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RICHARD G. PEDDICORD


EVERYTHING
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64

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Dedication

For my parents, Margaret and Everett, my wife Judy, and my children, Jennifer, Tracy and Max.

About the Author

Richard Peddicord has worked with computers for over 20 years, as a programmer, teacher, and writer. He received his Ph.D in mathematics from U.C. Davis in 1965, and he has been writing for Alfred since 1980. Currently he lives in Weed, California, near Mt. Shasta, with his wife and children, assorted animals, and an arthritic pig named Wilbur.

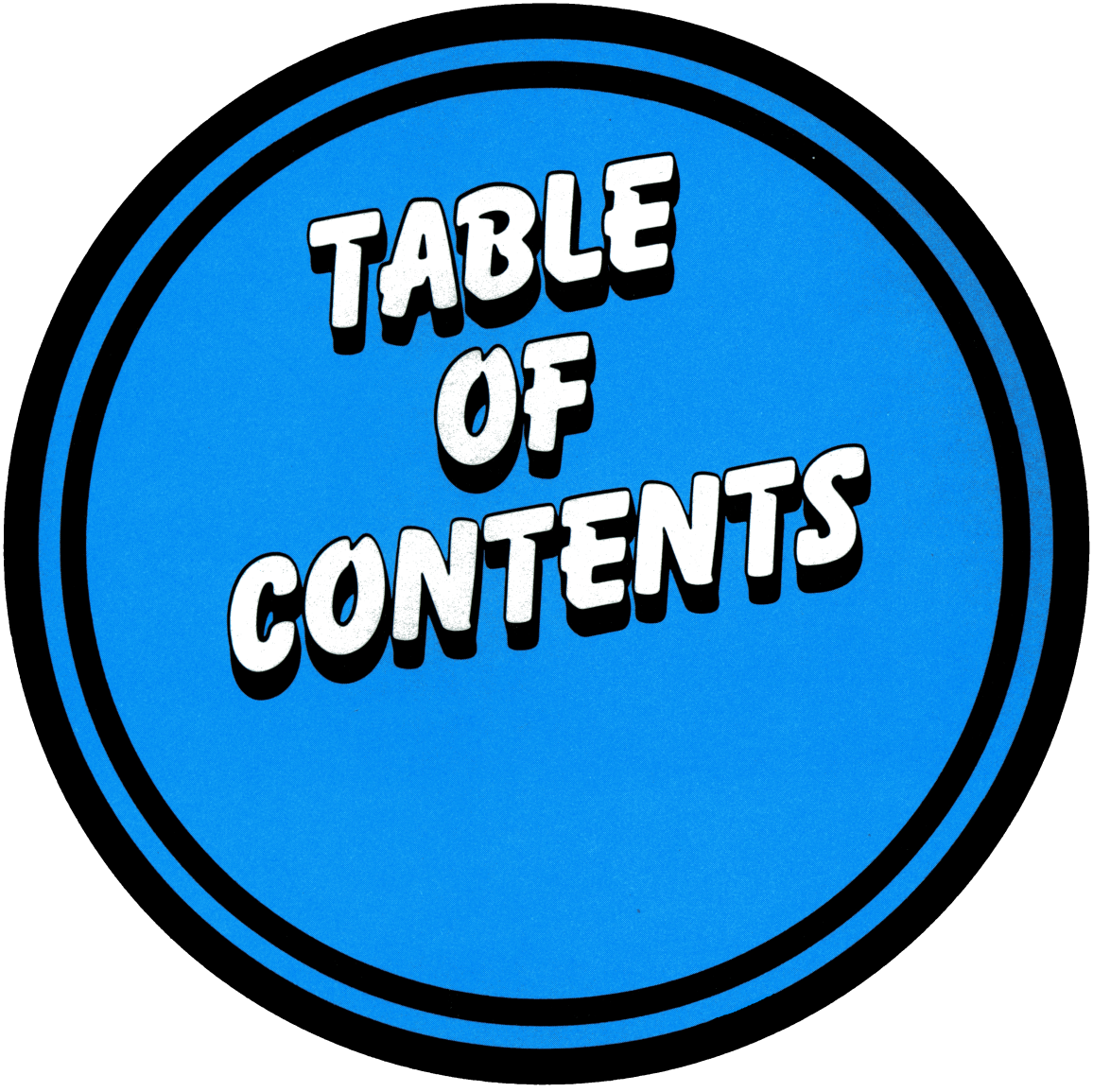

TABLE
OF
CONTENTS

TABLE OF CONTENTS

Chapter One:
HOW TO USE THIS BOOK **1**

Chapter Two:
WHAT'S IN THE BOX? **5**
Find the Right Power 7
Unpack the Shipping Container 9
The Power Supply 10
The Commodore 64 11
The Hi-fi Cable 13
The Antenna Switch Box 13
Turning Your System On 13

Chapter Three:
USING YOUR COMMODORE 64 ..... **15**
Using the Keyboard 17
Character Keys 18
Editing Keys 18
Shift 19
The Commodore Key 20
Shift and C = ... 20
CTRL 21
CRSR 21
CLR/HOME 22
INST/DEL 22
Executive Keys 22
RETURN 22
RUN/STOP 23
RESTORE 23
Function Keys 23

Table of Contents

Using Color 24
Text Color Changes 24
Border Color Changes 24
Background Color Changes 25

Chapter Four:
LEARNING BASIC PROGRAMMING 27
Your First Program 29
Line Numbers 31
REM Statements 32
Strings and Variables 32
Your Second Program 36
IF...THEN 37
Your Third Program: FOR...NEXT 38
READ and DATA 39

Chapter Five:
USING COMMODORE PERIPHERALS 45
Storage Devices 47
Cassette or Diskette? 47
The Datassette Recorder 50
Saving BASIC Programs 51
Saving Multiple Files 53
The 1541 Disk Drive 54
Putting a Diskette in the Drive 55
Formatting a New Diskette 56
Saving and Loading Programs 56
The Disk Directory 57
Renaming Files 57
Deleting Files 57
Changing an Existing File 57
The C=64 Wedge 58
The 1701 Video Monitor 59
The 1525 Printer 60
The MPS-801 Printer 62

Chapter Six:
GAMES, GRAPHICS, AND MUSIC 65
Game Software 67
Joysticks and Trackballs 68
Drawing and Painting Aids 69
Graphic Tablets 69

The KoalaPad 69
The PowerPad 70
Doodle 70
Light Pens 71
Graphics Programming Aids 72
High-level Graphics 72
UltraBasic-64 72
Sprite Editors 72
Making Music With Your Commodore 75
Synthy-64 76
Musicalc 80
Musicalc 2 Scorewriter 83
Musicalc 3 Keyboard Maker 84

Chapter Seven:
EDUCATION 87
Educational Software 89
Games and Drills 89
Simulations 90
Study Courses 90
How To Select Educational Software 90
Publications 91
Educational Software Vendors 92

Chapter Eight:
WORD PROCESSING 93
What Can Word Processors Do? 95
How to Select a Word Processor 96
Additional Hardware 97
Printers 97
Eighty-Column Screen Expanders and Monitors 97
Word Processing Programs 98
Magic Desk 98
Easy Script 101
WordPro 103
SpellRight 105
Other Word Processors 106

Chapter Nine:
KEEPING RECORDS WITH YOUR 64 109
How Does the 64 Keep Records 111
The Parts of a Record-keeping System 113
Input 113

Storage 114
Sorting Records 114
Selecting Records 115
Things to Check 115
Home Use 116
Office Use 116
Database Manager 117
The Consultant 121
Record-keeping Software 121

Chapter Ten:
FINANCIAL PROGRAMS 123
Accounting Programs 125
Some Selection Criteria 126
The Home Accountant 127
Available Software 130
Spreadsheets 131
What is a Spreadsheet? 131
What Can Spreadsheets Do? 131
PractiCalc 132
Available Spreadsheets 135

Chapter Eleven:
COMMUNICATIONS 137
Why Do I Need to Buy A Modem? 139
Connecting the Modem to the Commodore 139
Using a Modem 141
Who Should I Call? 142
CompuServe 142
Bulletin Boards 142
Other Services 142
Available Software 144

Chapter Twelve:
OTHER APPLICATIONS 145
Advanced Mathematics • Astronomy • Biology • Business • Chemistry • Computer Science • Elementary Mathematics • Energy • Farming and Agriculture • Foreign Languages • Health • Language Arts • Library Science • Mailing Lists • Physics • School Administration • Social Sciences • Sports • Statistics • Taxes

Chapter Thirteen:
LANGUAGES FOR YOUR 64 ..... **149**
Machine Language 151
Assembler 152
BASIC 152
FORTRAN 152
COBOL 153
Pilot 153
LOGO 153
FORTH 153
Pascal 153
COMAL 153
For More Information 154

Chapter Fourteen:
WHAT'S INSIDE THE COMPUTER **155**
The Keyboard 157
The Motherboard 157
Microprocessor Chip 158
Random-Access Memory 159
Read-Only Memory 160
The Complex Interface Adapter 160
The Video Interface Chip 161
The Sound Interface Device 161
Other Motherboard Systems 161

Chapter Fifteen
OTHER PERIPHERALS **163**
Cassette Interfaces 165
Printers 165
Printer Interfaces 168
Modems 168
Eighty-column Screen Expanders 169
RS 232 and IEEE Interfaces 170
A/D and D/A Converters 170
Speech Synthesizers 171
Port Expanders 171
Networking Devices 172

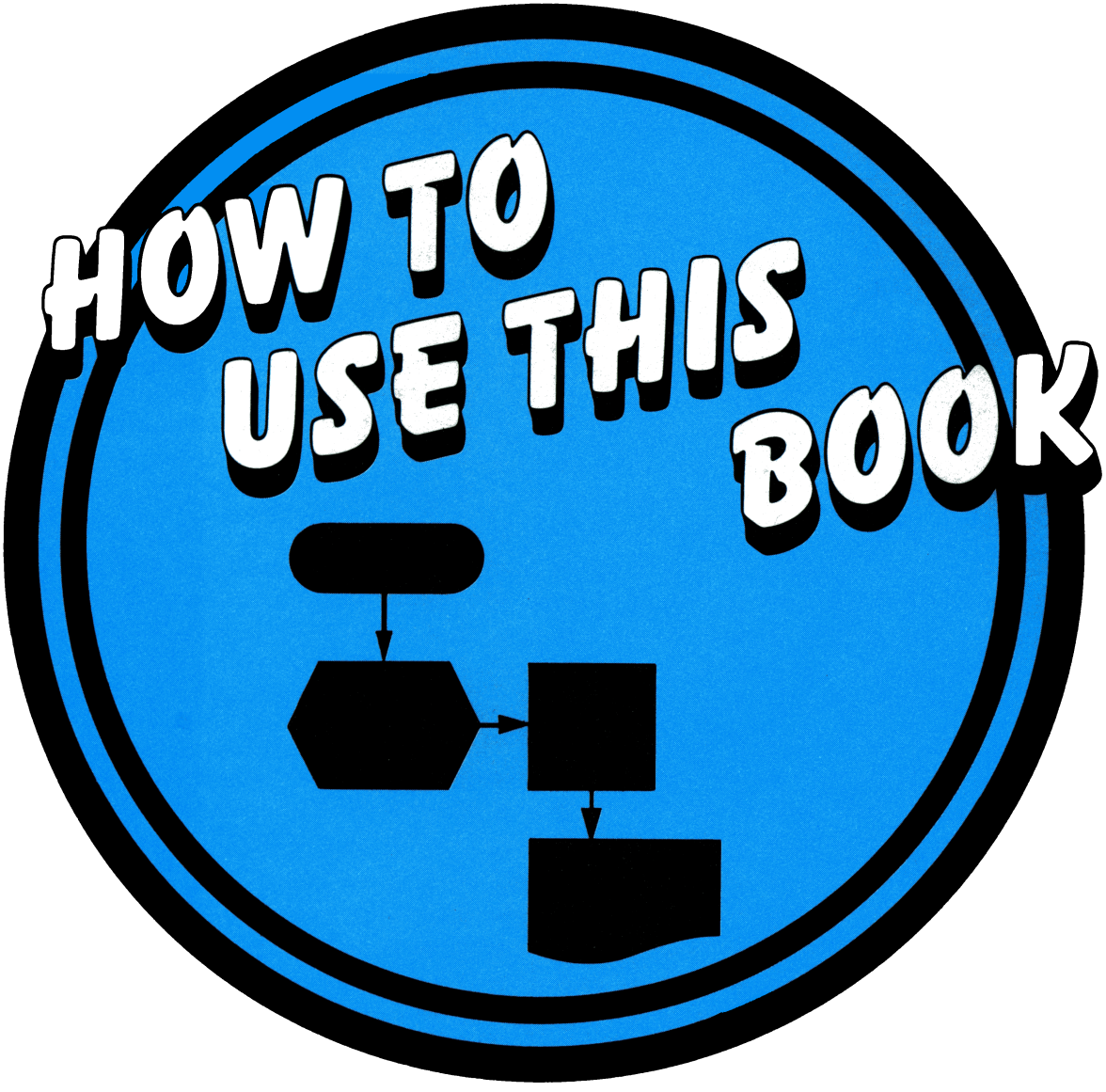
Chapter Sixteen:
THE NEW MACHINES **173**

The C264 175
The CV364 175
SFS 481 Fast Disk Drive 176
C1531 Cassete Drive Unit 176

Appendix A: Product Directory 179
Appendix B: Recommended Reading 199
Appendix C: Commodore 64 User Groups 209
Appendix D: Audio, Video, and Binary Signals 219
Appendix E: BASIC Reserved Words 223

Glossary 225

Index 229



Chapter One

Congratulations! The Commodore 64 is one of the most powerful personal computers in the low price range. It is flexible enough to handle many different tasks, from game playing to professional accounting, and it connects with a variety of peripherals such as disk drives, printers, cassette recorders, game paddles, cartridges, and other machines.

You will be able to use your Commodore 64 for just about anything, and you won't have to do any programming unless you want to. It is worthwhile, however, to know a little bit about how your machine works.

The first five chapters cover the things you will need to know in order to operate applications software or to program. Chapters 6 through 12 cover applications, and the remaining chapters cover programming languages, hardware, other peripherals, and the new family of 64s. If you are already familiar with how to operate your Commodore 64 you can go immediately to the chapter that interests you.

Many of the terms used in this book will be new to you, and may seem overly technical. It is important that you become familiar with these terms, so that you can discuss your needs with the professionals who can help you. The glossary in the back of this book should help. Knowing more about computers is definitely a good thing in today's world. I encourage you to read Chapter 14.

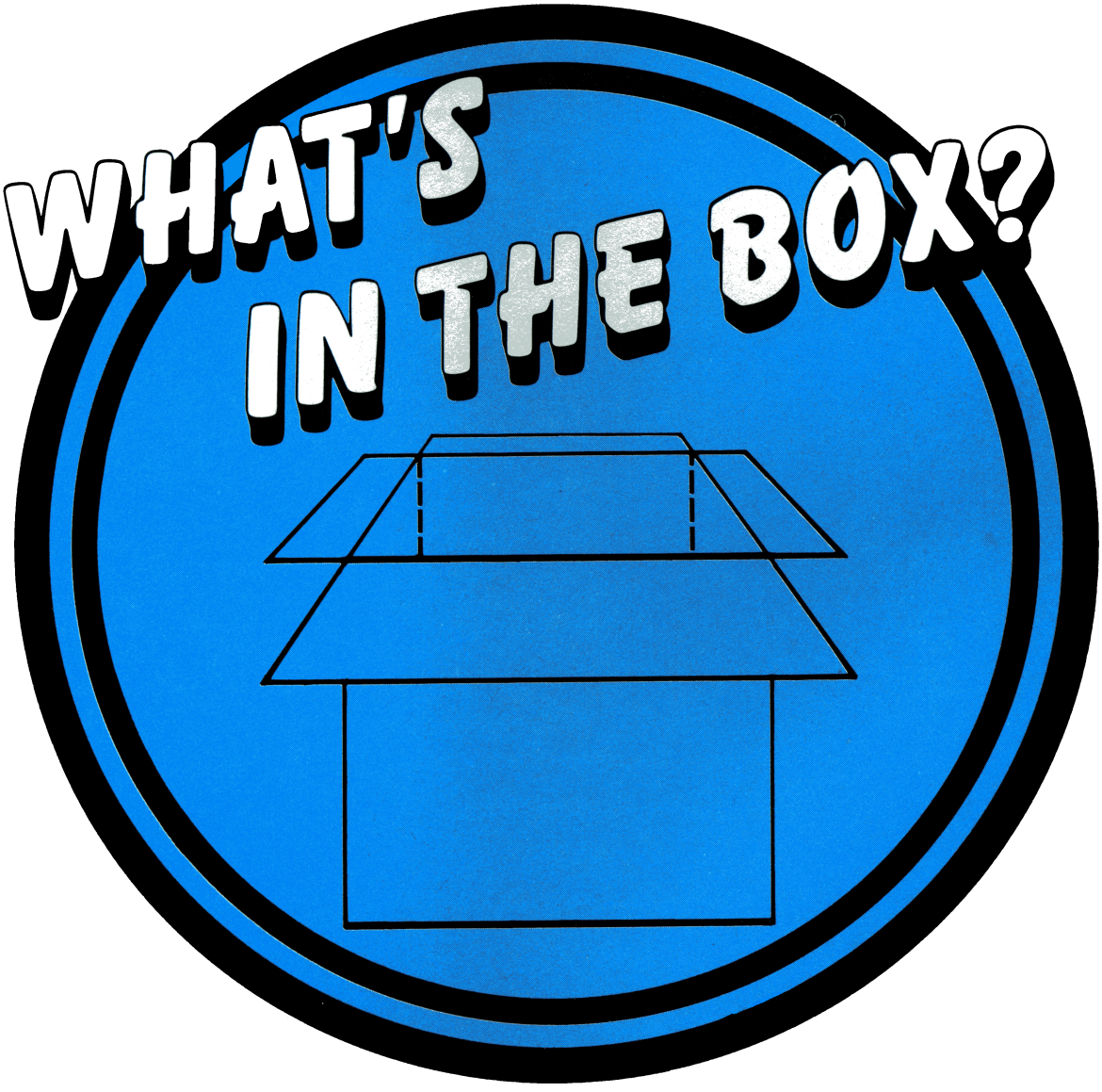
Good luck and have fun!

Some common applications and where to find them in this book.

Application	Chapter
Action-packed Games	6
Advanced Mathematics	12
Animation	6
Basic Learning Skills	7
BASIC Programming	4
Biology	12
Business Management	9, 12
Business Spreadsheets	10
Chemistry	12
Communications	11
Composing Songs	6
Computer Science	12
Database Management	9
Dexterity Training	6
Education	7
Electronics	12
Elementary Mathematics	7
Energy	12
Farming & Agriculture	12
Financial	10
Foreign Language	12
Games	6
General Science	12
Graphics & Art	6
Health	12
Home & Household	9, 10, 12
Instrument Control	12
Inventory	12
Invoicing & Billing	10
Language Arts	8, 12
Library Science	12
Light Pen Control	6
Machine Code Programming	13
Mailing Lists	9
Medical	12
Music	6
Personal	12
Personal Finance	10
Physics	12
Recipes	9
School Administration	9, 12
Simulations	7
Social Studies	12
Sports Data	9
Stock Quotes	9
TV Guide Database	9



The author taking one giant step for Commodorekind.



Chapter Two

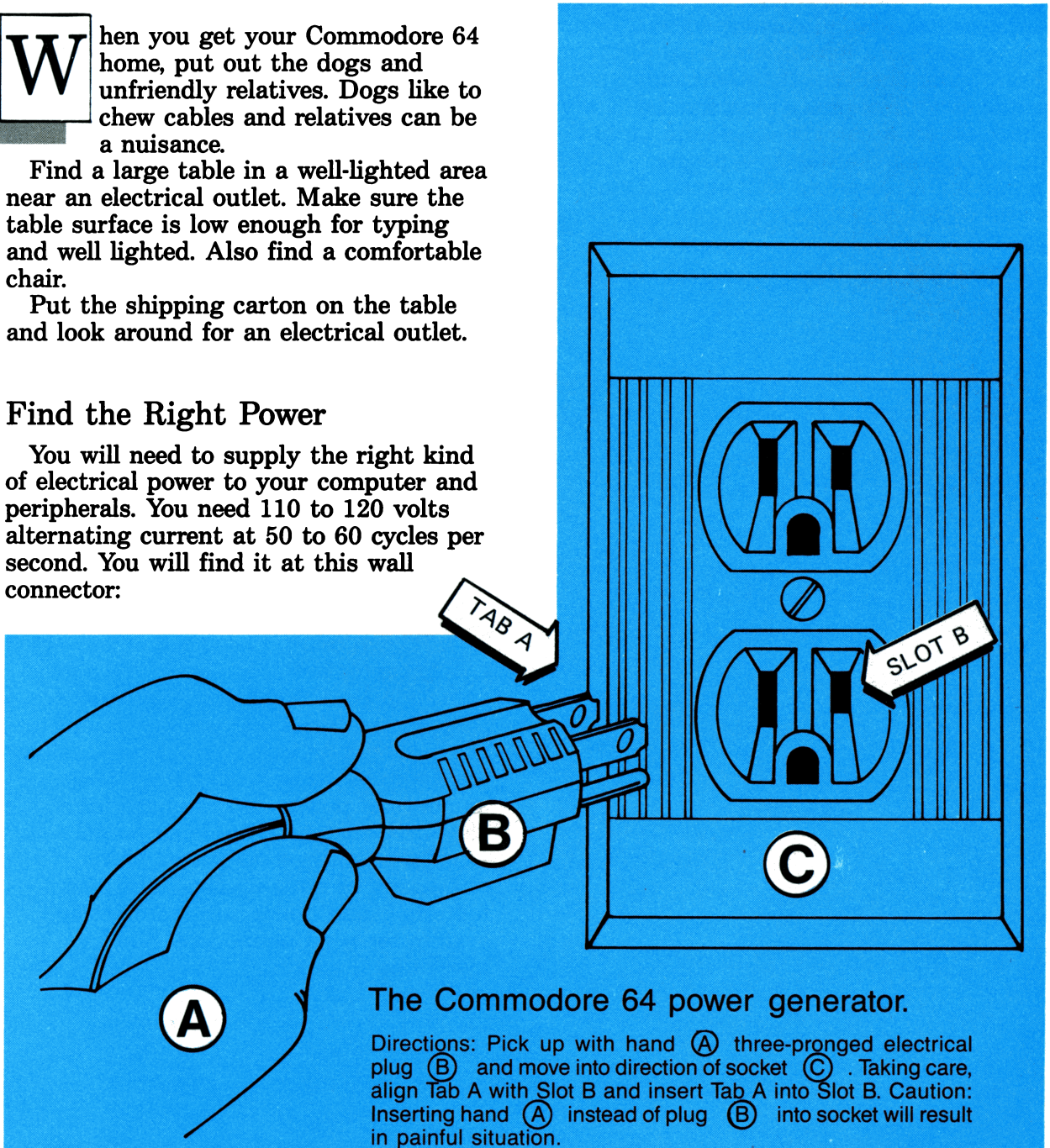
When you get your Commodore 64 home, put out the dogs and unfriendly relatives. Dogs like to chew cables and relatives can be a nuisance.

Find a large table in a well-lighted area near an electrical outlet. Make sure the table surface is low enough for typing and well lighted. Also find a comfortable chair.

Put the shipping carton on the table and look around for an electrical outlet.

Find the Right Power

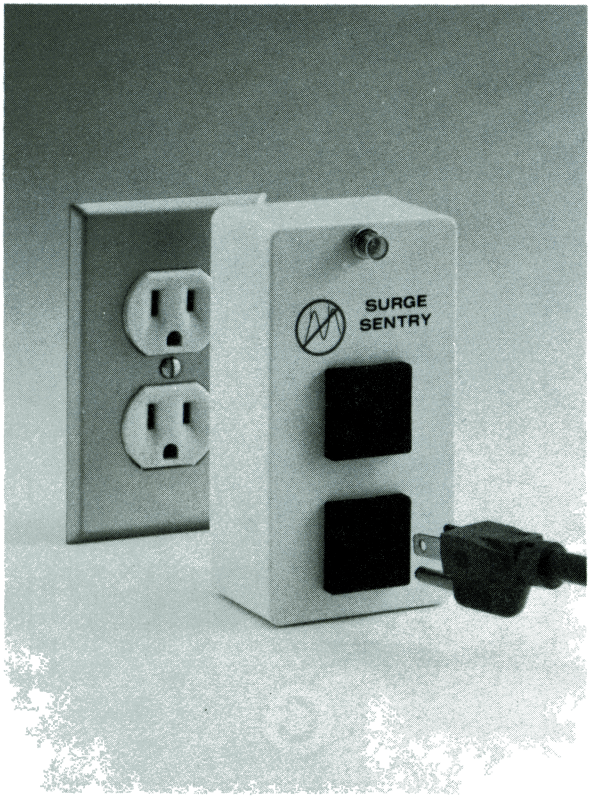
You will need to supply the right kind of electrical power to your computer and peripherals. You need 110 to 120 volts alternating current at 50 to 60 cycles per second. You will find it at this wall connector:



The Commodore 64 power generator.

Directions: Pick up with hand (A) three-pronged electrical plug (B) and move into direction of socket (C). Taking care, align Tab A with Slot B and insert Tab A into Slot B. Caution: Inserting hand (A) instead of plug (B) into socket will result in painful situation.

The hole below the pair of vertical slots is the ground conductor. It is supposed to ground current when something goes wrong, and keep you from being shocked. If the manufacturer supplies a three-prong plug for the device, always carry that ground conductor all the way to a proper, grounded three-prong wall outlet. Don't mess with Mother Power.



The Surge Sentry is a good surge protector at around $90. (Courtesy of Surge Sentry)

If you happen to live in an older home or trailer that has ungrounded, two-prong electrical outlets, you will have to be careful. In this case get those three-prong to two-prong converter plugs. They will have a short green wire that is supposed to attach to the center screw in the wall outlet. Cut if off, because you will not know, for any given outlet, which side of the two vertical power slots is grounded, or indeed how good the ground is. Therefore it is best to provide no grounding protection to your system.

Look closely at the two vertical slots above the ground hole. You will see that the left slot is slightly longer than the right slot. It permits a slightly wider blade to be inserted than does the right slot. Certain newer plugs that are not grounded do have a wider blade on one side, and this forces you to plug it in with the wide blade on the left. Left is ground, unless the electrician screwed up.

You will need one outlet for your Commodore 64, one for your monitor or TV set, and one for each peripheral device that you plan to use. Buy a good extension cord that ends in a strip of three-prong outlets. If you can afford it, get a surge protection box. It is possible for electrical storms to transfer large amounts of power into the lines for a very brief instant. These can produce very large voltages at your outlet.

A friend of mine up the street has a four thousand dollar surge protection system for her Commodore. She has always been a cautious type. Most surge protection boxes are in the $30 to $300 range. They are available in most computer stores.

Unpack the Shipping Container

Take a sharp knife and cut the mailing tape on your Commodore 64 shipping carton. Save everything for the entire warranty period of the machine (usually 90 days). Always save the boxes and packing material. They'll come in handy if you ever need to transport your computer.

Put the components on the table and put the shipping material and the box in a safe dry place. Go to the refrigerator and get a snack.

Figure 2.1 shows what we found in our box.

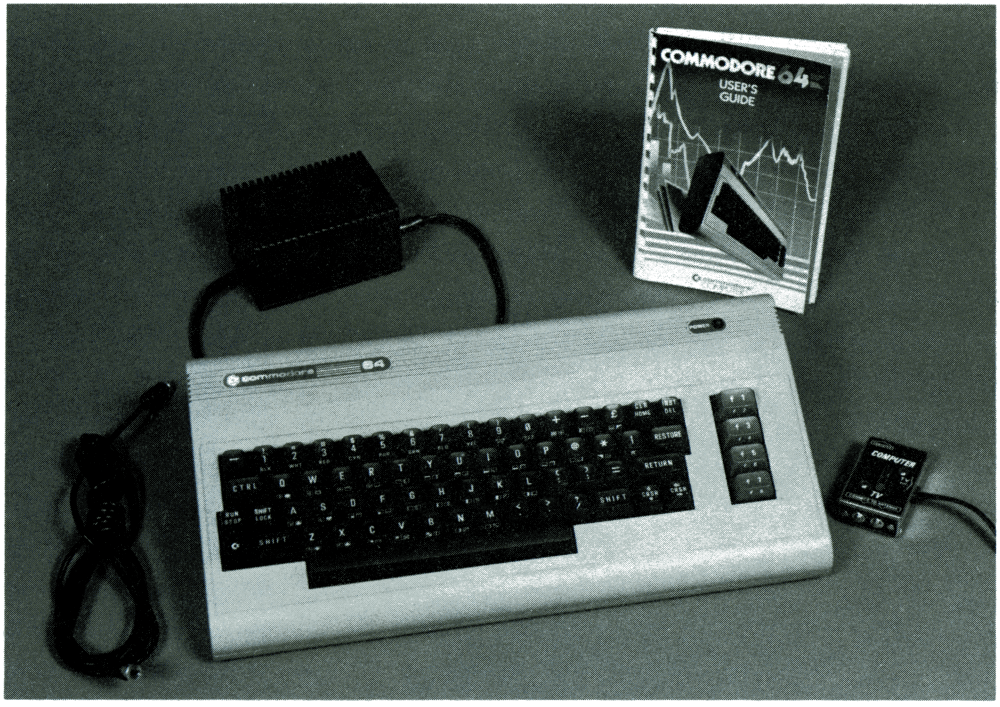
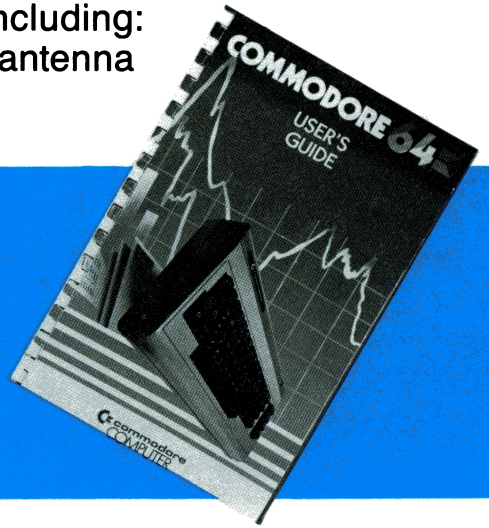


Figure 2.1. The unboxed Commodore 64 including: the computer, user's guide, hi-fi cable, TV antenna switch box, and power supply.

Commodorus Manualus

This booklet contains the essential information on your Commodore. Take it out of the box and turn to Chapter 1. Read it if you can understand it. If not, throw neither it nor your computer out the window. Read our book instead. Keep the manual around though. It has some important reference material.



The Power Supply

The small heavy unit with two cables coming out of it is the power supply. It supplies the operating voltages for your Commodore 64. By having a separate power supply, the C64 components have less heat to endure, and the computer is quite a bit lighter. Pick up the power supply in your hand and feel how heavy it is. It has a lot of iron in it to direct the magnetic fields that exchange the electrical energy between the power company and your computer.

Coming out of one side of the power supply is a cable that ends in a connector with seven little pins and a circular shield. This plugs into your C64 on the right side, toward the rear, as shown below. Go ahead and plug it in (see Figure 2.2). Make sure the little notch on the cable connector shield is pointing upward.

The other power supply cable plugs into a wall outlet. It will have either a grounded (three-prong) or an ungrounded (two-prong) plug. Plug it into an available electrical outlet, or into one of the outlets in your extension cable outlet box.

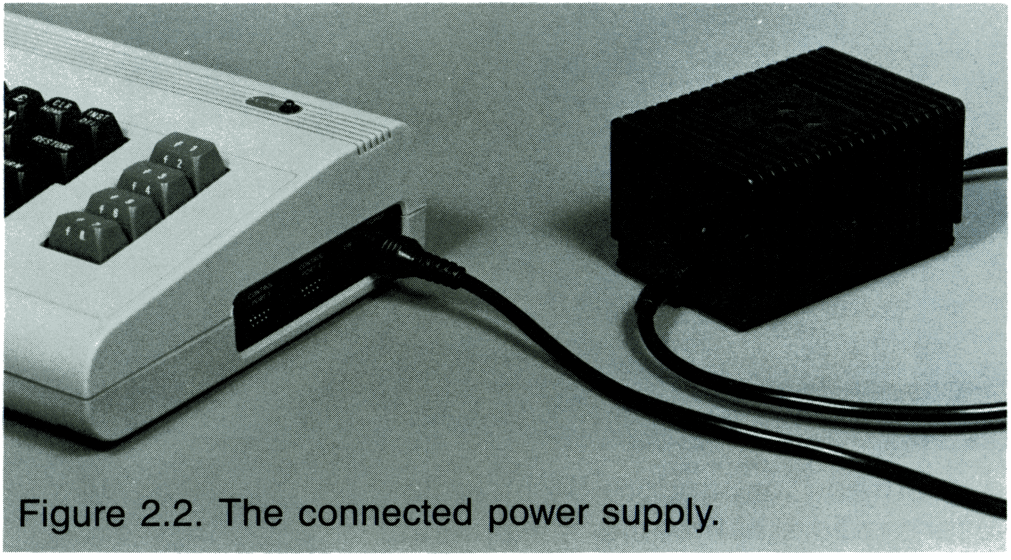


Figure 2.2. The connected power supply.

The two ports next to the power switch are for joy-sticks and other input devices. If you are using one of these, GOTO page 68

Computer Lesson #1

Whenever you do anything with a computer, always do so one module (translation: step) at a time. That way you can keep the errors under control. So now is a good time to check that your C64 has power.

Find the small rocker switch next to where the power cable comes in. Rotate it upward (on). You should see the red power light glow. If it does, congratulate yourself and move on.

If the power light doesn't glow, repeat all the steps. Make sure your electric bill is paid. If so, scream at the top of your lungs. That won't help the system, but you will feel much better about never being able to do anything right the first time.

The Commodore 64

Pick up your Commodore 64 and hold it in both hands. Toss it up in the air a few inches and catch it. Feels good, doesn't it? See how high you can toss it and still catch it. If you drop it, however, forget you ever saw this book.

Turn the machine around and look at the rear panel. In what follows, as we describe the rear panel, "left" means your left as you face the back of the machine.

The slot on the left is for cartridges. A cartridge is any system that plugs into this space. Most cartridges are programs stored in what is called read-only memory or ROM. We will talk about it in Chapter 14.

The main advantage of cartridges is that the programs don't take up any memory inside the computer, and they don't have to be read into memory by a disk drive or cassette recorder, which takes time and uses valuable memory space. There are even cartridges that allow you to plug in more than one cartridge at a time.

The little teeny switch to the immediate right of the cartridge port selects the TV channel on which to watch the computer output. You have a choice of channel 3 or channel 4. Later, once you connect your TV set, try both. Use the one that gives you the best picture.

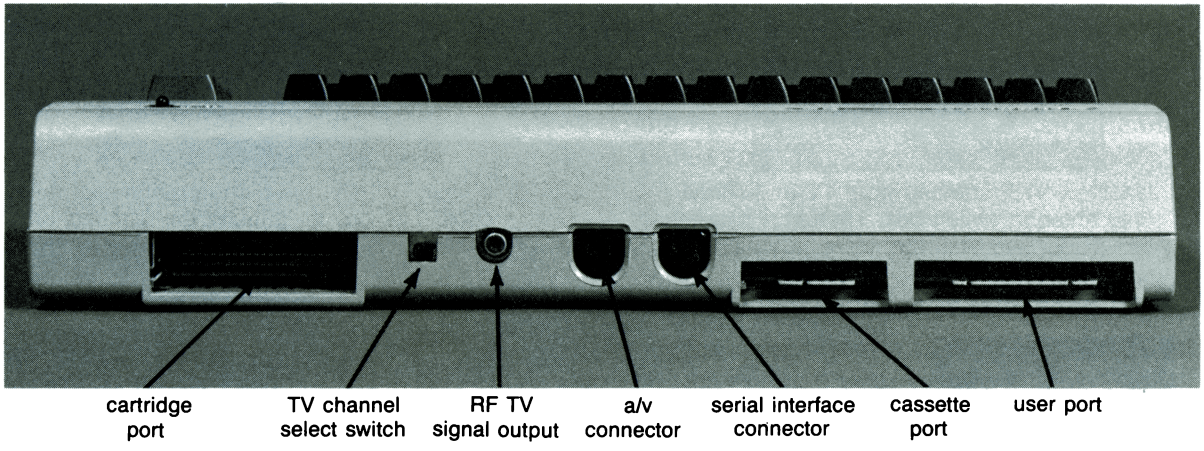


Figure 2.3. A Rear Commodore.

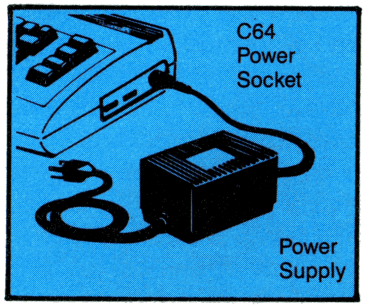
Right next to the switch is the signal output to your home TV set; the hi-fi cable that comes with your C64 plugs into this connector. The other end of the hi-fi cable plugs into that funny little box, the TV antenna switch.

If you will be using a video monitor, set the hi-fi cable and the antenna box aside. A video monitor is like a TV set, except it doesn't have a receiver that tunes in the various channels. A video monitor that works with the C64 uses what is called "composite video." That is the same kind of signal a home TV camera or tape recorder generates.

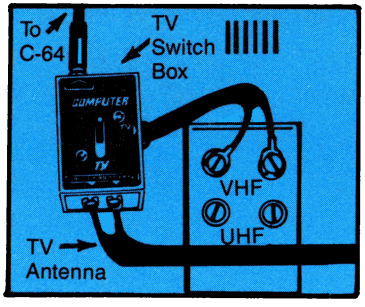
If you are using a monitor, GOTO pp. 59-60.

Figure 2.4. How to Hook Up Your System.

1. Connecting the Power Supply



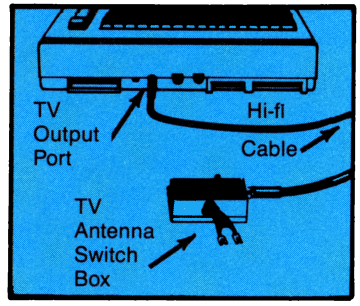
Connect the power supply to the port as shown and plug into a 3-prong outlet (if possible).



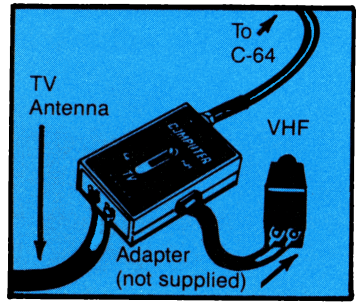
2. Unscrew VHF antenna from TV and screw onto antenna switch box. Then screw switch box leads onto VHF terminals on your TV.

