M3KXZ Portable Double-T Vertical for 20 thru 6m

Introduction

I was inspired by the discussions on the Verticals-2 Yahoo group about “double-T” antennas for the lower HF bands. A double-T is a top and bottom capacity hatted vertical dipole. Force 12 produce one, the Sigma-5, for the higher HF bands from 20 thru 10, with remote switchable loading coils in the centre for band selection. The cost is high, the weight is okay at just over 3kg, it is very portable (being only 9ft tall and breaking down into 2ft sections). But I don’t like to buy antennas! So here follows some brief construction notes for my homebrew double-T vertical dipole for /p.

Design

My homebrew double-T is 3 metres tall, with capacity hats 2 metres across. It is fed at the centre of the vertical section via a 1:1 current balun. The balun consists of 7 bifilar turns on an FT114-43 toroid, giving over 2000 Ohms of choking impedance from 10 MHz and up. This is sufficient (about 4x higher) for the range of impedances found at the antenna feedpoint across this range. This balun is connected via a very short coax to my tuner. Reason for the short coax is the high SWR that will be present on most bands, as no attempt is made to make the antenna resonant. It would be possible to add loading coils in the centre, as in the case of the Sigma-5, but for simplicity I prefer to make use of the tuner I already have to enable quick band switching and great flexibility.

Materials

The antenna is built from lengths of aluminium tubing of various diameter. Some of this is sourced from a hardware shop (B&Q), while the 22mm tubing for the bottom vertical section below the feedpoint is obtained from a military aluminium tent pole (including the pin in the top of it). The use of 22m tubing for the bottom section negates the need for guylines.

Two supports are used for the antenna, depending on weather conditions and location. One is a re-engineered plastic/nylon electric fence stake, and the other is a length of reinforcing bar (rebar). The base section of the antenna sits over whichever support is in use. The electric fence stake is ok when there is no wind and the ground is easy to push it into. The rebar is better for windy conditions and a wider range of ground types, although a hammer is needed to knock it into the ground.

A connection is made between the balun on the antenna and the coax using a strain relief plate made from an offcut of uPVC. This has stainless steel hardware for wire termination, and the coax end is weatherproofed with Araldite (epoxy resin). Stainless steel hose clamps are used for securing wires to the antenna elements. The top hat bracket and bottom support/bottom hat bracket are made from square section fibreglass tube.

Connections are made by drilling through the aluminium tube and securing with stainless steel hardware.

Construction

The Double-T is constructed in such a way that the antenna can be assembled just by pushing sections together. The section joins are secure enough and with enough overlap that there is barely measurable resistance between the ends of each half of the antenna.

Below is a picture showing the dipole centre piece. The pin sticking out from the 22mm tent pole tube is insulated from the main tube and is held in place in a plastic insert. This pin would have originally been used to locate the top of the pole in the tent. The balun is simple 7 bifilar turns on an FT114-43 toroid.

The picture below shows the centre of the dipole assembled. I inserted (with a hammer) a length of 8mm diameter tube inside the 10mm diameter tube, and then drilled it out to the right internal diameter (5.5mm) to fit snugly over the pin.

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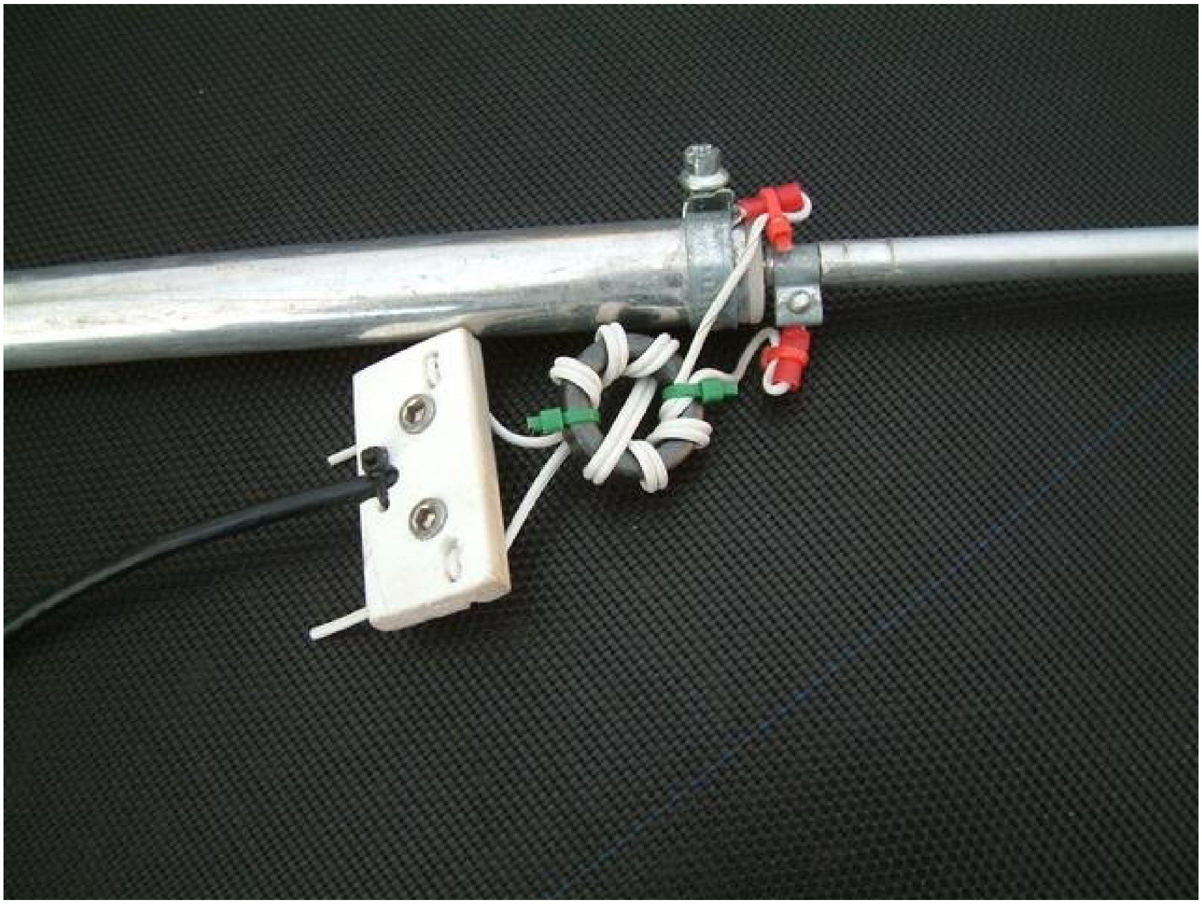

