6 Modems For Under $100!

How to Make Super Business Graphs

Bring Mainframe Data to Your Micro

Comparisons of Pointing Devices: Leading Edge PC & TRS80
Introducing the MTX 512

A World Apart from the Ordinary.

It begins with the sense of touch.
With the sleek black metal housing. Cool to the touch. Cool to the advanced circuitry and components contained within.
And the solid feel of people-sized keys set up in a field that gives you room to work and space in which to think.
But the difference only begins with what you see and feel. Where it ends...well, that's really up to you.
In a very practical sense, the only limits you'll experience with the MTX512 are those you choose to accept.

64K To 512K RAM – A Look On The Inside

Take a close look at the MTX512.
We could tell you it offers the greatest performance and versatility of any micro in its price range, but we think you're smart enough to draw your own conclusions.
The design is elegant in its simplicity. Remarkable for the power and complexity it represents. 64K RAM built in, with total expansion to 512K. And that doesn't include 16K of video RAM controlled by its own processor.

Speaking of video, keep in mind this is no ordinary monochromatic, single screen system. The MTX starts off where other micros end up. Delivering vivid screen capabilities with 256 x 192 pixels that crisply define interference-free high resolution graphics. 16 brilliant colors that can be displayed simultaneously. In a format powered by 32 easily movable, user-defined graphics characters. Graphics capabilities you’d find impressive in a system that gives you a single screen to work in. With the MTX, you have eight.

Yes, eight.
Eight definable windows to operate independently or in tandem. And still maintain full screen capabilities. Thus, you can manipulate spread sheets on the MTX and see the impact of changing variables in graphics at the same time. Eight separate windows on the world. We call them Virtual Screens. You’ll call them extraordinary.

Far from ordinary as well are the built-in system outputs that come standard on the MTX. The Centronics parallel printer port. The two industry-standard joystick ports. The uncommitted parallel I/O port. The Cassette port with 2400 baud. Separate TV and Video Monitor Ports. The 4-channel sound hi-fi output. We've even installed a ROM cartridge port for word processing and other dedicated programs.

Interactive Languages And Routines – A Look At The Way All Micros Will One Day Perform

Forget the way all other micros perform. This is the way they should.
Interactively.
With the MTX, you can create and manipulate programs using four different languages in dynamic interaction, all coordinated through the FRONT PANEL DISPLAY. Interweaving elements as you would in creating a symphony.

And take a serious look at the languages housed in the MTX's 24K ROM. MTX BASIC, a more powerful form of BASIC that allows you to use all standard BASIC programs. MTX GRAPHICS, with straight forward commands, eliminates the tedium and difficulty of creating complex graphics programs. NODDY, an I1-command “easy learn” language that can transform real world programming into a child-friendly activity. And MTX ASSEMBLER, which enables sophisticated programming in assembly language.

Something else the advanced programmer will appreciate is our ASSEMBLER/DISASSEMBLER, tied to BASIC, which provides unprecedented display and keyboard access to Z80 CPU storage locations, memory and program.

If you’re hungry for more, PASCAL and FORTH are also available as add-on ROM packs.

On the keyboard side of things, you’ll find a number of operator-oriented features that speed up and ease up the operation of the MTX. The separate numeric pad with quadri-directional cursor control and full editing functions. The eight dual function keys.
The auto repeat function on all alpha-numeric keys. Add to this such programmer-saving features as the use of abbreviated BASIC commands, a built-in syntax verifier, automatic cursor-honing to errors, auto-line numbering and automatic scrolling, and you begin to see the MTX not only opens a lot of doors that other micros leave closed, but speeds you through them as well.

The 160 Megabyte Connection - A Look At
The System

To build a good system, quality must be designed in at every level. We designed the MTX and its complete line of system peripherals using proven, standard components. Striking a strategic balance between power, versatility and dependability. Our Z80A processor, running at 4 MHz, gave us the high performance characteristics we were striving for, plus the ability to expand into the MTX Hard Disc, MTX Silicon and Floppy Disc CP/M operated systems. Systems that could provide up to 160 megabyte storage capacity. More power than you'll probably ever need, unless you take full advantage of the MTX's impressive system capabilities.

Systems hookup is as simple as every other MTX procedure. By merely plugging in the twin RS232C Serial interfaces and the Node software, sold optionally, you're ready to create a disc-driven interactive communications network (OXFORD RING®) that can link up to 255 units.

Software? You'll never worry about software availability with the MTX. Dozens of MTX-dedicated programs have already been created, supplementing the vast landscape of CP/M applications software currently available. And advance word of the MTX's technical capabilities has precipitated an MTX software "push" on the part of many leading software manufacturers.

Word Processing For $999 - A Look At A
Great Deal

Look first at the capabilities, then at the price. This is word processing the way it should be. Quick. Easy. Professional. A package that includes the MTX512; the powerful New Word,"™ word processing ROM cartridge; and the Memotech DMX80 correspondence quality printer. An exceptional value! And that brings us to the bottom line.

A Look At The Price

There's a very simple equation that covers the pricing of the MTX512.

The more engineering you put into a system, the less it will cost to produce. As you've already seen, the MTX is a pure product of advanced, innovative engineering. Which is why we can sell it for $595.

And why we can confidently back it up with a full one-year warranty.

Make no mistake. When you turn this page, you'll be returning to a world very different from this one.

A world in which all microcomputers will suddenly seem very different.

Suddenly very ordinary.

For more information about the MTX512, or to find out the location of the MTX dealer nearest you, contact Memotech Corporation, 99 Cabot Street, Needham, MA 02194; or phone (617) 449-6614.

MEMOTECH CORPORATION

CP/M is a trademark of Digital Research, Inc.
New Word™ is a trademark of New Star Software, Inc.
DMX80 correspondence quality printer suggested retail price $395
*DMX80 correspondence quality printer suggested retail price $395
**Suggested retail price.
THE DAY THE IBM® PC BECAME OBSOLETE.

It was a Monday in the autumn of '83:
The day they announced the Leading Edge® PC—a personal computer that's just plain better than the IBM® PC, at just about half the price.

The Leading Edge PC is faster (by more than 50%), more powerful, more flexible and more dependable (for example, our disk drives have a "mean time between failures" of 20,000 hours, versus an 8,000-hour MTBF for theirs). It's compatible with just about all the software and peripherals that the IBM is.

And unlike IBM's, ours comes complete with a high-resolution monitor, controller, seven expansion slots, serial port, parallel port, a time-of-day clock, double the standard memory (128K vs. 64K) plus hundreds of dollars worth of software to get you up and running immediately including MS-DOS version 1.25, GW Basic, and Leading Edge Word Processing™ (the most powerful WP. program ever created to run on an IBM-type personal computer). In short, the basic package comes to you complete and ready to work.

With IBM, on the other hand, you get charged extra for everything. Even for the PC DOS disk that makes it run (an extra $40)... and $170 just for the time of day (a calendar/clock that's standard with Leading Edge). In short, the basic package comes to you as a very expensive paperweight.

It's this simple: The Leading Edge Personal Computer is the first and only serious alternative to the IBM PC... and at only $2895 for the Leading Edge PC...

Get serious.

Now at 500 Leading Edge Dealers across the country. For the one nearest you, call toll free 1-800-343-6833. In Mass., call collect (617) 828-8150.
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IBM PC Software: the value of choosing

Size up the selection.

You'll find many types of programs in the IBM software library. They'll help keep you on your toes in the office, at home or in school.

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That's why it's altogether fitting that IBM Personal Computer Software offers you a choice.
programs that fit.

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Although every person isn't on equal footing when it comes to using personal computer software, there's something for almost everyone in the IBM software library.

For example, you may be on a shoestring budget and want a big selection of programs with small price tags.

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You may run a business requiring sophisticated inventory and payroll programs. Or you may run a business requiring a single accounting program.

You may write interoffice memos and want a streamlined word processing program. Or you may be a novelist looking for a program with features worth writing home about.

Now you can find IBM Personal Computer Software that fits — to help you accomplish specific tasks and reach individual goals.

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What's the next step?
Visit an authorized IBM Personal Computer dealer or IBM Product Center near you. To find out exactly where, call 800-447-4700. In Alaska or Hawaii, 800-447-0890.

Ask your dealer to demonstrate your choice of programs. Then get comfortable. Sit down at the keyboard and try IBM software on for size.

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IBM
Personal Computer Software
LETTERS

Kudos for Mims

I seldom write fan mail to authors but, since I have been a fan of Forrest Mims’s from the time I first read his books, I wanted to let you know how valuable his work has been and how we are planning to use the pressure sensitive resistors discussed in the “Project of the Month” of November 1982.

I work in an institution for severely mentally retarded/physically handicapped people, many of whom spend their days in wheelchairs. Because of the lack of sensation in the lower parts of their bodies, they don’t shift their weight when tissues begin to break down and therefore develop complications similar to bed sores.

Since many of the clients have various hip and spine deformities, the high-pressure areas when they sit are not always predictable. When we design cushions or wheelchair seats, it would help to have this information.

So we are working on a cushion made of approximately 260 small foam potentiometers. Using the comparator circuit in your article and some sort of monitoring device (a computer with video display or LEDs), we hope to get a visual presentation of the high-pressure areas on the client’s body and of the movement patterns and how they affect weight distribution.

—SCOTT A. ALLNER
New York, NY

Hey, Doc, Which Way Did the Glitch Go?

While working with my computer and a black-and-white monitor, I happened to be munching on a raw carrot. Suddenly, I noticed a faint glitch on the screen. Each time I took a bite of the carrot, another glitch was produced. Thinking the transient was due to mechanical vibration in the TV, I tried simulating the noise, but nothing happened. Checking for static charges, I stuck the probes of a VOM into the carrot and got 85 millivolts. Over a period of time, the polarity of this voltage changed from negative to positive. By inserting copper and zinc electrodes into the carrot, I measured 850 mV and this remained constant overnight. The output current measured about 50 microamperes. Several checks were made to determine whether the transient voltage was reaching the TV directly or through the computer. All indications point to the computer. The glitch is not serious but quite puzzling.

I plan to plant carrots this spring, wire them in series/parallel and use them as an alternate source of low-voltage energy for IC experiments.

—R. N. MUDDY
Wenatchee, WA

Have you tried celery? —Ed.

Strong Functionoid

Thanks for your mention of our functionoid in your March “Bits & Bytes.” Your readers might be interested to know that, while it has been designed for possible military applications to spare humans the dangers of the battlefield, it has commercial, industrial, and business applications as well. For the record, it can lift 2000 tons, the maximum 100 noted in your write-up.

—LES GOLDBERG
Odetics Inc.
Anahiem, CA

Electronic Mail

As noted in your article “From One Computer to Another” (March 1984), the electronic mail marketplace is undergoing tremendous change, with a variety of players vying for their respective shares of the market. Western Union, with its Easylink electronic mail, is one of the key players in the game. (This is in addition to Telex, Incom, and Teletex.) There are approximately 35,000 Easylink users in the U.S. By means of a wide variety of personal computers, communicating word processors, and intelligent terminals on Western Union’s network, these users can communicate with one another via the public telephone system.

—GUY B. PIERCE
Western Union Corp.
Upper Saddle River, NJ

Kaypro Hardware

In your review of the Kaypro 4 Plus 88 computer (March 1984), it was stated that plug-in expansion slots are not available. This is true but the following hardware can be used with piggy-back expansion methods: 16-bit 8088/8087 coprocessor conversion kit; external drives C & D add-on, 5-MHz CPU hop up kit; real-time clock kit; built in 300-1200 modem; 808K disk drive upgrade; 1M semiconductor disk (RAMdisk); 8" DS/DD disk drives; 640 x 256 pixel bitmap graphics; and external video monitor and hard disk drives.

—MELVIN F. PEZOK
Novato, CA
THE SANYO LINE OF SMALL BUSINESS COMPUTERS.

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An independent national survey has rated this Sanyo computer line in the top 20 for word processing capability.

So, whether you are writing a thank you letter to your aunt, a business letter to your partner, or a book for publication, Sanyo is here to help.

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FEATURE 1100/1150 1200/1250 4000/4050
Disk capacity per drive 320K 640K 640K
Bit/Ram 8/64K 8/64K 16/128K 256K
Number of Drives Single/Dual Single/Dual Single/Dual
Operating System CP/M80 CP/M80 CP/M86
CPU 280A 280A (Two) 8086/MS-DOS
Parallel Port STANDARD STANDARD STANDARD
Serial Port STANDARD STANDARD STANDARD
15 Function Keys STANDARD STANDARD STANDARD
12 inch Screen STANDARD STANDARD STANDARD
Detachable Ergonomic Keyboard STANDARD STANDARD STANDARD
PLUS FREE SOFTWARE TO GO WITH IT.

The 00 in the model number means single drive. The 50 indicates dual drive.

SANYO BUSINESS SYSTEMS CORP
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Keeping this robot army running calls for well-trained technicians...people who understand advanced systems and controls. By the end of the decade, conservative estimates call for more than 25,000 new technical jobs. These are the kind of careers that pay $25,000 to $35,000 a year right now. And as demand continues to grow, salaries have no place to go but up!

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Now, you can train for an exciting, rewarding career in robotics and industrial control right at home in your spare time. NRI, with 70 years of experience in technology training, offers a new world of opportunity in one of the most fascinating growth fields since the computer.

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Building this exciting robot will take you beyond the state of the art into the next generation of industrial robotics.

You'll learn how your completely self-powered robot interacts with its environment to sense light, sound, and motion. You program it to travel over a set course, avoid obstacles using its sonar ranging capability. Program in complex arm and body movements using its special teaching pendant. Build a wireless remote control device demonstrating independent robot control in hazardous environments. You'll even learn to synthesize speech using the top-mounted hexadecimal keyboard.

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EDITORIAL

OF MICROS
AND MAINFRAMES

The article “Getting Mainframe Data to Micors” by Jan Gugliotti and Elliot Weitz in this issue of C&E has set me thinking about those two classes of machines. Like anyone who has been in computing for a fair number of years, I got my start on mainframes. In those days, they were the only game in town and so were simply called computers. Big expensive things they were, and only the privileged could go near them, much less submit decks of cards for batch runs.

The advent of timesharing systems in the early seventies made computers more accessible and can in many ways be considered the start of personal computing. Gone were the hours of waiting to get your batch run back only to find that one card had a spelling mistake and the job had to be resubmitted. Gone too was the arcane JCL (Job Control Language) that accompanied every job and constituted one’s interaction with the operating system. Advanced languages for end users rather than programmers became available, making it easier for even larger numbers of people to use and benefit from computers.

As the widespread use of microcomputers and the explosive growth of easy-to-use software for them have carried this trend one step further, micros have proliferated to such a degree that large businesses are facing some serious dilemmas about connecting them to corporate mainframes for purposes of sharing data or computing resources. Gugliotti and Weitz discuss the issues involved here quite ably. I would like to discuss two related issues.

---

**Micros vs Mainframes**

As micros get more powerful, it will be harder to define how they differ from mainframes. Of course, we will continue to think of IBM’s biggest machines, like the 3081, as mainframes and its smallest machines, like the PCjr, as micros. But for other machines, the distinctions have begun to blur.

Let me cite a number of examples. Microcomputers can now provide around a megabyte of main memory and around 100 megabytes of disk storage, figures which are growing rapidly. Microprocessors with true 32-bit performance and virtual memory management will greatly enhance microcomputer processing power in the near future. As local area networks and supporting software become more prevalent, micros will begin replicating the shared databases and communications now available only on mainframe computers.

On the software side, operating systems for micros are gaining multitasking and multiuser capabilities, just like the operating systems for the big guys. Indeed, Unix may soon be running on everything from microcomputers to the largest mainframes. Similarly, applications software is rapidly growing in sophistication. In fact, mainframe software considerably lags that for micros when it comes to ease of use.

A machine that personifies these blurred distinctions between micros and mainframes is the IBM PC-XT/370. In addition to running PC-DOS, the XT/370 runs a version of IBM's mainframe operating system VM/CMS and can use a half megabyte of real memory and up to four megabytes of virtual memory. That is enough horsepower for a goodly number of existing mainframe applications.

---

**The Future of Mainframes**

These observations on the fuzzy line between micros and mainframes lead one to wonder what the future of mainframes will be. It seems safe to predict that the actual number of mainframes in existence will probably remain fairly stable in the coming years, but they will contribute an ever smaller percentage of the world's available computer power.

Mainframes will continue to be of great importance because of their unique abilities in carrying out certain specialized tasks. For one thing, their sheer processing power is essential for work that requires a lot of number crunching, like sophisticated computer graphics or animation, or that requires vast amounts of real memory. Similarly, mainframes will continue to be required for managing massive, shared data banks.

There is also a compelling business reason for corporations to go on running mainframes, as Jan Gugliotti has pointed out to me. The software that is used to run corporate America represents an enormous investment of money and man-years and virtually all of it is built to run on mainframes. Much of it isn't even that well understood by the companies using it, having been written by programmers who have long since moved to other positions without leaving behind very good documentation. Even the richest companies cannot afford the cost, to say nothing of the risk, associated with converting this software legacy to run in a new and incompatible environment.

---

**Getting it all Together**

I hope that at some point true distributed processing will be the order of the day. Then end users will no longer have to worry about which type of computer to use for a given task. Instead, the user will sit at a workstation that is his gateway to a network composed of many different computers and data bases. When he wants to accomplish a given task, he will simply enter a request and the network will decide which processors and data bases are best used to get the job done. Distinctions between micros and mainframes will no longer be a major concern for most of the world.
Radio Shack Presents the Transportable TRS-80®

The New Model 4P Computer—From the World’s Largest Computer Retailer

The Computer for Today’s Upwardly Mobile Society
If you’re headed for success, our newest TRS-80 can help you get there in record time. The Model 4P is a compact, disk-based desktop computer with a big difference: it has a handle. So wherever your work may take you, you can get a handle on scheduling problems, ever-changing sales projections, and last minute reports. It’s like having your office with you on trips, at home—anywhere!

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Prices apply at participating Radio Shack stores and dealers. CP/M Plus is a trademark of Digital Research.

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Send me Your free TRS-80 Computer Catalog today!

AmericanRadioHistory.Com
Introducing Macintosh.
What makes it tick. And talk.

Well, to begin with, 110 volts of alternating current.

Secondly, some of the hottest hardware to come down the pike in the last 3 years.

The garden variety 16-bit 8088 microprocessor:
Macintosh's 32-bit MC68000 microprocessor

Some hard facts may be in order at this point:

Macintosh's brain is the same blazingly-fast 32-bit microprocessor we gave our other brainchild, the Lisa Personal Computer. Far more powerful than the 16-bit 8088 found in current generation computers.

Its heart is the same Lisa Technology of windows, pull-down menus, mouse commands and icons. All of which make that 32-bit power far more useful by making the Macintosh™ Personal Computer far easier to use than current generation computers. In fact, if you can point without hurting yourself, you can use it.

Now for some small talk.
Thanks to its size, if you can't bring the problem to a Macintosh, you can always bring a Macintosh to the problem. (It weighs 9 pounds less than the most popular "portable").

Another miracle of miniaturization is Macintosh's built-in 3½" drive. Its disks store 400K—more than conventional 5½" floppies. So while they're big enough to hold a desk full of work, they're small enough to fit in a shirt pocket. And, they're totally encased in a rigid plastic so they're totally protected.

And talk about programming.
There are already plenty of programs to keep a Macintosh busy. Like MacPaint™, a program that, for the first time, lets a personal computer produce virtually any image the human hand can create. There's more software on the way from developers like Microsoft, Lotus™, and Software Publishing Corp., to mention a few.

And with Macintosh BASIC, Macintosh Pascal and our Macintosh Toolbox for writing your own mouse-driven programs, you, too, could make big bucks in your spare time.

You can even program Macintosh to talk in other languages, like Yiddish or Serbo-Croatian, because it has a built-in polyphonic sound generator capable of producing high quality speech or music.

All the right connections.
On the back of the machine, you'll find built-in RS232 and RS422 AppleBus serial communication ports. Which means you can connect printers, modems and other peripherals without adding $150 cards. It also means that Macintosh is ready to hook in to a local area network. (With AppleBus, you will be able to interconnect up to 16 different Apple computers and peripherals.)

Should you wish to double Macintosh's storage with an external disk
drive, you can do so without paying for a disk controller card— that connector's built-in, too.

There's also a built-in connector for Macintosh's mouse, a feature that costs up to $300 on computers that can't even run mouse-controlled software.

One last pointer:

Now that you've seen some of the logic, the technology, the engineering genius and the software wizardry that separates Macintosh from conventional computers, we'd like to point you in the direction of your nearest authorized Apple dealer.

Over 1500 of them are eagerly waiting to put a mouse in your hand. As one point-and-click makes perfectly clear, the real genius of Macintosh isn't its 32-bit Lisa Technology, or its 3½" floppy disks, or its serial ports, or its software, or its polyphonic sound generator. The real genius is that you don't have to be a genius to use a Macintosh. You just have to be smart enough to buy one.

Soon there'll be just two kinds of people. Those who use computers. And those who use Apples.
LES SOLOMON ON

COMPUTER HARDWARE

LOGIC IS OUR BUSINESS AND BUSINESS COULD BE BETTER

Those of us in the computer business pride ourselves on being pretty sharp when it comes to hardware and software.

We tell ourselves, and other people, that we are successful because we are so logical and fully understand a problem before we attack it.

Taking a look at the wealth of super hardware that is currently available and the abundance of great software that is obtainable to support it, I guess we're doing pretty well. The industry is certainly thriving and we can do great things with the devices and programs that we have. It all seems logical and well-planned. However, Lord help the person who buys one of our wonderful products and tries to figure out how to use it by reading accompanying instruction manuals, for this is where the logic of the people who run this business appears to fall apart. It is the one area that seems to defy our clear thinking; and if it is neglected, it may well cause problems.

I am talking about technical manuals written in English by technically oriented Americans. These are the manuals that come with over-the-counter computers, plug-in boards, and other peripherals. They also accompany most software packages.

Help!

Maybe I am naive, but I have always felt that an instruction is supposed to help the user. Unfortunately, like too many others, I tend to turn to the manual only as a last resort. But what do I do when the manual is more confused than I am?

If you don't know what I am talking about, you probably haven't bought a new piece of equipment recently. If you have—be it hardware or software—the odds are pretty good that you may have been somewhat puzzled as to how to use the manual, much less the equipment. Even when you think you know what is going on, you wonder, "What the heck does that paragraph on page 33 have to do with what's on the rest of the page?"

It seems that the writing specifications used by too many manual writers are based on the fog index—sometimes known as the "look how smart I am" syndrome. The source of the problem (and this is even more disturbing) may also be that the instruction manual wasn't even considered until the last possible minute before the product was shipped and so it wasn't written to any specifications at all.

A Word to the Source

Manufacturers, please have a heart. You spend so much time and money designing a beautiful new product and advertising it; please spend a little more time looking at the user manuals that accompany your product. Manuals are your interface with the customer in his home or place of business. They should not be considered to be simply a necessary evil that is relegated to creation and printing during the last week before shipping the product.

Even if you have the best product in the history of mankind, if a customer can't get it up and running in a reasonable time, he may speak badly of you and your product. And he shouldn't have to make phone calls to ask how to hook it up or to find out what he's supposed to do with some extraneous piece of stuff. If he gets it going, likes the way it works, and can understand your instructions, he will be happy and he will tell others, about it.

Word-of-mouth is good (and free) advertising. On the other hand, it can be disastrous if it is negative.

If you are a manufacturer of any computer products that require a manual, take one of them right now and start at page one. Put yourself in the position of a first-time reader—one who doesn't have your computer expertise and is trying to get your product to work as you claim it does in your ads. Remember, the customer paid good money to be helped, not confused.

Another possibility—and a good one—for the manufacturer is to get a nontechnical person to read the user manual. Obviously, the technical level of the manual reviewer should be representative of your typical customers. The reviewer shouldn't be one of the guys who works on development product.

Try it out. Pass your manual around for reading before shipping it with your product. You may be surprised at some of the questions that will be asked by readers of your "simple to understand" manual.

The Foggy Outlook

As I sat down to write this column, I was prepared to illustrate my point with some examples of the foggy impressions I had gleaned from manuals accompanying recently purchased equipment. But the more of these books I looked at, the more confusion I found.

Then I thought, "Maybe it's just me. I'll ask around." Well, I found that a lot of other people agree with me. In fact, at one computer store, I started a very lively discussion just by asking, "And what did you think about the manual?"

Of course, I must point out that not all manuals are confusing. There are still a few companies around that care. But there are so many that make the picture very cloudy that I decided that it would be unfair to single out a few to pick on. Go ahead and read the manuals and make up your own mind.

Illustration by Raquel Balin

16 Computers & Electronics
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High-Technology is a growth industry. The evidence is clear, and most observers predict a steady expansion due to a relatively strong flow of investment capital into computers, electronics and precision instruments. Sales of computers alone will reach an estimated ten million units this year. This means challenges and new employment opportunities, especially in servicing and maintenance. Computer servicing skills can best be learned by working directly on field-type equipment. NTS electronic hardware is selected and developed especially for the training program with which it is associated. You learn by doing, by assembling, by performing tests and experiments, covering principles of computer electronics, microprocessor troubleshooting, and circuitry.

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NTS offers three programs in computer electronics. You will receive training covering solid-state devices, digital logic circuitry, and the fundamentals of the computer itself. Instruction includes micro-control technology and detailed operation of microcomputers. These courses will prepare you for entry-level in many facets of the computer industry such as field service and customer engineering as well as programming. In addition to written texts your course includes the NTS/HEATH disc-drive computer which you assemble as part of the training process. The assembly and use of the computer will serve to reinforce practical application of principles.
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The field of industrial and microprocessor technology encompasses the application of electronic microprocessor control principles. Your course takes you from fundamentals of digital electronics and associated circuitry through the application of the microprocessor as a control device. You will learn how to move and manipulate instructions and information. The microprocessor trainer included in your course is a microcomputer system designed as a practical tool for learning the use of software and hardware techniques utilized in the linking of microprocessors to various systems.

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Rumors & Gossip

- Radio Shack is expected to shortly introduce the Model 200 Portable Computer, an upgraded version of the popular Model 100. Reportedly, it will be identical in size to the 100, have an 8 line by 80 character display and offer some IBM-PC compatibility. Samples of Zilog's new Z800 and Z80,000 microprocessor chips will not be available until late this year. The Z800 is a greatly enhanced version of the popular Z80-bit microprocessor; the Z80,000 is a new 32-bit microprocessor. Details on both chips appeared previously in this column. Digital Research will reportedly augment their recent contract to port Unix System V to the Intel IAPX family with an agreement to add such productivity tools as graphics, additional languages and a library of applications packages. Also expect Digital Research this month to announce 10 to 15 consumer-oriented applications packages to run under its new Personal CP/M system. They will be sold via mass merchandisers. The first Japanese home computers using Microsoft's MSX operating system will probably be introduced at next month's Consumer Electronics Show in Chicago, where dealers will be placing orders for the Christmas buying season. Expect machines by Matsushita and Toshiba and by U.S. maker Spectravideo. Look for NEC to soon introduce a battery-operated disk system for its knee-top computer. And Data Corp., Dallas TX to introduce a similar product for the Radio Shack and NEC machines. NEC is also rumored to be readying a new computer with MAC-like characteristics. Spectravideo is expected to introduce next month a knee-top portable with an 80-column display that is compatible with the Radio Shack and NEC machines, and to offer CP/M and MS-DOS as optional operating systems. Summer introductions of knee-top machines with 80 column displays should also come from TI, Casio, Radio Shack, Compaq and Commodore.

New Flat-Panel Display Technology Yields Color & 3-D

- Binary Star Inc., Bellevue, WA, has disclosed details of their new flat panel display. It is less than a half inch thick and capable of producing high-resolution color and 3-D at prices competitive with CRTs. The display consists of single or multiple transparent substrates, containing color filters and incandescent light elements that are sandwiched between glass faceplates. The tungsten light elements are smaller than grains of sand, have little thermal inertia, and develop little heat. Each element requires about 0.1 mW at 5 V and brightness is over 20 times that of a conventional CRT. There can be over a million elements on a panel. Multi-level color displays which provide true three dimensional images have already been constructed by Binary Star for military use. The company also claims to have developed low cost drive electronics.

IBM Announces Unix For PC

- As previously rumored in this column, IBM has introduced a single-user Unix operating system for the PC/XT. But the big surprise is that they did not go with Microsoft's Xenix. Instead they chose to have Interactive Systems Corp., of Santa Monica, CA transport their implementation of Unix for VAX machines to the PC. The operating system will be called "Personal Computer Interactive Executive" or "PC/IX." There is no doubt that this is a precursor of multiuser versions of Unix for other IBM machines.

ISSCC Features Papers On New IC Devices

- At the International Solid State Circuits Conference held in San Francisco in February, papers were presented on many new IC devices currently in development. Fujitsu, Hitachi and NEC described their new 1-megabit dynamic RAM chips. The NEC chip was organized as 128K x 8.

Stanford University, the University of California at Berkeley, and Digital Equipment Corporation presented papers on new 32-bit microprocessors. The SU unit is a pipelined NMOS device. The Berkeley device featured a reduced instruction set.

Other devices described at the conference were new image sensors, GaAs circuits, data acquisition, high-speed analog and data processing circuits, dedicated signal processors, non-volatile memories, and many others.

IBM Sues Two Rivals On PC-ROM Copyright

- IBM filed copyright-infringement suits against Corona Data Systems and Handwell Corp, charging they copied the software contained IBMPC BIOS ROM and used it in "look-alike" machines. The companies quickly reacted...
by agreeing to cease marketing machines that use the chip. Handwell is a California importer of Taiwanese machines.

Setting an industry precedent, Apple computer has filed suits against more than 50 companies (most outside the U.S.) charging similar copyright infringement. One case, against the U.S. micro manufacturer, Franklin Computer, dragged through the courts for over two years. Apple finally won and Franklin agreed to cease producing the chips and pay Apple damages. Nonetheless, there has been a virtual flood of Apple II computer copies arriving from Taiwan, Korea and Europe. The U.S. customs service has confiscated many, but a substantial number have slipped through. Thus, it is common to see Apple II clone computer kits being sold at computer hobbyist flea markets for about one third the list price of Apple's machine. The same may happen with the IBM PC.

Unix News

- Motorola has announced the completion of its port of AT&T Unix System V to the 68000 microprocessor and has submitted the product to Bell Labs for final acceptance testing. Motorola is the first semiconductor manufacturer to do this. Intel, National Semiconductor and Zilog also signed agreements with AT&T to port Unix System V but have not as yet completed their ports. Intel has entered into an agreement with Digital Research to have them to do the port to the 80286.

- Microsoft and National Semiconductor have announced that the Xenix operating system will soon be available for the National Semiconductor 16032 and 32032 microprocessors.

Predictions

- Industry prognosticators predict that IBM will manufacture between 1.5 and 2 million IBM PCs this year. If they can do it, then by the end of the year 2.3 to 2.8 million IBM PCs will be in operation. Thus, the number of IBM PCs will have exceeded the number of Apple II machines sold and will approach the number of Commodore C-64 machines sold. Of course, in dollar terms IBM-PC sales are almost equal to the combined sales of both the Apple II and C-64.

Motorola And DRI Announce Software Agreement

- Motorola has announced its commissioning of Digital Research to implement Concurrent CP/M, with windows, on the 68000 and to implement its family of languages to run under Concurrent CP/M-68K and Motorola's new version of Unix Version V. This arrangement should allow software developers to easily port source code applications programs developed using DRI's C, Pascal MT+, CBasic, Fortran 77, and PL/I languages between the IBM PC running either PC-DOS or CP/M-86 and 68000-based systems running either CP/M-68K or Unix Version V. Purportedly, Digital will complete the project by year-end and the software packages will be sold by both Motorola and DRI.

