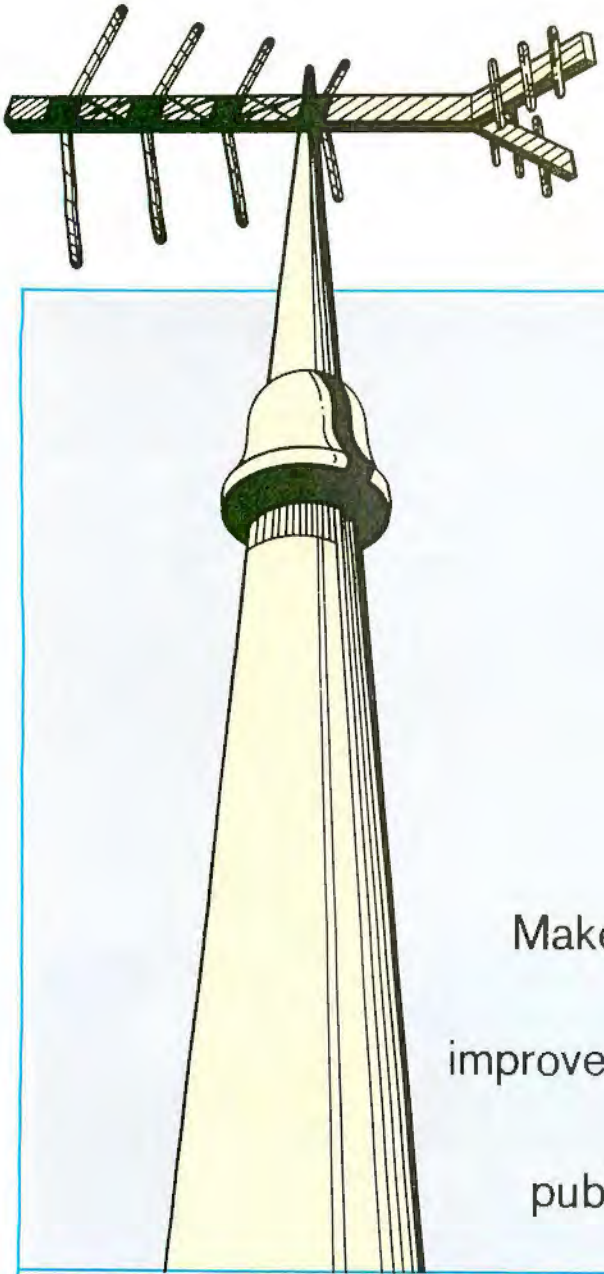


BY ROBERT GROVE

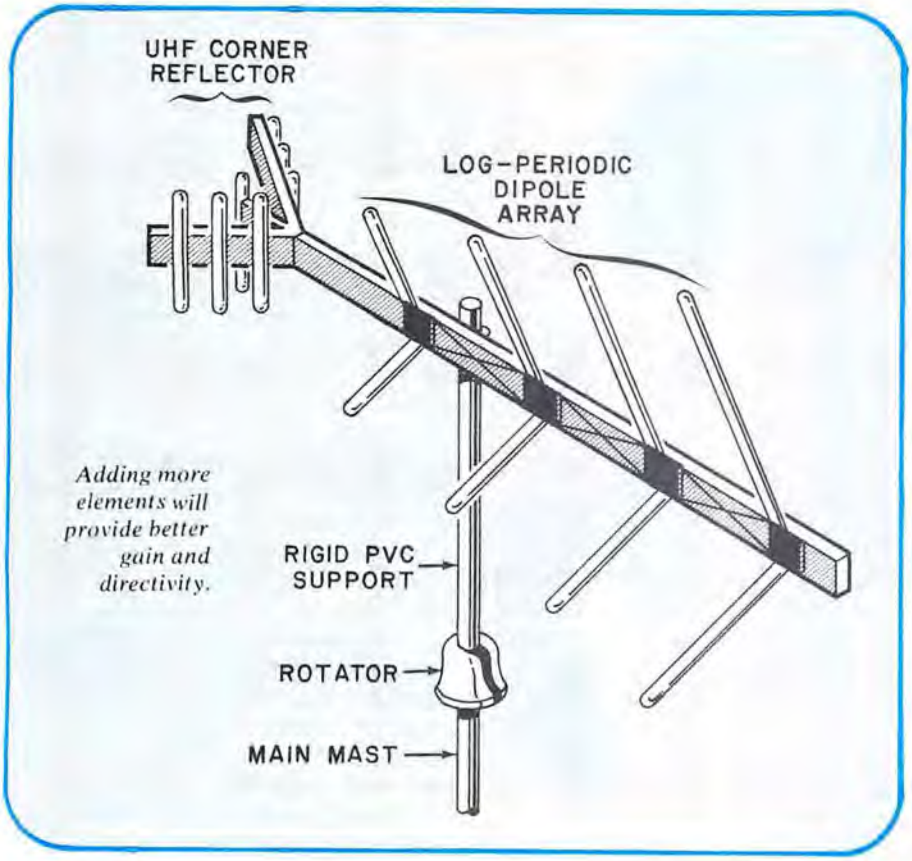
# SCANNER BEAM PINPOINTS THE ACTION!