The connections to the tubes are made with stainless steel hose clamps and ring terminals. Strain relief is provided where the wires go into the ring terminals by doubling them back and securing with small cable ties. This makes the assembly much stronger.

The two picture below show the method of securing the 22mm tube into the base sections and attaching the bottom capacity hat bracket. The round bottom section of tube had to be sqyared off slightly to fit into the square section fibreglass tube (can't fit a round peg into a square hole). The bottom capacity hat bracket is a single short length of 8mm tube that the 10mm bottom capacity hat elements can slip over.

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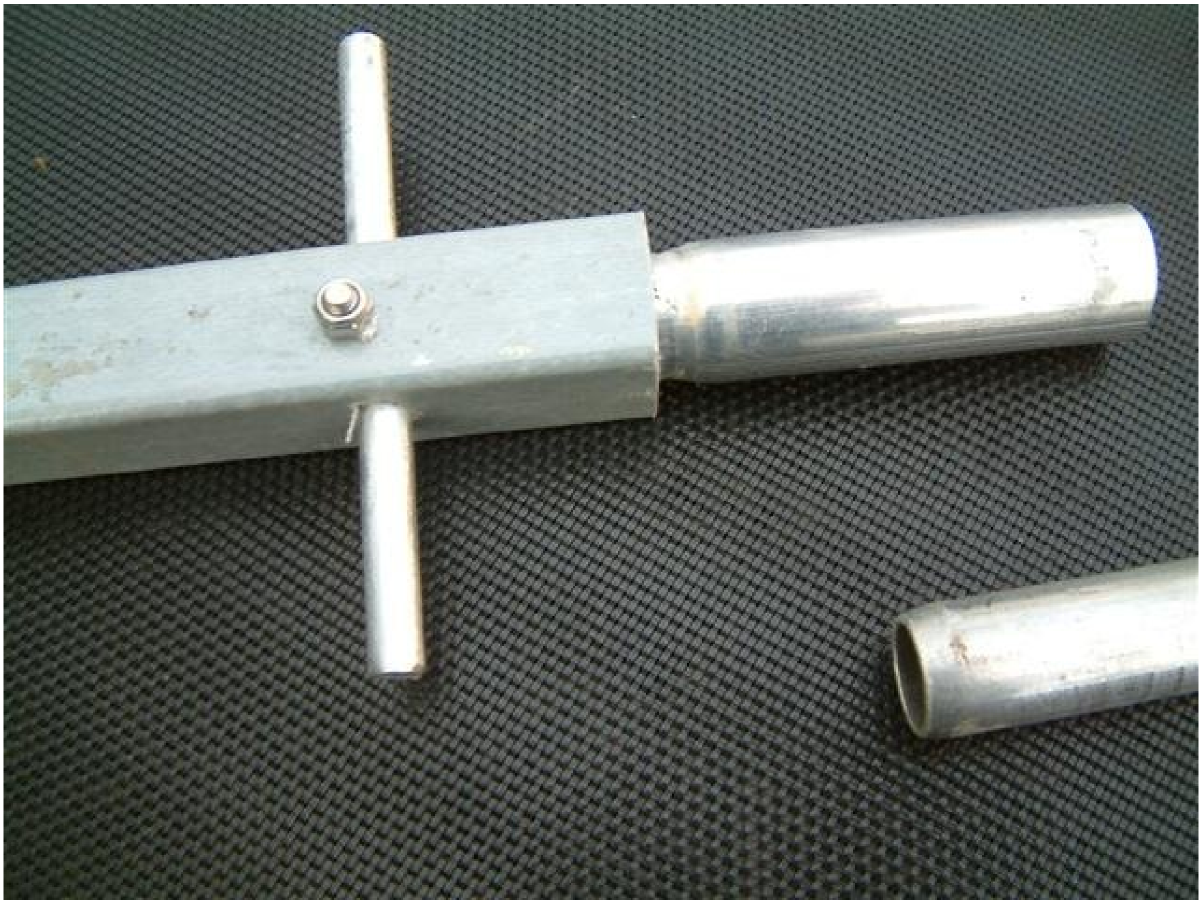

