CIRCUIT CELLAR ONLINE

LESSONS FROM THE TRENCHES

George Martin

# Expanding Your Horizons

## Using CAD Mechanical Software in Design Projects

The end of every year, brings the end to many projects for George. So, with this expected slowdown, he fills his time with smaller, more unusual projects. One such project, this year, was an industrial packaging project, which gave him the chance to use the mechanical CAD software he'd had lying around awhile.

At the end of every year, my projects wind down. There are fewer, smaller projects. Customers are too busy with year-end tasks to talk. However, after the first of the new year, everyone's budgets are in place and I restart the quoting activity. Expecting this slow down, I looked at and bid on a couple of smaller and unusual projects.

One such deal was for an industrial packaging project. I've always wanted mechanical CAD software in-house and this was my chance. The assignment was a simple one. I had to package a STD bus card cage, an OPTO 22 I/O panel, power supply, fan, and all of the input and output connectors. I built two prototypes for a proof of concept, so I purchased an off-the-shelf enclosure and then created the machining drawings for all of the modifications.

Two years ago, I purchased two CAD packages, Turbo CAD V.7 and Quick CAD V.7, for a 19″ cabinet design I was supposed to start at this time. That project never materialized, but at least now I was ready for this new project. Revised versions of both of these packages are now available. So, I don't have the latest, but I don't think I'll upgrade just yet.

I installed the Turbo CAD software because I had some other parts to design for recreational projects I was involved with also. It has 3-D capabilities, and I purchased two of the tutorials with the original software. I worked my way through the tutorials and was ready to start an original design. The real world, however, got in the way when a large software project came along.

While working on that project, I watched an electrical design engineer use Quick CAD to design a 19″ card rack, which was just the type of project I was supposed to be doing myself. Quick CAD is basically a 2-D system capable of orthogonal views. These views let you see an object in a 3-D perspective. All in all, it's a nice shortcut to a real 3-D system. I watched this engineer detail each part, then lay them together for an assembly drawing for the entire chassis. This proved that all of the parts would fit together.

So, when I got back to my packaging project, I started up Quick CAD. I had no tutorials and the manuals that came with the package only told me how to activate the various tools and

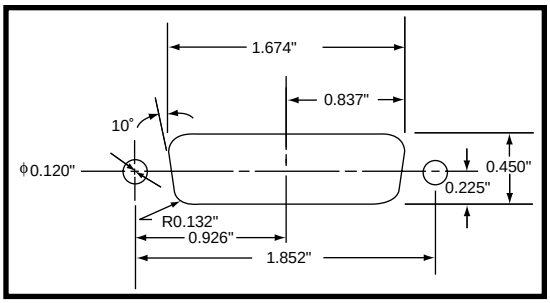


**Figure 1**—*Here you can see the drawing I did for the DB25 connector with all the dimensions included.*

features. There was nothing in the way of an explanation why you might want to use all of the various features of the product.

## DRAWING THE LINE

If you've ever taken a mechanical drawing or drafting course, you know what controls to look for and how to use them. Both the Quick and Turbo packages enable you to use bisecting lines, perpendicular lines, circles tangent to two lines, dimensioning, and so on. If none of this sounds familiar, an elementary drafting book will provide enough background information. The rudiments of drafting are straightforward.

Let's take a look at a simple drawing. Figure 1 is the panel cutout for a DB25 connector. If you're not familiar with this, you can find information in almost any electronic parts catalog. Check out DigiKey for its version (www.digikey.com).

I drew this diagram by first placing the two perpendicular center lines. I then drew two horizontal and two vertical lines parallel to the center lines and offset by the width and height on the main opening (0.225″ and 0.837″, respectively). Then, I drew the circles (0.132″ radius) that defined the top left and right corners. Next came the 10° lines that were tangent to those top corner circles. With these 10° lines in place, I could locate the lower left and right circles that defined the lower left and right radii. Lastly, I added offset lines (0.926″) that intersected the center line and located the mounting holes (0.120″ in diameter), which I then added. To clean up the drawing, I trimmed all of the lines, leaving only the lines you see in Figure 1 and added dimensions.

It took me about one day to do this first DB25 drawing. I then did the DE9, DA15, and DC37 in about 2 h. The learning curve is steep, but after you've figured it out, you can really fly. However, Figure 1 has an error. The height dimensions should be 0.225″ and 0.449″. I'm not going to change this because I'll probably purchase a punch to make these cutouts. Also, I sort of like the symmetry of matching dimension.

