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David D. Busch Expanding Your Commodore 64 Capabilities



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Preface

In exploring the expansion options for your Commodore 64 computer, this book is a "how to" and "what to" guide, with a bit of "where to" sprinkled in. It has been written specifically so that the information in it will not go quickly out of date. You will find solid information on how various expansion options will enhance your enjoyment of your computer. Tips are given on what to look for when shopping for disk drives, printers, modems, and software. Some of the products that are likely to remain on the market for a long time, such as those marketed by Commodore itself, are described in greater detail. In Appendix B, you will find the names and addresses of many suppliers of the products discussed.

However, this book is not a "Buyer's Guide" for the Commodore 64. Check the Commodore-oriented magazines, such as *Compute Gazette, RUN,* and *Power/Play* for the latest prices and features. *Expanding Your Commodore 64's Capabilities* will make you a smart computer consumer, so that you can go out and get the hardware and software add-ons you want, regardless of who happens to be marketing them at the moment.

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Introduction

You're one of the lucky ones, one of the million or more who hitched their ride to the microcomputer age on one of the winners, the Commodore 64. Whether it was a shrewd decision, an advertisement that caught your eye, or blind luck, you've gotten yourself a real computer that is priced like a games-only machine.

Yet, despite its attractive price, the Commodore 64 is no entrylevel dead-end street. Unlike some of the tiny, toylike computers you might have seen hawked at every department store, the Commodore 64 is meant to be used as a serious computer, and it can be expanded to do just about anything one of the \$1000-plus models can do.

Already one of the most feature-packed under-\$200 computers when it comes out of the box, the Commodore 64 can easily be expanded further at relatively low cost.

In fact, the small price tag for expanding a Commodore 64 is even more remarkable than the bargain-basement price of the computer itself. Some other computers in the same price class require a \$200 to \$300 expansion box before any accessories can be plugged in. The Commodore 64 disk drive costs less than that expansion box alone and can be used with a stock Commodore 64. The Commodore 64 modem, frequently discounted to \$59.95, costs little more than the modem cable for one non-Commodore product. Should Commodore 64 owners really want to expand their options, other Commodore 64 expansion adapters start at only \$29.95.

Expanding Your Commodore 64's Capabilities is a concise, advice-

filled compendium of Commodore 64 expansion options, delivered to you by an author who has gone the route himself. Things to look for—and pitfalls to avoid—are covered. Whether you have been a Commodore 64 owner for two weeks or two years (or still "just looking"), you will find some sound tips on getting the most from your computer.

The book covers all the expansion options available at this writing, from telecommunications to new operating systems such as CP/M. I'll show you where to get these door-opening new items that will be your entrée to more fun from computing. Commodore 64 expansion, like the expanding universe, is somewhat open-ended. Given the capabilities of this exciting computer, there's no telling where it will end.

1 The Commodore 64's Expanding Universe

If first impressions stick, then the Commodore 64 microcomputer should gain an invaluable head start in the minds of any potential purchaser. The computer just doesn't look like a \$200 to \$300 machine.

In fact, when I am demonstrating the unit to anyone who is not familiar with it, I always save the price for last. This ploy is especially effective if the potential user already has some familiarity with other microcomputers and their pricing. The gimmick works because Commodore has not emphasized the exact price in its advertising. Due to heavy discounting, the machine can sell for \$200—or much less.

First, I show off the full-stroke, typewriter style keyboard, which features four special-function keys and a control key. The PET BASIC is similar to that used in higher-priced Commodore machines and comparable in features to other versions of Microsoft BASIC. Lowercase characters are built in, but if the user desires, he or she can define any character set using an 8 × 8 dot matrix. There are high-resolution graphics (every dot on the screen may be addressed)—in eight colors—that make any Apple or Atari user nod appreciatively, and a TRS-80 Model 4 owner drool with envy. Sprite graphics provide a simple way of manipulating complex shapes on the screen. Need sound? Three synthesizer-quality voices are built in. Adding a joystick is as simple as plugging a stock Atari unit into a socket provided.



Figure 1-1 Straight out of the box, the Commodore 64 has more features and capabilities than any comparably priced computer. With shrewd expansion, the machine can rival systems costing several times as much.



Figure 1-2 One of the strong points of the Commodore 64 is the large number of accessories available for it. These include such exotic fare as this home weather-station interface. (*Photograph courtesy Vaisala, Inc.*)

At this point, I mention the price and watch eyes widen in disbelief. Almost immediately, I am asked, "What's the catch?" In truth, there are several. It is not really possible to do anything useful with the Commodore 64 for its basic price—not even save or load programs. To the basic price it is necessary to add about \$75 for the Commodore Datasette cassette recorder. Ordinary tape recorders, which produce sine wave output, cannot be substituted for the square-wave Commodore unit unless a special interface card is purchased. Not that one would be tempted to save a few dollars here, because I've found the Datasette to be remarkably reliable, even using very low-cost cassettes.

The final "catch" is that the Commodore 64 display is only 40 columns wide. This, too, may be remedied by add-ons and user programs. However, at a time when many micro users are complaining that 64-character screens should really be 80 columns wide, a 40-character display will cause much grumbling.

My feeling is that purchasers of the Commodore 64 should revel in the excellent value they get for the price but consider the unit for what it really is—a competent \$300 to \$400 color microcomputer. Not expanding the Commodore 64 to take maximum advantage of its potential is a little like buying a Cadillac without air conditioning.

HARDWARE

Commodore can easily be forgiven for lavishing attention on the keyboard while giving us a less-than-perfect screen display. Several 40-character screens are available on competing microcomputers, and there are at least a few that are no wider than 32 characters. The venerable VIC-20, which originally listed for \$300, had a 22-column screen at a price higher than what the Commodore 64 is selling for now.

After all, screen size is something you can live with. In addition, it is a feature that is relatively easy to modify with add-on components. Given the wide range of TVs likely to be used as monitors for low-cost micros, and narrow bandwidths, Commodore obviously opted to provide a sharp display that will suit many users but can be upgraded later to suit the higher resolution of composite video monitors.

But a clumsy, ill-liked keyboard is much more difficult to

retrofit to existing computers, as Radio Shack, Texas Instruments, and Commodore itself have discovered (remember the original PET keyboard?).

As a writer capable of (rare) 60-words-per-minute bursts, I was sold by the keyboard of the Commodore 64. It's a solid, professional-feeling keyboard that can accept input as quickly as any user can type. There is no keyboard bounce, and most of the keys have been arranged in a logical pattern.

My big complaint is the placement of the RETURN (ENTER) key. It is at the far right of the home row, four keys removed from the "L." I am most accustomed to the following layout: "J," "K," "L," "semicolon," "ENTER," although one of the computers I use follows a "J," "K," "L," "semicolon," "quotation mark," "ENTER" format. Both of these are standard typewriter-style layouts. The Commodore 64 uses "J," "K," "L," "colon," "semicolon," "equal sign," "RE-TURN." As a result, the tendency is to hit the equal sign key instead of RETURN.

The good news is that it is fairly easy to learn this unusual layout. By the time I had written two or three programs with the machine, I had slipped into the groove, and rarely hit "=" by mistake. All other keys have logical or unobtrusive placement.

One welcome feature is the addition of four special-function keys. These are marked F1, and so on, and by hitting shift, you can use them to produce a total of eight separate function keys. They are defined as CHR\$(133) through CHR\$(140), and thus they are accessible to any BASIC program. Business users and games enthusiasts will find special applications for these keys. For example, a menu may be designed instructing the operator to hit F1–F8 to invoke particular subroutines. Then, lines such as IF A\$=CHR\$(133) GOTO 100 may be used. An alternative might be ON VAL(A\$)–133 GOSUB 100,200,300,400,500,600,700,800.

A large number of characters are available from the 64 keyboard. The machine powers up in Graphics mode. Typing normally produces the uppercase characters and numbers shown on the keys.

However, each key may also produce one of two graphics characters while in Graphics mode. The easiest way to remember how to print these characters is to look at the pair of keys in the lower left of the keyboard. One of two SHIFT keys is on the right, while a special key, labeled with the Commodore logo, is on the left. Striking the left, Commodore key and then pressing another key produces the graphic character printed on the left side of the keyfront. Pushing the right, SHIFT key in tandem with another key produces the graphic character printed on the right side of the keyfront. Of course, either SHIFT key may be used, but it is easier for a beginner to stick to the one paired with the Commodore key.

The Commodore 64 also has a Text mode. By pressing SHIFT and the Commodore key simultaneously, this mode is invoked. Now the keyboard functions as an ordinary typewriter with upper- and lowercase letters produced by shifted and unshifted keys, respectively. Even so, the graphics on the left sides of the keyfront (those most likely to be used in business applications) are still available by hitting the Commodore key.

That's not all. Any of the characters available may be printed in any of eight colors, normally or reversed, by using a CONTROL key. The Commodore 64 prints its characters in cyan until CTRL plus a color key is pressed. The color keys are the 1 through 9 keys on the top row of the keyboard. CTRL–1 produces black characters, CTRL–2, white, and so on through red, cyan, purple, green, blue, and yellow. REVERSE ON and REVERSE OFF are also summoned through use of the control key. Once one of these has been entered, the display changes to the new parameters for all characters until the next control character is entered.

Commodore 64's PET BASIC does not have any graphics or color commands, such as LINE or FILL. Instead, graphics characters may be incorporated in programs through time-consuming but simple-to-use PRINT statements. For example:

100 PRINT "(RVS ON) (CTRL-3) THESE CHARACTERS WILL BE PRINTED IN THE BACKGROUND COLOR ON RED" 110 PRINT "(RVS OFF) THESE CHARACTERS WILL BE PRINTED IN RED, OVER THE BACKGROUND COLOR."

For the alpha characters, I could have substituted any of the graphics characters, but, of course, I could not reproduce them for the printed page. In fact, the (RVS ON) and (CTRL–3) in the above lines actually appear on the Commodore 64 screen replaced by graphics symbols that denote the function invoked. All screen controls are indicated in this manner. A reverse "Q" means cursor down, whereas a heart indicates clear screen. I found these symbols confusing at first, but I soon learned what they meant. Unless you have a printer with graphics capability, your program listings will be lacking all the information needed.

Despite my initial negative comments, I found the screen dis-

play of the Commodore 64 to be excellent. The unit connects to any color television through a built-in RF modulator. I have tried the Commodore 64 with seven different makes of TV, including several well-used units in motel rooms, and had no trouble getting a sharp image. The one exception was a 10-year-old veteran television that is known to have a dirty tuner mechanism. Fine-tuning the TV and, sometimes, moving the RF modulator around to get rid of a residual moiré effect invariably produced an excellent picture.

On some sets, adjustments had to be made to the color balance to clearly differentiate the eight colors available. Cyan tended to resemble green on a few units, whereas red often looked more brown or orange than red. To avoid constant plugging and unplugging, I have dedicated a 13-inch GE TV to permanent Commodore 64 duty in my office.

The display area on the screen is surrounded by a colored border. Both the border and the screen may be changed to other colors, with 255 combinations available. This may be accomplished by simple POKE statements, either in command mode or from a program.

POKE may also be used to generate sound and noise. Three voices, each with a different three-octave range, are available. The Commodore 64 introductory guide includes programs to simulate some sounds. Some fine-tuning of the television may be necessary to optimize the sound with the picture. A special synthesizer chip is used in the Commodore 64 to allow the user to control the attack/ decay and sustain/release parameters of the sound envelope. Special modulator filters may also be used, producing sound that is as flexible and as sophisticated as that generated by many full-fledged music synthesizers. The need to POKE all these commands does make the Commodore 64's sound needlessly complex. There are a number of utility programs that simplify this task.

Programs are loaded and run from the Datasette cassette recorder. This unit is totally slaved to the CPU, deriving its power and on-off signals from the main unit. At 300 baud, it is a little slow, but I found the capability of using long file names extremely helpful. With Radio Shack cassette files, for example, one may CLOAD or CSAVE a file by single letter name: CLOAD "A," for instance.

The Commodore 64 may be commanded to search for a more detailed file name, LOAD "CHECKBOOK 1984," for example. Or, if the file name is not known for certain, a partial specification may be entered. LOAD CHECK would cause the Commodore 64 to load

CHECKBOOK 1981, CHECKBOOK 1982, or CHECKERS, depending on which it found first. However, the system does tell you what files it has found as it passes through.

Disk drives, such as the Commodore 1541 drive, perform similarly to the cassette recorder, except a lot faster. The cost is low enough to bring this accessory within the reach of nearly every owner.

Two Atari-type joysticks may be "read" from user programs through a simple PEEKing routine described by Commodore in their *Programmer's Reference Guide*.

Although not tested, light pens and game paddles can also be used with the Commodore 64. I see this machine, because of its low cost, becoming a popular games machine—with some serious capabilities as an added attraction.

SOFTWARE

From a software standpoint, the Commodore 64 entered the field from an unusually strong position. All standard PET BASIC programs may be loaded and run, as long as ROM-dependent features (Such as PEEK and POKE) are not used. Commodore provides a PET Emulator program for the Commodore 64 that even takes care of some of the most common PEEKs for many programs.

Programs written for 80-column screens will cause material to wrap around the Commodore 64's 40-character display, but this minor annoyance can usually be fixed by the user.

Those who already know PET BASIC, or even some other Microsoft variation on that theme, will find the transition to the Commodore 64 painless. TRS-80 owners will be hard pressed to note any differences at all—GET\$ in place of INKEY\$, and FRE(X) for PRINT MEM are the two notable examples. Even file handling is very similar to Radio Shack's Disk BASIC. Files may be OPENed and CLOSEd, but the Commodore 64 allows specification of a device number so that the same syntax may be used either for cassette or disk data files.

Because of the common language, the Commodore 64 should prove to be formidable competition to the Radio Shack Color Computer as a second computer for current Model I or Model III owners.

Users of line-oriented program text editors may take several

weeks to become accustomed to the Commodore 64's screen editing. With line editing, the programmer LISTs a section of the program, types in EDIT 20 (or whatever line is to be changed), and then makes changes. The Commodore 64's screen editor works in a very different way.

Any program line that appears on the screen may be edited simply by moving the cursor up to that line, overtyping the next that is there, or making insertions or deletions by hitting an appropriate key. Pressing RETURN makes the changes permanent. One may even renumber a line simply by typing over the line number (the old version of the line remains, and should be deleted, however).

At first, this editing mode caused me a great deal of confusion. I was accustomed to editing a line, hitting ENTER, and then, frequently, typing RUN to see how the altered program worked. If you try that with a screen editor, the cursor may still be on a program line, above the READY prompt, or in some other location that will generate a syntax error instead of the desired RUN. However, after a few weeks of using the screen editor, I adapted quite well, and it became almost second nature to edit a line, zip the cursor down out of the way, and proceed.

It's important not to fall into a chauvinistic trap—both line editing and screen editing have advantages. I was more used to one and found the other annoying. However, now I see that neither is better, only different. I am comfortable with both, just as I no longer trip over the equal sign on my way to RETURN.

Beginners to computing will like the supplied guidebook. The Commodore guidebook is features-specific and helps the new user discover the capabilities of the Commodore 64 rather than serving as a thorough grounding in BASIC programming.

Those who are already familiar with some dialect of BASIC who choose the Commodore 64 will find the introductory guide somewhat frustrating. It is difficult to sort through the elementary material to find the "meat" that will help you make the switch. The guide is not at all detailed as far as helpful programming tricks.

Serious programmers must make the purchase of the Commodore 64 Programmer's Reference Guide their number-one priority. This volume not only contains all the material that is missing from the user's guide, but has a great deal more invaluable data than I ever expected to see. The reference guide is chock-full of techniques with examples—that left me more impressed than ever with the capabilities of the Commodore 64. Consider the elegance of generating special character sets. There is a register in RAM that controls where the Commodore 64 gets its character set information. This location may be changed by hitting the shift Commodore key, or by POKEing to toggle back and forth between two ROM addresses that contain the uppercase/full graphics or uppercase-lowercase/partial graphics characters. These character sets may also be reversed. Because the characters are stored in ROM, it is obviously impossible for the user to change them. However, by POKEing the RAM register that supplies the ROM addresses with a new location in RAM, it is possible to have the Commodore 64 derive all its character information from a user-supplied table instead. Then, when a letter "A" is printed, the screen will display whatever character has been created by the user instead.

Or, most of the existing character set may be copied over from ROM to the RAM table so that most keys still produce their ordinary output while others generate new characters. Each complete character set takes up 2K bytes of memory, but there is still plenty of room left for user programs with an unexpanded Commodore 64.

Also simple to understand is the method for designing characters. Each is built on an 8×8 matrix, so that eight bytes (each containing eight bits) are needed. It's easier to visualize this capability:

	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8
Byte 1	0	0	0	1	1	0	0	0
Byte 2	0	0	1	0	0	1	0	0
Byte 3	0	1	0	0	0	0	1	0
Byte 4	0	1	1	1	1	1	1	0
Byte 5	0	1	0	0	0	0	1	0
Byte 6	0	1	0	0	0	0	1	0
Byte 7	0	1	0	0	0	0	1	0
Byte 8	0	0	0	0	0	0	0	0

The above eight bytes, translated from binary and POKED to the desired location in the user's character set, will produce the uppercase letter A. By placing X's and O's in a similar matrix, users can custom-design their own flying saucers for games, or special language or scientific symbols.

Sprites are another graphic tool available to the programmer, especially those who can handle the machine language necessary to manipulate sprites with decent speed. Just think of sprites as giant characters, designed on a matrix of 24 horizontal dots and 21 verti-

the survey of

cal dots instead of 8×8 . Once designed, they can be moved about the screen like any character, except that each is given a "priority," or three-dimensional level. As a result, one sprite can pass "behind" a sprite with a higher priority, and in front of one with a lower priority. Commodore also has a provision to detect sprite collisions.

Machine-language programmers who don't like rewriting their code to be compatible with every new ROM will appreciate Commodore's dedication to the KERNAL concept. The KERNAL, the Commodore 64's operating system, contains a standardized jump table to the input, output, and memory management routines in the system. Should Commodore introduce new ROMs for the Commodore 64 (as they have done for the PET at intervals), the KERNAL jump table will be changed to match the new ROM locations for routines. Serving as a sort of forwarding address, it will allow programmers to address the ROM through the table, confident that program jumps will end up where they are supposed to, even if the ROM has been changed.

This has been a short introduction to the Commodore 64's capabilities as it comes out of the box. Now it's time to start on the road to expansion.

2 The Road to Expansion

Just look at the miracles mass production and merchandising have wrought. The Commodore 64, at its original list price of \$595, was a bargain. It had a professional-quality keyboard, built-in lowercase and color graphics and other features of computers in much higher price ranges. Now discounted well below \$200, the Commodore 64 still outclasses other offerings in its new, lower-price category.

Although the Commodore 64 is packed with features, accessories from Commodore and other firms can be added to give the computer just about any capability needed. These expansion options make the Commodore 64 more practical as a small business computer, a development system for games and software, or as a learning tool for the serious hobbyist.

Each of the expansion options will be covered in detail in this book. But, to whet your appetite, here is a brief summary of some of what is available. All of these items will be looked at in more detail in later chapters.

MISCELLANEOUS HARDWARE

For many, the VIC 1011A RS232 interface (about \$50) will be purchased first. It allows using any modem with the Commodore 64 to communicate with on-line data base services, such as Compu-

And Antonia State



Figure 2-1 Many graphics characters can be entered directly from the keyboard of the Commodore 64, but for best quality and ease of programming, expansion options like monitors and sprite editors should be considered.

Serve. In addition, a \$30 null modem adapter from Radio Shack lets the user transfer files directly from the Commodore 64 to another computer. Such a setup was used for the programs prepared for another of my Commodore 64 books. After transfer to another computer, the programs were reformatted using a word processing program's powerful text-editing features prior to printing out on a daisy wheel printer.

The RS232, of course, also makes it possible to plug the Commodore 64 directly into a serial printer or any other device using the popular serial interface. I found that other serial interfaces, as well as Centronics-type parallel interfaces, and IEEE-488 interfaces are also available for the Commodore 64.

Those who would prefer a compact, plug-in, direct-connect modem will like the two models sold by Commodore, one for as little as \$70. These include a BASIC terminal program that can be typed in, as well as free sign-ups with CompuServe and The Source.

CARTRIDGE EXPANSION

Expanders extend the expansion port and have several slots so that several ROM cartridges can be used at one time. You may opt for a simple unfused three-slot expander that sells for about \$30. More complex versions are available with six slots, switches to enable or disable the ROM cartridges of the user's choice, and integral power supplies. If you want the convenience of leaving several cartridges plugged in at all times, I'd recommend one of the units with slide or rotary switches.

The multislot adapter is essential for any serious programming. In addition to utility programs in ROM, many applications and games are available in that form for the Commodore 64. Word processing, telecommunications programs, and the popular arcade-style contests are all sold in ROM packs that range in price from \$25 to several hundred dollars.

VIDEO EXPANSION

Some users don't like the 40-column video format of the Commodore 64. Especially for business purposes, many would prefer an 80-column screen. For some applications, such as telecommunications, the conversion can be done in software. However, you present owners who want to add a hardware upgrade can do so. Several firms provide cards that change the Commodore 64 screen width. At least one software program allows viewing word processing output in a very readable 80-column fashion.

First, the good news. The hardware devices are simple to use and work very well. I tried the 80-column setup on several different monitors and was able to get sharp, easy-to-read characters. Even the graphics symbols were well defined. The 80-column mode, as the manufacturer warns, was too fuzzy on a television set, ranging from passable to almost unreadable. A monitor is required for optimum 80-column use. Commodore now offers a good 14-inch monitor for the Commodore 64, while others are available at prices from about \$300 and up.

With the video adapters, the board is plugged into the expansion port (or your expansion card) and its own power supply connected. For proper operation, the monitor or television cord should be plugged into the video pack as well. The 80-column mode is activated by typing a SYS command. The user can do this while the Commodore 64 is in normal video mode, and then unplug the video cord from the keyboard and insert it into the video pack. Or, the cord can be connected to the pack and the proper SYS command typed "blind." Neither is difficult.

There are two problems with the 80-column video expanders.

First, the displays are in black and white. You lose the color capabilities of the Commodore 64. Those wanting to make the change to use the computer for business purposes will probably find this of little importance.

From a beginning standpoint, I found the 80-column mode little help. Program lines can be only 80 characters wide. In complex or tightly packed programs, the 80-character limitation can be a serious one. You can load and run programs containing longer lines, but it is not possible to edit or enter longer lines without receiving a syntax error message.

INPUT/OUTPUT OPTIONS

The Commodore 64's Datasette recorder has proved to be reliable and reasonably fast in the years it has been used by VIC and Commodore owners. Although most owners will verify each cassette SAVE, they will rarely have a bad dump. The only loading problems most will experience can be traced to placing the cassette recorder too close to the color television set or monitor used as a display.

Exatron has been marketing its Stringy Floppy[®] for the TRS-80 Model I/III for several years, and advertised a \$199 version for the Commodore 64. However, the company has recently become a supplier only to other manufacturers, and the equipment may be difficult to find for the Commodore 64. Friends who have the TRS-80 versions tell me that they are somewhere between cassette and disk in both speed and reliability.

At less than \$250, though, the Commodore 1541 disk drive from Commodore is a definite improvement over cassette storage. Programs that took a minute to load can be loaded from disk in a few seconds—and through random access storage. There is no need to go through an entire tape to find one program saved serially.

Unlike diskdrives provided with other computer systems, the Commodore disk units are "intelligent." They contain their own microprocessor and operating system, and take none of the main computer's memory. In other words, it is entirely feasible to use the Commodore disk drive with a Commodore 64 and a program that requires all or most of the 38K available for BASIC. The tested unit performed flawlessly throughout extensive use during the final preparation stages of my Commodore 64 book. My big complaint is the lack of convenient disk commands. A "wedge" program is included that allows abbreviating some commands. The command "/program name", for example, will load a given program. Otherwise, the Commodore 64 makes you type in a *lot* of characters to perform simple commands. With the TRS-80 disk operating systems, a program file may be scratched simply by typing "KILL filename". From disk BASIC, storing an updated version of a file can be achieved by typing SAVE"filename".

With the Commodore 64, it is impossible to SAVE a file if a file by that name already exists on the disk. So, before making the SAVE, it is necessary to KILL the old file first. That's not as easy as you might think. A channel to the disk drive must be OPENed, and the scratch command entered. It's accomplished like this:

OPEN 15,8,15 PRINT#15,"S0:filename"

Whew! The little-known SAVE WITH REPLACE command is neglected with good reason. Under certain conditions it can destroy your program! So, try the "@S0:filename" syntax only at your own risk.

On the other hand, because the Commodore 64 is so device independent, it is simple for the user to route output to disk drives, cassette, the screen, the RS232 port, and so on, just by making changes in the OPEN command, and an appropriate CMD statement. A helpful red light on the front of the Commodore 64 disk drive lets you know when the intelligent peripheral has detected an error.

APPLICATION PROGRAMS

With more than a million sold, the Commodore 64 is an extremely attractive machine to software developers looking for high volumes. Commodore 64 games alone number in the hundreds, and they rival anything sold for dedicated games computers in graphics and playability.

However, serious users are not left behind. The most popular general programs—word processing, telecommunications, and Visi-Calc-like electronic spreadsheet systems—are all well represented in the Commodore 64 kingdom. The three sample programs tested all address the problem of the Commodore 64 screen size as it relates to serious applications.

Another bargain is Terminal-64 from Midwest Micro As-

sociates. This \$29.95 telecommunications program was a pleasure to use, especially because of the smooth scrolling. Lines moved up the screen a dot at a time rather than a line at a time. Instead of the usual jerky movement, the display had a fluid motion that made reading easy.

Midwest Micro provides a cutout function key overlay that shows various commands, such as turning the receive buffer on/off and toggling between full and half duplex. This program will *not* allow uploading of text or programs, or downloading to disk or cassette. However, input can be directed to a printer for permanent record. The program comes with a clearly written manual that explains data communications in general, as well as Terminal-64. My only complaint is that experienced users must read about 20 pages of this material before locating directions on how to load and run the program. A quick look at the index is in order.

When electronic spreadsheets often provide for 255-columnwide entries, how does a software developer account for the meager 40-column display of the Commodore 64? Not with much, I have found. The spreadsheets available for the Commodore 64, such as Practicalc from Computer Software Associates, display only a few columns at a time and scroll laboriously across the screen for the rest.

The \$39.95 Practicalc does not pretend to do everything that VisiCalc does. However, I think that most users will be surprised at how powerful this program is.

The basic features of spreadsheet programs—ability to enter formulas, labels, and perform math functions on combinations of cells—are all provided. Some sophisticated features, such as counting the number of entries in a range of cells or finding the minimum and maximum entry within a range of numbers, are provided. Don't look for all the capabilities found in programs costing four or five times as much, however.

The sheer size of the potential marketplace has encouraged programmers to find innovative ways of getting the most out of the Commodore 64's capabilities. The million-plus users are benefiting from low-cost, useful expansion options.

There are many other expansion options open to Commodore 64 owners. Printers, special joysticks, voice synthesizers, and even a CP/M adapter are promoted for this innovative machine. We'll look at each of the possibilities in succeeding chapters.

screen, as well as certain other devices, as "illogical" when used with certain commands, such as SAVE. However, another command is available in Commodore 64 BASIC, that of "CMD," which will redirect output intended for the screen to another device. Typing CMD4:LIST will cause a program to be listed on the printer instead of the screen, assuming we have OPENed that device first.

That bit of technical explanation helps make our discussion of device number one, the cassette recorder, a bit more clear. The most common recorder used with the Commodore 64 is the Datasette, which is a special unit tailored particularly to the Commodore 64's needs. Many users wonder why they cannot use their own tape machines with the computer instead of shelling out additional money for the Commodore model.

There are some good reasons for using the Datasette. Cassette recorders have, in other computer systems, been one of the most troublesome mass storage mediums available. There are few people involved in microcomputing today who remember when early models had only punched paper tape as permanent storage. Cassette tape followed, but manufacturers were unable to agree upon a standard. Some adopted slow-tape reading and writing systems that were highly dependent on tape quality, recording and playback volume level, and other nit-picking details.

Many users experienced bad tape loads, spoiled programs, and other aggravation from the early systems. The Commodore scheme of things, however, involves using special circuitry that encodes the data in a neat "square" waveform, rather than the more critical, curving "sine" wave used by some other systems. A square wave is either there or it isn't; the pulse is ON or OFF, just like the binary numbers used by the Commodore 64. A sine wave, much like the bell curves used by your teachers for grading, can gradually rise, reach its full peak, and then trail off.

Because of this more accurate recording method, the Commodore 64 and Datasette is not nearly as fussy about tape quality as other computer/recorder combinations. In fact, the system may even work less well when expensive hi-bias tape is used. Any tape that does not have massive blank spaces in it (dropouts) may be used for the Commodore 64.

In addition, the Datasette offers other advantages. It is totally slaved to the Commodore 64, even deriving its power from it. The computer can turn the recorder on and off as required, and you never have to worry about replacing batteries or plugging it into the wall socket. You *do*, however, have to press RECORD and PLAY as required, and rewind or advance the tape as you wish. A special signal line is included that tells the Commodore 64 when a button is pressed, so that it knows you have responded when it asks you to please press RECORD and PLAY. (It does assume that you press the proper key and not some other, though.)

If you were to use some other cassette recorder with the Commodore 64, you would lose all these advantages, unless, of course, the device were hooked up through an adapter that modifies the wave form and enables the Commodore 64 to control the recorder in a similar manner.