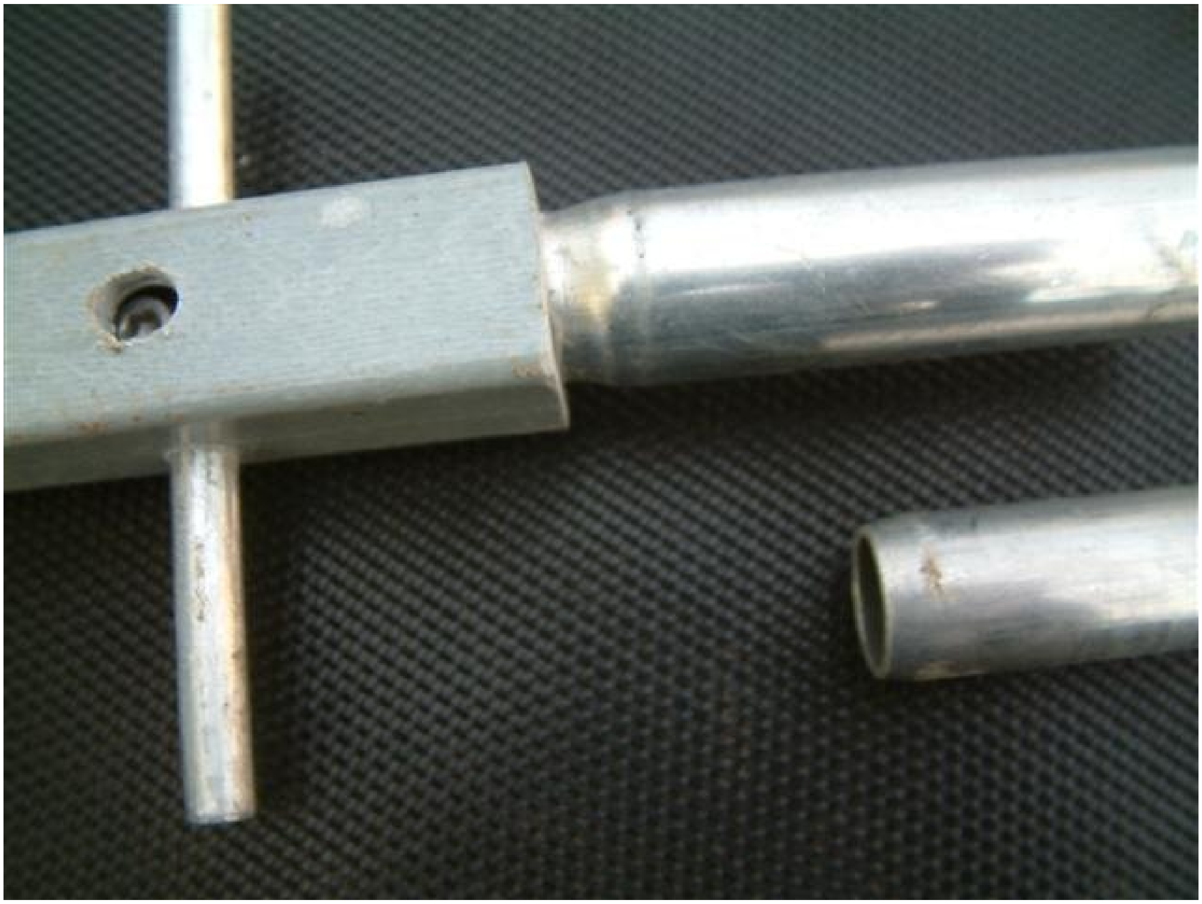

The 5mm diameter stainless steel screw goes through both the 8mm and the 22mm tube to secure them together. The allen head of the screw, shown in the second picture, is right in the 22mm tube so it pulls the 8mm capacity hat tube against the inside of the 22mm tube when tightened.

The top hat connector is shown below. Again the cross tube is a single short section of 8mm tube. This time, the top hat elements of 6mm diameter fit inside this tube. Once more, fibreglass square section tube and stainless steel hardware are used to form the connection.

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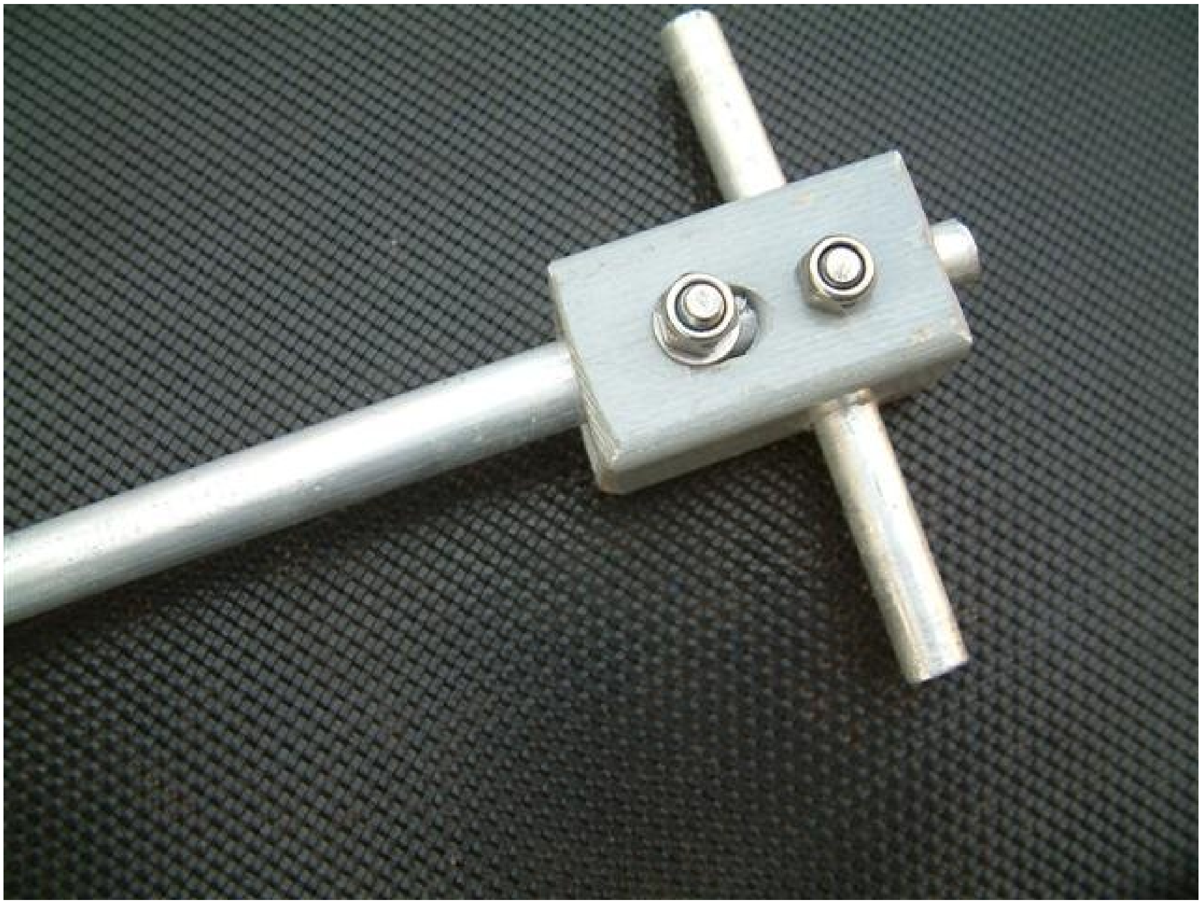

