Multi Band HyEndFed

Written by Administrator

Friday, 10 September 2010 16:51

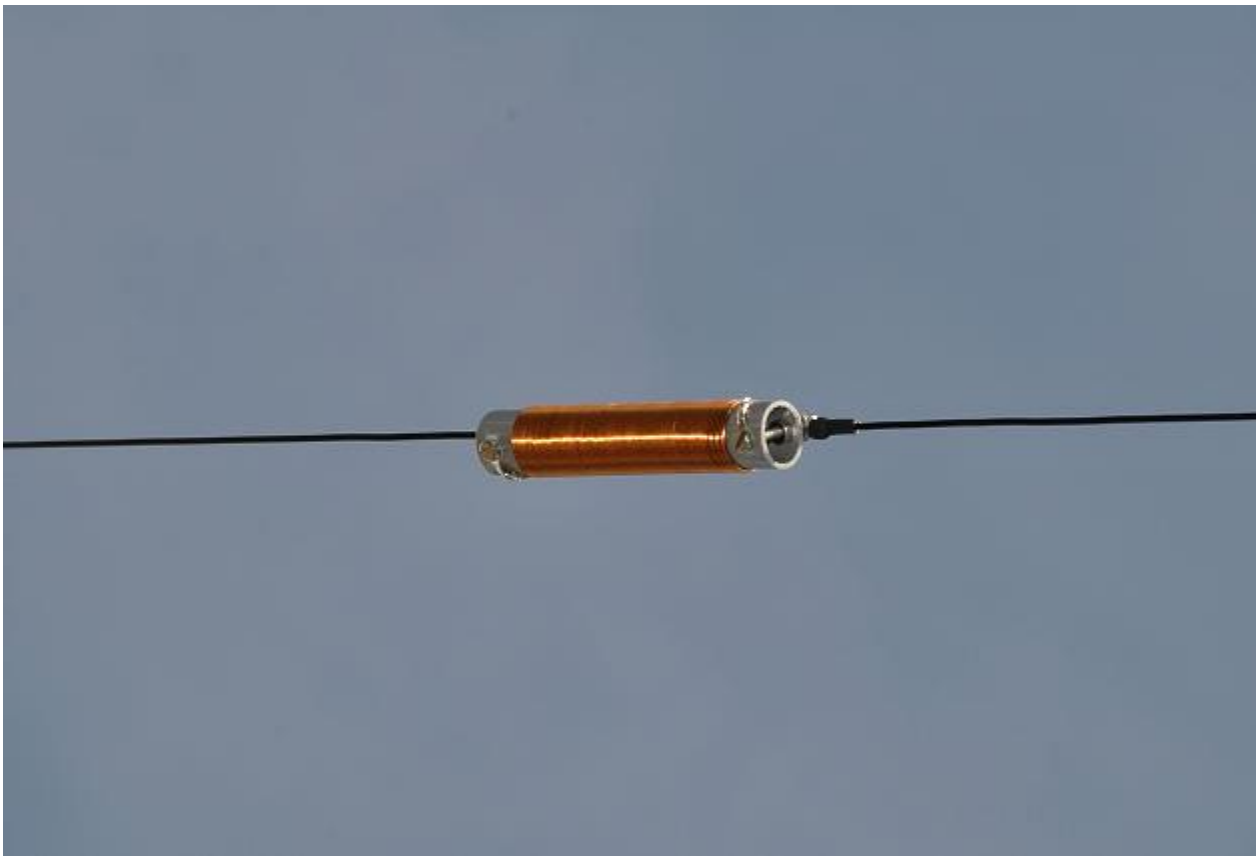
We started to develop a muliband HyEndFed for 40, 20 and 10 meters. A lot of people were asking for it.

We designed a new matching network and a loading coil. The antenna will be 12 meters long. No radials. Just a

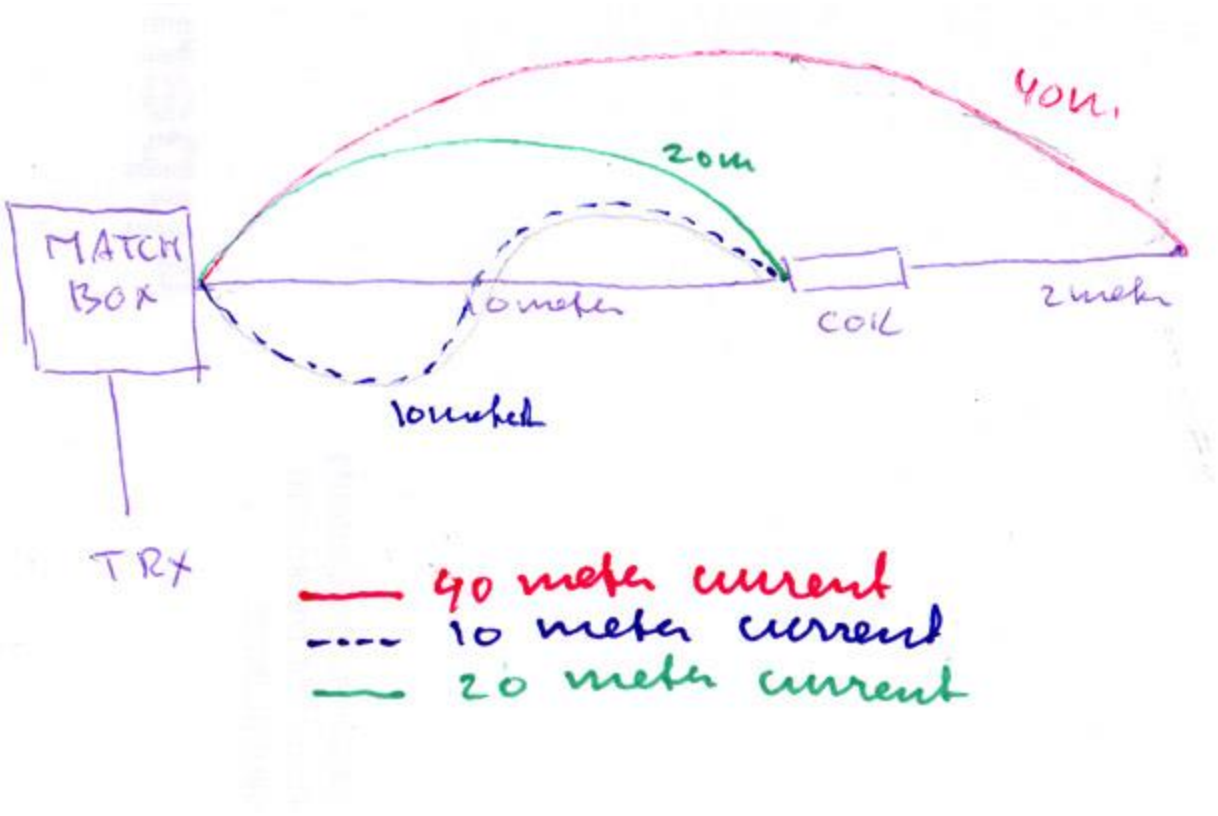
little matching box with 12 meter wire and a loading coil in it. No tuner needed. Just as the monoband HyEndFeds