Random News

- Digital Research and Coleco have announced an agreement for Coleco to implement Personal CP/M in ROM for the Coleco Adam home computer. There are reports that prices on 256K RAM chips, which are still in very limited supply, have already dropped over 50% from their initial $110 prices to $58. Further price decreases are expected this year as availability increases. Thus, we may see the devices being used in personal computers before the end of the year. Amiga Corp., Santa Clara, CA, a maker of peripherals for video games, has announced that this fall it will introduce a 68000-based home computer with 128K of RAM and a 320K disk drive that it expects will retail for under $700.
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THE COMPUTER SCIENTIST

EXPERIMENTING WITH COMPUTER ART

THOUGH pen plotters are primarily used to generate hard-copy business, engineering, and scientific graphics, many users enjoy programming their machines to create multicolored pen and ink compositions. The results, which we'll refer to as plotter art, can be intricately complex and spectacularly beautiful.

First-time plotter users are usually surprised to discover that striking examples of plotter art can be created by relatively simple programs. Considering the very high resolution of most pen plotters (up to 0.001 inch), the possibilities for plotter art programs are essentially endless.

Types of Plotter Art

Most programs for creating plotter art are based on one of the following:
1. Mathematical formula
2. Random number generation
3. Man-machine interaction
4. Sketch/paint manual control mode

I've used several different computers and a high-resolution HP7470A plotter to explore all of these categories. While the specific programs and art that accompany this column were generated with a Radio Shack TRS-80 Model 100, the programs can be easily revised for many other computers. Other plotters can also be used simply by revising the lines containing plotter instructions.

Each program includes a line that opens a file for establishing the computer-plotter communications protocol.

For the Model 100-HP7470A combination, the line is: OPEN "COM.48N2E" FOR OUTPUT AS 1. Each program also contains a line that closes the opened file when the program is complete.

As you experiment with plotter art, you may sometimes find that, when a program that's been temporarily stopped is restarted, the plotter fails to respond or begins plotting in an incorrect location. The plotter may also neglect to retrieve a pen from its stall, thereby producing lots of action but no drawing.

These problems can usually be eliminated by stopping the program and either sending the plotter a default command or switching it off and then back on. Now, when the program is run from the beginning, the correct plotter protocols will be reestablished and the plotter should perform properly.

Astroid and the beauty of The Four- Leaved Rose are enough to attract even those artists intimidated by the simplest formula.

Jerry O'Dell, a professor of psychology at Eastern Michigan University, is an expert at converting mathematical equations into plotter art. Professor O'Dell has described some of his work in 80 Microcomputing ("The Artful Plotter," September 1983). One of his more striking creations is an eight-leaved rose made by superimposing two offset four-leaved roses.

Figure 1 ("Spectralipse") is a three- color example of a modified eight-leaved rose generated by the program in Listing 1. The lines that draw the rose (130-220) are adapted from a program given in Professor O'Dell's article.

I've selected Spectralipse as an initial example of plotter art since it nicely illustrates some of the practical problems that may befall the novice plotter artist. The first is time. Plotters draw straight lines very fast, but curves require considerably more time, particularly when each tiny increment is calculated in BASIC. This explains why the HP-7470A required slightly more than one hour to draw Spectralipse.

Another problem is color selection and availability. Note that Listing 1 provides only two pen selections. Since the plotter works so slowly, pens of other colors can be placed in the unoccupied stall while the plotter is drawing.

Caution: Be sure to use care when substituting pens while the plotter is operating. Blocking the pen carriage or placing a pen in the wrong stall or in both stalls may damage the plotter.

Making plots with more than two colors is simplified by using plotters having three or more pens. In any case, the paper upon which the pens draw will be subjected to considerable stress when a complex figure having a common origin is drawn. Multiple layers of ink laid down over the origin and other intersections can soak through the paper and cause stains. Furthermore, excess ink can so soften the paper that it can be torn by pen motion.
This problem can be alleviated by using a good grade of coated plotter paper and by placing strips of transparent tape behind trouble spots on the back side of the paper. If these precautions don’t solve the problem, you may have to manually execute a Pen Up command from the plotter’s control panel each time the pen reaches a potentially soggy intersection. A more complicated but even better alternative would be to revise the program to automatically lift the pen over potential problem areas.

Random Art

To create the modified eight-leaved rose in Fig. 1, the computer followed a precise set of instructions that transformed the relevant equation into a hard-copy graph. In other words, the computer processed the instructions, calculated the plotter coordinates, and controlled the plotter. Therefore, the general appearance of the end result was known before the plotter drew the first line.

The random number function of most computers makes possible the creation of plotter art with a final appearance which cannot be planned or predicted in advance. Figure 2 (“Connections”), for example, was made by instructing the plotter to draw an asterisk at thirty random locations. By keeping the pen in the down position while it was moved to the next random point, all the asterisks were linked by a continuous line. The pen was changed after each ten asterisks to make the composition more colorful.

As you can see by referring to Listing 2, the program that draws Connections is very simple. Line 60 establishes a plotting window, outside of which the pen will not move. This leaves a blank strip along the bottom of the drawing for a title and byline. Line 60 also scales the plotter.

Line 70 specifies the size of the asterisk (0.5 x 0.5 centimeters) and selects the plotted character (*). Both the character and its dimensions can be easily changed.

Lines 80-110 select the random numbers used as coordinates for two successive random locations.

The program in Listing 3 is a modified version of the previous program. It produces the interesting pattern in Fig. 3 (“Asterisk Mosaic”). Like Listing 2, it draws asterisks at randomly selected locations. But they are much larger (10 x 10 centimeters; see line 100) and are oriented according to their location (see line 110). The program draws forty asterisks in two colors.

Figure 4 (“Asterisk Flats”) is a variation of Fig. 3. Here, the random character rotation command (line 110 in Listing 3) is omitted. The remainder of the program is unchanged.

Figure 5 (“Arrows”) shows one possible result of an additional revision to Listing 3. Here, the asterisk in line 100 is replaced by the “greater than” symbol (>). Also, the dimensions of the symbol are controlled by a third random number instruction contained in a new program line. Here are the two lines added to Listing 3 to create “Arrows”:

90 T=RND(1)*8
100 PRINT #1, “SM>SI”

Interactive Plotter Art

The programs in Listings 1-3 have a mind of their own. Though some of their parameters can be varied, when these programs are run, they draw without operator intervention.

Interactive plotter art programs allow you to revise drawing parameters as the plotter draws. This allows a relatively simple program such as Listing 4 (“Do-It-Yourself”) to produce plotter art having amazing diversity.

When Do-It-Yourself is run, the computer display asks “A,B,C,D?” (line 100). The four numbers entered by the user are then used as plotter coordinates in line 110. After the pen draws the figure, using the coordinates (see line 110), the computer asks for a new set of values, and the cycle is repeated.

Figure 6 (“Interconnected Triangles”) is a simple example of interactive plotter art. This composition was produced by running Listing 4 and making the following entries:

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
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<tbody>
<tr>
<td>90</td>
<td>100</td>
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<td>120</td>
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<tr>
<td>100</td>
<td>110</td>
<td>120</td>
<td>130</td>
</tr>
<tr>
<td>(change pen)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>130</td>
<td>120</td>
<td>110</td>
<td>100</td>
</tr>
<tr>
<td>120</td>
<td>110</td>
<td>100</td>
<td>90</td>
</tr>
</tbody>
</table>

Adding more entries and changing the starting point will give a diagonal string of interconnected triangles. Reducing the step size will reduce the size of the individual triangles and allow more to be drawn.

Modifying the sequence, order and step of the A,B,C,D inputs of “Do-It-Yourself” can provide an amazing diversity of compositions. Figure 7 ("Counterpoints"), for instance, is a pair of back-to-back, stepped sequences of triangles. Counterpoints was drawn by making the following entries into “Do-It-Yourself”:

<table>
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<tr>
<td>(change pen)</td>
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<td>95</td>
</tr>
</tbody>
</table>

(Continued on page 32)
Now A 16-Bit Microcomputer Designed To Expand Your Knowledge.
Here's How You Can Learn 16-Bit Technology. And Graduate To One Of Today's Most Powerful And Advanced Microcomputers.

Now you can master 16-bit technology with an all-new Advanced Microprocessor course. And build hands-on experience with the only 16-bit microcomputer specifically designed for the hobbyist, working engineer and student.

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A unique combination of design features makes this versatile microprocessor system much more than a "teaching machine." Use it as a trainer with the Advanced Microprocessor course. Use it as an experimental design computer. And use it to run a wide variety of 16-bit software—including Z-Dos, Multician, Z-Basic, Condor File Manager, and much more.

In its most basic form, the Trainer/Learning Computer is a 16-bit, cassette-based microcomputer. Its unique design features access ports and solderless breadboards to allow you to build interfaces, design and modify circuits, or simply experiment with the inner workings of the microprocessor system. The basic system has an 8088 processor, 32K ROM (including assembler, editor and debugger) and 16K RAM.

The unit also features a serial I/O printer port, cassette interface and a detached 95-key keyboard (including 16 function keys and a numeric keypad) which generates a full ASCII character set. It's available either in kit form or factory assembled.

And you can take advantage of the system's H/Z-100 computer design heritage by easily upgrading it to a disk-based, 16-bit microcomputer that will run H/Z-100 series software and many other forthcoming programs.

**Fully Upgradeable**
The powerful upgrade package and variety of accessories allow you to make the basic 16-bit system more powerful and versatile. You can add 128K or 192K bytes of RAM. Floppy disk controller, 48TPi double-sided, double-density single or dual floppy disk drive. Bit-mapped video graphics or full-color graphics. Two RS-232 ports. Programmable timer. And a Centronics-compatible printer port.

**Learn on it. Des gn with it. Use it as a 16-bit computer.**
It's the only 16-bit microprocessor system specifically designed to integrate theory with a hands-on understanding of how 16-bit computers work. And it's from Heathkit/Zenith Educational Systems, the world-leader in problem-solving courses, trainers and accessories to help you learn state-of-the-art technology.

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A very different array of triangles is shown in Fig. 8 ("Prisms"). Actually, only the smallest figure is a triangle. The remainder are four-sided figures having a common off-axis side. The unintended result is that all these figures appear to have part of one side blocked by the triangle. The visual effect is the masking of so-called hidden lines. "Prisms" was produced by entering this sequence into "Do-It-Yourself":

```
A  B  C  D
40 50 60 70
40 50 60 75
40 50 60 80
... ...
40 50 60 130
```

"Prisms" is prettier if you change the pen color between entries.

A very different product of "Do-It-Yourself" is Fig. 9 ("Acceleration"). Resembling an impossibly stylized swept/delta-wing aircraft, "Acceleration" requires a more complex series of entries than Figs. 6-8:

```
A  B  C  D
70 80 90 100
65 85 85 105
60 90 80 110
... ...
40 110 60 130
```

Figure 10 ("Spacewarp") is among the most spectacular and complex drawings I've coaxed from "Do-It-Yourself." Look closely and you'll see a four sided polygon rotated in uniform increments inside a square. All the lines are perfectly straight, but when viewed together they form four distinctive arcs.

Spacewarp is identical in appearance to a popular string art design. The computerized version is just as pretty and much easier to make. Here are the entries:

```
A  B  C  D
150 150 10 10
150 140 10 20
150 130 10 30
... ...
150 20 10 140
```

To produce many other kinds of drawings. The modifications can be as simple as lifting the pen between two adjacent coordinate pairs to provide a three-sided figure when a four-sided one would otherwise have been drawn. Figure 11 ("Arcle") is a good example. This figure was produced by revising line 90:

```
90 PRINT #1, "PA","AB","PD","BC",CD,DA,"PU","A,B;"
```

Here are the entries that produced "Arcle":

```
A  B  C  D
10 150 150 150
20 150 140 150
30 150 130 150
```

Do-It-Yourself can be easily modified.

---

**Fixed "Interactive" Plotter Art**

Many kinds of plotter art can be planned in advance using graph paper. Test programs can then be run and simple modifications made until a desired effect is achieved. Since revisions to such programs require only a few seconds, they can be considered interactive.

Figure 12 ("Trispangle") is an example of a drawing that was perfected by making minor modifications to a program during a series of trial runs. The program is given in Listing 5. The two-color, offset effect was achieved by first making an initial plot and then changing pens. The paper was then moved slightly away from its initial position, and the program was run a second time.

**Manually Controlled Plotter Art**

It's fairly simple to develop programs that cause a plotter's pen to follow the movements of a joystick or cursor control keys. With such programs you can create an electronic version of the Etch-A-Sketch toy. Though I've experimented with manual control programs, the results have not been nearly as appealing as the plotter art generated by using the other methods outlined above. Nevertheless, you may wish to explore this approach on your own.

**Titling Your Creations**

I would not be surprised to see a market develop for good examples of plotter art. In any event, examples of plotter art make nice gifts for friends and relatives, especially those who have glared at your computer and asked "What do you use it for?"

Listing 6 will let you label your creations with a title and your name. You can even include a copyright notice, serial number or other information.

The PA (Plot Absolute) coordinates in line 100 determine where the pen will begin labeling your title. The spaces after TS in line 110 determine the distance between the last letter of your title and your copyright notice.

Of course you can alter these parame-
Plotter Art Listings

Listings below were used to draw the plots in Figs. 1 through 12

**LISTING 1**

10 'SPECTRALiSPE
20 'FOR MODEL 100 AND HP7470 PLOTTER
30 'LINES 150-220 ADAPTED FROM "ROSE
PROGRAM"
40 'BY JERRY O'DELL (80 MICRO, 9/83)
50 CLS
60 PRINT "SET P I. TO CENTER OF PAPER."
70 FOR N = 1 TO 500: NEXT N
80 PRINT "PRESS R TO RUN."
90 IF INKEYS = 'R' THEN 80 ELSE 70
100 OPEN "COM.48N2E" FOR OUTPUT AS 1
110 PRINT #1,"50,500,5,000;"
120 PRINT #1,"SP1;"
130 S = 100
140 REM SIZE OF INITIAL ROSE
150 P = 10
151 REM NUMBER OF PETALS/2
152 R = 25 + S
153 REM DEGREES IF ONE RADIAN
154 FOR N = 1 TO 10
155 REU NUMBER OF ROSES
156 S = S + 15
157 REM SIZE OF NEXT ROSE
158 FOR N = 1 TO 360: NEXT N
159 REM PLOTTING INCREMENT
160 Q = I/RA
161 FOR N = 1 TO 20
162 PRINT R*SIN(Q)
163 PRINT R*COS(Q)
164 GOTO 160
165 REM PLOTTER'S X 
166 FOR N = 1 TO 20
167 PRINT R*SIN(Q)
168 PRINT R*COS(Q)
169 GOTO 160
170 PRINT "DONE."CLOSE #1:END

**LISTING 2**

10 "CONNECTIONS"
20 "COPYRIGHT 1984 BY FORREST M.
MIMS, III
30 'FOR MODEL 100 AND HP7470 PLOTTER
40 CLS
50 OPEN "COM.48N2E" FOR OUTPUT AS 1
60 PRINT #1,"1W250,500,10250,7479;50,100;SP1;"
70 PRINT #1,"513,5535;"
80 R = RND(1)*100
90 S = RND(1)*100
100 T = RND(1)*100
110 U = RND(1)*100
120 N = N + 1:PRINT N
130 IF N = 10 THEN PRINT #1, "SP2;"
140 IF N = 20 THEN PRINT #1, "SP1;"
150 IF N = 30 THEN PRINT #1, "SP0;"
160 IF N = 30 THEN CLOSE #1:END
170 PRINT #1,"PD;"
180 PRINT #1,"PA,R,S;PD,T,U;"
190 GOTO 80

**LISTING 3**

10 'ASTERISK MOSAIC'
20 'COPYRIGHT 1984 BY FORREST M.
MIMS, III
30 'FOR MODEL 100 AND HP7470 PLOTTER
40 CLS
50 OPEN "COM.48N2E" FOR OUTPUT AS 1
60 PRINT #1,"1W250,500,10250,7479;50,100;SP1;"
70 R = RND(1)*100
80 S = RND(1)*100
90 PRINT #1,"1W150,510,510,510;SM*510,10;"
100 PRINT #1,"1D,R,S;"
120 PRINT #1,"PA,R,S;"
130 N = N + 1:IF N = 20 THEN PRINT #1, "SP2;"
140 IF N = 40 THEN PRINT #1, "SP0;"
150 IF N = 40 THEN CLOSE #1:END
160 GOTO 70

**LISTING 4**

10 "DO IT YOURSELF"
20 "COPYRIGHT 1984 BY FORREST M.
MIMS, III
30 'FOR MODEL 100 AND HP7470 PLOTTER
40 CLS
50 PRINT "PRESS Q TO QUIT."
60 FOR N = 1 TO 500: NEXT N
70 OPEN "COM.48N2E" FOR OUTPUT AS 1
80 PRINT #1,"513,5535;"
90 PRINT #1,"513,5535;"
100 INPUT "A,B,C,D;A,B,C,D"
110 PRINT #1,"PA,A,B,PD,B,C,C,D,D,
A,A,B,PU;"
120 FOR X = 1 TO 500
130 IF INKEYS = "Q" OR INKEYS = "q" THEN
140 NEXT X
150 GOTO 70
160 PRINT #1,"SP0;"
170 PRINT "DONE."CLOSE #1:END

**LISTING 5**

10 'TRISPANGLE
20 "COPYRIGHT 1984 BY FORREST M.
MIMS, III
30 'FOR MODEL 100 AND HP7470 PLOTTER
40 CLS
50 OPEN "COM.48N2E" FOR OUTPUT AS 1
60 PRINT #1,"513,5535;"
70 PRINT #1,"513,5535;"
80 INPUT "A,B,C,D;A,B,C,D"
90 Y = 50
100 FOR X = 0 TO 50 STEP 10
110 Y = Y + 5
120 PRINT #1,"PD,PA,X,Y,Y,X;END
130 NEXT X
140 Y = Y + 5
150 FOR X = 50 TO 100 STEP 10
160 Y = Y + 5
170 PRINT #1,"PD,PA,X,Y,Y,X+10;50,50;"
180 NEXT X
190 PRINT #1,"SP0;"
200 CLOSE #1:END

**LISTING 6**

10 'TITLE LINE AND COPYRIGHT NOTICE
15 'FOR MODEL 100 AND HP7470 PLOTTER
20 CLS
30 OPEN "COM.48N2E" FOR OUTPUT AS 1
40 PRINT "PEN 1 SHOULD BE BLACK WITH
0.3 MM TIP."
50 PRINT ""
60 INPUT "WHAT IS THE TITLE?"T5
70 PRINT "ARE YOU SURE (Y OR N)?"
75 AS = INKEYS: IF AS = "N" THEN
70 ELSE AS = "y" THEN 60
80 IF AS = "y" OR AS = "Y" THEN 60
90 IF AS = "y" OR AS = "Y" THEN 100
100 PRINT #1,"1S1.15;SP1;IP,PA15000;"
110 PRINT #1,"LB,T5""COPYRIGHT 1984 BY
(YOUR NAME)chr(13)"
120 PRINT #1,"SP0;"
130 CLS
140 PRINT "DONE."PRINT ""
150 PRINT "CHANGE PEN 1 TO DRAWING
PEN."
160 PRINT "";CLOSE #1:END
170 END

May 1984
THE SANYO MBC 550

New low cost micro runs MS-DOS operating system

BY BILL BARDEN

Of the many IBM PC compatible microcomputers currently on the market, none is more intriguing than the Sanyo MBC550. And the reason can be summed up in one word—price. Sanyo offers its system with 128K RAM, the same high-resolution color graphics as the PC, a built-in Centronics parallel port, two word processors (WordStar and EasyWriter I), and a spreadsheet called CalcStar—all for a suggested retail price of $995. The cost of a comparably equipped IBM PC is roughly three times as much.

“What’s the catch?” you might ask—and rightfully so. The word “compatible” is sometimes used loosely by companies trying to gain a foothold in this market. If the machine is not “fully” (99%) compatible, questions arise. Will the computer gain enough of a market share to encourage software companies to rewrite their software for it? Is the computer a viable product at the price, regardless of the degree of compatibility? We’ll try to answer these and other questions about the Sanyo in this review.

The Sanyo MBC550 consists of a main computing unit and a detached keyboard. The main unit has one single-sided double-density 51/4” disk drive. This is a “half-height” drive that fits nicely into the right-hand side of the unit; a second drive can be added in place of a storage compartment on the left-hand side.

The main unit does not have IBM PC expansion board capability, but it does have a bus connector internally for external devices (as yet undefined by Sanyo). The motherboard in the main unit holds 256K of memory. It’s relatively easy to expand to this amount by adding 64K RAM chips to the basic configuration. (The manual provides the procedure for this.)

The Sanyo is compact. Its “footprint,” or area taken up by the system base and keyboard, is about 330 sq in. This is quite a bit smaller than the 450 sq in. of the IBM PC and makes it easier to fit the Sanyo on a small desk.

The rear panel of the main unit has plugs and connectors for the system. There’s a standard Centronics connector for a system printer, and an optional RS-232C DB-25 connector for a serial interface. (The serial interface is $100 and can be added internally in about 5 minutes.)

There’s both an RCA-type monochrome jack and a DIN-type RGB jack on the rear panel, along with a plug for the keyboard. Other rear-panel connectors include the line cord, a female ac plug for another piece of equipment, the main power fuse, and a “knock-out” plug for an optional joystick.

The keyboard on the MBC550 has 85 keys with 5 function keys on the left-hand side and a numeric keypad on the right-hand side. The LOCK and GRAPH keys have red LEDs that signify when they are active. The feel of the keyboard compares very favorably with the feel of the IBM PC although the keys are somewhat noisier in operation. The keyboard has two brackets that can be swung down to provide a better operating angle.

There’s a built-in cooling fan that is not excessively noisy. (I prefer a completely silent system, however, and am not favorably disposed towards any fans.)

Connecting a second disk drive is easy. It’s a 15-minute operation that is fully described in the operating manual, and you can use the TEAC drives that come with the Sanyo or a variety of other Shugart compatible half-height disk drives. Currently, though, the choice of a second drive may take some deliberation, and we’ll tell you why.

Second Drive or Not?

The most apparent difference between the Sanyo and the IBM PC is in the disk drives. The Sanyo MBC550 and MBC555 (the two-drive version) come
with single-sided double-density disk drives. The MS-DOS 2.0 version of the IBM PC, however, comes with double-sided double-density disk drives. Thus, the Sanyo user is faced with a dilemma.

If you buy the two-drive version of the Sanyo, you'll get two single-sided drives. You won't be able to upgrade to double-sided drives unless you buy new drives. Why would you want to upgrade? To use the new Sanyo MS-DOS 2.0 version of MS-DOS, of course. This isn't out yet and the stateside factory won't say when it will be coming out, but it is rumored to be in the works. Why not, then, buy a single-drive system and a second double-sided drive and install it yourself? A good idea, but then you won't get the second portion of "bundled" software available with the purchase of the second drive. This portion includes SpellStar (a spelling checker), InfoStar (a data manager), and Mailmerge (a program that can be used for form letters). The Sanyo user at this point, then, must either be prepared to buy the second drive and bundled software (for another $399) and then upgrade to two new drives when MS-DOS 2.0 becomes available or he can buy a second double-sided drive without the bundled software.

For those unfamiliar with MS-DOS, the 2.0 version includes support for double-sided drives and a more powerful structure for disk directory files. The remaining commands are largely the same as the 1.1 version. There's no question, however, that the double-sided disk capacity for the 2.0 version is a great convenience for storage.

**System Internals**

Like the IBM PC, the Sanyo uses an 8088 microprocessor. The 8088 is basically an 8-bit microprocessor as far as the system bus or memory accesses go, but it does perform 16-bit arithmetic. The clock rate of the MBC550 is 3.6 MHz compared to the 4.77 MHz of the PC.

There is a socket on the main computing board for an 8087 processor. The 8087 is a coprocessor that operates independently of the 8088 to perform operations such as floating-point additions, subtractions, multiplications, and divisions. Obviously, Sanyo plans to incorporate the 8087 into the MBC550, which is a big plus for the system, although the 8087 processor is not currently supported.

As mentioned, the MBC550 comes with 128K of RAM and can be upgraded on the motherboard to 256K. The memory map of the MBC550 is different from the IBM PC in that the BASIC interpreter is loaded from disk instead of being in high-memory ROM as it is on the PC. Most other system addresses, such as those of the I/O devices, are the same as on the PC.

**Graphics Capability**

Like the IBM PC, the Sanyo MBC550 is capable of 640 pixels horizontally by 200 pixels vertically in eight colors. Unlike the PC, however, color capability is included in the basic system at the base price. Like the PC, the Sanyo has commands relating to graphics such as CIRCLE, which draws a circle, ellipse, or arc; LINE, which draws a line, box, or filled-in box; GET/PUT, which defines a video area for storage and later retrieval; and PAINT, which colors a portion of a figure.

As in the latest release of PC BASIC, the Sanyo includes the powerful WINDOW and VIEW graphics commands. It allows you to operate in a logical coordinate system for graphing in which the coordinates could be as large as 32767 by 32767 (with a full complement of external RAM). You can select any portion of this logical area for display by the WINDOW command, which would display a 640 by 200 pixel area. Within the window, you could then VIEW any portion of the area and use this as your working space to plot points or draw figures, enabling you to perform instantaneous zooms or reductions at will. There are software packages that will allow you to do this on other systems, but this is a powerful capability that is integrated into the BASIC and is a definite plus for the system.

The Sanyo has full-screen editing capability, which means you can move the

(Continued on page 108)
THE LEADING EDGE PC

A well-known marketer enters the compatibles arena

BY ROBIN WEBSTER

Most people will recognize the name Leading Edge Products—it's the company that sells the low-cost Gorilla Banana dot-matrix printer and a host of other computer support products. Now, for the first time, Leading Edge is marketing a personal computer—one that is compatible with the IBM PC. I say marketing because the Leading Edge PC is actually manufactured by the giant Japanese computer maker, Mitsubishi.

While the Leading Edge machine offers a fair degree of IBM compatibility (it will run IBM format WordStar, for example), it is also described in one advertisement as having "a whole lot more." Translated, this means that, instead of the standard machine with just the same bare necessities as the IBM PC (64K of main memory, one low-capacity disk drive, no serial port, etc.), the Leading Edge PC comes with enough features to be put to serious use immediately.

The machine comes with 128K of main memory, seven internal expansion slots; a serial and a parallel communications port; a system clock/calendar; two half-height floppy disk drives (320K each); and a monochrome monitor. Additionally, Leading Edge has decided to include the following software: the MS-DOS 1.25 system disk, including the Microsoft GW BASIC programming language and the Leading Edge Word Processing package (which can also be used on the IBM PC or other MS-DOS machines).

That's a good line-up as IBM compatible machines go, particularly when you consider that this can all be yours for $2895. But let's look at how all this equipment works together as a system.

Hardware

The Leading Edge PC is not for users with a refined sense of aesthetics. Although it comes with the usual set of parts—a system unit, a monitor, and a keyboard—it is evident that Mitsubishi didn't really dwell too much on the external design of the product. The front part of the square, sharp-cornered, system unit is molded from the predictable corporate grayish-beige plastic. However, most of the front panel is covered by a sheet of satin finish aluminum with the Leading Edge logo set off to the left. I mention the logo merely in case anybody notices a startling similarity between the Leading Edge machine and the brand new machine from Sperry Univac.

The Leading Edge and Sperry machines are essentially the same Mitsubishi-built product and, as far as I could tell in a short and not too involved comparison, the only major differences (apart from the fact that the Sperry version is more expensive) are that one has a Leading Edge logo and an IBM-style keyboard and the other has a Sperry logo and a Sperry-designed keyboard.

Since the Leading Edge PC uses half-height disk drives, they occupy just a little more space than one normal drive would in the far right-hand corner of the system unit. The drives never failed to read from or write to disks correctly during the review, but it was occasionally troublesome to remove disks from the actual drives themselves. Normally, floppy disk drives have a simple latching mechanism (a flip-down door, or a small latch like those that you find holding up refreshment trays on the back of aircraft seats) that retains the disk securely in place. To remove the disk after use, you have to take it out manually.

With the Leading Edge PC drives, disks are first held in place by a spring-loaded mechanism and then gripped in the center by an arm that the user has to lower into position manually. It's all very precise. Occasionally, though, I had to fight with the mechanism to get the disks out. It would sometimes take two or three routines of opening and closing the drive doors before a disk would be
launched back into my hands by the reluctant springs. Obviously, this is not a serious problem, but it can be annoying when you’re working with a number of disks, say, during a copying operation. The other problem I noticed was that the drives were rather noisy: you could tell when the machine was switching from disk to disk by the clunking noises that occurred.

Below the drives on the right side of the system unit is the power switch, a simple on/off rocker unit. A small red light next to the switch indicates whether the power is on or off. At the front-left corner of the system unit is the keyboard connector. This is a five-pin plug into which the coiled, telephone cable keyboard lead is inserted. Unfortunately, the connector plug sticks out towards the user, preventing the keyboard from being positioned as near to the system unit as one might require. Also, the coiled lead itself does tend to get in the way.

The Leading Edge PC’s 83-button keyboard is totally compatible with that supplied with the IBM PC, even down to the awkward arrangement of many keys and the confusing use of arrows on the tab, return, and backspace key caps. However, it is a little bit more like a surfboard than IBM’s version, measuring 18” across and 8” deep. According to Leading Edge, the keyboard on the Mitsubishi machine uses as “inductive technology.” The importance of this is that there are no contact points and hence no wear or danger from spilled liquids.

With some systems, you can change the resting angle of the keyboard on a flat surface by adjusting little “legs” at both ends: the Leading Edge keyboard is no different. But it is an all-or-nothing adjustment—it’s either completely flat on its back or canted at a preset angle.

It’s hard to say which is the better keyboard: the Leading Edge version feels rather lightweight, but performed well; the IBM model has a professional look and feel to it, but it was designed by an engineer instead of a user and clicks a bit too much for my taste.

All the input/output connectors are arranged along the back of the system unit. To the left (looking from the back), there is the three-pin socket from which the monitor obtains its power. Next to this there is the power socket for the main system. Grouped to the right are all the I/O connections and switches: an RS-232C serial interface port; an 8-switch microswitch unit; an external disk drive interface port; a parallel printer port; and a 9-pin video monitor connector (for the monochrome or color display). The monochrome monitor bundled with the system has a 12” green phosphor screen, capable of displaying 80 columns by 25 lines.

To gain access to the inside of the machine you only have to remove five small screws that secure the top aluminum casing to the main chassis. Once these screws are removed, you slide the casing toward you and then lift it off—it comes away without a struggle. Internally, the components are laid out quite neatly—all the wiring is routed from point-to-point sensibly, and the heavier components (the power supply and two half-height drives) are securely held in place.

Interestingly, most disk units are normally encased in a sheet metal casing to reduce electronic interference, but the drives on the review machine were not separately covered at all.

The machine uses a version of the Intel 8088 microprocessor (the 8088-2) which can be set to run at one of two operating speeds: 4.77 MHz (as with the IBM PC) or 7.16 MHz. The speed is changed by the user by means of the microswitch panel on the back of the main system unit.

There are seven expansion slots designed into the main motherboard which is quite large and lies horizontally along the bottom of the system unit. Two of the slots are occupied with the video and disk controller cards, leaving five slots available for further expansion. Unlike the simple push-in/pull-out method of installation that you get with the Apple II, for example, the Leading Edge cards are first pushed in and then bolted securely into place (as with the IBM PC). This should reduce the possibility of system malfunction if the machine is ever jostled while in transit.

### Using the Leading Edge PC

After switching on the system unit, the Leading Edge PC goes through a diagnostics routine. The time taken to complete the test will depend on factors such as the amount of memory installed (you may have between 128K and 640K of RAM). If everything checks out OK and you have the system disk in drive A, the machine will beep once (it has a small internal speaker), display the Microsoft system messages, and ask for the current date. If, for some reason, the system loader code could not locate a disk or any system tracks on the current disk, then the machine will display the message:

**E-FD20-TIME OUT ERROR**

All this means is that 20 seconds have elapsed since the first attempt was made to load the MS-DOS system. This happened a couple of times during the review, but a second try overcame the problem.

After loading the system disk, I listed the directory to see what files were available. All the usual files such as COMMAND.COM and FORMAT.COM were on the disk along with a number of demo programs that either showed off the machine’s ability to combine graphics and sound, or its color generation facilities. Since I didn’t have the color monitor connected, I just ran a couple of the monochrome programs to make sure everything was working correctly.

