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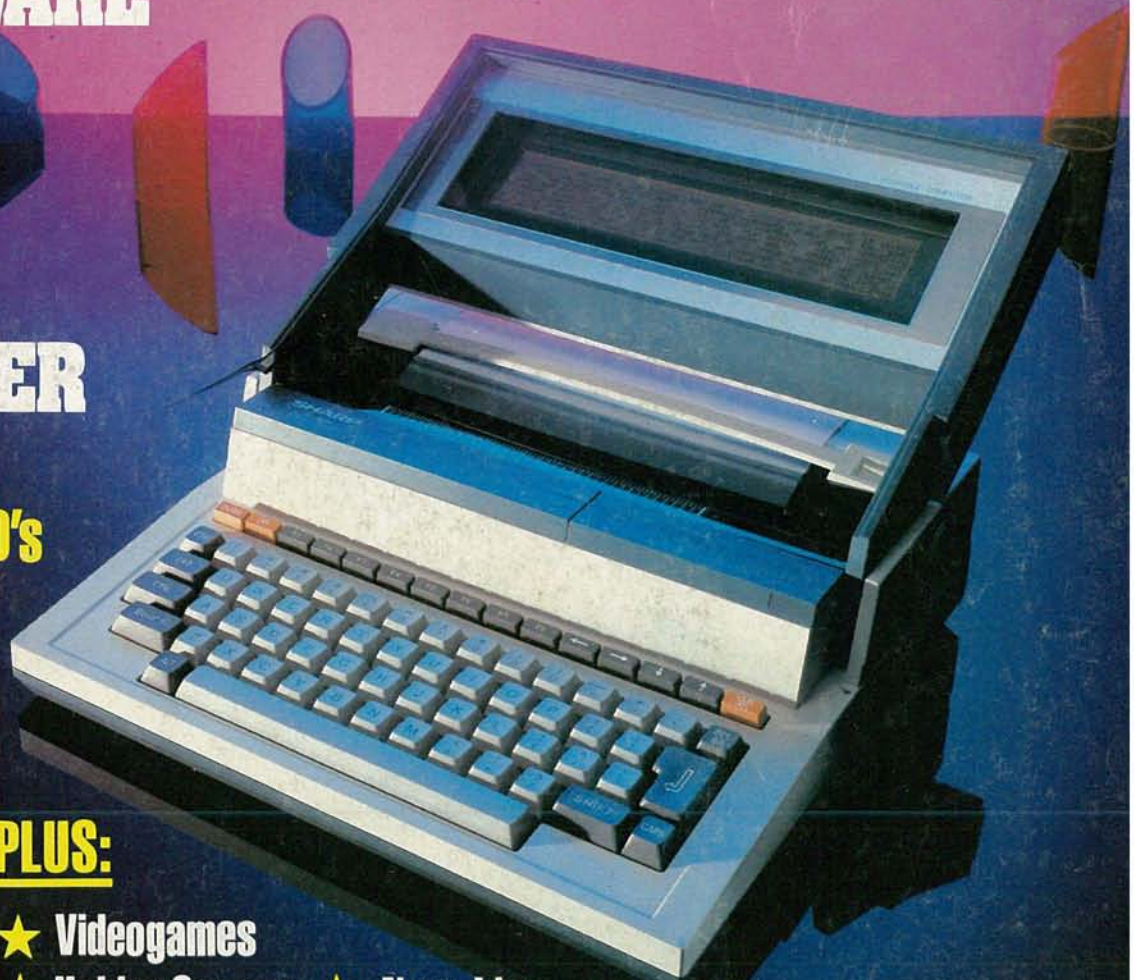

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OCTOBER 1983 Vol. 54 No. 10

ON THE COVER

There's little doubt that personal computers have become the fastest growing segment of the consumer-electronics market. In the past year many new companies have been founded, and scores of new machines have been introduced. In addition, most of the "established" manufacturers (in this industry that's anyone that's been around longer than two years) have either unveiled new systems, or beefed-up their existing ones, to remain competitive. The result has been greatly increased selection, generally lower prices, and just about utter confusion for the consumer. That's where this special section comes in—it's designed to help you make sense out of the jumble of systems by summarizing what's available. To help make comparisons easier, everything is organized by list price. The section begins on page 75.

TO OUR READERS

Due to our large computer-hardware section, several articles that were originally scheduled for this issue could not appear, due to space limitations. Those articles will be published in coming months.

COMING NEXT MONTH

On Sale October 20

- **Test Equipment.** A look at what's new and unusual.
- **Audio Tape.** Audio-cassette tapes and how they differ.
- **How To Design Analog Circuits.** All about filters.
- **And lots more!**

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WHAT'S NEWS

Postage stamps honor four U.S. inventors

The United States Postal Service has unveiled the design of a block of 20-cent stamps honoring four American inventors in the field of electricity and electronics. The stamps were issued September 21, 1983, at the U.S. Patent and Trademark Office in Arlington, VA.

The four inventors selected as most worthy of honor are Charles Proteus Steinmetz, Edwin H. Armstrong, Nikola Tesla, and Philo T. Farnsworth.

Charles Steinmetz—born in Breslau, Germany, in 1865—came to the United States in 1899, and became the leading engineer and scientist of General Electric Co. in Schenectady, NY. Among the more important of his many studies and inventions were researches on the theories of alternating current and high-voltage power.

Edwin Armstrong—born in New York City in 1890—is credited with the invention of the superheterodyne radio, the type used almost universally today. His most important achievement was the development of wide-band frequency modulation, known to the average listener as FM radio.

Nikola Tesla was born in 1857, in Smiljan Lika, Croatia, in what is now Yugoslavia. The more important of his more than 700 inventions included pioneering developments in radio, high-frequency electrical currents, glow-lamps, and polyphase alternating current theory and practice.

Philo T. Farnsworth was born in Utah in 1906. His more than 300 inventions were practically all in television and related subjects. He is most famous for his first all-electronic television transmission, made in San Francisco, CA, on September 7, 1927.

FOUR AMERICAN INVENTORS ARE HONORED on US postage stamps. Charles Steinmetz, upper left, for pioneering in electrical theories; Edwin Armstrong, upper right, for frequency modulation; Nikola Tesla, lower left, for alternating current theory and practice, and Philo Farnsworth, lower right, for television pioneering and invention.

Videogames to become computer terminals?

A new service, *Gameline*, by Control Video Corp of Vienna, VA, promises as a start to allow any owner of an Atari *2600* video computer system (and a few other brands) to tap into a vast central computerized library of popular videogames.

Eventually, says CVC, the game-system owner will be able to make use of a variety of other features, such as sports reports, stock quotations, news, electronic banking, and other services now available only to personal-computer owners who subscribe to services like CompuServe or The Source.

In addition to giving access to an enormous variety of games, Gameline gives the player a chance to preview new games just coming on the market, and to sample games before purchase. Contests, from regional to worldwide, with prizes ranging from T-shirts to four-year college scholarships, are also offered.

***MASTER MODULE* PLUGGED INTO AN ATARI *VCS 2600* and connected to the telephone brings the avid player a plethora of the latest video games.**

The "brain" that turns an Atari *2600* into a computer terminal is the CVC *Master Module*, which plugs into the console where the game cartridge would normally go. It consists of a sophisticated modem, two memory devices, and an automatic telephone dialer. One memory unit stores a videogame or up to six pages of typewritten text. The other stores the players' names, ID's, the module's serial number, contest scores, and telephone numbers to access the system.

The user simply turns on the TV and the game system, and selects the desired game from a list that flashes on the TV screen. He makes his selection with the joystick and "fire" button, and the module dials its memory-stored local number to connect with the central computer. The game's software is then fed into the *Master Module*. The whole telephone call lasts usually less than one minute.

Costs of the service are claimed to be moderate. The Master Module is being offered at an introductory rate of $49.50 (plus $5 for shipping and handling). Game sessions (multiple plays of a game) cost $1, or about 10 to 15 cents a play, depending on the player's skill. A $15 membership fee (waived during the introductory period) is charged each member, and if the player wants to enter contests, a fee of 50 cents for registering a high score in the central computer. Games are charged against credit cards. (Credit limits can be set.)

The Gameline *Master Module* is compatible with the Atari *2600 VCS* and Sears *Video Arcade*. It can also be used with ColecoVision units equipped with *Expansion Module #1*, or with the ColecoVision *Gemini* system.

New color display uses liquid crystals

A display system that uses a monochrome cathode-ray tube and a liquid crystal "color switch" to produce a high-resolution, field-sequential color display was demonstrated recently by Tektronix at the Philadelphia meeting of the Society for Information Display.

The success of the new system was due to the development of a new, proprietary, fast liquid-crystal optical switch. Combined with the monochrome CRT, it produces a high-resolution field-sequential color display.

Because there are no shadow masks or penetration phosphors, the resolution can be as high as that of any monochrome CRT. Other advantages are inherent convergence (there is only one electron beam) excellent contrast in high ambient light, and ruggedness. (The fragile shadow mask and complex color gun are eliminated.)

The new technology is expected to find applications in instrument displays, where its high resolution will make it useful. It will also be useful in small process-control displays, where the color can be used for warnings or for highlighting special situations.

VIDEOGAMES

Alternate means of distribution

DANNY GOODMAN, CONTRIBUTING EDITOR

THE TIME MAY COME WHEN, HAVING CONquered or become bored with a cartridge, we no longer put it on the shelf and go out to buy another. Recently, a couple of ideas have surfaced to offer different ways of providing us with games to play without investing in $20 to $40 cartridges or waiting for a cable-TV company to offer a game service.

One system getting underway now is called GameLine by Control Video Corporation (8620 Westwood Center Drive, Vienna, VA 22180). GameLine's idea is to have games downloaded to your *2600* via the telephone. Here's how it works.

First, you need to buy CVC's GameLine *Master Module* for $50-60 at a local videogame store. That gizmo, shown in Fig. 1, looks like an oversized cartridge and plugs into the cartridge slot of the *2600* (or a *2600*-compatible machine) It also comes with a cord that has modular telephone plugs on either end and a "Y" adapter. All you have to do is plug the adapter into the back of your telephone, and the cord from the adapter to the *Master Module*.

FIG. 1

A $15 registration fee sets up your account with CVC. All charges are billed to a credit card, and parents have the option of limiting the dollar amount playable per week. Each time you download a game, you are charged $1.00. For that dollar, you get about 10 complete games—then the game disappears from the console's memory.

To download a game, you must first look at the listings of games offered by GameLine in their monthly newsletter (free for the first year). Responding to prompts on the screen with your joystick, you select the number of the game you want. Then the *Master Module* automatically calls GameLine (either a toll-free or local call), tells the main computer who is calling, and asks for the game you want to play. The entire transfer process takes about a minute.

As of this writing, however, CVC has not lined up too many suppliers of games. Imagic is about the biggest of them all. The balance of the listings are of smaller—and a few defunct—producers, including Telesys, U.S. Games, Data Age, and so on. If CVC can attract the big guns—Atari, Activision, Parker, Coleco—only then will GameLine be something to consider. And even then, only if the companies release titles to GameLine at the same time they're released to the stores. Then it'll really be a great way to try out a potential blockbuster cartridge. Unfortunately, I don't believe CVC will get too big a following of the big-name game producers—they would rather sell cartridges outright.

The system does, however, hold promise as a telecommunications network for the *2600* as people graduate to the computer keyboard. The GameLine *Master Module* (technologically a fine product at an attractive price) and main computer could become a low-cost electronic mail system for the masses.

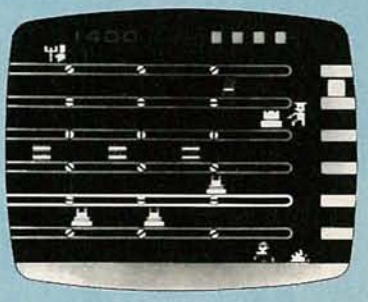
Another approach

Taking a different approach to game distribution is a company called Romox (501 Vandell Way, Campbell, CA 95008). Although the firm is focusing its attention on computer cartridge-type software now, there is nothing that would prevent its concept from being carried over to videogames.

Romox produces cartridges that can be reprogrammed by a dealer equipped with a special computer-like terminal. The system is based on periodic telephone transfers of software from a central computer to the in-store terminal where it is stored on a hard disk. The first cartridge you buy costs about the same as a regular game cartridge: $25-35. Later, if you find you don't use that program anymore, you can take it back to the dealer, look at the list of hundreds of programs on hand and have the cartridge reprogrammed with a new game for about $10. The process takes only a minute or two, and you leave the store with a new program at one-third the regular cost.

Romox has signed up several major computer-software houses, including Sierra On-Line, to participate in this new distribution method. What I like about this system over GameLine is that you get a cartridge that you can play as many times as you want. With GameLine, the meter is running every time you lose a life. That's too much like the quarter-eating arcades. I thought the home videogame was supposed to let us get away from constantly reaching into our pockets for one more chance.

CommaVid's Cake Walk for Atari 2600



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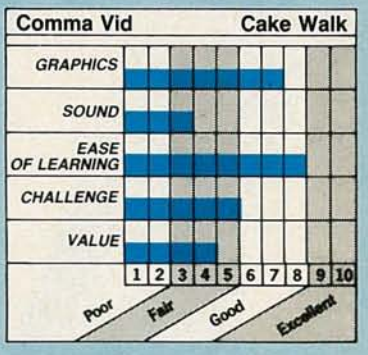


THERE IS NO LACK OF "CUTESY" videogame cartridges available for the *2600*, yet more keep coming. CommaVid Inc. (1470 N.Farnsworth, Suite 203, Aurora, IL 60505) has published another one of those games that seems aimed at the younger or more sensitive games player. This one is called *Cakewalk*, a simplistic hand-eye coordination activity.

continued on page 14

VIDEOGAMES

continued from page 12

An introductory screen depicts a large face of a mustached baker, complete with chef's hat, and pairs of cakes streaking along the bottom of the screen. When you turn on the game, the name of the cartridge and the CommaVid company logo appears at the upper left corner of the screen. That introductory screen comes back at the end of each game, displaying the final score.

The actual game begins with a press of the RESET button. Six rows of conveyor belts dominate the screen action. At the end of each conveyor is a small gap; on the other side of the gap is a shelf. The object of the game is to move the baker up and down the screen to each belt, where he transfers the cake or other pastry coming off the conveyor over to the shelf. If he fails to get to a pastry in time, it falls to the floor, and a cleanup man comes out and sweeps the mess away. To keep things interesting, pastries come at random, either singly or in groups of two and three, and at different speeds on each belt.

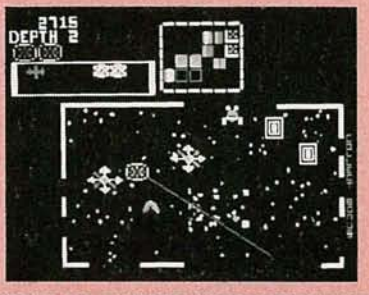
In defense of the oncoming cakes, you can stop one conveyor by positioning the baker at the end of that belt and pressing the action button on the controller. The belt turns red and stops for a few seconds, allowing you some time to catch up with the other cakes.

The cartridge contains 16 variations of this one-player game. Differences between versions lie for the most part in the speed of the cakes and the response speed of the baker to your joystick action. A few variations at the top-end feature tricky gingerbread men who move along the belts erratically.

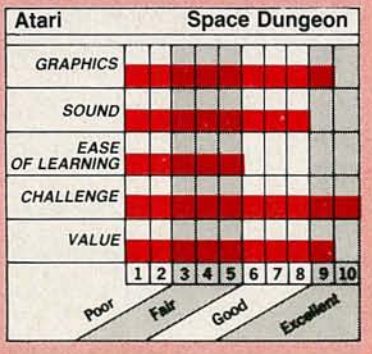
What disappointed me most about about this game is what I call the two-dimensionality of the game play. I'm not talking about graphics—which, I'm sorry to say, are nothing special either—but about how the game plays. All the action is on the screen at once, and the action or thought demanded of the player is minimal. In other words, there is essentially no depth to the game.

Perhaps this level of game is what the very young and/or inexperienced go for. But there are so many other similar-playing games in the store racks with much better graphics and sound (sound that does more than chime a dull tone at the acquisition of each point) that you probably already own enough games of this type to take care of the occasional players in your household. And I am concerned that between each game, when the title screen reappears, the cartridge does not cycle through the colors to avoid burn-in on a color TV. There is also another potential problem: the cartridge may not work on the *Colecovision 2600*-cartridge adapter—the sample we had did not.

Atari's Space Dungeon for Atari 5200



CIRCLE 102 ON FREE INFORMATION CARD



FOR THE POOR *5200* OWNERS WHO HAVE had to get by with only a handful of cartridges, let it be known that relief is on the way; the recent crop of Atari (1265 Borregas Ave., Sunnyvale, CA 94086) *5200* cartridges have been outstanding additions to the fledgling library. And I don't think I've come across a more challenging and purely addictive action-videogame cartridge on any system to date than *Space Dungeon*,

One of the most unusual features of this game is that the player must use both joysticks to control the action. The cartridge is packaged with a special plastic brace that tries to hold both controllers steady while you concentrate your physical action on the joystick. Without going into the somewhat inane instruction manual explanation of what your screen character is doing, suffice it to say that you must move your character into as many of the 36 chambers on each level as possible.

Treasures are picked up by running over them. But you have to avoid or destroy all the enemies who can do you in on a second's notice. There are many kinds to watch out for.

The only time you gain the bonus point for picked-up treasure is when you fight your way into the chamber with the bonus square. Then, not only do you collect bonus, but you proceed to the next, more intensive level of 36 chambers. And so on—for more levels than I could reach. At levels two and up, a Thief is also in the game. The Thief's objective is to try to take away treasures while you try to collect them.

Controller action takes quite a while to get used to. One joystick controls the movement of your character within the chamber and through openings to adjacent chambers. The other joystick controls the firing direction of a powerful laser-type cannon. Unfortunately, you have only eight firing directions, so to aim at a rapidly oncoming enemy, you need to juggle the firing direction and movement of your character. That's not an easy task by any means because each joystick needs to go in opposite directions: moving away from the enemy, while firing toward the enemy.

Your progress through a level is monitored in a map of the level that depicts which chambers you've been in. That map also shows which chambers still have enemies lurking within; which one has the bonus portal to the next level, and where you dropped the treasure the last time an enemy hit you.

The physical challenge of maneuvering two joysticks is trouble enough. When you add the very fast action on screen, you have one harried time keeping on top of the situation. *Space Dungeon* is an excellent example of the computer-quality games that the Atari *5200* is capable of. Let's hope Atari maintains the same level of quality in future *5200* offerings. **R-E**

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CIRCLE 61 ON FREE INFORMATION CARD

Radio-Electronics
OCTOBER 1983

YOUR OWN Computer®

COMPREHENSIVE BUYERS GUIDE TO COMPUTER SYSTEMS

MARC STERN

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IT HAS BEEN ONLY A YEAR SINCE THE last **Your Own Computer** hardware buying guide was published, but what a year it has been! Almost overnight, the shape of the microcomputer world has been changed. A generation of new microcomputers has appeared, bringing low-cost computing power to price levels unimagined at the time.

The primary change that brought this about has to do with economics more than anything else. As recently as five or six years ago, the small piece of silicon that carries the number-crunching circuitry—the CPU (*C*entral *P*rocessor *U*nit)—cost as much as $50 or more in small quantities. Yes, they were used in many items and as they became more common their cost began to drop. Soon they were selling for $20, and shortly thereafter for $10. The economies resulting from mass production techniques were making themselves felt.

At the same time, the price of mass memory fell dramatically. No longer was the price of this key ingredient in the makeup of a personal computer pro-

A NEW GENERATION OF COMPUTERS, the lap computer, makes its appearance this year.

hibitive. Instead, like the price of CPU's, the price of the memory IC's used to store information for use by the microcomputer fell to low levels, with the result that there are now home computers that have as much on-board memory as some of last year's higher-priced models. This development in the home-computer market is perhaps more dramatic than any other that has occurred in the last few years.

8-bit/16-bit CPU's

The face of the microcomputer industry is changing. No longer is the industry standardized around an 8-bit CPU (the length of a digital "word"). Instead, the standard word size found in many of today's moderate and higher-priced home-microcomputer systems is 16-bits. A 16-bit CPU can address more memory space. Where the 8-bit machine is limited in its memory-addressing capability to 64K bytes (actually 65,536 bytes) of memory to perform its tasks, the 16-bit CPU can address more than 1 megabyte. Thus, the 16-bit CPU can handle tasks that are far too complex for the 8-bit machine to handle and it can handle those tasks faster.

It should be noted, though, that 8-bit CPU's are still more than powerful enough for the average, single home user, so it isn't necessary to spend the extra money for a 16-bit system, unless you need its extra computing power.

The inevitable move to 16-bits has been spurred by the entry of IBM into the microcomputer market. Long dominant in the mainframe world, this computer giant jumped into the micro world nearly two years ago and, since that time, it has become a major force. Of course, Apple, Radio Shack, Heath, and Commodore Business Machine microcomputers are still abundant; but it has been estimated that nearly 20 percent of the microcomputer market is held by IBM and, with such representation in the market, it naturally calls the tune.

Thus, more and more microcomputer systems are becoming IBM-workalikes, IBM-lookalikes or IBM-compatibles. They also run similar operating systems to IBM's PC-DOS. In the non-IBM world, this disk operating system is known as MS-DOS and you will see many references to it in the "Operating System" category of the pricing charts included in this buying guide. Such is the success and dominance of this microcomputer system that other computer manufacturers are going out of their way to make their machines compatible.

In a sense, this is a good move because it provides a measure of standardization in an otherwise nonstandard, incompatible market. Just as IBM's 8-inch floppy-disk format became a standard, so to has its operating system become a standard for the micro world. However, it should be realized that though a machine may be capable of running MS-DOS, it may still be incompatible with others on the market because of incompatible storage formats. That is one facet of the microcomputer market that has yet to be worked out.

This trend has its parallel in the 8-bit world. The CP/M (Control Program/Microcomputers) operating system became the de facto 8-bit standard operating system because of its early headstart and subsequent dominance in this sphere. Yes, there is a 16-bit version of CP/M (CP/M-86), but it hasn't achieved the dominance of MS-DOS.

Portable computers

Another trend over the last year has affected the so-called portable market. Just a year ago, this type of computer was the rage of the microcomputer world. It had the following attributes: a small CRT screen (5 to 9 inches) built-in; two disk drives for storage; or comprehensive software applications packages included, and weighed up to 30 pounds. At this weight, these machines were certainly transportable, but were they portable? Obviously, the microcomputer industry didn't believe they were because it has come out with a new generation of lap computers (also called notebook or briefcase computers) which weigh between 9 and 11 pounds. This new generation has also split the "portable" market into the transportable computer market, as the heavier machines are called, and the lap-machine market, as the new notebook-sized machines are called.

Last year's portables are as different from these machines as day is from night. Where last year's portable had the two power-hungry drives and the CRT, this year's crop of lap computers is capable of running off battery power. And, where last year's group of machines included software packages that were stored on minifloppy diskettes that had to be inserted into the drives before they could be used, this year's breed of lap computers includes software that is part of the machine itself. This software is stored in ROM (*R*ead-*O*nly *M*emory) and is accessed with the push of a button. Typically, this software includes some variety of text editor, electronic mail system, appointments calendar and more. The lap computer usually includes at least 16K of user memory (RAM) with the upper limit being either 32K or a full 64K.

Like last year's portables, the majority of today's lap machines are driven by 8-bit CPU's, although some contain 16-bit CPU's. These microcomputers, though, aren't power-hungry. Instead, they are CMOS 8- or 16-bit microcomputers, which mean these machines can rely on battery power.

Unlike last year's portables, though, these compacts rely on liquid crystal displays, rather than cathode-ray tubes. Using this remarkable technology, the industry has been able to develop 8-line by 40-character displays for the new generation of lap computers. This means these devices are free of the need for large power-supplies and AC outlets.

Generally, these machines—like last year's models—feature full-travel, typewriter-style keyboards, which is a remarkable feature, when you consider that microcomputers of the same size class last year featured membrane or rubber overlay keyboards.

Like their larger counterparts, though, the new portables also feature some sort of storage medium. Some feature cassette interfaces for mass storage, while others—the Epson QX-10, for instance—have integral minicassette data storage. Still other portables use the more traditional minifloppy disks for storage, although they are capable of storing some information that may have been generated in the field in RAM.

An interesting use of RAM has been made by Athena Computer and Electronic Systems in its *Athena I*. Instead of using two disk-drives for mass storage, it uses RAM configured as a storage device. This allows a user to load applications software and files and use this memory space for work. The key advantage to using RAM in this configuration is a manyfold increase in speed because the necessary program files are available in memory for instant use. There is no need to wait for a disk access that slows program speed.

It must be noted that although RAM drives, as these are termed, are very quick and speed things up greatly, they are also volatile. In other words, the contents of these drives disappear as soon as the power is turned off. So, unless you want to keep the computer on all the time, you must eventually empty the contents of the RAM drive to some sort of storage device, which the *Athena I* does. It provides one standard drive for storage.

About this supplement

In this year's **Your Own Computer** supplement, we will take a look at small computer systems in order of increasing price, from below $100 to over $4500. A series of charts will help you understand how small-computer systems become more powerful as their prices increase. They will also show you the trends that we have just mentioned.

In a departure from last year's supplement, we have omitted printers because of the wide variety available for a wide range of prices. This means that instead of having to rely on a manufacturer's suggested printer, the small-computer buyer can find one of his own, within his price range. And, since most printers interface with small computers in only one of two manners, serial or parallel, there should be little trouble interfacing the printer with the computer. Thus, because of the disparity in printer prices and varieties, we leave it up to the individual buyer to make his own choice.

As for the system prices you will find they might differ somewhat from what you may see advertised. The reason is quite simple, we are using the *manufacturer's suggested retail price* as the basis for our pricing considerations. Using this type of guideline provides a more objective standard by which to judge the many systems on the market.

Many, but not all, computers can be purchased ready to plug in and run. They will usually have a minimal amount of standard memory and provisions for a video display. Further, they will also usually have some provision for storing programs and data, either on cassette tape or floppy disks. Most of our systems assume that—after the lowest price level—you will be buying one of the display devices offered by the manufacturer. The prices reflect this, although it should be noted that you can also buy a monitor yourself and save money with it.

Regardless of whether a particular device is included with our listings, the computer can usually be purchased without it and, in many cases, you will want to do that and then add the peripherals that best meet your needs.

For your own shopping, though, one of the items that must be carefully considered is the amount of memory available for a system. Memory is the most vital consideration in any small-computer system. The reason is that without it, the system is little more than an inert box, capable of little or nothing. Memory is vital because it provides an area in which to store and manipulate data.

Most small computers come with a minimal amount of user memory, usually ranging from 4K to 16K. While this level is adequate for game-playing and simple home applications, a computer used for more serious purposes will generally require at least 48K or memory and most of the systems mentioned in our supplement can be expanded beyond this point. And, with the new generation of memory-intensive 16-bit programs coming onto the market, 48K is not enough, with a minimum of 64K preferred, although 128K is better.

Some of the computers you will find listed here are "micromainframes." These systems are little more than boxes housing the CPU, disk drive storage devices and motherboard—the board that carries the bus signals. Usually found on high-end systems, these machines have several input/output ports and you will also find that these systems must have terminals or workstations attached to them before they can become useful. Typically, these systems are usually found in multiuser environments, although a single user can functions with one, too.

Every small-computer system comes with some means of mass data storage. The device can be a cassette interface or floppy-disk drives and controller. These devices allow data to be

stored for future use. Our tables show the typical configuration for the price range in question. In nearly every case, there are other alternatives open to the user, but it should be kept in mind that these are more expensive. For instance, the typical dual-drive 5¼-inch configuration may add $300 to $500 to the cost of a typical one-drive system, while an 8-inch drive may add $1500 or more. Also keep in mind, though, that higher-density storage options increase the usefulness of the system, but at a cost. For instance, a double-sided, double-density 8-inch floppy disk storage system is capable of storing 2 megabytes of information or about 16 million bits of information (8 bits to a byte).

Some of our completed systems mention "hard" or Winchester disk storage. These fixed medium storage devices are capable of huge amounts of storage, 5 megabytes and up to 20 for the typical 5¼-inch hard disk system. However, they add considerably to the cost of the unit—from $1500 to $3000 on average—and they should only be considered for serious computer work.

For the typical small-system user, we recommend a two-drive floppy-disk system. Not only will this give you greater storage, but you will also find it faster to copy files from one disk to another. More important, if you can afford this type of system, is the fact that if the storage capacity of the disk is small, it may not be possible to hold both the DOS (*D*isk *O*perating *S*ystem and the data you require. In the two-drive configuration, one drive is used to hold the application program and DOS, while the second drive holds the data.

Most systems require the use of a keyboard for input and some type of video display device for output. The most inexpensive computers usually rely on a home television set and interface with the video unit through an RF modulator. You will find the definition and clarity of this type of display device is poorer than a dedicated monitor. The RF modulator will usually be built into the unit or might be an extra-cost add-on and it pays to check.

Some computers, the Heath *H89* or Radio Shack *TRS-80 Model III*, come with built-in video display devices, while others, primarily the micromainframe category, require auxiliary terminals—a combination keyboard and display unit. If you opt for this type of unit, it should be noted that terminal prices start about $600.

We have tried to give you as complete an indication as possible as to what the display situation is with a particular system. However, it should be kept in mind there might be several possible choices for any system.

The tables included with each price-category section show which computers, features and accessories you can expect to find in a typical system within that price range. If a system has been upgraded from the previous table, the new information appears in blue print in the comments line to the right of the table. The tables will give you an idea of what you can get for a given price; a local computer store will be able to answer your questions and tailor a system to your specific requirements. **R-E**

COMMODORE 64
(more power than Apple II at half the price)

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- 170K DISK DRIVE $179.00*
- TRACTION FRICTION PRINTER $119.00*

(* with software savings applied)

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(a real computer at the price of a toy)

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- 40-80 COLUMN BOARD $99.00*
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COMMODORE 64 COMPUTER $139.00
You pay only $239.00 when you order the powerful 84K COMMODORE 64 COMPUTER! LESS the value of the SPECIAL SOFTWARE COUPON we pack with your computer that allows you to SAVE OVER $100 off software sale prices!! With only $100 of savings applied, your net computer cost is $139.00!! LESS a $49.50 BONUS PACK of 30 programs on tape or disk we give you absolutely FREE!!!

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TRACTION FRICTION PRINTER $119.00
You pay only $219.00 when you order the Comstar T/F deluxe line printer that prints 8 1/2 x 11 full size, single sheet, roll or fan fold paper, labels etc. 40, 66, 80, 132 columns. Impact dot matrix, bi-directional, 80 CPS. LESS the value of the SPECIAL SOFTWARE COUPON we pack with your printer that allows you to SAVE OVER $100 off software sale prices!! With only $100 of savings applied your net printer cost is only $119.00.

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You pay only $149.00 for this 80 Column Board when it is purchased with a COMMODORE 64 Computer or a Disk Drive or a Printer or a Monitor. If purchased alone the sale price is $169.00. Included with this board is word processor pack, electronic spread sheet and mail merge data base on two tapes. List $249.00. (Disk add $10.00).

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SCRIPT 64 EXECUTIVE WORD PROCESSOR is the finest available for the COMMODORE 64 Computer! THE ULTIMATE for PROFESSIONAL wordprocessing application. Featuring simple operation, powerful text editing with a customized word dictionary, complete cursor and insert/delete key controls, line and paragraph insertion, automatic deletion, centering, margin settings and output to all printers. Included is a powerful MAIL MERGE When used with THE COMPLETE DATA BASE PACKAGE. List $99.00. Sale $79.00. Coupon Price $52.00. (Disk only).

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PROFESSIONAL SOFTWARE COMMODORE 64

Name	List	Coupon
Executive Word Processor	$99.00	$52.00
Complete Data Base	$89.00	$46.00
Electronic Spreadsheet	$89.00	$46.00
Accounting Pack	$69.00	$32.00
Total 5.2 Word Processor—Plus		
Tape	$69.00	$37.00
Disk	$79.95	$42.00
Total Text 2.6 Word Processor—		
Tape	$44.95	$26.00
Disk	$49.95	$26.00
Total Label 2.6	$24.95	$12.00
Disk	$29.95	$15.00
Quick Brown Fox Word Processor	$69.00	$40.00
Programmers Reference Guide	$20.05	$12.50
Programmers Helper	$69.00	$40.00
Basic Tutor	$29.95	$15.00
Typing Tutor	$29.95	$15.00
Sprite Designer	$16.95	$10.00
Medicinemen	$19.95	$12.00
Weather War II	$19.95	$12.00
Music-Maker	$19.95	$12.00
EDU-Pack	$24.95	$13.00
3D Maze Craze	$24.95	$13.00
Professional Joy Stick	$24.95	$12.00
Light Pen	$39.95	$20.00
Deluxe Dust Cover	$ 8.95	$ 4.60

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Inventory Management	$89.00	$69.00
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Sales Analysis	$89.00	$69.00
General Ledger	$89.00	$69.00

(*COUPON PRICE $59.00)

VIC-20 COMPUTER $77.00
You get the Commodore VIC-20 Computer for only $77.00 when you buy at sale prices: The Commodore Data Cassette for only $69.00 and the Gortek Introduction to Basic program for only $19.95. TOTAL LIST PRICE $302.95. SPECIAL PACKAGE SALE PRICE $165.25.

40-80 COLUMN BOARD $89.00
A fantastic price breakthrough for VIC-20 owners on this most wanted accessory!! "Now you can get 40 or 80 Columns on your T.V. or Monitor Screen." Plus we add a word processor with mail merge, electronic spread sheet, time manager and terminal emulator!! These PLUS programs require 8K or 16K RAM memory. (Disk add $10.00).

VOICE SYNTHESIZER $59.00
Votrax Based. Make your VIC-20 COMPUTER TALK! Has features equivalent to other models costing over $370.00. You can program an unlimited number of words and sentences and even adjust volume and pitch. You can make adventure games that talk! A must for enhancing your programming creativity and pleasure.

60K MEMORY EXPANDER $59.00
Sixslot — Switch selectable — Reset button — Ribbon cable. A must to get the most out of your VIC-20 Computer. Includes FREE $29.95 adventure game.

8K RAM CARTRIDGE $39.95
Increases programming power 2 1/2 times. Expands total memory to 33K (33,000 bytes). Memory block switches are on outside of cover! Includes FREE $16.95 game.

16K RAM CARTRIDGE $69.00
Increases programming power 4 times. Expands total memory to 41K (41,000 bytes). Memory block switches are an outside cover! Includes FREE $29.95 adventure game!!

12" GREEN SCREEN MONITOR $109.00
Excellent quality GREEN PHOSPHOROUS VIDEO MONITOR with antiglare, 1920 characters (80 characters x 24 rows). Save your TV! a must for 80 column word processors. PLUS $9.95 for VIC 20 or Commodore 64 Cable.

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Premium quality AMBER VIDEO MONITOR With antiglare, (80 characters x 24 rows), exceptionally clear screen, faster scanning, 1000 lines. PLUS $9.95 for VIC 20 or Commodore 64 Cable.

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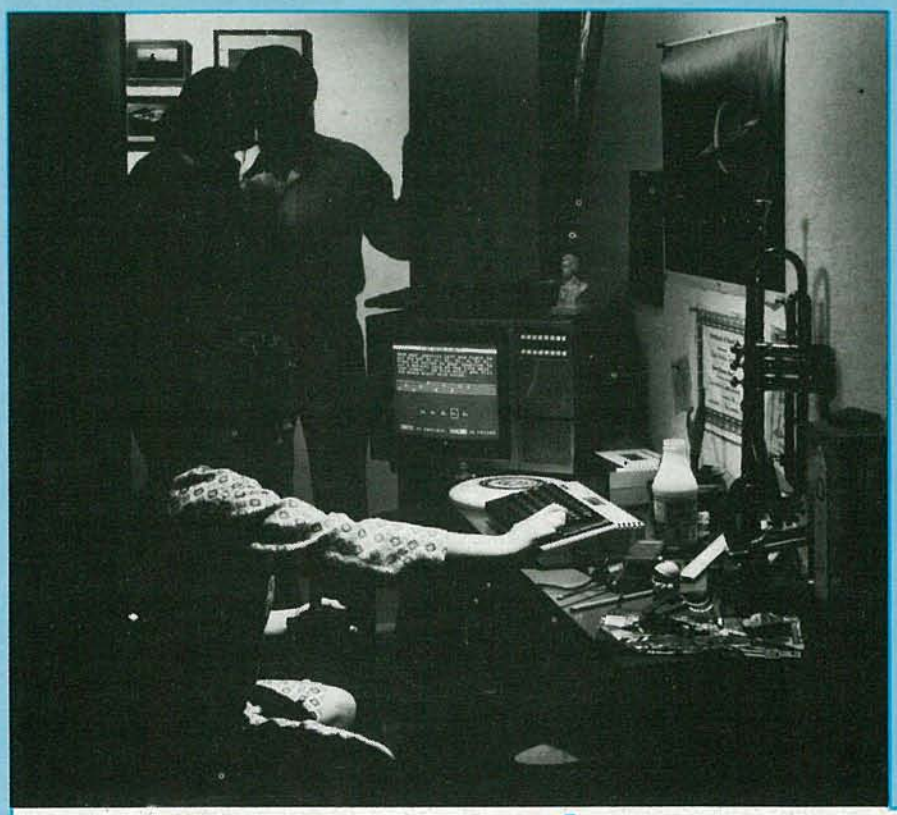


It's amazing how much computer power can be bought for less than $500. Let's take a look.

Under $500

MARC STERN

PERHAPS THE MOST VOLATILE SEGMENT OF THE PERSONAL-computer marketplace is the segment under $500. Since last year's supplement was published, seven new names have joined the ranks of the manufacturers producing machines here. Those manufacturers include some of the leading names in consumer electronics, notably Mattel and Panasonic, while the others include new companies whose products are now just hitting the market.

Timex

Still leading this price segment is the Timex-Sinclair *1000* (formerly the Sinclair *ZX81*). A tiny machine, about the size of a book, it features 2K of user memory—expandable to 16K—and a cassette interface. Essentially, it is a computer learning machine with which one can begin to understand the basics of microcomputing. Supplied with the *1000* is a BASIC learning guide with which you can learn how to program in this high-level language.

The BASIC programming language is resident in 8K ROM (*R*ead-*O*nly *M*emory). The *1000*'s unique multi-function, single-key entry system permits the user to enter BASIC commands and instructions with a single push of the tiny microcomputer's membrane keyboard.

This type of keyboard, which has been used on other machines on the market, is fine for hunt-and-peck typists, but it is lacking for touch typists. In fact, the size of the unit makes speedy text entry nearly impossible.

Capable of interfacing with a home television set as an output device, the *1000* has a limited 32-character by 24-line display. This is less than half the industry-standard 80 by 24 display and this is limiting because the display isn't entirely flicker-free.

Moving up a notch from the *1000*, we come to the recently introduced *1500*. Driven by a Z80A microprocessor, the same CPU that drives the *1000*, the *1500* has an improved keyboard, with small-sized calculator-type keys, much like those found on pocket calculatorrs. And, while this type of keyboard is better from a tactile standpoint, the experienced typist will be hindered by the non-standard keys.

This mini-microcomputer, which weighs in with a mini-price of $79.95, has 16K of user memory standard. This feature means it can handle far more complex tasks than the *1000*. It also makes the *1500* the first computer in the under-$100 market that has 16K of resident user memory.

Mass storage for the *1500* is provided with a standard cassette interface. User-generated data can be stored for future use via this interface.

Unlike the more limited *1000*, the *1500* can have its memory expanded to 32K, providing more than enough user memory for games and limited home-computing applications.

But like the *1000*, video output is handled via a built-in RF modulator that interfaces with a home television set. Both units are also capable of generating black-and-white graphics and include the plot and unplot graphics commands provided in the high-level Extended BASIC language provided in the ROM.

Another computer from Timex is the top-of-the-line *2000* series, that consists of two models, one priced at $149.95 with 40K of user memory and the other priced at $199.95 with 72K of user memory. Both provide color graphics and feature sophistication not normally found in low-cost home computers.

Physically much larger than its stablemates, the *2000* features a standard "QWERTY"-type keyboard with large calculator-type keys. The keys appear large enough so that an experienced typist should almost feel comfortable using it.

Actually developed by Sinclair Research Ltd. during Great Britain's Prestel videotext terminal competition, the *2000* is a sophisticated machine with a nearly normal screen display of 64-characters by 24-lines, or twice the capability of its stablemates.