with the only difference, the loadin coil.

Here you can see a prototype of the loading coil. The coil is mounted on 10 meters. Watch this section for more info
the next weeks!

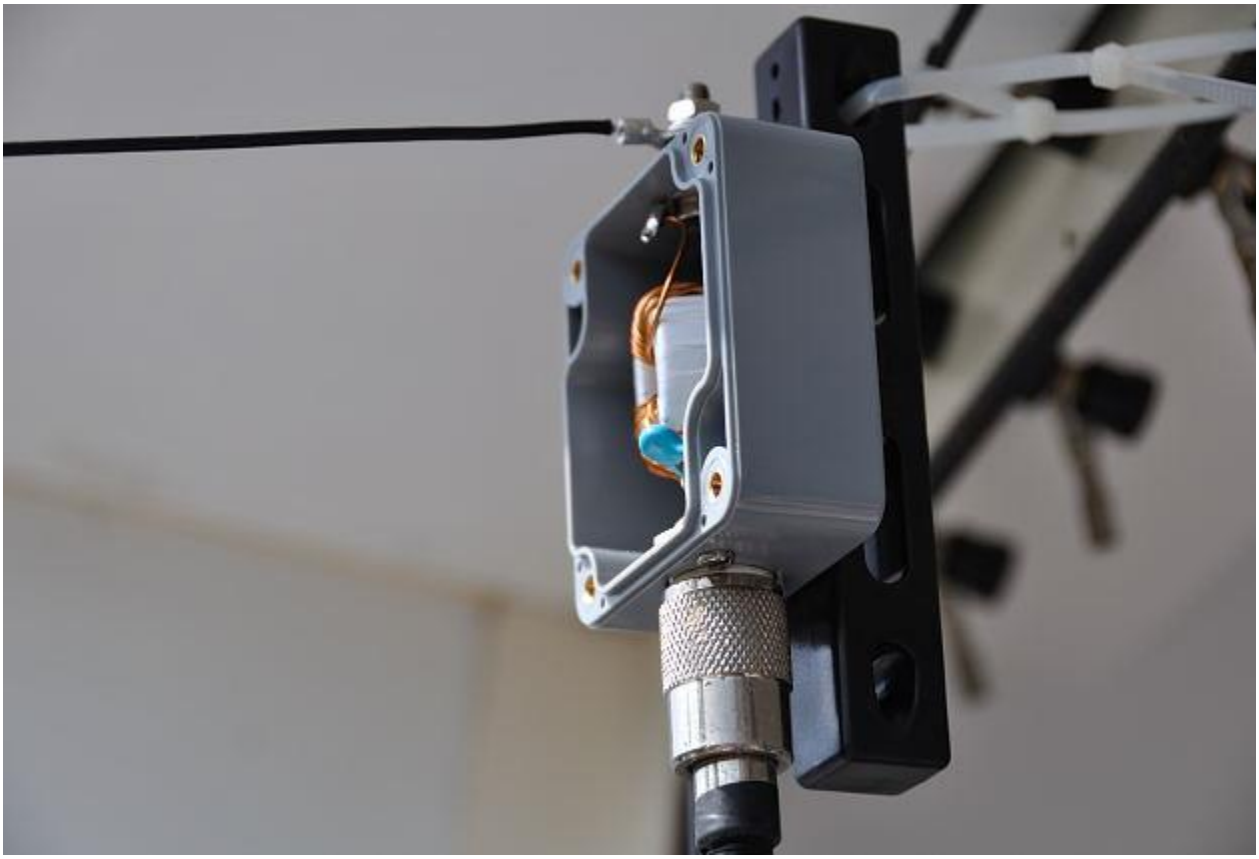


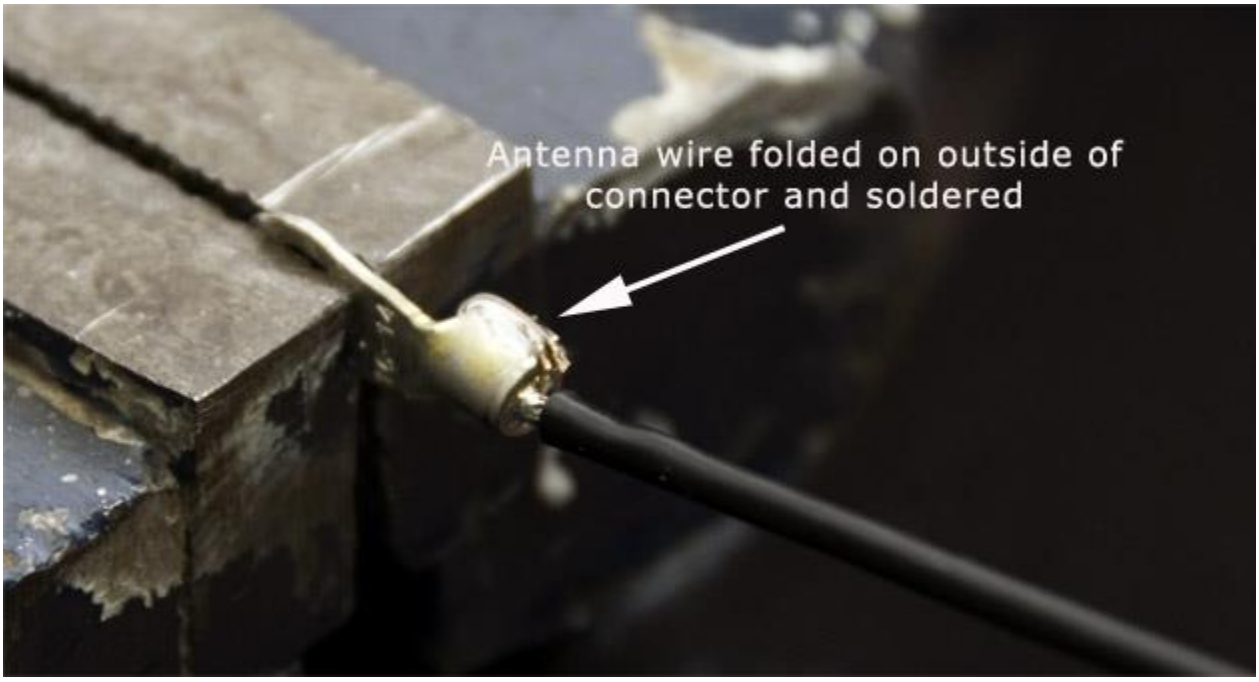
This is the principle of working. The coil acts as an line separator between 10,20 en 40 meter.
For 20 en 10 only the portion between the Matchbox en coil is active.
For 20 a half wave and for 10 a full wave. On 40 meter band the total 12 meter is used. The coils compensate the lack
