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Short Folded Dipoles

The conventional ½ wave folded dipole antenna has been used for a multitude of applications over the years. There are times however when space limitations require a radiator considerably shorter than ½ wavelength without compromising performance, particularly on the 3.5 and 7 mc bands. One answer to this problem is to use either a ⅜, or ¼ wave folded dipole configuration.

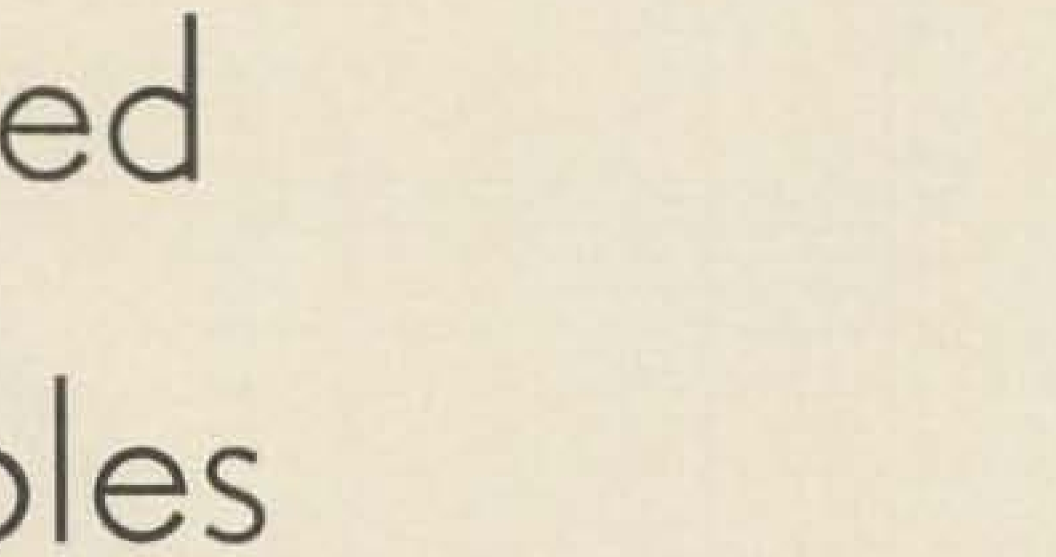


FIG. I CURRENT DISTRIBUTION IN 1/2λ FOLDED DIPOLE

The basic ½ wave two-wire folded dipole is shown in Fig. 1. When both conductors are of equal size, the currents in each are equal and in phase with each other. The impedance of this antenna is nominally 4 times that of a single dipole, or 280 ohms. If we add a third conductor in parallel, the impedance becomes 9 times that of the dipole, or approximately 630 ohms. Thus for a ½ wave folded dipole having all conductors the same diameter and equally spaced, the impedance step-up ratio is N^2, where N is the number of conductors.

If we use a shorter physical length than ½ wave for the folded dipole, the current magnitudes and phase relationships change considerably however. If we first consider the ⅜ wave configuration shown in Fig. 2, we