Make-it-yourself antenna improves reception of public services

GOOD RADIO reception depends as much on a good antenna as it does on a "hot" radio receiver. This is especially true with modern public-safety-band vhf/uhf scanning monitors, which almost invariably have high sensitivities in the range of 0.5 $\mu$V or better. Aside from the usual whip antenna supplied with the scanning monitor, there are few commercially made antennas available for working vhf and uhf.

Fortunately, there is an alternative to a commercially made vhf/uhf antenna. A standard TV antenna can be "tailored" to provide excellent reception on the public safety bands. In this article, we will describe how this can be done and give you some idea of how the modified TV antenna stacks up against a popular high-performance discone antenna.

**Antenna Theory.** The standard whip antenna supplied with scanning monitors is generally adequate for city-wide reception of repeaters and base stations. However, when an external antenna is connected to the scanner to improve weak-signal reception, *all* signal




*Adding more elements will provide better gain and directivity.*

levels increase dramatically—including the levels of local signals. This can lead to problems. The most serious forms of scanning monitor interference are front-end overloading and intermodulation distortion, recognized by their frequent recurrence throughout the tuning range of the receiver. Images from aircraft communication and FM and TV signals that pop up in the middle of the public safety bands are another problem.

The problems that plague the public-safety-band listener are especially severe in metropolitan areas. The problem is compounded with the use of omnidirectional ground-plane antennas that respond equally well in all directions. What is really needed to maximize reception is a beam antenna with high forward gain and greatly limited side and rear gain. Such an antenna can be aimed at the transmitting source to zero in on that single signal to the virtual exclusion of other signals that can interfere with and mask the desired signal.

A few modifications to a low-cost TV antenna can produce an excellent beam antenna for vhf/uhf public-safety-band monitoring. We modified a Radio Shack "Super Color Special" (similar to the Model VU-90) antenna for our purposes. The results we obtained were so satisfactory that no further experimentation was necessary.

The TV antenna employs a log-periodic design in which every element is cross-connected to the feed line. The antenna is actually a series of center-fed dipoles, each slightly different in length to resonate at a slightly different frequency. The dipoles are connected to a common feedline. The response of the elements is related to the logarithm of the frequency; hence, the name log-periodic dipole array.

Electrically, elements that are not resonant at the frequency to which a receiver is tuned at any given moment behave like directors and reflectors. This endows the antenna array with both directivity and gain. The elements of a log-periodic antenna are incrementally shortened from the longest wavelength at the lowest frequency to the shortest wavelength at the highest frequency, which gives the antenna a characteristic V-shaped outline.

Each dipole is used at two frequencies—its resonant half-wave ($\lambda/2$) frequency and its three-half-wave ($3\lambda/2$) frequency. Hence, the longest element performs on 140 and 420 MHz, while the shortest element performs on 174 and 522 MHz. Also, because of the large diameter of the elements, compared to their length, the dipoles are very broadband. This makes the modified antenna usable over a range from well below 130 to beyond 174 Mhz in its $\lambda/2$ mode and from below 400 to beyond 550 MHz in its $3\lambda/2$ mode.