of wire for the half wave working principle.
The Match Box transforms the high impedance to 50 Ohm.



Loading Coil with heat-shrink tubing and stainless steel bolts and nuts. Still prototype

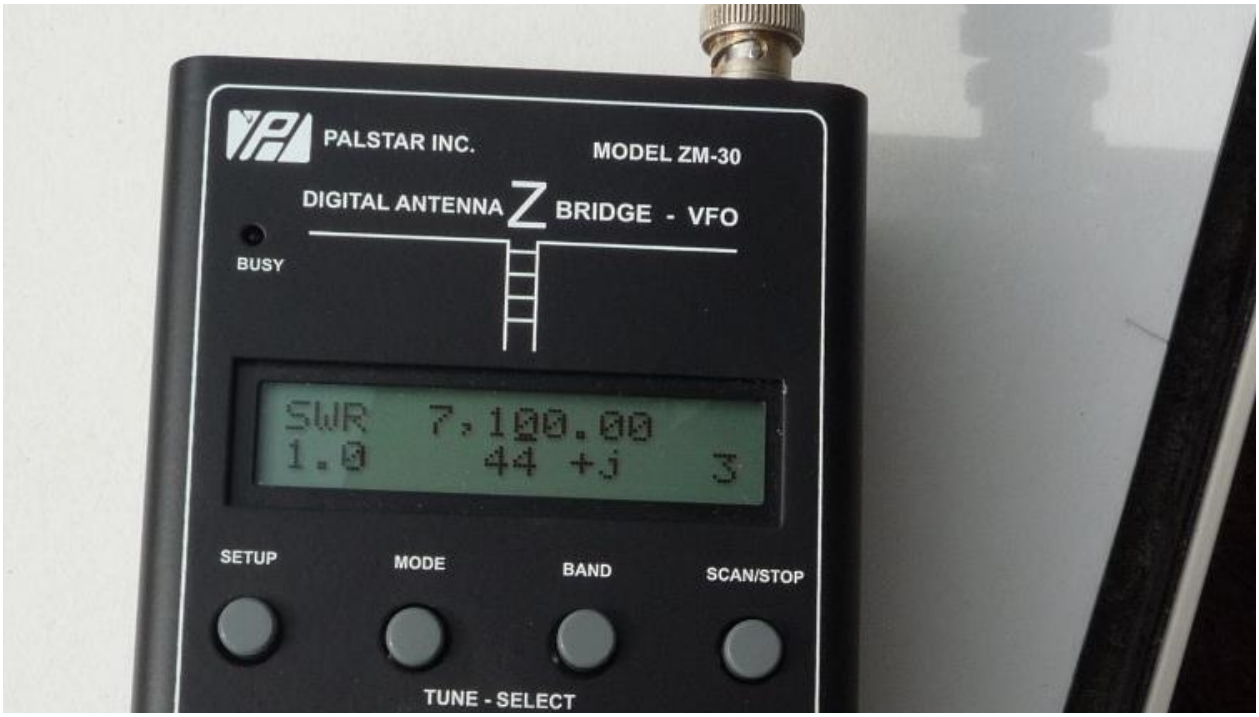
Matching network. Ringcore with teflon coating, Cu wire, and condensor. Working prototype but on 10 meters the
torid core heats up. We are now testing with different core type's to lower the losses