OR

2. Connecting a TV

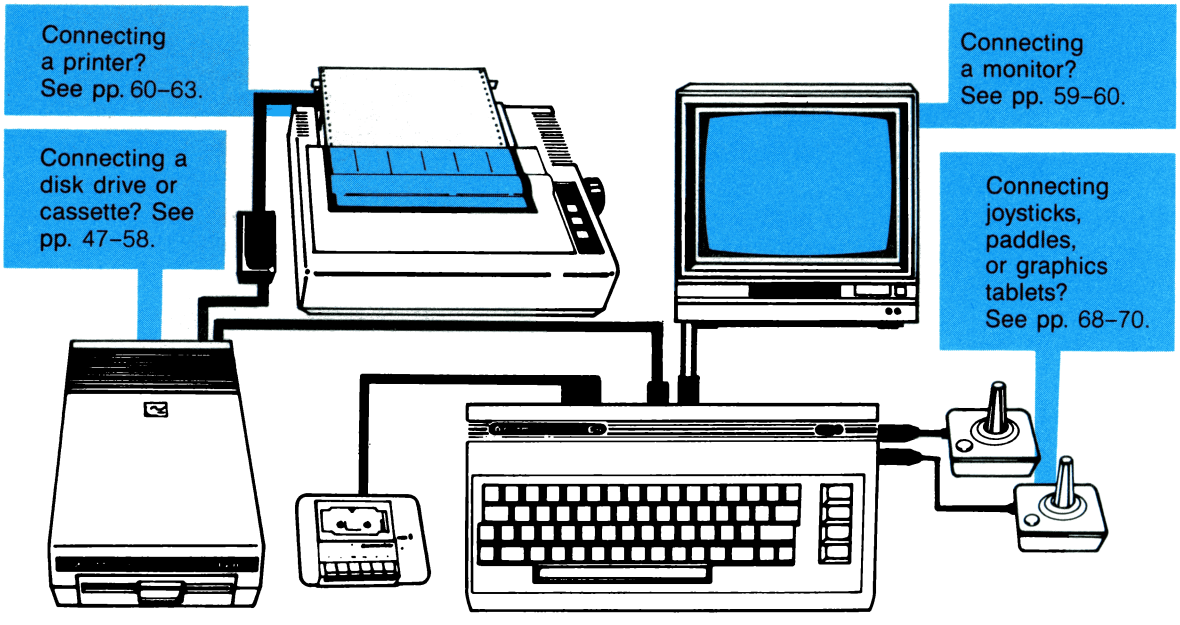


1. Plug one end of the hi-fi cable into the TV port and the other end into the TV antenna switch box.



2. If your TV uses the round F connector (for cable TV), *buy* an adapter and connect as shown.

3. Connecting Peripherals



A video monitor will connect to the audio/video port, to the right of the TV output (as you face the rear panel). The audio/video cable (see pp. 59-60) makes the required connection.

To the right of the audio/video connector is the serial interface connector. This is where you plug in a disk drive or printer, or other device using serial data transmission. These devices send one bit of information after another down just one wire. That is why they are called serial. Because the signal cable carries only a few wires, it can be thin and flexible. We will discuss these serial devices in Chapter 5.

If you are using a cassette or disk drive, GOTO pp. 47-58.



To the right of the serial port is the cassette port. The VIC Datassette or equivalent data recorder plugs into this port.

The last port on the right is for various user devices. We will describe some of these later on, in Chapter 15.

The Hi-Fi Cable

Pick up the hi-fi cable and bring both ends together. You will notice that both connectors are the same. That connector is called an RCA phono plug. The hi-fi cable is called a coaxial cable because it has a center conductor and an outside shielding conductor. The shield keeps out electrical noise.

You can use this cable in your stereo system. It so happens that it can be used for video as well.

If you plan to use a TV set rather than a monitor, plug one end of the hi-fi cable into the back of your Commodore 64. You will see that there is only one place where it can go, into the RCA female phono connector.

The Antenna Switch Box

That funny little box with the TV antenna twin lead coming out of it is used to connect your Commodore 64 with a standard television set.

If your TV set has a pair of twin lead terminals marked "VHF" (for Very High Frequency) use these. Do not use the terminals marked "UHF" as these go to the higher channels.

Find a good screwdriver of the right size and connect the twin lead cable to your TV set (see Figure 2.4).

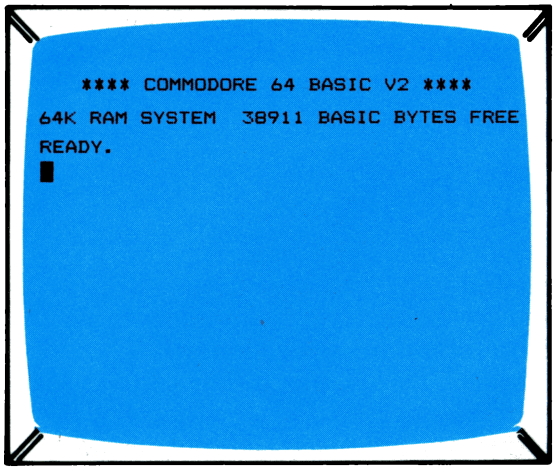
If your TV receiver does not have the twin lead screw-type antenna terminals it will have the other kind of TV antenna, the kind they use with cable television. This type of connector is called an F connector, and it is a newer, better designed fitting.

You can connect the TV cable from the computer directly to the F connector on your TV set (if it has one), but you will need a special connector that goes from the RCA male connector on a thin black cable to the F-type female connector on the TV set. Most electronics and TV/hi-fi stores have this particular connector, now that everybody is into component TV and color computer graphics. See Figure 2.4 to see the connection.

Turning Your System On

After you have connected a TV set or video monitor to your C64, you are ready to turn your system on.

First turn on the monitor or TV set, and let it warm up. Then turn on your C64. You should see the screen come up in dark and light-blue colors:



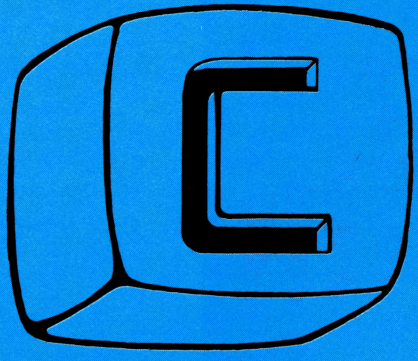
There should be a blinking light-blue square of light, called the cursor, immediately below the word READY. The cursor indicates the position of any character expressed on the keyboard. Its function will be described in greater detail in the section on using the keyboard, Chapter 3.

Blank Screen?

1. Be sure that all of the connections are made properly and are firmly in place.
2. Check the tuning on your TV. Try setting it to channel 3.
3. Check the position of the channel select switch in the rear of your C64. It should be switched to the left as you face the rear of your C64 (channel 3).
4. Make sure the TV antenna switch is set to "Computer."
5. Check the front-rear switch in the back of the 1701 monitor, if you are using one.
6. Refer to the troubleshooting chart in your *Commodore 64 User's Guide.*
7. Contact your dealer. Start gently and use a friendly tone. Slowly escalate to hysteria.

If you want to insert a program cartridge, do so while your computer is off. Inserting a cartridge while the computer is on can result in damage to the cartridge.

USING THE COMMODORE 64



Chapter Three

In the preceding chapter you learned how to hook up and turn on your system. In this chapter you will learn how to keep it going. As with all things, you have to develop a relationship that lasts, and this takes time and attention.

Some people would prefer to search for caterpillars rather than sit in front of a computer all day. As you probably know, there are lots of different kinds of caterpillars. You find them mostly in the spring.

If you are not into caterpillars just now, but would rather learn about your Commodore 64, read on.

Using the Keyboard

Your keyboard will look like the one in Figure 3.1.

The characters typed on the keyboard are automatically displayed on the screen. The print position on your screen is indicated by a blinking square of light called the *cursor.* When a character is typed on the keyboard, the cursor will be replaced by that character and the cursor will move forward one space.

When the end of a line is reached, the cursor will move to the first column of the next line automatically. This is called *wraparound.*

Type anything you like on the keyboard to become more familiar with how it functions. If you experience some unexpected results, such as text color changes or strange graphic symbols, just "reset" the computer by pressing the RUN/STOP key at the far left of the keyboard and the RESTORE key at the right of the keyboard, simultaneously. If the keyboard "locks up" and fails to respond, just turn the computer off and on again.

The computer may start talking back to you by displaying messages such as "?SYNTAX ERROR" and "READY" on the screen. Ignore these messages (for now). The machine is simply telling you either that it doesn't understand your commands or that it is READY to listen to you. You cannot damage the computer by experimenting with the keyboard, so go ahead and enjoy yourself.



Figure 3.I. The C 64 keyboard.

In your experimentation with the keyboard you may have noticed that the keys have many different functions and representations. In addition to the *character keys,* which display characters on the screen, there are three other kinds of keys. The *editing keys* move the characters and cursor around, delete characters, and perform other general editing functions. The *executive keys* can be thought of as the "boss keys" because they control the operations of the computer by performing functions such as resetting the computer and starting and stopping the execution of programs. The *function keys* are defined by the user to perform different functions while programs are running. This section will examine each of these types of keys in greater detail.

Character Keys



The character keys display the letters, numbers, and special symbols appearing on the keys themselves. They are shown in Figure 3.2.

The editing keys turn on and off the different character key modes shown in Figure 3.2.

Each character key represents at least one symbol. The editing keys, discussed next, determine which symbol is used.

Editing Keys



The editing keys move the cursor around the screen and select which characters are used.

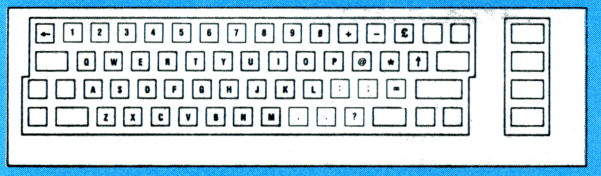
The editing keys SHIFT, CTRL, and C= (the Commodore key) are no good by themselves, but are always used in combination with other keys. Pressing either the SHIFT, CTRL, or C= key and a character key simultaneously will result in such things as upper- or lowercase letters, graphic symbols, and text color changes.

The CRSR, CLR/HOME, and INST/DEL keys are used to perform the functions normally associated with editing, such as cursor movement and character insertion and deletion. These keys are often used in combination with the SHIFT editing key to perform alternate functions, but unlike the SHIFT, CTRL, and C= keys, these editing keys can function without being combined with other keys.

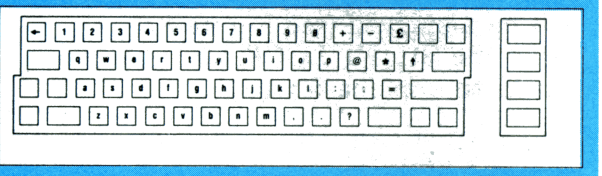


There are two SHIFT keys located in the bottom row of keys on either side of the keyboard. Using the SHIFT key in

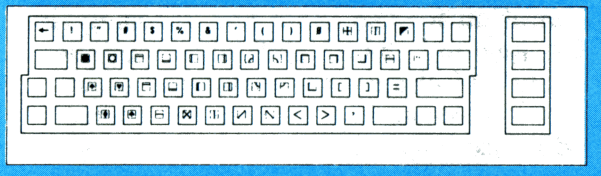
Figure 3.2. The Character Key Modes



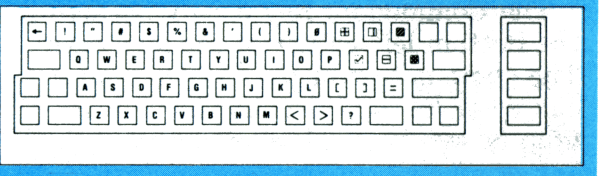
Upper-case mode



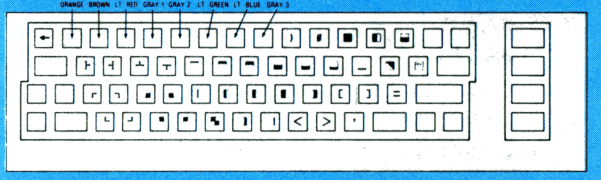
Lower-case mode (to activate, hold down C= and SHIFT at the same time)



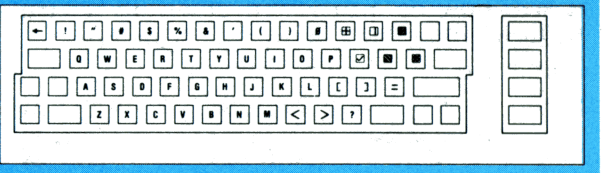
Upper-case mode while holding down SHIFT (graphics mode 1)



Lower-case mode while holding down SHIFT



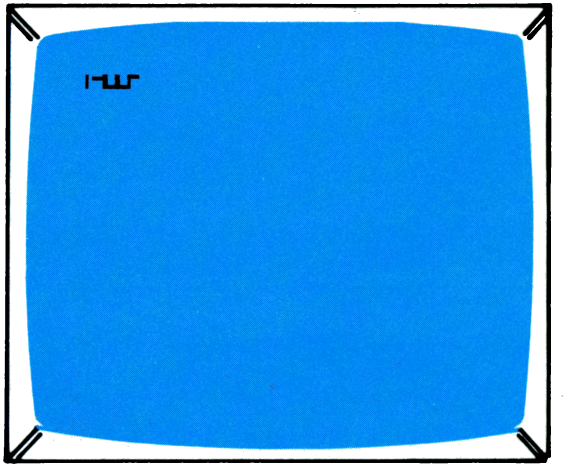
Upper-case mode while holding down C= (graphics mode 2)



Lower-case mode while holding down C=

combination with a character key will usually result in the graphics symbol on the front right of the character key or the symbol on the top of the numeral key. The SHIFT key may be locked on by pressing the SHIFT LOCK key. Any keys typed with the SHIFT LOCK key in the down position will respond as though the SHIFT key was being depressed simultaneously. To unlock the SHIFT key, press the SHIFT LOCK key again.

Type "hello" without using the shift key. Now press the SHIFT LOCK key and type "hello." Your screen should look like this:



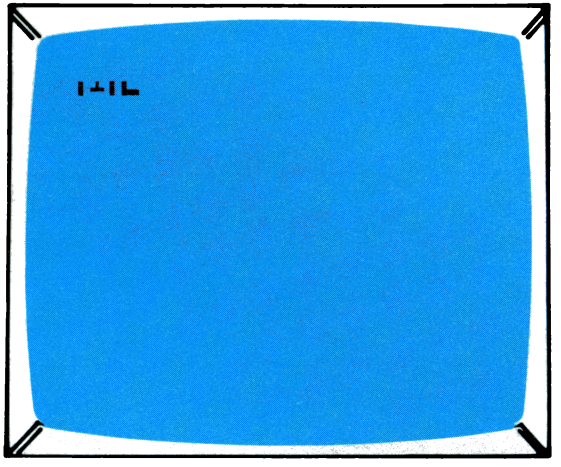
You are in the graphics mode. The graphic symbol on the right front of each character key (except the digit keys) will be displayed (see Figure 3.2). Press the SHIFT LOCK key again to return to uppercase mode.



The Commodore Key

The Commodore Key (C=) is located in the bottom left corner of the keyboard. The combination of the C= key and a character key will usually display the graphic symbol on the left front of the key or change the color of the text if used with keys 1-8 (see Figure 3.2).

Try holding down the C= key and hitting a number. When you type in text it will now be a different color. To return to light blue, hit C= and 7. Now try holding down the C= key while you type "hello." Your screen should look like this:



To change text and screen colors, GOTO pp. 24-25.



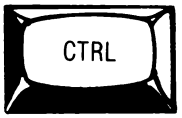


The SHIFTed C= key allows you to choose between the uppercase/graphics mode and the upper/lowercase mode. When the computer is first turned on, it is in the uppercase/graphics mode. All characters are displayed in uppercase and the SHIFT key selects a graphic representation for the letter key. Pressing the C= key and the SHIFT key simultaneously will change the display to upper- and lowercase. In this mode, all characters will automatically be displayed in lowercase unless the SHIFT key is pressed simultaneously to access their uppercase representations. To return to uppercase/graphics mode, press the C= and SHIFT keys again.

Press the C= and SHIFT keys at the same time. This will put you in upper/lowercase mode. Type "hello." You should see a lowercase "hello." Now press the SHIFT LOCK key and type "hello." This time it should display in uppercase letters. Press C= and SHIFT at the same time, once again. This will return you to uppercase/graphics mode.

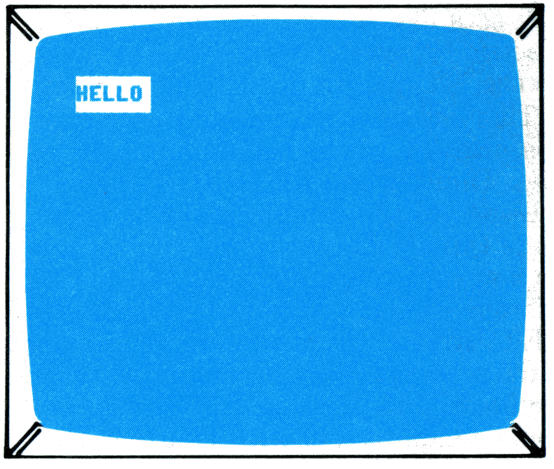
To change between uppercase/graphic modes and lower-/uppercase modes, hold down C= and SHIFT simultaneously.

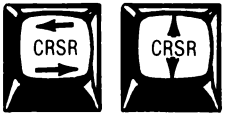
When you change modes, the characters already on the screen will change as well. This is because the memory of the Commodore 64 stores the keystrokes, not their representation on the screen. Changing modes changes the way in which the computer will interpret the keystrokes and, hence, how the keystrokes will be represented on the screen.



The CTRL key is found in the upper left of the keyboard. It is primarily used with the number keys 0-9 to access eight different colors in addition to those produced using the C= key. When the control key is used in combination with the number keys 1-8 the color of the text is changed to the color named on the front of the key.

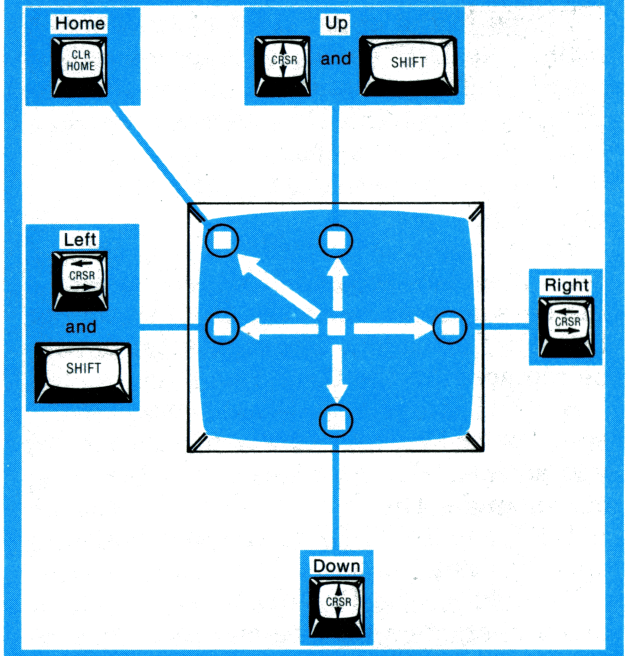
Combining the CTRL key with keys 9 and 0 will turn the reverse character feature on and off respectively. Characters printed with the reverse character feature turned on will be displayed as dark-blue characters with a light-blue block. In reverse video, the space bar prints small blocks of the current text color and is often used to create colored bars. Here's how "hello" looks in reverse video:





There are two CRSR keys located at the bottom right of the keyboard. These keys allow the cursor to move without affecting the characters it travels over. The left CRSR key with the up and down arrows moves the cursor downward and a SHIFTed left CRSR moves the cursor upward. The right CRSR key with the left and right arrows moves the cursor to the right and the SHIFTed right CRSR moves the cursor to the left. Holding these keys down will cause them to auto repeat and rapid movement in any direction can be accomplished.

Figure 3.3. Moving the cursor.





The CLR/HOME key is in the upper right corner of the keyboard. When used alone, it returns the cursor to "home" position in the upper left-hand corner of

the screen without disturbing the display currently on the screen. The shifted CLR/HOME key will not only return the cursor to the home position, but will clear the screen.

To clear the screen, hold down SHIFT and CLR/HOME.



Placed in the upper right of the keyboard, the INST/DEL key allows you to insert or delete characters on the screen. By itself, the INST/DEL key will move the cursor and the character beneath it left one space, deleting the character preceding the cursor.

For example, type "hello." Using the SHIFT and left-right CRSR key, move the cursor underneath the O. Then press the INST/DEL key. The rightmost L will be replaced by the O.

A SHIFTed INST/DEL will insert a space at the current cursor position. If you accidentally type "helo," put the cursor under the O or the L and press SHIFT and INST/DEL. A space will open up. Put the letter L in it.

By holding the INST/DEL key down, many characters may be erased or spaces inserted in a short time.

Executive Keys



There are three executive keys which can control the operation of the computer: the RETURN, the RESTORE, and the RUN/STOP keys.



The RETURN key is positioned at the right of the keyboard. When pressed, this key acts like the carriage return of an electric typewriter by moving the cursor to the left margin of the next line down.

This key does more than just return the printing to the beginning of the next line. Think of the RETURN key as a message to the computer saying "I'm done typing, I'm returning control to you so you can read my message." The C64 examines what you have typed after each RETURN, which is why we get so many error messages playing around with the keyboard and pressing RETURN. On some computers, the RETURN key is labelled ENTER instead, and this can be a better way of thinking about its function; it enters what you have just typed into the computer's memory, where the computer can deal with it.



The RUN/STOP key is directly over the C= key. Pressing the RUN/STOP key will usually stop the execution of a program. (Some programs disable this key so that it doesn't work.)



Located just above the RETURN key, the RESTORE key can get you out of most of the problems you can get into on the Commodore 64. If the computer fails to respond, the colors are wrong, your program is going crazy, or something else happens that you want to stop, pressing the RUN/STOP and RESTORE keys simultaneously will reset the computer to normal conditions and return control to you. The RESTORE will not erase the program in memory, so that you can correct whatever problem exists. Press RUN/STOP and RESTORE at the same time, just to see how they work together.

In some cases, the RESTORE key will not be able to resolve your problem. In these instances, only turning the computer off and on again will help and all of your work not saved on tape or disk will be lost.

Function Keys



The function keys are located at the far right of the keyboard. When the UNSHIFTED function keys are pressed, the functions 1, 3, 5, 7 can be accessed. By using the SHIFT key with the function keys, functions 2, 4, 6, and 8 can be accessed. Try pressing any or all of the function keys. At first glance, they seem to serve no function whatsoever. This is because the function keys differ from the other keys on the keyboard in that they are not preassigned any specific purposes. These keys are defined within a program to perform as desired when pressed. This allows greater flexibility of use than would be possible with predefined functions.

The operations assigned to the function keys may be changed from program to program. You must read the documentation that accompanies any program that uses function keys to determine what function each of the keys will perform. The function keys are very useful in programs that use a given function repeatedly. The extent of their use varies from program to program. In some programs, the function keys may be heavily used and in others they may not be used at all.

As you use your Commodore 64, you may notice that at times such keys as the editing, executive, and color keys will not respond in the way you expect them to but will begin to print strange graphic characters. If this happens, you are most likely typing in *quote mode*. To get out of quote mode, type another quote mark.

Using Color

The Commodore 64 has the ability to display sixteen different colors. This is considerably less than the several hundred colors that the North American Giblet-Eyed Peacock displays just prior to mating. That, however, is a separate subject, best left for after-dinner talk among adults.

The Commodore 64's color display is not so off-color, and so we can talk about it openly.

Text Color Changes

The keys numbered 1-8 on the top row of the keyboard are the color keys. Holding down the CTRL key and any of the color keys will change the color of the text to the color named on the front of the color key. Eight additional colors can be obtained by holding down the C= key and any one of the color keys.

Experiment with different text colors. The text can be changed back to the normal text color of LIGHT BLUE by depressing the C= and 7 keys simultaneously or by pressing the RUN/STOP and RESTORE keys.

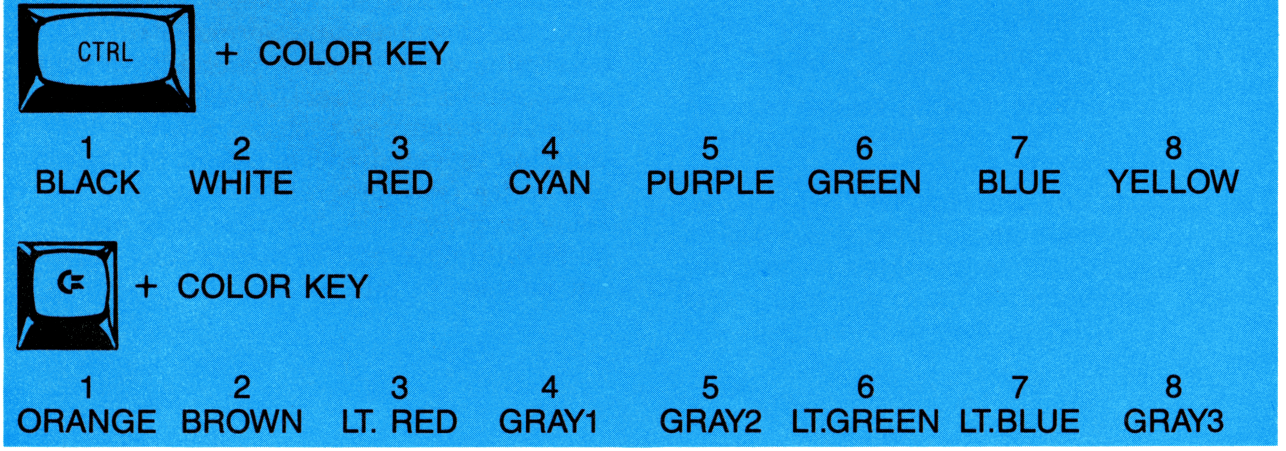
Border Color Changes

The color of the border of your screen is determined by the contents of a certain area of the computer's memory. The computer refers to this memory location to determine the color required. By changing the value of this memory location, the color of the border can be changed as well.

Example:

```
POKE 53280,7
```

Figure 3.4 Setting the text colors



The command POKE is used to place a value in memory; 53280 is the memory location containing the value that determines the color of the border. A value of 7, signifying yellow, has been placed in the memory location. Figure 3.5 provides a table of the color code numbers.

The normal border color can be reobtained by entering the command POKE 53280,6 or holding down the RUN/STOP and pressing RESTORE.

To restore all colors to the original setting, hold down RUN/STOP and RESTORE

Background Color Changes

The background color is changed in the same way as the border color. The memory location that holds the value controlling the background color is 53281. The color code numbers and command format are identical.

Example:

```
POKE 53281,5
```

This will turn the background green. The normal color of the background is light blue, or 14. Experiment with various color combinations of text, border, and background colors until you find the combination that suits you best.

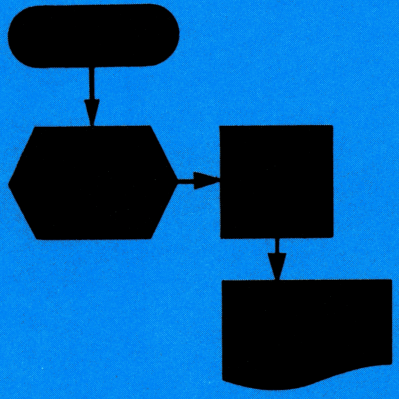
Some applications programs (programs that you buy) will let you select the colors; others select their own. Become conscious of color; it is one of the big advantages of your Commodore 64.

Figure 3.5. Setting the background and border colors

To set background, enter POKE 53281, color code number
To set border, enter POKE 53280, color code number

0	BLACK	8	ORANGE
1	WHITE	9	BROWN
2	RED	10	LIGHT RED
3	CYAN	11	GRAY 1
4	PURPLE	12	GRAY 2
5	GREEN	13	LIGHT GREEN
6	BLUE	14	LIGHT BLUE
7	YELLOW	15	GRAY 3

LEARNING BASIC PROGRAMMING



Chapter Four

BASIC is the programming language that your Commodore 64 comes equipped with. BASIC is short for Beginner's All-purpose Symbolic Instruction Code. It was created in the 1960s at Dartmouth College by John Jemeny and Thomas Kurtz. As its name suggests, BASIC was developed especially for beginners. Although there are many different versions of BASIC, the fundamental structure of all versions is the same. The Commodore 64 uses a version known as Commodore BASIC 2.0, a simplified version of Microsoft BASIC (developed by Microsoft Corporation).

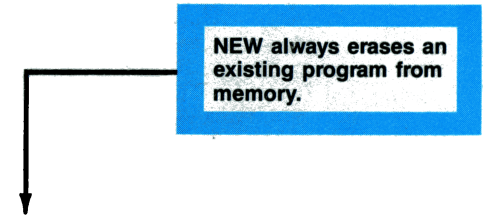
This chapter will introduce you to some of the simplest things you can do with BASIC.

For an explanation of programming languages, GOTO pp. 151-154.



Your First Program

A BASIC program consists of a sequence of numbered statements. Each statement consists of one or more commands. (If there is more than one command in a statement they must be separated by colons.) Here is a five-statement example one command per statement:




```
NEW
5 REM FIRST PROGRAM
10 REM PROGRAM SEGMENT 1
20 PRINT "WHAT IS YOUR NAME?"
30 INPUT N$
40 PRINT "THANKS " N$
```

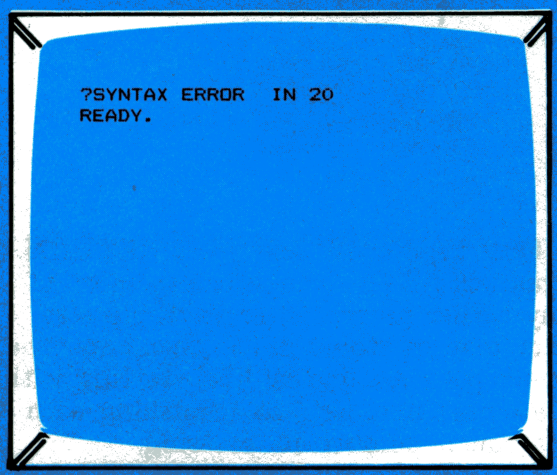
First type NEW and press RETURN. This will rid the computer's memory of any earlier programs (or anything else that may be stored in it). Then enter the above program line by line, starting with statement number 5 and finishing with statement number 40, pressing RETURN after each statement. Read each statement carefully before you press RETURN., If you make any mistakes, the computer will either not be able to perform the command, or will perform it in a way you don't wish. So it is important to correct any typing mistakes before trying to run the program. See Figure 4.1 on how to edit your programs.

Figure 4.1. How to correct errors

Once text is displayed on the screen, changes may be made by using the CRSR and INST/DEL keys. Try typing in a program with some mistakes:

```
NEW
10 REM CORRECT PORGRAM
20 PRNT "THIS IS TYPED"
30 PRINT "CORRACTLY"
```

Try running the program by typing RUN and hitting RETURN. You should see this:



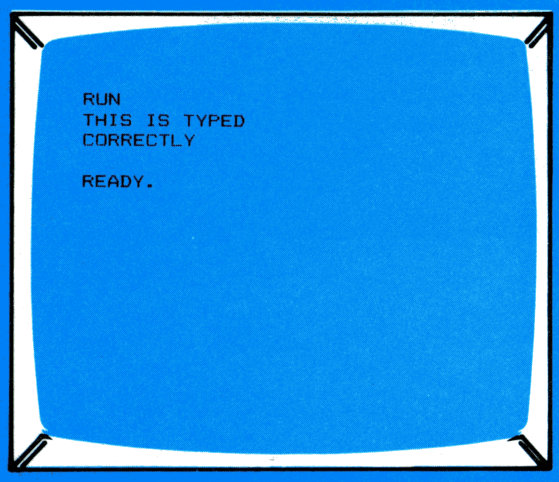
Your mistake on line 20 confused the computer and it could not execute that command. Let's edit the program.

Use SHIFT and CRSR together to move the cursor up to line 10. Then position the cursor under the "E" in "CORRECT" by using CRSR. Hit INST/DEL to delete the "R". Then move the cursor under the "O" in "PORGRAM". To correct the error, simply type "RO" which will replace the "OR."

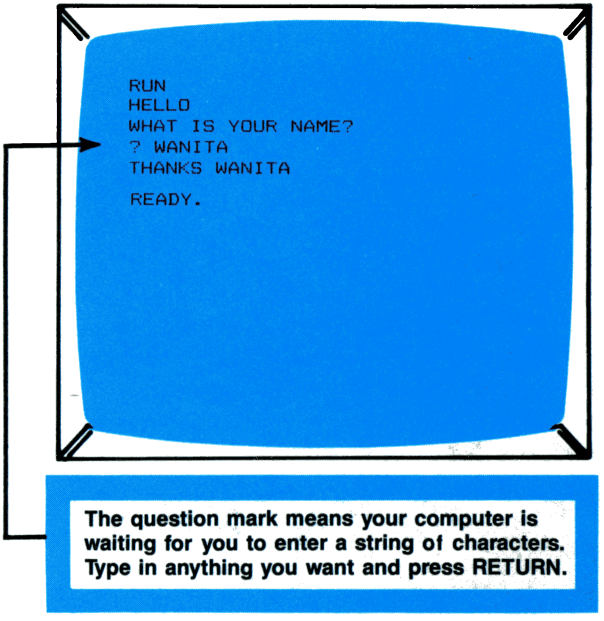
To put these changes into the computer's memory, you must hit RETURN. If you simply move the cursor to the next line, the changes will be made on the screen, but not recorded into memory. When you run the program, the error will still remain.

After you hit RETURN, the cursor will rest at the beginning of line 20. Move it under the "N" in "PRNT" and use SHIFT and INST/DEL to add a space before the "N." Then type "I." Hit RETURN.

Finally, move the cursor right to the "A." Simply type "E" and hit RETURN. Enter RUN and you should see the fruits of your labor:



After you've entered the program, type LIST and press RETURN. You will see your program listed. Read this program listing, checking for typos. Now type RUN and press RETURN. The screen will look like this:



LIST will make the computer display whatever program is currently in memory.

Let's examine the parts of this program.

Line Numbers

Line numbers are used to identify each instruction you want the computer to perform and specify the order in which you want them performed. As you enter statements with line numbers, the computer stores each statement in memory without trying to execute them. It waits until you enter the command RUN, and then will automatically execute each statement in ascending order by line number, regardless of the order in which you entered these statements. That is, you could have typed line 30, then line 5, then line 20, etc., and the computer would have still executed 5 first, then 10, then 20, etc. To see this, enter this new line:

```
15 PRINT "HELLO"
```

Now when you LIST the program, this line will be inserted between statements 10 and 20.

This is why it is a good idea to number your statements in multiples of 10. It leaves room for you to insert other statements between two existing statements. You might have forgotten to include an instruction or you might want to add new instructions to modify an existing program.

You can also delete statements by referring to their line numbers. Simply type the line number and hit RETURN. Try entering the following:

```
10
```

Now LIST the program and you will see that this statement has vanished. If you wish, reenter it.

RUN tells the computer to execute the program in memory.

REM Statements

REM stands for REMark and is used to place messages to yourself and other programmers in your program. When placed at the beginning of a line, REM tells the computer to ignore whatever follows in the statement.

REMark statements are useful to remind you of what different parts of your program are supposed to do. This is particularly important in long and complicated programs and all professional programmers use them to *document* their programs.

Strings and Variables

The PRINT statement prints whatever you put inside quotation marks on the screen exactly as you write it. Anything that is contained within quotation marks is called a *string*. As computer terms go, this is a pretty descriptive one, since the computer treats a string as a string of characters, one after the other. There are no rules governing what can be the contents of a string. Any letter, number, or symbol is ok. "WHAT IS YOUR NAME?" is a string the program will PRINT in statement 20.

Sometimes strings are confused with *variable names*. A varialbe name, like N$ in statement 30, refers to a place in memory where a value may be stored. (Don't worry where that place is physically in the computer. I have a theory it's stored in miniature filing cabinets in the center of the Commodore.) When you refer to that variable name, the computer will find that place in memory and look up the value stored there. The value may be a number of a string. Thus, you could have a variable named HELLO$ that stores the string "HELLO$" (notice the string must be surrounded by quotes while the variable name is not).

As programmer, you choose variable names. It is good practice to use names that help you remember what they represent. For example, you might use the variable ZIP to store the value of someone's Zip Code. Also, you must observe the rules listed in Figure 4.3.

Only one value may be held in a variable's memory location at any given time. The value stored in a memory location may be changed, if needed, any time during the execution of the program.

You can put a value into a variable by referring to that variable's name. In line 30, INPUT N$, for example, the computer takes whatever you type in and puts it into variable N$, that is, into the memory location marked with the name N$. Then, in line 40, the computer prints the string "THANKS" and whatever string you stored under the variable N$.

For A List Of Reserved Words, GOTO Appendix E.



Figure 4.2 Rules for naming variables

1. The first character of a variable name must be a letter from A to Z.

2. The second character can be any letter or digit.

3. The third and subsequent characters must be letters or digits, but they will be ignored by the system (these other characters are used by you to make your variable name more descriptive). Therefore, you must not have two variables in your program that begin with the same first two characters. TEST1 and TEST2 is not ok. Use instead, for example, T1EST and T2EST.

4. A variable name must not contain any BASIC keywords (reserved words such as PRINT, RUN, NEW). Reserved words have been set aside to perform specific commands. Your Commodore is not too bright and is confused if it sees any of these words in a variable name. PRUNE is not ok.

5. The final character must be "$" for a strong variable (a variable that can only store a string value) and "%" for an integer variable (a that can only store an integer).

Figure 4.3 Think of variables as post office boxes.

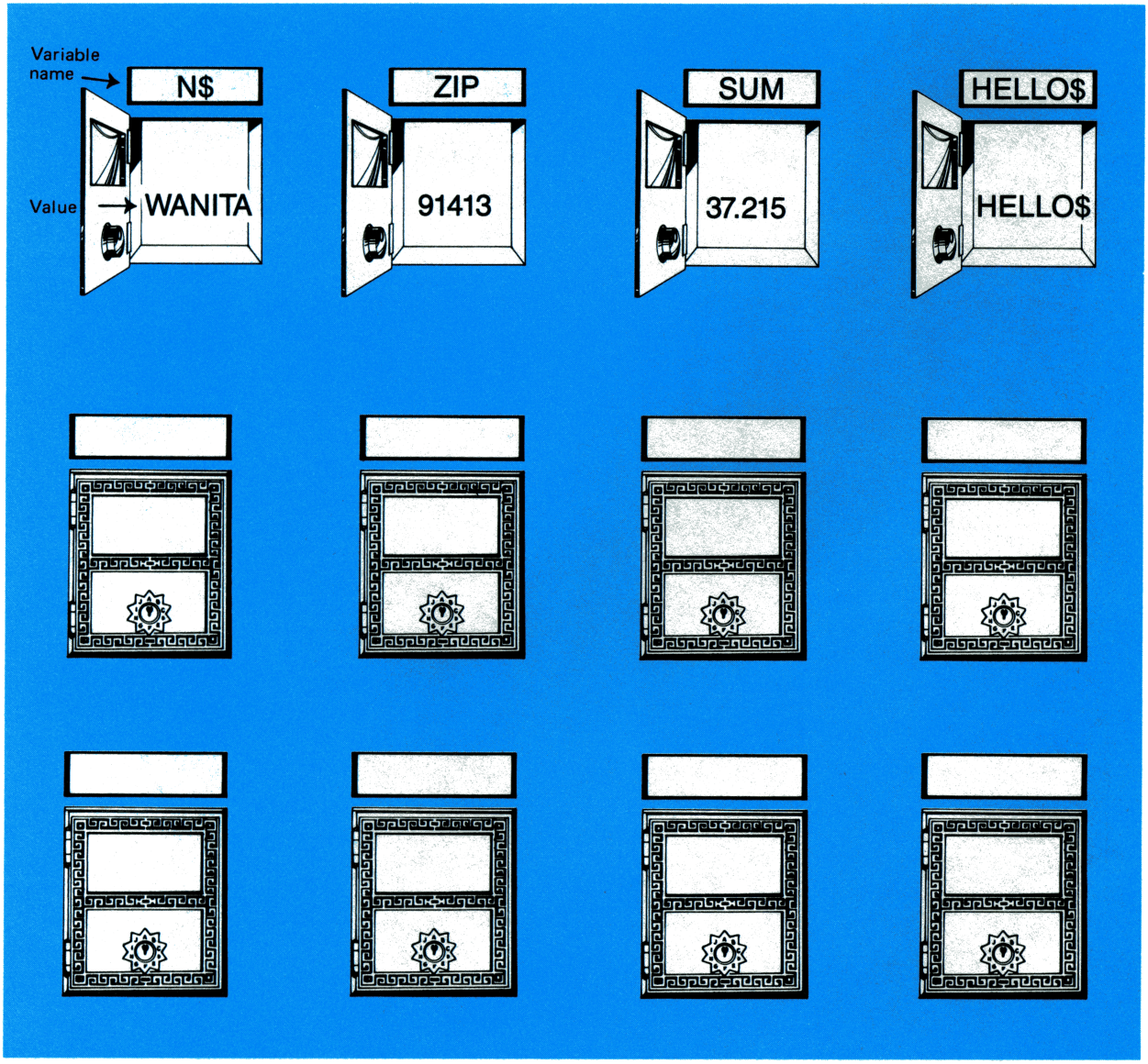


Figure 4.4. Playing with strings, numbers, and variables

The computer will perform certain commands even if they are not part of a program. This is called *direct mode*. To do this, simply enter a command without using a line number. The computer will immediately execute your command. This mode is useful to become familiar with some commands without having to write a whole program. Let's use it to play around with strings, numbers, and variables.

