THE MACMILLAN
EASY HOME COMPUTER SERIES

THE TI 99/4A USER'S GUIDE

THE ONLY MANUAL YOU NEED TO UNDERSTAND & GET THE MOST OUT OF YOUR HOME COMPUTER

HOW TO SET UP AND OPERATE THE TI 99/4A

HOW TO EXPAND YOUR SYSTEM THROUGH ADD-ONS

A CONSUMER GUIDE TO THE BEST SOFTWARE

GLOSSARY OF KEY TERMS AND ADVICE ON SERVICING

Text by Bill Brewer, with Mark Andrews. Edited by Roger C. Sharpe

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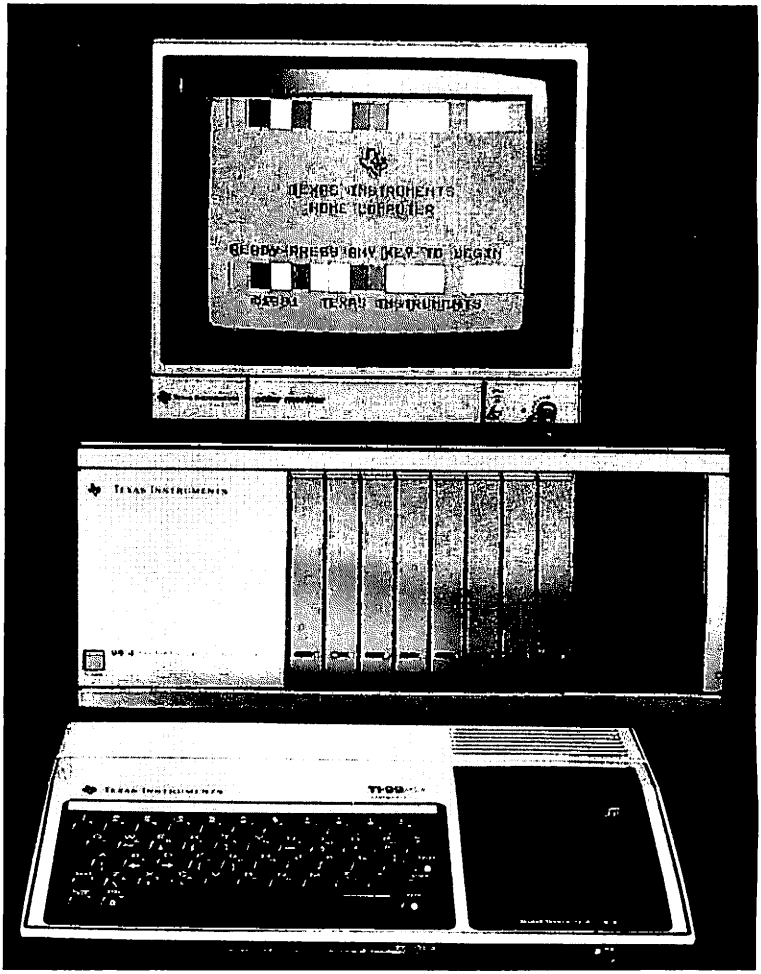


Although recently changed to a solid-color ivory-white finish and a light tan keyboard, the TI-99/4A is still identified by its distinctive silver body and black keyboard. It's shown here with an expansion box and video monitor.

INTRODUCTION

What can you do with a home computer? You can't do much, if it's the wrong computer. However, if it's the right one, perhaps more than you ever dreamed possible. And the right computer for you might well be the TI-99/4A.

This book was written for TI-99/4A owners, and for people who may consider buying TI-99/4A's. It's packed with facts, hints, and other valuable information about the 99/4A that have never before been published in a single volume.

Not too long ago, a small boy sat at a computer keyboard, absorbed in the images flashing across the computer's screen.

"What are you doing?" he was asked.

"I'm learning," he replied.

"Is the computer teaching you?"

He looked up. "Yes," he replied with a beaming smile. "And I'm teaching it, too."

That little boy, in his own words and without any prompting from anyone truly summed up what the home computer revolution is all about.

A home computer is more than a machine that can do certain types of work for you. It's more than a machine that can teach you. It can *learn from you.* You can tell a home computer what you want it to do for you. And then, if it understands your instructions and is capable of doing what you've asked, it will do it.

And therein lies the magic of home computers in general, and the TI-99/4A in particular.

WHAT THE TI-99/4A CAN DO

So what *can* you do with a home computer—or, to be more specific, with a Texas Instruments 99/4A? Well, here are a few things:

- You can use a TI-99/4A as a word processor for writing and printing out letter-perfect copies of correspondence, term papers, or the Great American Novel.

- If you would like some help with your checkbook balancing, household budgeting, or tax forms, a 99/4A could definitely come in handy.
- If you have some business or home-management files you'd like to organize—you'll be pleased to know that a TI-99/4A can be used as an electronic filing system.
- And with the help of a computerized accounting program—known as a *spreadsheet*—you can also turn your Texas Instruments 99/4A into a sophisticated electronic ledger system with extensive calculating, sorting and reporting-printing functions.
- Link your computer up with a modem (a telephone interface device), and your 99/4A can serve as an electronic telecommunications terminal, keeping you in touch with the rest of the world.
- And, at the end of a long day at your computer, you can relax and use your Texas Instruments 99/4A as an extraordinarily sophisticated electronic game machine.

WHAT EVERY COMPUTER BUYER SHOULD KNOW

Almost any personal computer can do all of these tasks, and much more. But not every computer can do every job equally well.

The Texas Instruments 99/4A, for instance, is a wonderful educational computer with more educational cartridges available for it than for any other computer on the market.

The 99/4A is also a terrific machine for people who like to play computer games. Its colors and graphics are superb, as are its sound capabilities. It can even talk, with the help of a small, inexpensive voice synthesizer. The 99/4A is a versatile game machine, too, with the addition of plug-in game controllers.

Texas Instruments additionally offers a number of business, home-management and utility (programmer's) programs for the 99/4A. And the word processor that TI manufactures for the 99/4A is one of the finest in the home computer industry.

You'll also find a large collection of 99/4A software that can help you learn to become a computer programmer. TI BASIC, a simple dialect of the BASIC programming language, is built into the 99/4A. An Extended BASIC package, which can increase the

The TI-99/4A with numerous educational cartridges can open up a new world of learning to computer users of all ages.

capabilities of the BASIC interpreter already built into the computer, is also available. With the help of other software packages, the 99/4A can also be programmed in other languages, such as LOGO and PASCAL. And there's an excellent assembler/editor kit that can be used to program the 99/4A in assembly language.

TI also manufactures a complete line of accessories (or *peripherals*) for the 99/4A, including monitors, disk drives, printers, modems, memory expanders, buffers, graphics tablets, and much more. TI has been reducing the prices of many 99/4A peripherals, so that the TI-99/4A can now be easily and inexpensively expanded into a customized home computer system.

Despite its many advantages, the TI-99/4A isn't a perfect computer. In fact there's no such thing as a perfect computer. The two main deficiencies of the 99/4A, most critics of the computer agree, are its keyboard and its *I/O* (input/output) system.

Although the 99/4A's keyboard has a good feel and nice action, there aren't as many keys on it as on a standard typewriter. Special CONTROL and FUNCTION keys have to be used in tandem with other keys to type many special characters, such as quotation and question marks (see pages 14-18).

An interesting feature of the TI-99/4A is that it's a 16-bit computer. Back in 1979, when the 99/4A went on the market, 16-bit technology wasn't quite as advanced as it is today. So even though the 99/4A is technically a 16-bit computer, its memory capabilities aren't any greater than those of a typical 8-bit home computer. And although a 16-bit computer can theoretically operate faster than an 8-bit computer, the TI-99/4A doesn't run perceptibly faster than any other home computer on the market.

BIRTH OF A COMPUTER

According to some historians, the computer era dates back to the 19th century, when engineers first designed punched cards that helped run French looms and American census-tabulating machinery. The age of electronic computers began much more recently—with the giant "electronic brains" that the U.S. military services started designing at the end of World War II.

The next stage of the computer revolution began when IBM and other manufacturers of business machinery started building huge computers for large corporations. Then, as computers became smaller and less expensive, they appeared in smaller offices, schools—and, finally, the home.

This "homecoming" took place so gradually, and so quietly, that it was scarcely noticed by anyone except computer manufacturers, computer hobbyists, and their small circles of friends. No one introduced a machine billed as a "home computer" until 1979—and the first home computer to be unveiled was the Texas Instruments 99/4—the predecessor of today's TI-99/4A.

Until June 1979, when the 99/4A was introduced, Texas Instruments had revealed no clues about its plans to manufacture a home computer. There were a few rumors that such a move was in the works, but TI was a tight-lipped organization in those days—as it still is now.

Until around 1970, TI had been known primarily as a "manufacturer's manufacturer"—a leading producer of electronic parts, such as transistors and IC (integrated-circuit) chips. In 1954, the company had cooperated in the development of the first commercially produced transistor radio. In 1958, TI had designed the first fully transistorized television set.

TI also invented the integrated circuit in 1958, the single-chip

microprocessor in 1970, and the single-chip microcomputer in 1971. These were all exotic, ahead-of-their-time devices, however, and none of them ever managed to find their way into home computers—at least not in the form originally created by TI.

Texas Instruments entered the retail market in 1970 with a line of LCD (liquid-crystal display) watches, invented at TI. Then, in 1972, came the introduction of TI's calculators.

A BUMPY ROAD TO SUCCESS

The original price of the TI-99/4A was $1,150, including a color monitor. The following year, TI started offering the computer without the monitor for $950—a $200 savings partially offset by the necessity of buying an adaptor (called an RF modulator) needed to connect the computer to a standard TV set.

Because of its high price, a scarcity of software and a keyboard designed with flat-topped, calculator-style "Chiclet" keys, the unit quickly gained the reputation as the black sheep of the personal computer flock. Fortunately, in May 1981, TI managed to introduce a new and improved TI-99/4 at a significantly lower price—$525. The unit was now called the TI-99/4A, and its touchy little keyboard was replaced by a full-size, full-stroke keyboard. And there was more software, as well. At last, the TI-99/4A was a highly marketable product.

At first, sales of the 99/4A were slow. Then, as America became more computer-conscious, sales began to mount. In 1982, as the Christmas season drew near, TI had to operate night and weekend shifts in its factories to keep up with the increased demand. The TI-99/4A is a better value than it's ever been. Today, although it sells for less than $100 (around $89, with discounts and rebates figured in), it's a better computer than you could get for $950 just three years ago.

1 SYSTEMS ANALYSIS

So what do you have when you take your TI-99/4A home and unpack it? First of all, you have the computer itself with a typewriter-like console that measures about 15 inches wide, 10¼ inches deep, and 3 inches high. Until the fall of 1983, the 99/4A had a silver-colored, brushed-aluminum top, a black keyboard with white letters, and a black plastic base. Now the computer is available in a solid-color ivory-white finish with a light tan keyboard.

The only other difference between the original silver-and-black 99/4A is the location of the power switch. In the old 99/4A, the switch and a red power-on LED, to the left of the switch, were on the computer's front panel. Now, both have been placed on the top panel, in the right-hand corner of the computer, for increased convenience and better visibility.

Internally, the new "white" 99/4A is identical to its silver-and-black predecessor. It has 16K (16,000-plus typed characters) of RAM (user-addressable random-access memory), expandable to 48K. And it has the BASIC programming language and color graphics capabilities built into ROM (read-only memory).

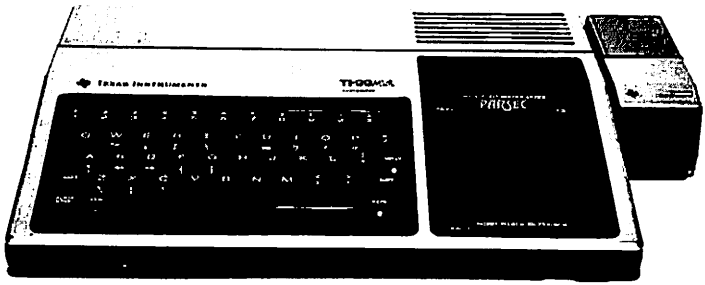
What you see when you look at the 99/4A isn't necessarily all you get. The computer looks quite small and unassuming when you take it home, take it out of the box, and plug it in. But once you get hooked on it and start adding accessories, your TI-99/4A system can grow to quite an impressive size. The componentry inside the 99/4A is also impressive. The computer is built around a TMS-9900 microprocessor, a 16-bit chip designed and manufactured by TI. The 99/4A also has a host of other interesting features. And many of them are a great deal more useful to most 99/4A owners than the unit's 16-bit microprocessor.

To begin with, the sound and graphics capabilities of the 99/4A are superb, and the voice synthesizer designed to be used with it is one of the best in the microcomputer industry.

Your TI-99/4A also has one of the finest software libraries available with more than 1,400 software packages, most of them being of professional or near-professional quality, and many of them are offered as solid-state plug-in cartridges. In addition, the 99/4A game library is now quite large and growing rapidly. TI has signed licensing agreements with some of world's leading game companies including Milton-Bradley, Sega, Broderbund and Sierra On-Line so that many of the best computer and arcade games on the market are now beginning to find their way into the TI game catalog.

The 99/4A's screen display is 40 columns (typed characters) wide, and 24 rows (lines of characters) high. The computer also has a high-resolution graphics mode in which it can generate 16-color graphics on a grid 256 pixels (picture elements) wide and 192 pixels high.

A special graphics chip built into the 99/4A—the TMS-9918A—provides program designers with many sophisticated graphics techniques. These include the use of "sprites," which are figures that can be moved smoothly over the screen without affecting backgrounds or character-generated graphics. They're often used in arcade-style computer games written for the 99/4A, and can also be used in many other types of programming applications.



Expanded computer capabilities with the addition of a speech synthesizer that is one of the best available today.

TI-99/4A programmers can also create special character sets including foreign-language alphabets, for example, and even sets of special graphics symbols.

The ability to generate new character sets is built into TI BASIC. Capabilities for using sprites, PLOT commands and many other useful programming techniques are included, however, in the Extended BASIC software package that TI offers for the 99/4A.

PROGRAMMING THE 99/4A

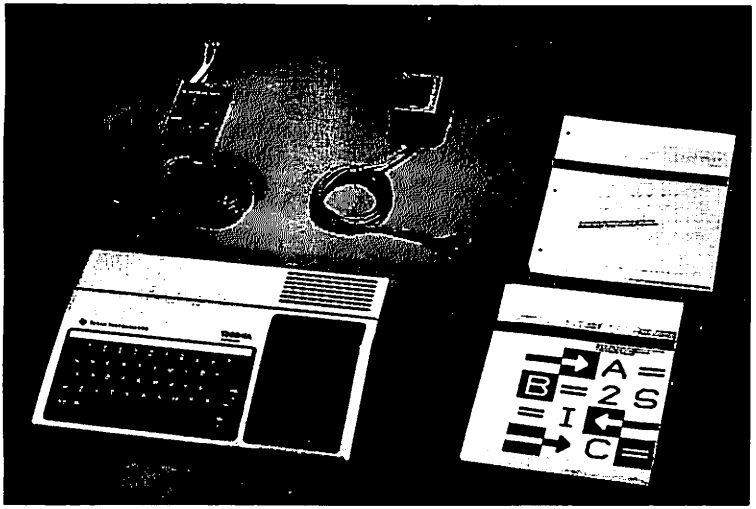
To help you start programming in TI BASIC, Texas Instruments has two well-written, easy-to-understand instruction books—a 144-page manual called *Beginner's BASIC*, and a *99/4A User's Reference Guide.*

Beginner's BASIC book is an educational book that's designed to teach you BASIC programming by using a hands-on approach. It teaches you to write your own short programs so you can direct the 99/4A to do exactly what you want it to do. And it also contains programs designed to help you learn the fundamentals of computer programming.

The *Beginner's BASIC* manual is packed with useful information, along with examples of short programs. The first thing you learn in Chapter 1 is how to make your computer print "Hi there!" on your video screen. Subsequent chapters cover both simple and more advanced programming, and deal with topics including graphics, sound, games, and mathematical operations.

The *User's Reference Guide* explains in detail how to connect cables and accessories to your computer. The book also contains a dictionary of words and phrases that the 99/4A is designed to know—a kind of phrase book covering all of the expressions in TI BASIC. You'll also find sample programs that you can actually type into the computer and run.

Along with the 99/4A, and the accessories and books provided with it, you'll also receive a certificate good for 5 hours of course work at a TI learning center. Each 99/4A buyer is entitled to 2½ hours of classroom instruction and another 2½ hours of laboratory and workshop experience with 99/4A computers under the direction of instructors trained by TI. In addition, you'll receive a full



Instruction manuals included with the 99/4A make setting up and programming the computer an easy task.

year's warranty on your computer, as well as a subscription to TI's own *Home Computer Newsletter.*

As you can see, the Texas Instruments 99/4A is a small wonder that's a lot of computer in a compact and inexpensive package.

It features 16K of *RAM (random-access memory)*, expandable to a total of 48K with optional memory-expansion add-ons. (That means that it will store 16,000 to more than 48,000 typewritten characters in its memory.)

It's also important to point out that the cost of expanding the TI-99/4A's capabilities is never very high. At current prices, you can equip a 99/4A with an expansion box, a memory expander, a disk controller and a disk drive for a total of less than $550. In the bargain, you'll get a free software package that retails for approximately $100 (the *TI Writer* word processor, plus either *TI LOGO* or *Multiplan.*)

CONNECTING THE CONSOLE

TI has put a great deal of work into making sure that the computer fits together easily and quickly. In fact, when you put it together, it's almost impossible to make a mistake.

The 99/4A console has six connectors for routing signals to and from its outside world. The connectors are intended for the following uses:

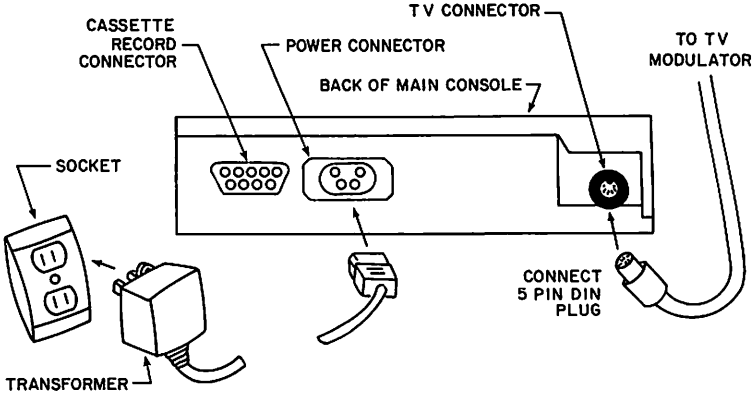
- ☐ Cartridge software
- ☐ Joysticks
- ☐ Television set
- ☐ Electrical power
- ☐ Cassette tape recorder
- ☐ Expansion accessories

The connections are virtually foolproof. The television output cable (that's included) can plug into the console in only one of the connectors. The power cable (with transformer) will only plug into one of the console connectors. You'll break the plugs or the console cabinet before you get these connectors mated wrong.

It is possible, however, to confuse the joystick connector and the cassette-recorder connector. Both are nine-pin male connectors of the same shape. Just remember that the joystick connector is on the left side of the console, while the cassette-recorder connector is on the back.

Only the power and television cables are packaged with the console. The cassette-recorder cable is a low-cost option that you may purchase if you want to save and load programs and data on

The Back of the 99/4A Console



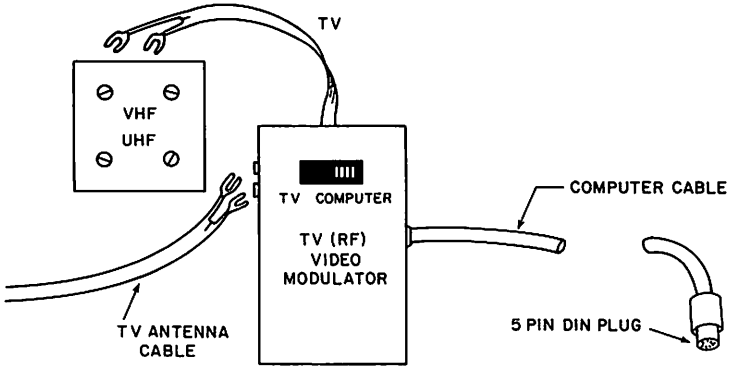
A rear view of the 99/4A console and the necessary connections.

cassette tape. TI markets its own "program recorder" (see Chapter 3) which you might want to buy to ensure that you have a recorder which works properly with the 99/4A, although almost any recorder should work.

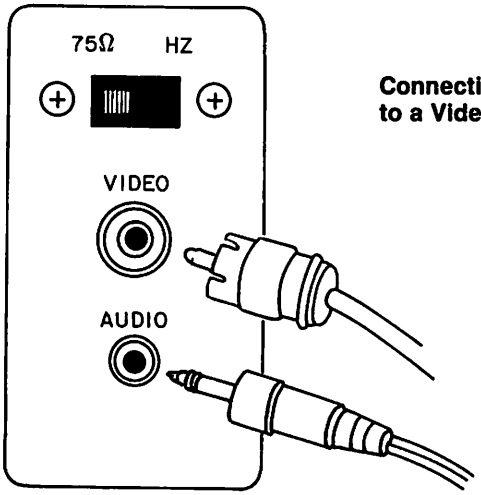
A cassette recorder isn't necessary in order to run many commercially prepared programs on the 99/4A. None of the video games and educational programs that you may purchase in cartridge form use the recorder. Some programs (from TI and other sources) are available on cassette tape, and a recorder is necessary for loading these programs. One further factor to consider is whether you might purchase disk or Wafertape expansion units (see Chapter 3). If you have these units, you won't need to save onto and load from cassette tape.

The TI-99/4A can be used with either a standard TV set or a special monitor. To connect the console to a TV set, plug the television cable into the round (DIN) connector on the back of the console. Insert the spade connectors on the other end of the cable under the VHF antenna terminal which screws on your television set. Slide the switch on top of the modulator box up to the "Modulator" position. Slide the channel select switch on the lower end of the modulator box to either channel 3 or 4 (preferably a channel which no television station in your area uses), and set your TV to the same channel.

Connecting to a Standard TV



Using an RF modulator to hook up the 99/4A to a television.



Connecting the 99/4A to a Video Monitor

Connecting the 99/4A to a video monitor is even easier because you don't use the RF modulator adaptor. Instead, take the two leads on the monitor end of your monitor cable and plug them into the audio and video inputs of a color monitor. (If the monitor doesn't have an audio input, then you won't get any sound from your computer system. So if you want to use a video monitor with your 99/4A, be sure to buy one that's wired for sound.)

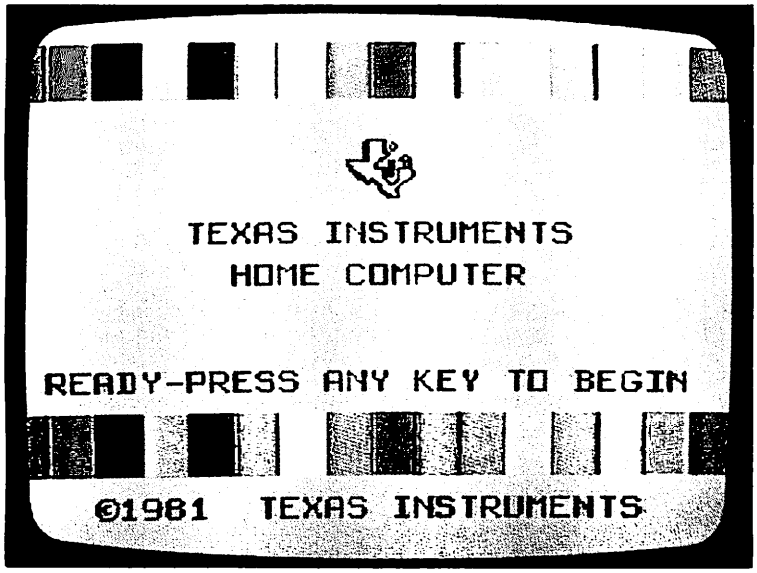
Once you have your computer connected to a TV set or a monitor, you're almost ready to start computing. All you have to do is plug one end of the power cord that came with your computer into the main unit, and the other end into the wall.

That done, you'll be ready to check your computer out and make it work for you.

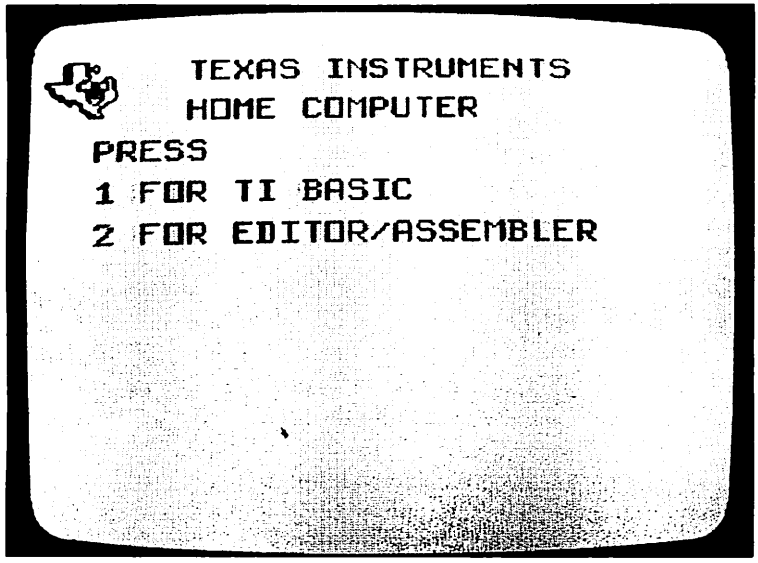
CHECKOUT

The power switch is located on the top of the console (the front panel on older 4A's) at the lower right. Turn on the switch and then your television set. A red light-emitting diode (LED) to the left of the power switch should come on. Your television set, assuming that the picture tube has had time to warm up, should show the TI title screen.