Here is a diagram of the cassette unit connector, as seen from the back of the computer:

1 2	3 4 5 6
== == ==	== == == == ==
== == ==	== == == == ==
A B	CDEF

PINS A/1 Ground B/2 +5 volts for electronics circuitry C/3 Motor power D/4 Read signal E/5 Write signal F/6 Sense button pressed

Several sources listed in the appendixes provide adapters to allow hooking up your own cassette recorder to a Commodore 64. These generally cost only \$20 to \$30 less than the recorder itself is sold for and may be a false economy. However, those who want to know all about their expansion horizons should be aware that they are available.

USING THE CASSETTE RECORDER

Here is where our earliest discussion of device numbers comes in handy. As mentioned, it is usually necessary to open a data "channel" to send information from one device to another. This is done with the OPEN command. In the Commodore 64, the SAVE or LOAD commands will serve the same function, that is, OPENing a channel for information to pass from memory to, say, device number 1, the cassette recorder; or to go into memory from that same device.

7 The Cassette Recorder and Other Serial Media Alternatives

Aside from the programs and routines built into its read-only memory (ROM), all of the data your Commodore 64 works with comes from outside sources. Sometimes this information is in the form of programs that the computer will RUN. Other times, the data are files of information that are processed and displayed as program commands. Data can also be entered directly into the Commodore 64's memory through the keyboard.

The flow of information is not one-way. The computer also sends data to the outside world. It may print results on a printer, display them on the screen, or write program or data files to some form of permanent storage, such as a disk drive or a cassette recorder like the Commodore Datasette. All of these components are known to the computer as "devices." You will understand how your Commodore 64 works a lot better if you realize that the computer doesn't really care whether it is sending information to the screen or to a printer. It doesn't notice whether it receives its data from the keyboard or from a tape recorder. The information all looks the same to the computer coming or going. It is only we humans who notice that a printed hard copy is more permanent than a screen display or who care that it is more convenient to load a program from a storage device than to type it in anew every time.

To apply a computer term in a special way, the Commodore 64 and its operating system is "device independent." Many of its com-

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mands for information input and output (I/O, for short) can apply to more than one device, as we choose. As mentioned, the computer doesn't particularly care where the data go.

Each of the devices the computer uses has been assigned a "device number." The keyboard is device number 0; the cassette tape recorder is device number 1; the screen is device number 3; and so forth. A serial printer is assigned device number 4, whereas the first disk drive in a system is usually assigned device number 8.

So, simply by substituting one device number for another, we can direct I/O to where we desire, within limits. For example, to SAVE a program to cassette, we can type:

SAVE"filename",1

If no device number is indicated, the computer assumes we mean device number one, the "default" value. Accordingly, most cassette SAVEs do not include the numeral 1. To SAVE the same program to disk, device number 8, we would type:

SAVE"filename",8

Using a numeral 4 instead would send the file to the printer. Logically, we could even list a program to the screen by SAVE"filename",3, except that the Commodore 64 defines the



Figure 3-1 A cassette interface such as this one will allow using nearly any type of audio cassette recorder with the Commodore 64. (*Photograph courtesy Cardco, Inc.*)

Think of SAVE or LOAD as just another way of OPENing a data channel.

The particular channel we use is given a number of its own. Which number is assigned to the data channel is not particularly important. However, a given channel can only be used to send information to one device at a time. To make the data channels easy to keep track of, it is often convenient to give them the same number as the device we are using. So, to open a cassette data file, we might type:

OPEN 1,1,1,"filename"

The first one is the number of the data channel, or, as it is also called, the "logical file number." The second one is the device number, or the cassette tape. The third one is what is referred to as the "secondary address," which is an instruction to the computer about what to do with the data. In this case, "1" means to write the data.

Let's go over that again. We could just as easily have used:

OPEN 2,1,1,"filename"

This would mean that logical file (or data channel) number 2 was being used with device number 1 to perform task number 1 (write) with the file name within quotes. However, we will follow the convention of using the same logical file number as the device number.

Test yourself. What would this mean?

OPEN 8,8,1,"filename"

If you thought that the command would open data channel number 8 for use by device number 8 for writing to a file called "filename", you were correct. Since device number 8 happens to be the disk, this would prepare a channel for writing information to the disk. But we are getting a little ahead of ourselves.

What about that secondary address number? What other options are available? For tape usage, there are two more. We may specify 0, which signifies reading a file from the tape, or 2, which will open the channel for writing to the tape but place a special "end-oftape" marker at the end of the file. In reading that file, the Commodore 64 will progress no further until the EOT marker is removed.

OPEN just prepares the data channel for us, however. To actually read or write data, we must use PRINT# or INPUT#, with each followed by the logical file number we are using.

As you may have guessed, since SAVE or LOAD are modified forms of the OPEN command (they combine OPEN and PRINT or INPUT in the same statement), the secondary address numbers may be used with them as well. So, it is possible to enter:

SAVE"filename",1,2

This writes the program to device number 1 (the cassette recorder) and places an end-of-tape marker after it. The numbers have a slightly different meaning when loading a program from the tape.

LOAD"filename",1,1 loads the file back into the memory location from which it was SAVEd.

Although this book is not intended as an introduction to BASIC programming for the Commodore 64, you now know enough to write your own programs that will read or write sequential data files to tape. You also should know whether or not you want to use the Commodore Datasette, get an adapter to use your own recorder, or, perhaps, go to a faster, disk system. But before you decide, there is one other mass storage option (at this writing).

MASS STORAGE ALTERNATIVE

The so-called Stringy Floppy, developed by Exatron Corporation, has been promoted as an alternative to either tape or disk. This system uses thin, credit-card-sized wafers containing an endless strip of magnetic media that is transported through the wafer by the Stringy Floppy drive, much like a repeating tape in a telephone answering device, or like an 8-track music tape.

This system has long been used by Radio Shack computers, and is reportedly somewhere between tape and disk in both speed and reliability. A model of the Stringy Floppy for the Commodore 64 and VIC-20 computers was marketed by Exatron shortly before it ceased marketing directly to consumers. At a price of \$200, it was slightly cheaper than a disk drive and considerably more compact.

Because the Stringy Floppy may be back on the market and available for the Commodore 64 again by the time this book is released, I am including this description of it under mass storage alternatives. TRS-80 models had been sold for under \$100, and, if produced at a similar price for the Commodore 64, the unit would be an attractive option for the budget-minded.
Besides cost, a chief advantage of the Stringy Floppy is the compact size of both the drive and the media. A handful of wafers could easily fit in a shirt or blouse pocket, and the drive itself could be packed and carried in a briefcase with plenty of room for other items. The Stringy Floppy comes with its own operating system and commands to access the wafers. The media themselves are furnished in various lengths, storing up to several hundred bytes of information.

The reason for the several lengths is that, like cassette tape, the wafers offer only serial storage. It is necessary to read all the files in between the current location and the one desired. Unlike cassette tapes, however, the Stringy Floppy wafers cannot be rewound. The endless loops operate only in a forward direction. So, if you happen to be at the very end of a file and want to access the beginning, the wafer would have to wind through the entire tape to find the beginning. In such a case, the shorter the wafer the better. Longer wafers are used to store longer programs or data.

Another disadvantage to the Stringy Floppy is the incompatibility with the other media. You can swap programs only with other users of Stringy Floppies, unless you also possess a disk drive or cassette recorder to make an alternate copy for distribution. This is also true for disk or cassette users, but their media are more universally used. A Commodore 64 owner with a cassette recorder who wants to communicate with another Commodore 64 owner with a disk drive needs only to find a friend with the other device, or visit a friendly computer store so equipped. Even at the height of their popularity among TRS-80 owners, Stringy Floppies were relatively few and far between. ,

4 Disk Drives: The Best \$250 You'll Ever Spend

Most users of cassette tape storage are not aware of how subtly the medium colors their use of the computer. Do you, on a whim, decide to load a certain game program and play for a few minutes before dinner? Not if it takes seven minutes to load the program. Or, when writing a program of your own, do you, as good practice dictates, SAVE your work to that point, in case a power outage or lockup erases what is in memory? Gosh, that is a lot of trouble when it might take four minutes to SAVE the program and then another four minutes to VERIFY it just to be sure.

Most cassette users won't bother with programs using data files as well. The time needed to load and use programs or files from cassette is just too long for many applications. Certainly, thousands of Commodore 64 owners are getting along just fine with their Datasettes. However, they may have unconsciously limited themselves to certain types of uses. If you are ready to move on to more sophisticated, convenient applications for your computer, consider the Commodore 1541 disk drive.

Those not familiar with other computer lines may not realize just how cost-effective the 1541 drive is. At current discount prices, a Commodore 64 AND drive can be purchased for less than \$500. Many computer systems (notably IBM) charge that much for the disk drive alone. Some require a \$200 to \$300 expansion box before a disk drive can be added. It is the rare home computer that can be bought with a disk drive for less than \$1000.



Figure 4-1 The disk drive is plugged into the DIN socket shown (center). Additional disk drives can be daisy-chained using similar sockets on the back of the Commodore 1541 disk drives themselves.



Figure 4-2 The Commodore 1541 disk drive.

Succumbing to a hackneyed comparison, a floppy diskette is something like a 45-rpm record, except that it has no grooves, is very thin and limp, and is always kept inside a square protective plastic jacket. There are several holes in the jacket. A long, oblong hole with rounded ends allows the "read/write" head of the drive to access the magnetic media coating (much like recording tape) inside. A smaller, round hole permits a photocell to "see" an index hole punched in media as it revolves. Finally, a "write enable" notch is punched on one edge of the disk. The drive senses this notch and if it is absent or covered by a write-protect tape will not permit writing to that disk.

When you place this disk in a drive and close the door, a drive "hub" clamps down on the center ring, and the motor rotates it at about 300 revolutions per minute. The disk drive's read/write head, which is similar to the record/play head on a tape recorder, is moved by a stepper motor from one "track" to another on the disk, much like an automatic record player. Because the disk drive can go directly from one track to another, unlike a cassette tape drive, which must read from one end of the tape to the other, access to a specific program or data is much faster.

You load a program by typing LOAD"filename".8 (with the 8 signifying the device number of the disk drive; the cassette is device number 1 and a default, so it does not have to be entered). The drive will check the disk directory, located on track 18, sector 1, for a list of the addresses of all the programs on the disk. Then it will go to where your specified program resides (if it is indeed on that disk) and read it into memory. If a program is in the middle of a cassette tape, you may have to spend several minutes or longer fastforwarding, skipping programs you do not want. The load itself can take minutes more. With a disk drive, the entire process can be completed in a few seconds. The drive also keeps track of a block availability map (BAM), which determines which blocks of space on the disk are in use and which are free to accept data. The drive checks the BAM each time you SAVE a program to the disk in order to place your program or data only on free space not occupied by other information.

Rarely, the BAM or directory will become fouled up, and a program will be made inaccessible. You can guard against this eventuality by making backup copies of your disks whenever possible. It is also a good idea not to WRITE to original program disks, especially those that cannot be backed up.

You can probably win yourself a few dollars with the following bet: How many grooves are there on an LP record? Most people will guess several hundred. However, if you think about it, you will realize that an LP actually has just *one* groove, a very long one that extends from the outer edge to the inner band. This is another area where the floppy diskette differs from the 45-rpm record with which it is often compared. The 35 tracks on the Commodore disk are truly concentric and separate from one another. Each is divided into sectors that hold 256 bytes of information. Unlike most singledensity disks, which are limited to about 100,000 bytes of information, the Commodore disk does not have the same number of sectors in each track. The larger, outside tracks have more sectors than the smaller, inside tracks. The actual number ranges from 17 to 21 sectors per track, leaving a total of 664 "blocks" of data free for storage, after subtracting some sectors required by the system for housekeeping.

As a result of this storage system, Commodore is able to get 170,000 bytes of data on a single-density diskette. This compares favorably with the capacity of 40-track, double-density diskettes of other systems, which require tighter tolerances in both equipment and media.

This economy (plus the economies of scale) allows Commodore to provide an intelligent disk drive for half the cost of many other nonintelligent drives.

By "intelligent," we mean that the 1541 drive has its own 6502 microprocessor, 2K of RAM, and an 8K ROM that has a built-in disk operating system. This "DOS" controls all the functions of the disk drive, manages allocation of space on the disk, and checks for errors. Because the drive is intelligent, the Commodore 64 does not have to concern itself with many of the details of input/output.

You simply type in various commands from your keyboard. LOAD"filename",8 will load a program file of your choice. LOAD"filename",8,1, will load the program back into the memory locations from which it was originally SAVEd (useful for machine language code). The disk directory can also be loaded as if it were a BASIC program by typing LOAD"\$",8. You may then LIST it to see what programs are on a given disk.

There is also an "error channel" to your disk drive. When the red light on the front flashes following a disk access, an error has occurred. You may "open" this channel by typing OPEN15,8,15, and then read the status of the errors by entering IN-PUT#15,A\$,B\$,C\$,D\$. If you PRINT each of these variables, their values will then tell you the error number and error name, and the track and block in which the error occurred.

This channel is also used to send various commands to the disk drive. After typing open15,8,15, you may enter PRINT#15,"N0:DISKNAME,ID", which will format a new, blank diskette. You should substitute a name of your choice for DISK-NAME and a number or other two-character code for ID. Each of your disks should have a separate ID to avoid problems when swapping disks in and out of the drive. The drive uses the ID number to tell that a different disk has been placed in it.

You may also type PRINT#15, "S0:FILENAME1, FILE-NAME2, FILENAME3" to erase or scratch files from a disk that you no longer want. In addition, the command PRINT#15, "V" will validate a disk (check the BAM and consolidate blocks). Two other commands, COPY and RENAME, are available, but they should be used with caution.

Three types of data files can be used with the Commodore 1541 disk drive: sequential, random access, and relative. Sequential files are very much like tape data files in that all the information must be read into memory serially. The entire file must be in memory and written back to the disk to change even one entry. Sequential files are easy to understand and use, however, even if they are slower than other forms of data files.

Random access and relative files are actually two forms of the same type of disk access. Each allows GETing any record on the disk. Relative files are more convenient for data because they allow you to structure files into records and fields. All data files are worth an entire chapter of their own and will not be covered in detail in this book.

The disk drives used on older PETs, such as the PET 2001, interfaced with the IEEE-488 bus of those computers. When a parallel bus is used, all eight bits of a byte can be transmitted at once, very quickly. The Commodore 64 uses a modified bus that uses only two wires instead of eight, in a "serial" configuration. The byte must be transmitted one bit at a time. While slower, this system was simpler for Commodore to design. It also permits "daisy-chaining" up to five disk drives and one printer on the same interface. Each simply needs to be given a different device number (for example, the second disk drive is configured as device number 9, not 8). There are two ports on the back of the 1541 disk drive: one to connect to your Commodore 64, the second to plug in a second disk drive.

Why would you want more than one disk drive? It is a simple fact of life that once we finally achieve our heart's desire—a first disk drive or a daisy wheel printer—the glow wears off in a few days, and we begin lusting after our *new* heart's desire.

This is usually the case with disk drives. One is never enough. Two are better, three are perfect, and four are more perfect yet.

However, there are some genuine reasons why having more than one disk drive is desirable for the average Commodore 64 user. In fact, if you haven't guessed by now, I'm about to tell you what they are.

To someone who has used nothing but cassette data and program storage, it sometimes seems incomprehensible why more than one disk drive would be necessary. After all, cutting 10-minute waits to load data files down to a few seconds is worth that \$200 to \$300 initial investment to many. However, it would seem that additional drives do nothing more than eliminate the minor inconvenience of making a few disk swaps. Why lay out \$250 or more for a second drive merely to save a few seconds?

The question is not quite that simple. Although much has been written about the pros and cons of upgrading from cassette to disk, there has been a great deal less comment on the advantages and disadvantages of multiple drives. However, the real utility of disk expansion doesn't hit home until you've tried it. Here are some comparisons, caveats, and advice to help you in making your own decision.

With a single drive, most owners will avoid swapping disks as much as possible despite their best intentions. That can lead to some dangerous situations. For example, have you spent several hours developing or modifying a program only to lose all that work to a bad directory or BAM? Most of us are smart enough to periodically SAVE a program we are coding, but how often would you remove your disk, insert another, and SAVE the program again to guard against disk crashes? Perhaps not frequently enough.

Those with two drives can stash disks in each and SAVE the program twice as frequently as necessary. With three, the process is even easier because two blank data disks can be used, and the first disk drive (full of utilities, no doubt) can be left untouched.

Hint: Add this program line to the very end of every program you have under development:

30000 SAVE "THISPROG",8:SAVE "THISPROG",9

Then, you simply type GOTO 30000 anytime you want to store the latest version to disk. Like to keep multiple versions? Use these lines instead:

30000 INPUT "VERSION NUMBER FOR THIS SAVE :";VN\$ 30010 F\$="THISPROG"+VN\$+",8" 30020 SAVE F\$

Also, added security comes from being able to have backup drives to use when one goes down. Those with two drives have to return to "primitive" single-drive status during repairs. An owner with only one may be out of operation entirely!

I do a great deal of writing with my Commodore 64. I've found

that I can work a great deal more efficiently with three drives and could do even better with four, because I can keep many more tools available for instant access. For example, in addition to my wordprocessing program, I can keep a word counter program and other writing-type utilities on disks mounted and ready to go at any time. Various text files, standard documents and formats, and other material that I might want to chain into my files can be stored as well. That still leaves my second drive for swapping data disks in and out as I work on various specific projects. Once I have set up for word processing at the beginning of a day, I can work straight through without hunting for a specific utility program or file.

With four drives, my work would be even easier. The fourth drive could hold the current, partially filled "archival storage" disk. Once I had finished with a text file, printed it out, and was ready to relegate the article to semipermanent storage, I could send it over to drive 4 and then go to work on the next.

In summary, what are the advantages of owning more than one disk drive? Surely not all computerists are well-heeled enough to afford the extra money just to avoid making a few disk swaps. The real gains, as I see them, include these:

1. Much larger data bases can be kept "on-line" at one time. Large mailing lists, inventory control information, and accounts payable or receivable can be divided into segments small enough to be handled comfortably by available memory and manipulated at will without the need for the operator to remove or insert a great many disks. Huge spelling-checker dictionary files can be kept available, too. Although the size of these data bases must be picayune by mini- or mainframe computer user standards, a respectably sized small business could get a great deal done even with a four-drive, singledensity configuration. Note that I specified business. Individuals should have even less demanding requirements of their computer data bases (how large can a Christmas card list be?). The decision between single and multiple drives should be made on the basis of expected data base size.

2. On a more personal level, the increased data storage available makes it more practical to include a large number of games or personal programs on a single data disk. Game-playing with friends becomes more relaxed and fun, and less time is spent hunting for the right disk.

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3. Program management becomes less of a chore when the user can quickly and conveniently swap programs from disk to disk without many disk exchanges.

4. Given the warnings about putting all one's eggs in a single data diskette basket, having two (or more) drives provides the user with very valuable hardware backup. In addition, if one drive goes awry, the second can serve as a control check. A problem that occurs in both drives can be traced to a faulty connecting cord or some other source. Nontechnically oriented single-drive users must puzzle out whether media, drives, software, or the computer are ailing every time an unfamiliar error message pops up on the CRT.

There are other pros and cons to owning several disk drives, but the best indication I've found is the obvious reluctance of any multiple-drive owner to return to single-disk operation. Once you've had more than one, one will never be enough again.

5 Modems: Your Outside Connection

Once a somewhat esoteric computer term, "modem" is rapidly entering the lexicon alongside other microcomputer jargon. A modem (short for modulator-demodulator) is a device that can turn your Commodore 64 from a powerful stand-alone machine into a much more effective business and personal tool by adding communications capability.

A computer without communications can use only the software in its memory or external data storage devices. The only data it can draw from to operate programs and update files are those data entered at its keyboard or provided from external storage devices. In short, the universe of such a computer is sharply limited.

With communications, on the other hand, even the simplest desktop microcomputer becomes a window on a veritable treasure trove of data and programming. Remote data bases, such as CompuServe and The Source, can bring stock quotations, news, and other important business intelligence to the manager in seconds. Some 1200 information providers are available for on-line access.

Communications allows time-sharing. A Commodore 64 can take on the attributes and power of a huge mainframe by the simple expedient of connecting over telephone lines. Programming that is not available for the micro or would be impractical to implement or buy can be operated. Computers that are incompatible because of language or operating system differences can still communicate quite easily.

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Through telephone communications, a microcomputer can become an electronic mail link that can keep one office in touch with other offices of the company in remote locations, or with customers and suppliers. Order entry, inventory control, and other functions can take place over great distances.

A modem is a peripheral device for your Commodore 64 that opens the doors of telecommunications to you. It is a device that receives information from your computer, similar to when you send data to your printer, a disk drive, or a cassette recorder. The modem translates this information into a signal that can be transmitted over telephone lines. It is also capable of receiving sounds over the phone lines and transforming them back into a signal that can be understood by your computer.

In other words, a modem is a sort of translating device that converts computer "language" into telephone "language" so that one computer can talk to another using telephone lines that were originally designed for voice communication. It does this by converting the computer signals to audio tones in a range that can be easily handled by phone systems.

Like your disk drive on many printers, the data is handled in "serial" fashion; that is, each bit is sent out sequentially. A slightly more technical explanation (for those of you into such things) is that the modem takes the series digital data from your Commodore 64 computer and translates (modulates) it into a signal that can be transmitted over telephone lines. It produces a continuous frequency (a carrier) that is impressed upon with a second, information-carrying, modulated signal. A modem is also capable of



Figure 5-1 The Bell 212A modem is compatible with both 300 and 1200 baud transmission, and features auto-answer capability.

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Figure 5-2 Microperipheral Corporation makes a number of modems, including this sophisticated model designed to interface directly with the Commodore 64 computer. (*Photograph courtesy Microperipheral Corporation*)

demodulating, that is, taking signals received from another computer and translating them back into serial digital information. This is why the device is called a modem (modulator/demodulator).

For most users, this is all the technical information that is of interest. The nuts and bolts of frequency shift keying (FSK) and other details matter much less than the questions, "How do I use a modem? What features should I look for?"

As a Commodore 64 owner, you have two broad modem choices. You can purchase the low-cost VICMODEM or the recently introduced, more sophisticated version from Commodore. Both plug directly into the user port at the left side of the keyboard. Or, you can get an RS232 adapter (\$30 to \$40 at this writing) for that same slot and use nearly any other modem compatible with the serial port.

Since the Commodore RS232 adapter costs nearly as much as the VICMODEM, why would you want to buy it *and* another modem? If you already own a modem, say, for another computer, buying only the RS232 might be the most cost-effective choice. The serial adapter could also come in handy if you want to hardwire your Commodore 64 directly to another computer through a null modem adapter. Or, you could use the RS232 to drive voice synthesizers, serial printers, or other accessories that use that port.

Using a modem is generally no more involved than connecting the device to the computer's port with cables provided, plugging the modem into a power source, and connecting it to the phone system. This interface with the telephone lines can be done in one of several ways. Until recently, the most common method for connecting a microcomputer to the phone lines was the acoustic coupler. With



Figure 5-3 A DB-25 connector cord (left) can be used with nearly any modem. The null modem adapter (right) is used to connect two computers together through their RS232 ports with no modems required.

this, the modem has its own miniature speaker and microphone. The telephone handset is pressed into a pair of soft rubber cups surrounding this pair of devices, and the modem's speaker "talks" to the mouthpiece of the telephone handset while the modem's microphone "listens" to the mouthpiece.

Extraneous noises can interfere with communications, but acoustically coupled modems can be used with any standard handset. Travelers don't have to be concerned about finding a telephone with a modular or other removable jack. Odd or decorator phones with unusual shapes may not work at all, however.

The chart accompanying this chapter lists one induction coupled modem, which looks similar to an acoustic modem, but avoids the inelegance of turning electronic signals into sound and then back into electronic signals by using inductance to convey the information. The problem with odd-shaped phones still applies, however.

Prices have dropped drastically on direct-connect modems in recent months. Now these units can be less costly than the acoustic couplers that formerly enjoyed a price advantage. In fact, the very lowest cost modems listed, retailing for less than \$100 (such as the VICMODEM) are all-electronic, direct-connect units. As a result of this pricing flip-flop, few new acoustic modems are introduced, and our chart shows only a handful available.

Direct-connect modems like the VICMODEM, as the name implies, are plugged into the phone system, just as if they were a telephone or answering machine. In fact, you may have to purchase a double jack, such as those sold with answering devices, to allow plugging more than one device into a single wall jack. This type of modem is slightly less portable, but only because a compatible jack must be found. Many of these units have a voice/data selection switch so that the telephone can be used for voice communication before or after data transmissions without having to unplug or disconnect the modem.

Another change is overtaking the microcomputer industry in the form of baud rates for reasonably priced modems. The "baud rate" is the speed at which the modem is capable of communicating. Higher baud rates allow quicker communication, reducing the amount of time the computer operator must spend at the task. This can be important when long files must be transmitted or when the user is connected to an information service that charges by the minute. Today the most common baud rate used by personal computers like the Commodore 64 is 300 baud, although 1200 baud is becoming more popular because it allows communicating at a speed four times faster.

Baud is roughly equivalent to bits-per-second, until 1200 baud is reached. However, until recently, 300 baud (about 30 characters per second) was the virtual standard for microcomputer communications. The much more efficient (especially when long-distance charges or connect time is accruing) 1200-baud communication was reserved for high-end users.

Although some microcomputers have difficulty handling 1200-baud telephone communications, this is a rarity. It was the high cost of 1200-baud modems that limited their application. Now, units in the \$400 to \$600 price range are making the 1200-baud option more attractive. It doesn't take too many months' use to pay for the price differential when communications take place over long-distance lines.

Most modems sold will be compatible with one or more Bell System standards. These communication standards provide an indication that the modem can communicate with other compatible equipment. The most common standards are the Bell 103 and 212A, which are the 300-baud and 300- and 1200-baud devices that can communicate both ways simultaneously.

There are also other, frequently less expensive modems with different communications standards, which generally allow them to communicate in only one direction at a time, such as the 202 (1200 baud) and 113 A and B.

Most of the units sold today can communicate at either full or half duplex. Full duplex can have two meanings. it indicates simultaneous, two-way communication, and also can refer to a method for checking data transmission accuracy by echoing received data back to the sending computer for a comparison with the original data. Similarly, half duplex can mean communicating in only one direction at a time, as well as nonechoed data communications.

Auto-answer provides extra flexibility by enabling the computer to answer the phone by itself. Given the correct software, this makes it possible for unattended data transmissions and receptions to take place. One common application for auto-answer modems is for electronic mail, where one central computer collects incoming messages without the need for an operator. Electronic bulletin board systems also use this capability. You should be aware that if a normal voice call comes in while the auto-answer modem is in attendance, it may be difficult to intercept the call before the computer gives your caller an unpleasant aural surprise.

Auto-originate lets the computer dial its own calls. With this feature and a direct-connect modem, it is possible to establish data communications without even touching the telephone itself. Autooriginate must be supported by software that will handle the actual input of numbers and dialing, and the modem itself should accommodate either rotary dialing (pulse) or touch-tone dialing (some will do both) to be compatible with your phone system.

Two other features are noted on our chart. Many of the modems listed can perform a short self-test to see that all the cables have been hooked properly and are making contact. This feature is listed. A carrier-detect signal of some sort is also useful to indicate when the carrier of another computer is detected (e.g., you are in touch and ready to communicate). With some direct-connect, autooriginate modems, the carrier-detect signal may be the only way for the user, without picking up the phone and listening, to know that he or she has, in fact, reached another computer and not an irate wrong number. A few, such as the Hayes Smartmodem, have built-in speakers that allow the user to listen to what is happening on the phone line.

To use a modem, you also need a software program that tells the computer to watch for incoming characters over its RS232 line and to send out the information you type at the keyboard. This program is called, variously, a "terminal" program, or "executive," or "communications" software.

It is not the purpose of this chapter to compare software terminal programs for modems. However, a purchaser should be aware that the terminal software can have a great deal of effect on how many of the modem's features can be implemented. Some software does not support 1200-baud communications. Other packages do not allow for auto-dialing. A special "host" program will usually be necessary to allow you to access your computer from a remote location even with an auto-answer modem installed. It is useful to have a program that will allow uploading and downloading of files. Uploading is the ability to take a file (either a program or text) from your disk and send it out to another computer. Downloading enables you to receive such a file and store it on your own disk. These capabilities mean that files can be prepared ahead of time, off-line, and sent out very quickly. Otherwise, your Commodore 64 is limited to transmitting only what you are able to type at the keyboard and to keeping that information available only as long as it appears on the screen.

There are a number of terminal programs that work well with the Commodore 64. We tested Superterm-64 from Midwest Micro and VIDTEX from CompuServe. Both have the valuable capabilities of uploading and downloading programs and files, and have many nice features. Both programs redefine your special function keys to streamline the commands used most often.

THE VICMODEM CLOSE UP

Because of its low cost and guaranteed compatibility with the Commodore 64, the VICMODEM is worth a closer look. The device is simplicity itself to use. Just plug it into the user port and load your communications/terminal software program. Place a call to the computer or communications service you want to "talk" to, plug the phone into the VICMODEM, and you are set.

However, the VICMODEM will not work with one of those fancy telephones with the dialer built into the handset. Nor will it work with an older, nonmodular phone. You must have a phone with a detachable, modular handset. If all the modern phones confuse you with their fancy terminology, the handset is the earphone/mouthpiece that you hold to your head when talking on the phone conventionally. The more recent models use two modular cords. One modular cord goes from the telephone base to your wall phone socket. The second connects the phone base with the handset. It is this second plug that you must disconnect.

