

# AutoCAD for Electronics

## Part 6

Drawing illustrations is easy,  
even if you aren't skilled in drafting techniques.

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If you've been following along so far, we've accumulated enough commands to draw fairly complicated schematics. Drawing an illustration, such as a chassis or a completed packaging scheme, is straightforward. We'll show this by drawing a 3D view of a chassis—not, alas, a real CAD 3D view (coming soon in a future issue), but a construction using standard isometric drafting techniques.

Don't lose heart if you haven't studied drafting. AutoCAD does it all for you.

### Isometrics

In isometric drawing, the artist uses various triangles as a guide to making specified vertical angles and specified horizontal angles—nothing in between. The usual angle for a rectangular box, say, is to tilt it up from the horizontal 30° and swing the far end 30° into the picture. Fig. 1 illustrates the familiar isometric presentation.

The advantage to this technique of synthesizing 3D out of 2D is that it's convenient and standardized. The disadvantage is that AutoCAD and drafting triangles produce parallel projection; there's no tapering down in size as the far end

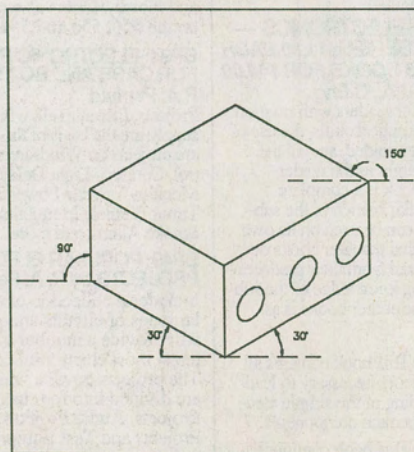


Fig. 1. The standard angles for isometric drawing.

recedes into the apparent distance. This lack of perspective correction can cause your rectangle to appear wedge-shaped. There are quick fixes for this.

### Ortho and Snap

AutoCAD provides some powerful tools for traditional 3D drawing. ORTHO and SNAP are two of these. Ortho allows you to draw only at certain angles, just as drafting triangles do. It's more powerful, of course, because you can choose any angles

that suit, and it's Snap that sets these angles for you.

If you have our Almost Free AutoCAD disk, the Mode pull-down menu will let you instantly change from 30° to 150° to standard Snap (see Fig. 2). If you don't have the menus, here's how to draw the box using manually-typed commands (and the menu macros are included in case you want to write them into the menu you're using now).

1. Turn on the Grid, Ortho and Snap with F7, F8 and F9.
2. Type SNAP and set the Style to Isometric. Type a Return (for Snap, again) and set the Rotation to zero.
3. Draw the left end of the box with Line or Pline.
4. Type Snap and reset the Rotation to 60.
5. Draw the top and front of the box.
6. Either reset the rotation to zero or reset the Snap to Standard, Ortho off, and draw the missing vertical line at the right end.



