



## END FED 6–40 Meter Multiband HF Antenna

### Introduction

This EARC project produces an inexpensive, multiband, end fed HF antenna matchbox that is quick and easy to setup and use. The end fed feature adds portable convenience, but does present another issue. The problem with an end fed half wave antenna is that the antenna presents high impedance, creating a significant miss match with the usual transceiver impedance of 50 ohms. This miss match is significantly greater than typical tuners can accommodate without a matching transformer.

This project creates a trifilar wound, 9:1 UNUN (unbalance to unbalance) toroid matching transformer that will match the high input impedance of an end fed antenna into the range where most antenna tuners can produce good performance. The matchbox handles 100 watts of power. ***This project requires an antenna tuner to achieve satisfactory SWR.*** If you need an auto tuner, we recommend the LDG line of auto tuners, shown to work well with these matchbox antennas, and highly rated by users. They are reasonably priced and available at most ham stores.

The matchbox project uses readily available common hardware and materials listed below.

### Matchbox Parts List

- 1 small plastic enclosure (shown right)
- 1 powdered iron toroid T130-2
- 3 20" pieces of 22 AWG solid insulated copper wire in red, green, and black
- 2 # 8-32 x 3/4" hex head machine screws
- 2 # 8 lock washers
- 2 # 8 ring wire lugs
- 2 # 8 flat washers
- 2 # 8 lock washer/nut combination
- 2 # 8 wing nut
- 1 SO-239 panel mount connector to fit keyed enclosure opening
- 30' # 18 AWG insulated stranded wire antenna with ring lug attached
- Small amount of clear silicone caulk to secure toroid in place



## Preparing the MATCHBOX Plastic Enclosure

The enclosure needs one 5/8" hole for the SO-239 connector, and one 11/64" hole for the counterpoise wing nut on the lower side of the enclosure. An 11/64" hole on the upper right side of the box facilitates antenna connector mounting.

### TOROID WINDING

First, wind the three 20" pieces of insulated solid wire onto the toroid. Place the wires as shown green-black-red, and wrap the toroid 9 turns so that it looks like the photo on the right. Notice there are three wires extending from the left winding and three wires extending from the right winding. As the connections are completed, the steps refer to the specific wires by left or right and color.

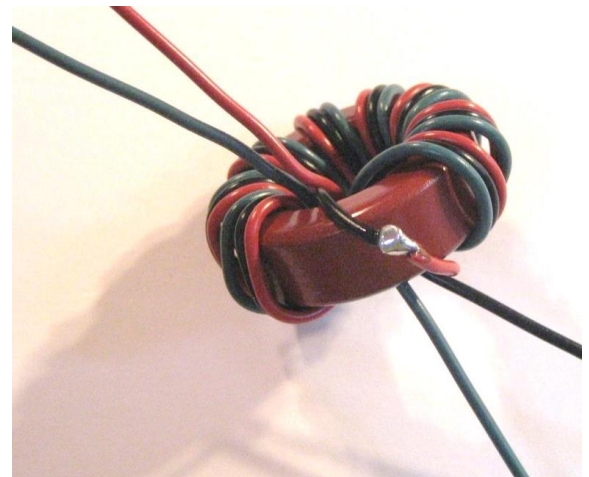
NOTE: Count turns by counting the number of times the wire goes thru the toroid center.

Crimp together and solder the left black wire with the right red wire. When the step is completed, it will look like the right photo.

The next three steps should appear as shown in the first photo on page 3. Crimp and solder a # 8 lug to the left red wire about 2" from the toroid. The completed lug will later connect to the antenna connection bolt on the upper inside of the enclosure.

Twist the left green wire with the right black wire. Strip the ends of the two wires and twist together at about 2". This twisted pair will solder to the center connection of the SO-239 connector in a later step.

Trim and strip the remaining right green wire at about 2". Cut an additional 2" piece of green wire, and crimp and solder both wires to a # 8 lug. The 2" green wire will connect to the ground connector on the SO-239 already installed in the enclosure. Strip remaining green wire end 3/8" and bend into a hook for connection to the SO-239 ground connector.

