Building the “Matchstick” Antenna Matching Device

Introduction

The “Matchstick” is a simple device designed to lower the SWR from the antenna to the transmitter. To do this, the “Matchstick” employs a combination of inductance (coil) and capacitance (capacitors). The proper values of coil and capacitor will results in maximum transfer of power to the antenna and minimum of reflected power (lower SWR). The “Matchstick” is designed to be used only on 40 meters at power output levels less than 5 watts. It will work best at “fine tuning” an antenna that is nearly resonate on 40 meters. Results will vary depending on what type of antenna is used and the configuration of the coil and capacitors. The circuit includes a built-in resistive SWR bridge with visual indicator.

Building Rules

1. Take your time. We recommend that you take at least two or three days to complete your kit. It will take three coats of paint on your breadboard anyway to give it a good finish and a day of drying between each coat is recommended. So, if you take your time, in three days you can have a beautiful working project that you will be proud to own and operate.

2. If you don’t know how to solder parts on a circuit board, get help. Learning to solder is not hard, but please do not start this kit if you have never soldered before!

3. Most of the parts are tiny. Please use a magnifying glass.

4. Build the kit by the instructions, one step at a time.

5. Use protective eyewear.

6. Be careful with the ICs and transistors to avoid damage from static.

7. All parts should be mounted flush or as close as possible to the circuit board keeping leads short. After soldering, clip all wires close to the board.

Finishing The Breadboard

The wooden breadboard furnished with your kit is your opportunity to express yourself. You get to finish it any way that you like...pick your color, pick your finish. MAY WE SUGGEST THE FOLLOWING?

1. Use fine grit sand paper to remove any roughness from the wood.

2. You can use brush on or spray paint or stain or no finish at all...it's up to you.

3. You are in charge of getting the board ready. Three coats with light sanding between coats and about 24 hours of drying time will produce great results.

4. When the board is finished, locate the circuit board and place it on top of the breadboard. Center the circuit board and using a small nail, phillips screwdriver or other small pointed object, push a small starter hole into the breadboard at each corner mounting hole. Then drill a 1/16th inch hole in each starter hole. These holes are to mount the assembled circuit board in the proper location at the end of the project. Place the breadboard aside for now.

Building the Circuit Board

Tools and supplies needed to build the circuit board:

1. needle nose pliers

2. diagonal cutters

3. small flat blade and phillips screwdrivers

4. Magnifying glass

5. 20-40 watt soldering iron

6. Hobby knife or coarse grit sand paper

Locate the parts bag. All of the parts required for circuit board construction are enclosed. You can work from the bag and find each part as it is called for, but placing all of the parts from the bag into a bowl or small plastic tray may make it easier to sort and properly identify the parts.

As each part is called for, be sure to identify it, then locate the proper mounting holes on the board. Insert the part and check it's placement before soldering it in place. Cut all leads flush with the board.

About The Toroid

The heart of the Matchstick is L1 a T-68-2 toroid. The winding has 37 turns and puts the inductance at about 5.0 uh. Combined with proper capacitance, the LC network will be resonate in the 7.0 MHz range. Winding a toroid is not difficult, but must be done correctly or the Matchstick will not work. Refer to the photos page and large toroid construction guide diagram to guide your winding of the toroid.

1. Wind 37 turns of magnet wire on L1. Cut lead ends to 1 inch and set it aside until the end of board construction.

2. Locate J1, a PC mount RCA jack and mount it on the board. NOTE: The two outside mounting tabs will be a tight fit. This insures a good mechanical connection. You may need to use needle nose pliers and some force to seat the tabs all the way in the board. Solder in place.

3. Locate J3 and mount in the same as J1.

4. Locate J2, a two position screw terminal and mount and solder in place.

5. Locate SW1, a DPDT slide switch and mount it flush on the board. NOTE: This will be a tight fit and may require some force to mount. Solder in place.

6. Locate SW2 and mount as in SW1 and solder in place.

7. Locate SW3 and mount as in SW1 and solder in place.

8. Locate R1, R2 and R3, all 51 ohm (Green, Brown, Black) 1/2 watt resistors. Mount and solder them at the indicated places on the board.