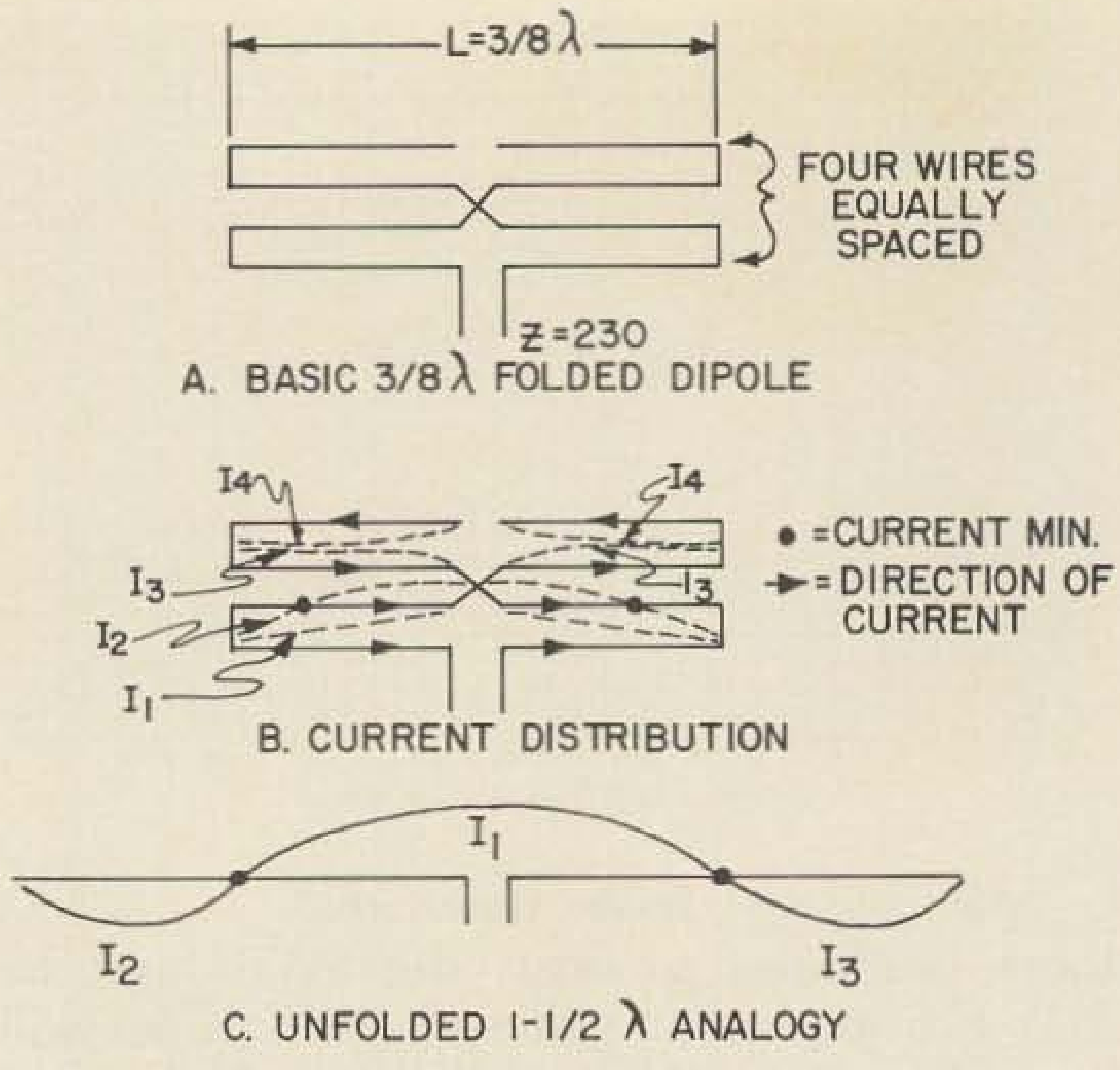


FIG. 2 THE 3/8λ FOLDED DIPOLE

find that the basic current distribution is the same as for an antenna 1½ wavelengths long, or the condition when a 7 mc folded dipole is resonated on 21 mc.

The analogy is not exactly true in this case however, as by folding the conductor back on itself we introduce phase reversals between the conductors, with their resulting additions and cancellations. The overall effect gives a total current in the antenna that is very similar to the one we find in a conventional two-wire folded dipole ½ wave long. The impedance step-up in this configuration is slightly over 3 times, and approximates 230 ohms. This is close enough to the 300 ohm value of common twin lead that the SWR is well below 1.5:1 for the ⅜ wave antenna.

Thus a ⅜ wave folded dipole for 7 mc is only 50 feet long, as opposed to 65 feet for the ½ wave version. The overall length could probably be reduced to 35 to 40 feet by drooping the ends without too much of a loss in efficiency if necessary.