To use the VICMODEM, dial your call and listen at the hand-

set for the ringing tone. You can also dial with the VICMODEM connected to the phone, as the indicator light will show when a carrier tone is sensed. However, beginners will want to try the safe method, which allows them to hear busy signals and so on. If you are fast at working with modular plugs, you may want to wait for the modem at the other end to answer and provide you with a carrier tone. This will guard against wrong numbers and other errors.

When you hear the high-pitched tone at the other end and are ready to connect the Commodore 64 with the VICMODEM, unplug the modular cord at the handset. This will leave you holding a loose, unconnected handset (lay it down), and a naked modular plug. Plug this connector into the VICMODEM. Usually, you will leave the switch on the side of the VICMODEM set to originate because you are placing the call. If someone phones you, you may want to switch to Answer. (Actually, either party can be Originate or Answer. It makes no difference as long as both have not used the *same* setting.)

Commodore and others have introduced more advanced (and more costly) modems that connect directly to the Commodore 64, but which have additional features (such as auto-answer). With the background supplied here, you should be equipped to evaluate any of these offerings and decide for yourself exactly which product to buy.

Now that you are connected, you may communicate with the other computer. Some of the opportunity-expanding aspects of telecommunications will be explored in more detail in the next chapter.

6. Telecommunications Part One: Bulletin Boards

Some of the opportunities to expand your Commodore 64 are only indirectly related to your own hardware and software. One example is in the area of telecommunications. Equipping your computer with a modem, terminal software, and a telephone line is something like going from the 1st floor to the 80th floor of a large office building. Everything looks the same until you glance out the window and notice that your horizons are very much farther away. A modem is only your window on the outside world. The universe that you explore through that portal is a large one, indeed.

One exciting facet of telecommunications that you will want to discover is that of the bulletin board system, or BBS. These are microcomputers, like your own, which have been set up with automatic-answer modems and special "host" software that allows them to receive your calls, ply you with messages and menus, and perform other functions—all without the attention of the system operator (or Sysop).

A BBS is generally set up for public use by a variety of amateur computer users. Sometimes a board will be frequented only by owners of a certain brand of computer. There are some Commodore-specific bulletin boards scattered throughout the United States. More frequently, a bulletin board will be aligned geographically; that is, all the interested users in a given city or county will call a certain bulletin board or group of boards regardless of what brand of computer they own. Commodore owners can leave

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Figure 6-1 The VIC-1011A serial interface adapter can be used with printers as well as with other peripherals, such as modems. It plugs into the port at the back left of the Commodore 64.

messages for other Commodore owners, but will also have friendships with users of other computers as well.

There are also bulletin boards dedicated to certain activities, both computer- and noncomputer-related. For example, ham radio operators and photographers operate special BBS. Many boards are dedicated to the subject of sex and serve as a sort of dating service. Others serve as manufacturer support for products—users contact the board with questions or problems they have. Some businesses use their bulletin boards as electronic mail order catalogs that buyers can contact with orders for merchandise.

How do you find bulletin board systems to access? Any local computer store should be able to provide you with some telephone numbers or put you in contact with one of your local computer user groups. You will usually need just one phone number to start. Most BBS have a section listing the phone numbers of other systems in the area. Many will include hundreds of numbers for BBS all around the country.

To access the board, simply phone the number. When you hear a carrier tone, activate your terminal software and modem in the usual manner. You may have hit one or two carriage returns so the other system can sense your baud rate. You will usually be asked your first and last name, and the city you are calling from. On your first call, most systems will ask a few questions about your type of terminal: screen width, whether or not you can receive lower case, need for line feeds, and so on.

Depending on the system, this might be all you need to gain access to the board. Others may ask for a password, which will grant

you passage to the inner board. Don't be alarmed if your access is limited on the first call. Many boards have so-called "privilege" levels that must be set by the Sysop for new users. This is done to screen out crank callers. Your privilege level may be revoked if you cause problems, leave obscene messages, or otherwise make a nuisance of yourself.

The board may ask you to leave a password that will be used to log you on in the future. The password may let you bypass the lengthy log-on procedure, and it also provides security. No one else can masquerade as you on that BBS unless they have your password. A password will usually be one to eight characters. You should choose one that is not too obvious; your middle name, your mother's maiden name, or the name of one of your children is *not* a good choice. Ideally, a password will be nonsense characters with some nonalpha characters included, such as R1&GOT. Such a string may be difficult to remember, however. At the very least, choose the name of a favorite character from literature or some other noncomputer term.

Once you have gained favored status, you might find yourself checking in with a BBS daily. Almost all boards are menu-operated, providing you with a list of commands and descriptions of those commands for every section. Once you become familiar with the operation of the board, you may be able to set an Expert user mode that will provide you only with a command line and ask for your choice. Even if you opt for that format, pressing RETURN or typing HELP will usually give you a listing of the commands you have forgotten.

A typical board will have a number of sections. The most popular will be the message board, which is used to post public (or private) messages for users. You may see messages like the following:

#2021 FROM: S. HOLLERITH TO: ALL SUBJECT: COMPUTER FOR SALE DATE: 08/03

I HAVE GOTTEN A NEW COMMODORE 64, AND WOULD LIKE TO SELL MY VIC-20. INCLUDES 16K MEMORY EXPANDER, PROGRAMMER'S AID CARTRIDGE, AND MUCH SOFTWARE. \$150.00 FIRM. LEAVE A MESSAGE 44 TELECOMMUNICATIONS—PART ONE: BULLETIN BOARDS ON THIS BOARD.

#2022

FROM: G. SMITH TO: RANDY SUBJECT: REPLY TO MSG. #1842 DATE: 08/03

I'LL BE GLAD TO DEMONSTRATE WORDPRO 3 FOR YOU. WHEN WOULD YOU LIKE ME TO COME OVER? GET YOUR PRINTER READY, AND LEAVE ME A MESSAGE. OR CALL -- I'M IN THE BOOK

#2023

THIS MESSAGE IS PRIVATE

#2024

FROM: BILL H. TO: SYSOP SUBJECT: HELP! DATE: 08/04

I CAN'T SEEM TO DOWNLOAD "MAZE" FROM THE PROGRAM SECTION OF THE BOARD. IS IT WORKING PROPERLY? OR HAVE I DONE SOMETHING WRONG?

Messages on most boards will be even more varied than this. They can even be sent privately, in case sensitive information is being surveyed (e.g., "JOE, YOU *STILL* OWE ME \$20!!). It's fun just to scroll through the notes to see what other users are talking about. A good BBS will also have a scanning feature that allows you to see just the headers of the messages if you are pressed for time. Some will let you "mark" those you find interesting and then read only marked messages. A bulletin board will usually tell you when you log on that you have messages waiting and have some provision for showing you when your own messages have been read. Often, a feature is included that shows how many times a public message has been read.

A "download" and "upload" section is added to many boards. There, public domain programs or software written by the users may be offered for downloading to your computer for free. You may also dump your own programs into the system. Sometimes, a small fee is charged for access to these sections. You will find many useful programs in these departments. Many will be in "plain vanilla" BASIC that is applicable to many computers; that is, there will be no clear screen or cursor movement commands, nor any use of your computer's color graphics. Only the common BASIC statements shared by many computers will be used. Other boards frequented by Commodore users will have programs specific to your machine. It is possible to list many Commodore programs strictly using ordinary ASCII characters. This is done by substituting the proper CHR\$ code for the special screen character used in the Commodore 64. For example, instead of using the heart symbol that clears the Commodore screen, the programmer can list CHR\$(147) instead, which accomplishes the same thing.

Another common feature of BBS is a merchandise section. The operator of the board may be a commercial enterprise or a hobbyist out to make a few bucks on the side. You will find a menu of products, along with descriptions, that you can order. Credit cards are usually needed for this feature, although some Sysops will ship COD.

Many boards have an on-line "arcade" section of games that you can play while connected to the system. You may be limited in the amount of time you can spend with these. In any case, BBS courtesy calls for limiting your time on the system. Other users may be waiting, and only one caller at a time can be served. By all means, do not leave your computer connected while you go have dinner. Some systems will disconnect you after a certain period of inactivity or after your Sysop-specified time limit is up. Others will let you monopolize the system for as long as you want.

One final common feature of BBS is the CHAT mode. You can sometimes summon the Sysop (or the Sysop can break in if he or she

recognizes you) for a real-time talk through your keyboards. These can be handy for a quick question or two, but they verge on the ridiculous for lengthy conversations. Since most BBS callers are local, the slow CHAT typing exchange could be replaced by a few seconds of voice communication in most cases. Yet I have seen many BBS users happily typing away to someone who was only a local phone call on the other side of town.

In the next chapter, we will look at the "super" belletin board systems—on-line information utilities like CompuServe and The Source. These systems allow many users to access their boards at once, plus they have huge data bases and other services that will greatly expand your Commodore 64's horizons.

7. Telecommunications Part Two: The Information Utilities

You wouldn't be too far wrong if you thought of information utilities like CompuServe[®] or The Source[®] as huge, multiuser bulletin board systems. Access to them is accomplished in a very similar manner. You may, in fact, leave messages for specific individuals or post broadsides for all to read. But there is much, much more to them. The communications aspect alone is mind-boggling. You may send messages to thousands of other Commodore 64 users, through special interest groups set up on CompuServe, for example. Or, you can contact those with similar interests through many Source programs, as well.

You may also gain the power of a larger, mainframe computer by linking up to an information service. Run programs on the utility's computers. Access encyclopedias, newswires, travel agencies. Talk directly to Commodore. The possibilities are endless. Appendix A is a listing of the various services recently available through one information service, CompuServe, alone.

CompuServe and The Source are accessed similarly. You may call a local value-added telecommunications network, such as Telenet or Tymnet, log on to that system, and then be switched through a computer link to one of The Source or CompuServe's host computers. In hundreds of cities throughout the United States, calling either service through Telenet or Tymnet is a local call. In addition, CompuServe has its own nodes in about 300 cities in the United States. These should provide local calling service for many more. At this writing, the charge to call CompuServe is \$6.25 per hour between the hours of 6 P.M. and 6 A.M. (the so-called "standard connect time." Calling during "prime time" will cost you \$12.25 an hour. There is a \$2 an hour surcharge if Tymnet or Telenet are used. The Source does not charge extra for the outside networks (it does not have nodes of its own, in any case), but costs \$7.75 an hour during nonprime hours. The tariff goes up to \$20.50 an hour during the regular business day. Charges for both CompuServe and The Source are calculated by your own local time, and may be increased by the services (or decreased) in the future.

You log into the system by typing an ID number and password. Your billing starts then and is figured in increments of a minute. Each system has its own advantages and disadvantages. The Source has a nice command, ONLINE, which can be used to display the ID numbers of all the users currently logged in. You may check to see if your friends are available, and "chat" them up by typing CHAT and their ID number. Any user may refuse to chat back or may type REFUSE CHAT to filter out all further chat requests completely.

The Source also has the more sophisticated electronic mail system. Missives sent "express" are transmitted instantly. If a user is on-line, he or she will be notified at that moment that a message is waiting. Electronic mail may be password-encoded so that several users of an ID can keep their mail separate and private. You may also set up sophisticated "mailing list files" and send a message to any or all the people on a mailing list with a single string of commands.

While indexes and menus are available in The Source, the utility is more command oriented. Once you know what you are doing, you may enter long strings of commands to accomplish a series of tasks.

CompuServe (CIS) on the other hand, is an endless series of menu layers. You may still go directly to one area by typing GO xxx, where xxx is the page number of the area you wish to access. CIS's electronic mail is not nearly as sophisticated as The Source's. Messages may take several hours to arrive and are limited in length. No built-in mailing list facilities are provided, and passwords cannot be included.

However, CIS does shine in the area of on-line communications. You may talk directly with one user by visiting one of the special interest groups (SIG) and using their Conference mode's "talk" facility. However, very large groups can also congregate in a SIG, and all chat among themselves. A more comprehensive description of this CB-like facility appears later in this chapter.

The following is a typical log-on session and a few of the menus available through CompuServe:

please type your terminal identifier: A -3111-005please log in: CIS02 remote: WELCOME TO COMPUSERVE 1134 User ID: 75725,1156 Password: PASSWORD Job 34 on CompuServe Information Service at 12:52 EDT 8-Mar-84 on T06QAK COMPUSERVE INFORMATION SERVICE 12:52 EDT SATURDAY 08-MAR-83 COMPUSERVE PAGE CIS-1 COMPUSERVE INFORMATION SERVICE 1 HOME SERVICES 2 BUSINESS & FINANCIAL 3 PERSONAL COMPUTING **4** SERVICES FOR PROFESSIONALS 5 USER INFORMATION 6 INDEX ENTER YOUR SELECTION NUMBER, OR H FOR MORE INFORMATION. 15 COMPUSERVE PAGE CIS-4 USER INFORMATION 1 WHAT'S NEW 2 COMMAND SUMMARY & USAGE TIPS 3 FEEDBACK, MANUALS, PRODUCTS

4 CHANGING TERMINAL DEFAULTS 5 CHANGING YOUR PASSWORD

- 6 REVIEWING YOUR CHARGES
- 7 CHANGING CREDIT CARD INFO
- 8 TELEPHONE ACCESS NUMBERS
- 9 CURRENT RATES
- 10 COMPUSERVE VIEWPOINT
- 11 ELECTRONIC BOUNCE BACK

LAST MENU PAGE. KEY DIGIT OR M.

You would wend your way through the CIS maze by these menus, or, if you knew the page number of the area of interest, by typing GO xxx. One section that you might want to visit frequently, as a Commodore 64 owner, is the Commodore special interest group. It is a large BBS-type program that allows you to leave messages, questions, and comments for all the other Commodore 64 owners on CompuServe. You may also send notes directly to Commodore personnel and receive the latest news on-line. From any "!" prompt you may get to the Commodore area by typing GO CBM.

Here is a sample session from the Commodore SIG.

COMMODORE PAGE CBM-1 COMMODORE INFORMATION NETWORK'S MAIN MENU 1 INTRODUCTION 2 SURVIVAL KIT 3 HOTLINE (ASK QUESTIONS) MENU **4 PRODUC'T ANNOUNCEMENTS** 5 BULLETIN BOARDS (SIGS) 6 COMMODORE MAGAZINE ARTICLES 8 DIRECTORY (DEALERS & USERS) 8 COMMODORE TIPS 9 COMMODORE PRODUCT LINE 10 USER QUESTIONNAIRE LAST MENU PAGE. KEY DIGIT OR M FOR PREVIOUS MENU. ! 4 COMMODORE PAGE CBM-7 PRODUCT ANNOUNCEMENT MENU 1) CARTRIDGES FOR THE C-64 2) MULTIPLE SPREADSHEET PACKAGE 3) SOFTWARE ENCYCLOPEDIA 4) MAGIC DESK 5) ADVENTURE GAMES FOR THE C-64 6) SPEECH MODULE

- 7) EXECUTIVE 64
- 8) NEW VIC 20 SOFTWARE
- 9) 64 BUSINESS SOFTWARE
- 10) C-64 HOME BUSINESS
- 11) EASYSCRIPT 64

LAST MENU PAGE. KEY DIGIT OR M FOR PREVIOUS MENU.

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COMMODORE PAGE CBM-74

*** EXECUTIVE COMMODORE 64 *** HEY TRAVELING BUSINESSMAN! FINALLY A PORTABLE COMPUTER CALLED THE EXECUTIVE 64 IS HERE. COMPLETE WITH 64K RAM, A FULL UPPER/LOWER CASE LOW-PROFILE DETACHABLE KEYBOARD, BUILT-IN 5-INCH COLOR MONITOR, AND A BUILT-IN SINGLE FLOPPY DISK DRIVE WITH 170K CAPACITY, THIS IS A NICE MACHINE! EVEN BETTER, IT ONLY WEIGHS 27.6 POUNDS AND IS BRIEFCASE SIZE - 5' X 14.5' X 14.5'. RESIDENT IN THE UNIT'S ROM IS BASIC V2. ALSO ACCEPTS Z-80 CARTIDGE, PET EMULATOR, MODEM, AND IS COMPATABLE WITH VIC 20 AND COMMODORE 64 PERIPHERALS. AND BEST OF ALL, ITS UNDER \$1000.

LAST PAGE. KEY M FOR MENU

!M

COMMODORE

PAGE CBM-7

PRODUCT ANNOUNCEMENT MENU

- CARTRIDGES FOR THE C-64
- 2) MULTIPLE SPREADSHEET PACKAGE
- 3) SOFTWARE ENCYCLOPEDIA
- 4) MAGIC DESK
- 5) ADVENTURE GAMES FOR THE C-64
- 6) SPEECH MODULE
- 7) EXECUTIVE 64
- 8) NEW VIC 20 SOFTWARE
- 9) 64 BUSINESS SOFTWARE
- 10) C-64 HOME BUSINESS
- 11) EASYSCRIPT 64

LAST MENU PAGE. KEY DIGIT OR M FOR PREVIOUS MENU.

!1

COMMODORE

PAGE CBM-59

ENTERTAINMENT CARTRIDGES FINALLY, 18 NEW ENTERTAINMENT GAMES AND EDUCATIONAL PROGRAMS ON CARTRIDGES FOR THE COMMODORE 64! THEY ARE:

AVENGER...THE CLASSIC INVADERS GAME BLUEPRINT...SUPERB BALLY-MIDWAY ANIMATION CLOWNS...CLOWNS JUMPING ON TEETER TOTTERS JUPITER LANDER...JOYSTICK CONTROLLED LANDING GAME KICKMAN...THE BALOON BALANCING CLOWN LAZARIAN...THE BALLY-MIDWAY BEST SELLER LEMANS...SPORTS CAR RACING ACTION NUMBER NABBER/SHAPE GRABBER...EDUCATIONAL GAME OMEGA RACE...DESTROYING ASTOROIDS AND SPACE SHIPS PINBALL SPECTACULAR...BETTER THAN PINBALL RADAR RATRACE...COMMODORE RAT CHASE SEAWOLF...BALLY-MIDWAY BEST SELLER SPEED BINGO MATH ... LEARNING FUN FROM BALLY STAR RANGER... UNIQUE SPACE MISSION GAME SUPERMSMASH...FAST ACTION RACQUETBALL TOOTH INVADERS...THE GAME DENTISTS LOVE THE VISIBLE SOLAR SYSTEM...LEARNING ASTRONOMY AND THATS ALL FOR NOW, MORE TO COME IN THE FUTURE.

COMMODORE

PAGE CBM-78

*** 64 BUSINESS SOFTWARE *** THE FOLLOWING IS A LIST OF NEW AVAILABLE SOFTWARE FOR THE COMMODORE 64 EASY SERIES. EASYCALC 64...AN ELECTRONIC SPREADSHEET EASYSCRIPT...A POWERFUL, EASY TO USE WORDPROCESSOR EASYFINANCE I...BUSINESS MANAGEMENT EASYFINANCE II...BUSINESS MANAGEMENT EASYFINANCE III...INVESTMENTS EASYFINANCE IV...ADVANCED INVESTMENTS EASYFINANCE V...STATISTICS EASYCODEWRITER...FILING PROGRAM GENERATOR FOR NON-PROGRAMMERS MORE TO COME IN THE FUTURE.

This provides you with only a taste of what can be found in the Commodore area of CompuServe. There are also many other SIGs available, ranging from counterculture and music to family counseling and arcade games. Look over Appendix A for some idea of the wealth of information available to you.

USING THE CB SIMULATOR

Strictly speaking, there are many CB-type facilities on CompuServe. Each SIG has its own Conference program, which can be accessed by typing CO from the "Function:" prompt. However, these are most frequently used by members of the SIG for their own conferences at designated times. There is nothing to prevent you from using any of them for your own chats; however, at most times you will be very lonely.

All the real action will be found on the "main" CB simulator, which can have several dozen people talking on any of 36 channels at a given time. However, all the commands available to the first-time user can be confusing. Even though HELP is available at the press of a few keys, most first-time users of this exciting time-sharing gabfest wander around aimlessly for awhile, trying to figure out what TALK is or, at worst, how to EXIT in order to end the session.

All the information you need can be discerned by running CB, but it may take the first-timer several visits to become adept. You should be aware that new features and commands are added at intervals, but the basics described have remained fairly stable for a long period of time.

There are many reasons why the CB simulator has attracted so many participants. You may find sparkling conversation or downright silliness at times. Somebody is likely to know somebody who can solve your most pressing problem. It's like electronic mail, but in real time. CB also resembles a wild, long-distance conference call, except that you type instead of talk, and you can talk across the country for about nine cents a minute.

Using the CB is also a bit unlike using the telephone. Because you cannot hear the inflection in the speaker's voice, you may not know if you are talking to a male or female, youngster or mature adult. The words themselves carry the entire meaning.

Some people use CB to meet others, and "eyeball" meetings are not uncommon. More isolated types find that the simulator is their only direct contact with other computer hobbyists. Whatever the reason, CB is good, clean fun.

From the menus, you can go directly to CB by typing GO CB-1, which points to the "page" at which CB's BAND A's entry point resides. There is also a main menu, allowing access to the CB special interest group (CBIG), CB instructions, CUPCAKE'S CB SOCIETY (an excellent gossip column), and CB BAND B. Once you get hooked, you may want to run the DEFALT program, and specify that every time you log in to CIS, you will go directly to CB after the current bulletins are displayed. DEFALT may be accessed by choosing menu option "Change terminal parameters" from the customer information page. DEFALT will interactively lead you step by step through the options. You may also want to change to transmitting lowercase as well as uppercase if you have that capability in your machine. In DEFALT, you may also request that menu options within CB (and certain other special interest groups) NOT be displayed to you every time you are asked for a command. Do this only after you are a veteran and no longer need to be reminded which entry is needed for which feature.

Once you enter CB, you will be asked for a handle (up to 20 characters long), told the number of channels in use, and the number of users tuned in to each. There are 36 channels available, but only a few will be used at any given time. Here is the typical prompt you might receive:

(Channel) users tuned in (10)4,(19)2,(33)4 Which channel:

Enter 10, and you are in business. Your screen will begin displaying a sometimes fast-moving series of quips and comments from the residents of that channel. The channel number and handle of each "speaker" is displayed first:

(A10,C Chaplin) Hello there. Anybody home? (A10,** Null **) Hi, CC. How are you?

As you can see, handles may include characters other than letters or numbers. Certain handles are reserved by CIS, and good taste should be followed. To change your handle, type /HANDLE, or /HAN for short. Commands can be abbreviated to three letters and should be preceded by the slash (/) character. The system will respond:

What's your handle: Charlie Chaplin

This handle will be listed in the user table. What's the user table, you ask? When you type/USTAT, the system scrolls through a list of all users presently participating in CB at that time.

The actual USTAT table may have 30 or more users listed. Anyone looking at this table can see at a glance who is using the system, what channel they are tuned into, their node (originating city), and user ID number. Some will not be using the CB. They might be visiting CBIG (CB interest group), playing DECWAR, or having a one-on-one TALK. However, we're still not finished with the ordinary CB simulator yet.

You may tune into any channel you wish by typing /TUN xx, where xx is the channel number. To go from channel 10 to channel 19, simply type /TUN 19. How do you decide where to go? Most users watch what activity is going on in all the other channels by entering /STA from time to time. That command gives you the status of the other channels (how many are tuned in at the present time), similar to the prompt on entry to CB.

You may also monitor two additional channels. The messages for these appear on the screen simultaneously with those of the channel you are tuned to. To monitor, enter/MON 19, and so on, up to the limit of two. To cancel this, type/UNMON 19. Then,/STA will mark your status by placing a pound sign next to the channel you are tuned to and an asterisk next to one that is being monitored.

/STA

(10) 6#,(19)12*,(21)3,(33)9

During busy times, your screen will rapidly fill up with messages, and you must watch fast to keep up with them all. Here's a brief rundown on all the commands available in the release of CB simulator in use at the time this article was prepared. We have already discussed /TUN, /MON, /UNMON, and /STA.

/WHO This returns the user ID number (called PPN in jargon, for programmer project number) of the last "speaker" in the CB system. If you see a message from Charlie Chaplin and want to know who he is, type /WHO, and you will see:

Charlie Chaplin=75725,1156

If you are not fast enough, however, you may see the PPN of some other talker on a different channel. Keep trying until you find out what you want to know. Getting the PPN allows contacting the user individually for a TALK, to determine their node (out of curiosity) if their handle is not displayed in USTAT, or for sending EMAIL.

/HAN Change your handle.

/SCR xyz Scramble on key "xyz." This is used by those "cliquey" individuals who wish to talk as a group, but privately. Only those who have typed in the /SCR command followed by the correct combination code can see or transmit these messages.

/XCL xyz You transmit unscrambled, so that everyone may read what you enter, but you can receive scrambled transmission.

/UNS Turn off scramble.

/HELP Display list of CB commands.

/SQU abc Squelch handle "abc."

/SBU number Squelch by user ID number.

If a weird 12-year-old gets on your favorite channel and tries to monopolize it, you can "turn off" that individual. Entering /SQU IDIOT means that all transmissions by the person with the handle IDIOT are ignored by your system. Everyone else can see his or her ravings, however, until they apply /SQU on their own. The system works by PPN, so changing handles will not help. IDIOT by any other name will still remain invisible to your tired eyes. You may also squelch by the ID number.

/**TALK xxx** Go to two-person talk with job number xxx. Job numbers are displayed in the user table or may be found out by typing "/JOB" (tells only *your* job number). Talk is a one-on-one private discussion, not using the public CB "airwaves."

/EXIT Leave the CB program.

You may also exit CB by typing CONTROL C. Once you leave, you will be presented with the CB menu, which you can access or use to GO to some other page.

You will probably like CB because it is so varied, and you will appreciate the opportunity to meet many talented and interesting people. One evening I carried on a lengthy conversation with a user in Swedish, even though I don't speak the language. The pauses in the conversation (while waiting for answers to be typed) were sufficient to allow looking up phrases in a Swedish dictionary and then composing answers from a ready-made phrase book. CB is just one of the services available through information networks. In the next chapter, some ideas for using them that you might not have thought of will be presented.

OTHER ON-LINE SERVICES

In addition to the two most popular information services, there are other on-line data bases and services that you as a Commodore 64 user might find useful. These include specialized electronic mail services, like MCI Mail, which allow sending messages across the country quickly and easily.

While you can send Mailgrams through some on-line information services, you are generally limited to sending messages to other subscribers. With MCI Mail, however, messages can be sent electronically to other MCI Mail users, or in paper form, with one/two day, before-noon, and four-hour delivery options. At this writing, the cost to send 7500 bytes (five or six pages) electronically on MCI Mail is \$1. One/two day delivery is priced at \$2 while before-noon can be guaranteed at \$6. The four-hour delivery, not available to all cities, costs \$20 or more. Each additional 7500-byte MCI "ounce" is only \$1 more, regardless of delivery option.

MCI Mail is very easy to use because it is entirely menu oriented. You can also employ it as a gateway to Dow Jones News/ Retrieval.

Here is a sample MCI Mail session to show you just how simple the system is.

Please enter your user name: DBUSCH Password: PASSWORD Connection initiated. . . Opened. Welcome to MCI Mail!

Port: 8.

REWARDS FOR THE WORKING WEEKEND

MCI Mail lets you post ONITE Letters on weekends for Monday morning delivery to 15 major cities. Type HELP NEWS for more information.

MCI Mail Version 1.14

There are no messages waiting in your INBOX.

Press <RETURN> to continue

You may enter:

SCAN	for a summary of your mail
READ	to READ messages one by one
PRINT	to display messages nonstop
CREATE	to write an MCI Letter
DOWJONES	for Dow Jones News/Retrieval
ACCOUNT	to adjust terminal display

HELP for assistance

Command (or MENU or EXIT): CREATE

TO: JMELLO

(John Mello Computer Comm Camden, ME)
```
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Subject: ARTICLE
Text: (Type / on a line by itself to end)
WILL BE SENDING THE ARTICLE TO YOU MCT MAIL TODAY.
LOOK FOR IT.
/
You may enter:
READ
          to review your letter
EDIT
          to correct your letter
SEND
           U.S. Mail for paper; instant electronic deliver
SEND ONITE OVERNIGHT courier for paper; PRIORITY electroni
delivery
SEND 4HOUR FOUR-HOUR courier for paper; PRIORITY electroni
delivery
      for assistance
HELP
Command (or MENU or EXIT): SEND
Signing off from MCI Mail.
```

Call clearing requested by remote source.

DATA BASES

Computerized on-line data bases, like trips to Mars, have been written and fantasized about since long before either became practical possibilities. After all, why needlessly duplicate extensive research libraries in universities all over the country? A single, centralized computer data base can provide users nationwide with the same information while using data processing power to streamline searches and statistical manipulation.

Yet, despite science fiction writers' predictions, it is not possible today to go to one mammoth encyclopedic computer, a sort of DP Library of Congress, to answer any question. Instead, a host of smaller, specialized data base services have risen to meet information needs.

There are a number of reasons why this has been so, the technical unfeasibility of an all-knowing "supercomputer" notwithstanding. Costs of maintaining these data bases are more logically spread among those who actually need the accumulated knowledge. Those with modest information requirements about, say, U.S. patents, aren't forced to subsidize those with more extensive data base maintenance requirements in the economic field. Individualizing each data base service allows tailoring information retrieval to the group who will be using it.

Even so, there are some "general purpose" data bases aimed at the general public and business user. CompuServe Information Service and The Source are the best known of these. In addition to their data processing and hobbyist applications, discussed earlier in this chapter, both services offer access to a number of useful data bases through simple menu-oriented commands. CompuServe, for example, allows tapping into the news files of some of the leading U.S. daily newspapers, such as *The New York Times, Washington Post, Los Angeles Times,* and *The Minneapolis Star.* Airline schedules, Dun and Bradstreet stock quotations, gold futures prices, and magazines such as *Popular Science* are all available on-line. The Source also provides entrée to stock market information, including the UNI-STOX data base of 160 financial reports, airline schedules, news, and a variety of other data.