Try entering the following:

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

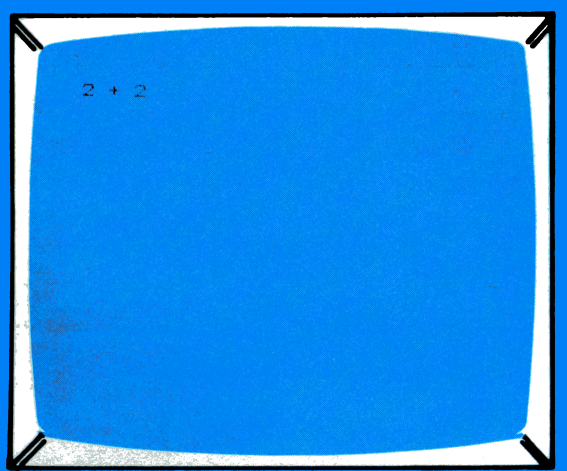
The computer will print the string exactly as you entered it. To store that string under the variable name SUM$, enter

```
SUM$ = "2 + 2"
```

Notice that nothing gets displayed. The computer simply stored the string into its memory, but was not instructed to PRING anything. Now let's display the value stored under that variable. Enter

```
PRINT SUM$
```

You should see on the display:



We can change the value stored under this variable simply by entering

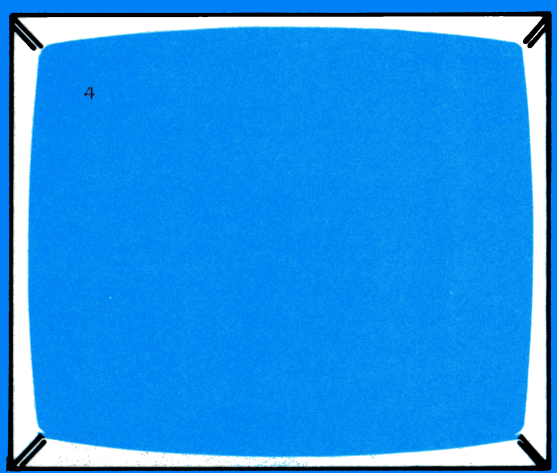
```
SUM$ (whatever you want here, but don't forget the quotes)
```

Try playing with other strings and other variable names (remember each name must end with a $).

The computer also manipulates numbers. Try entering

```
PRINT 2 + 2
```

You should see displayed:



What happened? Since you did not use quotation marks the computer treated 2 * 2 as an equation (not a string) and first evaluated it before printing out the result.

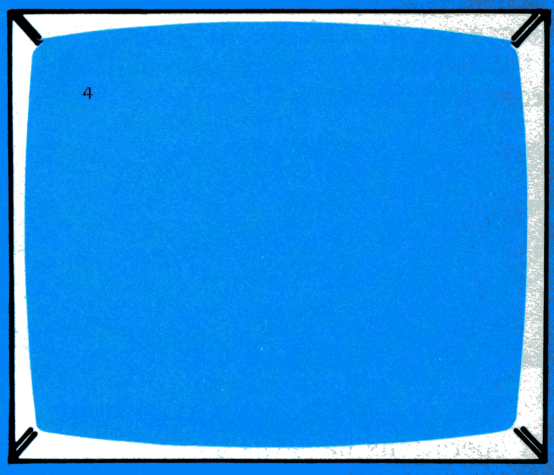
Like strings, you can also store numbers under variable names. For example, enter

```
SUM = 2 + 2
```

The computer will store the number 4 under the variable name SUM. If you now enter

```
PRINT SUM
```

the display will be



Now try entering

```
PRINT SUM + 2
```

The result? you guessed it, 6 should be displayed, Now enter

```
SUM = SUM + 2
```

and then

```
PRINT SUM
```

What happened here is that 2 was added to the value stored under SUM (4), and the new value stored under SUM. Then you displayed that new value. Play around with variables and numbers until you get the hang of it.

There are also two types of variables for use with numbers. A variable name that ends with % will store only integers (1, 2, 3, 4, etc.), while one that ends with a digit or character can store real numbers (2.34, 32/54, etc.) as well as integers. For example, try entering

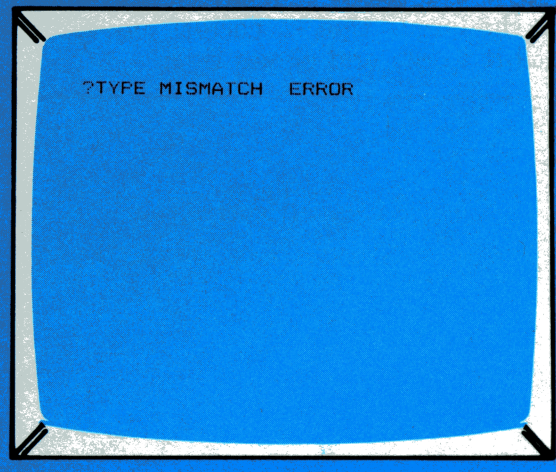
```
SUM% = 2.34
PRINT SUM%
```

The reason 2 was displayed was that since SUM% is an integer variable, it truncated off the fraction before storing it into memory. The variable name SUM would be able to store the entire fraction without truncation.

Notice that the computer does not manipulate strings the same way it does numbers. If you tried entering

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

the computer would reply with



It cannot add the value stored under SUM, which is a number, to a string. The computer sees a string as simply a collection of characters. It doesn't think of a string as having a value in the same way numbers do.

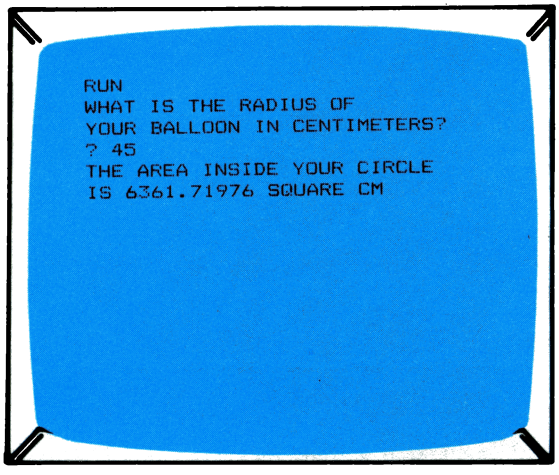
One last thing. If you don't assign a value to a variable, the computer will assume the value 0 for numeric variables and nothing for string variables. To see this, enter PRINT Z. Then try entering PRINT Z$.

Your Second Program

When you have finished with your first program, type NEW and press RETURN. This will clear memory. Then enter and run this program:

```
5 REM PROGRAM 2
10 PI = 3.14159
20 PRINT "WHAT IS THE RADIUS OF"
30 PRINT "YOUR BALLOON IN CENTIMETERS?"
40 INPUT R
50 AREA = PI*R^2
60 PRINT "THE AREA INSIDE YOUR CIRCLE"
70 PRINT "IS" AREA "SQUARE CM"
```

RUN and *debug* it (translation: "take out the bugs," that is, correct any errors) until it works and shows this:



In Line 50 we are computing the familiar equation "area equals pi times the square of the radius." The arithmetic symbols in BASIC are these:

↑ means EXPONENTIATION
* means MULTIPLICATION
/ means DIVISION
\+ means ADDITION
– means SUBTRACTION

Arithmetic operations are performed, if the expression contains no parentheses, in the following order, known as their "order of precedence."

1st ↑ EXPONENTIAION
2nd * and / MULTIPLICATION AND DIVISION
3rd + and – ADDITION AND SUBTRACTION

If operations have the same precedence, such as multiplication and division, or addition and subtraction, they are performed from left to right. However, any operations enclosed by parentheses will be performed first.

Now add to your program by entering these lines:

```
15 PRINT "WHAT'S YOUR NAME?"
16 INPUT N$
80 PRINT "WHAT'S THE LARGEST CIRCLE"
90 PRINT "YOU'VE EVER SEEN (IN CM)?"
100 INPUT RADIUS
110 IF RADIUS > 1000 THEN GOTO 140
120 PRINT "THAT'S A GOOD SIZE " N$
130 END
140 PRINT "HEY, " N$ ", THAT'S TOO BIG!"
```

END the program so that line 140 is not performed

GOTO branches the program to line 140, skipping lines 120 and 130

IF. . .THEN

In line 110 we see an IF. . .THEN statement. The expression between the word IF and the word THEN is called the *condition.* It will be true or false.

If it is false, then the computer skips whatever command follows the THEN and performs the next statement. If it is true, then whatever command that follows the THEN will be performed. In this case, a GOTO command. A GOTO tells the computer to branch to another part of the program, skipping any statements in between. In this case it jumps to statement 140.

Expressions such as these are known as logical or Boolean expressions. Logical expressions may compare two or more values, using the following comparison operators:

```
=  is equal to
<> is not equal to
<  is less than
>  is greater than
<= is less than or equal to
=> is greater than or equal to
```

Values are placed on both sides of a comparison operator and the logical expression is read from left to right. For example, in line 110, RADIUS > 1000 is read as "radius greater than one thousand." If the value held by the variable RADIUS is greater than 1000, the logical expression evaluates to TRUE; otherwise (for all other values of RADIUS less than or equal to 1000) it's FALSE.

The expressions on either side of the comparison operator are evaluated before any comparison is made. For example, 5+7*8 >=9*6+3 is evaluated as 61>=57 and then compared. (Since 61 is greater than 57, the comparison evalutes to TRUE.)

Figure 4.5. Logical operators

There may be logical operators within a logical expression itself. The standard three logical operators are NOT, AND, and OR.

NOT simply negates the logical value of an expression: NOT changes TRUE to FALSE, and FALSE to TRUE.

AND joins two values and both must be TRUE for the logical expression to evaluate to TRUE, as in:

```
32>14  AND 7 = 3 + 4
(TRUE  AND  TRUE)     =  TRUE

3*9>100 AND 80>= 8*10
(FALSE  AND   TRUE)   =  FALSE

50/25 = 2 AND 400>9*50
 (TRUE   AND  FALSE)  =  FALSE
```

OR joins two values and if either is TRUE, the logical expression evaluates to TRUE:

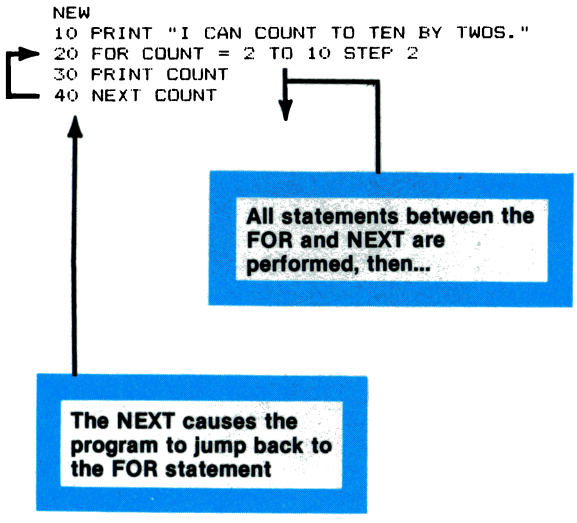
```
45 = 40 + 5 OR 6/2<3
   (TRUE    OR FALSE)  =  TRUE

77 = 7↑2 OR 4↑3>2↑3
 (FALSE  OR   TRUE)    =  TRUE

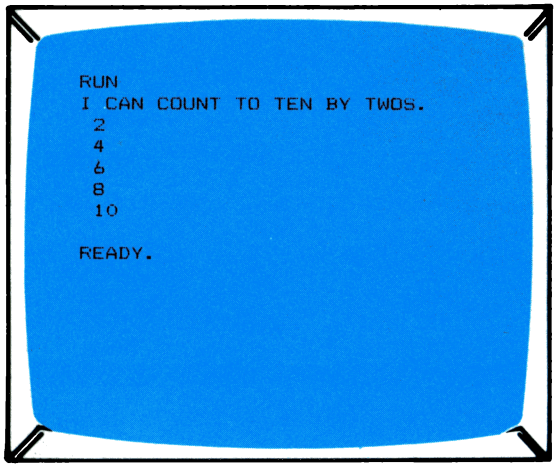
11>99/9 OR 65 = 60 - 5
(FALSE  OR    FALSE)   =  FALSE
```

Your Third Program: FOR...NEXT

With FOR...NEXT statements, you will be able to execute (repeat) the same group of program lines a controlled number of times. Try this:



When you RUN it, your screen should look like this:



The format of the FOR...NEXT statement is this:

FOR ⟨loop index⟩ = ⟨start⟩ TO ⟨finish⟩ STEP ⟨increment⟩

The FOR statement sets the initial (start) and terminal (finish) values for the variable known as the loop index. The STEP portion of the FOR statement specifies how much to add to the loop index each time it completes a loop. The STEP value may be negative, positive, or fractional decimal.l

The FOR statement is always used with a NEXT statement of the form:

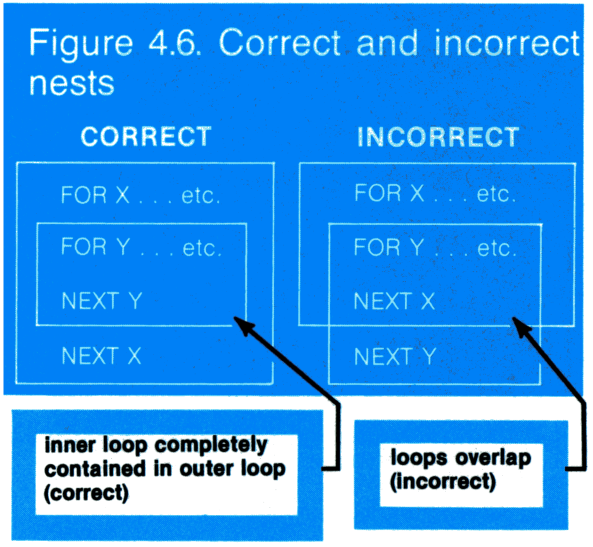
NEXT ⟨loop index⟩

The NEXT statement returns control of the program to the FOR statement as long as the value of the loop index has not reached or exceeded the terminal value. Each time through the loop the loop index is increased (or decreased) by the STEP value.

In the program above, the loop index, COUNT, was initially set at 2 by the FOR statement. This value was printed and the NEXT statement returned control to the FOR statement. The value of the loop index was increased by a STEP value of 2 to equal 4 and this value was printed. This process continued until the terminal value of 10 was reached.

FOR...NEXT loops may be placed within each other. This technique is called "nesting." The inner loop must be totally contained (surrounded) by the outer loop. The structure of "nested" loops is shown in Figure 4.6.

Figure 4.6. Correct and incorrect nests



When FOR...NEXT loops are nested, the inner loop completes all of its loops each time the outer loop performs one loop. Nested FOR...NEXT loops are useful whenever one set of actions must be done a number of times as a part of another set of repetitive actions.

Often the loop index is used in calculations within FOR...NEXT loops. This is legal as long as the value of the loop index itself is not changed within the loop. Enter and RUN the following program to print the multiplication tables for the values 1 through 12. (NOTE: If you declare no STEP the computer will assume a STEP of 1, which is the default step value.):

```
NEW
10 FOR X = 1 TO 12
20 PRINT X;"'S TABLE":PRINT
30 FOR Y = 1 TO 12
40 PRINT X;"X";Y;"=";X*Y
50 NEXT Y
60 PRINT
70 NEXT X
```

To use a printer with your programs, GOTO pp. 60-63.



The value of X remained constant while the value of Y took the values 1 to 12. Each time that the value of X was increased by 1 the process was repeated.

This program flew by, didn't it? The Commodore is faster than the eye. To slow it down, use a special form of the FOR...NEXT loop called a *delay* (or empty) *loop*. Add the following program lines.

```
65 FOR DELAY = 1 TO 500
67 NEXT DELAY
```

To slow down a program, figure 1 second for each 750 empty loops

These lines have the effect of slowing down the output of your program while the computer counts to 500. The length of the delay may be controlled by increasing or decreasing the final value.

READ and DATA

Sometimes it is useful to put a lot of data in your program. That way when you save your program you can also save the data.

DATA statements allow the storage of large amounts of information within the program. DATA statements can contain integers, real numbers, numbers expressed in scientific notation, and text strings. Data statements are used to assign values to variables contained in READ statements. For example:

```
10 READ X,Y%,Z$
100 DATA 25.4,6,YEAR
```

Each variable in the READ statement is assigned the corresponding value in the DATA statement.

Figure 4.7. Playing with the PRINT statement

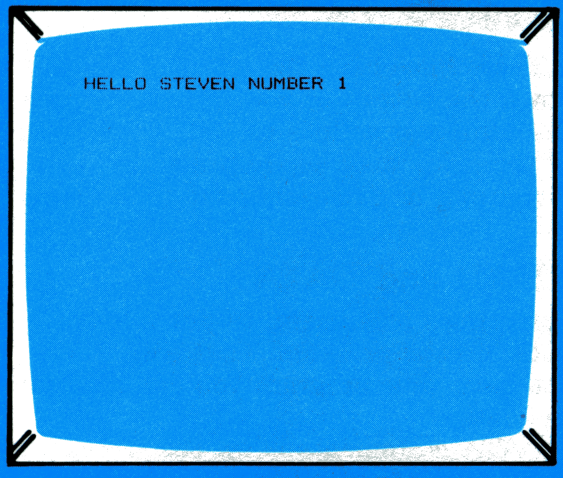
PRINT is your means of displaying characters and numbers on the screen. It is not necessary to use any punctuation between a string and a variable. If no punctuation is used, they will be displayed right next to each other. For example, enter:

```
H$ = "HELLO"
N = 1
```

then

```
PRINT H$ " STEVEN NUMBER" N
```

The PRINT statement should display:



However, if you want to print a row of variables, you will need to use one of two special punctuation symbols. They separate the variables from each other and format how they will be displayed on the screen.

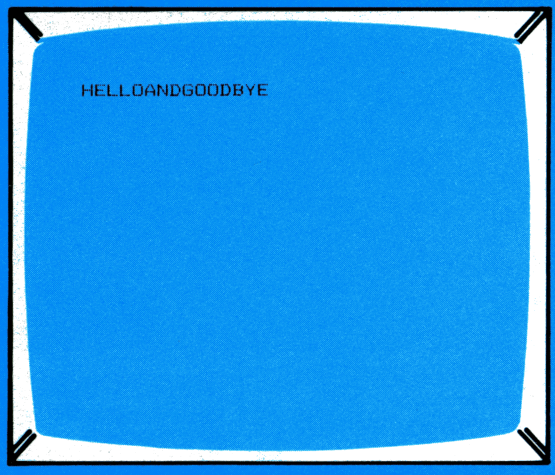
The semicolon (;) is used when you want no additional spaces to be added between variables. For example, enter:

```
A$ = "AND"
G$ = "GOOD"
B$ = "BYE"
```

then

```
PRINT H$;A$;G$;B$
```

You should see:



We could change the output to look a little nicer by changing the PRINT statement:

```
PRINT H$ " " A$ " "G$;B$
```

Try it.

If you use the semicolon with number variables you get the same sort of output. For example, try:

```
A = 43.54
B = -567.876
```

then

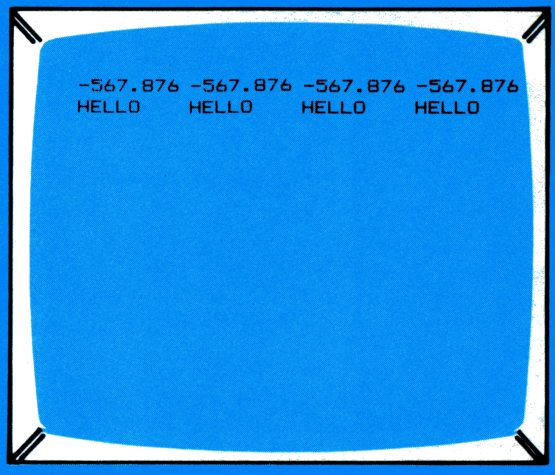
```
PRINT A;B;A;B
```

Notice that there is a space after each number and a space before each positive number. This is because the Commodore automatically leaves a space in front of any number for a sign (positive or negative), but doesn't bother to print the + sign. It also leaves a space at the end of any number, regardless of sign.

The comma (,) is used to space out variables across the screen. It divides the screen into four equal sections. For example, try:

```
FOR X = 1 TO 4:PRINT B,:NEXT X:FOR
X = 1 TO 4:PRINT H$,:NEXT X
```

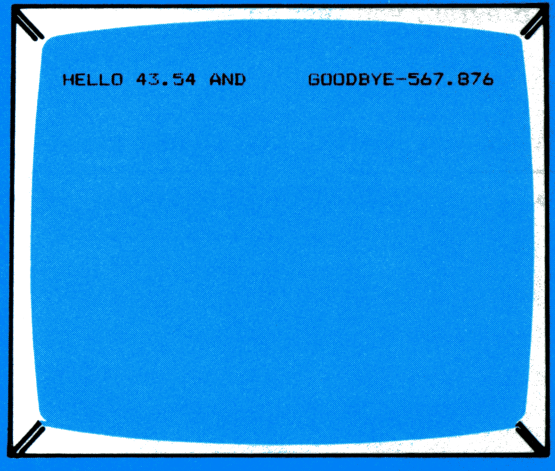
Your display should be:



The comma after each variable told the computer to jump to the next section before continuing to print. You can also use the comma in combination with the semicolon. Try, for example:

```
PRINT H$;A;A$,G$;B$;B
```

This cryptic-looking command should produce:



Thrilling, isn't it!

Finally, you should know that, in programs, any PRINT statement that does not end with a punctuation symbol will cause the display to jump to the next line. For example:

```
NEW
5 H$="HELLO":A$="AND":G$="GOOD":B$="BYE"
10 PRINT H$
20 PRINT A$
30 PRINT
40 PRINT G$
50 PRINT B$
```

produces an output much different from:

```
NEW
5 H$="HELLO":A$="AND":G$="GOOD":B$="BYE"
10 PRINT H$,
20 PRINT A$,
30 PRINT G$;
40 PRINT B$
```

Try it, you'll like it.

To save a program so you can use it later (and it won't disappear when you turn off the computer) GOTO pp. 51-57.

As in the above example, the type of the items in the DATA statement must agree with the type of the variables to which they are assigned. It would be invalid, for example, to assign the floating point number 25.4 to the string variable Z$.

There need not be a one-to-one correspondence between the number of DATA statements and the number of READ statements. The items of the DATA statements are treated as though they belong to one long list. As each data item is read by a READ statement, it is "crossed off" the list. The following lines are equivalent to the ones above and equally valid.

```
10 READ X
20 READ Y%,Z$
100 DATA 25.4,6,YEAR
```

or

```
10 READ X,Y%,Z$
100 DATA 25.4
110 DATA 6
120 DATA YEAR
```

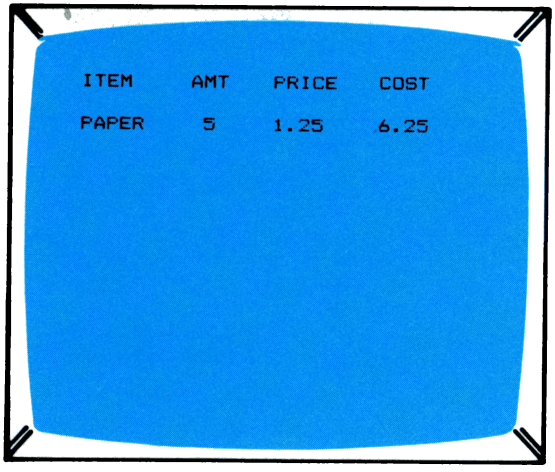
Try this:

```
NEW
10 ?"ITEM","AMT","  PRICE","  COST"
20 ?
30 READ ITEM$,AMT%,PRICE
40 CST=AMT%*PRICE
50 ?ITEM$,AMT%,PRICE,CST
140 DATA PAPER,5
150 DATA 1.25,PENS,12,3.99,DESKS
```

"PAPER" is READ into ITEM$, 5 is READ into AMT% , 1.25 is READ into PRICE. The extra DATA items are ignored.

The question mark is shorthand to the C64 for PRINT

The output should be:



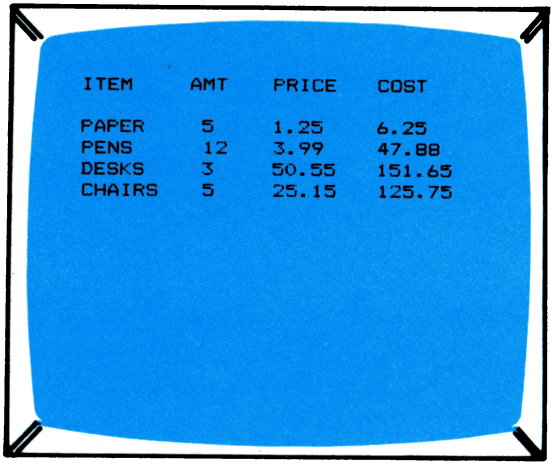
Notice that one READ statement accesses two DATA statements. There are also excess DATA items. Both of these conditions are valid.

It is not valid, however, to list too few data items to satisfy all of the variables in the READ statements.

Often the items of a DATA statement are read by a READ statement placed within a loop. Add the following lines to the program you just entered:

```
25 FOR K = 1 TO 4
60 NEXT K
160 DATA 3,50.55,CHAIRS,5,25.15
```

When you RUN it, you should get:



The FOR. . . NEXT loop in the above program is only suitable for cases in which exactly four sets of data must be read. When the same program is run more than once using different numbers of data items, the final set of data items has a "flag" to indicate the end of the data. A flag can be any value that valid data would never take. For example, if your program reads in weekly hours worked by your company's employees, then a data value such as 200 or −1 cannot be valid (because the week has 168 hours) and either could be used as a flag. After every READ statement, the program checks for the flag value before performing further operations within the loop. When the flag value is read in, the loop will stop.

Make the following changes to the last program. Erase lines 25 and 60 by entering each line number followed by RETURN. Then add the following lines:

```
50 IF PRICE>0 THEN ? ITEM$,AMT%,PRICE,CST:
GOTO 30
170 DATA 0,0,0
```

Notice that there are three items in the group of values containing the flag. If values for all three of the items in the READ statement are not found, the program will stop with an "out of data" message.

If you want to learn more about BASIC there are many good textbooks available, some of which are listed in Appendix B. A good one to start with is the Alfred Handy Guide *Understanding Commodore 64 Basic,* by R.G. Peddicord.

COMMODORE PERIPHERALS



Chapter Five

Commodore makes a line of peripherals that plug directly into your C64, and are compatible with it in all respects. These devices include a Datasette recorder, disk drive, video monitor, and printer, and we will discuss all of them in this Chapter. Other peripherals will be discussed later, in Chapter 15.

If you plan to hook up a modem, some other printer besides the Commodore printers, or some other device, read Chapter 15. We have limited this chapter to Commodore products made especially for the Commodore 64. You should expect compatible disk drives, cassette recorders, and printers to appear on the market, now that the Commodore 64 has established itself. It is, however, not that easy to surpass Commodore's convenience and beat Commodore's prices at the same time.

Storage Devices

Two of the peripherals, the Datasette and the disk drive, are storage devices. They store your data and programs when you are not using them.

Why do you need storage devices? Because your C64 has only so much memory inside it, and good applications software (programs you buy) take a lot of memory. A single diskette holds about four times as much information as you can fit inside the C64's internal memory.

Also, memory is volatile. That is, any program or data currently in memory disappears when the power is turned off. You want a way to safely store your programs or the data used by the program. Finally, it can take hours to input a program by typing (with lots of errors included). You need a fast, reliable way to input programs into memory.

Cassette or Diskette?

The Commodore 64 can operate with either a Datasette recorder or a disk drive. Which device is right for you depends upon your own individual needs, and how much money you have.

One of the big differences between cassette and diskette is the way data is stored and retrived. In either case data and programs are stored as files, that is, several pages worth of information. Each file has a *filename,* to identify it.

Files are stored on tape like the songs on an audio cassette, one after another in a linear fashion. To reach the last file (or song) on a tape, you must pass over all of the preceding files (or songs). If you have gone past the desired file, you must rewind the tape in order to get to it. This is called *sequential* access.

Files saved on a disk are analogous to songs on record. You need not pass through all of the preceding files or songs to access the last file or song. Just move the tone arm to any place you wish. This is called *random* access. Because disk drives are random-access devices, they are much faster and more efficient than Datasette recorders. For

Figure 5.1. What are files?

If your office files are kept at all like mine, they consist of folders filled with a mess of letters, notes, and reports. This mess of data has only the following in common: it is being saved for some reason and it is stored in one folder that pertains to one subject or person.

So it is with computer files. A file is a group of data collected together for the purpose of transmission to a peripheral (like a storage device or printer), grouped together under one name, its filename. It can be as messy as my collection of old baseball cards (kept in a shoebox), or as organized as the file the FBI keeps on me in Washington, D.C. (just a joke, I hope). Some sample files are:

```
5 REM FIRST PROGRAM
10 REM PROGRAM SEGMENT 1
20 PRINT "WHAT IS YOUR NAME?"
30 INPUT N$
40 PRINT "THANKS " N$
```

A computer program: a collection of commands

```
April 1, 2084

Dear 6510MPU:

     I'm sorry, but I've left
you and have run off with your
robot, Hal.

     May the FORCE be with you,

          MC68000
```

A letter: a collection of characters

CUSTOMERS

Name	Address	City	State	Zip	Balance
Acme Computing	1000 Findit Blvd	Wayoutville	CA	93707	1.32
Bigshot Tech	1 Bigshot Lane	Gotham	CA	90000	9999.99
Canary Computer	2 Calling Birds	Perchtown	CA	94362	500.00

A customer file: a collection of data organized into *records* (each customer is a separate record) and *fields* (name, address, city, etc.)

As you can see, a file can be simply a listing of data with little organization, or organized into specific groupings. The organization depends on the purpose of the file and how it was organized when you (or the program you are using) created it.

Just remember that whenever you store data onto a disk or cassette (or transmit it to a printer or modem), it is done so a file at a time. Each file is stored under a unique filename that you assign, and in order to retrieve the file from storage, you must refer to that filename. For more on files, see Chapter 9.

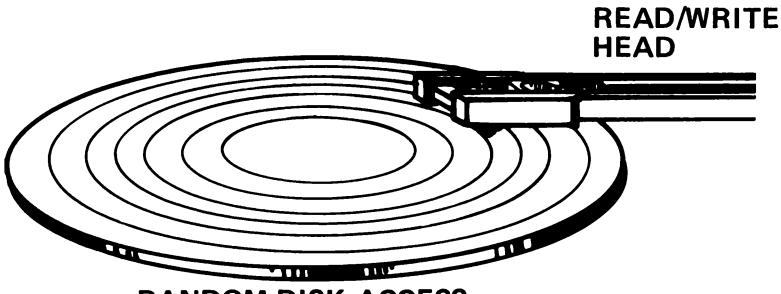
example, to load a program stored on cassette might take three to four minutes compared to one minute using a disk.

Datasette recorders cost about one-fourth what disk drives cost, and tapes can withstand a lot rougher handling than diskettes. Our dogs get ahold of a cassette and play with it for a while, and by golly, we can slap that thing into the Datassette just like it was brand spankin' new. You get your dogs chewing on a diskette and you know it's all over!

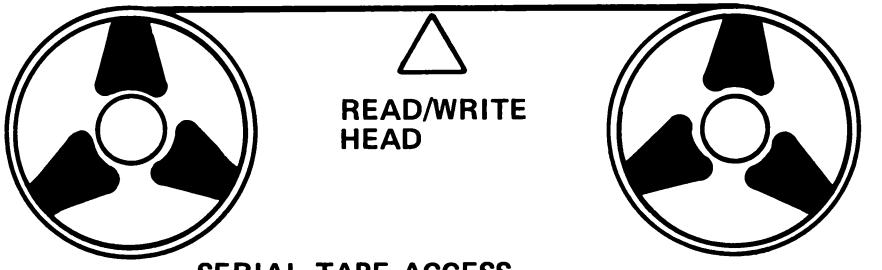
The decision on whether to purchase a Datasette or disk drive depends on your needs. The Datasette is adequate for simple applications and for the beginner just learning about programming. Serious or sophisticated applications, like word processing or graphics, require the speed and convenience of diskettes. In fact, much of the software discussed in the following chapters is available *only* on diskette. To use any of them, you will need a disk drive.

Most sophisticated programs require a disk drive. See Chapters 6 through 11 for the formats in which various software is available.

Figure 5.2. Tape vs. disk access.



RANDOM DISK ACCESS
Head can move to information



SERIAL TAPE ACCESS
Tape must be wound to correct spot.

The Datassette Recorder

Commodore makes two different cassette data recorders that plug directly into the cassette port of your Commodore (the smallest of the rectangular ports in the back). They derive their power from the Commodore.

One is the VIC Datassette, an earlier, larger recorder designed for the VIC 20; the other is a newer, more compact Datassette designed for the C64. Both work the same way as far as the user is concerned.

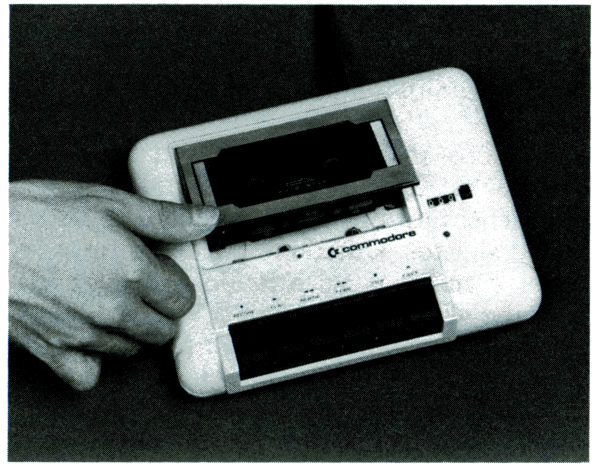
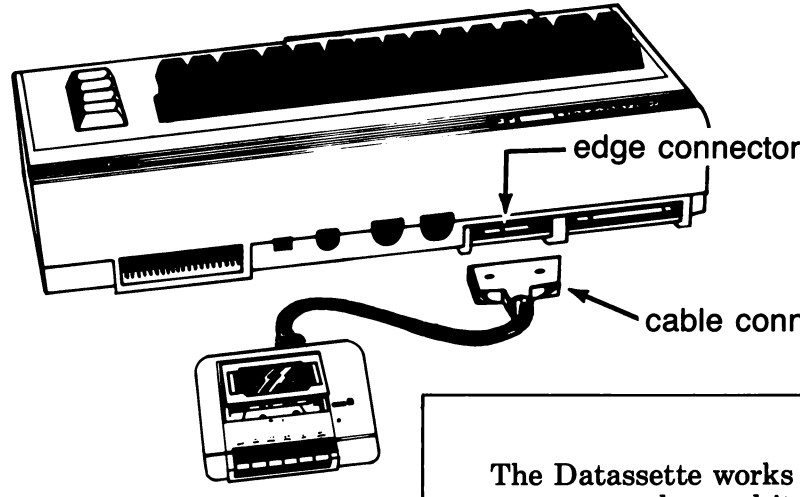


Figure 5.3. Loading a cassette into the Datassette recorder.

Figure 5.4. Connecting the Datassette to the C64.



Plug the Datassette cable into the cassette port of your C64; that is, into the second port from the right as you look at your Commodore from the rear.

Make sure the break in the edge connector matches the slot in the cable connector. Don't force the connector; it will go in easily when you have it right.

The Datassette works like any other cassette recorder, and it uses the same kind of tape. Don't bother with expensive chromium dioxide or metal tapes, and you might find C15 or C30 tapes are easier to use than longer ones. The shorter tapes are long enough to store most programs (or over 25,000 characters of data) and it is easier to find files if you place only one or two files on a side.

Try loading and unloading a cassette, to get the hang of it. The STOP/EJECT key will open the cassette door; the F.FWD (fast forward) and REW (rewind) keys move the tape forward and backward; the PLAY and REC (record) keys do what you would expect (play and record).

You can use an ordinary audio cassette recorder in place of the Datassette, but you will need a specially designed interface like the one Bytesize Micro Technology makes (see Appendix A).

Saving BASIC Programs

A cassette is ideal if your major application is saving and retrieving your own programs. Once your Datassette is connected and you have placed a blank cassette in it, you are ready to save your BASIC programs. To do this, enter and run a program. Then type:

```
SAVE "filename"
```

where filename can consist of any letter, number, or symbol (except ") and be up to sixteen characters long. For example, SAVE"PHONE BILL" saves the BASIC program you wrote to keep track of your phone expenses.

When you press RETURN the computer will respond with



Press both the RECORD and PLAY keys on the Datassette. They should lock into place, and the screen will blank out in light blue. The red save light of the recorder will light. The READY prompt will appear on the screen after the save operation is complete (after your program has been saved).