Antenna wire folded on outside of
connector and soldered

This is the SWR on 40 meter. The antenna is mounted as a sloper. From the 3th stock down into the garden.The

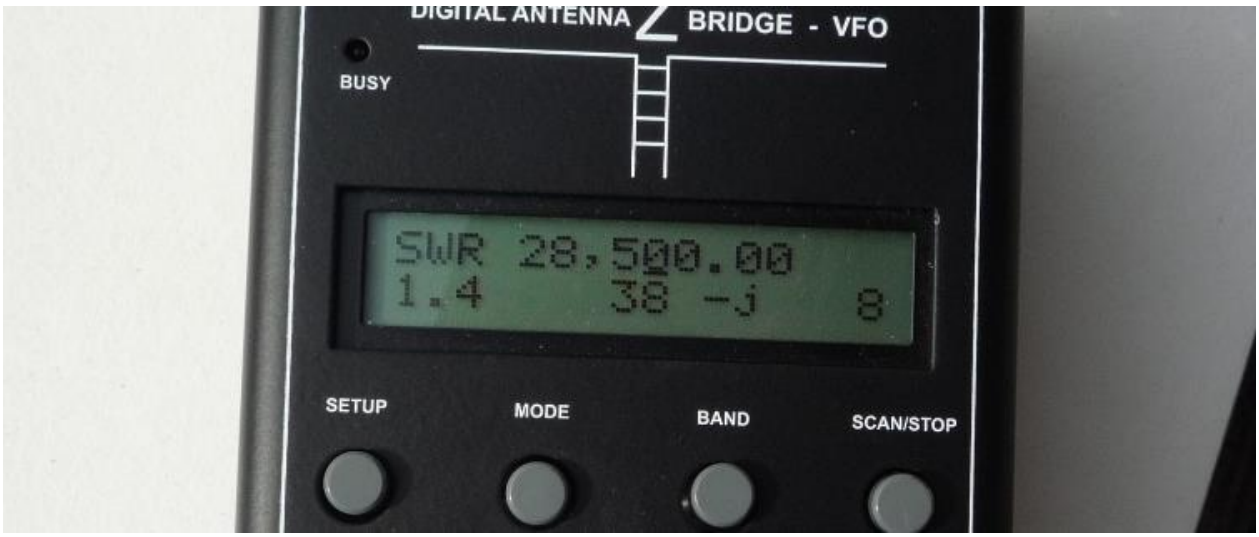
swr is below the 1:1,5 on the whole 40 meter band.



SWR on 20 meterband. No need for a tuner for the 20 meter band.

Idem SWR on 28.500 MHz. On 29.500 the SWR is 1:2.0. For most rigs the RF amplifier will be starting to reduce pwr.

So there you need the help of a (internal) antenna tuner



This is the location of the measurements. This is a typical location as is by many hams in The Netherlands. A House in the
middle of a row with a backyard of 13 meters. The ladderline has nothing to do with the Multi Band HyEndFed. Its the
ladderline of the G5RV junior.

The maximum power of the antenne will be 100W PEP. We are working on a matchbox for 200/300 W PEP.

This is the final version of the MultiBand HyEndFed antenna.

Introduction

Welcome to the dissection and examination of the, formally Par Electronics, LNR Precision EF-10/20/40 MKII Multi-band Portable HF Antenna with its end-fed half-wave approach.

Background

I love participating in outdoor ham activities be they Field Day, Appalachian Trail Golden Packet, etc. Summits on the Air (SOTA) is another activity I helped organize (in Virginia). Participation must wait for procurement of proper gear.

Objective

Procure portable Radio and Antenna and participate in SOTA soonest and 1B Field Day eventually.

The choice of radio is for another post, but for a whole lot of reasons I think I will settle on an Elecraft K2 QRP model.

Portable antennas for the backpack include a wide variety of dipoles, long-wires, and end fed possibilities. I am an antenna designer by trade, but the topic of end fed antennas is relatively new to me; I wanted to learn more.

One valuable resource is AA5TB's web page titled The End Fed Half Wave Antenna. The basic premise is to feed a half-wave antenna at its high impedance end using some form of impedance converter referenced to a counterpoise.

More information is found on the various outdoor ham radio email reflectors and other social sites. Most agree on the basic techniques of converting impedances. There is sharp disagreement on the need for a counterpoise. It appears the devil is in the details.

There are many cookbook designs for end fed dipoles. However, I wondered if commercial end fed antennas were available.

Commercial End Fed Antenna

After hearing many good things about the Par Electronics EndFedz Antenna product line I decided to see for myself what these aerials are all about.

Dale Parfitt, W4OP, appears to be the main designer of the entire EndFedz Line. Mr. Parfitt has a good resume of achievements as revealed during the interview on VE3MPG's Blog. Mr. Parfitt's Patents and Par Electronics' solid presence in the commercial radio markets suggest their ham radio related products are no joke.

As announced in 2012, LNR Precision has taken over production of the EndFedz product line.

Wanted: LNR EF-10/20/40 Antenna

My desire to review one of the EndFedz models led me to put the LNR EF-10/20/40 model on my Christmas List. What do you know, it was under the tree… and here it is spread out for examination in Figure 1.

Figure 1 - What comes with the Antenna

The little bag contains an optional thumb nut to replace the standard nut on the match box antenna stud. The little piece of wire allows you to "lengthen" the antenna if you cut it too short.

Superb Antenna Wire

The antenna wire is some of the best handling wire I have ever seen. It bends easily, does not kink and is practically invisible in most situations. The LNR web site talks up this wire and I can vouch for its nice properties. Bravo.