At the information provider's end, hardware and software advances in recent years have made on-line data bases more practical to build and maintain. The per-character data storage costs have dropped dramatically, while rapid-access storage devices have increased in capacity and reliability. Mainframes have become more powerful, making it simpler for a large number of users to work interactively with a CPU at the same time. Special computer programs with user-oriented "query" features allow more efficient searches by relatively untrained customers, reducing both user and CPU time. The net result is that data bases can be maintained and offered for very reasonable fees, which in turn encourages acceptance, use, and growth.

There are two essential kinds of on-line data bases. The "source" data base is the kind of information repository that made up so many science fiction writers' dreams. Such information centers contain all of the data or the complete text of the original source. Newswires containing full stories or an on-line dictionary with complete definitions are typical examples. Source data bases may contain either text or numeric data, or a combination of the two.

A second type of information resource is the "reference" data base. Although these may contain data of use to a researcher, their main function is to refer the user to an original source for the information. These may include source data bases, journal articles, patents, organizations, individuals, or audio-visual materials. This type of data base may be thought of as an "index" to information that is not limited to one medium or type of data provider.

Both types of information must be compiled by someone, the "producer" of the data base. The producer may or may not also be the group that makes the data available through an on-line service. Many provide their own service, whereas others make the data base available to another information provider, which offers on-line services to users.

Some producers are organizations with an interest in furthering the field, and which ostensibly have as a primary motive improving the quality of data available to others in that industry or line of study. Such data bases may be made available to users at cost or for a small profit, which is plowed back into the organization. Other data bases are put together by government agencies that have a responsibility to the public to make such information available.

Still other producers assemble data bases solely with a profit motive. Their business may consist entirely of providing consulting or advisory services to business, industry, or education. The data bases might be built from scratch or obtained from the government sources that originally compiled them, after which maintaining and updating the information is the responsibility of the firm marketing the data.

In either case, the information becomes available to users by contracting individually with each service. Many require an annual subscription fee, which can range from a few hundred dollars to several thousand. Data base access may also be included as part of a total time-sharing package, or charged according to usage. A combination of these pricing techniques can be used.

Time-sharing services offering data bases will most frequently charge for connect time, CPU time, and, if necessary, disk storage of information retrieved. In addition, a surcharge may be added to compensate the service for the "extra" costs incurred in maintaining the data base or in paying the producer.

Other data base services will charge based on an hourly connect-time rate. Use of telecommunications networks, such as Tymnet, is extra. Less generalized data bases charge proportionately more to reflect their access by a much more limited group of users. These charges can run from \$20 to more than \$300 per hour.

Where to find on-line data bases to access? If your own field does not have a national organization or clearinghouse for such information, a good place to start is an index to computer services, such as the *Directory of Online Databases*, \$29.95 from Cuadra Associates, Inc., 1523 Sixth Street, Suite 12, Santa Monica, CA 90401.

Another source, more international in scope, is the *Encyclopedia* of Information Systems and Services, by Gale Research Co., Book Tower, Detroit, MI 48226. This volume not only lists on-line services, but also organizations that will do research for you on selected topics for agreed-upon fees.

The on-line data bases break down into four major categories, as outlined in the Cuadra guide. The largest is business and industry. Dozens of data bases are available, from agriculture to banking, insurance and real estate, to securities and urban planning.

Under the multidisciplinary category, Cuadra lists biography, consumer affairs, government data bases, and news. Science and technology data bases encompass aeronautics and engineering, as well as life sciences and nuclear engineering. The fourth major category, social sciences and humanities, offers a host of data bases dealing with art, education, history, music, psychology, and other studies. case, however, it might be a list of magazines, newspapers, and other publications that the sender wishes to reach, and that are known to have accounts. Those marketing products in the computer field will find this route especially rewarding.

Sending such material in electronic form directly to the desired audience is highly effective. However, there is no reason why the time-honored "shotgun" approach cannot be used. Simply post the news release on the appropriate bulletin board section of the information utility, and let anyone who wants to read it have access. It never hurts to call attention to the piece with notices elsewhere in the system as well.

SELLING UNWANTED ITEMS

Your company sells its products or services locally and has no desire to reach a national audience? Fine. But how do you unload that old electronic accounting machine that uses magnetic ledger cards? Or that delivery van you no longer need? Again, the broadside approach may be best, with a well-placed bulletin on the national boards of the larger information services. Computers and related equipment sales will generate the most interest, but cameras and dune buggies have also been sold. Those 1,287 file cabinets left over from when you converted records to microfilm may be some other firm's treasure, at the right price.

GET ANSWERS TO TECHNICAL PROBLEMS

Need an answer from a businessperson like yourself, but don't know where to turn? Check out your colleagues who use information services. CompuServe, for example, has more than 50 special interest groups (SIGs), and not all of these are for hobbyists. The Work-At-Home SIG allows members to exchange information on the problems and advantages of working out of the home. Pilots, writers, physicians, and other professions all have representation. It's a simple matter to dial up, go on line, post a question, and come back the next day to find answers or suggestions from experienced businesspeople.

If you're lucky, you may evenfeind someone on-line at the

same time as you who can answer the question immediately. CompuServe has a Conference mode in each special interest group that allows typing messages in real time to another user who is also in the SIG. The Source's CHAT mode promotes similar interaction.

PROFESSIONAL OR INTERNAL CONFERENCES

These direct talks also have important uses in bringing groups of people together. In some ways, on-line conferences are better than conference calls. Cost can be as low as \$5 per hour per person, even if the conferees are on opposite coasts. Hard-copy records of the discussion are ridiculously easy to obtain. One or more participants with a "capture" buffer or some means of dumping the conversation to disk can preserve the entire conversation. In CompuServe's CB or CO modes, the name of each speaker is inserted before that person's comments automatically. Compare *that* with transcribing an audio tape recording.

Such conversations can be kept entirely private, while open to late arrivers. Each speaker can "scramble" on a prearranged code so that only those who know the code can read what is being typed.

Conferences of this type can and have been used by a variety of groups. On CompuServe, authors have held open discussions with print celebrities like William Barden, Jr. and Ernest Mau. Those interested in video gaming have been able to chat with Chris Crawford, the celebrated Atari programmer. Ed Juge of Radio Shack has also taken the hot seat.

Other conferences have been organized just as a means for professionals to exchange information among themselves. Or, a company with offices scattered around the United States could stage company "meetings" in this manner.

INTERNAL COMMUNICATIONS

More than just Conference mode can be used for improving communications within a company. The electronic mail facility of information services can be a key way of keeping wide-ranging staffers informed.

8 Telecommunications Part Three: Business Applications

You've seen how information utilities can let you communicate with friends and other Commodore 64 users through special interest groups and CB. A glance at Appendix A will show you all the games available on just one of the two leading services. But what if expanding your Commodore 64's horizons encompasses business applications?

There is not a great deal in this book on business uses for the Commodore 64. The unit's low price has brought it into the home, but its 40-column screen may have kept it out of the office. However, many small businesses are using Commodore 64s with great success. The on-line information services are a great place to start the discussion of a few business uses you might not have thought of.

For the average businessperson, on-line information services, such as The Source, CompuServe, or Dow Jones, conjure images of stock quotations and access to news bulletins. Useful, but not especially exciting. The middle manager without a large stock portfolio and the small entrepreneur or business owner can easily live without these services.

Information utilities are also well publicized for their data bases. These were discussed to an extent in the last chapter. By connecting a terminal or desktop computer to a modem and phone line, hundreds of data files, ranging from movie reviews to bibliographies, can be accessed fairly quickly and inexpensively. However, most businesses not engaged in scholarly research will seldom need the bulk of the available data bases.

However, organizations of any size can benefit from innovative applications of the less-heralded capabilities of the information utilities. Here are 10 highly useful applications you might not have thought of.

MOUNT A DIRECT "MAIL" CAMPAIGN

Have a product that you'd like to sell to a specific list of prospects? Once you've compiled a list of Source or CompuServe account numbers of those prospects, you can send out electronic mail "flyers," price updates, service information, and any other promotional material you desire efficiently.

The Source, for example, allows you to set up various mailing lists in your file space and then send a given message to *all* the other Source users on a given list with a single command. MCI Mail also permits its advanced users to do this. Each list can be as customized as the user desires. One list might contain especially "hot" prospects, another existing customers, and a third marginal leads. A given news release or mailing could be sent to any or all of these, as desired. Since your Source account number accompanies each piece of electronic mail, a built-in business reply function is available for fast responses.

CompuServe has no similar bulk mailing capability integral to its system. However, there are public access programs available that allow much the same function. These programs are used by special interest groups to send bulletins to club members. There is no reason why the modules could not be used for marketing as well.

The mass mailings do not have to be limited to promotional material. An important part of the sales cycle is keeping a customer satisfied and likely to make another purchase. So, sending out the latest product information, service advice, and other news can be valuable after the sale.

ON-LINE PUBLISHING

On-line publishing is in some cases an extension of the direct e-mail concept. News releases, articles, and other editorial matter can be sent through an information service to a select mailing list. In this

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A companywide memo can be sent to all concerned using the mailing list function. If a firm has only one account number, the message can be sent to ITSELF and tagged TO ALL EMPLOYEES so that everyone will read it. The Source allows using a password for messages. Two employees can exchange private memos, even though both use the company's "public" account.

Have people "on the road"? If they take their Commodore 64s or compatible Commodore computer along with a disk or cassette recorder and VICMODEM, they can check in throughout the day and pick up messages. Others in the company can send the notes themselves, without having to work through a secretary, and the missives are not limited to incoming phone messages.

INTERFACE UNLIKE COMPUTERS

Some local area networks allow a company to preserve its investment in mismatched personal computers by interfacing Apples and IBM PCs. Information utilities can provide a similar function on a nationwide basis without the need for the LAN. If a firm has information such as a text file in an Apple computer in one department and wishes to transfer it to, say, their Commodore 64 in another, there are several ways to do it. One way that will *not* work is to bring the Apple disk to the Commodore 64. They are not compatible. If both computers are connected to a modem, it is possible for one to "call up" the other and transfer the information directly. However, this must be done when both machines are doing nothing else. That may be inconvenient, especially when such transfers must take place frequently or among many machines. If the computers are separated by more than a few miles, long-distance phone charges accrue.

Why not simply send the file through an information service, which allows the data to be picked up at the receiver's convenience? The Source is probably most convenient for this, because its Sourcemail is instantaneous and allows unlimited file length (I've transmitted an entire book through The Source). However, CompuServe's EMAIL is a bit slower but fine for shorter documents. Longer files can be placed in Public Access (as an invisible entry, if desired), and downloaded 24 hours later.

SHARE RESOURCES

Why have an expensive daisy wheel printer for every user in a company? Install one or two such printers in the main office, and then let all the other users send their documents through an information service for hard-copy printing.

Data files and even programs can also be shared in this manner. Information utilities often have programming languages available so that users can run their own applications. You might not want to do this for frequently run programs, but it could prove economical for some software that must be accessed from various locations.

MARKET RESEARCH

Find out if your company's new product or service will sell—use the customers of the on-line service as your research base. Many types of surveys have been conducted through The Source and Compu-Serve. Mechanisms within the information services are already set up to allow surveying users on a variety of topics. You can also set up your own survey by posting notices on bulletin boards and asking for responses by electronic mail. I have also seen several companies simply get on line and chat directly with users, either one-to-one or in conference mode, to get feedback.

Although the sampling will not be representative of the general populace, surveys conducted through information services can be very helpful, especially if a company is marketing a computerrelated product. Try it.

SELL A SERVICE

The on-line services can be a money-making end in themselves for businesspeople. Information utilities have been open-minded about allowing their customers to set up profit-making services of their own within the on-line company's framework. One enterprising company will write a lobby letter for you, for a fee, through Compu-Serve. Another company will act as your travel agent, while yet another is eager to sell you products at a significant discount. It is even possible to pay for and receive family counseling through the computer.

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Electronic publishing has also proved to be profitable for individuals and organizations. Think up your own service, and find a utility willing to let you market it. The investment is relatively small, and the potentials are growing. The capabilities of on-line services have barely been tapped. Find a new application that businesses and individuals can use, and reap the profits.

9 Exploring the World of Video

Let's be frank. There is just one reason why your Commodore 64 did not come with a built-in color video monitor—to keep costs down. Any sane computer manufacturer wants to be able to advertise its product at as low a price as possible. For that reason, personal computers have often been sold as "keyboard-only" units, with prices quoted for the main computer component only.

That really makes little sense. If you spend \$200 for a Commodore 64, there is little you can do with it in that configuration. A viewing screen of some sort has to be connected to see what you are doing. Even then, the computer is little more than a toy until an additional expenditure is made for a cassette recorder or disk drive to allow access to user-written or commercial programs.

Computer manufacturers are fooling no one but the truly raw first-time computer users. Even they will usually be aware that the computer they are buying must be connected to their home television or some other CRT-type device.

The cost-cutting rationale should make it clear to you that the only reason why computers like the Commodore 64 use TVs as viewing devices is their low cost—to the manufacturer. Your television costs the manufacturer nothing. If you do not have a color TV or do not care to share one of yours with the Commodore 64, then a TV or a special computer monitor will be a necessary extra expense for you.

Which route should you take: monitor or color television?

Keeping the cost-cutting theme in mind should make you suspect that perhaps a color television is not the best choice as a computer monitor. With few exceptions, you would be correct. Actually, the output of your computer, composite video, and the signals that your color television's circuits like to process are very compatible. However, the TV does not usually receive its input in that form, except from special accessories like a video tape recorder (those set up for direct video output) or a video camera. In most cases, your television will receive its signals from an antenna or a cable television coax in the form of radio frequency, or RF input.

Few televisions sold in the past 10 years are equipped to accept anything other than RF input. As a result, video tape recorders, cameras, and home computers usually have a built-in RF converter that changes their signals into RF. You can attach the wires from any of these to your set's antenna terminals, just as if the signal were coming from an antenna. Then, the television can happily convert the RF back into composite video signals for display.

This process does not make a lot of sense, and many of the latest generation of television sets have direct video and audio input to accept output from video sources other than antennas or cable. The result of all this conversion is that the signal from your computer is degraded sharply. Few computers designed to use home televisions have screen widths wider than 40 columns. The smaller characters are simply too difficult to read. On some sets, especially older ones with dirty tuners, even your Commodore 64's output may be fuzzy.

A color monitor designed specifically for computer use has provision for direct video input. Instead of using the "phono" type connector on the back of your Commodore 64, you plug in a DIN plug, and feed the video, audio, and luminance signals directly to the monitor. Some color televisions now also have provisions for this type of input. This composite video is much sharper than is possible using the RF modulator route. Colors will tend to be purer.

What does all this video enhancement cost? The lowest price color monitors, such as the 14-inch Commodore 1702, sell for about \$250. This is actually about the same as what you might expect to pay for a good-quality 13-inch color television at discount. AMDEK and some other manufacturers also make excellent color monitors at competitive prices. You might even check out the competition to see what prices are being asked for monitors made specifically for Texas Instruments, IBM, or other computers. and 64-column-wide screens. Some applications programs use a "windowing" approach to move the screen from side to side over a fixed block of text or data, to make it appear as if the screen is actually wider than 40 columns.

Careful selection, placement, and use of your video output, whatever it may be, can enhance your enjoyment of your Commodore 64. Some other computers emit large quantities of RF interference and might cause objectionable artifacts to appear on your screen. They will also interfere with your normal television appearance. Be judicious about using or placing such other computer equipment. (In this day and age, the two-computer family is becoming more common. The other low-end devices are not always as conscientious as Commodore was about shielding against stray RF.)

If you are purchasing a color television specifically for the Commodore 64 (or for double duty), avoid models with oldfashioned mechanical tuning. These wear out rather quickly, compared to the long life you can expect from your computer, and dirty tuning mechanisms seem to be the number-one cause of a poor picture, both for computer and conventional use. Varactor or allelectronic tuning is a much better choice for any application, even though you will pay a bit more. Needless to say, frills like remote control are not at all needed. Automatic color control and even automatic frequency control will have little effect on your computing, but TVs without this facility are few and far between these days.

When selecting a color monitor, the choices are fewer. True monitors are available in only a couple of different types. Most will have a speaker for sound, but you should check for this. The Commodore 64's fine sound capabilities play an important part in most games and many applications programs being written today.

Make sure the monitor comes with or can be supplied with the proper cable. Usually, a simple cable with a DIN plug at one end (to plug into the Commodore 64) and an "octopus" of phone plugs at the other end, to be plugged into appropriate video, audio, and luminance jacks on the monitor, are all that are needed.

Finally, try to get a monitor with a volume control or on-off switch for the sound. Many games have repetitive or annoying music or sound effects, and few have a provision for turning them off. The user, however, has recourse by adjusting the volume knob of the monitor or TV. You will definitely want one on your own unit!

Size is another consideration you should ponder. I have used a good-quality, 9-inch color television set with my Commodore 64

with excellent results. The 40-column characters are about 5mm in height with such a configuration and quite easily read from normal viewing distances. If you wish to use a smaller set, say, in the 5-inch to 7-inch screen size, test out the unit thoroughly to make sure that you can read the characters and that they are large enough for easy viewing without having to place the set so close to the operator that it interferes with the keyboard.

At the other end of the scale, a 13-inch color television (or the 14-inch Commodore monitor) is about the largest that can be used with normal keyboard/CRT placement. There are many who use larger sets, including 19- to 25-inch consoles, with their computers. These owners may prefer to put a little distance between themselves and the viewing screen. With a larger set it is possible to sit on a couch and do some lap-style computing, if a long enough connecting cord is used. However, this separation makes it inconvenient to adjust volume and color, as may be required. You are probably better off sticking with color monitors in the 9- to 14-inch range. The smaller sets are more compact and easier to fit on a crowded desk with other components, such as a disk drive or a Datasette recorder. The monitors in the 14-inch range may be easier for some to view. Make your own choice.

What about using an ordinary black-and-white television? The truly cramped-for-cash crowd can try to get by with a black-and-white set if they wish. Such TVs can be purchased new for about \$70 and will produce images that are as sharp as most color televisions and many monitors.

However, unless the Commodore 64 will be used for business only, the user will be losing some of the nicest features of a very good computer. Color images make it easier to differentiate certain areas on the screen. Games may be more difficult to play in black-andwhite. Writing programs that take advantage of color will be tricky because it is hard to gauge the color relationships in monochrome. Yellow looks a lot like green in black-and-white, for example, and dark blue is almost indistinguishable from black.

At best, black-and-white should be used only as a stopgap until a color set can be made available. If Commodore had meant for us to compute in monochrome only, it wouldn't have put that slick rainbow at the left-hand side of the keyboard between the "Commodore" and the "64" logos.

10 Printers

The printer is possibly the oldest accessory made for personal computers. So-called "hard copy only" terminals were available for some of the pioneering small computers long before the first "television typewriter" became standard. Today nearly every home computer can be connected to a television or CRT monitor. This provides a convenient, low-cost way of monitoring (hence the name) your input and watching the computer's output as it is displayed. Those with some familiarity with hard-copy terminals know that they can eat up quite a lot of paper very quickly.

However, because of the way most home computers are configured today, much computer output is fleeting. Information printed to your CRT screen is replaced once every 1/30th of a second. Data in memory is lost forever when your Commodore 64 is switched off. Disk or cassette files are fairly **permane**nt, but they cannot be accessed without the computer itself. Permanent records of transactions and computer "reports" are important to many users. Thus, a printer is probably the second most-popular accessory for the Commodore 64 after a mass storage device like a disk drive or Datasette.

Printers serve you in a number of ways. Hard copy allows you to share computer output with others who may not have a computer like your own. Word processing on the Commodore 64 is fast and efficient, but it is impractical to ask a reader to come peek at your TV screen or to go out and buy their own Commodore 64 in order to access a letter you have written. Printing out the missive and mailing it is, then, a better answer.

You may have a very useful income tax or personal finance program for your Commodore 64. Perhaps you favor a checkbook program that will balance your entries and tell you how your money is spent. Such information is best assimilated in the form of "reports," which are printed out on paper for perusing at leisure.

Other Commodore 64 owners may be programmers. Ever get stuck by a bug and not know where to find it? Print out the entire program listing. Check it over carefully. Pencil in the function of each module. Sketch flow charts. Programming can be made simpler when a hard copy is available for reference.

Printers available for the Commodore 64 break down into several broad categories. There are two basic types of print output, dot matrix and daisy wheel, as well as two kinds of printer interfaces, parallel and serial. Let's look at print quality first.

Some of the first printers interfaced to personal computers used typewriter-like fixed characters. Old teletype terminals and IBM Selectric typewriters converted to personal computer use were very popular three to five years ago. These printers produced output that ranged from horrid all-caps printing with variable spacing (unintended) to very decent letter-quality printing. However, such printers were very slow, prone to breakdowns, and, when compared to the work they performed, frequently overpriced.



Figure 10-1 Daisy wheel printers offer the flexibility of using carbon film ribbons as well as fabric ribbons, and produce letter-quality printouts.

Gradually, dot matrix printers replaced the early devices among personal computer users. These were much faster in operation (several hundred characters per second or more), very reliable, and produced output of a consistent quality. Unfortunately, that quality was quite different from the letter-quality standards of the time. Dot matrix printers use tiny wires to strike, in most cases, a fabric ink ribbon. The array, or matrix, used to design the characters can be as coarse as 5×7 , which is even rougher than 8×8 matrix used to produce the Commodore 64's character set. Such printing had a distinct computer flavor and is unacceptable for many applications (such as formal correspondence) where the writer is trying to make the best possible impression.

Early dot matrix printers tended to be even more costly, in the \$1500 to \$3000 price range. Gradually, costs have come down to the point where a good-quality printer for the Commodore 64 can be purchased for about \$200. Print quality has also improved, with 7×9 dot matrixes, or better, used in the higher-priced models. Some printers use multiple passes over the same line to produce output almost indistinguishable from typewritten copy.

Recently, there has been a resurgence of letter-quality printers. Gone, for the most part, are the clumsy printers that use typing "balls." Today's letter -quality printers use print thimbles or, more commonly, daisy wheels. In fact, the term "daisy wheel printer" has become almost synonymous with letter-quality printing. You should be aware, however, that other high-quality printing techniques exist.

Letter-quality printers are still slower than the best dot matrix machines. At the high end of the price scale (\$1200 to \$3000), there are printers that can turn out copy at a rate of 40 characters per second or more. These have tractor feeds to allow "sprocketed" continuous paper to be used. Such printers are also very rugged and less prone to mechanical failure.

A lot of recent publicity has been directed at the low-end letter-quality printers. It is possible to purchase an Olivetti Praxis typewriter that can also be used as a computer printer for about \$400 at discount. Smith-Corona makes its TP-2 printer, a slow, noisy, but useful device, for sale at about \$500. There are many other daisy wheel-type printers in the \$500 to \$1200 price range. For the first time, nearly anyone who can afford a printer of any type can step up to letter quality for a few hundred dollars more.

What do you give up for that quality printing? Unfortunately, quite a lot. Low-end daisy wheel printers are very slow, some as slow

as 10 characters per second (only 5 percent of the speed of some dot matrix printers). It may take several minutes to print a single page. Where even \$400 dot matrix printers may have tractor feeds, allowing inexpensive, continuous paper to be used, many of the low-cost daisy wheels offer tractor feed only as an extra-cost option, if it is available at all. This means that you may have to hover near your printer and feed it single sheets every few minutes to print out any lengthy document. All the low-end daisy wheel printers are much noisier than the best dot matrix units, but this is a minor annoyance for some (and a major problem for others).

Also, daisy wheel printers cannot output graphics the way a dot matrix printer can. For some types of computers, this is of little consequence. However, as a Commodore 64 owner, your program listings are full of arcane graphics symbols that stand for various special color commands, and other screen formatting. The answer may be a Smart ASCII program (see Appendix B for suppliers), which automatically converts the graphics symbols to all-alpha abbreviations for program listings.

Both dot matrix and letter-quality printers are available in two interface configurations: parallel and serial. A parallel printer accepts data from your Commodore 64 eight bits at a time (all eight bits of the byte move onto the printer's bus in parallel, in other words, over eight data lines). A serial printer accepts data only one bit at a time over a single data line. Your Commodore 64 may use either, but you must have either the RS232 serial interface adapter or a Centronics-type parallel interface. Both devices are readily available from many sources. Or, you may purchase a printer designed especially for the Commodore 64, such as the Commodore 1515 graphics printer, which is plugged directly into the serial IEEE-488 bus (just like your disk drive) in daisy-chain fashion.

In looking for a printer, you should give first priority to models that are advertised specifically for the Commodore 64. This provides you with some assurance that the necessary cables or other items needed to connect it to your computer have been included or at least arranged for by the manufacturer. Other printer makers may leave you on your own. For those with little hardware experience, interfacing a foreign printer can be an unsettling experience.

You should also decide whether you want graphics or letter quality, or, possibly, an expensive dot matrix printer that will deliver both. Some consideration should be given to what you think of as



Figure 9-1 Sharpness of screen images can vary depending on the type of television or monitor you use. Here a display is shown on the screen of a standard 9-inch color television.

However, a color TV can also be used for viewing when not using your computer. If you are like most people, you may use your computer only a few hours a day, and watch television for a few more. You may prefer to buy a TV for your Commodore 64 and have a spare for your family that was not available before. Because they have no tuner mechanism, true monitors cannot be used for watching the *other* kind of program. However, many can be connected and used as a monitor for a video tape recorder, which most frequently *does* have a tuner. So, you may be able to get some double duty from your color monitor as well.

You may also want to look into the so-called monitor televisions and component TVs with direct video input. Some of these have provision for connecting component tuners and amplifiers, greatly improving the picture for conventional television watching and the sound for TV or computer use. Given the high quality of the Commodore 64's music synthesizer capabilities, the extra sound provisions of such a setup may appeal to you.

You should also be aware of RGB monitors, which require that each color of the video signal be fed separately. at this time, such equipment is very expensive (in the \$600 to \$1000 range) and impractical for most home computer applications. The video quality of a good color television or video monitor is quite sufficient for the Commodore 64's output.

Your computer's older "brother," the VIC-20, has been quite a candidate for video enhancement in recent years, due to its frightful 22-column screen. Many providers have developed 40- and 80-column video boards for this computer. Data 20 is one veteran supplier of these. Similar 80-column upgrades have only recently started to become available for the Commodore 64. Speaking in general terms, because the products are yet too new, these seem to work fairly well. However, there are a number of drawbacks.

First, all conventional color televisions are too limited in resolution and bandwidth to allow using an 80-column computer. You *must* have a monitor—black-and-white or color—to take advantage of the 80-column conversions. As an additional drawback, you can almost count on losing color capabilities when switching to 80 columns. So, a monochrome monitor is as good as any other for this application. All the 80-column boards available at this time have white (or green or amber, depending on your monitor) lettering against a black background.

On the plus side, 80 columns is much to be preferred for many applications, especially word-processing and spreadsheet programs. Some software available for the Commodore 64 can accommodate the 80-column screens automatically. Since your printed output from a word-processing program is likely to be 60 or 65 columns wide, an 80-column screen lets you see the full line width, with room for margins on either side. A wider screen allows viewing more cells of an electronic spreadsheet.

One plus of the monochrome output of an 80-column Commodore 64 is that such monitors are relatively inexpensive. For \$100 to \$150 you can get a very fine-quality, green-screen monochrome monitor that will display your text in high resolution. If your Commodore 64 will be used chiefly for business work where color and Commodore graphics are not needed (no games, in other words), such a monitor may do the job at little cost. Conceivably, you could put together a workable business computer system for a total cost of \$1000 or less for computer, monitor, 80-column board, printer, and disk drive.

Don't feel cheated if you decide to stick with your stock Commodore 64 and its 40-column screen. While 80 columns are desirable for business use, many owners have happily gotten by on less. This entire book, for example, was written on computers with 40letter quality. For many applications, such as writing letters to friends, better dot matrix printing is entirely acceptable.

Will you be printing long documents frequently, or lengthy program listings? You may find tractor feed and the fastest printer you can buy essential. Or do you most frequently print single- or two-page letters? A slow daisy wheel may be your best choice.

If you want the simplest decision possible, you could simply go out and purchase the Commodore printer, plug it in, and start using it. This model has a built-in ROM plus a small RAM printer buffer. It will produce all of the special Commodore characters with no need to convert Commodore ASCII to standard ASCII (which may have to be done for some other printers). It will print characters using a 5 \times 7 dot matrix or, optionally, a double-wide 10 \times 7 dot matrix. Normally, the printer is set up as device number 4. However, a factory switch allows changing this definition from 4 to 5. So, two serial printers can be used on the same IEEE-488 bus. Conceivably, you might have a daisy wheel printer adapted for the IEEE-488 bus as device number 4, with the Commodore printer redefined as device number 5 for program listings.

The Commodore printer is controlled using CHR\$ codes, which may be embedded in the text from many compatible word processing programs. For example, CHR\$(8) sets graphics mode. Each time the printer sees CHR\$(14), it will turn on its double-wide character mode, returning to normal when a CHR\$(15) is sent. CHR\$(18) and CHR\$(146) will turn reverse printing on and off, respectively.

There are many printer accessories you should consider. Appendix B lists various producers of Smart ASCII conversion software. There are also so-called "printer buffers" available that can be very handy.

You will notice that your Commodore 64 can send out information much faster than some printers can output it. As a result, the computer spends much of its time during printing waiting for the output device to ask for more data. During this long wait, your Commodore 64 is unavailable to do other work. If you are rushed, the delay can be annoying.