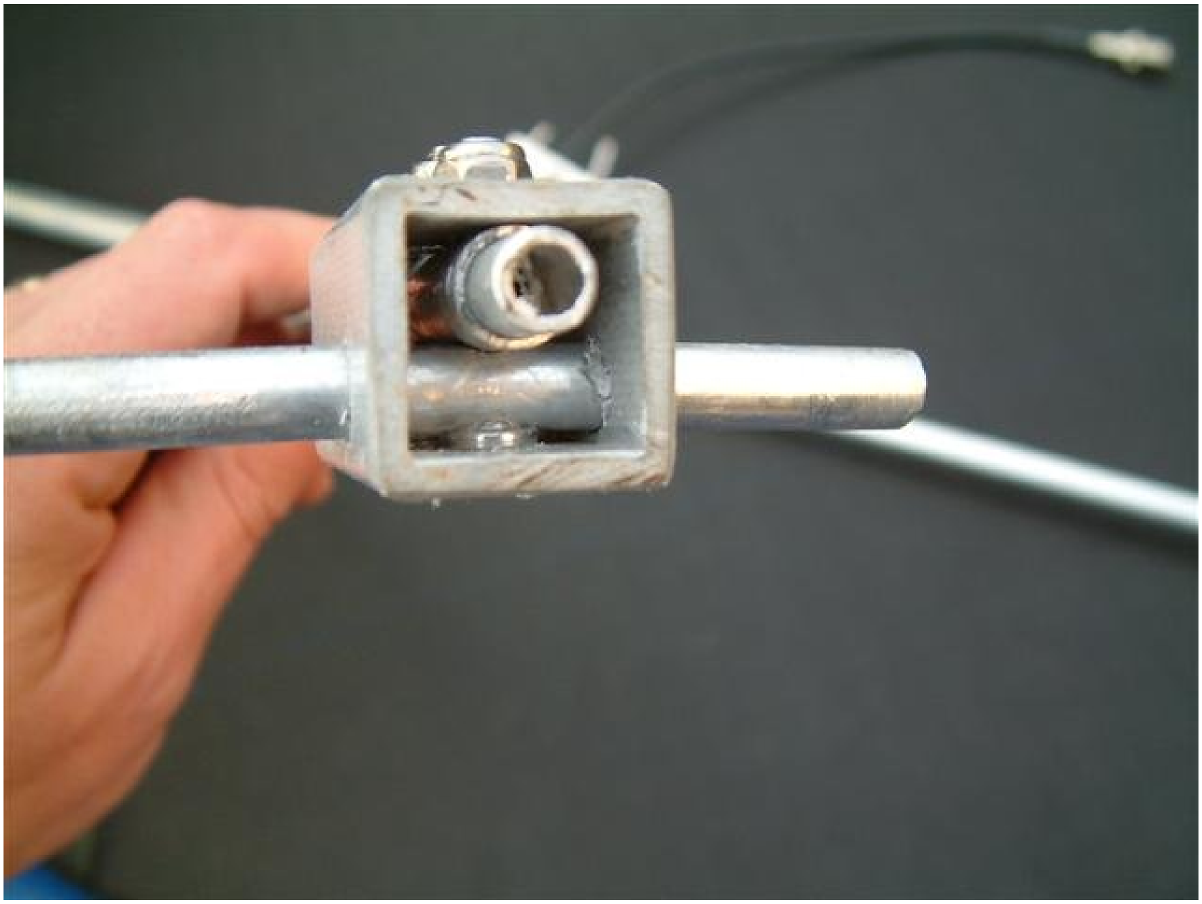

The individual sections of each element are joined by using inserts inside one of the tubes. The inserts in the 10mm tube are made from 8mm tube. The 8mm tube is deformed slightly in a vice and then tapped/hammered into the 10mm tube providing a very tight interference fit. The tube to which this is joined is drilled out very slightly to form a snug, but not too tight, fit over the 8mm insert. The exposed section of the inserts are sanded to ensure they don’t jam too firmly when the antenna is assembled (otherwise it is very difficult to disassemble!) Below is a picture of one of the joining sections.

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Top and bottom hat connections are shown below.