Press any key and the title screen will be replaced by a menu screen. The menu screen, lists only one item: "TI BASIC." When



The TI-99/4A title screen that appears when you power on.



The TI-99/4A menu screen lists TI BASIC (1) plus any other programs you have loaded in (2) from a cartridge, tape or diskette.

you have a cartridge in the computer, your menu screen would list programs in the cartridge as well as TI BASIC.

Press 1 to enter TI BASIC. The screen clears, and *TI BASIC READY* appears on the next-to-the-last line of the screen. Beneath the *T* in *TI BASIC READY*, a greater-than sign and a blinking black square appear. The greater-than sign, >, is a prompt from TI BASIC telling you to enter a line (by typing something followed by pressing ENTER). The blinking square is a place marker called a *cursor*. It shows you where characters that you type and then enter on the keyboard will appear on screen.

Let's enter and run a short program to check out your computer. Exactly as it is printed below, type each line. Look each line over carefully after you have typed it. If you've made a mistake in typing a line, press ENTER and type the line over again when the prompt and cursor reappear. If you have typed the line correctly, press ENTER and type the next line.

```
10 FOR X=1 TO 100
20 PRINT X:
30 NEXT X
```

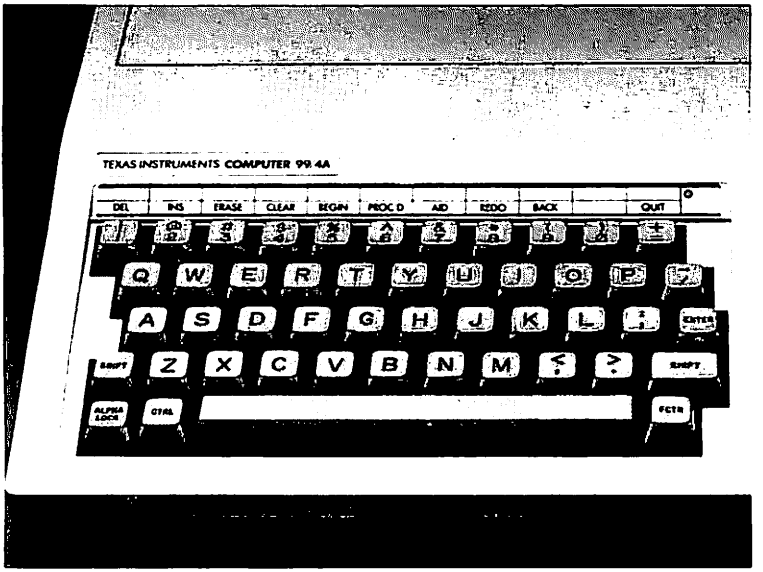
When you finish with the third line, type LIST. The lines are then listed as the computer has stored them. Check each one for errors, retyping any line with an error. Then type RUN, and press the ENTER key.

When your program begins to run, the screen turns green. Numbers from 1 to 100 begin scrolling up on the screen in two columns. When 100 is printed, the screen scrolls up a line and TI BASIC prints * * *DONE* * *. The screen changes back to its normal cyan (baby-blue) color.

THE KEYBOARD

The keyboard is one of the most pleasant *and functional* features of the 99/4A. It has, in fact, probably been the largest single factor in user acceptance of the 99/4A after the poor start made by its predecessor, the 99/4.

The 99/4A's keyboard is on the left-hand side of the computer console, and extends across part of the right half as well. To the right of the keyboard, and covering about one third of the computer's top panel, is a flat-topped area that doesn't tilt backward like the keyboard. At the top of this area sits is a small door with



A close-up of the new 99/4A keyboard.

a hinged lid. The lid automatically opens when you stick a solid-state program cartridge into it. The cartridge then clicks into place, and whatever program the cartridge might contain will then be automatically loaded into the computer as soon as the power is turned on.

One complaint that touch-typists sometimes express about the 99/4A concerns its keyboard. The computer does have nice, dish-topped, full-stroke typewriter keys, just like a large office-style unit. The keys feel comfortable, have nice action, and work just fine. There just aren't enough of them. The 99/4A has only 48 keys, making it necessary to double up a number of key functions.

The 99/4A's question mark is on the I key, for example—and to type a question mark, you have to hold down a special "function" key and hit the I key at the same time. To type a single quote mark, you have to hit FCTN-O, while to type double quotes you must hit FCTN-P.

Notice that the keyboard is full size, and the keys are located standard distances apart. The keyboard is, however, small,

because some of the usual punctuation keys which appear on most full-size keyboards aren't present. The characters normally produced by pressing these keys are produced in another way. The keyboard is ingenious in its methods of providing you the means of entering all necessary characters while permitting the console to remain as compact as it is.

The SHIFT keys above and to the left and right of the spacebar operate as they do on a typewriter, producing upper-case and lower- case letters, parentheses instead of the numbers 9 and 0, and so on. Unlike a typewriter shift-lock key, however, the ALPHA-LOCK key sets up the keyboard for shifting *only* alphabet keys. With ALPHA-LOCK pressed and latched down, all letters will be capitalized, but you still enter numbers with the keys in the top row rather than entering the symbols printed above them. The ALPHA-LOCK key makes it easy for you to enter programs in all-capitals, without penalizing you by making you unlatch a key when you want to type a number.

Four special characters are printed on the front surfaces of the S, D, E, and X keys. These characters are arrows pointing up, down, left, and right. When you hold down FCTN and strike one of these keys, it doesn't produce a character. Instead, it moves the cursor or controls the line being displayed. With the cursor beside the > prompt, hold down FCTN and press the right-arrow key a few times. The cursor moves to the right. Do the same with the left-arrow key; the cursor moves back to the left. Now, type in 100 AND without pressing ENTER. With the left-arrow key, move the cursor back over the A. Type an E, and press ENTER. Type LIST and ENTER to see the resulting line 100 in memory: 100 END.

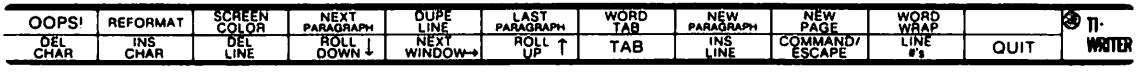
With the three-line program you entered above still in memory, type the number 10, hold down FCTN, and press the down-arrow key. Line 10 scrolls onto the screen with the cursor over the first text character. Press the down arrow again and line 20 appears. Now press the up arrow; line 10 reappears. Use the left- and right-arrow keys to move the cursor around on line 10, changing a few characters as you go.

Special keyboard entries are also possible with the keys on the top row of the keyboard. These keys have no entries printed on them or permanently assigned to them. Instead, an overlay strip, approximately ½ inch wide and 9 inches long, fits into a

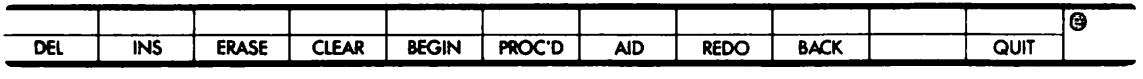
Overlay Strips for the 99/4A Keyboard

The capabilities of your 99/4A keyboard can be significantly increased with the help of specially designed plastic strips that can be inserted into the long, narrow slot just above the keyboard. Each key on the top row of the 99/4A's small keyboard can do several jobs, and with these strips, users of the computer can tell, at a glance, exactly what are the extra functions of each key.

Each strip has two rows of labels with a red dot next to the top row and a gray dot next to the labels on the second row. Labels marked with the red dot take effect when the keys below them are pressed in tandem with the special CONTROL key found on the lower left of the 99/4A keyboard. Labels on the second row show what each top-row key does when pressed in tandem with another special key called a FUNCTION key on the lower right of the keyboard.



This strip enables users of the *TI-Writer* word-processing system to perform such functions as inserting, deleting and moving text, and even recovering from an error by pressing the OOPS! key, which cancels your last command and restores things to the way they were before the command was given, if possible!



The labels on this second strip are commands often used in the editing of BASIC programs.

trough above this row of keys. Different overlay strips are used with different programs.

Seven such overlay strips are included with the console. Six of them are blank, and the seventh has key assignments for TI BASIC printed on it. With FCTN pressed, the 1 key enters INS (insert character). The insert- and delete-character keys are used when you type a line or recall it with the up- or down-arrow keys. Your pressing DEL removes the character under the cursor and closes up the line around it. Your pressing INS causes any further characters you type to be inserted before the one under the cursor. Pressing the right or left arrow causes the insertion to stop, and further characters you type will once again replace any characters under the cursor.

Notice that the key assignments on the TI BASIC overlay appear on the bottom row beside a light gray dot, and that the FCTN key also has a light gray dot. There is a similar correspondence of red dots in the top row of the overlay and the CTRL (control) key to the left of the keyboard. The CTRL key isn't used with TI BASIC, but with other software it is used similarly to the FCTN key. While CTRL is held down, the top-row keys reflect the assignments in the top row of the overlay.

USING A CARTRIDGE

For the 99/4A, to play video games you use cartridges that come in plastic cases containing circuit boards and read-only memory (ROM) chips. These chips contain already written, permanently stored programs to run the computer.

Cartridges containing educational, recreational, home management, business, and several other types of software may be purchased from TI and other sources. Programs in cartridges generally take command of the home computer once they're selected from the menu screen. They convert the general-purpose 99/4A into a "dedicated" or special-purpose machine. Insert a *Parsec* cartridge and you're fighting off the ships of enemy invaders. Unplug it and insert another, and you're programming the digital nooks and crannies of the 99/4A microchips in assembly language.

The cartridge connector is located behind the recessed door to the top and right of the keyboard. If you have the occasion for

using a cartridge, slide the leading edge of it through this door and press firmly.

It's been my experience that you don't have to turn off power to the console when you exchange cartridges. Theory says that your cartridges and console may last longer, however, if you do.

USING CASSETTES

You may save your BASIC programs, so that you don't have to type them in each time you use them, on cassette tape. The procedure is simple, once you have a cassette recorder connected to the console through a TI accessory cable. After you have saved a program on cassette, you can load it once more into computer memory with another equally simple procedure.

Attaching a cassette-recorder cable to the 99/4A and a recorder is as straightforward as attaching the other cables. Connect the end of the cable with the nine-conductor connector into the similarly shaped connector on the *back* surface of the console. Remember that the nine-pin connector on the left side of the console is for joysticks, not for the recorder.

Plug the miniature phone plug at the end of the *black* wire into the tape-recorder "Remote" jack. Now attach the phone plug at the end of the *red* wire into the "Microphone" jack, and plug the connector at the end of the *white* wire into the "Earphone" or "External Speaker" jack. Disregard any second set of black and white wires that your cable may have: They are for use with special application programs.

When you have a program in computer memory and you're ready to save it, simply type SAVE CS1 and ENTER. Easy-to-understand prompts in TI BASIC lead you through the procedure from there. Prompts and suitable responses are listed below.

Prompt: Rewind Cassette Tape CS1
Then Press Enter

Response: Rewind the tapes and press ENTER.

Press Cassette Record CS1
Then Press Enter

On most recorders, you hold down the RECORD button or key while you press PLAY; in any event, do whatever works for your recorder in recording voice.

Recording

You wait.

Press Cassette Stop CS1
Then Press Enter

That's all there is to get a program recorded on tape. There are other steps which may be taken to *verify* that the program is faithfully recorded on tape, however, and the next prompt offers you the option to check what you, in fact, have recorded.

Check Tape (Y OR N)?

Press Y to be on the safe side. If you press N, you merely return to the BASIC prompt and cursor.

Rewind Cassette Tape CS1
Then Press Enter

Rewind and press ENTER.

Press Cassette Play CS1
Then Press Enter

Press PLAY on the recorder and ENTER on the keyboard.

Checking

Data OK

Press Cassette Stop CS1
Then Press Enter

Now you have your program saved on cassette, and the 99/4A has verified that it is there for loading at your request. To load it once more into memory, you follow a series of prompts so similar to those above that we don't need to go through them here.

We should, however, note that to load a tape in TI BASIC you *do not* use a command with a name like "load." You use a command called OLD, as in the following.

OLD CS1

Someone at TI apparently thought that "olding" was the opposite of "saving," and so TI BASIC is "bound and determined" in ROM to always think likewise.

READY TO COMPUTE

Believe it or not, *that's all there is* to setting up and checking out your 99/4A. You can read the longer set of instructions in the TI manuals (and it's suggested that you do, because they are full of meticulous detail letting you know your computer better in case you have difficulty). But you are now ready to write your own program in BASIC, to run a program from cartridge or cassette, or to expand your system to include more than the console, a television set, and a tape recorder. If you're ready to expand your system, Chapter 3 has some easy words to help you choose and install accessory units.

2 TECH TALK

Once you start running programs on your TI-99/4A, you'll probably start getting curious about what starts happening inside your computer when that little red light on the right side of the keyboard goes on.

That's what we'll be talking about in this chapter.

THE THREE FACES OF 99/4A

Every computer has three main parts: a *central processing unit (CPU)*, a *memory*, and some *input/output (I/O)* devices such as *keyboards, video monitors, cassette data recorders*, and *disk drives*.

Your TI-99/4A's central processing unit is a *large-scale integrated circuit (LIS)* designed by Texas Instruments and called the *TMS9900 microprocessor*.

Your computer's memory is divided into two parts: *random-access memory (RAM)* and *read-only memory (ROM)*. We'll explain how those two kinds of memory differ in just a moment.

Your TI's main *input device* is its keyboard, and its primary *output device* is its video monitor.

ROM Wasn't Built in a Day

When your computer runs a program, there is constant interaction between its TMS9900 processor and its memory banks—both ROM and RAM.

ROM is your TI's long-term memory. It was installed in your computer at the factory, and it's as permanent as your keyboard, etched into a certain group of chips inside your computer, that never gets erased, even when the power goes off.

The biggest block of memory in your computer's ROM holds its *operating system*, or *OS*. This enables it to do all of the wonderful things that computers are supposed to do—such as accepting inputs from the keyboard, displaying characters on the

screen, loading games and other software into working memory, and so on.

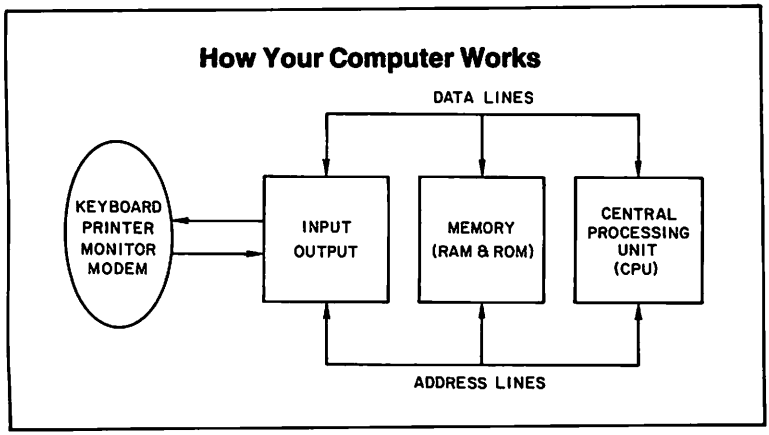
RAM Is Fleeting

To design the ROM that's built into your TI-99/4A, it took an incredible amount of hard work on the part of many highly skilled programmers. RAM, on the other hand, can be written by anybody—even you.

RAM is your computer's main memory. It comprises a much bigger chunk of memory than ROM, but isn't permanent. It's erasable—or, as a computer engineer might put it, *volatile.*

When you turn your computer on, the block of memory reserved for RAM is as empty as a blank sheet of paper. And when you turn your computer off, anything you may have had in RAM disappears. That's why most programs used in computers have to be loaded into memory from a mass-storage device such as a cassette data recorder or a disk drive. After you've written a program, you have to store it somewhere so it won't be erased when the power goes off and erases your RAM.

Your computer's RAM, or main memory, can be visualized as a huge grid made up of thousands of compartments, or cells. Each cell is called a *memory location*, and each memory location can be visualized as one post office box in a bank of post-office boxes built into a wall.



ROM

All computer memory is divided into two parts, ROM and RAM. ROM stands for read-only memory. ROM can be "read" by the computer, but you can't "write" anything into it or change it in any way. ROM is permanently written into the computer chips at the factory.

Well, ROM tells the computer what to do and how to do it when you first turn on the machine. ROM runs a quick test to see that everything is connected and working, then tells the computer's central processing unit (the CPU) what to do next.

The programs in ROM are always there, whether the power is on or not. And this is all you'll ever need to know about it.

RAM

RAM—random-access memory—takes over where ROM leaves off. RAM is where we do our reading and writing and arithmetic. We "load" programs into RAM either by typing them in through the keyboard, or instructing the computer to read them from a floppy disk. These programs, in turn, will tell the computer what to do.

One of the most important things to remember about RAM is that *it's erased every time the power is shut off!* RAM is your workspace inside the computer. Information can be written on or read from RAM in as little as a millionth of a second. Obviously, the bigger your RAM memory is, the bigger your workspace.

This is why people want more memory. Instead of, say, editing one page of the Great American Novel at a time, with more working memory, you can edit a whole chapter. With enough working memory, you could edit the entire manuscript at once.

Remember, though, should your precocious cat pull the computer's cord out of the socket, all of the novel will vanish from the computer's working memory. (You soon learn to store on a floppy disk each few hundred lines you write, to minimize the chance of losing them if RAM is erased?)

Programmers usually number their instructions in increments of 10 so that extra instructions can be inserted later if needed. For example, a simple algebra problem might be entered this way:

```
10 LET X = 2
20 LET Y = 3
30 PRINT X + Y
```

If you typed that program into your TI, and then typed the word RUN (followed by a carriage return), your computer would print

```
5
```

—the solution to *that* problem.

To program a computer to do algebra problems in which the variables can be changed, you can use this kind of program:

```
10 INPUT X
20 INPUT Y
30 PRINT X + Y
```

If you ran this program (by typing RUN and hitting RETURN), your computer would print

```
?
```

You could then punch in whatever number you wanted X to equal—for example, 5 —and then press the return key. The computer would then ask what number you wanted to call Y:

```
?
```

Suppose you responded by typing 4—and then pressed the RETURN key. The computer would immediately advance to the next line on the screen and print.

```
2
```

Now suppose you wanted to revise this program so someone else could run it. You could rewrite it in this fashion:

```
10 PRINT "X = ";
20 INPUT X
30 PRINT "Y = ";
40 INPUT Y
50 PRINT "X + Y = ";X + Y
```

As confusing as that might look to you (possibly because of the semicolons, which we'll discuss in a moment), your TI-99/4A would understand it immediately. As soon as you typed RUN (and hit RETURN), the computer would print

X = ?

At this point, you could type in any number. If you typed in a 13 and pressed the return key, the computer would immediately store your response somewhere in its memory and then ask:

Y = ?

Now you could once again type in any number you liked. If you typed in another 17, then pressed RETURN, the computer would print

X + Y = 30

Now we're ready to look at a more complex program: *The Name Game.* It looks like this:

```
10 REM THE NAME GAME
20 PRINT "THE NAME GAME"
30 PRINT "HELLO,";
40 PRINT "WHAT IS YOUR NAME?"
50 INPUT N$
60 IF N$ = "GEORGE" THEN 200
70 PRINT "GO AWAY, ";N$;", "
80 PRINT "BRING ME GEORGE."
90 GOTO 40
200 PRINT "HI, GEORGE!"
```

And each memory location in a computer, similar to each box in a post office, has an individual and unique address, which is called, quite logically, a *memory address*.

Each memory location can hold one number. And each number stored in a memory location can represent one of three things: (1) the stored number itself; (2) a code representing a typed character; or (3) a machine-language instruction.

To avoid confusing the computer, programs are usually stored in a different part of its memory from text and data.

Territorial Integrity

If your computer goes to a memory location and finds a number that equates to just a number, then the computer must be told what to do with the number it finds. If the number is a code representing a typed character, then the computer must be told how the character is to be used. And if the number is to be interpreted as a computer instruction, then the computer must be told that, too.

To tell the computer what to do, programmers write long lists of encoded instructions called *programs*.

If your computer goes to a memory location and finds a program instruction there, it will do whatever the instruction tells it to do, before moving on to the next instruction. And it will keep on doing that—following an instruction and moving on to the next one at lightning speed—until it finishes running its program.

There are countless varieties of computer programs. In fact, your computer's operating system is really nothing but a long program that automatically runs every time you turn on your 99/4A. You can also buy prepackaged programs for your computer—business software, educational software, home-management software, and games. And, if you decide you want to study BASIC or some other programming language, you can learn to write your own computer programs.

If you want to learn how to program, there isn't a better computer to learn on than the TI-99/4A. Scores of educational programs designed to teach programming are available, and there are also dozens of excellent books that can help you learn to program your Texas Instruments machine.

PROGRAMMING LANGUAGES

Computer programs can be written in many programming languages. BASIC (an acronym for "Beginner's All-purpose Symbolic Instruction Code") is the programming language most widely used by personal computer owners. TI BASIC, the dialect of BASIC used in the 99/4A, was designed by Texas Instruments and built into the computer's ROM package. TI BASIC is slightly different from other dialects of the language that run on other computers.

Extended TI BASIC—a more powerful version of TI BASIC—is available to 99/4A owners as an optional software package. Extended TI BASIC includes more sophisticated graphics and sound capabilities than standard TI BASIC, and also provides more commands for writing BASIC programs.

Other popular languages available for the 99/4A include PILOT, LOGO, and PASCAL.

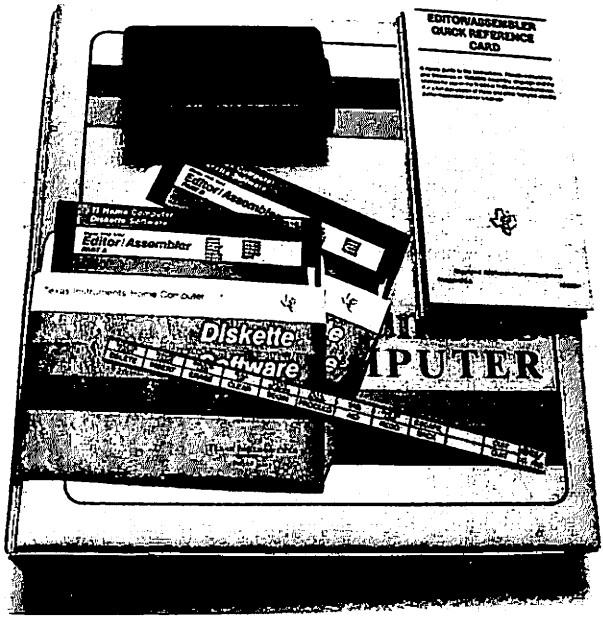
Machine Language

Even though programmers write programs in many different computer languages, a computer can actually understand just one language—*machine language*, which is composed of nothing but numbers. When a program is written in some other language—such as BASIC, COBOL or FORTRAN, which are sometimes called *high-level languages*—then the program has to be converted into machine language before a computer can understand it.

To convert programs from high-level languages into machine language, programmers use software packages called *interpreters* and *compilers*. Interpreters and compilers are what programmers use to translate so-called high-level languages—such as BASIC, COBOL and FORTRAN—into machine language. And we might as well say, just for the record, that assemblers are programming aids used by assembly-language programmers.

LEARNING TO PROGRAM

If you never use your TI for anything but running prepackaged programs, there'll be little need for you to learn to program. But if you plan to use your computer a great deal, some knowledge of programming will eventually come in handy. You may someday want to write a short BASIC program that will help



The 99/4A Editor/Assembler language software package.

you perform some repetitious calculations. You may want to write a program that will print form letters, checks or invoices. Someday you may even want to write a computer game.

Another benefit of knowing something about programming is that it will help you understand how your computer works. Even if you never write a program of your own, you'll have to run programs written by other people—and, unless you're more fortunate than any other computer user has been so far, you'll probably eventually encounter something called an *error message.* A message will flash across your screen telling you that something terrible has gone wrong. It may be a "boot error" (a disk has failed to load properly). You might get a "memory full" error, or even—a "fatal error!" And what will you do then?

Well, at that point there may not be much you *can* do. But, if you know something about computer programming, you'll have a better chance of recovering from a "fatal error," with your disk, your program and your data intact.

A Short BASIC Program

Programming on a TI-99/4A is not nearly as difficult as you might imagine. To start programming in TI BASIC, you need only know a few simple rules. For example:

When you type the word PRINT in a BASIC program, and follow it with something enclosed in quotation marks, your computer will print on your monitor screen whatever is *inside* the quotation marks.