Consider that you may want to print out a long program listing, but once the listing has been directed to the printer, you are interested in resuming debugging the program at hand. Printer spoolers and buffers can provide the solution. A spooler is a software



Figure 10-2 A parallel printer accessory will allow connecting any Centronics-compatible printer to the Commodore 64. (*Photograph courtesy Cardco, Inc.*)

module, usually written in machine language, which resides somewhere out of the way and handles printing tasks for you as a "background" job, while you continue computing. Your files for printing may be stored on disk, and the spooler will call up each file and direct it to the printer as needed. If you have a tractor feed and continuous paper, you can proceed with whatever you want to do while ignoring the printing operation entirely.

More common, at least for the Commodore 64, is the printer buffer. This is a device that connects between the computer and the printer. Some can be attached right to the printer itself. A printer buffer will have built-in memory (16K to 64K or more) and some intelligence. In use, you direct output that you want printed as normal. However, the RAM of the buffer accepts the data stream much faster than your printer can handle it. The overflow is stored in the buffer's memory and fed to the printer in a slow trickle at the proper rate. A long document that might take half an hour or longer to print may be "sucked up" by the buffer in a few seconds to a few minutes. Then your Commodore 64 is free to do other tasks.

In exploring this option, look to see how much memory is available. With the low-cost 64K chips now being marketed, prodigious amounts of RAM are used in the most common hardware items. You may find buffers with 256K or more at a reasonable price. Some have extra features, such as the ability to print multiple copies of a document at the press of a button. A buffer's intelligence may also be "smart" enough to format your text. In summary, a printer can be a valuable tool, and there are many printers available that can be interfaced successfully with the Commodore 64. With the possible exception of a modem, no other peripheral can turn your computer into such a useful communications device.

11.... CP/M: Outdated or Still the Standard?

Even if you have used your Commodore 64 with a disk drive for some period of time, you may not be aware of the term "operating system." Every computer has an operating system in one sense or another, although with the Commodore 64 the OS is nearly invisible. Other computers use more easily discernible operating systems. CP/M (Control Program/Microcomputer) is one of the oldest and most widely used. Even if you are unsure of what an operating system is, you have probably heard of CP/M. However, does your Commodore 64 really need it?

First, let's look at what an operating system is. Every computer consists of a microprocessor (such as the 6510 chip used in the Commodore 64), memory of the random-access and/or read-only type (RAM and ROM), as well as various peripherals, such as the keyboard, CRT, and storage devices. The microprocessor, as you probably know, does nothing more than follow the instructions given to it either from ROM or programs that you supply. User programs are often referred to as "applications," or "utilities," depending upon whether they do useful work or simply perform computer housekeeping. A checkbook program or a wordprocessing program are applications. Software you might use to make a full copy of one disk to another while using a single 1541 disk drive, are examples of utilities.

However, your Commodore 64's microprocessor, by itself, does not know how to do anything—even to load the programs. Built

into its ROM are a series of routines and programs that do all these tasks for you. When a Commodore 64 is turned on, it automatically accesses one program, BASIC V2. BASIC itself will do things instructed by programs. However, as you know, you may also type certain commands in from the keyboard without any program at all being in memory. For example, you can type LOAD"filename",8 or PRINT FRE(0) to do various things. Within BASIC you have a simple operating system that manages some jobs for you.

Your disk drive also has ROM, with its own "disk" operating system. The disk drive needs to know what to do when it receives the command LOAD"filename",8. The ROM tells the drive to start up, move a stepper motor controlling an arm with the read/write head, and access the disk's "directory" track. Then, when your program is found, the disk drive is instructed by the operating system how to read it, how to send the data back to the computer, and what to do when finished.

Because the disk operating system is built into the so-called "intelligent" disk drive, it does not take any of the Commodore 64's memory. In addition, you can perform other tasks with the computer while it finishes obeying a command (other than LOAD, of course).

Many computers other than Commodore use a slightly different technique for accessing disk drives. The drives themselves will be "dumb," with no means of deciding what to do or how to do it. Instead, detailed instructions for every task must come from the computer itself. These instructions, a program like that in the ROM of the 1541 disk drive, are an operating system that is stored, at least in part, in the computer's memory.

Such computers, when turned on, will not "boot up" in BASIC automatically. Instead, a short "bootstrap" program in their ROM tells the computer to start up the disk drive and read into memory a certain sector (usually the first on the disk). Then, the loader instructs the computer to RUN that particular program. This boot sector program will, in turn, load other information from the disk the essential parts of the disk operating system. The system, usually called DOS for short, stays in memory and acts as a "traffic cop" for the other operations of the computer. A large or complex DOS will not all be in memory at once. The computer may have to access portions called "overlays" that are still on the disk. These are loaded into memory, used, and then written over with other overlays as needed.

With a DOS, a computer's "command" mode is unlike that seen

in BASIC. BASIC programs cannot be run directly. It is necessary to load BASIC (which is itself a program) first, before accessing the BASIC commands to load a program. DOS commands are, however, usually a lot more powerful than those available from the Commodore 64's operating system. You can tell the DOS to copy several programs, format a disk, list a program, or perform a series of tasks, all with simple chains of commands.

This discussion was a roundabout way of introducing CP/M, which is a disk operating system. CP/M was developed by Digital Research in the mid-1970s as an operating system for a family of microprocessors. Those microprocessors include the 8080, 8085, and Z80 chips, which are all 8-bit microprocessors. Some computers using those chips (and that can be fitted with CP/M) are the Radio Shack Model 4 and the Kaypro II. CP/M has also been updated for the 16-bit "big brothers" of that family, notably the 8086 and 8088 microprocessors used in IBM Personal Computers and compatibles.

CP/M will not operate with computers having only a 6510 or 6502 microprocessor, such as the Commodore 64, VIC-20, or Apple IIe. However, some machines, particularly the Apple and the Commodore 64, can be fitted with a special adapter that contains a Z80 card and the circuitry needed to boot the CP/M operating system. The Commodore 64 CP/M adapter has some shortcomings. However, CP/M is an important enough expansion option that I felt it essential to include the DOS in this book.

Just what are the drawbacks? Any CP/M for the Commodore 64 will have no graphics or color capabilities. Operation will be strictly monochrome with alphanumerics. CP/M programs, for the most part, are set up for 80-column screen widths. Unfortunately, Commodore's version of CP/M only accesses the standard 40-column Commodore 64 screen. Many CP/M applications programs are written for an 80-column screen. Therefore, you will get two lines for every one intended to be displayed. This can cause problems, especially with menus written to fill a screen.

Another drawback is that there are few CP/M disks available, at least at this writing, for the 5½-inch Commodore disk format. Unlike 8-inch drives, which at least have a standard IBM "interchange" format, there is no standard disk format for 5½-inch drives. Since Commodore 64s using CP/M are so rare (and should continue to be so, as compared to the huge numbers of these computers already in the field), it is unlikely that many software vendors will make disks available in the Commodore format.

You can, however, download programs from any of the vari-

ous CP/M bulletin boards around the country. These are public domain programs that you may use freely and, after downloading them, store on your own disks. There has been talk of CP/M becoming available for the Commodore 64 from other vendors as well, with at least one offering an 8-inch disk drive option. In this configuration, you should be able to load and run any CP/M program compatible with the machine's 40-column screen.

Since CP/M was developed so long ago, you might think that it might be an archaic, difficult-to-use operating system with little power. Some purists think so, but these are the same people who feel that 8-bit computers like the Commodore 64 are useless Model T's.

However, CP/M has been upgraded considerably since its initial release. The widely used CP/M 1.4 has been generally supplanted by CP/M 2.2, a much more powerful and easy-to-use system. CP/M 3.0 (CP/M Plus) and Concurrent CP/M are even more recent upgrades. These very powerful tools (Concurrent CP/M allows running several tasks at one time on a single computer) may very well be available for the Commodore 64 at a later date.

In the meantime, CP/M has one important advantage for the Commodore 64 user, particularly those who want to apply their computers to business. There are several thousand tested, debugged, and low-cost programs available that run under the CP/M operating system. Nearly any possible program you would want is available. Many are in the public domain and can be purchased from CP/M user groups for little more than the cost of the diskette. Others have been sold in the hundreds of thousands and are priced very low.

Another limiting factor, if you can call it one, is that most of the programs available are set up for business. Accounts payable/ receivable, general ledger, inventory, and similar programs abound. There are also many utilities and communications programs that let CP/M computers transfer files and programs to other computers.

Fewer in number are games (because of the lack of graphics capabilities) and home or personal programs. However, given a universe of thousands of CP/M programs, you will still be able to find dozens of programs that suit your needs.

The projected cost of CP/M adapters for the Commodore 64 will probably preclude its use by the home computerist anyway. However, given the low price of the basic machine, that configuration could be a cost-effective business tool. For those with some other CP/M computer at work, it may be convenient to adapt their Commodore 64 at home to use the same programs.

Is CP/M obsolete: Has it been supplanted by more modern operating systems like MS-DOS[®], Unix[®], or p-System[®]? Although CP/M has been knocked about severely in the past year or two, it is on the rebound. CP/M is appearing on many of the new 8-bit and 16-bit computers from all the major manufacturers.

For an "antiquated" operating system, CP/M and its CP/M 3.0 (CP/M Plus) and CP/M-86 brethren are displaying surprising vitality. Although the same computer science purists who abhor BASIC usually favor some other operating system, manufacturers aren't paying attention. For every new system introduced that supports Unix, you'll see four that use CP/M.

The reason is simple: there are thousands of programs tested, ready to run, and available for any new computer using CP/M. Manufacturers know that software sells hardware; they don't really care that programmers would prefer an operating system that has nifty I/O capabilities or some feature that makes it simple to manage huge quantities of memory.

So, like it or not, CP/M will be a de facto standard for business users for a long time to come. In fact, it is chiefly business operations that will appreciate the wide variety of general ledger, accounts payable/receivable, and other programs available. Hobbyists and home-computer buffs will not find the capabilities they are looking for until the graphics enhancements announced by Digital Research and other features are added.

Make no mistake, though: CP/M is no primitive throwback to the Stone Age. It has features that would make users of other systems envious. They would love to have the "wild card" file name specifiers, for example. This feature allows KILLing a raft of program test clones named, for instance, TEST1.BAS, TEST2.BAK, and so on, with a single ERA TEST*.*—which is simpler than OPEN me" any day. Other CP/M features are equally sophisticated.

If you want to convert your Commodore 64 to CP/M, you should be sure to get a clear, easy-to-understand book. The new-comer to CP/M will be lost quickly by the Digital Research manuals. These seem to assume that the user is a computer expert and perhaps assisted in writing the source code for CP/M. Experts will love them. All others, which includes most business users, should go out and buy a good basic introduction to CP/M.

Then, start hunting up programs. You'll find that CP/M has broadened your Commodore 64's horizons in the programming area considerably.

12 Joysticks and Other Controllers

This book has not dwelt heavily on expansion in the games area for a simple reason. Most of the add-ons for the Commodore 64 covered so far have applied as much to games as to any other area. In other cases, expansion has little effect on the computer's use of games. Color monitors, of course, do provide a more attractive field for games-playing. Most games are available on plug-in ROM packs or both disks and cassettes, so the storage medium is of almost no consequence. Printers are rarely needed for games. And, your VICMODEM is only an indirect way of gaining access to a few more on-line games, like those available through The Source or Compu-Serve.

Joysticks, on the other hand, are almost synonymous with games-playing. As recently as ten years ago, a "stick" was something found in an airplane. Within a few years, the first hobbyist computer owner/builders were rigging up so-called "joysticks" out of old potentiometers and other electronic parts in order to provide an alternate input method for their early personal computers.

Some of the initial "mass market" home computers, like the Apple II, could also be fitted with joysticks. However, it took the arcade/home-video game craze to firmly plant joysticks into the lexicon, as well as into the hands of any gamer old enough to handle "PacMan[®]!" Like nearly every other home computer on the market today, the Commodore 64 has a provision for using joysticks, as well as other controllers.



Figure 12-1 Two joysticks can be plugged into the ports on the side of the Commodore 64 to provide control for games and other programs.

Joysticks can be constructed in one of two ways. Some computers use potentiometer-type joysticks, which are two continuously variable resistance switches, much like the volume controls on your television. The potentiometers are mounted at right angles to each other and attached to a lever in such a way that if the lever is moved right and left, switch 1 is adjusted in value while switch 2 remains at the same value. Moving the lever up and down alters the value of switch 2 while allowing switch 1 to remain at rest. Diagonal movement produces changes in both switches.

Given this scheme of things, the computer not only knows which direction the joystick is pressed, but also how far. The information fed back to the computer is not only in the form north, south, east, and west, but also northeast, southeast, and so on. In addition, the computer also knows whether the switch is oriented a little north or a lot north. Such joysticks are usually not self-centering and are useful for precisely positioning a cursor somewhere on the screen. Those with computers that accept this type of joystick find them useful for drawing on the CRT, such as for computer-assisted design and drafting applications.

Some think that a better choice for games is the simpler joystick used by the Commodore 64, as well as by the Atari 2699 video computer system, the VIC-20, and many other machines. These have five simple leaf switches built in, which are always either "on" or "off." When the joystick is pressed north, the switch at the top or front of the device is closed, and all the others are open. Moving right (east), left (west), or down (south) produces similar results. As you know, an Atari-style joystick can also be pressed diagonally. In these cases, a pair of switches is closed at one time. When oriented northwest, both the north and west switches are closed.

These joysticks do not tell anything about how far you have pressed the lever. Instead, the computer or video game checks the joystick status many times a second, usually before it is ready to move a screen object or do some other task. If the joystick is pressed up at that moment, the object will be moved up. This is why games respond to your joystick's movement so quickly—the computer actually checks hundreds of times a second, much faster than you can react to the game.

There is also a fifth switch in your joystick, much like the others, underneath the red "fire" button. The Commodore 64 checks the status of this switch at the same time it is looking at the other four, many times a second.

It reads the status of these five switches (actually, ten in all, because the Commodore 64 can use two joysticks) through two "ports." A port is simply a computer term for a gateway from the computer to the outside world. The status of the two ports used for each joystick is stored in a pair of memory locations. If you have done some programming, you know that the color of the screen or the border may be determined by PEEKing a memory location. The number found there tells you what the relevant color is.

In many such operations, such as the color example used, there are many combinations of values that may be in the memory location. One value might be stored for red, another for green, and so forth. However, when using joysticks, each switch can be only "on" or "off," just like a binary bit. So, it saves memory space to store the status of all five switches per joystick in a single 8-bit byte. Looking at the status of the proper bit within each byte tells us whether a certain switch is on or off.

It is possible to find out the status of a given bit by using the AND operator. ANDing a number with an appropriate power of two will tell us how that bit is set (this is called Boolean logic).

The byte that outlines the status of one joystick is found at memory location 56320. The other joystick can be read by an identical routine, but by substituting location 56321. A program line like IV-15–(PEEK(56320) AND 15) will produce a value for JV that relates to the orientation of the joystick. Consult a good book, such as the *Commodore 64 Programmer's Reference Guide*, for a detailed explanation of programming joystick operation.

Programs you write, plus those of commercial software houses, may access the joystick information in order to determine the actions of various games and other programs. You needn't be limited to recreational software, however, in your use of joysticks. Computerassisted design and drafting programs take advantage of joysticks' capabilities. There is no reason why a joystick can't be used to enter other forms of input, such as a menu. "Up" could represent one menu choice, "down" another.

Atari-style joysticks are available in many different configurations, thanks to the proliferation of video games. Those used for your Commodore 64 do not need to be quite so elaborate. The sturdy models marketed by Atari or Commodore will do just fine. If you are heavily involved in games-playing, you might want to consider a more rugged model or one with fancy fire button placement. Be sure to test out your joystick with the Commodore 64 or obtain return privileges. Some joysticks do not use all nine pins of the connector because they are not required for the Atari 2600 that the stick was designed for. Some Commodore 64 applications require a fully wired joystick, however.

In surveying available joysticks, consider apparent sturdiness of the joystick lever. It will get heavy use. If it seems a bit flimsy, light in weight, or uncomfortable to hold, pass that model by. Look at fire button placement. Some models have two or more fire buttons. Left-handers will want a button on the right side of the joystick or, perhaps, on the grip handle itself. A popular location is on top of the stick, where the button can be pressed by the thumb.

There are many joystick alternatives you might want to look into. Some controllers use five buttons instead of a stick to simulate certain kinds of arcade games (such as Defender®) more closely. The trackball, a sort of rotating cue ball controller like that found in arcade versions of Missile Command®, is gaining in favor.

The Commodore 64 can also be fitted with four paddle controllers, one pair for each of the two ports. These provide rheostatlike control in a single direction only and are used to move the player's screen object back and forth across the bottom of the screen or along the side, Pong-like. Like the rheostats used in analog-style joysticks, paddles tell the computer the position of the cursor at the current time rather than the direction of travel. However, because of
the limited flexibility of movement, paddles are not used much in modern video games. In addition, reading them is less reliable from BASIC with the Commodore 64 than monitoring joysticks. While this situation improves somewhat when machine language routines are used, you will find few programs using paddles on the Commodore 64.

Another rarity is the "light pen." Looking a bit like a penlight with a cord attached, the light pen is used to tell the computer where on the screen the pen is touched at any given instant. In use, the operator's program may display a menu, with white boxes next to each choice. The light pen is touched to the box on the screen next to the desired selection, and a trigger is pressed. While the trigger is pressed, the light pen sends a signal to the computer at the instant its photocell senses a pulse from the monitor's video scanning. Since the computer knows the exact point on the screen it was "painting" with light at that instant, it also knows where the pen was placed. The programs take advantage of this information to branch to the desired subroutine and carry out the requested task.

In other light pen applications, the computer keeps track of where the pen is traced and turns on the picture elements in relevant locations. This allows the user to "draw" on the screen with the light pen. There are many other uses for these devices, which are gaining favor as educational and engineering tools. Not many light pens are



Figure 12-2 A light pen allows "drawing" on the screen. Like the other controllers, the light pen requires special programming to take advantage of its features. (*Photograph courtesy Futurehouse*)



Figure 12-3 A numeric keypad is another input accessory available for the Commodore 64. (*Photograph courtesy Cardco, Inc.*)

available for the Commodore 64, nor is much software geared up to take advantage of these tools. However, look for an improved situation in the future.

With that, we have the controller picture fairly well under control. Now, it's time to go on to some Commodore 64 applications, such as word processing.

13 Applications: Word Processing

We have covered all of the major hardware options for the Commodore 64, from disk drives to color monitors. In addition, there have been some lengthy discussions of things you can do with your computer, especially in the area of telecommunications.

Now, we turn to the rest of the Commodore 64's expansion opportunities. These encompass three basic areas: miscellaneous hardware add-ons, such as joysticks; applications software, such as word processing; and utilities that make using the computer's music, graphics, or other capabilities easier or more enjoyable.

You'll find what you should look for in selecting any of these for your own computer, as well as brief discussions of what you can do with the accessories, applications, and utilities mentioned. When you've finished this section, you'll be an expert on the Commodore 64's expanding universe.

All the hardware expansion options increase the number of things the Commodore 64 is capable of doing given the proper software. Without software, however, the machine is little more than an impressive desk decoration. Word processing is one of the most popular applications for home computers, and, therefore, wordprocessing software is one of the hottest-selling program items.

Nearly everyone writes letters, sends in mail orders, keeps notes, prepares homework assignments, or sends memos. All of these tasks are more efficiently done with a computer. With your Commodore 64 you can compose your text material on the screen,

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change sentences, move blocks of information around, and store it on disk or cassette for permanent reference. A letter can be assembled from existing sample paragraphs, or one letter customized for many different recipients. Then, when the writer is satisfied that everything is perfect, a hard copy can be printed out at the press of a few buttons. There are no typing mistakes other than errors not caught while proofreading on the screen.

Previous chapters have discussed some of the enhancements that can be made to improve your computer's functioning as a word-processing device. Text is easier to examine and edit with an 80-column screen (although the Commodore 64's stock 40-column screen is perfectly workable). Output is much more impressive on a letter-quality printer. Monitors are preferable from a readability standpoint. Disk drives store and retrieve text much faster than cassette tape recorders. With those details out of the way, you should know how to choose the final element: the word-processing software itself. Here are some things to look for:

EASE OF TEXT ENTRY

Your word-processing package should be as simple to use in the text entry mode as possible. Does the program "wrap" words around from one line to another? With a typewriter, you must hit carriage return after the last word on a line. Most computer programs do not require this, but will split a word in the middle automatically when dropping down a line. Some find this objectionable. More sophisticated word processing packages will automatically end the screen line after the last word that will entirely fit. The resulting screen text is easier to read. However, even programs without this feature will not split your words when printing the text.

Can you enter required carriage returns, tabs, and special characters (such as printer codes) easily while entering text? Ideally, the program should take advantage of the Commodore 64's special function keys for some of these tasks. Can you specify background and character colors so that combinations that do not look good on your television or monitor screen can be avoided? Is backing up current text simple enough that you will do it regularly? If there is a power failure, all the text in memory can be lost, so frequent backups to your disk or tape should be easy and nearly automatic.

EASE OF EDITING

Can you edit text simply by moving the cursor around, or is it necessary to edit Text Entry mode and go to some awkward Edit mode? Find out how difficult it is to move and insert blocks of text. An easy way is to "highlight" the desired text in some manner, usually by pressing a control key of some sort and then moving the cursor to mark the beginning and end of the block. Then, a DE-LETE, COPY, or MOVE command should be available to take that block of text out entirely, copy it to some other portion of the text, or remove it from its old location and deposit it at the new one.

Give careful consideration to the method used for deleting or inserting single characters, words, or whole sentences. Some word processors can accomplish this at the press of a couple of keys.

EDITING POWER

Can your word processing program do global searches and replaces? That is, can you enter a text string to be searched for and a string that will be used to replace it? For example, you might want to convert every use of "John Jones" to "Dr. John Jones." Many word processors can replace dozens of occurrences of a word in a few seconds.

More sophisticated WP programs allow you to perform the same task selectively; that is, it will show you each occurrence in context and ask if you wish to make the change. A few offer only this option; they should be avoided because the faster global search and replace is used most often. However, selective replace can come in handy. Suppose your text contains references to both John Jones and John Jones III. You can check each appearance and decide which should be changed.

Text "find" without replace is handy when you need to locate a position in the text and remember a word or phrase at that point. Global "delete" is like search and replace, except that there is no replacement string.

Word-processing programs will have other powerful textediting features that may be of importance to you, depending on the type of work you do. How easy is it to merge one text file with another? Can you insert a paragraph from one file into the middle of an existing one? Can you chain or append a file onto the end of another?

FORMATTING FLEXIBILITY

When it comes time to print the text, the word-processing program should be able to format it the way you want to see it. Margin and tab setting are de rigueur, but can your program also print headers and footers the way you want them? Will it number pages automatically or change line spacing within a page? Can you send control codes to your dot matrix printer to change font or character size? Are page breaks indicated on the screen before you print out?

If you use single sheets of paper, the word-processing program should have the capability of pausing between pages to wait for you to reload your printer.

OTHER CAPABILITIES

More sophisticated word-processing programs allow merging mailing lists with form letters so that each letter contains some "canned" material along with the name and address from your mailing list. Check for the ability to read your disk directory from the wordprocessing software. Look for bonuses, such as the ability to encrypt files for privacy or the creative use of color to mark text files. At lease one marketer of word-processing software for the Commodore 64 has a software option that allows displaying text in an 80-column format.

I tested this program and found that the 80-column text was a bit more difficult to read but still highly legible. If you find this mode uncomfortable for text input, the 80-column format may still be of use when formatting text because you can more clearly see how the copy will appear on a piece of paper.

Several manufacturers of word-processing software are listed in Appendix B. The list grows daily. Once you've used word processing with your Commodore 64, you may never go back to a typewriter again.

14 Applications: Spreadsheets and Data Base Systems

If word processing is the most popular application program for personal computers like the Commodore 64, electronic spreadsheets and data base/records management systems are not far behind. It's easy to see why. Both provide powerful tools for personal and business use.

Entire books have been written on both spreadsheets and data base management programs. However, I'll try to give you a quick summary on each in this chapter so you'll know what they do and what to look for when shopping for a program suitable for your own needs.

SPREADSHEETS

Electronic spreadsheets all came on the market after the pioneering VisiCalc. They are one of the first applications for microcomputers that were created first for personal systems and not just adapted from programs designed for larger minicomputers or mainframes. Spreadsheets allow you to set up a large chartlike table in your Commodore 64. The rows and columns of this array can be given various labels. For example, row 1 might be January, row 2, February, and so forth. Each of the columns across the sheet could stand for certain categories—net sales, inventory, returns, and so on. The



Figure 14-1 An array of just a few of the software offerings available for the Commodore 64.

user then enters a formula for the boxes, or "cells," under each row and column. Some of the cells need to be filled in by the operator. Others can be calculated by using data from one or more other cells. If net sales is column 1, and each of the rows represents a different month of the year, then year net sales would be represented by column 1, row 1 + column 1, row 2 + column 1, row 3 . . . all the way to column 1, row 12.

Spreadsheets allow much more complex formulas. Once a template is finished, many "what if?" projections can be made. For example, you may want to see what total sales would be if your sales force worked extra hard in June and sold twice as much. Simply make one change, and all the other cells affected by that change will be updated quickly by the program. Again, this is an oversimplification of the sorts of things that are done. More commonly, businesses use spreadsheets to see how a move like raising prices by various percentages would affect profits, or how lowering inventories would affect service levels.

In the home, you can use spreadsheets for many personal applications. Put together a template with one row for each line of your income tax return. Use the appropriate formulas where necessary. For example, medical costs are only deductible to the extent that they exceed three percent of your adjusted gross income. As this figure changes (because you may be finding and adding deductions), the amount of your medical deduction changes as well. With a well-constructed tax template, you can juggle figures to see the approximate effects of any move on your tax obligation. (Approximate, because most people will not take the time to write the full tax tables into a spreadsheet layout.)

Considering buying a new car? Use your electronic spreadsheet to set up an array with various MPG values in one dimension and different per-gallon costs for gasoline in another. You can also include differing numbers of miles driven per year. A few simple formulas will relate all these factors so you can check how much a given car will cost to drive at so many cents per gallon for gas and at various numbers of miles driven.

In shopping for electronic spreadsheet programs, check over the features carefully. How many columns across can be displayed? You may find that only four columns of 10 characters each can fit on the 40-column screen of the Commodore 64. However, all spreadsheet programs will allow moving the screen "window" to look at wider sheets, as well as scrolling down to look at more rows.

Can the column width be varied? Is it possible to "freeze" certain rows or columns (to be used as "headers") while scrolling others around on the screen? Find out how many cells can be defined by the program you are considering. If you are limited to, say, 600 cells, you can define a spreadsheet that is only 30 columns by 20 rows. Some of the more powerful products, such as Calc Result from Computer Marketing Service, Cherry Hill, N.J., allows defining up to 32 pages of spreadsheets, which can be consolidated into a single sheet.

How difficult to use are the editing features of the spreadsheet program? Can you move rows and columns? What sort of functions are included? Are the tables built by the spreadsheet compatible with word-processing or data base management programs you want to run? This sort of software "integration" is new to the microcomputer field and may come to the Commodore 64 in the near future.

DATA BASE MANAGERS

Microcomputers have long been used to keep track of various files of information for their owners. Businesses all have data bases customer or order files, employee files, or accounting records, for example. But, if you are a home user of the Commodore 64, you may



Figure 14-2 Many data base managers are favored by Commodore 64 users to keep track of files of information. (*Photograph courtesy Mirage Concepts*)

find that you, too, have many potential data files that have not been collected simply because keeping track of the information was too tedious by manual methods.

For example, do you have a stamp collection? A data base management system (DBMS) can keep track of each stamp, including when it was purchased, your purchase price, current value, unusual features, country of origin, dates of all transactions, where you have it mounted, and dozens of other facts. If you want to know about a particular stamp, simply run your DBMS and inquire about it.

Data base systems can do much more powerful things. Do you want to have a list of airmail stamps of the United States, issued before 1950, for which you paid \$2 or less? Retrieving by many different categories of information is a standard procedure for a DBMS.

Do you collect records? It would be a bit of a job entering, say, information about every cut on every album you own. Once the data

was in the computer, however, making updates when new records are purchased would be a simple task. Think of the things you can do with your new data base. Have you wondered, perhaps, exactly which album tracks in your collection feature Nat Adderly? Or how many eongs by The Clash are more than four minutes in length? Is there an album by Hank Williams, Jr. that does *not* feature a reference to his father in the title of one of the songs? Just ask your data base.

Anything from recipes to income tax records can be stored in a data base management system. The simple rule to follow is to ask yourself whether or not this information could be tracked more easily using a set of index cards and a few minutes a week updating the file. If the answer is "Yes!", you are probably better off with the index cards. If the answer is "No! I'd rather just forget the whole thing than wade through index cards!", you might be a good candidate for DBMS.

Data base management systems consist of a number of components. You need to be able to "create" a data base by defining the way you want the information stored. This process is nothing more than listing the different types of data and answering some questions about how you would like to label them. For example, if you were setting up a name and address file, you would name all the individual "fields" within each record. These might be "name," "street address," "city," "state," "zip code," and "phone number," as well as any other information you might want to keep in that same file. You could add "birth date," "favorite color," or "shoe size," depending on whether your data file was going to be a personal data base on your friends or a file of customers for your shoe store.

