

Little Big Computer

The TRS-80 Model 100 Portable Computer

Rich Malloy, Technical Editor

Way back in 1977, Radio Shack introduced the TRS-80 Microcomputer System, a computer we now know as the Model I. It was not the first microcomputer to become available, but it was one of the first *complete* computer systems to be offered to the general public. The Model I subsequently spawned a whole line of microcomputers. The familiar gray-and-black motif became a standard feature of small businesses all over the country, and Radio Shack became one of the country's leading computer manufacturers. Now, six years after the Model I, Radio Shack releases the TRS-80 Model 100 (see photo 1), which by its small size, its off-white color, and its easy-to-use features seems to signal a new direction for the Texas company, a direction that may prove to be as significant as that of the original Model I.

In brief, the Model 100 is a big computer in a little package. It features a large (8-line by 40-character) LCD (liquid-crystal display), a standard-size keyboard, a low-power version of the 8085 microprocessor, 32K bytes of ROM (read-only memory), 8 to 32K bytes of RAM (random-access read/write memory), and a cassette interface. It also includes a built-in direct-connect modem with auto-dial and auto-log-on capabilities, an RS-232C serial port, a parallel printer port, a real-time clock/calendar, and even an interface for a bar-code reader. And that's just the hardware. The built-in software includes an easy-to-use text editor, a Microsoft BASIC interpreter, a communications program for the modem, and an address-book and appointment-schedule program. This all comes in a box that weighs less than 4 pounds and is smaller than the manual for the Model I. The price ranges from \$799 to \$1134, depending on the amount of memory you need. Overall, this is a well-designed, integrated machine that should prove to be very useful to a large number of people.

The Model 100 is not perfect for everyone, however. Serious hardware hackers will be frustrated by the inability to swap boards. Software enthusiasts will want more RAM and some disk storage. And professional writers will need a larger display and a lot more memory. Taken in its own context, however, the Model 100 is an extremely successful design. It should be quite useful for three groups: businesspeople who need a portable workstation, advanced computer users who need a portable terminal for their main system, and



Photo 1: The TRS-80 Model 100 Portable Computer.

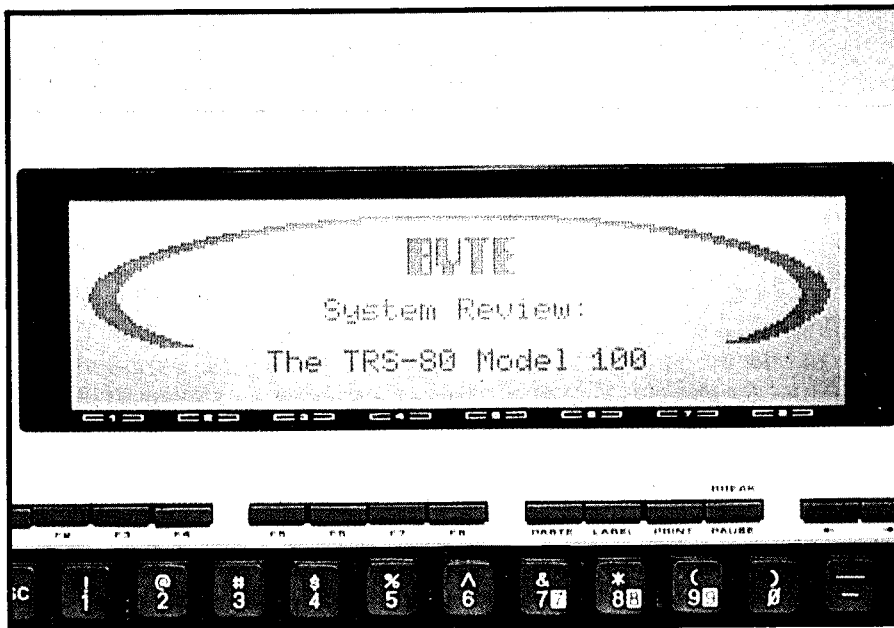


Photo 2: A close-up of the liquid-crystal display of the Model 100. The display size is 8 lines by 40 characters (64 by 240 pixels).

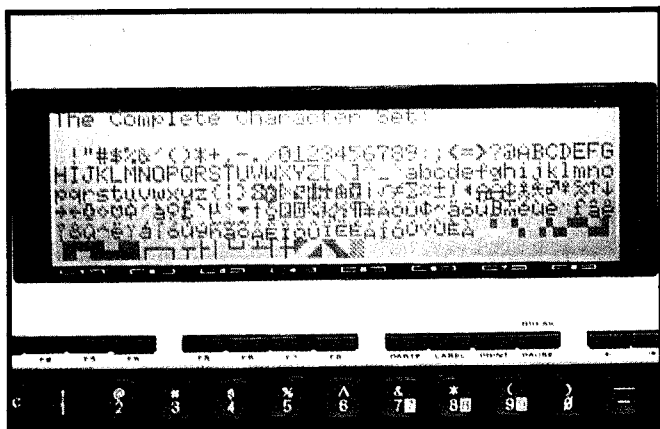


Photo 3: The complete character set of the Model 100.

