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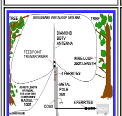
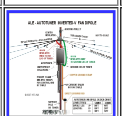
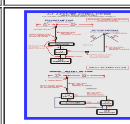
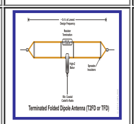
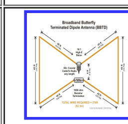
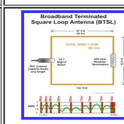
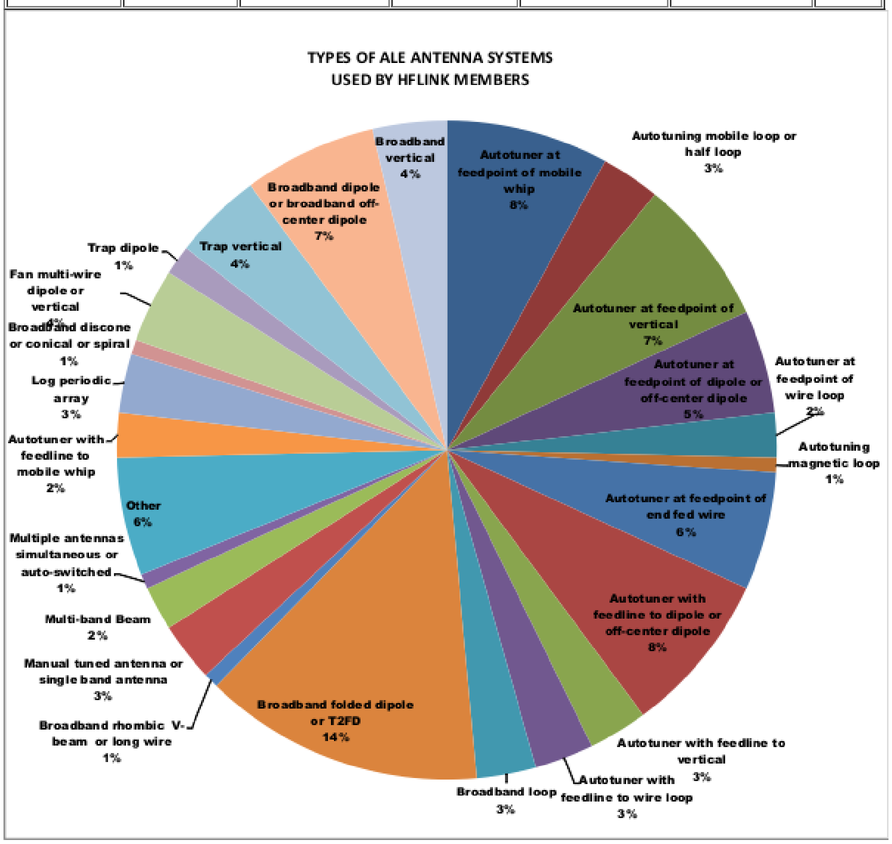
ALE Antenna Articles:

Broadband VertaLoop Antenna	Autotuner Fan Antennas	Using Autotuners Without ALE Capability for ALE	Terminated Folded Dipole & Monopole TFD T2FD TFM	Broadband Butterfly Terminated Dipole Antenna BBTD	Broadband Terminated Square Loop Antenna	16:1 Balun for BBTD
						



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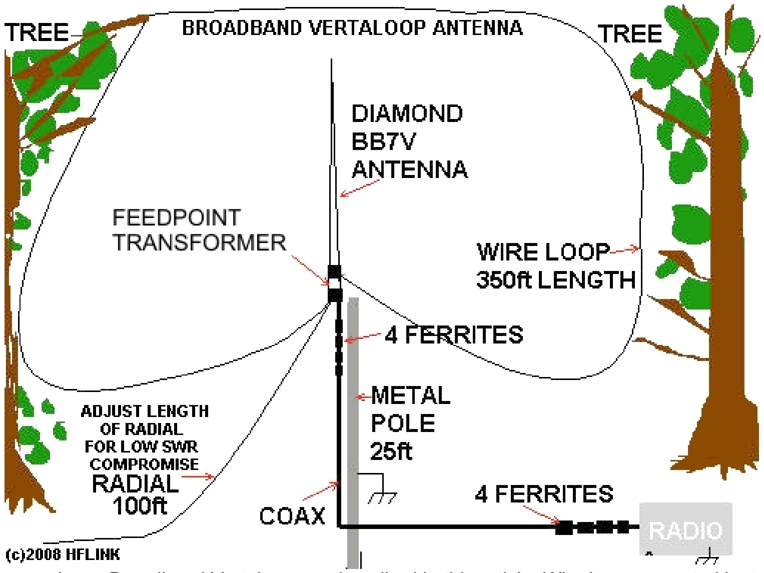
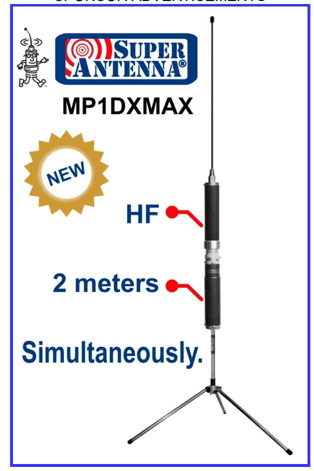


Diagram above: Broadband VertaLoop as described in this article. Wire loop supported by trees, Diamond BB7V Vertical Element with feedpoint resistive matching unit, "ground" radial wire, metal support pole, coaxial cable, ferrite feedline choke clamps, and grounding points.



Concepts and Construction of the Broadband VertaLoop Antenna

Design and Installation Notes by Bonnie Crystal KQ6XA

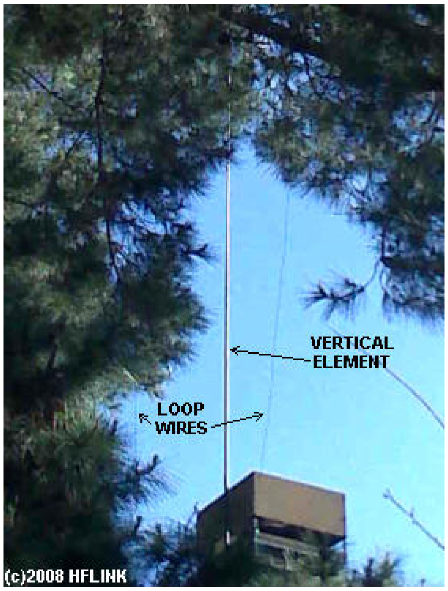
Background
The Broadband VertaLoop Antenna was developed for use with Automatic Link Establishment to cover HF frequencies from 3.5MHz to 30MHz continuously with low SWR. The antenna presented here is a convenient combination of the Diamond BB7V vertical antenna (modified) and a large irregularly-shaped quad loop of wire, and a wire radial that is used to fine tune the antenna for best comprimise of low SWR on the various frequencies of operation. The objective was to provide improved performance over just a Diamond BB7V alone, or just a quad loop alone. On the higher HF frequencies, the vertical tends to provide good DX performance, while at the lower and middle HF frequencies the the loop provides higher efficiency.

Improving Upon the Broadband Resistively-Matched Vertical
The Diamond BB7V is a transformer-matched vertical element antenna that normally uses the coaxial cable as the ground reference plane. In this configuration, both the coaxial cable and the support mast are part of the RF radiating element. This article is intended to show how the efficiency of a transformer-matched vertical may be increased, and to provide various design concepts and ideas for a range of broadband antenna types that can be built using the basic resistive-match method.

Expand on the Concepts
The antenna described in this article may be seen as a prototype antenna, more as a basis for design and use by radio operators seeking to erect broadband antennas. Keep in mind that exact length of the wires, antenna height, and other aspects of this design may be changed to suit the user's application and the environment that the antenna installation is being built for.

Advantage of the Large Loop
The advantage of the use of a large loop of wire for this application is that the impedance at any given frequency is usually above 100 ohms. This works in concert with the impedance of the resistance in the matching unit to provide the desired low SWR at 50 ohms nominal impedance for use with standard coaxial cable and HF transceivers.

Results
The installed Broadband VertaLoop Antenna, as built and documented here, provides SWR below 2:1 over 1.8MHz-30MHz range. The antenna system appears to provide approximately +3dB to +20dB of estimated transmit and receive signal strength advantage (depending upon frequency) over the original Diamond BB7V *vertical alone as intended by the manufacturer to be installed*. This huge advantage has provided a significant improvement in on-the-air performance for this station's ALE operations in the HF frequency range of 3 MHz -30MHz at the 100W to 200W transmitter power level.



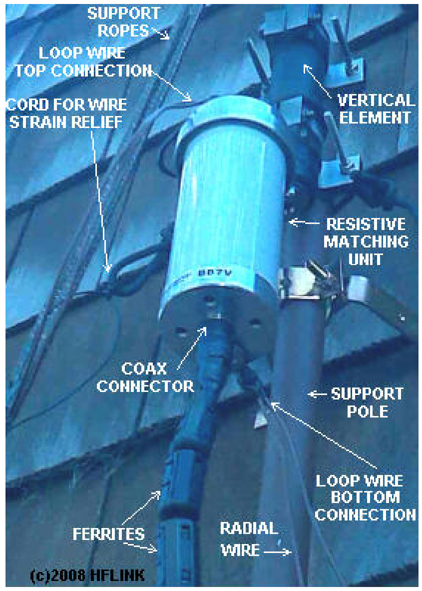


Photo above left: Broadband VertaLoop installed on a chimney.

Photo above right: the feedpoint connections of the Broadband VertaLoop, including the ferrites, the strain relief cords for the wires, the matching unit, and other parts.

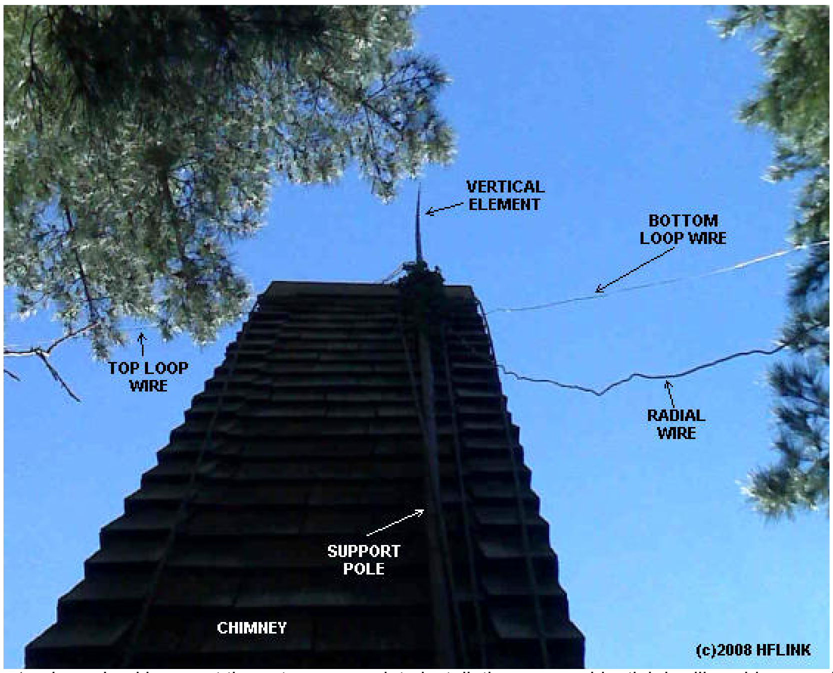
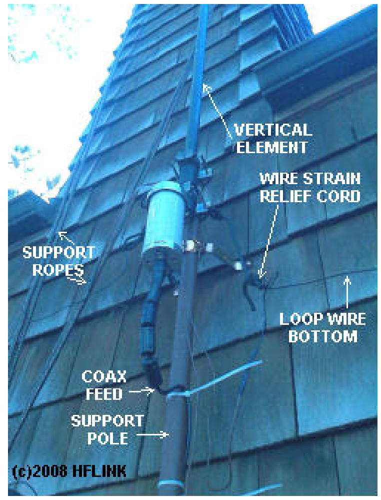


Photo above: Looking up at the antenna complete installation on a residential dwelling chimney, with vertical element, bottom loop wire, radial wire, and top loop wire.

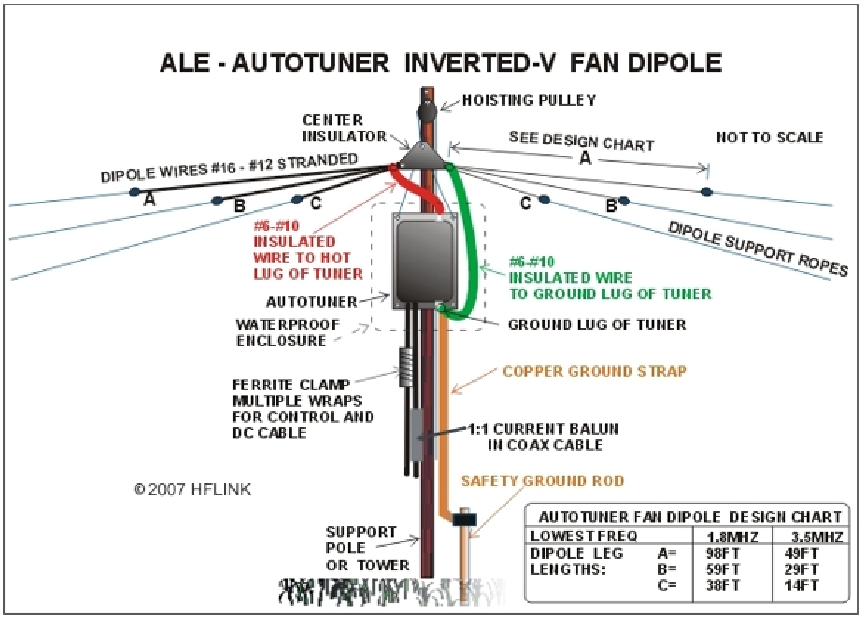


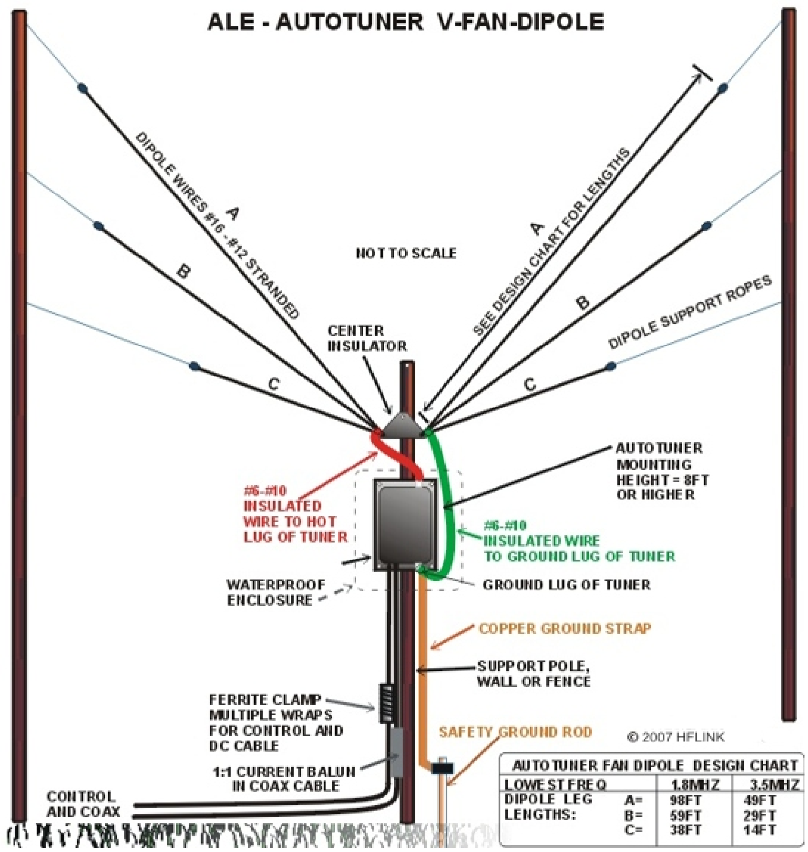
Photos above left and right: The Broadband VertaLoop being installed. Testing at lower height, being prepared and tested for SWR, ready for final installation; including details of the camouflage, the feedpoint connections, and the wires, cords, and cables. The antenna element has been painted black and the support pole has been painted to match the color of the residential structure, in an effort to minimize the appearance of the antenna, and blend in with the surrounding vegetation.