TABLE 1—under $500

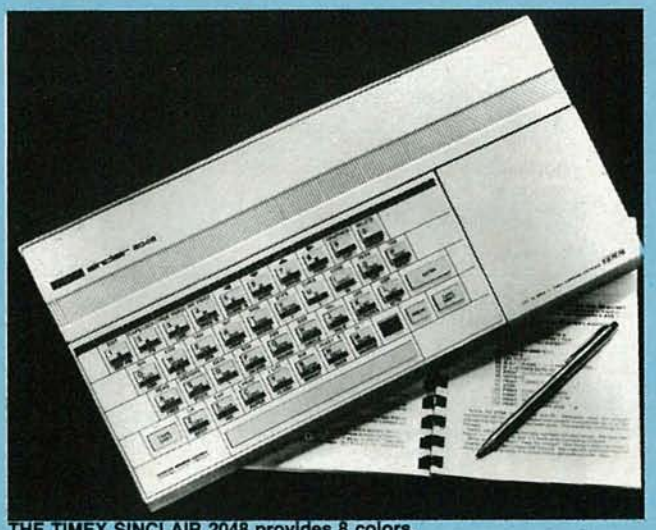
Manufacturer	Model	Price	CPU	Word length	Operating System	Languages
Timex Computer	1000	$49.95	Z80A	8-bit	N/A	BASIC
Radio Shack	TRS-80 Pocket Computer PC-4	$69.95	Custom CMOS	Not announced	N/A	BASIC
Timex Computer	1500	$79.95	Z80A	8-bit	N/A	BASIC
Radio Shack	TRS-80 Pocket Computer PC-4	$89.95	Custom CMOS	Not announced	N/A	BASIC
Video Technology Inc.	VZ200	$99.95	Z80A	8-bit	N/A	BASIC
Netronics Research	Elf II	$99.95	1802	8-bit	N/A	machine
Sharp Electronics	PC-1250	$110	Custom CMOS	8-bit	N/A	BASIC
Radio Shack	TRS-80 MC-10	$120	6803	8-bit	N/A	BASIC
Video Technology Inc.	VZ200	$125	Z80A	8-bit	N/A	BASIC
Netronics Research	Explorer/85	$130	8085	8-bit	N/A	machine
Radio Shack	TRS-80 Pocket Computer PC-4	$140	Custom CMOS	Not announced	N/A	BASIC
Timex Computer	2000	$150	Z80A	8-bit	N/A	BASIC
Netronics Research	Elf II	$150	1802	8-bit	N/A	machine
Mattel Electronics	Aquarius	$150	Z80A	8-bit	N/A	BASIC, LOGO
Video Technology Inc.	VZ200	$174.95	Z80A	8-bit	N/A	BASIC
Sharp Electronics	PC-1250	$185	Custom CMOS	8-bit	N/A	BASIC
Atari Products	600XL	$199	6502C	8-bit	N/A	BASIC
Sord Computer	M5	$199	Z80A	8-bit	N/A	BASIC
Multitech Electronics	MPF-IP	$199	Z80	8-bit	N/A	BASIC, FORTH
Timex Computer	2000	$199.95	Z80A	8-bit	N/A	BASIC
Radio Shack	TRS-80 Pocket Computer PC-2	$199.95	Custom CMOS	8-bit	N/A	BASIC
Commodore Business Machines	VIC-20	$199.95	6502	8-bit	N/A	BASIC
Mattel Electronics	Aquarius	$205	Z80A	8-bit	N/A	BASIC, LOGO
Sharp Electronics	PC-1500	$220	Custom CMOS	8-bit	N/A	BASIC
Netronics Research	Elf II	$224.45	1802	8-bit	N/A	machine
Video Technology Inc.	VZ200	$224.45	Z80A	8-bit	N/A	BASIC
Texas Instruments	TI-99/4A	$225	TMS9900	16-bit	N/A	BASIC
Texas Instruments	CC-40	$250	7C20	8-bit	N/A	BASIC
Mattel Electronics	Aquarius	$265	Z80A	8-bit	N/A	BASIC, LOGO
Radio Shack	TRS-80 Pocket Computer PC-2	$269.90	Custom CMOS	8-bit	N/A	BASIC
Commodore Business Machines	VIC-20	$274.95	6502	8-bit	N/A	BASIC
Panasonic Co.	JR-200	$279.95	Not announced	Not announced	Not announced	BASIC
Sharp Electronics	PC-1500	$295	custom CMOS	8-bit	N/A	BASIC
Radio Shack	TRS-80 Color Computer	$299	6809E	8-bit	N/A	BASIC

Memory/Storage	Keyboard	I/O	Display	Comments
2K/cassette interface	membrane keyboard/ multifuntion keys	peripheral interface	TV output/32 × 24 capability	basic system
544 steps	53 calculator keys, 10-key keypad	12-pin interface connector	1 line 12-character liquid crystal display	handheld computer, basic model
16 K/cassette interface	40 keys/multifunction/ rubber overlay	peripheral interface	TV output/32 × 24 capability	memory expands to 16K
1568 steps	53 calculator keys, 10-key keypad	12-pin interface connector	1 line 12-character liquid crystal display	memory expands
4K/cassette interface/software cartridges	45 keys, 16 predefined function		built-in modulator/32 × 16 text mode/128 × 64 color cap.	basic configuration kit
256 bytes/ cassette interface	hex keypad	N/A		
1.7K	54 keys, reservable keys, keypad		24-character × 1 line liquid crystal display	low-cost, handheld microcomputer
4K/cassette interface	48 multifunction keys	1 serial port	eight color output/32 × 16 text mode/RF modulator	entry level color computer
4K/cassette interface/software cartridges	45 keys, 16 predefined function	1 parallel	built-in modulator/32 × 16 text mode/128 × 64 color capability.	parallel printer port
256 bytes/cassette interface	N/A	N/A	N/A	basic Explorer/85 building block system
1568 steps/cassette interface	53 calculator keys, 10-key keypad	12-pin interface connector	1 line 12-character liquid crystal display	cassette interface
40K/cassette interface/ software cartrige slot	42 keys/multifunction/rubber overlay keyboard	peripheral interface	color output/256 × 192 capability/64 × 24 text mode	basic system
256 bytes/cassette interface	hex keypad	N/A		assembled
4K/cassette interface	49 keys	1 serial, peripheral interface	320 × 192 graphics/40 × 24 text/user option	basic system
4K/cassette recorder/software cartridges	45 keys, 16 predefined function	1 parallel	built-in modulator/32 × 16 text mode/128 × 64 color capability.	cassette recorder
5.7K	54 keys, reservable keys, keypad		24-character × 1 line liquid crystal display	memory increases 4K
16K/cartridge slot	62 keys, help key, 4 special function	1 serial, 2 controller, expansion connector	built-in video output supports 256 colors, 40 × 24 text	basic system
20K/cassette	54 keys	Not announced	Home television	
4K/cassette interface	49-key	peripheral connector	20-digit, 1-line alphanumeric display	basic system
72K/cassette interface/ software cartridges	42 keys/multifunction/ rubber overlay keyboard	peripheral interface	color output/256 × 192 capability/64 × 24 text mode	internal memory expanded to 72K
2640 bytes	65 calculator keys, 19-key pad, 18 definable	60-pin bus connector	1 line 7 × 156 dot matrix liquid crystal display	pocket computer
5K/cassette interface	66 keys, 4 user-programmable		color capability	basic system
4K/cassette recorder	49 keys	1 serial, peripheral interface	320 × 192 graphics/40 × 24 text	cassette recorder
2.6K	65 keys, 10-key keypad, function keys		26-character × 1 line liquid crystal display	basic system
256 bytes/cassette interface	hex key pad	1 serial, 2 parallel	home TV	expansion board with ports, RF modulator
20K/cassette recorder/software cartridges	45 keys, 16 predefined function	1 parallel	built-in modulator/32 × 16 text mode/128 × 64 color capacity	1 memory expansion module brings RAM to 20K
16K/cassette interface	standard		16 colors	basic system
6K/software cartridges	standard layout		31-character × 1 line liquid crystal display	hand-held computer
4K/cassette recorder	49 keys	system expander with cartridge/memory ports/1 serial	320 × 192 graphics/40 × 24 text	system expander, 2K memory added
4K	65 calculator keys, 19-key keypad, 18 definable	60 pin bus connector	1 line 7 × 156 dot matrix liquid crystal display	memory expanded to 4K
5K/cassette recorder	66 keys, 4 user-programmable		color capability	digital cassette recorder
32K/cassette interface	60 keys, multifunction	1 parallel	RGB/composite video output/CRT is user option	basic system
6.6K	65 keys, 10-key keypad, function keys		26-character × 1 line liquid crystal display	user memory expanded 4K
16K/cassette interface	53 keys	1 serial	CRT is user opt/32 × 16 color text mode/256 × 192 graphics capability	basic system

TABLE 1under $500 (*continued*)

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Spectravideo	SV-318	$299	Z80A	8-bit	N/A	BASIC
Atari Products	600XL	$299	6502C	8-bit	N/A	BASIC
Spectravideo	SV-318	$299	Z80A	8-bit	N/A	BASIC
Commodore Business Machines	VIC-20	$324.90	6502	8-bit	N/A	BASIC
Netronics Research	Elf II	$339.40	1802	8-bit	N/A	machine
Panasonic Co.	JR-200	$340	Not announced	Not announced	Not announced	BASIC
NEC Home Electronics	PC-6000	$349.95	Z80A-compatible	8-bit	N/A	BASIC
Sharp Electronics	PC-1500	$370	Custom CMOS	8-bit	N/A	BASIC
Panasonic Co.	H1400	$380	6502	8-bit	SNAP (version of FORTH)	BASIC
Radio Shack	TRS-80 Color Computer	$399	6809E	8-bit	N/A	BASIC
Multitech Electronics	MPF-II	$399	6502	8-bit	N/A	BASIC
Netronics Research	Explorer/88-PC	$399.95	8088	16-bit	N/A	machine
Texas Instruments	CC-40	$400	7C20	8-bit	N/A	BASIC
Unitronics	Sonic	$400 (est.)	6502	8-bit	N/A	BASIC
Unitronics	Sonic	$400 (est.)	6502	8-bit	N/A	BASIC
Commodore Business Machines	VIC-20	$404.85	6502	8-bit	N/A	ASIC
Sord Computer	M5	$421	Z80A	8-bit	N/A	BASIC
Video Technology Inc.	VZ200	$424.95	Z80A	8-bit	N/A	BASIC
Texas Instruments	TI-99/4A	$425	TMS9900	16-bit	N/A	BASIC
Panasonic Co.	JR-200	$430	Not announced	Not announced	Not announced	BASIC
NEC Home Electronics	PC-6000	$450	Z80A-compatible	8-bit	N/A	BASIC
Netronics Research	Elf II	$454.40	1802	8-bit	N/A	machine
Radio Shack	TRS-80 Pocket Computer PC-2	$480	Custom CMOS	8-bit	N/A	BASIC
Panasonic Co.	H1800	$480	6502	8-bit	SNAP (version of FORTH)	BASIC
Spectravideo	SV-318	$490	Z80A	8-bit	N/A	BASIC
Atari Products	1200XL	$499	6502	8-bit	N/A	BASIC
Netronics Research	Explorer/85	$499.75	8085	8-bit	N/A	machine
Panasonic Co.	JR-800	$499.95	Not announced	Not announced	N/A	BASIC

Memory/Storage	Keyboard	I/O	Display	Comments
16K/cassette interface	71 keys, 10 programmable, built-in joystick		256 × 192 resolution, 16 colors, television used as display	basic system
16K/cassette recorder/cartridge slot	62 keys, help key, 4 special function	1 serial, 2 controller, expansion connector	built-in video output supports 256 colors, 40 × 24 text	cassette recorder
16K/cassette recorder/cartridge slot	standard layout, function keys		256 × 192/16 colors	
13K/cassette recorder	66 keys, 4 user-programmable		color capability	user memory expanded 8K
4K/cassette interface	hex keypad	1 serial, 2 parallel	home TV	user memory expanded to 4K
32K/cassette interface	60 keys, multifunction	1 parallel, 1 serial	RGB/composite video output/CRT is user option	serial port
16K/cassette interface	71 keys, 5 multifunction	1 parallel, 2 game controller ports	256 × 192 capability, 32 × 16 text, composite video output avail.	basic system
10.6K	65 keys, 10-key keypad, function keys		26-character × 1 line liquid crystal display	user memory expanded by 8K
4K	65 calculator keys in typewriter arrangement, redefinable		1-line × 26-character liquid crystal display	basic hand-held computer
16K/cassette interface	53 keys	1 serial	CRT is user opt/32 × 16 color text mode/256 × 192 graphics capability	extended BASIC
64K/cassette interface	52 keys	1 parallel, 1 game controller	supports 40 × 24 text/6 colors/180 × 192 res./ user option	basic system
64K/cassette interface	N/A	1 serial	N/A	starter kit
22K/software cartridges	standard layout		31-character × 1 line liquid crystal display	user memory upgraded to 22K
80K/148K wafertape	70 keys, 10 function	expansion ports, game controller	16 colors, 40 column capability	basic Sonic home computer system, includes stringy-floppy mass storage
112K/148K waftertape	70 keys, 10 function	expansion ports, game controller	16 colors, 40 column capability	32K memory added
29K/cassette recorder	66 keys, 4 user-programmable		color capability	user memory expanded to 29K
20K/cassette/cartridges	54 keys	Not announced	Home television	BASIC home finance software, joysticks, games added
64K/cassette recorder/software cartridges	45 keys, 16 predefined function	1 parallel	built-in modulator/32 × 16 text mode/128 × 64 color capacity	44K memory added
16K/wafertape	standard	HEX-BUS expansion unit	16 colors	Wafertape drive used in place of cassette
32K/cassette recorder	60 keys, multifunction	1 parallel, 1 serial	RGB/composite video output/CRT is user option	cassette recorder
16K/cassette recorder	71 keys, 5 multifunction	1 parallel, 2 game controller ports	256 × 192 capability, 32 × 16 text, composite video output available	cassette recorder
16K/cassette interface	hex keypad	1 serial, 2 parallel	home TV	user memory expanded to 16K
16K	65 calculator keys, 19-key keypad, 18 definable	60 pin bus connector	1 line 7 × 156 dot matrix liquid crystal display	memory expanded to 16K
8K	65 calculator keys in typewriter arrangement, redefinable		1-line × 26-character liquid crystal display	basic system
4648K/cassette recorder	71 keys, 10 programmable, built-in joystick		256 × 192 resolution, 16 colors, television used as display	cassette recorder added for storage, user memory upgraded to 48K
64K/cassette recorder	standard typewriter/16 special function	1 printer, 2 controller, expansion connector	built-in video output supports 256 colors, 40 × 24 text	basic 1200 system/no std. CRT
256 bytes/cassette interface	56 keys	N/A	12-inch monochrome CRT	expansion board, keyboard, CRT
16K/cassette interface	47 keys, 20-key keypad, 10 programmable	parallel	8-line × 32-character LCD	notebook computer with ROM-based software



THE TIMEX SINCLAIR 2048 provides 8 colors.

Another feature not normally found on home computers in this price category is included: memory bank-switching. Using this technique, the microcomputer is fooled into thinking it can address more memory than it normally can. In reality, the Z80A can still only directly address 64K, but bank-switching allows it to address much more.

The *2000*-series can display a range of eight colors and allows separate control of foreground, background, and border areas. Resolution is fairly high with 256- by 192-dots (horizontal by vertical). All pixels (picture elements) are individually addressable by the user, which means the video output is memory mapped, with specific memory addresses provided for each pixel.

Like other members of the Timex Sinclair family, mass storage is via cassette interface to a cassette recorder.

Radio Shack

Competing heavily in the under-$100 market is Radio Shack with its $69.95 Pocket Computer *PC-4*, one of this manufacturer's series of handheld pocket computers that is driven by a custom CMOS VLSI microprocessor.

The miniscule *PC-4* reaches its fullest configuration in this pricing category with maximum memory expansion and all peripheral accessories. It features a 544-step user memory that can be expanded to 1568 steps with the plug-in memory expansion module.

Featuring a one-line, 12-character LCD readout, this tiny microcomputer is programmable in BASIC and can handle strings of up to 30 characters in length.

Using a "QWERTY" keyboard layout, you can use the 53 keys for text or program input. In fact, 15 BASIC programming functions can be entered with two keystrokes. While the keyboard does have the traditional layout, it should be noted that the keys are actually calculator-type keys and the close placement really won't allow touch typing. A separate keypad allows numeric entry. Total system expansion is achieved in this price range. This includes the 1K RAM module and cassette-recorder interface and tiny thermal printer with a total price of $140.

Radio Shack has many other entries in the under-$500 category. These microcomputers include a variety of handheld and small keyboard-computers.

While Radio Shack's bottom-of-the-line handheld microcomputer is the *PC-4*, its bigger brother is the recently introduced *PC-3* that sports a 1.4K nonexpandable memory. The $99.95 unit, like its stablemates, features a one-line LCD readout and it features a standard keyboard layout. Like its stablemates, it uses tiny calculator-type keys that aren't suited for speedy text entry.

The *PC-4*, driven by a CMOS 8-bit microprocessor, reaches its full configuration in this price category with the addition of a printer/cassette interface. This boosts the price to roughly $220.

While the *PC-1* has been discontinued since last year, the *PC-2*, manufactured for Radio Shack by Sharp, is still available and represents Radio Shacks's top-of-the-line handheld. Offered at a base price of $199.95, it reaches its fullest configuration in the $500 to $1000 price category.

A versatile unit, its basic user memory is 2.6K. This memory, however, is expandable to a maximum of 16K, with the addition of the proper memory modules. It will also accept ROM modules, but the limit is still 16K. This expandability makes this unit a powerful, flexible handheld microcomputer.

Programmable in Extended BASIC, the *PC-2* features 42 statements and 34 built-in functions. It allows a user to have two-dimensional arrays, variable-length character strings with extensive string handling, formatted printing, and other features.

The display is a 26-character by 1-line dot matrix LCD with user-addressable graphics over its complete range. The keyboard is a full "QWERTY" type, with 65 keys and a separate number pad. There are also six user-definable keys.

Like the others in the Radio Shack handheld line, the *PC-2* uses tiny calculator-type keys that are better suited to single-finger use, rather than two-handed touch typing. Another feature that might prove somewhat confusing is the placement of the space bar next to the function entry key. The layout, though, is about as clean as one could hope for in a small unit.

Driven by an 8-bit, low-power CMOS microprocessor, the *PC-2* is powered by 4 "AA" batteries. A 60-pin expansion port allows interfacing with a variety of peripherals, including a color-printer/dual-cassette interface (valuable for speedier program storage and retrieval) and an RS-232C interface for tying into such data networks as The Source or CompuServe via a phone line.

Altogether, the *PC-2* is a powerful handheld unit. However, this isn't the only Radio Shack offering in this pricing category. Radio Shack also offers two Color Computers, the new *MC-10 Micro Color Computer* and the more traditional *TRS-80 Color Computer*.

The *MC-10* is a tiny unit, about the size of the Timex *1000*. However, instead of using a membrane keyboard, Radio Shack has opted for a more standard set of small calculator-type keys in a standard keyboard format. The multi-function keys allow quick two-key entry of program commands. A learning machine, the *MC-10* comes with a tutorial manual that describes how to produce 8-color graphics and teaches a user BASIC programming.

The 4K memory of the *MC-10* is expandable to 20K through an expansion connector on the tiny box. Unlike other low-cost microcomputers, the *MC-10* has a built-in serial interface that allows the user to connect either a modem or printer to the unit. With either of these peripherals attached, the user gains flexibility in output format. In fact, with a modem the user will gain access to such services as The Source or CompuServe.

This year, only the 16K-version of the more-powerful $299.95 *TRS-80 Color Computer* is available rather than the 4K-version that was available last year.

Driven by an 8-bit 6809E microprocessor, the *Color Computer* interfaces directly with a color-television set as a display device through a built-in RF modulator.

An even more powerful version, capable of programming in Extended BASIC, is available for $399.95. This version of the *Color Computer* allows multi-character variable names and string arrays of up to 255 characters; full-featured editing, floating point 9-digit accuracy, trigonometric functions, user definable keys, specific error messages and PEEK, POKE and USR commands to call machine-language routines.

This machine is a good basic home system, capable of personal computer power or videogame entertainment. It is a flexible unit. There is a wide variety of prepackaged programs available for it on cassette and it includes a standard serial interface port for using a modem to tie into one of the many information services available.

The *Color Computer* can have its user memory expanded to 32K, with the addition of a RAM expansion kit. An already expanded version is available for $549.95 and it features the same functions already described.

For the user who would like the ultimate in flexibility and speedy mass storage, there is an optional external disk drive available. The *Color Computer* can support up to four of these drives and this gives the user far more flexibility in this system than in other low-end systems. However, the buyer should note that even one drive will significantly raise the cost of the system.

The *Color Computer*'s expansion possibilities are outlined in subsequent sections and you will find it becomes a full-blown system in the $1500 price range.

Handheld microcomputers continue to abound in the low-end price range, with offerings from Sharp, Hewlett-Packard, and Panasonic.

Sharp

For instance, Sharp offers two handhelds, the *PC-1250* and the *PC-1500*. The *PC-1500* is identical to Radio Shack's *PC-2*, so its description will suffice for the *1500*, except to say that it is more expensive than the Radio Shack unit, with a base price of $220. Both of these handhelds become fully configured in higher price categories.

The basic model, the *PC-1250*, is available for $185. It is driven by a CMOS 8-bit microprocessor, which means that it can be run by battery power because the current drain is low.

Programmable in BASIC, its 54-key small calculator-type keys are arranged in a "QWERTY" layout. However, since the unit is handheld, it isn't suited to fast touch-typing. The *PC-1250* has a one-line by 24-character LCD readout.

Panasonic

Another of the entrants in the handheld computer field is Panasonic, whose *H1400/H1800*-series builds into a portable briefcase system. In reality, this series uses the same handheld case, but each pricing level reflects more user memory. For instance, the $380 *H1400* features 4K of user memory, while the $480 *H1800* features 8K of user memory.

If you look closely at the accompanying table, you will see an operating system is noted. Unlike other handheld computers, which operate with machine language instruction sets, the *H1400/1800* series uses the SNAP operating system, a derivative of FORTH. Under this operating system, BASIC is the programming language.

Again, like other handheld computers, the keyboard is laid out in a standard "QWERTY" fashion, however, with 65 small calculator-type keys and narrow spacing on the keyboard, it would seem that this type of layout wouldn't lend itself to touch-typing. Instead, it seems more oriented toward one-finger entry. To give these units their due, though, they are larger than other handheld units on the market.

PANASONIC'S *JR-800* displays eight 32-character lines.

Notice that they are on the upper end of the pricing scale. Although they are less expensive than they were last year, all it takes is a bit of added memory—expansion RAM modules are available—to push them into the next price class, where you will again see them mentioned.

These aren't the only Panasonic units available in the under-$500 category. Another is the recently introduced $279.95 *JR-200*. It is a complete keyboard-computer and features a built-in AC power supply, a built-in RF modulator, built-in cassette interface port, and game-controller connections. Unlike other low-priced units, this one includes a standard printer interface port. Other systems in this price range usually make additional ports for communications or printers extra-cost add-ons.

With 32K of RAM, this unit is capable of handling some fairly sophisticated programs. Its programming language is BASIC, whose commands and other textual matter are inserted through the 60 multifunction small calculator-type keys. One of the nicer features of this keyboard is its standard key spacing that should make quick data entry easy.

The *JR-200* is also a color home computer that can interface not only with a home television set, but also with a monitor with either composite video or RGB inputs. It is capable of generating eight colors simultaneously and—for music composition or sound effects—three simultaneous tones in five octaves. Mass storage is through the cassette interface and Panasonic has an interesting option, a 2400-baud data cassette recorder that allows faster data storage and retrieval via cassette.

Rounding out Panasonic's entries in this field is one of the new breed of lap computers now making their way to the market. The *JR-800*, that weighs a mere 1⅝ pounds and which fits easily into a briefcase, is priced at $499.95. For that price, the user receives a powerful piece of equipment.

Initially equipped with 16K of user memory, or enough to perform complex tasks and to store a good deal of information, the memory is expandable to 24 or 32K, or as much RAM as some much larger machines had only a few years ago. No pricing was provided on this expandable feature.

Featuring a full travel standard layout typewriter keyboard, the *JR-800* also has 20 programmable function keys and an independent numeric keypad. The programmable keys can be programmed to carry out often-used commands to help simplify and speed up the computing process.

Like other lap computers, the *JR-800* has taken advantage of advances in liquid-crystal-display technology and sports a 32-character by 8-line LCD. The display can be scrolled through 255 columns and contrast control is provided so the display can be adjusted for easy viewing in a variety of lighting conditions.

Memory protection is provided so that any data or programming material that has been stored in RAM will be saved even if the power is turned off.

The BASIC programming language this unit uses is located in ROM for quick loading and 51 BASIC commands are provided on the keyboard, as well as 64 graphic symbols and 32 user-definable keys.

Texas Instruments

Since last year's supplement was published, there has been a tremendous price war going on in the low-cost home-computer field and the semiconductor giant, Texas Instruments, has been among those companies battling it out with its *TI-99/4A*, the only low-cost home computer to use a true 16-bit microprocessor, *TMS-9900*. In fact, TI was the first manufacturer on the market with a 16-bit CPU when the model was introduced three years ago. Although you might find the manufacturer's suggested retail list price somewhat shocking, in view of the heavy price discounting and rebate programs that have gone on, it is $225.

However, the user gets a machine with a typewriter-style keyboard and immediate availability to TI's wide library of prepackaged software. This software is immediately usable thanks to the *TI-99/4A*'s 16K user memory.

Programmable in BASIC, a user can use a built-in cassette interface for data storage. Disk drives are available, but they push its cost up to other pricing categories.

The *TI-99/4A* is capable of generating up to 16 colors and interfaces with a television set through a built-in RF modulator. It can also use a color monitor, as will be shown in other pricing categories.

This isn't the only TI entrant in this pricing category. The company is also marketing its *Compact Computer 40*, a hand-held unit with a base price of $249.95. It interfaces with a wide variety of peripherals.

Driven by a low-power CMOS 8-bit microprocessor, the *CC-40* comes equipped with 6K of user memory. Its standard keyboard layout allows entry of BASIC commands and text, although its display is only a 1-line by 32-character LCD. Mass storage is via TI's proprietary *Wafertape* drive system. In other circles, this type of tape system might be called a "stringy" floppy drive.

Wafertape is actually a continuous-loop cassette tape system that allows quick data entry and retrieval. This is similar to the endless tape loops used in telephone answering machines.

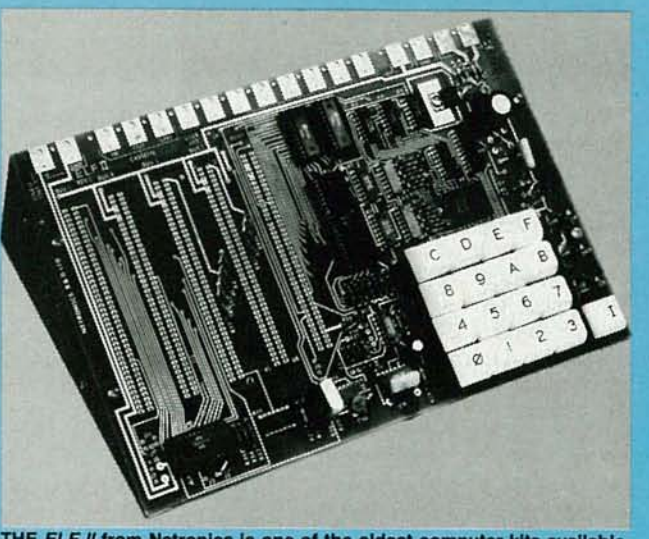
If you look closely at the accompanying table, you will find this system mentioned twice because it starts its upgrading within this price segment with the addition of a serial input/output port.

The *TI-99/4A* also begins upgrading and its price rises to $425 with the addition of the Wafertape drive, in place of a standard cassette recorder.

Video Technology

A newcomer to the home-computer wars, Video Technology is offering a keyboard-computer, the *VZ200*, whose pricing starts at $99.95. For this price, a user gets a Z80A 8-bit microprocessor, one of the 8-bit world's standards, but only 4K of user memory, which is enough for simple tasks and home games, but isn't really enough for complicated tasks. In fact, if you watch how the system upgrades, you will notice the first expansion is to increase the amount of user memory, which is accomplished before it reaches the $500 to $1000 pricing category.

COMMODORE'S *VIC-20* is a BASIC-programmable machine.



THE *ELF II* from Netronics is one of the oldest computer kits available.

Fully programmable in BASIC, the *VZ200* features a standard keyboard layout with small calculator-type keys. These multi-function keys allow one-key entry of BASIC commands and speed up programming.

The *VZ200* features a built-in cassette interface for data storage. In the next pricing level the manufacturer's proprietary data cassette recorder is added to the system configuration. (You will notice the same thing happening with many of the home-computer systems listed. In a departure from last year, we have included the proprietary cassette recorder in the pricing equation.)

The unit is also capable of a video output of 32-characters by 16-lines in its 9-color text mode. Low-resolution graphics of 64- by 32-dots are available in 9 colors, although a higher resolution of 128- by 64-dots is available in eight colors.

An interesting feature of the *VZ200* is its dedicated video RAM. The manufacturers have set aside 2K of user memory, roughly two pages of text, for video memory. This assures that display input won't be overwritten should the user-memory area become full. The unit is also capable of interfacing with a home television set (through an RF modulator) or a dedicated monitor.

In this pricing category, according to the manufacturer's released prices, the *VZ200* gains a printer port, memory expansion and peripheral expansion bus, and this just about exhausts the list of possibilities because other planned peripheral prices weren't available at press time.

Mattel Electronics

Making its first formal foray into the home-computer field, Mattel Electronics has introduced the $150 *Aquarius* system. (It has an add-on computer module for its Intellivision game controller, but this is its first formal home computer.)

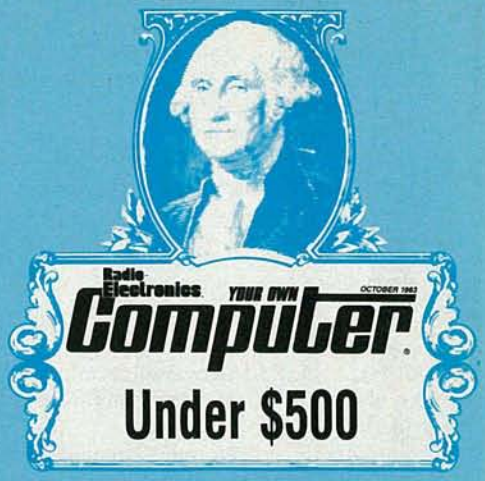
Driven by an 8-bit Z80A microprocessor, the *Aquarius* comes with only 4K of user memory. Eventually, the company plans total user memory capability of 52K.

Another of the keyboard-computers available, the *Aquarius* has a 49-key small calculator-type of keyboard. Its basic measurements are 13 by 6 inches and its is capable of 256 graphics characters, as well as 16 colors.

Capable of interfacing with a cassette recorder for mass storage, software is available not only on tape, but also in the form of plug-in cartridges. Programming languages include BASIC and the educationally-oriented LOGO.

In its two expansions in this pricing category, one will find the cassette recorder and the expansion bus have been added.

VIDEO TECHNOLOGY'S *VZ200* has calculator-type keys.



Commodore Business Machines

Commodore Business Machines, one of the longtime microcomputer manufacturers, also has a keyboard-computer entry in this price category, the *VIC-20*. CBM, as the manufacturer is also known, has been one of the firms engaged in a hotly contested drive for domination of the under-$500 marketplace and even though the *VIC-20* carries a $199.95 manufacturer's suggested retail price tag, you should be able to find it for much less.

Driven by a 6502, 8-bit microprocessor, the *VIC-20* features a full-travel keyboard. Some of its keys, such as the quotation marks, are in nonstandard locations, so this could slow an accomplished touch typist. However, once the user is familiar with the keyboard, it should be easy to use. Four function keys are provided.

In the accompanying table, you will find the *VIC-20* listed three times in this price class. At each level something has increased and if you note, the first addition is the data recorder. At the second level, user memory is expanded. At the third level, memory is expanded farther.

The *VIC-20* system is fully programmable in BASIC. It features color-display capability with graphics resolution of 176- by 184-dots and it is capable of generating a 22-character by 23-line display. It is also capable of generating sounds over a five-octave range.

In this portion of the price range, the *VIC-20* is limited to either cassette tape or plug-in cartridge software. However, its versatility grows as more system expansion takes place, as you will see later.

Atari

Atari Home Computers has three entries in this price category, the $199 model *600XL*, the $299 (give or take a few dollars) *800XL* and the $499 model *1200XL*. The reason the price of the *800XL* isn't detailed is because specific pricing for the new models offered by Atari was not available at press time. Atari has a total of five models in the home-computer market.

The low-cost *600XL* is equipped with 16K of user memory that is expandable to 64K. It also features a full-stroke typewriter keyboard and is programmable in BASIC. This low-cost unit expands once with the addition of Atari's data recorder and features five text modes and 11 graphics modes with 256 colors.

SPECTRAVIDEO'S *SV-328* uses a Z80A microprocessor.

The *600XL* is capable of a maximum graphic resolution of 320- by 192-dots and a 40-character by 24-line text display. A serial input-output port is standard on this unit as are two game-controller ports. It has a built-in RF modulator for using a home television as the output device.

The *800XL*, priced somewhere between the *600XL* and the *1200XL*, includes all the features of the lower-priced model, plus 64K of user memory. It also has outputs to enable you to connect the computer to either a televison set or a monitor.

This new line of computers seems to fix one of the weaknesses of the former price leader, the *400*, which has been discontinued. The *400* used a membrane keyboard that has never been popular. Instead, the new machines sport keyboards with typewriter-style keys. They also include slots to accept software cartridges.

The only machine that continues in Atari's lineup is the *1200XL*, which is driven by a 6502 8-bit microprocessor. It features a keyboard with typewriter-like keys and is programmable in BASIC.

Also included in the basic outline of this machine is a parallel printer port and two game controllers. Its display capabilities include the generation of up to 256 colors and 40-character by 24-line text generation. It interfaces with a home television set.

Netronics

If you want to "roll your own" microcomputer, then you have three choices from Netronics—the *Elf II*, *Explorer/85* and the *Explorer/88-PC*.

The *Elf II* is one of the oldest kit computers on the market and is driven by the venerable 1802 8-bit microcomputer from RCA. It is also one of the last microcomputers on the market to still use Tiny BASIC.

Constructed on a small PC board, the *Elf II* uses a hex keypad for machine-language programming. It generates a composite video display for interfacing with a monitor or it can interface with a home-television set through an RF modulator. An extremely expandable machine—more than half the motherboard is reserved for that—at its basic level there are only 256 bytes of user memory. However, that can be expanded to 64K. Options include a full keyboard and an A/D converter board. As you can see from the chart below, it upgrades several times in this price category.

Far more complete machines are represented by the *Explorer/85* and the *Explorer/88-PC*.

The *Explorer/85* contains an S-100 bus—100 signal-lines on the motherboard that carry data, address, and control information to the various boards plugged into it—and as a result, expansion is nearly unlimited. Various S-100 boards that are available include RAM boards, floppy-disk controllers, serial

and parallel I/O boards, and more. The *Explorer/85* is also capable of running the the CP/M operating system.

The *Explorer/88-PC* is a good learning experience for those who would like to see what makes an IBM-compatible machine tick. It not only includes the motherboard and microprocessor, but also the IBM-type expansion bus. With the correct add-on board, cabinet and drives, the user has an IBM-compatible system. In fact, in one of the higher price categories, there is a full-blown kit that will produce such a machine.

NEC

The NEC *PC-6000* is another of the computers found on the market today with an integral keyboard. Priced at $349.95, it is driven by a Z80A-compatible microprocessor. The *PC-6000* contains 16K of user RAM and is expandable to 32K with an optional cartridge.

Its BASIC programming language is resident in 16K of ROM and features enhanced graphics and sound capabilities. Capable of color graphics with a resolution of up to 256- by 192-dots, the *PC-6000* is useful for color graphics work. In the text mode, resolution is 32-characters by 16-lines. A composite video output is available.

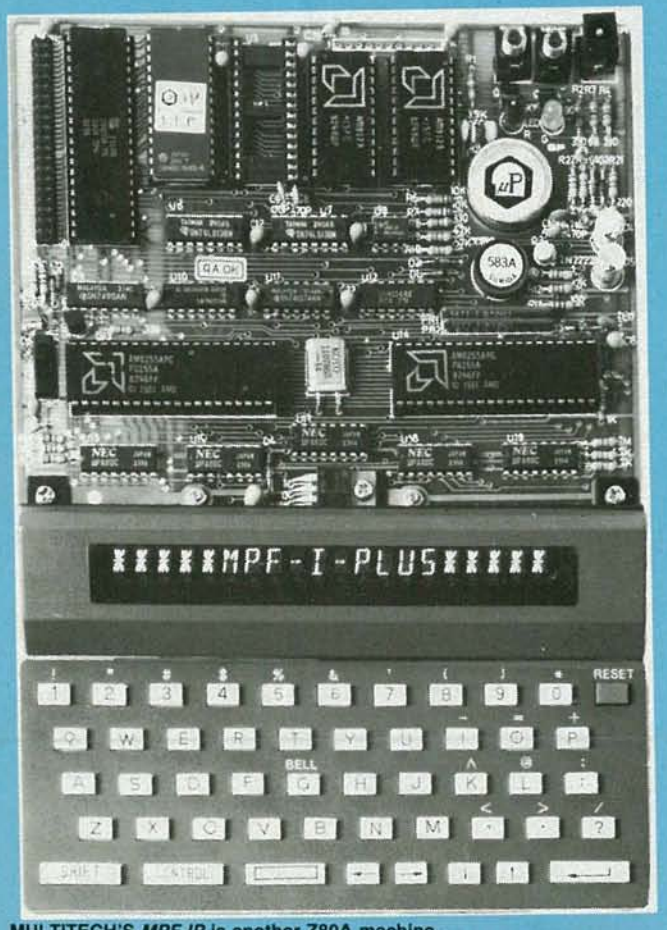
The *PC-6000* upgrades once in this price category with the addition of the NEC-offered cassette recorder for mass storage.

Multitech

Multitech Electronics has two offerings in this pricing category, the *MPF-IP* and the *MPF-II*.

The *MPF-IP* is driven by an 8-bit Z80 microprocessor. It contain 4K of RAM memory that is expandable to 10K via an optional input output and memory board.

Basically a computer literacy machine, the *MPF-IP* has a 49-key keyboard with calculator-type keys. The keyboard will enable a user to enter programs in assembly language, machine code, BASIC, or FORTH.



MULTITECH'S *MPF-IP* is another Z80A machine.

The display of this device is a 20-digit, 14-segment alphanumeric green tube display that scrolls much like a Times Square billboard.

It features a built-in speaker, battery-operated memory back-up circuit and such options as an EPROM (Erasable Programmable Read-Only Memory) board, a speech-synthesizer board, thermal printer, and a combination I/O and memory board and accessory kit for experiments.

The *MPF-II* is an Apple-compatible machine driven by a 6502 8-bit microprocessor. Featuring 64K of user memory, the *MPF-II* is programmable in BASIC via its 53-key standard-layout keyboard with calculator-like keys. A serial port allows interfacing with peripheral devices such as modems or printers.

The *MPF-II* will interface with a user's choice of video-display device. It is capable of displaying 40-characters by 24-lines of text and six colors with a resolution of up to a 180- by 192-dots.

Spectravideo

Spectravideo also has two computer offerings in this price category, the *SV-318* and the *SV-328*.

The *SV-318* is driven by a 3.6 MHz Z80A microprocessor and features 32K of user memory built-in. This means that nearly from the start this unit can handle sophisticated applications programs.

The keyboard, which uses a standard-keyboard layout and calculator-type keys, also features user-programmable function keys.

Programmable in BASIC, as are most of the other low-cost home computers on the market, it is capable of handling high-level color-graphics functions. A user can address 16 colors from the keyboard with a resolution of 256- by 192-dots.

The more expensive *SV-328* is also driven by a Z80A microprocessor. It features 80K of RAM—the top amount found in microcomputers in this price category—and built-in BASIC.

Further, this machine features CP/M compatibility, which increases the flexibility and usefulness of this computer, especially in a small-business setting.

It also features two built-in ROM-resident programs, a word-processing application and a terminal application, which make this a full-featured machine from the start.

An 87-key, full-stroke keyboard offers 10 user-definable functions, three special word-processor keys, 34 keyboard-generated computer-graphic symbols, and a separate numeric keypad.

The screen is somewhat limited for serious business work, offering 32 characters-per-line in the graphics mode and 40 characters-per-line in the text mode, but it should easily serve the average home user.

At this level, data storage is via a built-in cassette interface, while its composite video and audio output are through an RF modulator.

Sord

Another of the low-priced keyboard-computers is the Sord *M5*, which is driven by a Z80. It upgrades once in this price category and features two joysticks and programming for household accounting and bank-loan management. Input/output is handled through a parallel printer port, while data can be saved to cassette. A home-television set is used as a display.

Unitronics

Driven by an 8-bit 6502 microprocessor with a Texas Instruments video-display processor for arcade quality graphics, the Sonic uses a Waferdrive (endless-loop tape) that allows full read/write capabilities and mass storage for 128K.

The Sonic includes a 16-color display, 40 column display and a 70-key typewriter-style keyboard. The keyboard includes 10 function keys.

An additional 32K of RAM can be added to this system with the addition of a RAM module. It interfaces with the Sonic's expansion port. **R-E**

Surprising sophistication and low cost are the characteristics of the systems in this category.

$500 to $1000

MARC STERN

IT'S AMAZING THE AMOUNT OF SOPHISTICATION BUILT INTO today's crop of low-cost home computers. Just a few years ago, machines in this price category were fairly primitive affairs, with little user memory and few peripherals. In fact, the microcomputer world was dominated by hobbyists, rather than home users. These hobbyists put together their systems with a little bit from this source and a little bit from that source, until they had fairly decent machines.

Contrast this situation with today where anyone can go to a retail outlet or computer store and buy a machine with 64K of user memory, sophisticated peripherals, and graphics capability. Today's microcomputer market has radically changed and the consumer has benefited from that change.

In this price category, some new companies make their first appearance. Some of these companies are more widely known for their consumer-electronics goods than their computer hardware and they include Casio, Sanyo, and Toshiba. Other companies, better known in the computer peripheral business than for their home computers, have also joined and they include Epson America and Formula International. Even a widely known game manufacturer, Coleco, has an entry in this price level.

New machines also make their appearance from Commodore Business Machines and Atari.

At this price level, many of the machines mentioned in the under-$500 price category start to become more powerful systems. So, without further delay, let's take a look at the new entrants in this market and then wrap up with a look at how some systems have matured.

Coleco

The *Adam* is Coleco's first entry into the computer marketplace, and it is being marketed as a complete system. It includes a standard printer in its initial configuration.

User memory stands at 80K, which is enough for most chores that a home-computer user might have and the system features a standard typewriter-like keyboard with 75 full-travel keys. Built into this system is a word-processing package. The *Adam* is also compatible with CP/M, which makes this system a candidate for small businesses, because of access to the rich variety of CP/M programs.

Unlike other machines in this price category, the *Adam* includes an integral storage device, called a digital data-pack drive, capable of 500K of mass storage. According to industry reports, it is a tape drive, much like others on the market.

This near full configuration makes this machine ideal for the person looking for a fairly complete system under $1000. It is programmable in BASIC.

Formula International

Long associated with the hobby-electronics world, this company is offering an Apple-compatible kit called the *Pinecom*. It is driven by a 6502 8-bit microprocessor and the kit includes the basic computer with keyboard and little more.

Programmable in BASIC, the *Pinecom* has 64K of user memory. Data input is via a 60-key keyboard and the unit is capable of 40-character by 24-line display for output. It also has color capability. It upgrades once in this price category with the addition of a parallel printer port.

Toshiba

Better known for its semiconductors and consumer-electronics products, Toshiba has introduced its *T100* computer that is driven by a Z80A.

The *T100*, in this price category, is a pretty barebones machine. It includes 64K of user memory but mass storage is limited to cassette tape.

TABLE 1—$500 to $1000

Manufacturers	Model	Price	CPU	Word length	Operating System	Languages
NEC Home Electronics	PC-6000	$500	Z80A-compatible	8-bit	N/A	BASIC
Commodore Business Machines	Pet 64	$500	6500 series	8-bit	N/A	BASIC
Atari Products	800XL	$500 (est.)	6502C	8-bit	N/A	BASIC
Sharp Electronics	PC-1250	$505	Custom CMOS	8-bit	N/A	BASIC
Atari Products	600XL	$519	6502C	8-bit	N/A	BASIC
Texas Instruments	TI-99/4A	$525	TMS9900	16-bit	N/A	BASIC
Panasonic Co.	H1400	$538	6502	8-bit	SNAP	BASIC
Netronics Research	Explorer/85	$539.70	8085	8-bit	N/A	machine
Radio Shack	TRS-80 Color Computer	$549	6809E	8-bit	N/A	BASIC
NEC Home Electronics	PC-6000	$550	Z80A-compatible	8-bit	N/A	BASIC
Texas Instruments	CC-40	$555	7C20	8-bit	N/A	BASIC
Netronics Research	Elf II	$559.30	1802	8-bit	N/A	machine/BASIC
Texas Instruments	TI-99/4A	$585	TMS9900	16-bit	N/A	BASIC
Netronics Research	Explorer/85	$589.65	8085	8-bit	N/A	machine
Commodore Business Machines	Commodore 64	$595	6510	8-bit	N/A	BASIC
Atari Products	1200XL	$598	6502	8-bit	N/A	BASIC
Spectravideo	SV-328	$600	Z80A	8-bit	N/A	BASIC
Sharp Electronics	PC-1500	$600	Custom CMOS	8-bit	N/A	BASIC
Spectravideo	SV-328	$600 (est.)	Z80A	8-bit	N/A	BASIC
Coleco Industries	Adam	$600 (est.)	Not announced	Not announced	N/A	BASIC, LOGO
Panasonic Co.	H1800	$638	6502	8-bit	SNAP	BASIC
Formula International	Pinecom (kit)	$645	6502	8-bit	N/A	Not announced
Commodore Business Machines	Commodore 64	$670	6510	8-bit	N/A	BASIC
Netronics Research	Explorer/85	$689.60	8085	8-bits	N/A	machine/BASIC
Texas Instruments	CC-40	$695	7C20	8-bit	N/A	BASIC
Spectravideo	SV-328	$700	Z80A	8-bit	N/A	BASIC
Formula International	Pinecom (kit)	$730	6502	8-bit	N/A	Not announced
Radio Shack	TRS-80 Pocket Computer PC-2	$759.75	Custom CMOS	8-bit	N/A	BASIC
Netronics Research	Explorer/85	$789.80	8085	8-bit	N/A	machine/BASIC
Toshiba America	T100	$795	Z80A	8-bit	N/A	BASIC
Epson America	HX-20	$795	6301	8-bit	N/A	N/A
Multitech Electronics	MPF-II	$797	6502	8-bit	Proprietary	BASIC
Radio Shack	TRS-80 Model 100	$799	80C85	8-bit	N/A	BASIC

Memory/Storage	Keyboard	I/O	Display	Comments
32K/cassette recorder	71 keys, 5 multifunction keys	1 parallel, 2 game controller ports	256 × 192 capability, 32 × 16 text, composite video output avail.	memory expanded to 32K RAM
64K/cassette interface	standard, numeric keypad	1 serial	integral display	basic system
64K/cartridge slot	54 keys, help key, 4 special function keys	1 serial, 2 controller, expansion connector	built-in video output supports 256 colors, 40x24 text	basic system
9.7K/cassette recorder	54 keys, reservable keys, keypad		24-character × 1 line liquid crystal display	interface/printer/cassette unit added, user memory expanded 8K
16K/cassette recorder/cartridge slot	62 keys, help key, 4 special function keys	1 serial, 2 controller, expansion connector/ interface module	built-in video output supports 256 colors, 40x24 text	interface module added for future expansion
48K/cassette interface	standard		16 colors	user memory upgraded by 32K
4K	65 calculator keys in typewriter arrangement, redefinable keys	input/output adapter/expansion bus	1-line × 26-character liquid crystal display	I/O adapter
256 bytes/cassette interface	56 keys	N/A	12-inch monochrome CRT	S-100 card cage added for expansion boards
32K/cassete interface	53 keys	1 serial	32 × 16 color text mode/256 × 192 graphics capability	user memory expanded to 32K
32K/cassette recorder	71 keys, 5 multifunction keys	1 parallel, 1 serial, 2 game controller ports	256 × 192 capability, 32 × 16 text, composite video output avail.	serial port added
22K/software cartridges	standard layout	1 serial, 1 parallel	31-character × 1 line liquid crystal display	serial and parallel ports
16K/casette interface	56 keys	1 serial, 2 parallel	home TV	keyboard, BASIC added
48K/cassette interface	standard	HEX-BUS expansion unit	16 colors	HEX-BUS expansion unit
4K/cassette interface	56 keys	N/A	12-inch monochrome CRT	user memory increases to 4K
64K/cassette interface	60 keys, 4 programmable keys		16 color graphics capability/text	basic system
64K/cassette recorder/cartridge slot	standard typewriter/16 special function keys	1 printer, 2 controller, expansion connector	built-in video output supports 256 colors, 40x24 text	cassette recorder
80K/cassette interface	87 keys, keypad, 10 definable keys			basic system
10.6K/cassette interface	65 keys, 10-key keypad, function keys		26-character × 1 line liquid crystal display	cassette interface, printer/plotter added
80K/cassette interface	87 keys, 10 programmable, numeric keypad		40 × 24 text mode capability/16 colors	basic system
80K/500K memory storage drive (see text)/software cartridges	75-keys, 6 "smart" keys, detachable 12-key keypad	Not announced	color graphics capability/36 column	basic system
8K	65 calculator keys in typewriter arrangement, redefinable keys	input/output adapter/expansion bus	1-line × 26-character liquid crystal display	I/O adapter added
48K	66 keys, 14-key keypad		40 × 24 text mode/280 × 192 graphics capability	Apple-compatible kit
64K/cassette recorder	60 keys, 4 programmable keys		16 color graphics capability/text	cassette recorder
4K/cassette interface	56 keys	N/A	12-inch monochrome CRT	ROM-based BASIC added
22K/stringy floppy/software cartridges	standard layout	1 serial, 1 parallel	31-character × 1 line liquid crystal display	wafertape drive added
80K/cassette recorder	87 keys, 10 programmable, numeric keypad		40 × 24 text mode capability/16 colors	cassette recorder
48K	66 keys, 14-key keypad	1 parallel	40 × 24 text mode/280 × 192 graphics capability	parallel port
32K	65 calculator keys, 19-key keypad, 18 definable keys	60 pin bus connector	1 line 7 × 156 dot matrix liquid crystal display	memory expanded to 32K, 4 memory modules added
16K/cassette interface	56 keys	N/A	12-inch monochrome CRT	user memory expands to 16K
64K/cassette interface	89 keys, 8 special function keys	1 parallel, 1 serial		basic system
16K/microcassette storage (built-in)	standard, 5 function keys, 10-key keypad	1 serial	4-line liquid crystal display	lap computer
64K/1 190K SS/DD 5 ¼" drive	52 keys	1 parallel, 1 game controller	supports 40 × 24 text/6 colors/ 180 × 192 resolution/ display is user option	disk drive added
8K/cassette interface	56 keys, embedded 10-key keypad, 8 programmable	1 parallel, 1 serial, built-in modem	40 × 8 liquid crystal display	lap computer

TABLE 1—$500 to $1000 (*continued*)

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
NEC Home Electronics	PC-6000	$800	Z80A-compatible	8-bit	N/A	BASIC
Atari Products	1200XL	$818	6502	8-bit	N/A	BASIC
Sharp Electronics	PC-1500	$825	Custom CMOS	8-bit	N/A	BASIC
Texas Instruments	TI-99/4A	$835	TMS9900	16-bit	N/A	BASIC
Panasonic Co.	JR-200	$880	Not announced	Not announced	Not announced	BASIC
Panasonic Co.	H1400	$938	6502	8-bit	SNAP	BASIC
Netronics Research	Explorer/85	$939.80	8085	8-bit	N/A	machine/BASIC
Atari Products	600XL	$969	6502C	8-bit	Atari DOS II/III	BASIC
Radio Shack	TRS-80 Pocket Computer PC-2	$979.70	Custom CMOS	8-bit	N/A	BASIC
Sanyo	MBC 550	$995	8088	16-bit	MS-DOS	BASIC
Commodore Business Machines	Executive 64	$995	6500 series	8-bit	Proprietary	BASIC
Hewlett-Packard	HP75C	$995	Not announced		N/A	BASIC
Radio Shack	TRS-80 Model 100	$999	80C85	8-bit	N/A	BASIC
Radio Shack	TRS-80 Model 4	$999	Z80A	8-bit	N/A	BASIC
Radio Shack	TRS-80 Model III	$999	Z80	8-bit	N/A	BASIC
Casio, Inc.	FX-9000P	$999	Z80A-compatible	8-bit	Not announced	BASIC

Programmable in machine language and BASIC, data entry is via the 89-key typewriter-style keyboard. This keyboard also has 8 special-function keys that are user programmable. This unit includes standard serial and parallel ports for input/output.