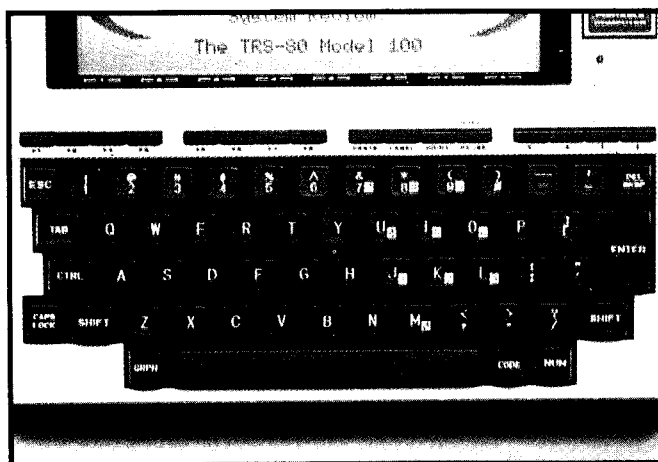


Photo 4: The Model 100's keyboard.

novices who want to experiment with a useful, powerful computer for a fairly modest cost.

Physical Dimensions

Because desk space tends to get crowded and briefcases rapidly fill, the size of a portable computer is a key factor. As for the Model 100, if you can make space for a standard 3-ring binder, you have more than enough room for this machine. The dimensions are 11 $\frac{1}{8}$ by 8 $\frac{1}{4}$ by 2 inches, similar to the Epson HX-20. The weight is 3 pounds, 14 ounces.

The computer's case is off-white, a color that is becoming popular with Radio Shack. The top of the unit shows the display, a low-battery indicator, and the keyboard. On the right side are an on/off switch, a dial for adjusting the LCD's brightness, and an AC adapter connector. On the left side are the bar-code-reader connector and two switches for the modem (direct/acoustic and originate/

answer). The rear panel contains the phone connector, the cassette connector, a printer connector, an RS-232C connector, and a well-protected Reset button. The bottom of the unit features the battery compartment, a compartment for an expansion ROM module and an external bus connector, and a RAM power switch (to be turned off only when the machine will not be used for an extended period).

The Display

The first thing you notice about the Model 100, besides its size, is the LCD shown in photo 2. The Model 100 can display 8 lines of 40 characters each. That's a little less than half of the typical home computer screen. It also can display graphics with a resolution of 240 by 64 pixels. Each character is composed of a 5- by 7-pixel area. Lowercase descenders on letters such as p and q make use of the row of pixels below the character area that is normally used to separate lines. The bottom line of charac-

At a Glance

Name

TRS-80 Model 100 Portable Computer

Manufacturer

Radio Shack
One Tandy Center
Forth Worth, TX 76102

Uses

Portable word processing, programming, and telecommunications

Dimensions

11 $\frac{1}{8}$ by 8 $\frac{1}{4}$ by 2 inches
(3 pounds, 14 ounces)

Features

8-line by 40-character liquid-crystal display, full-size, full-travel keyboard, 8085 microprocessor, 32K bytes of ROM, 8K to 32K bytes of RAM, cassette interface, built-in direct-connect modem, RS-232C interface, parallel printer interface, real-time clock/calendar, bar-code-reader interface, and piezoelectric tone generator

Software

Text editor, BASIC interpreter, communications program, address-book program, and appointment-calendar program

Documentation

Reference manual: 200 pages, spiral-bound
Pocket manual: 40 pages

Price

8K bytes RAM: \$799
24K bytes RAM: \$999
32K bytes RAM: \$1134

Options

Phone connector (\$19.95), printer cable (\$14.95), cassette cable (\$5.95), and acoustic adapter for modem (approximately \$50, to be available 3rd quarter 1983)

machines, and fortunately such tables do not occur frequently in general correspondence.

The large size of the characters and the nonflickering quality of the LCD caused me much less eyestrain than the usual cathode-ray tube display.

The Keyboard

The second most obvious thing about the Model 100 is its full-size keyboard (see photo 4). While the display is obviously limited by the small size of the unit, the keyboard exhibits few signs of compromise. In fact, it is one

While the Model 100's display was obviously limited by the small size of the unit, the keyboard exhibits few signs of compromise.

of the nicest keyboards I've used on any machine, large or small.

