EDN'S ALL-STAR PC

PART 5:

ENGINEERING SOFTWARE

After months of development, chronicled in four previous articles, it's time for the All-Star PC to do more than run operating systems, benchmarks, and utility programs. It's time to do real work by running engineering software.

PCs provide engineers with access to a wide array of hardware- and software-development tools, and EDN's All-Star PC excels at running them. The All-Star PC represents the pinnacle of PC technology—at least until the next wave of PC-related component introductions transform today's top performers into yesterday's news.

In a mere eight years, the PC has become a vital engineering tool for product development. The range of development software available for PCs numbs the mind. There are PC-based software packages for all imaginable product-development needs. These packages include software-development tools such as cross-assemblers, cross-compilers, debuggers, and version-management packages; circuit-development tools such as schematic-drafting packages, pc-board-layout tools, thermal-analysis packages, analog- and digital-circuit simulators, ASIC-development packages, and mechanical CAD packages for designing packaging; hybrid hardware/software products such as in-circuit emulators, PC-based EPROM programmers, and tools for designing PLDs and field-programmable gate arrays; and even pro-

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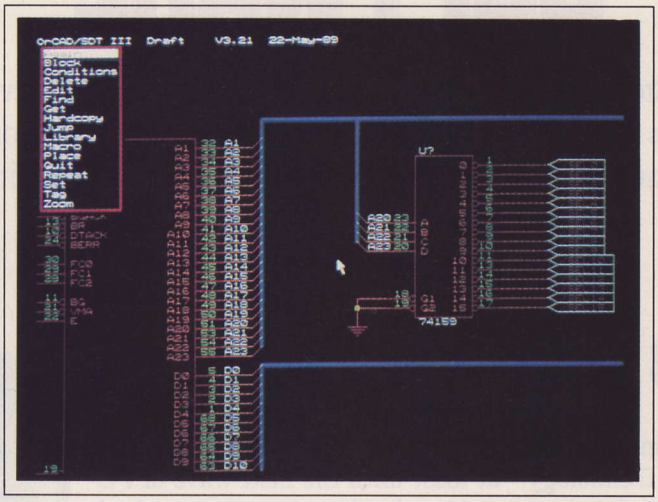
ject-management packages, which help keep your project on course.

You can also use your PC to generate proposals, progress reports, memos, and product documentation, using the general-business software developed for the PC such as word-processing software, desktop-publishing packages, spreadsheets, and database managers. Best of all, because of the PC's huge sales volumes and the resulting competition among products, these engineering- and business-software packages include some of the highest quality, lowest-priced software products for any computer ever placed on the market.

No one article could possibly cover all of the software products listed above. An entire issue of EDN devoted to the topic wouldn't suffice. Instead, we'll focus on two core tasks that nearly every electrical engineer performs when developing a product: circuit design and the associated pc-board development. The other types of product-development software packages are just as important, but no software product stresses a computer's abilities more than schematic drafting and pc-board layout. Schematics, circuit-board designs, and component databases consume large amounts of disk space, require plenty of RAM for efficient manipulation, and can use all the computing horsepower a PC can muster. In addition, schematic drafting, component placement, and trace routing push the limits of human concentration and consequently place heavy demands on a computer's user interface. For these reasons, schematic-drafting and pc-board-layout packages make for excellent tests of the All-Star PC's abilities.

The PC marketplace is flush with schematic-drafting and pc-board-layout products, making an exhaustive test of all available products impossible, and even making a choice difficult. The two well-known software-product families that provided the final shakedown tests for EDN's All-Star PC, OrCAD and Personal CAD Systems' (P-CAD) Master Designer, dwell at opposite ends of the product spectrum. OrCAD products will run on just about any PC, from vintage 8088-based PCs to 80486-based behemoths like the All-Star PC. OrCAD's design tools need 640k bytes of RAM (but won't use more), require a minimal amount of disk space (you don't even need a hard disk), don't require a mouse (although they can work with one), and include display drivers for nearly every dumb PC display card ever marketed (but don't support intelligent graphics cards). The P-CAD product family, on the other hand, consists of high-end tools that require at least an 80286 μP, can use as much as 16M bytes of RAM, require 20M bytes of hard-disk space and a 1.2M-byte floppy-disk drive, work substantially better with a mouse, and include drivers for both dumb and intelligent graphics cards.