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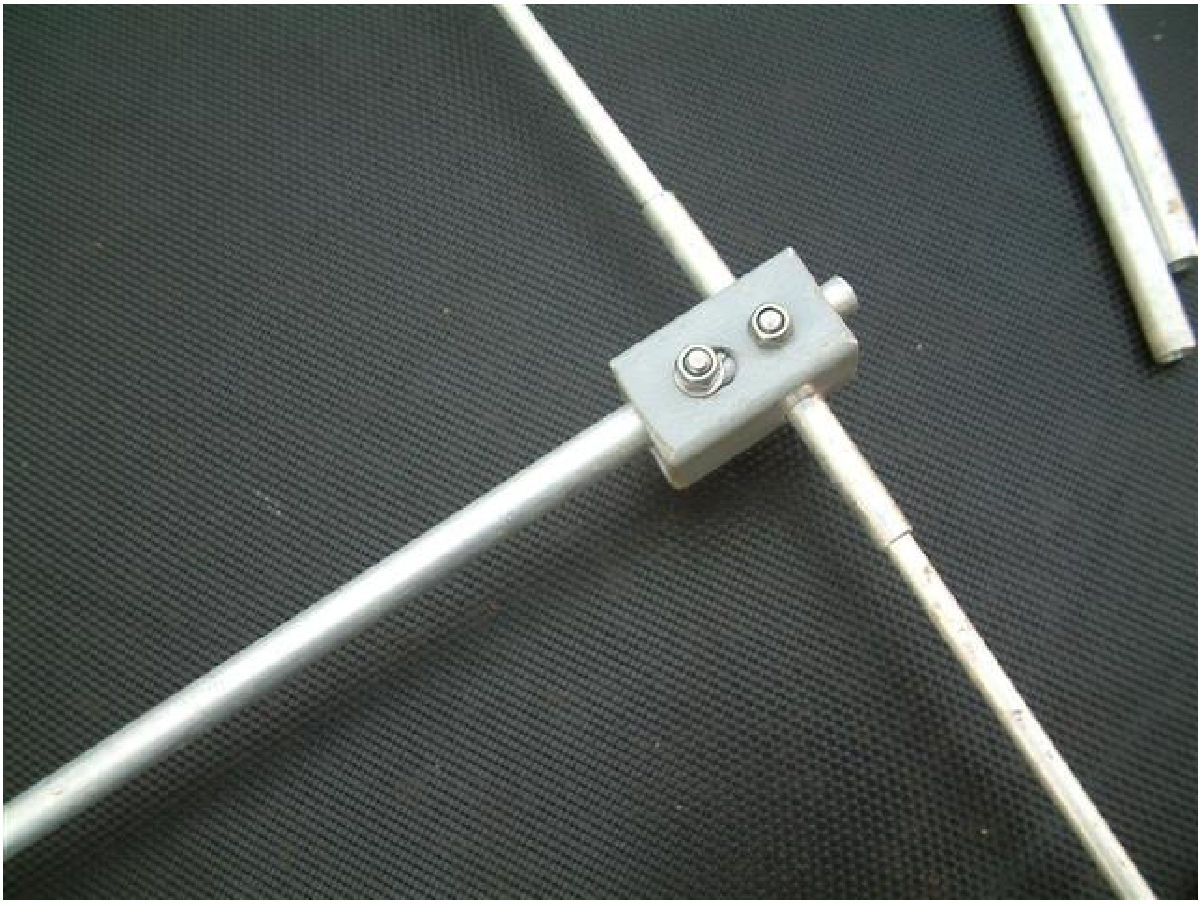

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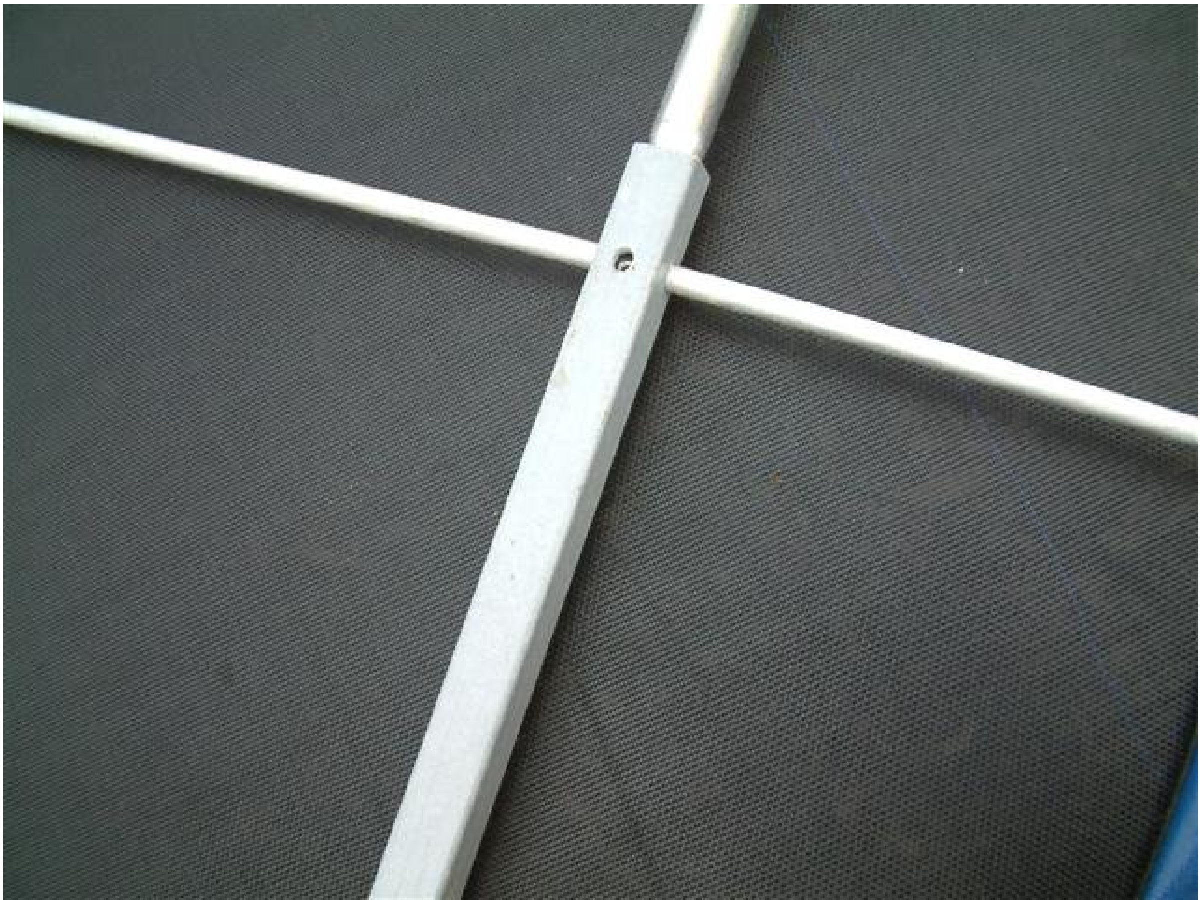