Most of the keys are in the standard Selectric-style arrangement. The Backspace, Control, and Return keys are in their usual places. The cursor control keys are located just above the Backspace key and are arranged in a horizontal row (L-R-U-D). This cursor key arrangement is fairly common, but I much prefer a diamond arrangement for these keys.

The keyboard is controlled by its own microprocessor, and it has a good type-ahead buffer. No matter how fast I typed, no characters were dropped. Key repeat is also provided.

Special shift keys marked Code and Graph allow you to key in all 256 of the Model 100's characters directly from the keyboard.

Twelve function keys are located above the main keyboard. Four of these are permanently marked and have constant functions in all the application programs that come with the machine. "Paste" works as a Block Insert key; "Label" turns the line of function key labels on and off; "Print" is used to print either the contents of the display or an entire file; and "Break/Pause" either terminates or temporarily halts execution of a process, depending on whether the key is cap shifted or not.

The other eight function keys are programmable and are not permanently labeled although they tend to have the same function in each application program. This is a good design feature. As mentioned previously, the bottom line of the display can be used as a label for these keys. Unfortunately, the labels do not line up exactly with the keys. These keys also have interrupt capabilities that could be put to use by advanced computer users.

A "Num" key converts some of the keys into a slanted numeric keypad. Because I'm not a numeric touch-typist, I couldn't test how easy this strange configuration would be to work with. If a numeric keypad is important to you, I suggest you test this keypad in the store to see if you can work with it.

ters can be used either as part of the display or as a line of labels for eight function keys.

The full 96-character ASCII (American National Standard Code for Information Interchange) set can be displayed along with 128 extra foreign and graphics symbols (see photo 3). Some of these graphics symbols are non-standard and cannot be printed on Radio Shack printers. Reverse video characters are available, but apparently not through BASIC.

The screen contrast is fairly good, but decreases quickly as you move away from an optimum viewing angle of about 60 degrees from the horizontal. Contrast can be adjusted with a dial on the right side of the machine. I had no problem reading the display whether it was on a desk or on my lap. The LCD does tend to reflect ceiling lights, however, and this could be a problem in certain offices. Placing the unit on your lap should solve this problem somewhat.

As in most displays, scrolling is done line by line, rather than pixel by pixel (smooth scrolled). The display seems a little slower than most video displays, but not objectionably so. Although the display is smaller than the typical home display—and a great deal smaller than the typical 80 by 24 office display—I grew accustomed to it fairly easily. It is a very good size for menus. The main problem occurs with tabular material wider than 40 columns. But tables tend to be a problem on *all*

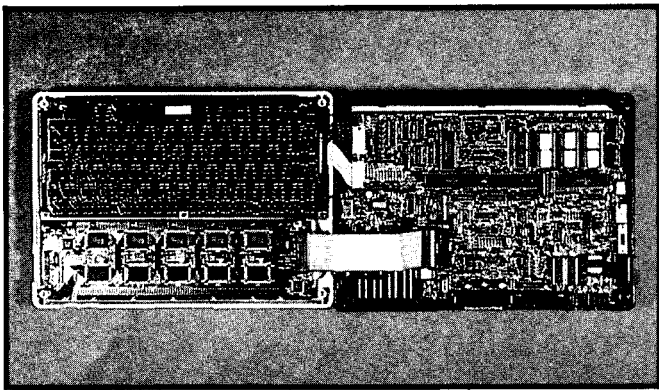


Photo 5: Inside the Model 100. On the right side are the undersides of the liquid-crystal display (top) and keyboard (bottom). The left side shows the main circuitry. The modem circuitry is in the upper left-hand corner. The random-access memory is in the lower left-hand corner. The 80C85 microprocessor is in the central part of the left side.

One slight problem with the keyboard is the sound each key makes. It's not a click exactly; it's more like a pop—a quite audible pop. In fact, a plane full of business executives typing on these machines might drown out the engine noise. That, of course, is an exaggeration, but the key-popping may cause a slight problem in quiet places such as libraries. Admittedly this is a small complaint, but if I were Radio Shack I would investigate putting some type of sound-dampener under the keys.

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Processor

The Model 100 uses the 80C85 microprocessor chip, a low-power CMOS (complementary metal-oxide semiconductor) version of the 8085, which is a well-respected member of the 8080 family. The clock speed for the microprocessor is 2.4 MHz. One of the advantages of the 8085 is its extensive interrupt capabilities, which, as we will see later, are well exploited by the Model 100's BASIC interpreter.