Modification of the Diamond BB7V transformer matching unit. Since the stock matching unit does not provide a connection to the shield of the coax for attachment of wires, it was necessary to add these connection points. The *photo at left* shows the tapped holes in the bottom part of the unit, with 5/16"-18 threads and "ground lug" bolts with washers. The modification includes tapping all of the 4 bottom ventilation holes of the unit, although only one of these connection points was used in this particular installation. These bolts are for the bottom connection of ground radials and loop wires. Extreme care must be observed when tapping the holes, not to cut into or disturb the internal parts of the matching unit. A small LED light can be placed at one of the holes to assist in viewing the internal parts while working on the modification. All of the bolts, nuts, and washers are stainless steel. The ring terminals for wire connections are plated or tinned copper or brass. It is important to avoid over-torque of the bolts, because the aluminum threads may be stripped if the bolts are tightened too much.

-end of article on Broadband VertaLoop Antenna

Autotuner Fan Antennas:





The Autotuner Inverted-V-Fan-Dipole and Autotuner V-Fan-Dipole
Design and Installation Notes by Bonnie Crystal KQ6XA

Background
Various versions of multi-wire dipole antennas are known and widely used. HF inverted-V antennas called "maypole" antennas, have been utilized with dipoles resonant in the amateur bands. The most common has been the 3.8MHz/7.1MHz resonant version fed with 50ohm coax. Technically, the antenna system consists of two or more dipoles of different lengths arranged radially in inverted-Vee form with a single common feedpoint. There are other configurations possible within the general category of "fan dipoles".

Autotuner Problems with Single Wire Antenna
Autotuners have been in popular use for both amateur and non-amateur applications, especially when many channels or bands of frequencies are utilized throughout the HF spectrum. *Problem frequencies* are sometimes found in long single-wire autotuner installations, usually due to combined RF reference plane (tuner ground) and wire resonance resulting in a very high impedance presented to the autotuner. At the problem frequencies, it can take a long time for the autotuner to repeatably find a match, or it may not be possible for it to find an acceptable match. Other problems with the same root cause can lead to excessive RF radiation from the feedline at the transmitter (hot mic syndrome). Sometimes, simply changing the length of the antenna wire slightly is sufficient to move the "problem" to an unused frequency. But changes in the ground conductivity due to rain or other factors can bring the problem

back.

Multiple Antenna Wires for Fast Autotuning
HF-ALE (Automatic Link Establishment) requires fast autotuner action, and the linking functions best when the antenna matching autotuning cycle is completed within a fraction of a second. Application of the multi-wire dipole principle to the autotuner installation provides a solution. In practice, it has been found that there are advantages to certain wire lengths or wire length ratios for autotuner use in the HF spectrum. These ratios of wire lengths present multiple "convenient" lower impedances to the autotuner at any given frequency, enabling it to achieve a matched condition rapidly and repeatably, thereby mitigating "problem frequencies".

Autotuner Fan Dipoles in Use for ALE
I have developed the two successful versions of an autotuner fan dipole antenna system shown above, through both theoretical and empirical design (trial and error). I am presently using one of these antenna systems on the air 24/7 for ALE, from 1.8MHz to 28MHz. I am using an SG-230 autotuner in this installation, but the principles are the same for most of the common autotuners of similar type.

Common Mode Chokes
I've set up 3 different SGC autotuner systems at base stations using the common mode chokes (1:1 balun a misnomer) in the control/DC cables/feedlines, combined with a grounding strap to earth. These techniques keep some of the noise from computers and equipment in the station from being conducted into the autotuner's antenna system on receive, and they help choke off RF currents on transmit from going down the cables into the station. In the first two of those installations, severe RFI was eliminated that was present before the "chokes" were installed. In the third, I installed the chokes during the initial installation, and have not removed them to see how much difference they make.

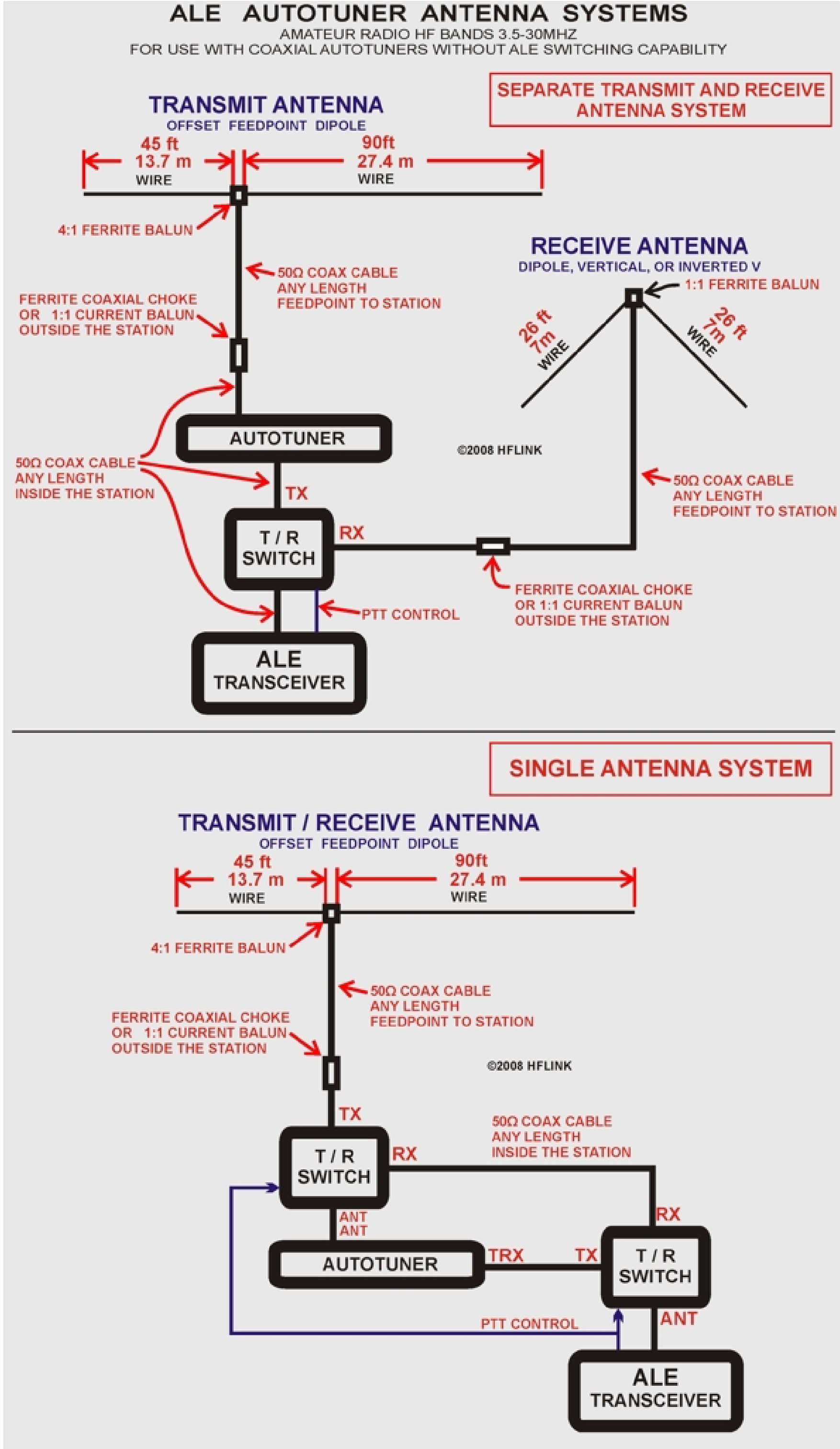
Grounding
Indeed, many operators are content to simply ground the coax and control cable at the station entrance (good practice). I'm from ye olde school of lightning protection (having built broadcast stations and telephone central switching offices in my earlier career), so you will see additional ground straps present near the antenna in my base station antenna designs. I believe that a direct lightning discharge path to earth ground is a good design starting point for basic lightning protection. I also believe that the possible loss in RF efficiency at some frequencies is worth trading for the added safety that earth grounding at the antenna provides.

Temporary Portable Installations
For temporary portable installations when no chance of lightning hazard exists, the safety ground strap could be eliminated. The common mode chokes and control feedline ferrites may also be eliminated if no "hot mic" RF feedback or RFI is experienced.

Feedback and Field Reports Requested
There are other possible combinations of wire lengths and configurations that should function in a similar manner. I am interested in the results of others who are using this type of antenna system or derivatives of it. Feedback or field reports may be sent directly to the HFLINK or HFpack groups.

Using Autotuners Without ALE Capability for ALE

Design and Installation Notes by Bonnie Crystal KQ6XA



OVERVIEW
Operators have expressed interest in using a wide variety of antenna autotuners for ALE. Many autotuners do not have ALE capability, which requires tuning element bypass switching inside the autotuner.

COAXIAL FEED AUTOTUNERS FOR ALE
Some types of autotuners are intended for use with antennas fed by coaxial cable. LDG is an example. With these autotuners, a suitable antenna must be used that provides a somewhat lower SWR on the bands of interest.

ALE TRANSMIT ANTENNA FOR COAX FEED AUTOTUNERS
An offset feedpoint dipole with a 4:1 balun or a coaxial fed fan dipole can provide a good enough match for coaxial autotuners to operate properly and provide the instantaneous tuning required for ALE operation.

ALE FEATURE IN AUTOTUNERS
Some manufacturers have ALE bypass switching in their autotuners, such as SGC or Icom, but the internal timing may not be adequate for good ALE operation or SSB voice.

A SOLUTION FOR ALL AUTOTUNERS
To solve all these problems, I've designed and used the autotuner antenna system shown in the diagram, with an external T/R switch, and a separate receive antenna. The basic set up is to enable the autotuner to operate only for transmit, into a good transmit antenna... then, use a separate antenna that does not require tuning, only on receive. This ALE Autotuner Antenna System is for use with all autotuners that do not have internal ALE bypass switching capability... such as SGC, LDG, Icom, Yaesu, etc. It is also possible to use a single antenna, with 2 T/R switches. Both of these systems are shown in the above diagram.

T/R SWITCH
A suitable coaxial T/R switch may be built homebrew or purchased complete. There are several different types of coaxial switches available on the market. Some transceivers have built-in receive antenna switching, and this can be used without the need for an external T/R switch.

SUITABLE MFJ T/R SWITCHES
Some MFJ products provide this T/R switch capability:
MFJ-1708 (RF Sense Transmit/Receive Switch)
http://www.mfjenterprises.com/Product.php?productid=MFJ-1708
MFJ-1026 (1.5-30 MHz Deluxe Noise Canceller)
http://www.mfjenterprises.com/Product.php?productid=MFJ-1026
MFJ-1025 (1.5 - 30 MHz Noise Canceling Antenna)
http://www.mfjenterprises.com/Product.php?productid=MFJ-1025

COMMENT ON MFJ T/R SWITCHES
I have used the MFJ-1026 for this purpose for many years, and therefore I can recommend it. Although I have not used the MFJ-1708, it is probably a more economical solution.

PTT T/R SWITCHING
For adequate ALE timing, it is recommended that the PTT switching output line of the transceiver is used to drive the T/R switch, rather than RF sensing. PTT transmit switching output is available at the accessory connector of most transceivers, commonly used to key the T/R of linear amplifiers.

FERRITE BALUNS AND CHOKES
Please note that I recommend ferrite coaxial chokes and ferrite baluns. Although it may be possible to operate without ferrites in the system, the performance on both receive and transmit will be degraded. I do not recommend "coax coil" chokes which are made by winding coax cable on a pipe or by looping coax cable. They do not work for
multiband operation, and their effectiveness is dubious for other applications.

RECEIVE ANTENNA
The receive antenna may be almost any type of antenna that provides low noise. I prefer an inverted V antenna cut for 10MHz. I have also used a vertical whip antenna, and a random wire antenna. Keep in mind that a ferrite coaxial choke should be used both at the feedpoint and on the coax cable just before it enters the building. This prevents local noise from power line, computer, monitor, TV sets, and lighting from being conducted into the antenna from the building. On the receive or transmit antenna, for the ferrite coaxial choke at the building, ferrite clamps can be used, but be sure to use at least 8 clamps in series.

CONCLUSION
I hope that this information will help to enable more operators to configure a viable ALE antenna autotuner system at their station. Perhaps many already have most of the
components necessary, such as a separate receive antenna and a balun or two, and most may only need a T/R switch and some coax jumpers to set it up.

Please feel free to discuss this system or other suggestions and comments, on the HFLINK forum.

TFD Terminated Folded Dipole (T2FD)

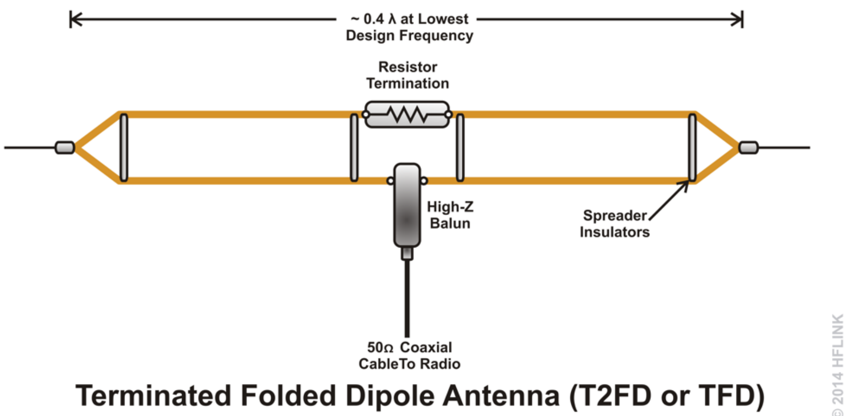
Article by Bonnie Crystal KQ6XA

The Terminated Folded Dipole, TFD or T2FD, is one of the most popular antennas for ALE Automatic Link Establishment. It performs well on the air, provides good SWR throughout the entire HF range, and does not require an autotuner or coupler. There are many commercial versions and homebrew flavors of the TFD.This article attempts to cover some of the historic background and evolution of this broadband antenna.

What Does T2FD Mean?

TFD or T2FD is a term of *initialism** that encompasses a classification group of antenna design. Terminated Folded Dipole is a folded dipole in which a resistive and/or reactive termination is inserted in the middle of the exposed loop of the active metallic dipole element circuit, opposite the feedpoint. The terminology and initialism has evolved over the past half-century, as variations in design have sprung forth, combined with the deep affinity among engineers and radio operators for descriptive jargon. The TFD or T2FD antenna is also known as a *Squashed Rhombic* and it is part of a more general category of Broadband Dipoles.