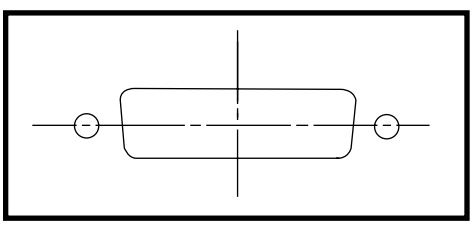

**Figure 2—***This is the DB25 connector with all of the unwanted lines and dimensions removed.*

## SCALING NEW HEIGHTS

I drew Figure 1 on A-size paper at a 1:1 scale. I also created the drawing you see in Figure 2. I copied the dimensions of the DB25 cutout in Figure 1 and then removed all of the unwanted lines to create the DB25 object. I'm reluctant to say it, but this is just like a routine in software or a hierarchical drawing in an FPGA design. Who would have thought that mechanical CAD was object-oriented? The really good part of this is that the DB25 drawing is created and remains in my library. So, for the next project I take on, I won't need to do this work over again.

I next created a D-sized drawing so that I could draw the cover of the enclosure at a 1:1 scale and have it fit on the paper. This is not a big deal, seeing as the cover is just a simple rectangle. I then copied the object in Figure 2 and placed it on the cover drawing. Presto! The cutout was scaled to the proper size for the D-sized drawing.

The true dimension of the cutout was preserved. I used the intersection of the center lines as the base point of the object. I measured the placement of all of the cutouts from the edge of the enclosure to the center of each cutout. I then placed a copy of the detailed opening for each cutout on the enclosure cover drawing.

Figure 3 is a clip of that front panel design. The cutout for the network is not in place because I haven't found the right connector yet.

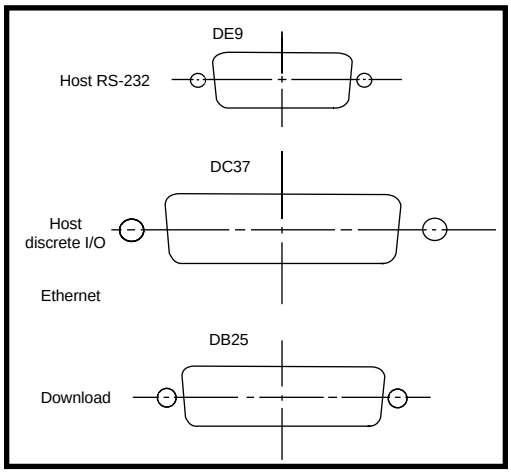


**Figure 3—***The front panel design is seen here. Notice the network is missing.*

## FITTING IN

Looking at the total problem, I printed out all of the parts that needed to fit inside the enclosure. I then cut out the parts from the drawings, allowing me to move them about looking for ways to fit them in the box. I need to plug cards in the card cage, so I didn't want to hide that cage in the enclosure.

Also, I need to be able to remove each of the internal components individually if possible. I probably could have (should have) done this step on the screen, but I didn't feel as comfortable with that approach. However, if I had a lot of parts to package, the computer would have been the better approach. As I get more comfortable with the software, I'm sure I'll switch to the screen. The last step, creating all of the views I needed to check for fit, I did on the screen.

After my experimenting, I concluded that if you have a packaging project, need to design and detail a mechanical component, or just want to use mechanical CAD for a hobby project, either software will fit the bill. Also, the cost is not prohibitive. And, I'm sure there are a variety of CAD software packages available.

I haven't tried to generate illustrations like the ones you find in user's manuals. You need more artistic skill than I have to produce complex diagrams. However, I see cable drawings as a probable next task on my list. I'll give you an update after I've completed a couple more projects.

*George Martin began his career in the aerospace industry in 1969. After five*

*years at a real job, he set out on his own and cofounded a design and manufacturing firm. Typical systems that he designs include servo-motion control, graphical input and output, data acquisition, and remote control. George is a charter member of the Ciarcia Design Works Team and most recently, he's been working on the people-tracking system for Bill Gates' new house. You can reach him at george.martin@worldnet.att.net*

## SOURCES

**Turbo CAD V.7**
IMSI
(415) 878-4000
Fax: (415) 897-2544
www.imsisoft.com
www.turbocad.com

**Quick CAD V.7**
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