A Simple 934MHz Antenna

As 'Quaynotes' is on holiday, we're giving Fred Judd G2BCX the opportunity to show you how to make a simple antenna for the 934MHz band.

At u.h.f. and especially at 934MHz, there are numerous antennas that have high performance characteristics making them suitable for 'base station' operation. Types such as parasitic (Yagi type) arrays, cubical quads, log periodic arrays (l.p.a.), helical antennas, etc. may be found in reference books. No constructional or performance details of these antennas are included in this article.

The antenna featured here is the corner reflector, which at 934MHz, with optimised dimensions, has a fairly 'wide-band' response and acceptable directivity gain. Being relatively and with the reflector constructed in 'grid' form, it offers very little resistance to wind. Furthermore, it may be operated to obtain either vertical or horizontal polarisation. There being virtually no difference in the radiation pattern, or directivity gain.

Configuration

This antenna is derived from a 'flat sheet' reflector and a single driven element. With a 'corner system' the reflector normally consists of two flat metal sheets (L) by (S) that join at a corner angle (Ø), as shown in **Fig. 1**. I have decided to use a corner angle of 90° (*square corner reflector*). An angle of less than 90° may be used, but has certain disadvantages.

Gain And Impedance

Refer now to **Fig. 2**. which is based on work by J.D.Kraus ‡, and it shows the directivity gain factor in dBd for a driven element distance (d) to the corner of 90° and 60° reflectors. There is little change in the 'gain' factor as the distance (d) is varied between about 0.2 to almost 0.5λ.

However, the input impedance is also determined by this distance (d). The feed cable will normally be 50Ω coaxial cable (ultra low loss for 934MHz). To create this impedance the distance (d) must be approximately 0.3λ for a 90° reflector. Keep in mind however, that small changes in the distance (d) produce an appreciable change in the **input impedance**. This change will drastically affect the v.s.w.r.

Optimum Sizes

To restrict radiation to a low order mode, i.e. with no side, or split main lobes, the most practical arrangement is a reflector with a corner angle of 90°. There is provision for positioning the driven element 0.25 to 0.4λ from the corner. This will enable a minimal v.s.w.r. to be obtained when the antenna is fed from 50Ω coaxial cable.

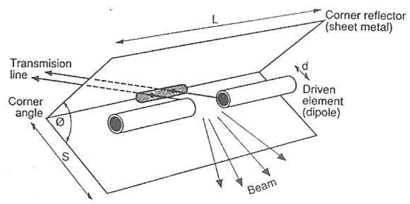


Fig. 1: The basic 'corner reflector'. The corner angle (Ø) is normally between 60° and 90° with (S) 0.9λ, (L) 0.6λ and (d) 0.3λ (λ at 934MHz is 319mm)

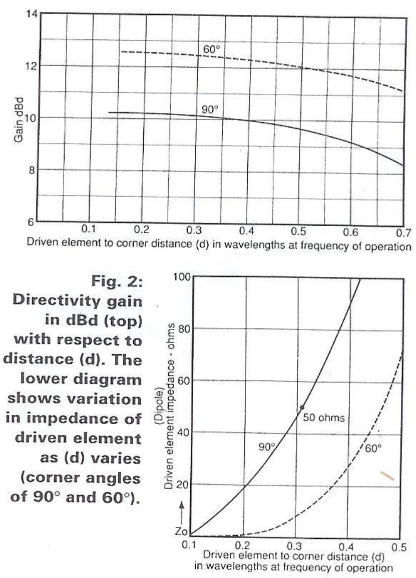


Fig. 2: Directivity gain in dBd (top) with respect to distance (d). The lower diagram shows variation in impedance of driven element as (d) varies (corner angles of 90° and 60°).

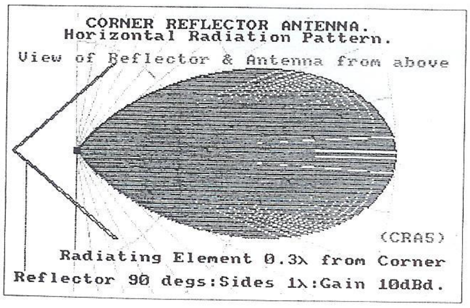


Fig. 3: Radiation pattern of a vertical 'optimised' 90° corner reflector antenna. Gain shown is average with a distance (d) of approximately 0.3λ and reflector sides (S) of λ.