With many DBMS, it is difficult to add fields at any later date, so you should give this step some careful thought before defining your data base. Be certain to "break out" any field that you may want to search for later on. You could combine "city" and "state" into a single category, but that might make it impossible to search for only one of the two items later on. You might want your DBMS to print out a list of everyone in the file who lives in, say, Ohio. Keep this factor in mind when designing your other fields. If someday you might want to know which members of your file regularly make purchases of more than \$50 in your store, you will have to include a field for that information when you define the data base.

Most data management systems also require you to tell them something about the individual fields as well. Will the field contain alphanumeric information, such as 5217 Cline Rd.? Or will it consist only of numbers, such as 25.5, 595, and .023? Data base programs can treat these two types of fields differently. Numeric fields may be added to find totals. You may want to arrange them flush right within the field; that is, the numbers will be "pushed" all the way to the right of the field with leading blanks to fill it out. Numeric information may then line up column for column, especially if the program allows for the decimal point.

Alpha fields can be sorted alphabetically. You might want to arrange them flush left just as they would appear on a typewritten page of columns. You may have surmised that many data base programs also ask you to tell them how large each field will be. Your "state" field may be only two characters, to allow for standard twoletter state abbreviations. Your "name" field might be 20 characters long, however, to allow for longer names.

Once you have defined the data base, you will want to use the second portion of any DBMS, "data entry." With this module, data is entered for each record into the fields you have defined. Other common data manager modules allow you to define "reports" and print them. A report is just a way of listing information in the data base. You might configure one report to list all file entries from Ohio in alphabetical order. The same information could be used to prepare another report of the entire file in zip code order. The more flexible data manager modules allow sorting and extracting information by several fields.

In selecting your own DBMS, look at how large the data base may be. Mini Jini,[®] from Jini Micro Systems, allows keeping 500 45-character records, each with four fields or less, in memory at one time. Some 250 100-character records with up to 10 fields may also be used. Database-64 from Melcomp, on the other hand, allows a file to contain up to 100 records of 10 fields each but tells you how to change the program for more records or a different number of fields.

In general, DBMS that keep only a small amount of the file in memory at once will require more disk accesses and be somewhat slower. However, they will allow larger data bases. For maximum flexibility, look for data management systems that allow you to sort by several fields and to use as many fields as possible as access "keys."

Some data base systems can be enlarged beyond the size initially defined. You must either use an overly large number or divide your data file in some way. All names from A to N could be in one file, and O to Z could be in a second. Such a move makes it clumsy to search across the two files for all the entries in both having attributes that do not involve alphabetizing.

Your DBMS should be as flexible as possible because these systems allow you to literally build your own programs. The same data manager can be used as an inventory control program, checkbook balancer, hobby file system, and appointment calendar.

15 Applications: Voice and Music Synthesizers

The sound capabilities of the Commodore 64 are something to hear. Demonstration programs played through the tiny speakers of an ordinary television sound great. When the Commodore 64 is connected to a good-quality stereo system, the sounds duplicate that of music synthesizers costing many times what the entire computer system sells for.

The secret, of course, is the 6581 music synthesizer chip built into the Commodore 64. Earlier computers without this chip had much more primitive sound-generation capabilities. Some can produce sounds through only a single voice. The VIC-20 has three musical voices and one "noise" generator with overlapping octaves. By comparison, the VIC-20's musical capabilities don't hold a candle to the many areas of control that the Commodore 64's synthesizer chip provides.

Yes, the Commodore 64 also has three voices, but in addition to pitch and duration, the user can specify the waveform of each voice, varying it from "sawtooth" to "pulse" to "triangle" to "noise." These terms may not mean much to you. However, it is the waveform of each musical note that helps give various musical instruments their distinctive timbre, or sound quality. Your Commodore 64 can play a note with four different waveforms, plus "filter" the waveform through a selection of "modulators."

Also important is the sound "envelope." This is controlled by the attack/decay and sustain/release parameters. When a note is first played, it rises from zero volume to its peak volume, then falls back to some middle range. The rate of rise is called "attack," while the speed of decline to the middle range is called "decay." That middle volume, called "sustain," can also be controlled by the Commodore 64. When the note finally stops playing, its rate of decline to zero volume is called "release." The attack/decay and sustain/release properties of a trumpet note differ from those produced by a piano. If we know each, we can duplicate the sound fairly closely with the Commodore 64.

That's good news. The bad news is that BASIC V2 does not have any commands to perform this magic other than tedious POKEs to various memory locations. For example, to play a single note in one voice to your specifications, you might have to include the following program lines:

10 POKE 54296,15	(Sets volume)
20 POKE 54277,130	(Sets attack/decay rate)
30 POKE 54278,66	(Sets sustain/release rate)
40 POKE 54273,34	(Plays middle
50 POKE 54272,75	C on voice 1)
60 POKE 54276,65	(Sets pulse waveform)
70 POKE 54275,12	(Sets high pulse rate)
80 POKE 54274,200	(Sets low pulse rate)

Length of the note is yet another parameter that must be taken care of by your programming, with a FOR-NEXT delay loop or some other means. It's nice to have that much control over a sound, isn't it? But who would want to do all that programming three times over (for each voice)? Granted, every line shown above is not needed for every note. Some are required only when you want to change some of the parameters for a given voice. However, keeping track can be a pain, even when "offsets" and special programming tricks are used to reduce the work.

It's more convenient to use one of the many "music synthesizer" programs available for the Commodore 64. These use programming to interpret your commands and calculate the PEEKs for you. A special function key might be used to change waveform. Another is used to alter the envelope. Voices can be switched at the press of another key. You can enter a string of notes, their duration, rests, and other information, and have the computer store the song or play it back at your command. Some of the more sophisticated software on the market allow the musical equivalent of word processing. The operator writes music on the screen using conventional staff symbols. The input is translated into sound when played through the Commodore 64's music synthesizer.

To get the best sound from your Commodore 64 music synthesizer, you should consider connecting your computer to a stereo system. The audio/video DIN plug on the back of the computer can be used with standard phono plugs to feed the sound to the stereo. If you are using a color monitor, the audio leads to the monitor's sound system are conveyed to the stereo instead. The difference in sound can be impressive.

Another sound "expander" for your Commodore 64 is the voice synthesizer. Because of the complexities of reproducing the human voice in recognizable form, these are often add-on hardware items that connect to the RS232 or some other port of the Commodore 64. The best voice synthesizers provide very good voice quality—at least equal to that of the latest soft drink vending machines.

Applications for voice synthesizers abound. One obvious use is to provide feedback for blind or sight-impaired computer users. Keyboard entries can be echoed aurally, data read, and other information repeated in a form that is more easily absorbed by those with vision problems. Very young children also have difficulty reading the CRT screen even though their sight is perfect. With a voice synthesizer, instructions can be given verbally and the child asked to respond by pressing a joystick, hitting a number or letter key, or making some other response. Even children who cannot read will be able to recognize the alphabet and numbers from one to nine, and thus operate simple computer programs.

Voice synthesis also has applications in making programs friendlier for both the new and experienced user. Directions and prompts can be in voice form, allowing the operator to concentrate on the task at hand.

These devices are one Commodore 64 accessory that you should attempt to try out before you purchase or at least buy with return privileges. The sound quality of voice synthesizers varies widely. Some may produce an almost unrecognizable "robot" voice that takes a great deal of getting used to. Such a synthesizer may be acceptable when used by a small number of operators repeatedly, but if your application involves greeting new users continually, you will want a more sophisticated synthesizer system.

Beware also of the text-to-speech algorithm. Some voice syn-

thesizers have a limited vocabulary of a few hundred words they can say. Others require you to translate the words into a fixed set of syllable sounds, or phonemes, that the synthesizer can pronounce using a complex series of rules. Using these synthesizers is very time-consuming. Others have a built-in algorithm with a series of rules that allow the synthesizer to translate any ASCII text into a close approximation of the correct sounds. The software can be fooled, however, so that "computer" comes out "compooter." However, the pronunciation is nearly always close enough to be understood. You may wish to tolerate the occasional miscues or just misspell the word involved (e.g., "compyuter").

Voice synthesis is still in its infancy. As special voice chips produced specially for that function become more sophisticated, before very long we should see everything from speaking automobiles and vending machines (What? They already do?) to talking computers.

16 Utilities

Utilities save you time in doing programming, computer maintenance work, and other tasks. Many chores that take a great deal of time to do in your head, with pencil and paper, or even at the computer keyboard can be accomplished in much less time with a utility program written for that task.

Consider for example, the job of copying a full disk for backup purposes. If you have two disk drives, the job is fairly straightforward. But what if you have, like most Commodore 64 owners, only one disk drive? Do you really have to LOAD every program into BASIC and then SAVE it to the backup disk? Will this work with machine language programs? Using manual methods, making a full disk backup even of BASIC programs could take an hour or more.

Instead you can use one of the many disk-duplicating programs available for the Commodore 64. Commodore's own disk "starter" bonus pack includes a program called "1541 Backup" that will do the job automatically. You can ask the program to copy only the programs on the disk or to make an exact duplicate. With the former option, the copy program will check the block allocation map (BAM) to see what programs are on the source disk and copy only those sectors. If you have only a few programs on the disk, such a backup can be performed in a few minutes.

On the other hand, you may want a full copy of the disk for some reason. This type of backup takes a bit longer—15 minutes or so during my tests. Even though the copy program supposedly does



Figure 16-1 A numeric keypad can be useful for working with utilities, such as monitors, where large amounts of numeric input are required. Such pads also come in handy for business applications. (*Photograph courtesy Computer Place*)

a sector-for-sector copy, this program will not work on some copyprotected disks.

In operation, the Commodore backup program first formats your target disk. This step is performed even if the disk has just been formatted by an aborted backup, but it takes only a minute or two. Then, disk data is loaded into the Commodore 64's memory. When this buffer is full, the operator is instructed to remove the source disk and reinsert the destination disk. When backing up disks with many free blocks remaining, one cycle may be enough to complete the process. Other times (as when making a full disk copy) the disks will have to be swapped four or five times.

There are other disk-duplicating programs available that may be faster or have more capabilities in copying protected software. Check the latest computer magazines for descriptions of the newest versions.

Another type of utility program adds features to Commodore BASIC V2, making your Commodore 64 an even friendlier computer. A series of programs called "Disk Support" and "Disk Retriever," marketed by H & H Enterprises of Milwaukee, lets you "unscratch" files that you have killed and do SAVEs and LOADs (among other functions) at the press of a few keys. Commodore's infamous "save with replace" bug has also been corrected. (The command "@SAVE" would sometimes destroy a file so that, to be safe, it was necessary to first scratch a file before SAVEing it under the same filename.) Commodore also provides a "wedge" program with the 1541 disk drive that can be used as a utility to speed many simple disk commands.

Simon's BASIC, the latest Commodore innovation, will also add various commands, but it is significant enough to deserve a more thorough discussion later in this book. It is a great deal more comprehensive than most utility programs, which generally perform just a few new tasks.

Very advanced programmers like to use machine language or assembly language to write programs that can be more directly understood by the Commodore 64's 6510 microprocessor chip. Programs called "monitors" (not to be confused with the video kind of monitor) allow looking directly at memory locations, writing new data in the form of machine code, and performing other tasks at what are called the "lowest" level of machine language. Previous Commodore computers (the PET series, for example) had monitors built in. Various firms have provided this software as a separate package for the Commodore 64. There have also been monitor programs published in magazines like *Compute!* that you can type in and run.

The next step up from the simple monitor is the editor/ assembler/disassembler-type program. The best of this type is "Develop-64," from French Silk Smoothware in Cannon Falls, MN. This type of software allows you to use mnemonics, which make up a type of medium-level language that the programmer can work with much faster than the binary-only machine code. Once a program has been written in assembly language, it can be "assembled" into machine language program that can be run by the Commodore 64. The editor part of the program allows you to write and change the assembly language listings. A disassembler takes machine code and breaks it down into mnemonics that may help the programmer understand and change the code.

Another useful utility is the so-called "sprite editor," which is to graphics what the music editors and synthesizer programs are to sound. The Commodore 64 has graphics features that are as innovative and powerful, when compared to many other personal computers, as the machine's synthesizer. However, BASIC V2 has few commands that let you use these graphics features. It is relatively easy to embed graphics characters in a BASIC program by using PRINT statements. Faster, more flexible graphics can be accomplished by POKEing any of 255 characters to character memory and POKEing various colors to the corresponding location in color memory.

However, the Commodore 64 also features "sprite" graphics. You can design a special character using a detailed grid 21 pixels down and 24 pixels across. These sprites are much mor sophisticated than simple screen characters, which also may be user-defined but are limited to an 8×8 matrix. Once a sprite has been designed, the computer will take care of drawing it on the screen in each new location that the user specifies. Up to eight different sprites may be used in any of 15 colors. Multicolor mode can be used with sprites, and you can "expand" the sprite in the vertical and horizontal directions, or both.

Sprites have "priorities" on the screen; that is, a sprite with a higher priority will pass "in front of" a sprite with a lower number. The effect is almost three-dimensional, and quite startling. There is also a provision for detecting collisions between sprites so that games can be programmed.

The feature of sprites all sound fantastic, don't they? Unfortunately, as in the music area, Commodore leaves you with no commands and a lot of work in using sprites. Just designing a sprite manually can be difficult. In BASIC, the technique involves laying out a 21×24 grid and marking each of the 504 locations as either "on" or "off." Each set of eight locations makes up one byte of information, for a total of 63 bytes that must be converted from the "on" and "off" binary into a decimal equivalent. The decimal numbers are then routinely placed in DATA statements and POKEd into the appropriate memory slots reserved for the individual sprites.

An easier way of doing this chore is to use a sprite editor. You can move the cursor around the editor's enlarged grid, turning pixels on and off as you please. Once the sprite has been designed to your satisfaction, press a key, and the editor generates the necessary numbers for you automatically. Some even allow building sprites into a file that can be SAVEd to disk and loaded by your own programs.

Although moving sprites around on the Commodore 64 screen from BASIC is probably too slow for most applications (they really shine in machine language, though), if you do choose to use sprites in your own programs, an editor program is the only way to go.

17. Languages

New Commodore 64 owners are sometimes surprised to discover that BASIC is not the only, nor even the first, language available for computers. Most of us never give the subject of languages much thought. When you turn on the Commodore 64, BASIC is there, ready for your command. Every personal computer of consequence has come with some form of BASIC furnished, and that is the language that most of us learn first. Computer scientists and programming purists will point to various defects of BASIC and single out some other high-level language as deserving the status of "standard" personal computer dialect.

True, BASIC is somewhat clumsy for many tasks and encourages sloppy, unstructured programming. Program mazes full of GOTOs and GOSUBs are difficult to traverse. Because it is so easy to learn and there are already so many computers available that can use BASIC, however, it will remain as the de facto standard language for some time to come.

One of the most interesting aspects of BASIC is that while a "standard," there is no standardized form of BASIC. The Microsoft version, found on Commodore computers as well as Radio Shack, IBM, Apple, and many of the other leading brands, is the closest to a standardized BASIC. However, there are many differences even among these computers using different editions of the same BASIC. For example, GET A\$ would be translated as A\$=INKEY\$ in other Microsoft dialects. While the Radio Shack Model 4 would use

"RND(6)" to produce random numbers in the range 1 to 6, the Commodore 64 requires the syntax INT(RND(1)*6)+1. There are many other small differences, even though the Microsoft BASICS are all very similar.

While similar commands and statements are different, some BASICs are more "extended" than others. Commodore BASIC V2, found in the VIC-20 and Commodore 64, lacks many useful features. Commodore's own "professional" computers use a BASIC 4.0 that has advanced capabilities. The BASIC A supplied with the IBM Personal Computer has dozens of commands not available with the unexpanded Commodore 64. These include renumbering commands, AUTO capabilities, and ON KEY statements that interrupt a program whenever a special function key is pressed.

Those who are interested in widening their Commodore 64 options will want to consider one of the BASIC enhancement utilities available for their machine. These programs add the needed extensions to make BASIC V2 into a worthy competitor with the BASICs found in other computer systems. Two of the best are the VicTree utility, marketed by Skyles Electric Works, and Simon's BASIC, sold by Commodore. Others may be found as well. Look for any utility of this type in a plug-in ROM cartridge rather than in disk form. ROM cartridges use none of the Commodore 64's RAM, leaving the maximum available for programming. Disk-based enhancements, on the other hand, must be loaded into protected RAM locations and isolated from your programs.

Simon's BASIC is the newest of the BASIC language extensions, which are also called "computermer's tool kits" because of the shortcuts they provide. With more than 100 new commands, the Simon's program is more comprehensive than most. What is provided are simple commands that allow better and faster graphics and sound programming, some code-writing utilities, and better editing procedures. When writing programs, some of the commands can be used in direct mode. Others are incorporated into the programs themselves and can only be used with computers that have loaded Simon's BASIC prior to run time.

Programmers will appreciate commands like AUTO, which lets the computer number program lines automatically as you enter them. RENUMBER will take line numbers (which might have odd numbers because the programmer has inserted new lines between old) and change them to a more evenly incremented arrangement. An OLD command un-NEWs a program that has been erased by mistake, while several other commands are available to hide program lines from normal LISTing procedures. FIND allows searching for commands and strings when the programmer wants to locate a certain word in order to change it to something else.

Simon's BASIC also adds statements that can be incorporated into program lines to add functions and capabilities lacking in BASIC V2. For example, MOD, INSTR, PRINT USING, and PRINT AT are all common statements in many versions of Microsoft BASIC. Simon's BASIC adds all of them plus many more. Disk commands are also included to speed up LOADing, SAVEing, and writing files.

The BASIC enhancements in the sound and graphics area make these capabilities practical for novice and intermediate programmers for the first time. REC, CIRCLE, and ARC commands permit drawing those figures on the screen by supplying the program with the proper coordinates. Dots can be plotted, lines drawn, and figures colored in (using PAINT) with single program lines rather than a half dozen or more.

Sprite commands add to the graphics capabilities, while the music statements (including VOL, WAVE, and ENVELOPE) provide some of the features of the music/synthesizer editors discussed previously.

Advanced programmers will appreciate the structured features similar to those found in Pascal and other languages added by Simon's BASIC. Procedures can be defined, and appreciated features like REPEAT . . . UNTIL are supported.

Given the large number of Commodore 64s installed before BASIC enhancements like Simon's became available, it's doubtful that the new version will become the "standard" BASIC for the Commodore line (that is, until the company introduces its next home computer). So, you should be aware that any programs you write taking advantage of these features will not be readily transportable to other Commodore 64s. The other machine must also have the same BASIC enhancements. Only commercial programmers need be concerned with this aspect, however.

BASIC, enhanced or otherwise, is not the only high-level language available for the Commodore 64. There are a number of options open should you want to expand in this area. Those with a CP/M adapter and 8-inch disk drives can use dozens of languages that run under CP/M. adapter and 8-inch disk drives can use dizens of languages that run under CP/M. These include CBASIC, MBASIC, Microsoft's BASIC Compiler, FORTRAN, Pascal, and FORTH.

Some companies also offer languages such as LOGO and PILOT for the straight Commodore 64. Both these are especially suitable for young programmers. LOGO uses turtlelike graphics and simple commands to let beginning users make their cursor draw on the screen. LOGO also has applications for more advanced programming. PILOT is a simple language often used by instructors because it simplifies providing a list of "matching" possible answers that can be compared against a user's input.

At this time some of the very popular languages, such as Pascal, can be difficult or impossible to obtain for the Commodore 64 (at least, without adding CP/M first). However, as the huge base of users attracts programmers, more languages should be added to the Commodore roster.

18 Commodore 64 AND BEYOND

Once you've explored every option discussed in this book and added all the hardware and software that will increase the abilities of the machine, where do you go? Possibly the ultimate in Commodore 64 system expansion is the addition of a second computer. There are already many two-computer families, either with one unit reserved for "serious" computing or both machines available to everyone equally. As computer use becomes a more regular part of your family or personal life, you might find that having more than one computer can be enormously beneficial. With its power and low cost, the Commodore 64 lends itself to multiple-unit installations.

For instance, one computer might be used by the kids for homework or to play games while the second is available for various personal applications, such as word processing and data base management. No family member need worry about bothering another if tandem computers are available. The second Commodore 64 could also serve as a backup to the first. Should one be out of service, all computerized functions need not stop while repairs are made. It is highly unlikely that the Commodore 64, once "burned in," will ever require maintenance. However, human-caused accidents (such as the "spilled-Pepsi"[®] syndrome) do happen. It may surprise you now, but once you have gotten used to accessing a computer for information or using it for your word-processing chores, manual methods will be anathema to you.

In most cases, it won't be necessary to duplicate your original

investment to add a second Commodore 64. Perhaps a monochrome monitor or old black-and-white television set (\$100 or less) could be used as the CRT for the second machine. If the two computers are set up side by side, one printer, disk drive, or Datasette recorder can be used for both simply by switching cords. Software, of course, is completely interchangeable between the two, as are modems and other devices.

A second dual-computer configuration would be to have a pair of Commodore 64s split between two locations. You might want to keep one at your office and one at home in order to do work at both places (or play games at either site when no one is watching!). In such a situation, some duplication of peripherals will be necessary. You might want to have a printer only at your office and simply transport from home files that must be printed out to that location. However, mass storage, either a disk drive or cassette recorder, will be required at both computers. It is possible to move one Datasette unit back and forth between two computers, but very inconvenient.

Perhaps you don't want to have two identical computers. From a cost standpoint, it doesn't make sense to buy a competing brand because few cost less than the Commodore 64 itself. However, you might have the opportunity to pick up a used more costly second computer at an attractive price. Or you may wish to learn a second computer system for personal or business reasons.

Your first choice should be within the Commodore line. The new Commodore Plus/4 might be considered. One of the PET computers or the higher priced CBM professional series would be a good choice. Some of the peripherals are interchangeable. Importantly, Commodore sells a PET Emulator utility that allows your Commodore 64 to load and run many PET programs. Software using only a 40-column screen will be most successfully transported, but the Emulator is sophisticated, even translating many of the more common PEEKs and POKEs into the Commodore 64 equivalents.

Next, you should consider the VIC-20. Disk drives, Datasettes, monitors, modems, and printers are all completely interchangeable. Some software has been written to work with both Commodore 64s and VIC-20s. The VIC requires memory expansion to use many programs, however, and cartridges that plug into the user slot are completely different. Nearly all games cannot be swapped between the two machines, because their screen graphics and joystick routines are entirely different. However, the VIC-20's low price makes it an attractive option. I used a VIC-20 with its Programmer's Aid Cartridge as an accessory for my Commodore 64 while preparing several books of programs for the latter machine. Since no renumbering utility was available for the Commodore 64 at that time, each program as completed was loaded into the VIC-20 and renumbered with the Programmer's Aid Cartridge utility as required.

Once you leave the Commodore line, the compatibility between computers is greatly reduced. No other computers can load Commodore programs and run them directly. You may be able to transmit many BASIC programs to and from the Commodore 64 to another computer using a smart terminal program with uploading and downloading capabilities. Then, with appropriate editing the software may be adapted to the new machine. Disk drives and cassette recorders, as well as many other hardware accessories, cannot be swapped. Some printers, especially those using the RS232 or parallel ports, can be used with several different computers. Outboard modems, attached through the RS232, can certainly be adapted. Monitors and televisions can also be interchanged.

What computers should you consider? At the high end are the IBMs, Apples, and Radio Shack computers that cost \$1000 or more for basic systems. At the low end of the scale are many computers that compete more or less directly with the Commodore 64 either in features, price, or both. The most popular at this time are the Radio Shack Color Computer, the low-end Atari line, such as the Atari 600, and any of several Timex Sinclair models.

In the past, the most significant difference in low-cost personal computers was in the keyboards. The Commodore line had great keyboards, but those available from Atari, Timex Sinclair, and, to a lesser extent, Radio Shack, were inferior. That has changed in recent years. The Timex computers have upgraded to calculatortype keys that are less convenient to use but a great improvement over the flat, membrane-type keyboard found on the old Timex computers and the discontinued Atari 400. Meanwhile, both Radio Shack and Atari have upgraded to full typewriter-style keyboards like the Commodore computers had all along.

All have 32- to 40-character-wide screen displays and either come with 64K of memory or can be upgraded to that level inexpensively. Other expansion options are not so reasonable, however. Both Atari and Radio Shack's disk drives are twice as expensive as those sold by Commodore.

However, a great deal of software for education, business, or

personal applications is available for any of the four. The BASICs are similar enough that a Commodore 64 user should be able to adapt quite quickly. None are really business-quality machines.

As the ultimate expansion, a second computer is extremely broadening. When you are ready for this step, your venture into computer literacy has obviously reached an advanced stage. Take a lot of credit for willingly spending the time necessary to learn about personal computers and their operation, but also recognize the role of your Commodore 64 as a powerful machine with open-ended capabilities that gave you the room to grow.

Appendix A

There are many on-line information services that can expand your Commodore 64's horizons. Although BRS After Dark and Delphi are two up-and-coming challengers, the Big Two remain Compu-Serve and The Source. The two are roughly equivalent in services provided, although each has idiosyncrasies and advantages the other does not.

This appendix is simply a representative listing of the sorts of services you will find available through an information utility. CompuServe and The Source were used as examples. These indexes were up-to-date as this book was completed. However, all information networks add and delete services frequently. You can get an up-to-date listing by accessing the index of both The Source and CompuServe on-line.