Epson

Another of the entrants on the market with lap computers, Epson America is probably better known for its microcomputer printers than it is for its small systems. However, in the last year it has come out with two, the *HX-20* lap computer and its user-friendly *QX-10*.

In this price category, the *HX-20* lap computer makes its debut. Like other lap models, this one is capable of independent operation with batteries. Its 6301 8-bit microprocessor is capable of handling sophisticated number-crunching or just about any other task it will be called on to handle.

The beauty of this type of machine is its ability to go anywhere. With 16K of user memory, it can store about 16 typewritten pages in memory, or about as much daily production as anyone in the field might generate. The machine also features a built-in microcassette storage system.

Its full-travel, keyboard has five multifunction keys. A serial port allows the *HX-20* to be used with a modem so that the person in the field can upload or download files to/from a mainframe or office minicomputer system. Further, this port will allow the user to tie into any of the many information networks available today.

The *HX-20*'s display is more limited than the competition in the lap market. Unlike other machines with 8-line liquid-crystal displays, the *HX-20* has a four-line display, although this should be enough for many users.

Sanyo

Another of the firms that is better known for its consumer electronics products, Sanyo, also has a microcomputer, the *MBC 550*. Unlike other small-computer systems in this price category, the *MBC 550* is driven by a 8088 microprocessor. This feature alone will give the user access to the rapidly growing world of MS-DOS applications software that runs on this microprocessor. (A version of this disk operating system—PC-DOS—is what is primarily used in the IBM Personal Computer world and this is what has contributed to its lead in the 16-bit single-user system world.)

Unlike other systems in this price category, this one comes with 128K of user memory. It is one of the only microcomputers in this area to provide so much standard start-off RAM. (Sixteen bit computers can address up to 1.2 megabytes of RAM.) And, unlike other systems in this category, the *MBC 550* comes with one single-sided, double-density 160K floppy disk drive for storage. When you add in other peripherals, as we have done in other price categories, you will find this is a powerful home system.

Radio Shack

Not only does this major consumer-electronics firm have small-computer-system entries in the $100-to-$500 field—primarily handheld and small color systems; they also have entries in this category that begin their climbs toward computing power.

The first new Radio Shack system is the *Model 100* lap computer. Another of the many lap computers that are appearing on the market, the model *100* uses a CMOS 80C85 8-bit microprocessor. It is a low-power version of the standard 8085.

This system comes with 8K of user memory, but, while that figure may seem small, it must be noted it has several powerful programs built into ROM that are accessed at the touch of a button. This means that the user memory can be used for user input without worrying about loading an applications program into memory.

Programmable in BASIC, the *Model 100* sports a full-travel,

Memory/Storage	Keyboard	I/O	Display	Comments
32K/cassette recorder	71 keys, 5 multifunction keys	1 parallel, 1 serial, 2 game controller, digitized touch panel	256 × 192 capability, 32 × 16 text, composite video output avail.	expansion module, digitized touch tablet added
64K/cassette recorder/cartridge slot	standard typewriter/16 special function keys	1 printer, 2 controller, expansion connector/interface module	built-in video output supports 256 colors, 40 × 24 text	interface module added
10.6K/cassette interface	65 keys, 10-key keypad, function keys	1 serial	26-character × 1 line liquid crystal display	serial port added
48K/cassette interface	standard	HEX-BUS expansion unit, peripheral interface	16 colors	expansion interface
32K/cassette interface	60 keys, multifunction keys	1 parallel, 1 serial	RGB CRT/RGB and composite video output	color CRT
14K	65 calculator keys in typewriter arrangement, redefinable keys	input/output adapter/expansion bus	1-line × 26-character liquid crystal display	memory expanded to 14K
64K/cassette interface	56 keys	N/A	12-inch monochrome CRT	user memory expands to 64K
16K/floppy disk drive	62 keys, help key, 4 special function keys	1 serial, 2 controller, expansion connector/interface module	no std. CRT/built-in video output supports 256 colors, 40x24 text	floppy disk drive added
32K/cassette interface	65 calculator keys, 19-key keypad, 18 definable keys	60 pin bus connector	1 line 7 × 156 dot matrix liquid crystal display	cassette interface/printer added
128K/1 160K floppy disk drive	Not announced	1 parallel, joystick port	color graphics capability (no further details)	basic system
64K/1 170K 5 ¼" floppy disk drive	standard	1 IEEE-488 serial	6-inch high-res. color display	transportable business computer
16K/built-in card reader (see text)	61 keys, multifunctional keys	interface port for add-on options	32 character one-line LCD	basic system, includes card reader
24K/cassette interface	56 keys, embedded 10-key keypad, 8 programmable keys	1 parallel, 1 serial, built-in modem	40 × 8 liquid crystal display	memory increased to 24K
16K/cassette interface	70 keys, 3 programmable keys, 12-key keypad	1 parallel	12-inch monochrome/80 × 24 text (64 × 16 double-sized)	basic system
16K/cassette interface	64 keys, 12-key keypad	1 parallel	12-inch monochrome	basic system
4K/cassette interface	67 keys, 16-key keypad		5.5-inch monochrome	basic system

typewriter-like keyboard. It also features a cassette-tape interface for data storage.

An interesting feature of this system is the built-in direct-connect modem and software to drive it. This makes the *Model 100* a very versatile machine for use in the field because it can act as a portable terminal from just about anywhere there is a phone. Its 40-character by 8-line display is more than adequate for most field situations. This unit upgrades once in this category with the addition of 16K of RAM.

Another offering from Radio Shack is the new *Model 4*, an all-in-one, terminal-type computer system.

At this point in its pricing, the *Model 4*, driven by an 8-bit Z80A microprocessor, relies on a cassette recorder for mass storage, has 16K of RAM (that is more than enough for average home usages), and it includes a 70-key standard typewriter-type keyboard. This keyboard contains three programmable keys and a separate 12-key pad.

The beauty of an all-in-one system versus others on the market is that the buyer doesn't have to worry about which display unit to buy, because the system includes one. The display on the *Model 4* is a full 80 characters by 24 lines.

Similarly, the *TRS-80 Model III* desktop, which uses a Z80 microprocessor instead of the Z80A, is another all-in-one system. It also differs from the *Model 4* in its display, which is 64-characters by 16-lines. It is an older unit and offers the same amount of basic user memory, although its keyboard is more limited.

Both systems can be expanded into fairly powerful units, as will be seen later.

Two other Radio Shack computers that were introduced in the $100 to $500 price category, upgrade in this price category. The *Color Computer* has its memory increased to 32K, while the *PC-2* Pocket Computer reaches 32K of RAM and its flexibility is increased with the addition of the printer/cassette interface expansion unit.

Commodore

Commodore is another computer manufacturer with a wide range of products. In this price category, alone, three new systems debut including the *Pet 64*, aimed at business, the *Commodore 64*, and the *Executive 64*, a tote-along system.

The *Pet 64* continues Commodore's policy of making a display screen available with its microcomputer systems. Driven by a 6500-series—Commodore actually came up with this series and uses it in all its products—8-bit microprocessor, the *Pet 64* has 64K of user memory standard.

With its standard typewriter-like keyboard, a user can program in BASIC and then save the results to a cassette recorder. Actually the basis of a very powerful system, the *Pet 64* comes with a standard 12-inch monochrome monitor and a serial port so the unit can interface with a printer or modem for output.

The *Commodore 64*, of which the *Pet 64* is a variant, is another unit driven by a 6500-series microprocessor. Very expandable, it will interface with all the peripherals offered for the *VIC-20*. Like the *VIC*, the *Commodore 64* has been part of the ongoing battle for dominance in the low-cost personal computer market and Commodore has cut its price. Although the price in our listing looks high, you should be able to find it substantially discounted.

Programmable in BASIC, the *Commodore 64* has a standard 64-key typewriter-like keyboard and it features 64K of RAM that makes it a highly versatile unit for many tasks. It will interface with a home television set through a built-in RF modulator and is capable of 16-color graphics and text. The system upgrades once in this price category with the addition of the digital tape recorder offered by Commodore.

Also based on the *Commodore 64* is the *Executive 64*, another entry in the transportable market. Again driven by a 6500-series 8-bit microprocessor, the *Executive 64* has one built-in 170K single-sided, double-density disk drive for mass storage. This

increases the capability of the unit from the start because it is able to access and store large amounts of data very quickly.

The built-in 6-inch display is capable of high-resolution color, a departure from the usual monochrome display found on other transportable computer systems.

The *Executive* is capable of interfacing with a printer through a parallel port for hard-copy output. It is the basis of an expandable transportable system and, as we shall see, it continues to expand in other price categories.

Atari

Best known for its home games, Atari's line expands in this price category with the addition of the *800XL*. Driven by a more advanced 6502C 8-bit microprocessor, the *800XL* features 64K of RAM. Not only is it capable of high-level tasks because of its level of RAM; it is also capable of using Atari's programming cartridges through a standard cartridge port.

Programmable in BASIC, the *800XL* has a standard typewriter-like keyboard for data entry. This is aided by four special-function keys and a HELP key. Its built-in video output supports 256 colors in the graphics mode or 40-characters by 24-lines in text mode. The display of 40 characters-per-line would seem to limit this unit's usefulness to casual word-processing or note writing.

In this price category the *600XL* upgrades with the addition of an expansion module that permits further system expansion. A second expansion adds a disk drive.

The *1200XL* upgrades twice. With the first upgrade, the Atari-offered data cassette recorder has been added to the picture for mass storage, while, with the second, the expansion interface module has been added to permit system growth.

Hewlett-Packard

Hewlett-Packard has a new entry in this price category, the *HP75C*. Actually a handheld, the *HP75C* features a "QWERTY" type of keyboard layout. In reality, though, the small calculator keys and the rather narrow placement of the keys make this keyboard suited only to one-finger entry than touch typing. Its display is a one-line by 32 character liquid-crystal display that is limited to casual or field use.

The *HP75C*'s forte is its portability. With 16K of built-in user memory, it is capable of most tasks one would expect it to perform in the field. However, this memory limits the sophistication of those tasks because it cannot perform functions requiring more memory. Perhaps its key feature is its built-in card reader. This allows the user to store data on magnetic cards.

Like other small-computer systems, this one is programmable in BASIC. This and other data entry is performed through the unit's 61-key keyboard. The *HP75C* also features an interface port for add-on perhipheral options.

NEC

The *PC-6000* begins to expand to a much more powerful system in this price category. Its first expansion brings the user memory to 32K, while its second, the addition of a serial port, gives it the ability to communicate with the outside world via either a printer or modem.

The addition of the expansion module and a digitized touch-tablet for graphic input gives this system more flexibility and sophistication.

Texas Instruments

The *TI-99/4A* expands three times in this segment. Its first expansion increases its user memory by 32K, while the second adds to its flexibility with the addition of the *Hex-Bus* option. The *Hex-Bus* allows external peripherals to be added to this unit to give it, for example, additional input/output capability through serial and parallel ports that can be added.

In its next upgrade, the expansion interface is added to increase the versatility of this system. The expansion interface is used to accommodate such items as disk drives.

TI's *CC-40* also becomes more fully configured in this price category. In its first expansion, it gains I/O capability with the addition of parallel and serial ports. With these ports, the computer can interface with either a printer or a modem for output or input. In its second expansion, the *CC-40* gains greater—and faster—mass storage with the addition of the *Wafertape* continuous tape-loop data drive.

Pansonic

The Panasonic *H1400 and H1800* begin to become more fully configured also. In the first expansion, the input/output adapter is added to each unit. This enables each unit to interface with other peripherals, as will be shown in other price categories.

In its second expansion, the *H1400* becomes more useful as its user memory is increased to 14K.

The *JR-200* computer also becomes a little more powerful in this price category as a color monitor is added.

Netronics

The *Explorer/85* kit expands five times. In the first expansion, the S-100 card cage is added. When this is done, the user has the ability to choose from the many S-100 add-in cards available to configure his system as he wants. For instance, there are cards adding serial or parallel ports, disk controllers, analog-to-digital and digital-to-analog conversion, etc.

However, the memory capacity is still lacking in this unit and the second expansion brings it up to 4K. At this level, though, it is still only capable of performing very basic functions because of the limited memory.

The third expansion adds BASIC, with the addition of the correct ROM. This simplifies the use of the *Explorer/85* because BASIC no longer has to be loaded from tape.

Expansion number 4 increases the RAM to a much more reasonable 16K. At this level, the machine is capable of performing more serious tasks. The final expansion brings memory up to 64K.

The *Elf II* expands here with the addition of a full-blown keyboard (replacing the hex pad of the earlier price level.) At the same time, the unit becomes more flexibile in its programming capabilities with the addition of BASIC. Now, a user has a choice of machine-level or BASIC programming.

Spectravideo

The Spectravideo *SV-328*, described in an earlier section of this supplement, expands once in this price category with the addition of the company-offered tape recorder. Although it was described earlier, as you will note from the chart, its basic price puts it in this category, as does its first expansion.

Sharp

The Sharp *PC-1250* becomes a more versatile unit with the addition of a cassette interface and printer. This gives the user the opportunity of storing his work on magnetic tape or outputting it to the thermal printer built into the unit. Additionally, the unit becomes more versatile with the expansion of user memory to 8K.

The *PC-1500* expands twice here. The first expansion adds the color printer, the plotter, and the cassette interface, which gives the user the option of outputting either hard text or saving the work to a cassette recorder.

In its next expansion, the *PC-1500* gains the possibility of accessing a data network or mainframe computer through the addition of a serial port. To use this capability, of course, you must add a modem to pass data through the phone lines. Still, it shows this system can become a powerful workstation for someone in the field.

Multitech

The *MPF-II* becomes a more powerful unit with the addition of a minifloppy disk drive for data storage. A disk drive helps increase the flexibility of any system because it gives the user a method for quick data storage and retrieval. It is a quantum leap over the use of a cassette recorder. **R-E**

Some big-name and some new-name manufacturers join the list of companies we have already mentioned.

$1000 to $1500

MARC STERN

BY NOW YOU ARE PROBABLY WONDERING WHERE ALL THE "BIG names" in the microcomputer industry are hiding. Well, this price category answers that question as such giants as IBM, Apple, and Heath join the parade of small-computer manufacturers.

At the same time, another Apple-compatible computer makes its debut, the *Ace*-series from Franklin Computer Corp., which has been the subject of controversy, but whose way seemingly has been cleared thanks to recent court actions. And, another system debuts from a manufacturer whose name has long been associated with consumer electronics: Sony.

New systems debut from manufacturers whose names we are familiar with. Atari has a new system as does NEC Home Electronics and Commodore Business Machines.

Meanwhile, systems launched in the lower-price categories begin to either become fully configured or take on new power and become much more versatile.

Let's start our exploration of this price category with the new entries on the block, moving on to the new entries from those manufacturers we have already met, and wrap it up with looks at how already-described systems take on new configurations.

IBM

Two key changes have occurred during the last 12 months. First, IBM increased the amount of user memory from 16K to 64K in the basic unit and second, the computer giant has dropped a standard cassette interface.

At this point in its life, the IBM *Personal Computer* is little more than the system box, motherboard, 64K of user memory, and the 83-key keyboard that boasts 10 function keys. However, this is the beginning of a truly powerful system.

Capable of interfacing with a home television set—providing the user opts for the correct monitor-interface board—the IBM *PC* is driven by a 16-bit 8088 microprocessor. This gives it the ability to handle up to 1.2 megabytes of RAM and, further, it also has the ability to handle complex applications programming.

In reality, these capabilities are reserved for higher price classes.

Franklin

Franklin was the perhaps the first domestic computer manufacturer to enter the highly lucrative Apple-compatible market last year with its *Ace*. It continues to market the *Ace 1000* this year and has expanded its offerings, as you will see in other price categories.

The *Ace 1000* is driven by an 8-bit 6502 microprocessor, the same micro that drives the venerable *Apple II* series. This small computer comes with 64K of user memory that makes it capable of highly complex applications. It also features a cassette interface for mass storage and is programmable in BASIC.

The *Ace 1000* features a full, typewriter-style keyboard with 72 keys and a 12-key numeric keypad. This feature, alone, makes this machine very usable and should enable quick data or program entry by a skilled typist.

The *Ace 1000* is capable of 40-character by 24-line text display and 280- by 192-dot graphics resolution.

Although it is the basic *Ace 1000* system, it is still a capable unit, whose functionality grows as we add more peripherals to it. For instance, the *Ace 1000* becomes more versatile in this price category with the addition of a floppy-disk drive that uses an Apple-compatible disk operating system.

Apple

Apple Computer, one of the long-time leaders in the microcomputer market, apparently knew it had a good thing on its hands with the *Apple II* and *Apple II-Plus* and so rather than phasing out this long-lived series, the company upgraded it to

TABLE 1—$1000-$1500

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Atari Products	1400XL	$1000 (est.)	6502C	8-bit	N/A	BASIC
Atari Products	1450XLD	$1000 (est.)	6502C	8-bit	Atari DOS III	BASIC
Texas Instruments	TI-99/4A	$1009	TMS9900	16-bit	N/A	BASIC
Commodore Business Machines	Commodore 64	$1018.95	6510	8-bit	N/A	BASIC
Formula International	Pinecom (kit)	$1029	6502	8-bit	N/A	Not announced
Panasonic Co.	H1800	$1038	6502	8-bit	SNAP	BASIC
Toshiba America	T100	$1050	Z80A	8-bit	N/A	BASIC
Radio Shack	TRS-80 Model III	$1059	Z80	8-bit	N/A	BASIC
Spectravideo	SV-318	$1079	Z80A	8-bit	N/A	BASIC
Commodore Business Machines	BX256-80	$1095	6509/8088	8/16-bit		BASIC
Franklin Computer Corp.	Ace 1000	$1095	6502	8-bit	N/A	BASIC
Radio Shack	TRS-80 Model 100	$1118	80C85	8-bit	N/A	BASIC
Sord Computer c/o Mitsui	M23	$1120	Z80A	8-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
Texas Instruments	TI-99/4A	$1135	TMS9900	16-bit	N/A	BASIC
Casio, Inc.	FX-9000P	$1144	Z80A-compatible	8-bit	Not announced	BASIC
Radio Shack	TRS-80 Color Computer	$1148	6809E	8-bit	Proprietary	BSIC
Commodore Business Machines	VIC-20	$1152.80	6502	8-bit	Proprietary	BASIC
Formula International	Pinecom (kit)	$1154	6502	8-bit	N/A	No anounced
Radio Shack	TRS-80 Pocket Computer PC-2	$1179.20	Custom CMOS	8-bit	N/A	BASIC
Panasonic Co.	H1400	$1188	6502	8-bit	SNAP	BASIC
NEC Home Electronics	PC-8800	$1199	Z80A-compatible	8-bit	N/A	BASIC
Spectravideo	SV-328	$1200	Z80A	8-bit	N/A	BASIC
Radio Shack	TRS-80 Model III	$1207	Z80	8-bit	N/A	BASIC
Radio Shack	TRS-80 Model III	$1255	Z80	8-bit	N/A	BASIC
Atari Products	1200XL	$1268	6502	8-bit	Atari DOS III	BASIC
Netronics Research	Explorer/88-PC	$1284.48	8088	16-bit	N/A	machine/BASIC
Panasonic Co.	H1800	$1288	6502	8-bit	SNAP	BASIC

Memory/Storage	Keyboard	I/O	Display	Comments
64K/cartridge slot	66 keys, 4 special function, 4 programmable, 12 preprogrammed	1 serial, 2 controller, expansion connector, modem, speech synthesizer	256 colors, 40 × 24 text	basic system
64K/1 slim line 254K DS/DD drive	66 keys, 4 special function, 4 programmable, 12 preprogrammed	1 serial, 2 controller, expansion connector, modem, speech synthesizer	256 colors, 40 × 24 text	basic system
48K/cassette interface	standard	1 serial, HEX-BUS expansion unit, peripheral interface	16 colors	serial port
64K/cassette recorder	60 keys, 4 programmable	1 serial	14-inch high-res. dedicated color monitor	color monitor, serial port
48K	66 keys, 14-key keypad	1 parallel	80-column text capability/280 × 192 graphics	80-column video card
16K	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus	1-line × 26-character liquid crystal display	memory expanded to 16K
64K/cassette interface	89 keys, 8 special function	1 parallel, 1 serial	80 × 25 monochrome	monitor
16K/cassette recorder	64 keys, 12-key keypad	1 parallel	12-inch monochrome/64 (32) × 16 text mode	cassette recorder
64K/cassette recorder	71 keys, 10 programmable, built-in joystick	1 serial, 1 parallel	256 × 192 resolution, 16 colors, television used as display	serial, parallel ports added, memory upgraded, expansion interface
256K	standard, numeric key-keypad	1 serial	12-inch monochrome CRT/80 × 25 text mode	basic system, dual processors
64K/cassette interface	72 keys, 12-key keypad	game controller	40 × 24/280 × 192 graphic capability	basic system
32K/cassette interface	56 keys, embedded 10-key keypad, 8 programmable	1 parallel, 1 serial, built-in modem	40 × 8 liquid crystal display	memory expanded to 32K
128K	59 keys, 20-key keypad, 9 special function	Not announced		basic system
48K/cassette interface	standard	1 serial, 1 parallel HEX-BUS expansion unit, peripheral interface	16 colors	parallel port
8k cassette interface	67 keys, 16-key keypad		5.5-inch, 32 × 16 monochrome, 256 × 128 graphics	4K RAM
32K/1 156K 5 ¼" floppy disk drive	53 keys	1 serial	32 × 16 color text mode/256 × 192 graphics capability	156K drive
29K/1 170K 5 ¼" floppy disk drive	66 keys, 4 user-programmable	1 serial	14-inch high-res. dedicated color monitor	color monitor, 170K floppy disk drive and serial port
48K	66 keys, 14-key keypad	1 parallel	9-inch monochrome CRT/280 × 192 graphics/80 column capability	monochrome monitor
32K/cassette interface	65 calculator keys, 19-key keypad, 18 definable	60 pin bus connector/RS-232C interface	1 line 7 × 156 dot matrix liquid crystal display	communications interface
22K	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus	1-line × 26-character liquid crystal display	memory expanded to 22K
64K/cassette interface/disk interface	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	RGB/composite video outputs 640 × 400 res./80 × 25 text	basic system
80K/cassette recorder	87 keys, 10 programmable, numeric keypad	1 serial, 1 parallel	80 × 24 text mode capability/16 colors	serial and parallel ports, 80-column display card, expansion interfac
32K/cassette recorder	64 keys, 12-key keypad	1 parallel, 1 serial	12-inch monochrome/64 (32) × 16 text mode	memory expands by 16K, serial port added
48K/cassette recorder	64 keys, 12-key keypad	1 parallel, 1 serial	12-inch monochrome/64 (32) × 16 text mode	memory expanded to 48K
64K/floppy disk drive	standard typewriter/16 special function	1 printer, 2 controller, expansion connector	built-in video output supports 256 colors, 40 × 24 text	floppy disk drive
64K/cassette interface	83 keys, 10 function, numeric keypad	1 serial	12-inch monochrome CRT	assembled Explorer/88-PC with keyboard, color board, ROM and monitor
24K	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus	1-line × 26-character liquid crystal display	memory expanded to 24K

TABLE 1—$1000-$1500 (*continued*)

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
NEC Home Electronics	PC-6000	$1350	Z80A-compatible	8-bit	Proprietary	BASIC
Formula International	Pinecom (kit)	$1354	6502	8-bit	N/A	Not announced
IBM	IBM-PC	$1355	8088	16-bit	N/A	COBOL, FORTRAN, BASIC, Macro Assembler, Pascal
Multitech Electronics	MIC-500	$1395	Z80A	8-bit	CP/M	BASIC, COBOL, Pascal
Apple Computer	Apple IIe	$1395	6502A	8-bit	N/A	BASIC
Heath Company	HS-89-3 (kit)	$1399	Z80	8-bit	HDOS/CP/M optional	BASIC
Commodore Business Machines	Commodore 64	$1417.95	6510	8-bit	Proprietary	BASIC
Heath Company	HS-89-2 (kit)	$1429	Z80	8-bit	HDOS/CP/M optional	BASIC
Commodore Business Machines	Commodore 64 Executive	$1443.95	6500 series	8-bit	Proprietary	BASIC
Hewlett-Packard	HP75C	$1445	Not announced		N/A	BASIC
NEC Home Electronics	PC-8800	$1448	Z80A-compatible	8-bit	N/A	BASIC
Sony	SMC-70	$1475	Z80A	8-bit	N/A	BASIC, CB-80, Pilot Plus
Franklin Computer Corp.	Ace 1000	$1494	6502	8-bit	Apple DOS 3.3 compatible	BASIC
Commodore Business Machines	CBM 8032	$1495	6502	8-bit	N/A	BASIC
TeleVideo Systems	Teletote	$1499	Z80A	8-bit	CP/M	Not announed

the *Apple IIe* that made its appearance earlier this year. Still using a 6502 microprocessor, the 8-bit *Apple IIe* has had its user memory upgraded to 64K. Further, it has also changed its keyboard slightly, providing 63 keys and two programmable keys.

As with other small-computer systems, this one uses BASIC as its primary user programming language and it features either low- or high-resolution graphics capability, along with a standard 40-character by 24-line text mode. The 40-character lines are fine for standard home applications, but it is limited for some applications such as word processing. If one wants to have word-processing capability, then the Apple-offered 80-column display card must be used. For output, a user can interface with a standard monitor or with a home television if he buys an RF modulator. (But not for 80 columns.)

Heath

For those would-be computer users who would like more than just an outside look at a microcomputer, there's the Heath line of computer kits, the *H89*-series. These computers give you an inside-out look at what makes a microcomputer tick as you put them together piece-by-piece.

Since this series, the *H89-2, H89-3*, comes with a single, built-in 5¼-inch minifloppy double-sided, double-density disk, the user has fast mass storage and retrieval capabilities right from the start.

Programmable in BASIC and Z80 based, this series features an 84-key keyboard and a separate 12-key keypad. The sloped keyboard allows for quick data entry. Input/output is provided by three serial ports. These allow the *H-89*-series to interface with a variety of printers or modems.

It should be noted that this CP/M-compatible system is all-in-one. It combines the CRT, system board, and keyboard into one box and looks much like the traditional type of computer workstation with which many of us are familiar.

TeleVideo

TeleVideo is another of the long-established firms in the computer industry and it has an entry in the transportable computer market, the *Teletote*. (Remember, the transportable market was last year's portable market, but the new generation of lap computers has changed this designation.)

The *Teletote* breaks no new ground in the computer industry, having been based around proven technology. It is driven by an 8-bit Z80A microprocessor and uses the industry-standard CP/M operating system.

It features 64K of RAM and one 368K double-sided, double-density 5¼-inch minifloppy disk drive for storage. This combination gives the user a great deal of flexibility and increases the system's capabilities. Its prime drawback is that the user must use the same drive for both the application program disk and a data disk, which can make it somewhat cumbersome, especially if a file has to be copied. In this situation, the user must keep switching disks, so it's a good idea to consider investing in a second disk.

Data entry is facilitated with the 75-key typewriter-type keyboard and output is aided by 2 standard serial-ports. It is also equipped with what seems to be becoming the standard-sized monitor in the transportable field, a 9-inch monochrome unit, capable of 80-characters by 24-lines in text mode and high-resolution graphics of 640- by 240-dots.

Sony

Sony, long a leader in consumer electronics, also has a small-computer offering in this price segment, the modular *SMC-70*. This computer contains a keyboard and easily upgrades into a powerful system. However, at this price level it is very much a basic unit.

Driven by an 8-bit Z80A microprocessor, the *SMC-70* consists of a system box and keyboard. The keyboard includes 71 keys, a keypad, and nine special-function keys. It is a standard

Memory/Storage	Keyboard	I/O	Display	Comments
32K/1 floppy disk drive unit	71 keys, 5 multifunction	1 parallel, 1 serial, 2 game controller, digitized touch panel	256 × 192 capability, 32 × 16 text, composite video output avail.	floppy disk drive
48K	66 keys, 14-key keypad	1 parallel	9-inch monochrome CRT/280 × 192 graphics/80 column capability	color monitor
64K	59 keys, 10 special function, 20-key keypad	N/A	N/A	basic system, includes mother board, cpu, 64K memory, system housing and keyboard only
64K/2 5 ¼" floppy disk drives	N/A	2 serial, 1 parallel	N/A	basic system, terminal required
64K/cassette interface	63-key typewriter, 2 programmable	game controller	low/high-res. color, 40 × 24 test mode, video output	basic system
48K/1 5 ¼" floppy disk drive	84 keys, 12-key keypad	3 serial, 1 parallel	white monochrome display/80 × 25 text mode	kit
64K/1 170K 5 ¼" floppy disk drive	60 keys, 4 programmable	1 serial	14-inch high-res. dedicated color monitor	floppy disk drive
48K/1 5 ¼" floppy disk drive	84 keys, 12-key keypad	3 serial, 1 parallel	green monochrome display/80 × 25 text mode	kit
64K/2 170K 5 ¼" floppy disk drives	standard	1 IEEE-488 serial, 1 standard serial	6-inch high-res. color display	2nd drive, standard serial port
24K/cassette recorder	61 keys, multifunctional	interface port for add-on options	32 character one-line LCD	cassette recorder
64K/cassette interface/disk interface	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch monochrome CRT/80 × 25 text	monochrome display
64K/cassette interface	72 keys, keypad, 9 special function	1 parallel		basic system
64K/1 5 ¼" floppy disk drive	71 keys, 12-key keypad	game controller	40 × 24/280 × 192 graphic capability	floppy disk drive
32K/cassette interface	standard, numeric keykeypad	1 serial	integral display	basic system
64K/1 368K DS/DD 5 ¼" floppy drive	75 keys, 16 special function, 17-key keypad	2 serial	9-inch CRT/640 × 240 graphics/80 × 24 text	basic system, transportable

typewriter-style unit that should facilitate keyboarding data or BASIC programming, the language that comes with the system.

At this stage, the *SMC-70* relies on a cassette interface and cassette recorder for data storage.

Commodore

A multi-line computer manufacturer, Commodore Business Machines has entries in many price classes and this price category is no exception. It is here that the *BX256-80* makes its appearance, as does the *8032*.

The *BX256-80* is a dual-processor machine, capable of handling both 8-bit and 16-bit programming. It was unveiled about a year ago.

Driven by dual 6509 and 8088 processors, the *BX256-80* is capable of sophisticated tasks. Its 256K of standard user memory assures that more than enough memory is available for almost anything a user may want to do. In fact, with some of the new generation of memory-hungry programs, 256K is needed.

It features a standard keyboard and is programmable in BASIC. It has a 12-inch monochrome CRT to display the machine's 80-characters by 25-lines.

The second system to debut in this category is the *8032*. This long-time veteran of the computer wars is driven by an 8-bit 6502 microprocessor and it comes with 32K of RAM as standard. Mass storage at this price level is handled via cassette recorder.

Data entry is facilitated by a standard keyboard and separate numeric keypad. It is programmable in BASIC. With a standard monochrome display, this basic system should easily meet most beginning home needs for most users. The user should also be able to access any information network by attaching a modem to the standard serial port.

While these are the new systems in this price category, there are also two other systems that have been upgraded, the *VIC-20* and the *Commodore 64*. The *VIC-20* upgrades and becomes a fairly sophisticated system. With 29K of RAM, the system is becoming fairly flexibile. However, it becomes even more flexible with the addition of a 170K 5¼-inch minifloppy disk for storage. This provides the user with a large increase in speed for both data access and retrieval. A color CRT is also added and a serial port gives this unit communications ability.

The *Commodore 64* upgrades twice. First, a color CRT and serial port are added. These two additions give the user the potential for color-graphics work and communications. Of course, if a user wants to take advantage of the communications potential he must add a modem.

The second expansion gives the user access to a 170K floppy disk, with its speed and storage flexibility advantages. With this system limited to one disk, though, it is a bit cumbersome. However, help is on the way when this system gains its second disk in another price category.

The *Executive 64*, on the other hand, becomes powerful with the addition of a second drive.

Atari

The new Atari systems appearing in this price category are the *1400XL* and *1450XLD*. Although exact prices hadn't been established at press time, they are likely to be in the $1000 range.

The *1400XL* is driven by an 8-bit 6502C microprocessor and it comes with 64K of RAM. It has an integral software cartridge slot which allows it to use Atari's proprietary packaged software.

Programmable in BASIC, it features a standard typewriter keyboard that has four special-function keys, four programmable keys and 12 preprogrammed function keys.

Input/output is provided by standard serial port. However, a user doesn't have to tie up this port by connecting it to a modem because it includes a built-in modem, which is a plus.

Capable of supporting up to 256 colors, the display is limited to 40-characters by 24-lines of text, which is somewhat limiting

for serious word-processing work.

The *1450XLD* is nearly identical to the *1400XL* with one major exception, it includes disk storage. The *-XLD* includes a slim line 5¼-inch minifloppy disk as standard and this gives the user access to 254K of mass storage.

Another Atari system, the *1200XL*, has its capabilities upgraded in this segment with the addition of a disk drive.

NEC

Not only does the NEC *PC-6000* ugrade in this price category, but the manufacturer also has another model that makes its debut here, the *PC-8800*, a more powerful version of last year's *PC-8001*-series.

What makes the new system different? At one point in its expansion, the *PC-8800* gains an 8086 co-processor, giving this unit 8-bit and 16-bit capability.

But, we're getting ahead of ourselves because at this level, the *PC-8800* is roughly equivalent to last year's *PC-8001*. It is driven by a Z80A-compatible 8-bit microprocessor and it includes 64K of user memory. However, at this level the user is limited to cassette storage that is far slower than disk storage and far less versatile. In its favor, though, is the fact that this model includes a disk interface, which gives the user the option of equipping this system with a disk drive, if he so desires.

The 81-key typewriter-like keyboard has five multifunction keys and a separate 10-key keypad. Input/output is aided by standard serial and parallel ports that enable you to tie a printer or modem to the unit, further increasing the unit's versatility.

This computer features RGB color or composite-video output. It is capable of 640- by 400-dot resolution in the graphics mode or 80 characters by 25 lines in the text mode.

The *PC-8800* also upgrades once in this price category with the addition of a monochrome display that provides far better resolution than using a home television set.

The *PC-6000* gains a minifloppy drive in this price range.

Sord

Sord, one of the newer names in the microcomputer business, has a new offering in this price category, the *M23*. Driven by a Z80A 8-bit microprocessor, the *M23* comes with 128K of RAM, which is about twice the user memory offered on other systems in this price category.

Programmable in BASIC, Pascal, or Fortran, this unit has a 59-key typewriter-like keyboard with a 20-key numeric keypad and nine special-function keys.

Multitech

Although a relative newcomer to the microcomputer marketplace, Multitech not only has lower-priced offerings, but is also offering a full-blown small-computer system, the *MIC-500*.

Driven by a Z80A 8-bit microprocessor, the *MIC-500* is a full-featured system. It includes not only dual serial ports, but also a parallel printer port.

Its standard 64K RAM will perform many tasks the system is called upon to perform, including sophisticated applications routines. It is equipped with two disk drives and runs under the industry-standard CP/M operating system.

It must be noted, should the user opt for the *MIC-500* system, that it is a micromainframe and a terminal will have to be added to handle input and output.

Radio Shack

Radio Shack has four systems that become more fully configured in this price category. For instance, the full complement of memory is added to the lap *Model 100* to bring the total memory to 32K.

The *Model III* is upgraded three times in this price category. The second and third expansions of the *Model III* make it a far more powerful system. In the first expansion, a cassette recorder is added. In the second, the memory is increased to 32K, which means the system can perform far more serious microcomputing tasks. A serial port is also added that gives this small-computer system the potential of tying into a modem and linking to other systems via the phone line. The third expansion brings this system up to its full memory complement of 48K.

The *Color Computer* becomes a more sophisticated system here with the addition of one 156K 5¼-inch drive.

The *PC-2* can now act as a terminal in the field with the addition of a communications interface.

Hewlett-Packard

Hewlett-Packard's handheld computer also becomes more powerful in this price segment. The lone upgrade to the *H75C* is the inclusion of a cassette recorder for data storage and retrieval.

Panasonic

The HHC series also upgrades in this pricing segment. For instance, the *H1400* has its memory expanded to 22K. This means that you can enter longer documents or handle more complex tasks with this handheld. At the same time, the *H1800* undergoes two memory upgrades.

Texas Instruments

Contrary to what one might have thought about the capabilities of the *TI-99/4A* system, it is much more than a simple, low-cost home computer.

In the first expansion, a serial port is added to this home computer. The second expansion adds a parallel port.

Formula International

The *Pinecom* kit becomes even more versatile in this price category with the addition of an 80-column card and two types of monitors. The 80-column card gives the user the ability to handle serious word-processing chores because the machine now has the ability of displaying a full page's worth of text.

The user is also given the option of choosing the type of monitor which best suits his needs. If he is interested in data and word-processing then a monochrome display is the best choice. However, if he is interested in graphics and color game-playing capability, then he should opt for the color CRT.

Netronics

The *Explorer/88-PC* from Netronics becomes nearly a full-blown system with the addition of a keyboard, color monitor board, ROM-based BASIC and system-monitor program, and a color CRT.

Although this system is still limited to cassette storage, a user can take advantage of cassette-based programs for applications. It should be kept in mind, though, that a cassette system is nowhere near as fast as a floppy-disk drive system for storage.

Spectravideo

Both the *SV-318* and *SV-328* upgrade in this category, too. The *SV-318* becomes a far more powerful system with the addition of parallel and serial ports for input/output and with the addition of more user memory for handling programs with greater sophistication. An expansion interface is also added for future system upgrading.

The *SV-328* also becomes more powerful as it gains parallel and serial interface ports. An 80-column card has also been added so that this system can handle either word-processing or sophisticated data processing chores. An expansion interface has also been added to facilitate system upgrading.

Toshiba

The *T100* upgrades with the addition of a monochrome display, giving the user the chance to handle sophisticated word-processing or data-processing applications.

Casio

The Casio *FX-9000P* becomes more versatile with the addition of 4K of RAM. This means it can now handle more sophsticated routines, although this amount of memory is somewhat limited for high-level tasks. **R-E**

COMPUTER MANUFACTURERS

The following is a list of the manufacturers whose systems were covered in this special section. Those readers who wish to get more information about a system should contact the manufacturer directly.

Access Matrix Corp.
2159 Bering Drive
San Jose, CA 95131

Albert Computers
3170 Los Feliz Drive
Unit C
Thousand Oaks, CA 91362

Alspa Computer
300 Harvey West Blvd
Santa Cruz, CA 95060

Altos Computer Systems,
2641 Orchard Park Way
San Jose, CA 95134

Apple Computer
20525 Mariani Drive
Cupertino, CA 95014

Atari Products
Box 50047
San Jose, CA 95150

Athena Computer
31952 Camino Capistrano
San Juan Capistrano, CA 92675

Basis, Inc.
5435 Scotts Valley Drive
Scotts Valley, CA 95066

Canon USA
One Canon Plaza
Lake Success, NY 11042

Casio, Inc.
15 Gardner Rd.
Fairfield, NJ 07006

Coleco Industries
945 Asylum Ave.
Hartford, CT 06105

Columbia Data Products
8990 Route 108
Columbia, MD 21045

Commodore Business Mach.
1200 Wilson Drive
West Chester, PA 19380

Compaq Computer Corp.
20333 FM 149
Houston, TX 77070

CompuPro
Box 2355
Oakland Airport, CA 94614

Computer Devices, Inc.
25 North Ave.
Burlington, MA 01803

Cromemco, Inc.
280 Bernado Ave.
Box 7400
Mountain View, CA 94039

Digital Equipment Corp.
2 Mount Royal Ave.
Box 1008
Maynard, MA 01752

Docutel/Olivetti Corp.
155 White Plains Rd.
Tarrytown, NY 10591

Durango Systens
3003 North First St.
San Jose, CA 95134

Dynalogic Info-Tech Corp.
8 Colonnade Road
Ottawa, CANADA, K2E 7M6

Eagle Computer, Inc.
983 University Ave.
Los Gatos, CA 95030

Epson America
3415 Kashiwa St.
Torrance, CA 90505

Formula International
12603 Crenshaw Blvd.
Hawthorne, CA 90250

Franklin Computer Corp.
2138 Route 38
Cherry Hill, NJ 08002

Fujitsu Microelectronics
3320 Scott Blvd.
Santa Clara, CA 95051

Gavilan Computer Corp.
240 Hacienda Ave.
Campbell, CA 95008

Gifford Systems
1922 Republic Ave.
San Leandro, CA 94577

Heath Company
Benton Harbor, MI 49022

Hewlett-Packard
1000 NE Circle Blvd.
Corvallis, OR 97330

Hitachi Sales Corp.
West Artesia
Compton, CA 90220

Honeywell, Inc.
200 Smith St.
Waltham, MA 02154

IBC
21592 Marilla St.
Chatsworth, CA 91311

IBM
Box 1328
Boca Raton, FL 33432

IMS International
2800 Lockheed Way
Carson City, NV 89701

Intertec Data Systems
2300 Broad River Rd.
Columbia, SC 29210

Ithaca Intersystems
200 E. Buffalo, Box 91
Ithaca, NY 14851

Kaypro Division
PO Box N
Del Mar, CA 92014

LNW Research Corp.
2620 Walnut
Tustin, CA 92680

Mattel Electronics
5150 Rosecrans Ave
Hawthorne, CA 90250

Morrow Designs
600 McCormick St.
San Leandro, CA 94577

Multitech Electronics
195 West El Camino Real
Sunnyvale, CA 94086

NEC Home Electronics
1401 Estes Ave.
Elk Grove Village, IL 60007

NEC Information Syst.
5 Militia Drive
Lexington, MA 02173

Netronics Research
333 Litchfield Rd.
New Milford, CT 06776

North Star Computers
14440 Catalina St.
San Leandro, CA 94577

Osborne Computer Corp.
26538 Danti Court
Hayward, CA 94545

Panasonic Co.
One Panasonic Way
Secaucus, NJ 07094

Radio Shack
One Tandy Center
Fort Worth, TX 76102

Sage Computer Tech.
35 North Edison Way, Suite 4
Reno, NV 89502

Sanyo
51 Joseph St.
Moonachie, NJ 07074

Seequa Computer Corp.
209 West St.
Annapolis, MD 21401

Sharp Electronics
10 Sharp Plaza
Paramus, NJ 07652

Sony
Sony Drive
Park Ridge, NJ 07656

Sord Computer
200 Park Ave
New York, NY 10166

Spectravideo
39 W. 37th St.
New York, NY 10018

Sumicom Inc.
17862 East 17 St.
Tustin, CA 92680

TeleVideo Systems
1170 Morse Ave
Sunnyvale, CA 94086

Texas Instruments
Box 53
Lubbock, TX 79408

Timex Computer
Box 1700
Waterbury, CT 06721

Toshiba America
2441 Michelle Dr.
Tustin, CA 92680

Unitronics
401 Grand Ave.
Suite 350
Oakland, CA 94610

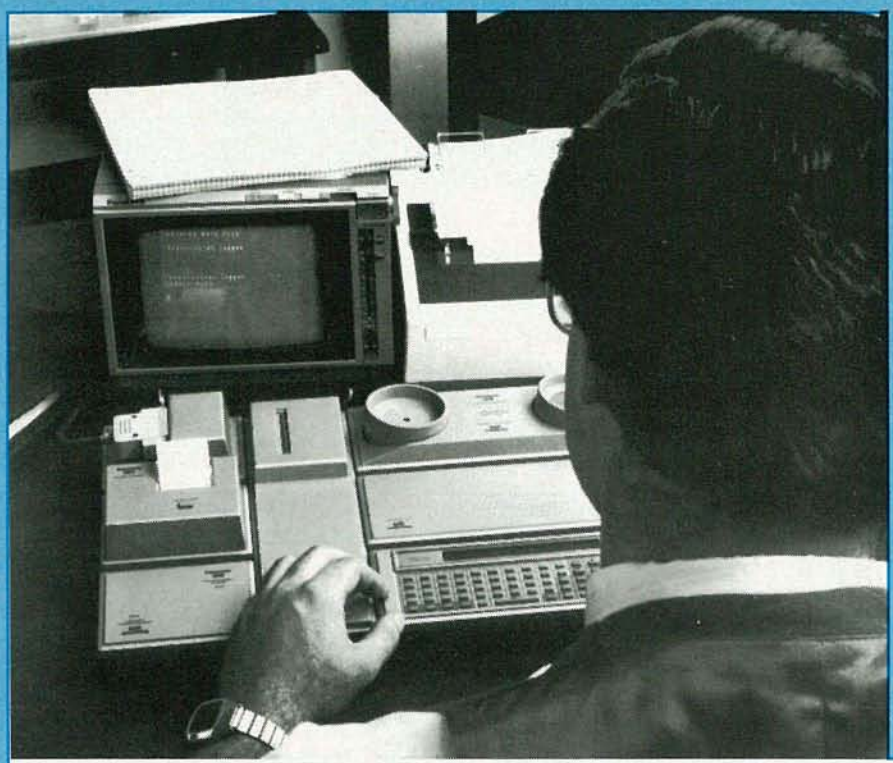
Vector Graphic, Inc.
500 North Ventu Park Rd.
Thousand Oaks, CA 91320-2798

Video Technology
2633 Greenleaf Ave.
Elk Grove, IL 60007

Wang Laboratories
One Industrial Ave.
Lowell, MA 01851

Xerox Corp.
1341 West Mockingbird Lane
Dallas, TX 75247

Zenith Data Systems
1000 North Milwaukee Ave
Glenview, IL 60025



Disk drives are almost standard equipment as we move into this range. And most machines here have at least 64K RAM.