The FORMAT.COM program obviously follows IBM specifications since a blank disk formatted by this program can be accessed and used to store information on an IBM machine. As far as

(Continued on page 130)
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1776 East 17th Street, Cleveland, Ohio 44114.
RADIO SHACK'S TRS-80 MODEL 4P

TRSDOS and CP/M compatibility in a transportable computer

BY J. SMITH-RICHARDSON

It is interesting to speculate what the state of the portable computer marketplace might be if Radio Shack's Model 4P had been the first "transportable" machine to appear on the scene. Quite likely, the models that have a tendency to lean like the Tower of Pisa when set on the floor or that have external hardware and controls that tend to snap and bump up against things would never have appeared.

Appearance is not all, though. This compact transportable computer is an excellent performer, able to use both Radio Shack's TRSDOS and third-party CP/M 2.2. And it is almost totally software compatible with Radio Shack TRS-80 Models I, III, and 4.

Hardware Characteristics

The Model 4P portable is derived from Radio Shack's Model 4 desktop computer. It has a Z80 microprocessor that operates at either 2 or 4 MHz, depending on the operating mode, and 64K of RAM, expandable to 128K. Built in are two "thinline" half-height 5½" single-sided, double-density floppy-disk drives, each capable of storing 184K of data. A 9" white-phosphor CRT, Centronics-compatible parallel printer port, RS-232C serial port, an I/O bus for future expansion, and a prewired compartment for a user-installable 300-baud plug-in modem round out the electrical hardware features of the Model 4P.

Housed in a heavy-duty plastic cabinet, the computer weighs slightly more than 27 pounds and measures 16½" × 13½" × 9½". The Model 4P's cabinet has to be the best-thought-out design for a transportable computer anywhere. Its pop-up handle is positioned off-center, over the center of gravity rather than the physical central axis, to evenly distribute the weight and provide the most comfortable grip for transporting the computer.

The front cover is really a front cover. It is secured with steel clamps—not the usual plastic snaps. This cover contains a storage area for the computer's ac line cord and separate storage bins for diskettes and/or documentation.

The CRT screen is centrally located in the computer's front panel. To the left of the CRT is a combination power switch/indicator assembly, RESET switch, and BRIGHTNESS and CONTRAST controls for the CRT display. To the right of the display are the two vertically mounted floppy-disk drives.

Stowed in a compartment under the 4P's front panel is the detached keyboard that slides in and out and is safely secured for transport when the cover is attached. The cable tether between keyboard and computer is 16" long, which is barely sufficient to allow lap operation. Two pivoting "legs" at the bottom rear of the keyboard assembly permit keyboard typing angle to be adjusted for desktop use. The keys have the sculpted look of the IBM Selectric II typewriter keyboard and have a very satisfactory "feel."

All I/O connectors and the modem compartment are concealed behind a flush door that spans almost the entire rear of the cabinet. Though Centronics compatible, access to the printer port is through a card-edge-connector arrangement, rather than the more common DB-25 connector. The RS-232C serial port, however, has the standard DB-25 connector arrangement. The I/O expansion bus and modem compartment are protected by a removable steel plate inside the compartment.

Modem installation is very simple. After removing two screws that secure the steel plate, the connector on a revealed cable plugs into the modem, which then slides into its own compartment, where it becomes an integral, though removable, part of the computer.

On the bottom-rear of the cabinet is a threaded leg, similar to that found on slide projectors, for adjusting the tilt angle of the front panel (actually, the entire computer). The leg is designed to combat potential reflection and glare from room lighting on the CRT's screen. There is a real need for this arrangement, because the CRT screen is as far forward as it can be inside the computer housing and is particularly sensitive to reflections from ceiling lighting. Though the leg can be effective in reducing some of the glare, a small slide-out hood or a lip on the front edge of the cabinet over the screen area would have been much more effective.
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SOFTWARE REVIEWS

THE LEADING EDGE WORD PROCESSOR

A powerful package with many text editing features

By Robin Webster

I was looking forward to reviewing the Leading Edge Word Processing package because the company has invested a large amount of money in marketing the product in computer and related publications. It has also generated a lot of interest at exhibitions around the country.

Most readers will be familiar with the assertion that begins by stating: “History will record as a profound irony that the most powerful word processing package ever created for the IBM Personal Computer can be worked with two fingers.” Another ad even suggests that the LE Word Processing package will transform your PC “into something with the speed and power of dedicated word processors costing $10,000 and more…”

There is some truth to the latter statement since Leading Edge—like the developers of the Multimate word processing package for the IBM PC—has drawn quite heavily on the word processing concepts developed by office automation companies like Wang. On the Wang Office Information System (OIS) range of machines, the word processing facilities are completely menu driven and are based around a proprietary keyboard design. Users are presented with a main menu which allows them to EDIT an old document, CREATE a new document, PRINT a document, and so on.

You are not required to type in any complex commands. You just place the cursor next to the menu option desired, enter the document number and the name of the library in which the document resides, then press the EXECUTE key. Depending upon your menu selection, documents for further editing are listed, or sub-menus with further, more specific, options are displayed. If at any time you want to escape from a menu selection, you press the CANCEL key and respond to prompts that usually appear at the top right of the screen.

While using the LE Word Processing package, I was constantly made aware of similarities with the Wang environment. Rather than having documents reside in libraries, however, Leading Edge has decided to adopt the more current concept of storing documents in “folders,” which are, in turn, stored in file cabinet “drawers.”

Because the Leading Edge and IBM-type personal computers do not have sufficiently high-resolution screens, they are really unable to display visual representations of desktop objects in the same manner as the newer computers with bitmap displays. Instead, the folders are given as a list of names; when one is selected, all the documents contained in that folder are shown as a further list. There may be up to 32 named folders per disk (or “drawer,” as Leading Edge refers to them in this context) depending on the size of saved documents.

When you start up the LE Word Processing package, you will find that the system already contains an initial folder (the Initial Document Folder) ready for use. Also, a first default format document is created by the system (the LE Standard Document) so that you don’t need to worry about learning all the margin settings and format options before you even write your first few words.

Since every subsequent document created by the package will conform to the initial document layout, once you have learned your way around the system, you can go in and alter the default document to suit your own personal preferences. This approach to automatic document formatting is similar to the “prototype documents” that are created with dedicated word processors.

Features

Rather than having menu options listed as “Edit a document,” or something similar, the LE Word Processing package employs the menu selection area at the bottom of the screen that Lotus 1-2-3 or Multiplan users will be familiar with.

A couple of lines are given over to a set of command words, such as “EDIT,” “CREATE,” “DELETE,” “COPY,” and “PRINT,” and as you place the cursor over each word it is highlighted in reverse video. Additionally, as each command is selected by the cursor, further text is displayed to explain the effect of each command.

Earlier, I mentioned that Wang word processing systems used a proprietary keyboard design. This greatly simplifies the typist’s job since special keys have

The Word Processor comes with an overlay for the IBM PC keyboard.

PHOTOGRAPH BY STEVE BORNS

Computers & Electronics
Now...Supercharged communications software for your high powered 16 bit PC.

The makers of CROSSTALK proudly announce the newest entry into our line of high performance communications software. CROSSTALK XVI — a communications program with the speed and features of a fine racing machine. Shift from status display to incoming communications and back again at full throttle. Drive smoothly through the program with CROSSTALK XVI's integrated help system. Enjoy the full use of function keys. CROSSTALK XVI can be used with most autodial modems, and emulates several of the most used terminals. Test drive CROSSTALK XVI today at your local dealer.
Your computer's telephone.

Hayes

What are the adverse effects of this compound?

Gary: The pedigrees for next week's auction are as follows...

Sold 1000 shares at 33 for net profit of 6000. Richard.

Wouldn't it be great if you could use your IBM* PC to tap into vast resource libraries across the country? To transfer files to your partner, upstate? Or from your broker, down the street?

It's possible. All you need is a modem, to connect your computer to others. Down the hall. Or thousands of miles away.

Hayes Smartmodem. Think of it as your computer's telephone. Hayes Smartmodem 300™ and the faster Smartmodem 1200™ allow you to communicate over ordinary phone lines. But any modem will send and receive data. Hayes Smartmodems also dial, answer and disconnect calls. Automatically. And without going through the telephone receiver, making them far superior to acoustic coupler modems.

Choose your speed; choose your price. The lower-priced Smartmodem 300 is ideal for local data swaps and communicates at 300 bps. For longer distance and larger volumes, Smartmodem 1200 operates at baud rates of 300 or 1200, with a built-in selector that automatically detects transmission speeds.

Both work with rotary dials, Touch Tone® and key-set systems; connect to most time-sharing systems; and feature an audio speaker.

Smartmodem 1200B™ is also available as a plug-in board. Developed specifically for the PC, it comes packaged with Hayes' own communications software, Smartcom II™.

Smartcom II. We spent a lot of time developing it, so you can spend less time using it. Smartcom II prompts you in the simple steps required to create, send, receive, display, list, name and rename files. It even receives data completely unattended—especially helpful when you're sending work from home to the office, or vice versa.

If you need it, there's always "help." This feature explains prompts, messages, etc. to make communicating extra easy.

With Smartcom II, it is. Case in point. Before you communicate with another system, you need to "set up" your computer to match the way the remote system transmits data. With Smartcom II, you do this only once. After that, parameters for 25 different remote systems are stored in a directory on Smartcom II.

Calling or answering a system listed in the directory requires just a few quick keystrokes. You can store lengthy log-on sequences the same way. Press one key, and Smartcom II automatically connects you to a utility or information service.
Leading Edge WP
(Continued from page 44)

been designated for every major editing
task. If you want to go to the next page in
a large document, you simply press the
“GO TO PAGE” key and respond to the
“WHICH PAGE?” prompt with the rele-
vant number. If you want to go to the end
of a document of unknown size, you
simply respond to the latter prompt with
an absurdly high number like “999.”

Wang uses special keys to center, in-
dent, insert, and move text around with-
in a document. There is even the so-
called glossary feature, which allows
users to write simple word processing
“programs” that will automatically for-
mat a document according to pre-deter-
mined settings (say, inserting a page
break every 33 lines and indenting the
first line of each paragraph by three
spaces).

While the LE Word Processing pack-
age has almost all these features, it does
run into trouble because it must cope
with the limitations of an IBM style key-
board. Leading Edge has decided that
the best way to tackle this is to provide
a multiple color keyboard template, which
fits around the keyboard and lists the ef-
effects of the various function keys when
used alone or in concert with special, or
“booster,” keys.

The Escape (esc) key has been chosen
as the cancel key and the plus (+) key
on the numeric pad has been chosen as
the execute key.

One aspect in which the Leading Edge
product differs from the Wang word
processing systems is that you can select
whether or not you wish to be in insert
mode (insert words in the middle of sen-
tences without overwriting what’s al-
ready there), or overtypr type mode (cur-
tent text is overwritten by new text).

On the Wang systems, you are always
in overtypr type mode and must press the
insert key to make additions in the midst of
text. The problem is that all text after the
insertion point is temporarily wiped off
the screen, making it a little difficult to
gauge the effect of the additional materi-
al on the document layout. I much pre-
ferred the Leading Edge way of doing
the job since you can immediately see
how your new text fits in with the old.

It is also possible to split the word pro-
cessing screen into two working areas,
or windows, and edit more than one docu-
ment at a time. By using the cut and
paste options it is also possible to trans-
fer data from one document to another.
There have been many times that I need-
ed to work in this way and, although rec-
ent “windowing” products such as the
Apple Lisa or Macintosh systems—as
well as the DesQ and Visi On software
packages—naturally do the job a lot bet-
ter, I found the LE Word Processing
package coped well with the task.

There are far too many functions
available with the LE Word Processing
package to cover them all in this review;
but it might be useful to indicate some of
the features assigned to the ten function
keys (F1 to F10). They are as follows:

- **F1:** obtain help information and
  list the main command menu.
- **F2:** the decimal tab key.
- **F3:** edit a current format line,
  insert a new format line.
- **F4:** select the type of text
  indentation.
- **F5:** set text attributes such as
  bold, and underline.
- **F6:** center text.
- **F7:** carry out search and replace
  operations.
- **F8:** insert page breaks.
- **F9:** select an area of text to
  move, or cut.
- **F10:** paste area of text previ-
  ously selected by a cut.

The exact result of each of these keys
changes when they are used in conjunc-
tion with the CTRL, ALT, and SHIFT keys.

Additional Functions

There is a very wide selection of other
specialized text editing features. You
can, for example, transpose two charac-
ters that are typed in the incorrect order
by placing the cursor to the immediate
right of the characters and pressing the
ALT and SHIFT keys. If you ever need to,
you can also switch lower-case letters
into upper-case letters (and vice versa)
by pressing the SHIFT and CAPS LOCK
keys, highlighting the text to be
switched, and then pressing the EXE-
CUTE (+) key. Groups of words that are
hyphenated, but which would normally
be split by the end-of-line word wrap,
can also be kept together by a “required
hyphen” facility.

It’s not that everyone will need such a
range of options—many people would
rather retype the two transposed charac-
ters than worry about learning the spe-
cial command—but it’s nice to know
that such a toolkit is there if needed.

Again, unlike word processing soft-
ware on some of the newer bit-mapped
machines, the LE Word Processing
package is not capable of displaying spe-
tial text attributes on-screen. So, when
you underline a section of text—single
underline, double underline, or under-
line in red—it is merely highlighted.
(Whenever you place the cursor within
the highlighted area, a brief message ap-
ppears at the top of the screen to indicate

(Continued on page 84)
NEW LOW COST MODEMS
Modems have become less expensive and more capable. Here's a roundup of products that retail for less than $100.

BY TJ BYERS

YOUR personal computer has been heralded as the ultimate communications device. Out there in the vast beyond are promises of home banking services, telephone catalog sales, and up-to-the-minute stock quotes. Presently, hundreds of database sources and community bulletin boards are available to the computer owner. All are but a phone call away.

Ah, but there's the rub. Unless you have some way to couple your computer to your telephone, these conveniences may as well not exist.

Fortunately, the situation is easily resolved with an ingenious device called a modem. A modem gives your computer the freedom to talk to other computers, access databases, and generally keep you in touch with the world.

Modems come in many different shapes and sizes, with a wide range of prices. Recently, low cost modems have appeared on the market—budget modems, which retail for under $100.

But does a lower price tag reflect an inferior product? Can you use one with your system? To answer these questions, we need to look first at modems in general.

Modems

Basically, the job of a modem is to transfer digital information from your computer to another computer, and vice versa. It does this over a telephone line (Fig. 1).

To our dismay though, we find that telephone lines are not equipped to handle digital
conversations. They are designed, instead, to carry audio signals in the range of 300 to 3500 Hz. This is intentional.

As we know, telephones are designed for the human voice, which falls within this narrow frequency range. By limiting bandwidth, and chopping those frequencies that carry little information, the speech patterns become very clear and intelligible.

This frequency cropping, though, severely attenuates digital pulses, making it impractical to send such pulses over telephone lines. They just can't get through.

But there is another way. Using the audio characteristics of the telephone line to its own advantage, the modem is able to communicate digital data. It begins by taking your digital pulse and encoding it into a frequency. One specific frequency is used to represent a logic 1 and a different frequency represents a logic 0.

As the train of pulses enters the modem, the pulses are changed into audio tones, the frequency of each tone corresponding to a logic state, and sent over the phone lines in serial form. The resulting output is a characteristic "doo-dah" sound. This form of encoding is called frequency shift keyed (FSK) modulation, appropriately enough. It is a specialized form of FM (frequency modulation) as illustrated in Fig. 2.

At the receiving end of the conversation is another modem, which takes the tones and converts them back into digital pulses.

By using different pairs of tones, a modem can both transmit (originate) a message and receive (answer) one. To do so, the modem must contain a modulator and a demodulator. Hence the acronym, modem.

The data is commonly sent at 300 bits per second, or 300 baud. When using the standard ASCII format, 300 baud translates roughly into 30 characters (letters) per second. An average word takes about one-fifth of a second to send, resulting in 300 words per minute.

**Typical Modem Cycle**

The best way to understand the operation of a modem is to actually put one through its paces. Of course, you need a computer. Let's say you wish to access a database, such as The Source. This is how it's done.

You begin by dialing the telephone number of The Source (which they gave you) and securing a connection. You can do this manually or the modem can do it automatically.

The Source responds to your call with a carrier tone, which the modem recognizes. The modem then returns a greeting carrier tone and the link is established. Next, you instruct The Source to serve up its menu. The modem makes this instruction clear to The Source by modulating its frequency according to the pulse commands.

Likewise, The Source responds with the requested information in tone format, which your modem decodes and displays on your CRT screen. If you were to listen to the conversation, it would sound like a cacaphonous four-note symphony by some obscure modern composer.

To prevent the transfer of erroneous data, a certain signal integrity must be maintained. In other words, you can't have the carrier signal fading in and out on you, otherwise valuable pieces of in-
formation will be lost. Therefore, a threshold is set, below which incoming data is ignored. This is the carrier-detect limit, and it is usually established right around –42 dBm. If the carrier is absent for too long, the link is broken altogether.

At the end of the conversation, the modems say their goodbyes and hang up the phones. All modems, cheap or expensive, are capable of doing what we’ve so far described.

Why, then, is there such a widespread difference in the prices of modems if they all do the same thing? What makes one modem cheaper than another? These are all good questions.

The answer is twofold. But in their ultimate use. Without filtering, there is a chance that cross modulation could generate a spurious signal that the modem would mistake for a data bit.

But separate filter chips have been developed. Until their advent, the function of filtering the telephone signal was performed by several operational amplifiers. A single filter chip can replace up to 18 such amplifiers. That’s quite a saving.

The final result is a modem chip set made up of two VLSI chips: a modem and a filter.

Frills

But dedicated chip sets are only part of the answer. Many of the expensive modems also use chip sets in their design. In fact, most modems on the market today are designed around a modem chip.

OK, so what does separate the expensive models from the budget modems? Frills.

Frills are those things that add convenience to life, but aren’t essential to performance. They can best be compared to the service on an airplane trip. There are economy coach flights and champagne flights. Despite the difference in price, they both accomplish the same end: getting you where you are going.

In a modem, frills amount to “gadgets.”

Oh, gadgets are neat things to have—if you need them. Most of us don’t. It was this lack of need that sparked the budget modem revolution. Let’s look at some of these convenience items, why they exist, and what they mean to you.

Probably the most frivolous of modem gadgets are the added monitors, cassette outputs, and TTL ports. I’m sure that, in their day, they were well-received additions to a bare-bones computer. But, those days are pretty well past.

Most personal computers nowadays have an RS-232C DB-25 connector or a dedicated I/O port built right into them. They also support their own version of a cassette interface or monitor, and unless you expect the modem to function on its own, extra interfacing is of little use.

Along more practical lines, you find modems with automatic answering. Although this feature is built right into the modem chip, it requires external circuitry for you to be able to use it. Extra circuits mean extra money... and a higher price tag.

Often the number of times the phone rings before the modem answers it can be programmed into the unit. This also increases price.

The development of VLSI (Very Large Scale Integration) chips has a lot to do with it. Using this process it is possible to incorporate all but a few of the modem’s operations into circuits on a single chip of silicon. And it’s a proven fact that multifunction chips cost little more to manufacture than single-function ones.

Therein lies the biggest gain. A modem chip, by itself, is a conglomerate of digital functions. It processes the digital input, converts it to an audio signal, and transmits the signal over the telephone lines. The modem chip is also responsible for the reception of the incoming signals, their decoding, and subsequent digital output to the computer. That’s quite an undertaking for just one device.

Well, in fact, it does have a little help. Until very recently, it has not been feasible to include all of the modem functions on only one chip. Filters, in particular, are not readily adaptable to multi-function designs because of the many parameters involved. Not in the filter design, but in the answer. Many of the expensive modems also use chip sets in their design. In fact, most modems on the market today are designed around a modem chip.

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On the opposite side of the coin are modems that can originate their own calls. They can even remember phone numbers and redial them if the line is busy.

Such a feature can be a definite time saver if you make several calls a day. Just think of all the labor saved by having the computer dial up and query the receiver with no user intervention. Then again, think of the price.

Budget Modems

As you may have gathered, budget modems have none of these frills. They are basically manually operated devices.

In almost all cases, the originate and answer modes are selected not by an automatic controller, but by a switch operated by you. If you’re placing a call, you flip the switch to the originate position. When receiving a message, you turn it to answer.

Budget modems also require you to dial the telephone number of the intended receiver and to answer the phone yourself when it rings. That’s not too much to ask for $100 or less, is it?

(Continued on page 93)
The best of the available hardware and software for building a top-notch business graphics system

BY JACK BISHOP

In the business community, the ability to communicate information and data to an audience in the least-complicated and easiest-to-grasp manner is of paramount importance. Since much of the business information communicated consists of numeric data, the best communication medium is pictures in the form of graphs and charts. It is usually easier and more acceptable to present dry numerical data in picture format than to tabulate it in columns.

Today's sophisticated and powerful microcomputers and software packages make it possible for nonprogrammers to construct dazzling, informative graphs and charts that save the person presenting the information a great deal of explanation time. Color gives modern business graphics visual appeal and makes it possible for graphs and charts to contain multiple levels of related information without undue complication. Assigning a different color to each division, for example, permits a graph of income data for several divisions over time without the need for possibly confusing solid, broken, and dotted lines or different gradations of shading.

Business Graphics Users

The term "business graphics" is a catch-all. It includes everything from line, bar and pie charts to sales territory maps to engineering drawings to pictorial representations of products to block (and other types of) diagrams that depict corporate structure trees or procedures to be performed. In fact, any pictorial representation can be constructed with and presented by a desktop computer. Sometimes, however, the computer must reach out beyond its own realm, to a larger mainframe or minicomputer, to obtain the data needed to construct a graphics image. However, since the focus here is on business graphics, our discussion will be limited to the charting and graphing options available. (For a discussion of getting corporate data to your micro, see "Getting Mainframe Data to Micros" elsewhere in this issue. Ed.)

Users of business graphics range from top executives in large companies to salesmen in the field to managers and analysts in accounting, stock, engineering, and any other departments in which pic-
torial images will be beneficial. Considering that numerical data is the common denominator at all levels, there is no limit to who can use business graphics in the professional community.

When we discuss business graphics, our frame of reference is on the "state of the art," since it is the standard by which a top-quality microcomputer business graphics system must be judged.

**Toward the Ideal**

It is almost impossible to avoid mentioning "state of the art" in any discussion of computers. Actually, the state of the art in business graphics at the microcomputer level is far from the ideal most users would like it to be. Available systems are too limited in their capabilities, too complicated to operate by the casual user, or both.

To be considered state of the art, a microcomputer-based system must support the charting needs of the business professional, though not necessarily by itself.

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**You must first decide on the types of charts needed for the intended audience**

To achieve the desired level of performance, hardware and software must be viewed as an integrated "system." The system chosen must be able to support all the charting needs for analysis and presentation both now and in the foreseeable future. In the business environment, however, one should think of state of the art in terms of simplicity and clarity, not complexity and dazzle.

Opinions differ about what constitutes state of the art in business graphics, depending on the user, the intended audience, and the information to be communicated. The three-dimensional graphics of the engineering department just now beginning to reach the boardroom in a few companies may indeed be state of the art by one definition but may be inappropriate to a user who does not require this level of sophistication. Very powerful and flexible systems are almost always unwieldy to use and require of the user a considerable amount of technical expertise. For the more casual user, such as the inventory manager, budget analyzer, or salesman, a high degree of technical sophistication bought at the price of complex operator requirements prevents the system from being considered to be the state of the art.

State-of-the-art software must be able to produce text and pictures, in addition to line, bar, scatter, and area (pie) charts. Ideally, the system should be able to develop maps of sales territories, plant and office layouts, process flows, and equipment placement. Additionally, the system should be able to develop a third dimension to permit evaluation of graphics from alternative perspectives. The software should also be flexible enough to permit the user to construct his own custom charts and graphs.

Most modern software can generate the four basic types of charts, but few packages are able to produce all types of charts easily, flexibly, and well. To be truly flexible, a state-of-the-art system must produce all types of charts simply and easily and have the ability to fetch data from other programs, data files, and databases. At the very least, such a system should be easy to operate in order to accommodate even infrequent users.

Regardless of type, any chart produced for business graphics applications falls into either of two categories. Most are standard charts produced on a regular basis. The other category consists of special charts that are produced only as the demand arises and that are almost always unique. The flexibility of the software required to produce special charts should not require repetitive operations to produce standard charts. Obviously, the hardware/software system must be able to accommodate both types of charts with ease.

** Charts**

The first step in putting together a business graphics system is to decide on what types of charts will be needed, based on the type of audience(s) for which they are to be designed. Different audiences require different things. For example, for a presentation to a drafting and engineering audience to be effective, sophisticated three-dimensional plotting capabilities might be required. For graphics artists, considerably higher resolution would be required than for, say, a sales department. If you have the responsibility for putting together a busi-
modern link to a mainframe computer can give access to software that can be used, with a microcomputer to produce almost any type of chart or graph.

Hardware

The hardware side of a business graphics system consists of a basic microcomputer with high-resolution color graphics monitor; a means to generate hard copy of the charts on paper and/or transparent film; and means to connect to the outside world. The external connection, obtained with a modem, provides the system with the ability to use powerful mainframe software packages when the capability of the simple micro-based system is overtaxed. Using a modem to access a mainframe computer provides other capabilities as well, such as the ability to get information (marketing, financial, cost, etc.) from centralized data banks to use in constructing charts and graphs.

Though the ideal system does not yet exist in the microcomputer world, some of the currently available machines come close to the mark. In terms of user-friendliness, the Apple Macintosh and Lisa and the Hewlett-Packard HP 150 are among the best. Though not available in color yet, they offer excellent graphics capabilities. If color is a necessity, the Texas Instruments Professional Computer (see "System Overview" box) provides an excellent choice, though at a slight sacrifice in resolution. The standard IBM PC is a distant second to the Apple, HP, and TI machines but is worthy of consideration because a great deal of third-party hardware and software is available or under development for it. (Note: The ranking of these computers is based on manufacturer-configured systems. In some cases, particularly with the IBM PC and PC-XT machines, basic system performance can be considerably enhanced by adding third-party hardware.)

Spending more money on the basic system yields greater performance capability. The $10,000 to $13,000 (fully loaded) DEC Professional 350 computer, for example, offers excellent color graphics capabilities. Going higher in price, to the $15,000 and up range, we reach the top of the graphics line with Tektronix and Hewlett-Packard machines. These long-standing favorites of the professional provide resolution that can be described as superb.

A fair amount of storage capacity is required to plot many points and for ease of use in handling many charts. Memory capacity in this context does not refer to available user RAM inside the computer so much as to the system's disk storage capacity. Though a good graphics system can be built around a computer with as little as 256K of user RAM, it would be a wise move to have as much RAM as possible to avoid needless system processing limitations.

Memory capacity is of paramount importance in being able to store very large programs, many of which may not fit on single floppy disks. This requirement is best filled by a hard-disk (also known as "Winchester") system with at least a 10M-byte capacity.

The system's video display monitor should be a color model, both to provide visual impact and to be able to display the various colors that will be used for combination charts and graphs. To assure maximum resolution and color rendition, with a minimum of interference, the monitor must have an RGB (red, green, blue) signal input. (See "Color Monitors" box.)

Printers and Plotters

Virtually all users of business graphics systems want the images constructed on a computer to be converted into hard copy. To meet this demand, a number of devices can be used to obtain images on paper, transparencies, and slides, in monochrome (black and white) or in full color.

In keeping with the low cost philosophy of microcomputers, the devices most likely to be chosen will require only a moderate investment. At this level (actually, at any level) of the cost spectrum, well-rounded business graphics system, however, a good dot-matrix printer offers an inexpensive means of obtaining rough copies of charts to be used for reference purposes.

A color pen plotter is a much better choice for generating hard copies of business graphics. Prices for plotters cover a wide range, with quality varying accordingly. There are, however, several brand names that instill confidence in the graphics arena. Among the most respected is Hewlett-Packard, which makes a series of color plotters that have achieved a deservedly good reputation. Plotters made by HP are the most widely used in the graphics community, both because of product quality and the fact that they are supported by a number of software packages and require no modifications or complicated hookup to the computer.

Though the Tektronix Model 4662 pen plotter has been around for more
than five years, it is still an excellent device for generating business graphics in hard copy. This top-of-the-line model, which sells for about $6000, can digitize drawings into the computer, a handy feature to have for some special applications.

Ink-jet printers offer an attractive alternative to the pen plotter. The $1600 Tektronix Model 4695 uses four ink cartridges to produce an 8" × 10" copy of the screen in three to four minutes at a cost of about 10¢ per copy. Time, price, and performance all recommend that this piece of equipment be seriously considered for inclusion as part of a business graphics system.

Another alternative to the conventional plotter is to capture screen images on photographic film. For photography-based hard copy, two choices exist—one optical, using a standard film camera and fast 400-speed film, the other electronic, using RGB video output signals for making direct-to-film images.

With the optical approach, two or three exposures of each screen are required to ensure a good print. An optical system requires a special lens housing and associated camera to avoid parallax from the curved screen, particularly at tight angles. Using a camera mounted on a tripod may be adequate for the budget-conscious, but it leaves much to be desired with regard to quality.

The electronic approach can be used with any computer that has an RS-232 serial output port. An electronic system, driven by a computer, can provide hard copy in color by bypassing the optical system altogether. Prices for such systems range from about $2500 to $15,000. The $3000 Polaroid VideoPrinter is an example of such a system. It has the ability to make 8" × 10" prints and/or transparencies from the screen image. The transparencies it generates can be made with either instant or regular film. (See "Hard-Copy Devices" box in a list of makes and models of hard-copy hardware that is suitable for business graphics applications.)

System Overview

<table>
<thead>
<tr>
<th>Manufacturer* / Model</th>
<th>TEK 4105</th>
<th>HP 150</th>
<th>DEC Pro</th>
<th>APPLE Lisa</th>
<th>IBM PC-XT</th>
<th>TI Pro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display Size (in.):</td>
<td>19</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>number of colors:</td>
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<td>1</td>
<td>8</td>
<td>16</td>
<td>8</td>
<td></td>
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<tr>
<td>horiz. resolution:</td>
<td>4096</td>
<td>512</td>
<td>960</td>
<td>720</td>
<td>170</td>
<td>300</td>
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<tr>
<td>vert. resolution:</td>
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<td>390</td>
<td>240</td>
<td>364</td>
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<td>300</td>
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<td>15</td>
<td>19</td>
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<td>256</td>
<td>256</td>
<td>1000</td>
<td>256</td>
<td>256</td>
</tr>
</tbody>
</table>

*Manufacturer abbreviations are as follows: TEK = Tektronix; HP = Hewlett-Packard; DEC = Digital Equipment Corp.; TI = Texas Instruments Inc.

Color Monitors

The following is a representative listing of RGB-input color video monitors available in the marketplace.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model and Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEC Home Electronics</td>
<td>Model JC 1216: 12&quot; RGB; 8 × 8-dot matrix; 10-MHz bandwidth; 640 × 240-pixel graphics resolution</td>
</tr>
<tr>
<td>Princeton Graphic Systems</td>
<td>Model SR-12: 12&quot; RGB; 0.31-mm dot pitch; 31.5-kHz scan rate; 690 × 480-pixel graphics resolution</td>
</tr>
<tr>
<td>Amdek</td>
<td>Model Color IV: 13&quot; RGB; 15.75-kHz scan rate; 720 × 420-pixel graphics resolution</td>
</tr>
<tr>
<td>TSK Electronics Corporation</td>
<td>Taxan RGBvision III: 12&quot; RGB; 15.75-kHz scan rate</td>
</tr>
<tr>
<td>Wyse Technology</td>
<td>Model WY300: 8 colors</td>
</tr>
</tbody>
</table>

Reconfiguring a System

One way to obtain near-state-of-the-art performance from a basic microcomputer system that ordinarily does not provide such a high level of performance is to reconfigure it. Most computers have expansion slots or facilities for using expansion chassis to accommodate hardware add-ins or add-ons. This feature can be used to upgrade a computer so that it has the desired capabilities. By reconfiguring a system, the user who wants near-state-of-the-art performance can preserve his original investment in computer hardware. This may not be the best route to take in all circumstances, however. Reconfiguring an existing system usually requires the services of an expert who has considerable experience with computer hardware and software to devise a working system. When such expertise is available, this can certainly be a viable approach.