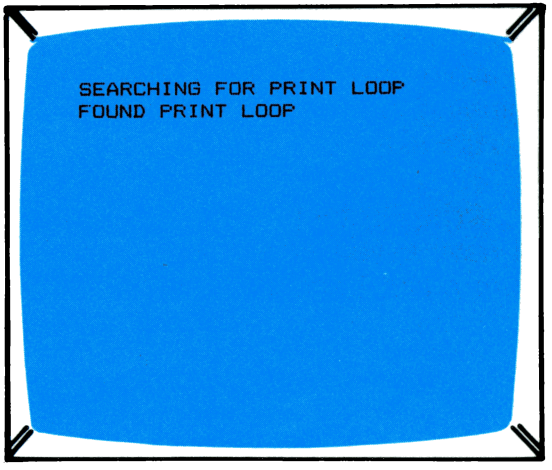
To load the saved program from the Datassette, rewind the tape to the beginning and enter

```
LOAD "PHONE BILL"
```

When you press RETURN the screen will display



This message will disappear as the Datassette recorder starts up. When the file is found you will get the message:



Then press the Commodore key C= and the program will begin loading. When loaded, the recorder will stop and your C64 will display:

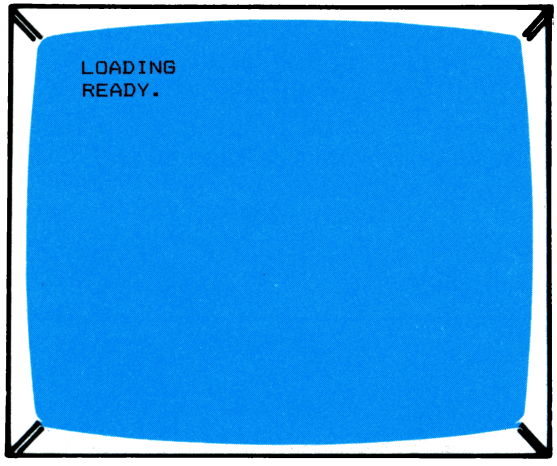
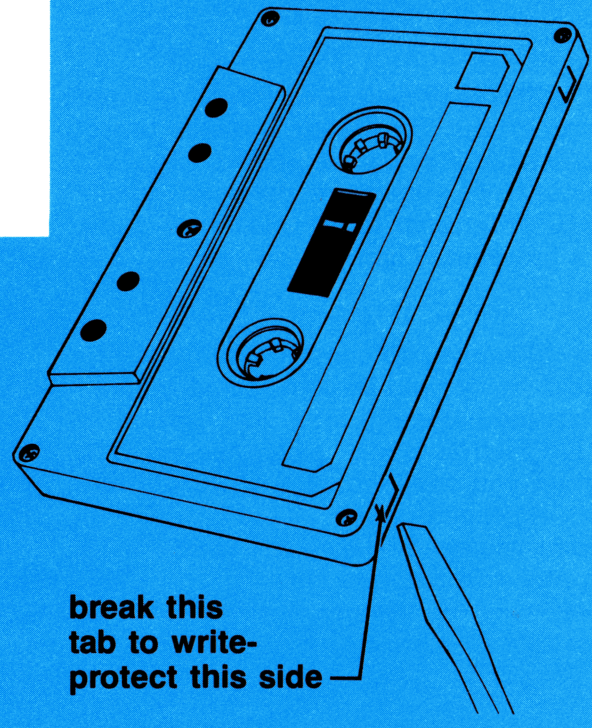


Figure 5.5. Cassette Storage Tips.

1. **Duplicating Files.** It is a good practice to make duplicate copies of important files by saving them on two separate tapes. If one of your tapes is faulty, you will always have a backup tape available. Keep one of the tapes rewound to the beginning of side one and the other rewound to the beginning of side two. In this way, you can avoid rewinding your tape to the beginning to access programs on opposite sides of the tape.

2. **Write Protection for Cassettes.** If you have saved a file that you want to insure against accidental erasure or overwriting, you can alter the cassette to prevent any further writing to the tape. This is called "write-protecting" the cassette. Position the cassette with the side you want protected facing up. Find the two small tabs in the back of the cassette. Break off the tab on the right. This will write-protect the top side of the cassette. To write-protect the bottom side of the cassette, break off the left tab.



It is possible to alter a write-protected cassette so that it will allow erasure and recording once again. Just tape over the socket where the tab was removed.

It is much more convenient to store only one file on each side of a cassette. Files stored in this manner can be located simply by rewinding the tape to the beginning and loading. However, you may want to store more than one file on each side to make maximum use of your money and cassette. This will require more effort on your part. To save and locate multiple files, you must use the tape counter on your Datassette recorder.

Saving Multiple Files.

If you plan to put several programs on the same side of the tape, follow this procedure:

1. Insert the cassette and rewind the tape to the beginning.
2. Reset the tape counter to 000 by pressing the button next to the counter.
3. Save the file as you would normally.
4. Advance the tape about 10 counts past the current counter reading.
5. Note the new counter reading and the name of your next file. (This marks the beginning of your next file.)
6. Save the file.

To load the files you have saved, follow this procedure:

1. Insert the cassette and rewind the tape to the beginning.
2. Reset the counter to 000 by pressing the button next to the counter.
3. Fast forward to a counter reading a few counts before the beginning of the file desired.
4. Load as usual.

If your file fails to load, the counter reading may be off. This will often happen when a different recorder was used to save the file than is being used to access it, as counters may vary from recorder to recorder. Try these steps to locate a misplaced file:

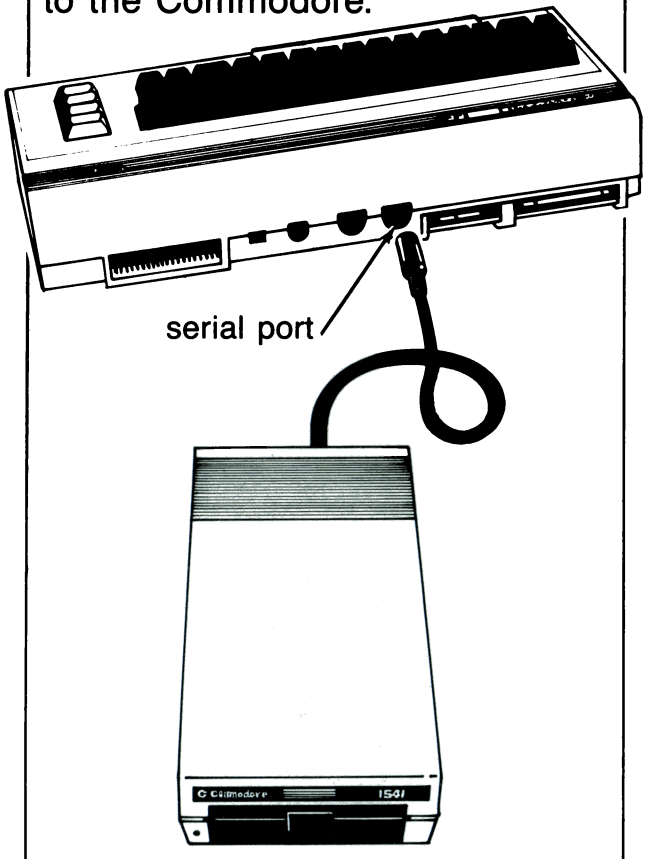
1. Start the load at a counter reading lower than the one noted, or,
2. Start loading from the beginning of the tape and load every program on it using the LOAD command by itself. This will load the first program encountered on the tape. Note the location (counter readings) of the programs when found.

It is always a good practice to keep an accurate record of the exact name and location of files in your library. This is especially true of cassettes on which multiple files have been saved. Accurate records can save you a great deal of time and trouble.

The 1541 Disk Drive

Sooner or later you will want to connect a disk drive to your Commodore. It will open to you the huge library of software available on disk. The drive made by Commodore for the C64 is the model 1541.

Figure 5.6. Connecting the 1541 to the Commodore.



When you unpack the disk drive you will find, in addition to the power cable, a short black cable that connects the disk drive to your Commodore. One end plugs into the serial port (just to the right of the audio/video port as you look at the Commodore from the rear), and the other end plugs into either one of the two identical ports in the back of the disk drive.

Always turn the drive on and off *without* a diskette in it, for otherwise you might write bad information onto the diskette.

The 1541 accepts 5¼-inch, single or double-sided, single or double-density, soft-sectored diskettes (floppy disks). The floppy disk itself is a very thin plastic (mylar) coated with magnetic material. It spins around inside its protective jacket.

Inside the disk drive is a read-and-write head that can magnetize, or read the magnetization of, very tiny areas of the diskette. It moves in and out to access different parts of the diskette. That's what causes the noises you hear when your disk drive is in operation. Unlike cassettes, you need not worry where files are stored on the diskette. The read/write head does that for you.

Floppy disks are not actually *floppy,* but are merely flexible. Floppy disks are available in three sizes; 8 inch, 5¼ inch, and 3½ inch. This measurement is related to the diameter of the disk. The only size that the 1541 can accept is the 5¼-inch disk.

The 1541 disk drive can use either *single-sided* or *double-sided* disks. Single-sided disks can only record on one side while double-sided disks can record on both sides. Double-sided disks can hold twice as muich information as single-sided disks, but they are also more expensive.

The *density* of the disk refers to how tightly the information may be packed on the disk. Double-density disks are of higher quality than single-density disks, but the 1541 disk drive is not designed to take advangage of their increased information capacity.

The term *soft-sectored* refers to how the information on the disk is located by the disk drive. The 1541 disk drive places magnetic signals on the disk to indicate how far the disk has rotated and allow relocation of information. This is called *soft-sectoring*. Some disks have holes punched in the disks that perform the same function as the soft-sectoring. These are known as *hard-sectored* disks.

What is the best disk for your Commodore 64 system? A 5¼-inch, single-sided, single-density, soft-sectored floppy disk is your best bet.

Figure 5.7. Diskette Care.

Here are some suggestions for keeping your diskettes in good shape:

1. Keep the diskette in its container when not in use.
2. Avoid exposure to extreme heat or sunlight.
3. Do not expose to magnetic fields.
4. Never touch the exposed surface of a diskette.
5. Store diskettes in a vertical position in a rigid container.
6. Never bend the diskette.
7. Do not write on the diskette with a pencil or pen. Use a felt tip marker or a prewritten label.
8. Do not paper clip or staple notes to a diskette.
9. Never leave the diskette on top of the disk drive.
10. Never remove a diskette from a drive while it is whirring or while the drive-active light is on.
11. Do not turn the disk drive on or off when a disk is inside.
12. Never chew on a diskette, and, especially, don't let your dog play with it!

Putting a Diskette in the Drive

Take a new diskette in one hand, and with your other hand remove the diskette from its protective jacket.

Flip up the disk drive door by pressing it inward until it pops up and clears a path for the diskette. Practice opening and closing the door a few times. Slide the diskette into the drive, with the long oval away from you and the diskette label visible near your thumb (see Figure 5.8). When the diskette is sticking out about half an inch you will feel the loading spring. Push in the diskette with your middle two fingers until it stops. It will catch by itself.

As soon as the diskette is all the way in, and after it catches, slide the door down and out. Now the diskette should be ready to go.

This particular drive is tricky to load and unload, and you can damage the rim of your diskettes if you are not careful. All it takes is care and a little practice. So be patient and practice opening and closing the door without any diskette in it.

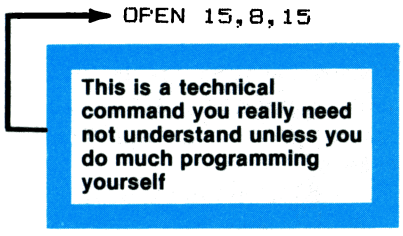


Figure 5.8. Loading a diskette into the 1541 disk drive.

Formatting a New Diskette

As we mentioned, the diskette has magnetic signals that mark where its tracks and sectors are. The process of setting these magnetic markers is called *formatting*. A diskette that has not been formatted cannot be used to store or retrieve information, because the drive doesn't know where anything is.

Let's practice formatting. Choose a diskette. A new diskette which is blank or an old diskette which you no longer need will do just fine. Put the diskette in the drive and enter



You will need to make up a diskname (16 characters maximum) and decide on a two-digit ID code. Let's say that FIRST DISK is your disk name and 84 the ID code. Then enter:

```
PRINT#15,"NEWO:FIRST DISK,84"
```

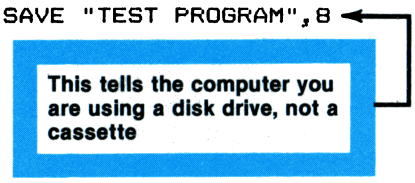
The 1541 will start formatting, beginning with a loud razz and continuing with some quiet chortling sounds. The red busy light will be on. After about a minute and a half, the red light will turn off, and the disk will be formatted. The name we chose will be stored in the disk's directory, and the ID code will be stored in various places throughout the disk for later disk identification.

Formatting will erase any information on the diskette, so make sure you are using either a new (blank) or an old (no longer needed) diskette.

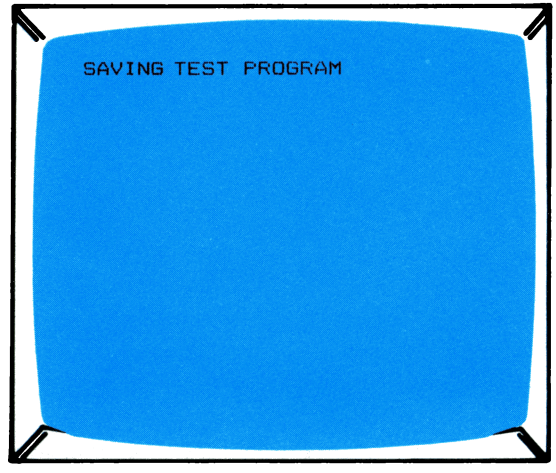
Many application programs, like word processors and spreadsheets, have routines that will format a diskette for you. It is best to use the above procedure, as some of these formatting routines don't work that well.

Saving Programs

Saving a program to disk is easier than using the Datassette, and takes much less time. Use a filename of no more than 16 characters (as with the cassette). Let's say, TEST PROGRAM. Making sure the drive is on and a formatted disk is inserted correctly in the drive, enter:



After entering this command, the disk drive will begin spinning and the red light will come on. The screen will display:



When it is finished, the red drive light will go out and the drive will stop spinning. The monitor screen will

respond with a READY. Your program is now saved.

To load a program from disk, first insert the program disk in the drive if it's not already in. Then enter:

```
LOAD TEST PROGRAM ,8
```

The Disk Directory

Each disk you format has a directory on it with the name and ID code of the disk, and a complete list of all the files it contains. There are times when it would be very handy to be able to read that directory, especially if you run across an unlabelled disk that you've completely forgotten.

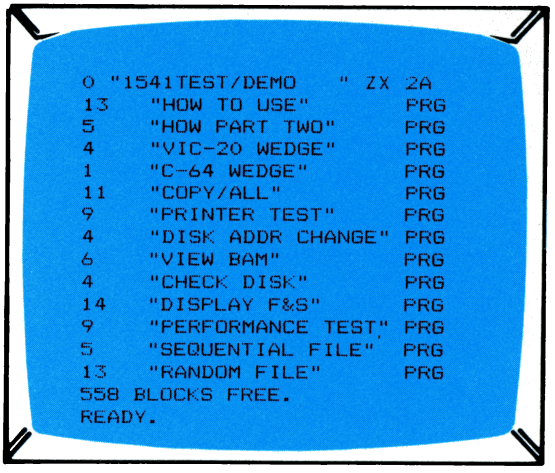
You can load the directory from the disk to your C64 just as you would a program. Try it with the demo diskette that comes with the 1541. The name of the directory is $. To load it, enter:

```
LOAD "$",8
```

To read the directory, enter:

```
LIST
```

The following directory (or something similar) should appear on your screen



On the top of the directory, after the number 0, is the name of the disk in reverse characters, followed by the ID code. Under the disk name follow the names of the files contained on the disk. In front of each file name is a number that tells how many blocks of disk space it takes up. The bottom of the directory is a statement telling you how many more blocks of disk storage you have free to use. As with formatting, there is one very important thing to know about reading the directory: by LOADing and LISTing it, you erase whatever program is in your computer at the time. Be wary of checking the directory while you are in the middle of writing a program.

Renaming Files

If, for some reason, you wish to change the filename of a stored file, use the following commands:

```
OPEN 1,8,15
PRINT#1,"RENAME:<new filename>
                =<old filename>"
```

The disk drive will become activated, indicating the filename is being changed. You can confirm the change by loading and listing the directory.

Deleting Files

If your disk begins to fill up with unwanted files, you can gain more room by erasing them. To delete a file from the disk, use these commands:

```
OPEN 1,8,15
PRINT#1, "SCRATCH:<filename>"
```

That file will no longer be on the diskette.

Changing an Existing File

In order to change the contents of a file stored on disk, while keeping the

same filename, you must perform the following steps: 1. Load the file into memory; 2. Make the changes; 3. Erase the existing file; 4. Store the new version of the file. Since you know how to perform each of these individual steps, I won't bother to list each one.

The reason for step 3, is that the Commodore will not let you overwrite an existing file. This prevents you from accidently changing files. If you omit step 3, the disk drive's red activity will flash intermittently, indicating that it could not write the data onto disk.

The disk drive's red light flashes to indicate an error or problem.

The C-64 Wedge

There is a DOS (Disk Operating System) support program that facilitates many disk operations. It is called the C-64 Wedge. This program may be on your demonstration disk. To set up the C-64 Wedge, just LOAD "C-64 WEDGE",8 and RUN it. The program will set itself up automatically in machine language (see Chapter 13 for an explanation) and then erase itself. You will now be able to send the following simplified disk commands.

Load (/)
The / replaces the word LOAD and no quotation marks are needed around the filename.
FORMAT: /⟨filename⟩
EXAMPLE: /TEST

List directory (@$) or ( )$)
Either of these commands will list the directory without loading it into memory and erasing the current contents.
FORMAT: @$ or)$
EXAMPLE: Same as format

Format A Disk
Allows a shortened use of the format command without having to open channels, use the PRINT# command or enclose the disk name in quotation marks.
FORMAT: @NEWØ: ⟨diskname⟩, ⟨id⟩
EXAMPLE: @NEWØ: DATA, 01

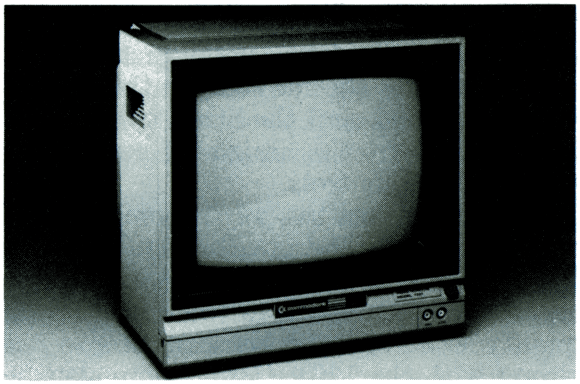
Figure 5.9. Diskette storage tips

1. Back-up. As I've noted before, diskettes are more fragile than cassettes, which means that on occasion (no matter how well you take care of your diskettes) you may find that the disk drive is unable to retrieve a file from the disk. Unless you have a duplicate copy available on another disk, you will be in big trouble. To back-up a file, simply load it into memory and then save it onto another diskette. It's a good idea to have several diskettes that are just use to keep duplicated files. These should be kept in a safe place.

2. Disk full? In the course of storing files on disk you might come across this error message. It means, quiter simply, that there is no more room on the diskette to store your file. This usually is not a disaster. Simply find another diskette with more room on it, and try to save the file again. To prepare for this, it is a good idea to always have a relatively empty, formatted disk handy. If you don't, then you will not be able to format a new diskette without erasing your current file from memory. Then you really won't be able to save it.

3. Write protection. Just like a cassette, you can prevent a diskette from having any files accidently deleted, altered, or added. Simply cover up the slot in the upper-right corner of the disk. There are usually specially-designed, self-sticking tabs for this purpose included in each box diskettes. To unprotect the disk, just remove the tab.

The 1701 Video Monitor

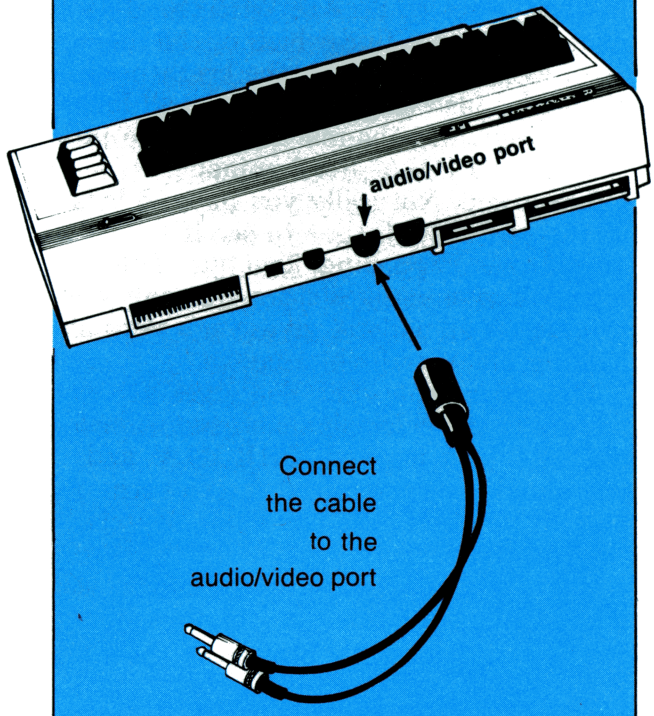


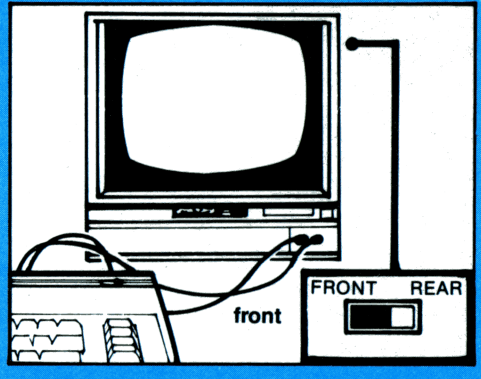
The Commodore 1701 video monitor is a fourteen-inch color monitor that was designed to interface directly with your Commodore 64. This monitor, like other high quality monitors, offers much better picture quality than a TV and good sound. This is particularly important if you will be staring at the display for hours (as in word processing) or need high quality graphics.

To connect the 1701, you need either a two-channel or four-channel audio/video cable, available from Commodore, your dealer, or from an electronics store. Either cable connects to the audio/video port in the rear of your C64. The four-channel cable offers a somewhat better picture.

To connect the two-channel cable, first connect it to the C64, and turn the C64 and the monitor on. There is a switch in back of the monitor that selects FRONT or REAR. Switch it to FRONT.

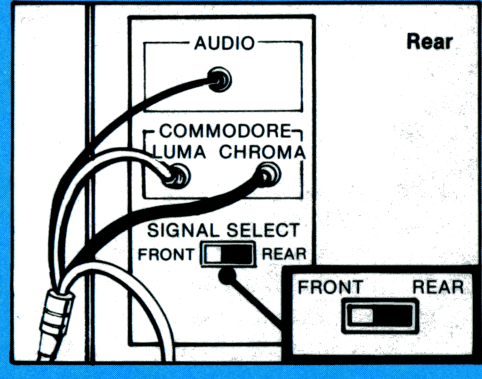
Figure 5.11. Connecting the 1701 monitor





Connect the two-channel cable to the front of the 1701

OR



Connect the four-channel cable to the rear of the 1701

Momentarily insert each RCA phono plug into the VIDEO jack in the front of the 1701 to find out which has the picture information. The other cable will be for sound. It plugs into the AUDIO jack in front.

If you have a 4-channel audio/video cable, you will connect it to the rear of the 1701 monitor. Make sure the switch in back is set to REAR. With the C-64 and monitor on, find which of the four male RCA plugs carries the brightness signal, by inserting, one by one, all four RCA plugs into the rear RCA phono jack that says "LUMA" (for luminance information). Naturally you have to look at the screen each time to see if anything is happening. Two out of the four will give you a picture, but only the brightness signal will give you a normal-looking black and white image.

The other cable that also gives a picture is the color signal. Insert it into the RCA jack marked "CHROMA" and you should see the initial screen turn blue. If you don't see any color, switch the two cables.

One of the remaining cables carries the audio signal, the other is left unused.

The strip along the bottom of the 1701 contains seven adjustments. Leave the four leftmost color controls in their center position, where the notch is. That will give you the best overall picture.

The knob on the far right is the volume control, and the other two knobs on the right are the horizontal and vertical hold controls.

I currently own two 1701 monitors, one for the C64 and one for regular TV. They are excellent video monitors, especially when you feed them with quality video signals. You cannot go wrong with the 1701. Commodore also makes the 1702 and 1703 monitors for use with their new line of 64s (see Chapter 16).

The 1525 Printer

Commodore now makes three printers that hook directly to the C64: model 1515, model 1525, and a new model, the MPS-801, that was released in early 1984.

For more information on printers, GOTO Chapter 15.



Figure 5.12. Connecting other monitors

If you are using a video monitor besides the 1701 the connections are the same as with the two channel audio/video connector. The RCA phono plug carrying the video signal plugs into the video input of your monitor, and the RCA phono plug carrying the audio signal plugs into an audio amplifier.

If your video monitor does not have an audio seciton, you will need an extra hi-fi cable to carry the audio signal from near the monitor to your hi-fi amplifier. Use an RCA phono double female connector to connect the audio/video cable to this extra hi-fi cable.

If your monitor does not use an RCA phono female jack to accept the signal (most computer monitors do), you will need a connector to go from the RCA phono male connector to whatever your monitor requires.

The Commodore 1525 printer has an eighty-character print line, and it can print thirty characters per second. It is a dot-matrix printer, which means that the characters are printed by a 5 x 7 array of tiny pins. If you look closely at the printed page you can see the individual dots.

One advantage of the 1525 is that it will print all of the special graphics characters that the C64 uses, exactly as they appear on the screen. Other printers can achieve this too, but the interfacing must be done correctly. Chapter 15 explains how to hook up a non-Commodore printer.

The printer cable connects to the serial port, the leftmost of the twin ports in the center of the C64 as you look over it from the front. The connector has six tiny pins and a shield, and is identical to the connector for the disk drive. Plug in the printer cable, making sure the small notch points upwards.

To connect the printer when using a disk drive, insert the printer cable into the second port on the rear of the drive.



Figure 5.13. The Commodore 1525 printer. (Courtesy of Commodore Electronics, Ltd.)

Find an available 110-120 volt outlet and plug in the printer. Find its power switch and turn it on. The red power light will glow.

Although the printer can print directly on the platen (the black rubber roller), it is better to use paper, and have a lasting image. You will want standard 8½-inch sprocketed printer paper (available through most office supply or stationery stores). With the printer off, remove the clear plastic cover. Snap open the paper guides. Feed the paper from the rear through the paper chute until it emerges from the front of the printer.

Gently arrange the paper guides so that the spokes on the guide wheels match up with the sprocket holes on the paper and snap the guides closed. The paper should not be too tight, nor too loose. Then adjust the paper-bails so that everything feels right. Common sense will tell you what to do.

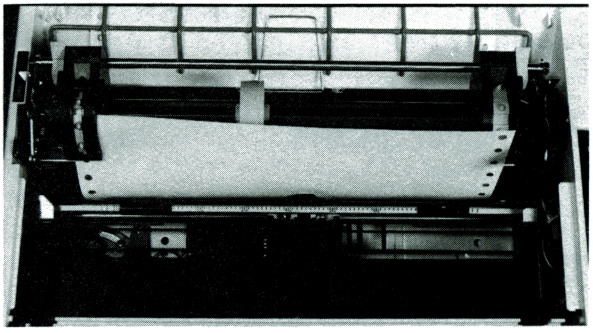


Figure 5.14. Loading paper into the printer.

Close the paper guides and replace the plastic cover. Your 1525 is ready to use.

First you must open a channel from your C64 to the printer. This is a technical operation that you need not be concerned with. Most programs you buy take care of this for you. But if you are doing your own programming you have to open the channel yourself.

Simply enter the command:

```
OPEN 1,4
```

and press RETURN. This will take care of it.

If you want your screen output to go to the printer, instead of to the screen, enter this command:

```
CMD1
```

and press RETURN. Try PRINT "HELLO". The message should print out.

To switch back from the printer to the monitor screen, enter:

```
PRINT#1
```

and press RETURN.

When you are done using the channel close it with this command:

```
CLOSE 1
```

When you are running a BASIC program and you want certain output to go to the printer, use the BASIC command PRINT#1 instead of PRINT.

Don't forget to use OPEN 1, 4 at the beginning of your program, and CLOSE 1 at the end.

The MPS-801 Printer

The MPS-801 is the newest printer Commodore has come out with for the Commodore 64. It prints fifty characters per second, almost twice as fast as the 1525. It is also quieter, and in general, gives better overall performance. Like the 1525, it plugs into the serial port of your Commodore 64, and it prints all the C64's graphic characters.

The printer cable plugs into either of the six-pin connectors in the back of the printer. They are wired together, so it doesn't matter which one you use. The other end of the cable plugs into the serial port of your C64, or into the extra port of a disk drive.



Figure 5.15. The Commodore MPS-801 printer. (Courtesy of Commodore Electronics, Ltd.)

The clear plastic cover lifts off when you pull it up vertically from the rear edge. The ribbon cassette snaps into place on the carrier unit, with the ribbon advance knob on the top right. First snap the left side in place, then the right side.

Don't try to move the print head by hand. This will wear out the belt that holds it in place.

You can plug the printer in, but don't apply power until there is paper in front of the print head. Without paper in the printer the pins in the dot matrix head strike the roller instead of the paper, and this unseats the pins slightly and puts ink on the roller.

The paper thickness lever is the left-hand lever as you face the printer. Pull it all the way toward you. This gives you the most paper clearance.

Feed 8½" sprocketed printer paper into the slot underneath the rear plastic paper shelf, using both hands, and slide it into the printer until it emerges just below the print head. Continue feeding it up past the print head.

The tractors on each side have covers that snap out. Position the tractors so that the paper is centered, insert the paper sprocket holes into the spikes on the tractor wheels, and snap the covers closed. Adjust the distance between the tractors so that the paper is just barely tight.

Turn the paper advance knob until you feel comfortable. If you are the nervous type, this may never happen.

In back of the printer is a small switch with three postions: T (test), 5 (serial channel 5), and 4 (serial channel 4). Switch it to 5, then turn the power on. Now switch it to T, and let the printer print its entire character set, over and over.

If the print is too weak, move the paper thickness lever further away from you, toward the roller. If the print is too dark, move it toward you.

When you are satisfied with the print quality, and everything seems to work OK, move the channel select switch to 4. If you had two printers, one would be channel 4, the other channel 5.

To print using your own programs, you must get the printer working with the Commodore 64. The MPS-801 has an internal microprocessor that adds a few special features, and also increases the operating procedures.

OPEN the channel to the printer the same way as for the 1525, namely, by issuing this command:

```
OPEN 1,4
```

This assigns logical device number 1 to channel 4, the printer channel.

With the MPS-801 you can add an extra number, as in:

```
OPEN 1,4,7
```

This extra number is called the *secondary address*, and it specifies the following printer options:

0	Print exactly as received
6	Set spacing between lines
7	Select business mode
8	Select graphic mode
10	Reset the printer

You should read the User's Manual that comes with the printer before you start using these special features. For now, just ignore this extra number.

Now transfer output to the printer channel with the command:

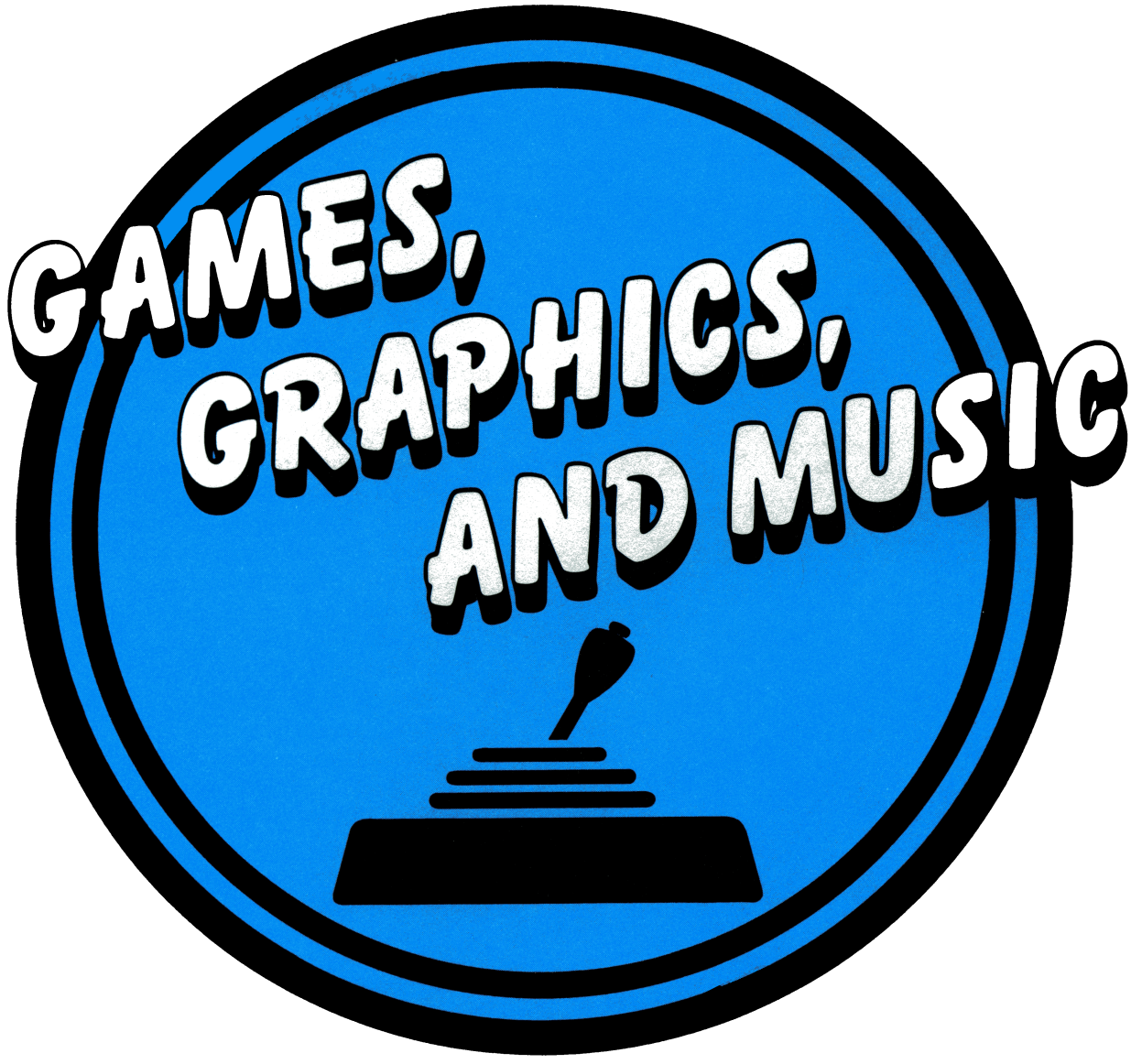
```
CMD1
```

From now on your listings will be directed to the printer instead of to the screen, although the screen will echo your original commands.

Issue PRINT#1 (no spaces) to get back to regular screen output, and CLOSE 1 when you are done using the printer channel.

There is much more to the MPS-801 than we have touched upon. You can borrow the User's Guide from any reasonable store that sells them. Look it over. You might really like this printer.

Unfortunately, most of the special features of the MPS-801 are not yet used by available application programs. If this printer gains acceptance, however, expect that to change.



Chapter Six

As you have probably discovered, the Commodore 64 has excellent sound and graphics. A lot of software manufacturers are taking advantage of the C64's capabilities in these areas, and so should you. Because there are so many 64 users out there, the cost of this software is quite low.

Game Software

There are all kinds of computer games: arcade, adventure, educational, role-playing, you name it. These games are fun to play, and there is a game for just about every part of your mind or body.

Even a game with no apparent redeeming qualitites just might be the game that keeps someone's son or daughter off the street late on a dark night when there is trouble in the air.

Arcade games are quite popular. Not much thinking is required, but they improve your hand-eye coordination and give you cheap thrills. A good arcade game is fast and action packed, with lots of color and sound. The more realistic the video the better.

Adventure games involve hunting for treasures and fighting fanciful foes in elaborate mazes. They improve your imagination and decision making skills. They are for quiet, thoughtful, adventuresome people like Sherlock Holmes or Nancy Drew. They are very good after a hard day's work in the city.

Educational games will improve your academic skills and help you make better grades. If you are having trouble learning, for whatever reason, there are educational games that will help.

Many software manufacturers make games in several categories, and indeed a particular game might belong to several categories. Some of the most popular games are listed in Figure 6.1. (See Color Plates 1, 2 and 3.)

Figure 6.1. Some of the more popular Commodore games*.

Product	Manufacturer	Available in: Cartridge	Cassette	Diskette
ARCADE				
Flight Simulator II	Sublogic			✓
Beach-Head	Access			✓
Archon	Electronic Arts			✓
Blue Max	Synapse		✓	✓
Q*Bert	Parker Bros.	✓		
Choplifter	Broderbund	✓		
Donkey Kong	Atari	✓		
ADVENTURE				
Zork I	Infocom			✓
Deadline	Infocom			✓
Temple of Apshai	Epyx		✓	✓
EDUCATIONAL				
Mastertype	Scarborough			✓
Kindercomp	Spinnaker	✓		✓
Facemaker	Spinnaker	✓		✓
Snooper Troops I	Spinnaker			✓
Spellicopter	Design Ware			✓

*From *Billboards Computer Software Survey* week ending 3/31/84.

Many games are available in cartridge form and simply plug into the cartridge port in the back of your computer. This makes them the least expensive and easiest application for your C64, since no storage devices are required. Adventure games are more complicated, and often require a disk drive.

Figure 6.2 Game Software Manufacturers

Appendix A lists addresses and products

Academy Software
Access
American Peripherals
Broderbund
Cardinal Software
Commodore
Computermat
Continental Software
Creative Software
Datamost, Inc.
Datasoft, Inc.
Design Ware
Electronic Arts
Epyx
HesWare
InfoCom
Krell
Madison Computer
Micro Software International
Pacific Coast
Protect Enterprises
Scarborough
Serius Software
Spinnaker
Sublogic
Synapse
Victory Software
Wunderware

Joysticks and Trackballs

For arcade games you will probably need a *joystick*, an inexpensive, hand-held device that swivels and sends position information to the computer. This input device is also used by some other application programs, such as *Doodle* (see pp.70-71) and *Magic Desk* (see pp.98-101). You can push forward or backward, left or right, or any direction in between. A thumb trigger or a first-finger firing button is a must, so that you can fire missiles or release other systems quickly, without losing direction control.

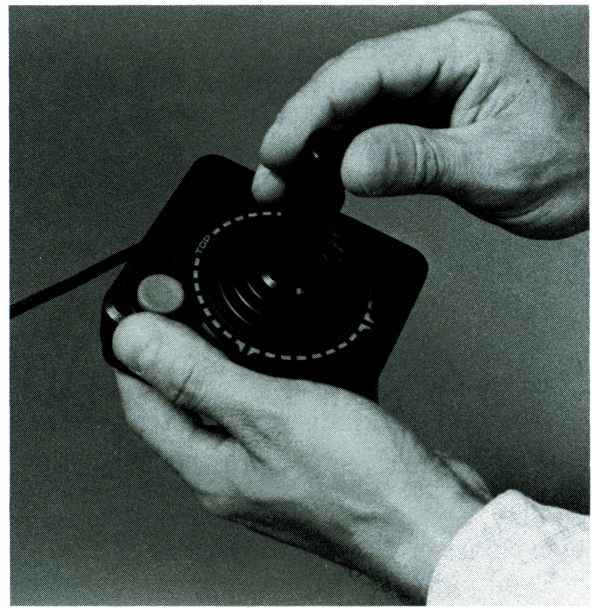


Figure 6.3. A joystick in the hands of an expert.

Joysticks and Trackballs connect to the two control ports on the right side of the computer.

Listed below are some of the joysticks that you can buy for your C64. Any joystick will work, even those that come with another manufacturer's video system, if it has the correct shaped plug.

JOYSTICKS

Product	Manufacturer
Starfighter	Suncom
TAC-2	Suncom
PointMaster	Discwasher
VC 2001	Ultra Tech Dist.
Minichamp	Championship Electronics
SuperChamp	Championship Electronics

A *trackball* (also called *gameball*) is similar to a joystick, except you roll it with the palm of your hand. For certain games and graphics applications it may be better than a joystick, because it has more momentum, and a different feel. Again, any trackball with the correct plug will work.

Be careful not to let computer games dominate your life, especially game hardware. You will know when you are out there too far: when you start carrying around several monogrammed competition joysticks, each in its own black leather case, and when you start wearing dark glasses to the game competitions.

