Making Shielded Enclosures without a Mill, Shear, or Brake

John Franke, WA4WDL*

Introduction

I have always admired people who have the capacity and skill to fabricate beautiful shielded enclosures for their microwave and other electronic projects. While in high school, the best I could do was re-use Mini-boxes. No matter how messy the circuitry was inside the box, the Mini-box with decals elevated the finished product. Later, I began re-using random enclosures found at hamfests or on auctions. The enclosures had the sharp clean edges, feedthrough capacitors threaded into the faces, connectors mounted with 4-40 and 2-56 hardware, and well fitting cover plates that constitute the look of a professional product. I still dig through boxes under hamfest tables for the obscure module – not for the circuitry – but for the enclosure. Of course, appearance is not the only factor. The enclosures provide electrical shielding, physical protection, modular construction, and even a heat sink surface. The electrical shielding is two way: radiation of signals and pickup of unwanted signals.

I tried and still make enclosures from flat and bar stock. I found getting 2-56 screw holes in cover plates to line up with holes drilled and tapped in the edges of 1/8" thick walls always seemed doomed to failure. I would spend hours converting aluminum stock into scrap metal. If I only had a mill! Someday I may yet have a compact mill, but for now I use another technique. I cut sections of thick walled rectangular or square aluminum tubing, sand the faces, and use a master plate to locate the screw holes. The tools needed are a bandsaw, a disc sander, and a drill press.

Making the enclosure sections

Square tubing comes in many sizes and wall thicknesses. The tubing is available online from a number of sources. I use a minimum wall of 1/8" when using 2-56 hardware and 1/4" when using 4-40 or 6-32 hardware. Many sources will cut the material to length, +/- 1/16", for a fee. Ordering sections 1" long can result in paying more for the cuts than for the metal. When I do order metal, I order uncut lengths.

My band saw is a combination vertical/horizontal cutoff saw. It is not a precision tool by any means. I can set it up to repeatedly cut sections from thick-walled square tubing. The set up is shown in Photo A. The cuts are not smooth, so I allow about 1/16" for waste. Usually the height of the enclosure is not critical. When I set up to make one enclosure, I typically go ahead and cut 5 to 10 sections. Being lazy can be productive. And, I have sections ready for finishing at any time which reduces procrastination.

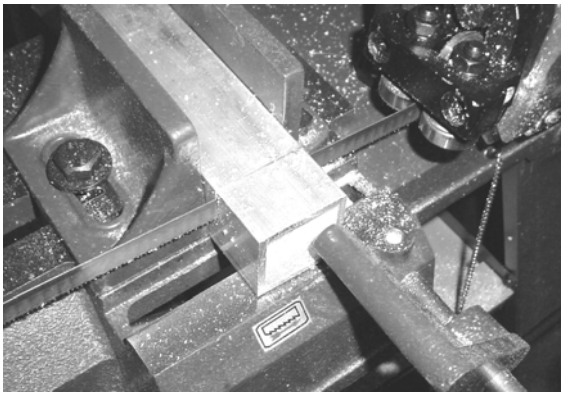

Photo A: Horizontal Bandsaw Set Up

Photo B: Freshly Cut and Sanded Sections

Once the sections have been cut, the ends need to be cleaned up. This is where the disc sander comes in handy. The pieces are marked with a square or the edge of a piece of scrap that is known to be at right angles. The use of layout fluid or dye and a sharp scribe is recommended. It produces a high contrast thin line. The pieces are held by hand against the disc. Well, actually I use a thick glove to protect me from the heat. The aluminum gets hot fast! Having a bucket of water close by is handy. After disc sanding, the sections look like those shown in the back row in Photo B, pretty but not quite there. The sanding marks and flash are removed by lightly holding the cut faces down against a sheet of 220 grit sand paper backed up with a flat metal or glass plate and moving the sections in a figure 8 pattern. Only a light force is applied. It is amazing to watch the disc sander marks disappear and as they go they give you an idea of how equally you are applying force across the face. At this point you have a nice section of an enclosure with four walls and flat end faces, see the front row in Photo B. This sanding technique is also handy for cleaning the other faces, especially after drilling and tapping operations.

Fabricating a face and cover drill guide plate

This step had always been the hardest part for me. There are two types of covers: close fit and base plate. The close fit covers are made to closely fit the section faces with little or no overlap. The base plate covers are meant to extend past one or more of the section edges for perhaps 1/4” to form a mounting lip. Either way, the first task is to make a drill guide plate which will be used for either type of cover and the enclosure end faces. The guide plate is a close fit cover plate but with smaller holes and made from thicker stock – typically 1/8”. In the past I would always use one edge of the stock material as one edge of the guide plate. Now, I lay out the guide plate coming close to the stock material edge, but not touching it. I start by spraying the stock piece with layout fluid or dye. Then I mark the center of what will be the guide plate with a sharp punch. A light tap is all that is desired, a deep blunt crater leads to a poor job. Next, I use my old drafting compass with needle points in each leg to geometrically layout the locations for the screw holes. Last, I lay out the borders. The locations of the screw holes are marked with the sharp center punch. I drill the screw holes with the appropriate tap drill. No, the screw holes will not be tapped but will be guide holes for drilling tap holes in the end faces of the enclosure sections and locating the clearance screw holes in the final cover plates. I find it easier to drill the holes before the guide plate is cut to shape.