Drop-down menus allow OrCAD/SDT III to use the entire screen as a drafting area.

Despite OrCAD's populist approach to software, its development tools provide excellent design capabilities. Central to the product family is OrCAD/SDT III, the schematic-drafting package. The company's pc-board, PLD, and simulation products can all accept schematics created with OrCAD/SDT III. Other companies have also created products that accept OrCAD's schematics. For example, International Microcircuits Inc (Milpitas, CA, (408) 263-6300) recently announced a PC-based development system for its Easygate gate-array design package that employs OrCAD/SDT III as its front-end design tool to create ASICs with as many as 16,000 gates.

OrCAD/SDT III handles hierarchical designs with 200 levels and features pop-up menus for ease of use. The package also includes a library containing more than 6000 parts. The pop-up windows minimize the need to read the manual. I was drawing schematics only minutes after installing the software. Although OrCAD/SDT III only supports dumb graphic-display cards, it is still quite fast, and it can operate displays at screen resolu-

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OrCAD

OrCAD Systems Corp, 3175 NW Aloclek Dr, Hillsboro, OR 97124. (503) 690-9881. FAX (503) 690-9891. TWX 910-240-2090.

Circle No. 667

BIO: The OrCAD family of development tools runs on nearly every PC, yet it includes many high-end features such as hierarchical design, simulation support, and pop-up menus. The pc-board-layout tool, OrCAD PCB II, can handle boards as large as 32×32 in. with a 0.001-in. resolution.

STATS:
SCHEMATIC-DRAFTING TOOL: OrCAD/SDT III
PC-BOARD-LAYOUT TOOL: OrCAD/PCB II (includes automatic router)
PLD DESIGN TOOLS: OrCAD/PLD and OrCAD/Mod
SIMULATOR: OrCAD/VST
RAM REQUIRED: 640k bytes
PROCESSOR REQUIRED: Any 80×86-compatible μP

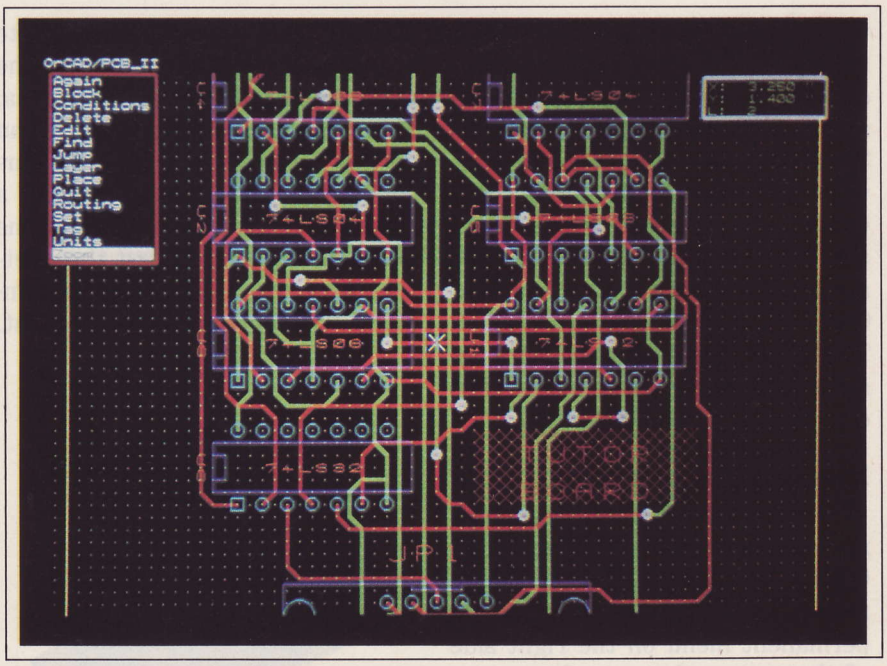
tions as high as 800×600 pixels. To see what display resolution might be acceptable, I set all of the OrCAD tools to the standard VGA resolution of 640×480 pixels, which worked just fine for schematic drafting and for pc-board layout.