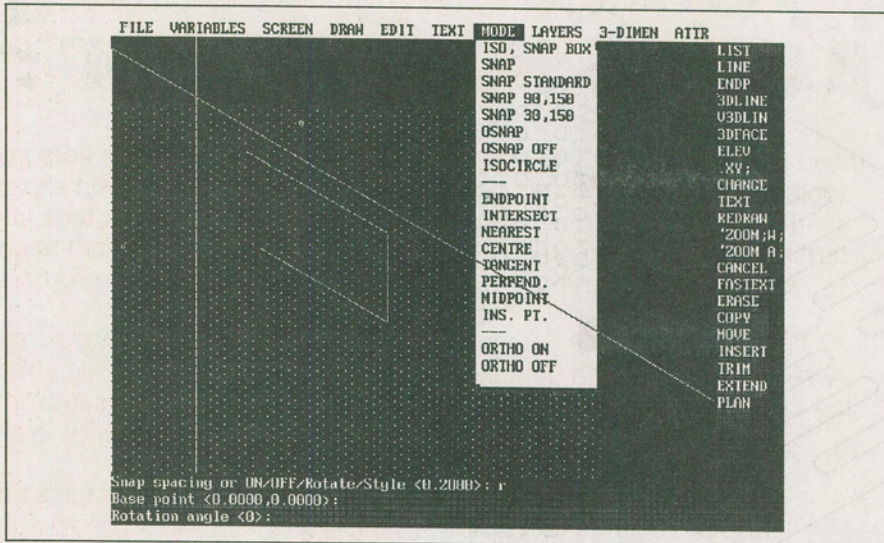


Fig. 2. AutoCAD's display with Ortho and Snap set for isometric drawing. The custom menu from the Almost Free AutoCAD disk provides instant changes to the Snap mode.

And that's it, an isometric box with no guesswork. If you'd like to add the above techniques to your own menu, or to AutoCAD's ACAD.MNU, find a likely spot somewhere in the Draw section of the Screen, Pulldown and/or Tablet menu and add these lines:

```
[SNAPSTANDARD]-
^CSNAP;S;S;SNAP;R;;0
[SNAP90,150]^CSNAP;S;I;;;R;;0;
[SNAP30,150]^CSNAP;S;I;;;R;;60;
[ORTHO ON]^CORTHO ON
[ORTHO OFF]^CORTHO OFF
[ISOCIRCLE]^CELLIPSE;I
[ISOPLANE TOGGLE]ISOPLANE
```

Isocircle? Isoplane?

### Isocircles

When you see a circle from some angle other than straight on, it appears to be an ellipse, with the major and minor diameters varying with the viewing angle. AutoCAD figures out how the ellipse should look, and will draw it correctly on one of three planes.

Before adding circles (to represent holes or knobs), type ISOPLANE. It will tell you whether the circle will suit the left, top or right plane of your box. Type Returns until it toggles to the plane you want. Now type Ellipse I, and you'll be set to draw an isocircle of any size with the axes automatically figured out for you.

You may find that the ellipse doesn't suit the plane that you've selected. If this happens, remember that Isoplane finds its way around according to the setting of the Snap mode; reset Snap to 30 or 150 and it should work out properly.

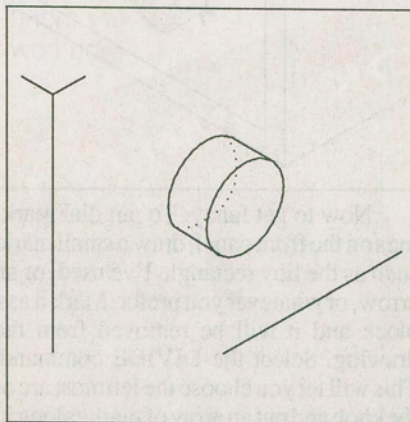


Fig. 3. The knob outline is drawn with two isocircles and the Trim command used to remove hidden lines.

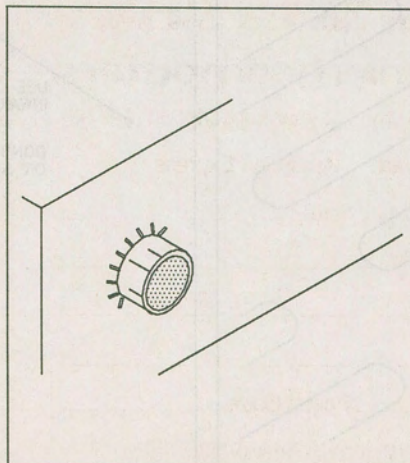


Fig. 4. The knob is dressed up with markings using the Divide command, plus some hatching; it's then marked as a block.