The Inline Choke

The large blob along the main antenna wire is a well built simple coil inductor. Figure 2 shows a close in view…

Figure 2a - Coil (or Choke) for 40m operation

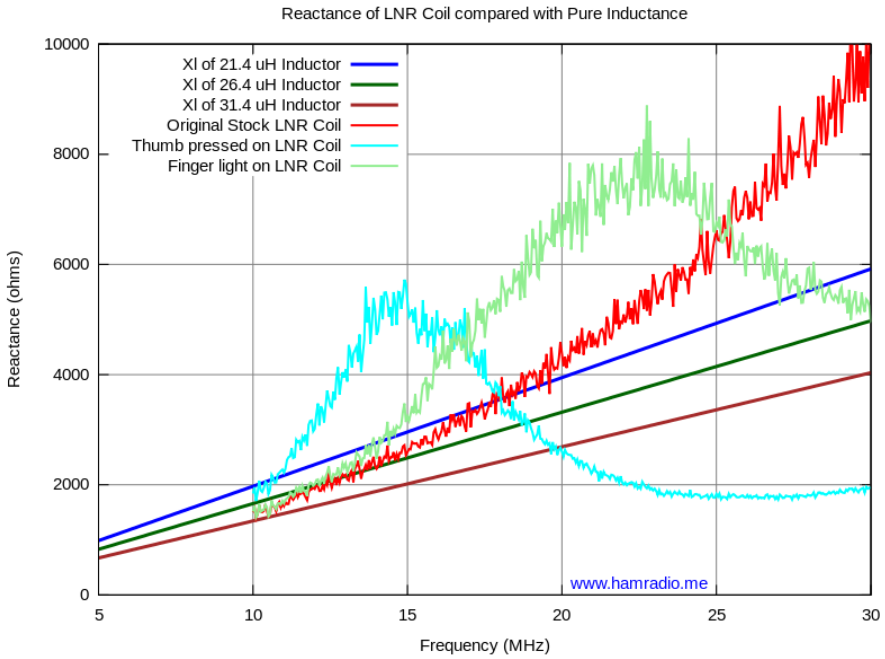
The documentation explains the inductance of this coil adds the additional wire element (plus whatever the choke adds) for 40m and isolates it for 20m and 10m operation. This is basic antenna inductive choke properties at work here.

Figure 2b – Revealing the Coil Winding

Figure 2b shows the coil without the heat-shrink cover. Measurements reveal the coil to be 51 turns of 26 AWG wire wrapped around a .85 inch form resulting in a winding length of 1.4 inches. Inductance calculators suggest this is between 20 and 30 uH.

This inductor "choke" is built clean and neat. The unique wire connection method makes for a straight wire-in/wire-out dress of the antenna wire. Nice, but what does the coil do?

The coil provides high reactance to 10m and 20m



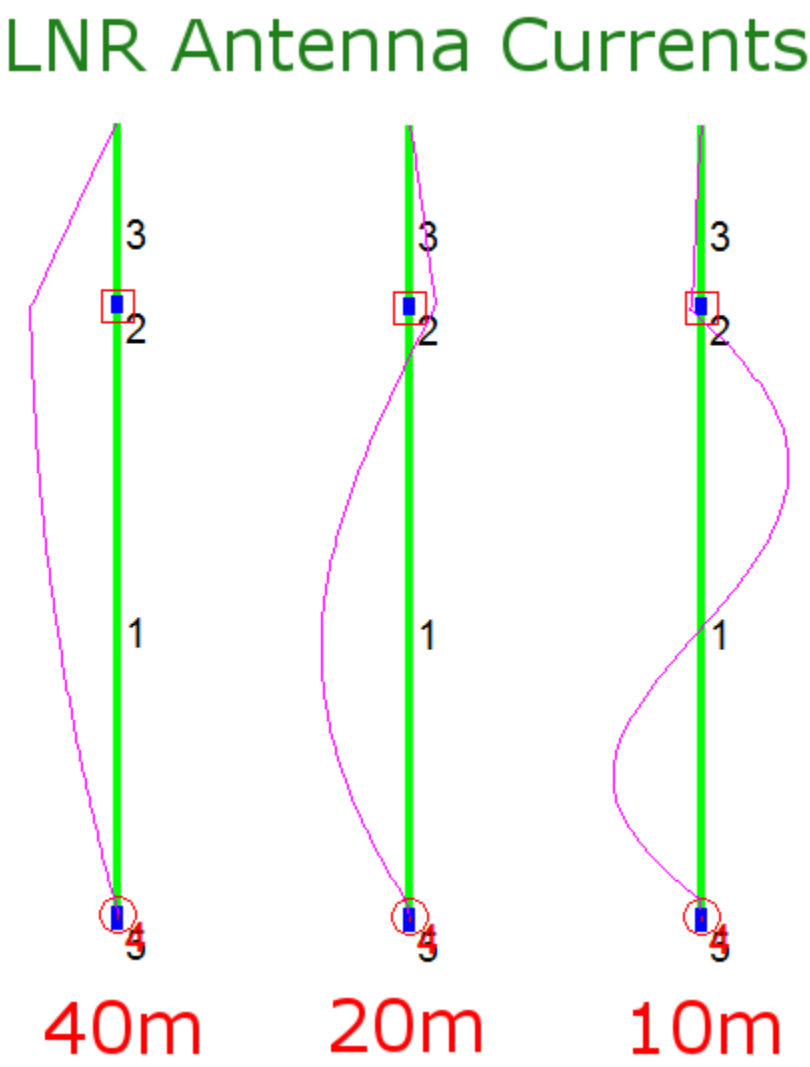
LNR 40m Coil Reactance

The above chart plots measured reactance of the coil from 10 MHz to 30 MHz. Calculations of Inductive reactance for three values of pure inductance are also shown as reference.