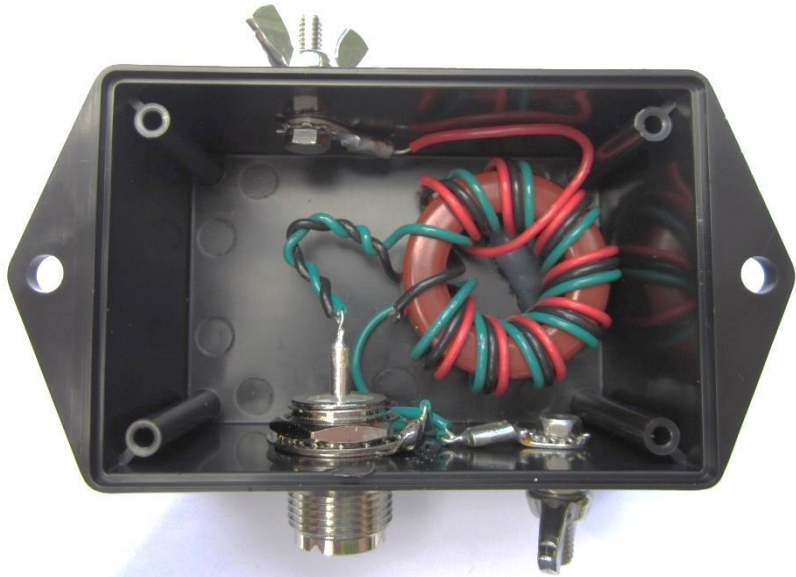


The SO-239 connector and ground lug should be installed through the keyed hole in the lower right with the mounting nut securely tightened.

Solder the green and black twisted pair to the SO-239 center connector. Solder the green wire hook to the ground lug on the SO-239 connector.



From inside the box, place an 8-32 machine screw through a lock washer, the # 8 lug on the green wire, then through the lower 11/64" mounting hole. Place a flat washer on the outside protruding machine screw followed by # 8 lock washer/nut and tighten securely. Place a # 8 wing nut on the machine screw to finish the **counterpoise connector**.



Position the toroid inside the box to allow connection of the red antenna wire lug to an 8-32 machine screw and lock-washer on the upper box side. Place a flat washer on the outside of the box followed with a # 8 lock washer/nut. Tighten the nut securely. Next, place the wing nut on the **antenna connector** and your project appears as shown above.

A small spot of clear silicone compound is used to secure the toroid from movement in the enclosure. The final assembly step is to secure the box cover in place with four screws.

### Preparing the Antenna Wire

Matchbox performance will be determined by two factors: The length of the antenna wire, and the capability of the tuner. The length of the antenna wire should be between 24 and 60 feet for best performance. Additional counterpoise is not normally required, as the coax shield provides the counterpoise function. Wires longer than 60 feet may have excessive impedance for some tuners to properly match. Wires shorter than 24 feet may not radiate as effectively. A 30 foot insulated 18 gauge stranded wire antenna and connecting lug is included with the project and should meet most requirements without need for any counterpoise.

Experience has shown that most external tuners and some internal tuners will tune 80–6 meters with an antenna length of 24' to 30'. If a longer antenna is desired, the provided antenna can be lengthened.

Some tuners, in particular internal tuners, may not tune the full 80-6 meter range. You may need to try different wire lengths to optimize your antenna configuration. If you are having difficulty getting your rig to tune, start with a 26' wire. This should produce good results on at least 40-6 meters using the narrowest performance range of internal tuners.

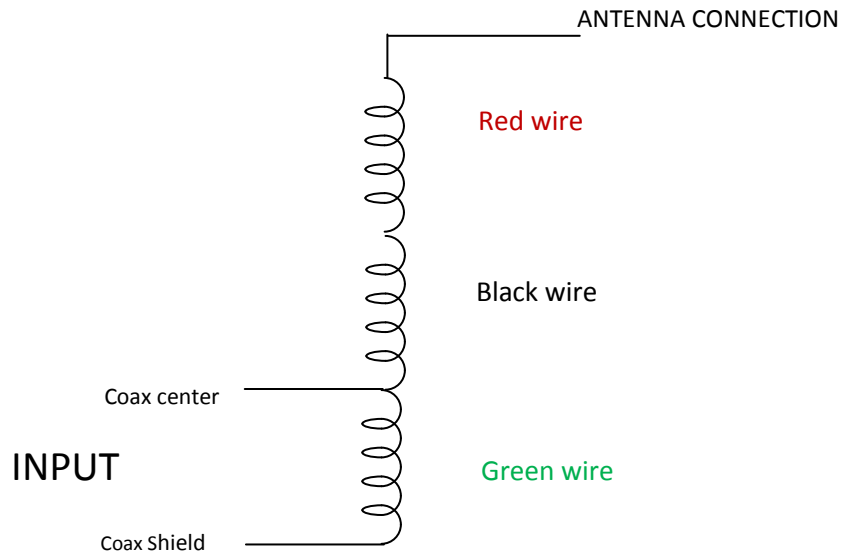
Best performance is achieved with a coax of 16' or longer, with the coax shield providing the counterpoise function. Additional counterpoise is usually not required in this design, although the lower wing nut provides a convenient counterpoise connector if needed. The end fed antenna system works well in horizontal, sloper, and vertical configurations.