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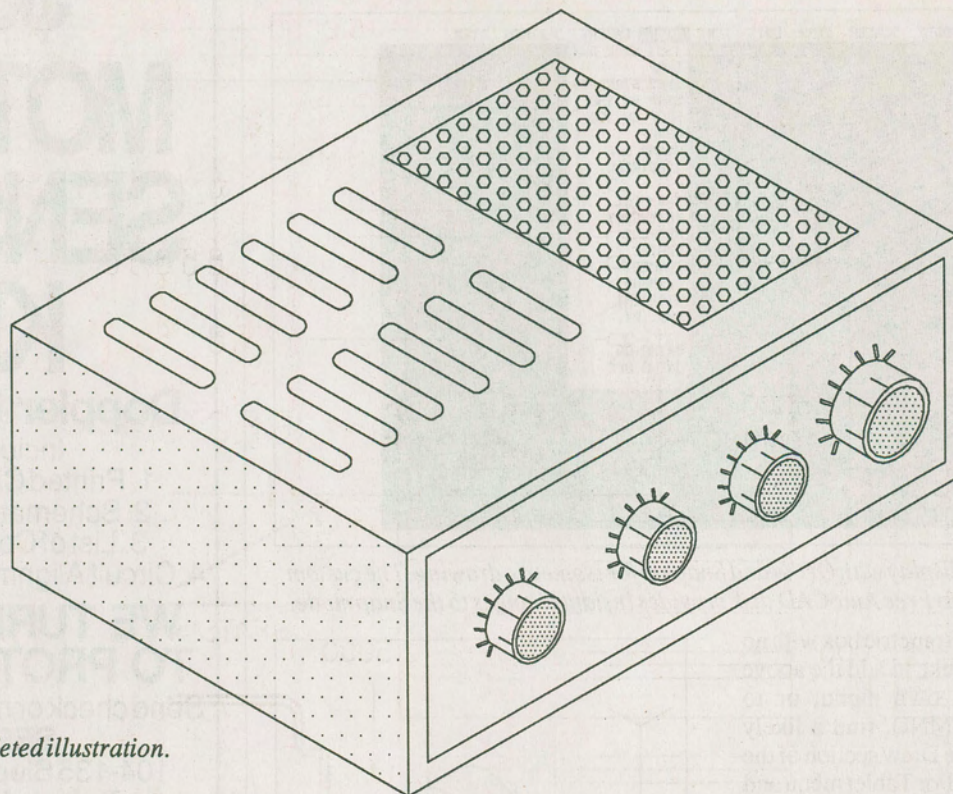


Fig. 6. The completed illustration.

## Knobs

Since we're only drawing ellipses, and without much effort at that, we might as well dress them up into proper control knobs. Place two overlapping isocircles as shown in Fig. 3; place two connecting lines as shown. Use the Trim command to snip out the arc segments that would be hidden (the dotted line in Fig. 3).

Now to get fancy. To put dial markings on the front panel, draw a small mark, such as the tiny rectangle I've used, or an arrow, or whatever you prefer. Mark it as a block and it will be removed from the drawing. Select the DIVIDE command. This will let you choose the leftmost arc of the knob and put an array of marks along it, automatically aligning them. I found that

asking for 12 segments gave a reasonably convincing spacing (I erased the extras). It isn't perfect, but it's adequate for most drawings, and it's very fast.

Add two or three lines to the knob to accentuate the appearance of roundness and put another isocircle inside the knob front. Hatch this circle with your choice of patterns.

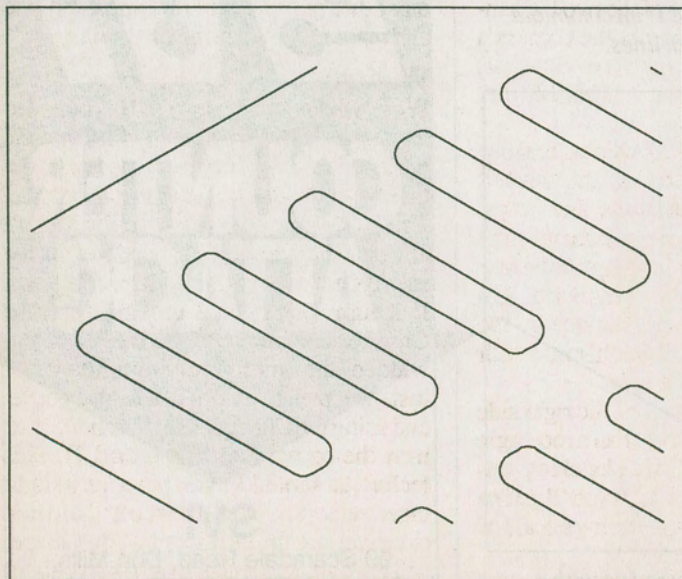


Fig. 5. The louvers are drawn with Ortho/Snap modes and rounded with the Fillet command. The Array command draws the desired rows and columns.