Some computers are more easily reconfigured than others. These machines have available to them performance-enhancement add-ins and/or add-ons from the computer manufacturer and other sources. Among the two most popular series of microcomputers with good expansion capability are the Apple II series and the IBM PC and PC-XT. The popularity of the Apple II series often has been attributed to the ease with which these machines can accommodate a wide variety of circuit cards that plug directly into the expansion slots. By plugging in a couple of cards, a lowly games-playing Apple II can be transformed into an advanced 16-bit computer with 256K of RAM to upgrade performance to the near-state-of-the-art level required for top-quality (Continued on page 108)
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GETTING MAINFRAME DATA TO MICROS

Making corporate databases available to micro users isn't as easy as it sounds

BY JAN A. GUGLIOTTI AND ELLIOT B. WEITZ

With the rapid proliferation of personal computers and inexpensive software in the workplace, there has been reason to celebrate. Applications software such as spreadsheets, database managers and word-processing packages is helping users of personal computers produce higher quality work more easily and rapidly. Their enthusiasm, however, can quickly come to a halt when they attempt to tap directly into their organization's big mainframe computer. Having developed a hunger for more fact and more analysis, users naturally begin to wonder why they have to wade through reams of paper to get at the information they need. Wouldn't it be simpler just to siphon off information from the corporate mainframe into a micro spreadsheet? Why not just bypass the mainframe entirely, and develop all new applications on personal computers?

Those who'd like to pursue this course of action typically run up against seemingly contradictory information. Their data-processing department, using extremely technical and rather obtuse language, says that the micro-to-mainframe connection can't be made—it costs too much money, takes months to implement, and won't produce the desired result (ready access to fresh data).

Yet, the packaged solutions advertised so widely seem to promise instant access to mainframe data at a reasonable cost. Who's telling the truth?

The fact is, both arguments contain an element of truth. The packages advertised can solve some of the problems of attaching a micro to a mainframe for purposes of data sharing. But the data-processing people are also correct—those packages solve only some of the problems.

The purpose of this article is to provide some explanation of the issues, definitions of technical jargon, and examples of products, so the personal computer user can have a more informed discussion with both vendors and data processing. But because the past months have literally opened the floodgates to new mainframe-to-PC software, the commercial products we reference have been limited to (a) those that provide a physical link between an IBM mainframe and an IBM PC, and (b) representative IBM-to-PC software packages. Apologies to those who have been omitted in the interest of space.

The Issues

Knowing the meaning of the technical terms you will encounter in your search for the micro-to-mainframe connection (see the sidebar) isn't enough. You need to understand the problems that exist and how they place a barrier between the personal computer and the company mainframe.

There are two technical issues that must be addressed to make the micro-mainframe link feasible. The first is

Jan A. Gugliotti and Elliot B. Weitz are senior associates of Index Systems, Inc., a consulting firm specializing in business applications of information technology.
Making the physical connection—how to introduce your personal computer to the company mainframe without spending a quarter of a million dollars for new hardware and software. The second, making the data connection, is how to get the data you want without the resources of a squad of black belt programmers.

The Physical Connection

Connecting your personal computer to your company’s big one requires playing by the mainframe’s rules. Before you run out to the corner computer store and spend money on hardware or software to make the link, spend time with your information systems and communications departments to define exactly what your mainframe requires or is able to provide to support communications with a personal computer.

If the mainframe already supports remote timesharing, and if the number of personal-computer users who want to access the mainframe is small (and likely to remain so), you’re in luck. You can use simple one-to-one links with your mainframe, and one of the asynchronous communications protocols that are widely supported by personal computer equipment and software vendors. These links are relatively inexpensive, and have been around for a long time. The investment required at the micro end is an ordinary personal-computer modem (e.g., Hayes, Novation, Rixon, etc.) and communications software (e.g., Crosstalk, Mite, or even a public domain program like MODEM 712).

Before you run out and spend money, define your requirements

If your mainframe does not support remote timesharing, however, you will be forced to explore and become familiar with the world of synchronous protocols, cluster communications, and IBM 3270 terminal emulation. As a general rule, personal-computer links to this environment are more expensive and have undergone less of a technical shakeout period. Examples of products that forge the physical link alone from the personal-computer end, in a synchronous, cluster-controlled environment, are the IRMA board (TAC, Atlanta, GA), various hardware/software connections from AST Research (Irvine, CA), and the 3270 PC made by IBM, which has the added advantage of allowing four separate programs running simultaneously on the mainframe to be piped into "windows" on the PC screen.

Most other vendors whose products primarily support the data-grabbing function (see The Data Connection, below) have integrated the physical connection into their "tool kits" of mainframe-to-PC software. A good example is the IT series of micro-to-mainframe connections, from Martin Marietta Data System of Princeton, NJ. The IT series includes a physical link for asynchronous communication (Link-IT), and for synchronous communication (Pass-IT), as well as data management software described below. Omnlink and Omnimicro (On-Line Software International, Fort Lee, NJ) is another powerful family of tools that support a variety of mainframe asynchronous, synchronous and networked physical links, in tandem with a query facility to grab data out of a

A Glossary of Terms

A physical link consists of the hardware, the media, and the actual physical configuration used to link one computer to another. The link starts (and ends) with a serial port for the computer and a modem (modulator/demodulator). The easiest way to understand the role of these components is to follow a single character as it is transmitted from one computer to another.

The character, represented by seven or eight bits (binary digits; logic 1s and 0s) in parallel—side-by-side—within computer A, is transferred from the computer’s keyboard or memory to the circuitry of its serial port as pulses of electricity. There the bits are rearranged so they can be sent serially—one bit after the other—as dc voltages to the physical termination of that port, the connector to which a modem can be attached. Each bit’s presence or absence is represented by a high (about 12 V) or low (close to 0 V) pulse whose duration depends on the transmission speed being used. The higher the speed, the shorter the length of the pulse.

From the (physical) serial port of computer A, the bits representing the character can be sent to the serial port of computer B, where the serial-to-parallel process is reversed and the character is displayed on the computer’s screen, printed out, or entered into its memory (see figure below). The character can get

Modem transmission of signals from one computer to another.
PROTOCOLS

By Charles Daney

PERSONAL computer owners who use their equipment to communicate with mainframes or other personal computers are generally aware that they must use "asynchronous terminal" emulation software to do this. Just what is an asynchronous terminal, and what makes it different from other types of terminals?
The chief respect in which terminals differ—as far as communications is concerned—is in the communications protocol employed. A dictionary definition of "protocol" might read: "A formal standard of speech or behavior governing interactions between individuals." The purpose of such a protocol is to establish who should speak at what time, and how his words should be interpreted.

Protocols determine how data flow is controlled and how potential errors can be corrected

same. Whose turn is it to transmit data? How fast can the data be transmitted? Are special signals required to get the other side's attention? Are there special signals to use to indicate that an error has occurred?

Strictly speaking, asynchronous communications really implies the absence of a protocol, since either side can talk at any time. The two ends do not need to be in sync with each other. In practice, of course, it is not feasible to communicate without some further conventions. Therefore, many asynchronous terminals and communications programs can be configured to use a specific baud rate, parity, number of data bits, number of stop bits, etc. But these parameters are arbitrary. They are not truly a part of an asynchronous protocol.

While the format in which data is transmitted is important, it is not "protocol." Protocol determines how the flow of data is controlled, and how potential errors in transmission (or reception) are detected and corrected.

For asynchronous terminals, a number of ad hoc methods have been devised for dealing with such matters. For example, the use of the parity bit permits the terminal or host computer to detect whether the number of bits in a byte is incorrect. The XON/XOFF characters (CONTROL-S, CONTROL-Q) can be used as signals for one side to stop sending momentarily while the other catches its breath. But every such device tends to introduce other problems. For example, if the parity bit is in use, arbitrary 8-bit bytes (binary data) cannot easily be sent, so special methods of character encoding must be provided.

To handle such problems in a satisfactory and uniform manner, genuine protocols have been defined with the intention that both terminals and host computers will employ them "transparently" to the user or application program. One of the earliest of these, developed by IBM in the 1960s, is called binary-synchronous communication, or bisync for short.

As the name "bisync" implies, both ends of the communications link attempt to remain in sync with each other. This is done using a special character (i.e., a bit pattern) called SYN. Bisync is a half duplex protocol, in that only one side can be transmitting at any given time. Another special character called ENQ (for "enquiry") is therefore used to gain control of the communications line, which must subsequently be relinquished with an EOT (for "end of transmission") character. This mechanism handles the flow control problem to prevent data from being sent faster than the recipient can handle it.

Instead of using a parity bit for error checking, bisync employs a checksum, which is just a number computed from the actual data to be sent. The sender computes the number and forwards it along with the data. The recipient recomputes it. If the checksums match, the recipient assumes the data is correct (although there is still a low probability that it isn't), and replies with an ACK (for "acknowledge") character. Otherwise the data is assumed to be in error and a NAK (for "negative acknowledgement") is sent. The originator then retransmits the data.

Note that ENQ, SYN, ACK, NAK, etc. are just ordinary control characters, so they could be present in normal (binary) data. To prevent confusion, yet another

(Continued on page 100)

May 1984
A Few Quick Pointers

Mouses, touch screens, touch pads, light pens, and the like can make your system easier to use

BY FORREST M. MIMS III

Among the most powerful peripherals for personal computers are those that enable the user to move a cursor and enter commands and data without resorting to the keyboard. Collectively known as pointing devices, they include various kinds of joysticks, digitizing tablets, touch screens, light pens, and mice.

Forrest M. Mims, III is a contributing editor to C&E.

Many of these pointing devices have long been available to users of sophisticated scientific and engineering computers. However, with the exception of some joysticks and light pens, their price was far beyond the means of the typical personal computer owner.

Fortunately, the rapid growth of the personal computer industry has made a major impact on the availability of reasonably priced pointing devices. Today a wide variety of such devices, along with quality driver software, is available.

Many computer users have had little or no experience in the use of pointing devices and therefore are unsure which is best suited for their needs. If you fall in this category, you're not alone. Even experienced users of pointing devices continue to debate the merits of the various kinds by citing research studies and scholarly papers that claim their favorite pointing device is indeed the best.

Notwithstanding the ongoing contro-
versy it is possible for even a novice user to decide which pointing device is superior for a particular application. All that's required is a comparison of the features of the various kinds, followed by a "hands-on" session with those that seem best. The review that follows will help you get started.

**Joysticks**

Thanks to the video game industry, joysticks and game paddles are the most pervasive of pointing devices. Virtually every low-cost computer system sold today includes a pair of joystick input ports.

The two major kinds of joysticks, analog and digital, use entirely different operating principles. The analog joystick is a proportional device. Long a favorite control interface for radio control airplane enthusiasts, the most common kind of analog joystick consists of two potentiometers whose rotors are mechanically linked by a two-axis coupler and shaft assembly. Movement of the shaft (the "stick") along either the x or y axis moves the rotor of the respective potentiometer. Off-axis movements of the stick move both rotors, each in direct proportion to the direction and displacement of the stick.

In a typical analog joystick, a dc voltage is connected across each potentiometer. A variable voltage appears at the ro-
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Joysticks, light pens, trackballs and mice are all pointers.

tor terminals. Thus, as the stick is moved, analog-to-digital conversion circuitry in the computer transforms the variable voltage into digital bytes that can be processed as data entries or used to move a cursor.

Some analog joysticks have a "floating" stick that remains where it is moved. Others are equipped with springs that return the stick to its center position when it is released. Some center-return joysticks can also be operated in the floating mode.

The digital joystick, commonly used with many low-cost home computers, is much simpler in design. It generates an output byte when its shaft is moved in each of eight directions. A typical digital joystick contains only four switches. The additional four output bytes are generated when two of the switches are simultaneously closed.

Analog joysticks are usually operated in an absolute mode in which the cursor follows the position of the stick. Digital joysticks are rate devices. The cursor moves in the direction the stick is moved. When the stick is returned to its center position, however, the cursor simply stops moving. The next time the stick is moved, the cursor follows in the same direction. Some rate joysticks increase the speed of the cursor as the stick is moved farther from its center position.

Recently the features of absolute and rate joysticks have been combined in a hybrid device called the absolute/rate joystick. One such device normally functions as a rate joystick. When a small switch on the stick is pressed, the joystick functions in the absolute mode. The absolute mode permits very quick movements of the cursor to a general area of interest, while the rate mode allows the cursor to be precisely located.

Quality joysticks for use with personal computers cost under $50, a good buy considering the ruggedness of most

The Mouse

The mouse is a movable pointing device. About the size of a bar of soap, most resemble an up-side down trackball designed to be rolled across the surface of a desk. Others incorporate optical sensors that generate pulses as the mouse is moved across the surface of a specially marked grid.

Developed more than fifteen years ago at Stanford Research Institute, the mouse has only recently come into widespread use. It's biggest proponent, Apple Computer, has staked its future on the viability of the mouse as an efficient, effective pointing device. Both Lisa and Macintosh replace function keys and complicated sequences of keyboard commands with on-screen options and icons that can be quickly selected by moving a small mouse-driven, on-screen pointer over them. The selection is then implemented by pressing a button on the mouse.

It's important to understand the differences between mechanical and optical mice. A mechanical mouse detects movements of its rotating ball using the same methods applied to trackballs. Some mechanical mice create noise when they are moved. And the ball can transfer eraser particles and other debris
from the desktop to the inside of the mouse's housing.

Optical mice have no moving parts. But the grid-marked pad they require occupies valuable desk space.

An ongoing debate among mouse manufacturers concerns the number of switch buttons on the device. Apple claims the best approach is a single switch that can be operated in three modes. For example, one press might select an option, two presses might implement an operation and continuous pressure might draw a line.

Others claim that multiple buttons are best. They note, for example, that several buttons allow lines to be drawn without the nuisance of having to press continuously on a switch.

How effective is the mouse? A 1978 project known as the Xerox study compared the relative effectiveness of the mouse, joystick and cursor and text keys for text selection and editing purposes. The mouse was "... found to be the fastest on all counts and also to have the lowest error rates." (Stuart K. Card, William K. English and Betty J. Burr in Ergonomics, Vol. 21, No. 8, pp. 601-613.)

These advantages, however, must be viewed in light of the mouse's drawbacks. These include the fact that it requires space and is totally unsuited for use with laptops and other portable computers. Furthermore, long-term operation of a mouse is more fatiguing than a joystick. Finally, the mouse is more expensive and more fragile than most joysticks.

**The Light Pen**

There's something magical about a pen that leaves behind a trail of color as it is moved across the face of a computer screen like an electronic paintbrush. And since the light pen is held and used like a pencil, it's operation is much more natural and familiar than most other pointing devices.

The operation of a light pen is less mysterious than it appears. The screen of a cathode-ray tube used as a computer display is repeatedly scanned by a tightly focused electron beam. Therefore, because of the slow response of the human eye, the entire screen appears to glow. Actually the glow is caused by a fast moving dot of light that can be easily sensed by a phototransistor or photodiode in a light pen.

The light pen generates a pulse when it detects the sweeping dot. Since the position of the dot at any time can be easily determined, the computer "knows" exactly where the light pen is pointed. Depending upon the software, it can then light (or extinguish) a pixel or select a menu option.

Recently several light pens specifically designed for home computers have been developed. Some cost as little as $25. Much more sophisticated versions can cost more than $100 and are sold with surprisingly complete software packages.

Worse, it's both tiring and unnatural to draw with a light pen on a typical computer monitor screen for extended periods. These drawbacks may not be significant when the light pen is used for relatively short sessions. And they can be eliminated entirely if the display screen is mounted in a horizontal position. The screen then becomes a properly positioned sketchpad on your desk or tabletop for the light pen.

**Touch Sensitive Screens**

Touch sensitive computer monitor screens permit an index finger or, perhaps, a stylus, to function much like a light pen. They provide a very simple and totally natural interface between a computer and its operator.

Because of the relatively large size of even the smallest finger tip, however, touch sensitive screens have low resolution. While they are fine for selecting menu options, they cannot be used to point to a single character or digit.

Some shopping malls have replaced their directory signs with a computerized touch screen system. Shoppers can find directions to any store in the mall simply by touching the appropriate category in the listing on the screen and, when it appears on the screen, the store's name. Instructions for finding the store then appear on the display.

Several sensing methods for touch screens are in use. The simplest incorporates two clear plastic sheets, each coated

(Continued on page 114)
New Architectures

Novel computer designs promise a dramatically faster generation of computers

BY ED TEJA

Designing computers that run faster than existing models is a never-ending challenge facing computer scientists. The task is largely a matter of looking at the places where a little more speed will make a lot more difference in the overall system performance.

A block diagram of conventional computer architecture is shown in Fig. 1. What can be done to speed it up? Without changing the architecture, about all a designer can do is choose newer and faster microprocessor chips. Since the processor does the bulk of the work in this design, faster processors usually mean faster computers. As a result, a great deal of research effort has been dedicated to finding new manufacturing processes and materials that will provide us with faster processors.

The point here is that steps one and two can be executed in any order, or, and this is important, they can be executed at the same time without adversely affecting the result. So instead of the system waiting the time it takes to perform two multiplications sequentially, the system could assign both at the same time. In an 8086 processor, the simplest possible addition, a register-to-register immediate, takes three clock cycles. Doing all three steps in sequence would require three complete clock cycles for each addition.

Adding Specialized Processors

But this describes the solution—what does the hardware look like? To put several processors to work in a single system requires a new architecture. The simplest approach is to extend the basic architecture somewhat, using one or more specialized processors that are optimized to repetitively perform a specialized task. Take, for example, the math coprocessor. No one, even computers it seems, likes to do arithmetic. Math is the processor's most difficult task. Therefore, nearly every one of the popular 16-bit microprocessors has a math chip available to work with it. This chip, the coprocessor, sits on the bus along with the microprocessor and handles all math processing—at much higher speeds than the processor could handle them.

Using the math coprocessor to save system time is fantastic if the application is sure to encounter certain types of math problems over and over again. But while the math processor is working, the main processor takes a vacation. It will pass the math problem to the math processor and wait for the answer; it won't do part of the math itself. So you still wind up doing all three steps of our problem in sequence. It is more of a divide-and-send-the-parts-to-a-specialist approach than it is divide-and-conquer.

We are stuck with what is termed a control-flow or control-driven computer architecture; a design developed in 1945 by John Von Neumann. The diagram shown in Fig. 2 describes the flow of data.
and instructions that defines the basic Von Neumann computer architecture.

The program counter (PC) plays an important role in Von Neumann's design—it controls the passage of instructions from memory to the processor. The PC tells the processor the next activity that should take place. The processor itself decodes and executes each instruction. The instruction will contain the coded address of the data. Before the processor can execute the instruction, therefore, it must first fetch the data from memory. Another part of the instruction tells the processor where to store the results when it is through executing the instruction.

Adding a coprocessor doesn't really change the computer's design—it extends it. We have modified the flow of data and instructions a bit so that the path appears as shown in Fig. 3. When the PC indicates that an instruction must be executed, the processor must still decode the instruction, but the math processor can access the data directly.

**Extending Control-Driven Computers**

You can gain a great deal more speed by extending the control-driven architecture until it resembles a tree, with a central processor passing tasks off to independent processing elements running concurrently (Fig. 4.). Each processor has access to the data directly, allowing it to run independently of the other processors. In the case of one such machine, the Non-Von 1 currently under development by a group headed by Dr. David Shaw at Columbia University in New York, each processor has its own path to memory via an intelligent head unit—a disk head that will read just the data needed by the processing element that it serves. (For more information on this project, see the accompanying sidebar.)

All control-driven machines suffer from one weakness—the programmer must decide, and then specify, how each problem will be divided among the processors. The central processor has no inherent way of knowing which pieces of the job can be performed concurrently. The programmer must subdivide the work; the central processor will assign it. Programming, therefore, becomes more of a chore with the enhanced architecture than it was on simpler machines.

**Data-Driven Machines**

But extending the existing architecture isn't the only way to improve performance. A new generation of designs might manage to gain speed and avoid the problems and limitations of control-driven machines by abandoning the Von Neumann approach altogether. Unlike the coprocessor approach, they will configure the processors as equal general-processing units that operate concurrently. And unlike the Non-Von-1, these machines will automatically uncover the concurrency within a problem.

Instead of using a program counter to control the flow of data and instructions, these machines will be either data- or demand-driven architectures. Let's see what that means.

Data-driven machines quite simply call for a processor to execute an instruc-
the information in the token indicates that other data is needed, the processor will monitor the network for data addressed to the same location as the current data. If no other data is needed, the processor will fetch the appropriate instruction and execute it. The processing unit then transmits the results via the network, to the destination required by the tokens.

The University of Manchester has developed a version of the data-driven machine that uses 12 processors. It executes 1.7 million machine instructions per second (MIPS).

**Demand-Driven Machines**

The last technique being used to make a computer's operations run in parallel is the demand-driven machine. Here, a task isn't executed until the results of that process are needed. Effectively, this prioritizes the parts of the problem.

Known as symbolic reduction machines to artificial intelligence researchers, the demand-driven engine automatically reduce a complex symbol to a simpler one, repeating this task until it can reduce it no further. In semantic terms, the machine evaluates symbols until it reduces them to actual values. The expression 3 + 4, for example, would become 7. The expression 2(3 + 4) would first reduce to 2(7), then 14.

The tree diagram shown in Fig. 6 illustrates how a demand-driven machine might execute the simple math problem we used earlier. The more complex a problem is, within limits, the more time the demand-driven engine saves when compared to Von Neumann machines.

Apparently then, systems using parallel architectures resemble networks of computers more than conventional computer architectures. Each processor does its job independently of the others the same way that each user on a network does his or her job, while sharing valuable system resources, such as a hard disk. Each user has access to the same data, the same programs, the same system capabilities. The success of the overall operation depends on how well management has divided up the problem parts and assigned them to the users.

**State of the Art**

Perhaps nowhere more than in artificial intelligence applications, where the computer is called upon to do large quantities of calculations quickly, is parallel processing awaited so excitedly. And the future is already beginning to appear. Architectures become more like networks and less like conventional configurations all the time. In other words, they become more parallel. The Lambda machine, for example, from LISP Machines, Inc. (Culver City, CA) uses a 10-MHz 68000 microprocessor and a 4-board 32-bit LISP processor that runs at 20 MHz. Each processor has its own memory and its own bus. The LISP processor uses the NuBus with its 40M-byte/s peak transfer rate while the 68000 plugs into a conventional Multibus.

The two processors are loosely coupled; the design is more parallel than many, but serves more as a practical example of the trend toward parallelism than as the first article of any particular architecture. The processors are nearly independent, but networked together.

The dual-processor environment uses the 68000 (running Unix) to handle normal system tasks; the faster LISP machine runs the AI algorithms—directly executing instructions written in the LISP programming language.

**Speaking in Tongues**

Part of the process of dividing problems and assigning tasks will reside in the system software. At least some of the success of parallel computers will depend on the ability of system software designers to develop high-level languages that take adequate advantage of the hardware. And this is no mean feat by any estimation.

At the University of Illinois in Champaign-Urbana, for example, researchers have spent 10 years working on making versions of the FORTRAN programming language that will support parallel, pipelined and multiprocessor systems. It's important that FORTRAN run on the next generation of machines, because it is the most popular language for large-scale scientific programming. Programmers want to be able to use the vast numbers of programs already written in FORTRAN. There's no pain like that of starting completely over. And most institutions won't be willing to do it.

But new languages are also being developed; languages that uniquely allow a programmer to get the most from a highly parallel structure. Many of the algorithms used in artificial intelligence have been contorted to fit the demands of conventional programming languages. Perhaps languages based on those algorithms would help break new ground in artificial intelligence.

**Getting There from Here**

Currently research and development projects to create what is called the "Fifth-Generation Computer" are underway in the United States, Japan and Europe. The Japanese goal, in fact, is to have a commercial model available by the 1990s. This drive to build a non-Von Neumann, parallel processing computer should not only give new meaning to the word "fast," but should also create a computer the likes of which we've never seen before.
WORKING FASTER TOGETHER
C&E talks with Dr. David Shaw about his efforts to build a new kind of computer
By Joe Desposito

There are various ways to squeeze more speed out of a computer, as discussed in the accompanying article. One of them is being tried by Dr. David Shaw, whom we spoke with at Columbia University in New York City. Shaw has designed a machine, called the Non-Von computer which uses massive parallelism as its underlying architecture. He contrasts his approach with other parallel processing designs, saying, "There are certainly various interesting relationships between it (Non-Von) and other architectures, but I think that most people in the field will agree—especially my critics—that it has very little to do with other approaches to parallelism.

"For one thing, many people today are trying to design parallel machines with one hundred, one thousand or at most a few thousand processing elements. Our machine, on the other hand, is really designed to ultimately use a million processors or something on that order. And you have to use those processors in completely different ways. Some of the influences on this architecture were, first of all, thinking about humans and how they work, and the association with parallel processing. We seem to come up fairly rapidly with many associations to a single concept. Also, there's the notion of massive parallelism. We know that the brain is made up of a tremendous number of neurons, and that there are a tremendous number of interconnections between them. Even though the neurons work quite slowly—in comparison to a computer a brain works extremely slowly, or at least an individual neuron does—when you put them all together, the net processing power of the brain seems to be sufficient to do all the things that we do. It's not that Non-Von is an attempt to be a brain by any means. And it's not that I believe that the brain is organized that way. But those are some of the subtle influences that pushed me in that direction."

Dr. Shaw's knowledge of the brain's structure doesn't come from casual reading about the subject. He studied experimental cognitive psychology at the University of California at San Diego (UCSD). His advisor there was very interested in using the computer to model how people think and remember things, what attention is all about, and so forth. That's what first got Shaw interested in making computers do things that seem to require intelligence. He went on to do graduate work at Stanford University, one of the two important research centers for that type of research at the time.

Shaw studied at the artificial intelligence laboratory there, trying to make computers do things that we consider intelligent. Near the end of his graduate career he realized that, even if he and his colleagues could figure out what thought is about and how you might trick a computer into imitating it, available computer power would be a limiting factor. That is, even if they were able to figure out how to get a computer to understand people speaking English and figure out what they were talking about—and there were still a lot of problems as to how they would go about achieving this—it would take existing computers hours to do things that ought to happen in seconds. That led Shaw to look at radically different ways of organizing computers to enable them to do work much faster. Most of his research over the last
New Architectures

five years has focused on this problem. He has also done work on artificial intelligence, database management, and other applications of computers. But his main concern is how these tasks can be done dramatically faster using completely different types of computers.

Dr. Shaw's perspective is not only theoretical; it's practical, too. Before he got his PhD at Stanford, he took out some time to start his own corporation and he ran it for three years. This gave him a slightly more practical perspective on the question of computation. It was really the first time that he stopped thinking about how "thought" could be accomplished on a computer and started to consider questions like efficiency and what computers really are and how they are organized.

What's the current status of the project? Dr. Shaw says, "There have been two significant milestones to date. One was having a chip that was 100% functional. The chip had a single processor on it, not the eight it will ultimately have, but it executed all of the instructions perfectly. That was just recently accomplished. The next big milestone will be producing our first prototype, a very small one. What we'll be doing is hooking up 64 of these single-processor chips in the same way that they will be hooked up in the final machine. So it will be a real Non-Von machine, but it will only have 64 processing elements. It won't be enough to demonstrate anything useful in terms of speed, but it will demonstrate that the approach works and give us the signal that our further work will be likely to produce a machine that could do something—funding permitted. The time that we're shooting for is the end of this year. At that time we should also have software to run on the machine. It won't be very extensive—just some toy programs—but we would be able to demonstrate a working machine.

As director of the project, Shaw oversees both the hardware and software development of the machine. However, the key person involved with the hardware effort is research engineer Ted Sabety, who has three other full-time engineers on his staff. In addition, he has a fairly large number of students working either for him or one of the other engineers. Although they aren't full-time staff members, per se, many of them spend huge amounts of their spare time on the project. "Because it's an exciting project for them," says Dr. Shaw. On the software side, most of the work has been done by PhD students doing theses, who report directly to Shaw. "We have had at least 60 people thus far writing software for Non-Von, or rather simulating it," says Shaw, "since we don't have a computer actually working."

Creating a new computer means using existing software and hardware as your primary tools. Dr. Shaw's group first defined what they wanted their computer to be and then went to great lengths to simulate it at various levels of detail. In fact, they have five levels of simulation for the machine. The first is to see whether or not programs can be run on it. Then there is a more detailed level to find out if the data is transferred between the registers the right way. The levels go all the way down to testing the primitive physics properties (device physics) that described the behavior of the transistors. Much of the work was done using ordinary computers, mostly from Digital Equipment Corporation (DEC). Software simulation is one part of the project and it is proceeding for designing later versions of the computer and for writing new programs for the one being implemented now.

The other part is the actual hardware design, which involves design of the chip. For that they use color graphics displays connected to DEC VAX computers. They also use a whole set of design tools imported from places such as Berkeley and MIT and software that they wrote themselves. The final part of the process is submitting integrated circuit chips to a manufacturer, first with various components of the processor, then with larger and larger pieces until a complete processing element is built. With this final step of processor design already completed, they have begun ordering all the components for the first prototype, Non-Von 1. They now have to put the whole system together. "And find out why it doesn't work the first time, because it never does," commented a smiling Shaw. "At that point we'll be able to perform some really interesting experiments with it."

Where does the broad range of abilities needed to build Non-Von 1 from scratch come from? "No one person on my staff has all those abilities," says Dr. Shaw. "For example, Ted Sabety came to us from Hewlett-Packard's integrated circuit labs where he was involved with several things. He was himself an IC designer, but also a consultant within the company, telling other people various things about how IC design works. This is, in fact, one of our advantages over many universities—most of them don't have a Ted Sabety. They have mostly university people who have learned about the process of IC design through a very effective system of teaching it, which has been spread through the country during the past three years. But the system doesn't help you get out of serious unexpected binds that come up when you're building a production chip. And then we have people with different sorts of experience in other technologies. "We also go outside for help—often to our competitors. For example, Chuck Seitz of Cal Tech, who I think is one of the most gifted researchers in this field, is building some very interesting machines that are organized according to completely different principles. He doesn't really agree with our basic architectural principles, but we enjoy talking to each other, and he has helped us tremendously in thinking out how we were going to do our timing and solve other system problems."

Does Dr. Shaw see commercial viability down the line? "I'm not sure about that," he says. "There seems to be some evidence in selected areas to indicate that it ought to be commercially viable. But we won't know until we actually build one. But I guess I should say that we wouldn't be doing any of this unless we thought it had the that kind of potential. Not that we want to do it here, but we're really interested in producing a machine that will have a substantial economic impact. It's just a long process of research and trying it out on various applications until one knows that it's possible."

When asked whether he thinks his approach to parallelism is the best one, Shaw responded, "Again, it's hard to say. I think it's premature to say whether Non-Von or any of the other machines is using the strongest approach. Most of my serious colleagues have some ingenious ideas, and we aren't yet able to compare them. We really won't know until we see a completed machine, find out how much it costs, and see if it's maintainable, producible, and so forth. Then we can actually run some applications programs generated by real users, instead of generated just as test programs."

(Continued on page 111)
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STOCKS, BONDS & PERSONAL COMPUTERS

Brokerage firms, beginning with EF Hutton, are providing on-line access to customers' account information

BY BARBARA E. McMULLEN & JOHN F. McMULLEN

On December 13, 1983, after 5 years of planning and development, EF Hutton & Company introduced an electronic information service called Huttonline. With this step, Hutton became the first securities firm to provide such a service to its clients. It also became one of the few companies with foresight enough to design a system before it became economically feasible to market it. While we expect that EF Hutton will soon have competition, the story of this unique product warrants our attention.

What is Huttonline and why is it important? It is a system that enables Hutton's clients to use a personal computer or terminal to access Hutton's computer files containing its Research and Investment Briefs as well as the client's own accounting records. It also allows the client to send messages to his Hutton account executive (AE) through the system and receive investment reports and messages from his or her AE. The system is menu-driven, and we expect that Hutton's clients will find it easy to use. The service is available to them for an initial charge of $25 and a monthly fee ($17 for the first 2 hours of use and $7.50 per hour thereafter).