OrCAD/SDT III's schematics feed OrCAD/PCB II (the company's pc-board design tool), OrCAD/VST (a digital simulator), and two PLD design tools, OrCAD/PLD and OrCAD/Mod. The pc-board-layout package can accommodate boards as large as 32×32 in. with a resolution of 0.001 in. It can handle designs with as many as 270 equivalent (14-pin) ICs, 5200 pads, and 16 copper layers—a significant capacity considering that the program and the design database must both fit into 640k bytes. OrCAD/PCB II incorporates an automatic pc-board router and allows you to manually route a board as well. Once again, OrCAD's tutorial enables you to learn OrCAD/PCB II in a matter of minutes.

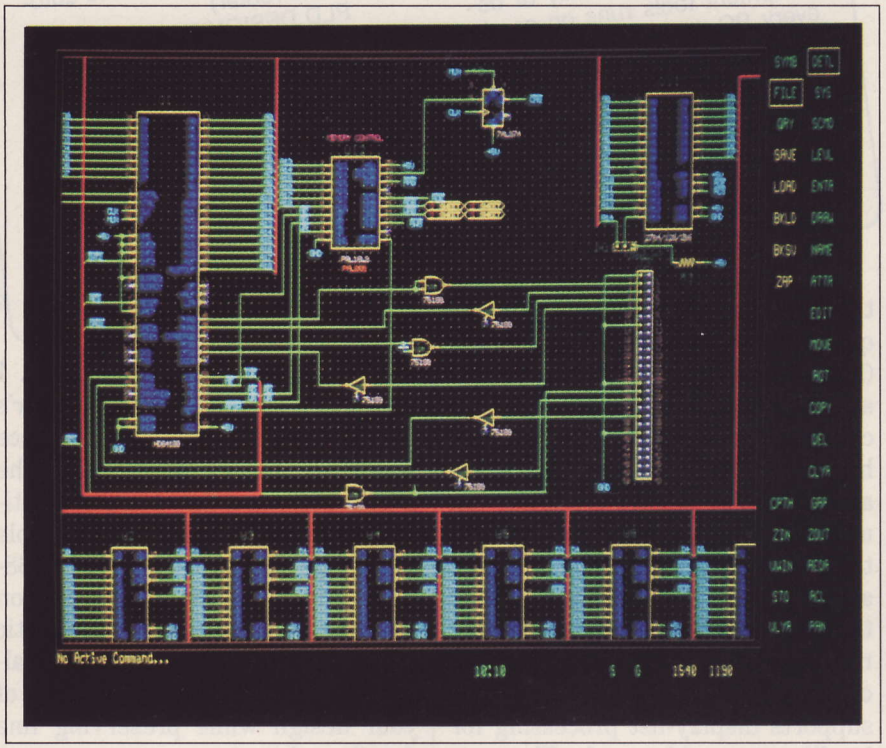
OrCAD/VST is a 12-state, event-driven logic simulator that accommodates designs with as many as 14,000 gates, limited once again by the 640k-byte barrier. The company claims that the simulator can evaluate 65,000 events/sec on a 20-MHz 80386-based PC. I had never used a digital simulator, and I found OrCAD/VST easy to set up and use. The simulator's output resembles a logic analyzer's display, making the simulation results easy for a hardware engineer like me to understand. I didn't try OrCAD/PLD or OrCAD/Mod, the two PLD design tools, because an article covering such tools will appear in EDN later this year.

