

## Software Review

# Robographics CAD-1

*Convert an off-the-shelf Apple into a drafting system*

There are more and more CAD (computer-aided design) packages coming out all the time. In fact, trying to keep up with them becomes a job in itself. Out of necessity, I find myself picking one or two outstanding characteristics from each to separate it from the rest. Robographics CAD-1 stands out for its use of libraries—

the way it enables you to assemble large drawings with complete disregard for the amount of available RAM (random-access read/write memory)—and for its drawing abilities—the way it allows you to draw in much greater detail than the graphics monitor can show.

CAD-1 is a computer-aided design software package for the Apple II and Apple IIe computers. Using CAD-1, you can draw a wide variety of pictures with great accuracy and plot the image precisely on various output devices. For example, you may draw simple block diagrams, flowcharts, or a more complex schematic; you may design a personal computer circuit board or do some mechanical drawing on a valve; or you may do some space planning or architectural design.

How well a CAD system performs these tasks depends on software quality, the central processor, the graphics processor and monitor, and the hard-copy output device. Within the limitations of Apple's 6502 processor and graphics resolution, CAD-1 performs very nicely. Written in assembly language with high-precision floating-point math, the program is lightning fast and seems to implement fully the processing power available.

### Hardware

With this software, you can convert an off-the-shelf Apple computer into a drafting system. You need the CAD-1 software, the joystick supplied with the software, an Apple II or IIe with 64K bytes of RAM, a suitable video display, and two Apple II DOS 3.3 disk drives with controller cards.

CAD-1, with its special input device (a hardware box with three buttons, a rotating dial, and a joystick) retails for \$1095. With it you can make the most of the entries necessary to run the program. You can draw accurately with the joystick and rotate and scale objects with the dial. More on this device later.

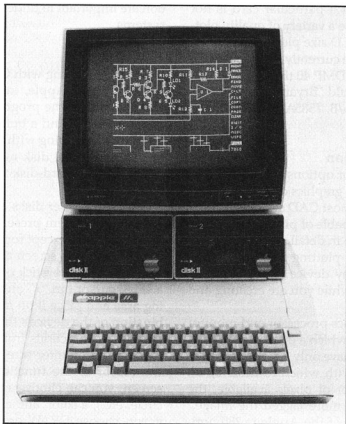
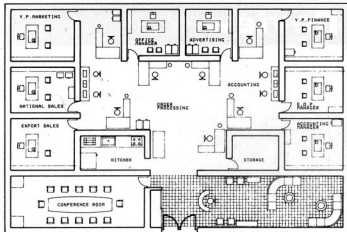
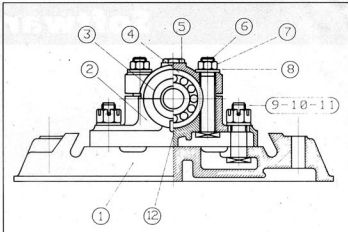


Photo 1: An Apple IIe displaying a typical CAD-1-created drawing.



**Figure 1:** A sample floor plan prepared with CAD-1. This drawing is made easy by manipulating different user-defined library drawings of standard office furnishings.



**Figure 2:** A mechanical drawing created with CAD-1 showing the potential accuracy of the software and the use of line types, arc, circles, and crosshatching.

Optionally, CAD-1 also supports the Robographics and Apple Graphics 11 by 11 digitizing tablets to make drawing easier. These devices simulate a drafting table and come in all sizes. You can trace existing drawings or simply draw from scratch on the digitizer surface. A stylus or cursor (sometimes called a puck) serves as an electronic pencil for entering data points at the press of a button.

To produce low-resolution, hard-copy plots of your drawings, you can use a dot-matrix printer. The software supports a variety of interface cards and you can configure the software yourself if a particular card is not directly supported. You can use a variety of quality plotters capable of producing A to D size plots (USA) or A1 to A4 size plots (Europe). These currently include Bausch & Lomb (Houston Instrument DMP 40 through 42), Calcomp (models 81, 84), Gould Bryans Colorwriter, Hewlett-Packard (7470A, 7580A/B, 7585A) and Watanabe Digiplot (all B or A3 sizes).

