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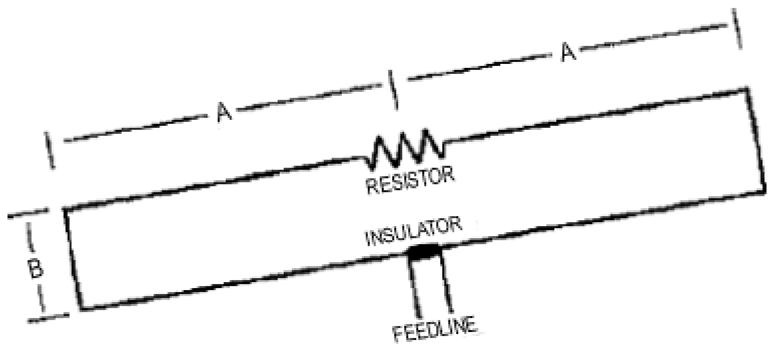

T2FD -- The Forgotten Antenna

By Guy Atkins

If a survey were taken of all shortwave DXers to find the antennas they use, I suspect the majority would be found using the random wire. Next In popularity would likely be the commercially available sloper antennas and trap dipole.

However, an antenna's popularity does not necessarily reflect excellent performance. While being simple and inexpensive to erect, the randomwire is susceptible to electrical noise, and presents a wide range of impedance to the receiver, depending on received frequency.

The terminated. tilted, folded dipole (T2FD) is a little known antenna that performs excellently. Compact in size compared to a halfwave dipole (approx. 67 feet long at 60 meters), the T2FD provides signal gain, wide frequency coverage, and exceptionally low noise characteristics.

An early discussion of the T2FD appeared in the June 1949 issue of QST, a popular magazine for radio amateurs. A more recent article on the T2FD appeared in the May 1984 73 Magazine.

The World Radio Television Handbook for 1988 gave a brief description and diagram of the T2FD, and that year's WRTH Newsletter provided additional construction information. Further details were given in the 1989 WRTH. However, some misleading and incomplete information is given in these WRTH sources, which this article will later clarify.

DESIGN

Some have called the T2FD a "squashed rhombic" antenna. It does bear some design similarities to the nonresonant rhombic, but theoretically it is admittedly inferior. However, the T2FD performs well in a modest amount of space, while a rhombic antenna can be immense virtually impractical at all but the highest SWBC bands.

The T2FD is essentially a closed loop design with the element ends folded back and joined by a noninductive resistor (see figure below). The feed line can be 300 to 600 ohm twinlead or open line.

Because twinlead and open line can be affected by nearby metallic objets (downspouts, metal window frames etc.), a better feed line is coaxia1 cable connected to an impedance transformer (balun).

The T2FD has a characteristic 5 or 6 to I frequency ratio, which means that it works effectively from its lowend design frequency up to 5 or 6 times that frequency. For instance, the T2FD which I use is designed for optimum performance at 4.9 MHz, but can operate up to the 2529 MHz range. In practice this antenna also works satisfactorily down to the 75 90 meter tropical bands, but not as well as a dipole or delta loop designed for 75 or 90 meters.

PERFORMANCE

The United States Navy conducted extensive transmitting and receiving tests of a single T2FD antenna in the late 1940s at Long Beach, California. They employed a Model TCC Navy I kW transmitter, with a frequency range from 2.0 to 18.0 MHz. After a year of use on all frequencies the T2FD was found to be superior to individual antennas on the various bands. The other antennas were removed from the Long Beach site affair the tests.

Similar results during the same period were experienced by the Kyushu Electric Communications Bureau of Japan. Their experiments indicated that the terminated tilted folded dipole was superior to the "zepp" and halfwave dipole types previously used. They noted wideband characteristics, and the T2FD gave a 4 to 8 dB signal increase at their various receiver site

My experience has shown the T2FD to be a fine performer when only a single shortwave receiving antenna can be erected, due to its wideband nature. It also has the advantage of electrical noise rejection (to a degree) compared to a random wire or even a dipole.