The importance of the system is hard to overestimate. In announcing the service, Norman Epstein, Executive Vice President and Managing Director of Operations at EF Hutton, said, "We are bringing our computing and communications resources even closer to the client. The home is the last frontier." We agree with Mr. Epstein and think it is obvious that Hutton has far outpaced its competitors in this area.

A service like Huttonline brings its users immense benefits that reach far beyond those directly related to investment. A significant portion of subscriptions (33% to date) come from individ-

Barbara and John McMullen each have nearly 20 years experience in data processing for the securities industry.
uals who have never before had up-close experience with computers or terminals. Using this system is bringing computer literacy to the novice; and, for many, it will be the first step toward the use of other information services such as CompuServe, The Source, and Dialog, and programs for word processing, spreadsheet analysis, and database management.

Another long-range benefit will accrue to users of Huttonline and any similar services that may arise. They will take part in a democratization of the investment decision-making process. As most insiders in the investment community know, institutions and professional investors have access to much more timely and comprehensive information and research opinion than the average individual investor. The reason for this advantage is not insidious; it relates, rather, to the cost of disseminating masses of information.

Institutions have both the capital to obtain costly services and a method of receiving such services with little or no out-of-pocket expense. As such wherewithal has normally not been available to the individual investor, there has been a decided difference between the quantity and quality of investment information available to individuals and that to financial institutions. Now, the gulf has been made smaller. Already available from Dow Jones are public disclosure information (including SEC form 10K), earnings estimates, fundamental information (from Media General), and automatic searches of the Wall Street Journal, Barrons, and the Dow Newswire. Now, research opinion and specific customer information is dispensed through Huttonline.

While the above points may be interesting from a social science viewpoint, Huttonline would have little impact if it were not an attractive product offered at a reasonable price—which it is. Furthermore, it would not be considered for discussion in this magazine if it were not an innovative system that made use of state-of-the-art electronic technology—which it does.

**Background**

Over 5 years ago, the management of EF Hutton recognized that eventually there would be the capability to deliver information directly to individual homes. They set up an organizational entity to study this rapidly developing world of microcomputers, videotex devices, and information services, hoping to determine what impact such developments might have on their own business. Chosen to head this study was Vincent T. Pica II, a staff assistant to Norman Epstein.

Pica had joined Hutton immediately following his graduation from Iona College in 1975. In the 3 years of his employment at Hutton that preceded this assignment, he had come to appreciate how well the company had responded in the past to technological opportunity in supporting its securities business. In 1904, the year the firm was founded, Edward F. Hutton helped finance the first private, direct coast-to-coast communications wire. (Hutton still holds Western Union’s contract No. 1.) Since the time when Epstein was responsible for its data processing and communications resources, the firm pioneered the following applications:

1966—Use of a third-generation, general-purpose computer (IBM System 360) for message switching and order entry.
1973—Branch-office retrieval from a central database.
1975—Installation of a comprehensive, high-speed telecommunications network.
1976—Integration of its market data system (Bunker Ramo System 7) into its private communications network.

In this environment, Pica felt confident in taking on this assignment even though it appeared that such in-home service would not be practical or economically feasible to anyone concerned until the 1990s.

By 1980, it became obvious to Epstein and Pica that technology was moving...
much more rapidly than they or anyone else had expected. To better enable Hutton to take advantage of the burgeoning technology, a new organization—MIS Operations—was set up under Pica; and his charter was expanded to include the support of microcomputers throughout Hutton's internal organization. Pica was presented with staffing and budget authorization and instructed to develop a formal plan for carrying out these responsibilities.

As a first step in the support area, Pica began planning an internal newsletter that would provide general information about personal computers, product reviews, and recommendations. To put this newsletter into operation, and to assist him generally, Pica added Lee R. Greenhouse to his staff. Shortly thereafter, EF Hutton Personal Computing Newsletter came into being.

At the same time, Pica and Greenhouse were planning the overall duties of MIS Operations. It was then, also, that Huttonline was conceived and integrated into the overall plan. The concept of Huttonline was dynamic for Pica and Greenhouse because expanding technology continually made new things feasible. Also, the planner's view of Huttonline's place in the overall scheme of Hutton operations changed dramatically. It was originally conceived as a supplementary service to benefit Hutton by increasing the number of accounts and improving the productivity of account executives through reduction of time-consuming customer inquiries. Soon, however, it came to be viewed as a significant product with a marketability of its own.

Pica and Greenhouse also foresaw that this service would attract clients who did not have either microcomputers or terminals of their own and that many of them would need guidance in selecting and installing a computer to use the Huttonline. They realized that it would be both a service to such clients and a source of revenue to sell the necessary equipment directly to clients requiring it. With the approval of management, they began to negotiate with the appropriate vendors to become what is known in IBM parlance as a VAR (Value Added Reseller).

By June 1983, it was decided that Huttonline was to be viewed as a profit-making entity. Agreements were reached with Convergent Technologies, IBM, Wang Laboratories, and Quazon, allowing Hutton to act as a vendor for their equipment. Huttonline was publicly announced and launched on December 13, 1983.

Design Considerations

There were two main goals in designing the system. The first was to provide the client with as much information as possible in the most efficient manner. The second was to insure that the system served only as a supplement to the services performed by the Hutton account executives. It was very important that Huttonline in no way reduce the responsibility of the AEs in managing the clients' accounts. The New York Stock Exchange and other agencies have "know-your-client" regulations that make AEs responsible for questioning any client trading activity that is inconsistent with either the client's stated or normal trading objectives. Nothing in the system design could be allowed to interfere with carrying out this responsibility. In short, there could be no inputting of orders directly by clients.

Another obvious design requirement was that the system be easy for the client to use. For many of them, this would be their first, and perhaps only, use of computers or terminals. Finally, the system had to be compatible with Hutton's overall high-speed communication network, Compass (an IBM TCAM communications system based on IBM 3033 and 3083 mainframes). Another new Hutton system, BIPS (Branch Information Processing System), is to be added to deliver electronic mail through Huttonline to the AE. BIPS is to be based on Data General MV/4000 superminicomputers in each of the 400 Hutton branch offices and will control over 8000 Data General Dasher and Bunker Ramo System 7/90 terminals. It will operate under Data General's CEO (Comprehensive Electronic Office) automation software.

System Configuration

In selecting equipment for both the client's use and the communications between Hutton and the client, Pica was concerned with imposing as few technical restrictions as possible on the client. He wanted any client anywhere to be able to access the system through public telephone lines (at local rates) using whatever terminal, personal computer, or communications device was available. This precluded terminals designed exclusively for use with Huttonline as well as the use of private communications lines connected directly to Hutton. According to Epstein, the aim was "to deliver services to clients through any ap-

(Continued on page 112)
IN-CIRCUIT EMULATION

A diagnostic approach to fixing a microcomputer from the inside out

BY LES SOLOMON

For a computer to run such a utility, the bulk of the system must be operating. This includes the microprocessor, RAM, ROM, I/O port, the disk controller, the diskette, and the bulk of the ICs in the system.

Then there is the question of disk-based CPU diagnostics. If the CPU is bad and requires the diagnostic, how do you run it?

To further compound the problem, it is always possible that the hardware is good, and the fault is in the software. Then what do you do?

There is an answer to this seemingly unanswerable paradox, and it is called "in circuit emulation," or I.C.E. for short.

To use this approach to digital servicing, in which every element in the faulty computer can be tested, all that the non-working system needs is system operating voltage (usually +5 volts) and "clock." That's all. The emulator doesn't need any of the target system's memory or I/O.

The operating voltage can be checked using a dc voltmeter, while almost any oscilloscope can show the presence of the clock signal at the pertinent CPU chip and bus pins.

An emulator can be used for debugging hardware and software, pinpointing potential problems before production, or for on-site repair calls to save the expense and bother of bringing complete systems into the shop for repair when only a plug-in board has a fault.

For the sake of this discussion, consider a hypothetical situation in which your computer's disk drive is acting up. Thus, even if you had the best diagnostic utility on the planet, there would be no way for you to load it.

How It Works

An emulator is a digital diagnostic device that permits complete control of the target microprocessor's function, including control of every device connected to the system bus. Although em-
ulators are (or soon will be) available for almost every microprocessor, our attention here will be devoted to a low-cost emulator for Z80 systems from Nicolet Paratronics Corp. of Fremont, CA.

To get started, as shown in Fig. 1, the microprocessor in the faulty computer is removed from its socket, and replaced by a plug with similar pins that is connected to the emulator control unit via a lead-mating pod. The emulator contains a microprocessor identical to that removed from the faulty system, and has its own dedicated operating system in ROM. Thus, in its most basic mode of operation, the emulator “tricks” the target system into “thinking” that nothing has changed. The emulator operating system is controlled by a conventional RS-232 terminal driven by circuits within the emulator.

However, as selected via the RS-232 terminal, the emulator firmware allows examination and modification of the microprocessor’s internal registers, and provides the capability to alter and manipulate the system RAM, to implement and observe system I/O operations, to control interrupts, to single-step the program to trace instructions, and to perform all the functions shown in Table I. Thus, almost all possible functions in the target system can be tested and checked.

In the following discussion, all emulator commands and the resulting CRT screen displays are specific to the Nicolet unit.

**Basic Operation**

Since emulation is at the CPU (machine language) level, it is very important that the user have a full understanding of the machine-language code of the program being run on the faulty target system.

When the target computer is turned on, it must first be reset. This is done automatically in many systems.

The reset command places the emulator in the GO mode which permits the target system to operate just as if its own microprocessor had never been removed. In this mode of operation, the emulator is said to be transparent to the target system.

The RS-232 terminal screen display will then produce a status message to indicate that the terminal, emulator, and the target system are all properly interconnected. If by chance, the disk drive problem goes away, then the Z80 that was removed from the faulty system was the problem.

Unfortunately, things are rarely that easy and the disk drive will probably still give you trouble. At this time, the best approach is to halt CPU operation and examine the processor registers, particularly the program counter which will tell you whether or not the target system is even executing the program within the disk driver routine.

After the prompt is displayed (in the case of the Nicolet instrument, this is an OK followed by an arrow), the user types in the Q (uit) command. This act stops the Z80, inhibits interrupts and bus requests, and displays a listing of current Z80 registers and the SZHVNC system status flags on the CRT screen as shown at the top of Fig. 2. Note that the program counter (P register) is at address E701 which is where it should be when exercising the disk driver routine in this particular program.

The next terminal entry is the T (race) command which is used to follow a program through one or more instruction steps. After each instruction is executed, the monitor CRT displays all the CPU registers and flags.

When the T is used alone, only a single instruction is traced. When a T is followed by a number such as 4 (as shown in Fig. 2), that number of instructions will be traced and displayed.

Examining these particular instructions, and comparing them to what should be going on according to the program, shows that the disk driver routine is functioning as it should.

Up to this point, everything looks normal. So, the next thing is to test the target system memory. This is accomplished by entering MT (memory test) after the prompt, followed by the starting and ending addresses (E800 and E8FF in the example shown in Fig. 3). This particular memory test uses a “walking” 1s and 0s pattern. If an error is detected, the address of the failed bit is displayed, otherwise the OK prompt appears. It takes approximately 15 seconds to check each 1K block of memory.

If the target system passes the memo-
ry test, the next step is to check the status of the disk I/O port. This is done by entering the command E (xamine) after the prompt followed by the address of that port (FF in the example shown in Fig. 3). The emulator returns 80H from the port which, according to the program, indicates that the disk drive is ready.

The fourth line in Fig. 3 shows the use of an O (output) command to send instructions to the disk head at port FE. The instruction 81H loads the disk head and sets the direction to "out."

The fifth line shows a simple routine that first sends a 0 to port FF, followed by a 1, a 0, and the command RL (Repeat Line). The effect of this alternating sequence is to skip the disk head from one track to the next in a continuous fashion so that the disk drive circuit can be checked with an oscilloscope if desired.

Thus, even with just a handful of the 48 powerful commands shown in Table I, you will note that an emulator permits some fairly in-depth tests.

**Bells and Whistles**

Most emulators display instructions and data from the target system in hexadecimal format. Some (including the Nicolet instrument) display this information as mnemonics—the English language equivalent abbreviation of the hex data which is far easier for the human operator to read and understand.

The process of translating a machine-language instruction into its mnemonic equivalent is called "disassembly". For example, the Z80 instruction for a jump in binary is 11000011, in hexadecimal it is C3, while the more understandable mnemonic is simply JP (Jump). An example of disassembled code for the Z80 is shown in Fig. 4.

The opposite of disassembly is called "assembly." In this mode the emulator accepts an English-language mnemonic and translates it to machine language for use by the processor. For example, if the programmer wants to jump to a particular item, he writes JP xxxx where the xxxx is the address to which the program should jump. The assembler converts this to the machine readable binary 11000011xxxx.

An emulator having assembly and disassembly capabilities and used with a computer (instead of just with a terminal) produces a Microprocessor Development System that can be used to develop, test, modify, and patch software in a target system.

**Emulator Design**

The block diagram of a typical in-circuit emulator is shown in Fig. 5.

To accomplish a low parts count (six ICs), Nicolet elected to use a 6-MHz Z80B as the main processor, a custom control microprocessor that incorporates the operating system within its internal ROM, two high-speed custom logic arrays, a PROM containing the assembly/disassembly routines, and an address latch for the PROM.

Some emulators multiplex a single CPU to perform the functions of both main and control CPUs. In the Nicolet instrument, the Z80B takes the place of the CPU removed from the faulty target system and acts like a Z80 and nothing more. The separate control CPU handles all aspects of the emulator including command execution and error reporting.

The high-speed logic arrays, under the control CPU, gate the Z80B's control lines as well as stopping the Z80B at particular states so that the control CPU can gain access to the Z80B's data bus.

The emulator's main CPU connects to the microprocessor socket in the target computer via an interface that connects all the required signals into their respective pins on the Z80 plug. Note that this particular emulator gets its operating power (+5 volts) and clock signal directly from the target CPU socket.

The RS-232 terminal connects to the emulator via a conventional DB-25 connector, with all signals passing through the proprietary logic arrays. An algorithm is provided within the emulator operating system to automatically set the communication rate between 150 baud and 19,200 baud by measuring the length of the first start bit transmitted from the terminal when a carriage return is entered.

**Conclusion**

You can now understand why in-circuit emulation is a very powerful diagnostic tool that can be used even with a "crashed" computer. When will such potentially useful instruments become readily available? Well, up to now, they cost several thousand dollars, but it is hoped that the introduction of the Nicolet emulator which is priced at under (Continued on page 98)
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Leading Edge WP
(Continued from page 47)

what special attribute has been given to that text).

Other special attributes include superscripts and subscripts, bold, special fonts (italics or other possible type styles), overstrike (where one character is printed over another to create special, non-standard symbols), and color (for display on the color monitor and eventual printing in color if you have the required peripherals).

Safety Features

Basic word processing packages just sit and take all the words a typist can throw at them. It's only when you go to save a document that anything is actually recorded on disk. The problem with this is that, if there is a power failure, or somebody removes your disk without typing "KD," or some other hallowed command, you lose your precious data.

The Leading Edge Word Processing package, however, offers users the ability to automatically create backup versions whenever they load an old document. (The system tells you that it's doing this when you enter the program.) I liked this feature, and you can turn it off if you are running short of disk space.

Another handy feature is that the program will occasionally save text to disk while you are actually typing. This can be a little disconcerting at first. In fact, since I once lost most of a 3000-word original article to a word processing program that had a similar feature, I am a little sensitive about such matters. In software design circles, it's a controversial issue whether or not programs should automatically carry out certain actions without the users' prior knowledge. I guess this kind of thing is just a question of personal taste.

As an experiment to test the program's ability to automatically save text

OVERVIEW

Product: Leading Edge Word Processor
Manufacturer: Leading Edge Products, Inc.
325 Turnpike Street
Canton, MA 02021
Price: $295 ($350 with mergeprint option)
Operating System: MS-DOS, PC-DOS
Memory Required: 256K
Disk Requirements: Two drives recommended

The Leading Edge Word Processor is a powerful one, and quite well designed for its intended task. It should find particular favor among those who learned word processing on Wang equipment and want to use a similar system on their personal computers.

and cope with a power failure, I created a small document and then switched the power off. On restarting the system, the program discovered that the document had been damaged in some way and announced that it was trying to repair it.

When the document was finally displayed, it was in just about the same condition as it was before I yanked the plug—only odd bits of garbled text had to be retyped.

The main documentation provided with the program is quite good, and should present the user with few problems (an "800" number is listed to call if troubles do occur). The documentation provided with the tutorial disk is another matter. While the tutorial lessons do show off the various features, they are a bit "over-the-top" and "gee whiz!" about it all.

While I'm not sure that the Leading Edge Word Processing package is "the most powerful word processing package created for the IBM Personal Computer," it has a lot to commend it to those users appalled by many of the other products on the market.

TWO DBASE II FRONT ENDS

By Robert Rioja

If you have ever needed to set up a specialized database on your computer, chances are you have done it with Ashton-Tate's DBase II. Although other database management programs may be easier to use, DBase has gained great popularity because of its inherent power. However, this power comes at a price: it requires you to learn DBase's unique language, which is often difficult to master. So you must spend time programming, testing, and debugging.

You can write a program using DBase's Modify command, which is actually a very simple and limited text editor. Otherwise, you can use a text editor or word processor like WordStar. But mastering the complexities of some of today's editors can be quite a chore. Thus, although the tools are there, using them can present problems.

To alleviate this difficulty, some clever people have come up with program generators—or "front ends"—that actually "write" DBase programs for you. These programs let you specify the characteristics of your database, and then generate a (presumably) bug-free program that can be run immediately by DBase. Of course, you can modify the program so generated at a later time to optimize it for your needs. Two such program generators are Quickcode and Autocode I.

Quickcode

Quickcode, from Fox & Gellar, is a huge program that consists of one main module (33K) and some twenty program overlay modules. The total size of the file on the Quickcode distribution disk is 229K. (As compensation it should be noted that Quickcode can generate code without DBase being present.) It is fairly obvious that one should think twice before running Quickcode on a system with low-capacity disk drives. In fact, when you consider the space needed for DBase, Quickcode, and the resulting application program, a hard disk system might be a good idea. This is especially true if you really want to use all of Quickcode's fancy features. The Quickcode manual is commensurate in size with the program, but you can get away with reading only parts of it if you are just setting up a simple database.

When you start up Quickcode, a menu filling the entire screen appears. It lists every single command and serves as a fast guide to Quickcode's capabilities. The first feature of Quickcode that you will probably want to use is its "Quickscreen" mode. This is a screen editor (Fox & Geller calls it an "electronic blackboard") that allows you to design data-entry forms with incredible ease. A data-entry form emulates on the screen a printed form, such as a driver's license application. It can contain instructions on how to fill out the form, descriptions of the data to be filled in, and blanks to write the data in.

To design such a form, you simply move the cursor of your terminal around on the screen and type in whatever descriptions, titles, prompts, etc., you wish to have. You also type in the names of each data item in the screen locations where you will be entering the data. If you want a simple database, that's all you have to do. You can let Quickcode take care of the rest. It will generate an integrated series of DBase programs that will let you enter, update, or delete records within the database. Also it will allow you to generate reports, print mailing labels, and produce a WordStar/MailMerge-compatible data file. If you don't specify any parameters, Quickcode will make assumptions and decide for you how to print the reports,
labels, etc. It will even decide how to set up menus so you can tell the program what to do next!

If you have a clear idea of what you want the program to be generated to do, you can give Quickcode all of your specifications and it will use them instead of making assumptions. For example, you can specify the exact nature and contents of each report, the actual wording of each menu, and perform complete data-entry error checking. If you are willing to learn all of the intricacies of Quickcode, you can tailor the programs it generates to your heart's content. However, if you don't feel like specifying every detail, Quickcode will not proach you but will use its default parameters to produce a complete, working dBase program.

The Quickcode manual has almost 170 pages. It is well organized and easy to understand. Its first section, "Instant Programs," gives an overview of Quickcode and shows how to create simple dBase programs very quickly. We generated a name-and-address database program in less than 15 minutes!

The second section of the manual, "Quickcode in Detail," explains how to make Quickcode generate tailored database programs. With a little practice, it was possible to set up relatively complex programs in half an hour. All this without once typing a dBase command! It is far easier to master Quickcode than it is to master dBase.

The third part of the manual, "Your Quickcode Programs," gives an insight into the dBase programs that Quickcode generates and is intended for those who are already somewhat familiar with dBase programming. Unfortunately, although the manual does explain every command, and gives examples of how to use each one, it does not contain a complete example of how to set up a database from beginning to end. You have to study the manual and learn what each command does. This means that if you are an absolute beginner, it may be difficult for you to follow the manual. Although a brief section on database terminology is included, it assumes you already have some background.

We didn't realize all that Quickcode was really capable of doing until we asked it to set up a simple database and saw the results. All in all, we were really impressed by Quickcode.

**Autocode 1**

Autocode 1, by Stemmos, Ltd., is a compact program generator for dBase II that should run well, even in floppy disk based systems. (The .COM file is only 7K long; the distribution disk contains a total of 138K.) To generate a database program, you must use it in conjunction with dBase; Autocode cannot stand alone the way Quickcode can. The manual consists of a user's guide of some 50 pages, and a larger "Book of Examples."

To use Autocode, you must first decide exactly what the program you want it to generate is going to do for you. Autocode will not make any decisions for you and has no default parameters. Although using Autocode is considerably easier than using dBase, it has no "quick-and-dirty" mode, so you must define all parameters for all databases. Fortunately, Autocode prompts you for all of the information it needs through a series of well-documented menus.

To set up a data-entry form, dBase must be used. You use the dBase Modify text editor to create the form using your terminal's cursor controls. This is similar to Quickcode's "Quickscreen" mode as explained above. Once you have used the dBase screen editor to set up the data-entry form, you can use the Autocode to generate the program that will employ the form.

When Autocode is run, it presents a simple menu with the following three selections: Menu Generation, File Maintenance Generation, and Report Generation. Each of these must be selected in sequence so that Autocode can generate the necessary dBase programs. Then, through sub-menus and prompts, Autocode asks you for every single scrap of information it needs. The user's guide has excellent examples that lead you step by step through the entire process.

Menu generation allows you to define the exact wording of whatever menus you may need to handle your database. This is actually the easiest part of Autocode.

The report generation lets you define your report formats very easily. Autocode simply presents on the screen a form for you to fill out with specifications such as page heading, lines per page, page width, totals and subtotals, formats for each column, selection criteria, and so forth.

**Evaluation**

It is difficult to say which of the two programs, Quickcode or Autocode, is better. Each has its pros and cons.

Quickcode is totally self sufficient, while Autocode relies on dBase's Modify command for screen generation. Although this seems to give Quickcode an edge, it is not necessarily a big one. Quickcode is great for quick-and-dirty work, but also allows you to go into detail should that be required. Autocode has no quick-and-dirty mode, but its menus and prompts make even detail work a snap.

The Autocode manual is definitely easier to read and understand. All of the instructions are printed on white paper, while the examples are printed on light blue paper. This allows you to easily distinguish instructions from examples as you leaf through the manual, and is a terrific idea. Autocode also has a separate book of examples that contains nine complete Autocode-generated programs covering such areas as payroll and stock control. Quickcode has the built-in ability to print mailing labels, as well as the WordStar/MailMerge interface referred to as the "WordStar Connection."

Both programs are well documented, easy to use, and require no dBase programming knowledge. Best of all, both seem to work quite well, although they are sold "as is" and neither is guaranteed by its manufacturer to produce perfect results.

If you are interested primarily in simple databases requiring virtually no work on your part, Quickcode is for you. If you are willing to do a little work to produce better application software, either program will do, although Autocode 1 is probably easier to use because of its example-filled manual.

**OVERVIEW**

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<th>Program Supplier</th>
<th>Quickcode</th>
<th>Autocode 1</th>
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<tr>
<td>Supplier</td>
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<td>Stemmos, Ltd.</td>
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<tr>
<td>604 Market Street, Elmwood Park, NJ 07407</td>
<td>666 Howard Street, San Francisco, CA 94105</td>
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<td>CP/M-80, CP/M-86, PC-DOS, MS-DOS</td>
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Both programs do their job well, although, in some cases, it may be possible for a programmer to work in close terms with dBase II to create a more elegant code. If disk space is no problem and your needs are not too demanding, use Quickcode. If your disk capacity is limited, or if your needs are complex and require some customization, use Autocode.
WITH IBM PC AT THE OFFICE AND PCjr AT YOUR HOUSE, YOU CAN TAKE WORK HOME ON YOUR LITTLE FINGER.
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Now, much of what you start at the office, you can finish at home, and vice versa. And while you're at the office, your family will find plenty to do with PCjr.

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PCjr is a powerful tool for modern times. With easy-to-follow new IBM Personal Computer programs, and with options like a printer and an internal modem for telecommunications, it can handle a great variety of jobs. Children can learn new ways of learning, and make short work of homework. Adults can keep track of household expenses, write letters, file tax data, plug into information networks. And everyone can enjoy challenging new cartridge games.

IBM designed PCjr with lots of bright ideas to make computing easier.

The "Freeboard"—a keyboard that doesn't need a connecting cord—is easy to get comfortable with.

Built-in picture instructions can help the first-time user get started.

Diskette-drive systems include a program that allows users to explore computer fundamentals at their own pace. And to get PCjr up and running from the very first day, a sample diskette with eleven useful mini-programs is also included.

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For a demonstration, visit an authorized IBM PCjr dealer or an IBM Product Center. And you can find the store nearest you with your little finger. Just dial 1-800-IBM-PCJR. In Alaska and Hawaii, 1-800-447-0890.

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NEW PRODUCTS

IBM-COMPATIBLE COMPUTERS
Zenith Data Systems' new Models Z-150 PC and Z-160 PC are claimed to be fully hardware and software compatible with third-party hardware and software designed and written for the IBM PC. The desktop Model Z-150 PC and Model Z-160 PC transportable share features 5-MHz 8088 16-bit CPU; 128K (expandable to 640K) of RAM; color/monochrome graphics with 80 × 25-character text and 320 × 200-pixel color or 640 × 200-pixel monochrome graphics resolution; detached keyboard with large RETURN and SHIFT keys; two RS-232 serial and one Centronics parallel I/O ports; RGB color and composite monochrome video outputs; and four user-available expansion slots. With the Z-150, display monitor is optional, while the Z-160 has a built-in 9" amber picture tube. Both computers are available with one or two 320K 5 1/4" disk drives. The Z-150 is also available with a single 5 1/4" floppy drive and 10.6M hard disk system. Z-150: $2699 with single drive, $3099 with dual drives, $4799 with one and one 10.6M hard disk; Z-160: $2799 with one, $3199 with dual floppy drives.

Circle No. 63 on Free Information Card

INTELLIGENCE FOR DUMB TERMINALS
"Screenstor" from Climax Computer Corp. provides dumb terminals with off-line intelligence and memory. It connects to any dumb terminal's RS-232C serial port and provides: up to 100 pages of memory; parameter and character conversion features and translation facilities to standardize different terminals; auxiliary printer/computer port; easy-access prompt menu; back/forward scrolling; character search facility; function key capabilities; character-by-character display. Technical features: three programmable RS-232C serial ports; 300 to 9600 baud rates; odd/even/no parity; 1/1.5/2 stop bits; full/half duplex and synchronous/asynchronous operation; XON/XOFF protocol; battery backup of parameter memory. $485. Address: Climax Computer Corp., 4790 Irvine Blvd., Suite 105-172, Irvine, CA 92715.

SOFTWARE SOURCES

Spreadsheet Calculator. Videx's UltraPlana spreadsheet program for use in Apple II and IIe computers is designed to automatically take advantage of a wide range of memory cards, up to a total of 512K, as well as Videx display cards. The program has a command structure similar to that of VisiCalc and includes individual column widths and a variety of security commands. With UltraPlan, standard VisiCalc or DIF data files can be used to insur compatibility with a wide range of programs. UltraPlan has easy-to-follow menus for printing and accessing the disk and can be used with Videx's own 132-column by 31-line display peripheral or in Apple's 40-column mode. UltraPlan supports upper- and lower-case text characters, uses control characters to move the cursor around the screen, and features individually adjustable column widths.

Circle No. 92 on Free Information Card

Graphics System. Chalk Board's "Leo's 'Lectric Graphics" computer graphics package gives the user the ability to construct finger-painted multiple-contact drawings or to draw fine point-to-point pictures. Built-in structures permit pushbutton creation of such basic shapes as circles, triangles, rectangles, and straight lines. 'Lectric Graphics also features a slide-show capability. $199.95 for IBM PC. Versions also available for most home computers.

Circle No. 93 on Free Information Card

COMPUTER PROTECTOR PAD
3M Static Control Systems' "First Touch" Series 900 Static Control Computer Pad for desktop computers is designed to save on computer malfunctions due to static discharges. The 24" X 26" X 1/8" (trimmable) pad consists of a semiconductive vinyl overlay and a highly conductive "scrim" intermediate layer bonded to a nonskid, noise-reducing foam backing. When grounded, the pad protects the computer from static-induced damage by draining static charges from the operator to ground in less than 0.5 second. $69.95.

Circle No. 84 on Free Information Card

AmericanRadioHistory.com
RGB CARD FOR APPLES

Amdek has introduced the Model DVM-III RGB card for Apple computers. The card fits into slot seven of the computer and reproduces on RGB monitors the video modes that the computer is capable of displaying in NTSC or composite-video monitors. The DVM-III permits user selection of text color by setting soft switches on the board. Modes supported include: 16-color low-resolution with option of mixing 40- or 80-column text; 16-color medium resolution with option of mixing 80-column text; 6-color high resolution with option of mixing 40- or 80-column text; 16-color double high resolution (140 × 192 pixels) with option of mixing 80-column text; and monochrome double high resolution (560 × 192 pixels). The card is compatible with all Apple II 40-column software.

Circle No. 85 on Free Information Card

PORTABLE 16-BIT COMPUTER

Packaged in an 18" × 15" × 3" attache case and weighing less than 16 lb, the Commuter from Visual is an IBM PC workalike in a go-anywhere portable. It is claimed to be hardware and software compatible with the PC and includes as standard features: 8088 CPU; 128K (expandable to 512K) of RAM; MS-DOS 2.1; keyboard with all IBM functions and identical keyboard layout; 5½" (360K) floppy-disk drive with room for a second optional drive; bit-mapped color graphics support (display is optional); support logic for 80 × 25- and 40 × 25-character display; parallel and RS-232C serial ports; RGB, composite-video, and r-f outputs; and a connector for using an IBM expansion chassis. An 80 × 16-character LCD display is optional. $1995 base; $2450 with optional second drive and display.

Circle No. 86 on Free Information Card

SOFTWARE SOURCES

Flowcharting Program. Automatic drafting of program flowcharts is now possible on the Sharp PC-1500/1500A and Radio Shack PC-2 handheld computers with the Flowchart program from PocketInfo. The program lets you select from among 15 different symbols, which are then drawn on the computer’s printer/plotter. A multiple-line description can be printed alongside the symbol. $29.95 cassette. Address: PocketInfo Corp., PO Box 152, Beaverton, OR 97075.

Text Formatter. Textform from Gibson Software is a CP/M-based text formatting program for the Heath/Zenith H/Z-89/90 computers. It recognizes more than 30 text-imbedded commands, allowing the user to control page and line lengths, margins, line spacing, text centering and justification, headlining, footnoting, and text underlining. Included are commands that provide access to many of the special print modes of Epson printers. Requires a minimum of 48K of RAM and at least one disk drive. $49.95 hard- or soft-sectored disk. Address: Gibson Software, Rte. 1, Box 317, Iron Station, NC 28080.

File Management System. MegaFinder from Megahaus is a database management program for Apple II and IIe computers. It comes complete with a report generator and includes a selection of ready-made forms and reports models. With MegaFinder, you can custom design forms from scratch, as well as change existing forms, using its built-in screen editor. The program maintains information in up to four sorted orders simultaneously, each of which can be sorted in up to five sublevels. A preview mode allows any report to be checked before printing. An on-line help facility is provided to make the system user-friendly. $149.95. Address: Megahaus Corp., 5703 Oberlin Dr., San Diego, CA 92121.