Memory

Each Model 100 contains 32K bytes of ROM. This is used to store a small menu-based operating system and five application programs. As for RAM, you have a choice of 8, 16, 24, or 32K bytes. The 8K-byte RAM machine sells for \$799. Each additional 8K bytes of RAM costs \$120 plus a \$15 installation charge. Thus, a 24K-byte machine should cost \$799 plus \$240 plus \$15, or \$1054. Radio Shack, however, is offering a special price for the 24K-byte machine of \$999—a savings of \$55. A full 32K-byte machine should then cost \$135 more, or \$1134.

The RAM is of the low-power CMOS type, and it is protected by its own power supply. This memory is powered at all times, whether the machine is on or off. Even after main battery failure, memory power continues for 8 to 32 days. There are apparently only three ways to wipe out the contents of memory: letting the batteries run down and not replacing them for a long time, initiating a cold start or Reset, or turning off the memory power switch on the bottom of the machine (which should be done only when the machine will not be used for an extended period of time).

As on most 8-bit processor machines, the maximum addressable memory space is 64K bytes. The memory appears to be allocated as follows: the bottom 32K bytes of memory (addresses 0 through 31999) are taken up by the ROM. The first 8K bytes of RAM fills the top 8K bytes of memory. Each additional 8K bytes of RAM is installed in the next highest 8K bytes of memory. The topmost part of the first 8K bytes of RAM is used by the computer's operating system for display memory and to store pointers for the BASIC programs and document files. These files are stored in the lowest part of RAM. The part of RAM between the pointers at the top and the files at the bottom can then be used for new files or for arrays for the BASIC programs. With a 32K-byte RAM machine, you have 29.6K bytes of RAM free; with the 8K-byte RAM machine, you have only 5.1K bytes of RAM free.

Future ROM modules for the ROM expansion socket will occupy the same address space as the built-in 32K-byte ROM. You will then be able to switch between the two banks of ROM available.

Some advanced users may feel limited with only 32K bytes of RAM. But programs such as the text editor reside outside of the precious RAM area. Also, the display eats up very little RAM. The result is that you can use almost the entire RAM area for document storage.

The machine I used had 32K bytes of RAM, and after about 25 hours of typing notes and running BASIC programs, I still had about 16K bytes of RAM left. Even with the 24K-byte machine, I think I would probably run out of batteries or things to write about before I ran out of memory.

I enjoyed using this type of protected RAM. It was a pleasure knowing that I did not immediately have to save everything and that whatever I put into memory would stay there until I deleted it. Still, on this or any other machine, irreplaceable files should be backed up.

Power Supply

For a portable computer that depends on RAM for data storage, the power supply is a crucial issue. On the Model 100, power is supplied by four AA batteries or by the optional AC adapter. Operating life of the batteries is about 20 hours. This time can be shortened if excessive use is made of the various interfaces (modem, cassette, printer, RS-232C). Because these interfaces will probably be used primarily within reach of an AC socket, this power drain should not be a big problem. The low-battery indicator lights when 20 minutes of battery power are left. I used the machine for about 15 hours, making extensive use of the printer and cassette interfaces, before the low-battery indicator went on. And then the machine continued for another hour and a half before it finally died. That seems to be ample warning to get more batteries.

The Model 100's volatile memory is protected by its own power supply, a separate nicad (nickel-cadmium) battery that is continually recharged by the main batteries or by the AC adapter. When the main batteries fail, the nicad battery will continue to power the memory for an extended period of time, depending on the amount of RAM you have. With 8K bytes of RAM, you have 32 days before the memory is lost. Even with 32K bytes, you still have 8 days to get new batteries.

Modem

In keeping with its portable nature, the Model 100 was given extensive communications capability. A key element in this design is its built-in direct-connect modem. All you need is the optional phone connector (\$19.95) and you can plug into any standard modular phone jack. If a modular phone jack is not available, you can use an optional acoustic adapter with any regular phone.

The modem is a standard Bell 103-compatible version with a transmission rate of 300 bps (bits per second). *Auto-dialing* capability is also included. However, it can dial only in the *pulse* mode, like a standard rotary-dial telephone. Radio Shack says it would have liked to add *tone-dialing* capability, but it was not available on low-power CMOS chips. If you have a private telephone system that can handle only tone-dialing, you will have to dial manually. The pulse dialing rate, by the way, can be set at either 10 or 20 pulses per second.

You have the option of using several serial communications parameters: the word length can be either 6, 7, or 8 bits. Parity can be handled in one of four ways: Ignore, Even, Odd, or No parity. The number of stop bits can be either 1 or 2. And the pause/continue protocol frequently indicated as XON/XOFF or <Ctl S> / <Ctl Q> can be enabled or disabled.