Suppose, for example, that you type

```
PRINT "HELLO."
```

At that point, you can press a key marked RETURN (which performs the same function as a typewriter's carriage return), and your computer will advance to the next line on the screen and print

HELLO.

Similarly, if you type

```
PRINT "2 + 2"
```

—your computer will advance to the next line and print

2 + 2

But if you omit the quotation marks and type

```
PRINT 2 + 2
```

—then your computer will work like a calculator and print

4

—the solution to the problem 2 + 2.

You can also use variables, such as X and Y, in computer problems. The way to do this is to number your instructions so that your computer knows the sequence in which to perform them.

Now let's go through this program line by line:

10. Your TI-99/4A will ignore this line. In BASIC, the term REM means "remarks." Lines that begin with REM are put there for your benefit, not for your computer's. Programmers use REM lines for titles of programs and explanatory notes, and sometimes just for extra spaces that make programs more readable. It's considered good programming practice to use many REM lines so that you won't forget what the programs and routines you write are supposed to do, and so that others can understand your programs.

20. When your computer encounters this line, it will simply print *The Name Game.*

30. Your 99/4A will print the word *Hello,* with a comma after it, but will not advance to a new line on the screen. That's because of the semicolon after the quotation marks after the word *Hello.* When your computer encounters a semicolon in a program (and the semicolon is not inside quotation marks), the computer will not print a space, a carriage return, or anything else. Instead, it will go right on and print whatever is to be printed next—in this case, the string in the next line, line 40.

40. The computer prints just that: *What Is Your Name?*

50. When your computer hits this line, it will set up a variable to be called N$ (pronounced "name string"). In computer jargon, *string* is a term used to describe an *alphanumeric variable*—a variable that can contain letters as well as numbers, and can set to just about anything that you can type on your TI's keyboard.

    The INPUT instruction in line 50 will allow you to type in any string you like, and from then on will call that string N$. Suppose, for example, that you type in the word EDGAR and then press the return key. Your computer would then consider EDGAR to be the value or meaning of N$.

60. Your TI checks to see if you punched in the name GEORGE. You didn't, so your 99/4A goes on to the next instruction.

70. Your computer prints, *Go Away, Edgar.* The semicolons instruct the computer not to print any spaces around N$ (EDGAR). Those are taken care of by the spaces inside the quotation marks.

80. Your computer will print *Bring Me George.*

90. The computer is instructed to go back to line 40. It does so, and again prints *What Is Your Name?* Suppose you now type the name SARAH. Your 99/4A would then redefine N$ as SARAH and would print *Go Away, Sarah, Bring Me George.*

You could play this game for as many rounds as you liked—computers are very patient—but eventually, *you* would probably give up and type GEORGE. As soon as you did that, the computer would read line 70, see the word GEORGE (that is, see that N$ = George), jump to line 200 (as instructed) and print:

Hi, George!

That's the end of the game.

The Name Game, as long and detailed as this explanation has been, is a very simple program. Once you start learning to write programs like *The Name Game*, you'll probably soon develop a desire to make them fancier—by adding nice graphics and colors, for instance, or by using more complex instructions and additional variables.

And once you start improving your first program, you may soon find that you're hooked on computer programming.

3 PERIPHERAL VISIONS

If you want to go out and buy a prepackaged computer system—including a keyboard, a printer, and everything you need all bundled together—you can do it. The TI-99/4A in contrast, is like the receiver or amplifier in a component audio system. You can add many other kinds of components to it to make it do exactly what you want it to do. It's far more versatile than any bundled computer system could ever be.

But to add exactly the right components to a 99/4A—so you'll have a computer system that meets your needs—you have to know what kinds of accessories (or *peripherals*) are available, and be able to choose what you really need.

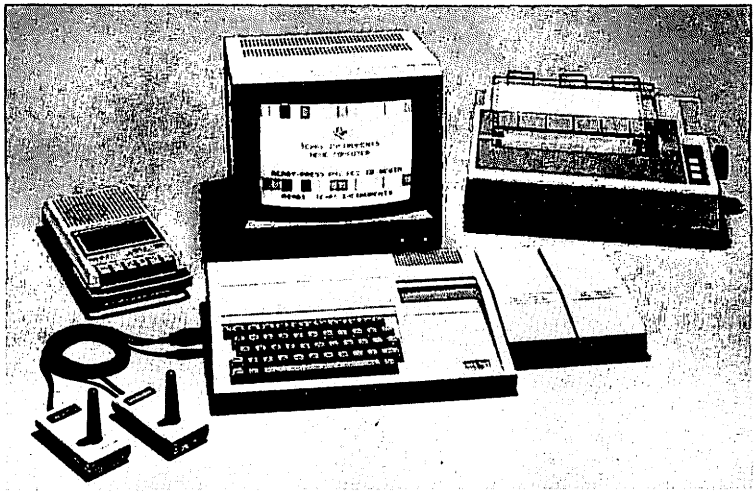
It isn't hard to decide what kinds of accessories to buy first. If you want your computer to produce a screen display, you'll need a *video monitor.* To print out text and data on paper, you'll need a *printer.* And to store text, data and programs, so that you can retrieve them and use them later, you'll need at least one *mass-storage device,* such as a *cassette recorder* or *disk drive.*

There are many other kinds of peripherals that you may or may not need, depending upon what you want to use your computer for. These include modems, buffers, memory expanders, graphics tablets, game controllers, and dozens more.

In this chapter, we'll take a look at the peripherals you're likely to buy first—monitors, printers, and disk drives—to expand the capabilities of your potentially very capable TI-99/4A.

NOW SEE THIS

Every computer needs a screen to display text and graphics—text for business uses, household management or telecommunications; and graphics for computer art or games.



The newly repackaged TI-99/4A with an array of peripherals, including the new HEX-BUS interface and speech synthesizer plugged into the right side of the keyboard console.

Most home computers in the 99/4A's price class are designed to be used with ordinary television sets, not with specially designed video monitors. And the 99/4A can be used quite successfully with a standard TV set. In fact the vast majority of 99/4A's in use today are connected to ordinary TV receivers. But your TI-99/4A will work best with a high-quality, high-resolution *video monitor*—or a *cathode-ray tube (CRT)* monitor.

The main difference between a TV set and a computer monitor is that the TV has a tuner, while a monitor doesn't have one. A tuner converts broadcast TV signals into video signals. A computer monitor doesn't have to receive broadcast signals, and thus has no need for a tuner. So computer monitors are made with video inputs, designed to accept straight video signals—not the *radio frequency (RF)* inputs coming from TV antennas (often with considerable amounts of static mixed in).

The TI-99/4A console does not produce an RF signal, but instead generates a straight video signal for static-free images on a high-quality video monitor. TI even offers a color monitor designed especially for your 99/4A, with a built-in speaker that can reproduce music, synthesized speech, beeps, buzzes, and

every other sound that can be generated by the 99/4A. And it can be hooked up directly to the 99/4A with a video cable included with the computer.

If you can afford the monitor that goes with the 99/4A, we strongly recommend that you buy it. But in case you decide not to, TI does provide with every 99/4A sold an RF modulator for hooking the computer up with your home TV.

Brand Names Among Monitors

If you decide not to use the TI-99/4A monitor, but go looking for a monitor made by some other company, you'll soon discover that there are numerous models to choose from. Amdek, Comrex, Taxan, Sanyo and many other companies make excellent color monitors that will work well with the TI-99/4A. Most of the monitors you'll see in computer stores have bigger screens than the 10½-inch one TI sells.

You may also discover when you go shopping for monitors that not all CRTs are color models. There are also one-color *(monochrome)* monitors, and these can have screen displays of several different colors. There are green-on-black, amber-on-black, and black-and-white screens. But unless your primary interest in buying a monitor is saving money, there's no reason to choose a monochrome monitor for your 99/4A. Most monochrome models are specifically designed to produce high-resolution text displays that are easy on the eyes.

Monochrome monitors can usually produce readable screen displays using lines of text that are 80 characters wide, or wider. But the 99/4A can't even produce letters that small on a screen. So there's no good reason—not even in terms of saving money—to justify buying a monochrome monitor for your TI-99/4A.

There's also no reason to buy an ultra-high-resolution color monitor, known as RGB (red-green-blue) monitors, because the TI-99/4A doesn't have an RGB output, and we don't know of any RGB adaptors that are available for the 99/4A.

Monitors are available in various sizes—the 9-inch, 12-inch and 13-inch models being very popular. Small monitors can easily be placed on top of a desktop computer, while larger units must usually be placed farther away. The size you pick is up to you, but

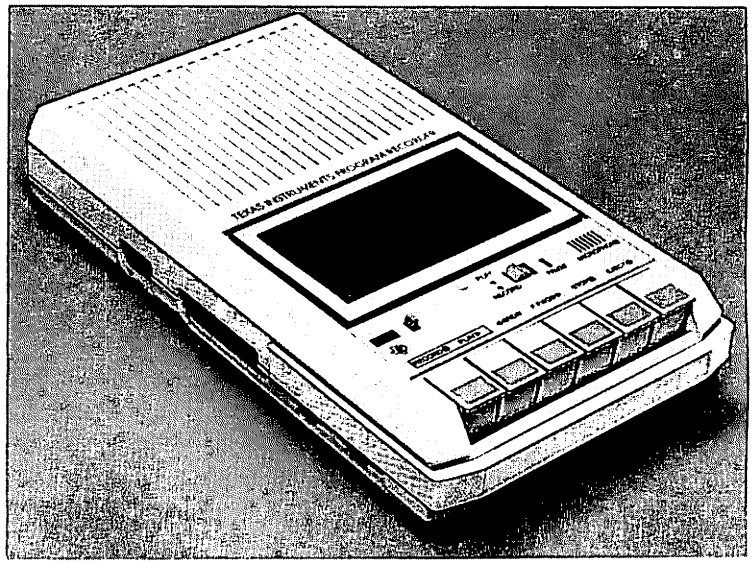
the model you buy should produce sharp graphics, with text characters that are easy to read.

A CASSETTE TAPE RECORDER

Besides connecting your TI-99/4A to a home TV or to a video monitor, there is another important peripheral that you can quickly and easily hook up to your computer—a cassette tape recorder. With a cassette recorder, you can store programs and data on cassette tapes so that they won't be erased when you turn off your computer.

If you want to connect a cassette recorder to your 99/4A, almost any ordinary audio cassette tape recorder will do. In computerese, a cassette recorder is called a *mass-storage device.* (There are also other mass-storage devices, such as disk drives and Wafertape drives. To use them, you have to have special kinds of interface devices that we'll talk more about these later on in this chapter.)

A mass-storage device is an electronic filing cabinet for stor-



TI Program Recorder lets you store almost any subject matter. (You can use a cassette recorder as well.)

ing programs and data generated by a computer. You can write programs on a 99/4A without connecting it to a mass-storage device, but as soon as you turn your computer's power off, the contents of its memory will be erased, and any programs or data that you've written and stored in the computer's memory will vanish. To keep programs that you've written, or data that you've been working with—so that you can retrieve and use it again whenever you like—you'll have to record it on some kind of mass-storage medium.

An audio cassette recorder is the least expensive kind of mass-storage device, but it has its disadvantages. It can save data or load it into a computer but much more slowly than most other kinds of mass-storage devices, and recorders, in general, aren't nearly as reliable.

If you have a standard cassette recorder lying around the house, however, and need a mass-storage device right now, then you have one. You can simply plug the recorder into your 99/4A (there are instructions telling you how to do this in the TI-99/4A *User's Reference Guide*), and you can use it as a mass-storage device until something better comes along.

EXPANDING HORIZONS

If you do decide to add anything to your 99/4A besides a TV or a video monitor and a cassette recorder, you'll need an expansion device that depends on what kinds of accessories you want to use. Three generations of expansion devices have been developed by TI since the TI-99/4A made its debut in 1979.

The first generation of 99/4A peripherals plugged directly into the computer. Each was in an individual box, and contained its own power supply. What's more, the units had rigid connectors on each side so that they couldn't be stacked. They had to be plugged into each other as well as the console, side-by-side, making the fully expanded 99/4A computer take on the appearance of a choo-choo train, and become doubtless the widest personal computer of all time.

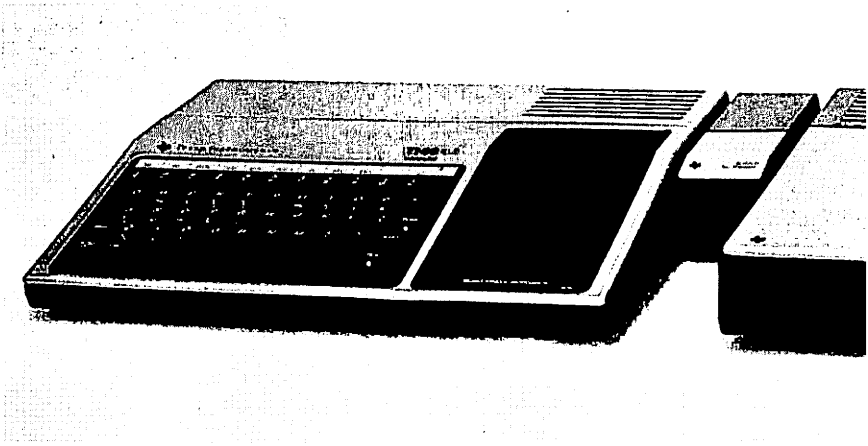
TI eventually phased out the unwieldly choo-choo-train units in favor of a more standard expansion technique. The company introduced an "expansion system" consisting of a metal box with

a power supply, a system board (motherboard) into which eight units could be plugged, and a cable containing noise-suppression circuitry used to connect the box to the console. The peripheral units themselves were designed as plug-in printed-circuit cards. Each one was encased in a plastic housing to reduce television interference.

The expansion box represented quite an improvement in packaging over the choo-choo train peripherals, as well as a significant gain in reliability. But it still made a fully expanded 99/4A into quite a bulky home computer system. (How to add a disk drive using the expansion system box is illustrated on pages 52-53.)

The New HEX-BUS Expansion Unit

TI's latest peripherals will use what may turn out to be a better way: a new connecting system called a HEX-BUS interface. The HEX-BUS interface unit will connect the 99/4A to an RS-232 serial interface; a Wafertape digital tape drive unit (more about that later); and a printer-plotter unit. TI recently announced that other low-cost peripherals, designed for HEX-BUS interfacing, will also be available soon after these are released, including modems, printers, and a wand unit designed for reading bar-code information.

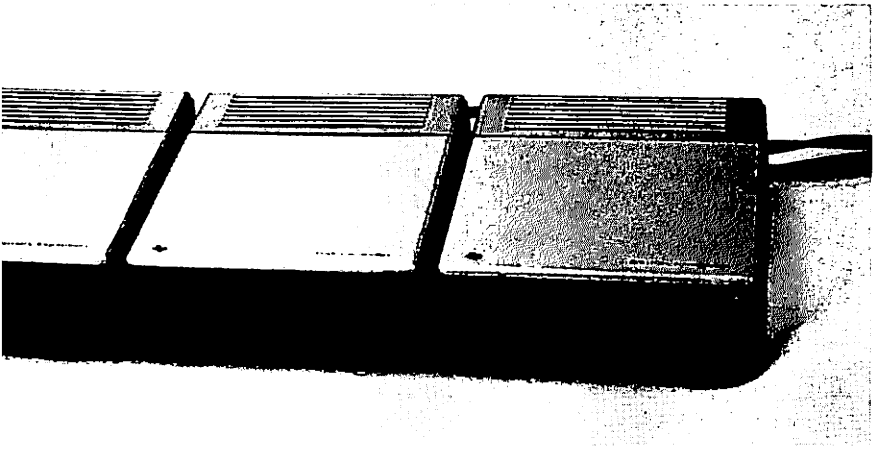


characteristics of the company's earlier expansion techniques along with a tremendous reduction in size. Similar to TI's earlier choo-choo train units, they will have individual power supplies and will be individually packaged. As is the case with the expansion-box units, they will connect together with a relatively noiseless "bus" or wiring scheme. Unlike the choo-choo-train units, however, the HEX-BUS peripherals are small. They will, in fact, run on batteries, and be connected with cables that give you freedom to arrange them any way you want. And unlike the expansion-box units, they will connect together with a bus that contains 8 (rather than 44) conductors, permitting them to be cabled together with what resembles modular-telephone connection cables and connectors.

With an announced price of approximately twice that of a cassette recorder (or "program recorder," in TI's words), the Wafertape unit should turn out to be a good deal for 99/4A owners who want an inexpensive storage device. But bear in mind that a Wafertape unit is still only a tape-storage unit, albeit with performance exceeding that of a cassette recorder. It is by no stretch of the imagination, however, comparable to a disk storage unit.

Disk storage *is* much faster than tape storage—hundreds to

The first generation of 99/4A choo-choo train peripherals had to be plugged in side-by-side.



INPUT/OUTPUT EXPANSION

There is no way to connect a printer or a telephone interface device (a "modem") directly to the TI-99/4A. The logic signals available at the expansion connector are processor (computer) signals, not input/output (I/O) signals.

One type of unit that can convert processor signals to I/O signals is called an RS-232 interface.

Units designed according to the RS-232 standard transfer data *serially*, which means that they send information characters in the smallest chunks possible, one *bit* at a time, for reassembly into characters at the other end. With serial data transfer, small cables (usually only three or four wires) can be used between a computer and its peripheral.

The choo-choo train and expansion-box RS-232 interfaces marketed by TI actually contain two RS-232 serial interfaces and one parallel interface. With these units, you can have three separate peripherals connected to your 99/4A at one time. For example, you might want to hook up a modem for telephone-line communications with your office and friends, a fast dot-matrix printer for printing out programs and telecommunicated messages, and a slower letter-quality printer for handling correspondence. Only one box or card provides for all three.

The TI HEX-BUS RS-232 unit, on the other hand, contains a single RS-232 interface, although you may purchase it with a factory-installed parallel interface built in. Remember, though, that you must have a separate interface between your HEX-BUS RS-232 unit and your home-computer expansion connector.

Separate RS-232 units that connect in the same way as do the choo-choo train peripherals are marketed by independent companies, including:

Doryt Systems, Inc.
14 Glen Street
Glen Cove, NY 11542

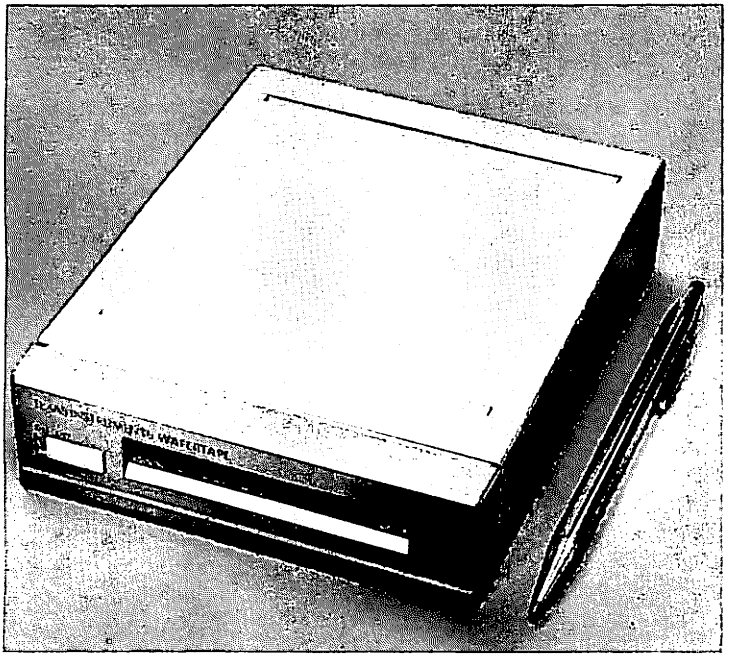
A J International
4023 Sommers Avenue
Drexel Hill, PA 19026

The unit available from Doryt Systems may also be purchased with 32-kilobyte memory expansion included to save you some disk space.

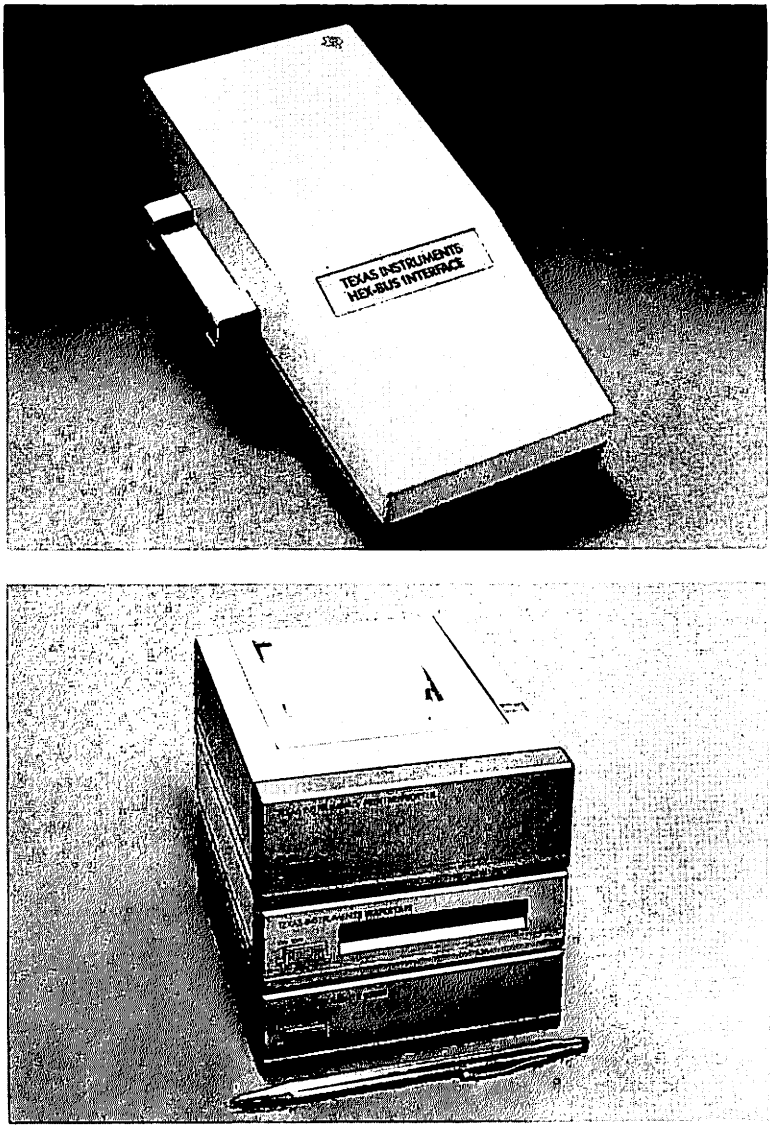
WAFERTAPES

TI has announced plans to introduce a Wafertape unit, a device that is an improved tape recorder, which may be connected to the 99/4A through a HEX-BUS interface. Other companies have called similar units "stringy floppies." Stringy floppies are said to be significantly faster than cassette tapes in the loading and storing of programs and data—perhaps twenty to fifty times faster. Reliability of stringy floppies is also said to be greater than that of standard cassette tapes.

TI's Wafertape unit uses continuous-loop tape operating at a high speed for a higher recording density than that available with cassette tape.



TI's HEX-BUS Wafertape unit can store and load programs much more rapidly than a standard cassette recorder.



Shown at top is a prototype of TI's new HEX-BUS interface unit that replaces the bulky expansion box. The new unit allows the convenient stacking of peripherals, such as those illustrated at bottom: a printer-plotter, a Wafertape unit, and an RS-232 input/output device.

thousands of times faster. And this speed, moreover, doesn't affect only the "one-time" operations of loading and storing programs. Disks can interact with programs as they control the operation of your computer. With disks under program control, subprograms may be rapidly loaded from the disk at the time they are needed, and thus the memory space they occupy can remain free at other times. When you use disks, therefore, the memory space that would be taken up by all programs and subprograms may be many times the actual memory available in the computer.

In short, with disks, programs can be longer and much more powerful than they can be with tapes.

As this book went to press, TI had not yet released any HEXBUS peripherals for the 99/4A. So the only way to add peripherals to the computer is still through the big, bulky expansion system box manufactured by TI. The rest of the peripherals we'll be looking at in this chapter will be devices that can be connected to your 99/4A through its current expansion system box.

A PRINTER PRIMER

A line printer is one of the most important accessories you can buy for a home computer.

If you use your computer as a word processor, the words it processes will have to be printed on something. If you buy an electronic spreadsheet program, so you can balance your budget or keep track of your household finances, you'll need printouts of your computer's calculations, so that you can file them away for future reference in case the tax man ever comes along.

And if you start writing your own computer programs, you'll soon discover that a line printer is an absolute necessity. To "debug" a computer program—that is, to track down mistakes you may have made in writing it—you have to have a printout of the program to sit down and go through.