The Master Designer tool set from P-CAD handles larger designs than OrCad. Consequently, it requires more PC processing power (it doesn't run on 8088-based PCs) and greater storage capacity; the company recommends that you have 20M bytes of hard-disk space available. The Master Designer can use expanded memory, and in fact, the system-overview booklet that accompanies the package states that expanded memory is "highly recommended." The latest version of Master Designer, release 4.5, supports display-list processing for intelligent graphics cards. The company claims a 20-fold speed improvement in redrawing the screen with intelligent display adapters. I combined the Master Designer's DGIS (direct graphics interface standard) display driver with the DGIS software for NEC's Multisync Graphics Engine and was able to use the display card's 1024×768-pixel mode. This configuration proved excellent for schematic drafting and pc-board layout; it allows you to view a large portion of your design while preserving fine details and text.

By taking advantage of the more powerful features of high-end PCs,



Although not essential for schematic drafting, color displays are indispensable for pc-board-layout programs such as OrCAD/PCB II.



At 1024×768 pixels, the schematic-capture portion of P-CAD's Master Designer can display a substantial part of your schematic and still keep text readable. Support for intelligent graphics adapters allows Master Designer to rapidly absorb advances in PC display technology.

the Master Designer can tackle large jobs. PC-Caps, the schematic-drafting package, handles multisheet schematics with as many as 300 sheets and hierarchical designs with as many as 15 levels. PC-Cards, the pc-board-layout package, accommodates boards as large as 60×60 in. with 100 layers at 0.001-in. or 0.01-mm resolution. The Master Designer deals with designs containing as many as 2500 components and 32,000 pins.

Many ways to use a menu

Three of the Master Designer's major components—PC-Caps, PC-Cards, and PC-Place (the component-placement tool)—employ a permanent menu on the right side of the screen that complements a main drafting area. Selecting a menu item throws a submenu onto the screen in a gap between the main menu and the drafting area. You can select among these menu entries with a mouse, with the cursor-control keys, or by typing a slash, to invoke the command-line entry mode, and the first three letters of a menu or submenu command. The fourth major component, the automatic router PC-Route, also employs menus, but it presents them as screens of text that allow you to select the routing parameters before starting the route.

A complicated network of utility programs links the four main modules. For example, to prepare a schematic for placement and routing, you must process the schematic with PC-Nodes to create a net list, PC-Link to join multisheet and hierarchical designs into one master net list, and PC-Pack, which uses the master net list to assign logical gates to physical packages. Once all components are packaged, you can place them on the pc board with PC-Place and then route the signals with PC-Cards and PC-Route. Other utility programs perform design-rule checks, back-annotation, which transfers design changes made on the pc board back to the schematic, and a variety of manufacturing-related tasks such as creating component and materials lists.

Master Designer's 2-in.-thick tutorial takes hours to complete. However, you'll have a good idea of what the package can do by the time you finish it. The company also provides a system map that shows you how all of the 17 programs in the Master Designer package interrelate. The large number of interlocking programs makes the Master Designer package somewhat confusing, but after working through the tutorials and studying the system map, the relationships among the various programs become clear. The Master Designer includes a text-based shell program that helps you move from program to program within the Master Designer family, but you must still acquire a good understanding of the product's in-

terlocking parts before you can make efficient use of the package.

Both the OrCAD and P-CAD products had no trouble running on the All-Star PC. It's impossible to rank one over the other, however, because the two packages are clearly aimed at different markets. OrCAD lets you create smaller designs on almost any PC. P-CAD's Master Designer takes on large designs but requires more speed and capacity from a PC. Product-design engineers wrestle with a range of design problems, so no one tool is going to meet everyone's needs. However, by adopting the PC as your design computer, you can

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Master Designer

Personal CAD Systems Inc,
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CA 95126. (408) 971-1300. FAX
(408) 279-3752. TLX 371799.
Circle No. 668

BIO: P-CAD's product family supports intelligent graphics cards and can use a PC's expanded memory to enhance the software's ability to handle very large designs. Its PC-Cards pc-board-layout tool can accommodate boards as large as 60×60 in. with 0.001-in. or 0.01-mm resolution.