$1500 to $2000

MARC STERN

IF THERE HAS BEEN ONE TRUTH ABOUT THE MICROCOMPUTER industry during the last couple of years, it is this: every day it gets more crowded. In this year's hardware guide alone, there are more than 500 entries as various machines go through their paces and upgrade.

Some estimates have put the number of small-computer systems available at more than 250, while others have put the number at more than 400. But, whatever the number, there's little doubt that it's confusing to the average buyer and our supplement is an attempt to ease that confusion.

As you look over the charts we offer, note how each system upgrades as the price climbs. And, if you pay careful attention, you should have a good idea of how much computing power you can buy and still be within your budget.

Don't let the absolute numbers confuse you because, in the final analysis, only you can judge which computer system is right for you. If we have helped you in that search, then we have succeeded in the purpose of this section.

In this price category nine new names join the list of manufacturers offering systems. But, these aren't all the new entries you will find. Other manufacturers that have already been mentioned also have new offerings to look at. Finally, existing systems continue to grow more and more powerful.

One of the more interesting things to note, as you examine the charts, is that in this category more and more systems are starting to come through with either one or two minifloppy disk drives for storage. Of course, including a drive does raise the system's price, but it also makes it much more flexible and provides speedier data retrieval and storage.

So, without further ado, let's look at the new additions to the price parade and see what each system has to offer.

Morrow Design

George Morrow is a longtime veteran of the microcomputer industry and you would expect his company to have an entry in the microcomputer field. Indeed he does. In fact, he has two—the *Micro Decision MD1* and *MD2*. Both have their starting prices in this category.

The *Micro Decision* is a Z80-based, 8-bit system that runs under the CP/M operating system. Its 64K of user memory provides more than enough memory space for many sophisticated routines. This operating system is a natural for the average user because it allows access to a wide variety of already-packaged, proven programs.

Programmable in BASIC, the *MD1* includes one 200K single-sided, double-density disk drive as standard. The typewriter-like keyboard allows quick data or word-processing entry and enhances this machine.

Input/output is provided through two serial ports that Morrow includes with this system. This gives the user the option of attaching both a dedicated printer and a modem. The modem, incidentally, gives the user access to the world of database networks, bulletin boards, or other computer systems and gives him the ability to upload or download files.

The *MD1* includes basic applications software in its base price and gives the user a monochrome display for output.

The *MD2* is an upgraded *MD1*. It adds a second single-sided, double-density disk drive. This is perhaps the most important improvement that can be made to any system, because adding a second drive so greatly improves the flexibility and productivity of any system. Using one disk limits the user to loading not only the program disk in the single drive, but also removing the program disk and loading the data. It involves an incredible amount of disk-swapping that having a second drive eliminates. Further, only having only one disk drive makes copying a program or data file cumbersome.

Kaypro

Although Kaypro (Non-Linear Systems) has been in the transportable computer business only a little more than a year, it has already made quite a market for itself. This firm has a long history of producing fine electronics test equipment and so its

TABLE 1—$2000-$2500

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
NEC Home Electronics	PC-6000	$1500	Z80A-compatible	8-bit	Proprietary	BASIC
Panasonic Co.	H1400	$1537	6502	8-bit	SNAP	BASIC
Radio Shack	TRS-80 Color Computer	$1547	6809E	8-bit	Proprietary	BASIC
Commodore Business Machines	VIC-20	$1551.80	6502	8-bit	Proprietary	BASIC
Spectravideo	SV-318	$1554	Z80A	8-bit	CP/M	BASIC
Toshiba America	T100	$1590	Z80A	8-bit	N/A	BASIC
Morrow Design	Micro Decision (MD1)	$1590	Z80A	8-bit	CP/M	BASIC
Kaypro Corporation	Kaypro II	$1595	Z80	8-bit	CP/M	BASIC, Pascal, Fortran, Assembly, COBOL
Franklin Computer Corp.	Ace Professional	$1595	6502	8-bit	Apple DOS 3.3 compatible	BASIC
Albert Computers	Albert	$1595	Not announced	Not announced	Apple DOS 3.3 compatible	Not announced
Eagle Computer Inc.	Eagle IIE-1	$1595	Z80A	8-bit	CP/M	BASIC
Panasonic Co.	H1800	$1637	6502	8-bit	SNAP	BASIC
Casio, Inc.	FX-9000P	$1637	Z80A-compatible	8-bit	Not announced	BASIC
Hewlett-Packard	HP75C	$1640	Not announced		N/A	BASIC
Radio Shack	TRS-80 Model 4	$1699	Z80A	8-bit	TRSDOS, LDOS, CP/M	BASIC
Atari Products	1200XL	$1718	6502	8-bit	Atari DOS III	BASIC
NEC Home Electronics	PC-6000	$1749	Z80A-compatible	8-bit	Proprietary	BASIC
Apple Computer	Apple IIe	$1769	6502A	8-bit	N/A	BASIC
Netronics Research	Explorer/85	$1784.75	8085	8-bit	CP/M	machine/BASIC
Texas Instruments	TI-99/4A	$1785	TMS9900	16-bit	Proprietary	BASIC
Cromemco Inc.	C-10	$1785	Z80A	8-bit	CP/M	BASIC, RATFOR, COBOL, Fortran, LISP, assembler
Panasonic Co.	H1400	$1791	6502	8-bit	SNAP	BASIC
Franklin Computer Corp.	Ace 1000	$1794	6502	8-bit	Apple DOS 3.3 compatible	BASIC
Sumicom Inc.	System 330	$1795	8088	16-bit	N/A	Fortran, COBOL, Pascal, BASIC
Hewlett-Packard	HP86A	$1795	Not announced		N/A	BASIC, Pascal, Fortran
Osborne Computer Corp.	Osborne I	$1795	Z80A	8-bit	CP/M	BASIC
Commodore Business Machines	Commodore 64	$1816.95	6510	8-bit	Proprietary	BASIC
Radio Shack	TRS-80 Model III	$1849	Z80A	8-bit	TRSDOS	BASIC, COBOL, Fortran, Assembler
Sony	SMC-70	$1850	Z80A	8-bit	N/A	BASIC, CB-80, Pilot Plus

Memory/Storage	Keyboard	I/O	Display	Comments
32K/1 floppy disk drive unit	71 keys, 5 multifunction	1 parallel, 1 serial, 2 game controller, digitized touch panel	monochrome CRT added, 32 × 16	monochrome (green) CRT
22K	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus	1-line × 26-character liquid crystal display/color TV adapter	color television adapter
32K/2 156K 5 ¼" floppy drives	53 keys	1 serial	32 × 16 color text mode/256 × 192 graphics capability	second drive added
29K/2 170K 5 ¼" floppy disk drives	66 keys, 4 user-programmable	1 serial	14-inch high-res. dedicated color monitor	2nd drive added
64K/1 256K 5 ¼" floppy disk drive	71 keys, 10 programmable, built-in joystick	1 serial, 1 parallel	256 × 192 resolution, 16 colors, television used as display	1 256K drive
64K/cassette, 16K RAM pack	89 keys, 8 special function	1 serial, 1 parallel	8-line by 40-char. liquid crystal display	liquid crystal display, 16K RAM cartridge
64K/1 160K 5 ¼" floppy drive	standard	1 serial, 1 parallel	monochrome CRT	basic system
64K/2 190K SS/DD 5 ¼" drives	72 keys, 14-key keypad, 20 programmable	1 serial, 1 parallel	9-inch monochrome monitor/80 × 25 text	portable system
64K/1 5 ¼" floppy disk drive	72 keys, 12-key keypad	game controller	80 × 24/280 × 192 graphic capability	system includes one drive monochrome monitor, 80-column card, and bundled software
64K/2 5 ¼" floppy drives	59 keys, 5 special function	1 serial, 1 parallel, RS-422/423 capability	RGB outputs, 256 colors, 40 or 80-column text mode	basic system
64K/1 390K 5 ¼" floppy drive	75 keys	2 serial, 2 parallel	optional	basic system
24K	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus	1-line × 26-character liquid crystal display/color TV adapter	color television adapter
24K/cassette interface	67 keys, 16-key keypad		5.5-inch monochrome, 32 × 16 text, 256 × 128 graphics	16K RAM added
24K/cassette recorder	61 keys, multifunction	interface port for add-on options		memory increased to 24K
64K/1 184K 5 ¼" floppy drive	70 keys, 3 programmable keys, 12-key keypad	1 parallel	12-inch monochrome/80 × 24 text (64 × 16 double-sized)	disk drive added
64K	standard typewriter/16 special function	1 printer, 2 controller, expansion connector	built-in video output supports 256 colors, 40 × 24 text	2nd floppy disk drive added
32K/1 floppy disk drive unit	71 keys, 5 multifunction	1 parallel, 1 serial, 2 game controller, digitized touch panel	composite color CRT added, 32 × 16, up to 256 × 192 graphics	color CRT
64K/cassette interface	63-key typewriter, 2 programmable	game controller	12-inch monochrome CRT/80-column card/80 × 24 text mode	CRT and 80-column card
64K/1 8" floppy disk drive	56 keys	N/A	12-inch monochrome CRT	disk drive, controller, operating system
48K/1 floppy disk drive	standard	1 serial, 1 parallel HEXBUS expansion unit, peripheral interface	16 colors	disk drive, plus controller
64K/1 390K 5 ¼" floppy disk drive	57 keys	1 serial, 1 parallel	12-inch monochrome/80 × 25 text/high-resolution graphics	modular system with one drive
22K	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus/1 serial	1-line × 26-character liquid crystal display/color TV adapter	serial port
64K/1 5 ¼" floppy disk	72 keys, 12-key keypad	game controller	40 × 24/280 × 192 graphic capability	integral disk housing and disk
128K	95 keys, 8 special function, 10-key keypad	1 parallel		basic system
64K	59 keys, 20-key keypad, 14 special function	1 parallel		basic system
64K/2 102K 5 ¼" floppy drives	57 keys, 12-key keypad	1 serial, 1 IEEE-488, modem, external video connector	5 ½" monochrome CRT/52 × 24 text mode	transportable
64K/2 170K 5 ¼" floppy disk drives	60 keys, 4 programmable	1 serial	14-inch high-res. dedicated color monitor	2nd drive added
48K/1 184K 5 ¼" floppy drive	64 keys, 12-key keypad	1 parallel	12-inch monochrome/64 (32) × 16 text mode	184K drive added
64K/cassette	72 keys, keypad, 9 special function	1 parallel, 1 serial	home television	basic system

TABLE 1—$2000-$2500 *(continued)*

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Atari Products	600XL	$1869	6502C	8-bit	Atari DOS III	BASIC
Spectravideo	SV-328	$1874	Z80A	8-bit	CP/M	BASIC
Panasonic Co.	H1800	$1891	6502	8-bit	SNAP	BASIC
Toshiba America	T100	$1895	Z80A	8-bit	N/A	BASIC
TeleVideo Systems	Teletote	$1899	Z80A	8-bit	CP/M	Not announced
Netronics Research	Explorer/88-PC	$1899.95	8088	16-bit	MS-DOS	machine/BASIC
Heath Company	HS-89-3 (kit)	$1924	Z80	8-bit	HDOS/CP/M optional	BASIC
Apple Computer	Apple IIe	$1934	6502A	8-bit	N/A	BASIC
Hewlett-Packard	HP75C	$1935	Not announced		N/A	BASIC
Radio Shack	TRS-80 Model III	$1948	Z80A	8-bit	TRSDOS	BASIC, COBOL, Fortran,
Spectravideo	SV-318	$1953	Z80A	8-bit	CP/M	BASIC
Heath Company	HS-89-2 (kit)	$1954	Z80	8-bit	HDOS/CP/M optional	BASIC
Docutel/Olivetti Corp.	M20	$1988	Z8001	16-bit	N/A	BASIC
Morrow Design	Micro Decision (MD2)	$1990	Z80A	8-bit	CP/M	BASIC
Commodore Business Machines	SuperPET	$1995	6502/6809	8-bit	N/A	BASIC, APL, COBOL, Fortran, Pascal
Osborne Computer Corp.	Osborne I	$1995	Z80A	8-bit	CP/M	BASIC
Seequa Computer Corp.	Chameleon	$1995	Z80A/8088	8/16-bit	MS-DOS, CP/M, CP/M-86	BASIC, Fortran, Pascal, COBOL, FORTH, LISP, assemb., C, PL/1
Franklin Computer Corp.	Ace 1200	$1995	6502/Z80	8-bit	Apple-compatible/CP/M	BASIC
Toshiba America	T100	$1995	Z80A	8-bit	CP/M	BASIC
LNW Research Corp.	LNW80 Model 2	$1995	Z80A	8-bit	N/A	BASIC
Kaypro Division	Kaypro IV	$1995	Z80	8-bit	CP/M	BASIC, Pascal, Fortran, Assemb., COBOL
Eagle Computer Inc.	Eagle IIE-2	$1995	Z80A	8-bit	CP/M	BASIC
Sanyo	MBC 1000	$1995	Z80A	8-bit	CP/M	BASIC
Eagle Computer Inc.	Eagle PC-E	$1995	8088	16-bit	CP/M-86	
NEC Home Electronics	PC-8800	$1998	Z80A-compatible/8086	8/16-bit	N/A	BASIC
Radio Shack	TRS-80 Model 4	$1999	Z80A	8-bit	TRSDOS, LDOS, CP/M	BASIC

move into the microcomputer field is somewhat logical.

Its offering in this field, the *Kaypro II*, easily shows its heritage. Packaged in a sturdy, all-metal box, the *Kaypro II* looks as if it would be more at home on a test bench than in a computer showroom. The box is heavy-gauge metal and the components look like they mean business.

Like the all-in-one transportable *Osborne I*, the *Kaypro II* is a fully configured system. It includes a Z80 8-bit microprocessor and a series of applications programs to complete this system. These applications include a spreadsheet, word-processing, and business BASIC programming language, plus the CP/M operating system. Its 64K of user memory lets the user take advantage of those sophisticated packages.

This system takes advantage of a disk operating system from the start as it includes two single-sided, double-density 190K 5¼-inch minifloppy disk drives.

The *Kaypro II* features a standard, sloped typewriter-like keyboard with 72 keys, and a 14-key numeric pad plus programmable keys. The keys make a telltale beeping sound as you input data.

Input/output is handled by a standard serial and a standard parallel port. Display output is handled by a 9-inch monochrome CRT. This is rapidly becoming the standard size in the transportable field.

There's also another Kaypro model in this field, the *Kaypro IV*, whose price puts it just at the top limit of this category. The

Memory/Storage	Keyboard	I/O	Display	Comments
16K/2 floppy disk drives	62 keys, help key, 4 special function	1 serial, 2 controller, expansion connector/ interface module	built-in video output supports 256 colors, 40 × 24 text	2nd floppy disk drive
144K/1 256K 5 ¼" floppy drive	87 keys, 10 programmable, numeric keypad	1 serial, 1 parallel	80 × 24 text mode capability/16 colors	64K, disk drive
24K	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus/1 serial	1-line × 26-character liquid crystal display/color TV adapter	serial port
64K/cassette, 32K RAM cartridges	89 keys, 8 special funct.	1 serial, 1 parallel	8-line by 40-char. liquid crystal display	liquid crystal display, 32K RAM cartridge
64K/2 368K DS/DD 5 ¼" floppy drives	75 keys, 16 special function, 17-key keypad	2 serial	9-inch CRT/640 × 240 graphics/80 × 24 text	2nd drive
64K/1 5 ¼" floppy disk drive	83 keys, 10 function, numeric keypad	1 serial	12-inch monochrome CRT	kit form of Explorer/88-PC with drive and boards
48K/2 5 ¼" floppy disk drives	84 keys, 12-key keypad	3 serial, 1 parallel	white monochrome display/80 × 25 text mode	2nd drive
64K/cassette interface	63-key typewriter, 2 programmable	1 parallel, game controller	12-inch monochrome CRT/80-column card/80 × 24 text mode	parallel port added
24K/cassette recorder	61 keys, multifunction	general purpose I/O port	32 character one-line LCD	general purpose I/O port added
48K/1 184K 5 ¼" floppy drive	64 keys, 12-key keypad	1 parallel, 1 serial	12-inch monochrome/64 (32) × 16 text mode	serial port
64K/2 256K 5 ¼" floppy disk drives	71 keys, 10 programmable, built-in joystick	1 serial, 1 parallel	256 × 192 resolution, 16 colors, television used as display	2nd drive
48K/2 5 ¼" floppy disk drives	84 keys, 12-key keypad	3 serial, 1 parallel	green monochrome display/80 × 25 text mode	2nd drive
128K/cassette interface	72 keys, 16-key keypad	1 serial, 1 parallel	12-inch high-res. monochrome/80 × 25 text mode	basic system
64K/2 200K 5¼" floppy drives	standard	1 serial	monochrome CRT	second SS/DD drive added
96K/cassette interface	standard, numeric keypad	1 serial	12-inch monochrome CRT/80 × 25 text mode	basic system
64K/2 204K 5 ¼" floppy drives	57 keys, 12-key keypad	1 serial, 1 IEEE-488, modem, external video connector	5 ½" monochrome CRT/52 × 24 text mode	disks now DS/DD
128K/2 160K SS/DD 5 ¼" floppy drives	83 keys, 10 function, 17-key keypad	1 serial, 1 parallel	9-inch monochrome/80 × 24 text/640 × 200 graphics	basic system
128K/1 5 ¼" floppy disk drive	72 keys, 12-key keypad	1 serial, 1 parallel, game controller	80 (40) × 24/280 × 192 graphic capability	basic system
64K/2 280K DS/DD 5 ¼" drives	89 keys, 8 special function	1 parallel, 1 serial	8 lines × 40 characters, LCD	2 drives added
96K/cassette interface	73 keys, 11-key keypad	1 parallel, 1 serial	480 × 192 color capability/62 × 16 text mode	basic system
64K/2 5 ¼" DS/DD drives	72 keys, 14-key keypad, 20 programmable	1 serial, 1 parallel	9-inch monochrome monitor, 80 × 25 character	DS/DD drives
64K/2 390K 5 ¼" floppy drives	75 keys	2 serial, 2 parallel	12-inch monochrome/80 × 25 text mode	2nd drive added
64K/1 328K DS/DD 5 ¼" floppy drive	55 keys, 5 programmable, 10-key keypad	1 parallel, 1 serial	12-inch monochrome/ 80 × 25 text mode	basic system
64K/1 320K 5¼" drive	105 keys	2 serial, 1 parallel	optional	basic system
128K/cassette interface/ disk interface	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch monochrome CRT/80 × 25 text	8086 co-processor, 64K, high-res CRT
64K/2 184K 5 ¼" floppy disk drives	70 keys, 3 programmable, keypad	1 parallel	12-inch monochrome	2nd drive added

Kaypro IV is essentially the same machine as the *II*, but with much greater memory. The amount of storage on the *IV* is upgraded to 800K by changing to two double-sided, double-density 5¼-inch minifloppy drives. It, too, comes with all the basic software one could need for serious computing as soon as the box is opened.

Osborne

The *Osborne I* is the machine that launched the transportable/portable computer market. When it was introduced in 1981, it was a daring gamble. How, people asked, could the company include software, dual disk drives, and a monitor in a portable package and still remain in business? After all, it was reasoned at the time, the software cost as much as the system itself. But, Osborne did it and established a new segment of the microcomputer market.

What does this package include? For starters, there's 64K of user memory, enough to use the sophisticated software packages included with this system efficiently. Further, the system includes two 102K single-sided 5¼-inch floppy disk drives and a full keyboard with 57 keys and a separate numeric keypad.

Perhaps its prime drawback is the size of its screen. At 5.5 inches, it is one of the smallest video displays on the market. Although it is a high-resolution affair, the display is limited to 52 characters by 24 lines; and, the size of the display makes the letters somewhat hard to see at times. However, a user should

soon become acclimated to this display and it should be easy to use.

It runs under the industry-standard CP/M operating system, so a user can have access to the wide range of packaged software available. Interestingly, this unit includes one serial port, that can be used with either a printer or modem, and an IEEE-488 port. This port, serial in nature, is extensively used in the scientific computing environment and allows the Osborne to interface with a wide variety of peripherals.

You don't have to tie up the serial port with a modem, though, because a modem is included with the *Osborne 1*, so the serial port can be used with a printer. The Osborne system upgrades once in this category as the disks are upgraded so they can accomodate a total of 400K of storage.

Eagle

A newcomer to the microcomputer field, Eagle Computers has three entries in this price category, the *Eagle IIE-1*, *Eagle IIE-2* and the *Eagle PC-E*.

The *Eagle IIE-1* is another of the many Z80A-based systems on the microcomputer market. This is important to the user looking for a wide base of existing applications software because the 8-bit Z80A, and the CP/M operating system that works with it, have a wide variety of software available. This software will fill just about any need a user might have.

This system can take advantage of CP/M from the start because it includes one 390K double-sided, double-density disk as standard. And, any time a system includes a disk, it needs a disk operating system to work correctly. The system also has more than enough user memory—64K—to take advantage of the sophisticated programs available on the market.

Input/output is aided by including two standard serial ports and two standard parallel ports. This means this machine can interface with a wide variety of peripherals.

The standard 12-inch monochrome display handles the industry-standard 80-by 25-line display, thus fulfilling the needs of users who have a great deal of serious data or word-processing work to attend to.

The *Eagle IIE-2* is essentially an upgraded *IIE-1* system. In this version, a second drive is added.

The *Eagle PC-E* represents another trend in the microcomputer field, the trend toward IBM *Personal Computer* workalikes and lookalikes. Under this trend, competing computer manufacturers are trying to build systems that operate as closely to the IBM as possible. The reason the manufacturers are taking this tack is because of the popularity of the IBM system and because of the wide software base that is rapidly building for that system.

Like the IBM, the *Eagle PC-E* is driven by a 16-bit 8088 microprocessor. It features 64K of user memory, about the minimum needed in this type of system for efficient performance. (Where 8-bit systems get along with 64K easily, 16-bit systems like a minimum of 64K, with 128K preferred, to promote efficient operation. This is because the programming is more complex.)

Running under CP/M-86 (the 16-bit version of CP/M), MS-DOS—the system used by the IBM-PC—is available as an option. The Eagle system is able to use a disk operating system because it comes with one 390K double-sided, double-density 5¼-inch minifloppy disk drive for storage. Output is provded by two standard serial ports and one parallel port. The user has the option of choosing a video-display device.

MORROW DESIGNS *MICRO DECISION MD1* is a CP/M machine that includes bundled software.

Docutel/Olivetti

Long a name in the office-equipment field, Olivetti introduced its *M207* microcomputer system more than a year ago. It is one of the few systems marketed that uses the 16-bit Z8001 microprocessor, something the potential buyer of this system should recognize.

Currently there is little likelihood a wide software base will develop rapidly, unless other manufacturers take advantage of this microprocessor. This means the user will be limited to those packages offered by the manufacturer and to the support the manufacturer offers.

The buyer who opts for this system will find that it offers plenty of potential power. Standard user memory is 128K, or about twice the amount offered by most small computer systems, and this means the system can handle sophisticated tasks.

What limits this system in this price category is the fact that storage is via cassette. Cassettes, while they can offer nearly 500K of storage, are much slower than disk-based storage systems and, unless the system can act randomly by reading the tape back and forth, it is limited to slower serial—one file after another—operation.

The typewriter-style 72-key keyboard and 16-key pad allow quick data or numeric entry and input/output is aided with standard serial and parallel ports. The 12-inch monochrome display is a high-resolution unit, with an 80-character by 25-line text display and respectable graphics.

Seequa

A newcomer to the transportable microcomputer market, Seequa's *Chameleon* is an IBM *PC*-compatible unit, with a difference; it uses two CPU's, an 8-bit Z80A and a 16-bit 8088. This feature alone offers the user the best of two worlds, CP/M and MS-DOS. CP/M is the standard operating system of the 8-bit microcomputer world, while MS-DOS is rapidly becoming the standard operating system of the 16-bit world. This system can also run the alternative 16-bit system, CP/M-86.

Because the *Chameleon* gives the user access to either processor, he has the option of running any of the many programs that exist in both microcomputer segments. Its 128K of user memory also gives the user enough memory space to take advantage of those programs. With its 9-inch monochrome display, 80-character by 24-line text mode or a 640- by 200-dot graphics mode, the *Chameleon* delivers a high-resolution video output.

Input is aided by an 83-key keyboard and a 17-key keypad. Like the IBM *PC*, the microcomputer has 10 function keys. Unlike the *PC*, the *Chameleon* has standard serial and parallel input and output ports. The IBM-*PC*'s are extra-cost add-ons. Programmable in a variety of high-level languages, this microcomputer, including two 160K single-sided, double-density drives as standard equipment, is a unit that can be used in a home or business environment.

Albert

Another newcomer to the microcomputer market is the *Albert*. An *Apple IIe*-compatible system, the *Albert* includes 64K of RAM and two 5¼-inch minifloppy disk drives. Because it has disk drives, it needs an operating system and it uses Apple's.

Its 59 typewriter-style keys and five special-function keys

make short work of data input, while output is handled by standard serial and parallel ports. It has RGB output and it can display up to 256 colors, and its text-display capability includes either 40 or 80 characters-per-line.

Sumicom

Sumicom, another newcomer to the small-computer system world, is another manufacturer that has chosen to take the IBM-workalike route with its *System 330*. Driven by a 16-bit 8088 CPU, this system has 128K of user memory.

With a 95-key keyboard that includes 8 special-function keys, data or word-processing input should be easy. A parallel interface is included in the basic configuration.

LNW

LNW Research is offering another of the many Z80A-based systems on the market. As with other 8-bit Z80A systems, the user has access to a wide variety of programming when disk drives are added to the configuration. However, in this price category, the user will have to content himself with a cassette recorder for data storage. The *LNW80 Model 2* comes with 96K of RAM standard.

Keyboard input is via a keyboard having 73 keys and an 11-key numeric keypad, while output is handled by standard serial or parallel ports. The monochrome display provides 80-characters by 25-lines of text.

Cromemco

Long associated with the microcomputer industry, Cromemco has an offering in this price category, the single-user *C-10* system. This is an 8-bit Z80A microprocessor-based system. It is programmable in several high-level languages.

Its 64K of standard memory and its standard 390K 5¼-inch minifloppy disk drive provide the basics for a very powerful system. This means he can take advantage of the CP/M operating system and the wide variety of programs available that run under it. Input is handled via a 57-key keyboard while output is handled either via a standard parallel or serial port. Its 12-inch monochrome monitor displays a standard 80-character by 25-line text or high-resolution graphics.

Franklin

Although this Apple-compatible computer manufacturer has only been in the microcomputer field for less than two years, it has already gathered a fine reputation and has built a rather wide product line. Two of those products make their debut in this price category.

The first is the *Ace Professional*, a business-oriented system, based on the Apple-compatible *Ace 1000*. It is driven by the same 8-bit 6502 microprocessor, and is programmable in BASIC, and shares many of the same attributes of the *Ace 1000*. However, this model differs in that it includes a standard 5¼-inch minifloppy disk drive for mass storage, an 80-column card, as well as some standard applications software. Since this system runs under an Apple-compatible operating system, it is able to take advantage of the many programs available. The keyboard is a typewriter-style affair with 72 keys and a 12-key numeric keypad.

THE *KAYPRO II* from Non-Linear Systems is one of the most popular transportable computers.

Also in this price category, the basic *Ace 1000* system can be upgraded with the *Ace 1100* integral disk drive and housing. Of course, that raises the price of the system.

The other new system here is the top-of-the-line *Ace 1200* which offers the user a way to enjoy the best of two worlds: Apple and CP/M. Unlike other dual-processor machines on the market, that combine either two Z80's for speed or a Z80 and an 8086/88 microprocessor for access to both the 8 and 16-bit worlds of software, the *Ace 1200* combines a 6502 and a Z80. This gives the user the option of running either Apple-compatible software or CP/M-compatible software.

Since it is the top-of-the-line, you would expect it to have other features that the other models don't offer and it does. The *Ace 1200* comes with a standard 128K of user memory and a built-in 5¼-inch minifloppy disk drive for storage. It also features the same keyboard as the other machines in the *Ace* line, but adds standard serial and parallel ports to its configuration and its display output capability is 80 columns for CP/M; forty columns for Apple programs.

Hewlett-Packard

A new Hewlett-Packard system makes its appearance in this category, the first of this manufacturer's full-blown *HP86A*. In this price level, the system is just the basic unit and includes one parallel port. It has a 59-key keyboard,. 20-key keypad and special-function keys and is programmable in several high-level languages, including BASIC.

Another of H-P's handheld systems, the *HP75C*, continues to become much more powerful in this price category. In its first upgrade, the user memory increases to 24K, enough to handle sophisticated routines in the field. In its second upgrade, a general-purpose I/O port is added. Don't unerestimate the importance of this second upgrade. With this port, the *HP75C* can now interface with a variety of peripherals and can become the heart of a very powerful portable system.

Commodore

As we have seen in the other price categories, Commodore Business Machines is a microcomputer manufacturer with a broad line, and its machines make their debuts in several price categories. This classification is no exception as CBM introduces the *SuperPET*, a dual-processor model driven by 8-bit 6502 and 6809 microprocessors.

The *SuperPET* is the basis of a powerful dual-processor development system and comes with 96K of memory as stan-

dard. Also standard, is the 12-inch monochrome display, that delivers an 80-characters by 25-lines text display. At this level, the speed of this system is somewhat limited by the need for cassette storage. But, this changes in other price categories as disk drives are added.

Its keyboard is a standard typewriter-type unit and it has a separate numeric keypad. This keyboard lets the user write programs in the high-level languages available for this machine. Those languages include: BASIC, COBOL, APL, Fortran, and Pascal.

Input/output is provided by a standard serial port a user can use to attach either a printer or a communications modem, should he have need of hard copy or communications ability.

The *VIC-20* and *64* are still being manufactured in quantity. Versions are now available with two 5¼-inch disc drives. This increases the effectiveness and flexibility of these units. When the *VIC-20* is equipped with two drives it can handle both data and program disks simultaneously, and no longer is the user limited to using one disk to copy files. Instead, he can use two disks, and gain a manyfold increase in system speed and capability.

In the same way, a second disk drive is added to the Commodore *64*.

Sanyo

The *MBC 1000* is another of the many Z80A, 8-bit systems in the small-computer market and because it is, the system can take advantage of the CP/M operating system and the many programs available under it. The system comes with one standard 328K double-sided, double-density 5¼-inch minifloppy disk.

With 64K of standard user memory, this system can perform highly sophisticated tasks. Data input is facilitated by the 55-key keyboard, that includes five multifunction keys and a 10-key numeric pad. Input/output is aided by a standard serial port and a standard parallel port. The 12-inch monochrome display handles 80-characters by 25-lines of text.

Radio Shack

Radio Shack has three systems that upgrade in this price category—the *Color Computer, Model III*, and *Model 4*. The *Color Computer* becomes fully configured by adding a second disk drive.

The *Model III* upgrades twice. The first step is to add a 184K 5¼-inch minifloppy drive. The second upgrade gives this system a serial port.

The *Model 4*, a newly introduced unit, becomes even more powerful when a 184K minifloppy-disk drive is added. The second upgrade adds a second drive to this system.

Toshiba

The Toshiba *T100* lap computer upgrades in this price category. In the first upgrade, the *T100* goes portable and its user-memory area is expanded by adding nonvolatile RAM cartrages that hold their contents even when unplugged from the system.

Also, the *T100* becomes configured with two 280K double-sided, double-density disk drives. This upgrade gives the user access to the CP/M operating system and the many programs that work under it. For the user who may not want to be limited to the liquid-crystal display, video monitors are available.

NEC

Both NEC systems, the *PC-6000* and *PC-8800*, include two upgrades. The first adds a green monochrome video display to the unit. This type of dedicated, high-resolution monitor lets the user take full advantage of the graphics capability of this or any other system, something a home television set can't match. The second upgrade shows you what happens to the price when the color monitor is added to the configuration.

The *PC-8800* becomes a more powerful unit when we add the 8086 16-bit card. This gives the user the option of taking advantage of the rapidly growing variety of 16-bit programs. In later stages, as disks are added, the user can take advantage of either the world of CP/M or MS-DOS and the many programs available that run under those systems.

Apple

In its first upgrade, the Apple *IIe* becomes more versatile when the screen enhancement card (80-column) and a video monitor are added. These changes, alone, give the user the advantage of the graphics capability of this system, plus letting the system handle serious word-processing or data processing chores.

The second upgrade gives this system output capabilities by adding a parallel printer port. Now the user can have hard copy backups of the material he is working on.

Atari

Two Atari systems upgrade in this price category, the *1200XL* and the *600XL*. The *1200XL*'s upgrade adds a second disk drive. The *600XL* also receives a second floppy disk drive.

Panasonic

The *HHC* series, (*H1400* and *H1800*), of handheld minimicrocomputers become true systems in this price category with the added color display adapter. It can be used to interface with a color television, and a serial port.

Heath

The Heath *HS-89-2(3)* system reaches its full configuration in this price category by adding a second drive.

Since it is a kit, the *HC-89-2(3)* system is a good learning experience for the potential computer user who wants to know his system inside and out.

Spectravideo

The *SV-318* system becomes fully configured in this price category and its first upgrade adds a 256K 5¼-inch minifloppy disk drive. This gives the user a manyfold increase in data access and retrieval time. Adding a second drive, also in this price category, makes this system even more versatile.

For the *SV-328*, the user gains more memory area and a disk drive for storage, thus increasing this system's versatility.

Netronics

By adding a disk drive, disk-drive controller and operating system, the *Explorer/85*, an 8085-based small-computer becomes much more powerful. It now has disk storage and speed, and it can access and use the many programs that run under its operating system.

The new Netronics system, the *Explorer/88-PC*, (also a kit) is a fully configured system at this point. The user who does take the time to put the kit together will be rewarded with an intimate understanding of an IBM-compatible microcomputer system.

Texas Instruments

By this time in the price categories, the Texas Instruments *TI-99/4A* is becoming a very powerful system. Not only is it driven by a 16-bit microprocessor, but it now has a disk drive for mass storage; it is now a far cry from the low-cost unit that was introduced in our first price category.

Sony

At this point in the *SMC-70*'s price path, it gains a serial interface for output. The RGB/composite video/RF-modulator gives the user several choices for video output.

TeleVideo

The transportable *Teletote* gains even more versatility when a second disk drive is added. This frees the user from the restriction of being tied to using only one drive.

Casio

The X-9000P becomes more versatile and able to perform more sophisticated tasks by adding 16K of RAM. **R-E**

The computer becomes more business-like than personal as we cross the $2000 mark.

$2000 to $2500

MARC STERN

IF THERE IS ANY LINE OF DEMARCATION IN THE SMALL-computer world, we have reached it, the $2000 barrier. Many of the systems that had their origins in the low-cost regions of the microcomputer marketplace, have, by now, reached their full configurations and those that continue in our charts become more and more oriented toward business, rather than home use, because of the powerful levels they attain.

Because of this you will find the systems that join our listings now are much more fully configured right out of the box. It's the usual practice in the industry to include at least one disk drive as standard equipment in this pricing level and to include at least 64K or more of user memory. And on those systems where disks are included as standard, the disk-operating system is also a standard or reasonable-cost option.

It's also an important line of demarcation in the type of microprocessor unit driving the system we will be discussing. In the $2000 region, it seems that more and more of the systems are using standard 16-bit microprocessors, as opposed to 8-bit CPU's. This stands in marked contrast to a year ago when the majority of systems on the market were 8-bit systems.

Why is the industry moving toward the 16-bit CPU? The most obvious reason is because IBM has chosen to market a 16-bit microcomputer and the rest of the industry is moving to cash in on the market created by that move. But another, not so obvious reason, is because the 16-bit CPU allows small-computer systems to achieve true power. They can handle applications that, a few years ago, were limited only to mainframe and powerful minicomputers. In fact, the 16-bit microprocessors now on the market and those planned for the near future blur the distinction between the minicomputer—a more powerful, business-oriented system—and the microcomputer.

So, as we cross the line of demarcation, we find 12 new systems joining the microcomputer field. Some of them are from companies whose names are already mentioned in earlier price categories, while others are new to the field.

Let's begin our look at this price category with those systems from the new manufacturers, moving on to those from established firms, and wrap it up with a look at some of the systems that have upgraded.

Access Matrix

Access Matrix Corp. is a new entrant to the microcomputer market and its product, the *Access*, is a full-featured transportable computer, based on the near-standard 8-bit Z80A CPU. With this CPU and the features this small-computer packs, a user needs little more to fulfill his computing needs.

For starters, the *Access* includes two standard 184K single-sided, double-density minifloppy disk drives for storage and 64K of RAM. With this combination, the user has access to the wide variety of ready-to-run programs available under the CP/M operating system, which is another 8-bit industry standard.

Programmable in BASIC, this unit features a typewriter-style keyboard, that has 62 keys, 15 special-function keys and a 15-key numeric keypad. Input/output is provided by standard serial and parallel ports.

The 7-inch built-in amber CRT display is capable of an 80-character by 24-line text mode, which is important for serious word-processing or data entry.

TABLE 1—$2000-$2500

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Casio, Inc.	FX-9000P	$2015	Z80A-compatible	8-bit	N/A	BASIC
Franklin Computer Corp.	Ace 1000	$2044	6502	8-bit	Apple DOS 3.3 compatible	BASIC
Hewlett-Packard	HP86A	$2090	Not announced		N/A	BASIC, Pascal, FORTRAN
Panasonic Co.	H1400	$2091	6502	8-bit	SNAP	BASIC
Apple Computer	Apple IIe	$2129	6502A	8-bit	N/A	BASIC
Franklin Computer Corp.	Ace Professional	$2144	6502	8-bit	Apple DOS 3.3	BASIC
Hewlett-Packard	HP75C	$2160	Not announced		N/A	BASIC
Sord Computer	M23P	$2185	Z80A	8-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
Panasonic Co.	H1800	$2191	6502	8-bit	SNAP	BASIC
NEC Home Electronics	PC-8800	$2197	Z80A-compatible	8-bit	N/A	BASIC
Heath Company	HS-100-31	$2199	8085/8088	8/16-bit	Proprietary ZDOS	BASIC
Toshiba America	T300	$2200	8088	16-bit	MS-DOS, CP/M-86	BASIC
Seequa Computer Corp.	Chameleon	$2219	Z80A/8088	8/16-bit	MS-DOS, CP/M, CP/M-86	BASIC, FORTRAN, Pascal, COBOL, FORTH, LISP, assemb., C, PL/1
Spectravideo	SV-328	$2273	Z80A	8-bit	CP/M	BASIC
Netronics Research	Explorer/85	$2284.70	8085	8-bit	CP/M	machine, BASIC
Texas Instruments	TI-99/4A	$2285	TMS9900	16-bit	Proprietary	BASIC
Radio Shack	TRS-80 Model III	$2295	Z80A	8-bit	TRSDOS	BASIC, COBOL, FORTRAN, Assembler
Commodore Business Mach.	Pet 64	$2295	6500 series	8-bit	Proprietary	BASIC
Franklin Computer Corp.	Ace 1000	$2343	6502	8-bit	Apple DOS 3.3 compatible	BASIC
Heath Company	HSA-120-31	$2349	8085/8088	8/16-bit	Proprietary ZDOS	BASIC
Sord Computer	M23P	$2380	Z80A	8-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
Seequa Computer Corp.	Chameleon	$2394	Z80A/8088	8/16-bit	MS-DOS, CP/M, CP/M-86	BASIC, FORTRAN, Pascal, COBOL, FORTH, LISP, Assembler, C, PL/1
Morrow Design	MD3	$2395	Z80A	8-bit	CP/M	BASIC
Hewlett-Packard	HP75C	$2455	Not announced		N/A	BASIC
Sanyo	MBC 1200	$2495	Z80As	8-bit	CP/M	BASIC, Pascal, FORTRAN, Macro-80
Osborne Computer Corp.	Executive	$2495	Z80A	8-bit	CP/M	BASIC
Access Matrix Corp.	Access	$2495	Z80A	8-bit	CP/M	BASIC
Intertec Data Systems	Superbrain II - Jr.	$2495	Z80As	8-bit	CP/M	BASIC, FORTRAN
Canon USA	AS100	$2495	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
Apple Computer	Apple III	$2495	6502B	8-bit	Apple SOS	BASIC, Pascal
TeleVideo Systems Inc.	TS 803	$2495	Z80A	8-bit	CP/M	COBOL
Toshiba America	T300	$2495	8088	16-bit	MS-DOS, CP/M-86	BASIC

Memory/Storage	Keyboard	I/O	Display	Comments
32K/cassette interface	67 keys, 16-key keypad		5.5-inch, 32 × 16 monochrome, 256 × 128 graphics	28K RAM
64K/2 5 ¼" floppy disk drives	72 keys, 12-key keypad	game controller	40 × 24/280 × 192 graphic capability	2nd floppy disk drive
64K	59 keys, 20-key keypad, 14 special function	1 parallel	9" monochrome CRT, 80 × 25 text	monochrome CRT
22K/cassette interface	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus/1 serial/modem	1-line × 26-character liquid crystal display/color TV adapter	modem/cassette interface
64K/cassette interface	63-key typewriter, 2 programmable	1 parallel, 1 serial, game controller	12-inch monochrome CRT/80-column card/80 × 24 text mode	serial port
64K/2 5 ¼" floppy disk drives	72 keys, 12-key keypad	game controller	40 × 24/280 × 192 graphic capability	2nd drive
24K/cassette recorder	61 keys, multifunction	general purpose I/O port	32 character one-line LCD/video interface	video interface
128K/290K microfloppy drives	60 keys, 20-key keypad, 9 special function	2 serial, 1 parallel		basic system
24K/cassette interface	65 calculator keys in typewriter arrangement, redefinable	input/output adapter/expansion bus/1 serial	1-line × 26-character liquid crystal display/color TV adapter	modem/cassette interface
64K/cassette interface/disk interface	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch color CRT/640 × 400 res./ 80 × 25 text	color display
192K/1 320K DS/DD 5 ¼" floppy disk drive	60 keys, 14 function keys, 18-key keypad	2 serial, 1 parallel	monochrome	basic version, includes 1 drive
192K/ 1 640K DS/DD 5 ¼" drive	67 keys, 18 special function, 10 edit, 18-key keypad	1 parallel, 1 serial		basic system
192K/2 160K SS/DD 5 ¼" floppy disk drives	83 keys, 10 function, 17-key keypad	1 serial, 1 parallel	9-inch monochrome/80 × 24 text/640 × 200 graphics/RGB output	user memory expands to 192K, RGB output card added
144K/2 256K 5 ¼" floppy drives	87 keys, 10 programmable, numeric keypad	1 serial, 1 parallel	80 × 24 text mode capability/16 colors	2nd drive
64K/2 8" floppy disk drives	56 keys	N/A	12-inch monochrome CRT	second disk drive
48K/2 floppy disk drives	standard	1 serial, 1 parallel HEXBUS expansion unit, peripheral interface	16 colors	2nd disk drive
48K/2 184K 5 ¼" floppy disk drives	64 keys, 12-key keypad	1 parallel, 1 serial	12-inch monochrome/64 (32) × 16 text mode	serial port, second drive
64K/dual 5 ¼" floppy disk drives	standard, numeric keykeypad	1 serial	integral display	standard 12-inch monochrome display; dual drives added
64K/2 5 ¼" floppy disk drives	72 keys, 12-key keypad	game controller	40 × 24/280 × 192 graphic capability	2nd drive added to Ace 1000 unit
192K/1 320K DS/DD 5 ¼" floppy disk drive	60 keys, 14 function keys, 18-key keypad	2 serial, 1 parallel	monochrome version	basic system
128K/2 290K microfloppy disk drives	60 keys, 20-key keypad, 9 special function	2 serial, 1 parallel	12-inch green CRT	CRT added
256K/2 160K SS/DD 5 ¼" floppy disk drives	83 keys, 10 function, 17-key keypad	1 serial	9-inch monochrome/80 × 24 text/640 × 200 graphics/RGB output	user memory expands to 256K
64K/2 320K 5 ¼" floppy disk drives	standard	1 serial, 1 parallel	monochrome CRT	drive capacity increases with DS/DD drives
24K/cassette recorder	61 keys, multifunction	general purpose I/O port	32 character one-line LCD/9" 80 × 25 CRT	CRT added
64K/1 640K slim line DS/DD floppy disk drive	50 keys, 15 programmable, 18-key keypad	1 parallel, 1 serial	12-inch monochrome/80 × 25 text/640 × 400 graphics	higher-density disk drives
64K/2 102K 5 ¼" floppy disk drives	57 keys, 12-key keypad	1 serial, 1 parallel	7-inch monochrome (amber)/80 × 24 text mode	basic system
64K/2 184K SS/DD floppy disk drives	62 keys, 15 special function, 15-key keypad	2 serial, 1 parallel, 1 IEEE-488	7-inch monochrome (amber)/80 × 25 text mode	full-featured transportable computer
64K/2 350K DS/DD 5 ¼" floppy disk drives	62 keys, 18-key keypad	2 serial	12-inch monochrome/80 × 24 text mode	basic system
Not announced/2 640K DS/DD 5 ¼" floppy disk drives	standard		monochrome display/80 × 25 text mode	basic system
128K/1 140K SS/DD 5 ¼" floppy disk drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller	280 × 192/560 × 192 graphics capability/80 × 24 text	basic system
64K/2 368K 5 ¼" DS/DD floppy disk drives	72 keys, 16 programmable, 17-key keypad	2 serial	14-inch monochrome/80 × 25 text	basic system
192K/ 1 640K DS/DD 5 ¼" drive	67 keys, 18 special funct., 10 edit, 18-key keypad	1 parallel, 1 serial	80 × 25 monochrome	display added

Intertec Data Systems

Although Intertec is a long-time veteran of the microcomputer wars, few consumers have probably heard of its products. The prime reason for this is that it has addressed the business market.