9. Locate D1, a glass 1N4148 diode. Mount and solder on the board. Observe the polarity as indicated by the stripe on one end of the diode and on the board diagram.

10. Locate C1, a 0.1mfd ceramic capacitor (104). Mount and solder in place.

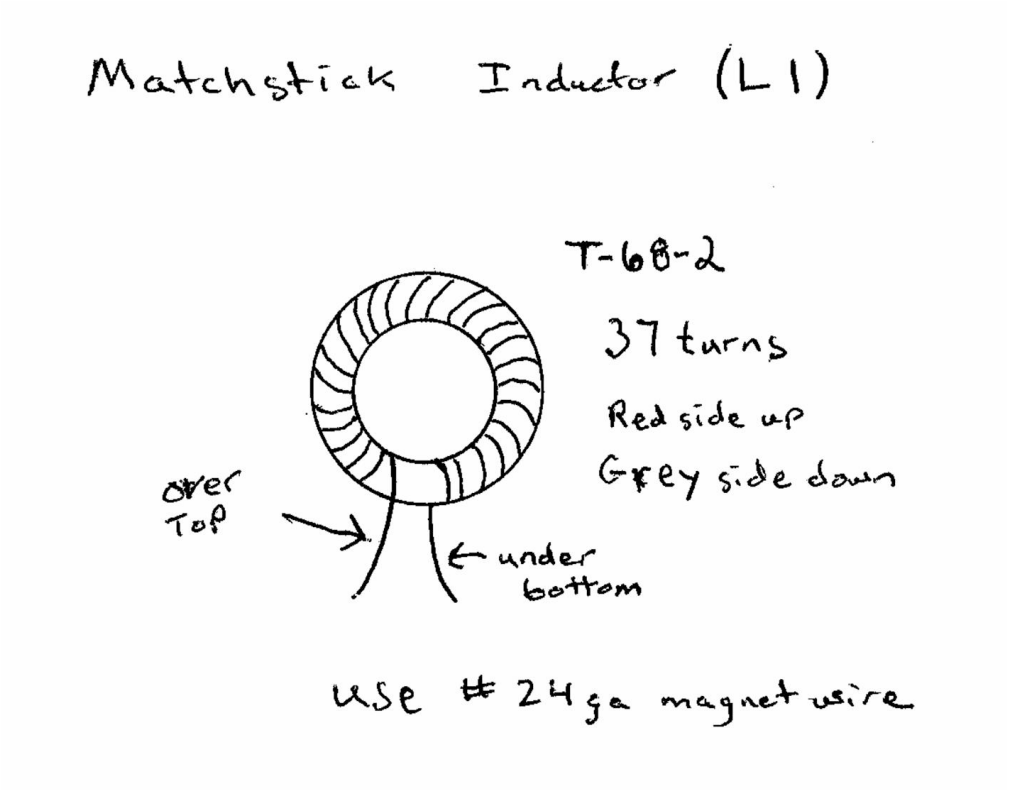
11. Locate R4 a 1K ohm 1/8 watt resistor (Brown, Black,Red). Mount and solder in place.

12.Locate LED 1 and mount it flush against the board. Solder in place. The short lead goes in the hole near the front of the circuit board.

13. Locate C2 the polyvaricon tuning capacitor. Refer to the diagram and mount and solder the capacitor flush to the board. Clip the solder tabs close to the board.

14. Locate the toroid you wound previously. Cut the leads to about 1/2 inch. Carefully strip the enamel and tin the stripped leads. Mount the toroid flush against the board and solder the leads.

This completes construction of the circuit board. Inspect the board for proper parts placement. Make sure that solder connections are good and that there are no solder bridges.