There are probably more brands of printers on the market than any other kind of component. But not every printer is compatible with your TI-99/4A. In fact, TI released only one thermal printer and only one dot-matrix printer for the 99/4A. The thermal printer is no longer manufactured by TI, but may still be available in some retail outlets. There are other printers that can be interfaced with the system, but you have to shop carefully, lest

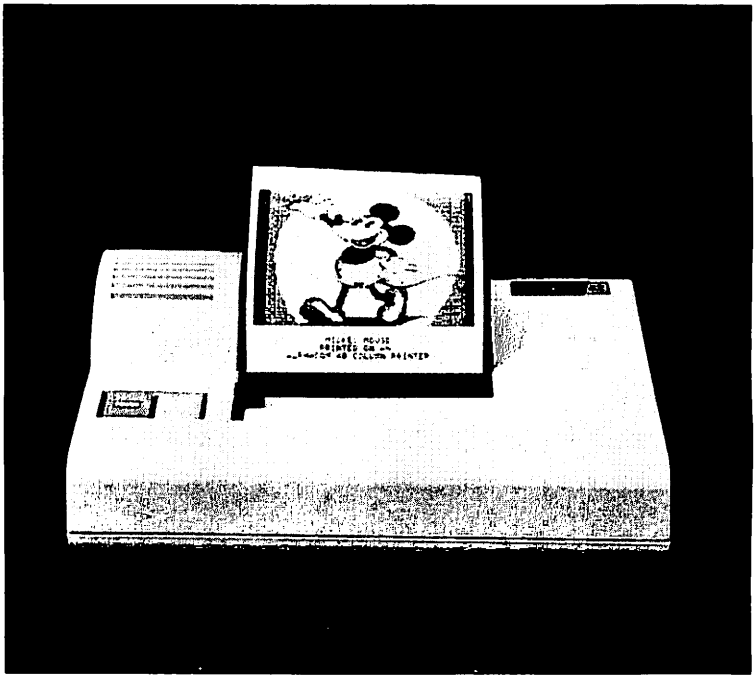
you choose a printer that doesn't work well with your machine.

Computer printers can be categorized two different ways—by the way in which they print letters on paper, and how they can be connected to a computer system.

Considering typing, there are four main varieties of printers—thermal, dot-matrix, type wheel, and printer-plotters.

The least expensive one, a thermal printer, sells for as little as $150, or perhaps even less if you shop around. But there are few thermal printers including TI's own old model that could be used with the TI-99/4A.

Some, not all thermal printers run quietly and can print both text and high-resolution dot graphics. But the quality of their printing is usually not as good as what you can get from other kinds of printers. They use a special unattractive silver-colored paper that's more expensive than conventional paper. TI's model prints



The Alphacom 42 is a light-weight thermal 40-column printer.

only 32 characters per line. So even though thermal printers cost less initially, they can be quite expensive to use in the long run if you do a great deal of computer printing.

Dot-matrix Printers

A dot-matrix impact printer, similar to a thermal printer, uses a needle to print letters made up of small dots. But it prints those letters on ordinary paper, using a ribbon much like those made for standard typewriters.

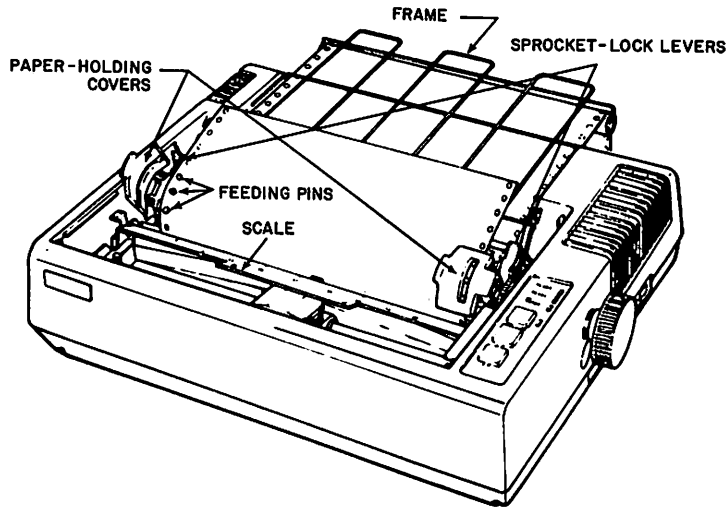
Dot-matrix printers can type rapidly—at rates of up to 160 characters per second, and more—turning out an incredible amount of printing in a short period of time. And dot-matrix printers are not outrageously expensive, with prices now ranging from around $300 to about $600.

Some dot-matrix printers can print high-resolution dot graphics as well as text, and many models can produce documents that are quite attractive. Never as crisp and clean as type-wheel printing, dot-matrix printing is rarely considered suitable if you need to print important documents and business correspondence.

The largest manufacturer of dot-matrix printers is Epson, and three of the company's most popular models include the MX-80, the FX-80 and the MX-100. The MX-80 is available either with or without a "Graftrax" option that can print pictures using dot graphics along with text. Graphics capabilities are standard on the MX-100. The FX-80 will do everything that the MX-80 will do, and also offers the option of user-redefinable characters. What that means is that if you own an FX-80, you can program it to print in any language—including those that don't use English-style letters, such as Greek, Russian or Hebrew.

Other well-known manufacturers of dot-matrix printers include Okidata, Mannesmann Tally, C. Itoh as well as Diablo, which until fairly recently manufactured only letter-quality printers, but now also offers a line of premium-quality dot-matrix models.

For the 99/4A, TI offers a dot-matrix model manufactured by Epson. It's identical to the Epson MX-80, but is especially configured to be used as a serial printer (more about that in a moment). An excellent printer, its rugged build is designed for



Print out copies of programs and data with the TI-99/4A model PHP2500 dot-matrix printer.

trouble-free performance and long life. If a dot-matrix printer will meet your needs, it would be hard to find a better unit than this one that Texas Instruments calls the Model PHP2500.

The TI PHP2500 printer uses fanfold paper with perforated seams along the left and right margins. There are holes in the seams for printer sprockets, and when a document has been printed, the seams can be torn off.

The printer will use paper from 4 to 9½ inches wide. Fanfold paper that's 9½ inches wide will produce documents in the standard letter-size width of 8½ inches.

The PHP2500 is designed to print 80 characters per second using a 9-dot by 1-dot print head to type 9-dot by 9-dot characters. On standard 8½-inch-wide paper, it can print 80 normal-width characters per line; 40 elongated (extra-wide) characters per line; 132 condensed characters per line; or 66 "condensed-enlarged" characters per line. Instructions to print special-width characters are included in some prepackaged software, and can also be included in user-written programs.

The TI PHP2500 can also provide hard-copy printouts of computer graphics. Two graphic modes—480 dots per line and

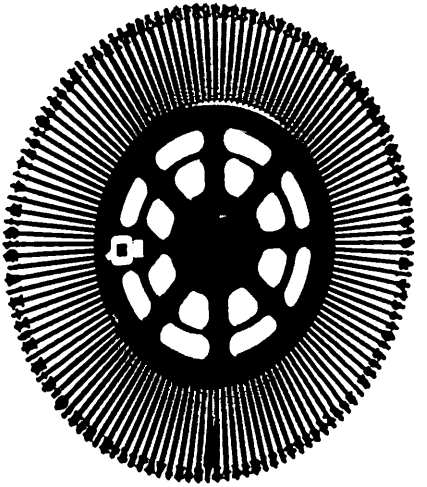
960 dots per line (dual density)—are available.

To use the PHP2500 printer with your 99/4A, the computer has to be hooked up to TI's expansion system box. And a plug-in RS-232 interface card has to be plugged into the box. Once the RS-232 card is in place, telecommunications devices and serial printers of many different kinds can be connected to your TI-99/4A.

Letter-Quality Printers

When you hear computer people talk about "letter-quality printers," they're usually referring to type-wheel printers. Up until fairly recently, letter-quality printers sold for $1,000 to $2,000 and more. But, these days, it isn't unusual to find type-wheel printers selling for as little as $600. And some small printers with letter-quality type, but few other features, are now available for less than $400.

Type-wheel printers produce letters in standard typewriter fashion—with a solid piece of type striking a sheet of paper through an inked ribbon. There are several kinds of type-wheel printers, though.



The Qume 130-character daisy wheel, available in a variety of type styles, prints letter-perfect characters.

Daisy-wheel printers, the kind used in most computer systems, have type elements that extend from a central hub, similar to the petals of a daisy. Other computer printers—though not many—have ball-shaped elements like those used in IBM Selectric typewriters. And a few computer printers have thimble-shaped type elements.

Diablo is probably the best-known manufacturer of letter-quality printers. But a number of typewriter companies have now jumped on the computer bandwagon by expanding into the letter-quality printer market. Smith-Corona now offers two high-quality, but relatively inexpensive daisy-wheel printers: the TP-1 ($700) and the TP-2 ($900). Both units are heavily discounted at least $100 to $200 below suggested book value.

Other manufacturers of letter-quality printers include Royal, Silver-Reed, Olympia, Daisywriter, and Atari—the latter offering a small, single-sheet, letter-quality unit for less than $350.

Any letter-quality printer with an RS-232 input can be connected to the TI-99/4A through its RS-232 serial card. But to work

Serial and Parallel Printers

Another way of categorizing printers is by the way they can be hooked up to computer systems. When printers are sorted out in this way, they fall into two categories: *parallel* and *serial*.

When a computer transmits streams of binary numbers just one digit (or bit) at a time, we say that it's transmitting data in a serial format. When a computer transmits data in parallel, it's doing so one 8-bit byte at a time.

Most printers on the market today—including all of those mentioned in this chapter—are available in serial or parallel models. To use either type of printer with your 99/4A, you have to plug the printer into the RS-232 card that plugs into the computer's expansion box. An RS-232 card has both serial and parallel input and output. With a serial connection between computer and printer, you have fewer wires and a thinner cable than with a parallel connection. A serial printer can be placed as far as 100 feet from the computer, while a parallel printer must be located within 15 feet of the computer console. For these reasons some people prefer serial over parallel printers, even though parallel printers are usually less expensive.

correctly with the 99/4A, the printer must be a "smart" model that can be programmed to accept exactly the kinds of signals that the TI-99/4A produces. One letter-quality printer that home computerists have used successfully with the 99/4A is the Smith-Corona TP-1.

Okidata printers can also be connected to the 99/4A with an interface unit manfuactured by Innovative Electronics of Denver. The device costs less than $30, plus $2.50 for postage and handling, and is available by mail. (4150 Fox St., Unit A-5, Denver, Colo. 80216, (303) 458-5600)

A DISK DRIVE DISCUSSION

A disk drive is not an absolutely essential peripheral for the TI-99/4A. A standard tape recorder can also be used to store programs and data. But after you've bought a monitor—and, perhaps, a printer—a disk drive is probably the next peripheral you'll want to own.

A floppy diskette is what computer people call a *mass-storage medium*. So to understand what disk drives are all about, it's necessary to have an understanding of what a mass-storage medium is.

Disks are used to store text, data and programs—material that you've written, or that someone else has written for you. Putting a disk into a disk drive is something like putting a record on a turntable—or, perhaps, more like putting a tape in a cassette tape recorder. When you slip a cassette into a recorder, you can either play it or record on it. In the same way, you can either run a disk or record on it once you've put it into a disk drive.

If there's a game stored on the disk, you can *boot* the disk (*load* it into your computer's memory), and then play the game.

If there's a word-processing program on the disk, it will turn your computer into a word-processing machine.

And once you learn to write your own programs—if you ever decide to do that—you can then *save* your programs on disks, so that you can load them into your computer again and run them whenever you want to.

Disk drives can store and retrieve information far more quickly than cassette recorders can—within seconds instead of minutes—and they are also far more reliable. In addition, many

prepackaged programs for the TI-99/4A are now available only in disk format. So the more you use your 99/4A, the more you'll realize that you really do need a disk drive.

Once you own a disk drive, you can use it for both running and storing programs as well as data. To play a game recorded on a disk, all you'll have to do is put the disk in your drive and then *boot* (or load) the program into your computer's memory.

To run some types of programs, two disk drives can come in handy. When you use a file-sorting program, for example, you can put the *master disk* that comes with the program into one disk drive (which we could call Drive 1), and a blank disk into the other drive (Drive 2). You could boot up your master disk using Drive 1, and your file-sorting program would automatically be loaded into your computer's memory. You'd be able to type in data on your computer's keyboard (say a list of friends' names and phone numbers, for example), and the data you entered could be stored on the blank disk in Drive 2.

That's actually an oversimplification of how file-management programs work, but you get the idea. Two-disk systems can also be used effectively in many other kinds of programs that call for text and data entries—word-processing programs, electronic spreadsheet programs and computer data-base programs, to name just three more.

Floppy Disks

Just as there are many kinds of programs available on disks, so too are there many kinds of disk drives. Many business-oriented computers use 8-inch disks, but the TI-99/4A is designed to be used only with 5¼-inch disks—sometimes called *diskettes, floppy diskettes*, or *5¼-inch floppies*.

Floppy diskettes are made of pliable plastic (hence their name) and are enclosed in cardboard sleeves. And diskettes are *never* supposed to be removed from their protective sleeves. The sleeves are permanently sealed, and are designed to be kept on the disks at all times—even while the disks are spinning like records inside your disk drive!

Since drives must handle disks while they are in their protective sleeves, the sleeves have to be made so that some of the disk shows through. In the center of the sleeve that encloses each disk,

there is a cutout hole for a spindle, on which the disks turn inside the disk drive. Also cut into the disk's sleeve is a slot through which information can be *read* by the machinery in the disk drive.

Take a look at a computer disk (or at least the part you can peek at through the holes in its sleeves), and you'll see that the disk has an oxide coating much like the coating on a magnetic tape. Disks are recorded and played much like a magnetic tape, too; inside a disk drive there are magnetic *heads* that can read the binary data recorded on a disk as it spins. The heads in a disk drive can also record data on diskettes, and can erase previously recorded data.

There are several kinds of 5¼-inch floppy disks—and several kinds of 5¼-inch disk drives. Shugart, Rana, Micro-Sci,Percom, Tandon, and several other companies make 99/4A-compatible disk drives, and some disk drives produced by independent manufacturers offer more storage capacity per disk than TI disk drives do. But when you connect a 99/4A to one or more TI drives, you can be pretty sure that they'll work properly together. So it's probably a good idea to start off by connecting your 99/4A to one or two TI drives. Then, if you like, you can add some other drives for extra storage later on.

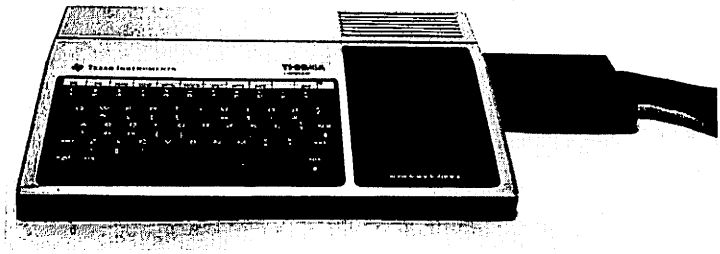
Installing a Disk Drive

To connect a disk drive to a 99/4A, you'll need that expansion system box that we've talked about earlier in the chapter. The disk drive that TI manufactures for the 99/4A is designed to be installed in slots in the expansion box, and an interface board called a disk controller card can also be plugged into the expansion module. The expansion box has space for only one disk drive. To add more than one disk drive, you need other boxes with additional space and power supplies for other drives. Instructions for installing a disk drive in the expansion box, and connecting it to the 99/4A, are provided with every 99/4A disk drive.

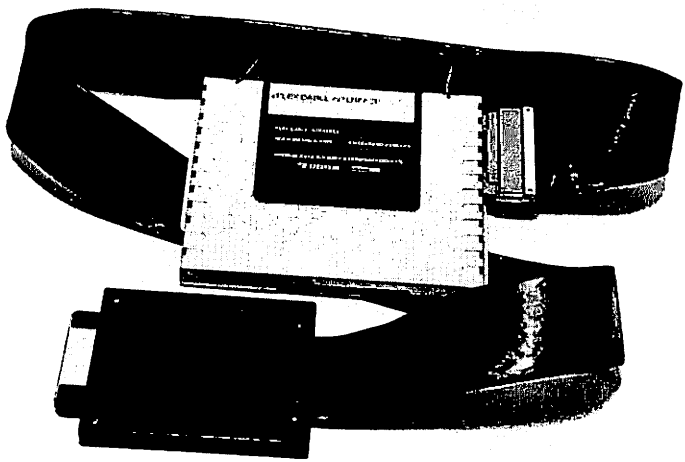
Once you get your disk drive(s) installed, you won't have much trouble learning how to use it (or them). Prepackaged software recorded on disks usually comes with instructions that are more or less complete. And after you've used a few disk-based programs, you'll pretty well know your way around TI's disk drives.

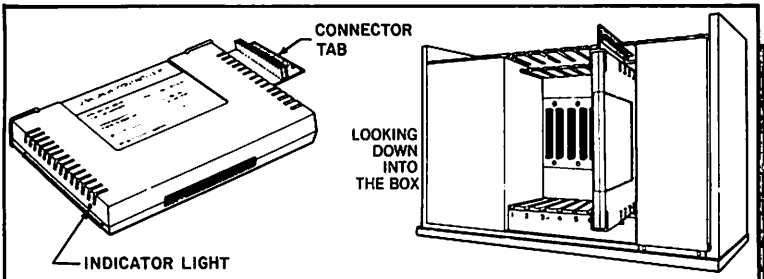
Connecting a TI Disk Drive— Using the Expansion System Box

To connect a disk drive to your 99/4A—or to connect a printer or telephone modem—you need to use an expansion device such as TI's large expansion system box. (The new *HEX-BUS* unit announced by TI could also be used to add a disk drive to your 99/4A.) There is room for only one disk drive in each expansion box.

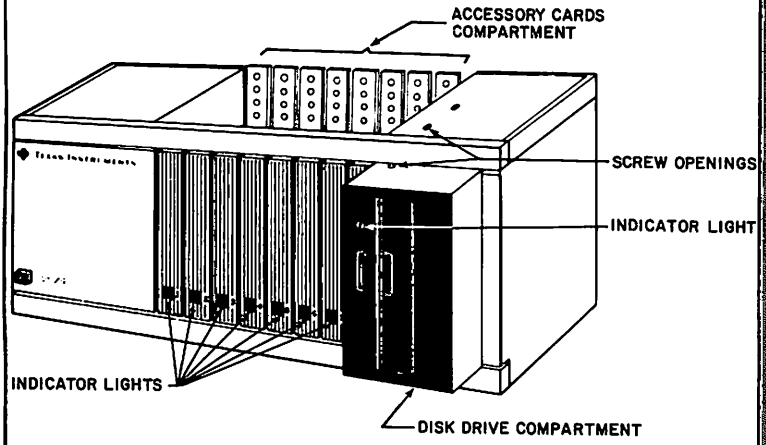


You plug the 99/4A into the expansion system module using a "Flexcable Interface." The black plug on the cable connects into the right side of the console (pictured above). The other end of the cable is actually a white plug-in card (see below). The card slips into the expansion system box into slot #1A of the accessory cards compartment (see the next page).

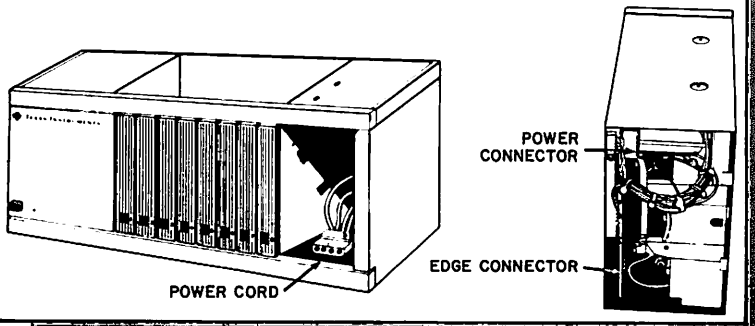




Once the 99/4A is connected to the expansion system box, via the Flexcable, a disk-drive interface card (above, left) can also be plugged into the expansion module (above, right), in slot #8A to the right.



TI's disk drive unit can then be slipped into the expansion box (above). At the back of the drive unit (below right), there is a power connector that plugs into the power cord in the box (below, left); while the edge connector slips into a corresponding slot in the expansion box.



Initializing Your Disks

When you by a box of blank disks, they're like phonograph records with no gooves; you can't *store*, or "record" anything on them. But you can use your TI-99/4A to *format* blank disks—and once you format a disk, you can record just about anything on it you like.

To run a prepackaged program stored on a disk, though, you *don't* have to format it. If there's a program recorded on a disk, then the disk is already formatted. It is possible to *reformat* a disk on which information is stored. But when you do that to a disk, you'll automatically erase everything on it.

The easiest way to format a disk on an 99/4A is to run an *initialization* program. And the initialization system that TI provides for the 99/4A is one of the simplest to use in the personal computer industry. That's because the 99/4A's DOS *(disk operating system)* is permanently installed in cartridge ROM, not furnished on a "master disk" as most disk operating systems are.

A disk operating system, as we explained in Chapter 2 "Tech Talk," is a machine-language program that tells a computer how to load data from disks, how to store data on disks, and how to manipulate disk-based data. Ironically, disk operating systems themselves are usually stored on a disk. But the 99/4A's DOS, as we've pointed out, is installed in a place that's both safer and more logical—in ROM (read-only memory).

TI's technique of installing the 99/4A DOS in ROM provides several distinct advantages over disk-based disk operating systems. For instance, when you copy a diskette, TI's ROM DOS—called the "Disk Manager Command Module"—rearranges the files on the disk alphabetically. And, if you like, you can copy selected files from disk to disk instead of having to copy entire diskettes. This and many other unusual features of the Disk Manager Command Module system are explained in detail in a comprehensive manual that comes with the 99/4A disk drive.

To initialize a disk for the 99/4A's disk drives, all you have to do is make sure your computer is connected to a disk drive, and then follow a simple "menu"—a list of easy-to-understand instructions that will appear on your monitor screen.

The menu will look like this:

Disk Commands
1 Catalog Disk
2 Backup Disk
3 Modify Disk Name
4 Initialize New Disk

Insert a blank disk into your disk drive, type "4," and your computer will ask you a couple of questions. As soon as you've answered them, your disk will be initialized.

Two Heads Are Better Than One

There are two ways to get more information onto a floppy diskette. One way is to use both sides of the diskette. The other way is to use special high-performance, or *double-density*, disks and disk drives.

You can buy double-sided 5¼-inch disks in any computer store, and you can use them in any 5¼-inch disk drive. But if you have a single-sided disk drive, there's no easy way to use Side 2 of a double-sided disk. To get the full benefit of double-sided disks, you have to have a special double-sided disk drive.

A disk drive designed to use double-sided disks has two recording heads, one facing each side of the disk. By using both of its heads, a double-sided drive can record data on both sides of a double-sided disk. And it can do that automatically—so with a double-head drive, you can load and save data to your heart's content without ever having to worry about which side of the disk it's on.

Double-density disks are made of special high-density materials and can hold roughly twice as much data than standard disks. To use a double-density disk, you also need a special kind of machine: a double-density disk drive.

There are also double-sided, double-density (quad) disk drives that can give you four times the storage space of standard single-sided, single-density drives. Manufacturers of double-sided, double-density quad drives include Shugart, Micro-Sci, Percom, Rana and Tandon.

Currently, the floppy disk drives marketed by TI are standard single-sided drives. TI's software cartridge, packaged with the

disk controller card, indicates that the software is designed for double-density, double-sided operation. Although both the drives and the software in the Disk Manager II cartridge are capable of double-density operation, the TI disk controller card can only operate single-density drives. For greater capacity with the TI disk controller, the double-sided drives (supported by Disk Manager II) manufactured by companies other than TI must be used. We can't give you all of the technical details for installing and using such drives here, but we can caution you to deal with someone you can trust in your obtaining double-sided drives and instructions for installing and using them. Otherwise, because drives vary in technical details and in quality, your chances for dissatisfaction are great.

Only in 1983 did we begin to see advertisements for disk products for the 99/4A other than those marketed by TI.

Hard-Disk Drives

There's one other kind of disk that recently became available for the TI-99/4A—a *hard disk*, or a *Winchester disk*. Winchester disks are made of metal coated with a magnetically sensitive oxide, and they spin at 3,600 RPM, compared with 300 RPM for a standard 5¼-inch floppy.

Although rotating at 3,600 RPM could hardly be called standing still, Winchester disks are sometimes called *stationary disks*. That's because they're so sensitive to dust and dirt that they're permanently sealed into their disk drives, and are never supposed to be removed by the user. So unless you become a disk-drive repairman, chances are that you'll never see a Winchester disk, even if you buy a Winchester disk drive.

How, then, do you change a hard disk? Well, you don't. But you'll probably never have to. One Winchester disk can hold more than 10 million bytes (10 megabytes) of data. And once you use that up (as you almost surely will, someday), you can simply transfer some old information that you seldom use any more to some standard 5¼-inch floppies and file them away. Then you can use your Winchester drive for more new data.

