6-Meter Halo Antenna for DXing

This classic mobile antenna is horizontally polarized.

Jerry Clement, VE6AB

Over the years, I've had various 6-meter antennas mounted on my mobile, and I continued to look at different designs, hoping to find the antenna that would give me the performance that I was looking for from my mobile. The design that I had in mind would be horizontally polarized, omnidirectional, and optimized for working the SSB portion of the 6-meter band. The 6-meter Halo antenna came to my attention via *The ARRL Antenna Book*, and it met my requirements.[1]

I wanted an antenna design that I felt was more in line with today's construction methods — an antenna that, once completed, would have a robust build that accommodates various mounting methods, whether it be as a mobile antenna like in the lead photo, mounted off the side of a tower, or mounted on the side of a push-up mast temporarily set up for Field Day. This antenna, once completed, would also have the appearance and construction of a factory-built antenna — important to my way of thinking.

With that in mind, I went through several prototype versions before arriving at the design that I describe here. The segment of the 6-meter band that is of interest to me is between 50.1 MHz and 50.3 MHz, where most of the SSB activity takes place. The antenna, as built, performs nicely in that section of the band.

Tools and Supplies

The antenna can be built with simple hand tools that include a measuring tape, ruler, center punch, hacksaw, files, taps in the required thread sizes, and a cordless drill with the required drill bits. Also a small, inexpensive bench-top drill press could be beneficial. All the materials used in building the antenna are readily available, and I have listed some suppliers in Table 1.

Building the Components

I built the housing for the antenna that supports the elements and the gamma match from a 1 × 2 × 4 inch length of aluminum rectangular tube with a ⅛-inch wall thickness. Building the housing is mainly an exercise in drilling the series of holes required for the various components that will attach to the housing. Figure 1 lists all

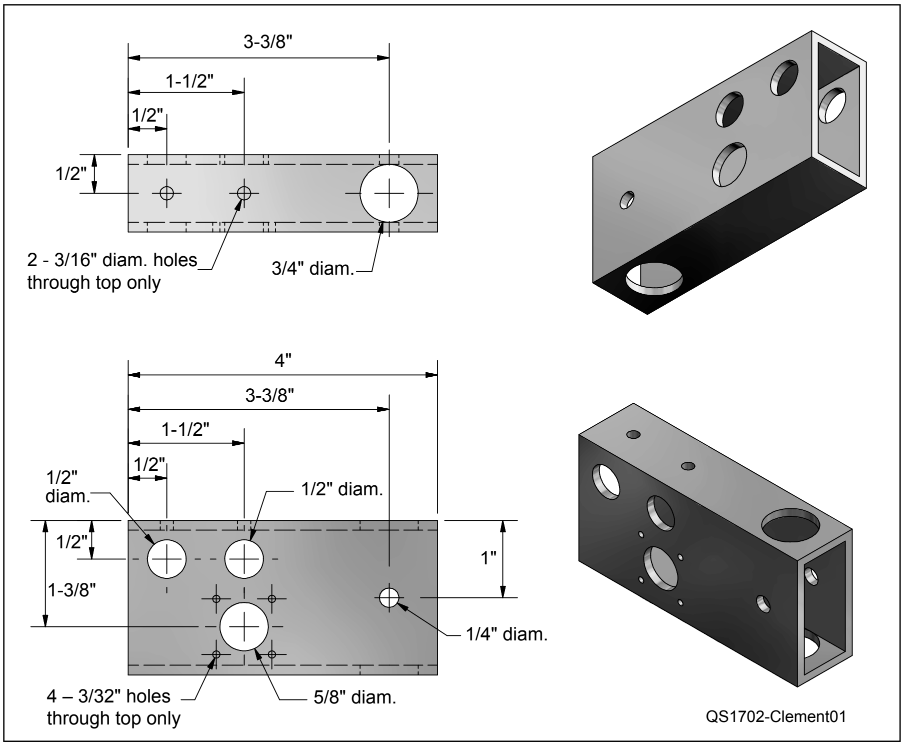

Figure 1 — The housing supports the antenna elements and the gamma match. It is fashioned from a 1 × 2 × 4 inch length of aluminum rectangular tube with a ⅛-inch wall thickness.

[1]See Section 16.6, *The ARRL Antenna Book, 23rd Edition*, Item no. 0444, available from your ARRL dealer, or from the ARRL Store. Telephone toll-free in the US 888-277-5289, or 860-594-0355, fax 860-594-0303; **www.arrl.org/shop/**; **pubsales@arrl.org**.