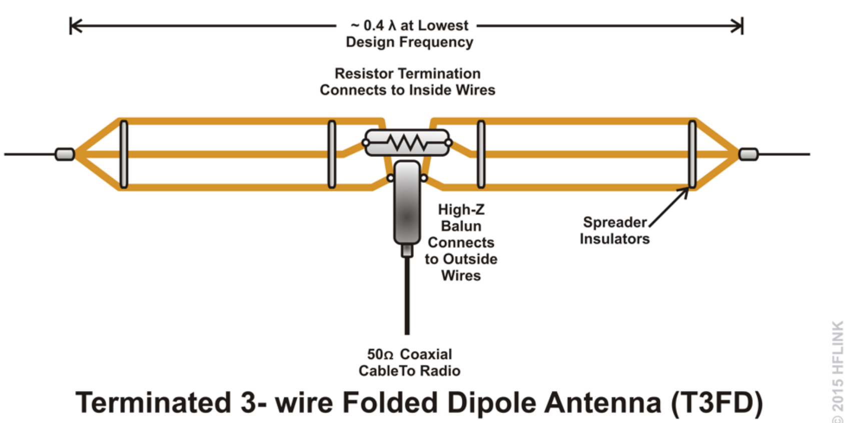
***Note**: Definition of **initialism** / in·i·tial·ism / iˈniSHəˌlizəm / *noun:* An abbreviation consisting of initial letters pronounced separately (e.g., *CPU*). Acronyms are abbreviations that are blended into pronunciation with syllables as if they were words (e.g., NASA or LASER).



Terminated Folded Dipole Antenna (T2FD or TFD)

Background History of the Name *T2FD Antenna*

Prior to 1949, the term TFD or TTFD originally stood for Tilted Folded Dipole, Terminated Folded Dipole, Terminated Tilted Folded Dipole, or Tilted Terminated Folded Dipole. see 1949 article snippet below By 1950 or 1951 it was widely known in commercial, military, and amateur radio. The TTFD term was converted to T^{2}FD (T-squared FD) and then T2FD with keyboards lacking superscript (the superscript ^{2} became a numerical figure 2). Insertion of other higher numerical integers (example: T3FD for a Terminated 3-wire Folded Dipole) into the initialism evolved much later, circa 1985 to 1990, as a shorthand for the number of half-wave elements connected in the active circuit of the dipole. Multi-wire TFDs became popular as they were found to have reduced termination losses, wider bandwidth, and higher radiation efficiency. T3FD, T4FD, etc.

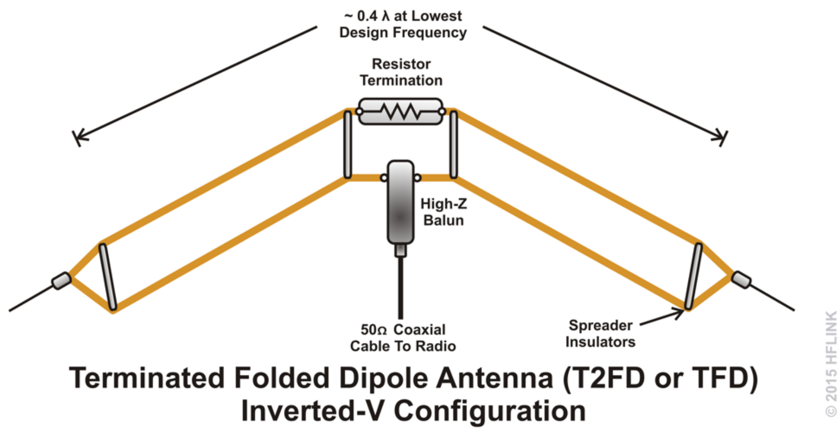


Terminated 3- wire Folded Dipole Antenna (T3FD)

To Tilt or Not to Tilt?

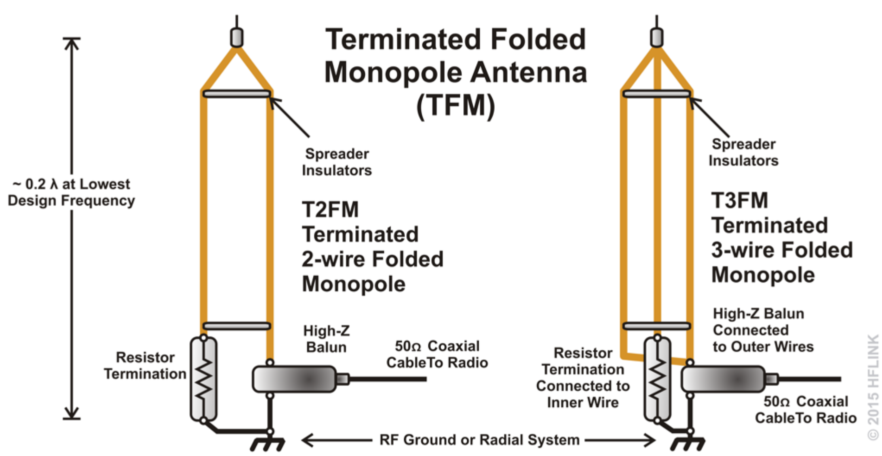
The recommended tilt or sloping dipole configuration in the T2FD original design articles purportedly achieved a particular beneficial radiation directional pattern for the application or location in which the antenna was developed, and this was widely carried over by other early experimenters.

The tilt was later found to be completely superfluous to basic TFD design and performance. The essence of the TFD antenna electrical structure can be applied to most all of the various orientation configurations of normal dipoles. It has a radiation pattern identical to a normal dipole of similar size. Tilt or slope is not necessary to the performance of the TFD. Tilt was found to be undesirable for NVIS and omnidirectional applications. Design requirements calling for tilt configuration or sloped installations are less common in modern installations, while the more popular Inverted-V or flat-top formats tend to be favored.



Yet the Tilt still lives on in antenna mythology and superstition. Some have joked that the Tilt made it a more complex acronym while imbuing black magic... therefore adding perceived value. At this point, most will agree that the TFD reputation benefits from such perceived value mystique, while simultaneously acknowledging that it continues to have many detractors. Below, some of the original articles show how the early T2FD was introduced and started to gain popularity.

Terminated Folded Monopole Antenna TFM T2FM T3FM
The Terminated Folded Monopole (TFM) is a derivation of the TFD, and it is usually implemented as a vertical antenna over an RF ground plane or a radial system. Like the TFD, the TFM can be designed as a multi-wire or cage antenna. T2FM, T3FM, T4FM, T5FM, etc. The TFM has the same broadband qualities as the TFD, but offers a lower footprint configuration and more omnidirectional pattern for different applications.



Article archive 1949: An Experimental All-Band Nondirectional Transmitting Antenna

An Experimental All-Band Nondirectional Transmitting Antenna

1949

Some Possibilities Offered by the Tilted Folded Dipole

BY G. L. COUNTRYMAN, * W1RBK, W3HH

FEW improvements in antennas for the lower-frequency bands have been forthcoming for several years. The arrangement to be discussed is not entirely original with the autor but was based on some Navy antenna studies.

• Those hams who are experimentally inclined will no doubt be interested in the possibilities that this antenna system suggests. Practical tests by the author have show that the single an-

Initial tests indicate that it may provide an acceptable solution to amateur multiband operation.

Briefly, it is an aperiodic system that will give uniform output over a frequency of approximately a 5-to-1 ratio with nondirectional characteristics and without critical adjustment. In fact, the only adjustment is to couple the final tank to a 600-ohm line.

The practical experiments conducted by the author are incomplete, but it is hoped that the publication of the data contained herein will encourage experimenting by other amateurs.

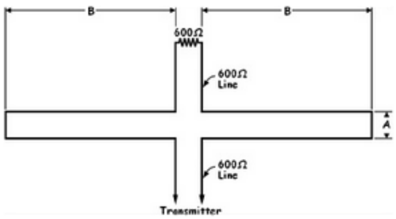


Fig. 1 General diagram of the terminated folded dipole. Dimensions for A and B are suggested in the text.

There are many questions unanswered: measured variation in standing-wave ratio over a given frequency range, loss in power attributable to the resistance termination, experimentally-obtained radiation patterns, etc.

Essentially, the system shown in Fig. 1 is a nonresonant folded dipole. It is fed with a 600-ohm line. This antenna, if horizontal, will be quite directional at right angles to its axis, with pronounced minima off the ends. As the antenna is tilted with respect to ground, this pattern gradually changes until at an angle of 30 degrees it becomes nondirectional for all practical purposes. Translated into terms of amateur construction this means that only one mast is required, together with a short pole six feet or so in height supporting the low end. There seems to be no marked advantage in an increase in over-all height of the antenna. On the contrary, reports from a distance indicate that signals are definitely better with one end of the antenna only six feet from the ground, perhaps because of a resulting lower angle of radiation.

* *Comdr.. USN: Electronics Officer, Boston Naval Shipyard, Boston, Mass.*

tenna may be operated over a frequency range as great as 5 to 1 with a relatively small change in the standing-wave ratio on the line and that the pattern is essentially nondirectional.

Because complications are introduced by the resistance termination, it is difficult to make an adequate analysis or evaluation of a terminated folded dipole by conventional methods. It becomes necessary to measure performance experimentally.

One of the Navy laboratories has investigated the performance of this type of antenna and has reported unfavorably upon it. However, the laboratory study was based upon a vertical monopole erected over a metallic ground plane, using conventional measuring instruments, and the characteristics obtained were applied mathematically to arrive at theoretical characteristics for the resistance-terminated folded dipole. Operational tests were not made by this laboratory and their theoretical findings are not borne out by the limited practical tests conducted by the author.

It is of interest to note that the standing-wave ratios estimated by the laboratory for various frequencies from 4 to 22 Mc. ranged from a minimum of 1.4 to a maximum of 2.6, with an average close to 1.7. These ratios compare favorably with average s.w.r.s found in amateur installations. It should be remembered that these standing-wave ratios were not measured but where arrived at by calculation.

Dimensions

Fig. 1 gives a general idea of the system with the important dimensions indicated except for

page 1

the angle of tilt. Fig. 2 indicates the required tilt with a suggested pole arrangement and dimensions pertaining thereto. Two particular sizes should be of interest to amateurs, one of which will have maximum efficiency from 3.5 Mc. to

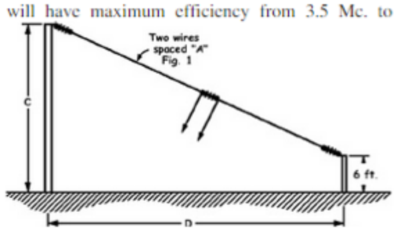


Fig. 2 Tilting the terminated folded dipole tends to make the pattern nondirectional. For dimensions C and D, see text.

17.5 Mc. and the other being optimum from 7 Mc. to 35 Mc. Dimensions may be developed using the formulas set forth to cover higher-frequency bands, but at 28 Mc. and higher frequencies directional arrays are easy to construct and preferable because of the increased gain. The following dimensions are applicable to the frequency ranges selected above:

Dimension (Figs. 1 and 2)	3.5 to 17.5 Mc.	7 to 35 Mc.
A	2 ft. 10 in.	1 ft. 6 in.
B	46 ft. 10 in.	23 ft. 5 in.
C	56 ft. 0 in.	32 ft. 0 in.
D	80 ft. 0 in.	44 ft. 0 in.

For an impedance of 600 ohms, the center-to-center spacing of the feeder wires, divided by the diameter of the feeder wires, must equal 70. This means that No. 12 wire spaced six inches will be acceptable. Six-inch spreaders are readily available and the wire will not stretch unduly. No. 10 wire should be spaced 7 inches and No. 16 wire should be spaced 3 ½ inches.

Terminating Resistor

protect it from the elements when it is installed at a fixed location on the ground than when it is suspended across an insulator in the antenna wire.

Formulas

The following formulas will be of assistance in developing antennas for different frequency coverages:

$$\text{Antenna-wire spacing (A) for lowest frequency} = \frac{3{,}000}{f\ (\text{kc.})} \times 3.28$$

$$\text{Antenna length, each half (B) for lowest frequency} = \frac{50{,}000}{f\ (\text{kc.})} \times 3.28$$

To convert decimal parts of one foot into inches, multiply by 12.
One meter = 3.28 feet.

$$\text{Frequency (kc.)} = \frac{300{,}000}{(\text{meters})}$$

The length of the antenna and the wire spacing may well be the object of further experiments but initial tests indicate that the first two formulas shown above are reasonably accurate and that the system is operable over a 5-to-1 frequency range as previously mentioned.

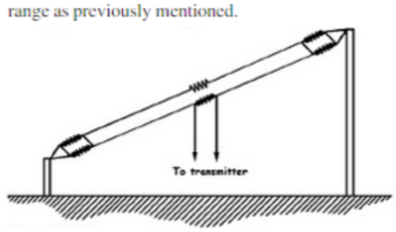


Fig. 3 The terminating resistor may be placed directly in the antenna, or at the end of a transmission line as indicated in Fig. 1.

Initial tests with these antennas indicate no change in signal strength on 40 meters at a distance of 2000 miles when compared with a

The terminating resistor should be non-inductive and have a minimum rating equal to 35 per cent of the input power to the final stage. It may be a carbon or graphite rod, adequately protected from the elements, or merely a long 600-ohm transmission line constructed of resistance wire. If the latter is used, the line may be carried vertically down from the center of one leg of the antenna to a short pole and then, if required, extended to one of the masts and doubled back and forth between the masts. If a carbon resistor is used, there is apparently no difference whether the rod is connected directly into the antenna as shown in Fig. 3, or at the end of a transmission line, as shown in Fig. 1. However, it is easier to adjust the resistance and conventional half-wave antenna, center fed with tuned feeders and carefully adjusted for optimum output at one selected frequency. Good reports were received on both 20 and 80 meters but comparative reports are not available because of the lack of antennas specifically designed for those bands. Transmitter loading was normal.

Article archive 1951: Performance of the Terminated Folded Dipole

Performance of the Terminated Folded Dipole

November 1951

G. L. COUNTRYMAN, W3HH*

Every once in awhile an antenna comes along that could be put to good use by the average amateur. The Terminated Folded Dipole (also known as the T2FD) is just such an antenna. Unfortunately, it has not been given its due publicity. This article is designed to clarify some of the points on the construction, as well as, report upon experimental results. —Editor.

INITIAL EXPERIMENTS with a terminated tilted folded dipole antenna were described by the author some two years ago.[1] This antenna has omnidirectional characteristics and a 5 or 6 to 1 frequency ratio which means that one "untuned" antenna is all that is required for operation on from three to five amateur bands.

The antenna has a definite application in connection with emergency communications in the lower frequency bands.

1. One antenna is all that needs to be erected for operation on several bands.
2. Only one elevated point (pole, tree or house gable) is required
3. Less space along the ground is needed for any given frequency as the flattop portion is shorter than the usual one-half wavelength.

Basically, the antenna is the hypotenuse of a right angle triangle, one leg of which is along the ground, as shown in *Fig. 1.* The spacing between the folded dipole wires, in feet is equal to 3,000 divided by the frequency in kilocycles, and the result multiplied by 3.28. The length of each leg in feet (from either end to the center insulator or resistor) is equal to 50,000 divided by the frequency in kilocycles, and the result multiplied by 3.28. The terminating resistor should have a wattage rating equal to 35% of the power input to the final stage, and should have a resistance equal to the impedance of the two wire feeder system—usually 600 ohms.