One company that advertises 5- and 10-megabyte hard disk drives for the 99/4A is Myarc, Inc., Box 35, East Hanover, NJ 07936. The prices of Myarc's drives start at over $2,000. These

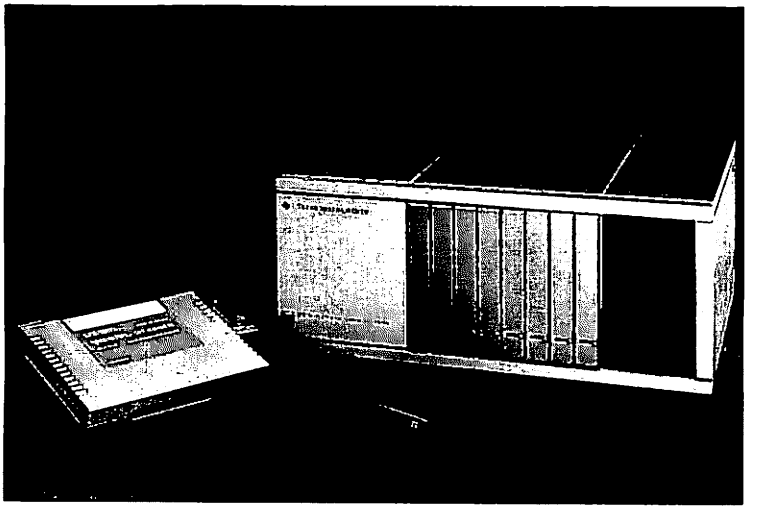
drives can't be operated directly through the standard TI BASIC operating system; they must be "patched" into it using software Myarc provides.

Memory-Expansion Cards

With memory-expansion cards, you can run bigger programs on the 99/4A—and store more data, too. Most of the commercial software which performs sophisticated work requires memory expansion. Without memory expansion, you can't run the powerful word-processing or "spreadsheet" programs available for the 99/4A (see the next chapter). And you can't convert assembly-language programs into machine-language programs. And without memory expansion, you can't use the 99/4A with a disk drive.

TI offered 32-kilobyte (32,000-plus-character) memory expansion units back in the days of the choo-choo train peripherals. Nowadays, they are available as plug-in cards for the 99/4A expansion system.

Independent companies also offer memory-expansion units that either plug into the computer's expansion box or connect to its expansion connector, as choo-choo train units used to do.



The TI-99/4A peripheral expansion system with an RS-232 interface and a program cartridge.

Companies that market 32-kilobyte cards for the expansion box include:

Foundation
74 Claire Way
Tiburton, CA 94920

Intellitec Computer Systems
2337 Bonanza Court
Riverton, Utah 84065

Foundation also markets a 128-kilobyte memory card, a device which could provide the 99/4A system with the means to run much larger and much faster programs than it now can. However, none of the software we have seen is *designed* to use such additional memory, and without software so designed the extra 96 kilobytes of memory is not a great help.

Companies that make 32-kilobyte units that are connected as choo-choo train units include:

Intellitec Computer Systems
2337 Bonanza Court
Riverton, Utah 84065

Doryt Systems, Inc.
14 Glen Street
Glen Cove, NY 11542

The Intellitec memory-expansion unit may also be purchased with a built-in RS-232 interface, saving you from the awkwardness of having a long train of peripherals to the right of the console if you need an input/output device as well.

LET YOUR MODEM DO THE TALKING

A *telephone-modem* is not an essential computer peripheral, but it's certainly a useful one. Without a modem, all you can do is sit alone in a room and compute. With a modem, compute and the world computes with you.

A modem—short for *modulator-demodulator*—is a device that can connect a computer to a telephone line so that you can send data, messages, programs, whatever you like, to other computer users.

With a modem, you can use your computer keyboard as a space-age teletype machine. You can sit at your computer and chat, ham-radio style, with other computer users across the nation—and (if you can afford the phone bills) around the world.

Once you own a modem, you can subscribe to computer data bases such as CompuServe, The Source, BRS After Dark, and the Dow Jones News/Retrieval service. Then you can use your computer to get the latest news, direct from United Press International; check stock prices and the Dow Jones averages; and communicate wth other computer owners.

You can read movie reviews, check your horoscope, dial up airline schedules, shop by computer, and play adventure games.

If you don't subscribe to a commercial data base, you can still find plenty of uses for a modem. In computer magazines and at computer-club meetings, you can get the telephone numbers of free computer "bulletin boards" run by computer hobbyists. Owners of personal computers make extensive use of these computerized CB-style ground stations, leaving messages for each other and even chatting with each other over live hookups when they're lucky enough to find another hacker at home and at the keyboard.

And modems have other uses, too. The co-author of this book, for example, writes a syndicated newspaper column on a personal computer each week, and then transmits it to a newspaper syndicate via a modem. The news syndicate, using its modem, receives the column and then sends it on to a wire service. The wire service then transmits it to newspapers across the country. And when their computers receive it, it is automatically set into type—without ever being typed, or being set into type, by anyone!

We'll be taking a closer look at commercial data banks, bulletin boards and other telecommunications topics in Chapter 5, "Information Stations."

Acoustic and Direct Connect

There are two main varieties of modems: acoustic and direct connect.

An acoustic modem is a brick-shaped device with two rubber-rimmed cups on top. To use an acoustic modem, you simply dial a number on a standard telephone and then wait for a high-pitched tone that tells you there's a computer at the other end. Then you place your telephone's handset down over your mode, with the microphone nestled down into one cup and the receiver resting

into the other. When a "ready" light on your modem lights up, your computer can start sending and receiving data.

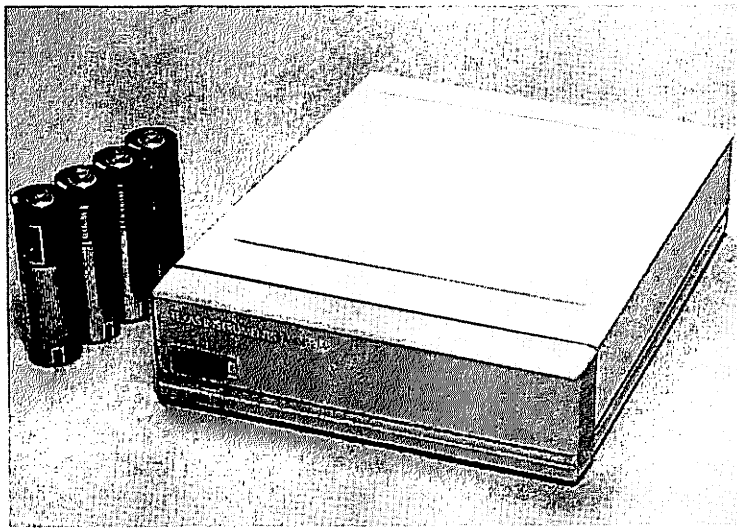
Up until a year or two ago, most modems were acoustic models. But now most modem manufacturers also offer direct-connect units that can be plugged directly into the standard plug-in wall boxes now found in most telephone-equipped homes.

Direct-connect modems transmit data much faster than acoustic ones, and are also more accurate, since they aren't sensitive to outside noises.

Direct-connect modems are also more convenient than acoustic units, since they require no mechanical coupling between a telephone receiver and a computer. And many direct-connect modems can transmit data at rates of up to 1,200 *baud* (about 120 typed characters per second) or more, compared with a limit of 300 baud (about 30 characters per second) for most acoustic modems.

Modems for the TI-99/4A

Texas Instruments offers two modems for the TI-99/4A—a direct-connect unit and an acoustic model. The acoustic unit,



The TI-99/4A HEX-BUS modem that plugs into the new Hex-bus expansion system's RS-232 interface.

which now retails for only about $100, is designed to be connected to the 99/4A through the RS-232 port in the computer's expansion system module. The direct-connect unit has a HEX-BUS connector and does not have to be connected to the computer through TI's expansion system. But it does require a HEX-BUS interface on the computer console.

There are many other kinds of direct-connect modems, and their prices vary widely, depending on their capabilities. Mura, for example, now offers a direct-connect modem priced at only $120. Low-cost modems—and higher-priced modems, too—are also offered by many other companies.

OTHER PERIPHERALS

One peripheral that can make life much easier if you use your computer a lot is a printer buffer. When you own a printer buffer, your printer can sit in the corner printing out material your computer has processed—without tying up your computer in the process.

Ordinarily, when a computer printer is printing out information—text, programs, data, or whatever—the computer attached to the printer can't be used for anything else. That's bcause when a printer is printing, the computer hooked up to it has to feed it.the information it's printing, character by character and line by line. And when a computer is doing that, it can't do anything else. So if you have other jobs to do at your computer, you're temporarily out of luck. As long as your computer is tied up doling out data to a printer, it will have no time for you.

A printer buffer can solve that problem.

A printer buffer's main task is to serve as a temporary storage area for information that's on its way to your printer. From then on, when you have something you want printed out, it will automatically be sent to your buffer instead of your printer. The buffer will store the material you want printed, and will assume the responsiblity for sending the material on to your printer at the proper speed. The buffer will also let your computer know that the printing has been taken care of, and will turn control of the computer back over to you.

From that point on, your printer will just sit there printing out the data being fed to it by your buffer. And your computer, instead

of being tied up in the task of doling out data to your printer, will be free to do whatever other work you want it to do. So if you spend a lot of time waiting for your computer while it waits for your printer, a printer buffer would be a useful accessory.

Printer buffers are manufactured by a number of companies. The two best-known buffer manufacturers are Practical Peripherals of West Lake Village, CA, and Quadram of Norcross, GA.

The buffers manufactured by Practical Peripherals and Quadram have LED lights that can show you at a glance the status of any print job your computer is doing. And by pressing buttons on your buffer module, you can instruct your printer to pause while you carry out tasks such as paper changing. So an outboard printer buffer can give you a great deal of control over the printing process.

Many other kinds of peripherals for the TI-99/4A are available, including light pens, graphics tablets, surge suppressors, and game controllers. There are many kinds of computer accessories, too, such as computer covers; disk-cleaning and cassette-cleaning kits; anti-glare screens for video monitors; and many other kinds of birthday presents, drawer-fillers, and Christmas stocking-stuffers.

With a light pen, you can draw a picture on a video screen and automatically store it in your computer's memory. Surge suppressors can smooth out house current, removing dangerous peaks and surges that could damage the delicate microchips inside your computer.

Game Controllers

There are three basic kinds of game controllers: joysticks, paddles and track balls. Joysticks, modeled after the airplane joysticks used in aviation, are by far the most popular variety of game controllers. Paddles are hand controllers with rotary knobs that can move on-screen objects only in straight lines.

A trackball is a hefty game controller with something round sticking out of the top that looks like—and sometimes is—a billiard ball. A track ball can move a cursor or a player from any point on a video screen to any other, with considerably more accuracy than a joystick can provide.

A dual port joystick adapter lets you use Atari-compatible game controllers with your 99/4A.

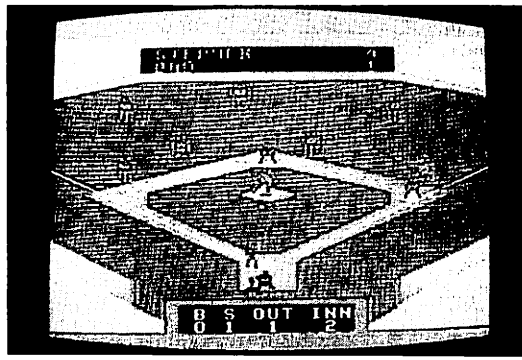
At this writing, there were no trackballs on the market for the TI-99/4A. TI makes joysticks and paddles for the unit, however, and there is a converter that will make Atari-compatible joysticks and paddles work with the 99/4A. It's made by Questar Controls, Inc., of Chehalis, WA.

The TI Speech Synthesizer

One of the most interesting and entertaining peripherals for the 99/4A is Texas Instruments' speech synthesizer. It has a built-in vocabulary of 373 words, and it can patch other words together by sounding out letters that are typed in on the computer's keyboard. Some games designed for the 99/4A—such as *M*A*S*H* from Twentieth Century-Fox—can "talk" to the player through the 99/4A speech synthesizer, adding a sense of lifelike excitement to the game.

The 373-word vocabulary of the speech synthesizer can be accessed through TI BASIC, but special software packages such as the TI *Speech Editor* are required for the use of additional vocabulary modules.

The speech synthesizer is one of the most exciting peripherals on the market today. It permits programs for the 99/4A to teach children (and adults) how to spell, and it permits students to learn math without their being penalized by low levels of reading skills. In addition, the speech synthesizer is a great aid in learning about the English language. With a TI software package called *Terminal Emulator II,* you can free yourself from the resident and special vocabularies of the module and build words and sentences from their most basic building blocks.



Designed specifically for the TI-99/4A is Milton Bradley's MBX Expansion System. Featuring voice recognition, a 64-position key pad, headset/microphone and joystick control, the unit adds a new dimension to the computer through entertainment and educational software such as Championship Baseball.

4 SOFTWARE SIGHTS

Without records, a phonograph can't make music. Without blades, a safety razor can't give you a shave. And without software, a home computer can't do any of those wonderful things that computers are supposed to do.

With the right software, however, a personal computer is an incredibly versatile machine. There are software packages that can turn a home computer into a word processor, a telecommunications terminal, or a high-tech electronic game console.

And there are also programs that can help you learn French, balance your checkbook, figure your taxes, improve your golf score, and maintain files of addresses, telephones, and recipes.

There are countless other varieties of software, too, but most of them can be divided into five main categories: (1) entertainment, (2) education, (3) business and home management, (4) telecommunications, and (5) programmer's utilities. Let's look at each of these categories, and at the kinds of programs that each heading includes.

Entertainment Software: Computer Games. There are two main varieties of computer games, action games and adventure games.

Action games are modeled after the pay-for-play game machines found in arcades. Adventure games are slower-moving contests in which the computer leads the player on a quest through some real or mythical land.

Adventure games work like interactive story books; the computer—using text, graphics, or both—presents you with a game scenario. And you play the game using either game controllers or keyboard commands.

There are also some smaller categories of computer games. War games with on-screen maps, on which battles are fought, are

known as *strategy games.* Computerized board games such as chess, backgammon and Othello also fall under the heading of strategy games. Games that take players on fanciful adventures through mythical lands are sometimes called *fantasy games.*

One important difference between action games and adventure games is that adventure games take much longer to play. If you're not very good at an action game, it can be over in a matter of seconds. But it can take hours, days, or even weeks to finish an adventure game.

In some adventure games, the video screen becomes a map, and you can move players around either with a joystick or with keyboard commands. In other games, the screen display consists only of text: In plain English words and sentences, the computer describes scenes and situations, and you use your keyboard to tell the computer how you want to handle each situation as it occurs.

In some text games—particularly older ones—the computer speaks in complete sentences but the player can use only one-word or two-word commands, such as GO NORTH or TAKE KEY. But in some newer text games, home computers can understand fairly complex commands.

There are also some adventure games that provide the player with both text and high-resolution graphics. The pictures appear above the text, and since they show what's going on around you, they can serve as valuable signposts as you make your way through a game.

Educational Software. This is the second most popular category of prepackaged computer software. And software publishers now offer educational programs designed to teach virtually every subject, including English, languages, math, art, science, and many more.

An abundance of educational software is available for the TI-99/4A. In fact, TI declares, there are more educational cartridges for the 99/4A than for any other home computer.

Some educational software is very serious and academic, designed to teach courses in an interesting but straightforward manner.

Other educational packages—particularly programs for small children—are tailored to mix fun with learning, and are more entertaining than purely educational programs.

The best educational programs are interactive; they ask you a question or pose a problem, then wait for you to type in an answer. If your answer is wrong, you are politely and gently given a chance to try again. If you're right, your computer praises you.

Well-known publishers of educational software for 99/4A computers include Spinnaker, Xerox, Edu-Ware, CBS Software, Control Data, and Sierra On-Line. Atari and other home computer manufacturers offer wide selections of educational programs. And smaller publishers of educational software abound.

Business and Home-management Software. Almost anything that you can do with a pencil, a sheet of paper and a calculator can be done better and faster with a home computer. And with the right software, you can also use a computer as a typewriter and an electronic filing system.

And there's no lack of home-management computer programs to choose from. There are word-processing programs for keeping up with correspondence and for writing term papers, business reports and the Great American Novel. There are home filing programs that you can use for filing away recipes, addresses, and telephone numbers. There are electronic "spreadsheet" programs that can help you straighten out your household finances or run a business. And there are even programs that can help you mix drinks and improve your golf score.

Telecommunications Programs. Sitting alone in a room with a computer, running the many kinds of programs that are available, or writing your own, can be a lonely pursuit—unless some of the titles in your software library are telecommunications packages.

To use a telecommunications program, you need a telephone modem (we talked about this in Chapter 3). And to use a modem, you have to have some kind of a telecommunications program. With these you can plug into the electronic data bases around the world, giving you access to more information than ever before available at one time to any one person.

Programmer's Utilities. After you get acquainted with your computer and the two of you become real friends, you'll probably start getting interested in programmer's programs—utility software packages.

Since your 99/4A came with built-in TI BASIC, you already

have one utility program: the BASIC interpreter etched into your computer's ROM (read-only memory). An extended BASIC software package for the 99/4A is also available.

As you learn more about the fascinating world of computer programming, you'll probably want to start collecting other utility programs, too, including graphics generators and computer drawing programs to create computer art; and even programs that are specially designed to help you create your own games.

If you become a dedicated computer hobbyist, you may also start buying programs that can help you learn to program in computer languages besides BASIC. Other programming languages available to 99/4A owners include PASCAL, PILOT, and LOGO.

Software for the 99/4A is available in three forms: in cartridge, on cassette, and on diskette. In a few cases, TI software "packages" of the same title are available on more than one medium. The TI video-game favorites *Munchman, TI Invaders* and *Tombstone City,* for example, are available on both cartridge and diskette.

A GAMUT OF GAMES

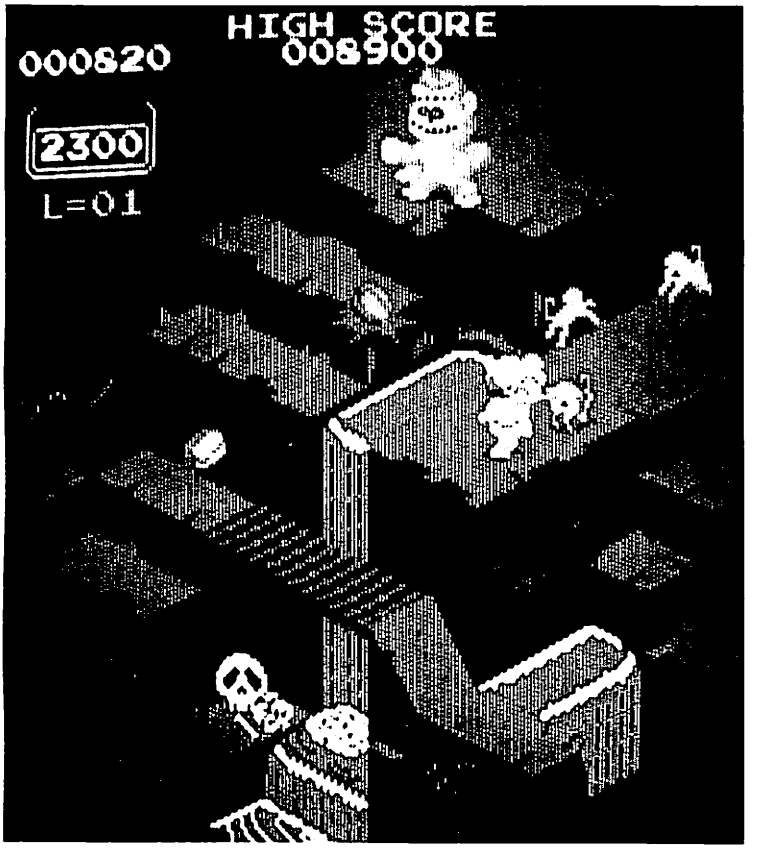
There are lots of good reasons for buying a home computer. But most people buy home computers, experts in the computer industry say, to play computer games.

To make sure that supply keeps up with demand, software publishers have released thousands of computer games over the past couple of years. And microcomputer games sell so well that new titles are now being introduced almost every day.

Most manufacturers of home computers offer extensive lines of game software for their machines. And thousands of computer games are also available from independent software companies.

Activision, Imagic, Parker Brothers, 20th Century-Fox and Mattel—companies already well known as manufacturers of video games—are now expanding into the computer game business, too. Other video game companies that have plunged into the computer game market include Spectravideo, Telesys, Tigervision and Zimag.

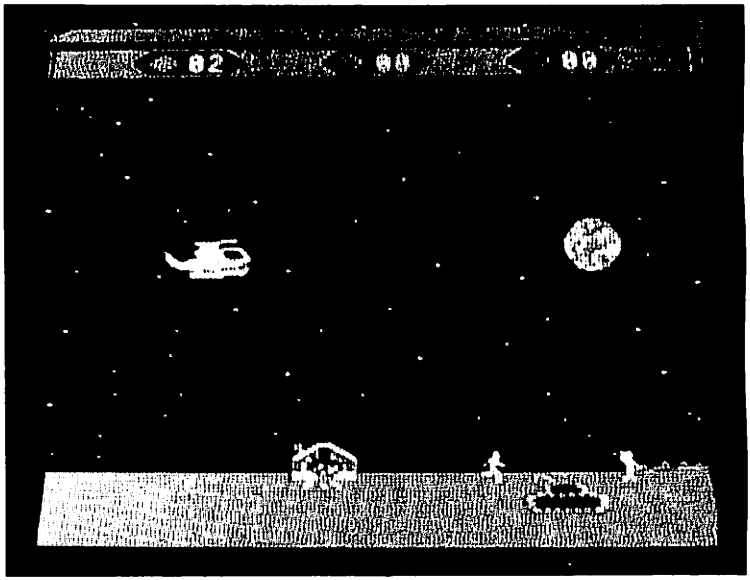
Texas Instruments insists on manufacturing all games for the 99/4A itself, but it has signed licensing agreements with a number



Sega's Congo Bongo *and other arcade-game favorites come home for 99/4A owners.*

of independent game manufacturers. And because of these agreements, popular games created by a number of independent companies—such as Adventure International, 20th Century-Fox, Broderbund, Sierra On-Line and Sega—are now available as cartridges for the TI-99/4A.

One Broderbund game now available for the 99/4A is *Choplifter*, an all-time best-seller in the home computer marketplace. In *Choplifter* you take on the role of a helicopter pilot whose mission is to rescue 64 political hostages and carry them to safety without getting blown up by gunfire from tanks and



There's daredevil rescue action with Broderbund's Choplifter.

planes. The helicopter in *Choplifter* swoops and careens realistically as it dips, dives and changes directions, and the hostages wave to you and run in an endearing way that's almost human.

David's Midnight Music, another popular game from Broderbund, is also available now in a 99/4A-compatible version. Sierra On-Line has released a 99/4A version of the hit game *Jawbreaker*, while the Fox game *M*A*S*H* is now available in a 99/4A version featuring synthesized voices.

Sega, a leading producer of coin-operated arcade games, has also signed a licensing agreement allowing TI to produce 99/4A cartridges of some of its top games. Under this agreement, 99/4A owners will be able to play home versions of games including *Congo Bongo,* Paramount Pictures' *Star Trek*, and *Buck Rogers: Planet of Zoom*.

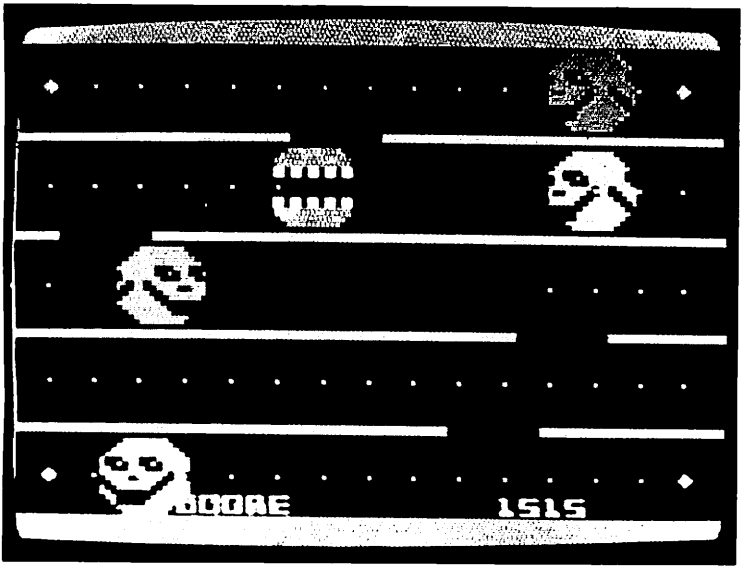
Arcade-style 99/4A games originated by TI include *Munchman*, *Parsec* and *Tombstone City*. *Munchman* is like Atari's *Pac-Man* played with an "opposite" objective: A little round man runs around in a maze, covering every path in it with links in a chain.

Just as Pac-Man flees from ghosts, your Munchman must flee from four Hoonos. Each Hoono has a distinctly different level of intelligence, and from one maze to the next, the Hoonos change shape. They sometimes resemble traveling pinwheels, sometimes rainclouds, sometimes tornados, and other times they have shapes that we have no names for—other than "Hoonos."

Most of the novelty of *Parsec*, a space travel and battle game, similar to Atari's *Defender,* lies in its use of voice synthesis. A female voice, like the voice in the *Star Trek* television series, talks to you from your spaceship's onboard computer, telling you when enemy invaders are about to attack and when asteroids are heading your way. You are also given compliments about your shooting.

If your 99/4A doesn't have a speech synthesizer, you play the game without the benefit of onboard spoken commands—but must do with written messages at the bottom of the screen that you may not notice if you are absorbed in other parts of the game.

