Technical Correspondence

Conducted By
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A HIGH-GAIN MONOBAND DIRECTIONAL ANTENNA

☐ The X-ray antenna system was developed for the purpose of obtaining a simplified, high-gain antenna system with directional characteristics that can be changed quickly by remote control. This system provides:

- 6.5-dBd main-lobe gain
- broad bandwidth
- simple coaxial-cable feed
- instantaneous remote beam control
- low-angle DX capability
- modest height and space requirements

Essentially, the X-ray antenna consists of a pair of back-to-back, parallel connected, 1.25-λ V arrays. It could be described as an "inside-out" rhombic. This arrangement requires five supports, including a central support that is at least 0.5 λ high. The remaining four supports, however, can be significantly shorter because a 22° to 35° tilt is applied to all four antenna elements. The basic 1.25-λ V antenna presents an impedance of approximately 100 Ω at the feed point. Therefore, two of them connected in parallel result in an impedance that is near 50 Ω. This offers an extremely convenient point to apply coaxial-cable feed to the system. A 1:1 balun transformer preserves antenna balance. Also, a relatively broadband effect results from the wide-band balance and combined terminal impedances of both Vs.

The tilt angle, α, applied to each element provides a lower vertical-lobe angle. This favors long-range communication paths although it also produces quasi-elliptical polarization. Angle α, as shown in Fig. 1, may be anywhere between 68° and 55° with respect to the central support. Fig. 1 shows a plan and elevation view of the X-ray system. Fig. 2 illustrates the method employed for relay control of directional characteristics, and Fig. 3 shows the relay enclosure mounted on the central mast.

The relay box contains a DPDT relay and a 1:1 balun transformer. Appropriate chassis connectors are mounted at the bottom of the box for remote relay control and coaxial cable to the station. The box should be waterproofed by covering any openings or seams with RTV (General Electric or Dow) sealant. Four 5/8- to 1-inch-diameter holes are provided at four corners of the enclosure and covered by square pieces of Lucite™ or Plexiglas® sheet bolted to the box.[1] Flexible wire leads, from the relay contacts, are brought out through small holes in the insulating sheets and connect to the antenna elements, as shown in Fig. 3.

Table 1 provides the antenna element lengths and the minimum recommended central-mast height for each operating band. The element-length formula is:

$$L = \frac{1230}{f} \qquad \text{(Eq. 1)}$$

where

L = length in feet
f = frequency in megahertz

[1]mm = in × 25.4; m = ft × 0.3048

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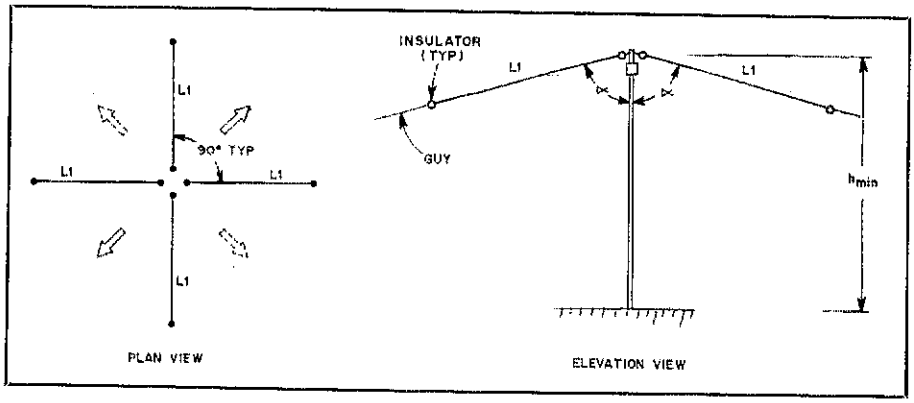

Fig. 1 — Plan View and Elevation of the X-ray antenna array. Minimum center mast height, h, is given in Table 1.

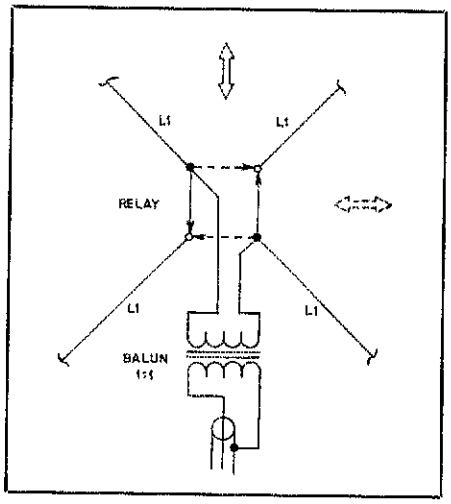

Fig. 2 — Schematic diagram of antenna array and switching system. The arrows indicate main-lobe orientation.

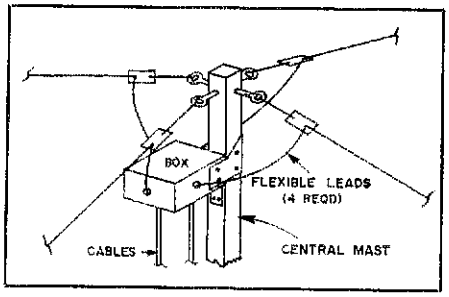

Fig. 3 — Arrangement of antenna and switching box at the top of the center mast.

The system completely covers all but the 10-m band, where it should be limited to any one 0.5-MHz segment. Cut the antenna elements for the center of any band shown in Table 1. Performance should be satisfactory, as long as all elements, including the leads to the relay and balun, are the same length. — *Richard R. Schellenbach, W1JF, Reading, Massachusetts*

Table 1
Element and Mast Dimensions

Band	Element Length	Center Mast
40 m	172 ft	67 ft
30 m	122 ft	46 ft
20 m	87 ft	34 ft
15 m	58 ft	22 ft
10 m (28.0-28.5 MHz)	43 ft 6 in	17 ft
10 m (28.5-29.0 MHz)	42 ft 9 in	
10 m (29.0-29.5 MHz)	42 ft	

TRANSMATCHES

☐ There seems to be mass confusion about what a Transmatch is and where it should be used. A Transmatch in the shack can, in fact, present a better load to the transmitter or amplifier than exists at the transmission-line input. In the presentation of this "corrected" load, however, only feed-line tuning is accomplished. That is, the transmitter is matched to the feed line, rather than the feed line to the antenna. At different frequencies and line lengths, the item that actually takes power (feed line or antenna) is determined by factors other than the Transmatch setting.

A Transmatch increases performance of the antenna system only when used at the antenna feed point. Consider a typical amateur installation. Coaxial cable has a fixed characteristic impedance. When attached to a mismatched load, however, the cable acts as a transformer. Input impedance may range from zero to infinity (if line losses are ignored) depending on the load impedance and cable length. Cable input impedance varies as a result of the difference between the load and cable characteristic impedances. Any matching is better done at the load, than the line input.

Transmatches are wonderful devices and I use