Table 1
Materials and Sources for the 6-Meter Band Halo Antenna

Part	Description	Source
Elements (2)	Aluminum tube, 6063-T832, 6 ft., 0.500 in. OD, 0.058 in. wall	Part number: DXE-AT1480, DX Engineering
Gamma match tube	Aluminum tube, 6063-T832, 3 ft., 0.375 in. OD, 0.058 in. wall	Part number: DXE-AT1240, DX Engineering
Housing	Multipurpose 6061 aluminum rectangular tube, ⅛ in. wall thickness, 1 × 2 × 6 in.	Part number: 6546K39, McMaster-Carr
Element supports (2)	Aluminum solid rod, ⅜ × 6 in.	Part number: 8974K24, McMaster-Carr
Mounting insulator	White Delrin® acetal resin rod, ¾ in, OD by 12 in.	Part number: 8572K58, McMaster-Carr
Gap insulator	Fiberglass rod, ⅜ in. OD by 6 in.	Part number: 8543K49, McMaster-Carr
Connector	SO-239 chassis mount connector	Various sources
Gamma match feed	14-inch length of RG-8/U coax cable	Various sources
Fasteners	Stainless-steel fasteners, various sizes required	Various sources

of the dimensions required for laying out the pattern of holes required. You can easily do the layout work with a center punch and a ruler, because the precision required is not critical to the performance of the antenna.

Once you have marked out all the required locations for drilling, and with the housing mounted in a vise, drill ⅛-inch pilot holes for the larger holes, and follow up by drilling the holes as dimensioned in Figure 1. This includes two ½-inch holes for the elements, a ⅝-inch hole for the SO-239 chassis mount connector, and the ¾-inch hole to accommodate the insulator used for mounting the antenna.

There are two 3⁄16-inch holes located in the top side of the housing sized for 8-32 tpi (threads per inch) stainless-steel machine screws that secure the elements in place. Also drill the ¼-inch hole for the ¼-inch by 20 tpi stainless-steel bolt that fastens the ¾-inch section of Delrin round in place. This insulator is used for mounting the antenna to a mast.

Using the SO-239 chassis mount connector as a drill guide, drill and tap the four 3⁄32-inch holes that will be required to fasten the SO-239 chassis mount connector in place with 4-40 tpi stainless-steel machine screws when assembling the gamma match.

Figure 2 shows the completed housing.

Although aluminum is an easy material to work, aluminum can also be a sticky material — it clogs files, catches in the flutes of drill bits, and makes thread tapping somewhat difficult. The best way to stop this is to purchase and use a small container of aluminum-cutting fluid that will solve these problems. There are various aluminum-cutting fluids available that will work; however, A9 Aluminum-Cutting Fluid is my personal favorite.

The design that I had in mind would be horizontally polarized, omnidirectional, and optimized for working the SSB portion of the 6-meter band.

Building the Elements

Once you have completed drilling all the holes required in the housing, you can put it aside while you work on building the elements. The elements are made from ½-inch OD 6063-T832 aluminum tubing with a 0.058-inch wall thickness that is capable of standing up to the rigors of vibration and corrosion. It also has a nice appearance. It's better to err on the side of caution by initially cutting the tubing for the elements longer, then trimming as required during tuning the completed antenna with the use of an antenna analyzer. I initially cut each element tube to a 53-inch length. Once the elements were formed and the antenna was assembled and in the desired tuning stage, cut them back to the required length, making the antenna resonant between 50.0 MHz and 50.5 MHz.

You must bend the straight lengths of tubing to form the half-circle loops that measure approximately 32 inches in diameter. Forming the elements is easy to do by using either a half-round 32-inch pattern cut from wood, or by utilizing an existing form that is close to that diameter. I found that the round coffee table in our living room measured 36 inches in diameter, and it was a simple matter to form the required shape by bending the tubing around the table top with simple hand pressure. Once the elements are roughly formed to shape, it is a simple matter to close them up to the required diameter with your hands. Next, install the elements into the housing, and adjust the curvature of the elements until the ends meet nicely.