*Capt., USN, 309 Windsor St., Silver Spring, Md.

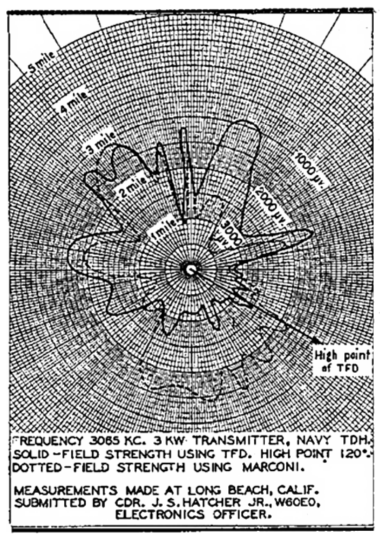


Figure 2

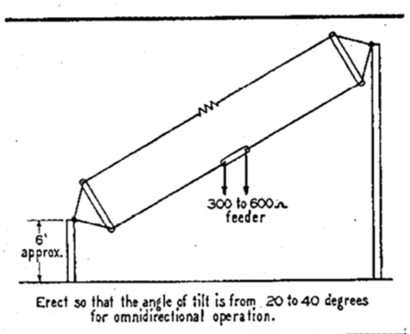


Figure 1

The formulas given are for the lowest frequency on which operation is desired. Applying these formulas, an antenna that will work well on the 10, 11, 15, 20 and 40 meter bands may have an overall length of forty-seven feet, with the two wires spaced about 17 inches.

During the past few months the response has indicated that there is considerable interest in, and several applications successful of the T2FD antenna. Some criticism from the theoretical gentlemen who dismiss the practicability with the statement; "It won't work," has also been received.

As far as the author is concerned, work on the antenna has progressed spasmodically, due to the

pressure of other duties, although additional tests continue to indicate that the formulae for length and spacing are accurate. Elsewhere, experimenters have reported advantages to be gained by spacing according to formula at the antenna ends, and doubling that spacing at the center. The author than a comparative single wire and "earth". He used an RCA AR88D in the receiving tests.

Commander H. E. Thomas, USN, W3AIU has reported that four of these antennas were erected at the Naval Station, Long Beach, California. Each T2FD was connected to a separate transmitter doubling that spacing at the center. The author has found that this apparent advantage is realized

Comparative Signal Strength at 3 Receiving Locations

Transmitting Antenna - Hitoyoshi

Local Time	1/2 wave doublet			W3HH Antenna - 30° tilt angle		
	Kagoshima	Miyazaki	Oita	Kagoshima	Miyazaki	Oita
0800	-	-	-	-	-	-
0900	4	2	2	4	2	3
1000	3	1	2	4	2	3
1100	2	1	1	-	-	2
1200	3	1		2	-	-
1300	2	1	2	-	-	-
1400	2	1	-	3	1	2
1500	3	1	-	-	-	-
1600	3	2	2	3	2	3
1700	2	1	3	2	2	-
1800	3	1	3	3	3	-
1900	2	3	1	-	-	-

Reception at Kagoshima and Miyazaki was on 2530 kcs.
Reception at Oita was on 3830 kcs.
- indicates no measurement due to QRM, QRN or other reasons.
Fractions in signal strength have been reduced to nearest whole number.

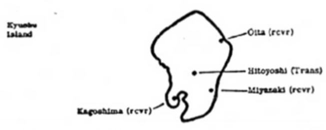


TABLE I

only because a center spacer is needed that will keep the wires fixed in their relative positions. It definitely appears that a center spacer is a good idea, but the dimension should keep the two antenna wires parallel throughout their entire length.

The only modification to the original data is that further experiments indicate the angle of tilt is not critical. Any tilt angle from about 20 degrees to about 40 degrees will radiate with omnidirectional characteristics. This greatly increases the flexibility of the system.

Performance Review

Leo Carreras, W3EC, reports that one antenna has been used on the Model TCC transmitter at NDM for over a year on all frequencies with results superior to individual antennas on the various bands. The other antennas have since been removed. The Model TCC is a Navy 1 KW transmitter of modern design, with a frequency range from 2,000 to 18,000 kc.

Captain H. O. Crisp (RAF), now retired, reports highly satisfactory results and suggested a wide center spacing. He also reports excellent results on receiving—considerably greater than could be accounted for by the antenna and transmission line presentng a better input match to the receiver

Field Intensity in db at Various Horizontal Angles

Tilt Angle of Antenna

Horizontal Angle in Degrees	44°	38°	30°	24°	18°
0	122.5	120	120	119.5	120
10	121.5	121	121.5	120.5	120
20	121.5	121.5	121.5	121.5	120.5
30	120.5	121.5	121.5	121.5	120.5
40	120.5	120.5	120.5	121.5	120.5
50	121.5	120.5	121.5	120.5	120.5
60	121	121.5	120.5	120.5	120.5
70	120.5	120.5	120.5	120.5	120.5
80	119.5	119.5	119.5	119.5	116.5
90	119.5	119.5	119.5	119.5	117

The horizontal angle is taken relative to plane of antenna. Under the same conditions, the field intensity of a conventional Zepp Antenna was 115.5 at all horizontal angles.

TABLE II

T2FD was connected to a separate transmitter. They were used over the entire frequency range of the antenna with excellent results. The antennas were erected along the sides of a square with the building housing the transmitters in the center of the square. Poles were erected at each corner and each antenna ran from the top of one pole to a point near the bottom of the pole at the adjoning corner. *Figure 2* shows field strength measurements made at this station comparing the T2FD and the Marconi antenna formerly used.

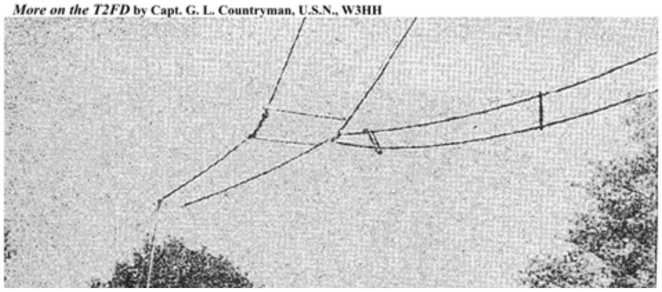
Some of the most interesting observational material was from Mr. Yasuhiro Itahashi. Mr. Itahashi is a Radio Engineer for the Kyushu Electric Communication Bureau (Japan). After extensive tests Mr. Itahashi has recommended that the T2FD antenna be used for all coastal, emergency and domestic radio transmitting stations on Kyushu Island. His permission has been received to publish the results of some of their field strength checks and propagation tests.

Briefly their experiments indicated that the tilted folded dipole was superior to the "Zepp" and one-half wave doublet types previously employed. Wide band characteristics were observed and the T2FD resulted in a 4 to 8 db increase in the signal at their various receiving locations. Tables I and II are self explanatory and should be of interest to antenna minded experimenters. Table I shows that reception from the tilted folded dipole gave an equal or louder signal at three widely separated locations, as compared to conventional dipoles. Table II shows the actual field intensity in db at five different tilt angles over a 90 degree horizontal pattern. The field strength from the same transmitter using a horizontal "Zepp" antenna was 115.5 db at all points. The distance from the field strength meter to the antenna was about two miles.

The author has had excellent practical results with the antenna. One big advantage to many hams who are not fortunate enough to live in an area permitting an "antenna farm" is that only one elevated point is required. Only 80 feet along the ground is required for operation on 75 and 80 meters, and only about 45 feet is required for a 40 meter T2FD. The 80 meter antenna will function equally well on 40 and 20, while the 40 meter job will give excellent results down to and including the ten meter band.

Article archive 1953: More on the T2FD

More on the T2FD by Capt. G. L. Countryman, U.S.N., W3HH *February 1953*



There is certainly nothing fancy or difficult in erecting a T2FD. This is the author's antenna. The peculiar photographic angle is due to the slope (coming towards the reader) of the antenna

tenna.

More on the T2FD

CAPT. G. L. COUNTRYMAN, U.S.N., W3HH

309 Windsor Street, Silver Spring, Maryland

While the average citizen walking down the street thinks and talks a lot about the weather, the average amateur radio operator is generally most concerned about his antenna. It, like another invaluable item, comes in an infinite variety and will probably never cease to attract interest and discussion.

About a year ago, CQ printed a little article on a type of folded dipole called the "T2FD." It was, in every sense of the word, a "sleeper." Those who put it up were amazed by its ability to load on three or more amateur bands. Others acclaimed its omni-directional properties, while a third group insisted that it radiated most of its energy at the most favorable vertical angles of radiation. Oddly enough, there still seemed to be some theory-bound skeptics who insisted that it couldn't work. For the benefit of those few, and for the fellows who haven't tried this unusual antenna, we append a few comments.—Editors.

"While looking for a compact antenna for my small backyard . . . I decided to give it a try.

"I put one up for 40 meters and the first night I worked all but the 6th district. Next night I thought I would see what would happen if I tried to load it on 80 meters. On first CQ I got a 579X report with only 40 watts input!"

W8IKB

"Saw your antenna just as I was about to put up the Zepp I use during the winter. Gave your plan preference and the next day . . . I casually asked for a report . . . and got 40 over S9 with doubts about my 450 watts. They said that the kilowatts were generally S6. This was on 75-meter phone.

"Next morning I tried 10-meters and heard more DX than on a beam at this location. In general, the T2FD surpasses anything I have used on 75-meter phone which included long wires up to 500 feet, center-fed and end-fed Zepps, and shortened center-fed Zepps with long feeders."

WØMIO

"I assisted VE1UL while erecting a T2FD and he found it to be one of the best antennas he had used."

VE1KQ

Several years ago the author experimented with a terminated, tilted, folded dipole that offered possibilities for ham use. The initial data appeared in *QST* for June 1949 on page 54. Apparently very few hams read the article, or, if they did, skimmed over it lightly. Certain communication services took it seriously, however, and the author continued to have excellent results with the system. Another article made its appearance in the November 1951 issue of *CQ*, and there is no doubt that this article was not only read, but that many brother hams went to the trouble of erecting a T2FD, and reporting its excellent performance.

Since then, more than a year has elapsed, and the mail continues to roll in. This article is now being published in self defense, as there is no time to answer the many letters. Most of these fall into two categories. First are the letters reporting excellent results with this "all-wave" omnidirectional antenna. Next come the questions, and they all follow a general pattern. Here are the answers to the questions most frequently asked:

page 1

More on the T2FD
Capt. G. L. Countryman, U.S.N., W3HH

page 2

Question: Is the use of a non-inductive terminating resistor necessary?

Answer: No. However, if you use a wire wound resistor, the antenna is not aperiodic and will resonate at some frequency. The difference is that with a wire-wound resistor it will be necessary to use some form of antenna coupler depending on your installation, and the coupling will probably be different for the various bands. With a non-inductive resistor the system is aperiodic and one coupling method will be satisfactory for all bands. This advantage is offset to some extent by the fact that the resistance value is fairly critical and it is convenient to adjust a wire-wound resistor with slider. Sprague makes a non-inductive "Kool-Ohm" in a 120-watt size that will handle an input to the final of 350 watts. Rhombic non-inductive terminating resistors in larger wattage ratings are still available, now and then, at surplus outlets.*

T2FD Basic Design Data

(See Fig. 4)

1. The length of each leg from the center is equal to 50,000 divided by the lowest desired operating frequency (in kc.) and then multiplied by 3.28. The answer is in feet.
2. The spacing between radiating wires is equal to 3000 divided by the lowest desired operating frequency (in Kc.) and then multiplied by 3.28. The answer is in feet.
3. The sloping angle for a nondirectional pattern should be of the order of 30 degrees.
4. The terminating resistor should be non-inductive and have a rating equal to 35% of the transmitter input power. For further details see the text.

Question: Must the resistor be exactly the same resistance as the feed line impedance?

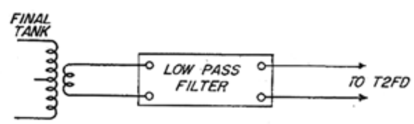


Fig. 1. The T2FD may be coupled to the final with a simple link. The use of a low-pass filter to prevent TVI is recommended.

Question: Is the antenna equally good on receiving and transmitting?

Answer: Definitely, provided the optimum resistance value is established and used. Rush Drake, W4ESK, reported that during the 1951 CQ DX Contest he "couldn't hear 'em on 80" with a hastily erected T2FD, but he had made no effort to establish an optimum value for the terminating resistor, and used the antenna only a few hours. (It's interesting to note that he won the contest!)

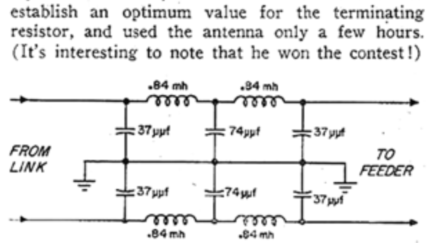


Fig. 2. This simple filter, when inserted as shown in Figure 1, has worked very well with 600-ohm lines.

Question: How is the transmission line coupled to the final amplifier?

Answer: If a non-inductive resistor is used, a simple link *(Fig. 1)* is all that is required. Remember that you must couple at your line impedance.

Answer: No. The value of the resistor is quite critical for optimum results, especially as the impedance of the feeder decreases. For example, with a 600-ohm line (No. 12 wire spaced 6 inches), a value of about 650 ohms seems best although operationally a 600-ohm resistor appears to be entirely satisfactory. When using 300-ohm twin-lead, the optimum resistance is 390 ohms, which results in a tremendous gain, approximately 30 db, over a 300-ohm resistor, although any value from 375 to 400 ohms gives excellent operational results. With 450-ohm line, a 500-ohm terminating resistor will be satisfactory. With lines of lower impedance including coaxial cable, reports indicate that for optimum results the value of the resistor is critical within about 5 ohms, although the author has used only open lines and twin-lead in his work.

* The PHOTOCON SALES (417 N. Foothill Blvd., Pasadena 8, Calif.) have advised us that they have the following available from stock, as this is being written.
300-ohm G.E. globar resistor (200-watt rating) new at $1.50 each.
600-ohm G.E. globar resistor (100-watt rating) new at $1.00 each.

otherwise your antenna will not load properly. For a 600-ohm line, a 3-turn link should be used for 20 meters and a 6-turn link will be a good match at 40 and 80. The B & W plug-in links are perfect in this application.

Question: How about TVI?

Answer: That's a good question! The usual precautions regarding parasitics, shielding, feedback into the a-c line, etc. should be taken. A low-pass filter in the line is best for all-band operation. If you operate on one band the half-wave "Harmoniker" type is better, but if you are on only one band, why worry about the T2FD? *Figure 2* shows a simple low-pass filter satisfactory for 300- to 600-ohm lines. Low-pass filters are available commercially for all line impedances.

Question: Should the two antenna wires be side-by-side or one over the other?

Answer: This is immaterial, although it usually is easier to erect them side-by-side, in the same plane as the surface of the earth.

