

A Mobile Antenna Base with Internal Capacitive Matching

Do you have a mobile antenna for that new car but don't want to drill any holes? Here's a great solution that adds the convenience of antenna matching built right into the mount.

For years I've tinkered with electronic projects at home. Two things have started to impact the fun: a harder time focusing up close (since I turned 50) and the fact that parts are getting smaller. One way around this is to concentrate on physically larger projects—like antennas and related items.

I needed a simple antenna mount that could easily attach to my new Volkswagen Beetle without drilling holes. I wanted this antenna mount to support most mobile HF antennas, especially a Hamstick or Carolina Bug Catcher, since these are my current antennas. Additionally, I wanted the mount to include internal capacitive matching which is normally required for short antennas.

The VW Beetle Mobile Mount

The Volkswagen New Beetle has a heavy steel "loop" under the right rear part of the car, and this loop is bolted into the car frame. This is a tie-down loop used for new vehicle transport and it is present on many newer vehicles. It's an excellent place to attach an antenna mount. I had a couple of scrap pieces of 1/4 inch thick aluminum rack channels and cut them to the dimensions shown in Figure 1. The completed mounting bracket is shown in Figure 2. This is a sturdy mount and a much larger antenna could be mounted on it with no problem.

Base Matching for Mobile Antenna

When any antenna is properly resonated, you will see a total resistance composed of the radiation resistance, coil losses and ground losses. For short antennas, the radiation resistance is very low—on the order of 2 to 3 Ω for a center loaded 40 meter antenna. Assuming you have reasonable coil and ground



ponent, so that shunt capacitive tuning works. The effective series inductance and shunt capacitance make up an L network that transforms the low impedance to 50 Ω . Similarly, if the antenna is shortened a bit, it looks capacitive and so a shunt inductor completes the L match to 50 Ω . With a shunt inductor, you need to change coil taps and with a shunt capacitor, you need to change the capacitors as you change bands. I've always preferred using shunt capacitors and I use 300 V silver-mica capacitors, which are fine for a 100 W transmitter.

The *ARRL Antenna Book*¹ and *ARRL Handbook for Radio Communications*² show how to calculate the capacitance values needed based on VSWR measurements. It's easy to just put a variable capacitor across the input to the antenna and find the value that gives the best match. Then measure this capacitor value with an antenna analyzer and replace it with a fixed value.

For the Carolina Bug Catcher and

losses, you will see low impedance at resonance that needs to be matched to 50 Ω . This can be done with either a shunt inductor or a shunt capacitor mounted at the base of the antenna.

By lengthening the antenna a little bit, the antenna will have an inductive com-

¹Notes appear on page 00.

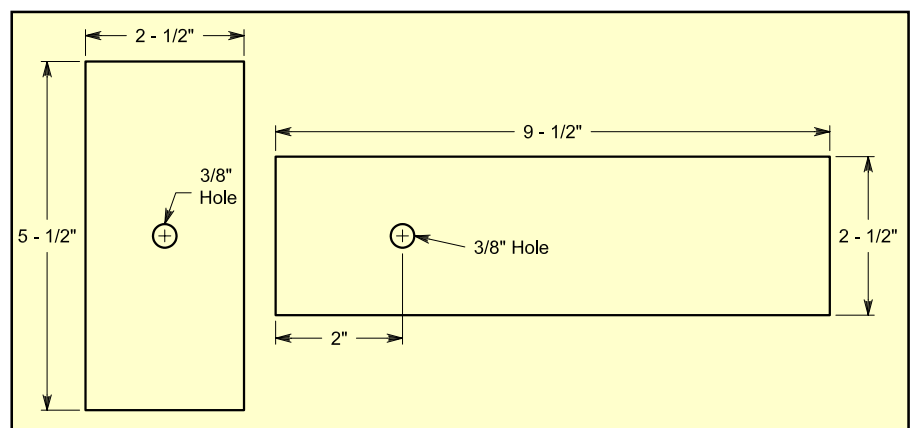


Figure 1—Detail of the Volkswagen antenna mounting bracket hardware.

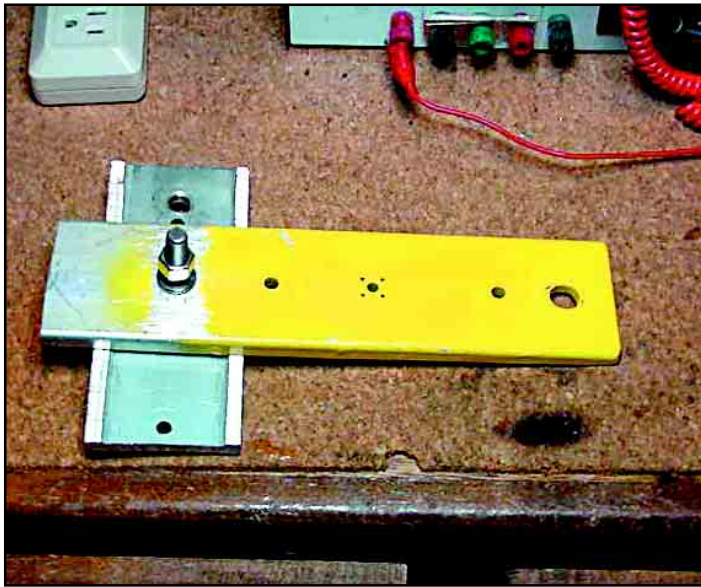


Figure 2—The completed bracket, ready for the mount.