Before fastening the elements into the housing, cut two lengths of solid aluminum rod that measure ⅜ inches OD by 3 inches in length. These two

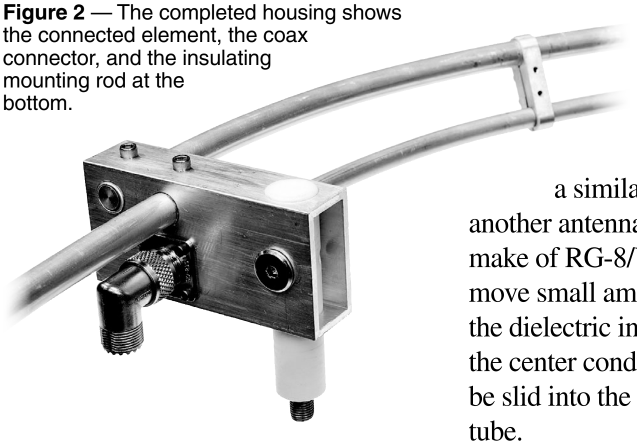

Figure 2 — The completed housing shows the connected element, the coax connector, and the insulating mounting rod at the bottom.

3-inch aluminum rods, once inserted in place at the mounting end of the elements, add support and also keep the elements from being deformed by the 8-32 tpi machine screws that fasten the elements in place to the housing (see Figure 2). Insert each element one at a time into place so that the ends are flush on one side of the housing, and using one of the two holes that you drilled in the housing as a drill guide, you can drill and tap the holes in each element/rod assembly for the 8-32 tpi stainless-steel machine screws. With the elements now fastened in place, you can now move on to building the gamma match required for tuning the antenna.

The Gamma Match

The gamma match consists of a 14-inch length of ⅜-inch OD aluminum tubing with an 0.058-inch wall, formed to a contour matching the main element. Take a 14-inch length of RG-8/U coax and strip off the outer jacket and the shield, and discard them. The center conductor with the included dielectric insulating material will slide nicely into the 14-inch length of ⅜-inch tubing previously cut to length. Make sure to seal the end of the gamma match tube to prevent arcing in wet conditions. Be aware that different makes of coax may have slightly different dimensions. I used a length of Carol RG-8/U coax, and the dielectric insulating material surrounding the center conductor had the perfect dimensions. In the past, I have built a similar gamma match for another antenna, but with a different make of RG-8/U coax, and I had to remove small amounts of material from the dielectric insulation surrounding the center conductor before it could be slid into the ⅜-inch gamma match tube.

Next, strip back ½ inch of the dielectric insulation surrounding the center conductor, and solder this end to the center pin of the SO-239 chassis mount connector. Leave 2.5 inches of the dielectric insulation that includes the ½ inch of exposed conductor sticking out of the gamma match tube. The gamma match assembly may now be slid through the hole in the housing, and fastened in place with four 4-40 tpi stainless-steel machine screws. The finished gamma assembly is shown in Figure 3.

Build the sliding clamp that fastens the gamma match to the element, and is also used for tuning the antenna. This clamp is made from a ⅜ × 1 × 3-inch length of aluminum. Initially, cut the piece of aluminum longer for clamping in the vise while drilling the holes. A simple way to build the clamp is to mark out the positions for the two required holes with the 1¼-inch center-to-center spacing of the holes. Drill one hole ½ inch in diameter and the other hole ⅜ inches in diameter. Then shape the outside of the clamp to a pleasing contour that may be rough-shaped with a hacksaw and finished with a file. Then, turn the clamp on its side and drill and tap the two holes required for the two 6-32 stainless-steel machine screws used to hold the clamp halves together when installed. Last, split the clamp in half with a hacksaw, sawing right down through the center of the two holes creating the two halves of the clamp.

In building the clamp as described, you will find the alignment of the clamp is perfect, and you will also find that building the gamma clamp in this fashion is far superior to building a clamp out of thin stock and bending it to the required form. With the clamp finished, fasten the gamma match to the element with the edge of the clamp placed 7 inches from the end of the gamma match tube, as seen in Figure 3.

Mounting the Antenna

With the antenna almost finished, you can think about the mounting arrangement you wish to use, depending on how you plan on using the antenna. The ¾-inch hole in the housing will accept a length of ¾-inch Delrin round that can be adapted to whatever arrangement you may wish to use for mounting the antenna. For my mobile mounting, I cut a 3-inch length of ¾-inch Delrin round and then drilled and tapped it ⅜ inches by 24 tpi on one end.