Final Assembly

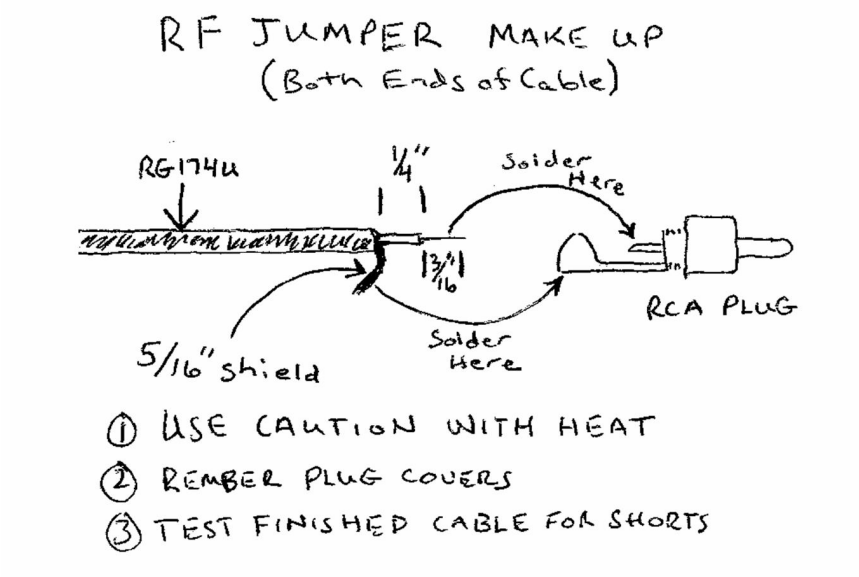
1. Mount the circuit board on your finished wooden breadboard with four brass wood screws and four 3/16th inch black spacers.

2. Install the knob on the tuning capacitor. Use the 6.5 metric machine screw, fiber shaft and star lock washer. Refer to the diagram. Tighten the screw to secure the shaft (do not over-tighten).

3. Mount the four rubber feet on the bottom of the wooden breadboard in the corners.

4. Mount the decals on your finished breadboard.

5. Make a coax jumper using the supplied length of RG-174U coaxial cable and two RCA phono jacks. Be careful not to use too much heat when soldering. See diagram.



Alignment and Testing

Before proceeding examine your work to make sure that all parts are in the correct place, all solder joints are good and there are no shorts.

Since the Matchstick contains only passive components, alignment is not indicated and testing is accomplished by using the device.

Using the Matchstick

The Matchstick, like all antenna tuners, will work best with an antenna that is already "got something going for it." That "something" can be height, resonance, length, good ground, radials or counterpoise, or any combination. The bottom line is this: An antenna that is resonate on frequency and offers a naturally low SWR is going to work better than a random length of wire at the same height even if a tuner makes the SWR 1:1. SWR is only one part of a good antenna system. I suggest that for more information on antennas, you consult the ARRL's Antenna Handbook.

After installing the best antenna that you can...here is how to use the matchstick in order to make the most of your installation.

Use the coaxial cable jumper supplied to connect your transmitter or transceiver to the RF input jack (J1). Your antenna must connect to either RF output jack J2 or J3. J3 is for coaxial cable fed antennas and J2 is for unbalanced wire and ground (or counterpoise / radials). The Matchstick will not work with open wire (balanced line) fed antennas. I have successfully used the following antennas with the Matchstick...Coax fed: 80-10 meter loop, 80-10 meter OCF dipole, 40 meter trap dipole, 73 foot vertical and 40 meter mobile antenna with 33 foot counterpoise. Also: 33 foot wire with 33 foot counterpoise and 150 foot long wire and ground. NOTE: Above, I define success as achieving a low SWR...NOT necessarily making contacts...Again, give me a good antenna with a modest SWR over a lousy antenna with a great SWR!

SW1 selects the resistive SWR bridge or bypasses it. SW2 selects the tuner circuit or bypasses it. SW3 selects the series or parallel configuration of the variable capacitor. The two circuit board holes labeled C0 are provided for experimentation...you may be able to add a fixed ceramic or silver mica capacitor here to extend the tuning range for an antenna that is difficult to match.