The objective of the game is to accumulate points by destroying enemy invaders and asteroids. You play through as many



Jawbreaker *from Sierra On-Line delivers fast-paced fun.*

Pop in TI's own Parsec *for a space travel and battle game.*

levels of difficulty as you can, at each of which you are attacked by waves of six different types of invading ships, each with different methods of destroying your ship. You must blast through an asteroid belt, but if you overheat your laser by blasting away too rapidly, your ship explodes. When your ship gets low on fuel, you must carefully fly through a tunnel with ship-shattering rock surfaces in order to refuel.

A favorite of many is the TI game, *Tombstone City*. Although, in many respects, it's just another game in which you blast away at the enemy before he gets you, it's also something refreshingly novel in setting. The game takes place in an old-West ghost town during the 21st century. A combination of aliens of weird biological origins, desert tumbleweeds and cactuses, and a desert schooner pose an attack that isn't just another battle-in-the-void-of-space game.

Tombstone City is a grid in the center of the screen where you—and your people—are safe from alien attack. Surrounding the city are tumbleweeds, cactuses, and alien morgs. The cactuses breeds morgs, and morgs become cactuses when they are shot. Tumbleweeds are obstacles which hinder your shooting morgs. If you shoot a morg from inside the city, the cactus he becomes

blocks one of your entrances into and exits from your city.

What you want to do in the game is to help your people increase in population. They do this whenever you shoot a population hazard: a tumbleweed or a morg. But the desert can become full of cactuses if you're not careful. If you shoot a morg when it is next to two cactuses, the resulting three cactuses become a single morg. You can clean up the desert of cactuses by shooting this morg and reducing him to a single cactus.

Other popular game titles for the 99/4A include *TI Invaders*, an excellent *Space Invaders*-like game, and an entertaining fantasy game called *Tunnels of Doom*.

Adventure Games

There are two main varieties of adventure games for home computers: text adventures, in which words appear on the screen, and graphic adventures, in which the computer screen becomes a map and the player uses either the keyboard or game controllers to move characters around.

Text adventures work like interactive story books; the computer tells a story by displaying text on the screen, and the player communicates with the computer by typing questions and commands on a computer keyboard. The computer text-and-graphics games on the market have somewhat sophisticated linguistics. Upon discovering a treasure, you might type in, TAKE DIAMOND. And once you have the gem, you might type N for north or E for east to move on to another location.

Adventure International, founded by Scott Adams, is the world's leading manufacturer of text-style adventure games. Adams founded AI to produce and market adventure games he had created—games with names like *Adventureland, Pirate Adventure, Voodoo Castle, Mission Impossible* and *The Count.*

When Adams started writing computer games, computers didn't have color screens or high-resolution graphics. So his games were originally text-only adventures—without action pictures on the screen. But in the updated version of Adams' games, full-color illustrations of what's going on in the game now appear above the original text. And, while each picture may not be worth a thousand words, the high-resolution graphics added to the Adams' adventures make you part of the action.

GAMES GALORE

You can purchase several hundred 99/4A games on cartridges, cassettes, and diskettes. Many of the games marketed by sources other than TI are programmed in BASIC, and they tend to be slow. An Extended BASIC cartridge (see "Computing Software," below) is often required for such games, so that special features of the language may be used to provide more rapid and continuous motion of objects on the screen.

Many of the games for the 99/4A are programmed by machine owners, rather than professional programmers. These programs are available through users' groups (see the chapter "Group Encounters"). They vary in quality from *simple-but-interesting* to *good.*

Under a special agreement with Adventure International, TI offers 11 adventure games created by Adams: *Adventureland, Pirate Adventure, Mission Impossible, Voodo Castle, The Count, Strange Odyssey, Mystery Fun House, Pyramid of Doom, Ghost Town, Savage Island (Part I and II)* and *The Golden Voyage.*

EDUCATIONAL SOFTWARE

Among TI software packages, educational programs far outnumber any other type of programs. Overall, TI educational software provides individualized learning through the use of the home-computer keyboard, screen, and sound and speech synthesizers.

Although most of the educational software is school related, some is not. Typical general-education courses include a typing tutor, and music recognition and composition courses. You can learn to operate a business in a competitive marketplace or run for president against an opponent.

A three-course set exemplifies TI general-education courses. *Bridge Bidding* I, II, and III strengthen bridge bidding skills for intermediate to advanced players. In the first, you practice bid-

ding your own hand with the 99/4A bidding other hands. If you can't tell the computer the best bid, it tells you what it is and explains why it is best. The second course provides similar practice in bidding slams, and the third leads you through some competitive bidding. These courses are available on tape or diskette.

Two courses tutor you in BASIC. *Teach Yourself BASIC*, available on tape or diskette, requires no peripherals with the home-computer console, but *Teach Yourself Extended BASIC*, available only on diskette, requires an Extended BASIC cartridge.

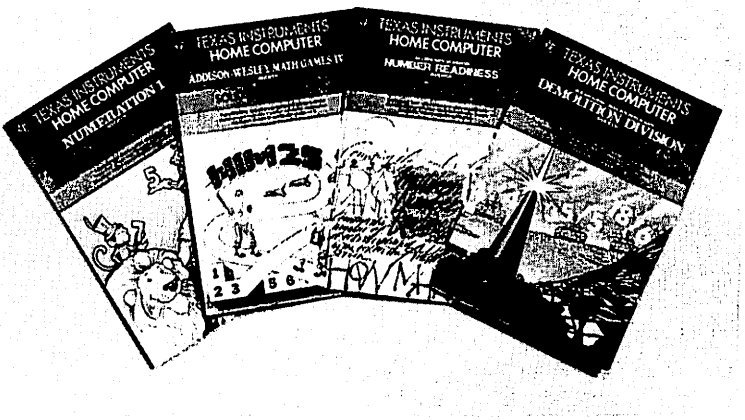
Preschool

At low level (preschool), the educational courses marketed by TI and others are like elementary games, except that they are more purposely educational than games are. They are like the preschool-education segments on *Sesame Street*, such as the "Which of these things belong together?" These segments courses have objectives such as increased awareness of colors, shapes, numbers, letters, and words and the teaching of pairs of related concepts (right, left; up, down).

Elementary-School Level

Elementary-school level coursework is much more plentiful than preschool coursework. *Early Reading Fun* and *Reading Fun*, both from TI, use speech synthesis to teach reading effectively. A series of mathematics courses in cartridges developed jointly by TI and textbook publisher Scott, Foresman and Company, takes first- through fourth-grade children through addition, subtraction, multiplication, and division with speech support. Even more important, for educational effectiveness, a series of four Scholastic spelling cartridges, developed jointly by TI and school-magazine publisher Scholastic Publishing Company, uses speech to teach children how to spell. Teaching spelling without speech synthesis would be like teaching swimming out of water.

Computer aids other than speech synthesis support the courseware for the elementary-school level. TI's *Math Mission*, *Alien Addition*, *Demolition Division*, and *Meteor Multiplication* provide the motivation for playing video games (complete with laser cannons and creeping slime) with effective instruction in the four



Fundamental learning skills are enhanced for elementary school children with this special software series.

basic math operations. Six mathematical games from TI and textbook publisher Addison Wesley make use of music and color graphics games for up to three players.

Speech synthesis is used in software that allows the 99/4A to behave like the TI "Speak and Math" and "Speak and Spell" educational toys. These programs provide the educational benefits that the toys provide. In addition, they let the child become familiar with the non-toy computer era.

A unique educational package called LOGO teaches children while they produce graphics. Statements typed into LOGO tell a "turtle" how to move around the screen. The turtle draws lines and shapes by leaving a trail. A child's learning comes into play because LOGO can be instructed to learn the procedure used to draw a line or shape. Thereafter, the line or shape can be redrawn by mention of its name in a statement. The drawing of pictures motivates children to work with a simple computer language, and working with this language in turn teaches children a great deal about learning, natural language, and even computer programming.

Nineteen courses for elementary-school students are included in TI's recently released PLATO "courseware." PLATO courseware covers a vast resource of proven computer-assisted instruction (CAI). Control Data Corporation, a large-computer manu-

facturer, developed this resource at a cost of $900 million over a period of 20 years. Control Data signed an agreement with TI, Atari, and Apple to provide 9 hours of its 12,000 courseware hours. Additionally, TI has secured a separate agreement with Control Data to offer an additional 800 hours of PLATO courseware to 99/4A owners. Overall, TI is coverting 117 PLATO courses so that they run on your 99/4A from diskettes.

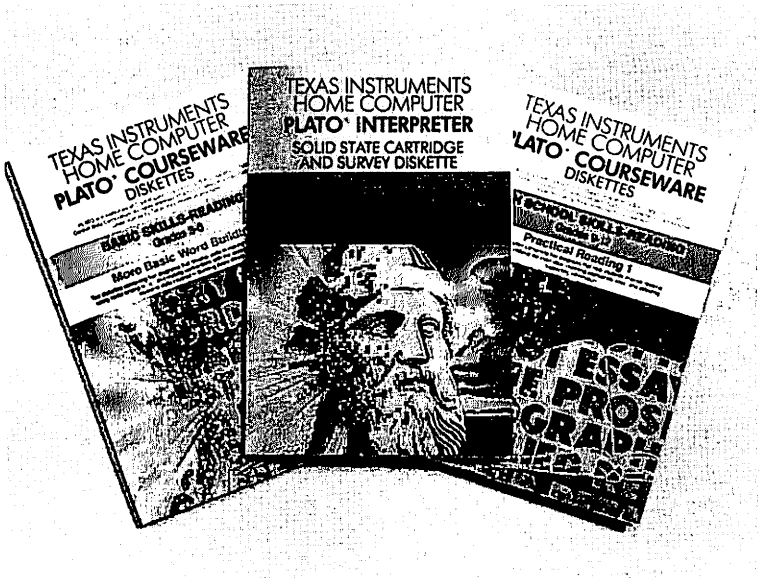
The elementary-school level PLATO courses which TI has currently announced include the following:

Understanding New Words
Understanding What You Read
Thinking about What You Read
Judging What You Read
Parts of Speech
Building and Using Sentences
Spelling and Usage
Capital Letters and Punctuation
Writing Letters (Correspondence)
Basic Number Ideas
Addition
Subtraction
Multiplication
Division
Fractions
Decimals
Ratio, Proportion, and Percent
Geometry and Measurement
Basic Word Building

You'll need a memory-expansion unit and a PLATO Interpreter cartridge from TI to use PLATO courseware on diskette. If you find a need for a good many courses and cost presents a problem to you, it's very likely that diskettes containing the courseware will be available for you to borrow from public libraries and schools.

High-School Level

Before it began offering PLATO courseware, TI offered a series of ten high-school level courses developed by the Minnesota



TI's highly acclaimed Plato *educational courseware contains a total of more than 450 programs.*

Educational Computing Consortium. These courses include the following titles:

Metric and Counting
Elementary Economics
Elementary Math and Science
Astronomy
Word Beginnings
Exploring
Math Practice
Science Facts
Natural Science
Social Science

These courses are intended for use by junior-high or high-school students, and they are available only on diskette. To run them, you must also have an Extended BASIC cartridge.

Now that TI is offering PLATO courseware, the company's previous high-school level courses are somewhat overshadowed.

High-school courses from PLATO courseware include the following.

Basic Number Ideas
Math Sentences with One Variable
Math Sentences with Two Variables
Geometry
Measurement
Special (Math) Topics
Reading
General Reading
Prose Literature
Poetry
Drama
Spelling and Punctuation
Grammar
Diction
Sentence Structure
Logic and Organization
Physics
Chemistry
Earth Science
Biology
Geography
Economics
Behavioral Science
Political Science
History

COMPUTING SOFTWARE

Several of the highest-quality software packages from TI specifically support computing. Four of these provide you computer-programming languages: TI BASIC (which is installed in ROM in the 99/4A console when you buy it), Extended BASIC, PASCAL, and TMS9900 assembly language. Another is a package that sets up the 99/4A to act as a data terminal for communication over telephone lines with other home computers, information utilities like The Source, and large computers.

TI BASIC. The "native language" of the 99/4A, TI BASIC software is included in ROM in the 99/4A console. It is a reasonably standard dialect of BASIC. If you know BASIC from working with it on another personal computer, you should have little difficulty with the few peculiarities built into TI BASIC.

An example of a peculiarity is TI's use of an OLD command. For some reason, after you have saved programs in 99/4A memory onto cassette or diskette with a SAVE command, you have to "old" them with an OLD command to get them back into memory. If you "new" a program in memory with a NEW command, you annihilate the program!

Some of the features of TI BASIC are inconvenient. The IF-THEN-ELSE statement, for example, permits only line numbers to be used as "result arguments." Most dialects of BASIC (and TI Extended BASIC) permit variable assignments and other statements as well. Also, there are no logical operators in TI BASIC. AND, OR, and XOR just didn't make it into the software.

Extended BASIC. Adding features to the TI BASIC inside the console, Extended BASIC allows you to input and display data anywhere on the screen; use "sprites" for smoothly animated graphics; write multiple statements on single lines; and have your programs stop running to report the errors to you on the screen. On a more detailed level, the "power" of certain statements has been increased. The IF-THEN-ELSE statement is no longer limited to line numbers when you specify the results of comparisons. You can, for example, assign values as a result of the following "equal" comparison.

```
110 IF X=10 THEN LET Y=0 ELSE LET Y=X
```

Extended BASIC also adds logical operators AND, OR, and XOR to the arithmetic operators already present in TI BASIC.

UCSD PASCAL. The PASCAL "language" package is really the entire UCSD (University of California at San Diego) "p-System." When you run the p-System in your 99/4A, it replaces the BASIC-oriented system in the console, giving you a different set of commands and programs to work with than those you used with TI BASIC.

The p-System requires an expansion-box "p-code" card (or a "choo-choo train" p-code peripheral). The card contains the core

of the p-System in ROM. On the back of the card is a slide switch which you can throw to select between the BASIC system and the PASCAL system. When you throw the switch, you control whether the 99/4A enters the p-System or TI BASIC upon start-up.

Within the p-System, you use the PASCAL language to write programs which are "compiled" into something like machine language. This "something like" is called "p-code," a language that is further translated into machine language by the p code card in the expansion box.

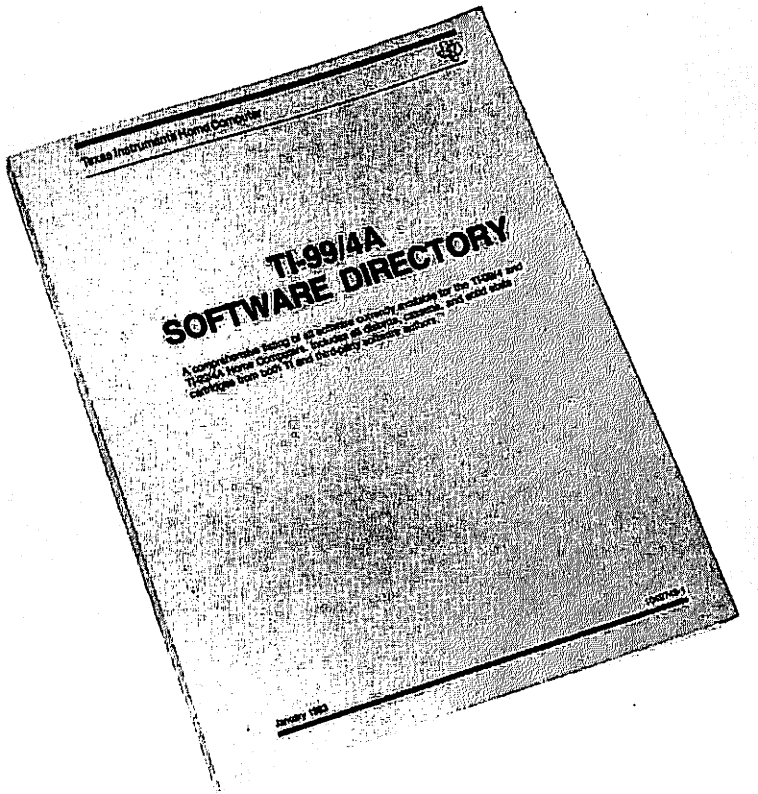
The PASCAL language has three advantages over Extended BASIC. First, PASCAL lets you use more methodical, procedure-oriented programming in which the concepts of program design are closer to statements in a program. Second, programs written in PASCAL run considerably faster. Third, programmers—people in the business hour by hour and day by day—*love* PASCAL.

Assembly Language. When speed is the most important consideration in the design of a program, the program can be written in TMS9900 assembly language. Assembly-language statements in a program are translated by an assembler into TMS9900 machine language, the fastest language that the home computer can ever run.

Assembly-language programming is difficult. Your programs can use few variables with very limited values in each statement, and you must know the most intricate details about the design and construction of the 99/4A in order to program in assembly language.

Terminal Emulation and Speech Synthesis. A TI package called *Terminal Emulator II* sets up the 99/4A to act as a terminal which can transfer keyboard-entered data or disk files to and from another home computer. Also, this package provides for transfer of graphics displays and speech synthesis of the words which appear on the screen.

The speech-synthesis software included in *Terminal Emulator II* gives it a second valuable use. You can, with the program cartridge inserted, use TI BASIC to pronounce any words which you output; you are not limited to the vocabulary built into the speech synthesizer in ROM. The package also lets you add intonation patterns (stress, and so on) to make sentences sound more natural.



The TI-99/4A Software Directory *provides a comprehensive listing of available titles in all areas.*

BUSINESS AND HOME-MANAGEMENT SOFTWARE

The 99/4A can write letters, figure your checks and bills for the month, and address envelopes. It can prepare budgets and bill clients for you. It watches your weight, and it tells you about foods that make your weight-watching less tedious. In short, a great amount of software is available for the 99/4A that can assist you in business and home management.

Word Processing

Word processing lets you do on a television screen what you might otherwise do—with considerably more difficulty—with a

typewriter and sheets of paper. Once you have what you want on the screen, a word processor prints your document on paper.

One of the most sophisticated word processors available for a home computer is the *TI Writer*, manufactured by Texas Instruments for the TI-99/4A. When you buy the *TI Writer*, you get a giant loose-leaf notebook containing a 176-page instruction manual, a 5¼-inch program diskette, a plug-in program cartridge, a keyboard overlay strip (see page 17), and a quick-reference command card.

The suggested retail price of the *TI Writer* is under $100. The *TI Writer* was designed "to bring many of the features of large word processors to users of the TI-99/4A home computer," the manual that comes with the system declares. And *TI Writer* does an excellent job of fulfilling this goal. It can handle up to 23,000 characters at a time, and its special features include:

- A screen-oriented editor with full cursor control.
- Thirty editing instructions and 24 format commands.
- Global (full-document) and local (shorter) search-and-replace functions.
- Automatic paragraph indentation.
- Margins and tab settings that are saved with the document.
- Text formatting capabilities that include overstriking, underscoring, right-margin justification, headers, footers, and more.
- Mail-list and form-letter capabilities, available from either the keyboard or saved files.
- Compatibility with a wide variety of serial-input or parallel-input printers.
- An "Oops" function that can be used to retrieve text that has been accidentally deleted.
- A versatile set of printing and formatting functions.

While you work on a document on the screen, *TI Writer* can insert and delete characters at the cursor. If you tell it to, *TI Writer* automatically indents paragraphs. Words occurring at the ends of lines, unlike with a typewriter or not-so-well designed word processors, are "wraped" to the next line: Any word that can't be completed by the end of the line is moved to the next line.

Screen size (40-by-24 characters) limits the usefulness of the 99/4A as a word processor, but *TI Writer* partially overcomes this limitation by using the screen as a "window" on text that can be

as many as 80 characters long. Initially, the window is positioned over the first forty characters of the lines. Finally, when you type further, it shows the last forty characters. By using this moving window, *TI Writer* lets you type in and view a document as it will later appear on paper, despite the limited screen size.

TI Writer also helps you with editing. If you need to reverse the order of paragraphs in a letter, you can have *TI Writer* pick one up and put it above or below the other. You can delete entire sections of text.

You can also have *TI Writer* tell your printer to underline and to overstrike for producing bold characters.

To use *TI Writer*, you must equip your 99/4A with a printer, an expansion unit, a disk interface card, and a memory-expansion card.

There are other (generally less expensive) word-processing packages that may fulfill your needs, but expect most of them to be slower in responding to your typing and commands than *TI Writer*. *TI Writer* is made up of TMS9900 machine language commands, which execute much faster than BASIC, the language used by most other word processors for the 99/4A home computer.

Despite its many features, the *TI Writer* is remarkably easy to use. And the system's documentation is outstanding. All in all, the *TI Writer* is about as good a word processor as you can buy for under $100— better than many packages that cost more.

Mailing

Keeping mailing lists up to date and printing them is another important area of business and home-management software. This software speeds up mailing form letters, meeting announcements, and similar correspondence.

There are two kinds of mailing programs. The simplest programs keep a list of names and addresses for periodic printing of mailing lables or envelopes. More complex programs insert information such as names and addresses into form letters so that they are personalized.

TI markets three mailing programs. *TI Writer* is one of the programs. In addition to the tasks mentioned above, *TI Writer* does mailing labels or merges information from either the keyboard or a file. A program called *Mailing List* is TI's plain

vanilla mailing-list program that stores, alphabetizes, sorts, and searches mailing-list information like names, addresses, phone numbers, and zip codes. *TI-Count Mail List* is TI's more capable program that supports bulk mailing. *TI-Count Mailing List* maintains up to 50,000 names. It prints labels at a rate of 2,000 per hour on a TI 810 thermal printer. It even does limited word processing in support of your writing and editing letters.

Spreadsheet Programs

Next to word-processing and mailing-list programs, spreadsheet programs are the most popular among personal computer users. These programs enable you to construct tables with a powerful feature. Entries in a table need not be constants: they may be "functions" of variables defined in some other entry in the table. This means, for example, if you have a table of costs versus quantity set up for some items, all of the cost entries in the table can be changed from American to Canadian dollars by your changing a single entry in the table.

Multiplan, a "spreadsheet" program written by Microsoft, Inc., a pioneer in personal-computing software, is the spreadsheet program marketed by TI. *Multiplan* is like *Visicalc*, *Supercalc*, and other spreadsheet programs: it permits you to turn your screen into a spreadsheet table. Like *TI Writer*, *Multiplan* uses a window on a much larger screen: your tables can be as large as 246 rows by 63 columns. After you are finished constructing a table, you can print your table or save it in a file (for example, for use in a document you are writing through word processing).

There is much, much more business and home-management software than we've seen so far. Software marketed by TI and independent companies includes complete accounting systems and some surprisingly specialized packages.

We haven't had enough space to discuss software dedicated strictly to home use. Weight control, nutrition, home-menu or restaurant selection, car-buying decisions, energy and security management, and many more household tasks are supported by home-management packages. Most of the more powerful packages, such as *Weight Control* and *Nutrition* marketed by TI, are available from stores, but some very good programs are available from users' groups at low cost.

5 INFORMATION STATIONS

When you combine a modem (discussed in Chapter 3) with a *Terminal Emulator II* program (discussed in Chapter 4), the 99/4A opens up a window onto an incredible new world. You're set for telecommunications as your 99/4A gains access to vast resources at the other end of your telephone line.

Telecommunications, more than any other use for your 99/4A, conjures up visions of the electronic cottage whose entrance leads to a brave new world. The facts underlying the feat are simple enough: Your computer sends messages to and receives information from another computer. The other computer may be tiny or huge. It may belong to your neighbor or it may belong to Dialog, a commercial data base possessing an incredible amount of information. The other computer may be one at the office from which you get information for a day's work and to which you send the results of your labor. It may be the computer your club or church uses as a bulletin board. Or it may be the one in a college dormitory receiving electronic mail for the people living there.

TELECOMMUNICATIONS WITH THE 99/4A

Texas Instruments markets two modems. One is an accoustically coupled cradle for a telephone handset that has a cable leading to 99/4A's RS-232 peripheral. The other is the announced HEX-BUS peripheral that directly connects to both a telephone line and your HEX-BUS interface at the 99/4A expansion connector. Either device connects your 99/4A to the telephone line by converting outgoing data into tones and incoming tones into data. The hardware for telecommunications could hardly be simpler.

The software for 99/4A telecommunications, however, is more complex. It's wrapped up in *Terminal Emulator II* (*TE2*),

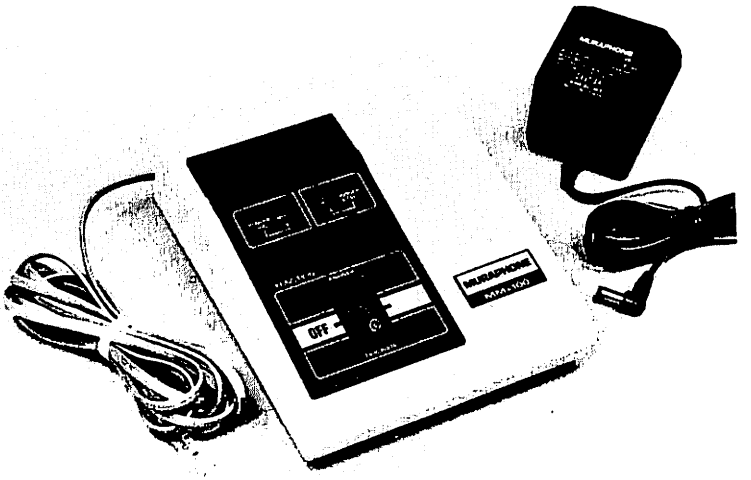
a sophisticated program that provides you with standard data communications at the same time that it makes the most of the outstanding speech and graphics features of your 99/4A.