Drawing and Painting Aids

With your Commodore 64, you can express yourself artistically as never before. The available software allows you to create, store, and retrieve high-resolution paintings and drawings. Whether you have the ability to draw by hand or not, you can get some art going on your C64.

Graphic Tablets

A *graphic tablet* is a pressure-sensitive device on which you write with various hard objects. The surface of the pad senses where something is pressing against it, and it relays this information to your computer.

There are at least three graphic tablets currently available for the C64. These are listed below:

The KoalaPad

The *KoalaPad*, by Audio Light, is a hand-held *graphic input tablet* that plugs into control port 1 of your 64. In order to use the pad it is necessary to use the included software. Called *KoalaPainter*, it is on diskette and must first be loaded into memory and run. Once the *KoalaPainter* software is loaded you will not need the keyboard, a good feature of this package. The pad comes with a solid plastic stick pen with which you draw and paint. Children as young as four have a great time with this device, and they make beautiful pictures with it.



Figure 6.4. The KoalaPad is a versatile graphics input tablet.

After the title screen comes the menu screen (see Color Plate 4).

Product	Manufacturer	Additional Software/Hardware Needed?
Koala Pad	Audio Light	Diskette included
Power Pad	Chalk board	Diskette included
Magic Wand	Chalkboard	Diskette included

When you touch the pen to the pad a small flickering arrow will appear on the screen in a position related to where you touch the pad. Either button at the top of the pad is like a RETURN key: nothing happens until you press it.

To select a command take the little arrow to it and press either button. The command title will light up. The graphics by the programmers are very good here. The way they make it light, it looks like a real light flashing behind the command title.

Prior to or after selecting a command you can select a brush and a color to paint with. This is done, as is everything, by taking the arrow to where you want and then pressing one of the buttons.

To get rid of the menu and start painting, take the pen down to the very bottom of the pad and press the button.

The commands allow you to do much more. You can have the device do your routine artwork: it will draw circles, lines, boxes of solid color, rectangular frames, rays from a point. It will put intersecting mirrors up so that you have vertical and horizontal symmetry. You can zoom in on an area for detail work (a very good feature), copy portions of the screen onto other areas of the same screen, and swap the painting you are working on with another painting that is stored behind the screen.

The zoom palette shows you a small rectangular portion of the picture at large scale, with a palette of colors that you "dip" into. The stroke of each type of brush is quite apparent in the zoom mode.

You can save up to sixteen pictures on one diskette. However with *KoalaPainter* you cannot get printouts of your creations. You will have to settle for photos you can take of the screen. Also, there is no way I know of to use your paintings in other BASIC programs.

Color Plate 5 shows a picture made using the *KoalaPad.*

The Powerpad

PowerPad has a one-square-foot writing area, including a special area for commands. You can write on the *PowerPad* with a variety of hard objects, and thus obtain different texture effects.

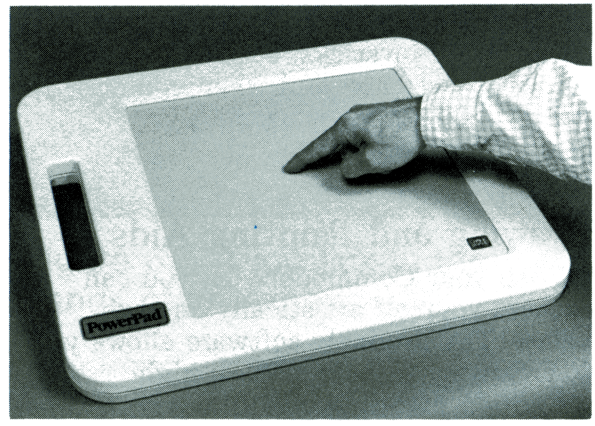


Figure 6.5. The PowerPad.

Software for the *PowerPad* includes *Leo's 'Lectric Paintbrush* (on diskette), also by Chalkboard. It has most of the same features of the *KoalaPad,* including storage and retrieval of your pictures.

One advantage of the *PowerPad* is that it can report many points being touched at once, something the *KoalaPad* can't do. This allows you to use various objects, including your fingers, as paint brushes.

Doodle

Doodle, written by Mark Rubin and distributed by City Software, is a powerful, versatile graphics program, available on diskette, that uses any joystick or trackball for graphic input. It

has all the features necessary to create first-class drawings and paintings, and to save and print them. It is, however, more complex than *KoalaPad*, and it takes longer to learn how to use. But it will produce more detailed drawings, it permits lettering to be added, and it enables you to print your drawings.

Doodle enables you to print your drawings on many dot matrix printers

There are ten modes in *Doodle*: sketch, lines, boxes, circles, color, zoom, copy, stamp, letter, and disk & print. Each mode has a menu screen that explains the options available for that mode. You have to be fairly intelligent to understand how to use these menus. Whereas the *KoalaPad* can be taught to a five-year-old in about ten minutes, *Doodle* takes an adult about an hour to master. On the other hand, *Doodle* will produce very complex, accurate, and professional-looking drawings and paintings.

In sketch mode the drawing speed can be changed from very slow to very fast, and the pen tip width can be varied from one line wide to about one-half-inch wide. This same pen tip can be changed into an eraser of the same width.

Doodle can print the drawings it makes on the Commodore 1525 printer and a wide variety of dot matrix printers including the C.Itoh 8510, NEC 8023, most Epson, Star/Gemini, and Okidata printers with graphics capabilities. This feature is very useful.

Also, the *Doodle* manual gives you instructions for using a picture you create in one of your BASIC programs. If you want to create your own adventure games, this is a great feature. For flowcharts, mechanical drawings, business graphics, and other "serious" drawings, *Doodle* is the best software I have seen so far. Color Plate 6 shows the detail possible with *Doodle*.

Light Pens

A light pen is a hand-held device about the size of an ordinary pen. One end contains a light-sensitive sensor that "reads" the light from the TV set or video monitor. Using special software, the C64 can know where the pen is pointing, provided, of course, that it is somewhere on the screen. If you put the light pen in your ear, for example, there's no way your C64 is going to know where it is.

Listed below are light pens that are compatible with your Comodore 64. They all include their own software on diskette and need no additional hardware.

LIGHT PENS

Product	Manufacturer
Cardriter	Cardco
Edumate	Futurehouse
Light Pen	Madison Computer
The Light Pen	Programmer's Institute
LP-10, LP-15	Tech-Sketch
3G Light Pen	3G Company

Generally speaking, the light pen is not an effective means of interacting with your Commodore 64. There are easier, more effective ways available, specifically graphic tablets.

Light pens are from an earlier era, before pressure-sensitive surfaces were developed.

There is, of course, something natural about drawing on the same surface that displays the picture, which is what you get with a light pen.

Take your C64 into a store that sells light pens and try one out. What can you lose?

Graphics Programming Aids

Drawing directly, as with a graphic input device such as a graphic tablet, is easy and convenient. But to do sophisticated and precise graphic designs, you'll need to do some programming. There are several products to help you program your own graphics.

GRAPHICS AIDS

Product	Manufacturer	Available In: Cartridge	Cassette	Diskette
UltraBasic	Abacus		✓	✓
Chartpak-64	Abacus			✓
Panorama	Midwest Micro Associates		✓	✓
Bar Charts	Powerbyte Software		✓	✓

High-level Graphics

High-level graphics are commands embedded in a programming language such as BASIC, LOGO, or Pilot (see Chapter 13), or commands that you can use on their own. By programming in these languages, you can generate many kinds of graphic images, and do all kinds of things with them. Some of the packages for the C64 are listed below:

UltraBasic-64

UltraBasic-64 is a useful package to have because it adds fifty commands to the CBM BASIC interpreter, all the commands that Commodore did not put into its own version of BASIC. It gives you access to x and y coordinates, and lets you write extended BASIC programs incorporating the new commands as if they came with the machine.

UltraBasic has high-resolution and multicolor commands, screen control commands, sprite commands, sprite picture definitions, turtle graphics, game functions, sound commands, and other features. To use *UltraBasic* properly, you will have to become familiar with BASIC and learn to program.(See Color Plate 7 for a sample *UltraBasic* creation.)

Sprite Editors

The shapes that you see moving around the screen when you play games are called *sprites*. The Commodore 64 has special hardware to store and move these shapes around.

A sprite is an array of twenty-one rows and twenty-four columns. Each square can be "on" or "off."

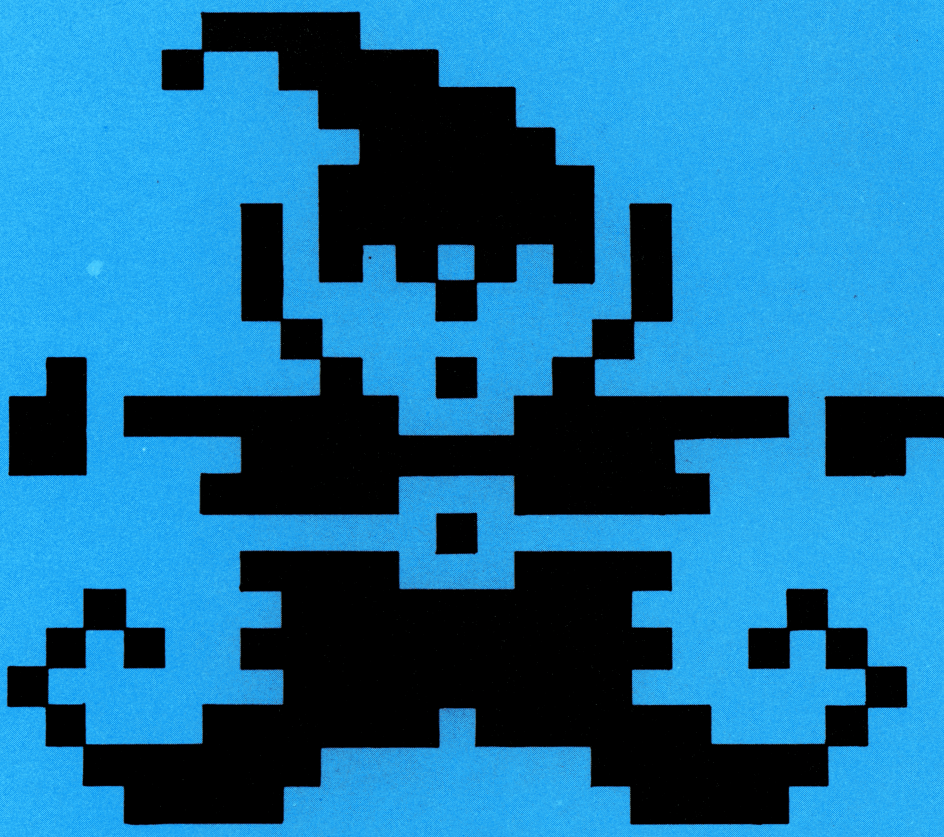


Figure 6.6. A sprite — n. an elf, fairy, or goblin.

If you are going to program with sprites you will want a sprite editor. Such an editor will allow you to construct a sprite without all the complicated calculations required if you don't have an editor. It's sort of a word processor for shapes.

SPRITE EDITORS

Product	Manufacturer	Available In: Cartridge	Cassette	Diskette
Sprite-Aid	Abacus Software		✓	✓
Sprite Designer	Academy Software		✓	✓
Sprite Graphics	Educational Software			✓

Figure 6.7. How Your 64 Makes Sounds

The music and sound effects that the C64 is capable of making are generated by the Sound Interface Device or SID. This system is a three-voice digitally controlled synthesizer, and it can do a lot. To appreciate what it does, and to understand how it works, you need to know something about vibrations. Sound is simply vibrations in the frequency range that humans hear, just as sight refers to what people can see.

You can make just about any sound you want by adding together individual voices. Each voice consists of one note of constant frequency, whose amplitude is shaped by the throat, mouth, and lips of the singer.

Many a resident of Moosejaw, Saskatchewan, is awakened at night by the results of this addition process.

The SID is somewhat similar to this trio of moose, in that it adds together three voices, each representing one frequency. The similarity stops there, fortunately.

The SID can be programmed by setting the frequencies of the three tones, the volume envelopes they are to follow, and the filtering to be applied to each. These and other parameters are set by poking the right values into the twenty-nine eight-bit registers that control the generation of sound by the SID.



The details of programming the SID are beyond the scope of this book. See one of the following books:

COMPUTE!'s First Book of Commodore 64 Sound and Graphics
Commodore 64 Programmer's Reference Manual
Commodore 64 Graphics & Sound Programming, by Stan Krute
Commodore 64: Getting the Most from It, by Tim Onosko
The Commodore 64 Music Book, by James Vogel and Nevin B. Scrimshaw

Making Music with Your Commmodore

The Commodore 64 is capable of making sounds, in the same way that keyboard synthesizers and organs produce musical notes. This makes it an excellent tool for learning and enjoying music. There are a number of music and sound packages for your C64.

MUSIC SOFTWARE

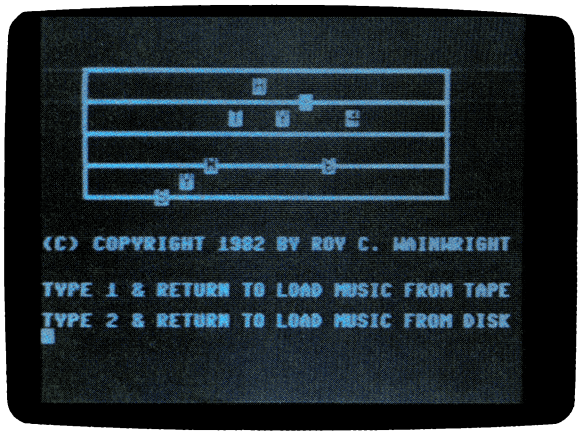
Product	Manufacturer	Available In: Cartridge	Cassette	Diskette
Synthy-64	Abacus Software		✓	✓
Music Machine	Commodore	✓		
Music Composer	Commodore	✓		
MicroMaestro	Chalkboard			✓
Music Maker	ComputerMat		✓	
Music Construction Set	Electronic Arts			✓
SongWriter	Scarborough Systems			✓
MusiCalc	Waveform Corp.			✓

Synthy-64

Synthy-64 by Abacus Software, is a music and sound synthesizer for the Commodore 64. It is a rather sophisticated program, taking several hours to master, but lets you compose, conduct, and play your own musical scores. Your compositions must be restricted to three voices, though, as the Sound Interface Device has only three tone generators.

> The Commodore can play up to 3 tones simultaneously.

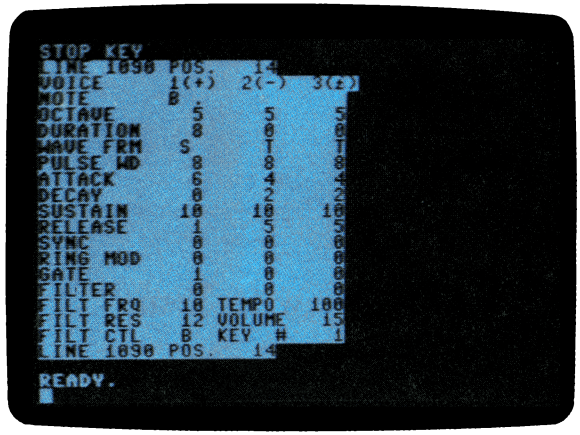
The program is available on disk or cassette. The diskette version is loaded by the command LOAD"SYNTHY-64",8 (press RETURN). When the drive stops and the READY prompt appears, enter RUN and wait. This screen will appear:



Here you indicate which device, tape or disk, you are using. We entered 2, for the disk. When you press RETURN it goes out to the disk and gets whatever songs are stored there. On the program disk there are three demonstration songs. Their menu appears next.

Enter option 1, the Battle Hymn. This will inspire in you those feelings of patriotism that may be lacking in your daily life. Fortunately this piece is limited to one voice, except during the sirens, and so you should be able to maintain your self-control. Option 1 shows you the trace feature.

Figure 6.8. *Synthy-64* trace screen during Battle Hymn.



The trace feature shows you the parameter settings for each note as it is being played. Since most of the time only the first voice is being played, you will be able to associate the sound values shown. Play the Battle Hymn over and over, watching the trace as you listen to the notes. This will show you a lot.

Each voice has a special symbol: voice 1 is +, voice 2 is −, voice 3 is £ . These symbols are used for all your work with *Synthy-64*.

The note shown is the standard letter symbol for the note. The octave is a digit from 1 to 8. You write the music in letter notes (including sharps and flats) and octave numbers, and *Synthy-64* converts these to the correct frequency values for the SID. Sharps are indicated by their usual symbol (#), but flats are a percent sign (%) and naturals are a dollar sign ($).

The duration is a number indicating what fraction of a measure the note played: 1 means a whole note, 2 is a half note, 4 is a quarter note, and so forth. Only powers of 2 are allowed.

The wave form setting determines the tonal quality of the unfiltered signal coming out of a tone generator. You can use four kinds of signals, shown in Figure 6.9.

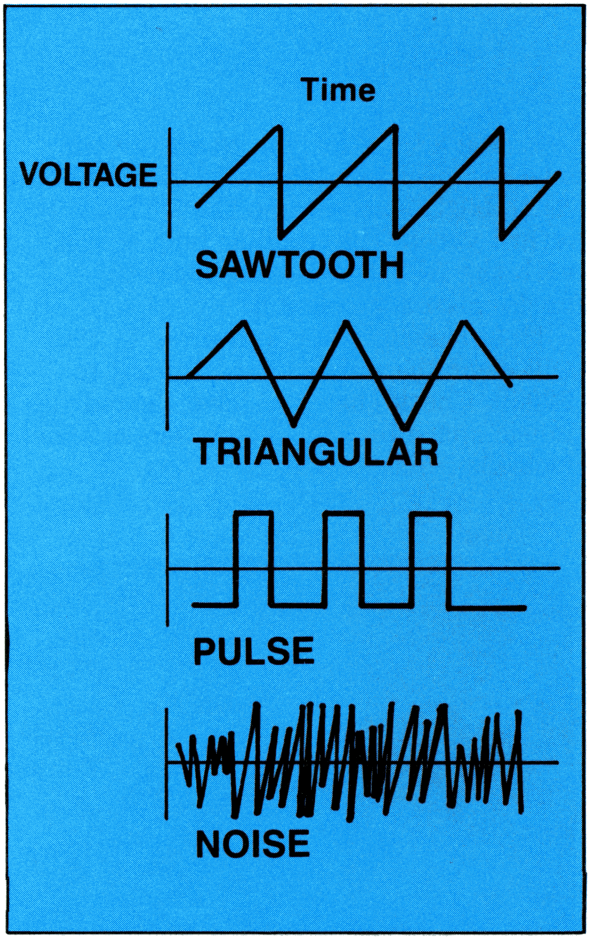


Figure 6.9. Sawtooth, triangular, pulse, and noise SID waveforms.

The pulse width applies only when a pulse waveform is selected. It determines how much of the time the pulse is in the "on" state.

The attack, decay, sustain, and release settings control the volume envelope of the note, as shown in Figure 6.10.

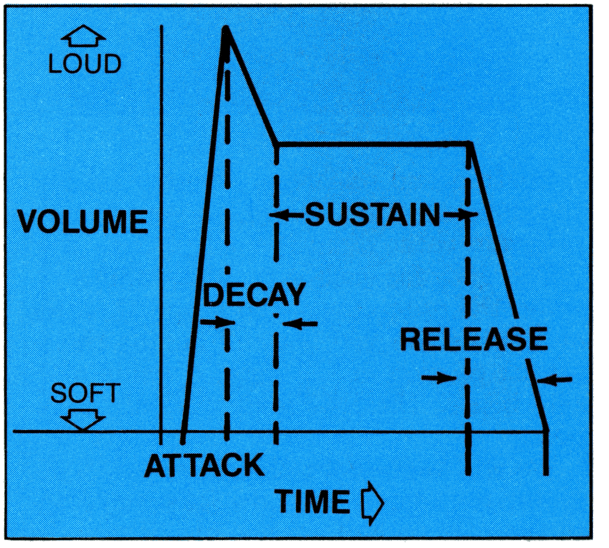


Figure 6.10. Attack, decay, sustain, and release.

These four periods of time are derived from experience with how notes are played on a wide range of instruments. The attack part is the time from when energy starts to when it reaches a peak; the decay is from that moment until the note "catches" on its sustained value. Finally, after the sustain period is over, the release begins, and continues until no note energy remains.

In physical instruments the sustain period is not horizontal, as the SID sustain is, but the note volume gradually falls. In the case of a violin string being bowed, or an electric guitar with feedback, or any kind of electronic organ or synthesizer, the sustain period can be maintained at a constant volume because energy is constantly being added. *Synthy-64* uses these values:

ATTACK
0 sound turned on instantly
15 longest time to reach maximum

DECAY
0 sustain level reached at once
15 longest time to sustain

Sustain and release are controlled by the note duration values, so you do not program these directly.

The gate for each voice determines when the note starts and stops. A value of 1 turns the gate on and begins the attack portion of the note. A value of zero begins the release portion of the note.

We will talk about the other parameters later. For now let's move on to the other songs on the program diskette.

Get some beer and chips, invite some friends over, and clear the living room floor. Enter selection 2 and press RETURN. The Beer Barrel Polka will start playing. Get out on that dance floor and go. Watch out for other people's toes, though.

Finally, when everyone is polka'd out, and feeling no pain, play selection 3, the Moonlight Sonata.

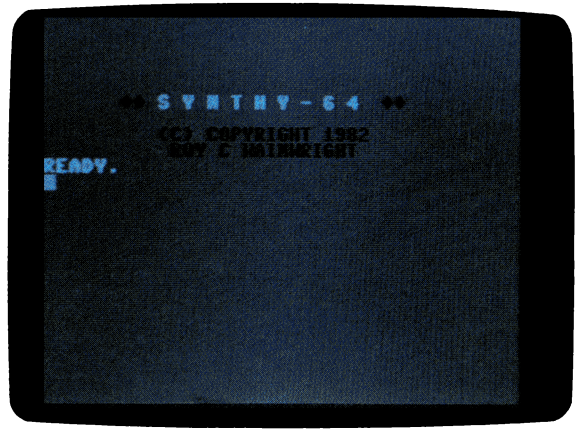
For an hour's worth of excellent classical music, performed on the Commodore 64 by Dave Rutkowski, put the Classical 64 diskette in the drive as soon as the first *Synthy-64* screen comes up. When you select the device you will get a menu of fifteen pieces, all of them well done.

You should play this classical work on your high-fidelity system to fully appreciate the sound that it makes, and the quality of the programming that went into this work.

To hook the C-64 to your hi-fi, get a two-channel a/v connector and run the audio line into the AUX or TAPE input of your hi-fi. If you have a TV, just don't use the video part of the a/v cable.

Now it's time for you to write your own compositions. Press RUN/STOP and RESTORE at the same time. This will return you to the familiar blue screen with the READY message and the flashing cursor below it.

Hold the shift key and press C. This will clear the music space, lines 2 to 62999. Check that you have cleared this music space by LIST. Your screen should look like this:



The *Synthy-64* program has replaced the BASIC interpreter, for the moment. Your compositions will be in SYNTHY-64 BASIC. Enter this "program":

```
1 RUN "<shifted CLR/HOME>"
10 T120
20 C5/4 D5/4 E5/4 F5/4
30 G5/4 A6/4 B6/4 C6/4
```

This means to press the SHIFT and CLR/HOME keys. The computer will make that part of the program.

Sets the tempo to 120 quarter notes per minute

Plays four quarter notes, C, D, E, and F in the 5th octave

Plays G, in the 5th octave, and A, B and C. in the 6th

Enter RUN, press RETURN, and you will hear the scale from C to C played.

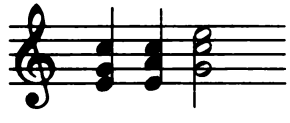
Synthy-64 will remember the most recent octave and duration, so you don't have to repeat it so much. You can get the same scale as above with this shorter program (clear music space first):

```
1 RUN "<shifted CLR/HOME>"
10 T100
20 C5/4 D E F G A6 B C
```

If you want to use more than one voice at a time, you precede the note with the voice symbol. Duration is aligned separately for each voice, and *Synthy-64* grabs as many notes as it can. The

```
1 RUN "<shifted CLR/HOME>"
10 T50
20 +E5/4 -G5/4 £C6/4 +E -A6
30 £C +G/2 -C/2 £E/2
```

program will play this chord progression:



Synthy-64 allows you to do much more than we have time to describe here. You can control all of the parameters of the SID. If you are interested in music on the Commodore 64, this is a good program to start with.

MusiCalc

MusiCalc is a synthesizer and sequencer program by Waveform Corporation. It is very well made, and it turns your Commodore 64 into a concert three-voice synthesizer. This is a hot program!

The program is self-loading: all you do is enter LOAD "MUSICALC",8,1 and press RETURN. You have to wait a while, as there appears to be a lot of program to load. Pretty soon the thing starts playing and the instrument's panel appears:

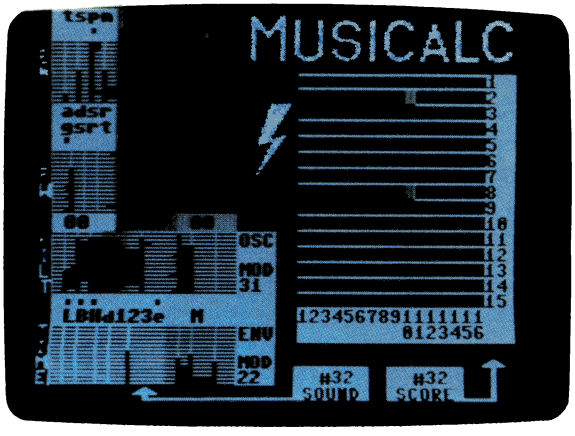


Figure 6.11. The *Musicalc* panel.

The left side of the screen displays the sound parameters, and the right side shows where in the score notes are being played. The score is set note by note in a separate routine. The sound parameters are set by pressing a key to select the parameter and then pressing the function keys to set its value. The keys that you press to select the switch or slider are arranged on the keyboard exactly as they are arranged on the screen.

You can look at the sound screen and see everything at a glance. The screen is in color, with each voice a separate color.

The top row of switches controls the waveform of each voice. The letters t, s, p, n stand for triangle, sawtooth, pulse, and noise, respectively.

The top row of faders controls the envelope of each voice. The letters a, d, s, r stand for attack, decay, sustain, and release, respectively.

Just below the top row of faders is another row of switches. The letters g, s, r, t stand for gate, synchronizer, ring modulator, and test, respectively. The gate switch turns a given voice on or off, and the test switch turns off a voice for testing. Synchronization and ring modulation are processes that intermix the voices against each other and produce interesting effects, difficult to describe, but characteristic of synthesizers.

The second row of sliders controls the pulse width of each voice. These faders are connected only when a pulse waveform is selected (switch p on top row).

The third row of faders controls the filters, and the bottom row controls the tempo. These controls apply to the ensemble of all three voices.

The right side of the panel shows the sequencer steps. There are fifteen rows of sixteen steps each, for a total of 240 steps or notes. Each step is assigned a note to play (or a rest), and the entire collection of 240 notes is called a score. The keyboard can access thirty-two different scores, and thirty-two different sound settings (or presets, as they are called).

You must first decide what will be the smallest note in your composition. That will be the duration value of a single step. All 240 steps in the score will have this same value. For example, if a 16th note is the smallest note, each row represents one measure. To play a quarter note you would keep the same note value for four steps, in this instance.

Each step receives a note value, an octave (0 to 7), and an articulation (yes or no). There is a screen (shown in Figure 6.12) that allows you to construct one row at a time.

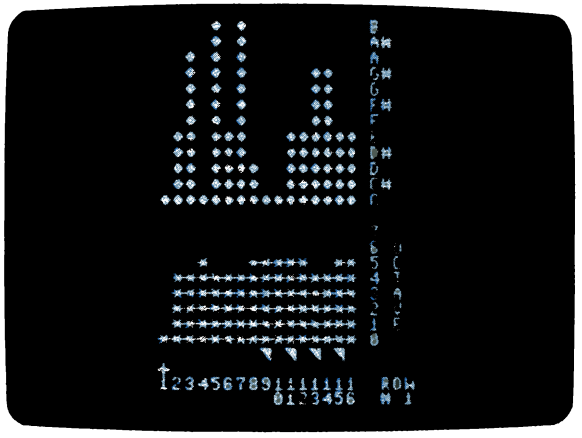


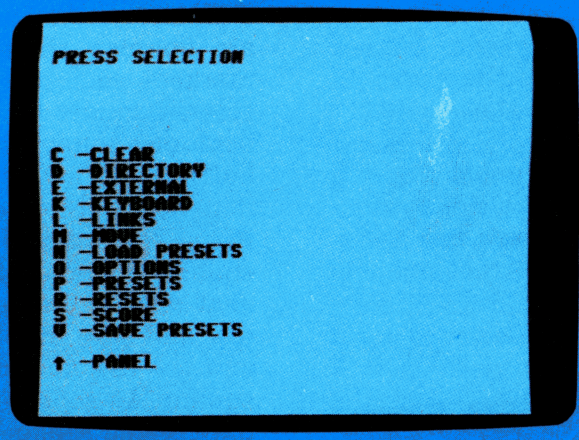
Figure 6.12. The *Musicalc* score screen.

The numbers across the bottom are the step numbers. The plus sign is the cursor, and you move it from one step to another with the cursor controls. When it is below the step you want to define, the function keys are used. F1 raises the note by one half-step, F7 lowers it by one half-step. F3 raises the octave, F5 lowers it. If you want a note to continue into the next note you press the space bar. This puts the articulation symbol, a triangle below the octave bar, and indicates that the note is to be slurred into the next note. If the notes are one pitch and the same octave they will sound like one note. Each step can define the note for only one voice. There are, however, three different note markers, each one a different color. The colored square for a given voice moves from one square to the next (top to bottom and left to right) until you send it to some other square using a linkage. A linkage is simply a patch from one square to some other square, not the next one. To create a link you enter the row and step number of the from square, and the row and step number of the to square. As soon as the from step is played, the sequencer will move that voice cursor to the to square and resume the sequencing.

To compose a three-voice piece, for example, you would have three separate "racetracks," or closed sequences. Each one would start in a different row and step. You tell the system which voice starts where, using what are called resets.

MusiCalc is designed so that the current score keeps right on playing while you take care of the various tasks necessary to get the composition where you want it to be. Whenever you need to do something that you can't get to from the panel, you press SHIFT and RETURN together, and this brings up the main menu (see Figure 6.13).

Figure 6.13. *Musicalc* main menu



CLEAR lets you clear out sounds, scores, and linkages.

DIRECTORY lists files and programs on the disk you are using.

EXTERNAL loads external program files.

KEYBOARD turns the Commodore 64 keyboard into a piano-type keyboard.

LINKS sets up score linkages.

MOVE lets you move scores and sounds around. This lets you assign adjacent scores to adjacent keys on the keyboard.

LOAD PRESETS loads stored sound presets.

OPTIONS is for certain special purposes.

PRESETS lets you construct or modify sound settings.

RESETS lets you start each voice at the appropriate step in the score.

SCORE lets you construct a score.

SAVE PRESETS saves all thirty-two sounds and all thirty-two scores on a diskette.

When the keyboard option is selected the Commodore 64 becomes a piano-type keyboard, with a four-octave range. Each row controls the twelve halftones of an octave, and the keys in a vertical row are all the same note. You can play this system as if it were a real synthesizer. Maybe some bands will start using it.

Once the program is loaded you can detach the disk drive, and then all you need is about thirty feet of power and signal cable, and you got yourself a synthesizer for a few hundred dollars that would cost several thousand dollars if you did it the regular way. The first rock keyboardist to get out there with *MusiCalc* on the 64 is gonna attract some attention.

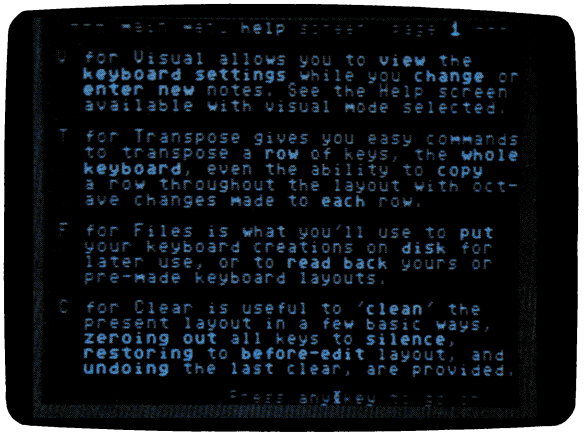


Figure 6.14. The *Musicalc 2* help screen.

MusiCalc enables you to print your compositions on a Commodore 1525 or Epson printer

MusiCalc 2 Scorewriter

There are two companion systems for *MusiCalc* (purchased separately), a scorewriter and a keyboard maker. The scorewriter prints the musical score to any score that has been created. It takes some time for the processing, as there is lots to do, but the results are impressive.

The *MusiCalc 2* diskette is loaded first (LOAD "S*",8,1). It assumes that you have *MusiCalc* on hand, and a file of the scores you want to convert to musical notation.

The first screens contain a description of the three main functions of *MusiCalc:* scorewriting, sequencer control (for longer songs), and external control (for controlling *MusiCalc* from an external device). The HELP screens are shown in Figure 6.14.

When you are ready to score a song, press R. You will be asked to indicate the printer, either a Commodore 1525 or an Epson with a Cardco Centronics interface.

Next you remove the *MusiCalc 2* diskette. Then you enter the file name of the preset file containing the songs you want to score. For this demonstration we used the demo file that comes with *MusiCalc.* Enter P.DEMO and press RETURN. Then wait while the presets are loaded.

Soon you will be prompted for the score. Now you place *MusiCalc 2* in the drive and press RETURN. You will want to set up to print a score. This means that you select the score number (32 in our example), the time signature (we chose four sequencer steps per measure), and the voices to score (we chose all three voices). Return to the main menu and turn on your printer. Enter P for print, then select where you want to start (we chose the beginning of the score). Pretty soon a score will appear on the screen; see Figure 6.15.

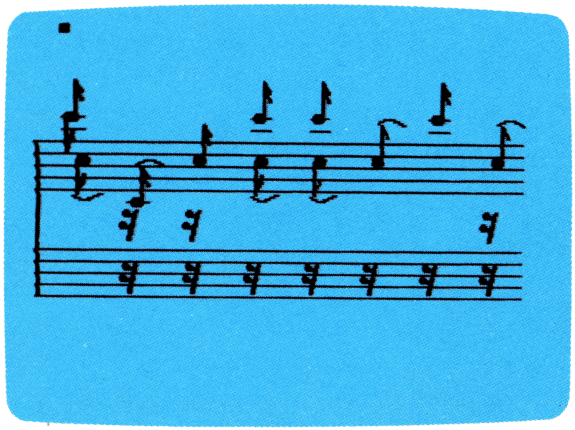


Figure 6.15. A *Musicalc 2* score being created.

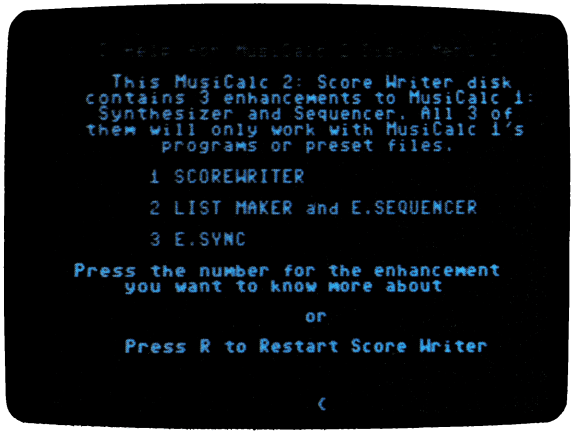
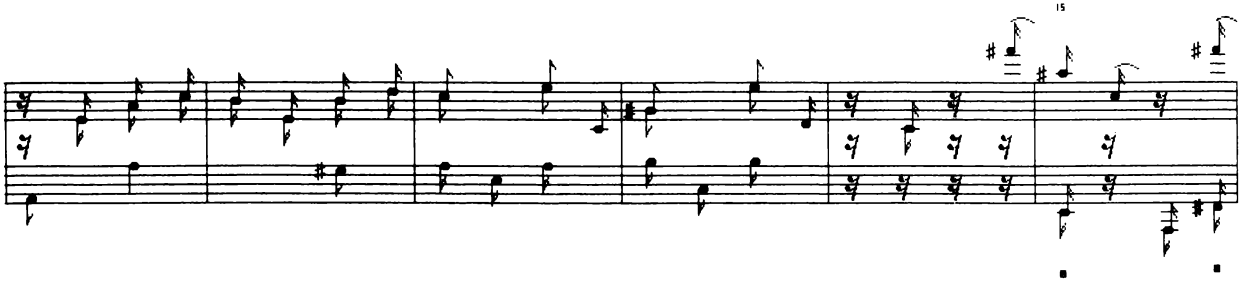


Figure 6.16. The *Musicalc 3* help screen.

Press P again and the score will start printing. You must use sprocketed continuous feed paper, because the score prints lengthwise. When the printing of the first two measures is complete, another two measures will be set up. Press P again and these will be printed as a continuation of the first two measures. Here's what a printed score looks like:



MusiCalc 2 produces a high-quality score, complete with correct spacing, sharps and flats, rests, everything. This is a good piece of software, and definitely worth having if you plan to have other people sight-read your compositions. You won't find another machine beside the Commodore 64 that can do this sort of thing, unless you are willing to pay several thousand dollars.

MusiCalc 3 Keyboard Maker

This is the other companion system to *MusiCalc*. The HELP screens are shown in Figure 6.16.

You can easily enter the note and octave for each key, and hence make any kind of keyboard you want. You can hear the notes as you assign them, and once assigned, you will hear the note whenever you press the key.

Keyboard Maker allows you to store the keyboard configuration, and even transpose the notes to another key signature.

The *Keyboard Maker* diskette comes with all sorts of predefined keyboards from all over the world, representing every conceivable kind of music. It is an education in itself trying out these different scales.

Select Visual and you will see this screen:

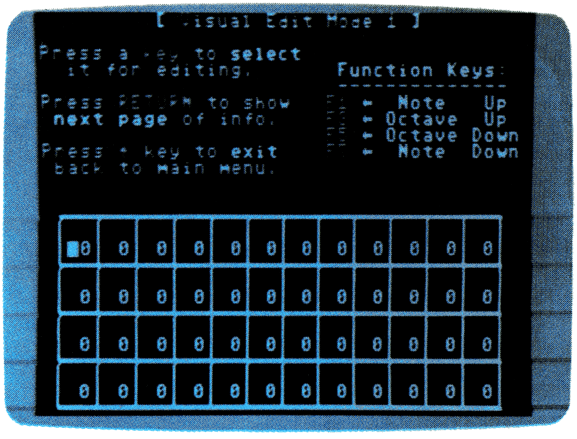


Figure 6.17. The *Musicalc 3* keyboard maker.

There are other systems that Waveform Corporation makes for *MusiCalc*, including two templates, African and Latin rhythms, new wave and rock, and a diskette of technopop hits. There is also a professional quality keyboard and a *MusiCalc 4* package to interface it to your *MusiCalc 1* and *2* packages.

All in all, Waveform Corporation has really come up with some excellent music software for the Commodore 64. Check it out.



Chapter Seven

It is no secret that the Commodore 64 has met with great success in the educational arena. Its low cost, and its excellent graphics and sound capability, have given it an advantage over other microcomputers in the educational field.

Educational Software

Most people use educational software to supplement the regular school curriculum, grades K through 12, and the preschool and college curricula.

The Commodore 64 is an excellent choice for a teaching aid, especially when it is fully configured with a color monitor and disk drive or cassette recorder. As you use educational products in the classroom you will see how powerful the Commodore 64 really is, and how much teaching it will do.