How To Tune

Once your transmitter and antenna are connected, set SW1 to the left (In) and SW2 to the right (In). Place SW3 to the left(SERIES) position. Now listen to your receiver (if the receiver is sharing the antenna with your transmitter) as you tune the variable capacitor. There should be a noticeable increase in signal strength at some point. Leave the capacitor at this setting. If your transmitter has the ability to vary the power output, set it so that the output is no more than 1 watt if possible or the lowest setting possible. Now, while transmitting, tune the variable capacitor (C2) while observing the SWR indicator LED1. Tune for the lowest brightness (this may be completely out). This indicates the lowest SWR. Once the lowest SWR has been obtained you may adjust your transmitter for higher power. SW1 should now be switched to the right (OUT) position...you may note an increase in receiver signal. This is normal and explained below.

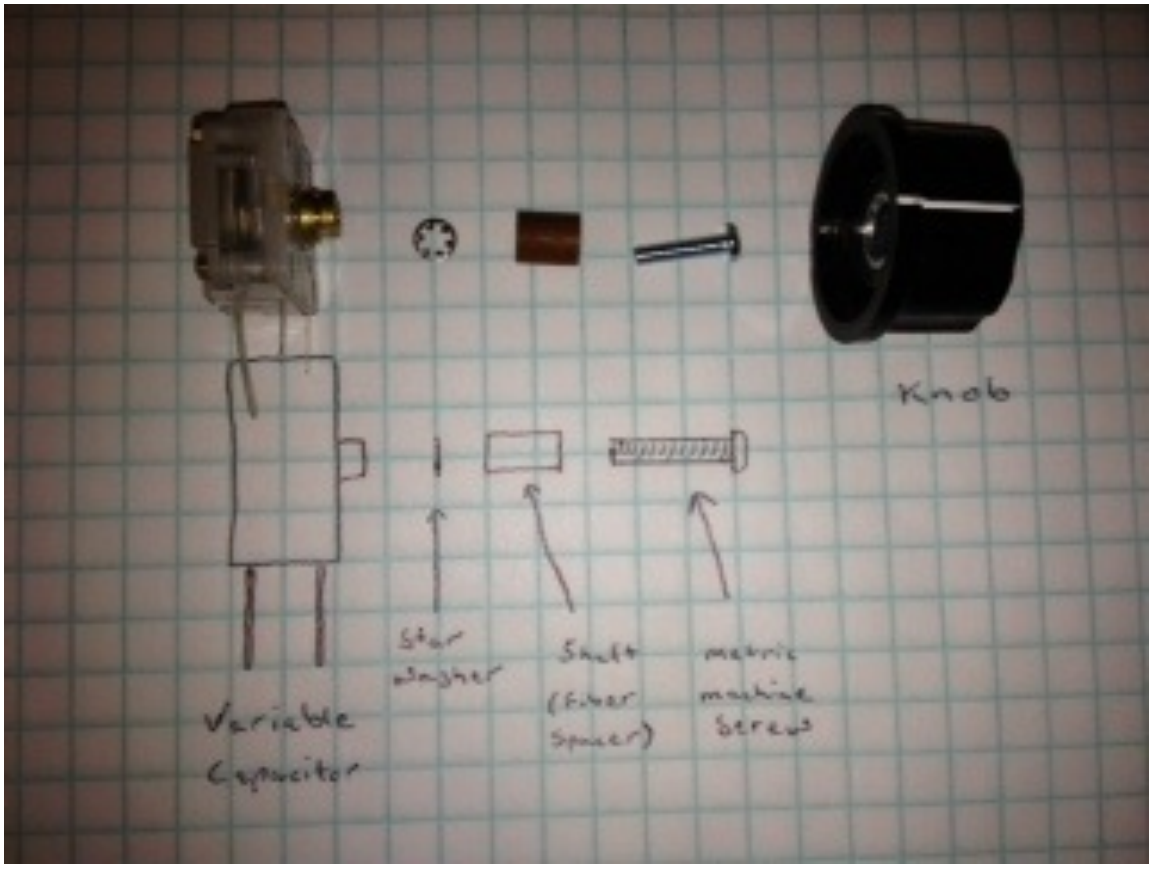
If you can not achieve a suitable SWR per the above, try the following.