Observe established safety practices when working with antennas, and avoid proximity to power or utility wires. Permanent installations should be equipped with appropriate static and lighting protection.

Keep amateur radio safe and fun!



## Toroid Wiring Schematic



## Feedback on 6-40 End Fed Matchbox Antennas

The antenna is amazing. I receive fantastic signal report from DX stations as well as hams around the country. I previously used a short version GR5V that was in an inverted V configuration on the roof of our house. This antenna was noisy but worked. Your antenna out performs the prior antenna and is much quieter. Thanks again for the fine product that your club offers. **May 2012**

It took me 10 minutes to install and WOW - within 10 minutes I made my first HF contact (from CT to GA). And in the span of 4 hours made 3 more !! I was transmitting just 5 Watts from Yaesu 857ND using this antenna. This antenna rocks ! Thanks a ton ! **73 May 2012**

The 6 - 40 Matchbox antenna works great! Easily tunes with the Z100 tuner - very low SWR's on 20m thru 10m. Antenna was up about 45 feet on tree branch - wire length was about 52.5 feet, slight slope, 55 feet of coax, line isolator at radio. **Work Hawaii for the very first time. Guess the antenna wanted to call home :-)** **57 report, 100 watts, 15 Meter band, Icom 718.** A great portable antenna that I will use often at Montrose Harbor along the lakefront in Chicago. Thank you for a fine, well made product. **April 2012**

It arrived today in fine shape. I got it up in the air this afternoon using a 31 foot radiator. Top is at 45 feet. Loads on all bands 80-10M with my LDG auto-tuner absolutely no problem, My first QSO was KH7X in the ARRL SS contest with 100W. Amazing. This thing rocks! It's a great antenna! Nice job and a great buy. **November 2011**

I set-up my jackite pole today and tried a 68' wire with the 9:1 unun matchbox. I set it up as an inverted L with about 26 feet vertical and 42 feet horizontal. With my IC-703 it tuned 80 through 6 all well below 1.5:1. I am going to leave the antenna up a few days and make a few contacts. I think the matchbox is terrific. **October 2011**

My 6 – 40 meter end fed arrived through the UK holiday mail and I departed from my norm of a sloper and mounted it vertically on a 10m fishing pole. It is surprisingly effective and rewarded me with a surprise contact on 17m into the Falkland Islands at 20:30UT last night. **January 2012**

When I attached it to a 10m fiberglass fishing pole and went vertical - wow! Easy 5/9 contacts out to 6,000+ miles when propagation was anything better than the worst. My simple ATU easily matches the antenna with SWR never greater than about 1.4 on any band it is built for. **December 2012**

You can dither and procrastinate, but with this antenna, you'll be talking to the world in no time on any band that happens to be hot - and with your hard-earned cash hardly touched! **January 2012**

Just wanted to report back that I have tossed the antenna into a tree about 20' up in an inverted vee shape and I am pleased to report that I can tune anywhere I need on 40-10M using the TS-590 internal tuner!! My first contact was on 40M within 10 minutes of erecting the antenna and was all the way to TX from my condo here in MI using just 10 watts. This is by far the best HAM related investment I have made in a long time. Living in a condo with strict association rules, I am able to conceal this wire in a tree out my bedroom window and talk all over. I'm very happy and would recommend this antenna to anyone in a similar situation. **March 2013**