### Monitor Drawing Resolution

A variety of graphics monitor options are available in addition to the standard Apple graphics capability. Herein lies the major limitation of most CAD systems including CAD-1. The software is capable of producing a large drawing (e.g., 24 by 36 inches) in detail, and a large-format plotter is fully capable of plotting the same detail. However, the graphics display device can't accurately represent the image you see while you are creating and editing your drawing.

The resolution of the graphics processor and monitor determines the accuracy with which a display can represent an image. These devices have only a certain number of pixels (picture elements) with which to describe an image. The lower the number of pixels available, the lower the resolution and the more jagged the image.

For example, the resolution of the Apple is 280 horizontal pixels by 192 vertical pixels. The Robographics CAD-1 system uses the rightmost 24 columns of pixels

for on-screen menus (see photo 1), leaving a workspace of 256 by 192 pixels. This area is used to represent your image no matter how large it is. It stands to reason that a 24- by 36-inch drawing appears very crude.

On the other hand, the actual drawing database is very accurate. The output device resolution provides the only limitation on the quality and resolution of the hard-copy output. For example, a dot-matrix graphics printer produces a low-resolution image while a high-resolution plotter reproduces the drawing accurately. These differences in actual, display, database, and output resolution are important to understand when configuring CAD systems.

### Let's Draw

To begin drawing with CAD-1, you hook up the input device to your Apple, insert the program disk in the drive, and load the program. Then you insert a library disk in drive A and a buffer disk in drive B. There is a lot of disk swapping with CAD-1. When you use a plotter, an additional disk must be swapped. The system really needs a hard-disk version developed for serious applications.

Once the proper disks are in place and the system is loaded, the system presents you with a clear screen to draw on—clear except for a menu area down the right-hand side of the screen and a function area at the bottom. Using the joystick on the input device, you move a small cursor (an "x" on the screen) around the drawing area and place it on menu choices. Pressing a combination of the device's three buttons, you choose commands and functions from the menu and create drawings on the monitor screen. For example, if you move the cursor to the function area at the bottom of the screen, you can choose a primitive type (e.g., line, arc, circle, etc.), a color, and a line type (e.g., dotted). Then if you choose DRAW on the monitor menu, you can draw images on the screen with the joystick (or digitizer) and the buttons. You can freehand sketch, trace lines of

## At a Glance

### Name

Robographics CAD-1

### Type

Computer-aided design (CAD) software

### Manufacturer

Chessel-Robocom Corporation  
111 Pheasant Run, Suite 2B  
Newtown, PA 18940  
Mr. Peter Kendall  
(215) 968-4422

### Format

Apple DOS 3.3 5¼-inch floppy disks

### Language

Assembler

### Computer

Apple II or Apple IIe

### Software required

None other than the program

### Documentation

167-page, 6- by 9-inch manual

### Price

\$1095 including hardware input device

### Comments

CAD-1 provides fast, powerful, and easy-to-use computer-aided design capability on an Apple II or Apple IIe

ferent elements of your drawing, is also missing. In addition, only one text font is provided and it is only adequately attractive.

## Zooming

CAD-1's ability to zoom into an area of the drawing helps to overcome the display monitor's limitations. For example, when you zoom into (or window) a particular room of a floor plan you are drawing, that room will fill the entire monitor screen. You can see more detail and you can draw with greater precision. The width of the screen could represent, for example, 1 inch, 1 foot, or 1 mile.

The concept of zooming is important to understand. CAD-1 provides a window into your drawing. Consider a 24- by 36-inch drawing. With CAD-1, you can see as much of that area as you want at a time. You can draw a border on the drawing and then zoom in to a 9- by 12-inch area to do some detailed work. You can zoom in further to a 1-inch square and draw at 0.001-inch precision. In effect, you are scrolling a window (often called a viewport) over the surface of a larger drawing. Zooming back to the full-size drawing condenses all that detail into a relatively small area on the screen. This doesn't have any effect on the final plot, however; the full 24- by 36-inch image is plotted to scale depending on output device capability.