In this price category, we find one of its several products, the *Superbrain II Jr.*, another of the 8-bit systems on the market using the Z80A as the CPU.

However, the *Superbrain II Jr.* departs from standard philosophy in its use of dual processors. Although there are several systems on the market today with two mircroprocessors, the chances are very good that one will be an 8-bit device, while the other is a 16-bit device. This gives the user access to the established base of 8-bit software and the rapidly growing base of 16-bit software. The *Superbrain II Jr.*, on the other hand, uses dual 8-bit processors for speed. While one is busy handling the processing (computing) chores, the other is handling housekeeping functions, such as keyboard input and screen output. That is a way to achieve faster throughput.

The *Superbrain II Jr.*, is an all-in-one unit, with dual 350K double-sided, double-density minifloppy-disk drives, 64K RAM, and runs CP/M.

Programmable in high-level Fortran or BASIC, this unit features a 62-key typewriter-style keyboard with an 18-key numeric keypad. Two serial ports are also included.

Video output is via a built-in 12-inch monochrome display unit, capable of 80-characters by 24-lines in the text mode.

Canon

If the inclusion of the name Canon in a computer hardware supplement startles you, it shouldn't. The reason is Canon is not only big in the camera field, but also in the office-equipment field. And because it is, its development of a microcomputer system isn't really any surprise. The *AS100* is a new system and like many other machines on the market, it is an IBM-workalike. It runs under MS-DOS, although Canon is also hedging its bet by providing access to CP/M-86, the 16-bit version of the CP/M operating system. This second option gives the user access to many programs that run under this operating system and, if the market swings in its direction, then the user also has this advantage, too.

That it can use an operating system indicates that this system has floppy disk drives, and it does. Canon provides the user with two 640K minifloppy disk drives for mass storage and retrieval.

Programmable in BASIC and COBOL, the *AS100* has a typewriter-style keyboard for data input. Data is output to an 80-character by 25-line monochrome display, which is the standard for serious data or word-processing work.

Apple

Although Apple's name has appeared before, it has a new system appearing in this category, the *Apple III*, a more powerful, business-oriented system than other Apple offerings.

The *Apple III* system has twice the RAM of the *Apple IIe* with 128K and it features a standard 140K single-sided, double-density minifloppy disk drive for storage.

A sophisticated system, the *Apple III*'s operating system is also more sophisticated. Called Apple SOS, it allows the user access to not only the software written to operate under it, but the existing base of software written for other Apple computers.

Yet, despite its sophistication, the *Apple III* is driven by the same 6502 8-bit microprocessor that drives the other members of the Apple family. Its keyboard is a standard typewriter-like affair with 61 keys, two programmable keys and a 17-key keypad. (It was quite an improvement over the old *Apple II* and *Apple II-Plus* keyboard.)

This system also differs from the rest of the Apple lineup in two other key areas. It is provided with a standard serial port and it has a standard 80-column display capability. (Other members of the family require add-on video cards to provide this function.) This display capability also can be used to generate up to 560- by 192-dot graphics. The actual display device is a user option.

The *Apple IIe* becomes more flexibile in its input/output capabilities here with the addition of a serial port.

Heath

Heath Co. has two kits that debut in this price spectrum, both of which give the user an inside-out knowledge of his microcomputer system, the *HS-100-31* and the *HSA-120-31*. Both microcomputers are kit versions of the Zenith *Z-100* series of 8/16-bit computer systems. About the only real difference between the two systems is that the *HS-100-31* is the low-profile version—no monitor included—and the *HSA-120-31* is the all-in-one unit—monitor, keyboard, and system unit in one box. With this in mind, what follows will apply to both.

Driven by a dual 8085/8088 processor set, this series has access to the world of 8- and 16-bit programs and, although it seems like an IBM-workalike, it doesn't run under MS-DOS. Instead, it runs under the proprietary Zenith Disk Operating System—ZDOS.

A 320K double-sided, double-density floppy is built into its standard configuration that includes 192K RAM.

Programmable in BASIC, that unit features a 60-key keyboard that includes 14 function keys and an 18-key keypad.

About the only remaining differences between the two systems is that the all-in-one *HSA-120* has two serial ports and one parallel port, while the *HS-100* has one serial and one parallel; and, the *HSA-120* has a standard monochrome video display, while the *HS-100* leaves it to the user's option.

Toshiba

Toshiba has another system which debuts in this price category, the *T300*, another IBM-workalike.

Driven by a 16-bit 8088 CPU, the T300 provides the user with 192K of standard memory. A standard 640K 5¼-inch minifloppy disk drive is provided for data storage and retrieval.

Programmable in several high-level languages, data is entered via a typewriter-style keyboard with 67 keys. The keyboard also includes 18 special-function keys, 10 editing keys, and an 18-key numeric keypad.

Equipped with standard serial and parallel ports—extra-cost options on the IBM *PC*—the *T300* is a flexible unit. It upgrades once in this category. That upgrade provides the user with an 80-character by 25-line video display monitor. In its first configuration, that device is left to the user's option.

Sord

Another Z80A-based system debuts in this manufacturer's lineup, the *M23P* with 128K of RAM as standard. The Z80 CPU gives you access to the world of CP/M.

In a departure from usual practice, the *M23P* is equipped with a microfloppy-disk drive capable of holding 290K of data. Very few manufacturers now offer this type of drive and there is an ongoing controversy about standardization.

Sporting a typewriter-style keyboard with a 20-key pad, 60 keys and 9 special-function keys, the *M23P* relies on this device for input, either in the high-level programming languages this system recognizes or word-processing applications.

An almost fully configured system, it includes an input/output adapter, expansion bus, and a serial port. This system also upgrades once in this category with the addition of a 12-inch green monochrome video display device.

TeleVideo

Another single-user system from TeleVideo makes its appearance in this price category, the *TS 803*.

Driven by an 8-bit Z80A microprocessor unit, the modular *TS 803* runs the industry-standard CP/M operating system. The computer includes dual 368K double-sided, double-density minifloppy disk drives for storage.

Programmable in the high-level COBOL language, the *TS 803* is aimed primarily at the business community and its level of

standard features, such as 64K of user memory and two standard serial communications ports, indicates this.

Equipped with a typewriter-style keyboard containing 72 keys, 16 programmable keys and a 17-key numeric keypad, the *TS 803* also features a standard 14-inch monochrome CRT that is capable of 80-characters by 25-lines of display.

Osborne

Osborne Computer Corp. is the firm that kicked off the portable-computer revolution and it has a new offering that debuts in this price spectrum, the *Executive*.

Although based on its *Osborne I*—described elsewhere in this supplement—the *Executive* is substantially upgraded.

Still driven by the same 8-bit Z80A CPU, the *Executive* has dual single-sided, double-density disk drives, rather than the single-density drives of the *Osborne I*.

It also sports the same 62-key detachable keyboard, but its input/output capabilities have been upgraded with the addition of a second serial port and a parallel port for a printer.

Further, the video display has been upgraded to a 7-inch amber monochrome unit, capable of an 80-character by 24-line text display.

The most important improvement in this system is the ability of it to recognize a variety of disk formats and its capability of reading files generated on those systems. This means it can be used with a variety of desktop office-based systems and files can be transported.

Sanyo

Sanyo's *MBC 1200* upgrades in this price segment. Driven by dual Z80A 8-bit CPU's, the *MBC 1200* relies on one of those devices for information processing, while the other handles the housekeeping chores. In this version, the *MBC 1200* has more storage capacity with the addition of a higher-density half-height 640K minifloppy disk drive.

Morrow

The last new system that debuts in this category is the Morrow *MD3 Business Computer*, a full-featured small-business computer. Like the others in the *MD*-series, this micro is driven by an 8-bit Z80A CPU. It comes equipped with 64K of user memory as standard.

Using the industry-standard CP/M operating system, the *MD3* is sold with a powerful set of programs included in the price. These programs include the basic applications needed by a small business or serious home user and, in fact, may be all the user needs.

The *MD3* has two 320K 5¼-inch minifloppy-disk drives for storage. It also has a standard typewriter-style detachable keyboard for user input. Input/output is further provided by two serial ports. This system features a monochrome monitor.

Franklin

Two Franklin systems upgrade in this price category, the *Ace 1000* and the *Ace Professional*. These systems gain a second disk drive for greater storage and this, of course, raises the price of these devices.

Why is a second drive so important? It provides a manyfold increase in the flexibility of the system because the user is no longer limited to using just one disk for program and data loading. Instead, the program can be loaded and kept in one disk drive, while the other is used to house the data disk.

Panasonic

The *HHC*-series of handheld computers becomes even more fully configured with the addition of a modem/cassette interface. Now this system has become a true portable, capable of acting as a workstation in the field.

Hewlett-Packard

Another handheld system, the *HP75C* becomes fully configured with the addition of a monochrome video-display device. The importance of this upgrade to a handheld system can't be overestimated. The reason is the user is freed from the necessity of using a one-line liquid crystal display. Now he can see his input and the system's output in a more convenient manner.

This upgrade wouldn't have been possible without the other upgrade that occurs in this segment, the addition of the video interface.

The same type of upgrade occurs to the *HP86A* microcomputer system. It has also received a monochrome display. The reason this is important is the user now gains far higher resolution by using a dedicated video device, rather than trying to use a home television with its resolution limitations.

Seequa

The dual-processor (Z80A, 8088) *Chameleon* upgrades twice in this price category. In its first upgrade, the buyer receives an increase in user memory to 192K. This gives it enough memory to handle most 8- or 16-bit program on the market. This expansion also gives it color graphics capability.

The second expansion brings user memory to 256K, which is becoming one of the standards of the IBM-workalike world. Yes, many of the IBM-workalikes do have less memory, but it seems that most of them are urging their buyers to upgrade memory to at least 256K.

Radio Shack

In this price category, the *TRS-80 Model III* reaches its full configuration with two drives and a serial port. This all-in-one system is a powerful unit in this configuration.

Commodore

The *Pet 64*, based on the *Commodore 64* system, also becomes fully configured in this price category

The addition of dual floppy drives for data storage and access makes this a powerful system for either the business or home user.

Texas Instruments

Believe it or not, the low-cost *TI-99/4A* can become a high-powered home system and it does, indeed, have a version that appears in this price category.

The addition of a second drive makes the *TI-99/4A* a system that can be used by either the serious home user or the small businessman who needs a small computer system. The second drive adds flexibility to the system.

Panasonic

Panasonic's *PC-8800* series is still an 8-bit microcomputer at this point. Another upgrade or two will be needed to make it a dual-processor 8/16-bit machine. However, in this configuration a user should find it very powerful.

At this point, color graphics output capability is added to the *PC-8800* system with the addition of a high-resolution, RGB video display device.

Spectravideo

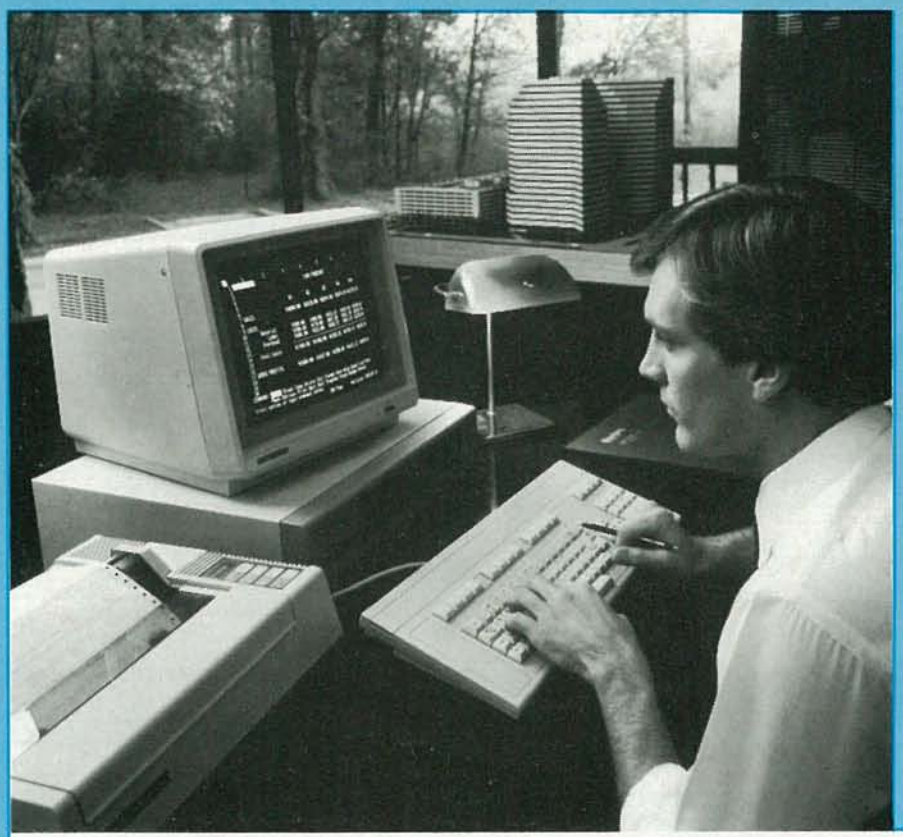
At this point in the price categories, the *SV-328* becomes fully configured. A second drive is added at this point, which provides the user added flexibility and makes this system a full-featured choice for the small business or home user.

Netronics

Another system that reaches its full configuration is the *Explorer/85* from Netronics. This upgrade adds a second disk drive to its configuration that brings with it greater storage capability and far better system flexibility.

Casio

Still a very basic system, the Casio *FX-9000P* has its memory increased to 32K at this point. It still relies on a cassette recorder for storage. **R-E**



Seven new manufacturers join our expanding list.

$2500 to $3000

MARC STERN

IF YOU THOUGHT THE MICROCOMPUTER FIELD BELOW THE $2000 level was crowded, then take a look at the chart accompanying this article; this price area is even more crowded. Almost every week there seems to be a new microcomputer entry in this or the higher-priced categories. And, as noted in the previous story, there are more and more 16-bit machines coming out.

With this in mind, a closer look shows that 18 new machines join the market fray. Some of them are from companies whose names are already familiar, while others are from firms whose names appear here for the first time.

Seven manufacturers join the list here, all featuring fairly well configured, powerful systems. Among them there is a fairly even split between 8- and 16-bit microprocessor units.

The other 12 new machines come from already-mentioned manufacturers, while the rest of the listing presents upgrades of systems that were introduced in lower-priced levels.

Without further ado, let's begin our look at the new offerings from the new manufacturers. From there we'll look at what the familiar firms have to offer and we'll tie up this piece with a peek at how various systems upgrade.

Wang

Perhaps best known in the business field, Wang has long held a dominant position in the word-processing/minicomputer market. Its *Wangwriter* has set the standard in this field for years. Now it has an offering in the microcomputer field, its *Professional Computer*.

An IBM-workalike, it differs from the *Personal Computer* because it uses a 16-bit 8086 CPU. However, the 8086 recognizes the 8088's instruction set and will work with any software written for the 8088. With the 128K standard user memory, the buyer has a powerful system from the start.

Equipped with a standard 128K single-sided, double-density floppy disk drive, the *Professional* runs under MS-DOS. CP/M-86 is also available.

Programmable in several high-level languages, this data can be input via a 101-key typewriter-style keyboard, that features 16 programmable keys, as well as an 18-key numeric pad. Input/output is handled via standard parallel and serial ports.

Compaq

One of the major newcomers in the IBM-compatible field, Compaq Computer's *Compaq* is nearly totally compatible with the IBM offering.

A transportable, the *Compaq* is driven by a 16-bit 8088 CPU, the same one used by the *PC*. It features more standard user memory: 128K.

Operating under Compaq DOS, an IBM workalike disk-operating system, the *Compaq* can use many of the programs written for the IBM-*PC*. Further, it comes with one double-sided, double-density 320K minifloppy disk drive as standard equipment.

Like other small-computer systems, the *Compaq* is programmable in BASIC and data are entered via an 83-key IBM-*PC*-like keyboard. Unlike the *PC*, the *Compaq* comes with a standard parallel printer port. Its built-in 9-inch monochrome display handles both an 80-character by 25-line text mode and graphics.

Altos

The user looking for a more business-oriented system, should check out the Altos *5-15D*. A micromainframe—the system box and drives, the terminal is a user option—the *5-15D* is driven by an 8-bit Z80A CPU and comes with 192K of memory.

Running under the industry-standard CP/M operating system, the *5-15D* comes with two standard 1-megabyte 5¼-inch floppy

TABLE 1—$2500-$3000

Manufacturers	Model	Price	CPU	Word Length	Operating System	Languages
Sord Computer	M23 Mark III G	$2530	Z80A	8-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
Franklin Computer Corp.	Ace 1200	$2544	6502/Z80	8-bit	Apple DOS 3.3 compatible, CP/M	BASIC
NEC Home Electronics	PC-8800	$2547	Z80A-compatible	8-bit	CP/M	BASIC
IBM	IBM-PC	$2564	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FRTRN, BASIC, MACRO assembler, Pascal
Heath Company	HS-100-31	$2594	8085/8088	8/16-bit	Proprietary ZDOS	BASIC
Texas Instruments	Professional Computer	$2595	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Sharp Electronics	PC-5000	$2599 (est.)	8088	16-bit	N/A	
Canon USA	AS100	$2620	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
Toshiba America	T100	$2635	Z80A	8-bit	CP/M	BASIC
LNW Research Corp.	LNW80 Model 2	$2645	Z80A	8-bit	CP/M, Proprietary	BASIC
Apple Computer	Apple IIe	$2674	6502A	8-bit	Apple DOS 3.3	BASIC, PILOT, Logo, Pascal, FORTRAN, COBOL
Sony	SMC-70	$2675	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Apple Computer	Apple III	$2695	6502B	8-bit	Apple SOS	BASIC, Pascal
Access Matrix Corp.	Access	$2695	Z80A	8-bit	CP/M	BASIC
Apple Computer	Apple III	$2720	6502B	8-bit	Apple SOS	BASIC, Pascal
Heath Company	HSA-120-31	$2744	8085/8088	8/16-bit	Proprietary ZDOS	BASIC
Canon USA	AS100	$2745	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
NEC Home Electronics	PC-8800	$2747	Z80A-compatible/8086	8/16-bit	N/A	BASIC
NEC Information Syst.	APC	$2748	8086	16-bit	CP/M-86, MS-DOS	BASIC, COBOL, FORTRAN, PASCAL, Assem.
Hewlett-Packard	HP85A	$2750	Not announced		N/A	BASIC, assembler
Hewlett-Packard	HP120/125	$2775	Z80A	8-bit	N/A	BASIC, assembler
IBM	IBM-PC	$2788	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, MACRO assembler, Pascal
Kaypro Division	Kaypro 10	$2795	Z80	8-bit	CP/M	BASIC, Pascal, FORTRAN, Assembler, COBOL
Texas Instruments	Professional Computer	$2820	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Commodore Business Machines	BX256-80	$2890	6509/8088	8/16-bit	Proprietary	BASIC
Zenith Data Systems	ZF-100	$2899	8085/8088	8/16-bit	CP/M, ZDOS (proprietary)	BASIC, COBOL, FORTRAN
IBM	IBM-PC	$2904	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, MACRO assembler, Pascal
Apple Computer	Apple III	$2920	6502B	8-bit	Apple SOS	BASIC, Pascal
Sord Computer	M23P	$2930	Z80A	8-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
Hewlett-Packard	HP-85A	$2945	Not announced		Proprietary	BASIC, assembler

Memory/Storage	Keyboard	I/O	Display	Comments
128K/2 330K 5 ¼" DS/DD drives	59 keys, 20-key keypad, 9 special function	2 serial, 1 parallel	12-inch green CRT	2 DS/DD drives, CRT
128K/2 5 ¼" floppy disk drives	72 keys, 12-key keypad	1 serial, 1 parallel, game controller	80 (40) × 24/280 × 192 graphic capability	Ace 1200 gains further storage with second floppy disk drive
64K/2 320K DS/DD 5 ¼" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch monochrome CRT/80 × 25 text	dual 320K DS/DD drives
64K/1 SS/DD 180K 5 ¼" floppy drive	59 keys, 10 special function, 20-key keypad	1 parallel	12-inch monochrome CRT/80 × 25 text	1 drive added, display device added
192K/2 320K DS/DD 5 ¼" floppy drives	60 keys, 14 function keys, 18-key keypad	2 serial, 1 parallel	monochrome capability	2nd drive
64K/1 320K DS/DD 5 ¼" floppy drive	97 keys, 17-key keypad, 12 special function	1 parallel	12-inch monochrome CRT, 720 × 300 res., 80 × 25 display	base system
128K/128K bubble memory storage/cassette interface	standard typewriter		80-character × 8-line liquid crystal display	base system
Not announced/2 640K DS/DD 5 ¼" floppy drives	standard	1 serial	monochrome display/80 × 25 text mode	serial port
64K/2 280K DS/DD 5 ¼" drives	89 keys, 8 special function	1 parallel, 1 serial	640 × 200 color display, 80 × 25 in text mode	color display
96K/1 5 ¼" floppy disk drive	73 keys, 11-key keypad	1 parallel, 1 serial	480 × 192 color capability/62 × 16 text mode/monochrome CRT	first drive and monochrome
64K/1 5 ¼" floppy drive	63-key typewriter, 2 programmable	1 parallel, 1 serial, game controller	12-inch monochrome CRT/80-column card/80 × 24 text mode	1 disk drive and controller added
64K/1 280K microfloppy drive	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch green 80 × 25 text	disk drive and CRT added, video converter deleted
128K/1 140K SS/DD 5 ¼" floppy drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller	280 × 192 and 560 × 192 graphics capability/80 × 24 text	128K memory
64K/2 DS/DD floppy disk drives	62 keys, 15 special function, 15-key keypad	2 serial, 1 parallel, 1 IEEE-488	7-inch monochrome (amber)/80 × 25 text mode	drives upgraded to DS/DD
128K/1 140K SS/DD 5 ¼" floppy drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	280 × 192 and 560 × 192 graphics capability/80 × 24 text	parallel port
192K/2 320K DS/DD 5 ¼" floppy drives	60 keys, 14 function keys, 18-key keypad	2 serial, 1 parallel	monochrome version	2nd drive
Not announced/2 640K DS/DD 5 ¼" floppy drives	standard	1 serial, 1 parallel	monochrome display/80 × 25 text mode	parallel port
128K/cassette interface/disk interface	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch color CRT/640 × 400 res./80 × 25 text	optional 8086 card/memory upgraded to 128K color CRT for display
128K/1MB 8-inch half-height DS/DD drive	66 keys, 25-key keypad, 23 function	1 parallel, 1 serial	80 × 25 monochrome	basic system
16K/tape cartridge	58 keys, 20-key keypad, 8 special function		built-in 5" CRT, 256 × 192 graphics, 32 × 16 text	portable system
64K	58 keys, 8 special function	2 serial, 1 IEEE-488	9" or 12"-monochrome CRT/80 × 25 text	basic system, HP120 has 9" display, 125 has 12"
64K/1 SS/DD 180K 5 ¼" floppy drive	59 keys, 10 special function, 20-key keypad	1 parallel	12-inch high-res. color display/80 × 25 text	color display adapter
64K/ 1 5 ¼" DS/DD drive, 10MB hard disk	72 keys, 14-key keypad, 20 programmable	1 serial, 1 parallel	9-inch, monochrome CRT/80 × 25 text	basic system
64K/1 320K DS/DD 5 ¼" floppy drive	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	12-inch monochrome CRT, 720 × 300 res., 80 × 25 display	serial port
256K/dual 5 ¼" floppy disk drives	standard, numeric keypad	1 serial	12-inch monochrome CRT/80 × 25 text mode	dual drives
128K/1 320K DS/DD 5 ¼" drive	77 keys, 18-key keypad, 13 special function	2 serial, 1 parallel	composite video output	basic system
64K/1 320K DS/DD 5 ¼" floppy drive	59 keys, 10 special function, 20-key keypad	1 parallel, 1 serial	12-inch monochrome CRT/80 × 25 text	drive becomes DS/DD, serial port added
256K/1 140K SS/DD 5 ¼" floppy drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	280 × 192 and 560 × 192 graphics capability/80 × 24 text	parallel port added, memory upgrades to 256K
128K/2 290K microfloppy drives	60 keys, 20-key keypad, 9 special function	2 serial, 1 parallel	14-inch color monitor	color monitor
32K/tape cartridge	58 keys, 20-key keypad, 8 special function		built-in 5" CRT, 256 × 192 graphics, 32 × 16 text	16K RAM added

TABLE 1—$2500-$3000 (*continued*)

Manufacturers	Model	Price	CPU	Word Length	Operating System	Languages
Hewlett-Packard	HP86A	$2950	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN,
Docutel/Olivetti Corp.	M20	$2965	Z8001	16-bit	PCOS (Prof. Computer Operating Sys.)	BASIC
Apple Computer	Apple III	$2969	6502B	8-bit	Apple SOS	BASIC, Pascal
Toshiba America	T300	$2975	8088	16-bit	MS-DOS, CP/M-86	BASIC
Basis Inc.	Basis 108	$2985	Z80A/6502	8-bit	CP/M, Apple DOS 3.3	BASIC, Pascal, LOGO
Altos Computer Systems	5-15D	$2990	Z80A	8-bit	CP/M	BASIC, COBOL, Pascal, FORTRAN, SOFTBOL
Eagle Computer Inc.	Eagle PC-1	$2995	8088	16-bit	CP/M-86, MS-DOS	
Eagle Computer Inc.	Eagle IIE-3	$2995	Z80A	8-bit	CP/M	BASIC
Vector Graphic Inc.	Vector 4	$2995	Z80B, 8088	8/16-bit	N/A	Not announced
Computer Devices Inc.	DOT-3000A	$2995	8088	16-bit	MS-DOS	BASIC, FORTRAN, COBOL, Pascal, assembler
Hewlett-Packard	H85B	$2995	Not announced		Proprietary	BASIC, assembler
Sanyo	MBC 1250	$2995	Z80A	8-bit	CP/M	BASIC, Pascal, Fortran, Macro-80
Sumicom Inc.	System 330B	$2995	8088	16-bit	MS-DOS/CP/M-86	FORTRAN, COBOL, Pascal, BASIC
Wang Laboratories	Professional Computer	$2995	8086	16-bit	MS-DOS, CP/M emulation	BASIC, COBOL, FORTRAN, Pascal
Hewlett-Packard	HP87XM	$2995	Not announced		N/A	BASIC, Pascal, FORTRAN
Intertec Data Systems	Superbrain II - QD	$2995	Z80A	8-bit	CP/M	BASIC, FORTRAN
Compaq Computer Corp.	Compaq	$2995	8088	16-bit	Compaq DOS (Similar to IBM PC-DOS)	BASIC
Columbia Data Products	1600-VP	$2995	8088	16-bit	MS-DOS	Not announced
Basis Inc.	Basis 108	$2995	Z80A/6502	8-bit	CP/M 3.0, Apple DOS 3.3	BASIC, Pascal, LOGO
TeleVideo Systems Inc.	TS 1603	$2995	8088	16-bit	CP/M-86, MS-DOS	COBOL
North Star Computers	Horizon	$2999	Z80A	8-bit	TSS/C (Proprietary CP/M-like)	Not announced
North Star Computers	Advantage	$2999	Z80A	8-bit	CP/M, GDOS	BASIC, FORTRAN, COBOL, Pascal

disk drives.

The *5-15D* has two serial ports and one parallel port as standard.

Vector Graphic

Vector Graphic is a long-time veteran of the microcomputer marketplace. It was one of the first microcomputer manufacturers and remains in the thick of the fray with its *Vector 4* system. It has 128K of user memory and, with the addition of a couple of drives, can become a powerful system.

Driven by dual Z80B and 8088 CPU's, the system has a typewriter-style keyboard with 91 keys, 15 special-function keys and an 18-key numeric pad. Its 12-inch monochrome display delivers an 80-column by 24-line display or 640- by 312-dot graphics.

Basis

A newcomer to the microcomputer market, Basis Inc. sells the *Basis 108* system, that takes a different tack. A dual-processor small-computer system, it does not use Z80A's or a Z80/8086(8) combination. Instead the company has opted to make this single-user system compatible with CP/M and its many programs and Apple's disk-operating system and the many programs that run under it. Driven by a Z80A 8-bit microprocessor and a 6502, another 8-bit CPU, the *Basis 108* has 128K of user memory.

The *108* comes with two 5¼-inch minifloppy disk drives. Input/output is provided by serial and parallel ports.

With RGB color outputs available, the *Basis 108* can generate up to 280- by 192-dot video resolution or an 80-character by 25-line text display. This system upgrades once in this price category by adding CP/M 3.0.

Zenith

The parent of the Heath Co., who offers kit versions of the *Z-100* series, Zenith has a ready-to-go version of the same system. The *ZF-100* outlined here is the low-profile version of this system.

Memory/Storage	Keyboard	I/O	Display	Comments
64K/1 270K 5 ¼" drive	59 keys, 20-key keypad, 14 special function	1 parallel	9" monochrome CRT/80 × 25 text	5 ¼" drive added
128K/1 360K 5 ¼" floppy drive	72 keys, 16-key keypad	1 serial, 1 parallel	12-inch high-res. monochrome/80 × 25 text mode	one-drive added
128K/1 140K 5 ¼" floppy drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	12-inch CRT/280 × 192 and 560 × 192 graphics cap./80 × 24 text	CRT added to 128K Apple III
192K/2 640K DS/DD 5 ¼" drives	67 keys, 18 special funct., 10 edit, 18-key keypad	1 parallel, 1 serial		2nd drive added
128K/2 5 ¼" floppy drives	58 keys, 15 programmable, numeric keypad	1 parallel, 1 serial	RGB and composite/280 × 192 res./80 × 25 text	basic system
192K/2 1MB DS/DD 5 ¼" floppy drives	N/A	4 serial, 1 parallel	N/A	micro-mainframe, can drive 1 to 3 terminals
128K/1 320K DS/DD 5 ¼" floppy drive	105 keys	2 serial, 1 parallel	12-inch high-res. monochrome/720 × 352 capability/80 × 25 text mode	memory increases to 16K, monitor added
64K/2 780K DS/DD 5 ¼" floppy drives	75 keys	2 serial, 2 parallel	12-inch monochrome/80 × 25 text mode	DS/DD 96-track disk drives
128K	91 keys, 15 special function, 18-key keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 24 text/640 × 312 graphics	basic system
64K/1 3 ⅛" 280K micro floppy drive	59 keys, 10 function keys, 18-key keypad		80 × 24 text	basic system
32K/tape drive/electronic (RAM) disk	58 keys, 20-key keypad, 8 special function		built-in 5" CRT, 256 × 192 graphics, 32 × 16 text	electronic RAM disk, 32K memory
64K/2 640K slim line DS/DD floppy drives	50 keys, 15 programmable, 18-key keypad	1 parallel, 1 serial	12-inch monochrome/80 × 25 text/640 × 400 graphics	2nd high-density slim line disk
128K/2 SS/DD 160K 5 ¼" floppy drives	95 keys, 8 special function, 10-key keypad	1 serial, 1 parallel	monochrome CRT	2 SS/DD disks, CRT
128K/1 360K DS/DD 5 ¼" floppy drive	101 keys, 16 programmable, 18-key keypad	1 parallel, 1 serial		basic system
128K	59 keys, 20-key keypad, 14 special function	multipurpose port	8" monochrome CRT/80 × 25 text	basic system
64K/2 750K 5 ¼" floppy drives	62 keys, 18-key keypad	2 serial	12-inch monochrome/80 × 24 text mode	drives upgraded to 750K
128K/1 320K 5 ¼" DS/DD drive	83 keys, 10-key keypad, 10 special function	1 parallel, opt. serial	9-inch monochrome, 80 × 25 text	basic system
128K/2 320K 5 ¼" floppy disk drives	83 keys, 10 special function, keypad	1 serial, 1 parallel	9-inch monochrome CRT/80 × 25 text	basic system
128K/2 5 ¼" floppy drives	58 keys, 15 programmable, numeric keypad	1 parallel, 1 serial	RGB and composite/280 × 192 res./80 × 25 text	CP/M 3.0
128K/2 half-height 1MB floppy drives	72 keys, 16 programmable, 16-key keypad	2 serial, 1 serial RS-422 port	14-inch monochrome/80 × 25 text	16-bit system
64K/2 360K DS/DD 5 ¼" floppy drives	N/A	2 serial, 1 parallel	N/A	micromainframe system
64K/2 360K DS/DD 5 ¼" floppy drives	49 keys, 14-key keypad, 15 function keys	1 parallel, 1 serial	12-inch monochrome CRT/640 × 240 graphics res./80 × 24 text mode	all-in-one microcomputer with dual floppy disks

Driven by an 8085 8-bit processor and an 8088 16-bit processor, this system has 128K of standard user memory.

Another of the IBM-workalikes on the market, the *ZF-100* operates under its own proprietary operating system and CP/M.

With one standard double-sided, double-density 320K minifloppy-disk drive available for storage, the system is almost fully configured right from the box.

Programmable in BASIC, COBOL and Fortran, this and other data are entered via a typewriter-style keyboard with 77 keys. It also features an 18-key numeric keypad and 13 special-function keys. Input/output is through two serial ports and one parallel port.

Computer Devices

Another of the many IBM-compatible systems now on the market, the Computer Devices *DOT-3000A*, is a transportable system. This new manufacturer is using the same CPU found in the IBM, the 16-bit 8088 to drive the *DOT*. Its 64K of user memory is the minimum needed for efficient operation of the many programs available for MS-DOS, the *DOT's* operating system.

The *DOT* can use several high-level programming languages and this data are input through a 59-key keyboard. Since it is a transportable, the *DOT* has a built-in display, with an 80-character by 24-line text mode.

Columbia Data Products

Although this manufacturer is not widely known outside the computer industry, it also has a microcomputer offering, the *1600-VP*, another IBM-compatible transportable system.

Driven by the 16-bit 8088 CPU, the *1600-VP* has 128K of standard user memory. It is compatible with MS-DOS and runs under it.

The *1600-VP* comes with two 320K double-sided, double-density minifloppy disk drives for storage. The keyboard is patterned after the IBM's 83-key unit. However, unlike the IBM, the *1600-VP* includes standard serial and parallel ports for interfacing with a variety of peripherals. The 9-inch

monochrome screen unit has an 80-character by 25-line text display.

Sord

From Sord/Mitsui comes the *M23 Mark III G*, another of the many Z80A-based systems. A fully configured system right out of the box, it comes with 128K of user memory and a basic set of applications software, something a growing number of systems are doing.

With two standard double-sided, double-density 330K minifloppy disk drives, this system is flexible. Not only does it run under its own proprietary operating system, it is also CP/M compatible and is programmable in BASIC, Pascal, and Fortran.

Basically the *M23* system, it is actually an upgraded version with the drives and 12-inch green monochrome display device included. User input is via a keyboard containing 59 keys, a 20-key numeric pad and nine special-function keys. Input/output is handled through two serial ports and a parallel port.

The basic *M23* upgrades in this price category by adding a high-resolution color video monitor.

Texas Instruments

A new personal computer joins the array from this semiconductor giant. Its the *Professional Computer*, another of the many IBM-workalikes. Driven by a 16-bit 8088 microprocessor, the same one used by IBM, this system has 64K of RAM.

Its standard 320K double-sided, double-density disk provides basic storage capability, although the addition of a second disk drive increases system flexibility. It runs under MS-DOS, but CP/M-86 and the UCSD p-System are also available.

Output is through a standard parallel port for a printer. The standard display is a 12-inch monochrome screen, with 720- by 300-dot resolution and an 80-character by 25-line text display. It upgrades once in this price category by adding a serial port.

Sharp

A new model joins the Sharp lineup in this price category, the lap computer *PC-5000*. Driven by a 16-bit 8088 microprocessor, the *PC-5000* has a rather unusual feature; it relies on magnetic bubble-memory storage in place of a disk drive. Magnetic bubble memory is nonvolatile user memory that retains its contents even when the power is shut down. This type of memory can effectively eliminate the need for disks for mass storage. The unit comes with 128K of RAM. With a standard keyboard, the *PC-5000* can be programmed in BASIC. Its screen is an 80-character by 8-line liquid-crystal display.

NEC

A new small-computer joins the NEC lineup here, the *APC*, another IBM workalike. Instead of using an 8088, 16-bit CPU, the *APC* takes advantage of its brother the 8086, that recognizes the same instruction set. It is equipped with 128K user memory and a 1-MB 8-inch half-height double-sided, double-density disk drive. It runs under MS-DOS or CP/M-86.

It is programmable in several high-level languages input via a typewriter-style keyboard with 66 keys. Twenty-three function keys and a 25-key numeric pad aid functionality. Input/output is through standard parallel and serial ports. Video output is 80-characters by 25-lines text on a monochrome display.

The *PC-8800*—still only a CP/M-compatible machine at this point—upgrades by adding dual 320K double-sided, double-density minifloppy disk drives. Its second upgrade makes it a true 16-bit machine with the addition of the optional 16-bit card. This gives the user the advantage of MS-DOS capability.

Hewlett-Packard

Two new systems join the Hewlett/Packard lineup in this price category, the *120/125* and the *HP87XM*. In this price category, the new *HP120/125* system is in its most basic configuration. Driven by dual Z80A CPU's, the system has 64K of user memory. But no disk storage is available at this price. Programmable in BASIC and assembler, this and other data are input via a typewriter-style keyboard with 58 keys. The keyboard includes 8 special-function keys and other soft or programmable keys. Input/output is aided by two standard serial ports as well as an IEEE-488 port, for a variety of test and measurement, and other devices. The standard display on the *HP120* is a 9-inch monochrome display, while the *HP125* has a 12-inch monochrome display.

The *HP87XM* is a very basic machine at this point. Although it has 128K of user memory and is programmable in BASIC, Fortran, Pascal, and COBOL, you will need disk drives to take full advantage of them.

The basic configuration of this system includes a typewriter-style keyboard with 58 keys, a 20-key numeric keypad and eight special-function keys. A multipurpose port facilitates input/output. A built-in 8-inch monochrome display rounds out the basic unit.

Other H-P small-computer systems also upgrade or are introduced in this price segment. There's the portable *HP85A*. It is not only introduced, but also has its RAM expanded to 32K. This system includes 195K of built-in tape storage and a built-in thermal printer and a built-in 5-inch monochrome CRT. It also includes 2 serial ports and an IEEE-488 port.

The *HP85B* enhances the *HP85A* system by including an electronic (RAM) disk for speed and storage and greater user memory. Meanwhile, the *HP86A* system debuts in this category and, while it has many of the attributes of the *HP85* system, it also includes a standard minifloppy disk drive for storage.

North Star

North Star Computers has two systems that debut in this price category, the *Horizon* and the *Advantage*. A micromainframe, the *Horizon* is driven by an 8-bit Z80A CPU. The basis of a multi-user system, it includes 64K of user memory and two standard double-sided, double-density 360K minifloppy disk drives for storage. With access to a proprietary operating system, there are many applications for this computer system, which includes two serial ports and one parallel for input/output. The terminal is a user option.

The *Advantage* is an all-in-one microcomputer system that includes dual floppy-disk storage. Also driven by a Z80A, it has 64K of user memory and runs CP/M. Programmable in BASIC, Fortran, COBOL, and Pascal, this and other data are entered via a typewriter-style keyboard with 49 keys. It also includes a 14-key numeric pad and 15 function keys. Input/output is aided with standard serial and parallel ports. The built-in 12-inch monochrome screen displays 640 by 240 graphics or an 80-character by 24-line text mode.

THE *APC* from NEC is an IBM workalike.

TeleVideo

Many IBM workalikes have appeared on the market in the recent past from many manufacturers.

TeleVideo is no exception with its 8088-driven *TS 1603* that runs CP/M or MS-DOS. It offers 128K RAM and two half-height one-megabyte double-sided, double-density floppy-disk drives.

With two standard serial ports and an RS-422 serial port, a user has several peripheral interface options for input/output. The *TS 1603* is programmable in COBOL, so it's readily apparent this small-computer is aimed at the business market.

Sanyo

The *MBC 1250* expands in this category with the addition of a second high-density slim-line floppy-disk drive. This type of drive shows an important trend in the small-computer industry, miniaturization.

Unfortunately it also shows another important trend: computer manufacturers often find it hard to agree on standards. There are several computers from different companies who offer microfloppy-disk drives—each with its own "standard".

Kaypro

Kaypro adds to its line of Z80-based, 8-bit transportable microcomputer systems with the *Kaypro 10*. Like the other members of this manufacturer's line, the *Kaypro 10* comes as a full-featured unit right out of the box. However, it features not only a double-sided, double-density 5¼" floppy-disk drive, but also a ten-megabyte hard-disk drive.

Intertec

Intertec's new offering in this price category is the *Superbrain II—QD*. Like the *Superbrain II—Jr.*, this small-computer system is driven by dual Z80A microprocessors; one handles the actual data processing, while the other microprocessor handles the housekeeping.

The key change in this system, and the one that raises it above the *Superbrain II—Jr.* is the use of dual 750K 5¼-inch minifloppy disk drives for storage. It has the same specifications as the Junior and is an all-in-one unit.

Sumicom

The *System 330B* expands in this price category with the addition of two 160K single-sided, double-density minifloppy-disk drives. This turns it into a fully configured microcomputer system.

Apple

Two systems upgrade in this price category, the *Apple IIe* and the *Apple III*. The *Apple IIe* upgrades once with the addition of a minifloppy disk drive and disk-drive controller circuitry.

The business-oriented *Apple III* upgrades four times. Its first upgrade is its increase in user memory to 128K as standard, while its second upgrade gives it output capability by adding a parallel port for a printer. The third upgrade brings the user memory to 256K, and also adds a parallel port for increased output capability, while the fourth upgrade to the 128K version adds a standard video-display device.

IBM

The IBM *Personal Computer* becomes a far more powerful tool with its first upgrade, the addition of a minifloppy disk drive for storage. This upgrade also adds the high-resolution display that enhances serious computing. Its second upgrade adds the color display device to the one-disk drive version of the IBM-*PC*. In its third upgrade, the *PC* gains further input/output capabilities with the addition of a serial port and the disk drive becomes even more versatile as its mass-storage capabilities increase to 320K.

Eagle Computer

Both Eagle models, the *PC-1* and *IIE-3*, upgrade here. The *PC* gains more user memory and a standard video-display device, in addition to its complete complement of bundled (included) software. The storage capacity of the *Eagle IIE-3* increases with the addition of 96-track double-sided, double-density minifloppy disks.

THE *BASIS 108* from Basis, Inc. is a dual microprocessor (Z80A/6502) system that runs CP/M and an Apple-compatible DOS.

Toshiba

The *T100* system can handle high-resolution color graphics in this price spectrum by adding a 640- by 200-dot resolution color video display device.

The *T300* system gains greater mass-storage capability in this price category with the addition of a second minifloppy-disk drive to its configuration.