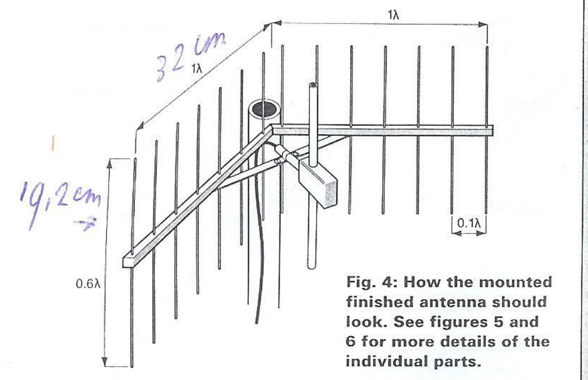


Fig. 4: How the mounted finished antenna should look. See figures 5 and 6 for more details of the individual parts.

Lobes And Gain

The computer produced radiation pattern shown in **Fig. 3**, is for a 90° reflector with the driven element located at 0.3λ. The directivity gain is about 10dBd. This pattern remains virtually the same, regardless of whether the antenna is used vertically or horizontally.

Higher forward gains are possible with corner reflector antennas, but the main lobe may be too narrow for convenient operation. For example, with a gain of nearly 13dBd, the forward lobe 'width' at -3dB will be in the region of 10°. Such a narrow beam width is not particularly desirable, unless of course the antenna is required for point-to-point communication over a fixed path.

Construction

A corner reflector for 934MHz could be made from thin aluminium, or perforated zinc sheet to keep down wind resistance. However, this resistance can be reduced even more by making the reflector with a grid of parallel conductors as in **Fig. 4**. This shows a 90° corner reflector antenna constructed in this way.

Incidentally, it must be remembered that the frequency of 934MHz is almost 'microwave'. This is a region where care must be taken with construction. You can't take even small liberties with dimensions which, at lower frequencies, have little or no effect on the performance of antennas.

The Driven Element

The comments regarding dimensions apply particularly to the construction of the driven element. This is half-wave dipole, fed via a balun sleeve to ensure a proper match between the antenna and the unbalanced coaxial cable. More details are given in **Fig. 5**. The dipole and the sleeve are made from copper water-pipe, with diameters nearest to those given. Note: the balun sleeve is approximately twice the diameter of the cable used.

The two lugs for fitting the sleeve to the protection box, are formed by making two saw cuts each side of the sleeve and bending the cut sections outward. Don't make the bend too sharp, or the lugs may break off. The copper disc soldered to the end of the sleeve is in contact with the coaxial cable braid at that point.

The soldering can be done by first stripping a very short length of the cable outer cover away where it passes through the disc. Two or three turns of tinned copper are wrapped around the braid and soldered to it. Take care not to melt the dielectric beneath. Solder each end of the wire across the disc. The cable will be held centrally to the sleeve by the hole in the protection

Fig. 5: The balun sleeve and antenna elements in detail. The dipole elements are made of 12mm diameter copper tube.

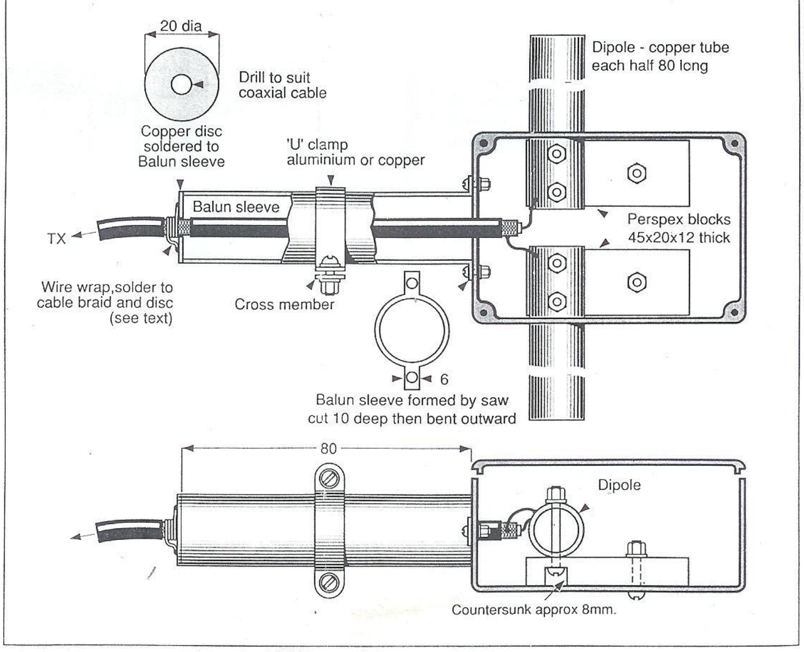
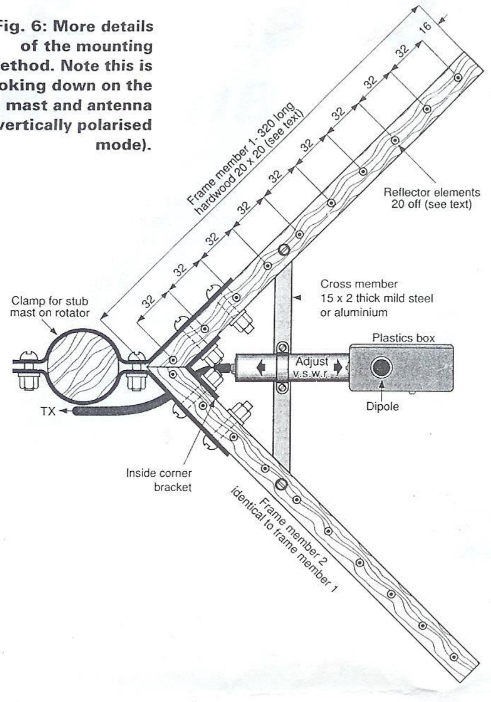