With *TE2*, you can easily set up the 99/4A for the communications characteristics of the system on the other end of the line. These characteristics may by no means follow a standard, and you'll have to change them from time to time to telecommunicate with numerous other computers. The characteristics that you set up control the way data is sent and received and the way the 99/4A operates.

By menu selection you set up data transmission to occur at either 110 or 300 baud (bits per second), about 14 or 38 characters per second. Most of today's communications are carried out at 300 baud, with 110 baud being the standard of bygone days when mechanical teletypes required low-speed inputs. You also choose parity, a means for checking data transmission for correctness at the receiving end. Parity can be *even*, *odd*, or *none*, in accordance with the way your signal is checked by the computer you are communicating with.

The way the 99/4A operates during data communication is selected on the same menu. You can select either full duplex or half duplex. With full duplex, the computer displays the characters you type on your screen at the same time as it sends them. With half duplex, you do not see on your monitor what you are typing for transmission, but depend on the other computer to "echo" your characters back to your screen. You also set up the 99/4A for either of the two RS-232 interfaces in the TI RS-232 peripheral, depending on whether your modem cable is wired for RS-232 port number 1 or number 2. Then, you set the column width for the number of characters you want displayed on each line of your screen. The maximum number is 40, but using 40 requires a perfectly adjusted television set for the beginning and ending characters of the line to be viewed on the screen. The minimum number of characters per line is 32.

One further item you set up in the 99/4A is the provision for a *log on* transmission. When you dial up a large, time-sharing computer, you must always send a series of characters to identify yourself (by account number, for example). Entering such data by keyboard at the beginning of each communication session can be



Mura Corporation's MM-100 non-acoustic mini-modem brings the world of telecommunications home.

a nuisance. *TE2* therefore lets you store such information in a file on diskette, if your computer is so equipped, and the information is "typed" automatically for you each time you log onto the big system. The log-on option in the menu is simply the name of the disk file that your log-on characters are stored in.

You may bypass all of these set-up options if you want the 99/4A set up the way *TE2* considers to be standard, as follows:

300 baud
Even parity
Full duplex
RS-232 port 1
40-character line
File named LOGON

Telecommunications in Operation

When you have completed 99/4A's setup with *TE2*, you may dial the computer you want to talk to. The communication is simple: You type characters on the keyboard and view remote-computer responses on the screen. While you are communicating through keyboard and screen, the 99/4A stores the characters you are receiving in memory. It stores approximately 6 kilobytes

INFORMATION UTILITIES

You may telecommunicate with several information utilities, companies that are in business to provide information and information services. Once you have contracted for a company's services (usually with a one-time subscription fee), you may dial its number and get "on the air" with its large computers and its megabytes and gigabytes of information. If you live in a city, you'll be able to dial a local number to access the service.

Hundreds of thousands of computer users are subscribing to information utilities for as many uses as they can find for them. One of the most popular uses has developed from one of the services' offering a simulation of citizen's band radio, in which users communicate with "whoever's listening." The success of this novelty service indicates the openness of the telecommunications field for personal exploration and development. At the present time, telecommunications is not devoted exclusively to work or play, but to a combination of both that has always characterized "personal computing" as a whole.

The overall services of an information utility include the following:

- *News Service.* You gain access to the current information being distributed by news services, such as United Press International, to television and radio stations and newspapers throughout the world. But it's not the sort of access you might have with a continuously running "teletype" machine in your home. You get to select which topics you want to hear about by searching keywords, and you save yourself the time, trouble, and expense of reading through information that you have no interest in.
- *Travel Service.* You can make your airline and lodging reservations directly, examine airline schedules, and check ratings of restaurants in cities where you'll be staying.
- *Mail.* Your memos, letters, and reports are stored by the information-utility computer. When the subscriber you are sending them to logs onto the utility, he's notified that messages are there, and he can receive them immediately.
- *Programming.* If you want to program in FORTRAN or COBOL, which you might find historically interesting, you can

before it "beeps" and continues storing characters by overwriting the oldest it's already stored.

You can, during communication, control the function of the 99/4A in several ways.

You may, if you have a speech synthesizer, have the 99/4A read the information displayed on the current screen to you. Hold down CTRL and press the 1 key to start the process. After a moment, the reading begins. You might note that any incoming communications are lost while the 99/4A is speaking. You might want to be certain that the remote computer is pausing for your further input before you take out time to have the 99/4A read to you.

If you want the characters on the screen to be printed (or even sent out to yet another modem, computer, or RS-232 device) or saved on cassette or diskette, you hold down CTRL and press 2. *TE2* prompts you for the destination of the data on the screen. When you want to output or save additional screens of data to the same device or in the same file, *TE2* remembers the destination from the first time you sent it; you won't have to type in the destination for subsequent operations.

If you want to do the opposite—that is, send the remote computer some information that you have stored on cassette or diskette—hold down CTRL and press 3. The screen prompts you for the cassette recorder or disk drive to be used and for the name of the disk file before transfer begins.

You can redefine the maximum number of characters displayed on each line of received data by holding down CTRL and pressing 5. This disables the word-wrap feature of *TE2*. The 99/4A screen then becomes a window on a line larger than the one specified during setup. Once a line is full of received characters, the window moves to the right with each new character received. You should change the word-wrap feature with care, however, because when it is changed all data previously stored in memory is lost!

There are further detailed features of *TE2* described in its accompanying manual that you'll want to know about it when you are doing serious work with it. But this description of the major features of 99/4A telecommunications operation is sufficient to get you started and put in perspective the following overview of what you can do through telecommunications.

use the information-utility to write, debug, and run your programs.

- *Markets.* You'll find quotations for stocks, bonds, foreign currencies, commodities futures, and more.
- *Shopping.* If you're tired of pouring through magazine advertisements for comparison shopping, you'll appreciate getting the best available prices in seconds (and you can order through your keyboard immediately, if you wish).

There are so many information utilities available for your use that it is impossible to describe more than the most popular here.

THE SOURCE
1616 Anderson Road
McLean, Virginia 22102
(703) 821-6660

A Reader's Digest Association company, The Source pioneered the information-utility business. It is also the host service for TEXNET, the data-base and information service devoted exclusively to TI users. With TEXNET, the information you have returned to you is specifically formatted for your use with the 99/4A and *TE2.* TEXNET permits you to tap into libraries of programs with 99/4A color graphics and sound- and speech-synthesis. You can transfer programs which you've written to others and have them transfer their programs to you. TEXNET also carries the latest news about TI products and programs. If you're interested in speech synthesis, TEXNET has a growing "phonetic dictionary" that'll help you spell words for *TE2* so that they are optimally pronounced: the dictionary now has over 2000 entries. You can even listen to, view, and download (get for use on your system) graphic displays and musical scores for use with your 99/4A.

Other services available on The Source include:

- *Communications.* Electronic mail, live "chatting" with other subscribers, teleconferencing, bulletin boards, and a Mailgram message service.
- *News and information.* The United Press International news wire, a "Business Update," the *U.S. News & World Report,* "Washington Letter," and several other news, features, sports and reference services.
- *Consumer services.* Electronic shopping, an employment-

assistance service, a personal-finance service, a travel service, and consumer information.

- *Entertainment.* Games, horoscopes, biorhythms, a service for meeting other subscribers, and movie reviews.
- *Electronic publishing.* A facility for "publishing" information that other users can read. There's a public section that anyone can gain access to, and there are also private areas for confidential reports and messages.
- *Travel.* Airline schedules, restaurant and hotel guides, a guide to New York City, and travel services.
- *Education.* A section designed to provide help in mathematics and in elementary-education subjects.
- *Creating and computing.* An on-line word-processing program, facilities for *uploading* and *downloading* (sending and receiving) files, and compilers for writing computer programs in BASIC, PASCAL and FORTRAN.

The Source has close to 30,000 subscribers, with thousands joining the service every month.

Between 6 p.m. and 7 a.m. on weekdays, The Source's basic rate is $7.75 an hour. And the rates are higher in daytime hours and in remote parts of the country. For fast (1,200-baud) transmission to subscribers in Alaska, for example, the rate is $44.75 an hour. And certain premium services cost extra.

COMPUSERVE
500 Arlington Centre Boulevard
Columbus, Ohio
(614) 457-8600

CompuServe is owned by H&R Block, the same company that helps people figure out their income taxes. There's an initial hookup fee of $20, but some modems and telecommunications software packages come with free introductory CompuServe kits. With an introductory kit, you can get hooked up to CompuServe for nothing, and you can also get an hour of free time online.

CompuServe's rates range from $2 to $20 an hour, depending on where you live (Alaskan users pay the most) and what hours of the day you're online. And there are extra services than can increase your bill even more. But if you use only CompuServe's

standard services, and if you use them only in the evening and on weekends, you can find a lot to do for $2.

Services available on CompuServe include:

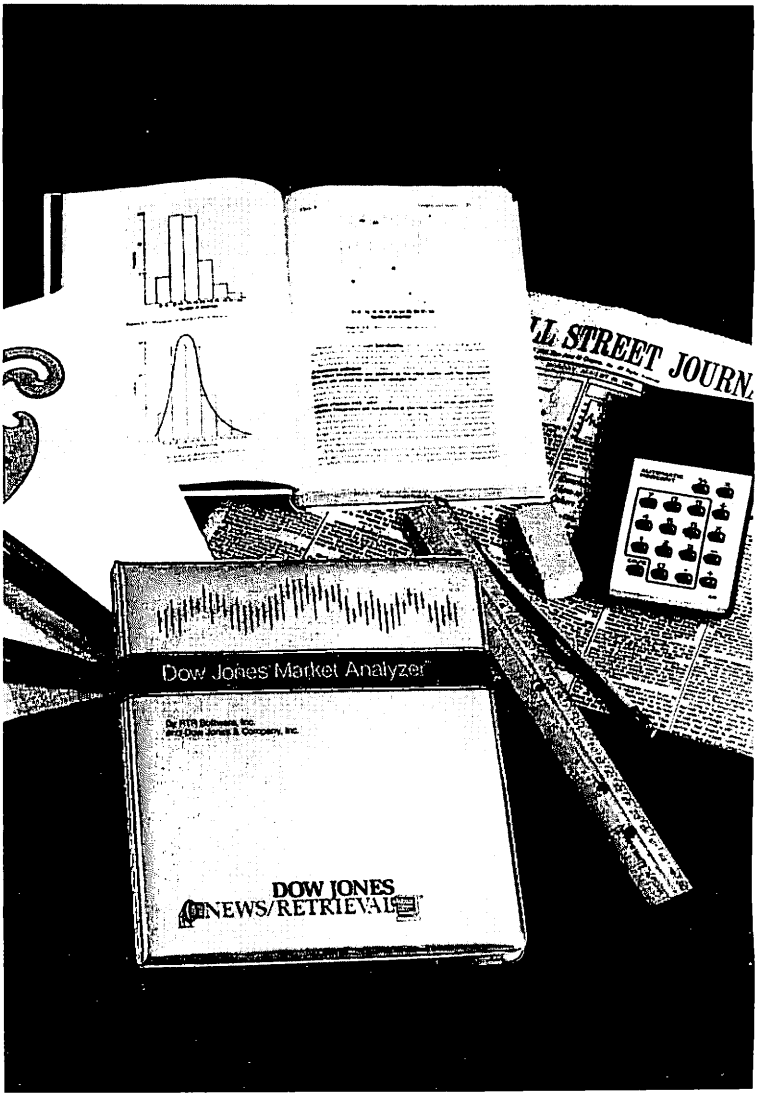
- *News, weather and sports.* Reports from major newspapers and international news services.
- *Financial information.* Includes updates and historical information on stocks, bonds and mutual funds.
- *Entertainment.* Theater, book, movie and restaurant reviews, plus information on opera, concerts, ballet, dance, museums, galleries, and more.
- *Electronic mail services.* You can write messages and exchange them with other CompuServe users across the nation.
- *Home information.* You can read home-related articles from government publications and magazines.
- *Personal computing services.* These include a software exchange; a "line-printer art gallery"; games; programming languages you can actually use to write programs; an on-line word-processing program; business and educational programs; and much more.

DOW JONES NEWS/RETRIEVAL
P.O. Box 300
Princeton, New Jersey 08540
(800) 257-5114

Operated by Dow Jones, the company that publishes *The Wall Street Journal*, this information utility charges from 30 cents per minute to $1.20 per minute and more, depending upon the service being accessed, the time of day, and the type of service purchased (special "blue-chip" and "executive" rates are available for heavy users).

Services available on the Dow Jones News/Retrieval service include:

- *Dow Jones News.* News on more than 6,000 companies and more than 700 Canadian companies in over industries.
- *Dow Jones New Quotas.* Current and historical quotes on common and preferred stocks and warrants, corporate and foreign bonds, mutual funds, U.S. Treasury issues and options.
- *Business Reports.* Earning forecasts for 2,400 companies, detail



To better utilize information utilities, software is becoming available that enhances basic services by analyzing data and information you retrieve. For example, Dow Jones Market Analyzer, *from the Dow Jones News Retrieval Service, automatically collects historical and daily stock market quotes, allowing computer owners to chart stock prices and economic trends in minutes for more accurate investment guidelines.*

financial information on more than 3,200 companies, and complete company reports on selected firms.

- *A Weekly Economic Survey.* Covers 40 to 50 of the nation's top institutions, and includes a *Weekly Economic Update* of financial news.
- *News.* Highlights from *The Wall Street Journal* and the PBS television program *Wall Street Week.*
- *Other Services.* Sports and weather reports, movie reviews, a free text search service for locating data on any subject, and an on-line encyclopedia.

BRS/AFTER DARK
1200 Route 7
Latham, New York 12110
(518) 783-1161

For $6 to $20 per connect hour, BRS/After Dark offers what it declares are "more data bases on more subjects than any other popular on-line information services—at the lowest cost."

The files available through BRS/After Dark are the same ones used by major reference libraries and corporations nationwide. These files contain up-to-date information on subjects ranging from business management, mathematics and education to health, psychology, chemistry, family planning, and much more.

BRS/After Dark subscribers also have access to the full text of the *Academic American Encyclopedia* and the *Harvard Business Review.*

There's a search service on the BRS wire that allows subscribers to retrieve information by subject or by using both keywords and names of publications.

BRS/After Dark is adding still more data bases to its files, such as a newsletter service for subscribers. It plans to soon offer a software service, an electronic mail service, a swap shop, and a number of other new services.

COMPUTERIZED BULLETIN BOARDS

You can also use a modem to dial up many computerized *bulletin boards* that are available, usually free, to any home computer user.

Once you've made your connection, regardless of how you've done it—you can just sit back and watch messages coming in over

your phone wire and magically appearing on your computer screen.

If there's a computer at the other end of the line, messages you transmit will usually go into a file along with messages that other people have sent to the bulletin-board service. On most bulletin boards, you may leave either public messages—which anyone who goes on-line can read—or private messages addressed to other people who use the board's services.

Once you've made a good connection with a bulletin-board service, the first transmission you see will probably be a message welcoming you on-line. You may then be asked to type in your name, and you may also be asked whether it's your first time on-line with the service you've gotten yourself connected to.

If you've been on-line before, the service's *sysop* may ask you to wait for a moment while a check is made to see if any messages have been left for you. If there are messages, you'll be able to read them. If there are no messages, you'll probably be allowed to read whatever messages may be available to the general public—and you'll probably also be allowed to leave messages for others who use the system.

What happens next will depend upon the kind of bulletin board you've interfaced with—and upon what you want to do. Some bulletin boards have ham-radio-like operations on which hackers talk mainly about the equipment they own and programs that they've used or written. Others are scholarly exchanges, full of amateur poetry and literary discussion. Still others are political forums.

Some bulletin boards may assign you a password or let you make up one, so no one can read your electronic "mail" unless you want them to. And most bulletin boards provide you with menus of their functions at sign-on time so you'll know how to move from one section of the bulletin board to the other.

To move from one bulletin-service to another, you usually type in certain letter codes that are clearly spelled out in the main menu—and if you get confused, and don't know how to get into a certain part of the service or out of one, you can often type the word HELP—or just the letter H—and receive instructions on the options that are open to you.

No matter where you live or what your interests are, there's

a bulletin board out there for you somewhere. But patience is definitely a virtue for bulletin-board users, since getting through to the board of your choice can get time-consuming—even frustrating. Since most boards are nonprofit enterprises, and are managed out of the hip pockets of the hackers that created them, bulletin boards tend to be here-today, gone-tomorrow operations; the board you were connected to today may no longer be there tomorrow. Another problem that often arises is that bulletin boards are very busy, so if you call bulletin boards a lot, you can expect to get frequent busy signals.

These are a few of the bulletin-board services that are currently available:

- *CBBS, Chicago, IL, (312) 545-8086.* A board handling general news of interest to computer hobbyists, including news of computer clubs. Ham-radio operators and general electronics hobbyists also use this board.
- *The Assembly Line, Louisville, KY, (502) 459-5531.* A general-interest message board of special interest to 99/4A users. One special feature is a monthly contest.
- *Magnetic Fantasies, Los Angeles, CA, (213) 388-5198.* Another 99/4A-based board that specializes in exchanges of information about science-fiction and fantasy literature, along with computer programs.
- *Drucom, North Wales, PA, (215) 855-3809.* An elaborate service operated by Ms. Dru Simon, it features an advice column on romance, a mail-order section for computer hardware and software, and an "adult-only" section including ads for lingerie and sexual aids. There's also a game section, and one that offers computer art and computer programs.
- *GameMaster, Evanston, IL, (312) 475-4884.* An interactive board that allows game-players across the nation to get together and play computer strategy games. When you get into the game, you find yourself in a six-story mansion containing about a dozen game rooms, each devoted to different kinds of games. There are military strategy games, sports games, and much more.
- *Fantasy Plaza, Glendale, CA, (213) 840-8066.* An electronic department store specializing in computer hardware and software but also offering many other products, from watches to

books and from brass bookends to decorator telephones. You can shop at Fantasy Plaza just as you would in an ordinary department store, moving from floor to floor and from department to department as you pick out what you need. When you've decided what you want, you can either order it C.O.D. or charge it to a credit card. And when you've finished your shopping trip, you'll find a limousine outside the store, waiting to take you home!

- *Dial-Your-Match, Los Angeles, CA, (213) 842-3322.* This service, founded by the same folks who run Fantasy Plaza, is the flagship of scores of dating-service bulletin boards across the country. It matches up lovelorn computer users according to the answers they give to a long questionnaire about their activities and interests. As this book went to press, other active Dial-Your-Match numbers included (213) 840-8252, (201) 272-3686, (617) 334-6369 and (201) 462-0435.
- *Central Directory.* There is currently one central service, the *People's Message System* in Santee, CA, that lists the numbers of more than 400 other bulletin boards. Dial (619) 561-7277.

6 GROUP ENCOUNTERS

When you buy a TI-99/4A, it gives you a comfortable feeling to know that you share interests, experiences, problems, and solutions with more than a million other people. Getting you in touch with those other people in a forum that lets both you and them make the most of your interests and experience is the role of 99/4A users' groups.

Users' groups are essentially computer clubs. There are 180 users' groups that devote at least part of their activities to the 99/4 and 99/4A computers, and they are made up of over 100,000 members.

Users' groups usually hold at least one meeting a month, and they often hold more to accommodate subgroups with special interests (speech synthesis, PASCAL programming, and so on). Meetings provide the opportunity for a presentation, a demonstration, or both. In addition, a variety of other activities and services can also be found when you join a user group including the following:

- Exchange of information about products, services, methods, and tools which make for better computing.
- Exchange of programs.
- Demonstration of new products.
- Maintenance of a group software library.
- Contact with representatives of computer manufacturers for information about past, present, and future products.
- Work on newsletters, meeting notices, club electronic bulletin boards, and the like.

Five of the users' groups for the 99/4A are international in membership:

The 99/4 Program Exchange
Box 3242
Torrance, CA 90510

99/4A Users of America
5028 Merit Drive
Flint, MI 48506

International 99/4 Users Group
Box 67
Bethany, OK 73008

New York 99/4A Users' Group
34 Maple Avenue
Armonk, NY 10504

Young People's LOGO Association
Box 85567
Richardson, TX 75081

As you might expect, the international groups are active in software exchange and newsletter publication.

Local groups are plentiful in most states of the United States, and there are local groups in Australia, Belgium, Canada, Columbia, England, and Germany.

TI supports users' groups through various services. The company maintains an office specially for users'-group support, providing help in starting up an organization (of 20 or more members), with monthly "care packages" consisting of software, product information, and copies of TI's user-oriented newsletter, *Home Computer Newsletter*. It also provides speakers for the club meetings.

If you would like more information about TI users' groups write to the Users' Group Coordinator at the following address:

Texas Instruments Inc.
Attn: Users' Group Coordinator
Box 10508 MS 5890
Lubbock, TX 79408

7 READOUTS

A directory of all currently available software for the 99/4A home computer is published by Texas Instruments. This directory is far from a company catalog. In fact, it vividly shows the extent to which independent companies and users' groups contribute to the software-writing effort for the 99/4A.

In its directory, TI attempts to list all software available for the computer by inviting all "third-party" software authors to describe the products they offer. The current directory lists and describes approximately 1000 software packages. Four indexes (category, TI category, author, and keyword) get you to the piece of software you're interested in.

You may order the *TI 99/4A Software Directory* at $5.95 plus shipping charges. To order it, call 800-858-4075 or 800-858-4565.

MAGAZINES

Magazines are usually the most up-to-date source of information about the 99/4A. They provide you with articles to help you use the computer, reviews to help you select among products for it, book reviews, advertisements about products, and a great deal of other information.

99ER HOME COMPUTER MAGAZINE
Box 5537, Eugene, OR 97405
$25 per year, 12 issues

This monthly publication is the most comprehensive one devoted to the 99/4A. It exclusively covers TI's and independent companies' hardware and software. Most of the articles and reviews in it are about products used with the 99/4A home computer, although some articles and reviews cover TI's recently introduced Compact Computer 40.

In *99er Home Computer*, most of the articles are for beginning through intermediate users, although some are for advanced

users. It has articles about programming in all of the languages available for the 99/4A. Each issue contains several program listings in these languages.

Overall, this magazine has an excellent balance of interesting material, including articles on topics such as word processing, voice recognition and speech synthesis, and the human implications of computers. On the more human side, it prints interviews with programmers who develop software for the home computer: often these individuals give you tips on how to use assembly language to speed up your own programs, as well as how to play a better game of *Tombstone City* or *Parsec*.

This magazine covers the entire field of home computing, including the TI-99/4A. It's perhaps what speakers of the language of "computerese" would call the most "user-friendly" of all the magazines that cover the 99/4A.

COMPUTE! MAGAZINE
Box 5406, Greensboro, N.C. 27403
$20 per year, 12 issues

Compute! is an excellent source of information for owners of the 99/4A and also features articles about TI, Atari, Apple, Commodore, Radio Shack, and Timex Sinclair computers. The magazine is nicely illustrated, and is filled with programs you can enter and run on your computer. Also, there are many articles about possible uses for the 99/4A. Most of the articles are for beginning through intermediate users, although a few are for advanced users.

Compute! also contains regular columns on topics such as educational computing and programming in LOGO. Issues contain articles on programming, reviews of commercial software and hardware, and articles on topics such as word processing, games, and the social implications of computers.

BOOKS

There are hundreds of books about BASIC programming language, and most of what they say applies to TI BASIC and TI Extended Basic. Browse through some of these books at your local bookstore to find one that covers your interests and helps you at your particular level of programming skill.

8 SMALL BYTES

I wish I could tell you that nothing would ever go wrong with your 99/4A, but I can't. The computer is well built and, in general, it will give you trouble-free service for years. TI even has enough faith in the console to provide you with a one-year warranty. But realistically, you may have trouble with it tomorrow or five years from now. So let's look at what you might be able to do if something does happen.

ROUTINE MAINTENANCE AND CARE

There's not much required of you in terms of routine maintenance and care. Overall, the same care that you give your television set or stereo equipment is good enough for your 99/4A.

You might have noticed that some people make a very big deal about using computers *correctly.* They worry about where to put the system, such as never in a carpeted area. Well, you needn't get caught up in this frenzy. It's all right to use your 99/4A in a carpeted room, if you're normally cautious about static electricity. You shouldn't even have problems if you chain smoke in the depths of debugging one of your programs. Floppy disk drives and diskettes are much more rugged than the unsealed "hard disks" that were prevalent in the earlier days of large computers.

What you *should* watch out for, and exercise normal caution with, are static electricity and heat buildup. The spark that annoyingly zaps you when you touch a doorknob on a dry winter's day is lethal to integrated-circuit chips in any computer. This doesn't mean that you have to strap yourself to a water-pipe ground while you operate your 99/4A, but that you must make sure you're discharged when you sit down at the keyboard. And you must especially make sure that you aren't carrying a big charge when you insert cartridges or plug units into the expansion connector. *Never plug units into, or unplug units from, the expansion connector while any unit, including the console, is turned on.*

The 99/4A will probably operate well at any temperature you care to work in, but in extremely high temperatures you should keep the system as cool as possible. Don't, for example, operate it in direct sunlight coming through a window.