There is a lot of solid educational software for the C64 on disk, cassette, and cartridge. Some of the areas currently active are listed in Figure 7.1. This is a very rapidly expanding area, so watch for new products.

Currently, some of the most popular software is for children below the age of ten. However, high-quality educational programs are becoming available for older children and adults.

Most educational software is of one of three basic types: drill and practice, simulation, or tutorial. It is not unusual for elements of one or both of the other types to be found in software belonging to any given category. All three types of programs are effective when well planned and presented.

Figure 7.1. The educational software curriculum

- Alphabet
- Arithmetic
- Art
- Astrology
- Audio-visual equipment
- Biology
- Chemistry
- Colors
- Composition
- Computer science
- Consumer education
- Critical thinking
- Decision making
- Driver training
- Energy conservation
- Ecology
- Economics
- Evolution
- Exam preparation
- Foreign languages
- Genetics
- Geography
- Geometry
- Grammar
- History
- Interviewing skills
- Job-search skills
- Memory improvement
- Music
- Pilot training
- Preparation for college entrance exams
- Punctuation
- Remedial education
- Sex education
- Shapes
- Spelling
- Statistics
- Time management
- Typing
- Values clarification

Games and Drills

Educational games and drills teach basic concepts through their repeated application in related exercises. Though this may seem to be a very dull and unimaginative method of instruction, this is not necessarily the case when practice is combined with gamelike scenarios,

For information on educational games, GOTO pp. 67



color graphics, sound, and plenty of positive reinforcement. Drills and practice strutures are of particular merit in fields such as typing, mathematics, and spelling. See Chapter 6 for more discussion on educational games.

Simulations

Simulations are programs that place the user in situations demanding decision making, planning, and, in some cases, real-time responses. Simulations are often used as effective and less expensive ways to teach subjects normally requiring the use of costly equipment or actual observation and participation. An obvious advantage of learning subjects such as business decision making and analysis or driver training via the computer is that one can learn from one's mistakes without paying the prices in real money or loss of life or limb. (See Color Plate 1.)

Study Courses

These are like books on diskette or cassette. They present text and pictorial information and sound, one screenful at a time. They represent only a small fraction of educational material, since they are more traditional than the currently popular educational games. As the Commodore 64 continues to spread into more and more classrooms, you can expect a good catalogue of study courses.

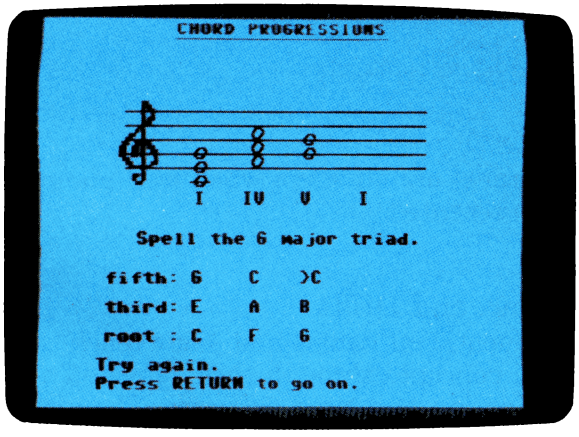


Figure 7.2. *Music Made Easy,* by Alfred Software, offers a complete course in music fundamentals.

How To Select Educational Software

Before purchasing any software, be sure that it is compatible with your system. Some programs require paddle controls, joysticks, eighty-column cards (to allow the display of 80 characters across the screen), or color monitors.

Most educational software is on diskette which can be damaged by children's often sticky and inquisitive fingers. Be sure that a replacement copy of the disk is available at a nominal charge, or request permission to make a backup.

Seek the best possible match between the person who will be using the software and the presentation and level of difficulty of the subject. Examine the manual to determine grade level and the prerequisites required by the program. If the primary objective is to assist the child with school work, choose the programs that most closely coincide with the courses of study offered at the school.

The best way to apply these criteria to software is to use the software personally. Computer stores will sometimes offer a demonstration. When this is not available, there are some alternative sources of information.

The instruction manual of the software you are considering is often a very good source of information. You can discover

Quality Educational Software Should:

1. Encourage the *interaction* of the user. Beware of software that simply prompts the user for a response. This is reactive, not interactive.
2. Be *flexible*. As a rule, the more flexibility given to the learner the more effective the lesson will be.
3. Effectively *utilize* the unique *graphics, sound,* and *special effects* available on the computer when it is appropriate.
4. Have *properly sequenced* lessons that build upon each other.
5. *Pace the lessons* to the needs of the user. Many good programs allow the user to control the segments of the program presented.
6. Present the opportunity for *practice*. This is essential.
7. Be free of bugs.
8. Contain the *good documentation* and error-handling routines necessary to avoid user frustration.
9. Provide *rewarding positive feedback* for correct responses.
10. Be highly *motivating* and *creative*.
11. Be *easy* to use.
12. Provide for some *challenge* and *progress*. Reasonable challenge is 10-20 percent beyond the child's current ability. Good programs provide several levels of difficulty.

how clear and complete the documentation and learning objectives are, the grade level and prerequisites needed, the type of lesson design used, etc.

Publications

The Blue Book for the Commodore Computer (see Appendix B) provides a good initial guide to the available software. It lists educational software by category and/or subject, and gives product descriptions and current prices. You will find it very handy.

Family Computing (see Appendix B) is a good magazine for educational software. The February 1984 issue has some good reviews of educational software for the Commodore 64 (and other machines).

Two popular magazines with objective reviews of current software are *Softalk* and *Creative Computing*. The April and October issues of *Creative Computing* usually devote most of their pages to educational reviews and articles.

There are also many publications that specialize in educational software. A partial list is shown in Figure 7.3.

Figure 7.3. Educational Software Publications

TITLE	PUBLISHER
Classroom Computer News	Pitman Learning Inc., 19 David Drive Belmont, CA 94002
The Computing Teacher	International Council for Computers in Education 135 Education Eugene, OR 97403
Educational Computer	EdComp.Inc., P.O. Box 535 Cupertino, CA 95015
Electronic Learning	Scholastic Inc. 730 Broadway New York, NY 10003

You may also find the book *Software Reports* in your local bookstore or computer store. This useful book evaluates almost 400 educational programs in twenty subject areas.

Educational Software Vendors

Listed in Figure 7.4 are some of the companies that manufacture educational software. Appendix A gives their addresses and some of their products. Phone them and they will send you free literature describing their products.

Figure 7.4. Educational Software Vendors

Academy Software
Alfred Software
Athena Software
Byte by Byte
Cardinal Software
Chalkboard
Comm Data Computer House, Inc.
Computermat
Creative Software
Educational Software
Hayden Software
Home Software
Island Software
JMH Software of Minnesota, Inc.
Krell
Limbic Systems
Micrograms, Inc.
Microphys Programs
Midwest Software
Quality Educational Designs
Riverbank Software
Scholastic, Inc.
Spinnaker
Tamarack
Terrapin

Educational software is useful, but the most effective method of computer-assisted instruction is, in my opinion, a robot with a bamboo cane. Equipped with face and voice recognition systems, and good arm and hand hydraulics, such a robot can contribute substantially to the efficiency of the educational process. The University of Moosejaw has these robots installed in all their classrooms, and the students work very hard even when the teacher is asleep. This is modern technology at work.

WORD PROCESSING



Chapter Eight

What Can Word Processors Do?

One of the most useful and widely used functions of the computer is *word processing*. A word processor is a program that edits, stores, and prints text. The text must still be typed in, but word processors relieve the user of much of the additional typing usually required in correcting errors and making revisions.

Figure 8.1 shows how useful a word processor can be. Many different word processors are available for your Commodore 64. Here are some suggestions on how to purchase one to fit your needs.

Figure 8.1. Word processing features.

1. *Screen editing.* You can move around on the screen and fix things, using the cursor controls (the editing keys mentioned in Chapter 3).

2. *Word wrap.* No carriage returns are required at the end of each line and the text automatically wraps around the screen to continue on the next line. The text layout is not controlled by the typing, but by later formatting commands when it is output.

3. *Choice of output formats.* Once entered, the text may be output in any number of formats. Some of the most common choices include spacing, margin control, and text length. There are software packages that also allow a choice of fonts (different size and style of type) to take advantage of the abilities of the better printers.

4. *Multiple copies.* Files can be output any number of times after a single entry as they can be saved for future output, alterations, or combinations with other files.

5. *Justification and centering.* Many word processors will justify the text by adjusting the spacing between each pair of words in a line to insure an even right-hand margin. Some of the more sophisticated programs will even make minute adjustments between each pair of letters in order to avoid any overly wide spaces between words. Automatic hyphenation usually is not available, and user-hyphenation is also rare. Therefore, a line containing two or three long words will not look as well spaced as a line with many short words.

Words and phrases may also be automatically centered. Headings may be automatically centered and placed at the top of the page.

6. *Block move.* Whole blocks of text may be moved from one place in the text to another place. The surrounding text will automatically expand to accommodate the inserted text and contract around the gap created by its removal. Blocks may be deleted or new blocks may be added anywhere in the text.

7. *Search and replace.* The computer can be requested to search for occurrences of a given word or phrase in all or part of your text. If you wish to replace the word or phrase with another word or phrase this can also be accomplished. When you are searching for a particular word or phrase in your entire text so that it can be replaced with another word or phrase, the operation is referred to as "global search and replace". It's a very useful operation. An example of it is the typing of "form letters": a letter addressed to Mr. Jones can be automatically retyped with Mr. Jones replaced everywhere by Ms. Smith.

8. *Merger with other software.* Files created using the word processor may be merged with other software to produce the desired end product. For example, a form letter may be merged with a mailing program and an accompanying name and address file to send personalized letters to selected members of a mailing list. Another very common software partnership is the use of spelling checkers in conjunction with a word processor to prevent misspellings and typographic errors.

How To Select a Word Processor

There is a lot of word processing software on the market today. Although this provides the potential buyer with a wide range of choices, it can also make choosing the right software an overwhelming task.

Software should be selected like any other tool with an eye toward its intended use and the other hardware with which is is to be used. As you see what capabilities you want in a system, you will have to consider what additional hardware this requires and whether the advantages are worth the investment.

The first step in selecting word processing software is to define your goals. There are many different types of applications. Some require very sophisticated word processing features and others very little more than what is available on a good electronic typewriter.

If your requirements are minimal, beware of buying a more sophisticated, and consequently more expensive, word processor than you need. More is not necessarily better. You may want a word processor to aid in simple functions such as letter writing. In a case like this almost any competent word processor will meet your needs. The primary concern should be the speed with which the software operates and its ease of use. Also look for the ability to format the text on the screen before it's output to the printer. Some word processors will display the text on the screen exactly as it will appear on the printed page. This is a real time-saver. Printing should be a relatively simple operation as well. If the output need be of a high quality, be sure that the software is compatible with a good quality printer. If you do not already own such a printer, determine if its added cost will be justified by your use.

For the more demanding requirements of manuscript preparation, a more complex set of features is needed in addition to those mentioned above. As in any writing requiring frequent revisions, ease of movement through the document and strong editing capabilities are a must. The speed with which operations are performed is more important than ever, due to the increased use of the word processor's functions. The search function is also very useful, especially when dealing with large documents. In addition, the ability to replace the items located by the search can save many hours.

Block operations are invaluable as text will often be moved, inserted, and deleted before the manuscript is completed. Footnote capabilities are often important, but are not available in the majority of work processing packages. Temporary indentation is useful for the indentation of entire paragraphs or sections of text, as in script (play) writing or other forms of writing requiring the use of indented quoted material within the text.

For manuscripts, the formatting capabilities may be more important than for other documents because good appearance and layout improve readability and visual appeal. Most manuscripts require double spacing and the use of footers and headers. Be sure that these formatting capabilities are available and easily used on the system you select. Also look for formatted on-screen display. This will save you the disappointment of printing a file only to discover it was not formatted as you thought.

The more formal technical or business applications require all of the above features plus some or all of the following more sophisticated options. Superscript and subscript abilities are of value, especially in technical papers requiring

the heavy use of formulas and footnotes.

Another important consideration is the ability of the word processing software to interface successfully with your existing or future software. Some word processing programs can operate in conjunction with other software such as spreadsheet, database, or mailing programs. This ability can be invaluable in business applications.

Figure 8.2. Word processing features to look for

1. *On-line help facility.* Some word processors provide a help function that provides additional information on the procedures desired.
2. *Vendor "hotline"* for assistance.
3. Clear and thorough *documentation*.
4. *Good error detection and recovery.* Many programs require verification of those actions, such as overwriting a good file, which could have disastrous ramifications if they were performed erroneously. You should be able to escape any erroneous function selection with the minimum of harm to your work.
5. *Compatibility* with a range of printers to allow for future upgrading.
6. The ability to *read and write* standard ASCII text files.
7. *Compatibility* with other software.
8. The ability to handle memory shortage (the "out of disk space" condition).
9. Availability of *replacement copies* of the software at nominal cost.

After you have determined the features you will need to meet your individual requirements, you must locate the package offering you the best combination of these features that is compatible with your system and your pocketbook. Resist the temptation to get a deluxe model just because you can afford it and the salespitch sounds convincing. Stick to the features that you need and evaluate any additional features in light of their worth to you in the long run. Finding the right word processor necessitates some time and research on your part, but is well worth the effort. A poor selection may be very disappointing and expensive.

Additional Hardware

You might need to purchase some additional hardware to meet your word processing needs. Here are some of the major peripherals to consider.

Printers

You of course need some sort of printer to do word processing. Even with the dawning of the "electronic mail" age, most people expect to read your words of wisdom on good, old-fashioned paper. Therefore, if you haven't already bought a printer, you should think carefully of what type you will need for your word processing.

The Commodore 1525 is certainly an excellent choice. It prints at 30 characters per second (about 300 words per minute) and all word processing programs are designed to work with it. However, it does not allow you to use single sheets of paper, but rather you must use continuous form, peforated, sprocketed paper. This can be a problem if you need to use your own stationery (though you can arrange to have your letterhead preprinted on continuous form paper). Also, the 1525 is a dot matrix printer, so your documents will have a "computer look" to them. If you want a typewritten appearance, you will need to purchase a letter-quality printer. Chapter 15 describes the types and models of printers that are available.

80-Column Screen Expanders and Monitors

The Commodore is designed to display 40 characters across the screen. Most paper is 8½" wide and can hold 80 characters across and all printers can print at least 80 characters on a line. As a result, the Commodore display will not look like your final document unless you print at 40 characters or less (certainly a waste of paper).

If this is a problem for you, then you must get an 80-column screen expander. You install this circuitry insider your C64 and the computer will then display the smaller characters that fit 80 per line.

However, there is one problem. You will have a hard time making out these smaller characters on a TV set, and possibly even with a color monitor like the 1701. Therefore, you might need a monochrome (one color) monitor, like those you've probably seen on large computers. See Chapter 15 for more on monitors and expanders.

Word Processing Programs

Let's take a look in detail at some representative programs.

Magic Desk

Commodore's *Magic Desk* is a computerized typewriter and filing system that is designed for someone with no prior experience with word processors. It is the ultimate in user-friendly systems.

Magic Desk comes only in cartridge form but its filing system requires a disk drive. Also, a joystick is required. Make sure your C64 is turned off, then insert the cartridge (label side up) into the cartridge slot at the right rear of your C64. Turn the power on and wait. You will see the screen in Color Plate 8.

As you can see, it looks pretty simple and fun. Now connect a joystick to game port number 2 (it won't work if you use game port number 1). Move the joystick handle and you will see the hand move around the screen.

First set the digital clock, located at the upper right of the screen (on top of the filing cabinet). Move the hand to the clock and press the action button on the joystick. A white square will appear around the clock. Enter the time using the keyboard and press the action key. The time you entered will appear in the clock window.

There is a HELP menu in case you need help. Just press the Commodore key. Then move the hand to the function you want help on. The wastebasket help screen is shown in Figure 8.3.



Figure 8.3. The wastebasket help screen.

Now go back to the main screen by pointing the hand to EXIT. Then select the typewriter, and press the action button. You can then start typing from the keyboard. You can only see forty columns at a time, but the page is set up for eighty columns. You move around the page using the joystick or cursor keys.



Figure 8.4. The typewriter screen.

Initially the margins are set at 10 and 70, but you can change them by pointing the finger at the margin picture and using the joystick to set the margins. The F1/F2 key is the margin release key.

While you are typing, these keys do the following:

RETURN	Move 1 line down and go to the beginning of the next line.
SPACE	Move 1 space to the right.
INST/DEL	Erase letter to the immediate left of the carriage guide.
SHIFT	Shift to uppercase.
COMMODORE	Displays HELP menu.

When you have typed a page that you want to file, leave it in the typewriter and then open a file drawer by going to the desk screen and pointing to one of the three file drawers. *Magic Desk* uses three separate file drawers, so your files will be stored into and retrieved from whichever drawer you choose. Make sure you have a formatted diskette in the drive. Then push the action key. You will see the screen in Figure 8.5.

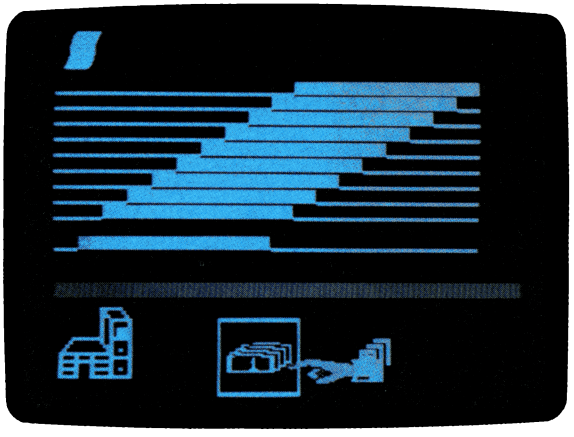


Figure 8.5. The file folder screen.

As you can see, there are ten separate file folders. If you are using a new diskette, there will be no *Magic Desk* files, so all the tabs will be blank. To save your page, select one of the file folders (using the joystick), and enter a name in the "tab." Then press the action button to deactivate the file folder screen, move the pointer to the picture of three pages, and press the action button again. The disk drive will whirl and clack, and pretty soon white "pages" will appear. Each folder can store up to ten pages. When empty, these pages are blank. As pages are saved, they are numbered from 1 to 10. Select a blank page (start with the bottom one, which is page one) by moving the joystick (the page you have selected will be separated from the rest and a flashing asterisk will appear in front of it). Press the action button and move the pointer to the picture of the diskette (Figure 8.6).

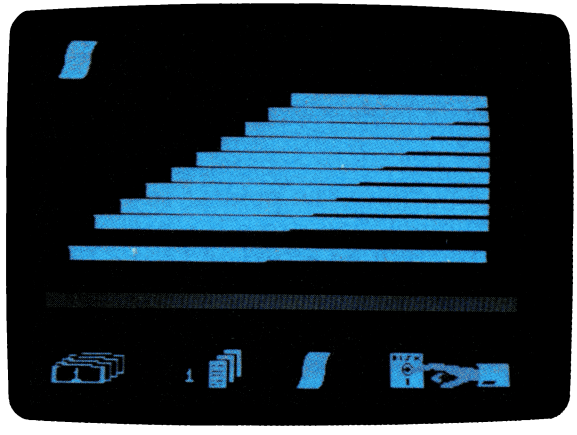
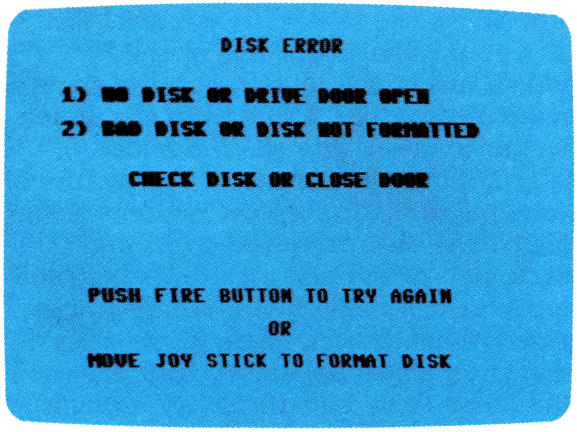


Figure 8.6. Saving a page onto disk.

When you press the action button, the disk drive will begin to save your page.

If the diskette is full, or not formatted, you will get this message:

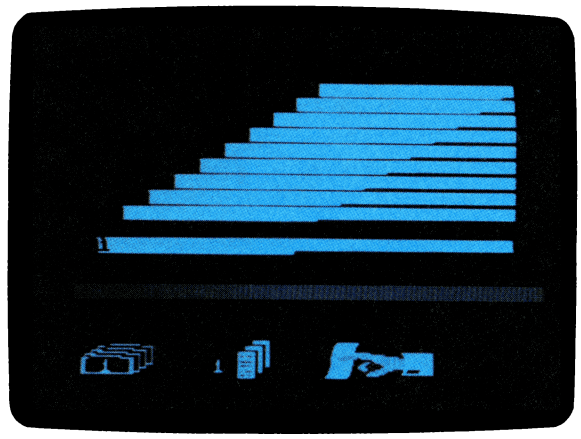


As it says, insert another disk (unformatted if you want) in the drive and press the action button. Type Y and wait for the diskette to be formatted. Make sure you don't want to save any information on that diskette, since everything will be erased.

Once your page is saved, you will return to the pages screen and your saved page is now numbered.

To exit the filing cabinet, press the action key, move the pointer to the file folder symbol, and press the action key again. You will be returned to the file folder screen. By pressing the action key again, moving the pointer to the desk symbol, and hitting the action key once more, you will return to the starting screen.

Once you have saved a page, you can alter it or print it out at any later time. Select the filing cabinet in which your page is stored. Then select the proper folder. Then the page. To see that you have the correct page and to load it into memory, move the pointer to the single page symbol:



Your page will appear, just as you typed it:

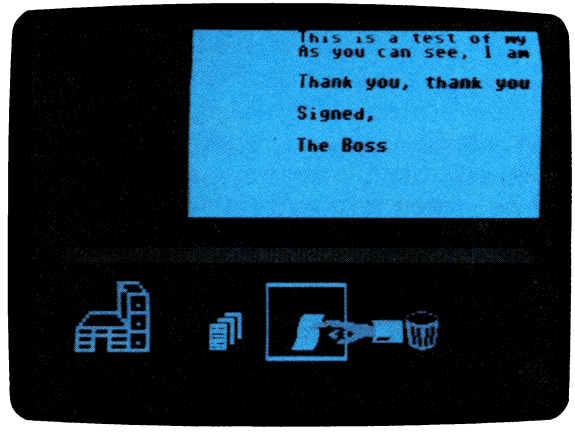


Figure 8.7. Examining a page.

Now, exit the filing cabinet and return to the typing mode. When you do, your page will be there. You can now edit it or print it. If you edit the page and wish to save the new version, simply repeat the steps for saving the page as before.

To print the page, move the pointer to the printer symbol (Figure 8.8).

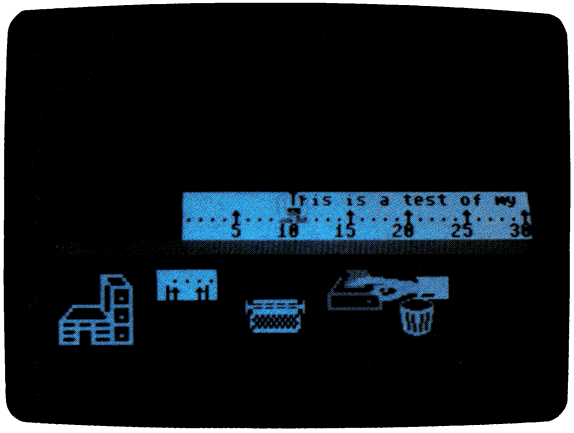


Figure 8.8. Printing a page.

Make sure your printer is on and has paper in it. Then press the action button. Presto! Your page will be printed.

If you want to throw a page into the wastebasket, point at the wastebasket and press the action button. A little page will appear suspended over the wastebasket. You get a second chance to keep it. If you really want to get rid of it, press the action button again. You will hear a whistle and then a crash. Your page will be gone.

There seems to be no way to delete a page or folder already stored onto disk. This is a nuisance if your diskette begins to fill up or become cluttered with files.

Well, that's about it. In terms of capacity, *Magic Desk* has room for three file drawers, each with ten file folders, and each folder can hold ten pages. Thus you can store about 300 pages on one diskette.

The other symbols on the desk are for future cartridges that Commodore plans to release soon. These will include a calculator, a financial journal, and other items.

In my opinion *Magic Desk* is good for computer beginners who have need of a simple and straightforward computer typewriter and filing system. If you plan to do a lot of text editing or word processing, *Magic Desk* is not what you want. *Easy Script* or some other equivalent word processor will serve your needs much better. But *Magic Desk* is fun to use, as it provides a good introduction to the concepts and elementary techniques of word processing in a format you might enjoy.

Easy Script

East Script, also from Commodore, is a full-function word processor that offers many sophisticated capabilities at a very affordable price. It will work with most printers that can be interfaced with the Commodore 64. While most professional-quality word processors are only available on disk, *Easy Script* is available on both disk and tape. This makes *Easy Script* equally accessible to users of modest systems employing Datassette recorders and professional users with more sophisticated systems. Since it's written in 100 percent machine-language, *Easy Script* is very fast and flexible.

Easy Script is just that—*easy.* The basic commands needed to create, edit, save, and print your first document can be learned quickly. The documentation is clear and complete. The first half of the manual presents the commands in a tutorial format and provides many exercises for hands-on experience. Periodic recaps are also included in these sections. The remainder of the manual is devoted to a reference section for quick referral. The comprehensive index makes it easy to locate information. This is especially important as there is no quick reference card or appendix containing a summary of the command sequences and no help function is provided.



Figure 8.9. The *Easy Script* initial screen.

Four modes are available: EDIT, COMMAND, DISK, and TAPE. All text operations are performed in the EDIT mode. The COMMAND mode is used to relay instructions to perform functions such as printing. The DISK or TAPE mode is used to perform routine disk or tape functions. Mode changes are accompanied by an audible bleep and the current mode is displayed on the status line.

Documents can be easily reviewed on the screen. Commands are available to move the cursor to the beginning, to the top, or to any given line of a document. Documents can also be viewed screen by screen. For more rapid review, panning up, down, left and right is also available. A formatted display of a document can be placed on the screen by outputting the file to video instead of the printer.

Most of the editing functions are accessed by pressing the F1 function key and the appropriate character key. When wrongly accessed, these functions can be exited by pressing the F1 key again or the RUN/STOP key. Some of the major editing functions available in *Easy Script* are *hunt, search and replace, block functions* and *decimal tabbing.*

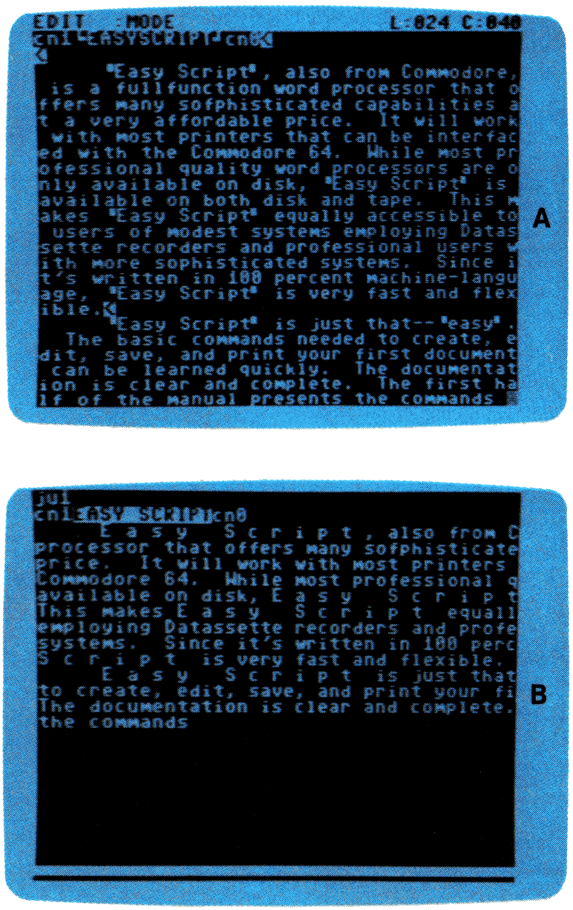


Figure 8.10. The *Easy Script* screen can display how a document (A) will look when printed (B).

Easy Script has many advanced file-handling capabilities. Files can be appended or inserted at any given point. Files can be linked to allow the user to perform search and replace, save, and output operations on several related files. Blank forms can be created and merged with a fill file or filled in manually. Likewise, it's possible to do mail merge.

Format commands can be embedded within the text to produce output in a wide variety of formats. *East Script* has many formatting features in addition to

the more commonly found margin controls, spacing, justification, and pagination. Headers and footers can be specified. Text can be centered, indented, enhanced, and underlined. Both horizontal and vertical tabs are available. Conditional forced pages may be indicated to insure that a related body of text is not divided by pagination. Soft hyphens may be used to indicate where hyphenation should occur if the word is divided over two lines when printed. If available on the printer, pitch (characters per inch), lines per inch, and back spacing may be selected.

Right justification can be specified. This is accomplished by the automatic insertion of extra blank spaces between words in order to move the last character of each text line to the right-hand margin. This sometimes results in rather large gaps between some of the words. Error messages are limited, with print format and disk errors represented by a single letter or number that must be looked up in the reference index of the manual. Superscripts and subscripts are not available, a definite handicap for the sceintific or technical writer.

Despite its shortcomings, *Easy Script* is easy to learn, inexpensive, and simple to use.

Word Pro

WordPro is a professional-quality word processor. In addition to providing most of the features found in *Easy Script,* the *WordPro 3 Plus/64* package includes a spelling checker. Although only available on disk, *WordPro* can be used with suitably interfaced high-quality Commodore ASCII, and Spinwriter printers, resulting in a system flexible enough for most users.

Though the *WordPro 3* manual is complete and clearly written, its format could be improved. The index is by no means comprehensive, making reference to specific areas in question a chore. The manual does not provide a separate training section and reference section. As a result, you will have to search through more verbiage than necessary to define procedures. At times, many commands are introduced before there is a chance to apply these commands in an exercise.

Commands to perform most functions are accessed by pressing the Control key and an alphabetic key. The creators of *WordPro* have chosen sensible letters for many of the functions, such as "a" for append and "h" for hunt. However, there are enough exceptions to this convention, such as Control 8 for bold face type and Control @ for search and replace, to make the summary of function commands a necessity. Although located in the middle of the User Manual, this summary is not easy to find. Functions are listed in alphabetical order by key instead of by function name. This makes finding a command sequence more difficult than if commands were ordered by function name. The manual also includes a similar summary of the formatting commands. Copies of these pages should be made for easier referral as no quick reference card is supplied and no help feature is available.

WordPro offers five modes: Extra text, Insert, Shift lock, Control, and Numeric. The Extra text mode allows the user to work on two files at a time. The Extra text area is also used to perform special functions, such as merging and appending files. The Insert mode is used to insert words, lines, or paragraphs of text into existing text. The Shift lock mode allows you to enter all capital letters while retaining the ability to type the numbers on the number keys. The Control mode is used to access the special nonprinting functions represented

WordPro 3 Plus/64 User's Guide EXAMPLE LETTER ON SYSTEMS DISKETTE

January 1, 1983

WordPro 3 Plus/64 Operator,
c/o Your Location
One PSI Drive
Needham, MA 02194

Dear WordPro 3 Plus/64 Operator:

As the saying goes, "a picture is worth a thousand words". The following "example letter" is intended to act as "picture". A careful study of this letter will enable you to graphically see how almost every major format command in WordPro is used in a real example.

Justification: The "ju" command tells the printer to justify the right margin so that the right margin is "flush" down the page (as seen in books or newspapers).

Headers/Footers: The "hd" and "ft" commands allow you to automatically number your pages or print out the same text at the top or bottom of each and every page. The Header and Footer commands should be on format lines of their own.

Centering

The centering command is usually placed on a line of its own. As will all format commands, it must be preceded by a check mark.

Line Spacing:

The imbedded command preceding this paragraph instructs the printer to automatically double space from this point on. If you prefer triple spacing, the number 3 would follow the "sp" command rather than a 2.

If you need to block indent a paragraph instruct the printer to change the left and right-hand margins. Use the same format as you did to originally set the margins (ie:, check mark at the beginning of the line and a colon to break up the commands). Your paragraph will automatically indent for you.

Bold Face Printing

Notice that it is very easy to have Bold Face Printing. Bold Face Printing is accomplished by:

<PRESS>ing <CONTROL> 8

Figure 8.11. A sample *WordPro* printout.
(Courtesy of Professional Software Inc.)

by many of the keys of the keyboard. (This is the most frequently accessed mode.) The Numeric mode is used to line up columns of numbers having equal decimal places. When a mode is accessed, the corresponding letter will be highlighted on the status line. Using some unknown logic, Shift + Control was designated as the key sequence to access the Insert mode. Pressing "£" enters and exits the Shift lock mode, a surprising choice as most mode and function selections require a combination of keys as a safeguard against accidental entry and exit.

WordPro includes much the same functions as are found in *Easy Script*. *WordPro* can perform all the basic text editing functions as well as search and replace, merge files, link files, and block functions. Embedded format commands can be used to center, tabulate, define headers and footers, create conditional forced paging, define optional hyphenation, select pitch and lines per inch. Though *WordPro* does not offer the ability to preview formatted text on the screen, it does offer an extra text area, the ability to print superscripts and subscripts, and to add columns of numbers, all of which are valuable assets. The justification in *WordPro* is also an added plus as it inserts fractions of spaces between the words as opposed to the whole spaces inserted in *Easy Script*. *WordPro* has good error-handling abilities and the error messages are easily interpreted.

SpellRight

SpellRight Plus/64 is a spelling checker included on the reverse of the *WordPro 3* Plus diskette. Spelling errors are corrected using a review phase and an edit phase. The review phase proofreads *WordPro 3* text files for possible misspellings. This is accomplished by searching for an exact match for each text file word in the *SpellRight Plus* dictionary. In the edit phase, any unlocated or "suspect" words are displayed in reverse video—in black letters against a white background. These words may be either corrected or identified as correctly spelled words not found in the *SpellRight Plus* dictionary.

During the review phase, you can use either the complete dictionary or a smaller, "fast track" dictionary containing 7,000 words plus the user dictionary (words added by you). This is useful when processing time is limited on rush jobs or when preparing documents that do not need to be highly polished.

Another time-saving feature is the ability to display the directory of the text files and automaticaly load the file desired for checking. While the text file is being reviewed, the screen will display the name of the file being processed and the number of the dictionary module being examined, and a stream of letters will cycle across the screen. This is a nice feature for those impatient souls among us who are sure the process is taking too long and is not functioning properly.

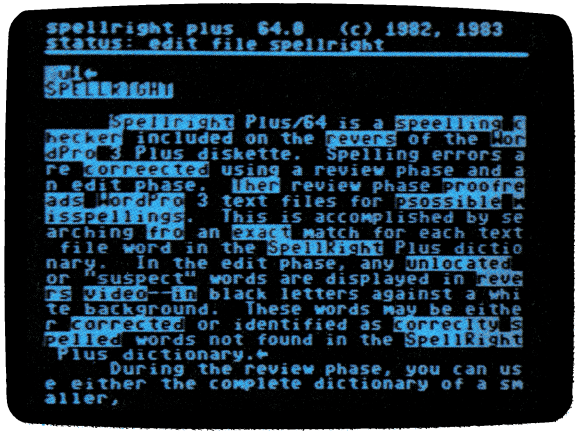


Figure 8.12. The *SpellRight* checker catching my errors.

In the edit phase, misspelled words are corrected by typing over the misspelled segment of the word and entering a RETURN. Correctly spelled suspect words can be skipped by simply entering a RETURN. In either case, the RETURN advances the cursor to the next highlighted word.

The words included in the *SpellRight Plus* dictionary were selected with the needs of average business and professional users in mind. The user can customize the dictionary to meet specific needs by adding from 1,400 to 1,700 additional words to the User Dictionary. Entering ↑ at a highlighted word will place the word in memory. Added words will be displayed and entered into the User Dictionary upon completion of the editing session. If words have been erroneously entered into the user dictionary during the current editing session, it is possible to exit the session without saving the words added. This will erase the memory containing the added words while preserving the edited text. As deletions to the user dictionary require up to three minutes to complete, this can be a useful alternative.

Movement through the text file during the editing process is limited to movement within suspect words, from one suspect word to the next suspect word, to the first suspect word on the screen page, and to the next screen page. To move back to a previous page required an update of the user dictionary, exit to the menu, and reentry into the edit mode. Errors located during the editing process that were not found by *SpellRight* cannot be corrected, as the cursor will not move to nonhighlighted areas.

SpellRight Plus includes the ability to check the dictionary for damage. The program will still function with errors in any of the modules following module E. If several errors are located or if errors are severe, a replacement copy may be obtained at a nominal cost.

Other Word Processors

Quite a few word processors are available for your Commodore 64, and more are on the way.

WORD PROCESSORS

PRODUCT	MANUFACTURER	AVAILABLE IN Cartridge	Cassette	Diskette
PageMate	AB Computers		✓	✓
Paper Clip	Batteries Included			✓
Letter Writer	Bizware, Inc.			✓
Bank Street Writer	Broderbund			✓
Easy Script	Commodore			✓
Magic Desk	Commodore	✓		✓
HesWriter	HesWare	✓		
Word Processor	International Trio Micro			✓
Terminal	Midwest Micro Associates		✓	✓
WordPro & SpellRight	Professional Software, Inc.			✓
Quick Brown Fox	Quick Brown Fox	✓		✓
C-64 Typewriter	RAK Electronics		✓	
C-64 Mail List	RAK Electronics		✓	
Script 64	Richvale Telecommunications			✓
Homeword	Sierra On-Line			✓
Word Writer	Timeworks, Inc.			✓
Word Processor & TOTL Speller	TOTL Software		✓	✓

KEEPING RECORDS WITH YOUR '64



Chapter Nine

Although I am not one of them, I have always admired people who keep careful records. These people generally are neat and clean, they pay their income tax before it is due, and they usually get money back.

People like me throw away any piece of paper that has information on it, we scuff up our shoes a lot, and not only are we late on our taxes, but we know most of the local IRS agents by their first names.

People like me need computer record-keeping systems to keep us from falling off the edge.

So what is record keeping? It means keeping the information you want, rather than throwing it away.

If you don't have any use for information, don't keep it.

Here are but a few of the things you can keep records on:

HOME USE	OFFICE USE
Addresses and phone numbers	Accounts payable
Books	Accounts receivable
Budget	Advertising
Entertainment	Business expenses
Income tax	Business history analysis
Magazine articles	Forecasting
Personal possessions	General ledger
Receipts	Inventory
Recipes	Mailing lists
Record collection	Payroll
School grades	
Shopping prices	
Sports information	

How Does the 64 Keep Records?

Your Commodore 64 keeps records the same way that all computers keep records: in files.

When you saved a BASIC program, your 64 created a file, and stored that file on the diskette.

So what is a file? In computer terms a file is a sequence of records, where each record is a string of characters. You can think of a record as something like a short piece of motion picture film, where each frame is a character.

There is a big difference between the words "file" and "record" as they are used in everyday conversation, and the computer words "file" and "record." In computer terms a file is simply a sequence of records, where each record is a sequence of characters. Nothing more, nothing less.

A computer record will contain certain pertinent information items, like name and address, or balance due. Each information item is placed in a separate field.

The words "file," "record," and "field" have been used around offices for many decades with slightly different meanings. The word "file" might mean several cabinets worth of material, as in, "They are in our accounts file. . ." or it might mean one folder's worth, as in, "Get me the file on Jones."