TYPICAL INDEX OF ON-LINE SERVICES

COMPUSERVE INFORMATION SERVICES

AAMSI MEDICAL FORUM:...GO SFP-5 AID CALCULATIONS:....GO PCS-72 AMEX PRICES (MQUOTE):.GO FIN-20 ASCMD (SIG):.....GO SFP-7 A.S.I. MONITOR:....GO ASI-10 AVSIG:.....GO SFP-6 ADVERTISING: FOR SALE.....GO HOM-24 NOTICES.....GO HOM-24 TODAY MAGAZINE.....GO EBB WANT ADS.....GO HOM-24 ADVERTISING, CLASSIFIED: STL POST-DISPATCH..GO SPD-1002 ADVICE: AUNT NETTIE.....GO NET AFRICAN WEATHER:....GO CNS-17 AGRIBUSINESS:....GO SFP-10 AGRICULTURAL NEWS:....GO CNS-14 AIR TRAVEL: FIRSTWORLD TRAVEL CLUB..GO TVL OFFICIAL AIRLINE GUIDE ... GO OAG PAN AM.....GO PAN TRAVEL FAX.....GO ESC AIR TRAVEL DELAYS:.....GO PDG AIRCRAFT:.....GO ASI AIRCRAFT INSURANCE:.....GO AVL AIRLINE GUIDE:.....GO OAG AIRPORT DELAY GUIDE:....GO PDG ALTERNATIVE EDUCATION GO AES ALTERTEXT REPORTS:.....GO ALT AMATEUR RADIO:.....GO HOM-11 ANALOGIES TEST:.....GO TMC-15 ANNUAL REPORTS:.....GO FIN-18 APPLE, PROGRAMS FOR:..GO PCS-45 APPLE USER'S GROUP:...GO PCS-51 APPLIANCES FOR SALE:....GO CUS ARCADE (SIG):.....GO HOM-138 ART GALLERY:.....GO HOM-101 ARTICLES, COMPUTER:.....GO PER ASIAN WEATHER:.....GO CNS-17 ASSOC. PRESS ACCESS:..GO IND-52 ASSOC. VIEWDATA WIRE:....GO APV ASTROLOGY GAME:.....GO GAM-45 ASTRONAUTICS:.....GO HOM-127 ATARI FORUM:.....GO PCS-132 ATHLETE'S OUTFITTER:....GO HAN ATHLETIC EQUIPMENT:.GO CUS, HAN ATLAS, SHOPPING SERVICE:.GO TRV ATTORNEYS:.....GO SFP-40 AUTHOR'S (SIG):....GO PCS-117 AUTO INFORMATION: GOV'T PUBLICATION.....GO GPO-6 POPULAR SCIENCE.....GO PSC AUTONET:.....GO A'TO AUTOS, BUYING: AUTONET.....GO ATO STL POST-DISPATCH..GO SPD-1002 AVIATION: ASI MONITOR.....GO ASI-10 EMI FLIGHT PLANNING..... GO EMI NWS AVIATION WEATHER....GO AWX CEMSIG:.....GO CEM-450

OFFICIAL AIRLINE GUIDE...GO OAG PEAK DELAY GUIDE.....GO PDG AVIATION RULES & REG:....GO AVR AVIATION SAFETY INST:.... GO ASI AVIATION (SIG):.....GO SFP-6 AVIATION WEATHER:.....GO AWX BACCHUS DATA SERVICES:...GO VIN BANKING, ELECTRONIC:..GO HOM-45 BANKS: HUNTINGTON NAT'L BANK ... GO HNB SHAWMUT BANK OF BOSTON..GO SHW UNITED AMERICAN BANK.G HOM-152 BANSHI GAME:.....GO GAM-30 BASIC COMPUSERVE:....GO PCS-73 BEEF PRICES:.....GO CNS-12 BELMONT GOLF ASSOCIATION: GO BEL BELMONT'S GOLF (SIG):GO HOM-129 BILLING, GENERAL:.....GO CIS-4 BILLING, REVIEWING:...GO CIS-176 BIORHYTHMS:.....GO GAM-29 BLACKJACK GAME:....GO GAM-13 BLISS LANGUAGE:.....GO PCS-74 BOOK, REVIEWS: AAMSI, MEDICAL JOURNALS.GO AAM HOLLYWOOD HOTLINE.....GO HHL RAINBO'S REVIEWS.....GO WIT BOOKS, ORDERING: FIFTH AVENUE SHOPPER.... GO FTH HOWARD SAMS' BOOKS GO SAM BOSTON, SHAWMUT BANK:....GO SHW BRIDGE GAME:.....GO GAM-18 BROKERAGE:.....GO UMC, GO TKR BROKERAGE, DIAMOND:.....GO RDC BUDGETING, HOME: GOV'T PUBLICATIONS....GO GPO-4 INVESTORS DIVERSIFIED.GO IDS-6 COMPUSERVE.....GO HOM-80 BULLETIN BOARD:....GO HOM-23 BUSINESS, FARMING:....GO SFP-10 BUSINESS INFORMATION WIRE:G BIW BUSINESS NEWS: AP VIEWDATA WIRE.....GO APV BUSINESS WIRE.....GO TBW CANADIAN, U.S., INT'L...GO BIW COMPUSERVE.....GO FIN-10 STL POST-DISPATCH..GO SPD-1005 WASHINGTON POST.....GO TWP-12 CB INTEREST GROUP:....GO HOM-9 CB RADIO SIMULATION: CB ETIQUETTE.....GO CB-40 DIRECT ACCESS TO.....GO CB-1 INSTRUCTIONS......GO CB-15 INTRODUCTION.....GO CB-10 CB SOCIETY:.....GO CUP

CP/M USER'S GROUP:....GO PCS-47 CAMERAS FOR SALE:.....GO CUS CANADIAN: BUSINESS NEWS.....GO BIW CURRENCY EXCHANGE..GO FIN4, BIW STOCKS.....GO FIN-4 CANNING, HOME:.....GO GPO-11 CAR CARE:.....GO PSC CAREER PLANNING:.....GO AES CARS, COMPARISON:.....GO ATO CATTLE PRICES:.....GO CNS-12 CHANGING TERMINAL TYPE: GO CIS-9 CHANGING PASSWORD:...GO CIS-175 CHARGES, MONTHLY:....GO CIS-176 CHECKING, BANKING:....GO HOM-45 CHILD CARE:.....GO GPO-8 CHILDREN, EDUCATION:....GO AAE CHILDREN'S GAMES:....GO TMC-27 CINEMA NEWS:.....GO HHL CLARKE SCHOOL FOR DEAF:..GO CSD CLASSIFIED ADS: STL POST-DISPATCH..GO SPD-1002 CLINICAL ADVICE:.....GO HSX CLOTHING, FASHION:.....GO GAN CLOTHING, SPORT:.....GO HAN COCOA NEWS:.....GO CNS-15 COFFEE NEWS:.....GO CNS-15 COLLEGE COST PROGRAM:..GO TCB-6 COLOR COMPUTER (SIG):GO PCS-126 COLOR GRAPHICS:.....GO CIS-91 COLUMBUS AREA: BANKS.....GO HOM-45 CHAMBER OF COMMERCE.....GO CCC EDUCATION.....GO CCC SIG.....GO CCC-150 COMMAND LEVEL:.....GO PCS-71 COMMENTARIES: VIDEO.....GO VIF COMMODITIES CALENDAR:..GO HCI-7 COMMODITIES FUTURE:...GO CNS-12 COMMODITIES GLOSSARY:GO HCI-230 COMMODITY NEWS SERVICE: AGRICULTURAL NEWS....GO CNS-14 COMMODITY PRICES..... GO CNS-12 ECONOMIC NEWS.....GO CNS FUTURES INDUS NEWS...GO FIN-10 FUTURES MKT PRICES...GO CNS-12 GENERAL NEWS......GO CNS-15 METALS NEWS......GO CNS-15 WEATHER.....GO CNS-17 COMMODORE NEWSLETTER:....GO CBM COMMODORE VIC (SIG):.GO PCS-160 COMM. INDUSTRY FORUM:.GO SFP-35 COMPANY FORECASTS:....GO FIN-18 COMPUSERVE COMMANDS:..GO CIS-11 COMP-U-STORE:.....GO CUS COMPUTER, BOOKS:.....GO SAM COMPUTER AIDED LEARNING: COMPUSERVE.....GO PCS-121

EDUTECH......GO CAI COMPUTER ART (SIG):..GO PCS-157 COMPUTER CLUB NEWS:

COMPUTERS & ELECTRONICS.GO CEM COMPUTER MAGAZINE INDEX:.GO PER COMPUTERS & ELECTRONICS:.GO CEM CONCENTRATION GAME:...GO GAM-32 CONSUMER ITEMS FOR SALE:.GO CUS CONSUMER NEWS:

SOFTWARE.....GO PSP-101 CONTINUING EDUCATION:.GO TCB-13 COOKING (SIG):....GO HOM-109 CORPORATE NEWS RELEASE ... GO TBW CORPORATIONS:.....GO INC COPPER FUTURES PRICES:GO CNS-12 COPPER NEWS:.....GO CNS-15 COTTON FUTURES PRICES: GO CNS-12 COTTON NEWS:.....GO CNS-14 COURT CASES, AIRCRAFT:...GO AVL CROSS ASSEMBLERS:.....GO PCS-75 CURRENT RATES:.....GO CIS-53 DATABASE, HOW TO USE:.GO CIS-1S1 DATABASE SEARCHES:.....GO IFT DATAFAMILIAE:.....GO PFL DECWARS GAME:.....GO GAM-19 DEFALTS, SETTING:.....GO CIS-6 DEPARTMENT OF STATE:....GO DOS DIAMOND SYSTEM:.....GO RDC DISCOUNTED GOODS:.....GO SAV DISK AREA:.....GO SPCS-71 DOCUMENT DELIVERY:.....GO IOD DOCUMENT RETRIEVAL:.....GO IFT DOCUMENTATION ORDERING: GO CIS-8 DRESS:.....GO GAN DRUGS, MEDICINE:....GO GPO-399 EMI FLIGHT PLANS: GO EMI EARNINGS FORECASTS:.... GO FIN-4 ECONOMIC NEWS:.....GO FIN-10 ECONOMY: FORECASTS......GO MMS EDITORIALS: WASHINGTON POST.....GO TWP-17 EDUCATION: ACADEMIC ENCYCLOPEDIA...GO AAE CLARKE SCHOOL FOR DEAF..GO CSD EDUTECH (PILOT).....GO CAI THE COLLEGE BOARD.....GO TCB THE MULTIPLE CHOICE..... GO TMC EDUCATION, FAMILY:.....GO PFL EDUCATIONAL GAMES:

SUPER BRAIN CHALLENGE.G TMC-19

WITTY WRITE-INS.....GO TMC-18 EDUCATORS' (SIG):....GO HOM-137 EDUTECH (PILOT):.....GO CAI ELECTRONIC BANKING:...GO HOM-45 ELECTRONIC BOUNCE BACK:..GO EBB ELECTRONIC HEATH CATALOG:GO HTH ELECTRONIC MAIL:.....GO EMA ELECTRONIC SHOPPING:.....GO CUS ELIZA PROGRAM:.....GO GAM-15 EMAIL:.....GO EMA EMERGENCIES, AUTO:..GO GPO-1081 EMPLOYEE BENEFITS:...GO IDS-242 ENCYCLOPEDIA:.....GO AAE ENERGY CONSERVATION: GOV'T PUBLICATIONS....GO GPO-9 POPULAR SCIENCE.....GO PSE ENERGY NEWS:.....GO CNS-15 ENTERTAINMENT: AP VIEWDATA WIRE.....GO APV COMPUSERVE.....GO GAM HOLLYWOOD HOTLINE.....GO HHL ENTERTAINMENT (SIG):..GO HOM-29 ENVIRONMENTAL FORUM:..GO SFP-38 EOUIPMENT, MINING:...GO MIN-100 EUROPEAN WEATHER:....GO CNS-17 EXESCUTIVE, TERMINAL:.GO PCS-103 EXPERT, MUSIC:.....GO MUS FAA REPORTS: Q.....GO ASI-12 FAA RULE CHANGES:.....GO AVR FOI NEWSLINE:.....GO FOI FACTS, GENERAL:.....GO AAE FAMILY BUDGET:....GO IDS-6 FAMILY LIFE:....S..GO PFL FAMILY MATTERS FORUM: GO HOM-144 FANTASY GAME:.....GO GAM-16 FARMING:.GO CNS-14, SFP-10, VIC FASHIONS:.....GO GAN FEDERAL GOV'T NEWS: WASHINGTON POST.....GO TWP FEDERAL PUBLICATIONS:....GO GPO FQSEDWATCH NEWSLETTER:....GO MM FEEDBACK, COMPUSERVE:..GO CIS-8 FIFTH AVENUE SHOPPER:....GO FTH FILGE INSTRUCTIONS:...GO CVP-23 FINANCE:.....GO FIN FINANCIAL ADVICE:.....GO TWP-12 FINANCIAL AID, COLLEGE: GO TCB-14 FINANCIAL FORECASTS:...GO FIN-4 FINANCIAL INFORMATION: GO FIN-20 FINANCIAL INSURANCE:...GO IDS-5 FINANCIAL NEWS (AP):..GO IND-52 FINANCIAL PLANNING:...GO IDS-581 FINANCIAL SERVICES:...GO FIN-20 FIRE FIGHTERS' (SIG):.GO SFP-36

FIRE PREVENTION:.....GO SFP-30 FIREPLACES, FIREWOOD:..GO GPO-9 FIRSTWORLD TRAVEL CLUB:..GO TVL FITNESS:.....GO GPO-5 FLIGHT OPERATIONS:....GO ASI-11 FLIGHT PLANS:.....GO EMI FLOWERS & PERFUME, ORDER:GO FTH FOOD & DRUG ADMIN:.....GO FOI FOOD BUYLINE (SIG):..GO HOM-151 FOOD INFORMATION: FDA.....GO FOI FOOD STORAGE.....GO GPO-7 FOR FITNESS.....GO GPO-5 FREEZING.....GO GPO-7 MENU.....GO VIC, GPO FOOTBALL GAME:.....GO GAM-27 FOR SALE: BULLETIN BOARD.....GO HOM-30 CLOTHING, SPORT.....GO HAN CONSUMER GOODS.....GO CUS FOREIGN EXCHANGE: ANALYSIS.....GO MMS FORTRAN (XF4):....GO PCS-80 FUNDS MANAGEMENT:.....GO UMC FUR TRADER GAME:.....GO GAM-36 FUTURES INDUSTRY NEWS: GO FIN-10 FUTURES PRICES:.....GO CNS-12 GAMES, COMPUTER: ADVENTURE.....GO GAM-11 ASTROLOGY.....GO GAM-45 BACKGAMMON.....GO GAM-31 BANSHI.....GO GAM-30 BIORHYTHMS.....GO GAM-29 BLACKJACK.....GO GAM-13 BRIDGE.....GO GAM-18 CHESS.....GO GAM-34 CIVIL WAR.....GO GAM-14 CONCENTRATION.....GO GAM-32 DECWARS.....GO GAM-19 DICE.....GO GAM-33 ELIZA.....GO GAM-15 FANTASY.....GO GAM-16 FASTERMIND.....GO GAM-17 FOOTBALL.....GO GAM-27 FUR TRADER.....GO GAM-36 GOLF.....GO GAM-21 GOMOKU.....GO GAM-22 HAMMURABI.....GO GAM-37 HANGMAN.....GO GAM-23 KESMAI.....GO GAM-46 LUNAR LANDER.....GO GAM-24 MAGIC CUBE SOLUTION..GO GAM-35 MAZE.....GO GAM-38 MEGAWARS.....GO GAM-20 MUGWUMP......GO GAM-39
NEW ADVENTURE.....GO GAM-12 REAL-TIME STAR TREK..GO GAM-41 REVERSI.....GO GAM-40 ROULETTE.....GO GAM-42 SCOTT ADAMS'.....GO GAM-28 SCRAMBLE.....GO GAM-43 SPACE WAR.....GO GAM-25 STAR TREK.....GO GAM-26 TRIVIA TEST.....GO TMC WUMPUS.....GO GAM-44 GAMES SCORPIA (SIG):.GO GAM-310 GAMESIG ARCHIVES:.....GO GSA GANDOLF'S REPORTS:.....GO GAN GARDENING:.....GO VIC GASOLINE, SAVING:...GO GPO-1131 GENERAL BANKING:.....GO HOM-45 GOLD: FUTURE PRICES..GO FIN-4, CNS-12 NEWS.....GO FIN-4, CNS-15 GOLF, BELMONT GOLF ASSO:.GO BEL GOLF, OFFICIAL PGA TOUR: BIOGRAPHIES.....GO PGA PLAYERS.....GO PGA STATISTICS.....GO PGA GOLF (SIG):.....GO HOM-129 GOMOKU GAME:.....GO GAM-22 GOOD EARTH (SIG):....GO HOM-145 GRAIN PRICES:.....GO HCI-10 GRAINS FUTURES:.....GO CNS-12 GROLIER'S ENCYCLOPEDIA:..GO AAE GROUND WATER:.....GO WWA HAMMURABI GAME:.....GO GAM-37 HAMNET (SIG):....GO HOM-11 HANDICAPPED, DEAF:.....GO CSD HEALTH AND FITNESS:....GO GPO-5 HEATH USER'S GROUP:...GO PCS-48 HEATHKIT CATALOG:.....GO HTH HEINOLD COMMODITIES:.....GO HCI HELP (DOCUMENTATION):..GO CIS-8 HI-TECH FORUM:.....GO CCC-150 HIGH TECH NEWS:.....GO ALT HOLLYWOOD HOTLINE:.....GO HHL HOME BANKING:.....GO HOM-45 HOME FINANCE:.....GO HOM-80 HOME SERVICES:.....GO HOM HOME MANAGEMENT PROGRAMS: AMORTIZE A LOAN.....GO HOM-17 CALCULATE A RAISE.... GO HOM-15 CHECKBOOK BALANCER...GO HOM-14 NET WORTH.....GO HOM-16 HORTICULTURE:....GO SFP-10, VIC HOUSE PLANTS:.....GO VIC HOWARD SAMS' BOOKS GO SAM HUMAN SEXUALITY:.....GO HSX

HUMOR, SATIRE:.....GO KCS HUNTINGTON, BANK:.....GO HNB HUSBANDRY:.....GO SFP-10 IBM-PC (SIG):.....GO PCS-131 IDS:....GO IDS IRA:.....GO IDS-567 IMMIGRATION:.....GO PAN, ESC INCORPORATING GUIDE:.....GO INC INDEX: COMPUSERVE.....GO IND COMPUTER PERIODICAL....GO PER STOCK MARKET.....GO FIN-4 INDUSTRIES, FARMING:...GO SFP-10 INFORMATION, MUSIC:.....GO MUS INFORMATION ON DEMAND:...GO IOD INFORMATION RETRIEVAL SER:G IFT INSURANCE: DENTAL.....GO IDS-283 DISABILITY.....GO IDS-277 EMPLOYEE BENEFITS...GO IDS-257 HEALTH.....GO IDS-269 LIFE.....GO IDS-587, 192, 260 MISCELLANEOUS.....GO IDS-286 INSURANCE, AIRCRAFT:.....GO AVL INTELLIGENCE TEST:....GO TMC-28 INTEREST RATE:.....GO MMS INVESTMENT NEWS:.....GO FIN-10 INVESTMENTS: DIAMOND.....GO RDC MICROQUOTE.....GO FIN-20 QUICK QUOTE.....GO FIN-20 TICKERSCREEN......GO TKR INVESTORS DIVERSIFIED:...GO IDS JOB, IN THE HOME:.... GO HOM-146 JOBS: STL POST-DISPATCH.. GO SPD-1002 KITBUILDING:.....GO HTH LANGUAGES ON COMPUSERVE: BLISS.....GO PCS-74 CROSS ASSEMBLERS.....GO PCS-75 FORTRAN......GO PCS-80 MACRO.....GO PCS-76 PASCAL.....GO PCS-77 SNOBOL.....GO PCS-79 LEGAL: FORUM.....GO SFP-40 INCORPORATING SERVICES..GO INC LIBRARY, ELECTRONIC:.....GO AAE LINEPRINTER ART: GO HOM-101 LIQUID GREEN:.....GO UMC LITERARY (SIG):....GO HOM-136

LIVESTOCK FUTURES:....GO CNS-12 LIVESTOCK PRICES:.....GO HCI-10 MMS FINANCIAL ANALYSIS ... GO MMS MNET-11 (SIG):.....GO PCS-53 MACRO:.....GO PCS-76 MACROECONOMICS:.....GO MMS MAGAZINE, ADVERTISERS:...GO EBB MAGIC CUBE SOLUTION:..GO GAM-35 MAINSTREAMING:.....GO CSD MAINTENANCE EOUIP:...GO MIN-100 MANUALS, DOCUMENTATION: GO CIS-8 MANUFACTURER'S NEWSLETTERS: COMMODORE.....GO CBM RCA.....GO RCA TANDY.....GO TRS MAPS, ROAD TRAVEL:.....GO TRV MARINE WEATHER:....GO WEA MARKET PRICES:.....GO FIN-20 MARKET RESEARCH:.....GO IOD MASSACHUSETTS, BANKING ... GO SHW MAX ULE'S TICKERSCREEN:..GO TKR MEDICAL: AAMSI FORUM.....GO SFP-5 ASCMD FORUM......GO SFP-7 FOI NEWSLINE.....GO FOI MEDICAL NEWSLETTER:.....GO AAM METAL FUTURES PRICES:.GO CNS-12 METAL PRICES:.....GO HCI-10 MICROCOMPUTERS: GENERAL.....GO PCS-10 RCA.....GO RCA TANDY.....GO TRS MICROQUOTE:.....GO FIN-20 MICROSOFT (SIG):....GO PCS-145 MINE-EQUIP:.....GO MIN-100 MONEY MARKET:.....GO UMC MONTHLY CHARGES:....GO CIS-176 MORTGAGE BUDGETING:....GO GPO-4 MOVIE REVIEWS: COMPUSERVE.....GO NMM-1 HOLLYWOOD HOTLINE.....GO HHL SHO-TIME CATALOG.....GO MOV MULTIPLE CHOICE, THE:....GO TMC MULTI-PLAYER GAME SIG:G GAM-300 MUSIC:.....GO MUS MUSIC FORUM:.....GO HOM-150 MUSIC INFO. SERVICE:.....GO MUS MUSUS-PASCAL (SIG):...GO PCS-55 MUTUAL FUNDS:GO IDS-245, PCS-55 NASA:.....GO HOM-127 NIPSIG:.....GO HOM-132 NOAA WEATHER:....GO WEA, GO AWX NTSB CASES (AVIATION):...GO AVR NWS AVIATION WEATHER:....GO AWX NYSE PRICES (MQUOTE):.GO FIN-20

NAMES OF USERS:.....GO HOM-4 NAT'L ISSUES (SIG):..GO HOM-132 NATIONAL WATER WELL ASS:.GO WWA NATIONAL WEATHER SERVICE: GO AWX NETWITS:.....GO WIT NETWITS (SIG):.....GO WIT-100 NEW ISSUES(SECURITIES):G TKR-40 NEW PRODUCT NEWS: POPULAR SCIENCE.....GO PSP NEW SERVICES:.....GO NEW NEW YORK FASHION REPORT:.GO GAN NESWS, CB:.....GO CUP **NEWSLETTERS:** AAMSI COMMUNICATIONS....GO AAM ALTERTEXT....QGO ALT COMMODORE.....GO CBM RCA.....GO RCA TANDY.....GO TRS NEWSPAPERS:.....GO HOM-10 NODE LOCATIONS:.....GO CVP-66 NO. AMERICAN WEATHER:.GO CNS-17 NOTICES (BULLET):....GO HOM-23 NUTRITIONAL ANALYSIS: GO GPO-401 OK LEVEL:.....GO PCS-71 OTC PRIQ CES (MQUOTE):..GO FIN-20 OFFICE SUPPLIES:.....GO SAV OFFICIAL AIRLINE GUIDE:..GO OAG OHIO, BANKING:.....GO HNB OHIO SCIENTIFIC(SIG):GO PCS-125 OPTIONS, STOCK:.....GO FIN-4 ORCH-90 ARCHIVES:.....GO ORC ORCH-90 MUSIC (SIG):..GO HOM-13 PGA OFFICIAL TOUR GUIDE:.GO PGA PUG (PANASONIC SIG):.GO PCS-114 PAN AM:.....GO PAN PANASONIC (SIG):....GO PCS-114 PARENTING & FAMILY LIFE:.GO PFL PASCAL (SIG):.....GO PCS-55 PASSWORD, CHANGES:...GO CIS-175 PEAK DELAY GUIDE:.....GO PDG PENSIONS:.....GO INC PERIODICAL GUIDE:.....GO PER PERSONAL COMPUTING:.....GO PCS PERSONAL DEVELOPMENT:....GO AES PERSONAL FINANCE: ALTERNATIVE EDUCATION...GO AES GOV'T PUBLICATIONS....GO GPO-4 HOME MANAGEMENT.....GO HOM-80 INVESTORS DIVERSIFIED.GO IDS-6 PERSONALITY PROFILE:...GO TMC-17 PETS:.....GO SFP-37 PILOT WEATHER:.....GO AWX PLANTS:.....GO VIC

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POLITICS: AP VIEWDATA WIRE.....GO APV WASHINGTON POST.....GO TWP-15 POPULAR SCIENCE MAGAZINE: AUTOMOTIVE NEWS......GO PSC NEW PRODUCTS.....GO PSP SCIENCE & TECHNOLOGY....GO PSE SOFTWARE REVIEWS......GO PSP PORK PRICES:.....GO CNS-12 PORTFOLIO VALUATION:...GO FIN-4 POWERSOFT'S XTRA-80:..GO PCS-56 PRECIOUS METALS:.....GO CNS-12 PRECIOUS METALS NEWS:.GO CNS-15 PRESCRIPTIONS:.....GO GPO-399 PRIME INTEREST RATE:....GO HNB PRIMETIME RADIO CLASSICS:GO PRC PROFESSIONAL: AGRIBUSINESS DATABASE...GO IFT ENG/TECHNICAL DATABASE..GO IFT ENVIRONMENTAL DATABASE..GO IFT PROGRAMMER'S (SIG):..GO PCS-158 PROGRAMMING AREA:....GO PCS-71 PROGRAMMING LANGUAGES: GO PCS-72 PROGRAMS FROM USERS:..GO PCS-46 PROGRAMS FOR SALE:....GO PCS-45 PROGRAMS, MEDICAL:.....GO AAM PUBLIC ACCESS:.....GO PCS-46 QUICK QUOTE:.....GO FIN-20 RCA NEWSLETTER:.....GO RCA RCA (SIG):.....GO PCS-57 RADIO: AMATEUR.....GO HOM-11 OLD RADIO SHOWS.....GO PRC RADIO SHACK COMPUTERS:...GO TRS RAINBO'S REVIEWS:.....GO WIT RATES, COMPUSERVE:....GO CIS-53 REAL ESTATE, ADS: STL POST-DISPATCH..GO SPD-1002 RECIPES (SIG):....GO HOM-109 RECORDKEEPING, HOME:.GO GPO-228 REFERENCE GUIDE:.....GO AAE REFERRAL SERVICE, LAW:GO SFP-40 REGULATORY AFFAIRS PROF:.GO FOI RESERVATIONS, AIRLINE: FIRSTWORLD TRAVEL.....GO TVL RESOURCE, WATER:.....GO WWA RETIREMENT:.....GO INC REVIEWS, GAMES:.....GO GSA REVIEWS, SOFTWARE: POPULAR SCIENCE..... GO PSP-101 SAT TEST INFORMATION:.GO TCB-18 SIGS: AAMSI.....GO SFP-5 ARCADE.....GO HOM-138 ASCMD.....GO SFP-7

ASK MR FED CO MMG_20
ATAKI
AUTHOR'S
AVSIGGO SFP-6
CBIG
CEMSIGGO CEM-450
COMMODORE
COMMODORE PET CO PCS-116
COMMODORE FA
COMMODORE 64GO PCS-156
COMMODORE VIC 20GO PCS-155
COMMUNICATIONSGO SFP-35
COMPUTER ARTGO PCS-157
COOKS' UNDERGROUNDGO HOM-109
CP/M GROUPGO PCS-47
EDUCATORS' GO HOM-137
ENTERTAINMENT CO HOM-20
ENUTRIMENTAL CO GED 20
ENVIRONMENTALGO SFP-38
FAMILY MATTERSGO HOM-144
FIRENETGO SFP-36
FOOD BUYLINEGO HOM-151
GAMES (SCORPIA)GO GAM-310
GOLF
GOOD EARTH GO HOM-145
HAMNET CO HOM-11
HI-IECH
HUG (HEATH)GO PCS-48
IBM-PCGO PCS-131
LEGALGO SFP-40
LITERARY
LSI USERS
MAUG (APPLE) GO PCS-51
MICROSOFT CO DCS-145
MNET_11 00 PCS-143
MNET-11
MNET80 TRS-80GO PCS-54
MULTI-PLAYER GAMESGO GAM-300
MUSICGO HOM-150
MUSUS=PASCALGO PCS-55
NETWITSGO WIT-100
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ORCH-90
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POWERSOFT'S YTRA-80 CO PCS-56
PROCRAMMERIC CO. DCC 150
PROGRAMMER'SGO PCS-158
PUG (PANASUNIC)GO PCS-114
RCA GROUPGO PCS-57
SPACEGO HOM-127
SPORTSGO HOM-110
TELECOMM
TRAVEL
TRS-80 COLOR
TRS=80 MODEL 100 CO PCG-154
VETERINARIANSGO SFP-3/
WORK-AT-HOMEGO HOM-146
ST. LOUIS POST-DISPATCH:.GO SPD
SAMS, HOWARD BOOKS:GO SAM

SATIRE:.....GO KCS SAVING ACCOUNTS:.....GO HOM-45 SAVING-SCAN:.....GO SAV SCOTT ADAMS' GAMES:...GO GAM-28 SCRAMBLE GAME:....GO GAM-43 SELF-EMPLOYMENT:.....GO SBR SERVICES FOR THE DEAF:...GO CSD SHAWMUT, BANK:.....GO SHW SHOP-AT-HOME:.....GO HOM-40 SHOPPING: CARS.....GO ATO FIFTH AVENUE SHOPPER....GO FTH MUSICAL.....GO MUS RADIO SHOWS.....GO PRC SAVING-SCAN.....GO SAV SHO-TIME MOVIE CATALOG:..GO MOV SHUTTLE, SPACE:.....GO HOM-127 SILLY FILL-INS:.....GO TMC-41 SILVER FUTURES PRICES:GO CNS-12 SILVER NEWS:.....GO CNS-15 SKI CONDITIONS:.....GO WEA SMALL BUSINESS REPORTS:...GO SBR SMOKING AND HEALTH:..GO GPO-398 SNOBOL:.....GO PCS-79 SOAPS, TELEVISION:.....GO HHL SOFTEX:.....GO PCS-45 SOFTWARE AUTHORS' SIG:GO PCS117 SOFTWARE EXCHANGE:....GO PCS-40 SOFTWARE REVIEWS: POPULAR SCIENCE.....GO PSP-101 SO. AMERICAN WEATHER:.GO CNS-17 SPACE (SIG):.....GO HOM-127 SPECIAL INTEREST GROUPS: ACCESS TO.GO HOM-50, GO PCS-50 COMMERCIAL.....GO PCS-50 DESCRIPTIONS.GO HOM-50, PCS-50 GENERAL.....GO HOM-50 HARDWARE RELATED..... GO PCS-50 INSTRUCTIONS.GO HOM-51, PCS-58 SOFTWARE RELATED.....GO PCS-50 SPORT, CLOTHES:.....GO HAN SPORTS NEWS: GOLF.....GO PGA STL POST-DISPATCH..GO SPD-1005 SPORTS (SIG):.....GO HOM-110 SPORTS QUIZ:.....GO TMC-42 SPOTLIGHT, CBERS:.....GO CUP STANDARD & POORS:.....GO FIN-20 STAR TREK GAME:.....GO GAM-26 STATE CAPITAL GAMES:..GO TMC-44 STEREOS FOR SALE:.....GO CUS STEVENS BUSINESS REPORTS: GO SBR STOCKS, BONDS: MICROQUOTE.....GO FIN-20 QUICK QUOTE.....GO FIN-20

TICKERSCREEN.....GO TKR-10 SUGAR FUTURES PRICES:.GO CNS-12 SUPPLIER, ATHLETE'S:....GO HAN TMC FOR KIDS!:.....GO TMC-27 TRS-80 COLOR (SIG):..GO PCS-126 TRS-80 COMPUTERS:.....GO TRS TRS-80 MNET80 (SIG):..GO PCS-54 TRS-80 MODEL 100(SIG):G PCS-154 TRS-80, PROGRAMS FOR:.GO PCS-45 TV SOAP OPERA SUMMARIES:.GO HHL TANDY CORP. NEWS:.....GO TRS TECHNICAL BOOKS:.....GO SAM TECHNICAL RESEARCH:.....GO IOD TELECOMM (SIG):....GO PCS-52 TELEPHONE ACCESS:....GO CIS-177 TENNESSEE, BANKING:...GO HOM-141 TERMINAL PARAMETERS:...GO CIS-6 TERMINAL SOFTWARE:...GO PCS-103 TERMINAL TYPES:.....GO CIS-6 TESTS, CHILDREN:.....GO TMC-27 TESTS, INTERACTIVE:....GO TMC-4 TESTS, SAT:.....GO TCB-18 TEXT EDITORS:.....GO PCS-82 THE COLLEGE BOARD: ADULT EDUCATION.....GO TCB-13 CHOOSING A COLLEGE...GO TCB-17 FINANCIAL AID.....GO TCB-12 PUBLICATIONS OF.....GO TCB-15 SAT TEST INFORMATION.GO TCB-18 THE NATIONAL SATIRIST GO KCS TICKERSCREEN:.....GO TKR TIME USED:.....GO CIS-176 TODAY, ADVERTISERS:.....GO EBB TRADING, COMMODITIES:.GO FIN-10 TRAVEL: DEPARTMENT OF STATE....GO DOS FIRSTWORLD TRAVEL CLUB..GO TVL OFFICIAL AIRLINE GUIDE..GO OAG PAN AM.....GO PAN TRAVEL FAX.....GO ESC TRAVELVISION.....GO TRV WORLDWIDE EXCHANGES.....GO WWX TRAVEL, ABROAD: DEPARTMENT OF STATE....GO DOS FIRSTWORLD TRAVEL CLUB..GO TVL OFFICIAL AIRLINE GUIDE..GO OAG PAN AM.....GO PAN TRAVEL, ADVISORIES:.....GO DOS TRAVEL, AIRLINE GUIDE:...GO OAG TRAVEL FAX:.....GO ESC TRAVEL (SIG):.....GO HOM-157 TRAVELER, AIRPORT GUIDE:.GO PDG TRAVELVISION:.....GO TRV TREASURY BILLS, YIELDS:.GO FIN-4