In the lower of these pictures is the bottom support. Below the 22mm element is inserted a plastic “cork” from a wine bottle. This ensures that when the bottom support is set on to a length of reinforcing bar that the element remains insulated from the bar.

Below are the two support methods. First picture showing the re-engineered electric fence stake, and second picture the reinforcing bar.

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Finally, below is the antenna completely assembled. Please ignore the mast in the background.

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The bottom half of the vertical element is 1.5m of 22mm tube. The top half is 1.5m of 10mm tube. Each of these breaks down into short sections. The capacity hats each consist of 2 x 1 metre lengths of tube – 10mm for the bottom and 6mm for the top. The total length across each hat is 2m.

EZNEC images

Here are some EZNEC plots for the antenna, situated over salt water ground with the bottom capacity hat at a height of 1m. First, at 14MHz

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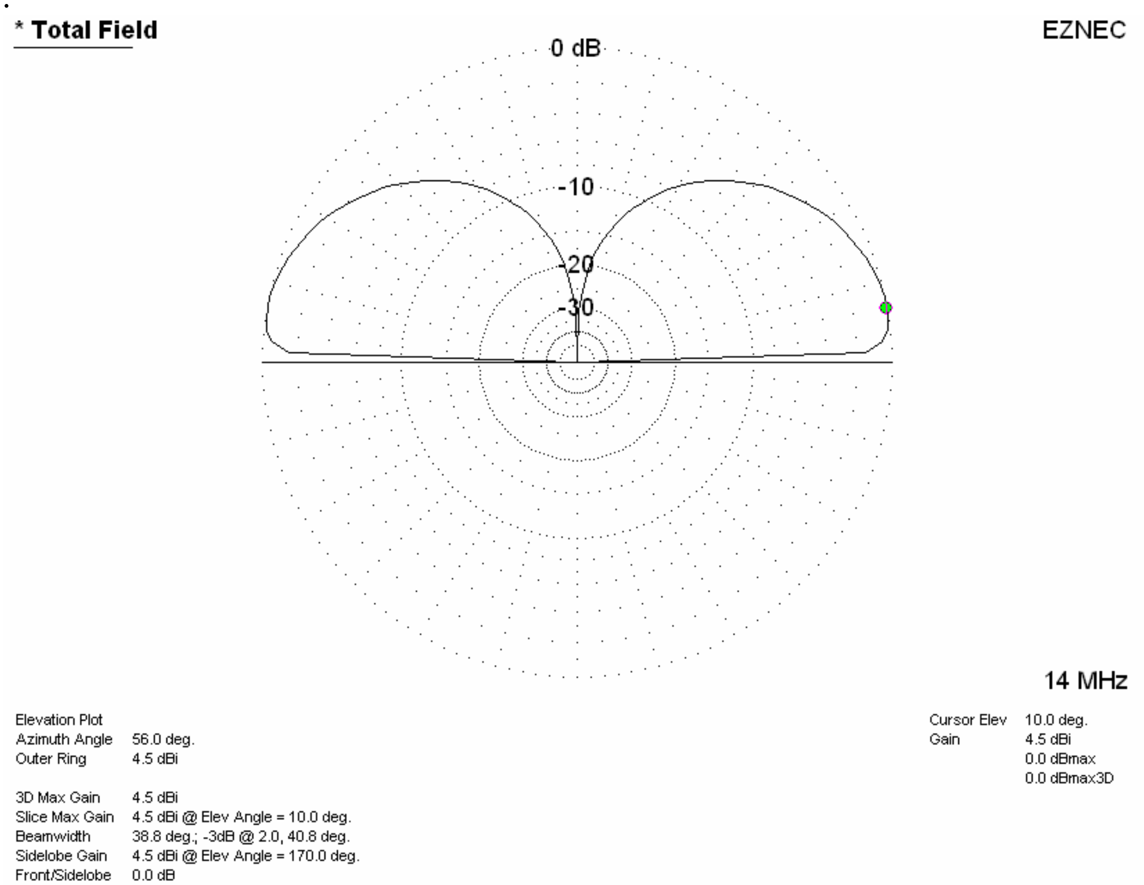
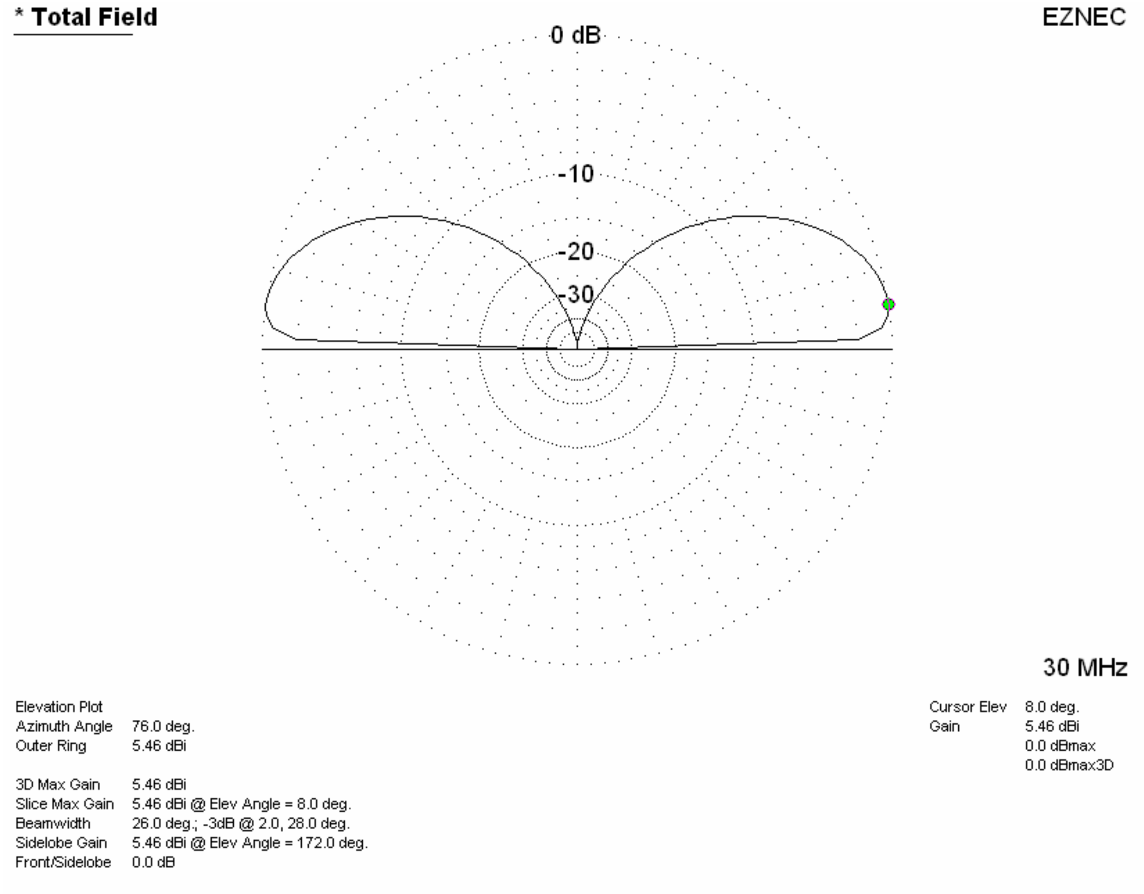