Place SW3 to the right (PARALLEL) position and try the tuning steps above again. I have found that most coax fed antennas work in the SERIES configuration and some wire fed antennas work best in the PARALLEL configuration.

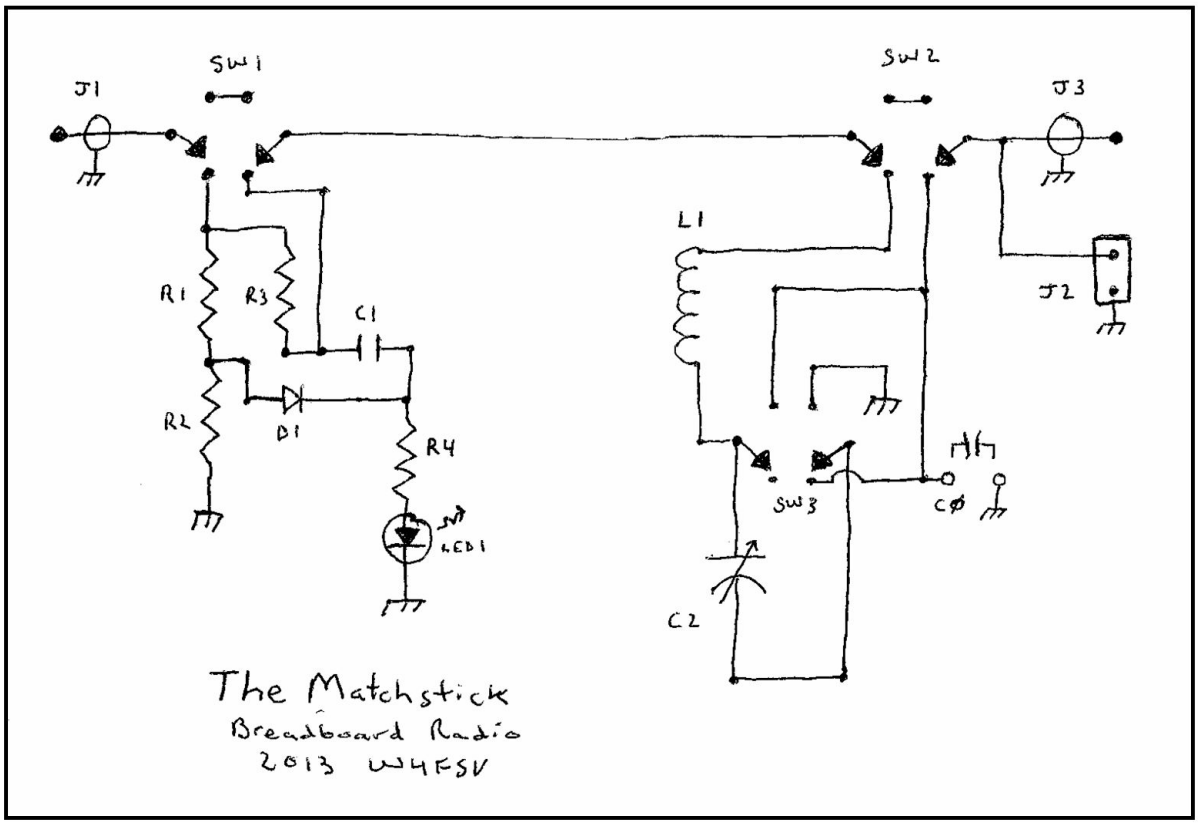
Added Receiver Bonuses!

1. You may have noted above that switching in the SWR bridge results in a slight reduction in received signal. This is because the bridge resistance acts like an attenuator. You can use this to help when a strong signal causes interference thus increasing selectivity.

2. You may have also noted that as the antenna is tuned, the received signal is peaked. This is because the tuned circuit (L1 and C2) acts like a bandpass filter in receive, peaking signals near the operating frequency and rejecting signals farther away.



Problems



If you have any problems with your kit, please email us at: w4fsv@breadboardradio.com You can also refer to our website at: www.breadboardradio.com