The immediate thought of many might be the inter-winding capacitance will be an issue and create trap-like behavior. Indeed we see the red trace reactance rising faster than the pure inductor and peaking somewhere above 30 MHz. Also, when I increase the capacitance by placing my thumb or fingertip on the coil, you clearly see reactance peaks at lower frequencies… just like a trap tuned for those frequencies. Standing free, however, the inductor more closely follows the reactance of a perfect inductor. Traps clearly provide lots of reactance at a narrow range of frequencies, but this one simple coil provides a modest amount of reactance over a wide range of frequencies. LNR (Par) selected this simple single coil as a compromise…, but does it work?

Choke'em

Here we see simulation current magnitudes of the LNR EF-10/20/40 antenna at 40, 20 and 10 meter operation using a perfect 26 uH inductor as choke. In this case, the antenna is oriented straight up only to highlight the currents. This doesn't necessarily represent the best deployment in real use.



Current Control wirh LNR Choke

For 40m operation the choke offers the least, but not zero, reactance to the antenna currents. The coil helps resonate the antenna with its lumped inductance making it much shorter than the tradition half-wave length. The wire beyond the choke has plenty of current, but fades to nothing quick much the way documented by Terman in 1943 [1]. In this orientation we have max current near the top of the antenna.

For 20m operation the inductor chokes more, but not all, of the current leaving most of the action on the lower wire. This is a nice full length half-wave dipole antenna for 20m.

For 10m operation the inductor chokes most of the current leaving the majority on the lower wire. Here we have a full-wave antenna which will have a more figure 8 type of pattern.

It's interesting to note when using 20m or 10m the choke is at the high impedance point of the longer wire wave form. This suggests the choking impedance needs to be higher than the 2-3 kOhms of this point. If my measurements are correct the 20m impedance of the choke equals this. This might explain the noticeable residual current above the choke. However, wire 3 is electrically short which helps keep it from being much of a player. In the 10m case, the choke impedance is higher still with the much less, but not zero residual current. This is good because wire 3 is not electrically short so the choke seems more important in this band.

For as simple as this antenna system is, it's clear a lot of good thought went into the design resulting in a good, functional compromise of several antenna parameters. Well done.

The Impedance Match Assembly

The key to everything is the "little black box" that provides connection to a regular 50 ohm coaxial cable. I measure a direct short between the antenna terminal and the coaxial shell and center pin. This tells me this antenna uses the coaxial cable as the counterpoise as shown by AA5TB's Figure 15.

I was so intrigued I just had to know what was inside this box…
so… I…
…cracked it open to show you in Figure 3…

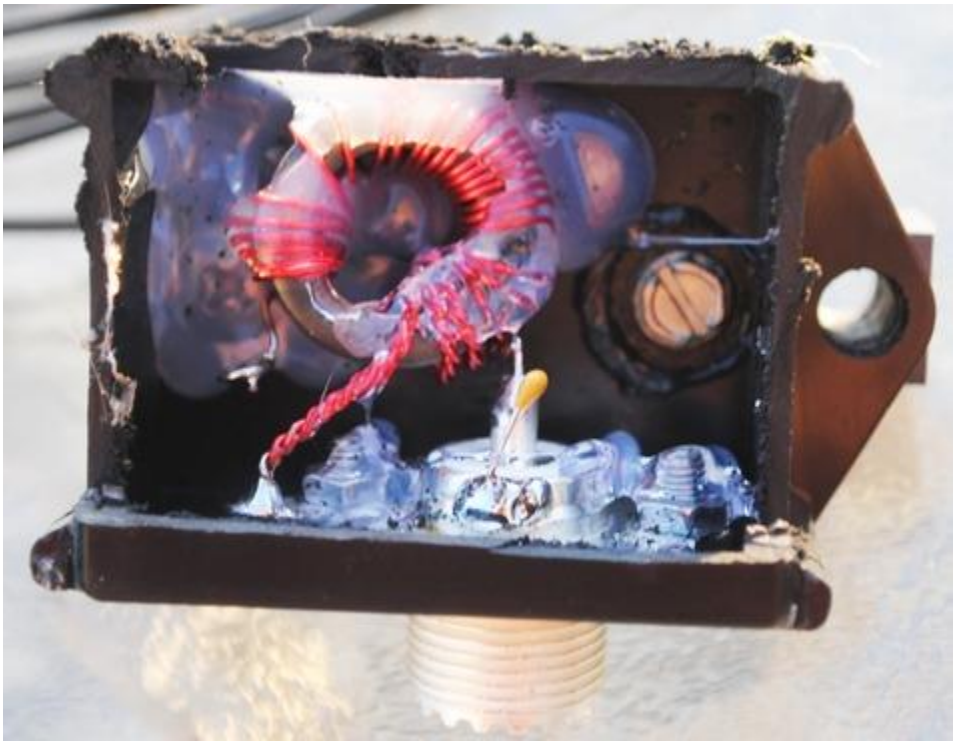


Figure 3 - Match Box Innards

Hmmm what do we have here in all that goo? I see a capacitor across the SO-239 connectors. I see a toroid wired as a transformer with a bifilar winding the first few turns… and… well, that's it! How simple. How beautifully simple.

The schematic drawing in Figure 4 highlights the straightforward design.