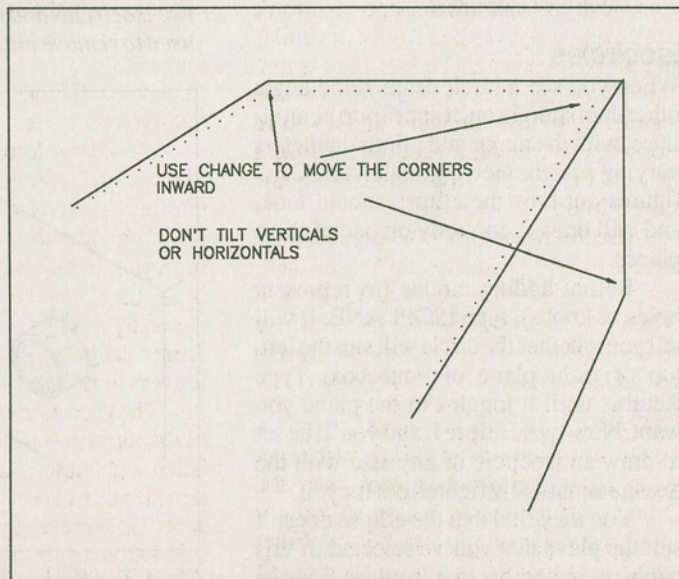


Fig. 7. If a wedge shape results from the lack of perspective correction, use the Change and/or Move commands to reduce the size of the far end by a tiny amount.