The gain on 14MHz is quite respectable given that this antenna is only 3 metres tall. Of course, the salt water ground helps. Over average ground the gain is -0.8dBi, which again isn’t too bad considering the antenna is so small and so low to the ground. There will be matching considerations to take into account but provided a good tuner is used then this shouldn’t be a problem The Elecraft T1 has no problem at all with matching, and initial testing from the beach has shown that the antenna seems to perform just as well on 14MHz as my 8 metre tall vertical.

Below is the plot for 30MHz. This is where problem can often occur if using the same antenna on 10m as is being used on 20m. With a tall antenna, the radiation pattern breaks up and forms wasteful high angle lobes. This increases noise on receive as well as wastes energy on transmit. We find with this short antenna that the radiation pattern is very good on 30MHz, and all bands in between.



It’s only when we get to the 6m band that we find the high angle lobes developing. The plot below is that for 52MHz.

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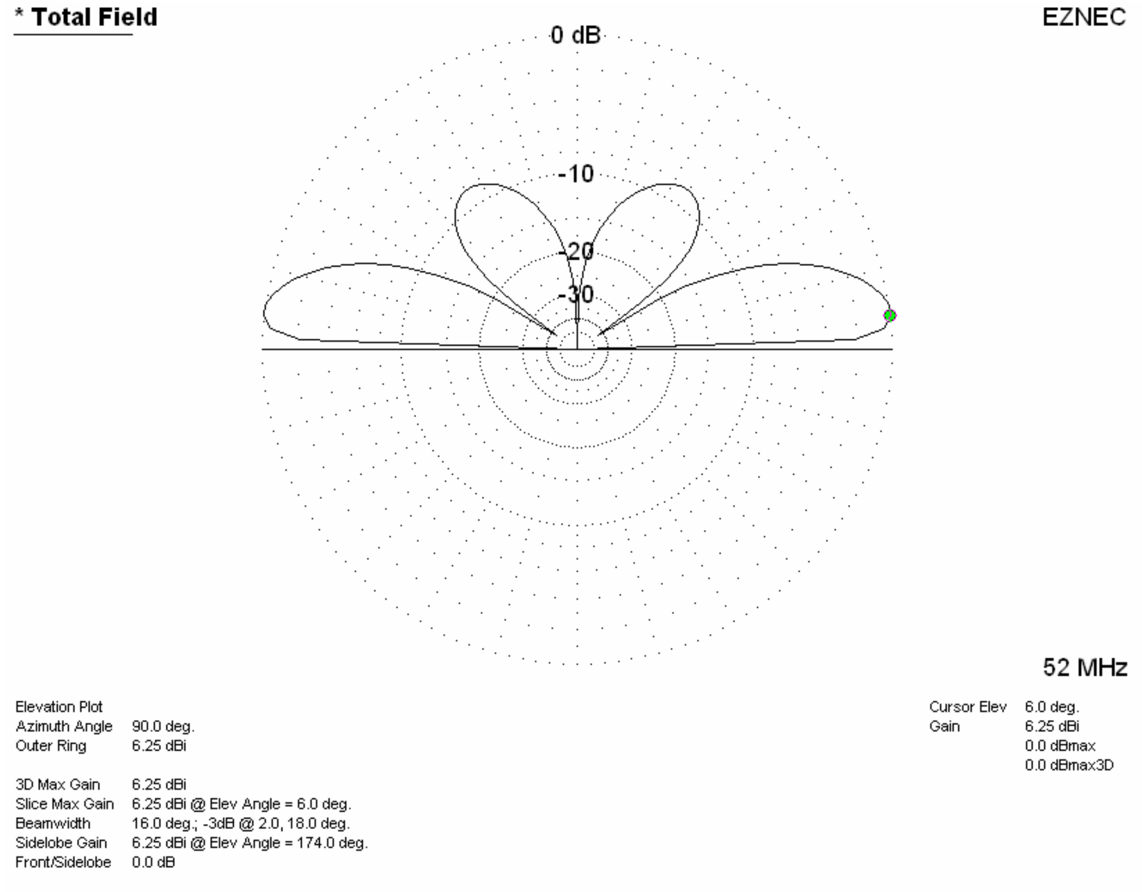