Canon

This manufacturer's offering, the *AS100*, has two upgrades. The first adds a serial port for greater input/output capability. The second upgrade adds a parallel port.

Heath

At this time, second disk drives for greater mass-storage capabilities are added to the low-profile Heath *HS-100-31* kit and the *HS-120-31* kit.

Franklin

A second disk drive is added to the Franklin *Ace 1200*. As you might expect, that increases the mass-storage capabilities of this unit.

Sony

The *SMC-70* becomes even more fully configured as a disk drive is added for mass storage and a standard video-display device is also added.

Commodore

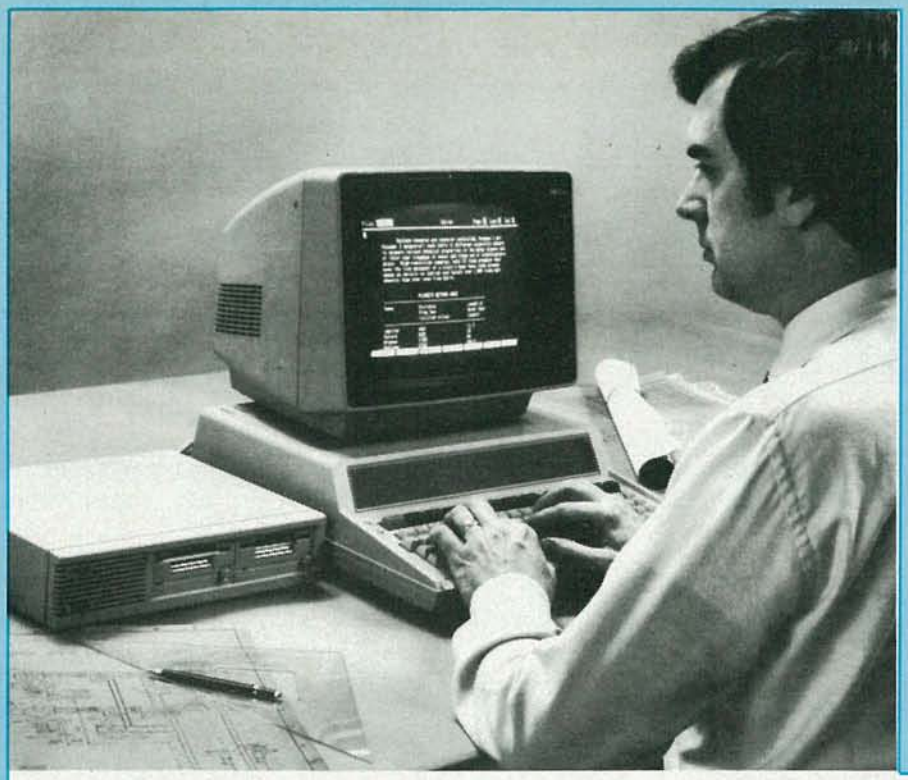
The *CBX256-80* becomes fully configured with the addition of two disk drives.

Access Matrix

With the addition of higher-density disks, the mass-storage capabilities of the *Access* transportable increase dramatically.

LNW

In this price category's configuration, the *LNW80 Model 2* gains its first disk drive for storage. Further, the user gains a standard video-display device. **R-E**



Sixteen-bit machines begin to take a greater share of the market.

$3000 to $3500

MARC STERN

DURING THE LAST YEAR, THE BIGGEST TREND IN THE microcomputer industry has been the swing to the 16-bit machine. And, it's no mystery why it has happened. With the arrival of IBM in the small-computer market, more and more of the computer industry has jumped aboard the bandwagon, hoping to carve out its niche.

For the person thinking of buying such a system there are a couple of benefits. The first is the ability of the 16-bit microcomputer to handle much larger amounts of memory. This means that applications programs can become more comprehensive and more powerful.

The second reason is that IBM is bringing some stability and order to this market. Just as CP/M caught on in the 8-bit market and assured some stability and rationalization and a degree of standardization, so has IBM and the operating system it has chosen—MS-DOS—brought some order to the market.

This means that the buyer will have an easier time deciding which type of machine is the best to buy, since the base of MS-DOS-compatible software is rapidly growing.

Yes, there are a great many machines that are IBM-workalikes and the search for the right one can be confusing. However, if the buyer opts for one using an 8086(88) CPU, there is a measure of order.

Don't think, though, the 8-bit CPU is dead. There are still many fine machines on the market using this type of CPU. In fact, this type of CPU is likely to be around for several years to come in single-user machines and you'll still find a wide variety of those machines available in our listings.

So let's begin our look at the new machines making their debuts here and move on to seeing how other offerings have upgraded.

Epson

Although Epson has long been known for its small-computer peripheral equipment, it has also entered the microcomputer market with two offerings of its own, the *HX-20* and the easy-to-use *QX-10*. The *HX-20* is a low-cost lap computer, while the *QX-10* is a full-featured small system

Right from the box, the user has access to the power of an 8-bit Z80A microprocessor and 64K of RAM. This amount of memory is more than enough to handle all the user-oriented software available for this system. This system features a plain language user-interface and a one-key function access.

Fully configured, this system features the CP/M operating system and two double-sided, double-density 5¼-inch minifloppy-disk drives.

Data are entered via a typewriter-style keyboard with 63 keys. This keyboard includes 21 special-function keys. With the push of one of these buttons, a user is able to access functions without the necesssity of entering a series of "computer-like" commands.

Output is via a standard 12-inch monochrome display, capable of 640- by 400-dot graphics resolution or an 80-character by 25-line text display. Input/output is provided by standard serial and parallel ports.

Hitachi

Better known for its consumer electronics products, Hitachi also has an offering that makes its debut in this price range, the 16-bit *MBE 16000* system. Another of the IBM-workalikes, it is driven by an 8088 microprocessor, the same one used by IBM in its *Personal Computer*.

With 128K of user memory, this system is easily able to handle many functions a user may care to undertake. It uses MS-DOS and comes with two 5¼-inch minifloppy-disk drives for storage.

Although a firm price for this system hadn't been established at press time, it's likely to be about $3000 and for this amount

TABLE 1—$3000-$3500

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Epson America	QX-10	$3000 (est.)	Z80A	8-bit	CP/M	Not announced
Hewlett-Packard	HP86B	$3000 (est.)	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN
Hitachi Sales Corp.	MBE 16000	$3000 (est.)	8088	16-bit	MS-DOS	BASIC, FORTRAN, COBOL, Pascal, assemb.
Zenith Data Systems	Z-120	$3038	8085/8088	8/16-bit	CP/M, ZDOS (proprietary)	BASIC, COBOL, FORTRAN
LNW Research Corp.	LNW80 Model 2	$3045	Z80A	8-bit	CP/M, Proprietary	BASIC
Apple Computer	Apple IIe	$3069	6502A	8-bit	Apple DOS 3.3	BASIC, PILOT, Logo, Pascal, FORTRAN, COBOL
Sord Computer	M23 Mark III C	$3075	Z80A	8-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
Toshiba America	T300	$3090	8088	16-bit	MS-DOS, CP/M-86	BASIC
NEC Home Electronics	PC-8800	$3097	Z80A-compatible/8086	8/16-bit	CP/M, CP/M-86, MS-DOS	BASIC
Sony	SMC-70	$3125	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
IBM	IBM-PC	$3148	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, MACRO assembler, Pascal
Apple Computer	Apple III	$3169	6502B	8-bit	Apple SOS	BASIC, Pascal
Dynalogic Info-Tech Corp.	Hyperion	$3195	8088	16-bit	MS-DOS	BASIC, COBOL, FORTRAN, Pascal
Sony	SMC-70	$3195	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Toshiba America	T300	$3195	8088	16-bit	MS-DOS, CP/M-86	BASIC
Canon USA	AS100	$3195	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
Radio Shack	TRS-80 Model 12	$3199	Z80A	8-bit	TRSDOS	BASIC
Casio, Inc.	FX-9000P	$3214	Z80A-compatible	8-bit	Not announced	BASIC
Athena Computer	Athena I	$3250	NSC-800 (low-power Z80)	8-bit	CP/M	Pascal
Commodore Business Mach.	CBM 8032	$3290	6502	8-bit	Proprietary	BASIC
Hewlett-Packard	HP86A	$3290	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN
Computer Devices Inc.	DOT-3000X	$3295	8088	16-bit	MS-DOS	BASIC, FORTRAN, COBOL, Pascal, assembler
Sanyo	MBC 4000	$3295	8086	16-bit	CP/M-86	BASIC, assembler
Xerox Corp.	820-II	$3295	Z80A	8-bit	CP/M	Not announced
NEC Home Electronics	PC-8800	$3296	Z80A-compatible	8-bit	CP/M	BASIC
IMS International	5000SX	$3300	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
Canon USA	AS100	$3320	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
Hewlett-Packard	HP-85A	$3340	Not announced		N/A	BASIC, assembler
NEC Information Syst.	APC	$3346	8086	16-bit	CP/M-86, MS-DOS	BASIC, COBOL, FORTRAN, PASCAL, Assem.
Texas Instruments	Professional Computer	$3370	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Columbia Data Products	1600-1	$3395	8088	16-bit	MS-DOS	BASIC, assembler

Memory/Storage	Keyboard	I/O	Display	Comments
64K/2 340K DS/DD 5 ¼" floppy drives	63 keys, 21 special function, 18-key keypad	1 serial, 1 parallel	12-inch monochrome CRT/80 × 25 text mode/640 × 400 graphics res.	basic system
128K/1 3.5-inch 270K drive	59 keys, 20-key keypad, 14 special function	1 parallel	12" monochrome CRT/80 × 20 text	memory expands to 128K and microdrive added
128K/2 5 ¼-inch floppy drives	61 keys, 8 special function, 18-key keypad	1 serial, 1 parallel	80 × 25 text/640 × 400 graphics capability	IBM-workalike
128K/1 320K DS/DD 5 ¼" drive	77 keys, 18-key keypad, 13 special function	2 serial, 1 parallel	80 × 25 text/green monochrome CRT	green monochrome display added
96K/2 5 ¼" SS floppy disk drives	73 keys, 11-key keypad	1 parallel, 1 serial	480 × 192 color capability/62 × 16 text mode/monochrome CRT	2nd drive
64K/2 5¼" minifloppy disk-drives	63-key typewriter, 2 programmable	1 parallel, 1 serial, game controller	12-inch monochrome CRT/80-column card/80 × 24 text mode	2nd drive
128K/2 330K 5 ¼" DS/DD drives	59 keys, 20-key keypad, 9 special function	2 serial, 1 parallel	14-inch color CRT	color display
192K/2 640K DS/DD 5 ¼" drives	67 keys, 18 special funct., 10 edit, 18-key keypad	1 parallel, 1 serial	80 × 25 monochrome	2nd drive
128K/2 320K DS/DD 5 ¼" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch monochrome CRT/80 × 25 text	dual 320K DS/DD drives added
64K/2 280K 3.5" microfloppy drives	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch green CRT/80 × 25	2nd drive
64K/1 320K DS/DD 5 ¼" floppy drive	59 keys, 10 special function, 20-key keypad	1 parallel, 1 serial	12-inch high-res. color display/80 × 25 text	color, serial port added
256K/1 140K SS/DD 5 ¼" floppy drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	12-inch CRT/280 × 192/560 × 192 graphics cap./80 × 24 text	CRT added to 256K Apple III
256K/1 320K DS/DD 5 ¼" floppy drive	84 keys, 10 function keys, 10-key keypad	1 serial, 1 parallel	7-inch amber monochrome CRT/80 × 25 text mode/640 × 250 graphics	transportable IBM-compatible
64K/1 280K 3.5" microfloppy drive	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch RGB high-res. color CRT	color CRT subsituted
192K/2 640K DS/DD 5¼" drive	67 keys, 18 special funct., 10 edit, 18-key keypad	1 parallel, 1 serial	640 × 200 color display, 80 × 25 in text mode	color display
Not announced/2 640K DS/DD 5 ¼" floppy drives	standard		640 × 400 color graphics capability	color version with high-res. graphics capability
80K/1 1.25MB 8" DS/DD floppy drive	82 keys, 8 programmable keys, 19-key keypad	2 serial, 1 parallel	12-inch monochrome/80 (40) × 24 text mode	basic system
32K/dual floppy disk drive	67 keys, 16-key keypad		5.5-inch monochrome CRT, 32 × 16, 256 × 128 graphics	28K RAM, plus disk storage added
68K/128K of RAM-disk storage/1 DD 5 ¼" floppy included	standard	2 serial, 1 parallel	80-character × 4-line liquid crystal display/external CRT connector	lap computer
32K/dual 5¼" floppy disk drivers	standard, numeric keypad	1 serial	integral display	dual drives added
64K/1 3.5-inch micro 270K drive	59 keys, 20-key keypad, 14 special function	1 parallel	9" monochrome CRT, 80 × 25 text	3 ½-inch drive added
128K/1 3.5" 280K micro floppy drive	59 keys, 10 function keys, 18-key keypad		monochrome monitor (built-in)/80 × 24 text	64K RAM added
128K/1 640K slim line 5 ¼" DS/DD floppy drive	60 keys, 15 programmable, 18-key keypad	1 parallel, 1 serial	12-inch monochrome/80 × 25 text mode	basic system
64K/2 SS/DD 5 ¼" floppy drives	standard, 10-key keypad	2 serial, 2 parallel	monochrome CRT/80 × 24 text mode	business-oriented system
64K/2 320K DS/DD 5 ¼" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch color CRT/640 × 400 res./ 80 × 25 text	color display added
64K/2 409K DS/DD half-height 5 ¼" floppy drives	N/A	2 serial, 3 parallel	N/A	micromainframe system
Not announced/2 640K DS/DD 5 ¼" floppy drives	standard	1 serial	640 × 400 color graphics capability	serial port added
32K/built-in tape storage, 195K	58 keys, 20-key keypad, 8 special function	1 serial	built-in 5" CRT/256 × 192 graphics/32 × 16 text	serial port added
256K/1 1MB 8-inch half-height DS/DD drive	66 keys, 25-key keypad, 23 function	1 parallel, 1 serial	80 × 25 monochrome	128K memory added
64K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	12-inch monochrome CRT, 720 × 300 res., 80 × 25 text	
128K/2 320K 5 ¼" floppy disk drives	83 keys, 10 special function, keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 25 text	basic system

TABLE 1—$3000-$3500 *(continued)*

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
North Star Computers	Advantage 8/16	$3399	Z80A/8088	8/16-bit	MS-DOS, GDOS	BASIC, FORTRAN, COBOL, Pascal
Apple Computer	Apple III	$3404	6502B	8-bit	Apple SOS	BASIC, Pascal
IBM	IBM-PC	$3433	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, MACRO assembler, Pascal
Canon USA	AS100	$3445	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
NEC Home Electronics	PC-8800	$3447	Z80A-compatible	8-bit	CP/M	BASIC
NEC Information Syst.	APC	$3448	8086	16-bit	CP/M-86, MS-DOS	BASIC, COBOL, FORTRAN, PASCAL, Assem.
TeleVideo Systems Inc.	TS 802	$3495	Z80A	8-bit	CP/M	COBOL
Alspa Computer	BC-800	$3495	Z80A	8-bit	CP/M	
Sumicom Inc.	System 330E	$3495	8088	16-bit	MS-DOS/CP/M-86	FORTRAN, COBOL, Pascal, BASIC
Computer Devices Inc.	DOT-3000Y	$3495	8088	16-bit	MS-DOS	BASIC, FORTRAN, COBOL, Pascal, Assembler
Eagle Computer Inc.	Eagle PC-2	$3495	8088	16-bit	CP/M-86, MS-DOS	
Digital Equipment Corp.	Rainbow 100	$3495	Z80/8088	8/16-bit	proprietary	Not announced
Intertec Data Systems	Superbrain II - SD	$3495	Z80A	8-bit	CP/M	BASIC, FORTRAN
NEC Information Syst.	APC	$3498	8086	16-bit	CP/M-86, MS-DOS	BASIC, COBOL, FORTRAN, PASCAL, Assem.
Zenith Data Systems	ZF-110	$3499	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN

the user gains access to such high-level languages as BASIC, Fortran, COBOL, Pascal, and assembler.

The graphics resolution of this computer is 640- by 400-dots and the text display is 80-characters by 25-lines. Input/output is provided by standard parallel and serial ports to which a user can add a variety of peripherals including printers and modems.

The *MBE 16000* is fully configured right out of the carton.

Hyperion

One of the remarkable events of the last year has been the appearance of a number of IBM-workalike transportable computers and the *Hyperion* is one of them.

Driven by a 16-bit 8088 CPU, this micro system comes with 256K of user memory as standard.

Capable of running under the near-standard MS-DOS, the *Hyperion* comes equipped with one double-sided, double-density 320K minifloppy-disk drive.

Programmable in BASIC, COBOL, Fortran and Pascal, this and other data are entered via an IBM-like 84-key low-profile keyboard. It features 10 special-function keys and a 10-key numeric keypad. Input/output is aided by standard parallel and serial ports (extra-cost options on the IBM *PC*).

Since it is a transportable, it has a built-in display. This video display is a 7-inch 80-character by 25-line amber unit. It is also capable of 640- by 250-dot graphics.

Radio Shack

The *Model 12* debuts in this price category. A business-oriented system, the *Model 12* is driven by an 8-bit Z80A microprocessor and is equipped with 80K of user memory. There is a powerful base of proprietary and second-source software available for it which gives the user access to many applications.

This system uses the proprietary TRSDOS system and because it does, one can easily assume that it comes with a standard disk drive, which it does. The standard drive is a double-sided, double-density 8-inch slim-line floppy capable of 1.25MB of mass storage. This amount of storage is enough to satisfy anyone's needs at first.

Programmable in BASIC, this and other data are entered through a keyboard with 82 typewriter-style keys. This unit also features eight programmable keys and 14 special-function keys.

An all-in-one unit, the 12-inch green monochrome monitor, keyboard and system box are housed in the same cabinet. The display is 80 characters by 24-lines in the text mode. Input/output is aided with two standard serial ports and one standard parallel port.

Athena

This is one of the more unusual transportables on the market because it relies on using user memory configured as a disk for high-speed storage and data access. Using memory configured as a pseudo-disk or virtual memory disk isn't a new idea in the microcomputer market, but it is usually an add-on feature, rather than a standard one. The key advantage to a *memory disk* is a manyfold increase in program execution speed. Further, the *Athena I* relies on low-power CPU's and circuitry to have effective battery operation.

The *Athena I* is driven by dual NSC-800's, low-power versions of the popular Z80 8-bit microprocessor. It comes equipped with 68K of RAM and 128K of memory dedicated to the virtual memory disk.

The user doesn't have to keep this machine powered up indefinitely to retain this storage because Athena makes a double-density 5¼-inch floppy disk available for permenant backup. The system runs under the CP/M operating system and so the user has a wide range of already-produced programs available.

Memory/Storage	Keyboard	I/O	Display	Comments
128K/2 360K DS/DD 5 ¼" floppy drives	49 keys, 14-key keypad, 15 function keys	1 parallel, 1 serial	12-inch monochrome CRT/640 × 240 graphics res./80 × 24 text mode	basic system
128K/2 140K SS/DD 5 ¼" floppy drives	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	12-inch CRT/280 × 192/560 × 192 graphics cap./80 × 24 text	2nd drive added to 128K Apple III
64K/2 320K DS/DD 5 ¼" drives	59 keys, 10 special function, 20-key keypad	1 parallel, 1 serial	12-inch monochrome/80 × 25 text	2nd drive
Not announced/2 640K DS/DD 5 ¼" floppy drives	standard	1 serial, 1 parallel	640 × 400 color graphics capability	parallel port
64K/2 1 MB DS/DD 8" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch monochrome CRT/80 × 25 text	dual 8" DS/DD drives added
128K/2 1MB 8-inch half-height DS/DD drives	66 keys, 25-key keypad, 23 function	1 parallel, 1 serial	80 × 25 monochrome	1 disk drive added
64K/2 368K DS/DD 5 ¼" drives	72 keys, 16 programmable, 17-key keypad	2 serial, 1 serial RS-422 port	14-inch monochrome/80 × 25 text	third serial port
64K/2 1.2MB floppy drives	95 keys	2 serial, 2 parallel, 1 RS-422 network port	12-inch monochrome/80 × 25 text	basic system
128K/2 720K 5 ¼" floppy dives	95 keys, 8 special function, 10-key keypad	1 serial, 1 parallel	monochrome CRT	2 720K 5 ¼" drives
128K/1 3 ⅛" 280K micro floppy drive	59 keys, 10 function keys, 18-key keypad		monochrome (built-in)/80 × 24 text	64K RAM added
128K/2 320K DS/DD 5 ¼" floppy drives	105 keys	2 serial, 1 parallel	12-inch high-res. monochrome/720 × 352 capability/80 × 25 text mode	2nd drive added
64K/2 400K 5 ¼" floppy drives	58 keys, special function, 14-key keypad	1 serial, 1 RS-423 synchronous	monochrome CRT/80 × 25 text	basic system
64K/2 1.5MB 5 ¼" floppy drives	62 keys, 18-key keypad	2 serial	12-inch monochrome/80 × 24 text mode	disk capacity increases by 750K
128K/1MB 8-inch half-height DS/DD drive	66 keys, 25-key keypad, 23 function	1 parallel, 1 serial	80 × 24 color, 640 × 200 mono res., 160 × 100 16-color, 320 × 200 4-color	color CRT added to 1 drive model
128K/2 320K DS/DD 5 ¼" drives	77 keys, 18-key keypad, 13 special function	2 serial, 1 parallel	user option	basic system

Programmable in high-level Pascal, this and other data are input via a standard typewriter-style keyboard. Input/output is provided by two standard serial ports and one parallel port. These can be used to interface with a wide variety of peripherals.

The *Athena I* makes one other departure from standard transportable configuration with its display. Unlike other transportables that use power-hungry CRT's, this small system uses a four-line, 80-character liquid crystal display. It seems this unit is a cross between the lap and the transportable computer. An external video output is available for a standard video display.

Computer Devices

The *DOT-3000X* is another of the many IBM-workalike transportables on the market.

Driven by a 16-bit 8088 microprocessor, the *DOT-3000X* comes with 128K of RAM. This amount of memory should enable the user to take advantage of the new generation of powerful 16-bit software coming to the market.

Capable of operating under MS-DOS (MicroSoft Disk Operating System), the *DOT-3000X* comes with a 3.5-inch 280K microfloppy disk drive. It is programmable in BASIC, Fortran, COBOL, Pascal, and assembler.

User input is via a typewriter-style keyboard with 59 keys. There are also 10 special-function keys and an 18-key numeric keypad. Output is via a built-in 5½ by 9-inch display that is capable of an 80-character by 24-line text mode.

Sanyo

Another of the many 16-bit machines on the market is another offering from Sanyo, the *MBC 4000*. Driven by a 16-bit 8086 CPU, the *MBC 4000* comes equipped with 128K of RAM.

Departing from what seems like the norm today, this system runs under the 16-bit version of CP/M, CP/M-86, which, at the moment, limits the user in the amount of software that has been written for this system. However, Digital Research, the producers of CP/M-86, indicates that this will soon change and more companies will write software for this operating system.

Since it has an operating system, one can assume it also has a disk and it does. It comes equipped with a 640K slim-line double-sided, double-density minifloppy disk drive that saves a great deal of space.

Programmable in BASIC and assembler, this and other data are input via a keyboard containing 60 keys, 15 programmable keys and an 18-key numeric keypad. Input/output is provided by standard serial and parallel ports.

The standard display device for the 80-character by 25-line text display of the *MBC 4000* is a 12-inch monochrome unit.

An upgraded system, the *3000Y*, is also included in this price category. In this higher-cost version, the amount of user memory doubles.

Xerox

Long active in the office-product market, Xerox has an entry in the small-computer sphere, the *820-II*. First released as the *820*, this system was upgraded last year.

Driven by an 8-bit Z80A CPU, the *820-II* comes equipped with 64K of RAM. It features two standard single-sided, double-density minifloppy-disk drives for storage. It operates under CP/M and gives the user access to the wide variety of programs available under that operating system.

Input/output is handled by a standard serial port to which a variety of peripheral equipment can be interfaced, while video output (80 characters by 24 lines of text) is handled by a standard monochrome display.

IMS International

An S-100 micromainframe system is available from IMS International, the *5000SX*.

THE *HYPERION* is a transportable IBM workalike.

The *5000SX* is a Z80-based, 8-bit system that includes two 409K double-sided, double-density minifloppy-disk drives for mass storage. It is capable of operating under CP/M and this gives the user a wide choice of application programs.

When this disk storage is combined with the 64K of RAM, the system's power is quite evident. It will easily handle many routines a user may choose to run.

With two standard serial ports and three standard parallel ports, one can see the *5000SX* is the basis of a multiuser system. With this number of input/output ports, a user can interface two terminals and three printers or a terminal, modem, and several other peripherals. Thus, more than one person can use this system, if it has more than one terminal installed. With the number of parallel ports, it can act as the mainframe driving several peripherals in an office or manufacturing setting.

Columbia Data Products

Every day it seems that one manufacturer or another is introducing an IBM-workalike small-computer system and Columbia is no exception. Its *1600-1* is driven by the same 16-bit CPU, an 8088, used by IBM and it runs under the same operating systems, MS-DOS, CP/M-86 (available for the IBM *PC*) and UCSD p-System (also available for the *PC*).

With 128K of RAM, the basic version of the *1600-1* has twice the memory of the basic *PC*. It also includes two 320K double-sided, double-density 5¼-inch minifloppy disks as standard for mass storage. This system is programmable in BASIC and assembler.

Equipped with an 83-key typewriter-style keyboard, this unit includes 10 special-function keys—as does the IBM—and a numeric keypad. (The importance of a numeric keypad can't be underestimated. It speeds numeric data entry and makes the system far more flexible to use.)

With two standard serial ports and one standard parallel port, the user has a number of interfacing options. He can use the serial ports to support printers, plotters, or modems and he can use the parallel port to support a printer. IBM makes these user options.

An 80-character by 25-line text display is read on a standard 12-inch monochrome video display.

North Star

North Star's all-in-one *Advantage 8/16* combines all the features of an 8-bit small computer with those of a 16-bit machine by using dual Z80A and 8088 CPU's. This gives the user access to the wide variety of programs available for each type of system.

With 128K of RAM, the *Advantage 8/16* is a versatile machine that is programmable in BASIC, Fortran, COBOL, and Pascal. It provides two standard 360K double-sided, double-density minifloppy disk drives for storage.

Equipped with a typewriter-style keyboard, having 49 keys, it also includes a 14-key numeric keypad and 15 special-function keys. User input is handled by this device. However, input can also come via the standard serial port.

Output, on the other hand, is displayed on a standard 12-inch monochrome video screen, either as 640- by 240-dot graphics or 80-character by 25-line text. Output can also be routed through the standard parallel port to a printer.

TeleVideo

The TeleVideo *TS 802* is another of this computer manufacturer's Z80A-based, single-user systems. Fully configured right from the box, it includes two standard 368K double-sided, double-density minifloppy-disk drives.

With 64K of RAM, the *TS 802* is easily able to handle many tasks. When this amount of user memory is combined with the standard disk drives, one can easily see it is a powerful system, capable of running under the industry-standard CP/M operating system.

Programmable in COBOL, this and other data are entered via a typewriter-style keyboard with 72 keys. The keyboard also features 16 programmable keys and a 17-key numeric keypad. Input/output is provided by two standard serial ports and an RS-422 serial port.

Since this is a fully configured system, the video-display device is standard. It uses a 14-inch monochrome screen to display 80 characters by 24 lines of text.

Alspa

A newcomer to the small-computer arena, the Alspa *BC-800* includes a great deal of bundled (included) software. Relying on proven 8-bit Z80A technology, this system comes with 64K of RAM.

A fully configured system, it comes with two 1.2MB floppy-disk drives for storage—a valuable asset. It operates under CP/M, which provides the user with access to a wide variety of proven application programs.

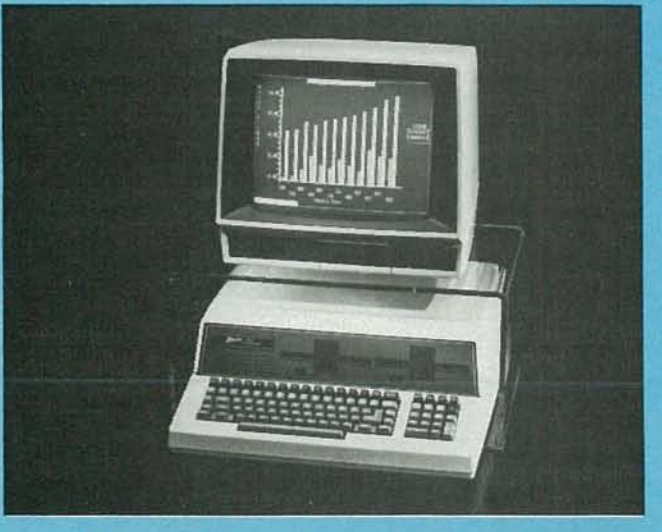
Data is input via a 95-key keyboard and it is output to a standard 12-inch monochrome display. Input/output is provided by two standard serial, two standard parallel and one serial RS-422 port.

Sumicom

Sumicom's *System 330E* is another of the IBM workalikes on the market and it uses the same CPU, the 16-bit 8088, that IBM chose for its *Personal Computer*.

Equipped with 128K of user memory—enough to handle the biggest of spreadsheet programs—the *System 330E* comes with two 720K 5¼-inch minifloppy disks for mass storage. This feature makes this system far more flexible than relying on one disk. Adding to its capabilities are the operating systems available, MS-DOS and CP/M-86.

This typewriter-style keyboard with 95 keys also includes eight special-function keys and a 14-key numeric keypad.



ZENITH'S LOW PROFILE *ZF-100* is a powerful machine.

Actually a system upgrade over lower-priced versions, the *System 330E* is capable of input and output through standard serial and parallel ports. Video output via a monochrome video display device.

Eagle

The Eagle *PC-2* is another of the IBM-workalikes on the market and uses the same CPU that is used in the IBM *PC*, a 16-bit 8088.

The computer comes with 128K of RAM, or twice that of the IBM. This is enough to handle any of the 16-bit applications programs on the market.

That it can run programs written under either MS-DOS or CP/M-86 indicates it has standard disk drives, and it does. The Eagle *PC-2* comes equipped with dual 320K 5¼-inch minifloppy disk drives. This feature makes it a highly versatile system.

User input is via a 105-key keyboard and input/output is handled via two standard serial ports and one standard parallel port.

A fully configured system, video output is to a standard 12-inch high-resolution monochrome display that's capable of an 80-character by 25-line text display.

DEC

Long the leader of the minicomputer world, Digital Equipment Corp. joined the microcomputer world a year and a half ago with its release of several small-computer systems. These systems included the *Rainbow 100*.

Equipped with Z80 and 8088 CPU's, this system uses a proprietary operating system that allows the user access to the world of CP/M and MS-DOS.

The computer comes with 64K of RAM, or enough to handle fairly complex tasks. The dual-standard minifloppy-disk drives are capable of 400K of storage apiece and add to the versatility of this system.

The main slim-line, typewriter-like keyboard has 58 keys including special-function keys and a 14-key numeric keypad. Output to the user is handled via a high-resolution monochrome video display.

Fully configured, this system includes one standard serial port and one serial RS-423 synchronous port.

Intertec

The Intertec *Superbrain II—SD* is the third upgrade of this manufacturer's all-in-one series of microcomputers. Using dual Z80A 8-bit CPU's, this system has 64K of RAM, and uses the CP/M operating system.

It upgrades in its disk storage capability. This system now has two 1.5MB super-density 5¼-inch minifloppy-disk drives. An all-in-one unit, it includes a 12-inch monochrome display in the same cabinet with the system box and the keyboard that contains 62 typewriter-like keys, a 25-key numeric keypad and 23 special-function keys. This box also houses the two standard serial ports.

COMPUTER DEVICES' *DOT-3000X* is another transportable IBM workalike.

Zenith

The second member of the Zenith *Z-100* family appears in this price category, the all-in-one version, called the *Z-120*. This unit combines the keyboard, system box, and video-display tube into one cabinet, much like the computer workstations with which many people are familiar. Unlike those terminals, which are usually linked to a mainframe and lack any real power of their own, the *Z-100* is a full-blown small-computer system.

Driven by an 8-bit 8085 and a 16-bit 8088, this 8/16-bit system comes with 128K of RAM. An IBM-workalike, it has twice the memory of the IBM *PC*.

Because it uses the proprietary Zenith Disk Operating System (ZDOS) and CP/M, one can assume it has a disk drive included as standard for storage, and it does. The disk drive is a 5¼-inch minifloppy 320K double-sided, double-density unit. This combination is powerful enough to give a user a good start in microcomputing.

Programmable in BASIC, COBOL, and Fortran, this and other data are entered via a typewriter-style keyboard with 77 keys. This keyboard includes an 18-key numeric keypad and nine special-function keys. Input/output is provided by two standard serial ports and a parallel port.

Since it's an all-in-one unit, the video-display tube is included in its basic configuration. It's a 12-inch monochrome display, capable of displaying 80-characters by 24-lines.

The low-profile system, the *ZF-100*, upgrades in this price category to become a full-featured system, with the exception of a standard display. This upgrade adds a second disk drive to the low-profile *ZF-100* system. The video display is still a user option.

Hewlett-Packard

The *HP86B* system upgrades with the addition of more user memory—128K now—and a 3.5-inch 270K microfloppy drive. More and more manufacturers are turning to this type of drive because of the space savings. Like a minifloppy, it makes a system more versatile.

At the same time, the *HP86A* is also upgraded with the addition of the same type of 3.5-inch drive, while the *HP85A* upgrades with the addition of a serial port. This gives the *HP85A* telecommunications capability if you add a modem or the capability to interface with a serial printer, rather than relying on the built-in thermal printer.

IBM

The IBM *Personal Computer* becomes more powerful and capable of high-resolution color output with the addition of a color video-display tube to the double-sided, double-density drive model. In this configuration, a serial port is also added for

communications capability, if you choose, or to interface with a serial printer.

The second upgrade—a second disk drive for storage—brings the IBM *Personal Computer* to its full configuration. Now it has two disk drives for added flexibility in mass storage and data access.

Apple

The *Apple IIe* is just about fully configured in this price category. In the latest upgrade, a second minifloppy-disk drive is added for greater mass storage.

At the same time, the *Apple III* upgrades twice. In the first upgrade, a standard high-resolution video display device is added to the 256K version of this small-computer system.

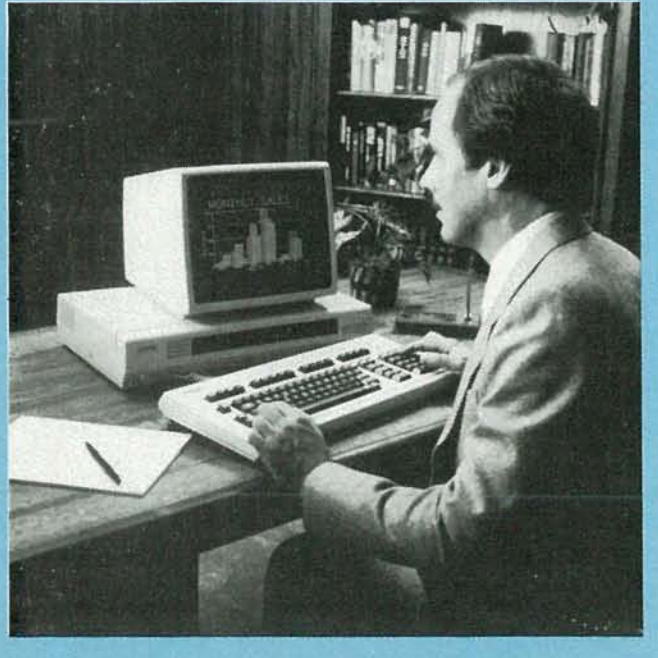
The 128K version of the same system becomes fully configured with the addition of a second minifloppy disk drive for mass storage.

NEC

The NEC *APC* becomes a far more powerful system with its three upgrades. The first adds 128K to the amount of RAM, while the second adds a disk drive. At once, this upgrade makes the system far more flexible. The third upgrade adds a color video-display device to the one-drive needed and gives you color-graphics capability.

The *PC-8800*, now an 8/16-bit system with access to both CP/M and MS-DOS, the leading operating systems of the 8-bit and 16-bit worlds, now becomes fully configured as dual 320K double-sided, double-density disk drives are added. It gains even more capability as the disk-drive capacity is increased even further with dual eight-inch floppy-disk drives.

THE ALL-IN-ONE version of Zenith's 8/16-bit computer system, the Z-100 has a non-glare green CRT and two 320K 5¼-inch drives.



EPSON's *QX-10* desktop computer features two double-sided, double-density disk drives and runs the CP/M operating system.

Toshiba

With the two upgrades to the *T300* small-computer system, it makes the transition from a monochrome microcomputer with two drives to a color computer with two drives..

The first upgrade brings the monochrome system to full configuration with the addition of a second disk drive. This increases the flexibility of this system.

Under the second upgrade, the monochrome display is changed to a high-resolution color display and this system gains color-graphics capability, if the user chooses to use it.

Sony

The *SMC-70* system becomes quite full-featured here. With its first upgrade, a second disk drive increases this system's storage flexibility and capability. This system was the first to make use of 3.5-inch microfloppy-disk drives, which a number of other microcomputer companies are also making use of. However, this isn't yet the standard size because there are also varieties available in the 3 to 3.25-inch range.

The second upgrade substitutes a high resolution RGB color video-display device for the monochrome display and gives this system its full configuration.

Canon

In this price category, the Canon *AS100* system upgrades three times. The first upgrade gives this system color-graphics capability with a color video-display tube capable of a 640- by 400-dot resolution.

In the second upgrade, a serial port is added to the *AS100*'s configuration. The third upgrade, adding a parallel interface, frees the serial port for communications use solely. (The parallel port can be dedicated to a printer.)

Texas Instruments

The *Professional Computer* becomes nearly fully configured in this price category with the addition of a second double-sided, double-density 320K minifloppy-disk drive. This addition gives the user access to a second disk which speeds system operation.

Casio

The Casio *FX-9000P* has its memory increased to 32K with the addition of 28K of memory. Further, the versatility of this small system is increased with the addition of a minifloppy-disk drive.

LNW Research

The *LNW80 Model II* becomes a fully configured system with the addition of a second minifloppy-disk drive.

Sord

Although the name *M23 Mark III C* looks as if it might be a new system, it is, in reality, an upgraded Sord *M23* system. In this configuration, the system upgrades and gains color capability with, as you might expect, the addition of a color video-display device.

Commodore

The *8032* system, which was introduced several price categories ago, makes its appearance again, now in its fully configured state. This system, which includes a standard CRT, now also has duel 5¼-inch minifloppy-disk drives included for storage. **R-E**

An innovative lap computer is among the new machines we see here.

$3500 to $4000

MARC STERN

AS WE MOVE INTO THE HIGHER PRICE CATEGORIES, PERHAPS you've noticed how more and more central processing units have become 16-bit devices. This contrasts quite markedly with the situation a year ago, when the majority of higher-priced, small-computer systems on the market were still 8-bit machines.

Why has this happened? The key reason is IBM's move into the microcomputer market. It has legitimatized the microcomputer in the eyes of many and it has created a vast market of new users. Seeing this, the rest of the microcomputer industry has jumped aboard the bandwagon with new IBM-workalike or compatible systems. A second reason, that is just as important, is that the microcomputer industry has seen the power available in the 16-bit CPU and it wants to make use of that power.

In this price category, 11 new systems make their debuts. Most are from manufacturers that have already been introduced in other price categories. However, there are four new companies that make their appearances here. Let's begin our look at this market with those four new companies. Then we will explore the rest of the category and see how various systems upgrade.

Gavilan

The *Gavilan* is one of the most innovative of the new generation of lap computers, now making their debuts. It is very frankly aimed at the business market and makes no bones about saying so. Because it is, this system includes a variety of bundled (included) software for word-processing, appointments and other business-oriented tasks. They are contained in plug-in capsules, as the company terms them.

Perhaps the most innovative fact about the *Gavilan* is its size. Even though it includes a microdisk drive for storage as part of its basic configuration, it easily folds up and fits into the average briefcase. If you've looked closely at the chart you've probably noticed that it only comes with 32K of RAM. Other ROM-based functions reside in another 32K of built-in memory and this leaves a full 32K available for the user. This ROM handles much of the work that RAM is required to do in other systems. This system is driven by a 16-bit 8088 microprocessor, that makes it another of the many IBM-workalikes that are now on the market.

Because it does have a standard disk drive it needs an operating system and the one Gavilan has chosen is the near-standard 16-bit operating system, MS-DOS. Due to the extensive package of software included with this system, a user really won't have need of much more software than that included.

The *Gavilan*'s other unique feature is its "mouse." A relatively new feature in the small-computer world, a mouse is a small device that rolls around a desk top. It interfaces with the system's memory and lets the user move the cursor all over the screen. This eliminates the need for keyboard use and lets the user pick a function from several on the screen, provided a program has this type of feature, by just moving the mouse around. But rather than relying on a true "mouse," Gavilan uses a touch-sensitive plate under the 8 line by 66-character liquid-crystal display so a user can access a particular function.

Fujitsu

A leading Japanese computer manufacturer, Fujitsu has an entry in the microcomputer field, the *Micro 16*, a unit with 8- and 16-bit co-processors.

Driven by either a proven 8-bit Z80A CPU or a reliable 16-bit 8086—the bigger brother of the 8088—the Micro 16 has access to the world of CP/M and its many programs, Concurrent CP/M and its multitasking capabilities, or optional MS-DOS. This gives the user access to a versatile software base.

Equipped with 128K of user memory, this system will easily handle any of the many sophisticated programs available on the market today. Its mass-storage capabilities—two standard 320K double-sided, double-density minifloppy-disk drives—is also easily up to any task given the system.