Cataloging Program. Cat*Man from Zephyr is a mini-file system that lets you catalog your books, records, tapes, etc., on an IBM PC or Apple II/III computer. You input title, author, and subject for each item to be cataloged, according to prompts from the computer. Up to 5000 items can be cataloged on a single IBM PC disk (2000 on an Apple disk). The program makes it easy to add or delete items and includes a handy search function that quickly pinpoints any item or group of items called by name. Requires 64K of RAM and at least one disk drive. $19.95 for disk. Address: Zephyr Services, 306 S. Homewood Ave., Pittsburgh, PA 15208.

Spelling Corrector. Star-Kits’ Spell ‘N Fix Level II is a spelling correction program for the Radio Shack Color Computer. The program splits the CoCo’s screen into two windows. The upper window displays upper/lower-case text as it is being read, while the lower window displays program status, misspelled words, and possible alternative spellings. Supplied is a 20,000-word dictionary, to which you can add an additional 20,000 words or use alternative dictionaries. The program is self-prompting and has extensive error-recovery routines that eliminate the need for you to refer to the manual after first use. Requires 32K minimum RAM and at least one disk drive. $69.29. Address: Star-Kits Software Systems Corp., PO Box 209, Mt. Kisco, NY 10549.
NEW PRODUCTS

DUAL-DISK DRIVE
A new floppy-disk drive unit containing two half-height, 140K drives side-by-side in a single case has been introduced by Apple. Called Duodisk, the system offers improved technology and full compatibility with Apple II software at a lower price than two separate Disk II drives. Duodisk is exactly as wide as the Apple II computer and can sit between computer and video monitor. Technical improvements include a new disk-eject mechanism and advanced head-positioning mechanism for more precise reading of half tracks. Operationally identical to the Disk II floppy drive, Duodisk runs all Apple II software and is supplied with a controller card that connects to any Apple II, II+, or Iie computer. $795.

Circle No. 87 on Free Information Card

INTELLIGENT MODEM
Anchor Automation's Signalman Mark XII intelligent low-noise auto-dial/auto-answer modem is said to emulate the command structures used in the Hayes Smarmodem. It can be operated manually, through a keyboard, without computer coding, or automatically to answer or originate calls at 1200 bps for Bell 212A and up to 300 bps for Bell 103 compatibility. The Mark XII detects dialtone and busy signals and automatically displays dialing status on-screen. A CMOS microprocessor assures very low power consumption and high reliability. An RS-232 cable and two telephone jacks (one for an attendant phone) are built in. $399.

Address: Anchor Automation, Inc., 6913 Valjean Ave., Van Nuys, CA 91406.

PRINTER UPGRADE ACCESSORY
Finger Print from Dresselhaus upgrades Epson MX and FX series and IBM PC printers by providing easy access to special print functions such as compressed, italic, or emphasized. The plug-in module puts numerous modes at the user's fingertips, permitting instant selection from a variety of print functions simply by tapping the printer's control panel buttons. The increased capabilities do not interfere with normal printer operations. Installs without soldering and is accompanied by instructions. $59.95. Address: Dresselhaus Computer Products, 837 E. Alosta Ave., Glendora, CA 91740.

SOFTWARE SOURCES

Word Processor. OmniWriter from Human Engineered Software offers a word processor and integrated spelling checker for Commodore 64 users. The page-based WP program provides such features as multiple line headings and footings; name, address, and label merging; underlining and boldfacing; full scrolling and function keys to page forward/backward; global search/replace; and support for a wide variety of printers. The integrated 30,000-word OmmSpeller can be expanded to include additional words. A simple conversion allows files from Microsoft's Multiplan spreadsheet to be transferred to OmniWriter. Supplied are a quick reference card, keyboard overlay, and reference manual. $69.95. Address: Human Engineered Software, 150 N. Hill Dr., Suite 35, Brisbane, CA 94005.

Mainframe Graphics Link. CompuView Products has announced availability of V-gopher, a software package designed to allow microcomputer users to access powerful mainframe graphics packages. The program emulates a Tektronix Model 4010, the industry standard display terminal. It also allows the user to print out his display screen and, with the aid of a color monitor, to display text in up to eight colors. The software is menu driven and permits modification of communications parameters during execution. Computers currently supported include the Heath/Zenith H/Z-100 series and Victor 9000. $120. Address: CompuView Products, Inc., 1955 Pauline Blvd., Suite 200, Ann Arbor, MI 48103.

Word Processor for PCjr. Word-Jr from Micro Architect ist a word processor for the IBM PCjr that supports both color and monochrome monitors. The program consists of a full-screen editor and a powerful text processor. Also included is a built-in file/merge capability. Word-Jr requires a minimum of 128K of RAM and at least one disk drive. $59. Address: Micro Architect Inc., 6 Great Pines Ave., Burlington, MA 01803.
NEW PRODUCTS

PARALLEL I/O INTERFACE
MetraByte's Model PIO-12 I/O parallel interface board for the IBM PC and XT provides 24 TTL/DTL-compatible lines. It also offers interrupt input, enable lines, and external connections to the PC's power buses. Interrupt handling is via a tristate driver with a separate enable line, and it can be configured to any of the available interrupt levels on the IBM PC by means of a plug-type jumper on the board. All outputs can drive one standard or four low-power Schottky TTL devices, and CMOS compatibility can be obtained by adding a pullup resistor. Three programming modes are available to the user to permit standard, strobed, and bidirectional I/O. $89. Address: MetraByte Corp., 254 Tosca Dr., Stoughton, MA 02072.

INK-JET COLOR PRINTER
Quadjet from Quadram Corp. is a compact, lightweight inkjet printer that prints out in up to seven colors at a speed of 40 characters per second. It uses a drop-on-demand ink-jet printing system capable of a text and graphics resolution of 640 dots per line. Its bidirectional scanner prints 80 standard or 40 enlarged text characters per line. Each color user-replaceable cartridge is rated at 4 million characters. Quadjet has both image printing and hard-copy functions and can use almost the entire width of an 8½" sheet of paper. Operating sound level is rated at less than 50 dB. The printer measures 15½"W x 11½"D x 4½"H and weighs only 12.3 lb. Accessory kits containing software programs to take advantage of Quadjet's features, are available for the IBM PC and Apple II series computers. $895.

HIGH-SPEED/RES JOYSTICK
The Turbo Stick is a new type of joystick from KA Design Group. It offers high pointing speed, high resolution (one part in 4096), and full RS-232 ASCII output. Incorporated into the handle are two finger-tip-operated microswitches that allow the user to switch between an absolute mode with high pointing speed and a rate mode with high resolution. These switches can also be redefined through software to perform different functions. $395. Address: KA Design Group, 6300 Telegraph Ave., Oakland, CA 94069.

SOFTWARE SOURCES

Financial Management. Turning Point Software's Time is Money™ personal/small-business management tool is designed for the person with no accounting or bookkeeping background. It balances checkbooks, calculates and monitors budgets, calculates net worth, prints out checks, and tracks fully or partially deductible items. Full report generation and graphics capabilities are included. The program can keep track of 240 accounts, 240 expense categories, and 240 income types from 240 sources. Any transaction in any category can be added, deleted, or edited at any time. A system of virtual menus allows instantaneous movement to any point within the program. Available for Apple II, II+, IIe, and Apple-compatible computers with at least one drive. $100. Address: Turning Point Software, Inc., 11A Main St., Watertown, MA 02172.

Information Control System. Precision Software's Superbase 64 is a comprehensive database management/information control system for the Commodore C-64 computer. It is claimed to be the only multiform information retrieval system available for the C-64. The number of possible databases Superbase 64 can handle is claimed to be unlimited. Each database can contain up to 15 files, while the number of records possible for each file is constrained only by disk capacity. The program comes with a user-programmable interface that permits creation of custom applications packages within the Superbase environment. The program can also be menu-driven or accessed via direct commands to the database. Linking to other programs is also supported.

Operating System Enhancer. DoubleDOS from SoftLogic Solutions lets the IBM PC and XT run foreground and background programs simultaneously. It divides memory into two separate areas, in either one of which a program can run in the background without keyboard interaction. When that program is recalled, the current screen display reflects any processing that has occurred while the program was running. Meanwhile, the operator can run any other program in the foreground. If two video displays are used, one can be assigned to display background runs while the other displays the foreground run. DoubleDOS can run in systems as little as 128K of RAM, but 192K is recommended. DoubleDOS supports PC DOS versions 1.2 and 2.0. $299. Address: SoftLogic Solutions, 530 Chestnut St., Manchester, NH 03101.

Circle No. 94 on Free Information Card
Modems (Continued from page 51)

The fancy cases, indicator lights, and elaborate switches are also conspicuously missing. Most budget modems have cases made of molded plastic, not metal. And few have fancy panels or expensive nomenclature.

The only indicator you will find on a budget modem is an LED that lights up when the modem has locked onto the carrier signal. Acquisition of the carrier permits you to carry on a conversation.

Switch count is reduced by eliminating the self-test function from the modem. And some budget modems don't even have an off/on switch! Now, that's really cutting costs to the bone.

Almost all low cost modems connect to the computer through an RS-232C interface. This is done with a DB-25 connector built right into the modem. All you have to do is hook a cable from the modem to the RS-232 port of your computer.

Fig. 23. FSK modulation is a form of FM.

Unfortunately, few budget modems come with this cable, although you will need one to make the modem work. So be prepared to dish out another $20 or so above and beyond the cost of the modem itself for a cable.

Connecting the modem to your telephone line, though, is quite another matter. It seems everyone has a different idea of how to do it.

Direct-Connect Modems

Most budget modems, you will find, are of the direct-connect type. What this means is that they plug directly into a standard RJ-11 modular phone jack.

In some cases, as with the Radio Shack 1B modem, you disconnect your telephone from the wall jack and insert the phone plug into a modular jack on the modem. You then connect the modem to the wall jack.

Sometimes a modem comes with a telephone extension cord, other times you will have to supply your own. One modem, the Teledata model TD200 by Compro Electronics, has only one telephone outlet on the modem, and no provision is made for you to connect the telephone. In this case, you will need to purchase a "Y" adapter that accepts one input from your phone and another input from the modem and connects them to a single wall jack.

In direct-connect modem setups, the modem and telephone are connected in parallel with each other. This means you are free to use your telephone normally, as if the modem weren't there.

When the modem is engaged, though, it seizes control of the telephone line and directs phone operations. Even though you are instructed to replace the receiver of the phone back into the cradle after dialing the number, the modem keeps the circuit alive until it is requested to hang up the phone.

Disconnecting the modem from the line is done in many different ways. More often than not, however, you simply turn the modem off.

Telephone-Based Modems

Since a modem connects to the telephone lines, it actually becomes part of the telephone system. Therefore, it must meet certain FCC requirements, as laid out in Part 68 of the Rules and Regulations for direct telephone connection. Don't worry, though, the rules aren't terribly restrictive.

First, direct connection to the telephone lines may only be made using a standard RJ-11 modular plug. No other type of direct interface is acceptable.

If your present telephone doesn't have a modular plug outlet, one can be easily added. All telephone stores and Radio Shacks sell a modification kit (for a couple of dollars) that changes your current junction-box into a modular jack. All you have to do is remove the old cover and replace it with the one supplied in the kit. Everything is color coded, so you can't make a mistake.

If your telephone company doesn't have the conversion for you, just remember, they're going to charge you a service call for doing it, which could cost as much as $50. If you have the older 4-pin phone jack, you don't have to change it. You can buy an adapter that simply plugs into the outlet and converts it to a modular hook up.

Direct-connect modems cannot be connected to telephones on a party line, in multi-phone systems or to coin-operated phones.

Some telephone companies require that you inform them before installing an alien device such as a modem, and register it with them. You need to give them the telephone numbers(s) of the line(s) the modem will be connected to, the make and model of the modem, the FCC registration number, and the ringer equivalent. This information is printed right on the modem itself.

Not all phone companies require you to alert them of your intentions, though. Mine doesn't. You are, however, responsible for the modem's actions while it is connected to their system. If a modem causes abnormal operation of the phone or induces noise on the lines, you must disconnect it immediately. This is your responsibility.

Should the telephone company have to notify you that your device is causing harm, it has the option of discontinuing your phone service. If this becomes the case, the telephone company will notify you in writing of a temporary discontinuance of service, give you an opportunity to repair the modem, and inform you that you have the right to bring an FCC complaint against them if you feel they are in error.

All repairs to the modem must be made by the manufacturer or an authorized service agency. In other words, don't try to repair it yourself. Failure to comply with this rule voids the FCC certification, making it illegal to use the modem until restored to its original condition.

Modem circuits operate at and generate radio frequencies. Consequently, they must also adhere to Part 15 of the FCC's Rules and Regulations concerning spurious radio emissions.

Part 15 states that no electronic device may cause interference to other electronic equipment. This section refers primarily to radio and television, but does not exclude other devices that may be affected.

If your modem does happen to cause interference with your television set or a neighbor's, the problem is usually easily corrected. Look for excessively long cables or loose connections. Chances are you will find the problem there.

In more stubborn cases, you may have to reorient the TV antenna or relocate the modem with respect to the receiver affected. If necessary, contact the manufacturer or an experienced repair technician to resolve the problem.

FCC REQUIREMENTS

Another way to approach the problem of connecting a modem to a telephone line is to make use of the telephone itself. The H.E.S. (Human Engineered Soft-
Modems

ware) HESModem I is a good example of this type of modem, although others exist. The H.E.S. modem actually uses part of the telephone as an extension of the modem.

To use the modem, you dial your phone normally and establish contact with the receiving modem. Once the link is made, you unplug your handset from the phone base and connect the modem to the telephone base, not to the telephone wall jack.

Of course, you must have a telephone with modular plugs on both ends of the coiled cord and the dialing mechanism in the base of the phone. You can't use a phone that has the dialing portion of the telephone contained in the handset, like the Princess or Trimline models.

Furthermore, not all phones will work with this scheme even if they meet the above requirements. You're probably not aware of it, but pushbutton phones actually come in two different styles. There is the short-keystroke model, and the full-keystroke version.

To identify which is which, you need to measure the travel of the button as you depress it. If the travel is only 1/32", the phone is a short-keystroke model. A movement of 1/8" or more means it has a full keystroke.

The HESModem I (by H.E.S.) won't work on telephones with a short keystroke. It will, however, on all full keystroke models and on all pushbutton phones that have removable handsets.

Does a lower price reflect an inferior product?

MHz oscillator which generates the clock signal necessary for modem operation. The clock-output frequency is divided several times to create the carrier frequencies used for modem communications. A sine-wave generator shapes the square wave clock pulses into distortion-free sine waves, which the telephone lines are better equipped to handle.

The MC14412 modem also contains circuitry to process incoming modem signals. The signal is first passed through a level change detector, which monitors the input voltage, then sent along to a demodulator. With the help of the clock signal, the demodulator decodes the incoming frequencies and changes them back into digital 1s and 0s. The reconstructed digital message is buffered and output to the computer.

The modem chip even has provisions for self-testing. It does this by internally routing the transmitter's output to the receiver's input. This way, you test the modem alone, not the telephone lines. A similar test for the entire system is also possible by placing the modem in the echo mode.

The second half of the modem chip set is made up of the MC145440 filter network. This chip is a switched-capacitor digital filter that provides the necessary upper- and lower-band separation for full duplex (simultaneous two-way) operation at 300 baud. Without filtering, the narrowly separated information frequencies could become entangled.

When these two chips are used together, the result is a modem. Some external circuitry is required, however, to support the modem in its efforts. The simple modem block diagram in Fig. B better explains the story.

Basically, the external amplifier, limiter, and comparator receive and condition the incoming modem signal before the modem chip ever sees it. They also evaluate the quality of the transmission by monitoring the level of the signal. If the input level is too low (usually less than -42 dBm), it forces the MC14412 to ignore the signal, thus preventing the deciphering of erroneous data.

MODEM CHIP SETS

THE introduction of modem chip sets has dramatically reduced the complexity of modems and is chiefly responsible for the appearance of the low cost modem. Although modem chip sets are available from a number of manufacturers, notably Motorola, Texas Instruments, and Exar, most modem makers have adapted Motorola's MC14412/MC145440 chip set to their designs.

The actual modem is the MC14412 chip. Inside this single 16-pin package reside all the functions needed to generate and receive modem communications. A block diagram of the chip is presented in the drawing shown here in Fig. A.

The modem contains its own 1-

Fig. A. Block diagram of Motorola's MC14412 modem chip.
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<table>
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<tr>
<th>Part Number</th>
<th>Socket Strips</th>
<th>Buss Strips</th>
<th>Ground Plate</th>
<th>Tie Points</th>
<th>14 pin IC Capty.</th>
<th>Price</th>
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<td>HB-0100</td>
<td>N/A</td>
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<td>no</td>
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<td>N/A</td>
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<td>N/A</td>
<td>no</td>
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#### HANDY Breadboard Assemblies

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<td>HB-4714</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>3260</td>
<td>36</td>
<td>63.95</td>
</tr>
</tbody>
</table>

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Modems

and the dial in the main body of the phone.

In other words, check your phone before considering a modem that uses the phone base for its operation. You might wind up buying a new phone just to accommodate the modem if you don't. And that's no bargain.

Dedicated Modems

Another trick the manufacturers have used to bring down the cost of modems is to specifically tailor a modem to work with only one computer model. In fact, the HESModem, described above is a dedicated modem. The Model 6420 modem from Westridge Communications, Inc. is another.

With VLSI an entire modem circuit can be put on one chip

Unlike the universal modems so far discussed, which are made to interface to all computers with an RS-232C port, the HESModem I and the Model 6420 are specifically designed to work with the Commodore 64. Two benefits are gained by using this approach.

The first is the lack of connecting cables. As we've seen, most budget modems come without connecting cables. To use them, you must purchase one, which adds to the total cost of the modem system.

The 6420 and H.E.S. modems, on the other hand, use the expansion outlet of the Commodore 64 for connection. In fact, the modem cases have the edge connector molded right into them, and the entire modem plugs into the back of the computer. No cables are needed!

Software

The second benefit is derived from the software. Most universal modems don't come with a software package, but one is needed before the computer can communicate over telephone lines.

Depending upon the computer you are using, this software can run you anywhere from $20 to $150. Suddenly, our budget modem begins looking pretty expensive.

Dedicated modems have eliminated this expense. The Westridge Communications modem and the HESModem I come complete with software—and sell for under $100. The reason is, the software has to be written for only one machine: the Commodore 64.

But that's not all that happens. Remember our mentioning that the modem chip comes with automatic features built right into it? It could originate and answer calls—if extra hardware were added.

Well, the same thing can be done with a software package. By tying the automatic-function pins of the modem chip to the I/O ports of the computer, we can use software to control its operation.

In fact, the Model 6420 does just that. It has automatic answering and dialing—all controlled from the keyboard. In effect, this budget modem has become a smart modem. Computer controlled, of course.

You will probably see more and more of this type of modem in the near future. Dedicated modems that plug right into the expansion slots of computer cabinets will eventually replace many of the universal designs now on the market—and at lower prices with better features.

MODERN POWER SOURCES

The means by which budget modems are powered are just as diverse as the modems themselves. Some simply use a battery. The Volksmodem is such a model. It uses a standard 9-volt transistor battery.

In order to make the battery last, though, some design improvements had to be made in the circuit. The use of a small battery precluded the inclusion of any indicator, including the carrier-monitoring LED. In its place is a piezo-electric beeper that emits an audible carrier-detect tone when the carrier has been acquired. To further reduce power consumption, all chips are of CMOS design.

A unique approach has been ventured by Compro Electronics in its Teledata model TD200 modem. It actually takes power from the telephone lines and uses it to operate the modem!

No batteries, no cables; no muss, no fuss. Simply plug the modem into any telephone jack and it's ready to go. One disconcerting feature of this design, though, is that the modem may hang up if someone picks up an extension telephone while the modem is in operation. This forces you to re-establish the contact and begin transmission of your information over again.

Radio Shack and others several power their modems right from the ac line. In all cases, a stepdown transformer plugs into a wall outlet and a cable runs from the transformer to the modem, where the ac input is rectified and used to power the modem.

Dedicated modems, naturally, receive their power directly from the computer's I/O expansion port.

MODERN MANUFACTURERS

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Make</th>
<th>Price</th>
<th>Power Supply</th>
<th>Features</th>
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<td>Signalman</td>
<td>$99.95</td>
<td>AC Adapter</td>
<td>Universal Type</td>
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<td>Mark I</td>
<td></td>
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<tr>
<td>Compro Electronics</td>
<td>Volksmodem</td>
<td>$69.95</td>
<td>Battery</td>
<td>Audio carrier-detect</td>
</tr>
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<td>Teledata</td>
<td>$79.95</td>
<td>Phone lines</td>
<td>tone</td>
</tr>
<tr>
<td></td>
<td>TD-200</td>
<td></td>
<td></td>
<td>No power supply needed</td>
</tr>
<tr>
<td>Human Engineered</td>
<td>HESModem I</td>
<td>$69.95</td>
<td>I/O port</td>
<td>Uses telephone base</td>
</tr>
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<td>Software</td>
<td></td>
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<td>powered</td>
<td></td>
</tr>
<tr>
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<td>6420</td>
<td></td>
<td>powered</td>
<td>dedicated modem/with software</td>
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In-Circuit Emulation
(Continued from page 82)

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### TABLE 1—EMULATOR COMMANDS

<table>
<thead>
<tr>
<th>Command Description</th>
<th>Type in Command</th>
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<tr>
<td>1. Display a block of memory starting at the last referenced memory address.</td>
<td>D</td>
</tr>
<tr>
<td>2. Display a block of memory beginning at a given start address (sa).</td>
<td>D sa</td>
</tr>
<tr>
<td>3. Display a block of memory beginning at a given start address (sa) and stopping at a particular last address (la).</td>
<td>D sa,la</td>
</tr>
<tr>
<td>4. Examine the data at an I/O port address (pa).</td>
<td>E pa</td>
</tr>
<tr>
<td>5. Fill memory from a starting address (sa) up to and including the given last address (la) with a particular 8 bit data byte (db).</td>
<td>F sa,la,db</td>
</tr>
<tr>
<td>6. Go into run mode starting at the current program counter location.</td>
<td>G</td>
</tr>
<tr>
<td>7. Go into run mode beginning at the given start address (sa).</td>
<td>G sa</td>
</tr>
<tr>
<td>8. Use hex arithmetic to calculate the sum and difference of the two given 16 bit data values.</td>
<td>H d16,d16</td>
</tr>
<tr>
<td>9. Move memory between a given start address (sa) and a given last address (la) to a destination address (da).</td>
<td>M sa,la,da</td>
</tr>
<tr>
<td>10. Run a memory test on the target system RAM between a given start address (sa) and a given last address (la).</td>
<td>MT sa,la</td>
</tr>
<tr>
<td>11. Output to the specified port address (pa), one or more 8 bit data bytes (db).</td>
<td>O pa,db,db,...</td>
</tr>
<tr>
<td>12. Quit full speed run mode.</td>
<td>Q</td>
</tr>
<tr>
<td>13. Read an Intel hex file and load the data into the target system’s RAM.</td>
<td>R</td>
</tr>
<tr>
<td>14. Read an Intel hex file and apply the given offset (off) value prior to loading the target system RAM.</td>
<td>R off</td>
</tr>
<tr>
<td>15. Repeat the given command line in order to provide a loop. (Useful for oscilloscope troubleshooting.)</td>
<td>RL</td>
</tr>
<tr>
<td>16. Substitute into memory starting at the last referenced memory address.</td>
<td>S</td>
</tr>
<tr>
<td>17. Substitute into memory beginning at the given start address (sa).</td>
<td>S sa</td>
</tr>
<tr>
<td>18. Trace one instruction.</td>
<td>T</td>
</tr>
<tr>
<td>19. Trace one or more instructions.</td>
<td>T d16</td>
</tr>
<tr>
<td>20. Untrace one or more instructions. (Only display the registers for the last instruction traced.)</td>
<td>U d16</td>
</tr>
<tr>
<td>21. Verify that target system memory is the same [beginning at a given start address (sa) and ending at a given last address (la)] as that value beginning at a given destination address (da).</td>
<td>V sa,la,da</td>
</tr>
<tr>
<td>22. Display all the Z80 internal registers and flags.</td>
<td>X</td>
</tr>
<tr>
<td>23. Display and allow for modification of one of the Z80’s internal registers, where z can be any one of the given registers as indicated below:</td>
<td>Xz</td>
</tr>
<tr>
<td>24. Have the emulator wait a given amount of time before executing the next command. (Good for scope loops.)</td>
<td>Z d16</td>
</tr>
<tr>
<td>25. Set breakpoint address 1 to the given 16 bit value (d16).</td>
<td>BP 1,d16</td>
</tr>
<tr>
<td>26. Set breakpoint address 2 to the given 16 bit value (d16).</td>
<td>BP 2,d16</td>
</tr>
<tr>
<td>27. Set breakpoint address 3 to the given 16 bit value (d16).</td>
<td>BP 3,d16</td>
</tr>
<tr>
<td>28. Set breakpoint pass counter 1 to the given 8 bit value (d8).</td>
<td>BPC 2,d8</td>
</tr>
<tr>
<td>29. Set breakpoint pass counter 2 to the given 8 bit value (d8).</td>
<td>BPC 2,d8</td>
</tr>
<tr>
<td>30. Set breakpoint pass counter 3 to the given 8 bit value (d8).</td>
<td>BPC 3,d8</td>
</tr>
<tr>
<td>31. Enable all three breakpoints.</td>
<td>EBP</td>
</tr>
<tr>
<td>32. Enable breakpoint 1, 2 or 3.</td>
<td>EBP n</td>
</tr>
<tr>
<td>33. Disable all breakpoints.</td>
<td>DBP</td>
</tr>
<tr>
<td>34. Disable breakpoint 1, 2 or 3, where (n) is the breakpoint number.</td>
<td>DBP n</td>
</tr>
<tr>
<td>35. Enable all printpoints.</td>
<td>EPP</td>
</tr>
<tr>
<td>36. Enable printpoint 1, 2 or 3, where (n) is the printpoint number.</td>
<td>EPP n</td>
</tr>
<tr>
<td>37. Disable all printpoints.</td>
<td>DPP</td>
</tr>
<tr>
<td>38. Disable printpoint 1, 2 or 3, where (n) is the printpoint number.</td>
<td>DPP n</td>
</tr>
<tr>
<td>39. Enable interrupts to be received from the target system.</td>
<td>EI</td>
</tr>
<tr>
<td>40. Disable interrupts from the target system.</td>
<td>DI</td>
</tr>
<tr>
<td>41. Enable bus requests to be received from the target system.</td>
<td>EB</td>
</tr>
<tr>
<td>42. Disable bus requests from the target system.</td>
<td>DB</td>
</tr>
<tr>
<td>43. Enable the emulator’s automatic refresh function.</td>
<td>ER</td>
</tr>
<tr>
<td>44. Disable the emulator’s automatic refresh function.</td>
<td>DR</td>
</tr>
<tr>
<td>45. Display the emulator’s status which includes:</td>
<td>ST</td>
</tr>
<tr>
<td>breakpoint address pass counters</td>
<td>SR</td>
</tr>
<tr>
<td>breakpoint enable or disable</td>
<td></td>
</tr>
<tr>
<td>printpoint enable or disable</td>
<td></td>
</tr>
<tr>
<td>interrupts enable or disable</td>
<td></td>
</tr>
<tr>
<td>bus requests enable or disable</td>
<td></td>
</tr>
<tr>
<td>refresh enable or disable</td>
<td></td>
</tr>
<tr>
<td>46. Soft reset the Z80 by storing zeros into all the internal registers.</td>
<td></td>
</tr>
<tr>
<td>47. Accept assembly language A sa inputs at the terminal and place the machine-language equivalents in the target system’s RAM beginning at a starting address (sa).</td>
<td></td>
</tr>
<tr>
<td>48. List Z80 machine-language L sa,la instructions as disassembled English-language mnemonics. The list will begin at starting address (sa) and end at last address (la).</td>
<td></td>
</tr>
</tbody>
</table>
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Mainframe to Micros
(Continued from page 63)

- Each time the user wants a copy of the latest data stored in the mainframe, the "data fetch" program is used to bring a copy of the data shown to the micro, sometimes formatting it in a way that makes it accessible to a micro spreadsheet such as Lotus 1-2-3 or VisiCalc.

Popular fourth-generation languages or "decision support tools" for which personal computer bridges have recently been announced include Express (Management Decision Systems, Waltham, MA); System W, a financial manipulation language (Comshare, Ann Arbor, MI); Focus (Information Builders, New York, NY); Empire (Applied Data Research, Princeton, NJ); and Ramis (Mathematica, Princeton, NJ).

The second type of software provides a bridge from mainframe database management software to a micro spreadsheet or other application. It also extracts, formats and downloads data. As a rule of thumb, however, the database bridge requires more technical skill or learning time than a fourth-generation language.

A skilled programmer will still be required to ensure that the "right" data is written onto the mainframe database. However, the latest database-to-PC programs have built features into themselves that make it easier for non-sophisticated users to do their own "data fetching." Typical of the way the easier-to-use database links work is the recently announced PC/204 from Computer Corporation of America (Cambridge, MA). It allows the user to position a cursor over an empty spreadsheet on his or her micro and scroll through data labels on the mainframe database until the name of the right data is "pointed" into personal computer. Most of the application package vendors who have announced personal computer bridges are in the accounting area, although others (for example, vendors of Manufacturing Resource Planning systems) are likely to follow suit. Whereas fourth generation languages and database management systems usually serve as a common storage facility for data that originated under a variety of application programs, these mainframe software products are themselves applications. This is an advantage if the information you need on the micro compiles entirely from a single application (for example, a payroll system). But if you need to combine types of information, you will probably need a programmer's help to get it. The most advanced application package-to-PC programs (for example, Management Science's Peachpack series from Atlanta, GA; McCormack and Dodge's PC Link from Natick, MA) do provide help in accessing information generated by other than their own mainframe applications.

The obvious limitation of each of these three "bridge" packages is that the data you want to access must already reside in the mainframe version of the vendor's software. If they don't—either because your company doesn't have the software, or because some of the data you want are kept somewhere else (for example, in an old fashioned "flat file" of the sort maintained by a 15-year-old COBOL program)—none of these solutions will help you.

The final bridge type is a file-to-file transfer facility from a mainframe to a personal computer (one example is Omnilink). This software does not require that the data you are looking for be in any vendor's proprietary structure. Unfortunately, it only reformats and downloads data. You (or your data-processing department) must write a program to actually find and extract the data you want, and store it in a transfer file. It also requires a special batch job to be run on the mainframe every time you want to update the stored data. Examples of these simple bridges are Simware's SIM3278 (Ottawa, Ont.); VM Personal Computing's Please and Relay (New York, NY).

How does a company handle thousands of users and still maintain a semblance of security?

the spreadsheet. Examples of other database bridge vendors include: Applied Data Resource's ADR/Datacom DB (Princeton, NJ); Cullinet's Information Database/Cullinet PC Software (Westwood, MA); Informatics General Answer/DB (Canoga Park, CA).

The third type of bridge extends from a mainframe application package to a thousand of personal computer users into the mainframe database, while still maintaining some semblance of security, system resources, and sanity?

One of the reasons companies have mainframes (even though the power of personal computers is approaching that of the mainframes of the early 1970s) is that they have to support hundreds or even thousands of users and devices at one time with just one set of data. Balancing the potential benefits of linking micros to mainframes for greater productivity are a number of potential drawbacks.

For instance, whose numbers should you believe? Once data are transferred from a mainframe to a micro, they no longer stay up to date with the mainframe files. When sales figures are updated or revised today on the mainframe, the month-end total you downloaded last night for your VisiCalc spreadsheet will no longer be correct.

Business issues will be solved more slowly than those of hardware and software

Horror stories are common in the mainframe world about managers arguing over who has the "right" value for sales, costs, inventory levels, etc. But at least the concept of a central database—a single collection of data maintained for all users—minimizes such conflicts. As "personal databases" start to spring up on diverse personal computers around the office, arguments (or worse, bad decisions) are likely to increase. At the least, corporate policy for micro users should insist that all users timestamp the time and source of their downloaded data, and refer to the timestamp whenever they use or present analyses based on that data.