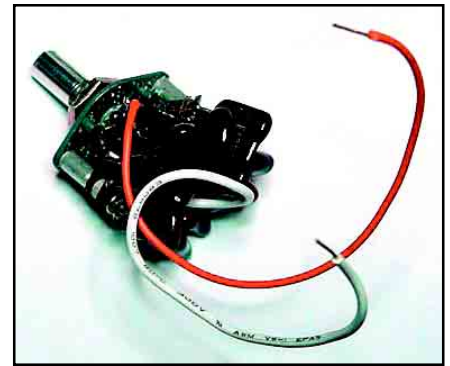


Figure 4—The 1 pole, 12 position rotary switch with the matching capacitors attached.

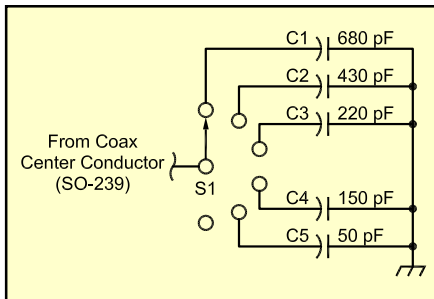


Figure 3—The schematic and parts list for the antenna matching base and rotary capacitor switch. Parts are available from a number of sources. The suppliers listed are Mouser Electronics, 1000 N Main St, Mansfield, TX 76063; tel 800-346-6873; www.mouser.com and RadioShack, www.radioshack.com.

- C1—680 pF capacitor, 300 V (Mouser 5982-15-300V680).
 C2—430 pF capacitor, 300 V (Mouser 5982-15-500V430).
 C3—220 pF capacitor, 300 V (Mouser 5982-15-500V220).
 C4—150 pF capacitor, 300 V (Mouser 5982-15-500V150).
 C5—50 pF capacitor, 300 V (Mouser 5982-15-500V50).
 S1—Switch, 1 pole, 12 position (Mouser 10YX112 or RadioShack 275-1385).
 SO-239 UHF socket (Mouser 523-83-1R-RFX or RadioShack 278-201).

Plumbing Parts & Hardware

- (1) 1/2x1/8 NPT brass adapter.
- (1) 1 inch PVC "X" (4 port PVC junction).
- (1) 1 1/4 inch PVC cap.
- (1) 1x1/2 inch PVC threaded adapter.
- (1) 1x1/2 inch PVC smooth adapter.
- (1) 1 inch PVC plug.
- (10) #6x3/8 inch stainless steel sheet metal screws.
- (1) 3/8x16x2 1/2 inch stainless steel carriage bolt.
- (1) 3/8 inch stainless steel lock washer.
- (1) 3/8 inch stainless steel nut.
- (1) #8x1 inch brass machine screw.
- (1) #8 copper plated steel lock washer.
- (1) #8 nut.
- (1) #8 wing nut.

Table 1

Capacitance Values for Each Band

	40 M	30 M	20 M	17 M	15 M	12/10 M
Carolina Bug Catcher	680 pF	430 pF	220 pF	150 pF	50 pF	none
Hamstick	560 pF	390 pF	150 pF	150 pF	none	none

Hamstick antennas, the values of capacitance that properly match the antennas are shown in Table 1.

Antenna Mount with Capacitive Base Matcher

A 1 pole, 12 position, rotary switch is used for the capacitor selection. The schematic of the capacitor switch is shown in Figure 3, and a photo of this switch fully loaded with capacitors is shown in Figure 4. The necessary capacitors for the Carolina Bug Catcher are in the 40-10 meter positions I also have in-between values of capacitors in the other 6 positions for other antennas.

The antenna mount with switched capacitors is built using a 1 inch PVC "X" (a 4 port PVC assembly). All PVC parts are standard 1 inch and 1 1/4 inch pieces along with a 1/8 NPTx1/2 inch brass adapter and stainless steel hardware as shown in the parts list of Figure 3. The 1/8 NPT (national pipe thread) threaded hole is slightly tapered and fits the 3/8x24 thread—the standard thread used for mobile antennas. Antennas terminated with the standard 3/8x24 thread will fit the 1/8 NPT threaded hole. Included is a brass screw ground point so radials can be added in a non-mobile situation or to enhance the ground if you are a "mobile-at-rest." The drawing of Figure 5 is self-explanatory and will aid the builder in assembly.