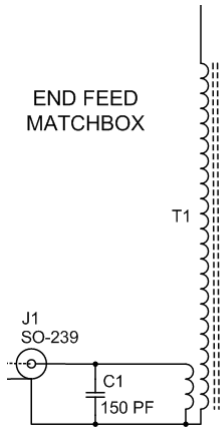
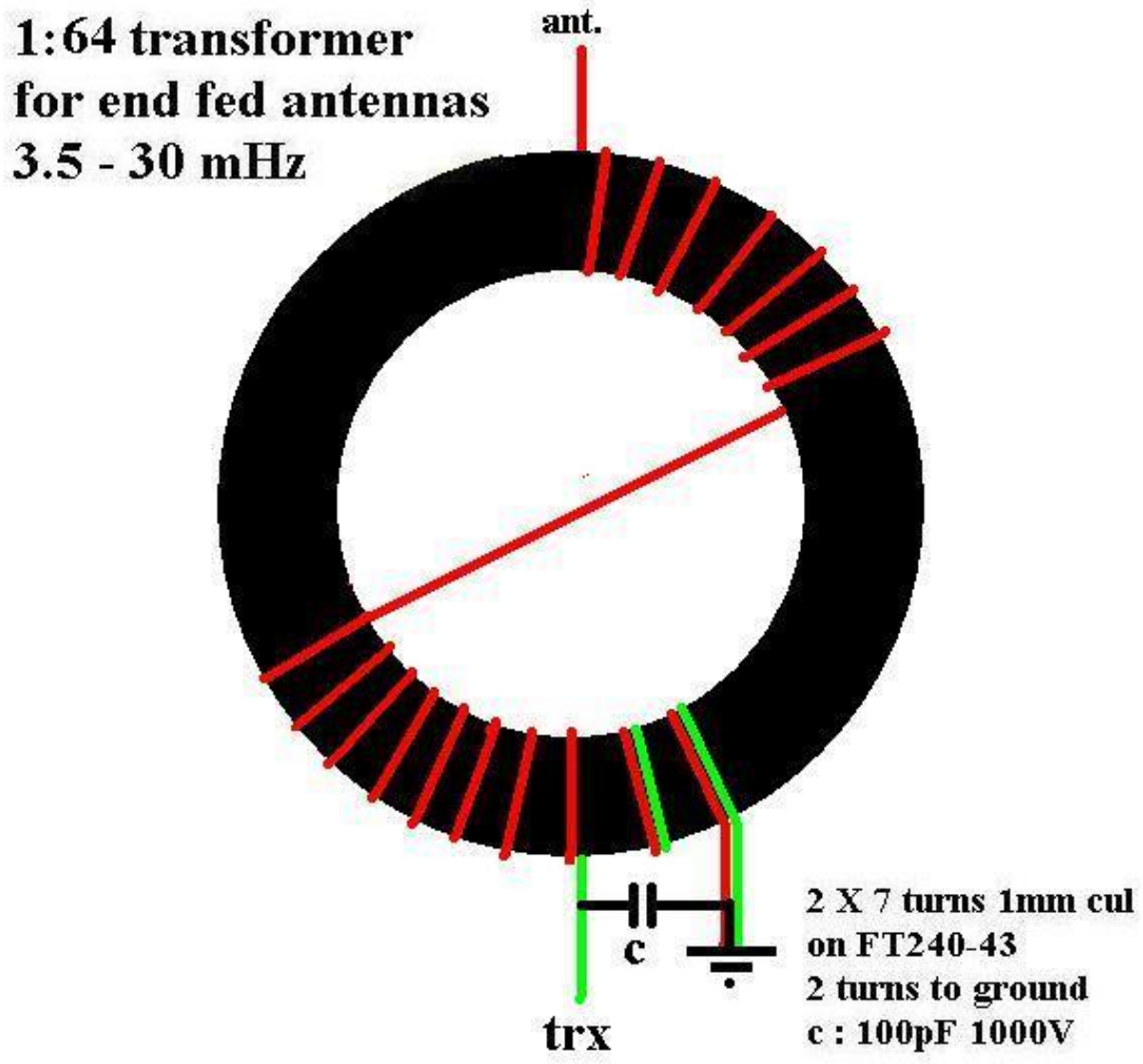