Also, how do you keep a corporate secret? Another reason companies continue to use mainframes is the elaborate security precautions built into the system itself and into individual data files. Once a copy of sensitive data is downloaded to a microcomputer, and saved on a floppy disk, security for that data is about as primitive as a locked file drawer.

Finally, how do you avoid personal computer users tying up the mainframe? Unfortunately, one of the functions with
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the highest “overhead” performed by a mainframe is I/O—moving data out of and into the computer and from various peripheral devices. And downloading data to a personal computer is a classic example of high-overhead I/O. As increasing numbers of personal computer users place heavy I/O demands on a mainframe, companies have a limited number of alternatives. Among them are:

• Giving low priority to basic transaction-processing applications; that is, slowing up order entry, payroll, accounting or inventory control users who are generating the numbers that the personal computer users in management want to access. This solution is not likely to please operating departments.

• Giving low priority to personal computer users; i.e., come in at 3 a.m. to do your download, or expect the application to take a few hours to complete. This may defeat the purpose for making the micro-to-mainframe link, increasing management productivity.

• Buying another mainframe dedicated to personal computer users. This alternative may defeat the argument for personal computers—an inexpensive way to put computer power in users’ hands.

In Conclusion

There are no easy answers at this time for those who would link micros to mainframes. Because of the overwhelming appetite personal computer users have better, faster and more data, vendors of packaged solutions have great incentive to work on the problems that technology can address. These include integration—which provides a single-package answer to the questions of the physical link, the data link, and systems-security assurance—and universality.

A system utilizing the concept of universality would embody a single piece of software or hardware able to speak and translate among the hundreds of different models of mainframes, microcomputers, telecommunication data storage, and data interchange standards that exist in the typical corporate mainframe environment, as well as the relatively broad line of personal computers and applications programs that find their way into the office.

The business issues will be solved more slowly than those of hardware and software, and on a company-by-company basis. But it is safe to predict that the personal computer on a manager’s desk is here to stay, and it’s just a matter of time until that computer is linked into the corporate mainframe.

In the early 1970s IBM introduced a new type of data link protocol called Synchronous Data Link Control (SDLC) for “synchronous data link control” as part of its Systems Network Architecture (SNA). SDLC protocol is supported by different types of mainframe terminals and control units. IBM has tried very hard to convince its customers of the wisdom of using SDLC and SNA, at the expense of both the bisync and async protocols. Indeed, most IBM mainframes support asynchronous communications very poorly, if at all. The newest and most advanced facilities are generally provided chiefly for SDLC terminals, and sometimes grudgingly, for bisync terminals. This has created a rather awkward and difficult situation for the very popular IBM PC, which is usually equipped to communicate only in the async mode. Although both bisync and SDLC hardware and software are available for the PC, they are considerably more expensive. This often makes it almost impossible for PC owners to use their computers with their office mainframe.

A second primary respect in which 3270 terminals differ from most async terminals is 3270s generally use EBCDIC character set. EBCDIC (Extended Binary-Coded Decimal Interchange Code), which assigns hexadecimal values to printable characters, is used on most IBM mainframes. It is quite different from its principal alternative, ASCII (American Standard Code for Information Interchange), which is, of course, what is used by the IBM PC and most “ASCII” terminals.

While conversion between EBCDIC and ASCII is reasonably straightforward, there are a few symbols that are in one set and not the other. For example, there is a “cent” character and a “logical-not” character in EBCDIC but not in ASCII. The latter, however, has the tilde and grave accent all to itself. Since these symbols aren’t too commonly used, this is mainly just a nuisance in trying to simulate an ASCII terminal on a 3270, or vice versa.

A third and final area in which members of the 3270 family differ from most asynchronous terminals is in specific capabilities and features. Most important, 3270s are essentially block mode devices. That is, the basic unit of data is a field or
even a full screen. (A field is a portion of the screen used for a specific type of data. In a database there may be, for example, a “name” field, a “zip code” field, a “customer” field, and so forth.) Data is identified according to the field on the screen to which it belongs, and its position on the screen has little or nothing to do with the order in which it is sent in relation to other fields. Most asynchronous terminals, in contrast, are serial devices that display data in sequential order, unless this is modified by “cursor pointing.”

This distinction is very significant in terms of the way programs are written to use the terminals. It is, for example, much easier to create screens having fields of diverse types (protected or unprotected, highlighted or not, of a specific color, etc.) on a block mode terminal like a 3270. Some 3270-family models even permit arbitrary redefinition of their displayable character sets. On the other hand, the 3270 hardware is incapable of the scrolling that almost all asynchronous terminals can perform.

As mentioned earlier, 3270s can be attached to mainframes in a variety of ways. A 3270 terminal is always first attached to a control unit (unless it has one built-in). The control unit, in turn, can be connected directly to a mainframe I/O channel. This is by far the fastest type of connection (capable of supporting a data rate of about 650,000 characters per second). Needless to say, it is also the most popular kind of connection for people who can conveniently work near the location of the computer. This kind of connection is known as a local attachment.

For those not so fortunate, who must work remotely from the mainframe, the connection must be by means of a communications line, which is considerably slower—at most 9600 baud, or about 1000 characters per second. This is known as a remote attachment. Although 9600 baud may sound fast to PC users who are accustomed to 300 or 1200 baud, it can be very unsatisfactory, since many 3270 applications are written, inefficiently, to send full screens of data (1960 characters or more) back and forth quite frequently on the assumption that most users will be attached to the high-speed channel.

The communications protocol used for remote terminals can be either bisync or SDLC. In the latter case, the terminal will be part of an SNA network. Although there is no such thing as a concise description of what SNA is, a little can be said about the general functions of communications networks.

It turns out that the problems that a data link protocol like bisync or SDLC is intended to solve are just a small subset of all the concerns of a network. The data link protocol “merely” ensures the reliable transmission of data from one point to another. Other problems of equal or greater difficulty include how data is routed over a variety of different transmission facilities, how a legitimate user connects to a particular application by name, and how the data is formatted so as to be comprehensible to both the sender and receiver.

All these problems are the concern of network architecture in general, and IBM’s SNA is just one example. SNA is organized into a number of different layers, each of which deals with a particular class of problems. Data link control is the function of one specific layer. Other layers are known as the “path control layer,” and there are still others as well.

An SNA network consists of a number of nodes (computers or terminals usually, although other peripheral devices may be included) connected by communications lines. Only the lowest logical layer of each node actually controls the physical communication with other nodes but, in a more abstract sense, the higher layers of each node also communicate with their peers in other nodes. The situation is analogous to communications between nations or large corporations: the “higher-ups” generally communicate with each other via intermediaries at lower layers (ministers, managers), who in turn use even more basic means (couriers, telephones).

Like the 3270 itself, but on a much grander scale, SNA is complex and elaborate. Indeed, since the 3270 terminal and control unit have many duties to perform in the network, their own complexity is understandable. SNA was designed to serve the needs of many other types of communications devices besides terminals as they are normally conceived of. It also supports such devices as point-of-sale terminals and RJE (for “remote job entry”) workstations.

The IBM 3770 product line is typical of RJE terminals. An RJE terminal is usually distinguished from an ordinary terminal by having a card reader and high-speed printer for servicing batch job submission and output. It is intended for performing the typical batch-job processing functions at locations remote from the mainframe. The 3770 uses SDLC protocol in an SNA network. There is also an analogous product, the 3780 terminal, that communicates in bisync. Hardware and software are available for the IBM PC to emulate 3770 and 3870 terminals and the 3770.

Protocols

(Continued from page 63)

special character, D.L.E (for “data link escape”), is defined. It must be sent preceding any attempt to use one of the other special characters for its special protocol function. To use D.L.E as normal data, it has to be sent twice.

Obviously, a lot of computation must take place if bisync is to be spoken correctly. The algorithms used for this are typically hard-wired into bisync terminals for greater efficiency; that is, they are built right into the terminals. Ordinarily, a personal computer can speak bisync only if it has a special bisync communications card installed. Special (and expensive) modems are also required.

Many of the older terminals produced by IBM and others used bisync. Those include certain models of the 3270 communications terminal and the 2780/3780 RJE terminals. However, bisync has a number of shortcomings. To give just one example, it tends to use a lot of extra characters to control communications, which, in turn, lowers the net throughput of useful data. Also, it is half duplex, which is a disadvantage because time is wasted in “turning the line around.”

A newer protocol that attempts to overcome some of the problems of bisync is called SDLC (for “synchronous data link control”). This is part of IBM’s very general Systems Network Architecture (SNA). In addition to support of full duplex (two way) communications, SDLC distinguishes protocol information from other data sent by a technique called “bit stuffing.” This method manipulates bit patterns in such a way that control information can be readily distinguished from data with less communications overhead than bisyncronous “byte stuffing” protocol. SDLC, too, has its disadvantages. It is computationally more expensive, so again, specially wired hardware—SDLC terminals—must be used. Most new IBM communications products, including the latest of the 3270 line, use SDLC. Also, special SDLC modems must be used with such terminals.

Although we have spoken of bisync and SDLC as if they were specific unambiguous protocols, this is not really the case. Various dialects exist. There are additional protocols that terminals can use in addition to either bisync or SDLC. This situation, coupled with the fact that specialized hardware must be used to support the protocols, makes agreement on standards among terminal manufacturers and communications services very important. Fortunately, this is taking place. Even so, plain old async will still be around for a number of years.
from one computer to the other by one of two means.

If the distance between the two is short, the character can be transmitted directly as electrical impulses through a null modem connection. (A null modem connection actually involves no modem at all—the serial ports of the two computers are simply connected one to the other by a cable.) This method is limited to distances of about 3000 feet.

When longer distances are involved, modems are used to send the data over a medium such as a telephone line. The modem connected to the computer converts the serial pulse train into tones. A tone of one frequency represents a high voltage, and a tone of another a low voltage. Tones are used because voice-grade telephone lines are not equipped to handle information in digital form.

At the receiving end, the modem translates the tones back into true digital form and feeds the resulting electrical pulses to the second computer's serial port. There they are converted back into parallel form.

There are two types of modems. Acoustic modems have two soft rubber cups into which a telephone handset is placed. One cup has a microphone, and the other a speaker. These pick up and generate the audio tones used for data transmission. There is no electrical connection to the phone lines—the coupling is acoustic.

Direct connect modems are connected directly to the phone line, usually through a standard modular jack. They are usually more "intelligent" than acoustically coupled modems, and eliminate the possibility of ambient room noise being mixed with the audio tones and "garbage"ing the data.

Transmission media for data transfer, besides ordinary telephone lines, include coaxial cable, CATV (broadband radio-frequency), fiber optics, infrared light (with air being the transmission medium), microwaves, and satellites (a special case of microwave transmission).

The characteristics of the transmission medium determine the speed at which data can be passed back and forth between computers. For example, dial-up voice-grade telephone lines are considered reliable at speeds up to 2400 baud (bits per second), or about 240 characters per second. Special leased phone lines can handle data rates of up to 19,200 baud. Coaxial cable and broadband media permit rates up to 56,000 baud, and the more exotic media extend rates to millions of bits per second.

The last point to be addressed on the subject of physical links is that of configuration. The simplest configuration, point-to-point, uses a serial port and modem at the mainframe connected by some medium to a modem and serial port at a terminal or personal computer.

This one-to-one connection is expensive both in terms of the number of serial ports and modems, and the number of feet (or, more commonly, miles) of transmission medium required to support a large number of users. It is also wasteful in that a single user rarely requires the full capacity of a 4800-baud-or-greater line. Mainframe manufacturers have therefore developed some ways to reduce these costs and increase the utilization of a link.

One method used is a multi-drop line. One serial port and modem, and a medium-speed line (usually 4800 baud) at the mainframe connects to a star or daisy-chain network of terminals or personal computers. This eliminates the need for multiple modems and lines at the mainframe, but each terminal or personal computer still requires its own modem.

An alternative to multi-drop networking is to put small special-purpose computers, known as cluster controllers, in an area serving several terminals, personal computers, remote line-printers, or other peripheral devices. Cluster controllers use one fast, expensive modem and line (usually rated at 9600 baud) to communicate with the mainframe, and cheap null modems or coaxial cable to make the connection to each computer or peripheral. The major advantage of this system is the elimination of expensive modems for each user station (or node), although the controller itself is a costly piece of hardware.

### Transmission Protocols

After deciding how to make the physical link, we need to look at the transmission protocols used in telecommunications. There are two ways for information to be communicated between a modem and a serial port: synchronous (favored by IBM and other mainframe manufacturers) and asynchronous, which is used by most mini- and microcomputers. The difference between the two protocols is the way in which characters are "framed"—that is, how the beginning and end of a single character are signaled to the computer.

Asynchronous protocols frame data by adding a bit to each end of the stream of bits representing one character. These are called "start" and "stop" bits. Synchronous protocols rely on internal clocks to time the start and finish of a block of characters by sending three to six "sync characters" at the beginning of a transmission. If the transmission consists of many characters, additional sync characters are transmitted every now and then to keep the computers in sync. Synchronous transmission requires more overhead in the form of software protocols to keep everything running smoothly, but allows about 15% greater throughput than asynchronous transmission at the same baud rate. This is because synchronous transmission requires two fewer bits per character than asynchronous transmission.

### Software Protocols

Personal computers require relatively little in the way of software protocols. Commonly used is the XON/XOFF protocol (which allows one computer to indicate to another when to send and when to stop sending) to govern the transmission of large amounts of data. Error checking schemes using a CRC (cyclical redundancy check) or checksum method are also being included in a growing number of communications packages.

Mainframes have developed far more complex protocols over the years to allow them to be connected to a large number of devices without interfering with applications software. These more complex software protocols have evolved in layers to service today's networks of terminals and other peripherals. The following descriptions are abstracted from the International Organization for Standardization (ISO) DP7498 Reference Model for Open Systems Interconnection.

- **Data link protocols** are the lowest layer, dealing with initialization, control, termination and error recovery relative to the physical link and the transmission protocols.
- **Network protocols** deal with network management, message formats, and data-block structure.
- **Transport protocols** handle message or packet assembly and disassembly, and message priority in a network. These protocols also ensure end-to-end control of network transmissions.
- **Session protocols** control the dialogue between processes in a network, as well as buffering and segmenting large transmissions.
- **Presentation protocols** are used to handle data formats, and to translate various sending codes to representations understood by the receiving equipment.
to the full 64K of RAM and switch the screen display to 80 characters by 24 lines. To say that the system works well is an understatement. It is superb.

Since the Model 4P does not contain the Model III ROMs, a software utility creates an image of the ROMs in the first 16K of RAM. To get into the Model III mode, it is necessary to first load a MODELA/III utility (supplied with the computer). Screen prompts tell when to load the utility and when the disk can be removed and replaced by the Model III applications disk. If the system is to come up directly in the Model III mode, the MODELA/III utility must be copied onto the applications disk. Then when the disk is booted up, the utility will auto-load the ROM image in RAM and automatically start the program. As far as the user is concerned, the computer functions as if the Model III ROMs are present.

User Observations

Experiments with a broad range of Model III software, including operating systems from sources other than Radio Shack, produced no unusual effects because of the pseudo-ROM image. The only Model 4 software that would not work in the Model 4P was a CPU speed-up. At the time we tested the Model 4P, Radio Shack still had not released its CP/M operating system for either the Model 4 or the 4P. So we used Montezuma Micro CP/M Version 2.2, which worked notably well.

More About the Keyboard

Perhaps the reason Radio Shack has delayed providing CP/M for its Model 4 series computers has to do with their “programming keyboards.” Both computers have almost the same keyboard used in the Model I computer, plus a numeric keypad, a control key for CP/M, an alpha caps-lock key, and three function keys labeled F1, F2, and F3. Unlike the ASCII keyboard in general use today and patterned on the typewriter keyboard, a programming keyboard is derived from the Model 33 Teletypewriter, which was the original standard terminal for time-share computers. Its slightly different key arrangement makes BASIC and other programs somewhat easier to enter, but certain keys—tab, left and right brackets, backslash, line feed, escape, underscore, and vertical—required for CP/M and most CP/M-based applications programs are not present.

To make its Model 4 series computers CP/M-compatible, Radio Shack synthesizes the “missing” keys by permitting simultaneous pressing of two or more keys to obtain the desired functions. CLEAR and comma are used for the left bracket, CLEAR and ENTER for underscore, etc. This approach, however, can lead to conflict. For example, the ASCII EM is used to advance the cursor in the Model 4 series and also happens to be the automatic underscore command for a popular daisy-wheel printer.

Aftermarket vendors of CP/M for the Model 4 series such as Montezuma Micro, provide the missing keys through the use of two keys simultaneously, such as SHIFT and 1 to create the escape function, SHIFT and 2 for the left bracket,
TRS-80 Model 4P and only → for tab in Montezuma Micro's CP/M. Additionally, this version of CP/M simplifies the use of CP/M software by causing the Model 4 series to function as the ADM-3A terminal, which is recognized by almost all CP/M software. We tried a sampling of popular CP/M applications software, including WordStar, Word Plus, Multi-Plan, and DataStar, with Montezuma CP/M and found that they operated the same as they would have in any CP/M-only computer.

Remarks

Our only complaint with the Model 4P is the same as for most other computers in which thin-line disk drives are used. These drives depend on a mechanical system to pop out disks, which does not always work—particularly if a disk's write-protect tab comes loose while the disk is in the drive. The fault is not in Radio Shack's choice of thin-line drives but, rather, in the fact that all thin-line drives tend to jam. The industry simply needs a better eject mechanism for these drives.

Otherwise, the 4P is a magnificent machine. It runs quietly, without a trace of heat, and is convenient to use and transport. It is almost the ideal portable computer, “almost” because the disk drives are single-sided when the competition has double-sided drives. While Radio Shack does not have its own version of CP/M for the Model 4 series, Montezuma CP/M works admirably and comes with a disk interchange utility that permits the computers to read or write 20 different disk formats, including MS-DOS. This allows the Model 4P to simulate most other 8-bit computers. It will run an Osborne or Kaypro program and copy the program or store or copy the data in either the Osborne (or Kaypro) or the Model 4P's own format.

Also, with an aftermarket TRSDOS-like operating system, such as NEWDOS Version 2.0, the Model 4 can simultaneously work in the Model III and Model I modes, either single- or double-density. With a conversion utility, it will even read or write Radio Shack Color Computer software.

The Bottom Line

The Radio Shack Model 4P computer has awesome potential. To really appreciate this computer and become a believer in its potential, you have to use it as I have. Words are inadequate to describe the level of software interchangeability it provides.

Sanyo MBC550 (Continued from page 35)

screen cursor to a BASIC line to be edited and then delete or insert characters. At the same time the screen listing is edited, the BASIC program in memory is also changed. Some PC compatibles do not have this capability.

Documentation

The documentation for the Sanyo MBC550 consists of two manuals in the usual IBM “small notebook” format. The first is the operating manual for the system and consists of rudimentary operating instructions, a description of the BASIC, and a description of the MS-DOS commands. Using the IBM manuals as a criterion, I must say that the Sanyo operating manual (at least in the version that I received) is poor. A user unfamiliar with MS-DOS or PC BASIC would have to supplement the operating system manual with the IBM BASIC and MS-DOS manuals. One good feature in the manual, however, is the “Technical Reference” section. It gives you step-by-step instructions on installation of additional RAM, disk drives, the serial interface, and a joystick. Other technical information is sparse.

The other manual contains the installation and operating instructions for MicroPro WordStar, CalcStar, SpellStar, MailMerge, and InfoStar. This manual is adequate (and voluminous). The IUS EasyWriter I word-processing software includes its own operations manual.

Benchmarks

Benchmarking is an inexact science. Too often a benchmark program will be biased to tout the strong points of an individual machine. I've been running five benchmarks for some time now. They are not perfect but I've tried to make them general and unbiased. They will give you a rough idea of what the Sanyo can do in comparison to other IBM PC machines. The machines I'm comparing here are the IBM PC, the new Tandy 2000, and the ACT Apricot (an 8086 machine with 3½" disk drives).

Benchmark 1: This benchmark simply measures the time it takes BASIC to count from 1 to 30000 in a two-statement for...next loop. The faster the time, the faster the clock rate of the system and the efficiency of BASIC.

Tandy 2000: 15.7s
IBM PC: 37.8s
ACT Apricot: 42.9s
Sanyo MBC550: 47.1s

Benchmark 2: This benchmark measures the time it takes for a BASIC program to compute and display sin, cos, values. It's a measure not only of "number crunching," but also the "display driver" software in the MS-DOS BIOS. Again, the faster the time, the higher the "throughput" of the machine.

ACT Apricot: 38.6s
IBM PC: 45.6s
Sanyo MBC550: 56.2s
Tandy 2000: 218.7s

Benchmark 2A: This is identical to Benchmark 2 except that no screen display is done. It is a measure of the computational efficiency of BASIC.

Tandy 2000: 7.9s
Sanyo MBC550: 15.2s
IBM PC: 17.6s

Benchmark 3: This benchmark measures the time to write out varying file lengths to a sequential disk file in BASIC. The test starts with 100 80-byte records and increases in 9 steps up to 1000 80-byte records. The test is a measure of the efficiency of the disk driver in the MS-DOS BIOS and of the disk drive itself, for such nonstandard drives as the 3½" disk the ACT Apricot uses. Disk VERIFY is off in all cases.

Sanyo MBC550: 19s
ACT Apricot: 34s
Tandy 2000: 37s
IBM PC: 69s

Benchmark 4: This is similar to Benchmark 3, but delays a random time between writes (greater than one disk revolution) to simulate random processing in BASIC. This is primarily a measure of the efficiency of the MS-DOS BIOS disk driver.

Tandy 2000: 39s
ACT Apricot: 52s
Sanyo MBC550: 64s
IBM PC: 107s

How Compatible is the Sanyo?

Sanyo literature says the the MBC550 will run 80% to 85% of off-the-shelf software for the IBM PC. I think this figure is exaggerated and would put it at closer to 50%. Any program with graphics that does not go through the BIOS (the software input/output driver programs) will probably not run on the Sanyo. Other systems with a high degree of IBM PC compatibility will run such programs as Lotus 1-2-3 and the Microsoft Flight Simulator, both of which bypass the BIOS drivers. The Sanyo definitely will not run these programs and also will not run such pro-
grams as the Personal Editor and the Asynchronous Communications packages, as well as many others.

One would hope that the MBC550 would load and run BASIC programs from the 1.1 version of the IBM PC. However, BASIC programs stored with the normal SAVE command on the PC will not load at all on the Sanyo due to file format differences. Only BASIC programs stored in ASCII format on the PC (using SAVE "xxxx",A) will load and run on the Sanyo, for the most part. Additionally, Sanyo BASIC is not identical to IBM BASIC. (The versions differ in commands relating to sound generation, joysticks, light pen operation, and disk directories.) Be prepared, then, for disappointment if you expect your favorite IBM PC BASIC program to execute properly on the Sanyo. Also be prepared to do some work transferring your PC BASIC programs over to Sanyo BASIC. In my case, one of the main things I wanted to run was the PC Macro Assembler. It runs fine on the Sanyo. The mistake I made was believing the Sanyo documentation and using the Macro Assembler as a test program for compatibility before I purchased the system!

The good news on the compatibility front is that sales of the Sanyo should be impressive enough so that companies producing IBM PC software will produce versions to run on the Sanyo as well. This appears to be happening already. Companies such as IUS, MicroPro, and Ashton Tate are producing Sanyo versions of their products or certifying that existing packages will run on the Sanyo.

Conclusions

The Sanyo MBC550 is a fine microcomputer regardless of its compatibility problems with the IBM PC. The results of the benchmarks given above indicate that the MBC550 compares favorably with the IBM PC, even surpassing it in computational speed and disk file benchmarks. My primary criticisms of the Sanyo are the current lack of double-sided disk drives, and its inadequate documentation. In the latter case, you can solve the problem by borrowing a friend's IBM documentation.

If the Sanyo MBC550 were closer in price to the IBM PC, I'd have to opt for the name and software base of the PC. But at about one third the price (considering the bundled software), I consider the Sanyo a great bargain. The MBC550 commands attention now, and will be an even more attractive machine as its software base grows.

For more information on advertised products, equipment tested, etc., circle appropriate number on postpaid Free Information Card.

May 1984
business graphics. Similar comments can be made for the IBM PC and PC-XT, whose third-party hardware support base rivals that for Apple IIIs. (See “Hardware Upgrades for Apple and IBM” box for details.) No other make of computer rivals Apple and IBM for third-party support.

Business Graphics Software

The graphics software situation presents quite a puzzle. The basic packages for each computer are usually too rudimentary to be used for very sophisticated graphing. To approach what might be considered to be state-of-the-art performance, a great deal of power and flexibility are required.

Certain features of a graphics system are inherent to the software, and hardware devices must be chosen accordingly. The more important features the software should have are detailed in what follows.

From the artistic viewpoint, the ability to vary the size and type style of all text characters must be provided in the software. The “window” for the body of the chart or graph must be locatable anywhere on a screen or page and be size-adjustable to fit any allocated space. There should be no practical limit placed on the number of data items a chart can contain. The ability to combine lines and bars on the same chart must be a standard feature. For maximum flexibility, the software should permit placement of multiple charts on the same page. It should be possible to develop pie charts with exploded segments. Additionally, a built-in feature should eliminate the possibility of text legends and overwriting each other or the graphics. Graphics software must have defeatable automatic scaling of the axes and permit logarithmic as well as rectangular coordinates. Finally, bar graphs must be orientable either horizontally or vertically.

To my knowledge, no currently available software package that fulfills all the above requirements exists, but GrafTalk comes closest. This software provides superior ease of use and a presentation quality approaching that available with mainframe graphics systems. For most graphs, Chartmaster is a good alternative. Though Chartmaster is not as powerful as GrafTalk, it is far better than the average graphics package currently being sold. Neither GrafTalk nor Chartmaster can develop area maps for marketing uses. These two products can serve as benchmarks for evaluating other graphics packages.

A true state-of-the-art graphics system should be capable of constructing images in both two and three dimensions, though most support the former and very few the latter. To meet this requirement a number of computer-aided drafting systems available for architects and design engineers are now beginning to

HARD-COPY DEVICES

Printers and Plotters:

<table>
<thead>
<tr>
<th>Model</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black-Print Printers:</td>
<td></td>
</tr>
<tr>
<td>Almost any single-color impact dot-matrix model capable of printing screen graphics images can be used with business graphics computer/software systems. Printers made by Epson, Okidata, Star Micronics, IBM, Apple, and others are good choices. Of course, the higher-priced makes and models will usually yield higher-density, more precisely controlled graphics images.</td>
<td></td>
</tr>
<tr>
<td>Color-Print Printers:</td>
<td></td>
</tr>
<tr>
<td>Among the more popular color models are those listed here. This list represents only a sampling of the makes and models available.</td>
<td></td>
</tr>
<tr>
<td>Color/Scribe DP-9725 (240 char./sec.)</td>
<td>Anadex</td>
</tr>
<tr>
<td>Quadjet</td>
<td>Quadram Corp.</td>
</tr>
<tr>
<td>Transtar 315 (4-color ribbon for 7 colors; 30 shades)</td>
<td>Vivitar Computer</td>
</tr>
<tr>
<td>Plotters:</td>
<td></td>
</tr>
<tr>
<td>As with color printers above, the following list of products is provided as a representative sampling of the various models of plotters available in the marketplace.</td>
<td></td>
</tr>
<tr>
<td>Amplot II (11&quot; x 17&quot;; 6 pens; 8 in./sec. write speed; 0.002&quot; resolution)</td>
<td>Amdek</td>
</tr>
<tr>
<td>Color Plotter (11&quot; x 17&quot;; 4 pens)</td>
<td>Apple Computer Inc.</td>
</tr>
<tr>
<td>945 (24.5&quot; x 48&quot;; 4 pens; 30 in./sec. write speed; 0.0005&quot; resolution)</td>
<td>Calcomp</td>
</tr>
<tr>
<td>Sweet-P Six Shooter (11&quot; x 17&quot;; 6 pens; 14 in./sec write speed; 2K buffer)</td>
<td>Enter Computer, Inc.</td>
</tr>
<tr>
<td>HP7475A (11&quot; x 17&quot;; 6 pens)</td>
<td>Hewlett-Packard Co.</td>
</tr>
<tr>
<td>DPM-40-2 (11&quot; x 17&quot;; 16K buffer; 2 pens)</td>
<td>Houston Instruments</td>
</tr>
<tr>
<td>XY750 (11&quot; x 17&quot;; 8 pens; 0.004&quot; resolution)</td>
<td>IBM</td>
</tr>
<tr>
<td>Zeta 8 (8 pens; 20 in./sec. write speed)</td>
<td>Nicolet Zeta Corp.</td>
</tr>
<tr>
<td>Strobe 100, 200</td>
<td>Tektronix, Inc.</td>
</tr>
</tbody>
</table>

Direct-to-Film Hard-Copy Devices

Since many business presentations to large audiences are still best handled with color slides of graphics images, direct-to-film hard-copy devices deserve serious consideration. Among the low-to-medium-priced products that directly convert electrical image signals to 35-mm slide film are the following:

- VFR-2000-TL-135 ($2495; 35-mm only)
- 635 ($12,950 for 35-mm 8" x 10" formats; adaptable to any format)
- Videoprint 5000 ($7000; 4" x 5" Polaroid back is available)
- VideoSlide 35 ($2599; 35-mm only)
- 3000 ($10,000 to $12,000; 35-mm, SX-70, 4" x 5", 8" x 10", 16-mm formats)
- MFR-6 ($9000 to $11,000; 35-mm, 4" x 5", 8" x 10", SX-70, Kodak PR-10 formats)
- Palette ($1300; 3½" x 4½" formats)

Computers & Electronics
# GRAPHICS SOFTWARE SAMPLER

The following is an abbreviated listing of software packages that can be used to generate medium-to-high-density graphics on popular makes and models of personal computers.

## Standard Graphics Packages:

<table>
<thead>
<tr>
<th>Software Name</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Graphics</td>
<td>Business &amp; Professional Software</td>
</tr>
<tr>
<td>Flexigraf</td>
<td>Computer Associates</td>
</tr>
<tr>
<td>ChartMaster</td>
<td>Decision Resources</td>
</tr>
<tr>
<td>D148S Color Slide System</td>
<td>DICOMED Corp.</td>
</tr>
<tr>
<td>GraphWriter</td>
<td>Graphic Communications</td>
</tr>
<tr>
<td>Display Telegraf</td>
<td>ISSCO Graphics</td>
</tr>
<tr>
<td>Executive Briefing System</td>
<td>Lotus Development Corp.</td>
</tr>
<tr>
<td>ZChart</td>
<td>Nicolet Zeta Corp.</td>
</tr>
<tr>
<td>GrapTalk</td>
<td>Redding Group Inc.</td>
</tr>
<tr>
<td>SAS/Graph</td>
<td>SAS Institute</td>
</tr>
</tbody>
</table>

## 3-D Graphics Software Packages:

<table>
<thead>
<tr>
<th>Software Name</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>AutoCAD</td>
<td>Autodesk, Inc.</td>
</tr>
<tr>
<td>Drawing Processor</td>
<td>BG Graphics Systems</td>
</tr>
<tr>
<td>Energraphics/PC</td>
<td>Enertronics Research</td>
</tr>
<tr>
<td>Vector Sketch</td>
<td>GTCO Corp.</td>
</tr>
<tr>
<td>Benchmark</td>
<td>MetaSoft Corp.</td>
</tr>
<tr>
<td>3D CAD; MCS</td>
<td>Micro Control Systems, Inc.</td>
</tr>
<tr>
<td>Software, Space Tablet</td>
<td></td>
</tr>
<tr>
<td>PC-Draw</td>
<td>Micrografx</td>
</tr>
<tr>
<td>CADplan, CADdraft</td>
<td>Personal CAD Systems</td>
</tr>
<tr>
<td>VersaCAD, CADapple</td>
<td>T&amp;W Systems</td>
</tr>
<tr>
<td>3Design</td>
<td>3Design</td>
</tr>
</tbody>
</table>

# HARDWARE UPGRADES FOR APPLE AND IBM COMPUTERS

The following is a representative listing of plug-in cards that upgrade the graphics capabilities, including color, of popular Apple II and IBM PC personal computers. All products listed are printed-circuit-card assemblies that are designed to plug directly into the specific computers' expansion buses.