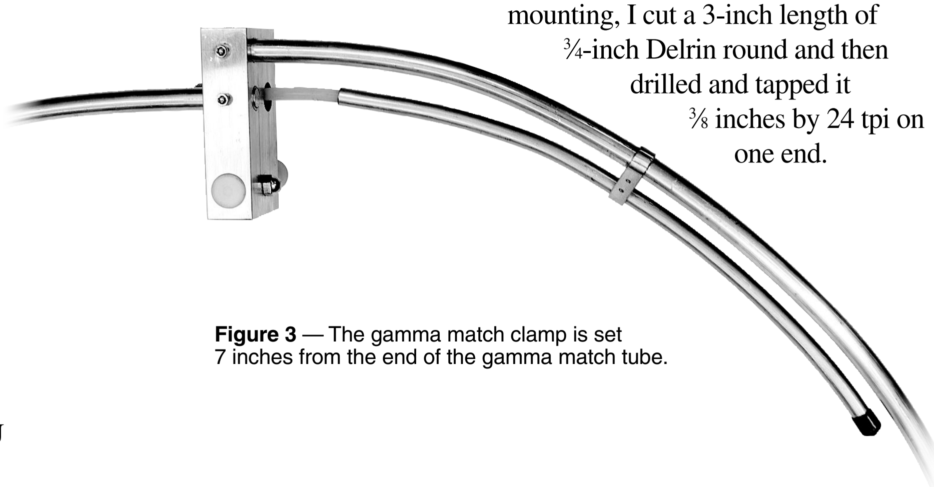

Figure 3 — The gamma match clamp is set 7 inches from the end of the gamma match tube.

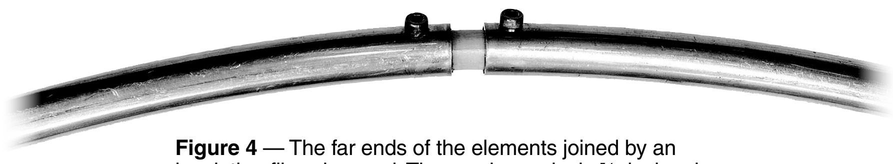

Figure 4 — The far ends of the elements joined by an insulating fiberglass rod. The gap is precisely 5/16 inches long.

On my mobile, the antenna is supported by a 1-inch aluminum tubular mast assembly. That in turn couples to the HF mount that is also used by the HF antennas stored in my mobile. Remember that the antenna housing must be insulated from the mast or mount assembly, here using the ¾-inch diameter Delrin round.

In the final step, cut a ⅜ × 2-inch length of fiberglass dowel, and insert it into the element ends at the gap joining the elements together (see Figure 4). You can now check and tune the antenna.

Tuning the Halo

With the aid of your antenna analyzer, you can trim the element ends, making the antenna resonant on the center frequency of your choice. Once the elements have been trimmed to the required length, and you have the spacing for the gap between the two element ends set as required for the lowest VSWR reading on your antenna analyzer, you can secure the elements in place to the fiberglass dowel by drilling and tapping holes for 6-32 tpi stainless-steel machine screws placed in each element near the gap (see Figure 4). Securing the elements together in this fashion makes for a very strong antenna assembly, and built in this fashion, the antenna will not go out of tune over time.

With the aid of your antenna analyzer, you can trim the element ends, making the antenna resonant on the center frequency of your choice.

With the antenna analyzer connected to the antenna, check the VSWR readings for the antenna, and if needed, make any adjustments by moving the gamma clamp. Finally, tighten the two 6/32-inch stainless-steel machine screws that lock the clamp in place on the gamma match and element.

On my antenna, built as described here and mounted on my mobile, each element measures 52.5 inches around the outside circumference, the gap between the elements set precisely at 5/16 inches, and the gamma match clamp set 7 inches from the end of the gamma match tube. My antenna has a measured VSWR of less than 1.1:1 between 50.0 MHz and 50.3 MHz. The VSWR still measures a respectable 1.5:1 at 50.5 MHz.

Final Words

This completes the description as to how you can build a horizontally polarized 6-meter Halo antenna. I hope you enjoy using your finished antenna to work DX from your mobile, ham shack, or on Field Day. Built as described and mounted on my mobile, I've extensively tested the antenna over a period of 6 months. I am more than pleased with the performance of this 6-meter DXing Halo antenna.

Photos by the author.

International ARRL member Jerry Clement, VE6AB, has been a licensed Amateur Radio operator since 1992. Jerry is a machinist who owns and operates a machine shop where he builds scale models and makes mobile antennas. Jerry also specializes in automatic controls for refrigeration systems. Currently, he provides technical support to agricultural clients located throughout western Canada. An HF mobile enthusiast, he builds mobile antennas and evaluates their performance. He enjoys working through Amateur Radio satellites with antennas built in his shop. Jerry is also a photographer, and when not doing event work, enjoys photographing landscapes, wildlife, and nature scenes as he explores the back roads of southern Alberta. You can reach Jerry by e-mail at **ve6ab@shaw.ca**.

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