The keyboard has a total of 98 keys and a separate numeric

TABLE 1—$3500-$4000

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Athena Computer	Athena I	$3500	NSC-800 (low-power Z80)	8-bit	CP/M	Pascal
Texas Instruments	Professional Computer	$3515	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Basis Inc.	Basis 108	$3590	Z80A/6502	8-bit	CP/M, Apple	BASIC, Pascal, LOGO
TeleVideo Systems Inc.	TS 1603	$3590	8088	16-bit	CP/M-86, MS-DOS	COBOL
Compaq Computer Corp.	Compaq	$3590	8088	16-bit	Compaq DOS (Similar to IBM PC-DOS)	BASIC
Zenith Data Systems	ZF-100	$3598	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN
IBM	IBM-PC	$3598	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, Macro Assembler, Pascal
Zenith Data Systems	Z-120	$3599	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN
Sage Computer Tech.	Sage II	$3600	MC68000	16/32-bit	UCSD p-System, CP/M-86K, Modula 2, Hyper-FORTH	BASIC, FORTRAN, Pascal, Assembler
Apple Computer	Apple III	$3604	6502B	8-bit	Apple SOS	BASIC, Pascal
Zenith Data Systems	ZF-100	$3638	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN
Sony	SMC-70	$3645	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Texas Instruments	Professional Computer	$3670	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
IBM	IBM-PC	$3677	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, Macro Assembler, Pascal
Dynalogic Info-Tech Corp.	Hyperion	$3690	8088	16-bit	MS-DOS	BASIC, COBOL, FORTRAN, Pascal
Basis Inc.	Basis 108	$3690	Z80A/6502	8-bit	CP/M, Apple	BASIC, Pascal, LOGO
IMS International	5000IS	$3700	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
Sony	SMC-70	$3700	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Compaq Computer Corp.	Compaq	$3705	8088	16-bit	Compaq DOS (Similar to IBM PC-DOS)	BASIC
Hewlett-Packard	HP-85A	$3735	Not announced		Proprietary	BASIC, Assembler
Sord Computer	M23 Mark V G	$3785	Z80A	8-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
Wang Laboratories	Professional Computer	$3790	8086	16-bit	MS-DOS, CP/M emulation	BASIC, COBOL, FORTRAN, Pascal
Hewlett-Packard	H85B	$3790	Not announced		Proprietary	BASIC, Assembler
Commodore Business Mach.	SuperPET	$3790	6502/6809	8-bit	Proprietary	BASIC, APL, COBOL, FORTRAN, Pascal
Toshiba America	T300	$3795	8088	16-bit	MS-DOS, CP/M-86	BASIC
Columbia Data Products	1600-1	$3840	8088	16-bit	MS-DOS	BASIC, Assembler
IBM	IBM-PC	$3842	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, Macro Assembler, Pascal
NEC Home Electronics	PC-8800	$3846	Z80A-compatible/8086	8/16-bit	CP/M, CP/M-86, MS-DOS	BASIC
Hewlett-Packard	HP86A	$3865	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN

Memory/Storage	Keyboard	I/O	Display	Comments
68K/256K of RAM-disk storage/1 DD 5 ¼" floppy included	standard	2 serial, 1 parallel	80-character × 4-line liquid crystal display/external CRT connector	256K RAM-disk
64K/1 320K DS/DD 5 ¼" floppy drive	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	13-inch color CRT, 720 × 300 res., 80 × 25 text	color CRT added to 1-disk version
128K/2 5 ¼" floppy drives/256K memory (RAM) disk added	58 keys, 15 programmable, number keypad	1 parallel, 1 serial	RGB and composite/280 × 192 res./80 × 25 text	256K memory RAM-disk
256K/2 half-height 368K DS/DD floppy drives	72 keys, 16 programmable, 16-key keypad	2 serial, 1 serial RS-422 port	14-inch monochrome/80 × 25 text	memory expanded to 256K
128K/2 5 ¼" DS/DD drives, 640K	83 keys, 10-key keypad, 10 special funct.	1 parallel, opt. serial	9-inch monochrome (built-in)/80 × 25 text	second drive added
128K/1 320K DS/DD 5 ¼" drive	77 keys, 18-key keypad, 13 special funct.	2 serial, 1 parallel	color CRT/640 × 225 high-res., 80 × 25 lines	high-res. color CRT added
128K/2 320K DS/DD 5 ¼" drives	59 keys, 10 special function, 20-key keypad	1 parallel, 1 serial	12-inch monochrome/80 × 25 text	memory expanded to 128K
128K/2 320K DS/DD 5 ¼" drives	77 keys, 18-key keypad, 13 special funct.	2 serial, 1 parallel	built-in 80 × 25 monochrome CRT	2nd drive added
128K/1 640K 5 ¼" floppy drive	N/A	2 serial, 1 RS-488, 1 parallel	N/A	powerful MC68000-based micromainframe
256K/2 140K SS/DD 5 ¼" floppy drives	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	12-inch CRT/280 × 192/560 × 192 graphics cap./80 × 24 text	2nd drive added to 256K Apple III
128K/2 320K DS/DD 5 ¼" drives	77 keys, 18-key keypad, 13 special funct.	2 serial, 1 parallel	green monochrome CRT/80 × 25 text	green monochrome display added
64K/2 280K 3.5" microfloppy drives	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch RGB high-res. color CRT	color CRT subsituted for display
128K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	12-inch monochrome CRT, 720 × 300 res., 80 × 25 display	64K memory added to 2-drive monochrome unit
64K/2 320K DS/DD 5 ¼" drives	59 keys, 10 special function, 20-key keypad	1 parallel, 1 serial	12-inch high-res. color display/80 × 25 text	color display added to 2-drive DS/DD system
256K/2 320K DS/DD 5 ¼" floppy drives	84 keys, 10 function keys, 10-key keypad	1 serial, 1 parallel	7-inch amber monochrome CRT/80 × 25 text mode/640 × 250 graphics	second drive added
128K/2 5 ¼" floppy drives/256K memory (RAM) disk	58 keys, 15 programmable, keypad	1 parallel, 1 serial	RGB and composite/280 × 192 res./80 × 25 text	256K memory RAM disk for greater speed added
64K/2 409K DS/DD half-height 5 ¼" floppy drives	64 keys, 14 special function, 19-key keypad	1 serial	monochrome CRT/80 × 24 text mode	basic system
64K/2 280K 3.5" microfloppy drives	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch green CRT/80 × 25 text	expansion unit
128K/2 5 ¼" DS/DD drives, 640K	83 keys, 10-key keypad, 10 special funct.	1 parallel, 1 serial	9-inch monochrome (built-in)/80 × 25 text	serial port
32K/built-in tape storage, 195K	58 keys, 20-key keypad, 8 special function	1 serial, 1 general purpose interface	built-in 5" CRT/256 × 192 graphics, 32 × 16 text	2nd port serial added
128K/2 1MB 8" drives	59 keys, 20-key keypad, 9 special function	2 serial, 1 parallel	12-inch green CRT	system upgraded to 8-inch drives with 1MB storage
128K/2 360K DS/DD 5 ¼" floppy drives	101 keys, 16 programmable, 18-key keypad	1 parallel, 1 serial	monochrome CRT 800 × 300	second drive, display, and adapter added to Wang PC
160K/tape drive/RAM disk	58 keys, 20-key keypad, 8 special function		built-in 5" CRT/256 × 192 graphics, 32 × 16 text	RAM expanded to 160K
96K/dual 5 ¼" floppy disk drives	standard, numeric keykeypad	1 serial	12-inch monochrome CRT/80 × 25 text mode	dual floppy disk drives added
192K/2 640K 5 ¼" drives	67 keys, 18 special funct., 10 edit, 18-key keypad	1 parallel, 1 serial	640 × 200, 80 × 25 in text mode	2nd drive added to color model
256K/2 320K 5 ¼" floppy disk drives	83 keys, 10 special function, keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 25 text	user memory increased to 256K
128K/2 320K DS/DD 5 ¼" drives	59 keys, 10 special function, 20-key keypad	1 parallel, 1 serial	12-inch high-res. color display/80 × 25 text	memory expanded to 128K in color IBM-PC
128K/2 320K DS/DD 5 ¼" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch color CRT/640 × 400 res./80 × 25 text	color display added to 5 ¼-inch system
64K/2 270K 3.5-inch microdrives for storage	59 keys, 20-key keypad, 14 special function	1 parallel	9" monochrome CRT/80 × 25 text	2nd drive added

TABLE 1—$3500-$4000 *(continued)*

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Texas Instruments	Professional Computer	$3870	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Vector Graphic Inc.	Vector 4/10	$3895	Z80B, 8088	8/16-bit	CP/M-86, MS-DOS (optional), CP/M	Not announced
Micro Source	M6000P	$3900	Z80A	8-bit	CP/M	Not announced
Compaq Computer Corp.	Compaq	$3910	8088	16-bit	Compaq DOS (Similar to IBM PC-DOS)	BASIC
IBM	IBM-PC	$3928	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, MACRO Assembler, Pascal
Digital Equipment Corp.	Professional 325	$3945	PDP-11/238	16-bit	Proprietary, CP/M optional	Not announced
Athena Computer	Athena I	$3950	NSC-800 (low-power Z80)	8-bit	CP/M	Pascal
Hewlett-Packard	HP120/125	$3975	Z80A	8-bit	CP/M	BASIC, Assembler
Hewlett-Packard	HP200	$3985	MC68000	16/32-bit	N/A	BASIC, Pascal, HPL
Computer Devices Inc.	DOT-3000Z	$3995	8088	16-bit	MS-DOS	BASIC, FORTRAN, COBOL, Pascal, Assembler
Gavilan Computer Corp.	Gavilan	$3995	8088	16-bit	MS-DOS	BASIC, Pascal
Sanyo	MBC 4050	$3995	8086	16-bit	CP/M-86	BASIC, Assembler
Toshiba America	T250-4	$3995	Z80	8-bit	CP/M	BASIC
Eagle Computer Inc.	Eagle IIE-4	$3995	Z80A	8-bit	CP/M	BASIC
Fujitsu Microelectronics	Micro 16	$3995	Z80A, 8086	8/16-bit	CP/M-86, Concurrent CP/M/MS-DOS optional	Not announced
NEC Home Electronics	PC-8800	$3997	Z80A-compatible/8086	8/16-bit	CP/M, CP/M-86, MS-DOS	BASIC
Radio Shack	TRS-80 Model 12	$3999	Z80A	8-bit	TRSDOS	BASIC

keypad, plus 10 programmable keys. This device handles user input, while input/output is handled by standard serial and parallel ports. The video display delivers 640 by 200-line high-resolution graphics or an 80-character by 25-line text mode.

Micro Source

The Micro Source *M6000P* is an industry-oriented S-100 compatible transportable microcomputer system. (The industry-standard S-100 bus features a 100-line bus that accessory cards are plugged into. The micprocessor's motherboard is also tied into this bus.) The *M6000P* has 64K of RAM and operates under CP/M. Because it operates under CP/M, the operator has many programs to use with the standard 376K double-sided, double-density 5¼-inch minifloppy disk drives.

User input is via the keyboard that has a total of 83 keys, including four function keys and a separate 14-key numeric pad. Standard serial and parallel ports handle input/output. The built-in monochrome display is a 9-inch screen that displays 80 characters by 24 lines. RGB outputs are also available for color graphics.

Sage

The Sage *II* is a powerful, multiuser MC68000-based small-computer system. Its 16-, 32-bit MC68000 CPU makes it special, because few other systems use this powerful microprocessor chip (a situation that's likely to change in the relatively near future). Actually a micromainframe, the Sage *II* has 128K of standard user memory available, enough for a single-user system, but really not enough for an extended multiuser system.

The single 640K 5¼-inch minifloppy disk drive gives the user of this system a great deal of initial mass storage. It can run under several high-level operating systems and the system is programmable in BASIC, Fortran, Pascal, and assembler.

Since this is the basis of a multiuser system, it includes several standard input/output ports. These include two standard serial, an RS-488 general purpose serial port, and a parallel port. The user has his choice of a terminal.

IMS International

The IMS *5000IS* is, at this stage, a fully configured system. Driven by a Z80 microprocessor, it runs under CP/M, MP/M (the multiuser version of CP/M) and TurboDOS, another high-level operating system. Standard user memory is 64K and disk storage is handled by two 409K double-sided, double-density 5¼-inch minifloppy disks.

Programmable in BASIC, COBOL, Fortran, and Pascal, this and other data are input via a typewriter-style keyboard with 64 typewriter-style keys. There are also 14 special-function keys, as well as a separate 19-key numeric pad. Input/output is handled with a standard serial port so that a user can interface a printer or modem for telecommunications. The standard monochrome monitor displays 80 characters by 25 lines.

Memory/Storage	Keyboard	I/O	Display	Comments
192K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	12-inch monochrome CRT/720 × 300 res., 80 × 25 display	2-drive monochrome version, memory expanded to 192K
128K/1 630K 5 ¼" floppy drive	91 keys, 15 special function, 18-key keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 24 text/640 × 312 graphics	1 630K 5 ¼" drive added
64K/2 376K DS/DD 5 ¼" floppy drives	83 keys, 4 function, 14-key keypad	1 serial, 1 parallel	9-inch CRT, RGB color avail./80 × 24 text	basic system
256K/2 5 ¼" DS/DD drives, 640K	83 keys, 10-key keypad, 10 special funct.	1 parallel, 1 serial	9-inch monochrome (built-in)/80 × 25 text	128K memory expansion
256K/2 320K DS/DD 5 ¼" drives	59 keys, 10 special function, 20-key keypad	1 parallel, 1 serial	12-inch monochrome/80 × 25 text	memory expanded to 256K
256K/2 400K 5 ¼" floppy drives	58 keys, special function, 14-key keypad	1 serial, 1 RS-423 synchronous	monochrome CRT/80 × 25 text	professional system with powerful CPU and operating system
68K/512K of RAM-disk storage/1 DD 5 ¼" floppy included	standard	2 serial, 1 parallel	80-character × 4-line liquid crystal display/external CRT connector	512K RAM-disk
64K/1 3.5-inch 248K microdrive	58 keys, 8 special functions, programmable keys	2 serial, 1 IEEE-488	9" or 12"-monochrome CRT/80 × 25 text	3.5-inch drive added
128K	57 keys, 10 definable functions on 5 keys	1 serial, 1 multipurpose IEEE-488 port	9" monochrome CRT/80 × 25 text	base configuration
128K/1 3.5" 280K micro floppy drive	59 keys, 10 function keys, 18-key keypad		monochrome (built-in)/80 × 24 text	software package enhanced
32K/1 320K 3" microfloppy disk drive	61 key board, embedded 10-key keypad	1 serial	66-character × 8-line liquid crystal display/touch panel	full-featured lap computer
128K/2 640K slim line 5 ¼" DS/DD floppy drives	60 keys, 15 programmable, 18-key keypad	1 parallel, 1 serial	12-inch monochrome/80 × 25 text mode	2nd drive added to MBC 4000
64K/2 8-inch DS/DD drives	not announced	not announced	not announced	
64K/1 780K DS/DD 5 ¼" floppy drive/1 10MB hard disk	75 keys	2 serial, 2 parallel	12-inch monochrome/80 × 25 text mode	10MB hard (Winchester) disk drive
128K/2 320K DS/DD 5 ¼" floppy drives	98 keys, separate numeric keypad, 10 programmable keys	1 serial, 1 parallel	80 × 25 text mode/640 × 200 graphics	basic system
128K/2 1MB DS/DD 8" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch monochrome CRT/80 × 25 text	storage grows to 2MB with 8" DS/DD drives
80K/2 1.2MB 8" DS/DD floppy drives	82 keys, 8 programmable keys, 19-key keypad	2 serial, 1 parallel	12-inch monochrome/80 (40) × 24 text mode	2nd drive

Toshiba

With entries in several other pricing categories, Toshiba has a new entry in this one, the *T250-4*. Another of the many Z80 8-bit systems on the market, it features 64K of user memory. Operating under the CP/M operating system, the *T250-4* comes with two standard 8-inch double-sided, double-density floppy-disk drives for storage. Information on the display was unavailable at press time.

DEC

Another of the Digital Equipment small-computer offerings is the *Professional 325*, that uses a proprietary 16-bit microprocessor based on the architecture of the DEC *PDP-11/238*. Equipped with 256K of user memory, this system has two standard 400K 5¼-inch minifloppy disks for storage. It operates under a proprietary operating system, but CP/M is also available as an option.

Fully configured at this point, the *Professional* uses a slim-line typewriter-style keyboard with a total of 58 typewriter keys. This keyboard also features special function keys and a separate 14-key numeric pad. While the keyboard handles user input, output is sent to a high-resolution monochrome display that has an 80-character by 25-line display. Input/output is handled by a standard serial port as well as by an RS-423 synchronous port. That port can be used for communications or can interface with a larger network.

Eagle

The Eagle *IIE-4* is another small-computer system that makes its appearance here. Actually an upgrade of an already existing system, the Eagle *IIE* series, that was introduced in another pricing category, the Eagle *IIE-4* is driven by the same type of 8-bit Z80A CPU. Operating under CP/M, it has one 780K double-sided, double-density minifloppy disk available for storage. Its other storage medium, also part of the system upgrade, is a 10-MB hard disk.

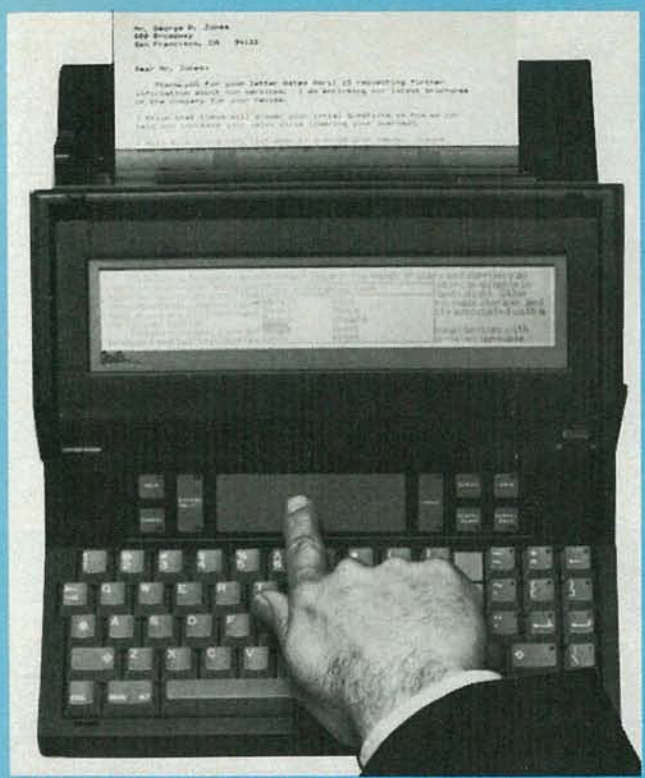
Programmable in BASIC, this and other data are input via the 75-key typewriter-style keyboard. Output is to a 12-inch 80-character by 25-line monochrome display screen. Input/output is handled by two standard serial and two standard parallel ports, so a variety of peripherals can be attached.

Vector Graphic

The Vector *4/10* is an 8/16-bit small-computer that makes use of co-processors, a Z80B (8-bit) and an 8088 (16-bit). The Vector *4/10* runs CP/M-86—the 16-bit version of CP/M—CP/M, with MS-DOS available as an option.

The standard disk drive is a 630K 5¼-inch minifloppy unit. When this is combined with the standard 128K RAM, it becomes a flexible unit.

Having a total of 91 typewriter-style keys, the Vector *4/10*'s keyboard also has 15 special-function keys and an 18-key numeric pad. User input is via this device and output is to a



THE *GAVILAN* is an IBM workalike *lap* computer.

12-inch monochrome video tube that delivers 640 by 312 graphics or an 80-character by 24-line text display. There are two standard serial ports and one standard parallel port.

Sanyo

A new Sanyo offering is the *MBC 4050* 16-bit small-computer system. Driven by an 8086, 16-bit microprocessor, it has 128K of user memory. This amount of memory is enough to handle any of the complex 16-bit programs available on the market today. Unlike other 16-bit systems today, the *MBC 4050* relies on the CP/M-86 operating system. It could be somewhat limiting to a computer user because most 16-bit programs are being written for MS-DOS. The *MBC 4050* is equipped with two 640K slim-line minifloppy-disk drives for mass storage.

Programmable in BASIC and assembler, this and other data are input via a standard typewriter-style keyboard with 60 typewriter keys. There are also 15 separate programmable keys and a separate 18-key numeric pad. Video output (80 characters by 25 lines text) is to a standard 12-inch monochrome display. Input/output is handled via standard serial and parallel ports. The MBC *4050* system is actually an upgrade to the *MBC 4000* small-computer system. It adds a second drive for greater storage.

Computer Devices

The *DOT-3000Z* is basically an upgraded system at this point. The key change to this 8088, 16-bit CPU-based *3000Z* is an enhanced software package. It still has only one 3.5-inch microfloppy drive for storage, but it does offer 128K of user memory. A transportable, it has 59 typewriter-style keys on the main keyboard and eight special-function keys, plus programmable softkeys. Its monochrome display is still a built-in 5½ by 9-inch screen.

Hewlett-Packard

A new system joins the wide-ranging Hewlett-Packard lineup in this price category, the *HP200*, one of the first small-computers in the reasonable-cost market to make use of the powerful MC68000 16-bit microprocessor. That CPU offers seventeen 32-bit registers and can directly address 16 megabytes.

This microcomputer uses the powerful multiuser UNIX operating system, but there is no disk storage indicated at this price level.

Programmable in BASIC, Pascal, and HPL, the system has 128K of standard user memory. The typewriter-style keyboard has 57 keys and 10 definable functions included on five multifunction keys.

In this base configuration, input/output is handled via a standard serial port or a multipurpose IEEE-488 general input/output port. Both of these ports can be interfaced with a variety of peripherals, including printers, plotters, modems, and scientific or manufacturing instruments. The standard screen is a 9-inch monochrome display that shows 80-characters by 25-lines.

For the portable *HP85A*, this upgrade adds a second serial port—a general-purpose input/output port— that lets this small-computer system be linked to a wide variety of peripheral equipment. Meanwhile, the *HP85B* has its user memory increased to 160K. That means it can handle more user input and far more complex routines and tasks.

The *HP86A*, meantime, becomes fully configured with an added second 270K 3.5-inch microfloppy-disk drive for mass storage. This frees the user from the limitations imposed by only having one disk drive. The *HP120/125* becomes much more versatile with one 248K 3.5-inch microfloppy-disk drive.

Compaq

This IBM-compatible transportable small-computer system becomes fully configured in this pricing category. With the addition of a second 320K double-sided, double-density minifloppy-disk drive, the *Compaq* gains much more power and flexibility. Its second upgrade gives it even further capability by allowing serial communications ability. The optional serial interface port is now standard and a user can tie in a variety of peripherals, including printers, plotters, and modems.

Its next upgrade adds to its full configuration by adding a full

THE *SAGE II* is shown here with some of its "big brothers."

DIGITAL EQUIPMENT CORP.'s computers—the *Professional* is in center.

128K of user memory, thus bringing its standard memory to a full 256K. With this much memory, this system can easily handle the memory-hungry 16-bit programs available.

Sony

The full-featured *SMC-70* system becomes even more versatile with the addition of a 12-inch RGB high-resolution color monitor. This system now has color-graphics capability. It becomes even more flexible in its second expansion with the addition of an expansion unit that broadens the range of peripherals to which it can be interfaced.

IBM

The IBM *Personal Computer* begins to become rather powerful as it approaches its fullest configuration. In its first change, the user memory capacity is increased to 128K on the monochrome version. That makes it able to handle just about any program on the market. In its second upgrade, the high-resolution monochrome display is changed to a high-resolution color display.

With this second upgrade completed, the next upgrade increases the memory of the color display version of the IBM-*PC* to 128K. The final upgrade brings the amount of user memory up to 256K.

Texas Instruments

The one-disk version of the TI *Professional Computer* gains color-graphics capability with the addition of a 13-inch color monitor. It delivers 720 by 300 resolution. Another version, the two-drive monochrome version, has its user memory increased to 128K for more capability.

The last upgrade to the two-drive monochrome TI *PC* brings the amount of user memory up to 192K. Although you may think this is far too much memory, remember that the new generation of memory-hungry 16-bit programs requires great amounts of memory to function correctly.

Zenith

The *Z-100* line becomes more powerful in this region, too. In the first expansion to the low-profile unit, a high-resolution color monitor is added to enhance the unit's graphics capability. Although this seems unlikely, adding the high-resolution green monochrome display increases the cost of the low-profile *Z-100* beyond that of the color version. The prices, though, were obtained from two different Heath/Zenith sources.

The last upgrade to this line makes the all-in-one *Z-100* a fully configured unit. It adds a second 320K double-sided, double-density disk drive to the all-in-one.

NEC

The now-dual processor *PC-8800* series receives the addition of a 14-inch, high-resolution color monitor.

NEC's POWERFUL *PC-8800* is shown here.

Basis

The Apple/CP/M-compatible Basis *108* system becomes a speedier unit with the addition of a 256K virtual-memory disk.

Athena

The transportable Athena *I*, has its standard virtual-memory disk expanded to 256K for greater storage potential. It means a user can now load and use larger programs in this type of pseudo-disk system. The second expansion makes this system even more powerful as this memory disk is expanded to 512K.

TeleVideo

The memory capacity of the *TS 1603* 16-bit system is expanded to 256K, the fully configured number for this supplement. It means this system can use any of the memory-hungry 16-bit programs now coming to the market very efficiently.

Apple

At this stage, the Apple *III* becomes fully configured. Not only does it have a standard display and 256K of memory, but it also has a second drive for more flexible system operation.

Hyperion

This transportable small-computer system finds its flexibility increase in this pricing category with the addition of a second 320K double-sided, double-density minifloppy-disk drive.

Sord

The *M23* system becomes even more powerful as it upgrades to the *Mark V G* model. In this configuration, the drives are upgraded to 8-inch units with 1-megabyte of storage potential per drive.

Wang

The *Professional Computer*—this company also makes one—gains more power and flexibility with the addition of a second 360K double-sided, double-density drive. At the same time, a high-resolution—800 by 300—monochrome display and its adapter become standard equipment.

Commodore

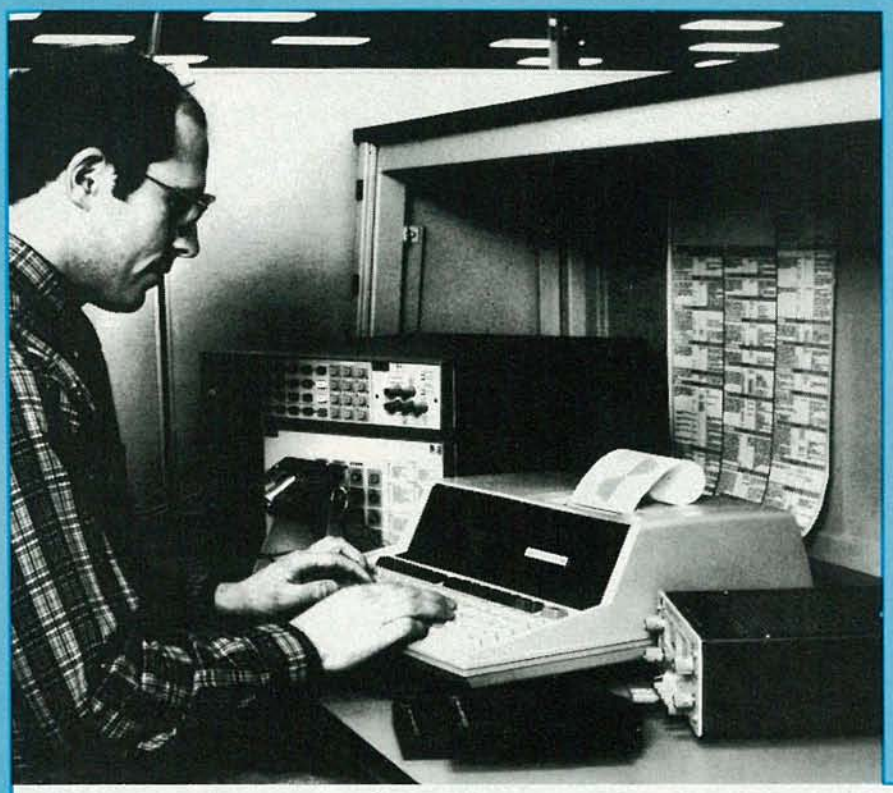
With the addition of dual 5¼-inch disk drives, the 96K *SuperPET* system becomes fully configured.

Toshiba

The *T300*, now a color-capable computer, becomes even more capable with the addition of a second 640K 5¼-inch minifloppy-disk drive.

Radio Shack

The *TRS-80 Model 12* business computer becomes even more powerful and flexibile with the addition of a second 1.2-MB 8-inch floppy-disk drive. **R-E**



The major change in this price range, when compared to last year, is the inclusion of a hard-disk drive in many systems.

$4000 to $4500

MARC STERN

SOMETHING INTERESTING IS BEGINNING TO OCCUR AT THIS POINT in our buyer's guide; the Winchester drive is beginning to appear more frequently. Also known as the hard disk, this storage option was, until a couple of years ago, associated only with full-sized mainframe computers or minicomputers. If any were available for the small-computer world, they were only available on high-end systems costing nearly $10000.

Now, hard disks are available near the top-end of any affordable computer line. Their cost isn't much greater than the cost of a pair of high-density 8-inch floppy-disk drives, but their advantages are greater.

These disks are capable of much greater storage potential. Where a high-density minifloppy may store up to 700 kilobytes of data and an 8-inch floppy may now store over 1 megabyte, the smallest hard disk stores 5 megabytes or more of information.

Perhaps their greatest drawback is backup because it takes a great many floppy or minifloppy disks to back up the information on a hard disk.

In this price category, nine new machines debut and without further ado, we'll begin our look at those machines.

DEC

The *DECmate II* is another of the Digital Equipment Small Computer offerings that were first unveiled about a year and a half ago.

Driven by a proprietary PDP-8 16-bit microprocessor and a Z80 co-processor, the *DECmate II* features 64K of RAM in this configuration.

Capable of using CP/M-86, MS-DOS or its own proprietary operating system, this microcomputer is equipped with two standard 400K 5¼-inch minifloppy-disk drives.

The slim-line typewriter-like keyboard of the *DECmate II* has 58 keys. It also features separate special-function keys and a 14-key numeric keypad.

Equipped with a standard serial port, which can be interfaced with a wide variety of peripherals, including printers, plotters, and modems, the *DECmate II* also features an RS-423 synchronous port. This type of port allows this machine to be tied into a larger office network and provides high-speed data communication in this setting.

User output is via a black-and-white CRT that provides an 80-character by 25-line text display.

IMS

The *5000X16* system is another of the micromainframe systems offered by IMS International. A micromainframe is a small-computer system that features a system box, two drives, and a number of input/output ports. A user has the option of interfacing his own terminal, a device that includes a keyboard and a display screen.

Driven by a 16-bit 8088 CPU—the same one used by the IBM *Personal Computer*, this system runs under either MS-DOS or CP/M-86.

This last feature is also one worth noting. Since the 16-bit microcomputer world seems to be standardizing around MS-DOS as the operating system, it makes sense for a microcomputer manufacturer to offer it. There is a wealth of new, powerful software being written for this operating system. At the same time, though, Digital Research, which offers CP/M-86, is becoming more aggressive in this field and it is possible another body of software will grow under this system. It just gives the user another "in case" option.

With 256K of user memory, this system can handle any of the new 16-bit programs which might be thrown at it. It can also become a multiuser machine with the addition of a hard disk.

The standard disk drives for the *5000X16* are dual 409K double-sided, double-density 5¼-inch minifloppies.

With two standard serial and three parallel ports, there are

enough input/output options for a user to interface a number of peripherals. Those will likely include, in this case, terminals, printers or plotters, and, possibly, a modem. This computer is programmable in BASIC, COBOL, Fortran, and Pascal.

Another IMS offering, the *5000IS16* is also driven by a 16-bit 8088 CPU. An IBM-workalike small computer, this system also has 256K of RAM. This allows the *5000IS16* to easily handle any of the sophisticated 16-bit programs now coming to the market. In fact, most of those programs require a minimum of 90 to 128K of memory for efficient operation.

Running under either MS-DOS or CP/M-86, a user has access to a wide variety of programs. The disk drives are double-sided, double-density 409K 5¼-inch minifloppies.

Programmable in BASIC, COBOL, Fortran, and Pascal, this and other data are are input via a keyboard containing 64 separate typewriter-style keys. The keyboard also contains 14 special-function keys and a 19-key numeric keypad.

User output is to a monochrome monitor with an 80-character by 24-line text mode display.

Input/output is handled via a standard serial port to which a variety of peripherals can be attached.

Vector Graphic

The *Vector 4/20* is a new offering from this long-established microcomputer manufacturer.

A co-processor machine, it is driven by an 8-bit Z80B CPU or an 8088 16-bit CPU. This gives the user access to the worlds of CP/M, CP/M-86 or, optionally, MS-DOS. Standard user memory is 128K.

The *Vector 4/20* comes equipped with two standard 630K 5¼-inch minifloppy-disk drives.

User input is handled via a typewriter-style keyboard featuring a total of 91 keys. Included are 15 special-function keys and an 18-key numeric keypad.

Output is a 12-inch monochrome display that is capable of 640- by 312-dot graphics or an 80-character by 24-line text display. Other input/output is provided via two standard serial ports and a parallel port.

Durango Systems

The Durango *Poppy* computer takes advantage of the powerful 80186 16-bit advanced CPU.

This advanced CPU, when combined with the 128K of user memory, allows use to take advantage of the many sophisticated 16-bit programs on the market. Since it has a more powerful architecture it allows the user to have access to MS-DOS, CP/M-86, MP/M-86 and the multiuser, multitasking operating system, Xenix.

Equipped with dual 800K 5¼-inch minifloppy disks, the *Poppy* has more than enough mass storage for most needs.

User input is via a keyboard with 64 typewriter-style keys, eight special-function keys, and a 14-key keypad. Output is to a monochrome CRT with an 80-character by 25-line text display.

Input/output is handled via standard serial and parallel ports that allow the user the ability to interface such peripherals as printers, plotters, and modems.

Eagle

Two new models debut in this pricing category, the *Eagle 1620* and the *Eagle PC-XL*.

The *Eagle 1620* is driven by a 16-bit 8086 CPU, the big brother to the 8088 used by the IBM *Personal Computer*. It comes with 128K of RAM.

Operating under MS-DOS or CP/M-86, the *Eagle 1620* has two 780K double-sided, double-density 5¼-inch minifloppy disks as standard equipment.

User input is via a 105-key keyboard and output is to a 12-inch, high-resolution monochrome display. The display is capable of 720- by 352-dot graphics resolution and an 80-character by 25-line text mode.

Input/output is handled via two standard parallel ports and two standard serial ports.

The *Eagle PC-XL* uses essentially the same mechanical components, but differs in three key areas: CPU, storage, and input/output.

This computer also uses a 16-bit CPU, but it is an 8088, rather than the slightly faster 8086.

Further, rather than having two parallel ports and two serial ports, it only has one parallel port and two serial ports.

Finally, this system includes a standard 10 megabyte Winchester hard disk. This means this system has much greater storage capability and faster data access and retrieval.

Software is also bundled (included) in this configuration.

TeleVideo

A new model appears in this pricing category, the *TS-1602G*, driven by an 8088, 16-bit CPU. This allows the user access to the many programs now appearing for this type of device.

With 128K of RAM memory, the *TS-1602G* is capable of handling any of those new programs. It runs under either CP/M-86 or MS-DOS. The standard disk drives are 2 1-megabyte double-sided, double-density 5¼-inch minifloppies.

Programmable in COBOL, this system accepts this and other data input from its 72 typewriter-style keys, 16 programmable keys, and a 16-key numeric keypad. Output is to a 14-inch monochrome display tube that is capable of an 80-character by 25-line text display. Additional I/O is via two standard serial ports and one parallel port.

The *1603H*, which uses the same components, is an upgraded version of the *TS-1603*. In this version, a 10-megabyte hard disk is added to its configuration for greater storage density.

Hewlett-Packard

The *HP85B* becomes a more completely configured system in this price range with the addition of a serial port. This gives the user the option of interfacing this small-computer system with a printer or a modem.

Meanwhile, the *HP86A* reaches its full configuration with the addition of a second disk drive.

The *HP87XM* becomes more versatile with the addition of a 270K 3.5-inch microfloppy disk for storage.

The change made to the *HP120/125* system finds this small-computer system's drives changed to 5¼-inches.

NEC

The *PC-8800* is becoming fully configured at this point. In this version, the *PC-8800* is still only a CP/M-compatible machine and uses dual 8-inch floppy disk drives for storage. The upgrade to this version adds a high-resolution color monitor. The 14-inch color display is capable of 640- by 400-dot color resolution or an 80-character by 25-line text mode.

Texas Instruments

Both the color version of the TI *Professional Computer* and the monochrome version are upgraded.

The first upgrade to the color version is the addition of a second 320K minifloppy-disk drive.

The second upgrade to that system brings the amount of user memory up to 128K.

The monochrome version reaches its fullest memory configuration—for our supplement—with its upgrade to 256K of RAM.

North Star

The *Horizon* micromainframe system becomes much more powerful with the addition of a 5-megabyte hard disk. The advantage of a Winchester disk is its rapid data-retrieval capability and its voluminous storage.

The *Advantage* also gains much more storage capability with the addition of a hard-disk system.

IBM

The IBM *Personal Computer* reaches its full configuration in this price category by having its on-board RAM memory in-

TABLE 1—$4000-$4500

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Wang Laboratories	Professional Computer	$4030	8086	16-bit	MS-DOS, CP/M emulation	BASIC, COBOL, Fortran, Pascal
Texas Instruments	Professional Computer	$4065	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Texas Instruments	Professional Computer	$4070	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
IMS International	5000X16	$4100	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL, Fortran, Pascal
IBM	IBM-PC	$4172	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, MACRO assembler, Pascal
Hewlett-Packard	HP85B	$4185	Not announced		Proprietary	BASIC, assembler
Hewlett-Packard	HP87XM	$4195	Not announced		UCSD p-System, CP/M	BASIC, Pascal, Fortran
NEC Home Electronics	PC-8800	$4196	Z80A-compatible	8-bit	CP/M	BASIC
NEC Information Syst.	APC	$4198	8086	16-bit	CP/M-86, MS-DOS	BASIC, COBOL, FORTRAN, PASCAL, Assem.
Zenith Data Systems	ZF-100	$4198	8085/8088	8/16-bit	CP/M, ZDOS (proprietary)	BASIC, COBOL, FORTRAN
Digital Equipment Corp.	DECmate II	$4240	PDP-8 microprocessor, Z80	8/16-bit	CP/M-86, MS-DOS, Proprietary	Not announced
IMS International	5000IS16	$4250	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL, Fortran, Pascal
Hewlett-Packard	HP120/125	$4275	Z80A	8-bit	CP/M	BASIC, assembler
Hewlett-Packard	HP86A	$4320	Not announced	8-bit	UCSD p-System, CP/M	BASIC, Pascal, Fortran
Sord Computer	M23 Mark V C	$4330	Z80A		Proprietary, CP/M-compatible	BASIC, Pascal, Fortran
Computer Devices Inc.	DOT-3000B	$4344	8088	16-bit	MS-DOS	BASIC, Fortran, COBOL, Pascal, assembler
Texas Instruments	Professional Computer	$4365	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Vector Graphic Inc.	Vector 4/20	$4395	Z80B, 8088	8/16-bit	CP/M-86, MS-DOS (optional), CP/M	Not announced
Durango Systems	Poppy	$4395	80186	16-bit	MS-DOS, CP/M-86, MP/M-86, Xenix	Not announced
Sage Computer Tech.	Sage II	$4400	MC68000	16/32-bit	UCSD p-System, CP/M-86K, Modula 2, Hyper-FORTH	BASIC, Fortran, Pascal, assembler
Radio Shack	TRS-80 Model III Desktop	$4443	Z80A	8-bit	TRSDOS	BASIC, COBOL, Fortran, Assembler
TeleVideo Systems	TS 1603H	$4495	8088	16-bit	MS-DOS, CP/M-86	COBOL
Eagle Computer Inc.	Eagle 1620	$4495	8086	16-bit	MS-DOS, CP/M-86	optional
Eagle Computer Inc.	Eagle PC-XL	$4495	8088	16-bit	CP/M-86, MS-DOS	optional
TeleVideo Systems Inc.	TS 1602G	$4495	8088	16-bit	CP/M-86, MS-DOS	COBOL
North Star Computers	Horizon	$4499	Z80A	8-bit	TSS/C (Proprietary CP/M-like)	Not announced
North Star Computers	Advantage	$4499	Z80A	8-bit	CP/M, GDOS	BASIC, Fortran, COBOL, Pascal

Memory/Storage	Keyboard	I/O	Display	Comments
128K/2 360K DS/DD 5 ¼" floppy drives	101 keys, 16 programmable, 18-key keypad	1 parallel, 1 serial	monochrome CRT/ 800 × 300 graphics capability	second drive, display and adapter, graphics adapter
64K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	13-inch color CRT/720 × 300 res., 80 × 25 display	2nd drive drive added to color version
256K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	12-inch monochrome CRT/720 × 300 res., 80 × 25 display	64K added to 2 drive monochrome system
256K/2 409K DS/DD half-height 5 ¼" floppy drives	N/A	2 serial, 3 parallel	N/A	basic micromainframe system with dual disk drives
256K/2 320K DS/DD 5 ¼" drives	59 keys, 10 special function, 20-key keypad	1 serial, 1 parallel	12-inch high-res. color display/80 × 25 text	memory expanded to 256K in color version
160K/tape drive/electronic (RAM) disk	58 keys, 20-key keypad, 8 special function	1 serial	built-in 5" CRT/256 × 192 graphics, text	serial port added
128K/1 270K 3.5-inch micro drive	59 keys, 20-key keypad, 14 special function	multipurpose port	monchrome CRT, 80 × 24 text	3 ½-inch drive added
64K/2 1 MB DS/DD 8" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch color CRT/640 × 400 res./ 80 × 25 text	color display added
128K/2 1MB 8-inch half-height DS/DD drives	66 keys, 25-key keypad, 23 function	1 parallel, 1 serial	color/640 × 200 mono res., 160 × 100 16-color, 320 × 200 4-color 80 × 25 text	color CRT added
128K/2 320K DS/DD 5 ¼" drives	77 keys, 18-key keypad, 13 special function	2 serial, 1 parallel	color CRT 640 × 225 high-res., 80 × 25 lines	high-res. color CRT added
64K/2 400K 5 ¼" floppy drives	58 keys, special function, 14-key keypad	1 serial, 1 RS-423 synchronous	monochrome CRT80 × 25 text	basic system
256K/2 409K DS/DD half-height 5¼" floppy drives	64 keys, 14 special function, 19-key keypad	1 serial	monochrome CRT/80 × 24 text mode	basic system
64K/1 248K 5 ¼" floppy drive	58 keys, 8 special functions, programmable keys	2 serial, 1 IEEE-488	9- or 12- monochrome CRT/80 × 25 text	drive changed to 5 ¼ inches
64K/2 270K 5 ¼" drives	59 keys, 20-key keypad, 14 special function	1 parallel	9" monochrome CRT/80 × 25 text	2nd 5 ¼" drive added
128K/2 1MB 8" drives	59 keys, 20-key keypad, 9 special function	2 serial, 1 parallel	14-inch color CRT	dual 8-inch drives
128K/2 3.5" 280K micro floppy drives	59 keys, 10 function keys, 18-key keypad	2 serial	monochrome (built-in)/80 × 24 text	2 serial ports, 2nd drive added
128K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	13-inch color CRT/720 × 300 res., 80 × 25 display	64K memory added to 2-drive color version
128K/ 2 630K 5 ¼" floppy drives	91 keys, 15 special function, 18-key keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 24 text/640 × 312 graphics	2nd 630K drive
128K/2 800K 5 ¼" floppy disk drives	64 keys, 8 special function, 14-key keypad	1 serial, 1 parallel	monochrome CRT/80 × 25 text	16-bit system
128K/2 640K 5 ¼" floppy drives	N/A	2 serial, 1 RS-488, 1 parallel	N/A	storage expands to 1.28MB with second drive
48K/1 184K 5 ¼" floppy drive/5MB hard disk	64 keys, 12-key keypad	1 parallel, 1 serial	12-inch monochrome/64 (32) × 16 text mode	hard disk drive (5MB) added
128K/1 1MB DS/DD 5 ¼" floppy drive/1 5 ¼" 10MB hard disk	72 keys, 16 programmable, 16-key keypad	2 serial, 1 serial RS-422 port	14-inch monochrome/80 × 25 text	hard disk system added to TS 1603
128K/2 DS/DD 780K (96 tpi) 5 ¼" floppy drives	105 keys	2 serial, 2 parallel	12-inch high-res. monochrome/720 × 352 capability/80 × 25 text mode	base system
128K/1 320K DS/DD 5 ¼" floppy drive/1 10MB hard disk	105 keys	2 serial, 1 parallel	12-inch high-res. monochrome/720 × 352 capability/80 × 25 text mode	fully configured base system
128K/2 1MB DS/DD 5 ¼" floppy drives	72 keys, 16 programmable, 16-key keypad	2 serial, 1 serial RS-422 port	14-inch monochrome/80 × 25 text	base system
64K/1 360K 5 ¼" DS/DD floppy/5MB hard disk	N/A	2 serial, 1 parallel	N/A	micromainframe storage grows with addition of 5 MB hard disk
64K/1 360K DS/DD 5 ¼" floppy drive/5MB hard disk	49 keys, 14-key keypad, 15 function keys	1 parallel, 1 serial	12-inch monochrome CRT/640 × 240 graphics res./80 × 24 text mode	hard disk added

creased to 256K. This upgrade allows the *PC* to take efficient advantage of the many powerful 16-bit programs now on the market. By this point in this system's expansion we have already added a color display, I/O ports, disk drives, and all the other features necessary to make it a full-featured system.

Zenith

The low-profile Zenith *Z-100* becomes a color graphics-capable system with the addition of a high-resolution color-video display. Capable of a 640- by 225-dot resolution, this display is also capable of an 80-character by 25-line text mode.

Sord

Although the *M23 Mark V C* small-computer system bears another name at this point, it is actually an upgrade to the overall *M23* system. At this point, the system has gained dual 1-megabyte 8-inch floppy-disk drives for storage. This fully configured system is now aimed more at the business user than the home computer hobbyist and the potential 2 megabytes of storage provide more than enough to meet the needs of most small businessmen.

Radio Shack

At this point, the *Model III* system reaches its fullest configuration with the addition of a 5-megabyte hard disk. This same disk can also be added to the *Model 4*, whose price is just about the same as the *Model III*. The key advantage to a hard-disk system is the increase in data access and storage speed and a secondary advantage is the massive storage capabilities of such a system.

Sage

The micromainframe *Sage II* has its potential storage capacity increased to 1.28 megabytes with the addition of a second 640K minifloppy disk.

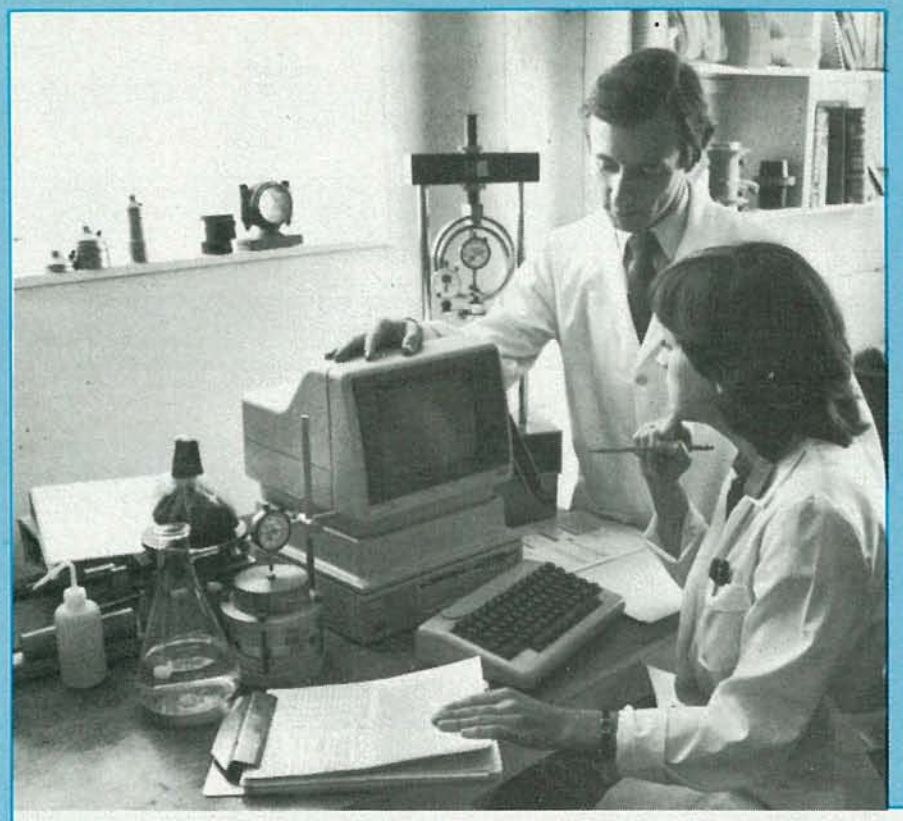
Computer Devices

The *DOT-3000B*, another variation of the DOT series of transportable microcomputers, becomes fully configured at this point with the addition of two serial ports and a second disk drive.