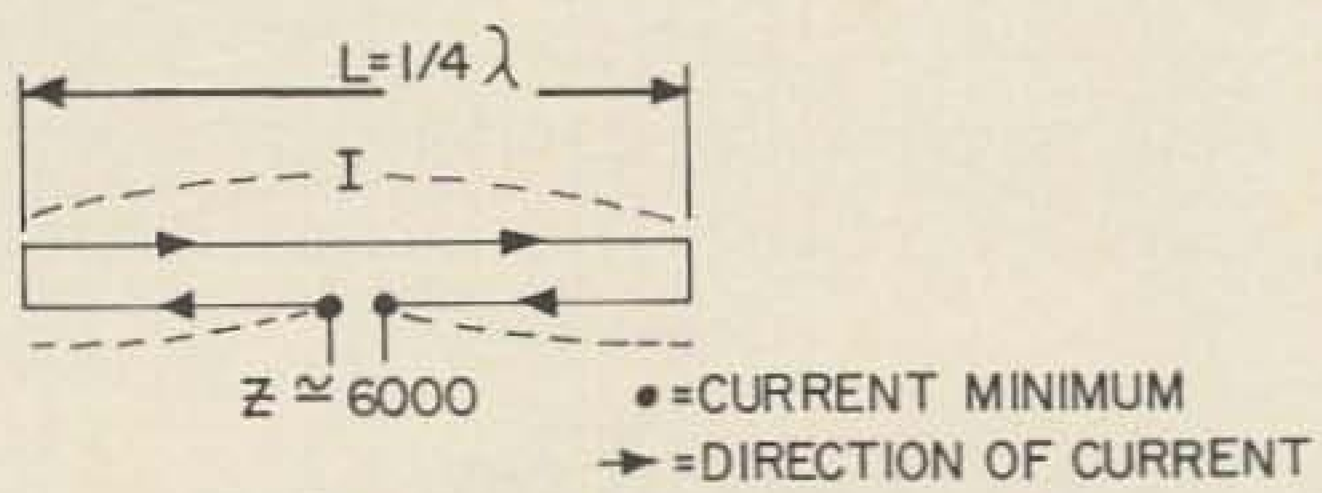
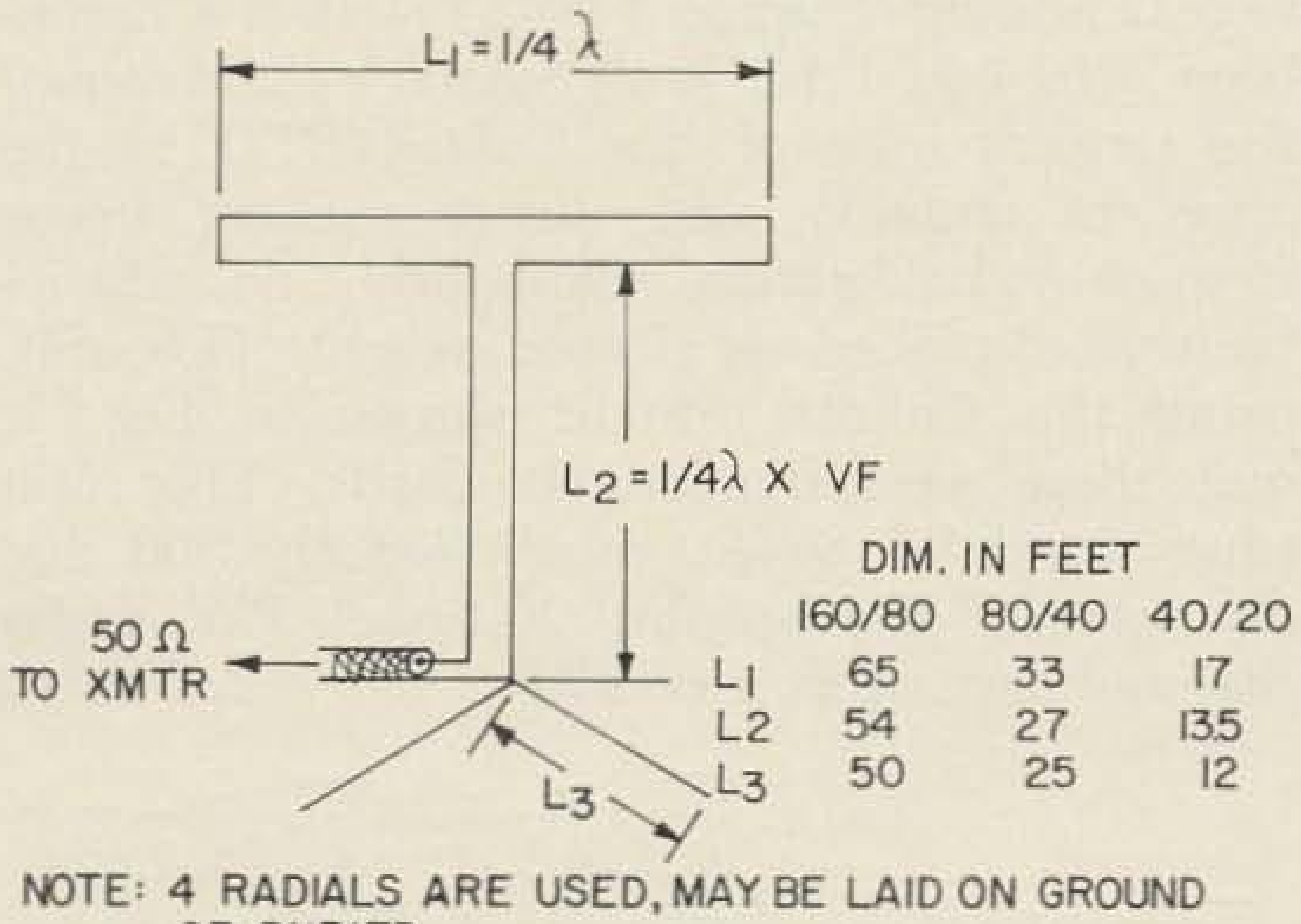