MAKING REPAIRS

If one of your 99/4A units needs repair, you have at least one reliable source to turn to: Texas Instruments. The 99/4A, with its 16-bit processor, is a much more complex machine to troubleshoot than any other low-cost home computer and many high-priced business models. The knowledge and equipment required for repair of the 99/4A are so extensive that independent repair organizations haven't yet begun to service the system.

Although TI is the single source of 99/4A repair, it's a good one. TI service is both convenient and fast. There are currently 46 repair centers located in cities throughout the country, and the company maintains an extensive repair shop in Lubbock, Texas for any mail-in repairs. You don't, however, have to wait for repairs to be made. You can take your ailing 99/4A console or peripheral into one of the repair centers and exchange it for a reconditioned unit. If your unit is under warranty, the exchange won't cost you anything. If the warranty has expired on your unit, the exchange is available at a fixed rate. For example, it currently costs you either $25 or $45 to exchange consoles, depending on the severity of the repair symptoms.

With the 99/4A, there's never a reason for you to feel that you're stranded with a strange computer. When you have a problem, whatever it might be, you can dial a single toll-free telephone number to talk to TI about it. If you have questions about software, hardware, service, or product availability, just dial 1-800-TI-CARES to get your answers.

A courteous, knowledgeable staff answers this number during working hours five days a week. If they don't know the answers, they'll get them for you very quickly. On top of this, there's no charge for the help.

An alternate route into the heart of TI operations is through your users' group. Each one recognized by TI has direct contact with a representative *in the home computer development area.* This

is especially helpful if you want fast answers to technical questions. Work through your users' group, and chances are that you're only a few minutes away from getting advice from the hardware or software designer who has the expert knowledge to give you immediate and effective answers.

You can also get detailed technical information about your 99/4A from TI through the manual written for the 99/4A Editor/Assembler assembly-language software package. The entire software package, if you want to try your hand at assembly language, as well as have the technical information on hand, is currently retailing for under $50. If you have no desire to get into assembly language, but want to know about RAM and ROM locations, workspaces, the communications register unit (CRU), or some other mystery to peak and poke around with in BASIC, you can get the manual without the software for under $15.

If you want technical information that extends to the intricacies of the hardware, then you'll need another manual. It's called the *TI-99/4A Console and Peripheral Expansion System Technical Data*, and is available for less than $15.

You can get these manuals from your local dealer, but if he doesn't have it in stock, don't forget that toll-free number. And have fun knowing you've purchased a super system that delivers a great deal at an affordable price.

9 WORDS FOR THE WISE

If the strange words have scared you off from computers, this section is for you. First of all, you're not alone. The new technology has brought with it an entirely new language to learn. But you can become more comfortable and knowledgeable just by taking note of the necessary fundamental vocabulary and terms you'll be encountering as we become a more computerized society. Below are your building blocks to a world of computer literacy.

Access. To read or get information, often from memory.

Access time. The time between calling for and receiving information from storage.

Accumulator. A microprocessor memory register that temporarily stores the results of arithmetical operations.

Acoustic coupler. Lets the computer send and receive information through a telephone's handset. It first converts signals from the computer into audible tones.

Add-on. Attaching circuitry or components to increase memory capacity or improve a system's performance in some other way.

Address. An exact place in a computer's memory that stores information, represented by a name, a label or a number.

Address bus. A communication line inside a computer along which the memory locations of data are sent.

Algorithm. A step-by-step procedure required to solve a problem. The algorithm is translated into computer language by the programmer.

Alphanumeric characters. Symbols including alphabet letters, numbers, punctuation marks and mathematical symbols.

AppleSoft BASIC. A particular dialect of the BASIC programming language.

Applications software. Programs designed to perform specific tasks, such as games, educational programs, payroll programs or spreadsheets.

Arithmetic/logic unit (ALU). A microprocessor register that performs arithmetic and logical operations.

ASCII. Acronym for American Standard Code for Information Interchange. Translates 128 keyboard symbols and control instructions into 7-bit binary combinations. Is the most common encoding system for English language alphanumerics.

Assembler. A computer program that translates assembly-language programs into the binary-coded machine language all computers use.

Assembly language. A low-level, symbolic programming language easier to use than machine language but not as easy as high-level language. Usually expressed in two- or three-letter combinations that are easily memorized.

Asynchronous transmission. The sending of information one byte at a time, with a start bit and a stop bit surrounding each character. Simplicity and reliability make this method desirable.

Auxiliary storage. Mass storage of data on media other than the computer's main memory.

Backup. Copying a set of data, such as a file, onto another storage medium in case the original is lost or damaged.

Bank switching. A method of moving data back and forth between a computer's memory and an external memory bank.

BASIC. An acronym for Beginner's All-purpose Symbolic Instruction Code, a high-level computer language designed for beginners. Because of its simplicity, BASIC quickly became the most common microcomputer language.

Batch processing. The collecting of input items over time, and the grouping and processing of them at once. An internal computer function. There is no interaction between the operator and the computer.

Baud. A unit of information transfer. In microcomputers, the Baud is defined as one bit per second.

Baud rate. The rate at which information is transferred. For instance, a 300 Baud rate is 300 bits per second.

Benchmark program. A program designed to be "typical" so that a user can run it through different computers to compare their

characteristics and capabilities.

Binary. A number system that uses only two digits, 0 and 1, to express all numeric values. *See digital computer.*

Bit. The basic unit of computer memory. Bit is a binary digit and can have a value of either 1 or 0.

Black box. A piece of equipment viewed only in terms of its input and output, ignoring how it performs its tasks or what it is made of.

Block. A group of records treated as a unit because of their positions next to each other in memory.

Bootstrap. A process where built-in instructions are used to load other programs.

Bubble memory. A solid-state memory capable of storing large amounts of information in an extremely small area.

Buffer. A temporary storage area for computer data. A buffer is often used to compensate for differing speeds between devices—for example, between a computer and a printer.

Bug. A problem that prevents the computer from performing correctly, or at all.

Byte. A group of eight bits (or a memory cell that can store eight bits) usually treated as a unit. It takes one byte to store each letter of information. For instance, the four-letter word *love* requires four bytes of memory.

Calling sequence. Instructions linking going to and from program subroutines.

Canned software. One or a series of programs ready to run without having to be altered. Many of these programs are copy-protected so changes are extremely difficult to make if not impossible.

Carrier wave. A broadcast wave that carries a radio or television signal.

Cartridge. A 2x3x¾-inch plastic box that contains ROM software such as BASIC. Cartridges are commonly used for home video game player machines.

Cassette drive. A standard tape recorder used to store programs or data.

Cassette. A standard tape cassette.

Cathode-ray tube (CRT). The picture tube of a television set or a monitor. It's used to display computer output.

Cell. A place for a single unit of information in memory, usually one character or byte.

Central processing unit. The heart of the computer, containing the circuits that control the interpretation and execution of instructions.

Chip. A tiny piece of silicon treated to accommodate thousands of electrical circuits to form an integrated circuit.

Clock. A circuit in a computer that produces precisely timed electronic signals to ensure proper timing of the operations of all other circuits.

Code. Any system used to represent symbols (such as alphanumeric characters) with binary numbers.

Compiler. A program designed to translate a high-level language (such as BASIC or DOS) into machine language (1's and 0's) prior to execution of the program by the computer. This eliminates the need for translation each time the program is run.

Computer. An electronic device for juggling information, in either numeric or verbal form. A computer can receive and follow instructions to perform calculations or compile, select or correlate data. The primary differences between a computer and a calculator are that a computer can manipulate text, display graphics and make decisions.

Computer-aided instruction (CAI). Using computers in an educational process.

Concatenation. The connecting of two or more text strings to form a single longer string.

Console computer. A desktop computer with its own video screen.

Control bus. A communication line along which control data flows.

Control information. Information that controls functions of devices.

CPU. Central processing unit.

CRT. Cathode-ray tube.

Cursor. The little flashing square or bar on a video monitor that indicates where the next character will be displayed.

Cursor tracking. The manipulation of a cursor on a screen using a stylus and graphics tablet.

Cycle time. The time needed by a microprocessor to complete a

certain function in a program.

Daisy wheel. A print element used in some printers that resembles a wheel with "spokes" having a letter on the end of each one.

Data. Any and all items of information—numbers, letters, symbols, facts, statements—which can be processed or generated by computer.

Data base. An entire collection of data in a computer system that can be accessed at one time.

Data bus. A communication line that transports program data.

Debugger program. A program that helps a user locate and correct programming errors. The debugger stops an execution at points preselected by the user (break points). This makes inspection for errors more efficient, as the program can be tested a portion at a time.

Decoder. A program that translates coded signals.

Degausser (bulk eraser). A device used to demagnetize a magnetic tape.

Demodulator. A device that separates a TV signal from its carrier wave so that a TV picture can be produced. Demodulators are used in TV sets, but are not needed in computer monitors, since monitors don't receive broadcast signals.

Digital. A number system that uses 0 and 1 to represent variables involved in calculation. This means that information can be represented by a series of bits.

Digital computer. A computer that uses a series of electronic offs and ons to represent information. These offs and ons are converted to (or from) binary numbers. Microcomputers are digital computers.

Directory. Information on a floppy disk that tells the computer where on the disk a program is located. Directories also give the user easy reference to files. The command DIR will display the directory on the disk in the main disk drive.

Disk. A flat rotating circular sheet that's used to store bits of information.

Diskette. A flexible disk made of a plastic-like magnetizable material that's either 5¼ or 8 inches in diameter (about the size of a 45 RPM record).

Disk drive. An electromechanical device that stores information

on or recalls information from a disk.

Disk operating system (DOS). An operating system that must be present when disk storage is used. The functions of a DOS include keeping track of files, controlling space allocation, and saving and retrieving files.

Documentation. All of the available information about a particular computer, computer program or set of programs. It should include operating instructions, troubleshooting warnings, and labeling. The term usually refers to the printed form of this information in books or pamphlets.

Dot-matrix printer. A printer that forms symbols by the use of dots in a pattern. Letters are of poorer quality than those of letter quality printers but are typed faster, and the unit is less expensive.

Double-density disk. A disk that can store twice as much information as an ordinary (single-density) disk because of increased storage density.

Double-sided floppy disk. A floppy disk with two usable sides to increase storage capacity.

Driver. Instructions controlling peripherals and their connections with the CPU (central processing unit).

Dual disk drive. A floppy disk system using two drive mechanisms and recording heads, which yields such advantages as increased storage capacity.

Dumb terminal. A monitor-and-keyboard module that looks much like a microcomputer, but can be operated only when connected to a mainframe computer, since it cannot perform computer functions by itself. Dumb terminals are most commonly used to retrieve and receive information stored in a data base that is often located at a different location.

Editor program. A standard program (in ROM or external storage) that lets users enter corrections, insert or delete information, as well as move text, while inputting programs.

Electronic mail. Personal or business messages generated on a computer and transmitted via phone lines to another computer at a different location.

Electrostatic printer. A printer in which dry ink is melted onto an electrostatic charge placed on paper to form characters.

Embedded command. Text characters that do not appear on the screen or printout, but instead instruct a computer to perform

some task. Embedded commands are used in word processing and other applications. For example, the instruction may be to begin a new page.

External memory. Mass storage.

Field. One or more characters treated as a data unit.

Field gap. A space used at the end of a file to indicate to a computer system where the file ends.

Firmware. Unalterable, permanent programs or data stored in ROM.

Fixed-head disk system. A disk system that uses one head for each track of information on a disk. The positions of the heads are therefore fixed.

Floating-point representation. A system used for translating decimal numbers into binary numbers so they can be processed by a computer.

Floppy disk. A flexible plastic disk coated with magnetic recording material on which computer data may be stored; a diskette.

Flowchart. A programming aid that illustrates problem-solving procedures (algorithms) step by step. Standard flowcharts use geometrical shapes such as rectangles (for operations) or diamonds (for testing conditions), along with arrows to illustrate procedures clearly.

Formatting. Preparing a disk to accept information or preparing text for printout. Includes putting down data tracks on a disk; or setting margins, line and character spacing, and page length for printing.

Full duplex. In telecommunications, a two-way transmission mode.

Glitch. An undesirable variation in an electrical flow that can cause errors in a program or other failures in a computer system.

Graphics. The ability of a computer to show pictures, line drawings, and special characters on a video monitor or printer.

Graphics tablet. An electronic writing tablet used to convert shapes and drawings into the digital form needed for computer storage. As a special stylus is moved across the tablet (to trace drawings, for example), the shape shows up on a display screen and is entered into the system.

Green phosphor. The chemical giving the characters their green color on the background of video monitors.

Half duplex. In telecommunications, a one-way transmission mode.

Handshaking. A brief interruption in a program's execution so that a computer can perform some other task.

Hard copy. A copy of the computer's output printed on paper.

Hard disk. A rotating mass-storage device that uses a rigid disk made of a hard plastic-like material. It has many times the storage capacity of a floppy disk.

Hardware. All of the various physical components of a computer system: the computer itself, the printer, the monitor, etc.

Head. A device to magnetically read records or erase data on a disk, a tape or other magnetic medium.

Heuristic. A trial-and-error method of solving a problem.

High-level language. A computer language that uses simple English words to represent computer commands. For instance, the command RUN in BASIC tells the computer to run a program.

High resolution. The extent of detail offered in the graphics of a printer or video display.

Horizontal scrolling. Moving text or data horizontally on a display screen so more of it can be seen than what fits within the screen's width at any one time.

Idle time. An interval during which some or all of a system isn't being used.

Impact printer. A printer where ink is put onto paper by a hammer mechanism.

Input. To transfer data from the keyboard, a diskette or a cassette to RAM.

Input/output (I/O). The process of entering data into a computer or taking it out.

Interface. Where two systems meet and act upon each other.

Interpreter. A program that translates high-level language instructions into machine readable form while executing the high-level program.

Iteration. The repetition of a part of a program.

Keyboard. An input device, normally comprised of a standard typewriter-style set of keys and various special keys.

Keypad. An input device, usually consisting of keys for the numbers 0-9 and a period.

Key stations. The number of input terminals in a multiple-user system.

Keyword. In a computer language, a word that has a specific meaning and therefore cannot be used as a variable name.

Kilo. A prefix meaning 1000. It's abbreviated K, and for computers is overwhelmingly used as a handy approximation of 2^{10} or 1024.

Kilobyte. 1024 bytes. Thus 4K of memory is about 4000 bytes of memory. (It's actually 4×2^{10} or 4096 bytes, but 4K is a convenient way to keep track of it.)

Language. When used in reference to computers, the same thing as human language. The only difference is that a computer language allows humans to communicate with a computer.

Laser writer. A printer in which electrostatically charged paper attracts dry ink powder to form images that are baked onto the paper. This method offers excellent quality and high speed, but at a high initial cost.

Letter-quality printer. A printer producing a complete character with each stroke, using a ball, daisy wheel or thimble element. The same as "line-quality" printer.

Light pen. A pen-shaped instrument that allows the user to "draw" on a display screen. The photosensitivity of the pen allows various coordinates to be inputted.

Line feed. A command that moves the printout onto the next line; also called a line break.

LOGO. A complete language simple enough for beginners yet sophisticated enough for advanced programming. Originally designed to teach programming to children, it focuses on drawing shapes using simple commands.

Loop. The repeating of a sequence of instructions in a program a given number of times.

Low-level language. A computer language at the machine-language level (a pattern of pure binary coding) or somewhat higher. A low-level language is neither simple nor obvious for a human being to read, understand or use. (Compare with *High-level language.)*

Machine-dependent. Capable of being used only on a particular machine.

Machine language. The lowest level language. It's a pattern of binary coding that tells the computer what to do.

Magnetic media. Devices that store data in the form of magnetic

impulses; includes disks and tapes.

Mainframe computer. A large, expensive computer generally used for data processing in large corporations, laboratories and government installations. Originally, the term referred to the extensive array of large rack and panel cabinets that held the extensive bulk of the early computers.

Main memory. Memory that is immediately accessible for programs and data storage; includes ROM and RAM.

Mass storage. Large capacity, secondary storage systems, such as recording tape and magnetic disks. Synonymous with external memory.

Megabyte. One million bytes.

Memory. The internal hardware in the computer that stores information for further use.

Menu. A list of commands appearing on the screen, from which you can choose. One menu sometimes leads to others. Programs using menus to present all their main commands and operations are called menu-driven programs.

Microcomputer. A fully operational small computer that uses a microprocessor and its central processing unit (CPU).

Microprocessor. A central processing unit contained on a single chip.

Minicomputer. A small computer based on large-computer technology.

Minifloppy disk. A floppy disk about 5¼" in diameter.

Modem. A *mod*ulating and *dem*odulating device that enables computers to communicate over telephone lines.

Modulation. The altering of a signal to allow it to be broadcast. For example, a TV signal is modulated by being combined with a carrier wave.

Module. A plastic housing holding one or more memory chips which can be connected to a computer.

Monitor. A television receiver or CRT device used to display computer output.

Monitor program. A program that controls simple, frequently performed tasks such as inspecting or changing the contents of locations in memory, loading or storing programs, etc.

Monochrome monitor. A video monitor with a single-color display.

Mouse. A device that rolls on wheels and is used to move a cursor on a screen.

Multiple key rollover protection. A keyboard feature that stores typed characters temporarily when several keys are pressed almost simultaneously on a keyboard. Then, when a pause is detected, the characters can be printed. This technique prevents loss of data.

Multiprocessor. A computer with more than one microprocessor chip.

Nesting. Using hierarchical levels of programming instructions. These instructions are usually in subroutines.

Network. Computers, peripherals or terminals that are interconnected to communicate with each other. One type is a data-communications network, which basically supplies information to subscribers.

Nonacoustic coupler. Similar in concept to an acoustic coupler, but connects the computer directly to a telephone line without using the telephone headset.

Object program. A program that has been translated into machine language.

On-line. When a system and its peripherals are directly communicating with the central processing unit (CPU).

Operating system. A set of computer programs devoted to the operation of the computer itself, which must be present in the computer before applications programs can be loaded or expected to work.

Operation code. A command that identifies a specific operation to be carried out, such as MUL (meaning "multiply").

OS. Operating system.

Output. Information or data transferred from the internal memory of the computer to some external device, such as a CRT, a mass-storage device or printer.

Overflow. A number, produced through an arithmetic operation, that is too large for the computer's register.

Overlay. A technique used to utilize programs that are too large for a system's memory. One part of the program is executed, and additional routines are brought in later, taking the place of the program segment that is no longer needed.

Packaged software. Canned software—that is, software pro-

grams available as commercial products.

Parallel interface. A connection over which several bits move at the same time over different wires.

Parallel processing. An operation that runs two programs simultaneously with more than one central processing unit (CPU).

PASCAL. A powerful high-level computer language with modular structure, intended for business and general use. Named for French mathematician and philosopher Blaise Pascal (1623-62).

PC. Personal computer.

Peripheral. Any I/O device, for instance, a printer.

PILOT. An easy-to-learn, high-level language designed for use by novice computer users. Primarily intended for educational settings.

Pin feed. The pin apparatus of a printer which guides fan fold paper by its holes.

Pixel. The rectangular element used in combinations to form images on video display terminal screens. The more pixels, the sharper the picture.

PLATO. An educational system using computer timesharing, where students interact with the computer on an individual level.

Plotter. A peripheral that draws and produces output, such as drawings and blueprints, in permanent form.

Port. The connection for input/output between interfacing computers and peripherals.

Printed circuit board. An insulating board which contains a circuit and has transistors, resistors, diodes and other electrical components mounted on it.

Printer. A device for producing paper copies *(hard copy)* of the data output by a computer.

Program. An organized group of instructions that tells the computer what to do. The program must be in a language (like BASIC or PASCAL) the computer understands.

Program counter. A memory register in a central processing unit that stores the sequence of a program's instructions as they are executed.

Program development cycle. A definite sequence of steps involved in writing a program.

PROM (Programmable read-only memory). A memory cir-

cuit that can be programmed (unlike ROM) with an inexpensive programmer. It cannot be changed after being programmed.

Prompt. A message given by the computer to the operator to tell him there's an error or something he should do.

Proportional spacing. Compensation by a printer for the varying widths of letters, giving a better overall appearance.

Public domain software. Software with no copyright, allowing for free copying and exchanging.

Random-access memory (RAM). Read-write memory available for use in the computer. Through random access the computer can retrieve or deposit information instantly at any memory address. RAM is the computer's working memory area and its size (64K or 128K) largely determines the sophistication of the programs the computer can handle.

Raster. The horizontal lines on a video screen which are scanned and illuminated by the electron beam.

Read. The act of taking data from a storage device, such as a diskette, and putting it in computer memory.

Read-only memory (ROM). A random-access memory device that has permanently stored information. The contents of this memory are set during manufacture.

Refreshing. The constant regenerating of the information that decays or fades when left idle, such as the phosphor on a video screen. The image would fade if not for the electron beam.

Registers. Memory locations in a microprocessor in which information is processed.

RF modulator (Radio Frequency Modulator). A device that allows a computer-output signal to be modified for display on a television screen.

RGB monitor. An ultra-high-resolution color video monitor with separate inputs for red, green and blue video signals. Gives excellent color graphics but is expensive and requires a computer with special outputs.

RPG (Report Program Generator). A high-level language designed for business applications.

Search and replace. A word-processing program's ability to find and replace a given piece of information wherever it appears in the text.

Sector. Individual portions of a circular track on a disk, providing

easy retrieval of information by locating sector and track number. A typical sector contains 128 bytes.

Serial (sequential) access. The searching for data by going through information in the order it is stored on the disk. The slowest of all access methods.

Serial interface. A connection over which one bit moves after the other over the same wire.

Smart terminal. A peripheral, usually consisting of a combined video screen and keyboard, that has its own microprocessor and can therefore perform some computer functions. Its main role, however, is interfacing with a computer.

Software. The programs and data used to control a computer.

Static memory elements. Memory devices that retain their contents indefinitely (without refreshing) as long as power is provided.

String. A sequence of letters, numerals and other characters. String length refers to the number of characters a string contains.

Structured programming. A method of programming, using modules, that simplifies much of the aspects of programming computers.

Subroutines. A group of instructions within a program that are used several times, whenever needed.

Synchronous transmission. A method of sending and receiving information in which careful timing is needed for characters to be decoded. This method provides high speed but requires expensive equipment.

System. All of the various hardware components that make the computer usable—the computer, the printer, modem, disk drive, etc.

Terminal. A keyboard and CRT combined in one package, for both input and output. A printer that incorporates a typewriter-style keyboard is also a terminal when used with a computer, or a teleprinter when used or considered by itself.

Thermal printer. A device that uses heat and heat-sensitive paper to form characters. Advantages: low initial cost, ease in combining alphanumerics and graphics. Disadvantages: slow, average reproduction quality, high cost of paper.

Timesharing. An arrangement where a central processing system serves several users over phone lines.

Touch terminal. A terminal into which the user writes information by touching his fingers to a screen, rather than by using a keyboard.

Turtle graphics. Line drawings created in the LOGO programming language by moving the cursor. The term "turtle" is derived from the triangular cursor used.

Typewriter interfaces. Devices that allow a computer to employ a standard electric or electronic typewriter as a printer.

User friendly. Systems designed to be easily learned and operated by computer owners.

User group. An organized club or group of people who share hardware and software information for a particular brand of computer.

Utility functions. Programs for frequently used applications, such as file-to-file conversion, printing, etc.

Vertical scrolling. Moving text up or down on the display screen.

VLSI (Very Large Scale Integration). A chip that contains the equivalent of thousands of semiconductors (five times more than the 20,000 or so on a large-scale integrated chip, or LSI).

Volatile. Computer memory requiring current to retain information, such as random-access memory (RAM). The contents of RAM disappear when the power is turned off.

Wafer. Also "silicon wafer." A piece of silicon on which integrated circuits are made. The wafer is later cut into individual chips.

Wait state. The state a microprocessor is in when it is not processing data, i.e. when it has idle time.

Warm start. Returning the computer to its initial condition, without stopping the power. Data is cleared from memory when this is done.

Winchester disk. A hard disk with higher storage capacity and much shorter access time than a floppy disk.

Word processing. A special feature of a computer that allows you to manipulate text.

Word processor. A special computer program that helps you manipulate text. You can write a document, insert or change words, paragraphs or pages, and then print the document letter-perfect.

Word size. The basic unit of information. Word size is equal to a specific number of bits, and varies with the system used.

Word wrap. The automatic placement by a word-processing system of a word on the next line if it doesn't fit within one line.

Write: To store data on external media such as disk or cassette. The expression *write to diskette* means that the information stored in the computer's memory is sent to the diskette, where it is stored.

Write-protection. A technique used to prevent the accidental erasure of information by writing over data on a disk or other storage medium. To write-protect a floppy disk, a user attaches a special tab to the jacket that covers a notch in the jacket.

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AJ International (TI Products) 4023 Sommers Ave., Drexel Hill, PA 19026
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SOFTWARE VENDORS

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Microsoft 10700 Northrup Way, Bellevue WA 98004
Sega, 5555 Melrose Ave., Los Angeles, CA 90038
Sierra On-Line, Sierra On-Line Bldg., Coarsegold, CA 93614
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