Even down on 7MHz the antenna provides a useful pattern and reasonable gain provided one's tuner is able to match it effectively. The Elecraft T1 again had no problem getting a match on 7MHz

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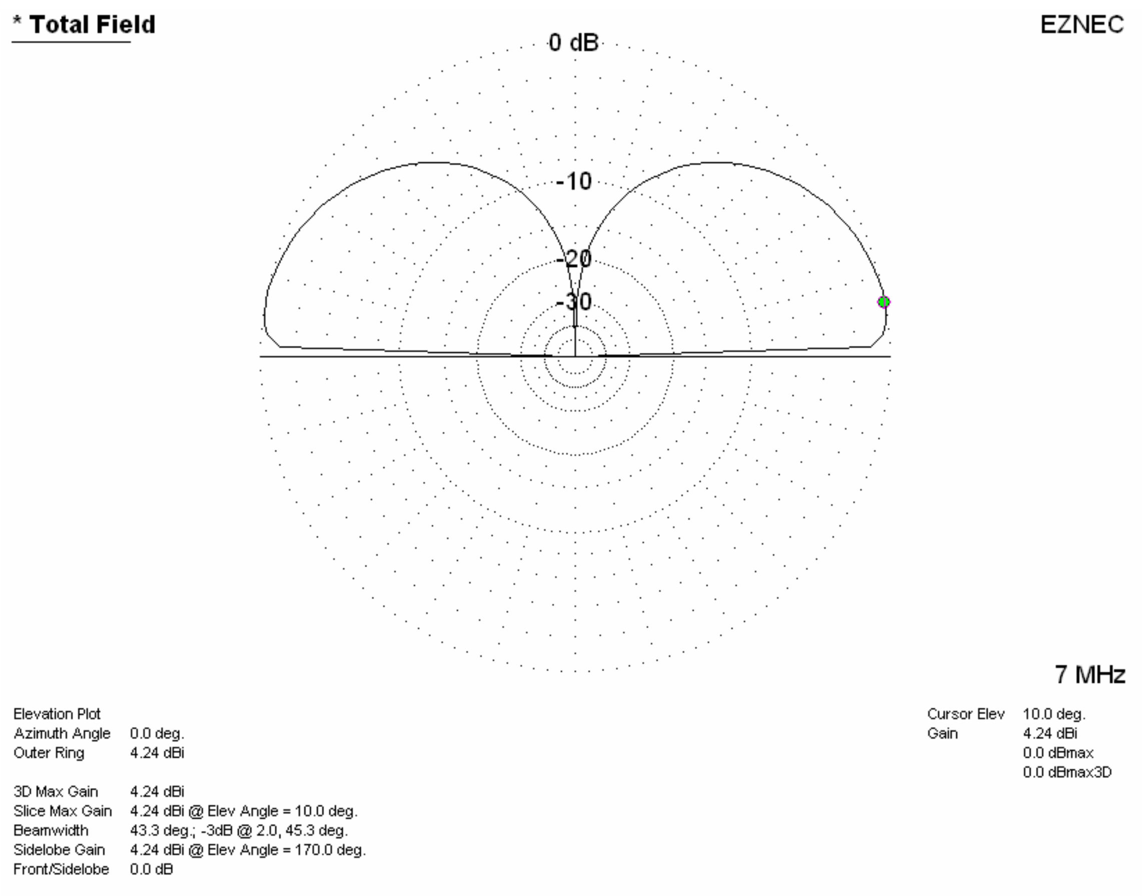

So that's it – the story of my simple double-T antenna. First day using the antenna, from the beach, with 2.5W SSB on 20m saw a 57 to the Gambia (C52B) from south coast of England. And a fantastic QRP to QRP QSO with an operator in Valencia running 5W fro his roof terrace into a 44ft doublet. This would indicate that even on 20m the antenna is certainly matching fairly effiently with the Elecraft T1. A back to back comparison with this antenna and an 8 metre vertical on 20m saw no noticeable difference in either RX or TX when in QSO with an operator in Switzerland.

If anybody would like any more details then please email me at
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