The serial ports give this small-computer system input/output capability and allow it to be connected to a variety of peripheral devices, including printers, plotters, and modems.

Wang

In this configuration, the Wang *Professional Computer* reaches its full capability as a color-graphics machine. This upgrade involves more than one item and includes the addition of a second 360K double-sided, double-density minifloppy-disk drive for mass storage; an 800- by 300-dot color-graphics monitor and the adapter needed to support this monitor. **R-E**



The machines we'll discuss here are the most powerful—and the most expensive.

Over $4500

MARC STERN

AT THIS POINT IN OUR BUYER'S GUIDE, YOU WILL NOTICE MORE and more systems with hard—Winchester—disks for storage. These devices offer a manyfold increase in data access and storage speed. Usually, storage densities begin at a minimum of 5-megabytes and increase rapidly from there. This is a minimum of a fifteenfold increase in data density over a 300K double-sided, double-density minifloppy disk. Since hard disks rotate much faster than the average minifloppy or even an 8-inch floppy, data access time is quicker. This means that you can load a program from a hard-disk system much quicker than you can load the same program from a floppy-disk system.

One of the most attractive features of the hard disk—besides its data-storage capability—is that a few of these devices have been trimmed down to 5¼ inches, and are no larger than the minifloppy drives they replace.

Many new machines make their debut in this category, and there are upgrades of existing systems. Most of the new machines are from manufacturers we have already discussed in earlier sections of this report. So rather than first looking at the new machines, we'll look at all the offerings from each manufacturer, and put the new ones at the opening of each set.

Hewlett-Packard

A new machine makes its appearance in this price category, the *HP200*, the top-of-the-line HP small-computer system, for our supplement's purposes. This system is not only introduced here, but also upgrades several times in this category.

Based on the Motorola MC68000 CPU, this powerful machine has 128K of standard user memory. Operating under the powerful *UNIX* multiuser operating system, this system includes one 3.5-inch 270K microfloppy-disk drive as standard.

Programmable in BASIC, Pascal, and HPL, this and other data are entered via a keyboard featuring 57 typewriter keys and five keys offering a total of 10 definable functions. User output is displayed on a standard 9-inch 80-character by 25-line monochrome display. Other input and output functions are handled via a standard serial port or an IEEE-488 general-purpose interface port. This second port allows the *HP200* to be interfaced with a wide variety of test, measurement, scientific, and other peripherals.

This system also upgrades three times in this price realm. In its first significant change, the size of the drive increases from 3.5 inches to the more standard 5¼-inch drive. The second upgrade adds a second 3.5-inch microfloppy-disk drive for storage. The third reconfiguration merely changes the size of the disk drive from a microdrive to a more standard 5¼-inch unit.

The *HP120/125* upgrades twice in this category. In the first upgrade, a second 248K 3.5-inch microfloppy drive is added to this system's configuration. The second reconfiguration increases the size of the disk to a more standard 5¼-inch drive. But there's no increase in storage.

The *HP87XM* has three changes in its configuration, two of which deal with 5¼-inch drives, and a third that deals with a microfloppy drive. Looking at the most important change first, the *HP87XM* gains a second 270K microfloppy-disk drive.

The two changes involving 5¼-inch drives merely involve an increasing drive size to a more standard size configuration. The *HP85B* becomes even more versatile when an IEEE-488 port is added. It allows the user to interface this small-computer system with a number of test, measurement, and manufacturing instruments, as well as other peripherals.

For the *HP86A*, the upgrade increases user memory to 128K.

Texas Instruments

The TI *Professional Computer* undergoes four upgrades in this price category. In the first upgrade, the color *PC* has its user memory expanded to 192K by adding 64K of RAM. At this level a user can configure a portion of that RAM into a pseudo-disk or

TABLE 1—$4500 AND UP

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Hewlett-Packard	HP87XM	$4515	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN
Hewlett-Packard	HP120/125	$4550	Z80A	8-bit	CP/M	BASIC, Assembler
Texas Instruments	Professional Computer	$4565	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Hewlett-Packard	H85B	$4580	Not announced		Proprietary	BASIC, Assembler
Docutel/Olivetti Corp.	M20	$4610	Z8001	16-bit	PCOS (Prof. Computer Operating Sys.)	BASIC
Gavilan Computer Corp.	Gavilan	$4690	8088	16-bit	MS-DOS	BASIC, Pascal
IMS International	5000SX	$4700	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
NEC Home Electronics	PC-8800	$4746	Z80A-compatible/8086	8/16-bit	CP/M, CP/M-86, MS-DOS	BASIC
Texas Instruments	Professional Computer	$4765	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Hewlett-Packard	HP86A	$4770	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN
Hewlett-Packard	HP87XM	$4770	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN
IMS International	8000SX	$4780	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
Radio Shack	TRS-80 Model III	$4790	Z80A	8-bit	TRSDOS	BASIC, COBOL, FORTRAN, Assembler
Sony	SMC-70	$4820	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Honeywell, Inc.	microSystem 6/10	$4870	Proprietary (Micro 6)/8086	16-bit	Proprietary, MS-DOS, CP/M-86	BASIC
North Star Computers	Advantage 8/16	$4899	Z80A/8088	8/16-bit	MS-DOS, GDOS	BASIC, FORTRAN, COBOL, Pascal
Sord Computer	M68	$4899	M68000/ Z80A	8/16/32-bit	Proprietary, CP/M-compatible	BASIC, Pascal, FORTRAN
IBC/Integrated Bus. Comp.	Cadet	$4925	Z80	8-bit	OASIS, CP/M, MP/M, MVT-FAMOS	Not announced
Computer Devices Inc.	DOT-3000D	$4943	8088	16-bit	MS-DOS	BASIC, FORTRAN, COBOL, Pascal, Assemble
Computer Devices Inc.	DOT-3000C	$4943	8088	16-bit	MS-DOS	BASIC, FORTRAN, COBOL, Pascal, Assembler
Athena Computer	Athena I	$4950	NSC-800 (low-power Z80)	8-bit	CP/M	Pascal
Gavilan Computer Corp.	Gavilan	$4970	8088	16-bit	MS-DOS	BASIC, Pascal
Hewlett-Packard	HP120/125	$4975	Z80A	8-bit	CP/M	BASIC, Assembler
Altos Computer Systems	ACS8000-15	$4990	Z80A	8-bit	CP/M	BASIC, COBOL, Fortran, SOFTBOL Pascal,
IBM	IBM-PC XT	$4995	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, Macro Assembler Pascal
Durango Systems	Poppy	$4995	80186	16-bit	MS-DOS, CP/M-86, MP/M-86, Xenix	Not announced
Toshiba America	T250-5	$4995	Z80	8-bit	CP/M	BASIC
Columbia Data Products	1600-4	$4995	8088	16-bit	MS-DOS	BASIC, Assembler
Ithaca Intersystems	Encore	$4995	Z80B	8-bit	CP/M	Not announced
Digital Equipment Corp.	Professional 350	$4995	PDP-11/238 microprocessor	16-bit	Proprietary, CP/M optional	Not announced

Memory/Storage	Keyboard	I/O	Display	Comments
128K/1 270K 5 ¼" drive	59 keys, 20-key keypad, 14 special function	multipurpose port	8" monochrome CRT/80 × 25 text	drive changed to 5 ¼ inches
64K/2 3.5-inch 248 microdrives	58 keys, 8 special functions, programmable keys	2 serial, 1 IEEE-488	9" or 12" monochrome CRT/80 × 25 text	2nd microdrive added
192K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	13-inch color CRT/720 × 300 res., 80 × 25 display	memory expanded to 192K
160K/tape drive/electronic disk	58 keys, 20-key keypad, 8 special function	1 serial, 1 general purpose port	built-in 5" CRT/ 256 × 192 graphics, 32 × 16 text	general purpose port
160K/2 360K 5 ¼" floppy drives	72 keys, 16-key keypad	1 serial, 1 parallel	12-inch high-res. monochrome/80 × 25 text mode	2nd drive added, memory upgrade to 160K
32K/2 320K 3" microfloppy disk drives	61 key board, 10-key keypad	1 serial	66-character × 8-line liquid crystal display/touch panel	second drive
64K/1 409K DS/DD half-height 5 ¼" drive/6MB hard disk	N/A	2 serial, 3 parallel	N/A	micromainframe system
128K/2 1MB DS/DD 8" floppy drives	81 keys, 5 multifunction, 10-key keypad	1 parallel, 1 serial	14-inch color CRT/640 × 400 res./80 × 25 text	color display added
256K/2 320K DS/DD 5 ¼" floppy drives	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	13-inch color CRT/720 × 300 res., 80 × 25 display	memory expanded to 256K
128K/2 270K 5 ¼" drives for storage	59 keys, 20-key keypad, 14 special function	1 parallel	9" monochrome CRT/80 × 25 text	memory expanded to 128K
128K/2 270K 3.5-inch microdrives for storage	59 keys, 20-key keypad, 14 special function	multipurpose port	8" monochrome CRT/80 × 25 text	2nd drive added
64K/2 1.2MB 8" DS/DD half-height floppy drives/6MB hard disk	N/A	2 serial, 3 parallel	N/A	micromainframe system
48K/2 184K 5 ¼" floppy drives/5MB hard disk	64 keys, 12-key keypad	1 parallel, 1 serial	12-inch monochrome/64 (32) × 16 text mode	hard disk drive (5MB) added
64K/2 280K 3.5" microfloppy/5.7MB hard disk	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch green CRT/80 × 25 text	hard disk and interface unit added, 1 microdrive deleted
128K/1 5 ¼" floppy disk drive	standard, keypad, function keys	2 serial, 1 parallel	12-inch monochrome CRT	basic system
128K/1 360K DS/DD 5 ¼" floppy drive/5MB hard disk	49 keys, 14-key keypad, 15 function keys	1 parallel, 1 serial	12-inch monochrome CRT/640 × 240 graphics res./80 × 24 text mode	5MB hard disk
256K/2 1.2M 5 ¼" drives	Typewriter style, keypad, function keys	2 serial, 1 parallel, 1 IEEE-488	12-inch green CRT/80 × 25	base configuration
64K/1 1MB floppy disk drive	N/A	Not announced	N/A	micromainframe system
256K/2 3.5" 280K micro floppy drives	59 keys, 10 function keys, 18-key keypad	2 serial	monochrome (built-in)/80 × 24 text	user memory expanded to 256K
128K/2 3.5" 280K micro floppy drives	59 keys, 10 function keys, 18-key keypad	2 serial	monochrome (built-in)/80 × 24 text	integral printer, 128K memory
68K/1MB of RAMdisk storage/1 DD 5 ¼" floppy included	standard	2 serial, 1 parallel	80-character × 4-line liquid crystal display/external CRT connector	1MB RAM-disk
96K/2 320K 3" microfloppy disk drives	61 key board, embedded 10-key keypad	1 serial	66-character × 8-line liquid crystal display/touch panel	64K memory added
64K/2 248K 5 ¼" drives	58 keys, 8 special functions, programmable keys	2 serial, 1 IEEE-488	9" or 12" monochrome CRT/80 × 25 text	2nd drive added
208K/2 500K SS/DD floppy drives	N/A	6 serial, 1 parallel	N/A	micromainframe
128K/1 DS/DD 5 ¼" floppy drive/10MB hard disk	59 keys, 10 special function, 20-key keypad	1 parallel		basic system
256K/2 800K 5 ¼" floppy disk drives	64 keys, 8 special function, 14-key keypad	1 serial, 1 parallel	monochrome CRT/80 × 25 text	user memory increased to 256K
64K/ 1 8-inch DS/DD drive, 1 5MB hard disk	not announced	not announced	not announced	hard disk added
128K/1 320K 5 ¼" floppy disk drive/12MB hard disk	83 keys, 10 special function, keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 25 text	hard disk added for greater storage
128K/2 SS/DD 5 ¼" floppy disk drives	N/A	Not announced	N/A	micromainframe system
256K/1 400K 5 ¼" floppy drive	58 keys, special function, 14-key keypad	1 serial, 1 RS-423 synchronous	monochrome CRT/80 × 25 text	system box enlarged for hard disk

TABLE 1—$4500 AND UP *(continued)*

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
Sanyo	MBC 3000	$4995	Z80A	8-bit	CP/M, TS-DOS	BASIC, Pascal, FORTRAN, Macro-80
Gifford Systems	100	$4995	8085/8088	8/16-bit	CP/M, CP/M-86	Not announced
Radio Shack	Model 16	$4999	MC68000/Z80A	8/16/32-bit	Proprietary	Assembly
TeleVideo Systems Inc.	TS 1602G	$5090	8088	16-bit	CP/M-86, MS-DOS	COBOL
IMS International	5000SX	$5090	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
IMS International	5000IS	$5100	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
Apple Computer	Apple III	$5164	6502B	8-bit	Apple SOS	BASIC, Pascal
Hewlett-Packard	HP200	$5185	MC68000	16/32-bit	UNIX	BASIC, Pascal, HPL
Hewlett-Packard	HP87XM	$5225	Not announced		UCSD p-System, CP/M	BASIC, Pascal, FORTRAN
Gavilan Computer Corp.	Gavilan	$5240	8088	16-bit	MS-DOS	BASIC, Pascal
Canon USA	AS100	$5245	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
Sony	SMC-70	$5340	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Apple Computer	Apple III	$5364	6502B	8-bit	Apple SOS	BASIC, Pascal
Columbia Data Products	1600-4	$5440	8088	16-bit	MS-DOS	BASIC, assembler
NEC Information Syst.	APC	$5446	8086	16-bit	CP/M-86, MS-DOS	BASIC, COBOL, FORTRAN, PASCAL, Assem.
IMS International	5000IS	$5490	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
Texas Instruments	Professional Computer	$5490	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Altos Computer Systems	5-5D	$5490	Z80A	8-bit	CP/M	BASIC, COBOL, Pascal, FORTRAN, SOFTBOL
CompuPro Division	System 816/A	$5495	8085/8088	8/16-bit	CP/M, CP/M-86	Not announced
Vector Graphic Inc.	Vector 4/30	$5495	Z80B/8088	8/16-bit	CP/M-86, MS-DOS (optional), CP/M	Not announced
Zenith Data Systems	ZF-100	$5499	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN
IMS International	5000X16	$5500	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL, FORTRAN, Pascal
Hewlett-Packard	HP200	$5505	MC68000	16/32-bit	UNIX	BASIC, Pascal, HPL
Computer Devices Inc.	DOT-3000E	$5542	8088	16-bit	MS-DOS	BASIC, Fortran, COBOL, Pascal, assembler
IMS International	8000X16	$5580	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL, FORTRAN, Pascal
Gifford Systems	100+	$5595	8085/8088	8/16-bit	CP/M, CP/M-86	Not announced
Zenith Data Systems	Z-120	$5599	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN
Zenith Data Systems	ZF-100	$5638	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN
IMS International	5000IS16	$5650	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL, FORTRAN, Pascal
IBM	IBM-PC XT	$5675	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, Macro Assembler, Pascal
Hewlett-Packard	HP200	$5760	MC68000	16/32-bit	UNIX	BASIC, Pascal, HPL

Memory/Storage	Keyboard	I/O	Display	Comments
64K/2 8" DS/DD drives, 1MB per drive	59 keys, 22 programmable, 18-key keypad	2 serial, 1 parallel	12-inch monochrome/80 × 25 text mode	basic system
64K/2 1.2MB 8" DS/DD 8" floppy drives	N/A	1 serial	user option	micromainframe
128K/1.25MB 8" floppy disk	76 keys, numeric keypad	2 serial, 1 parallel	12" green monochrome, 80 × 24 text	basic system
256K/2 1MB DS/DD 5 ¼" floppy drives	72 keys, 16 programmable, 16-key keypad	2 serial, 1 serial RS-422 port	14-inch monochrome/80 × 25 text	256K memory added
64K/2 409K DS/DD half-height 5 ¼" floppy drives/6MB hard disk	N/A	2 serial, 3 parallel	N/A	second floppy drive added
64K/1 409K DS/DD floppy drive/6MB hard disk	64 keys, 14 special function, 19-key keypad	1 serial	monochrome CRT/80 × 24 text mode	storage increased with addition of 6MB hard disk
128K/1 140K SS/DD 5 ¼" floppy drive/hard disk drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	12-inch CRT/280 × 192/560 × 192 graphics cap./80 × 24 text	hard disk (Winchester drive) added to 128K Apple III
128K/1 3.5-inch 270K microfloppy drive	57 keys, 10 definable functions on 5 keys	1 serial, 1 multipurpose IEEE-488 port	9" monochrome CRT/80 × 25 text	3.5-inch microfloppy added
128K/2 270K 5 ¼" drives	59 keys, 20-key keypad, 14 special function	multipurpose port	8" monochrome CRT/80 × 25 text	2nd 5 ¼-inch drive added
160K/2 320K 3" microfloppy disk drives	61 key board, embedded 10-key keypad	1 serial	66-character × 8-line liquid crystal display/touch panel	128K of user memory added
Not announced/2 640K DS/DD 5 ¼" floppy drives/2 8" floppies	standard	1 serial, 1 parallel	monochrome display/80 × 25 text mode	2 eight-inch floppy drives
64K/1 280K 3.5" microfloppy/5.7MB hard disk	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch RGB high-res. color CRT	color CRT subsituted for display
256K/1 140K SS/DD 5 ¼" floppy drive/hard disk drive	61-key typewriter, 13-key keypad, 2 programmable	1 serial, 2 game controller, 1 parallel	12-inch CRT/280 × 192/560 × 192 graphics cap./80 × 24 text	hard disk (Winchester drive) added to 256K Apple III
256K/1 320K 5 ¼" floppy disk drive/12MB hard disk	83 keys, 10 special function, keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 25 text	user memory increase to 256K
128K/1MB, half-height DS/DD drive, 10MB hard disk	66 keys, 25-key keypad, 23 function	1 parallel, 1 serial	monochrome/80 × 25 text	hard disk added to 1 drive monochrome model
64K/2 409K DS/DD half-height 5 ¼" floppy drives/6MB hard disk	64 keys, 14 special function, 19-key keypad	1 serial	monochrome CRT/80 × 24 text mode	2nd DS/DD floppy drive added
256K/1 320K 5 ¼" DS/DD drive/5MB hard disk	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	12-inch monochrome CRT/720 × 300 res., 80 × 25 display	hard disk added to monochrome unit
192K/1 1MB DS/DD 5 ¼" floppy	N/A	4 serial, 1 parallel	N/A	micromainframe
128K/2 8-inch floppy drives, 2.4MB storage	N/A	4 serial, 1 parallel	user option	micromainframe
128K/ 1 630K 5 ¼" floppy drive/5 MB hard disk drive	91 keys, 15 special function, 18-key keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 24 text/640 × 312 graphics	hard (Winchester) disk
192K/1 320K DS/DD 5 ¼ drive/11.3 MB hard disk	77 keys, 18-key keypad, 13 special funct.	2 serial, 1 parallel	user option	memory increased to 192K and hard disk added, one floppy deleted
256K/1 409K DS/DD half-height floppy drive/6MB hard disk	N/A	2 serial, 3 parallel	N/A	micromainframe
128K/1 270K 5 ¼" drive	57 keys, 10 definable functions on 5 keys	1 serial, 1 multipurpose IEEE-488 port	9" monochrome CRT/80 × 25 text	drive changed to 5 ¼"
256K/2 3.5" 280K micro floppy drives	59 keys, 10 function keys, 18-key keypad	2 serial	monochrome (built-in)/80 × 24 text	256K memory, printer included
256K/2 1.2MB 8" DS/DD half-height drives	N/A	2 serial, 3 parallel	N/A	micromainframe
128K/2 1.2MB 8" DS/DD 8" floppy drives	N/A	1 serial	user option	memory capacity increased to 128K
192K/1 320K DS/DD 5 ¼ drive/11.3 MB hard disk	77 keys, 18-key keypad, 13 special funct.	2 serial, 1 parallel	built-in monochrome CRT/80 × 25 text	hard disk, 92K of memory added, 1 floppy deleted
192K/1 320K DS/DD 5 ¼ drive/11.3 MB hard disk	77 keys, 18-key keypad, 13 special funct.	2 serial, 1 parallel	green monochrome CRT/80 × 25 text	monochrome CRT added
256K/1 409K DS/DD half-height 5 ¼" floppy drive/6 MB hard disk	64 keys, 14 special function, 19-key keypad	1 serial	monochrome CRT/80 × 24 text mode	hard disk added
128K/1 DS/DD 5 ¼" floppy drive/10MB hard disk	59 keys, 10 special function, 20-key keypad	1 serial, 1 parallel	12-inch monochrome/80 × 25 text	monochrome CRT
128K/2 3.5-inch 270K microfloppy drives	57 keys, 10 definable functions on 5 keys	1 serial, 1 multipurpose IEEE-488 port	9" CRT/80 × 25 text	2nd 3.5-inch microfloppy added

TABLE 1—$4500 AND UP *(continued)*

Manufacturer	Model	Price	CPU	Word Length	Operating System	Languages
IMS International	8000SX	$5780	Z80	8-bit	CP/M, MP/M TurboDOS	BASIC, COBOL, FORTRAN, Pascal
Radio Shack	Model 16	$5798	MC68000/Z80A	8/16/32-bit	Proprietary	assembly
Sony	SMC-70	$5820	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Gifford Systems	100	$5870	8085/8088	8/16-bit	CP/M, CP/M-86	Not announced
IMS International	5000X16	$5890	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL, FORTRAN, Pascal
IBM	IBM-PC XT	$5919	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, Macro Assembler, Pascal
Canon USA	AS100	$5945	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL
Fujitsu Microelectronics	Micro 16	$5990	Z80A/8086	8/16-bit	CP/M-86, Concurrent CP/M/MS-DOS optional	Not announced
Vector Graphic Inc.	Vector 4/40	$5995	Z80B/8088	8/16-bit	CP/M-86, MS-DOS (optional), CP/M	Not announced
Durango Systems	Poppy	$5995	80186	16-bit	MS-DOS, CP/M-86, MP/M-86, Xenix	Not announced
TeleVideo Systems Inc.	TS 802H	$5995	Z80A	8-bit	CP/M	COBOL
North Star Computers	Horizon	$5999	Z80A	8-bit	TSS/C (Proprietary CP/M-like)	Not announced
North Star Computers	Advantage	$5999	Z80A	8-bit	CP/M, GDOS	BASIC, FORTRAN, COBOL, Pascal
IBM	IBM-PC XT	$6005	8088	16-bit	PC-DOS (MS-DOS), CP/M-86, UCSD p-System	COBOL, FORTRAN, BASIC, MACRO assembler, Pascal
IMS International	5000IS16	$6040	8088	16-bit	MS-DOS, CP/M-86	BASIC, COBOL, FORTRAN, Pascal
Texas Instruments	Professional Computer	$6185	8088	16-bit	MS-DOS, CP/M-86, UCSD p-System	Macro Assembler, BASIC, COBOL, FORTRAN, Pascal
Zenith Data Systems	Z-100	$6198	8085/8088	8/16-bit	CP/M/ZDOS (proprietary)	BASIC, COBOL, FORTRAN
Hewlett-Packard	HP200	$6215	MC68000	16/32-bit	UNIX	BASIC, Pascal, HPL
Sony	SMC-70	$6340	Z80A	8-bit	CP/M	BASIC, CB-80, Pilot Plus
Honeywell, Inc.	microSystem 6/10	$6370	Proprietary (Micro 6)/8086	16-bit	Proprietary, MS-DOS, CP/M-86	BASIC
Wang Laboratories	Professional Computer	$6400	8086	16-bit	MS-DOS, CP/M emulation	BASIC, COBOL, FORTRAN Pascal
Gifford Systems	100 +	$6470	8085/8088	8/16-bit	CP/M, CP/M-86	Not announced
Fujitsu Microelectronics	Micro 16	$6490	Z80A/8086	8/16-bit	CP/M-86, Concurrent CP/M, MS-DOS optional	Not announced

virtual-memory disk, provided the system has the proper software. A greater part of this report was written with the assist of such a "disk."

The second upgrade brings the *PC*'s user memory to 256K. The third upgrade to this system involves the monochrome *PC*. At this stage it reaches its maximum configuration, for our purposes, with the addition of a 5-megabyte hard-disk drive. This provides the user with denser storage and truly high-speed data access, storage and retrieval. The final change brings the color *PC* up to its fullest configuration with the addition of the 5-megabyte 5¼-inch hard-disk drive.

Zenith

Zenith has four system configuration changes here. With the first, the user memory of the *ZF-100* low-profile small-computer system increases to 192K and, at the same time, the

Memory/Storage	Keyboard	I/O	Display	Comments
64K/1 1.2MB 8″ DS/DD half-height floppy drive/6MB hard disk	N/A	2 serial, 3 parallel	N/A	6MB hard disk
128K/slim-line 1.25MB 8-inch floppy disks	76 keys, numeric keypad	2 serial, 1 parallel	12-inch green monochrome/80 × 24 text	2nd drive
64K/1 280K 3.5″ microfloppy/12.1 MB hard disk	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch green CRT/80 × 25 text	12.1MB hard disk
64K/2 1.2MB 8″ DS/DD 8″ floppy drives	N/A	1 serial	standard terminal	micromainframe with user terminal attached
256K/2 409K DS/DD half-height floppy drives/6MB hard disk	N/A	2 serial, 3 parallel	N/A	2nd floppy disk drive
128K/1 DS/DD 5 ¼″ floppy drive/10MB hard disk	59 keys, 10 special function, 20-key keypad	1 serial, 1 parallel	12-inch high-res. color display/80 × 25 text	color display and adapter
Not announced/2 640K DS/DD 5 ¼″ floppy drives/2 8″ floppies	standard	1 serial, 1 parallel	640 × 400 color graphics capability	2 eight-inch floppy drives added
128K/2 320K DS/DD 5 ¼″ floppy drives/20MB 5 ¼″ hard disk	98 keys, separate numeric keypad, 10 programmable keys	1 serial, 1 parallel	80 × 25 text mode/640 × 200 graphics	hard disk added
128K/1 630K 5 ¼″ floppy drive/10MB hard disk drive	91 keys, 15 special function, 18-key keypad	2 serial, 1 parallel	12-inch monochrome CRT/80 × 24 text/640 × 312 graphics	hard disk capacity increased to 10 MB
128K/1 800K 5 ¼″ floppy disk drive/10MB hard disk	64 keys, 8 special function, 14-key keypad	1 serial, 1 parallel	monochrome CRT/80 × 25 text	hard disk added
64K/1 368K 5 ¼″ DS/DD floppy drive/9.6MB hard disk	72 keys, 16 programmable, 17-key keypad	2 serial, 1 serial RS-422 port	14-inch monochrome/80 × 25 text	hard disk
64K/1 360K 5 ¼″ DS/DD floppy/15MB hard disk	N/A	2 serial, 1 parallel	N/A	15MB hard disk
64K/1 360K DS/DD 5 ¼″ floppy drive/15MB hard disk	49 keys, 14-key keypad, 15 function keys	1 parallel, 1 serial	12-inch monochrome CRT/640 × 240 graphics res./80 × 24 text mode	15 MB hard disk
256K/1 DS/DD 5 ¼″ floppy drive/10MB hard disk	59 keys, 10 special function, 20-key keypad	1 serial, 1 parallel	12-inch monochrome/80 × 25 text	memory expanded to 256K
256K/2 409K DS/DD half-height floppy drives/6MB hard disk	64 keys, 14 special function, 19-key keypad	1 serial	monochrome CRT/80 × 24 text mode	2nd disk added
256K/1 320K 5 ¼″ DS/DD drive/5MB hard disk	97 keys, 17-key keypad, 12 special function	1 parallel, 1 serial	13-inch color CRT/720 × 300 res., 80 × 25 display	hard disk added to color unit
192K/1 320K DS/DD 5 ¼ drive/11.3 MB hard disk	77 keys, 18-key keypad, 13 special funct.	2 serial, 1 parallel	high-res. color CRT/80 × 25 text mode	color CRT added
128K/3 270K 5 ¼″ drives	59 keys, 20-key keypad, 14 special function	1 serial, 1 multipurpose IEEE-488 port	9″ monochrome CRT/80 × 25 text	2nd 5¼″ drive added
64K/1 280K 3.5″ microfloppy/12.1 MB hard disk	72 keys, keypad, 9 special function	1 parallel, 1 serial	12-inch RGB high-res. color CRT	color CRT subsituted for display
128K/2 5 ¼″ floppy disk drives	standard, keypad, function keys	2 serial, 1 parallel	12-inch monochrome CRT	second high-density disk added
128K/1 360K DS/DD 5 ¼″ floppy drive/1 10MB hard disk	101 keys, 16 programmable, 18-key keypad	1 parallel, 1 serial	monochrome CRT/graphics capability	hard disk
128K/2 1.2MB 8″ DS/DD 8″ floppy drives	N/A	1 serial	standard terminal	terminal added
1MB/2 320K DS/DD 5 ¼″ floppy drives	98 keys, separate numeric keypad, 10 programmable keys	1 serial, 1 parallel	80 × 25 text mode/640 × 200 graphics	user memory expanded to 1MB

second minifloppy drive is swapped for an 11.3-megabyte hard-disk drive, with all its advantages. The all-in-one *Z-120* system also has the same changes in the second reconfiguration, while the low-profile system gains a high-resolution monochrome display in the third change to the models of this system.

The low-profile, monochrome hard-disk *ZF-100* reaches its fullest configuration and capability as a color graphics-capable system by adding a 640- by 225-dot high-resolution color monitor. This display handles an 80-character by 25-line text mode.

IBM

A new version of the IBM *Personal Computer* debuts in this price category, the *PC-XT* (Extended). Having the same essential specifications as the standard IBM *PC*—8088 CPU, PC-DOS, double-sided, double-density minifloppy-disk drive, 59 typewriter-style keys, 10 special-function keys and numeric

keypad—the new system differs in two key areas. First is that the amount of user memory is doubled from 64K to a standard 128K. The second change is an added standard 10-megabyte 5¼-inch hard-disk drive.

This system also has three configuration changes in this price range. The first one involves adding a high-resolution monochrome green display to the *PC-XT*. This monitor delivers a flicker-free detailed text display and is ideal for serious word-processing. In its next change, the *XT* becomes a color-graphics machine with the addition of a color adapter card and a high-resolution 12-inch color monitor. The final expansion of this system brings the user memory up to 256K.

Apple

The 128K version of the *Apple III* becomes a far more versatile system with an added hard-disk drive. This gives the user higher-density, high-speed data storage and access. The last change to this system brings it to its full configuration. The 256K version of the *Apple III* includes a hard disk.

Computer Devices

The *DOT-3000* series has several changes in this price category. The IBM-compatible transportable *DOT-3000D* adds RAM for a total of 256K.

The transportable *DOT-3000C*, retains the standard 128K user memory configuration, and becomes more versatile as the optional built-in printer capability is used and a printer is added. At once, a user has a complete system at his fingertips that can close up and travel with him.

The final version of this system, the *DOT-3000E*, brings both features together. The user memory is expanded to 256K, and the printer is also included.

Gavilan

The innovative, IBM-compatible, 8088-driven *Gavilan* lap-computer system upgrades three times in this price range. In its first upgrade, this system becomes more versatile and flexible by adding a second 320K 3-inch microfloppy-disk drive. The second upgrade gives the user 96K of RAM by adding a 64K RAM memory add-on cartridge. When this is combined with the dual disk drives now included, this system becomes a truly versatile lap machine. In its final upgrade, memory capacity is increased to 160K.

IMS International

This microcomputer manufacturer has a variety of new machines debuting, as well as others that upgrade, in this price category. The micromainframe *5000SX* system, driven by an 8-bit Z80 microprocessor, debuts with a 6-megabyte hard-disk system. Immediately, this increases the versatility of the system, which also has 64K of RAM. The standard minifloppy-disk drive for this system is a 409K, half-height double-sided, double-density unit.

Capable of operating under CP/M, MP/M (the multiuser version) or TurboDOS, this system is programmable in BASIC, COBOL, Fortran, or Pascal. Since it is a micromainframe system, terminal choice is up to the user. However, this system can also support a variety of input/output devices through two standard serial ports and three standard parallel ports. The system upgrades once in this category with an added second 409K half-height minifloppy drive. This makes backing up the contents of the hard disk far easier.

The *8000SX* is another version of this micromainframe system and shares many of the same features with the *5000SX*. The key difference is in the amount of floppy-disk storage. Instead of relying on minifloppy-disks, this system uses half-height, 8-inch floppy-disk drives for storage. Their capacity is 1.2-megabytes per drive and offer the user up to 2.4-megabytes of potential storage.

In this system's upgrade, the second floppy disk is replaced by a 6-megabyte hard-disk drive. This gives the user access to high-density, high-speed data access and retrieval. The Z80-based *5000IS* system upgrades in this price realm, too. This system, which operates under CP/M, MP/M, and TurboDOS and is programmable in BASIC, COBOL, Fortran, and Pascal, gains a 6-megabyte hard disk.

Also added to the configuration of the *5000IS*—which has a keyboard containing 64 keys, 14 special-function keys, and a 19-key numeric keypad and a serial port, plus 64K of RAM, and a monochrome CRT—is a second 409K double-sided, double-density, half-height minifloppy, disk drive. It is in addition to the already-existing minifloppy and hard-disk drives.

The 16-bit 8088-based version of the *5000* system, the *5000X16*, also has a 6-megabyte hard-disk drive added to its configuration. In this configuration, it has a single 409K double-sided, double-density minifloppy-disk drive, as well as the hard disk and 256K of user memory. This system operates under MS-DOS and CP/M-86 and, since it is a micromainframe, the terminal is a user option. It is programmable in BASIC, COBOL, Fortran, and Pascal. The second upgrade to this system adds a second minifloppy to speed hard-disk backup.

The *8000X16*, which shares the same basic attributes as the *5000X16*, differs in that it has a pair of half-height, 1.2-megabyte 8-inch floppy-disk drives, rather than the 5¼-inch units. The *5000IS16*, which is has the same basic mechanical attributes as the *5000IS* system, differs in that it has a 16-bit 8088 CPU and operates under MS-DOS and CP/M-86.

In its first upgrade in this price realm, this machine, with its 256K of user memory, gains a 6-megabyte hard disk for storage. This is in addition to the standard 409K, half-height, double-sided, double-density disk drive. The second upgrade adds a second half-height minifloppy drive.

Sony

The *SMC-70* small-computer system upgrades four times in this price category. In the first upgrade, the *SMC-70* gains a 5.7-megabyte hard-disk drive for data storage, while in the second, the system becomes a color computer, with an added 12-inch RGB high-resolution color monitor. The third upgrade to this system brings the capacity of the hard-disk drive to 12.1-megabytes, allowing much greater storage capability on the monochrome version of this system, while the fourth upgrade brings much greater hard-disk storage capability with the addition of the 12.1-megabyte unit to the color *SMC-70*.

Canon

The *AS100* upgrades twice in this price range. The first upgrade adds two 8-inch floppy-disk drives to the system configuration, giving the user access to four disk drives for storage and increasing system capability. The second upgrade adds two

TI's *PROFESSIONAL COMPUTER* gains a RAM disk in this price range.

8-inch floppy disk drives to the configuration of the color *AS100*.

NEC

The *PC-8800C* small-computer system upgrades in this category. The 8-inch drive version of the *PC-8800* becomes a color graphics-capable machine when a 14-inch color monitor is added that can handle 640- by 400-dot resolution and an 80-character by 25-line text display.

Fujitsu

The *Micro 16* upgrades twice in this price category. The first step adds a 20-megabyte 5¼-inch hard disk for dense, high-speed data storage and retrieval, while the second upgrade expands the user memory to a phenomenal 1 megabyte.

North Star

There are three systems that upgrade in this price category, the *Advantage 8/16*, the *Horizon* and the *Advantage*. The *Advantage 8/16*, driven by an 8-bit Z80A and a 16-bit 8088, has its mass-storage capabilities increase with an added 5-megabyte hard disk. This change gives the user access to dense high-speed data storage and retrieval capabilities. The micromainframe *Horizon* becomes a truly powerful system with an added 15-megabyte hard disk. In fact, this change gives this system potential multiuser capability. A 15-megabyte hard disk gives the *Advantage* high-density data-storage capability and brings added versatility to this system.

Durango

The powerful Durango *Poppy* upgrades twice in this price category. With the first upgrade, the small-computer system has its user memory increased to 256K. This lets the system take fuller advantage of the advanced capabilities of its powerful CPU, the 80186. With the second upgrade, the *Poppy* becomes much more fully configured. This is the addition of a 10-megabyte hard disk. When the memory size and hard disk are taken into account, this system becomes a candidate for multi-user status.

Vector Graphic

The co-processor *Vector 4/20* system upgrades as its name changes in this price category. With the addition of a 5-megabyte hard disk for increased storage capability, this system becomes the *Vector 4/30*. This change provides the user with a powerful, high-speed data storage option and increases the versatility of this system by several orders of magnitude. As the hard-disk capacity increases to 10 megabytes, the system's name becomes the *Vector 4/40*.

TeleVideo

The 16-bit *TS1602G* becomes a much more potent machine with the addition of user memory. At this point, this small-

HEWLETT-PACKARD's *HP200* features Motorola's MC68000 microprocessor.

computer system can use any of the advanced programs on the market. With an added 9.6-megabyte hard disk, the *TS802H*, a Z80A, 64K system, becomes much more potent. It now gives the user the option of truly high-density, high-speed data storage and retrieval.

Gifford Systems

A newcomer to our buyer's guide is Gifford Systems' *100/100+* series of co-processor micromainframes. Since these are micromainframes, it's up to the user to supply the terminal—although two of our listings indicate terminals and show how these change the cost parameters for these systems.

Driven by 8-bit 8085 and 16-bit 8088 CPUs, these systems are offered only with the CP/M operating system or CP/M-86, as opposed to MS-DOS. (This could prove a drawback in the 16-bit realm because the emerging standard operating system, and the one that most software is being written for, is MS-DOS.) Equipped with 64K of user memory—somewhat limited for some 16-bit applications—this system has two standard 8-inch double-sided, double-density 1.2-megabyte floppy-disk drives for storage. This makes this system very versatile. Input/output is handled via standard serial ports, to which a variety of peripherals can be interfaced.

These systems upgrade twice. The first upgrade adds 64K to the user memory, bringing it up to 128K. This makes this system more versatile and able to handle 16-bit programs more efficiently, while the second upgrade adds a terminal offered by the manufacturer.

Docutel/Olivetti

At this point, the Olivetti *M20* becomes fully configured. Actually two upgrades are included at once. With the first change, user memory is increased to 160K, making this system more versatile. The second change here adds a second 360K 5¼-inch minifloppy-disk drive.

Honeywell

This is Honeywell's first appearance in this buyer's guide with its *microSystem 6/10*. Driven by a proprietary 8-bit microprocessor—Honeywell Micro 6—teamed with an 8086, 16-bit CPU, the 6/10 has 128K of standard user memory. It works under three operating systems: MS-DOS, CP/M-86, and a proprietary system. The standard disk drive is a 5¼-inch minifloppy-disk drive for storage.

Programmable in BASIC, the *6/10* accepts this and other data input through a standard typewriter-style keyboard. The keyboard also includes a separate numeric keypad and special-function keys. User output is to a standard 12-inch monochrome CRT. Input/output chores are handled through two serial ports or one parallel port. To these ports a user can interface a variety of peripherals.

The system has a key upgrade in the upper end of this price guide with the addition of a second 5¼-inch drive.

Wang

The Wang *Professional Computer* reaches its fullest configuration with the addition of a 10-megabyte hard-disk drive. It gives the user much higher-speed data access, storage, and retrieval capabilities and increases the flexibility of this system.

Athena

This transportable microcomputer system reaches its fullest configuration in this price category. At this point, the memory capacity is increased to a full megabyte. However, much of this memory is used as a virtual or pseudo-disk for high-speed program execution.

Sanyo

A new system debuts in this price range, the *MBC 3000*, driven by dual Z80A CPU's. With two operating systems available, CP/M and the proprietary TS-DOS, this system has more than enough to handle most average applications. The disk drives available are two 8-inch double-sided, double-density floppies. Each of those drives is capable of up to 1 megabyte of storage.

Programmable in BASIC, Pascal, Fortran, and Macro-80, this system accepts this and other data input through 59 typewriter-style keys. The keyboard also features 22 programmable keys and a 18-key numeric keypad. User output is to a 12-inch monochrome display that can deliver an 80-character by 25-line text mode. Input/output is handled by two standard serial ports or an RS-423 synchronous serial port.

Toshiba

The *T250-5* system is an upgrade of the *T250* system already described. It upgrades here and becomes more versatile with an added 5-megabyte hard disk. The addition of that drive gives the user the ability to have truly high-speed, high-density data access and retrieval.

Columbia Data Products

The 16-bit *1600-4*, based on the 8088 CPU, upgrades twice. The first upgrade brings a 12-megabyte hard disk to this 128K system. Backup disk storage is provided by a 320K 5¼-inch floppy disk.

This system, which runs under MS-DOS and is programmable in BASIC and assembler, upgrades again here to 256K of user memory in the second reconfiguration.

Sord

The *M68* is this small-computer firm's top-of-the-line system. A versatile system, it is driven by a powerful MC68000 CPU, with a Z80A acting as co-processor. Running under an operating system that is CP/M-compatible, this system has 256K of user memory and two 1.2-megabyte 5¼-inch minifloppy drives for storage. This configuration is powerful enough to take advantage of the potential of this system. User input is via a typewriter-style keyboard and output is to a 12-inch monochrome CRT. Input/output is handled by two serial ports plus one parallel, and one IEEE-4888 general-purpose interface port.

IBC

The *Cadet* micromainframe uses proven 8-bit technology with a Z80 CPU. It has 64K of standard user memory and runs CP/M, MP/M and two other operating systems, MVT-FAMOS and OASIS. It is programmable in BASIC, COBOL, Fortran, and assembler. Standard disk storage is one 8-inch 1-megabyte floppy-disk drive. The terminal is a user option.

Altos

Another micromainframe that debuts here is the *ACS8000-15*. Driven by an 8-bit Z80A, it has 208K of user memory. It runs under the industry-standard CP/M operating system and has two 500K single-sided, double-density disks for storage. It is programmable in BASIC, Fortran, COBOL, and SOFTBOL and is meant to be the basis of a multi-user system. It has six standard serial ports and one parallel port as standard. Terminal choice is up to the user.

This company's *5-15D* is another micromainframe system, that debuts here. Driven by a Z80B, this 8-bit system operates under the CP/M operating system. It has 192K of user memory and includes a 1-megabyte double-sided, double-density 5¼-inch minifloppy-disk drive for storage. Programmable in BASIC, COBOL, Pascal, Fortran, and SOFTBOL, the system uses four serial ports and one parallel port for input/output. Since it is a micromainframe—a system box with a disk drive and interface ports—the terminal choice is up to the user.

Ithaca Intersystems

Another 8-bit micromainframe—driven by a Z80B microprocessor—is the *Encore* from Ithaca Intersystems. It operates under CP/M. Standard user memory is 128K, and storage is on two 5¼-inch single-sided, double-density disk drives. Since it is a micromainframe, the choice of terminal devices is up to the user.

CompuPro

Long a leader in S-100 bus products, CompuPro's *System 816/A* also debuts here. A micromainframe small-computer system, it is driven by co-processors, an 8-bit 8085 and a 16-bit 8088 and runs under CP/M and CP/M-86. User memory is 128K and storage is handled by two 1.2-megabyte 8-inch floppy-disk drives. Since it is a micromainframe, terminal choice is up to the user, but input/output functions are handled through four serial ports and one parallel port included as standard.

DEC

The last of the four single-user microcomputer systems introduced a year and a half ago makes its debut here, the *Professional 350*. Actually an upgrade of the *Professional 325*, this system includes a larger system-unit box, that is made to accept a 5¼-inch hard-disk drive. In this version, storage is provided by a single 400K 5¼-inch minifloppy-disk drive. User memory stands at 256K, or more than enough to handle any advanced application program.

The system is driven by a proprietary 16-bit CPU, the PDP-11/238 and operates under a proprietary operating system. CP/M is available as an option. User input is via a slim-line keyboard which contains 58 typing keys. There are special-function keys and a separate 14-key numeric pad. User output is handled by an 80-character by 25-line black-and-white monochrome display, while input/output chores are handled by a serial port or an RS-423 synchronous port.

Radio Shack

The *Model III Desktop* reaches its top configuration in this price category. It becomes a full-blown business small-computer system with the addition of a 5-megabyte hard-disk drive. This allows the user high-speed, high-density data access and storage. A similarly equipped Model 4 would top out about the same price in this range, too.

A new model makes its appearance and becomes fully configured in this price category, the *Model 16*. Driven by the advanced MC68000, the *Model 16* also uses a Z80A to handle the housekeeping chores. This frees the main CPU to handle information-processing functions. Equipped with 128K of user memory, that is expandable, this system operates under a proprietary operating system. In its base configuration, it includes one double-sided, double-density 1.2-megabyte slim-line 8-inch floppy-disk drive for mass storage.

The 76-key keyboard includes a numeric keypad. Output is to a 12-inch green monochrome video-display screen that delivers an 80-character by 24-line display. Input/output is handled via two serial ports and one parallel port, included as standard. It upgrades and becomes fully configured at the upper end of this price category with the addition of a second drive 1.25-megabyte slim-line 8-inch floppy-disk drive. **R-E**