The word "record" is used to mean many different things, depending on the context. It might mean criminal record, phonograph record, academic record, off the record, or something else. They all mean more or less the same thing: "record" means to "put it in writing." The information is *written*, i.e., "recorded," for future use.

In manual record keeping, records are often kept in manila folders, or something similar, and each one always has an index tab sticking up from the rectangular profile of the folder. This tab contains the keyword associated with the folder.

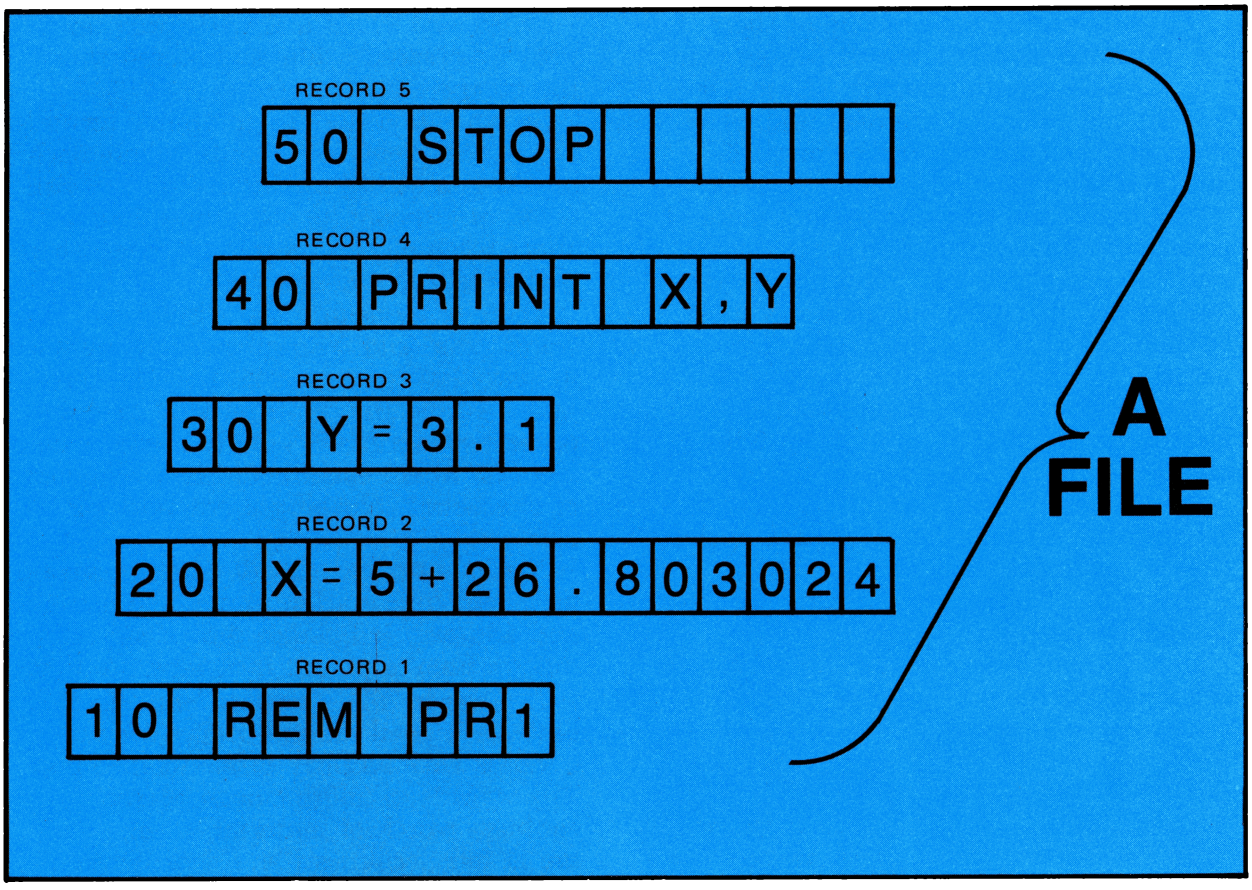


Figure 9.1. A file with 5 records.

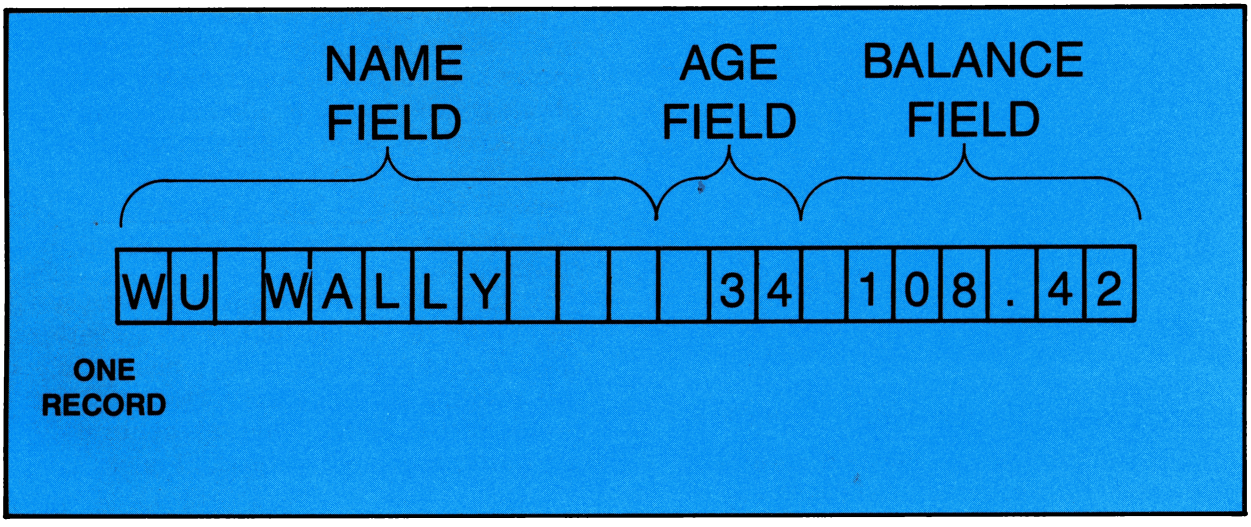
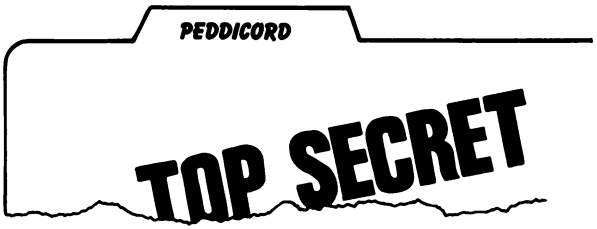


Figure 9.2. A record with 3 fields.



When keypunched cards came into use, material had to be taken from folders and condensed into a format that would fit into an eighty-column card. This meant, for one thing, setting up codes so as to save space. Each consecutive block of card columns was called a field, and each field had a specific meaning.

The word "field" means the same thing in computer terminology; namely, a consecutive sequence of characters, a so-called character string.

Cards were called unit records, and the machines that processed them were called unit-record devices. A given condensed version of the folder contents might take up several unit records. You couldn't put all the information in the folder onto cards, unless you were a very large corporation, because only very large (and very expensive) machines could process such a volume of information.

Card records don't have index tabs sticking up from the profile, for two reasons: (1) no one would be inside the machine trying to read them, and (2) it would make card readers very expensive, having to cut a little notch for the index tab in all the gates of the reader.

But the keyword on the manila folder ended up on the card, and it was one of the most important fields in the entire series of unit records, though it lost its relative importance as a search item key. Once machines began to process cards, any field in a record could just as easily serve as a key. Sorters, machines that sorted by key field, such as name, social security number, or telephone number, had to sort one column at a time anyway, and they did not care which of the eighty columns it was. There were twelve baskets, and you told it what characters to put where.

Nowadays records are kept magnetically, on tape, on diskette, or in semiconductor memory. Record length is no longer so important, and there is room for very short records and very long records.

You can now see the evolution of the word "record" into a very specific meaning: a block of consecutive fields that are moved around as a unit. Each such record is a part of a file.

A file is a collection of records of the same type, a record is a sequence of fields, and a field is a string of characters. A collection of files is referred to as a "database."

The Parts of a Record Keeping System

Every record keeping system must be able to handle the following functions.

Input

Inputting information into a database is a critical part of record keeping. Records are useless if they are inaccurate.

Most of the time you will enter information on your keyboard and you will view it on your monitor or TV screen. The appearance of the information on the screen is very important for efficient data entry. Each entry made by the user should be edited, to make sure it is the right kind of reponse. You should be given a chance to correct any errors discovered by the system.

For business applications, you might also have need of other forms of input,

such as diskettes and magnetic tapes or cassettes, or even files transmitted over the phone using modems on each end. This enables you to add to your database information that was accumulated and input elsewhere.

Soon you will have practical voice input and output systems. Until then your Commodore 64 keyboard will be your main form of data entry. The faster and more accurately you can type the better. Pay close attention to detail.

Storage

The basic idea of a database is to be able to store information for later referral. Information, that resides in your records system takes on several physical forms as it moves around your database. When it is actively being processed it usually resides in main memory, the high-speed random-access memory that every computer has. Storage requires that your data be kept in a more permanent medium than your Commodore's memory. Thus, information must be constantly moved back and forth between your storage device and memory. This makes the type of device you use most important.

A cassette is not a very practical storage medium for record keeping. It's too slow for searching, sorting, and moving around large numbers of records.

Diskettes are better. Access is fast. A single disk can hold roughly 2,000 eighty-character records. This is the most popular storage medium for record keeping.

Fixed disks are disk drives with permanent, high-capacity diskettes mounted inside. They can hold up to twenty million characters, over 100 times what your C1541 diskette holds. And they can access data more quickly than diskettes. So, hard disk is essential for a business that must have frequent access to a large database. But, fixed disks are quite expensive. They are really beyond the scope of the inexpensive Commodore.

Some folks store their files on a microcomputer network, like *The Source* or *Compuserve*. Ignoring phone costs, it is very economical to store your files on a large system, and you don't have to handle diskettes. Therefore the structure and costs of your phone pathway will determine if off-site storage is a good alternative.

Sorting

Sorting, as you know, means putting records in a given order. There are two reasons for sorting: (1) to get an orderly output for your data (for example, alphabetical order), and (2) to find something quickly. If your records are in a certain order you or your computer can find an item by scanning down the list.

① Alphabetical

Acme Inc.	35 Regular Way	Houston	TX	77046	5000.00
Anderson Bros.	5678 Friends Rd.	New York	NY	10012	13567.50
Baxter Corp.	14 Longview Dr.	Sacramento	CA	95832	234.37
Clark Co., Inc.	786 Tempest Ct.	Detroit	MI	48202	1234.76

② By Zip Code

Anderson Bros.	5678 Friends Rd.	New York	NY	10012	13567.50
Clark Co., Inc.	786 Tempest Ct.	Detroit	MI	48202	1234.76
Acme Inc.	35 Regular Way	Houston	TX	77046	5000.00
Baxter Corp.	14 Longview Dr.	Sacramento	CA	95832	234.37

③ By Balance

Anderson Bros.	5678 Friends Rd.	New York	NY	10012	13567.50
Acme Inc.	35 Regular Way	Houston	TX	77046	5000.00
Clark Co., Inc.	786 Tempest Ct.	Detroit	MI	48202	1234.76
Baxter Corp.	14 Longview Dr.	Sacramento	CA	95832	234.37

Figure 9.3. An address file sorted a number of ways.

In most records systems you will want to sort numerically and alphabetically and be able to print a copy of your sorted file. Systems differ very much in their sorting capabilities. For large files, sorting speed is a big factor, since sorting can be a very slow process.

One way to speed up sorting is to create an index file. You specify which field you want the file sorted on, and the system takes its usual time in sorting your records. But, while sorting it, the system will have made a list indicating the location of each record. This list is the *index file*. Later on, if you have a particular value for the indexed field, the record with that value can be retrieved quickly. Because the index values are sorted, the system can find the right index record within a few lookups. Once it finds the index record, getting the main record associated with it is a snap.

Selecting Records

As important as sorting is the ability to quickly locate a particular record or group of records for viewing, printing, or updating. For example, you may have a magazine article file, and you may want to see all May articles on the Commodore. In this case you would search by two fields: month and category.

Every record-keeping system has a user-oriented language for selecting records. That language might be very similar to the logical expressions used in BASIC for defining true or false conditions or it might be much simpler.

Things To Check

Every kind of record-keeping package will have advantages and limitations. You must know your applications before you buy. Some of the things you must consider are listed in Figure 9.4.

Figure 9.4. How to select record keeping software.

1. *Fields per record.* Does the package allow as many fields per record as you will need?

2. *Characters per record.* In addition to a limit on the number of fields per record, there will e a limit on the number of characters in a record. Most systems have a character limit of 256 characters per record.

3. *Characters per field.* How many characters can the largest field contain? Will it be enough for your application? For example, a city field might need to include San Juan Capistrano, 19 characters including spaces.

4. *Records per file.* Here you will be limited by your disk drive rather than the program. You can put 170,000 characters on one diskette. If you have a file with more than that number of characters on it, you will have to break it into two or more files. Once you do that, however, you lose any rapid access you had to the data.

5. *Record selection logic.* Will the record-keeping system allow you to select the records you want without having to look at all the records one by one? You must look ahead and picture your application. What parameters will you use to select records?

6. *Inserting and deleting records.* Make sure your system allows you to add and erase records.

7. *Naming data elements.* Can you name your own data elements and define how long each one will be? All database packages will allow you to do this. Some other systems also allow you to name data elements.

8. *Inserting and deleting data elements.* If the system allows you to create your own data elements, will it let you add some at a later time? Can you get rid of elements that are no longer useful?

9. *Screen layout.* Are the screens attractive and easy to use? Does the system work with forty-column displays?

10. *Writing reports.* Most record-keeping systems will have some sort of report writer. This allows you to make reports from the data with a minimum of effort. Again you must look ahead and see what kinds of reports you will want.

Home Use

For home use several different packages are available, including mailing lists, database systems, recipe files, and many others. Your files will not get very long, and you will not need instant results because there is not the same time pressure at home as at the office. (There are, of course, other and different pressures at home, screaming kids, for example, and it's often difficult or impossible to delete them. But that's life.) So a home database system can be less expensive, less powerful, and easier to use than a business system.

Say you wanted to keep a recipes file, accessing it every day, and adding to it every few days. Let's say you want to keep ten years' worth of recipes at your fingertips.

If the average recipe contains 400 characters and you collect 1,000 recipes, that file requires 400,000 bytes, or about three disks' worth. So capacity is a factor, even in home use.

You will definitely want a name and address file, possibly several. Each one might be on a separate diskette.

You will also want to print mailing labels. Many record keeping systems work in conjunction with a mailing list system.

A shopping list system can prove quite useful, especially if you enjoy keeping records. A fair amount of data entry is involved because prices change constantly. Maintining such a database is very good practice for larger systems. A shopping list system might have one file per store that you shop at, and another file for the products that you buy, one product per record. Each product record, in addition to the name of the product, gives a price at each of the stores. The task for your database system, given how many stores you are willing to shop at, is to tell you what to buy at each store in order to save the most money. You can save a lot of money.

Another useful home application is accounting. Here we are not talking about a canned application program. We are talking about you programming your own tailor-made system, using your database command language. It is not that difficult, and can be fun and instructive.

The idea is to have an accounts file, one record per mailing address. In each record you would have room for several dollar amounts representing anything you want, balance due, thirty-day balance due, and so forth. You can mix payables (people you owe) with receivables (people who owe you).

You would also want a date due field and a days overdue field. Interest rate on the unpaid balance should be there too. This way you can check the service charge for interest.

One of the main things your accounts system would do for you is to remind you of which bills you should pay on any given day, or during any given time period.

For home applications speed is not important. Therefore you can sacrifice speed for lower cost.

Office Use

Office use requires more logical complexity than does home use, response time becomes important, and capacity is often a limiting factor. Documentation also becomes more important, because of multiple users, another distinction between home and office.

Capacity and speed will be your big concerns. In the Commmodore 64 single-side, single-density diskette format you

can get 176,000 bytes per diskette. It is very inconvenient to search for a record among more than one diskette. Therefore you will need to plan your file structure carefully to make sure you can get to the information you need, or invest in a fixed drive.

Backup is another, stricter requirement in office use. If your business depends on your database, you cannot afford to have all your customer records disappear on a defective diskette. You will need a system to reliably, quickly, and regularly make copies of files.

Speed is also important. You want to be able to ask qustions of your database within minutes, and get your answers within a minute or so. Asking the questions is the hard part for you. For general office use you will want record selection logic with the same capabilities as BASIC logical expressions have; in other words, a complete set.

Response time is a complex issue, because it depends on how the data is structured within the database. In the simplest case, you tell it the select criteria and it goes through all its records, one at a time, selecting those for which your logical expression is true. These serial (one-by-one) searches are time-consuming.

One way to speed things up is to create index files, smaller versions of the original, with a different, sorted key field. More of these short records will fit on a diskette sector and so it will take fewer disk accesses to search your index file than the main file that it references. The fields that you are selecting on must be in the index file, naturally. When an index record is discovered that matches the select criteria, the machine knows exactly where the main record is, and it goes and fetches it without delay. So make sure your database has provision for index files, and that it sorts fast enough for your needs.

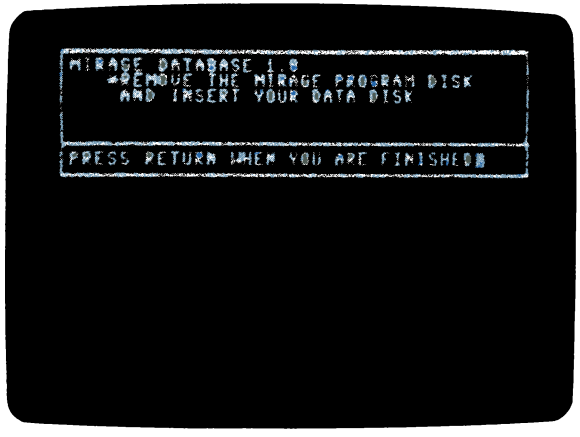
So make sure your database has provision for index files, and that it sorts fast enough for your needs.

A good report writer is a must for small business use. It should have provision for 132-column printer format, and it should have control breaks where you want your accounting subtotals.

Database Manager

We will demonstrate the use of an easy-to-use database program, *Database Manager,* by Mirage Concepts. It is a menu-driven, self-explanatory program that has most of the features you might want.

To start the program, place the diskette in the drive, enter LOAD"MDB",8,1 and press RETURN. When READY appears, type in RUN. In a few moments you will see this screen:



Remove the program diskette and replace it with a brand-new diskette, or a used diskette that you are willing to erase. Then press RETURN. You will see the main menu.



The eight commands shown accomplish these tasks:

SELECT FILE	Retrieves the file you want from the disk
APPEND FILE	Adds new data to the file you are working on
REVIEW/EDIT	Lets you examine and change your existing records
SORT RECORDS	Sorts your records in any order you want
PRINT RECORDS	Prints the records in a file
CREATE NEW FORM	Allows you to design the data entry form
FILE COMMANDS	Sends you to a separate menu, discussed below.
QUIT	Returns you to the C64 power-on state, with the blue opening screen

Figure 9.5. The *Database Manager* main menu.

First we will format the diskette. This is a file operation, so select option 7 and press RETURN. The FILE COMMANDS menu (Figure 9.6) will appear:

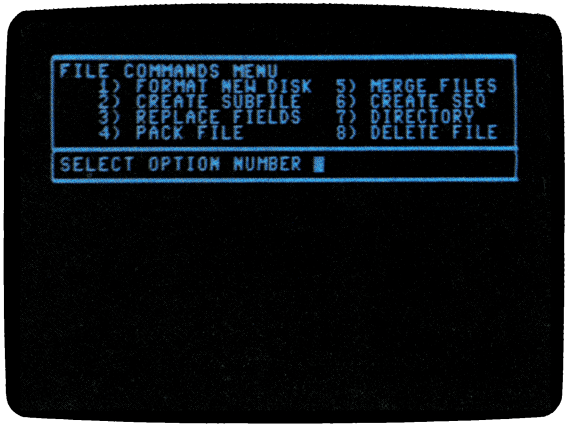


Figure 9.6. File commands menu.

Select option 1, FORMAT NEW DISK. You will get a warning that this operation will erase everything on the diskette. Enter Y and press RETURN. The disk drive will whirl and clack for a couple of minutes; then the red disk drive light will go off. Your new diskette has been formatted.

Press function key F7 to get back to the main menu.

Next you will create a form to enter the information into the file. Select option 6, CREATE NEW FORM, and press RETURN. You will see the screen shown in Figure 9.7.

The F1, F5, and F7 options refer to the function keys. You create a data field by pressing F1 many times, once for each character in the field. Each pressing creates one underlining.

The database program keeps track of all the data fields (consecutive groups of F1 underlined characters) on your form, and numbers them from top to bottom, left to right. It's quite simple.

You can put any kind of text you want on the screen, using the regular screen editing features.

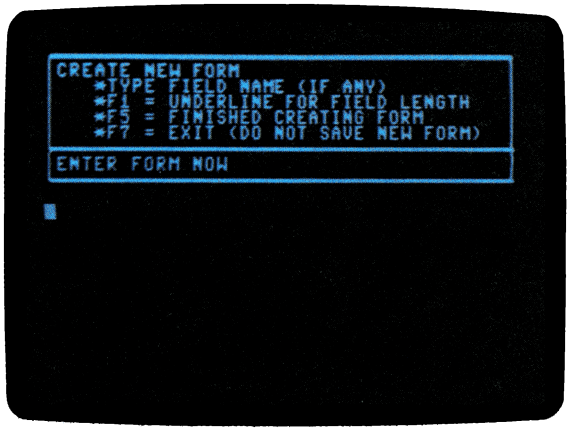
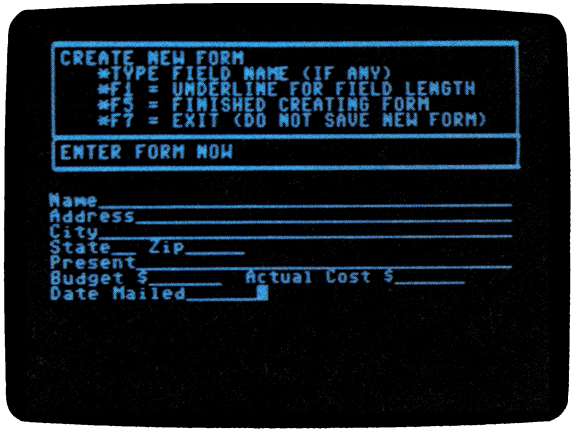


Figure 9.7. The create new form screen.

Our sample application is a Christmas list file. The form we designed looks like this:



When the form is complete, press F5. You will be asked to name your file. In this case we named it "xmaslist." After the last character of the name, press RETURN. The disk drive will start up. When it stops your form will have been saved.

Next you will want to enter some records. From the main menu select option 2, APPEND FILE. Figure 9.8 will appear:

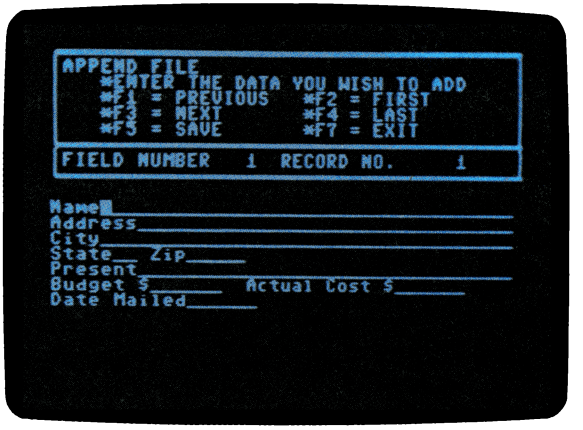


Figure 9.8. Append file screen.

The cursor will be waiting at the first character position of the first field. Enter the name and press RETURN. The cursor will move to the beginning of the next field.

While in APPEND mode you can move all around the form, fixing any errors as you notice them.

Press function key F5 to save the record you are editing. The next record will appear on the screen, and you can repeat the steps for that record.

When you have added all the records you want at this time, press F7 to return to the main menu.

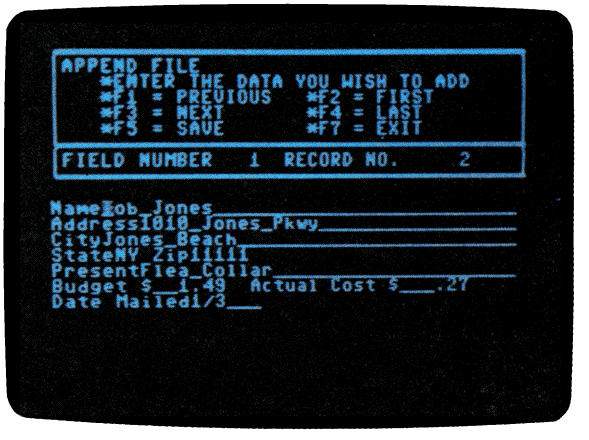


Figure 9.9. Adding a record.

You can either QUIT, option 8, or you can do some more things. Let's suppose you want to review the names and other information you have entered so far. This requires option 3, REVIEW/EDIT.

When the REVIEW/EDIT screen comes up, select option 1, review/edit all records. The form will appear, and the data from the first record will fill it out.

Press F3 (NEXT) until the record you want appears. Then Press F3 until the cursor is at the field you want to edit. You can either retype the entire field or else use the right and left cursor commands to fix it. When the record looks OK, press F5 to save it. The edited version will replace the original version.

If you want to delete a record, say in case that person didn't give you a Christmas present after you spent more than you could afford on them, find their record and press F2 (DELETE). Poof! No present for them next year.

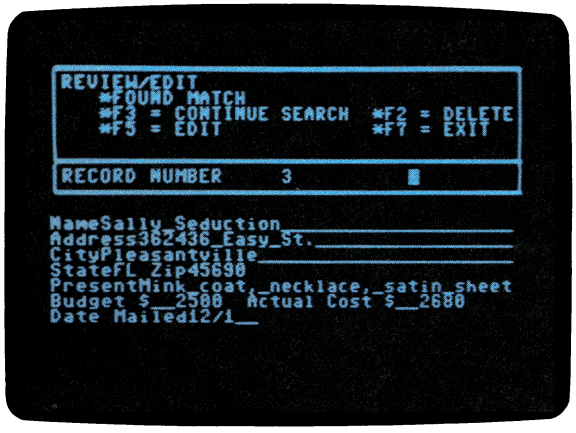


Figure 9.10. Editing a record.

You can select and edit individual records. Database Manager makes it as simple as possible. When you choose option 2 (select/edit individual records), a reverse bar will appear at the first field. Press F3 to move it to the next field (if you want). When you have it at the field you want to select on, press F5. Then enter the value you want to search for. When you press RETURN the first record whose selected field matches what you wrote will appear.

You can ask for a partial match using an asterisk in the character string you entered. If you place an asterisk after so many characters, it will only match the beginning characters. If you place an asterisk after a block of characters, it will search for that block anywhere in the field. This partial match feature is useful, because you might not remember exactly how to spell someone's name. If you can get a consecutive block of characters correct, you will get the name back.

When you have created your xmaslist file you may want to sort it in a particular order, on a particular field. Select option 4, SORT RECORDS. The xmaslist form will appear, and you select the field to sort on. Press F5 to start the construction of a sort index file. When the file is constructed, answer Y to save it, N to discard it.

You can review, edit, or print a file in sorted order, if you have saved the sorted index file.

There are two other features of *Database Manager*, and most systems in its class, which we should mention: calculated fields and conditionals.

A *calculated field* is one that is derived from other fields on your form. Such a calculated value is defined by an equation involving addition, subtraction, multiplication, and division. Here is an example:

```
f$(5) = f$(2) * .06 + f$(4)
```

This says multiply field #2 by .06, add that to field #4, and place that value in field #5.

Calculated fields are entered when you create the form. Their values appear as soon as you enter data in the fields that define them.

Conditional statements are used to select specific records for either viewing or printing. A record will be displayed only if it satisfied the conditional. These conditional statements look very much like the true or false statements that BASIC uses inside the IF. . .THEN statement (see Chapter 4). Most database systems use the same kind of logical expressions for these conditional expressions.

There is, of course, a lot more to *Database Manager* than we have touched upon, but this will give you some idea of what to expect. My only complaint about the program is that there are several natural mistakes you can make that force you to restart the system; at least, it happened several times to me. Most reliable computer stores will let you try out software before you buy it. Try *Database Manager,* and see if you like it.

The Consultant

The Consultant, formerly called *Delphi's Oracle,* is a professional database management system for the Commodore 64. Made by Batteries Included, it is compatible with *PaperClip,* a word processor by the same company.

We won't take you through a hands-on description of this product, but we will mention some of its features.

Form layout is defined by the more usual method of naming each field and indicating the number of characters that field has. You can have up to ninety-nine fields per record, and as many records as your storage device will handle.

The sort and record searches are particularly fast, a very important feature in professional work. The manufacturer claims that an entire disk full of records can be sorted in fifteen seconds. That's quite fast, assuming the records are of average length.

The Consultant provides good security, with four levels of access. It seems as well protected as any professsional database.

The program also has built-in error checking, recovery, and backup. Another useful feature is the ability to modify record layout after data has been entered. The program will restructure your files without your having to reenter the date.

The program also allows a wide variety of printed report formats, with page headings and footings, automatic page numbering, and so forth.

If you are looking for a professional-quality database management system, you should definitely try out *The Consultant.* It is slightly more difficult to use than *Database Manager,* and slightly more expensive, but it is much more powerful, and very well designed. The people at Batteries Included have their stuff together.

Record-keeping Software

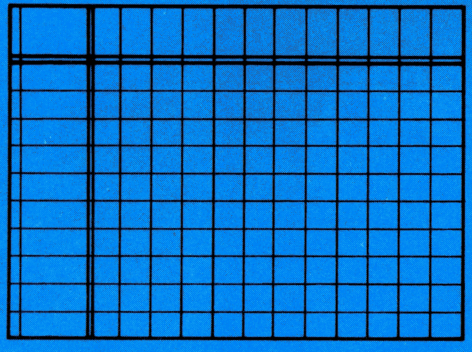
Listed on the following page are currently available record-keeping programs that are not financial packages (see Chapter 10) or word processors (see Chapter 8). We include inventory programs because they are functionally very similar to file management packages, and many can be used for that purpose.

The distinction between a file manager and a database management system is not worth making when you are talking about the C64. There is not enough random-access memory to make a difference.

RECORD KEEPERS

PRODUCT	MANUFACTURER	AVAILABLE IN: Cartridge	Cassette	Diskette
Flex File 2	AB Computers			✓
Dataman 64	American Peripherals			✓
The Manager	Commodore			✓
Home Inventory	Continental Software			✓
File Manager	International Tri Micro			✓
Mini Jini	Jini Micro Systems	✓		
Mailing List	Micro Spec			✓
Disk Data Manager	Micro Spec			✓
Inventory Package	Micro Spec			✓
Inventory	Powerbyte Software		✓	✓
Business Calendar	Powerbyte Software		✓	✓
Medical Records	Powerbyte Software		✓	✓
Recipe File	Powerbyte Software		✓	✓
C-64 File	RAK Electronics		✓	
Inventory	Southern Solutions			✓
Data Manager 2	Timeworks			✓
Mailing List	TOTL Software		✓	✓
TOTL Info Master	TOTL Software			✓
Research Assistant	TOTL Software		✓	✓

FINANCIAL PROGRAMS



Chapter Ten

Accounting Programs

Your Commodore 64 can help you manage money by providing several kinds of acounting services like checkbook keeping and budgeting. There is quite a bit of available software, and it costs very little compared with the service it provides. Put your 64 to work for you, and have more time to relax and have fun.

Accounting simply means writing down figures and calculating with them. Some of the functions you may wish to perform include these:

- Accounts payable
- Accounts receivable
- Budget projections
- Checking accounts
- General ledger
- Income tax calculations
- Mortgage calculations
- Payroll
- Professional accounting

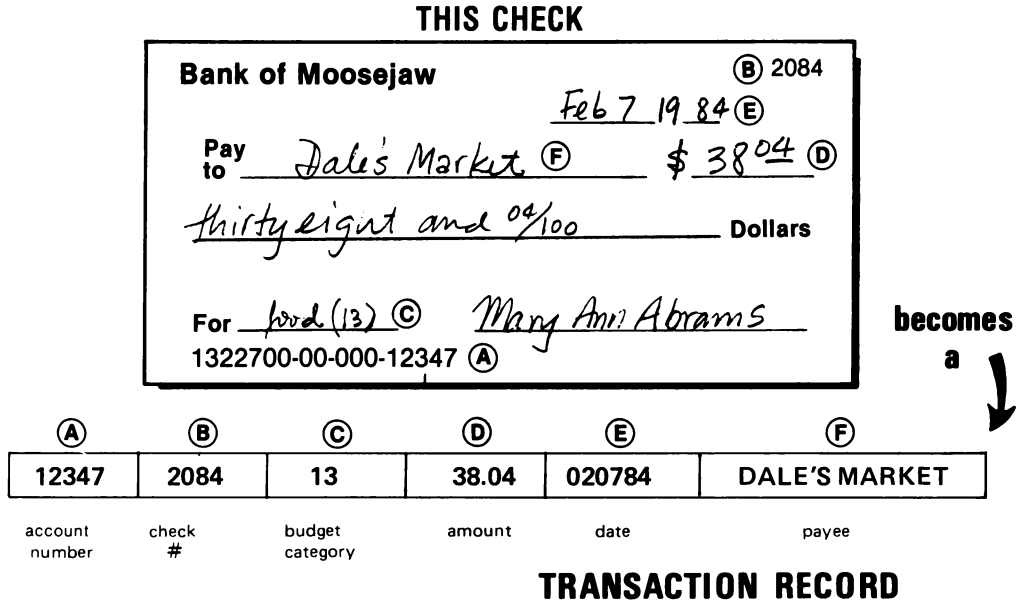
Many of these same functions can be performed with a database system, but in that case you have to define all the data elements and tell the system what you want done. Accounting programs take care of everything for you.

The simplest type of accounting system is a computerized checking account. In such a system each check or deposit generates a single transaction record that goes in a transactions file. A typical record might look like Figure 10.1.

The typical checking account program will post your withdrawals and deposits and prepare several types of reports. You can list expenditures by budget category, for example, or produce a bank statement to compare with the statement sent by the bank. These programs are of great help in preparing your income tax deductions.

Many checking account programs will print checks for you. For this application

Figure 10.1. A checking transaction record



you use a standard check form that you can get to fit the Commodore 1525 and other printers that have sprocket feed. The more sophisticated checking account programs include interest and aging. Interest calculations are becoming more and more important to incorporate into accounts payable and accounts receivable, even for home use.

Your checking account program can be expanded into, or interfaced with, a budget program. The budget records would look something like checking transactions, but the dollar amount would indicate a limiting total for that budget category. There would be monthly and yearly budget targeting.

One useful task would be to have the system compare deposits and withdrawals for each budget category against the stored projected budget.

Mortgage programs apply the interest formulas to various user-supplied parameters for a loan and print the answers to some questions you might have: How much will my monthly payments be? How long will it take to pay off the loan? How much will I make loaning my money? How much interest will I pay this year?

If you know some BASIC and the formulas, you can write these loan programs yourself. Also there are many books of programs for the 64 (see Appendix B) and these always contain loan calculation programs.

Accounting programs are just sophisticated checking account programs. They are designed to comply with the legal aspects of bookkeeping. This increases their complexity and produces a separation into three manageable subdivisions: general ledger, accounts receivable, and accounts payable.

What was a budget category in a checking account program becomes an account in an accounting program. General ledger keeps track of a balance for each separate account, and the records sent from accounts receivable and accounts payable are "posted" when their dollar amounts are added or subtracted from the account balance in general ledger.

Some Selection Criteria

You will want an accounting program that fits your needs and your personality. If you are the type that dislikes record keeping and reading manuals, get a program that is easy to use, rather than fast and powerful.

If you plan to expand into accounting, some desirable features in a checking account program are:

- Check printing
- Edit prompts
- Helpful prompts
- Menu drive
- Multiple search options
- Unlimited accounts

The multiple search item allows you some of the potential of a database system (see Chapter 9). Check printing is another feature of many programs, but these are designed primarily for commercial use. Helpful prompts are part of being easy to use. One keystroke response, where you don't have to press RETURN to respond to a prompt, is good to have.

In selecting an integrated accounting package, make sure the number of checking accounts and the number of budget categories is sufficient for your needs. Good features include credit card transactions, flags for tax deductibles, multiple expense accounts per check, and good reports, including balance sheets with income/expenses itemized.

The Home Accountant

The Home Accountant, by Continental Software, is one of the currently popular accounting packages for the Commodore 64. It is very flexible and easy to use, and it will satisfy any home accounting needs you might have.

You will need to format a blank data diskette, as outlined in Chapter 5.

To start the system, place the program diskette in the drive, enter LOAD"0:HA",8 and press RETURN. Then enter RUN and press RETURN. Pretty soon the main menu will come up:

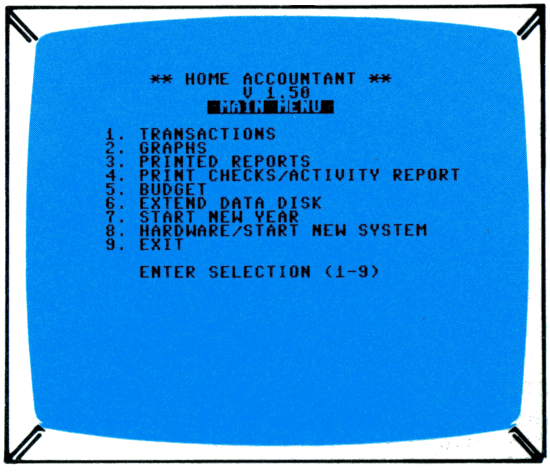
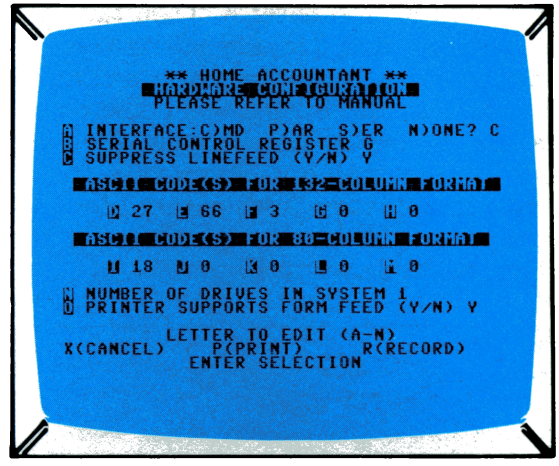


Figure 10.2. The main menu.

Select option 8 to configure the program to match your system. You will be asked if you really want to start a new system and if you have a formatted diskette. Answer yes to these questions.

The manual that comes with the program will tell you how to configure your printer to the program. The settings we used for our Epson MX-80 are shown following:



This configuration page can be printed. This will test your printer and give you a reference copy of the set-up parameters.

When everything looks OK press R to record your hardware configuration. The disk drive light will come on for a bit, and then the main menu will appear.

The next thing you must do is set up the budget information. This option will appear in reverse video; the program is suggesting that you go there next. Enter 5, then the letter R, to run that option. Soon the budget menu will appear, with option 6 in reverse video. Our next logical choice is to start a new system.