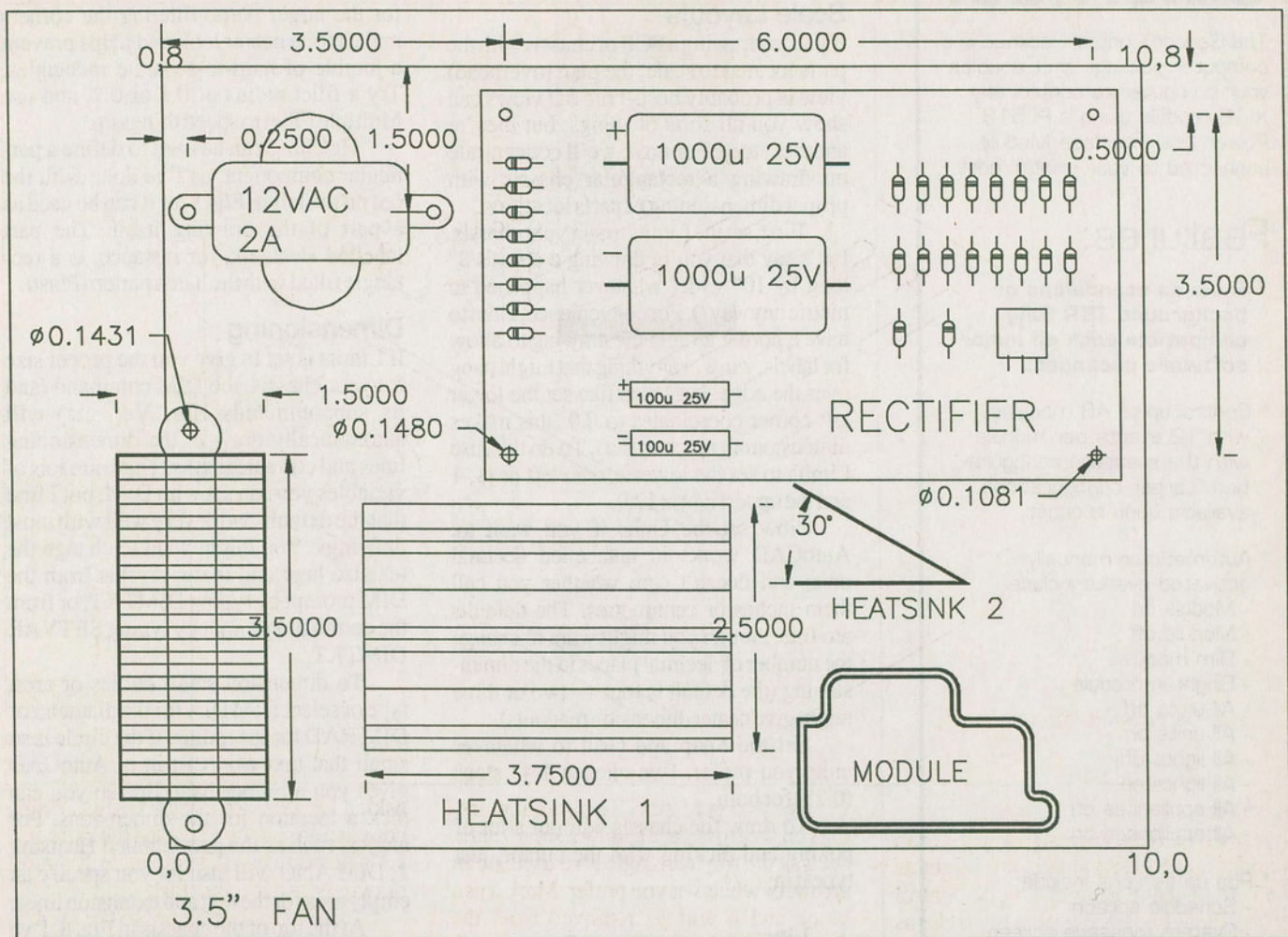


Fig. 8. An example of a scale parts layout drawing. Multiple copies are easily inserted with arrays or the Copy command; the DIM function provides automatic dimensioning.

There you are. Save this as a block (all your work will seem to disappear — don't fret). Make a layer called Knobs or similar and make it current. The idea here is that hatching and arrays slow down the regeneration of the drawing, and if you're working on some other section, you might as well Freeze the layer containing the control knobs.

Use Insert to return some knobs to your control panel. Make one or two of them larger by setting the scale to 1.2 or 1.5. When you're happy with the location (use Move if you're not), change the current layer and Freeze the control knob layer.

### Hanging in the Louver

To put some louvers in the top just to get away from the shoebox look, use the Ortho/Snap modes as before to draw a small rectangle on the top. Set the Fillet radius to 0.1 (if you're using the default Limits of 12,9 — otherwise do a bit of experimenting). Fillet the corners of your rectangle; note that the appearance of the

rounded corner will vary somewhat, depending on the angle of the two lines involved. This seems to give the corners a reasonably good perspective view, although it will make you think that the fillet radius is changing.

Mark your louver as a block, and use the Array command to set the desired number of louver columns and rows. Here's a rub: the Array command may send your louvers climbing up off the box or at some other angle — the trick is that the array's baseline is determined by the Snap rotation angle. 30° should make your louvers line up properly.

The perforated panel on the right side of the top is nothing more than a rectangle filled with AutoCAD's Hex hatching pattern. If your Limits are 12,9 you'll get an acceptable perf look by selecting a scale of 0.35 and an angle of zero.

Put some hatching on the left end of the box just to create the illusion of shadowing.

Thaw the control knob layer and have

a look at your completed drawing. Add any other bits of detail that appeal to you and make a test plot at the final size.

### Wedgies

When your drawing is plotted or printed to letter size or larger, you may find that the box appears to be wedge-shaped, with the far end somewhat larger than it should be. This lack of perspective correction doesn't always cause trouble; it depends on the size, type of drawing, and other conditions. If it turns out to be a problem, use the Change command to shrink the height and width of the far end by a tiny amount (for instance, pick two lines that form a corner and using the Change Point function, click near the corner (see Fig. 6 and 7). This technique should let you put a very slight taper on the box. Don't overdo it; the idea is to cancel out the unwanted wedge shape, and it won't take much. Don't worry about vanishing points and other rules of perspective — there's a fair amount of room for error.