FIG. 3 THE 1/4λ FOLDED DIPOLE

Now for the ¼ wave folded dipole. How does it work? Well the answer to this is that the antenna is really ½ wave long. This can be seen clearer if we again consider the regular ½ wave folded dipole. In the ½ wave configuration the antenna is operating on its second resonance, or in actuality the current distribution is the same as for a full-wave antenna before we folded it to bring about a phase reversal.

The ¼ wave folded dipole then is equivalent to an end fed ½ wave radiator, operating on its first resonance. As the ends are folded back, the efficiency suffers a bit from out of phase current cancellation, as shown in Fig. 3. However, this normally only amounts to about 0.5 db loss in the system, and is a small price for shrinking the antenna 50% in overall length.

There is a sour note to this antenna though, which has discouraged many potential users. This is that the antenna exhibits a feed point impedance of around 6000 ohms, which certainly does not conform to our standard feed line impedances. This problem can be cured easily however by use of a ¼ wave matching transformer section. For a 75 ohm feed line, the matching section is 670 ohms. Similarly for a 50 ohm line it becomes 385 ohms, and conceivably could be made from either 300 or 425 ohm open wire TV line with a resulting low SWR.



DIM. IN FEET

	160/80	80/40	40/20
L1	65	33	17
L2	54	27	13.5
L3	50	25	12

NOTE: 4 RADIALS ARE USED, MAY BE LAID ON GROUND OR BURIED.

FIG. 4 THE MULTEE ANTENNA

The ¼ wave folded dipole was used successfully in an antenna popular several years ago, known as the "multee". This antenna was fabricated from 300 ohm line for both the flat top and matching section, as shown in Fig. 4. The main feature of the "multee" was that it provided two band operation in a restricted space. On the lower frequency, the antenna functions as a top loaded vertical, while on the higher frequency it becomes a ¼ wave folded dipole, fed thru a matching transformer from a 50 ohm line. The use of radials at the base serve two purposes: first, to provide a ground return when the antenna is used as a vertical, and second, to de-couple the unbalanced/balanced effect of feeding with a coaxial line.

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