Construction Notes

Now for some helpful hints. The best connectors for the round end terminals of a resistor approxi-

More on the T2FD
Capt. G. L. Countryman, U.S.N., W3HH

page 3

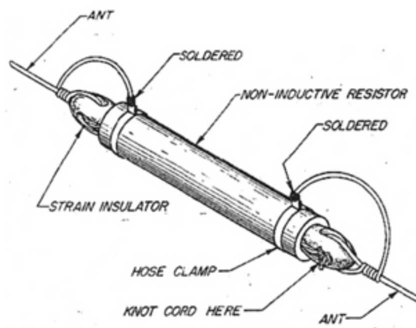


Fig. 3. A very easy method of mounting the terminating resistor is shown above. Note that two egg type insulators are tied together with a short length of heavy cord. This cord runs down the hollow center of the terminating resistor. The radiating wires are attached to the insulators and short jumpers brought over to the resistor terminals.

mating one inch in diameter are ordinary hose couplings, available in any hardware store for a dime. They won't rust and no soldering to the resistor is necessary, although the antenna should be soldered to the connectors.

No strain should be placed on the resistor. If it is hollow, and it usually is, a stout cord, similar to a venetian blind cord can be passed through it and a strain insulator used at each end, as shown in *Fig. 3*. Use spreaders at each end of a heavy resistor. A ⅜-inch diameter wood dowel is fine. Wipe them with oil before installing. A threaded ³⁄₁₆-inch diameter brass rod is ideal for the high end and it serves both as a spreader and connector for the two antenna legs. At the low end it is usually easier to attach insulators to a short pole

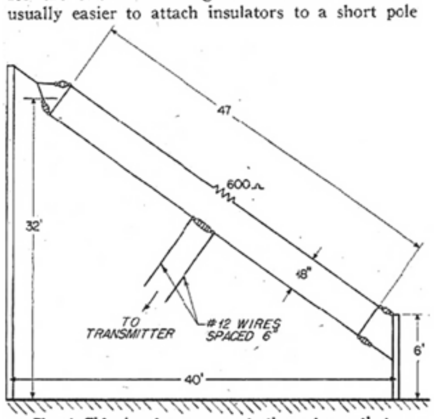


Fig. 4. This drawing represents the antenna that appears on the opening page of this article. Although it was cut for the 40-meter band it has been used on 80 meters with only a small

or building (far enough apart to give the proper separation) and solder a connecting wire between the two antenna legs.

Further experimenting indicates that formulas for length and spacing previously published for the lowest frequency to be used remain the best. However, with negligible operational loss an antenna cut for 40 meters will, for example, load perfectly on 80. *Figure 4* shows the installation the author has used for some time on 20, 40 and 80 with excellent results. On 40, the band for which the antenna is cut, the T2FD is definitely superior to a "center-fed Zepp" for DX. Reports average two S-figures higher from Europe, South Africa and Australia even though the loading to the final amplifier is slightly less than with the tuned-feeder current-fed antenna used as a "standard."

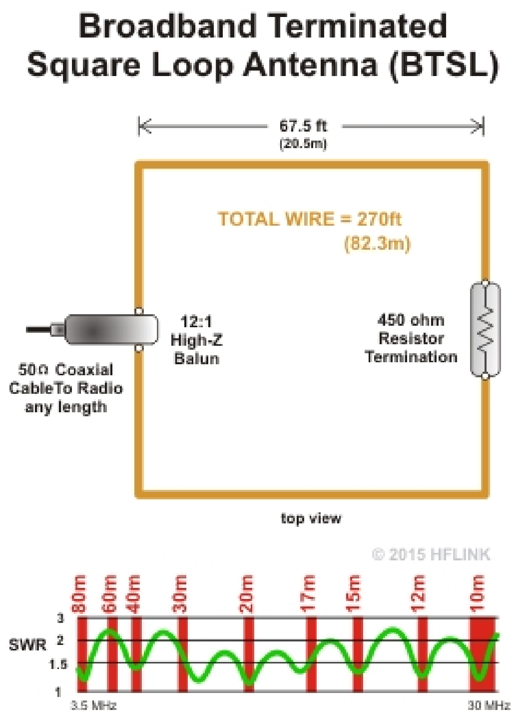
There is a "mental hazard" with the T2FD that is hard to overcome. Upon seeing an antenna with one end only six feet from the ground (in contrast to the usual "higher the better" skywire), one experiences a natural reaction to the effect that "It won't get out." Don't be fooled. The T2FD will hold its own with other omni-directional antennas and normally out performs any of them when properly loaded.

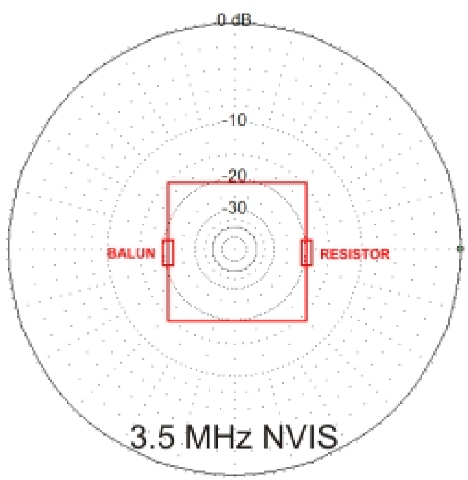
This may be a good place to mention that the long-haired gents still cast a jaundiced eye at the "squashed rhombic." Admittedly it is theoretically inferior but it may be time to overhaul some of our theory! The U. S. Air Force finds it acceptable at Pacific Bases; the British RAF are well satisfied; our Navy uses it at certain locations; Japanese domestic communications on Kyushu use it exclusively, and some 200 Hams have taken the trouble to express to the author the excellent results they have obtained. It's not a "cure all" but if you want a simple unostentatious skywire, which requires little space, that will put out in commendable fashion on 3 or 4 ham bands and is omni-directional, you can't do better than put up a T2FD some Sunday afternoon.

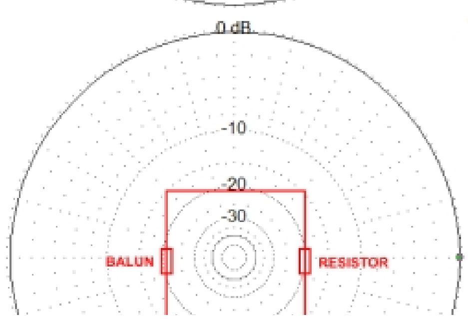
Broadband Terminated Square Loop Antenna (BTSL)

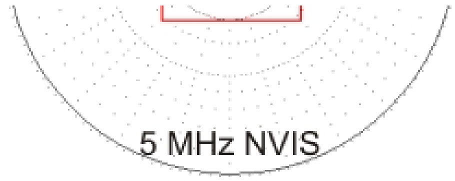
Article by Bonnie Crystal KQ6XA

The following diagram shows a typical BTSL Antenna configuration, SWR curve, and radiation patterns. The length and impedance is optimized for low SWR in the Amateur Radio HF bands. It is a horizontal loop, constructed of wire. The terminating resistance is 450 ohms, and the balun may be either 9:1 or 12:1 impedance ratio. The SWR in the 4MHz to 6MHz range is better with the 12:1 balun. It is made with the same components commonly found with T2FD or T3FD antennas. The main difference between the T2FD and the BTSL is: the BTSL has superior NVIS performance. However, at lower radiation angles (below 45 degrees) on 7MHz to 30MHz, it breaks into directive beam lobes, mostly favoring the general direction of the resistor termination. This can be either an advantage or undesirable, depending on the user's application and location.

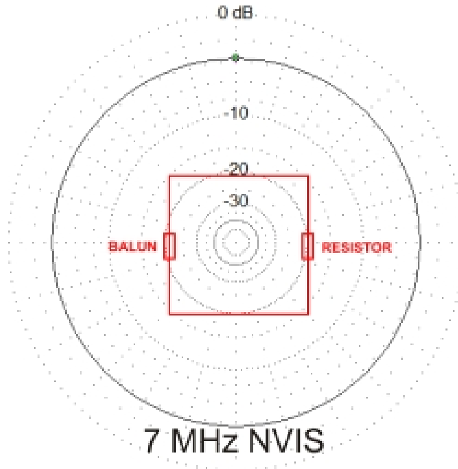




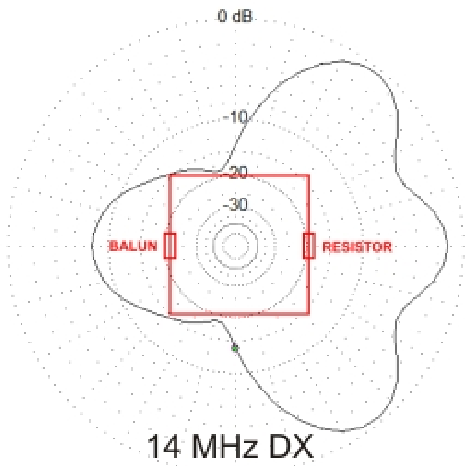




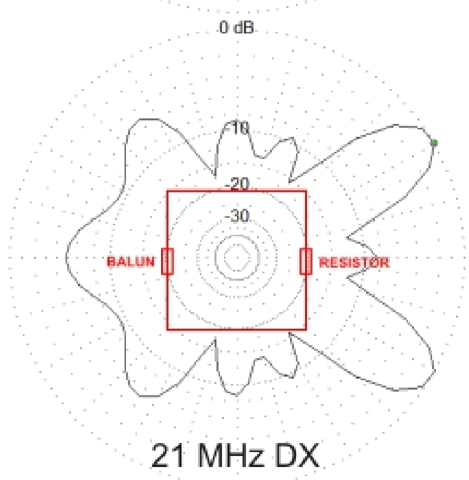
5 MHz NVIS



7 MHz NVIS



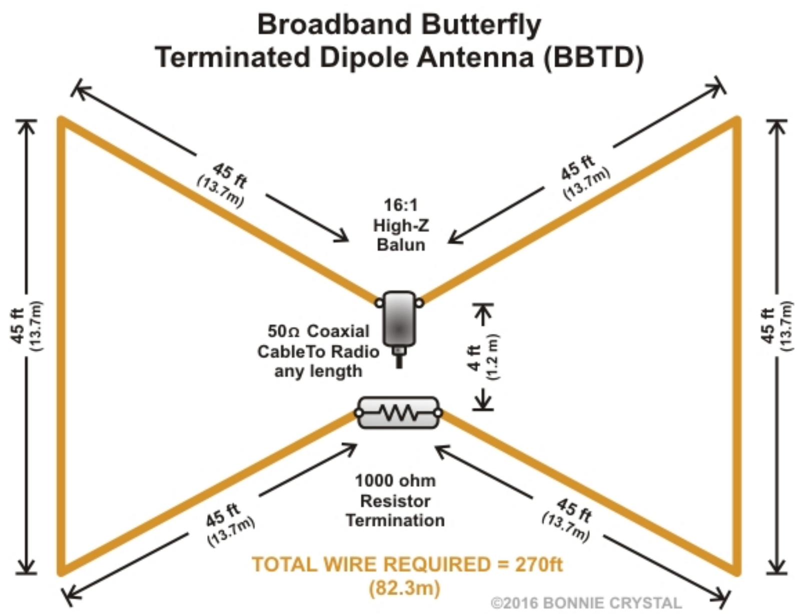
14 MHz DX



21 MHz DX

Broadband Butterfly Terminated Dipole Antenna BBTD
3 MHz to 30 MHz
2:1 SWR or less

Article by Bonnie Crystal KQ6XA

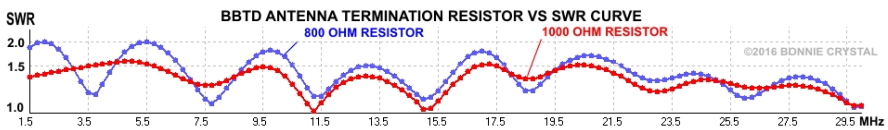


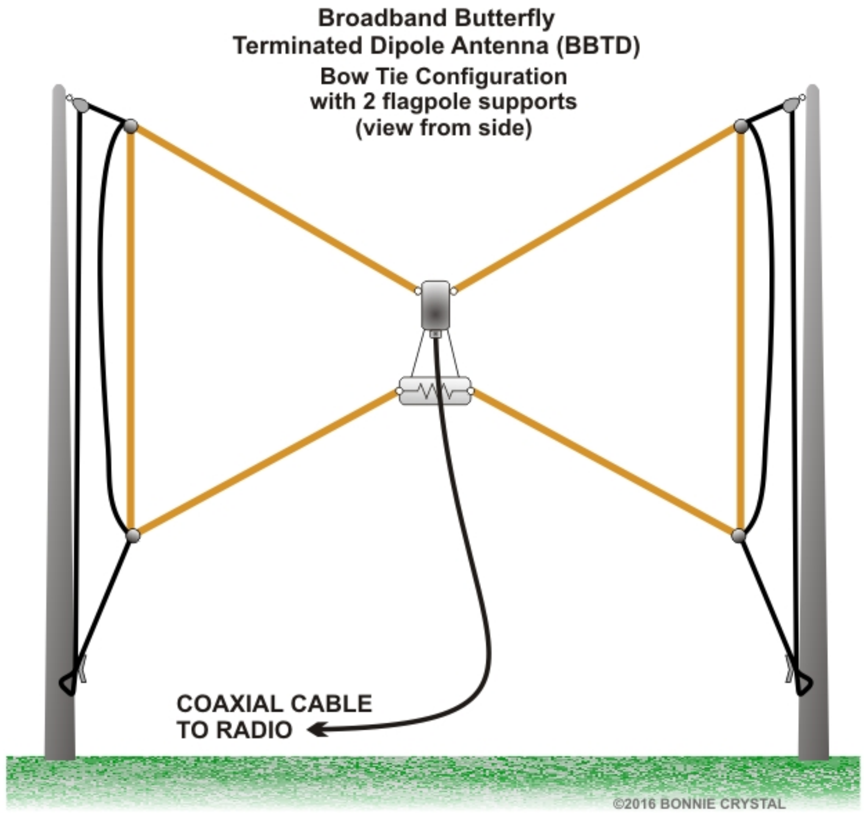
About the BBTD Antenna
The Broadband Butterfly Terminated Dipole antenna (BBTD) was invented by Bonnie Crystal (KQ6XA). It is a type of traveling wave antenna, similar to a terminated folded dipole antenna (T2FD or TFD). But, the BBTD antenna is constructed of triangular or irregularly-shaped elements, instead of narrow rectangular elements. The triangular geometry has many structural and electrical advantages over a common T2FD:

1. There are no spreaders, making it easier to construct than a T2FD.
2. Radiation efficiency gain approximately +2dB better than a T2FD.
3. Less visibly obtrusive and more stealthy than a T2FD.
4. Good NVIS high angle regional performance below 14MHz.
5. Good DX performance at 14MHz and above.
6. Lower frequency rolloff knee than T2FD of same length.
7. Smooth and well-matched SWR curve.
8. Omni-directional radiation pattern.

Prototype Construction of a BBTD
The first prototype, as shown in the above drawing, was built in 2016 to fit within a horizontal area constraint of 100 feet between 2 supports. The prototype is built as if looking at it from the side in the drawing, with the appearance of a bow tie. It had an SWR design goal of less than 2:1 from 1.8 MHz to 60 MHz. The measured SWR of the prototype is about 1.5:1. It covers 80 meters through 10 meters continuously with no gaps. The prototype utilized a 16:1 balun and an 800 ohm non-inductive resistor termination, but a **1000 ohm resistor is recommended** for best SWR over the entire HF range. **The resistor should be rated at the full transmitter power**. Fed with 50 ohm coax, a tuner is not needed.