# AutoCAD for Electronics, Part 6

## Scale Layouts

If you're drawing a PCB or chassis with the parts located to scale, the plan (overhead) view is probably best. True 3D views can show you all sorts of things, but they're another story. For now, we'll concentrate on drawing a rectangular chassis with proper dimensioning of parts locations.

First, set the Limits to suit your chassis. Let's say that you're drawing a chassis 8" long by 10" wide (whatever happened to metric anyway?). For convenience, I like to have a border around the drawing to allow for labels, wires or anything that might hang over the edge, but I also like set the lower left corner coordinates to 0,0 (this makes dimensioning much easier). To do this, use Limits to set the lower screen left at -1,-1 and the upper right at 12,9.

Now set the Units if you want to. AutoCAD works in unlabelled decimal units and doesn't care whether you call them inches or centimetres. The defaults are fine, though you might want to change the number of decimal places in the dimensioning (the default is four — two or three might give neater dimension readouts).

Set the Snap and Grid to whatever units you prefer. I've chosen 1/4" steps (0.25) for both.

To draw the chassis without a lot of poking and picking with the cursor, just type it in:

### Line:

from: 0,0 to 0,8 to 10,8 to 10,0 to C

The "C" closes the rectangle and leaves us with an 8 x 10 chassis with some room around it to add extras.

## Parts Placement

You can save a lot of time if you make blocks for inserting lots of the same thing. You could make a rectangle, save it as a block, and then insert it with different X and Y scales whenever you need to. It could serve as almost anything, but keep in mind that changing the X and Y scales will defeat certain functions, such as Explode. This means that you can't Fillet the corners, since Fillet expects blocks to be Exploded first.

There are several ways to insert multiple components, such as resistors or capacitors. If they're saved as a block, the MINSERT command combines Insert with Array. If they're not, either Array or Multiple Copy will do it (I always use Multiple Copy — it's much faster than anything else).

Once you've drawn basic rectangles

for the larger parts, filleting the corners makes for a neater look and helps prevent a jumble of hard-to-separate rectangles. Try a fillet radius of 0.1 or 0.2, and use Multiple Fillet to speed things up.

Hatching can be used to define a particular component, as I've done with the fan on the left in Fig. 8, or it can be used as a part of the drawing itself. The part labelled Heatsink, for instance, is a rectangle filled with the hatch pattern Plasti.

## Dimensioning

If Limits is set to give you the proper size for your chassis, the DIM command (and its subcommands Hor, Ver, etc) will automatically draw in the dimensioning lines and correct lengths. There are lots of variables you can set with DIM, but I find that the defaults work very well with most drawings. You might want to change the text size here and there; do this from the DIM prompt by typing DIMTXT, or from the command prompt by typing SETVAR DIMTXT.

To dimension small circles or arcs, type or select DIMDIA for the diameter or DIMRAD for the radius. If the circle is so small that text won't fit in it, AutoCAD gives you a rubber-band line so you can pick a location for the dimensions. For angles, such as the part labelled Heatsink 2, DIM ANG will also let you specify an empty area for the text and extension lines.

At the top of the chassis in Fig. 8, I've used cumulative dimensioning; the 6" takes off where the 3.5" ends. If you'd prefer to have all the dimensions start at the left (or any other specified point), use DIM BASELINE. This will offset the dimension lines so they don't overwrite each other. It takes up a lot more room, but each location gets its own measurement back to a common point.

Don't forget the versatile Polyline, or Pline. It may be cumbersome to edit, but the idea of having line segments of any width forming a continuous line is too good to ignore. At the bottom of the drawing you'll see a widget marked "module". This was drawn as a polyline following the Snap and Grid layout. Then the Fillet Polyline command rounded all the corners in one operation (except one — I didn't Close the polyline, so a break remains where one end joins the other). The Offset command drew the Pline around itself to produce the double-wall effect in one command.

The above commands and tips are only a few of the many zillion that you can find in AutoCAD, but they'll get you started. ■