Fig. 6: More details of the mounting method. Note this is looking down on the mast and antenna (vertically polarised mode).



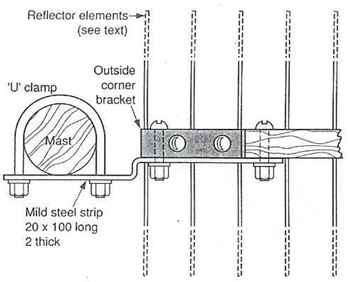


Fig. 7: These modifications need to be made to the mounting method if it is intended to use the antenna horizontally.

box. A plastics disc may be added in the middle of the balun to hold the coaxial cable centrally. ***If possible a single length of cable should be used to run between the antenna and transceiver. This will avoid a plug and socket connection, and its losses, at the antenna.***

Final Assembly

The 'frame members', as in **Fig. 6**, may be constructed from hardwood (Oak), or metal such as square aluminium tube. Dimensions should be as close as possible to those given. If wood is used, it must be treated for protection.

The 'cross member' should ideally be mild steel although aluminium, at least 2mm thick, will support the driven element assembly. This is secured by a 'U' clamp as shown. Slightly loosening the fixing bolts, will help when this assembly is moved later to adjust for minimum v.s.w.r.

The 'grid' elements, each 192mm long, may be cut from aluminium, brass or copper rod 2 or 3mm diameter. Welding rod could also be used. They should be a tight fit, and be secured in position with an epoxy adhesive or, if possible soldered into place, electrical contact with a metal frame is not essential.

Any Way Up

The diagram **Fig. 6,** shows how the rear corner brackets are extended to form a clamp, allowing the whole antenna to be mounted vertically. If horizontal polarisation is required the whole antenna is mounted horizontally. The illustration, **Fig. 7,** shows how this may be achieved with aid of a mild steel strip, mounted under a frame member extending beyond the corner.

Each of the reflectors must be isolated from the mounting boom. So holes must be be drilled through this strip to clear any of the reflecting elements. Note: The radiation pattern in the horizontal plane, remains the same regardless of whether the antenna is mounted vertically or horizontally.

Adjustment

With the assembled antenna temporarily mounted about two metres above ground, adjust the position of the driven element assembly (as previously mentioned) until the lowest possible v.s.w.r. is obtained. A reading of 1.12:1 was obtained with the experimental model over the bandwidth 933 to 934MHz.

Finally, secure the driven element assembly and attach the lid on the protective box. Run a sealant around the holes in the box, and around each end of the balun sleeve to prevent the entry of moisture. It's a good idea to bind adhesive tape around the end of the cable where it enters the balun sleeve, and onto the end of the sleeve itself before applying the sealant.

Various types of low loss coaxial cable suitable for use at 934MHz are available from advertisers in this issue of *Practical Wireless.*

Other Antennas

There are of course many other types of antennas that may be used on 934MHz, some of which I mentioned above. But those would be the subject of other articles (letters to the editor in support perhaps?).

Thanks

My thanks go to Nevada Communications of London Road, Portsmouth, for the loan of the 934MHz equipment used in connection with testing the corner reflector antenna dealt with in this article. I hope you enjoy using this simple antenna, if built carefully it should serve you well. PW

Further Reading

‡*Antennas.* by Prof: J.D. Kraus. McGraw-Hill book Co. USA (available UK libraries. Considerable theoretical information. Chapter 12 is about reflector antennas.

Wires And Waves a reprint of articles from previous issues of *PW.*

Out Of Thin Air reprints of other articles from previous issues of *PW.*

Beam Antenna Handbook William I. Orr W6SAI and Stuart D. Cowan W2LX, Radio Publications Inc.

VHF-UHF Handbook, edited by D. Evans G3RPE and G. Jessop G6JP, an RSGB Publication.