I cut the drill guide plate to shape with my bandsaw in the vertical position and then sand the plate to final shape on the disc sander. The edges are cleaned by rubbing them against the 220 grit paper backed up with a flat metal or glass plate. The guide plate should be a close fit to an enclosure section end face. If not, make another. For my first, I had to make three. But, the final one has been used to make a dozen cover plates and enclosures and is still going strong. One way to check its accuracy is to place an enclosure section face down on a dyed surface. Scribe around the section with a sharp thin scribe. Remove the section and place the guide place on the surface and align the edges. Then take a twist drill, the same size as used to drill the guide holes, insert the drill in each hole while lightly twisting the drill by hand. Remove the guide plate and you should see 4 marks where the holes go. Replace the guide plate in different rotational positions and you should see the drill marks centered in the drill guide holes no matter which way the plate is placed. Congratulations, you have a good guide plate.

Using the drill guide plate

The guide plate is used to accurately drill the holes in the cover plates and the enclosure end faces. The procedure is easy. Clamp the plate in place, see Photo C, and then drill through the guide holes with the appropriate size tap drill. Do not drill full depth or through holes. The idea is to form craters to guide the final drilling. The final drilling of the cover plates is done with a screw clearance drill bit whereas the

final holes in the enclosure end faces are drilled using a tap drill bit. When tapping the screw holes make sure the tap is perpendicular to the surface and always use a tapping or cutting fluid.

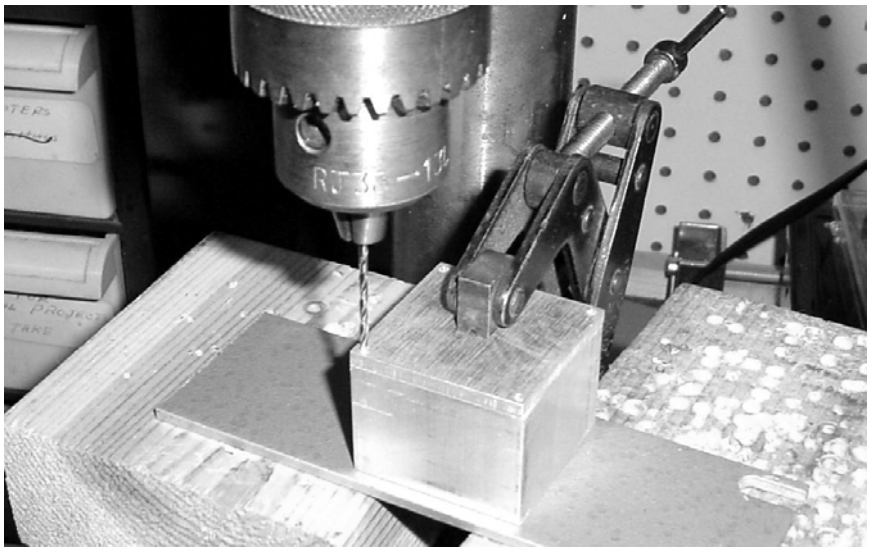

Photo C: A Section End Face Being Frilled with a Drill Guide Plate Clamped in Place

The final results are shown in Photo D.

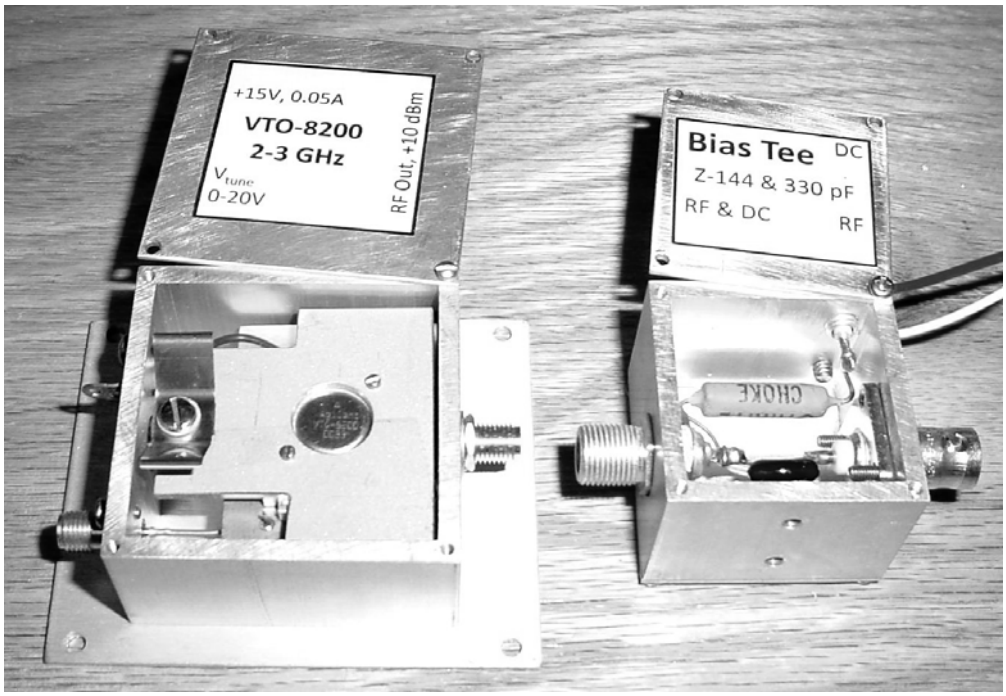

Photo D: Completed Enclosures with Internal Circuitry and Ready for Use

I really like my new enclosures which work better and look more professional than my previous efforts.

*4500 Ibis Ct., Portsmouth, VA 23703, jmfranke@cox.net