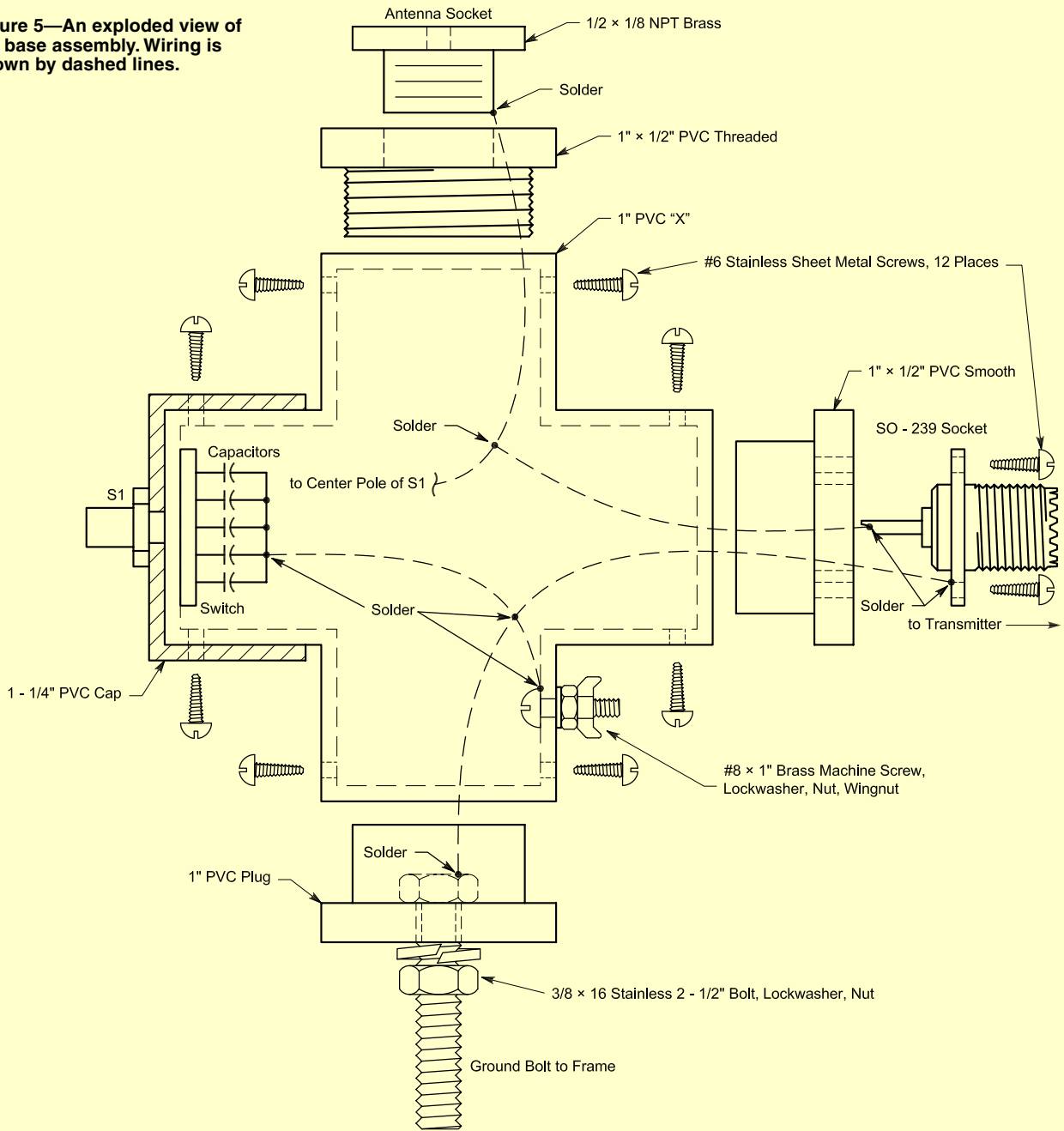
The only thing that takes a little work is filing, sanding or grinding off part of the surface of the 1 1/2 inch PVC cap. The PVC material is a little too thick for the switch bushing to extend through completely. With a little work, you can thin the material enough so the switch mounts correctly. With a large wood file it only takes a few minutes to accomplish.

I prefer to cut off about half of the internal collars of the PVC plugs (1x1/2 inch threaded, 1x1/2 inch smooth and 1 inch plug) to leave plenty of room inside the PVC "X" for components and wiring.