TRIVIA: KIDS.....GO TMC-45 MOVIE.....GO HHL RADIO.....GO PRC UNLIMITED TEST.....GO TMC-16 TUTORIALS: EDUTECH.....GO CAI PERSONAL COMPUTING..GO PCS-121 UCSD PASCAL GROUP:....GO PCS-55 USDA GRADES:.....GO GPO-10 USDA STANDARDS: MEAT.....GO GPO-1340 POULTRY.....GO GPO-1405 U.S. DEPART. OF STATE:...GO DOS U.S. NEWS: STL POST-DISPATCH..GO SPD-1005 WASHINGTON POST.....GO TWP UNITED AMERICAN BANK: GO HOM-152 USED CARS, BUYING:..GO GPO-1199 USER DIRECTORY:.....GO HOM-4 USER INFORMATION:.....GO CIS-4 USER'S PROGRAMS:.....GO PCS-30 VIC-20 (SIG):.....GO PCS-116 VACATIONING:.....GO WWX VALUE LINE DATABASE:..GO FIN-20 VEGETABLES:.....GO VIC VETERINARIANS FORUM:...GO SFP-37 VICTORY GARDEN:.....GO VIC VIDEO INFORMATION:.....GO VIF VIDEOTEX, VIEWS ON:..GO CVP-154 VIDTEX EXECUTIVE:....GO PCS-103 VIEWPOINT, COMPUSERVE:.GO CVP-5 WANT ADS (BULLET):....GO HOM-23 WAR GAMES: DECWARS.....GO GAM-19 MEGAWARS.....GO GAM-20 SPACE WAR.....GO GAM-25 WASHINGTON, D.C. AREA: STL POST-DISPATCH..GO SPD-1005 WASHINGTON POST.....GO TWP-12 WASHINGTON POST:.....GO TWP WATER, GROUND:.....GO WWA WATERLINE:.....GO WWA

SAMPLE SOURCE SESSION

THE SOURCE MAIN MENU

- 1 NEWS AND REFERENCE RESOURCES
- 2 BUSINESS/FINANCIAL MARKETS
- 3 CATALOGUE SHOPPING
- **4 HOME AND LEISURE**
- 5 EDUCATION AND CAREER

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6 MAIL AND COMMUNICATIONS 7 CREATING AND COMPUTING 8 SOURCE*PLUS Enter item number or HELP: HELP LIBALL SERVICES DIRECTORY _____ The commands on the right will call up information on the corresponding program or the program itself. Access numbers used to connect to THE SOURCE ACCESS Airline Schedules HELP AIRSCHED Almanac (daily) TODAY Bestsellers List (Publisher's Weekly) HELP BESTSELLERS Book Ordering Service BOOKS Bulletin Boards HELP POST Business News (updated throughout the day) BIZDATE Business Publications Abstract Service (Management Contents, Ltd.) Business Calculations Programs CONTENTS HELP COMPUDEX Business Services Index HELP BIZDEX CHAT (Live conversation with another member of THE SOURCE) HELP CHAT Classified Ads HELP POST Conferencing PARTI Commands Used on THE SOURCE HELP COMMANDS Commodity News Currency Trading Quotes Discount Shopping: General Merchandise BIZDATE CURRENCY CSTORE Records and Tapes MUSICSOURCE Classic Radio Programs RADIOSOURCE Dow Jones Hourly Indexes DOW ECOM Mail Message Service ECOM Editorials (Syndicated Columnists) BYLINES Educational Programs and Drills HELP EDUCAT Employment Network EMPLOY Encode Text Files HELP CIPHER Finance: Personal Finance Programs Latest Stock Market Quotes HELP PERSFI HELP STOCKCHECK Stock Market Reports HELP UNISTOX Stock Performance Analysis STOCKVUE Stock Portfolio Management HELP FOLDEX New York Stock Exchange Indexes NYSE Standard and Poors Indexes SP Dow Jones Indexes DOW Metal Market Activity METALS Gold Prices (Daily) GOLD Currency Trading Quotes CURRENCY Financial Modeling/Business Planning HELP MODEL1 Financial Programming HELP INFOX Business Finance Calculation Programs HELP COMPUDEX Games Library HELP GAMES Gold Prices (Daily) GOLD

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APPENDIX A 137

Horoscopes Hotel Guide (U.S. and Canada) Mail Mailgram Message Service Members Directory Members Currently Online Menu of Services on THE SOURCE Metal Market Activity Microcomputer News Movie Reviews Music To Order News and Sports Service (United Press Int'l.) Business News News Bulletins News Features News About THE SOURCE New York Stock Exchange Hourly Indexes Personal Finance Programs Personality Spotlight Phone Numbers to Connect with THE SOURCE Programming/Advanced Applications Radio Programs to Order Rates and Fees for THE SOURCE Research Service (Information On Demand) Restaurant Guides: U.S and Canada Shared-File System Explanation Shopping Services: General Merchandise Records and Tapes Classic Radio Programs Book Ordering Ski Reports (winter months only) Sports Schedules and Scores Standard and Poors Hourly Indexes Stock Market - Latest Quotes Stock Market Reports Stock Performance Analysis (Media General) Stock Portfolio Management Suggestions for THE SOURCE Syndicated Editorials, Columns, Features System News Teleconferencing Text Editor Travel Services: Airline Schedules Hotel Guide (U.S. and Canada) HELP USROOM Make Reservations Vacation Packages TV Listings U.S. News & World Report Washington Letter User-Publishing Using THE SOURCE

TODAY and BYLINES USROOM HELP MAIL MGRAM DISEARCH ONLINE MENU METALS MICROLINE MOVIES MUSICSOURCE HELP UPI BIZDATE BULLETIN TODAY and BYLINES NEW NYSE HELP PERSFI TODAY ACCESS HELP ADAPPR RADIOSOURCE HELP RATES HELP IOD HELP USREST HELP SHAREFILES CSTORE MUSICSOURCE RADIOSOURCE BOOKS HELP SKI SPORTS SP HELP STOCKCHECK HELP UNISTOX STOCKVUE HELP FOLDEX HELP SUGBOX BYLINES NEW PARTI HELP ED HELP AIRSCHED HELP TRAVEL TOURS TODAY USNEWS PUBLIC NEW

Appendix B

HARDWARE, SOFTWARE, AND ACCESSORIES SUPPLIERS

In compiling this list of suppliers of products for the Commodore 64, I prowled retail stores, combed the ads in dozens of magazines, and wrote to more than 100 firms for information. While the list is as complete as possible, it by no means encompasses every product made for the Commodore 64. Rather, here is a sampling of items from the major suppliers and a few up-and-coming companies. Be forewarned that some of the smaller organizations have gone out of business since this writing; however, there are alternate suppliers for nearly every item included.

I have concentrated on hardware items. There are some software firms listed, too. Chiefly, they are those providing utility, telecommunications, or applications programs. While some of the companies may also produce games for the Commodore 64, there is no separate games category in this listing. Computer games marketing is so competitive that the games themselves come and go in a matter of weeks, and the firms selling them sometimes last only a little longer. This month's favorite game is last month's has-been. So, in the interests of timeliness, no games have been listed as such.

Also missing is a listing of suppliers of CP/M software. Converting a Commodore 64 to CP/M is a specialized application. Only a few



Figure B-1 An EPROM programmer allows producing custom EPROMs that may serve as plug-in software for your Commodore 64. (*Photograph courtesy Electrosharp Technologies*)



Figure B-2 Accounting software enables the Commodore 64 to perform many valuable business functions. (*Photograph courtesy Futurehouse*)



Figure B-3 Another business accounting program available for the Commodore 64. (*Photograph courtesy Totl Software, Inc.*)



Figure B-4 This general-purpose input output card allows interfacing the Commodore 64 with a variety of devices. (*Photograph courtesy Micro World Electromix*)



Figure B-5 One of the many expansion interfaces available for the Commodore 64. (*Photograph courtesy Cardco, Inc.*)

of the readers of this book will ever consider it. There are thousands of programs available to run under CP/M, too many to even begin to list here. If you want a more complete run-down of what's available for CP/M, check out one of the more technical or business-oriented computer publications, such as *Byte* or *Interface Age*.

For many listings, the address of the company as well as its major product in that category is listed. Where only the company name is provided, the list of applicable products was too long in most cases. Write directly to the manufacturer, stating your computer configuration, and ask for more information.

RS232 SERIAL INTERFACE ADAPTERS

These are used to connect your Commodore 64 to a modem, serial printer, and other accessories that use the standard RS232-C interface. All require connecting cables, usually with DB-25 plugs at either end.

Cardco, Inc. 313 Mathewson Wichita, KS 67214 RS232 Interface Commodore 487 Devon Park Rd. Wayne, PA 19087 VIC1011A

Eastern House 3239 Linda Dr. Winston-Salem, NC 27106 STCP RS232 board

CASSETTE ACCESSORIES

Cassette accessories include devices to speed up your loading and adapters to allow connecting ordinary audio cassette recorders to the Commodore 64 computer.

Bytesize Micro Technology Box 12309 Seattle, WA 98111 Cassette dubber

Cardco, Inc. 313 Mathewson Wichita, KS 67214 Cassette Interface

Commodore 487 Devon Park Rd. Wayne, PA 19087 Datasette Eastern House 3239 Linda Dr. Winston-Salem, NC 27106 CBM 64 Rabbit Cartridge, faster cassette loading

Software Plus 6201 Suite C Greenback Lane Citrus Heights, CA 95610 COPY CAD—Cassette aided duplicator

PROGRAMMING UTILITIES

Programming utilities range from simple DOS "wedges" that make disk commands easier to use to full-fledged BASIC language extensions that add many more features to your Commodore 64. Some provide graphics, sound, and sprite commands.

Abacus Software PO Box 7211 Grand Rapids, MI 49510 Screen graphics commands Ultrabasic 64 Commodore 487 Devon Park Rd. Wayne, PA 19087 Simon's BASIC

Eastern House 3239 Linda Dr. Winston-Salem NC 27106 MAE assembler/editor

Electrosharp Technologies 1981 Sandalwood Drive Orcutt, CA 93455 EPROM programmer

French Silk Smoothware PO Box 207 Cannon Falls, MN 55009 Develop-64 Editor/assembler monitor H & H Enterprises 5056 N. 41st St. Milwaukee, WI 53209 Disk support DOS utility Disk duplicator Disk retriever

Interesting Software 21101 S. Harvard Blvd. Torrance, CA 90501 GRAFDOS disk utility Mini monitor

Skyles Electric Works 231E South Whisman Road Mountain View, CA 94041 VicTree utility

HARDWARE AND MISCELLANEOUS ADD-ONS

Grouped here are hardware and other accessories that do not fall neatly into one of the other hardware categories. Numeric keypads, EPROM programmers, and other items are listed.

Batteries Included 186 Queen Street West Toronto, Ont., Canada Buscard parallel printer port, BASIC 4, and IEEE Cardco, Inc. 313 Mathewson Wichita, KS 67214 Numeric keypad, expansion interface Cheatsheet Products PO Box 8299

PO Box 8299 Pittsburgh, PA 15218 Keyboard overlays Commodore 487 Devon Park Rd. Wayne, PA 19087 Z80, CP/M cartridge

Computer Case Company 5650 Indian Mound Court Columbus, OH 43213 Cases

Computer Place 23914 Crenshaw Blvd. Torrance, CA 90505 CP numeric keypad

Electrosharp Technologies 1981 Sandalwood Drive Orcutt, CA 93455 EPROM programmer

Genesis Computer Corporation 1444 Linden Street Bethlehem, PA 18018 VicController appliance controller up to 256 lights and appliances using BSR units

Gosub International 501 E. Pawnee Suite 430 Wichita, KS 67211 19-key keypad

Hytec Systems PO Box 446 West Lynn, OR 97068 Furniture

Limbic Systems, Inc. 1056 Elwell Court Palo Alto, CA 94303 Pet peripherals interface

Micro Ware Distributing Inc. 1342 B Rt. 23 Butler, NJ 07405 The Connection buffered printer parallel interface

Micro World Electronics 3333 S. Wadsworth Blvd. Lakewood, CO 80227 Parallel printer interface

Micro Systems Development, Inc. 11105 Shady Trail Suite 104 Dallas, TX 75229 Parallel printer interface IEEE interface Persimmon Peripherals Route 2, Box 2306A Clayton, GA 30525 Digitizer Precision Technology Inc. PO Box 15454 Salt Lake City, UT 84115 CBM 4-slot expander board Protecto Enterprizes Box 550 Barrington, IL 00000 80-column board Quality Computer 801 S. Victoria Ave., Suite 105 Ventura, CA 93003 ADDON, 10 key pad Random Access Marketing PO Box 1561 Newport Beach, CA 92663 Busmaster six slot expander Busmaster II software enabled, memory paging of up to $6 \times 64 \text{ K}$ Minimus 3-slot expander—fuse protected, switches **Richvale Telecommunications** 10610 Bayview Richmond Hill, Ontario, Canada C-64 link. Plugs in expansion slot Vaisala, Inc. 22 Cummings Park Woburn, MA 01801 Automatic home weather station Yield House North Conway, NH 03860 Furniture

SPRITE EDITORS

Sprite editors make games and graphics programming a bit easier by allowing the operator to design and save special sprite characters using word-processing-like cursor movement and commands.

Access Software, Inc.	Oxford, PA 19363
925 East 900 South	Sprite editor
Salt Lake City, UT 84105	Foxsoft
Sprite editor	PO Box 507
Commodore	Deer Park, TX 77536
487 Devon Park Rd.	Spryte Byter sprite editor
Wayne, PA 19087	Quality Computer
Sprite editor	801 S. Victoria Ave., Suite 105
Data-Assette	Ventura, CA 93003
56 South 3rd Street	Sprite shaper

SOUND SOFTWARE, SYNTHESIZERS

Music editors are the sound equivalent of the sprite utilities, allowing programmers to take advantage of the sophisticated Commodore 64 synthesizer capabilities without having to use dozens of PEEK and POKE statements.

Abacus Software PO Box 7211 Grand Rapids, MI 49510 Synthy 64
Computer Software Associates 50 Teed Drive Randolph, MA 02368 Composer
Electronic Lab Industries 100 W. 33nd St. Baltimore, MD 21218 Note Pro II

Genesis Computer Corporation 1444 Linden Street Bethlehem, PA 18018 COMvoice automatic English to speech conversion

Quality Computer 801 S. Victoria Ave. Suite 105 Ventura, CA 93003 Sound shaper

PRINTER ACCESSORIES

Printer accessories can include conversion programs to change PET ASCII to conventional ASCII, and other aids to printer use. Printer buffers are listed separately.

Cardco, Inc. 313 Mathewson Wichita, KS 67214 Printer interface

MicroWorld Electronics 3333 S. Wadsworth Blvd. Lakewood, CO 80227 Parallel printer interface

Midwest Micro Associates PO Box 6148 Kansas City, MO 64110 Smart ASCII Plus

TERMINAL SOFTWARE

Telecommunications requires a special program to allow your Commodore 64 to transmit and receive information simultaneously. Such terminal software can either turn the computer into a "dumb" terminal, which can only type and receive, or an "intelligent" terminal, capable of uploading and downloading programs and text, and performing other tasks.

Byte Ryte PO Box 205 Station Cart. Montreal, Quebec, Canada Smart terminal CompuServe Information Service 5000 Arlington Centre Blvd. Columbus, OH 43220 VIDTEX

Electrosharp Technologies 1981 Sandalwood Drive Orcutt, CA 93455 Versaterm

Micro Systems Development, Inc. 11105 Shady Trail Suite 104 Dallas, TX 75229

Midwest Micro Associates PO Box 6148 Kansas City, MO 64110 Terminal 64

MASS STORAGE ALTERNATIVES

Mass storage devices—disk drives, cassette recorders, or other components—enable you to load and save data and programs. The faster alternatives, chiefly disk drives, allow for extremely sophisticated file manipulation as well.

Commodore 487 Devon Park Rd. Wayne, PA 19087 1541 disk drive

Micro Systems Development, Inc. 11105 Shady Trail Suite 104 Dallas, TX 75229 Floppy disk

Unitronics VADEM 3517 Ryder St. Santa Clara, CA 95051 Waferdrive module

BUSINESS AND PERSONAL SOFTWARE

Here are all the various business and personal programs that allow your Commodore 64 to perform useful work. Word-processing software is listed separately.

Abacus Software	Wichita, KS 67214
PO Box 7211	Mail Now mailing list program
Grand Rapids, MI 49510 Screen graphics commands Chartpak 64	Cimarron 2158 South Hathaway Street Santa Ana, CA 92705
Batteries Included	Insta-Mail
186 Queen Street West	Insta-Calc
Toronto, Ontario, Canada	Insta-Graph
Delphi's Oracle DBMS	Insta-Vestor
Cardco, Inc. 313 Mathewson	Insta-File Insta-Check

City Software 735 West Wisconsin Avenue Milwaukee, WI 53233 Powerfile DBMS

Commodore 487 Devon Park Rd. Wayne, PA 19087 Electric desk

Computer Marketing Services 300 W. Marlton Pike Cherry Hill, NJ 08002 CalcResult

Computer Software Associates 50 Teed Drive Randolph, MA 02368 Practicalc Inventory 64

HesWare 150 North Hill Drive Brisbane, CA 94005 Omnicalc Heswriter TimeMoney Manager

InfoDesigns 6905 Telegraph Rd. Birmingham, MI 48010 Small Business Accounting

Jini Micro-Systems, Inc. Box 274 Riverdale, NY 10463 Jinsam Data Manager

Melcomp PO Box 1085 Melbourne, FL 32901 Database-64

Mirage Concepts, Inc. 2519 West Shaw, #106 Fresno, CA 93711 Data Base Manager Performance Micro Products 770 Dedham Street S-2 Canton, MA 02021 C-64 FORTH

Programmer's Institute PO Box 3470 Chapel Hill, NC 27514 Color Accountant Business programs

Sophware 19123 Hamlin Street Suite 4 Reseda, CA 91335 Family Finances

Southern Solutions PO Box P McKinney, TX 75069 Business software

Systems Management Associates 3700 Computer Drive PO Box 20025 Raleigh, NC 27619 Documate keyboard overlays

T&F Software Company 10902 Riverside Drive North Hollywood, CA 91602 CheckEase

Timeworks, Inc. PO Box 321 Deerfield, IL 60015 Business Systems

Totl Software 1555 Third Avenue Walnut Creek, CA 94596 Mailing List and Label Time Manager Research Assistant Small Business Accounting

WORD PROCESSING

The number-one Commodore 64 application in terms of popularity has one of the largest selections of available software. Most of these listed will do a good job of personal letters and short documents. Some will handle the most complex word-processing chores.

A B Computers 252 Bethlehem Pike Colmar, PA 18915 Page-Mate

Cardco, Inc. 313 Mathewson Wichita, KS 67214 Write Now!

Cimarron 2158 South Hathaway Street Santa Ana, CA 92705 Insta-Writer

Mirage Concepts, Inc. 3519 West Shaw, #106 Fresno, CA 93711 Word Processor (with software 80-column feature)

Professional Software, Inc. 51 Fremont Street Needham, MA 02194 WordPro 3 Plus/64

Quick Brown Fox 548 Broadway New York, NY 10012 Quick Brown Fox

Skyles Electric Works 231E South Whisman Road Mountain View, CA 94041 Busiwriter 64

Softsmith Corp. 2935 Whipple Rd. Union City, CA 94587 Smithwriter

Totl Software 1555 Third Avenue Walnut Creek, CA 94596 Totl.Text 2.6 Spelling Checker

PRINTERS

Hard copy output is one of the essentials for all business and many personal applications. Individual printer models are not listed, because most firms offer several different printers that can be adapted to the Commodore 64. Product lineups change frequently in this highly competitive area.

Anacom General Corp.	Anadex Inc.
1116 E. Valencia Dr.	9825 De Soto Ave.
Fullerton, CA 92631	Chatsworth, CA 9263

Brother Industry Ltd. 5698 Bandini Blvd. Bell. CA 90201 C. Itoh Electronics 5301 Beethoven St. Los Angeles, CA 90066 Centronics 1 Wall St. Hudson, NH 03051 Commodore 487 Devon Park Rd. Wayne, PA 19087 Components Express, Inc. 1380 E. Edinger Santa Ana, CA 92705 Computer Devices Inc. 25 North Avenue Burlington, MA 01803 **Computer Printers** International 340 E. Middlefield Rd. Mt. View, CA 94043 Computer Transceiver Systems, Inc. 366 Midland Avenue Paramus, NJ 97652 Computers International, Inc. 3540 Wilshire Blvd. Los Angeles, ca 90010 Daisy Systems 41 Duesenberg Dr., Ste. B Thousand Oaks, CA 91362 Data Impact Products Inc. 745 Atlantic Avenue Boston, MA 02111 Data Terminals & Communications

590 Division St. Campbell, CA 95008 Datapoint Corp. 9725 Datapoint Drive San Antonio, TX 78284

Dataproducts Corp. 6200 Canoga Avenue Woodland Hills, CA 91365

Datasouth Computer Corp. 4216 Stuart Andrew Blvd. Charlotte, NC 28210

Diablo Systems 24500 Industrial Blvd. Hayward, CA 94545

Epson America Inc. 3415 Kashiwa St. Torrance, CA 90505

Heath Co. Benton Harbor, MI 49022

Infoscribe, Inc. 2720 S. Croddy Way Santa Ana, CA 92704

Leading Edge Products 225 Turnpike Street Canton, MA 02021

Lear Siegler, Inc. 714 N. Brookhurst St. Anaheim, CA 92803

MannesMann Tally 8301 South 180th St. Kent, WA 98032

MDS Trivex 3180 Red Hill Avenue Costa Mesa, CA 92626

Micro Peripherals, Inc. 4425 South Century Drive Salt Lake City, UT 84107

NEC Information Systems 3 Militia Drive Lexington, MA 02173 Okidata Corp. 111 Gaither Drive Mount Laurel, NJ 08054 Olivetti OPE 2000 Green Road Ann Arbor, MI 48105 Olympia USA Inc. Box 22 Somerville, NJ 08876 Printek, Inc. 1517 Townline Rd. Benton Harbor, MI 49022 Protecto Enterprizes Box 550 Barrington, IL 00000 Qantex Div./North Atlantic Ind. 60 Plant Avenue Hauppauge, NY 11788

Qume/ITT 2350 Qume Drive San Jose, CA 95131 Smith-Corona 65 Locust Avenue New Canaan, CT 06840 Star Manufacturing 200 Park Avenue, Ste. 2309 New York, NY 10166 Star Micronics Inc. 2803 NW 12th St. Dallas/Ft. Worth Airport, TX 75261 Transtar Box C-96975 Bellevue, WA 98009

BUFFERS

Printer buffers have one purpose: to free your computer for other tasks while printing long documents or series of documents. The main consideration in buffers is how much memory they have and whether or not they have some intelligence, so as to provide other features (such as formatting).

Applied Creative	Interactive Structures Inc.
Technology Inc.	146 Montgomery Avenue
2723 Avenue E. East, Suite 717	PO Box 404
Arlington, TX 76011	Bala Cynwyd, PA 19004
Data-Match Corp. 3810 Oakcliff Industrial Court Doraville, GA 30340	Microtek Inc. 9514 Chesapeake Drive San Diego, CA 92123
Digital Graphic Systems Inc. 935 Industrial Avenue Palo Alto, CA 94303	Orange Micro Inc. 1400 N. Lakeview Anaheim, CA 92807

Practical Peripherals 31245 La Baya Drive Westlake Village, CA 91362

Prometheus Products 45277 Fremont Blvd. Fremont, CA 94538

Quadram Corporation 4357 Park Drive Norcross, GA 30093 Warn Electronics Ltd. PO Box 526 315 Park Avenue Knightdale, NC 27545 Wesper Micro Systems

3188A Pullman Street Costa Mesa, CA 92626

MODEMS

Modems are your connection with the outside world. Some listed connect directly to your Commodore 64 without the need for an RS232 adapter. The others all require that you have the serial interface attached.

Commodore 487 Devon Park Rd. Wayne, PA 19087 VICMODEM

Emtrol Systems, Inc. 123 Locust St. Lancaster, PA 17602

Hayes Microcomputer Products 5835 Peachtree Corners E. Norcross, GA 30092

Incomm 115 N. Wolf Rd. Wheeling, IL 60090

Leading Edge Products 225 Turnpike St. Canton, MA 02021

Lexicon Corp. 1541 NW 65th Ave. Ft. Lauderdale, FL 33313

MFJ Enterprises, Inc. 921 Louisville Rd. Starkville, MS 39759 Microperipheral Corp. 2643 151st Place NE Redmond, WA 98052

Novation, Inc. 18664 Oxnard St. Tarzana, CA 91356

Prentice Corp. 266 Caspian Dr. Sunnyvale, CA 94086

Racal-Vadic 222 Caspian Dr. Sunnyvale, CA 94086

TNW Corp. 3444 Hancock St. San Diego, CA 92110

Universal Data Systems 500 Bradford Dr. Huntsville, AL 35805

U.S. Robotics, Inc. 123 West Washington Chicago, IL 60607

INFORMATION UTILITIES

These firms provide data bases for individuals to access, electronic mail, and many other services that can be accessed through a Commodore 64 equipped with a modem and terminal software.

BRS/After Dark
1200 Rt. 7
Latham, NY 12110
CompuServe Information Service
5000 Arlington Centre Blvd.
Columbus, OH 43220
Delphi
377 Putnam Ave.
Cambridge, MA 02139
Dow Jones News/Retrieval
PO Box 300
Princeton, NJ 08540

MCI 2000 M Street, NW Washington, DC 20036 Partynet, Inc. 350 W. Clark St. Suite 650 Chicago, IL 60610 Source Telecomputing Corporation 1616 Anderson Road McLean, VA 22102

MONITORS

Given the excellent graphics capabilities of the Commodore 64, you should consider upgrading to a 1702 monitor. The price can be as low as \$250.

Amdek 2201 Lively Blvd. Elk Grove Village, IL 60007

Commodore 487 Devon Park Rd. Wayne, PA 19087 Commodore 1702 monitor

JOYSTICKS

No gamer should be without a joystick. Explore the alternative controllers, such as trackballs, as well.

Cardco, Inc. 313 Mathewson Wichita, KS 67214 Light pen Commodore 487 Devon Park Rd. Wayne, PA 19087 Cynex Manufacturing Corp. 28 Sager Place Hillside, NJ 07205 Game Mate, 2 wireless joysticks Discwasher 1407 N. Providence Rd. Columbia, MO 65205 Pointmaster

Futurehouse PO Box 3470 Chapel Hill, NC 27514 Light pen Quest Industries, Inc. 670 NW Pennsylvania Ave. Chehailis, WA 98532 Quest Star Blaster Starplex Electronics, Inc. E. 233301 Mission Liberty Lake, WA 99019 Starplex Deluxe controller Tech Sketch, Inc. 26 Just Rd. Fairfield, NJ 07006 Light pen Wico Consumer Division Niles, IL 60648 Command Control joysticks

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You're one of the lucky ones—you've gotten yourself a real computer that is priced like a games-only machine. Yet, despite its attractive price, the *Commodore 64* is no entry-level dead-end street. Unlike some of the tiny, toy-like computers you might have seen hawked at every department store, *the Commodore 64 is meant to be used as a serious computer, and it can be expanded to do just about anything one of the \$1,000-plus models can do.*

-abridged from the introduction

Expanding Your Commodore 64 Capabilities is here to provide you with the "how-to, what-to, and where-to" guide you need to *get more from your 64.* It's a concise, advice-filled compendium of all possible Commodore 64 expansion options and the many ways you can enjoy them. It tells you exactly what to look for—and the pitfalls to avoid—when shopping for peripherals, accessories, and software. Paying special attention to Commodore products, it covers:

modems • disk drives • video expansion • 1/0 options • on-line information services • data bases • telecommunications • color • printers • music and voice synthesis • new operating systems such as CP/M • joysticks • and much more.

Including the names and addresses of the suppliers who carry these extras, *Expanding Your Commodore 64 Capabilities* will make you a smarter computer consumer. Whether you've been a Commodore 64 owner for two weeks or for two years or are still "just looking," this is your source of sound tips for building the computer of your dreams.

David D. Busch is a contributing editor of four computer magazines, including *RUN*, a magazine designed specifically for Commodore 64 users. He has also written more than 300 articles and 20 books on computers.



COMPUTERS

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PRENTICE-HALL, Inc., Englewood Cliffs, New Jersey 07632

Cover design by Hal Siegel