BBTD Antenna Termination Resistor vs SWR Curve
For best SWR, the optimum value of termination resistor is 1000 ohms. The value of resistor is not very critical. Any value between about 800 ohms and 1200 ohms may be utilized. The value of 800 ohms works well for the HF ham radio bands (800 ohms is a commonly available termination resistor for T2FD antennas). The following graph shows the computed SWR curve for either 800 ohms or 1000 ohms. Prototype testing found the SWR is similar to results of the BBTD Antenna NEC2 computer model BBTD_Butterfly_Prototype1_as_built_4s.nec (zip file)



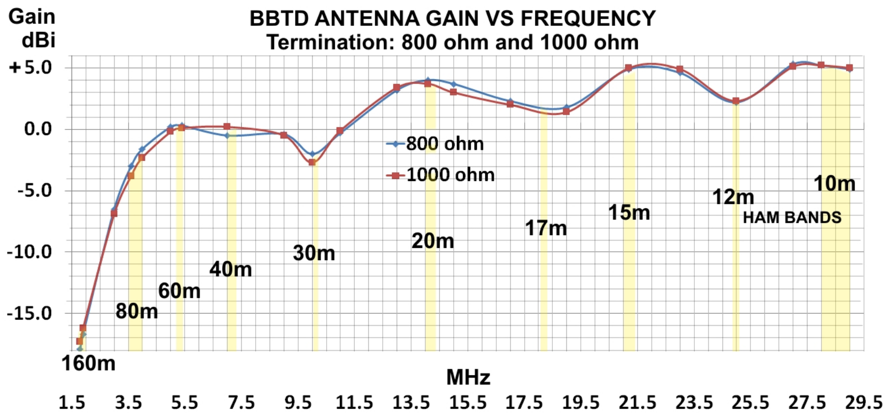


BBTD Bow Tie Configuration
The above image shows a side view of a BBTD antenna in the *bow tie* configuration with 2 flagpole type supports. A simple arrangement of insulated rope or cord provides the taut structural shape of the antenna. The center balun is supported by the upper wires of the antenna, and the resistor termination is suspended below the balun by insulated rope or cord. Stealthy construction using trees is possible with this configuration.

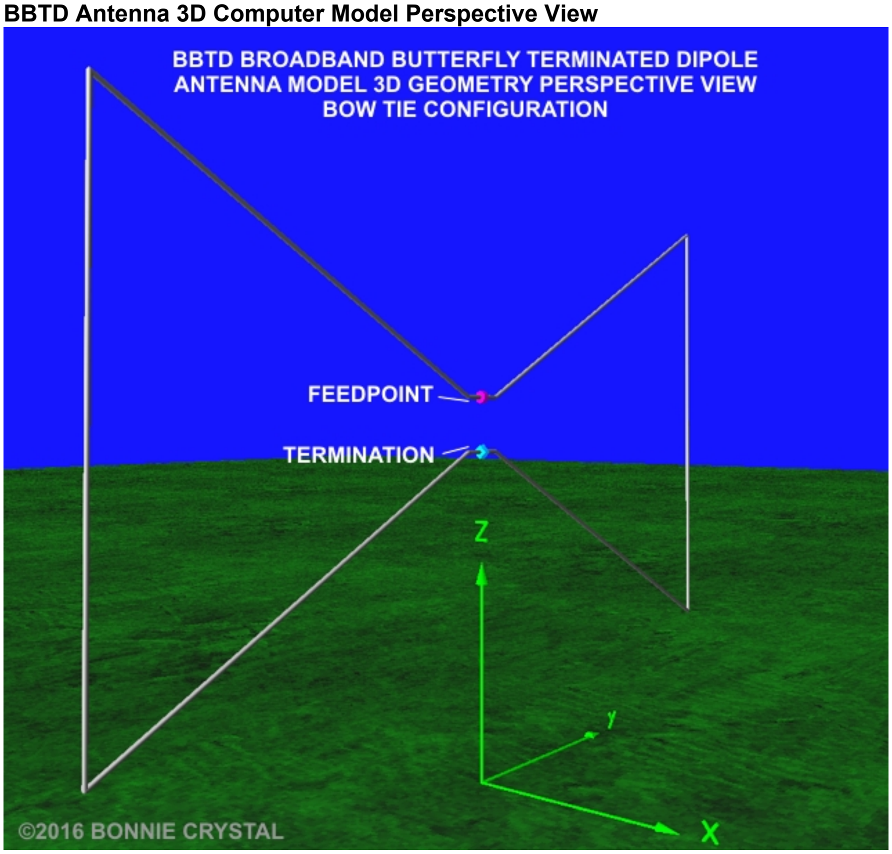
Gain and Efficiency of the BBTD
The model of the BBTD bow tie configuration prototype has a calculated gain (dBi) as shown in the following table:

MHz	Gain dBi 800 ohm termination	Gain dBi 1000 ohm termination
1.8	-17.9	-17.3
1.9	-16.7	-16.2
3.0	-6.5	-6.9
3.6	-3.0	-3.8
4.0	-1.6	-2.3
5.0	0.2	-0.2
5.4	0.3	0.1
7.0	-0.5	0.2
9.0	-0.4	-0.5
10.0	-2.0	-2.7
11.0	-0.3	-0.1
13.0	3.2	3.4
14.1	4.0	3.7
15.0	3.7	3.0
17.0	2.3	2.0
19.0	1.8	1.4
21.2	4.9	5.0
23.0	4.6	4.9
25.0	2.2	2.3
27.0	5.3	5.1
28.0	5.2	5.2
29.0	4.9	5.0

Graph of BBTD Antenna Gain vs Frequency



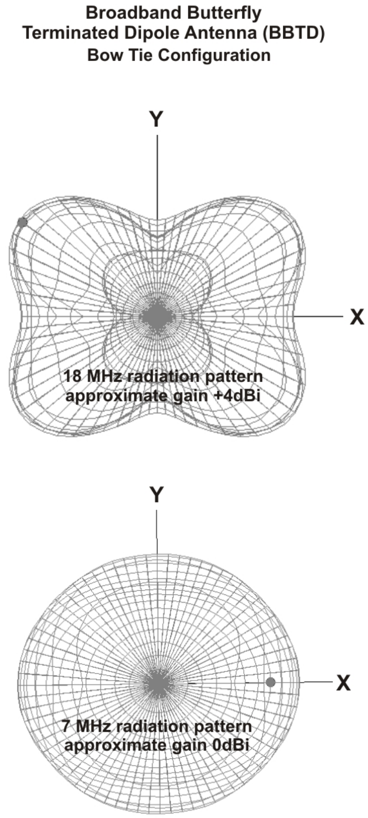
BBTD Antenna 3D Computer Model Perspective View



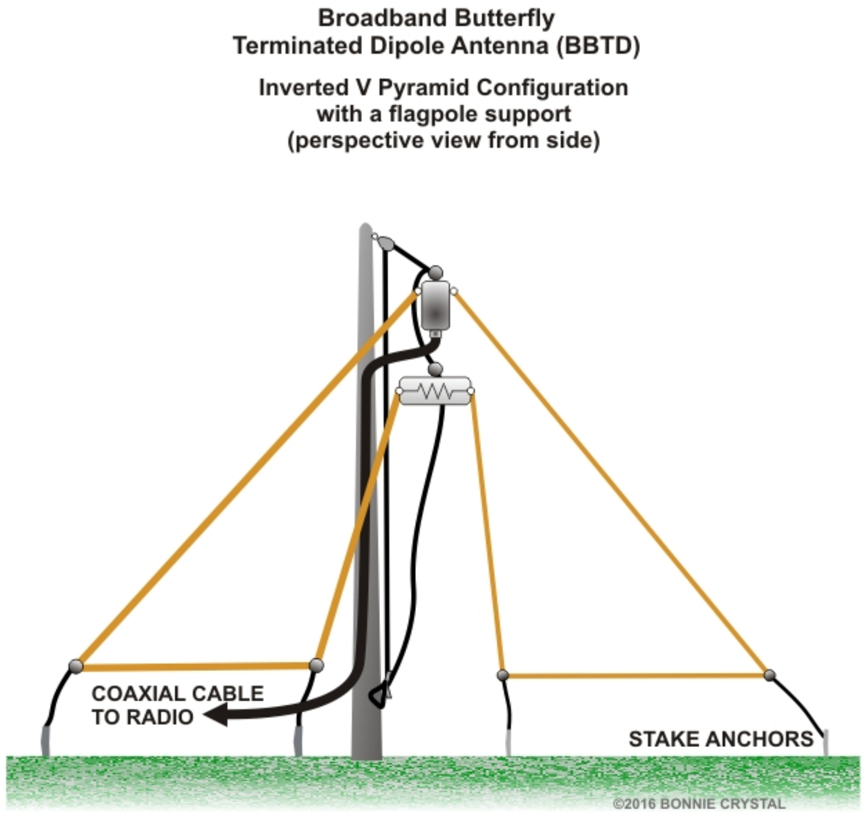
Operation on the 160 Metre Band
The *bow tie* configuration prototype BBTD with dimensions shown above has a low frequency efficiency knee drop off around 3.5 MHz. With a gain of about -16dB on 160 meters, it is very inefficient. But the SWR is good :) On 160 meters SSB with 100 Watts at night, it can still be expected to work stations out to a radius of about 300 miles. One suggested method to get better performance below 2 MHz is to disconnect the termination resistor with a relay, then use an antenna tuner at the radio.

Radiation Pattern of the BBTD
Antenna models show that the BBTD *bow tie* configuration is omni-directional at 14 MHz and below. See the radiation pattern plot image below. At frequencies of 18 MHz and higher, it shows a vague omni X pattern. It is more omni-directional than a dipole of similar size and position. The Inverted-V or other horizontal configurations are expected to exhibit similar patterns.

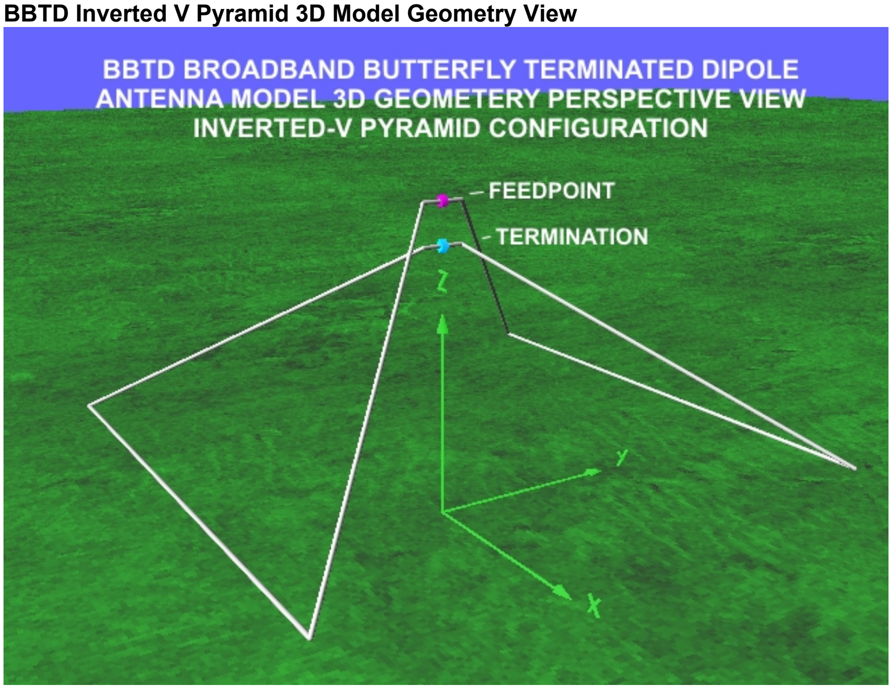
Radiation Pattern Plots for BBTD Antenna in Bow Tie Configuration



BBTD Inverted-V Configuration
The image below shows a side perspective view of a BBTD antenna in the *inverted V* configuration with a single flagpole type support. The bottom sides of the triangular wire elements should be deployed as far above ground as possible, and staked out to anchors with insulated rope or cord. Stealthy or temporary construction using a tree is also possible with this configuration.



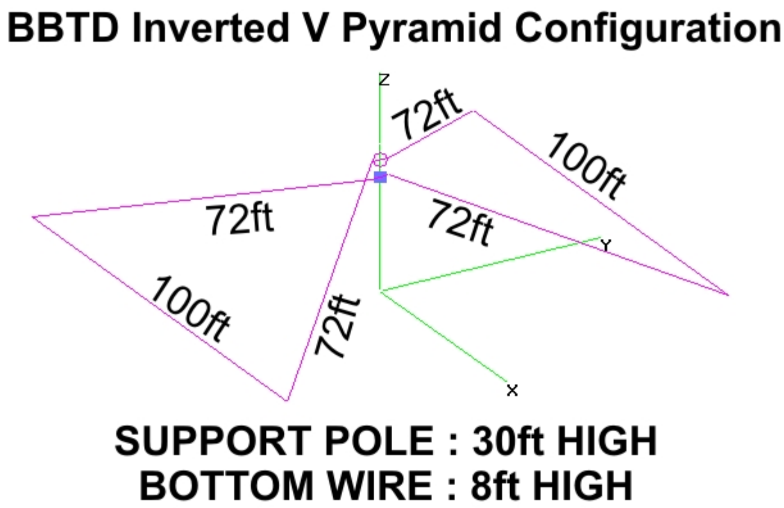
BBTD Inverted V Pyramid 3D Model Geometry View



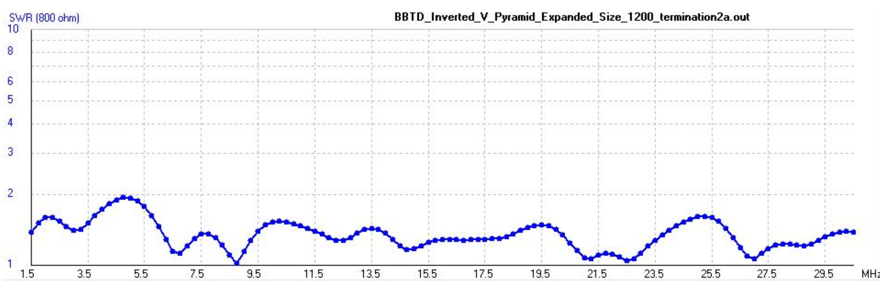
BBTD Inverted V Pyramid (Large Size) Model Dimensions
A large size BBTD Inverted V Pyramid configuration is modeled in 4NEC2 . This configuration has a -3dB low frequency knee at 3.5 MHz. The model is designed with the following details:
Shape: square base pyramid
Feedpoint impedance: 800 ohms (16:1 balun)
Termination resistor: 1000 ohms
Resistor power rating: Same Watts as transmitter power Watts.
Total wire: 488ft
Leg wire length: 72ft
Horizontal wire length 100ft
Height of feedpoint: 30ft

Height of termination: 26ft.
Height of horizontal wire: 8ft

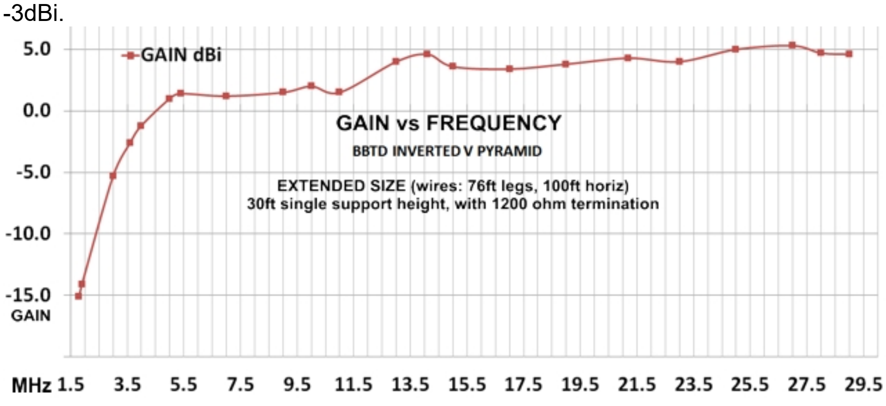
BBTD Inverted V Pyramid (Large Size) Model Diagram with Dimensions



BBTD Inverted V Pyramid (Large Size) SWR Curve
The model shows a good SWR, below 2:1 over the entire MF-HF range from 1.5MHz to 30MHz.