The Model 100's modem in combination with its ROM-based communications program presents a quite powerful package. The only thing I might want to have added is auto-answer capability, but this might not be a cost-effective option. After all, a portable machine like this will probably not be in one place long enough to receive phone calls.

RS-232C Interface

The Model 100 also has an RS-232C serial connector for connecting to serial printers, other computers, or high-speed (1200-bps) modems. This interface uses the same circuitry as the modem, and all communications parameters for the modem will likewise affect the RS-232C connector. Unlike the modem, however, the RS-232C port has a wide range of transmission rates: from 75 to 19,200 bps.

Parallel Printer Interface

For connections to most printers, the Model 100 has a parallel printer port. This takes the form of a 26-pin, dual-row connector on the rear panel of the machine. An optional connector cable converts this to a standard

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Centronics-type plug. I was surprised they didn't put a standard Centronics jack on the machine itself.

The Print key prints out through this interface. I connected the Model 100 to a Radio Shack Lineprinter VIII and it worked without any problem, except for a few of the Model 100's nonstandard graphics symbols that could not be printed.

Cassette Interface

Besides uploading and downloading files over the telephone lines, you can also store files on a cassette. The Model 100's cassette interface stores information at the rate of 1500 bps. This translates to about 20 seconds for a 150-word letter. When you load files from the cassette, the Model 100 lets you hear the bit stream. Because this is not the most pleasant of sounds, you can turn this feature off with a BASIC command.

Other Features

The Model 100 has several other features worth mention. A real-time clock/calendar indicates the time of day, the date, and even the day of the week. A piezoelectric sound generator functions as a speaker and allows you to generate musical notes without using too much power. An automatic power-off feature is also included. After 10 minutes of not being used, the machine turns itself off to save battery power. This time interval can be lengthened or shortened or it can be disabled.

Options

Perhaps the most valuable option is the phone connector cable. This cable, which sells for \$19.95, allows you to insert the Model 100 between a standard modular phone and its phone jack. The cable package also includes automatic log-on sequences for CompuServe and the Dow Jones News/Retrieval services, plus membership in these services and one hour's free time on each. That's quite a bit for \$20.

The cassette cable comes free with the optional Radio Shack cassette recorder or can be purchased separately for \$5.95. The printer cable for connecting a printer to the Model 100's parallel port costs \$14.95.

For people who may not have access to a modular phone jack (as in certain hotel rooms or in phone booths), Radio Shack will be offering an acoustic adapter that consists of two cups that fit onto a regular telephone handset. This should be available some time this summer for about \$50.

The bar-code reader is designed to work with a Hewlett-Packard bar-code wand. Software for this option will probably be available at some future time.

The Model 100 also allows for options that have not yet been announced. On the bottom of the machine is a compartment for a 32K-byte ROM module. We can only speculate about what type of software Radio Shack will put on such a chip (a mini-spreadsheet program?). Also in this compartment is a 40-pin external bus connector. Radio Shack is not telling, but this would seem to be perfect for adding storage devices or a larger display.

Software

It has frequently been said that you should buy a machine not for its hardware but for its software. Microsoft, the designer of the Model 100's software, really took that maxim to heart. On top of the impressive collection of hardware that makes up the Model 100 is an equally impressive collection of software. This is one computer you can start using immediately; you won't have to wait six months to a year for the software to be developed.

Not only are the various software packages extensive, easy to use, and of fairly good quality, but they also work well with each other and are all crammed into just 32K bytes of ROM. Of course, judging software is a subjective task, but if you keep in mind the design goal of the machine—an easy-to-use portable workstation—I'm sure you'll agree that this goal has been reached and then some.

When the machine is turned on, a simple operating system is engaged and the system's main menu appears. This shows the time, the date, the amount of free memory available, and a list of all the files in memory. The five built-in application programs are listed with no filename extension. Document files all have the extension ".DO"; BASIC programs have the extension ".BA".

Choosing a particular file to work with is easy. You simply move the cursor over that file name and press Return. If a document or BASIC program is chosen, the

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text editor or BASIC interpreter, respectively, is automatically invoked. Typical operating-system functions such as file deleting are handled in BASIC.

When you finish with a particular file or program, you press one of the function keys marked Menu. This closes your file and returns you to the main menu again. Having the complete list of files appear on each warm boot, as it were, is a particularly good idea. It makes the system extremely easy to use and would save time on any operating system.