I have had your multiband end fed antenna installed here in Singapore for a few weeks now and am very pleased. I used the wire from my previous antenna which is 66 feet long. It works beautifully! I have it hanging vertically outside my 15th story apartment window on a 5 foot horizontal pole (to get it away from the reinforced concrete building). A couple of fish weights on the end keep it from blowing around too much. I would recommend this antenna to anyone who is facing a challenging QTH. **April 2013**

I received my antenna yesterday, a quick 4 days since I ordered it. I attached it to a 31 foot pole and my IC-706MK2. Within minutes, I made my first contact with 9A4KW in Zagreb, Croatia on 20 meters. Being able to reach out over 4,000 miles gives me real confidence that I have found my portable antenna. Thanks for your rapid response and fine product. **May 2013**

In only 2 weeks of casual on-air time. If you could see how I had to zig-zag it through a big tree above the roof of my RV, you'd be saying like I am, "how the heck can that work? I worked 90% of the stations I called, and just added Mexico City on 15m that gave me a 5x9. **September 2013**

Just wanted to let you know how pleased I am with my ERAC matchbox antenna. I put the EARC antenna in the backyard with the feed point at 4 feet and the wire sloping up to 35 feet. I have 125 feet of coax feed line. My transceiver's built-in antenna tuner will adjust the SWR to below 1.2 to 1 on all bands 80-6 meters. Last weekend I worked 65 countries on 5 continents. I live in an antenna restricted community and this antenna has allowed me to enjoy ham radio again. **February 2014**

I used the EARC Matchbox today. It works GREAT on 20m with a 30 ft radiator in vertical positioning, fed with 25ft of RG175/u coax. I've been talking up and down the east coast with 3W on SSB all afternoon! People ask me to repeat my power output again and again. I can't wait until I get the chance to use it at night, where I think it'll really shine! This has a permanent place in my portable kit. Thanks for the great product! **April 2014**

I performed a simple install in Virginia making it vertical by using a 28 foot fiber glass kite pole. Within 30 minutes (NO KIDDING) I was receiving Lebanon on 17 meters! I also worked Russia and Eastern Europe that night on 20 meters. I love this antenna and I give it a 100% (5 STAR) rating. **May 2014**

This little box is magic. NY, IA and NM from GA with ease on 100w **June 2014**

Just wanted to let you guys know, this matchbox is wonderful. I built the matchbox, connected it to 55 feet of solid #14 about 20 feet in the air. My rig is a Yaesu FT-817ND connected to a MFJ-971 tuner with coax running between the tuner and the matchbox. So far I have worked Slovenia twice, Morocco, St. Helena Island, Cuba, Cost Rica, Vermont, Wyoming, Florida, North Dakota, Brazil, and Colombia. This

setup works really well on the higher bands. Thank you for putting this design on the internet. I like it so much its become permanent here. **September 2014**

This antenna continues to amaze me. It worked well U-shaped "indoors" with 50 watts, and now outdoors as a sloper. It easily loads 10-40m with my TS-570s internal tuner. I'm sold on it and own two of them now. I'm working at least 90% of the DX I chase. I have no RFI in the shack either. **November 2014**

**EARC Antennas are operating in virtually every state, these countries and more!**

Argentina Australia Belgium Brazil Canada Chile Denmark Greece  
Hong Kong India Ireland Israel Italy Mexico Mozambique New Zealand Russia  
Singapore Sweden Tasmania United Kingdom

### **ORDERING A MATCHBOX ANTENNA FROM EARC**

Volunteers of the Honolulu Emergency Amateur Radio Club (EARC) carefully assemble the 6-40 End Fed matchbox antennas for those who prefer not to build one. For a donation of **\$56** (Including USPS priority mail shipping) club volunteers will build and deliver a 6-40 matchbox with a 30 foot antenna wire anywhere in the U.S., we do not ship internationally. Note that coax cable is not included.

#### **Payment by PayPal**

To pay via **PayPal**, make your payment to [paypal@earchi.org](mailto:paypal@earchi.org) using any major credit card. Include your name, mailing address, and email address with the order.

We will ship promptly and you will likely receive the order in the US in 7 days or less. If you have any questions about your order, please email [webmaster@earchi.org](mailto:webmaster@earchi.org)

Thank you for your interest in the activities of Honolulu Emergency Amateur Radio Club and amateur radio.