Figure 4 - Matchbox Schematic

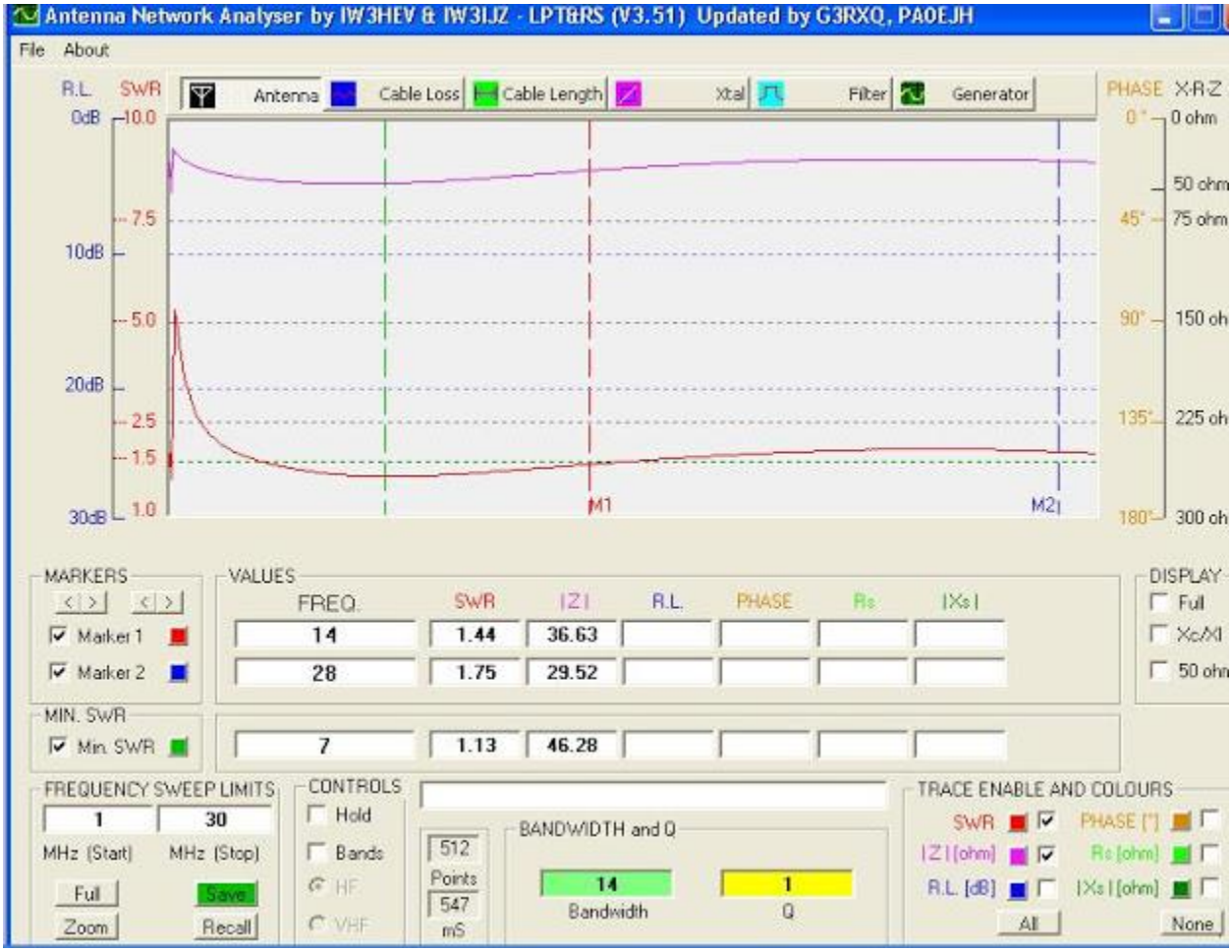
There is no mystery here. T1 is a step up transformer with some compensation across the 50 ohm input. A very nice feature is the non-isolating common point to help make the coax part of the counterpoise. Indeed, this circuit looks remarkably similar to Fig. 4 in Mr. Parfitt's expired 1980 Patent #4238799 on end feeding a "thru-the-glass" 1/2 wave mobile antenna. The notable difference is the location of the capacitor. Many EFHW designs place a capacitor on the antenna side of the transformer and tune it to resonate at one frequency. The EF-10/20/40 has no resonant "tank" circuit on the antenna side. Rather it has a 150 pF capacitance across the coaxial 50 ohm side; Measurements confirm the necessity of this capacitor in the next post.

Multiband end fed antennas 3.5 - 30mHz

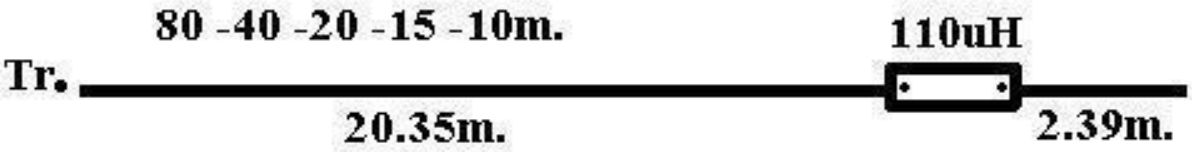


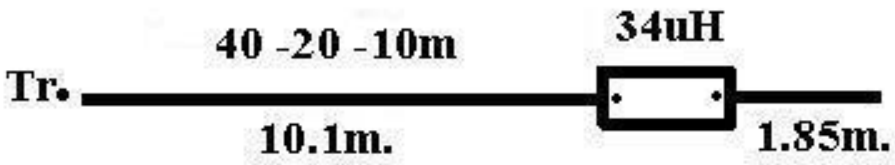
This is a 200 Watt PEP step up transformer for end fed full and half wave antennas without radials, designed as a 200 Watt PEP upgrade for the originaly Par Electronics designed 25 Watt HF endfedz multiband end fed antenna.
The original design has a 27/3 turn ratio (1: 81) on a small 43 material toroid, but the larger toroid has more wire so the nr of turns had to be reduced for max.efficiency on 10m. The coil now has a 16/2 ratio (1: 64) For max. performance the 2 turns to ground must be twisted . The 100-150pF capacitor gives a better match on 10m.and both windings start at the ground side of

the coil .Don't try to stack toroids for more power for this will increase overall inductance . This makes it impossible to tune the high bands. The best results are obtained with a small toroid.....The 3 band antenna has a length of 10.1m. followed by a coil of about 34 uH (90 turns 1mm enamel wire on a 19mm pvc tube) and a endpiece of 1.85m , offering you a perfect vertical or horizontal antenna for fieldwork at 40 -20 and 10m. There is also a 5 band version with 20.35m wire followed by a 110 - 120uH coil (about 260 turns 1 mm cul on a 19mm pvc tube) and a 2.39m. endpiece. This antenna works on 80 - 40 - 20 -15 and 10m.without radials and has a verry low swr combined with a low noise level. Keep in mind that every end fed / vertical needs some kind of counterpoise to pusch against and in this case that's the coax , so don't forget a line choke near to your transceiver.



Tranformer with 150pF and 3K3 resistor to ground





110uH coil : 260 turns 1mm. cul. 34uH coil : 90 turns 1mm. cul close wound on a 19mm pvc tube
start tuning the long wire on the high bands.

Transformer made by Tony PA3GWO on a smaller FT140-43 toroid for max. 100 Watt pep

Antenna Idea. How about a 41m longwire fed by the 1:49 transformer ? 80-10m.without tuner.....