## Drawing Size

Each drawing holds up to 3000 bytes of information. For example, a line takes 10 bytes, an arc 15, a circle 8, a nib fill pattern 18, text 10 (plus 1 byte per letter). When the workspace fills up, the system notifies you with a beep. This is where CAD-1 gets creative. It is obvious that 3000 bytes is not much room for a detailed drawing. CAD-1 lets you store the work you have done in a library on disk. Within one library file you are allowed three pages of drawings. The number of drawings you can keep on each page varies from 4 to 64. Put simple images like letters on the 64-division page and more complex drawings on the 4-division page where you can save more detail.

Once you store your drawing in a library slot, you can return to the drawing editor, clear the screen, and draw another 3000-byte image. You can also store this drawing in a library and return to do another and so on until the memory is used up. Then you can copy back the stored library images to your current drawing. As the images come in, you can freely scale them by  $x$  and  $y$  and rotate them in increments of 5 degrees (by turning the rotating dial on the input device). Once copied, they are treated as one entity and occupy only 20 bytes in your current drawing. You can assemble about 150 of these drawings within the new drawing and then save that drawing as a library image. When copied into another drawing, this image also takes only 20 bytes of memory. This procedure can go on until the disk space is used up.

Developing large drawings with CAD-1 is a process of assembling smaller drawings that have been stored in the library. A certain amount of preorganization is, therefore, required to do complex drawings. You can even copy library items from different library disks into your current drawing. When the current screen is full, simply save the increasingly complex image to an available library slot and continue, incorporating it in another drawing. Animation effects can be developed by creatively interacting with the library images and the drawing-regeneration process.

There are some limitations associated with using library images that ought to be mentioned. When you copy a complex drawing in from the library, you can't edit it in detail. However, you can edit the original library image after which all references to it reflect the revisions. You can also print/plot your library pages for reference in assembling your drawings. Needless to say, this is a clever way of overcoming the RAM limitations of the Apple. The real drawing size limitation becomes the available disk space.

Since the regeneration of your drawing slows down in proportion to the drawing size, it makes more sense to assemble large drawings by overlaying a series of smaller drawings onto your plotter rather than by trying to fit everything into one drawing. Nevertheless, significant capability is available and one Apple disk will store several 24- by 36-inch plots with an average amount of detail.

## Packaging

CAD-1 documentation consists of one 6- by 9-inch manual with typeset pages printed on one side. The manual contains three sections, Getting Started, Basic Drawing, and Precision Drawing, and eight appendices covering subjects like library archives, constructing lines with a given angle and length, creating symmetrical drawings with the mirroring function, discussion of the plotting utility and the options available, and others. The manual is well illustrated with a good tutorial. It needs double-sided pages and a good section on CAD basics, though.

The package includes an intelligent plot utility on a separate disk with a variety of options. You can search the library pages for the image you want to plot and window the appropriate area. You can change line types or colors, choose predefined zoom and plot scales, and plot with dimensions in metric or English units (in decimals). The program automatically selects different pens on multipen plotters, and you can stop or pause the plot at any time—very handy if you need to change a pen.

The software is copy protected with one backup of the program disk supplied. There is a 90-day warranty against defects in material and workmanship after which disk replacement costs \$10. Enhanced versions seem to be on the horizon, so check the company's update policy.