THE TERMINATING RESISTOR

According to the QST articles mentioned, the value of the terminating resistor is rather critical. Its value depends on the feedpoint impedance, and is normally above it. For instance, if 300 ohm feed line is used (or 75 ohm coax into a 41 balun) the correct termination value is 390 ohms. For 600 ohm feed line, a 650 ohm value is best. If a 450 ohm feed line is in use, the correct resistor would be in the vicinity of 500 ohms. I have not discovered why the optimum terminating resistance is higher than the feedpoint impedance, nor do I know of a formula for calculating this relationship.

The terminating resistance becomes more critical as the feedpoint impedance is lowered. With lines of lower impedance (including a directly connected 50 ohm coaxial cable), the value is critical within about 5 ohms. (The QST articles did not state an exact recommended value when using a low impedance line.)

The WRTH editions give the erroneous impression that T2FD antennas *require* a 500 ohm resistor and a 10:1 balun transformer, used with 50 ohm coax cable. This is not the case, although these values will work fine if you have the 10:1 balun available (normally hard to come by). A T2FD built with 75 ohm coax (RG59 or RG6), a common 4:1 balun, and a 390 ohm terminating resistor is recommended.

The resistor used *must not* be a wirewound type, its inductance would affect performance to a substantial degree. A carbon resistor of 1/2 to 1 watt in size is perfect (for a receive only T2FD). The WRTH Newsletter in 1988 said that the wire for a T2FD must be made of pure copper between 3mm and 5mm thick In reality, the exact tbickness and type of wire have very little bearing on the T2FDs performance for receiving. Your main consideration will be wire strength, regardless of diameter.

CONSTRUCTION TIPS

A T2FD takes more hardware to construct than a typical dipole. Maintaining a uniform spacing between the parallel wires, as well as sturdiness, are the primary considerations. My first attempt at a T2FD selfdestructed when the antenna was hoisted into the air. I underestimated tbe strain the wires would be under. My current T2FD has been in use for over 11/2 years, and was built with 14 gauge stranded, colddrawn copperwire.

The spacers or spreader bars ean be fashioned from 5/8" (minimum) diameter wood dowels, or even acrylic rod if available. Drill appropriate sized holes at eacb end of the spreader bar for the wire to pass through. The spreaders should be secured to the wires so that they do not slide; one method is to "jumper" each spreader end with a short piece of stiff wire and solder to the antenna wire.

It is essential that you encase the terminating resistor inside a plastic cylinder or other support, and weatherproof the assembly. Be positive that the resistor will not receive the strain from the wires.

I prefer to use eyelet bolts on the end spreader bars for tbe antenna wire to pass through. An alternative would be some type of rod or strong, small diameter tubing cut to the length of dimension "B". The wire would simply thread through the rod.

Most amateur radio supply stores sell 4:1 baluns tbat only need a wrap of "Coax Seal" around the connections to be totally waterproof. The type with a coax connector that will accept a PL259 plug is perfect.

The diagram on the following page illustrates this type of construction, using the commonly available 4:1 balun, 390 ohm resistor, and 75 ohm RG59 coaxial cable.
On the following page is a comparison of a 60 meterband T2FD, a 500 ft. longwire and a 50 ft. random wire antenna.

Easier with Inverted Tilted Vee

Andreé Knott, DD3LY
Email comment, 18 April 2002

I built an "inverted tilted vee" antenna for my QRL with two 250 Ohm resistors at each end and a 50:450 Ohm homemade Guanella BalUn at the top.
This antenna is not very different to a T2FD at all as well as to the WRTH recommendation.
My antenna has 60m legs, spreaded 60 degerees, the apex was only 8m high. VSWR less than 2 from 3 to 30 MHz and great reports.
I think the WRTH recommendation is OK and easy homebuilt too, with the small exception that one should use a resistor which is about 20% higher than the output impedance of the transformer.
