END FED 6 – 40 Meter Multiband HF Antenna

Introduction

This project produces an inexpensive, multiband, end fed HF antenna matchbox that is quick and easy to setup and use. The end fed feature adds convenience, but does present another issue. The problem with an end fed half wave antenna is that the antenna presents a 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.*

The matchbox project uses readily available common hardware and materials. For your convenience, Emergency Amateur Radio Club of Honolulu volunteers make fully assembled matchboxes for those who don't want to construct one. Proceeds support the club and amateur radio. Order information is included on the last two pages.

Matchbox Parts List

1	small plastic enclosure and cover
1	powdered iron toroid T106-2
3	20" pieces of 22 gauge solid insulated copper wire in red, green, and black
2	6-32 x 3/8" machine screws
2	#6 lock washer/nut combination
1	10-24 x ¾" machine screw and nut
2	#10 flat washers
1	#10 lock washer
1	#10 wing nut
2	#10 wire lugs
1	#6 wire lug
1	SO-239 panel mount connector
1	30' #18 AWG insulated stranded wire antenna
	Few drops of clear PVC adhesive to secure cover in place
	Clear silicone caulk to secure toroid in place

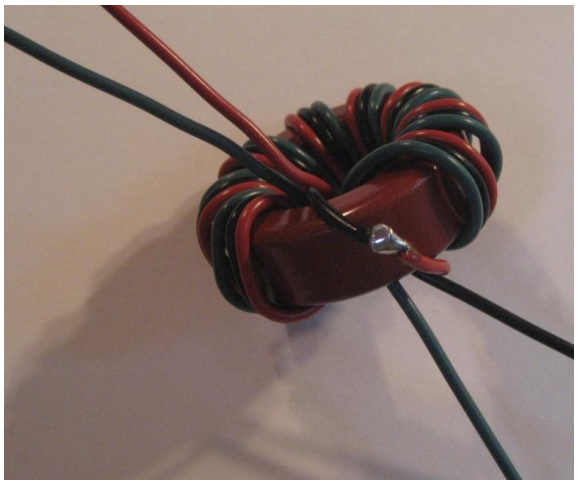
Preparing the MATCHBOX Plastic Enclosure

EARC sells completely fabricated ABS enclosures with all holes machined for the matchbox project. If you are making your own enclosure, start the project by drilling one 5/8" hole and two 9/64" holes for mounting the SO-239 coax connector on the lower side of the enclosure. Use the connector as a guide to mark for accurate drilling of smaller holes. Next, drill a 3/16" hole in the upper right side of the box for mounting the antenna connector.

TOROID WINDING

Next 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.

Next, trim, crimp together and solder ***the left black wire*** with the ***right red wire*** When the step is completed, it will look like the photo on the right:



The next three steps should appear as shown in the right photo. Crimp and solder a #10 lug to the ***left red*** wire about 2" from the toroid. The completed lug will later connect to the antenna connection bolt on the top side of the enclosure.

Twist the **left green** wire with the ***right black*** wire. Strip the ends of the two wires; twist together at about 2". Solder this wire pair to the center connection of the SO-239 connector.

Trim and strip the remaining ***right green*** wire at about 2". Crimp and solder a #6 lug. This lug will connect through a 6/32 machine screw to the ground of the coax connector.

Next, place the SO-239 though the 5/8" mounting hole from inside the box and position over the two mounting holes. Place a 6/32 x 3/8" machine screw through each mounting hole and connector. Place the #6 lug connected to the green wire over one of the machine screws. Next place a #6 lock washer/nut over both machine screws. Securely tighten both machine screws.

Position the toroid inside the box to allow connection of the red antenna wire lug to the 10-24 machine screw on the upper right box side. Place the 10-24 machine screw through the #10 lug connector on the red wire, followed by a lock washer, then a flat washer, and next insert it through the 3/16" hole in the upper side. Place a flat washer on the outside of the box followed by a #10 hex nut. Tighten the nut to hold securely. Next, place the wing nut on the antenna connector and your project appears as show above.

A small spot of clear silicone caulking compound is used to secure the toroid from movement in the enclosure. The only remaining assembly step is to securely glue the box cover in place with PVC cement.

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 wire should generally be between 22 and 60 feet for best performance. Longer wires may have excessive impedance for some tuners to properly match. Wires

shorter 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.
Experience has shown that most external tuners and many internal tuners will tune 80–6 meters with an antenna length of 22’ to 30’. If a longer antenna is desired, the provided antenna can be lengthened.

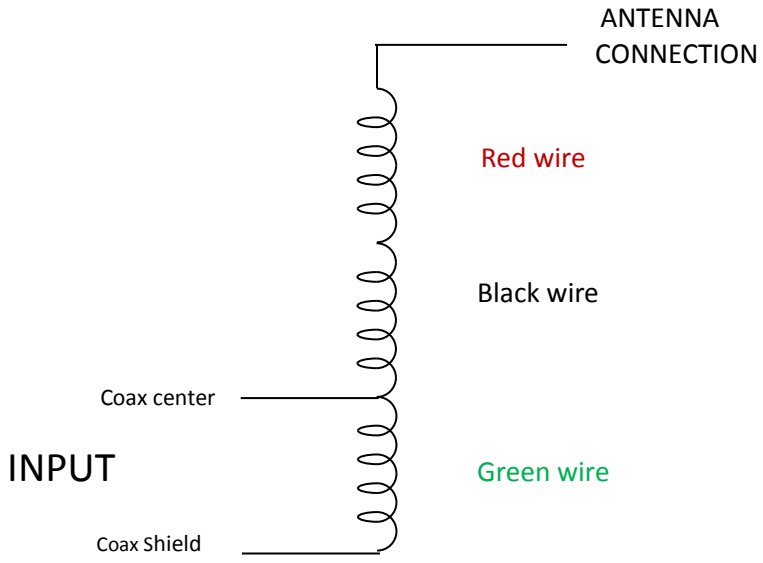
Some tuners, in particular internal tuners, may not tune the full 80-6 meter range. You may need to try different wire lengths to optimize your antenna configuration. If you are having difficulty getting your rig to tune, start with a 26’ wire. This should produce good results on at least 40-6 meters using the narrowest performance range of internal tuners. Best performance is achieved with a coax of 16’ or longer.