## For Apple II Computers:

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Nine (1024 x 1024 pixels, 16+ colors)</td>
<td>Number Nine Computer Engrng.</td>
</tr>
<tr>
<td>MicroAngelo</td>
<td>Scion Corp.</td>
</tr>
<tr>
<td>SuperSprite</td>
<td>Synetix Inc.</td>
</tr>
<tr>
<td>Arcade Board</td>
<td>Third Millenium Engrng.</td>
</tr>
</tbody>
</table>

## For IBM PC series Computers:

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>BiGraphix II (640 x 400 pixels, 16 colors)</td>
<td>Applied Computer Products</td>
</tr>
<tr>
<td>Cono Color (640 x 400 pixels, 16 colors)</td>
<td>Conographic Corp.</td>
</tr>
<tr>
<td>Artist I (1024 x 1024 pixels)</td>
<td>Control Systems</td>
</tr>
<tr>
<td>RGB Boards (1024 x 1024 pixels, 4 colors; 640 x 280 pixels, 16 colors; 2 planes)</td>
<td>Frontier Technologies</td>
</tr>
</tbody>
</table>
Business Graphics

reach the business graphics arena. With these packages, new ways to easily and simply communicate complex business analyses become possible. (For a list of currently available graphics software packages, see “Graphics Software Sampler” box.)

Putting It All Together

Simply putting the best of each of the components of a graphics system together will not yield a system that works. Any added hardware must be able to support the features of the software that is to be used, which means that software and hardware must be selected together. Bear in mind, too, that any hardware component added to a computer must be physically and electrically installed in the working environment. In fact, addition of any hardware item—more memory, a super-high-resolution color graphics board, or any other device—redefines the working environment.

Any microcomputer that is selected will involve hardware trade-off decisions. As mentioned above, the IBM PC or PC-XT computers, as configured by IBM, are far from state of the art in terms of business graphics applications, but they may well fill the bill when mated with appropriate hardware and software from other vendors.

Advanced Systems

Since the objective of using business graphics is to tell a story, why not let the computer tell the whole story? Two computers currently on the market offer a special feature that takes them one step beyond other graphics systems. The Texas Instruments Professional Computer and the Digital Equipment Corp. Professional 350 offer a vocalizing feature that can add synthesized narration to a graphics slide show. The spoken words generated by these computers are digitized and replayed for a voice-over narration (16 minutes of text can be stored on one double-sided floppy diskette for the TI).

The DEC Professional 350 computer can be equipped with an optional text-to-speech device called DECTalk that converts standard ASCII text into vocalized speech. DECTalk generates very human-sounding speech in an adult male's, adult female's, or child's voice at rates of 120 to 350 wpm. It has a vocabulary of more than 20,000 words and an auxiliary dictionary for special terms. Added to the 800 x 240-pixel display in four colors (384 x 240 pixels in 16 colors), drawn from a selection of more than

MANUFACTURERS & ADDRESSES

Adwar
335 W. 35 St.
New York, NY 10011
212-691-0976

Amdek
2110 Livey Blvd.
Elk Grove Village
IL 60007
312-256-1180

Anadex
1001 Flynn Rd.
Camarillo, CA 93010
805-987-8460

Apple Computer Corp.
2055 Mariani Ave.
Cupertino, CA 95014
800-538-9566

Applied Computer Products
1916 Welsh Rd. No. 6
Philadelphia, PA 19115
215-634-6990

Autodesk, Inc.
Bldg. 5
150 Shoreline Hwy.
Mill Valley, CA 94941
415-331-0356

BG Graphics Systems
824 Stetson Ave.
Kent, WA 98031
206-853-2766

Business & Professional Software
154 Binney St.
Cambridge, MA 02142
617-491-3377

Calcomp
2411 W. La Palma Ave.
Anaheim, CA 92803
714-621-2011

Celtic Technology
6285 Varief Ave.
Woodland Hills, CA 91367
213-846-6677

Computer Associates
125 Jericho Tpke.
Jericho, NY 11753
516-645-3003

Comshare
1935 CIRF Valley Way
Atlanta, GA 30329
404-635-6255

Conographic Corp.
2206 Golden Ct.
Newport Beach, CA 92660
714-642-6778

Control Systems
2855 Anthony Lane
Minneapolis, MN 55418
612-789-8731

DataSouth Computer Corp.
Box 249947
Charlotte, NC 28224
704-523-8500

DeCrome Resources
25 Silvan Rd.
Westport, CT 06880
203-222-1974

DICON Medical
9700 Newton Ave. S.
Minneapolis, MN 55431
612-887-9710

Digital Computer Corp.
149 Main St.
Maynard, MA 01754
800-344-4825

Dunn Instruments
Box 7717
544 Second Ave.
San Francisco, CA 94107
415-957-1600

Enter Computer, Inc.
6587 Nancy Ridge Dr.
San Diego, CA 92121
619-450-0601

Entronics Research
150 N. Meramec, No. 207
St. Louis, MO 63105
800-325-0174

Epson America, Inc.
3415 Kashwa St.
Torrance, CA 90050
213-543-0360

Frontier Technologies
PO Box 1128
Milwaukee, WI 53211
414-864-8869

GraphComm Communications
200 Fifth Ave.
Waltham, MA 02254
617-880-8778

GTCO Corp.
1055 First St.
Rockville, MD 20850
301-278-9550

Hewlett-Packard, Inc.
6309 W. Bernardino Dr.
San Diego, CA 92107
800-547-3400

Houston Instrument
6500 Cameron Rd.
Austin, TX 78753
512-828-5090

IBM (Plotter only)
Orchard Park, Box 332
Dansbury, CT 06810
203-786-2500

IBM (all other products)
Information available from IBM computer centers and authorized IBM distributors

Image Resource
2260 Townsgate Rd.
Westlake Village, CA 91361
805-499-6317

IBSSCO Graphics
1050 Sorrento Valley Rd.
San Diego, CA 92121
619-452-0170

Lang Systems, Inc.
1015 Franklin Dr.
Menlo Park, CA 94025
415-326-5555

Lotus Development Corp.
161 First St.
Cambridge, MA 02142
617-482-7171

MA Systems, Inc.
2015 O'Toole Ave.
San Jose, CA 95131
408-963-0596

Matrix Instruments
230 Pogue Ave.
Northvale, NJ 07647
201-767-1750

MetaSoft Corp.
6500 W. Frye Rd., No. 12
Chandler, AZ 85244
602-621-1908

Micro Control Systems, Inc.
143 Turning Rd.
Vernon, CT 06066
203-672-0602

MicroGraphics Technology
1820 McCarthy Blvd.
Milpitas, CA 95035
800-633-2163

Micrografix
21396 Sorrento Valley Blvd.
San Diego, CA 92121
800-762-6666

MicroGroup
7545 Skyridge Rd.
Las Vegas, NV 89117
702-387-6218

Microprox
4535 International Blvd.
Norcoos, CA 90655
408-963-1860

Quadram Corp.
4355 International Blvd.
Norcoos, CA 90655
408-963-6666

Redding Group, Inc.
620 Main St.
Ridgefield, CT 06877
203-43-1301

SAS Institute
Box 8000, SAS Circle
Cary, N.C. 27513
919-481-8000

Sclon Corp.
12310 Pinconrat Dr.
Reston, VA 22091
703-476-6100

STB Systems, Inc.
601 N. Glenview Ave.
No. 12
Richmond, TX 77401
214-234-7670

Symtec
15932 W. 8 Mile Rd.
Detroit, MI 48235
313-732-2950

Synetics
1600 NE 55 St.
Redmond, WA 98052
206-828-4884

T&W Systems
No. 106
7372 Prince Dr.
Huntington Beach, CA 92647
714-847-9660

Tektronix
6225 Cochran Rd.
Cleveland, OH 44139
216-349-0600

Tenntronics, Inc.
PO Box 4828
Portland, OR 97208
503-477-4116

Texas Instruments, Inc.
PO Box 20243-3-h-642
Dallas, TX 75240
800-527-3500

Third Millennium Eng.
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Business Graphics

4000 colors, this system offers much for the business graphics user. Furthermore, a variety of business software is available for the Pro 350.

The Tektronix Model 4109, with Model 4170 processing unit, provides an even more powerful graphics capability. For $16,000 to $20,000, this system gives access to the bottom line of engineering packages, providing a great deal more graphics power. At the same time, the CP/M-86 operating system should provide access to many business graphics programs.

The eight colors that this computer can put on a chart are chosen from a 64-color palette and can be changed on the graph easily with a "joy disk." The 480 × 360-pixel image is superb. And the system can drive a signal for video projection.

Hewlett-Packard represents the top level in microcomputer-based graphics systems. For about $17,000, the HP-8936 computer offers 4960 colors (or shades of gray) from which to choose and 500K (expandable to 7M) of user RAM. Its very-high-resolution 512 × 390-pixel screen brings more life to colors than other systems, since it is backed by four memory banks that provide 16 shades for each of the system's displayable 199,680 pixels. And round things out, the HP-8936 makes it possible to use 3D graphics, even though software support for 3D is not yet really ready for the business user's needs.

Practical Considerations

A single graphics screen takes time to compose. Developing the 10 to 20 graphics screens that might normally be used during an hour-long presentation can require 4 to 5 hours of computer and composition time, which doesn't include time spent fussing with the data to get the charts to show what you want them to show and in what manner. To take advantage of microcomputer business graphics charting, plan to spend about one hour of work per chart.

In Closing

The ability to use 16 colors and 100 lines in a chart is a technical triumph. It is also a practical disaster! The brilliance of not using all the available technology simultaneously comes only with experience in constructing useful and informative graphics images. One learns fairly rapidly that communicating information effectively is best accomplished in relatively small, easy-to-digest bites.

New Architectures
(Continued from page 74)

“One other thing worth mentioning,” said Dr. Shaw, “is that there is at least one other project that we on the Non-Von project view as being of a kindred spirit, even though it’s very different in some ways. That’s the Connection machine up at MIT. One of the main people there is Dan Hills. Like ours, the Connection machine is based on massive parallelism.

“They, too, are trying to put a number of processors on a chip. Like ours, it’s based on something called SIMD (Single Instruction Multiple Data) execution, which says that all—in our case, it’s actually large subsets of— the processing elements are at any given time all doing the same thing instead of working as completely independent processors. And many of our colleagues don’t believe that’s the right way to go. In fact, probably the majority of our colleagues think that it’s a mistake. They think it’s better to use a different approach where the processors are independent. But this approach to the problem doesn’t allow you as many processors.

“So things are very controversial, but I think it’s too early to say who’s right. What would be exciting to all of us, I think, would be if one type of parallel architecture emerged ten years from now that turned out to be better than the Von Neumann machine. And it also turned out to be better for most purposes, even if not all, than most of the other kinds of machines.

“It’s clear to everybody that, if you want to do a particular problem as fast as you can, and you have a large amount of money to spend (there are such applications), it will be best done by a special-purpose machine. None of us is going to come up with a general-purpose machine that will do as well. On the other hand, the big prize in the field, will be to come up with a successor to the Von Neumann machine.

“That’s what we’re all trying to achieve. It will be some new way of organizing computers that, although it isn’t perfect, is good enough for people to adopt it for 90% of what they do. And it can be capable of being mass produced and sold to a very wide set of markets.

“We don’t yet have any evidence of whether that can be done. I rather suspect that it can. It would surprise me greatly if, by the year 2000, there weren’t some other kind of machine that was general purpose enough for people to use it in a wide range of applications. But we still don’t know what that is at this point.”

May 1984
propriate technology.”

To achieve this aim, Hutton began to consider the private communications networks already capable of providing database access to owners of terminals of all varieties throughout the country. An agreement was soon reached with CompuServe, a subsidiary of H. & R. Block in Columbus, OH. CompuServe was to function as the first conduit into the Hutton network. Best-known to most consumers as an information utility, similar in many ways to The Source, CompuServe has for years provided network capability to industry as a competitor to the possibly better-known Telnet and Tymnet.

The agreement negotiated with CompuServe was of a nonexclusive nature and thus allowed Hutton to use other forms of information delivery that might seem attractive. Another method of delivery was found in the three-county area surrounding Miami, FL, where Viewdata Corporation, a subsidiary of Knight-Ridder Newspapers offers a videotex service called Viewtron. (See “Videotex and You,” by John Hellwell in the February 1984 issue of COMPUTERS & ELECTRONICS.) Hutton adopted this delivery service for Huttonline on a different basis than the CompuServe service.

To the client accessing through CompuServe, using whatever terminal is available, the CompuServe link is completely invisible. CompuServe is nothing more than a conduit and the user does not have access to the CompuServe information utility unless a separate agreement has been signed. On the other hand, Huttonline is presented as an option to all Viewtron users, each of whom must have a dedicated videotex terminal (the AT&T Sceptre).

Both CompuServe and Viewtron lines connect with the Hutton Compass system in New York. Compass interacts with the CompuServe network at 9600 baud using X.25 protocol. Information is then transmitted to users at either 300 or 1200 baud, depending on the user’s terminal. Data is transmitted to Viewtron using 3270 protocol at 9600 baud; and information goes to users at 1200 baud.

While Hutton wanted its information service to be accessible to as many types of hardware as possible, it also wanted to be in a position to recommend and sell a broad range of hardware that would suit the individual client’s needs. It was decided to offer both a low-priced terminal and a full-service microcomputer. The low-priced terminal selected was the Quazon Quik-Link, which sells for $249 (suggested retail price). It connects directly to telephone lines and can be used with a standard telephone instrument. It can be expanded by adding a computer.

The choice of a microcomputer was relatively easy. Hutton sought one that was certain to be around for a while and that would accommodate the widest possible variety of software for users other than Huttonline. Furthermore, Hutton did not preclude itself from eventually developing its own software or marketing someone else’s. Obviously, then, Hutton wanted to select the equipment with the widest possible distribution. There was only one company with a product that met these criteria—IBM—and Hutton reached an agreement with Big Blue. Hutton also selected another MS-DOS system, the Wang Professional Computer, as an option for their clients. This provides a quasi-IBM-compatible alternative for users oriented toward word processing.

The most interesting of the hardware choices is the Workslate from Convergent Technologies (see the review of this product in the November 1983 issue of COMPUTERS & ELECTRONICS). This is a portable computer weighing less than 3 pounds and designed specifically for business people. Its components include a built-in modem, a calculator, a date book with alarm memory, a telephone answering machine, a speaker phone with electronic phone book and auto dialer, and a portable dictating machine. While the Workslate has, the same lightweight portability as the Radio Shack Model 100, it has quite a different orientation as far as use is concerned.

The Model 100 is a traditional computer that includes Microsoft BASIC and various applications (including a text editor, a calendar, and communications) contained in ROM. The Workslate, on the other hand, is intended to be an end-user computing tool, centered around a spreadsheet similar to VisiCalc; it is designed as a productivity-enhancement tool for managers and professionals and performs extremely well in this capacity. In announcing the arrangement with Convergent, Epstein said, “We are very pleased to get into the area of personal computer distribution with a product as exciting as the Workslate. It’s an excellent tool for many of our clients who require truly portable computing power.” We would go slightly further than that and say that it is an excellent tool for almost every business person.

Options available for the Workslate are a microprinter, Portfolio Analysis TaskWare (a series of programs that analyses stocks and bonds, taxes, and cash flow and perform beta and internal rate-of-return calculations), and connections to financial databases of CompuServe, Dow Jones, and The Source. Hutton is selling the basic Workslate to its clients for $895, including the initial $25 Huttonline sign-up fee and one month’s unlimited access to Huttonline. Workslate purchases, and all other purchases related to Huttonline, are made through the Hutton client’s account executive and can be charged directly to the client’s account.

System Operation

Clients sign on to Huttonline by dialing the local telephone number that Hutton has provided with the start-up instructions. (As mentioned, this is actually the local number for CompuServe.) Once connected, the system asks for a “Host Name” and the user responds by entering “EFH,” which directs the system to the Huttonline facility. The system will then request “VIC” and, upon receiving the user’s request, will request a password. It is these last two entries that identify the user to Huttonline and also ensure the confidentiality of the user’s records. The user is then presented with a menu allowing a choice of the following:

1. Use the service
2. About the service
3. Quit the service

This menu is the first of a series that takes the novice user through the system with little difficulty (see Fig. 1). The experienced user can bypass the menu tree by using GO commands to take him directly to the section desired (Table 1). Access through either method is smooth and does not irritate the user with inordinate delays, even at 300 baud.

The presentation of information in all areas is both clear and concise and the information is certainly useful to the average investor. The only possible disappointment to the new user may come in the section of the “Your Account” menu entitled “Portfolio.” This choice presents the user with a snapshot valuation of present holdings. It is not a classic portfolio management system that includes the original cost of each transaction, unrealized profit or loss of each completed transaction, and other pertinent information. We do not see this as a serious limitation to the user, however, for the investor requiring such information can turn to software such as PEAR, Personal Investor, or Reveal (for the IBM PC). The Workslate user can take advantage of the Portfolio Analysis.
Stocks and Bonds

TaskWare, which provides some of these functions. The Huttonline approach to the portfolio section is consistent with the entire system, which presents current snapshots of balances, investment reports, and so forth.

The option "Send Message to Your Account Executive" allows the user to send instructions of a general nature and to request research reports, which are then mailed to the user the same day. It is not intended to be used as a means of order entry. This restriction is consistent with the system design considerations discussed above. The other menu items require little explanation.

**Evaluation**

The decisive question for investors considering the use of Huttonline—which for which some will require switching accounts from another brokerage firm to EF Hutton—is "What will it do for me?" or "How will it improve my investment performance?" Unfortunately, the actual benefits are difficult to quantify. Huttonline allows the client to receive more information in a much more timely fashion than was previously possible.

Making optimum use of the system, however, depends on both the client and the AE. The client must make intelligent use of the newly found abundance of information in making investment decisions. The AE must be tuned in to both the capabilities of Huttonline and the client's interests and needs in order to properly utilize the electronic mail facilities.

The availability of information is very important, but the ability to use it well is more important. Each potential client will have to evaluate the service in relation to these factors. From our point of view, Huttonline is well worth the investment of time and money.

**TABLE I—GO COMMANDS**

<table>
<thead>
<tr>
<th>ACC—Your account menu</th>
</tr>
</thead>
<tbody>
<tr>
<td>BAL—Balances</td>
</tr>
<tr>
<td>BOU—Bought/sold (transactions by class)</td>
</tr>
<tr>
<td>CHE—AMA/ARA checking</td>
</tr>
<tr>
<td>COM—Communications menu</td>
</tr>
<tr>
<td>DEP—Deposits (transactions by class)</td>
</tr>
<tr>
<td>FEE—Feedback to EF Hutton</td>
</tr>
<tr>
<td>INC—Income (transactions by class)</td>
</tr>
<tr>
<td>INV—Investment briefs</td>
</tr>
<tr>
<td>MIA—Mail your mail</td>
</tr>
<tr>
<td>OPE—Open orders</td>
</tr>
<tr>
<td>PAI—Paid out (transactions by class)</td>
</tr>
<tr>
<td>POR—Portfolio</td>
</tr>
<tr>
<td>RES—Research</td>
</tr>
<tr>
<td>TRA—Transactions this month</td>
</tr>
<tr>
<td>USA—Usage tips</td>
</tr>
<tr>
<td>WHA—What's new</td>
</tr>
</tbody>
</table>

Other commands

- F—Forward 1 page
- Fn—Forward n pages
- B—Backward 1 page
- Bn—Backward n pages
- M—Previous menu

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ed with parallel rows of transparent, conductive strips. The sheets are placed over the monitor at right angles to one another to provide an intersecting grid of switches that can be easily closed by finger pressure.

Capacitive sensing can also be used. Touch Technology, for example, has developed a touch sensitive screen of glass coated with a transparent array of tin oxide rectangles. Each rectangle senses the presence of a finger by the resulting capacitance change.

The company makes a touch sensitive screen having higher resolution by applying a uniform film of tin oxide over the entire surface of a glass sheet. Two terminals connected to the sides of the screen sense capacitance changes anywhere on its surface with a resolution of about 100 by 100 points.

Elographics, Inc. uses a resistive sensing method in which a glass sheet coated with a transparent, resistive film is covered by a flexible plastic sheet coated with a transparent, conductive film. A voltage is applied alternately across each axis of the resistive film. When the plastic cover is pressed against the resistive film, two alternating voltages are developed which, when digitized, enable the computer to determine where its screen has been touched.

All these touch screen sensors attenuate the brightness of the image on the monitor's screen. One sensing method that does not employs a grid of infrared beams on the screen. Infrared emitters along two adjacent sides of the screen project their beams to phototransistors along the opposite two sides of the screen. The result is an intersecting grid of infrared beams that permits a computer to determine where a finger has been placed.

Some companies make infrared touch sensor systems that can be mounted over the screen of a standard monitor. Others sell monitors with built-in infrared sensors. Hewlett-Packard's HP 150 personal computer, for example, features many menu driven operating modes that can be selected by touching the appropriate box or icon displayed on the screen.

**Digitizing Tablets**

Digitizing tablets, the largest family of pointing devices, have flat surfaces that can detect the presence of a special pen, stylus, or even a finger. In 1967, prior to the commercial development of either the mouse or the personal computer, a classic study concluded that the digitizing tablet was the best pointing device (W.K. English, D.C. Engelbart and M.L. Berman, *IEEE Transactions on Human Factors in Electronics*, HFE-8, 1, 21-31). Many experienced users of pointing devices still agree. After all, what could be more natural than a pointing device that's used like a pencil and paper? Until recently, however, digitizing tablets were far too expensive to be considered for use with personal computers. Now the price barrier has been penetrated by the introduction of several kinds of economical digitizer tablets. Some of them are supported by software having surprisingly high quality.

The tablets with the highest resolution, which also happen to be the most costly, use indirect sensing schemes. Typically, the tablet incorporates a crossed grid of conductors directly under its surface. As a special ballpoint pen or cursor fitted with crosshairs is moved across the tablet, electromagnetic radiation from oscillatory signals sent sequentially through the tablet's grid is detected by a small pickup coil in the pen or cursor. A properly programmed computer enables the position of the pen or cursor on the active surface to be detected with a resolution of 0.005" or less.

Electromagnetically scanned tablets cost from several hundred to several thousand dollars. And while they have better resolution than pressure-activated tablets, some low-cost units may exhibit pin cushion distortion. This means the spacing between minimum resolution points may increase around the edges of the table's sensitive region.

This phenomenon may require the time consuming development of software correction factors or grid overlays with curved, rather than straight, lines. Several new kinds of low-cost, pressure-sensitive digitizing tablets have appeared on the market in the past few years. Designed specifically for use with personal computers, these devices use innovative means to detect the pressure of a stylus or finger on their active surfaces.

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Pointers

layer coated with a thin resistive film. A plastic square with a second resistive film on its back and having an adhesive border is installed over the base.

An array of some 2000 tiny, nonconductive bumps in the first plastic layer separates the two resistive films by a few thousandths of an inch. A simple analog circuit alternately switches a current across first one resistive layer and then the other. When the two pads are pressed together, the circuit can detect both the presence of the pressure and its location.

The PowerPad by Chalk Board, Inc. is another innovative, yet affordable, digitizer tablet. Its large 12-inch-square active surface is backed by an array of 120 by 120 pressure-sensitive membrane switches. This provides a resolution of 100 switches per square inch.

The PowerPad's hardware scans all 14,400 switches twenty times each second. Since the device is purely digital, the scanning circuitry detects all switch closures. This means the PowerPad can respond virtually simultaneously to multiple data entries. For instance, it can display on a computer monitor the shape of a hand pressed down on the tablet's active surface.

Kaolapad and PowerPad are representative of the new generation of touch-sensitive digitizer tablets. Already other companies have introduced similar products and the prices for these devices, currently in the range of $100 or less, will likely decrease.

Touch sensitive tablets will play an important role in producing computer novices to any type of personal computing. The icon-oriented software available for Kaolapad, PowerPad and similar tablets is so "user-friendly" even a beginner can perform sophisticated operations without referring to an operator's manual or learning to use a keyboard.

Computers can be trained to remember words and act accordingly

MISCELLANEOUS POINTING DEVICES

The pointing device families described thus far are supplemented by a wide variety of related devices. Here are some of the more significant:

Joydisks and Cursor Disks. Identical in function to the rate joystick, joydisks and touch disks are circular control disks small enough to be installed directly on a keyboard. A typical joydisk is octagonal in shape and can be pressed along each of its eight sides to move a cursor in a desired direction. A cursor disk such as the one used on the Xerox 860 Word Processor senses finger capacity. The cursor of this machine moves in the direction indicated by finger movements on the cursor disk. The cursor speed is increased when the finger is moved closer to the edge of the disk.

Single-Axis Joysticks and Thumbwheels. A single potentiometer with an attached handle forms a single-axis joystick. It is used to move a cursor along only one axis. A thumbwheel is a potentiometer with a serrated knob whose edge emerges through a slot in a control.
Pointers

A single thumbwheel moves a cursor along one axis. Usually two thumbwheels are mounted adjacent to one another but at right angles. This provides two-axis control.

The Track Pen. The Track Pen is a modified mouse. Developed by Ampower, it incorporates a rotating ball mounted in one end of a large stylus. It is claimed to be more natural to use than a mouse since it is held like a pen.

Sonic Digitizers. This device incorporates a stylus that emits a series of sonic pulses. Two microphones in a receiver system placed nearby detect the pulses and determine the exact distance between the pen and each microphone. With this information, the location of the pen can then be determined.

Pantograph Digitizers. Pantograph digitizers use cursor crosshairs attached to one end of a mechanical arm that slides up, down and through a slotted assembly placed to one side of the work area. Rows of conductive contacts along the arm and in the slotted assembly act as switches that enable the device to determine the position of the crosshairs. Though they are clumsy to use, they give very accurate results.

Voice Recognition Devices. Voice recognition hardware provides a fascinating new kind of pointing mechanism. Even a brief session with a Texas Instruments' Professional Computer equipped with a voice recognition capability is enough to convince a skeptic. This computer can be "trained" to remember words and respond accordingly when the words are used as commands. This permits menu options to be selected by simply stating the appropriate name.

Eye Position Detection. By detecting light reflected from the cornea or the retina of the eye, it is possible to determine where the eye is gazing. The military has used the former method to develop, among other things, automatic weapon-aiming devices for helicopter gunships. The same technology can be used to control the movement of a cursor on a monitor or to determine where a monitor a user is staring.

Selecting a Pointing Device

As should be apparent by now, there is a plethora of pointing devices. Since each manufacturer claims its device is the most ergonomic and the easiest to use, remember that no single pointing device is the best for all applications.

Currently, the mouse and pressure-sensitive touch tablets are receiving the most attention, but neither provides the natural sensation of the light pen. The latter, however, has less resolution and is tiring to use with a conventional monitor.

The serious pointing-device user should keep all options open. For digitizing drawings, either original or traced, of circuit diagrams, floor plans, surveys and the like, a digitizing table is probably the best choice. For moving a cursor in word-processing applications, consider a cursor disk or a mouse.

Trackballs are excellent for very fast cursor movements. And joysticks are good for tracking and in applications where precise pointing is not important. As for selecting an actual device, nothing beats a hands-on trial with a variety of working pointing devices. Finally, no matter which device you select, be sure to keep other pointing devices in mind as your requirements expand.
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low the IBM conventions. So if you're an
experienced user, there is virtually noth-
ing new to learn.

As mentioned, Leading Edge includes
Microsoft's GW Basic programming
language in the purchase price of the ma-
tine. This is very important since the
IBM, or PC-DOS, version of BASIC
will most definitely not work on the
Leading Edge PC. My first, and only at-
tempt to load IBM BASIC resulted in
the disks whirring a lot; but nothing ac-
tually happened. The problem has to do
with inevitable code differences in the
IBM and Mitsubishi ROM chips.

Is this a problem? No, not really. Ac-
cording to Leading Edge, this version of
BASIC will correctly execute any IBM
BASIC program. Of course, if you want
a machine that will run all IBM pro-
grams and IBM BASIC with absolutely
no surprises, then you'd better buy an
IBM PC, because that's the only street-
legal 100% compatible product around.
If you want to run some IBM programs
and are willing to load Microsoft BASIC
from disk, then the Leading Edge PC is
not a bad choice.

Like many of its peers, the Leading
Edge PC is a bit noisy since it uses an
electric fan to keep the system cool.
Again, this is just a small point, but it
could be bothersome in an office where
two or three machines are in constant
use. Certainly, the fan works since there
were no signs of overheating during the
time I used the machine. The main air
vents are along the back of the system
unit, near the power sockets.

Documentation

If there is one thing that really makes
life hard for the user it's poor documen-
tation. Leading Edge, however, has
managed to avoid a lot of the common
traps and provide a well-designed set of
manuals for its personal computer cus-
tomers. These manuals are quite well-
written, professionally printed, and have
a number of high-quality illustrations
wherever relevant.

The technical specification sections
provide very detailed information for all
interested users, and an index of con-
tents is supplied. (It's amazing how
many other document writers for this
type of equipment have failed to include
indexes with manuals.)

Conclusion

The Leading Edge PC is not an espe-
cially pretty machine. But what it lacks
in design it makes up for in terms of price
and performance. There are other IBM
compatibles on the market that are less
expensive than this machine—the Tava
and the Sanyo PCs for example. But I
liked the Leading Edge idea of supplying
a machine that comes standard with al-
most everything a user might immedi-
ately need.

You can use the Leading Edge PC to
write BASIC programs, run MS-DOS
and PC-DOS software, and see it all on
the monitor supplied within the pur-
chase price. You can then print out hard
copies of documents using either the se-
rial or parallel communications port.
Plus, at the flick of a microswitch, you
can make the machine do lots of process-
ing tasks at a speed that is anywhere up
to twice as fast as an ordinary Intel 8088-
based computer.

If you've already decided to buy an
MS-DOS machine, but don't want to pay
the full price for an IBM PC, the
$3000 Leading Edge PC should be a seri-
ous contender for your business.
When it comes to superior performance, we study our lines very carefully.

Superior printer performance is not a fluke. It evolves from analyzing printed line after printed line. Taking the time to test and retest. After 30 years of manufacturing precision parts, we know that there are no shortcuts.

And so we took the Gemini-10X and methodically put it through its 120 cps pace. We achieved a print head life of over 100 million characters with an extremely precise dot alignment creating each crisp character.

So far so good.

Next, sophisticated performance demanded versatility. A wide choice of character sets, a buffer expandable to 8K, and the ability to interface with all popular personal computers. We added macro instruction, giving Gemini-10X the capability to perform up to 16 operations with one command. We included as standard a paper feed system that has a friction and fully adjustable tractor feed. Then we even built in the dexterity to print graphics and text on the same line.

Done.

And, of course, staying the best means constant reviewing and fine-tuning. Keeping the Gemini easy to find, easy to afford and so reliable it can be warranted for up to twice as long as its major competitors.

Only the most careful engineering has built the new hard-working Gemini-10X. You'll applaud its performance.

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Quite simply, Leading Edge® is the simplest, yet most powerful word processing program ever created for sophisticated Personal Computers like the IBM® or the even more powerful Leading Edge® PC. You can learn the basics of the system in a matter of minutes, master it in a matter of hours, and never outgrow it in a lifetime.

Thanks to the system itself, even the most complex functions are typically reduced to just one or two keystrokes with Leading Edge®. And thanks to an impecably logical and easy-to-reference Operators Manual, you can quickly flip to any function you want to perform, and immediately start performing it.

So you can hunt and peck your way into the future, or (if you're already a good typist)...you can fly. It's backed by a lifetime warranty, available at around a thousand stores across the country, and comes standard with a toll-free Technical Help Hot Line that connects you directly with a highly trained human being to walk you through, talk you through, any questions you may ever have. For more information, or for the name of the nearest dealer, just give us a call, toll free 1-800-423-0300, In Mass., call collect (617) 328-8190. Leading Edge®, Big word processing for the small computer.