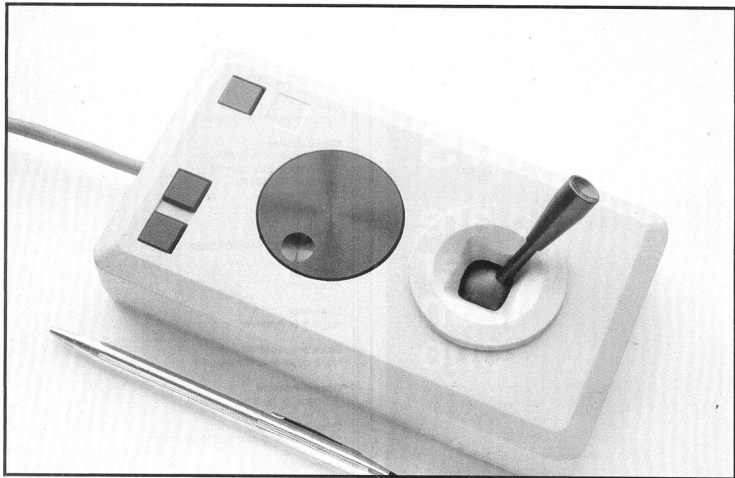
## Conclusions

CAD-1 makes good use of the Apple computer. I am amazed at how much is possible with the processing power of the 8-bit 6502 chip. The accompanying hardware input device provides a very friendly interface; however, it is nice to see that a selection of digitizer devices and plotters is also supported.

CAD-1 is written in fast assembly language and uses floating-point math for very high precision capability. The drawing library is a very strong feature. The ability to copy library drawings into the current drawing with minimal RAM overhead makes large drawings possible within the limitations of addressable RAM. Automatic dimensioning in feet and inches will be a welcome addition.

Like all CAD systems, this package needs a graphics processor/monitor combination with higher resolution to take full advantage of its capabilities. Running the program requires too much disk-shuffling, especially for more complex drawings. A hard-disk version is needed along with more addressable RAM and an MS-DOS version. Currently the program runs on the IBM PC with a Quadlink card installed. A true MS-DOS version is planned for release in 1984.

This software appears as somewhat of a sleeper, like a Ferrari engine in a Volkswagen. It is worth checking out, especially if you plan some serious drawing with an Apple computer. ■



**Photo 2:** The Robographics CAD-1 specially designed input device, consisting of a hardware box with three buttons for selecting and de-selecting points and menu options, a joystick for positioning the cursor on the display screen, and a rotating dial for controlling such things as the radius length of a circle, or an arc, or the rotation of objects on the screen.

ifferent widths, fill areas temporarily or permanently, insert text, erase objects, zoom, and pan (scroll from one area to another). See figures 1 and 2.

Since the program is written in assembly language, the cursor movements and placement of lines and shapes are instantaneous. You can freely manipulate lines, arcs, and circles while you watch them stretch and shrink on the screen before you. You can turn on a grid system and lock your drawing to the grid points (your drawing points snap to the nearest grid point—standard or user-defined) to produce precision drawing. You can have different *x*- and *y*-axis values and you can rotate the grid if you want to work on isometric images.

### Commands

Several cursor lock modes are available for drawing precision. You can lock the cursor to move in only two fixed directions from its current position. The axes of these two directions can be set at different angles providing tremendous help in constructing isometric images. A NORMALTANGENT lock mode automatically senses the slope of the last line drawn then sets an orthogonal axis (at right angles) lock at the end of the line. I find this helps to create a smooth continuation of a previous line with an arc—a good way to construct a fillet (the concave transition surface between two other-

wise intersecting surfaces).

You can determine the location of a specific point with the FIND command, snap the current grid to that point with SHIFT-GRID, and rotate the grid using NORMALTANGENT. You can even skew the grid for more variety. These are very powerful features for precision work. You can draw isometric projections in true scale or, if this is too confusing, call up two preset standard grids to restore your sanity.

The scale of the CAD-1 system is metric but the database units could just as well be feet or inches with decimal fractions. By the time you read this, CAD-1 expects to have automatic dimensioning with feet and inches (requiring a Saturn RAM expansion board to boost the Apple to 192K bytes of RAM), but currently dimensioning must be done manually.

With the NIB command you can determine the spacing between, and the direction of, the fill elements. This allows you to shade objects, giving dimension to your drawings.

There are some software limitations in CAD-1. I did not see a provision for entering data-point coordinates manually from the keyboard, either relative to the origin (0,0), relative to the current point, or using polar coordinates (angle and distance from a point). The ability to draw on layers, turning them on and off to display dif-