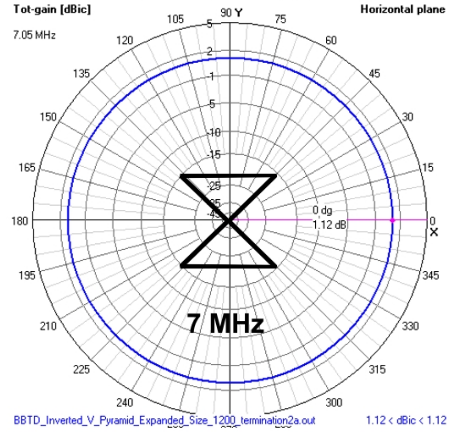


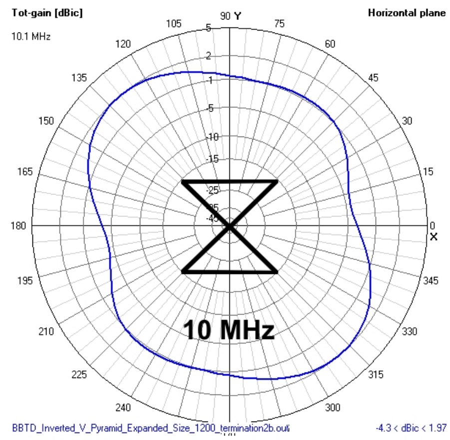
BBTD Inverted V Pyramid (Large Size) Gain vs Frequency Graph
The model shows a gain of about +5dBi above 13MHz, and good performance on lower frequencies. The efficiency drops off at around 3.5 MHz, where the gain is about -3dBi.

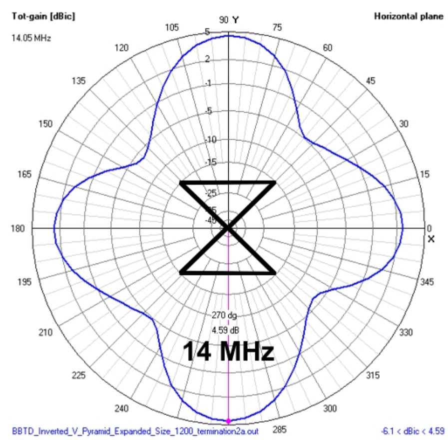


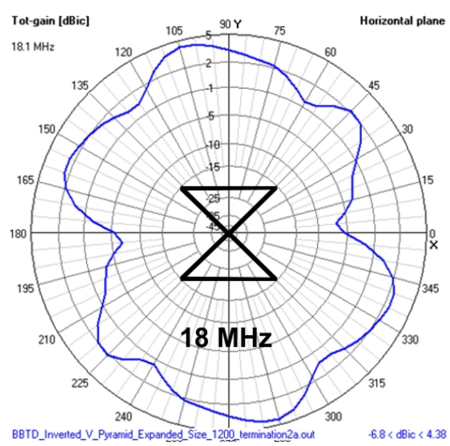
BBTD Inverted V Pyramid (Large Size) Radiation Patterns
The model shows that the radiation pattern is substantially omnidirectional at 10MHz and below. At 14MHz and above, it has a broad X or lumpy square pattern, slightly favoring the direction of the horizontal wires.

BBTD Inverted V Pyramid (Large Size)
Radiation Patterns









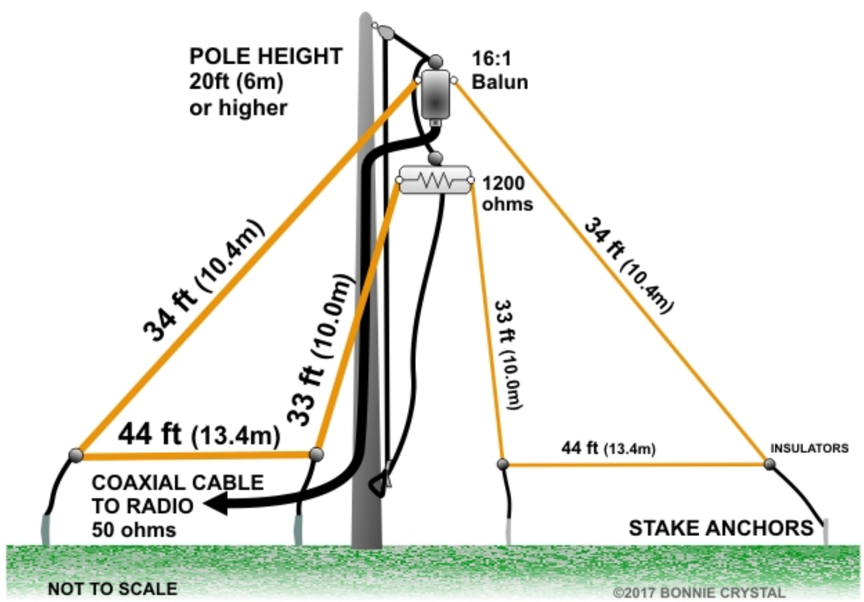
Photos of a BBTD Antenna Inverted V Pyramid at Station K6KBE



Click to ZOOM. above photos ©2017 Mel Farrer K6KBE. Used by permission.

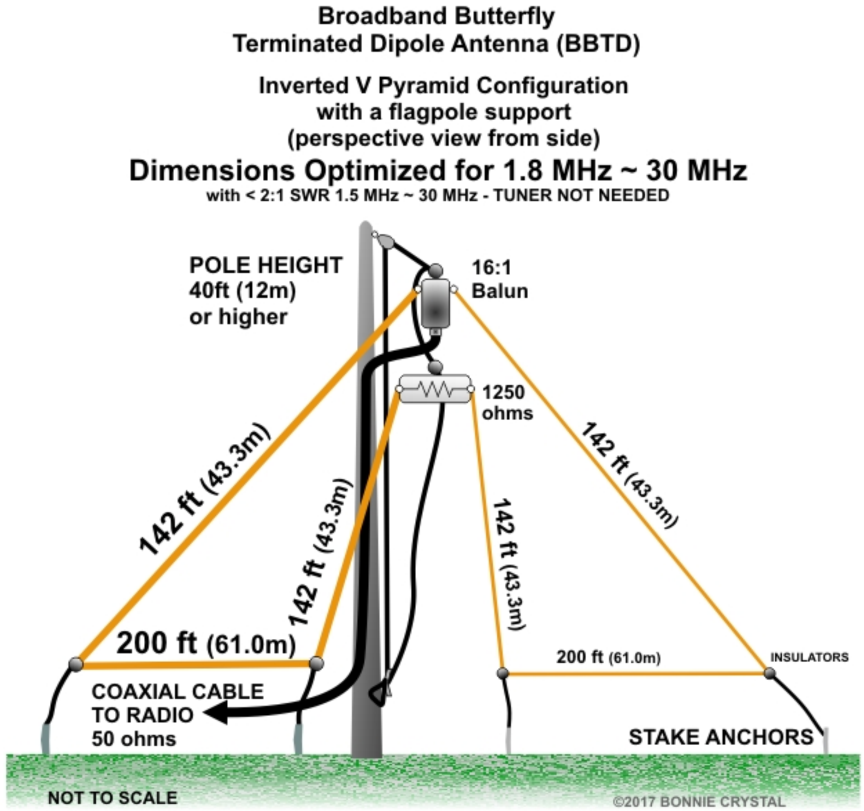
A Broadband Butterfly Terminated Dipole Antenna BBTD Inverted V optimized for the 7MHz to 54MHz frequency range

For situations where full size BBTD antenna will not fit within the area required, a dimension drawing for a more compact version is presented below. The minimum support pole height is 20 feet (6m) high. It is recommended that the bottom wire be elevated at least 5 feet above the surface of the ground, and preferably higher if possible. This version of the antenna provides excellent performance above 7 MHz, with a mostly omni-directional pattern. Like the full size BBTD, it provides continuous good SWR over the entire 1.8 MHz to 54 MHz frequency range. The termination resistor in the range of 1000 ohms is optimum. A 16:1 balun is required for 50 ohm coaxial feed. For use below 7 MHz, **the termination resistor should be rated at the power of the transmitter**.



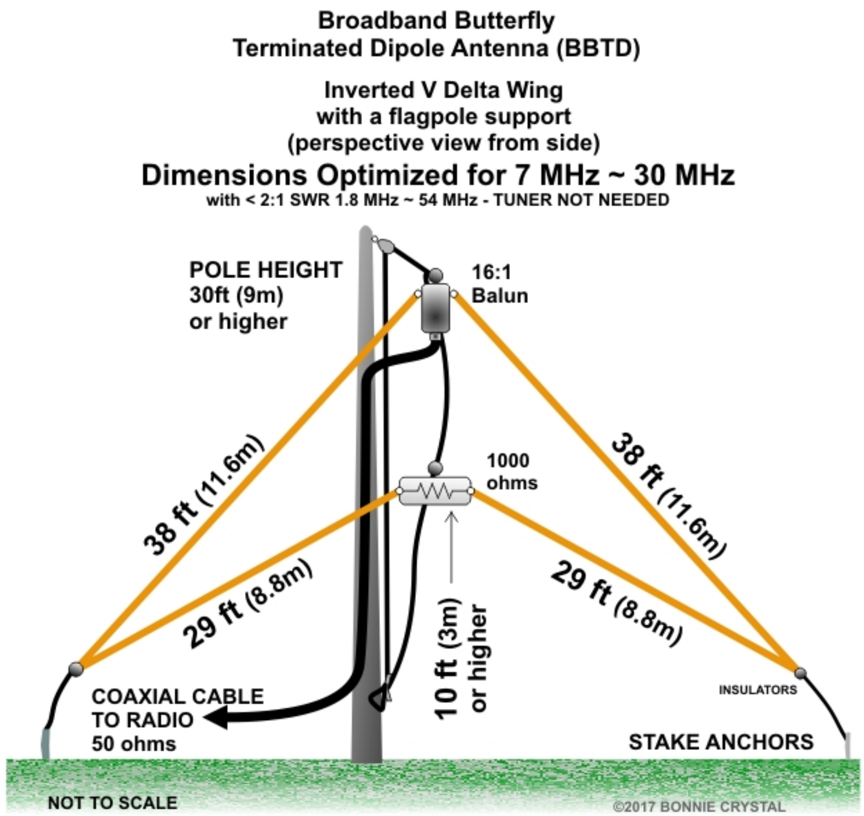
A Broadband Butterfly Terminated Dipole Antenna BBTD Inverted V optimized for the 1.8MHz to 30MHz frequency range

For better performance on the 160 meter band, a dimension drawing for a larger version is presented below. The minimum support pole height is 40 feet (12m) high. It is recommended that the bottom wire be elevated at least 10 feet above the surface of the ground, and preferably higher if possible. This version of the antenna provides excellent performance at 1.8 MHz through 5 MHz, with a mostly omni-directional pattern favoring the zenith for NVIS. Like other BBTD antennas, it provides continuous good SWR over the entire 1.5 MHz to 30 MHz frequency range. The termination resistor in the range of 1200 ohms is optimum. A 16:1 balun is required for 50 ohm coaxial feed. The termination resistor should be rated at the power of the transmitter. This version of the BBTD requires a 200 feet by 200 feet area.



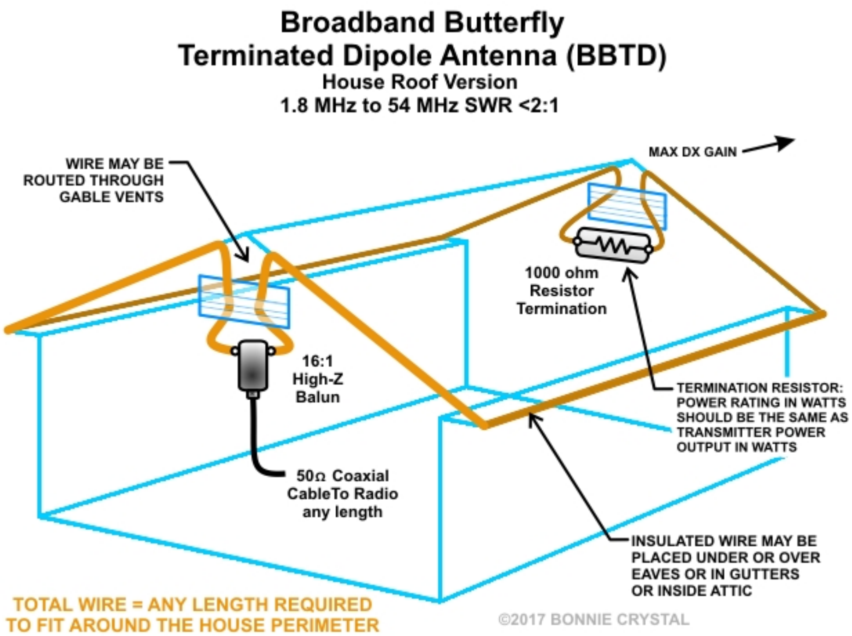
A Broadband Butterfly Terminated Dipole Antenna BBTD Inverted V Delta Wing optimized for the 7MHz to 30MHz frequency range

For situations where an antenna in a much more compact area is required, a somewhat different configuration may be utilized. This Delta Wing configuration takes half the wire of a normal BBTD, and is similar in size to a common 40 meter band Inverted V dipole antenna. A dimension drawing is presented below. The minimum support pole height is 30 feet (6m) or higher if possible. It is recommended that the termination resistor be elevated at least 10 feet above the surface of the ground, and the bottom ends should be at least 5 feet above ground surface level. This version of the antenna provides fairly good performance at 7 MHz and up, with a mostly omni-directional pattern favoring the zenith for NVIS . Like the full size BBTD, it provides continuous good SWR over the entire 1.8 MHz to 54 MHz frequency range. The termination resistor of 1000 ohms is optimum. The termination resistor should be rated at the power of the transmitter. A 16:1 balun is required for 50 ohm coaxial feed.