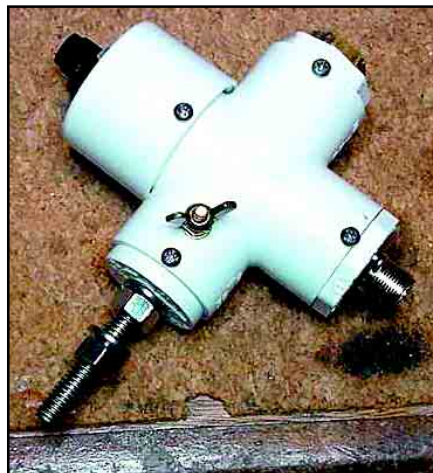
Soldering a short piece of 16 gauge bare wire to the inside flat edge of the brass adapter allows wiring to the 1/8 NPT brass adapter. This requires a heavy-duty soldering iron. This bare wire then becomes the tie point for interconnections. After soldering the wire to the brass adapter, screw the brass adapter into the 1x1/2 inch PVC threaded adapter. Drill and tap two 1/16 inch diameter holes in a 1x1/2 inch PVC smooth adapter such that you can attach an SO-239 connector as shown.

Connect a wire from the SO-239 center conductor to the wire soldered to the 1/2x1/8 NPT brass adapter for the antenna and to the switch for selecting the right capacitor. Then solder a wire to the SO-239 body and route it to the #8 ground screw, then to the 3/8x16 bolt. Solder the wire directly to the heads of the #8 brass

Figure 5—An exploded view of the base assembly. Wiring is shown by dashed lines.



screw and $\frac{3}{8} \times 16$ bolt. Use a big soldering iron and, with a bit of filing and cleaning, you should be able to solder the wire to the stainless steel bolt. It is much easier if you use a galvanized bolt or one made from brass. Make sure all connections are electrically sound and watch out for “cold” joints—the mount will be subject to lots of vibration. You’ll need sufficient heat on the larger bolts and fittings. Solder another wire from the common point of the capacitors on the switch to the brass screw head. You can use PVC glue but I prefer having the option of taking things apart if something needs to be fixed or changed. The completed PVC assembly is shown in Figure 6, and Figure 7 shows



it mounted to the aluminum bracket.

Mounting it to the Car

Use a $1\frac{1}{2}$ inch long $\frac{3}{8} \times 24$ stainless steel bolt, lock washer and nut to clamp the two pieces of aluminum. This configuration makes up the antenna-mounting bracket which secures to the steel loop. I lightly filed both sides of the steel loop to clear away paint and dirt and applied DeoxIt to the steel/aluminum interface to prevent corrosion (Noalox or Penetrox are also fine). It’s probably a

Figure 6—A view of the antenna matcher (not attached to mounting bracket).

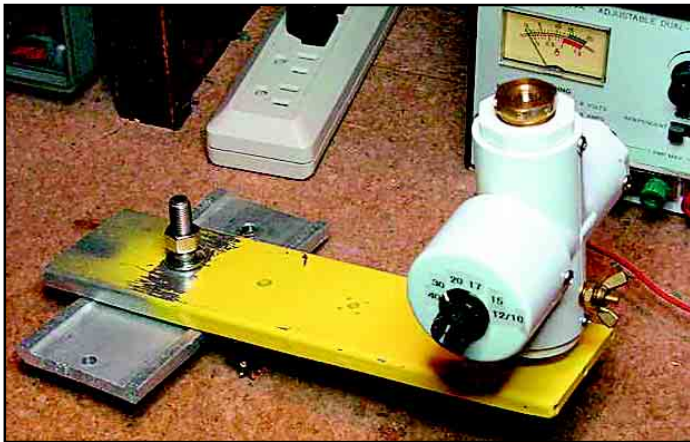


Figure 7—The antenna mounting bracket with antenna matcher attached. All that's missing is an antenna and a VW Beetle.



Figure 8—The completed assembly, consisting of mount, bracket, feed line and antenna, attached to the car and "ready to roll."

good idea to use quick-disconnects for your antenna. This leaves the hole in the antenna mount plugged so it will not fill with water when you don't have an antenna installed. The base mounted to the car with feedline and antenna can be seen in Figure 8.

Conclusion

With all the small HF radios available today, operating HF mobile has never been easier. However, actually mounting an antenna on your car can be quite a challenge, especially if you have a small vehicle. The matching assembly is ge-

neric to any type of mount, so you can use this idea on other cars and antenna mounts. All the parts are readily available and inexpensive—give it a try.

Notes

¹Available from your local dealer or the ARRL Bookstore. ARRL order no. 9043. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; www.arrrl.org/shop/; pubsales@arrrl.org.

²Available from your local dealer or the ARRL Bookstore. ARRL order no. 1964. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; www.arrrl.org/shop/; pubsales@arrrl.org.

All photos by the author.

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