The five application programs included as standard equipment are the following: a text editor (TEXT), a BASIC interpreter (BASIC), a communications program (TELCOM), an address-book program (ADDRSS), and an appointment-calendar program (SCHEDL). These programs work well with each other. TEXT can be used to edit BASIC programs or the data files used by TELCOM, ADDRSS, and SCHEDL. Also, TELCOM and ADDRSS share the same data file.

The Text Editor

TEXT will probably be the most used program on the Model 100. It is a full-fledged character-oriented editor (i.e., not a line editor) with word-wrapping, so that words are not broken mercilessly at the end of those 40-character lines. Owing to its compactness, it lacks many of the features found on large packages such as Wordstar or Perfect Writer, but it is well designed, simple to learn, and fairly powerful.

TEXT contains only the most needed functions of a word processor, but makes up for this shortage of functions by making those it has as easy to use as possible. These functions are Insert, Delete, Search (Find), Copy a block, Delete a block (Cut), Insert a block (Paste), Save on cassette, Load from cassette, Print, and Cancel any operation (Break). Note the use of familiar names such as Cut and Paste.

Using TEXT is simple. To create a file, you merely choose TEXT in the main menu. Because it's already in memory, TEXT "loads" in an instant and asks for a file-name for your new file. After that everything you enter becomes part of that file. All controls are handled by function keys. You don't have to remember any control key combinations. For those who prefer them, however, each function key has a corresponding control key combination. Of course, if your text will later be used by another word processor, you can embed the necessary commands into your text.

An interesting thing about TEXT is that it is always in the Insert mode. In other words, you can't "write over" anything you've already written. You must insert the new material and delete the old or vice versa. This took a little while to get used to, but it actually makes a lot of sense and saves time. Most of the editing I do is either inserting or deleting, and this makes the first of the two a bit easier.

As I said earlier, some functions had to be left out, but some of these are quite useful. Perhaps they can be handled by small BASIC utilities. For example, a Search and Replace function could probably be handled by a short BASIC routine. Also, an indication of the file length (which is quite important on a machine with a small display) might be provided by a short BASIC word-counter.

Lastly, the Print function allows you to print either the whole document file or just the contents of the display. It will print in whatever line length you want, and the lines will be word-wrapped. The only problem is you can't set the left margin. Again, a short BASIC routine could probably handle this also.

To test the performance of TEXT, I tried a little text-editing benchmark. I timed how long it would take to retrieve a 150-word letter, change the date, the addressee, the address, and the salutation, and then store the new

CLOAD?	Verifies a previous cassette load
CLOADM	Loads a machine-language program from cassette
COM ON/OFF/STOP	Enables/disables communications interrupt
CSAVEM	Saves a machine-language program on cassette
CSRLIN	Returns vertical cursor position
DATE\$	Represents the current date (MM/DD/YY)
DAYS	Represents the day of the week (e.g., Fri)
EDIT	Invokes text editor
ERL	Gets line number of error
ERR	Returns error-code number
FIX	Truncates real numbers
HIMEM	Returns high-memory address
INP	Inputs data from a port
INPUT\$(N)	Inputs N characters from keyboard
INPUT\$(N,F)	Inputs string of length N from file numbered F
INSTR	Searches for a given string
IPL	Defines program to run on power-up
KEY	Defines function key as string
KEY LIST	Lists current functions of function keys
KEY ON/OFF/STOP	Enables/disables function-key interrupts
LCOPY	Copies screen to printer
LINE INPUT	Inputs string from keyboard
LPOS	Returns the current position of printer head
MAXFILES	Represents the maximum number of open files
MAXRAM	Returns the maximum amount of RAM available
MDM ON/OFF/STOP	Enables/disables modem interrupt
MENU	Closes files and returns to main menu
ON COM GOSUB	Defines routine to handle RS-232C interrupt
ON KEY GOSUB	Defines routine to handle function-key interrupt
ON MDM GOSUB	Defines routine to handle modem interrupt
ON TIMES GOSUB	Defines routine to handle clock interrupt
OPEN	Opens file and sets logical file number
OUT	Outputs a byte to processor port
POS	Returns horizontal screen position
POWER	Sets automatic power-down period
POWER CONT	Disables auto power-down feature
POWER OFF	Turns off machine
PRESET	Turns off pixel in display
PSET	Turns on pixel in display
RESUME	Resumes execution after error
SCREEN	Turns on/off function-key label line
SOUND	Generates a tone
SOUND ON/OFF	Enables/disables beep when carrier signal comes on telephone line
SPACE\$	Defines a string of spaces
STRING\$	Defines a repetitive string of a given character
TIMES	Represents the time of day (HH:MM:SS)
TIMES ON/OFF/STOP	Enables/disables time interrupt
VARPTR	Returns memory address of a given variable