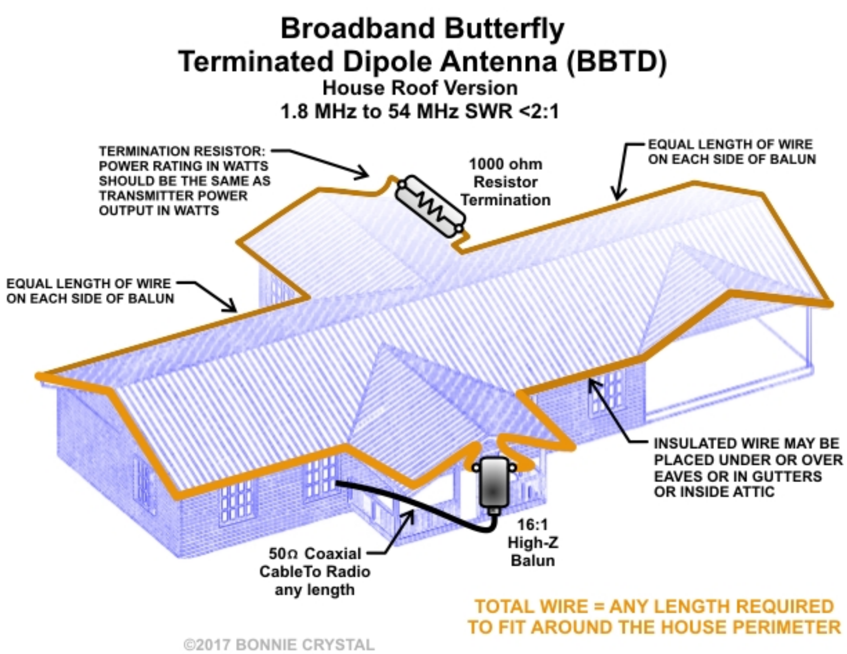


A Broadband Butterfly Terminated Dipole Antenna BBTD Version for House Roof or Attic

Many HF radio station situations require a hidden or stealth antenna using only a house or building to support the antenna. This BBTD House Roof configuration provides broadband good SWR <2:1 over a continuous wide range of frequencies without requiring a tuner. A skeleton drawing is presented below. The total length of wire is whatever is needed to go around the perimeter of the house or building (plus zig zags and connections). A typical wood frame 40 feet by 40 feet (12m x 12m) house provides a large enough perimeter to support optimum performance from 7 MHz to 54 MHz, with somewhat less efficiency at 3.5 MHz. The efficiency is poor on the 160 meter band, but it still provides a good SWR. This version of the antenna has a mostly omni-directional pattern favoring the zenith for NVIS at the lower frequencies. At 14 MHz and above, it has modest gain favoring the direction of the termination resistor. **The termination resistor should be approximately 1000 ohms, and rated at the same Watts of power as the transmitter output power in Watts.** A 16:1 balun is required for 50 ohm coaxial feed. The coax cable may be any length.



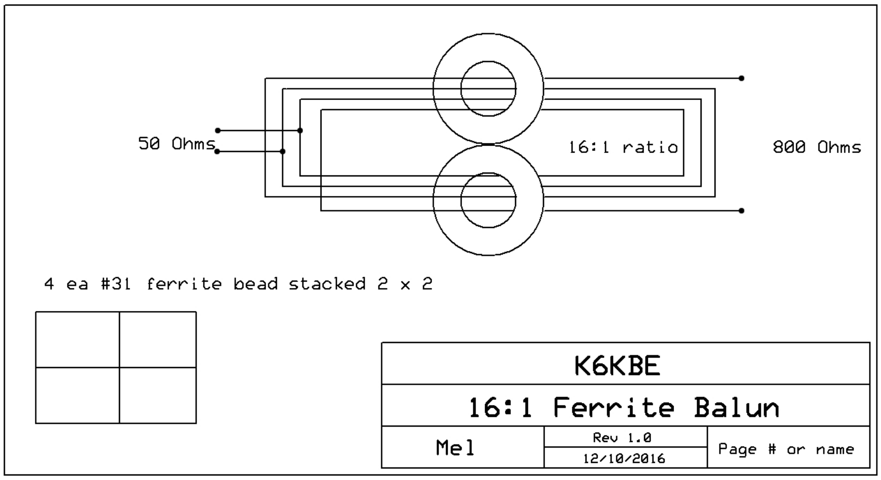
The BBTD Antenna House Roof version can be utilized with buildings of various shapes and sizes. As a guideline, the more wire around the perimeter, the better the performance will be at lower frequencies (below 6 MHz). **The length of wire on each side of the balun to the resistor should be within about 6ft (2m) of the same length, to maintain good SWR and balance of the antenna.** Use insulated wire; #18 AWG (1mm) insulated wire is sufficient size for 500 Watts transmitter power. #22 AWG wire is sufficient for 100 Watts. The wire may be formed into a zig-zag, serpentine pattern, bent up and down, or around the corners and crevices of the building. It is very advantageous to elevate the wire as much as possible. The balun and/or termination resistor may be mounted inside the building, and the wires routed through air vents, gable vents, or holes in the walls or eaves. The insulated wire may be placed under or over eaves, or in gutters, or in the attic. Avoid close proximity of the balun or the resistor to AC mains power cables, because of risk and RFI or EMI or RX noise. Do not let any antenna wire touch an AC mains wire, internal or external to the building. Warning: contact with AC mains can kill you. Also, be sure to use good lightning protection.



16:1 Baluns For Use With Broadband Terminated Antennas

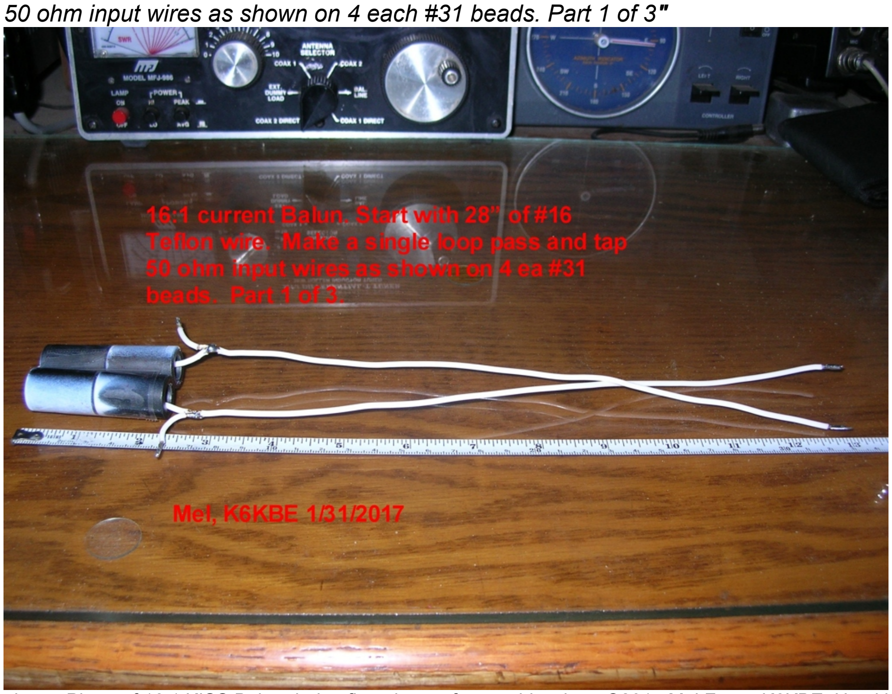
There are several types, and various methods, for making 16:1 baluns and ununs for use with Broadband Terminated Antennas. A few types are be presented below.

The *16:1 KISS Balun* by Mel Farrer K6KBE
"You cannot build a simpler 16:1 current balun than this. PERIOD. It takes 4 ea #31 ferrite beads, 28-30" of #16 AWG teflon wire. NO tape, NO twisted wires, SMALL."



above: Schematic of 16:1 KISS Balun by Mel K6KBE**.** ©2016 Mel Farrer K6KBE. Used by permission.

"16:1 current Balun. Start with 28" of #16 Teflon wire. Make a single loop pass and tap 50 ohm input wires as shown on 4 each #31 beads. Part 1 of 3"



above: Photo of 16:1 KISS Balun during first phase of assembly. photo ©2017 Mel Farrer K6KBE. Used by permission.

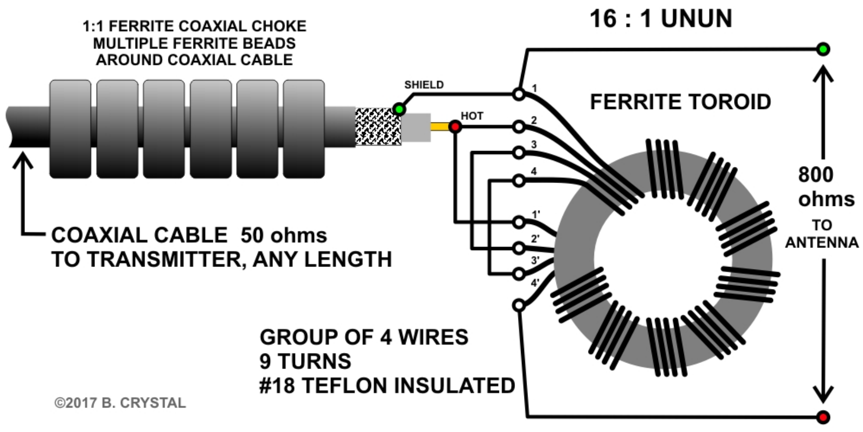
"Single start loop and 50 ohm taps. Part 2 of 3"

above: Close-up photo of 16:1 KISS Balun during first phase of assembly. photo ©2017 Mel Farrer K6KBE. Used by permission.

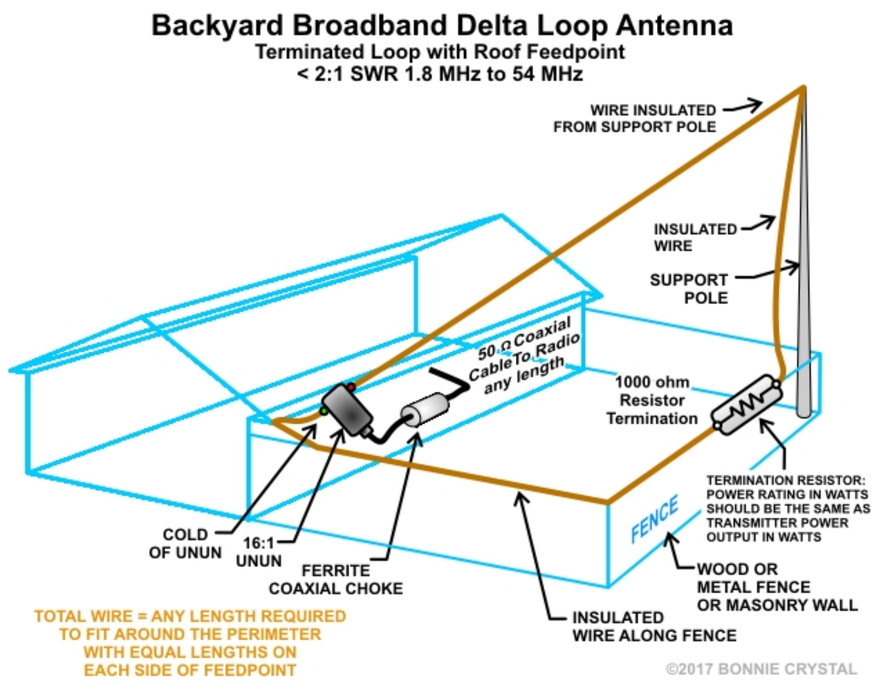
"Wrap the rest of the wires around until you come up on the opposite end from 50 ohms. Part 3 of 3."

above: Photo of completed assembly of the 16:1 KISS Balun. Housing and connectors not shown. photo ©2017 Mel Farrer K6KBE. Used by permission.

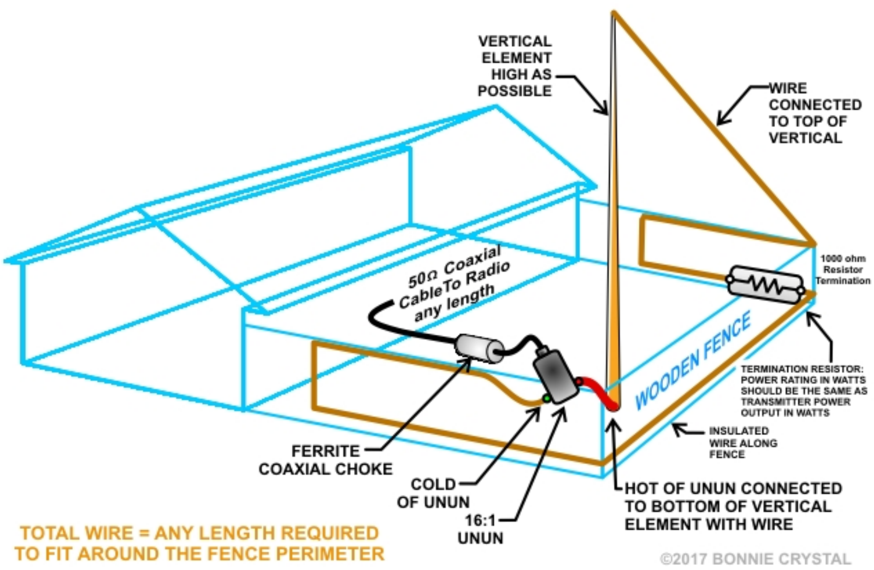
A 16:1 Balun Using A 16:1 Toroidal Unun and 1:1 Ferrite Coaxial Choke



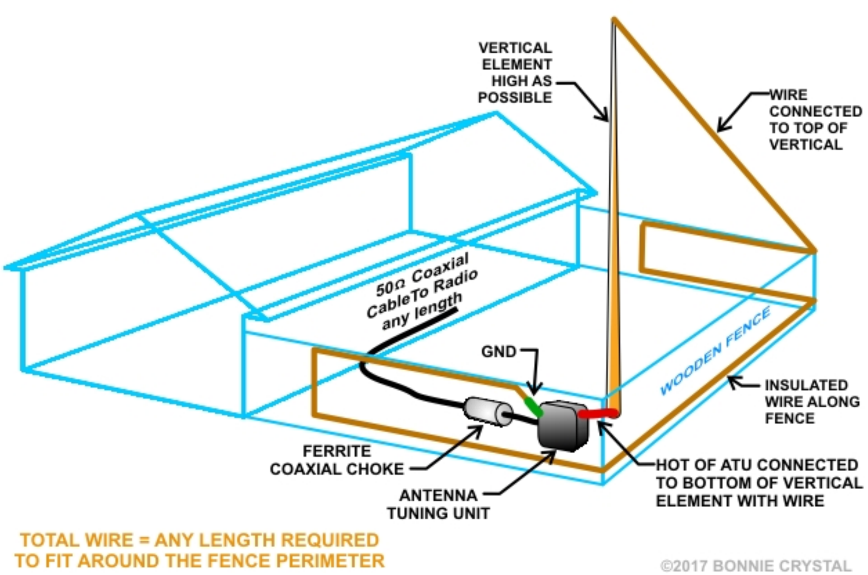
Backyard Broadband Delta Loop Antennas
Unbalanced loops can provide fairly good performance while meeting the requirements for CC&R, HOA, condo, or stealth. This type of antenna shows a minimum visual impact to the backyard garden environment when insulated black wire is utilized. The feedpoint and terminations are mounted at convenient points provided by building eave, fence, roof, or wall supports. A single support pole (or convenient tree) for an insulated wire element is needed. The hot side of the 16:1 Unun goes to the highest wire. The lower wire may be run along the fence or even laid upon the surface of the ground. As with most antennas, the higher the wire, the better the signal. An automatic tuning unit (ATU) may be alternatively mounted at the feedpoint, in which case, a termination resistor is not needed.



Fence Mounted Broadband Delta Loop Antenna
Terminated Loop Version
<2:1 SWR 1.8 MHz to 54 MHz



Backyard Multi-Band Delta Loop Antenna
ATU Version
3.5 MHz to 30 MHz



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