STATS:
SCHEMATIC-DRAFTING TOOL: PC-Caps
PC-BOARD-LAYOUT TOOL: PC-Cards
AUTOMATIC ROUTER: PC-Route
RAM REQUIRED (MIN/MAX): 640k/16M bytes
HARD-DISK SPACE REQUIRED: 20M bytes
PROCESSOR REQUIRED: 80286 or 80386-family μP

The CAD Showdown

The Woodland Hills Country Club in California's San Fernando Valley makes an unlikely venue for a PC-based CAD software competition, but that is where Compudraft Engineering (Chatsworth, CA, (818) 709-0202) held its third annual CAD Showdown on February 7 and 8. Compudraft sells several PC-based CAD packages and provides pc-board-design services. Of the 54 CAD software vendors invited to the event, 12 companies with full-featured schematic-capture/pc-board-layout products attended. Two companies that offer stand-alone PC-based router packages also participated.

This year's meet put software products to three tests. Benchmark 1 required the entrants to create a schematic and pc-board layout for a design composed of approximately 75% digital and 25% analog components. Participants could elect to create a surface-mount version of the design in addition to the mandatory through-hole version. Benchmark 2 required building a denser pc board, incorporating only digital components. The last benchmark was a simulation exercise. Benchmarks 1 and 2 measured the ease of schematic entry (measured by the time required to enter the drawings), the ease of pc-board creation (measured by the time required to draw the board's outline and place the components), and the speed and efficacy of the software packages' automatic routers. Twelve companies completed the first benchmark, four of which also completed the surface-mount version. Nine companies completed Benchmark 2. Only two companies tackled the simulation problem.

Nearly every participating vendor claims to have won this year's showdown. Because there are few uniquely correct solutions in engineering or in pc-board design, it's impossible to declare a winner. You must settle issues such as which company had the better CAD operator, how much difference the computers made (the machines used by the different companies incorporated a variety of processors operating at different clock speeds), and whether a 2-layer board with many vias is better (cheaper to build, more manufacturable, or prettier) than a 4-layer design with fewer vias. You must also consider the cost of the CAD software when trying to determine an overall winner.

These factors' relative importance depends on your particular circumstances, so you're far better off ordering the *CAD Showdown 3 Official Results* book ($25, plus $2.50 for handling) from Compudraft and then declaring your own winner. Despite the brouhaha generated by this year's event, Compudraft plans to sponsor another showdown next year.

choose among many possible design tools. (For more information about the various PC-based design tools, see **box**, "The CAD Showdown".)

Master Designer and the OrCAD tools run under DOS. OrCAD's products simply acquiesce to DOS's 640k-byte barrier; Master Designer circumvents the barrier by using expanded memory. The rapidly aging operating system gets in the way of programs like these design tools, which are trying to tackle big jobs. Because PCs based on the 80386 μP are readily available and have been on the market for some time, the installed base of machines now exists to profitably support a more capable operating system.

Unix and OS/2 version 2.0 are the two prime candidates for this succession (**Ref** 8). Both operating systems support large memory models and feature graphical user interfaces that make intelligent graphics display cards practical. The All-Star PC runs both Unix and OS/2, so it is ready when the application software for these two operating systems becomes more common. Several CAD and CAE vendors already offer Unix-based engineering software, though not yet targeted at the PC. Other vendors are starting to offer OS/2 versions of their engineering software. For example, EEsof (Westlake Village, CA, (818) 991-7530) offers versions of its microwave and RF design tools that run under OS/2.

However, until Unix or OS/2 takes over the PC arena, engineering-software packages that run under DOS continue to solve many of today's problems. One of EDN's motives for building the All-Star PC was to evaluate all this software. That's exactly what the All-Star PC will do in the future.

EDN

The author with his creation—the All-Star PC.

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Article Interest Quotient
(Circle One)
High 515 Medium 516 Low 517

Acknowledgment

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