Table 1: Some selected commands found on the Model 100's version of Microsoft BASIC.

letter. My average time on TEXT was about twice as long as it is when I use Magic Wand, the word processor on my 4-MHz, Z80-based office machine, with which I am quite familiar. Undoubtedly, some of this time difference is due to my inexperience with the portable unit; and some of it is due to the fact that TEXT is always in Insert

mode, and thus simple write-over corrections require twice as many keystrokes; but a large portion of the difference is due to the slowness of the Model 100's LCD versus the 9600-bps display on my office machine. Subjectively, however, the Model 100 "seemed" faster than my office machine because it did not need extra time to load the text editor and the document file from the disk and later store the document on disk and reload CP/M (do a warm boot).

This illustrates a nice feature of the Model 100. You don't have to wait for the disk drives or for the display tube to warm up. You can take the machine out of your desk drawer, turn it on, and be writing a memo in about 2 seconds.

Overall, I found TEXT to be a good product. It seems perfectly designed for the Model 100, almost like a hand in a glove. Even the novice user should be able to write a short letter on it in about an hour, and there aren't many word processors you can say that about.

BASIC

For the Model 100's BASIC interpreter, Radio Shack has again gone to its traditional source—Microsoft BASIC. Of course, a few commands are missing on the Model 100 version of MBASIC, but several more have been added to take advantage of the interrupt capabilities of the 8085 processor, and it is well integrated with the Model 100's other application programs.

Table 1 describes some selected commands. Of particular note are the interrupt-handling commands, which can work with the modem, the clock, the RS-232C port, and the function keys. For example, in a long program you can insert a routine to handle an interrupt from one of the function keys. Then, whenever that function key is pressed, control is automatically transferred to that routine. The program does not have to continually check the function keys to see if they have been pressed.

As mentioned before, some commands such as WHILE. . .WEND are missing, but these can be replaced with combinations of other commands.

As for performance, I timed the BASIC interpreter with the Eratosthenes Sieve benchmark described in the January issue of BYTE on page 283. The Model 100 took 2820 seconds for 10 iterations of the routine. Compare this with 2880 seconds for BASIC on the TRS-80 Model III, 2806 seconds for Applesoft BASIC on the Apple II, and 1950 seconds for BASIC on the IBM PC.

Like the other application programs, the BASIC interpreter is integrated with the text editor. The result is that you can edit your BASIC programs in two ways: either by using the common line-oriented approach or by using TEXT. To use the latter method, you merely type TEXT while in BASIC and your program will be translated into ASCII and TEXT will be invoked. When you leave TEXT, your program will be translated back into its normal tokenized form. Long programs can require a few seconds for these translations to occur.

The Model 100's BASIC is also well integrated with the machine itself. Every hardware port and interface seems

to be accessible from BASIC. Overall, this version of BASIC is fairly comprehensive and pretty fast for a portable machine.

TELCOM

In order to take advantage of the built-in modem, Radio Shack has provided the Model 100 with a built-in communications program, and a fairly powerful one at that.

With this program, you can automatically dial a database and execute the required log-on procedures. Once online, you simply press a function key to upload any of your document files onto the database or download a file onto your Model 100. Other function keys let you "echo" your communications to a printer or change from the full-duplex mode to half-duplex.

In the event a database sends you more than eight lines of text at once, Radio Shack has even supplied a function key that lets you refer back to the previous eight lines.

The upload routine includes a very important feature that, surprisingly, is frequently missing from communications software packages. When you upload a document, TELCOM will automatically format it to any line length that your database requires. This is important because some systems cannot handle lines that are longer than a certain length.

The TELCOM program can even be used as an auto-dialer for voice communication.

I found TELCOM a bit harder to use than TEXT or BASIC. The auto-dial and auto-log-on routines use special notation, which is a little hard to remember. Of course, auto-log-on procedures tend to be difficult to encode on any system. Fortunately, Radio Shack will help things by including auto-log-on procedures for both CompuServe and Dow Jones with its optional phone connector. Once these procedures are properly encoded on the Model 100, data communications become easy. In fact, some Radio Shack executives have their log-on procedures for Dow Jones set up so that all they have to do is turn the machine on, press a few keys, and a few seconds later the latest price of Tandy stock appears on their display.

ADDRSS and SCHEDL

Two simple programs are provided that can turn the Model 100 into an electronic address book and appointment calendar. ADDRSS can be used to store names, phone numbers, and addresses in a special file called "ADRS.DO", which is also used by TELCOM. Once the data has been stored in this file, you can use a function key marked Find to locate, for example, all records containing the string "Bill" or "Fort Worth." Upper-case/lowercase distinctions are disregarded.