Additional counterpoise is not required in this design. The 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! If you would like to share your experiences with this project, email the club at http://www.earchi.org.

Toroid Wiring Schematic



Customer Feedback on EARC Antennas

6 to 40 Meter End Fed Antenna

First let me tell you that I received the antenna in record time. I ordered it on a Friday and received it on Monday. Quite impressive. It was well packed. I put the antenna up using a tree at 18 feet sloping down to the room of our family room which is 8 feet high. I use an Icom IC 706 MKIIG and a LDG Z-11 Pro Tuner. With my low power I get through the pile ups on 20M and compete with the big guys.

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***

I got my general class license almost 5 years ago but never made a single HF contact. This is because I live in a townhouse and do not have access to outdoor antennas. I have tried SEVERAL indoor HF antennas but never had luck. Other day I ordered this EARC antenna. It took me 10 minutes to install and WOW - with in 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***

I am happy to inform you that I did in fact take your advice regarding throwing my g5rv jr over the roof. The difference in received signal and transmit signal is like night & day. ***April 2012***

Bearing in mind this is my first HF antenna: I have it going from the centre of my 1300 sq. ft metal roof to the metal mast of my 2-meter antenna, the coax screening is grounded to the metal for ground plane effect, and the open end is tied onto twine via an insulator onto the metal mast. It is facing (mast to roof) WSW towards Los Angeles (700 miles). I am a new Tech so I can only use the 10 meter band. I have equal listening success on the 40 and 20 meter bands. Kenwood TS-430S 100 watts, AT-130 antenna tuner & MC-60A mike. Thanks, and 73. ***April 2012***

Not surprisingly I pick up many southern Californian stations. But my joy was my first two DX QSOs; first KD1NA Boston, Mass., on 28.400.0, off the back of the antenna then PY2XC Sau Paulo, Brazil on 28470.0 where we talked for about five minutes. I call that success! ***April 2012***

It arrived today in fine shape. I got is 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! Its 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***

EARC does a very fine service to the community by providing DIY plans and selling ready-made versions of this antenna. The club is also very helpful and cares about whether or not the postal service gets it to you in a good time. ***November 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***

Fully Assembled 6-40 Meter Matchbox Antenna

Volunteers at the Honolulu Emergency Amateur Radio Club (EARC) carefully assemble these HF matchboxes for those who prefer not to build one. The club will build one for **$44** including USPS priority mail shipping anywhere in the U.S. A 30 foot 18 gauge antenna wire is included.

Matchbox Antenna Parts Kit

Emergency Amateur Radio Club (EARC) makes a parts kit for the EARC 6 – 40 Meter End Fed Matchbox available for those who want to build the matchbox on their own. The enclosure is shown on the right. The ABS box is approximately 1” x 2” x 3”. It comes with a weatherproof glue-on cover. Adhesive is not included, but the best choices are clear PVC cement, clear silicone caulk, or high quality model glue.

Full Parts Kit Contents

1	ABS matchbox enclosure and cover
1	powdered iron toroid T106-2
3	20” pieces of 22 gauge solid insulated copper wire in red, green, and black
2	6-32 x 3/8” machine screws
2	#6 lock washer/nut combination
1	10-24 x ¾” machine screw and nut
2	#10 flat washers
1	#10 lock washer
1	#10 wing nut
2	#10 wire lugs
1	#6 wire lug
1	SO-239 panel mount connector
1	30’ #18 AWG insulated stranded antenna wire
1	EARC Project Paper detailing assembly

EARC sells the Parts Kit for **$35** including priority mail shipping in the U.S.

Three core components

The club sells just the three core hard to find parts, *the box and cover plus T106-2 Toroid and SO-239 connector* to fit the enclosure for **$20** including priority mail shipping in the U.S.

Matchbox Enclosure only

The club sells the enclosure box with cover for **$12** including shipping in the U.S.

ORDERING MATCHBOX AND PARTS FROM EARC

EARC gives you four ways to obtain a 6-40 meter Matchbox Antenna.

A fully assembled 6-40 Meter Matchbox antenna is **$44** including priority mail shipping in the U.S.

A kit of parts excluding adhesives is **$35** including priority mail shipping in the U.S.

A set of three core components is **$20** including priority mail shipping in the U.S.

A matchbox enclosure and cover is **$12** including priority mail shipping in the U.S.

Proceeds go to the club to promote amateur radio activities. To order, make payment via PayPal, to our fundraising chairman chanebuth@yahoo.com . Be sure to include your name and mailing address in the remarks section with the PayPal remittance.

We will ship promptly and you will likely receive the order in 7 days or less. If you have any questions about the matchbox or your order, please email Mr. Hanebuth at chanebuth@yahoo.com.

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

Email your experiences with this project to the club at http://www.earchi.org.

Chuck Hanebuth KH6HNL
Emergency Amateur Radio Club (EARC)
Fundraising Chairman