With the antenna erected, you will note that its elements are angled forward. This is done to merge the front lobes of the characteristic cloverleaf pattern that occurs on any $3\lambda/2$ dipole. The result is that the directivity of the antenna is considerably increased.

When used for TV only applications, the Radio Shack Super Color Special (as well as the Model VU-90) antenna offers an average gain of 4 to 6 dB (about 1 S unit) over a single dipole. Its front-to-back ratio is around 12 dB. Antennas with more elements will provide better gain and directivity figures.

Because the feed impedance for the antenna is approximately 300 ohms or less, a standard 4:1 TV Balun matching transformer is required between the antenna and the coaxial line you will be using. You need not concern yourself about the impedance of the feed line; either 50- or 75-ohm coax will work fine. For cable runs in excess of 50' (15.2 m), use RG-8/U foam dielectric coax. Although new dry 300-ohm twin-lead feed cable is low in losses, when it gets old, wet, and cracked, it causes more problems than it is worth. It is for this reason that coaxial cable is recommended industry-wide for two-way radio communication and commercial TV signal distribution systems.

**Modification.** Referring to the drawing, saw off the entire boom section that contains the 6" (15.2-cm) elements in front of the corner reflector. Be careful to avoid damaging the longer element closest to the reflector (this element is connected to the antenna's cross-feed system) or any of the reflector elements.

Next, cut the longest pair of angled elements to a length of 20" (50.8 cm) on each side of the boom. This 40" (101.6-cm) dipole is now cut for 140 and 420 MHz. Now, cut the shortest pair of angled elements to 16" (40.6 cm) on each side of the boom. This 32" (81.2-cm) dipole is now cut for 170 and 510 MHz.

Once the longest and shortest elements are trimmed to size, the remaining elements can be proportionately trimmed so that the outline of the antenna will have a characteristic V shape. You simply place a straightedge on each side of the antenna so that it touches the extreme ends of the cut elements and locate the cut points for the remaining elements. In the case of the Super Color Special and Model VU-90 antennas, the third and second longest elements will be 17" (43.2-cm) and 18" (45.4-cm) long, respectively, on each side of the log periodic array's boom.

Trim the longer corner reflector elements so that each of them is 16" long. Then lift the antenna to locate its new center of balance. Drill two new ¼" (6.35-mm) holes, properly spaced, through the boom to accommodate the U bolt that fastens the antenna to its mast. Make certain that these holes are drilled to permit the antenna to be oriented so that its elements point up and down after mast mounting. Also, make certain that the U-bolt hardware does not touch the aluminum wire that cross-connects the elements.

Mount the antenna on a 36" (0.91-m) length of 1¼" (31.8-mm) outer-diameter rigid PVC pipe. Do *not* substitute a metal pipe because it will interfere with the signal path. The metal mast should be at least $\lambda/4$ away from the longest antenna element. (Rigid PVC pipe can be obtained from any building supply house and many hardware stores.)

Mount the antenna and PVC pipe support on a rotator, following the cable-routing instructions faithfully. Connect the Balun transformer to the antenna and the coax feed line to the Balun. Then coat the connections with silicone adhesive to weatherproof them.

**How It Performs.** We made comparison checks between the modified TV antenna and an excellent commercially available vhf/uhf discone monitor antenna. Signals that were barely readable on vhf with the discone antenna came in substantially stronger with the modified beam antenna. More important was the fact that signals from the back of the antenna were noticeably reduced and those off to the sides were deeply attenuated with the beam, all of which contribute to a reduction in interference and an overall improvement in reception. The modified beam performed even better on uhf than it did on vhf. Signals improved from "barely-discernable" to "full-quieting."

Our experience with the modified beam makes it clear that this antenna is an excellent choice for listeners who are plagued by strong nearby transmitters and experience weak incoming signals. The modified beam even has the added advantage that it works well on the 2-meter amateur radio band; just be careful to avoid pumping more than a few watts into the Balun to avoid overheating. Happy listening. ◇