SCHEDL works similarly to ADDRSS except that it uses dates and times rather than names and addresses. It stores this data in a file named "NOTE.DO". Using the Find key, you can quickly locate all records you've entered for a given date or time or all appointments you've made with a certain person.

ADDRSS is pretty handy because it shares its data file with TELCOM. SCHEDL seems somewhat limited by contrast. It would have been nice if Radio Shack had incorporated the clock/calendar into it, but I imagine ROM space must have gotten pretty scarce by the time SCHEDL was added. Again, you could probably write a simple BASIC program to do this. For example, it could check the clock/calendar, then check each record of the NOTE.DO file, and sound some type of alarm when the two coincide. Such a program could automatically tell you when you have an appointment and with whom.

Possible Applications

With all this hardware and software, the Model 100 is well suited for a large number of applications. It should be a great tool for writers, programmers, businesspeople, and students. With the bar-code reader, it could even be used at the local supermarket. The Model 100 looks very flexible. It should be interesting to watch applications for it develop.

Limitations

As good as the Model 100 is, it does have certain limitations.

One is the lack of convenient mass storage. There will be times when you wish you could quickly load and store large documents or programs. Looking at the external bus connector on the bottom of the machine, I wouldn't

be surprised if Radio Shack already has a mass-storage device in the works. My guess is either a thin-line 5¼-inch floppy disk or a large disk-simulating CMOS RAM module. Of course, 3½-inch floppies and bubble memory are also possibilities.

Another limitation is the display. Although it is of a useful size, it could be a hindrance, for example, in spreadsheet programs. Again, looking at that bus connector, I've got a feeling some type of video display is on someone's drawing board. Also, as LCDs get larger and larger, I wonder if 16-line by 80-character displays are that far down the road.

A small dot-matrix printer would be a useful accessory for the Model 100. Something on the order of the new briefcase-size typewriter from Brother would be handy.

We're completely in the dark as to what that extra ROM socket might be used for. The best bet is a mini-spreadsheet program. But I wouldn't be surprised if some type of disk operating system were in the works, or even some games. I'm sure Radio Shack will think of something.

Speaking of games, the bit-mapped graphics of the LCD and the interrupt capabilities of the machine might lend themselves nicely to possible game applications.

Documentation

The Model 100 comes with two manuals: a large 200-page spiral-bound manual and a small pocket-size

40-page booklet. The first chapter of the large manual explains how to get the system up and running in as short a time as possible. Later chapters describe each application program in great detail. Several appendixes contain various technical information.

The pocket manual is meant to be the one you take along on trips. It contains much the same information as in the first chapter, plus most of the technical information from the appendixes, in the large manual. I would have liked a reference card with all the application program commands on it, but most of these commands are fairly intuitive anyway. The pocket manual seems like a good compromise between a large, comprehensive manual and a short, incomplete reference card.

The manuals are well written. A novice user should be able to get the text editor working without too much trouble. BASIC and TELCOM may present some problems. Novices might find an introductory book on BASIC helpful. Although the TELCOM section may not be as easy as that for TEXT, it does not seem to be any harder than the databases you will be connecting to.

In addition to the ROM-based application programs, Radio Shack also includes some useful BASIC programs in its manual. For example, one of these will alphabetically sort all the records in your ADRS.DO file.

Summary

The TRS-80 Model 100 is an amazing machine. In one fell swoop, Radio Shack seems to have bypassed the "electronic cottage" and brought us the "electronic shopping bag."

Just out of curiosity I added up what it would roughly cost to buy the separate elements that make up the Model 100, that is, if you could buy them separately. There's the display, the keyboard, the processor, the memory, the modem, the RS-232C interface, the parallel printer interface, the clock/calendar, the cassette interface, the bar-code-reader interface, the text editor, the BASIC interpreter, the communications program, and the address-book and appointment-calendar programs. My rough estimate comes to about \$1500, and that doesn't include the tremendous amount of time you would have to spend getting all these things to work together. No matter what your feelings are about the software or the size of the memory or display, I think you'll agree that, at \$999 for a 24K-byte RAM machine, the Model 100 is a pretty good bargain.

A few weeks ago a short note on the Model 100 was leaked by the *Wall Street Journal*. Rumor has it that at least one person saw this note, promptly ran down to the local Radio Shack store, and placed an \$800 deposit in a very surprised salesperson's hands.

Radio Shack could probably make money issuing just a mediocre portable computer. Instead, it produced an exceptional machine. The designers of this machine—including Bill Walters of Radio Shack, Bill Gates of Microsoft, and several others at both companies—should be congratulated. And I have a feeling they will be—all the way to the bank. ■