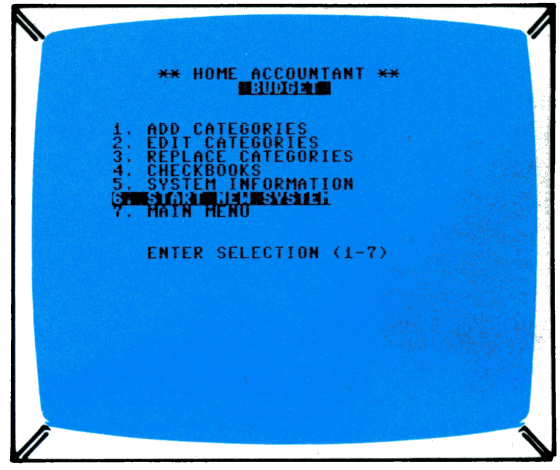


Figure 10.3. The Budget menu.

Go with it, and enter 6. Then take out the program diskette and put in the formatted data diskette. Press any key. The red disk drive light will come on and stay on for five or ten minutes. Turn on your TV and watch a commercial. Finally the system information screen will appear. Fill it out with the information shown in Figure 10.4.

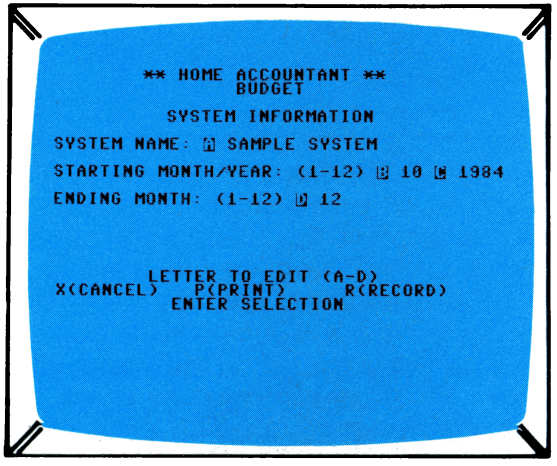


Figure 10.4. The system information screen.

When the screen looks OK press R to record the system information.

Shortly the budget menu will reappear. This time CHECKBOOKS will be in reverse video. Fill out the information relating to checkbook #1.

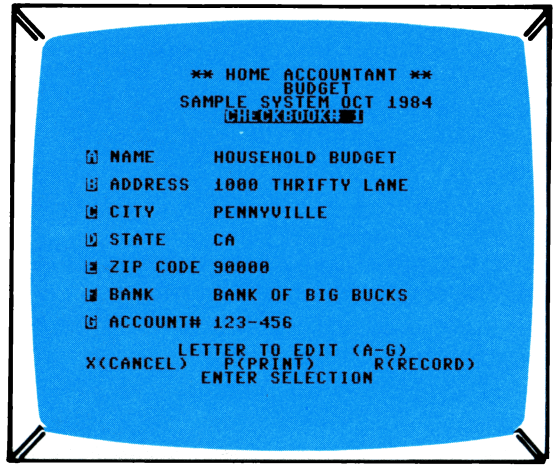
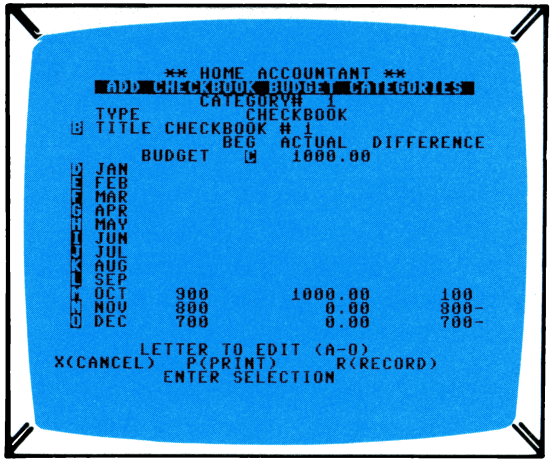


Figure 10.5. Sample checkbook.

The Home Accountant allows five checkbooks, each with a separate cash account. After you define and record the checkbook information, the budget screen for that checkbook will appear.

Enter 1000 as your beginning actual in field C. Press RETURN. Enter 900 as your ending balance estimate in field M. Press RETURN. Enter 800 as your ending balance in field N and 700 as your ending balance in field 0. Press RETURN after each entry.

The difference between the budget and actual amounts will be shown for each month. The sample screen looks like this:

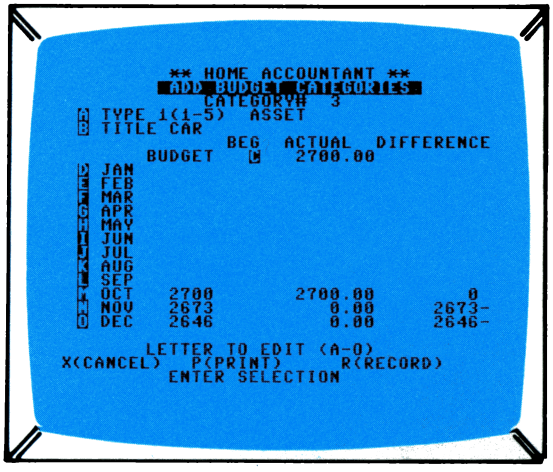


After this budget is recorded you must fill out a budget for the cash account that is linked to this checkbook. It appears on the same type of screen.

If you have other checkbooks to set up, you may do so now or later.

The next thing to do is to set up your budget categories, option 1 from the main menu. There are five types of budget categories: (1) assets, (2) credit cards, (3) liabilities, (4) income, and (5) expenses.

A sample of an asset budget category is shown below:



There are several helpful features that allow you to develop a budget, including notation that adds or subtracts a fixed amount, or a fixed percentage, to each successive month's budget amount.

Now you are ready to enter transactions. From the main menu select option 1, TRANSACTIONS. You will then be asked to choose one of the checkbooks you have defined so far. Select checkbook 1, press RETURN, and wait for the screen shown in Figure 10.6.

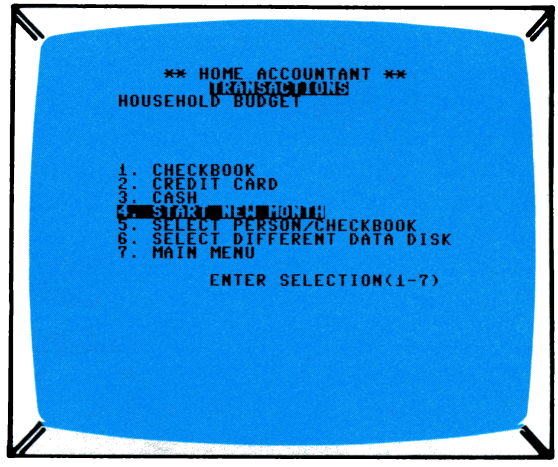


Figure 10.6. Transactions menu.

When you are starting a new month you select option 4, and you enter all the checks and deposits that will be automatically posted at the beginning of the month. Then these are posted.

Using options 1, 2, and 3 you can enter checkbook, credit card, or cash transactions. The check entry screen looks like Figure 10.7.

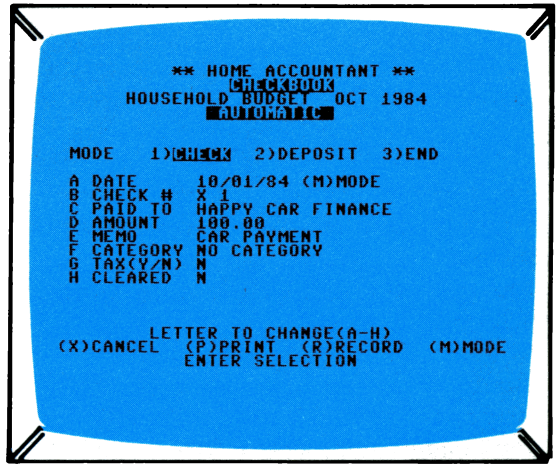


Figure 10.7. A sample check entry screen.

You can change to another checkbook at any time, or exit the program.

When your bank statement arrives you can reconcile it against the transactions you have posted. Each transaction is displayed in turn, and you indicate if the bank has paid or deposited it. After all transactions have been "marked" you will get the difference between the bank's balance and yours. The screen looks like:

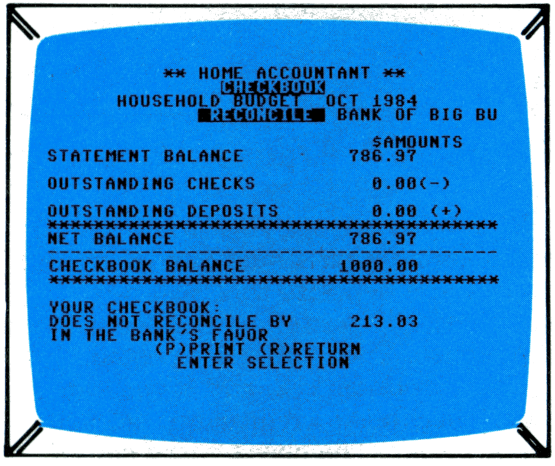


Figure 10.8. Reconciling a bank statement.

The Home Accountant has many other features, including a variety of printed reports and graphs. Reports include budget versus actual, personal balance sheet, income and expense summary. These reports can cover any number of months.

You can even print checks, by ordering special check forms.

In general this package is quite sophisticated. You have to be careful though. If you make a mistake it's not always easy to correct it. Also, the program is slow, especially when you are reconciling your checkbook (though, in part, this is the fault of the 1541 disk drive). For home use, though, it is a good system.

Available Software

Lots of accounting software is currently available for the Commodore 64, and lots more is on the way. Figure 10.9 lists some of the packages that we know about:

Figure 10.9. Accounting Programs

PRODUCT	MANUFACTURER	Available in: Cartridge	Cassette	Diskette
Budgeteer	Abacus Software			✓
Accounting Ledger	Bizware, Inc.			✓
Easy Finance I	Commodore			✓
Easy Finance II	Commodore			✓
Easy Finance III	Commodore			✓
Easy Finance IV	Commodore			✓
East Finance V	Commodore			✓
Accounts Payable	Commodore			✓
Accounts Receivable	Commodore			✓
General Ledger	Commodore			✓
Payroll	Commodore			✓
The Home Accountant	Continental Software			✓
Loan Analyzer	Creative Software		✓	✓
ACC/SYS GA 1600	Data Equipment Supply Corp.			✓
Business Pac	H&E Computronics			✓
VersaLedger	H&E Computronics			✓
TimeMoney Manager	HESWare	✓		✓
Savings Account Miser	Powerbyte Software		✓	
Checkbook Booky	Powerbyte Software		✓	✓
The Budgeter	Powerbyte Software		✓	✓
Accounts Receivable	Powerbyte Software		✓	✓
Accounts Payable	Powerbyte Software		✓	✓
The Accountant	Powerbyte Software		✓	✓
Cash Flow Model	Powerbyte Software		✓	✓
Net Worth Statement	Powerbyte Software		✓	✓
Investment Analyst	Powerbyte Software		✓	✓
Color Accountant	Programmers Institute		✓	
Super Budget	R A K Electronics		✓	✓
Super Checkbook	R A K Electronics		✓	
Management Accounting	Info Designs			✓
Payroll	Micro Spec			✓
General Ledger	Micro Spec			✓
Checkbook Manager	Micro Spec			✓
Supertax I, II, III	Rockware Data Corporation		✓	✓
Financial Record Sys	SimplexSoft Ltd.			✓
Accounts Receivable	Southern Solutions			✓
Accounts Payable	Southern Solutions			✓
General Ledger	Southern Solutions			✓
Payroll	Southern Solutions			✓

Spreadsheets

Another financial tool is the spreadsheet. You will find them extremely useful for many different purposes, at home, at school, and at work.

What is a Spreadsheet?

A spreadsheet simulates a large sheet of paper laid out in rows and columns, something like the sheets that accountants use. The intersection of a row and column is called a cell. Each cell can hold a number or a label, and be attached to a formula. The formula you attach to a certain cell might call for the sum of all the values in the cells above it. When you change one or more values in your spreadsheet, and call for a recalculation, presto, all the formulas that you have specified are recomputed. The values that are computed are displayed in their cells just like values that you input. The spreadsheet does all the work that you need done.

Even though you can only see so many rows and columns at a time, your spreadsheet can be quite large, with hundreds of rows and columns. Stock portfolios, for example, can become quite large.

Each cell automatically has a name, its row label followed by its column label. Some systems number the columns and letter the rows, others do just the opposite. But you never have to make up or remember names.

Spreadsheets can do any type of financial calculations that are expressible in matrix (rows and columns) form. Some spreadsheets are three-dimensional, with many separate spreadsheet pages bound into a file with some thickness.

Some spreadsheets cost less than dinner for two at a fast-food place. You should get one as soon as you finish this chapter.

What Can Spreadsheets Do?

Spreadsheets can be used for many purposes, including but not limited to the following:

- Accounts payable
- Accounts receivable
- Attendance Records
- Balance sheets
- Calendar
- Cash flow analysis
- Forecasting
- General ledger
- Grades
- Home improvement projects
- Household budget
- Inventory records
- Job cost estimates
- Market share analysis
- Patient records
- Profit projections
- Profit statements
- Project budgeting and control
- Reminder board
- Reporting data
- Salary records
- Sales projections and records
- Sports data
- Tax estimation

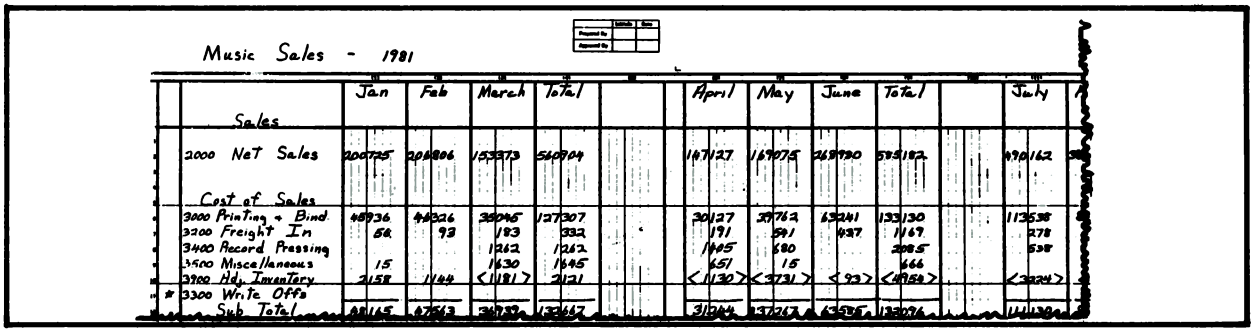


Figure 10.10. A spreadsheet the old-fashioned-way.

Essentially, a spreadsheet allows you to perform any type of financial calculation that you once did with paper and pencil. In addition, you can supply headings and text material that make your spreadsheet easy to understand. You can print all or portions of your spreadsheet just as it appears on your screen, or you can reformat it for special reports.

You will find that a spreadsheet will allow you to estimate the cost of a project before you begin, and will allow you to monitor your costs as the project is underway.

PractiCalc

We will describe how to set up a spreadsheet using *PractiCalc*, a popular spreadsheet by PractiCorp. It is low cost and easy to use and makes a good spreadsheet to learn from.

You place the diskette in the disk drive, enter LOAD"PRACTICALC",8,1 and press RETURN. After a while you will be prompted for the number of rows. Press RETURN. Then press RETURN again. You will see a blank spreadsheet come up, as in Figure 10.11.

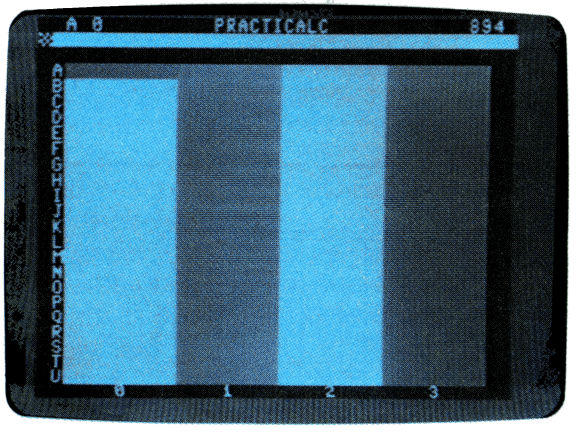


Figure 10.11. The blank *PractiCalc* spreadsheet.

The shaded rectangle over cell A0 is the cursor. It marks the active cell. As you can see, the columns are numbered 0, l, 2, . . . from left to right, while the rows are labeled a, b, c, . . . from top to bottom. The active cell, indicated by a reversed field, is the cell into which you are going to put data, labels, or formulas. You can select the active cell using the cursor controls. They work the same as with the screen editor.

If you cursor all the way to the left, to column 0, and continue pressing the left CRSR keys, nothing more will happen. The same is true if you cursor up to row A; further pressing produces no result.

If, however, you cursor to the right-most column, and then continue pressing the right cursor key, new columns will be added, and new numbers provided. Similarly, if you cursor down to the last row, and continue pressing the down cursor, new rows will be added and lettered.

So your spreadsheet can be as large as you need, even though you can see only so much of it on the screen.

Anything you have placed into a cell already has a variable name, the row letter followed by the column number. This allows you to refer to any value on your screen. As you will see, this gives you enormous computing power.

We have a few bills to pay. Since we are the ones paying for services rendered, this is an accounts payable problem and each account is called a vendor. So we will label our spreadsheet with the words "VENDOR" in A0, "old bal" in A1, "TO PAY" in A2, and "NEW BAL" in A3. The developing spreadsheet will look like the one in Figure 10.12.

Next we input the first vendor, placing its name in column 0, the amount we

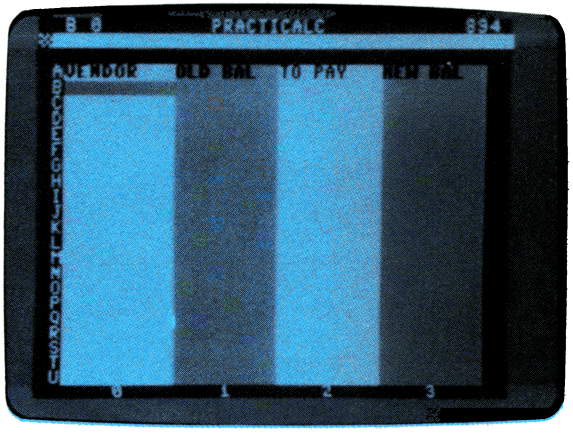
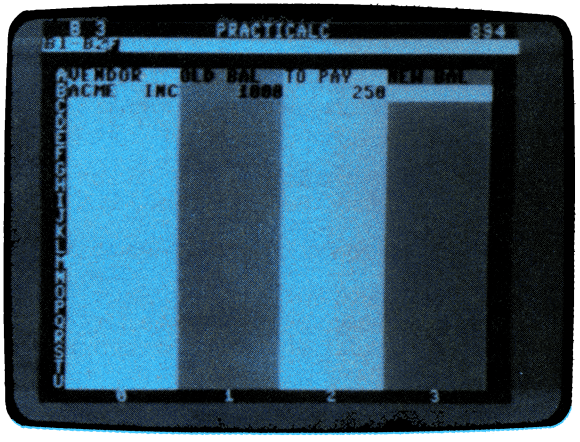


Figure 10.12. The spreadsheet with labels in row A.

owe in column 1, the amount we plan to pay in column 2. When we get to active cell B3, we are not going to input a value. We are going to attach the formula

```
B1 - B2
```

to cell B3. To do this we press function key F1 and enter the formula in the set-up line. This is what your screen will look like just before you press RETURN:



When you press RETURN the formula does not appear in the active cell as numbers and labels do, but jumps down one line to the display line. Whenever the active cell has an attached formula, it will appear on the display line. The value obtained from the last recalculation will appear within the cell itself.

Unlike some more elaborate spreadsheets, *PractiCalc* does not recompute all the formulas every time you enter a new value. You have to tell it to recompute everything. Press SHIFT and 1 at the same time. A value will appear in cell B3.

While working with formulas we might as well input the other formulas we need. In this case we simply want to total up each of the three columns. Therefore we move the cursor to R1 and press F1. We then enter this formula:

```
+SUM(B1:F1)
```

and press RETURN. Into R2 and R3 we enter, respectively,

```
+SUM(B2:F2)
```

and

```
+SUM(B3:F3)
```

This means add up all the numbers in cells B2, C2, D2...to P2

Now we can enter the rest of our vendors, and the new balance formula for each vendor. When we are done we press SHIFT 1 and all the calculations will be performed and displayed. Our finished spreadsheet looks like the one in Figure 10.13.

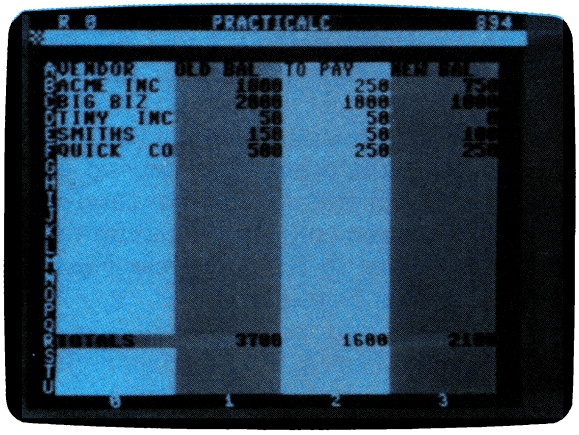


Figure 10.13. The finished spreadsheet.

You can print a spreadsheet at any time. First turn your printer on and put paper in it. Then move the active cell cursor to the upper left cell of the area to be printed. Press F3 (options), then P (for print). Type in the row and column of the lower right cell in the area to be printed. Press RETURN and your printer will start printing.

In the above example we used very simple formulas. *PractiCalc* allows you the same formulas, for the most part, that BASIC does. The formulas are interpreted the same way, and quite a few functions are available (see Figure 10.14).

So you see, you can do any kind of calculations you want with *PractiCalc.*

Figure 10.14. *PractiCalc* Functions

SUM	Finds the total of a range of numbers
AVG	Finds the average of a range of numbers
MAX	Finds the maximum value in a range of numbers
MIN	Finds the minimum value in a range of numbers
COU	Counts the number of numeric entries in a range
LOG	Finds the log (base e) of a number
EXP	Raises e to the power of a number
ABS	Finds the absolute value of a number
INT	Gives you the largest whole number not greater than the number you furnish it.
SGN	Gives you 1 if the number is positive, 0 if the number is zero, and -1 if the number is negative.
SQR	The square root of a number
RND	Generates a random number between zero and 1
SIN	The SINe of a number (in radians)
COS	The COSine of a number
TAN	The TANgent of a number
ATAN	The Arc TANgent of a number

We will briefly describe the other options available in *PractiCalc.* This will give you a reference point in evaluating other spreadsheets.

Whenever you press F3 you will be given a choice of the following options:

Figure 10.15. The *PractiCalc* Commands

B	Clears the contents of a cell
C	Clears the entire screen
D	Deletes an entire row or column
F	Formats the contents of a cell: I=integer, $=dollar amount, F=floating decimal, G=global format
G	Formats all cells the same (I, $, F, H [high resolution graphics], number of characters in a column)
I	Inserts a blank row or column between two existing ones.
J	Right-justifies label in a cell
L	Loads a previously saved spreadsheet
M	Moves cell contents, or rows, or columns, to other places
P	Prints a selected area of your spreadsheet
S	Saves a spreadsheet
T	Makes certain cells titles to columns or rows
X	Sorts by column, alphabetically or numerically
@	Searches through column to find a complete or partial match to what you furnish

Finally, *PractiCalc* has some high-resolution graphics capability, in that it can draw histograms or bar charts from the data contained in your spreadsheet.

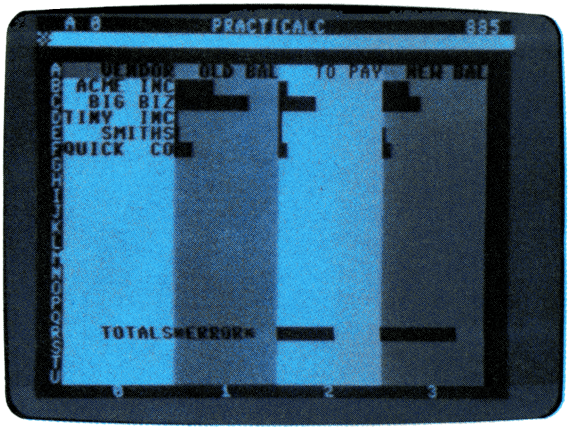


Figure 10.16. A *PractiCalc* bar graph. (The "error" is because the number is too large to fit into the column.)

PractiCalc is a good spreadsheet to start with, or to compare other spreadsheets with. It does a lot and it costs very little.

Available Spreadsheets

Here are some of the other spreadsheets I know about at this time. The list is only a sample, and no judgments of quality are expressed. Check them out. Look at other packages not listed here.

SPREADSHEETS

PRODUCT	MANUFACTURER	Available in: Cartridge	Cassette	Diskette
CalcResult	Computer Marketing Services	✓		✓
EasyCalc 64	Commodore	✓		
MultiPlan	HESWare			✓
PractiCalc 64	Micro Software International		✓	✓

COMMUNICATIONS



Chapter Eleven

Eventually you will want to communicate with other systems. That's called telecommunications, the transmitting of information over long distances. With it, you can exchange information with friends and colleagues, connect to large data bases, and tap into electronic bulletin boards.

In general, telecommunications refers to any type of electrical signal sent over any kind of channel, but for you and your Commodore 64 it usually means using the available phone lines.

Why Do I Need To Buy A Modem?

The phone line you will be using can only send a certain range of frequencies, those corresponding to the human voice range and its important harmonics. In terms of cycles per second, or Hertz, the typical telephone line goes from a few hundred to a few thousand Hertz.

Because your phone line has such a limited range of frequencies that it can handle, you need a device that generates tones within those frequencies instead of the electrical pulses your computer uses. Such a device is called a *modem,* and you must have one to use the phone line.

The modem attaches between your Commodore 64 and your telephone, or telephone jack. It uses a very high tone as a carrier and two lower tones to carry the true/false, yes/no information. Only one true/false tone is sent at a time.

For more on Modems, GOTO pp. 168-169.



Connecting the Modem to the Commodore

The user port on the Commodore 64 can be used for all sorts of things. This is where you plug in a modem, among other devices. Three types of data channels are available. All three use the standard ASCII code to exchange information, character by character. Since ASCII is a standard code, it is used to allow communication between any two computers, sort of like Esperanto.

One of these ASCII channels is a parallel channel. It sends all eight bits (a byte) of an ASCII character at the same time. Therefore eight separate wires are required. This method is good for speed, but only short cables are possible. It is not used for the Commodore 64.

The other two communications channels are called serial channels. They send the eight bits one after the other in time, and that is why they are called serial.

The two serial systems are almost the same, but they have a different *hand-shaking* (and dancing) *protocol.* One is called an RS232 channel and the other is called a IEEE 488 channel.

In general the IEEE 488 channel is used to communicate with disk drives and printers, and the RS232 with modems and other general purpose devices. Both channels have top speeds of about 9600 bits per second.

In addition to the communications protocol, that is, how to greet the other system and exchange information with it, the RS232 system specifies what kind of connector is to be used, and what voltages are to be sent along the wires. The RS232 standard calls for a 25-pin connector and −12 volt and +12 volt signal voltages.

The high voltages are so that you can

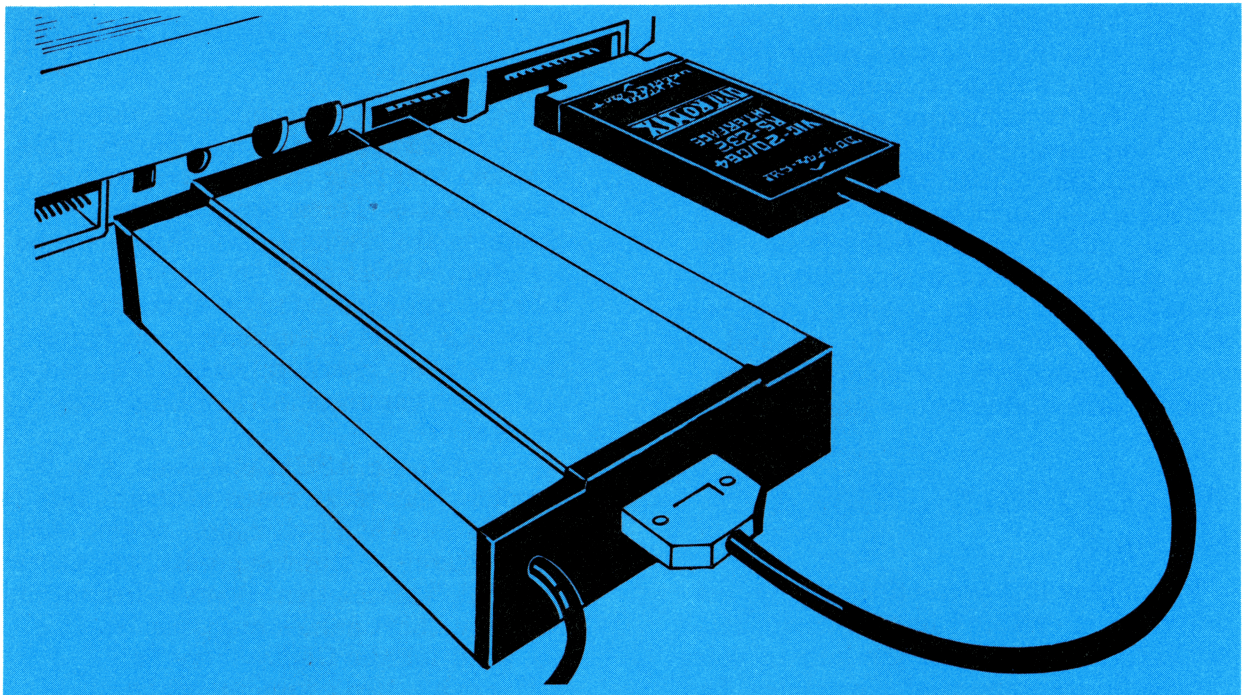


Figure 11.1. Connecting a modem using an RS 232 cartridge.

send the signal down several thousand feet of cable, if needed.

The Commodore 64 does not have an official RS232 port. Logically everything is the same, but the voltages and physical connectors are different. You can get a cartridge that plugs into the user port and converts it into a bonafide RS232 port complete with 25-pin connector.

But for most cases you will only want to hook up a modem to your user port. There is no good reason to buy all that expensive stuff associated with the official RS232 standard.

Since your typical modem for the Commodore 64 plugs directly into the user port, you will need to buy nothing but a standard telephone receiver cable, available in any electronics store.

If you already have a modem that uses a standard 25-pin connector and the standard −12, +12 volt signals, you will need an RS232 cartridge and several feet of 25-pin conductor cable. The cable will have a male 25-pin connector on each end, since panel connectors are usually female.

Many devices besides modems use the standard RS232 connector and communications protocol, so you can't go wrong in getting an RS232 cartridge.

Omnitronix makes a good RS232 cartridge, the Model C232. They also make IEEE interfaces for your C64.

For a listing of RS232 cartridges, GOTO page 170.



Using A Modem

We will describe the basic procedure for using a modem such as the Commodore 1650 AUTOMODEM. It is one of the more sophisticated modems on the market. Since it is designed to plug into the user port of your C64, you save some cabling costs by getting this type of unit. A standard RS232 modem requires an additional RS232 cartridge, but you can use it with any other computer.

First, plug the modem into the user port with your Commodore 64 turned off. Then turn on the computer and load the software that comes with the modem. If you don't have a C64 specific modem, you will have to write your own software or else purchase a commercial program to do the job.

The AUTOMODEM has a setting for O (originate) or A (answer). Set it to O for starters.

You will need a modular phone jack to use most modems. If you don't have one, the phone company will install one for you or you can purchase the necessary equipment yourself. Then buy a 2-to-1 connector at any electronics store. This is an inexpensive piece of wiring that lets you connect two phones into one jack. Plug it into the wall jack, and then plug in your telephone and modem. Now you can use both the phone and the modem without any hassle.

The AUTOMODEM is designed to automatically dial or receive calls without using the phone. Just follow the software instructions. If your modem does not have autodial capabilities, then you will need to dial the call yourself. Pick up the receiver and dial the number of a computer set to receive a call, and listen on the receiver for a high-pitched tone. That tone is the carrier sent out by the answering system: it is produced by the modem on the other side. Your modem also sends out such a carrier when it answers a call.

Once you hear the carrier, put the receiver aside. If your modem has been set up correctly, and the software instructions followed, your modem should hear the carrier, and a connection will be made. (If your modem has a CARRIER-DETECT light, it will go on.) You can hang up the phone receiver once a connection has been established.

At this point, your Commodore is communicating with another computer. Depending upon the software you are using, you will be able to chat with an operator on the other end, interact with a computer program stored in the other computer, or transmit entire files between computers and save them on disk.

Try one of the bulletin boards listed on page 143.

Communication doesn't always work smoothly the first few times you try it. Be patient. The problems are usually caused by a failure to match the protocols of the two communicating computers. Variations in *baud rate, parity, duplex, word length,* and *stop bits* are usually the culprits. I won't go into a technical explanation of each of these parameters, but make sure your software will allow you to set the parameters to those most commonly used by bulletin boards and information networks:

300 or 1200 baud (depends on your modem)
no parity
full duplex (though half is usually ok)
8-bit word length
1 stop bit

Baud rate is worth discussing. It refers to the number of bits per second that are transmitted. Most inexpensive modems allow only a baud rate of 300 (that's about 6 words per second), but higher speeds are available. Though larger computers often transmit at 9600 baud, a 1200 baud modem is probably as fast as you would need. Be aware that these modems are more expensive. Also make sure the software you use can accommodate a 1200 baud rate.

Who Should I Call?

Once you get into telecommunications, a whole world of computing and information will open up to you. Since I don't recommend your tapping into the Pentagon ala *War Games,* here are some safe places to get started.

CompuServe

If you purchased a Commodore modem, you will probably get a free subscription to *CompuServe,* one of several popular information networks. You can access any of their data banks (and of particular interest is the Commodore Information Network) at a rate of around $5 per hour of connect time. That's quite a lot of information for five bucks!

There are many kinds of information on *CompuServe,* home services, business and financial, personal computing, services for professionals, user information, and an index. The service is menu-driven and fun to use.

One of the subsystems supported by *CompuServe* is the Commodore Information Network. It contains information and references that are likely to be of interest to Commodore owners. It supports all four levels of Commodore machines, PET, VIC-20, C64, and the CBM business machines.

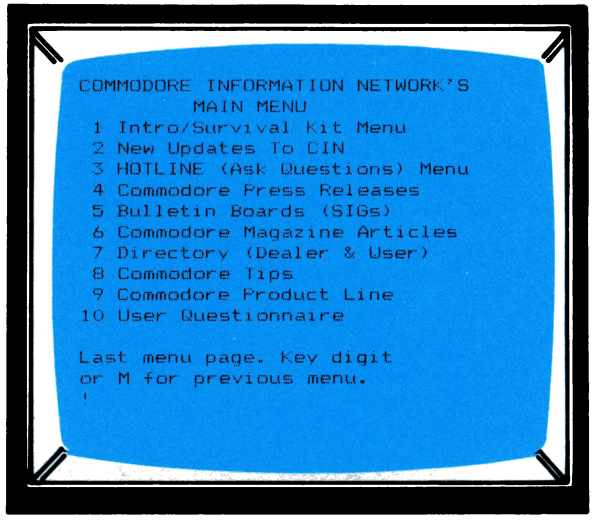


Figure 11.2. The Commodore Information Network main menu.

Bulletin Boards

A bulletin board is just that, a place to stick messages for other people to read. Many Commodore user groups have some kind of bulletin board operating, and the software necessary to use it.

There are other, more general, bulletin boards that are free to use, fun, and helpful. Figure 11.3. provides a listing of some particularly popular ones.

Other Services

There is a growing list of vendors, both commercial and public, that you can tap. From local libraries to computer retailers. From medical databanks to programming sources. An

Figure 11.3. Some bulletin boards of interest

Photographer's Bulletin Board, Haledon NJ
201-790-6795
Besides a message exchange center for photographers, you can obtain lists of other general interest boards in the New Jersey area.

McGraw-Hill Book Store, New York, NY
212-512-2488
Operates just like a regular bulletin board.

Photonet, New York, NY
212-750-1386
Special board for photojournalists.

Fantasy Plaza, Burbank, CA
213-840-8066
Online department store with a bargain basement, computer floor, bakery, and classified advertising. Directions for getting around are clear and easy to follow. If you have a MasterCard or Visa, you can purchase items from the cashier on the first floor.

Dial-Your-Match, Beverly Hills, CA
213-842-3322
A sexually oriented board. You must fill out a questionnaire (which anyone can read) and obtain a password before you can use this system. More men are shopping for the right woman than vice versa.

Novation, Inc., Tarzana, CA
213-881-6880
Information about their own CAT modems (the password is CAT), plus listings of other bulletin boards.

Handicapped Educational Exchange
301-593-7033
Special interest for hearing-impaired individuals.

RBBS, Bethesda, MD
301-460-0538
Sponsored by PC Concepts, Limited. Besides federal information, PC Concepts also offers a medical forum board.

Electronic Magazine
303-598-4500

UFO Info Exchange, Golden, CO
303-278-4244
The title is deceptive, as there are boards online for science fiction aficionados, game players, ham operators, NASA buffs, literary writers, and more.

Writer's Notebook, West Palm, FL
305-686-4862
Good board for writers, editors, publishers, and photographers.

The 1st Bulletin Board, Chicago, IL
312-545-8086
If you're new to computer communications, this board holds your hand and guides you through step-by-step instructions on using a bulletin board. Tends to be busy. Good luck getting online!

TBBS, Fremont, CA
415-651-4147
Has a long list of current bulletin boards.

PET User Group, Toronto, CANADA
416-223-2625
User group bulletin board that also covers C64 and VIC-20.

ABBS, Long Island, NY
516-698-4008
An incredible bulletin board system with what appears to be more than 40 separate boards covering a wide range of interests.

Call-A-Lawyer, Phoenix, AZ
602-275-6644
Open 5:30 P.M. to 7:30 A.M. weekdays, 24 hours weekends.

Law Special Interest Group, Minneapolis, MN
612-872-2352
Excellent information exchange for those interested in law and computers.

PMS, Santee, CA
619-561-7277
Among many other features, you can obtain a current list of coast-to-coast bulletin boards.

CVBBS, Chula Vista, CA
619-691-8367
Has nine different boards. Special boards for TRS-80 and Commodore users, along with game and general interest boards.

PMS, Los Angeles, CA
818-331-3574
Great bulletin board. Worth a call.

Medical Forum, Memphis, TN
901-276-8196

TBBS, Tulsa, OK
918-438-3363
Looks like a good board, but you must become a registered member before you can gain full access.

excellent source of additional information on available networks is the Alfred Handy Guide, *Understanding Computer Information Networks,* by Jan Owen.

Available Software

Most modems have software specially designed to work with them and are included or sold alongside the modem. Other communication software packages include:

COMMUNICATIONS SOFTWARE

PRODUCT	MANUFACTURER	Available in: Cartridge	Cassette	Diskette
Morse Code Terminal	RAK Electronics			✓
Super Term	Midwest Micro		✓	✓
The SMART 64 Terminal	Microtechnic Solutions			✓



Chapter Twelve

This chapter is a short guide to manufacturers who support applications other than those already discussed. Select the area you are interested in and make a note of the manufacturers in that area. Then go to Appendix A and look up more information about the manufacturers. Keep your eyes open for those manufacturers when you look at computer magazines.

A full complement of software for the Commodore 64 is only now starting to develop. Next year at this time there will be many more products available. We would appreciate hearing about any that you know of, for inclusion in next year's edition.



ADVANCED MATHEMATICS
JMH Software of Minnesota, Inc.
Microcomputer Workshops
Microphys Programs



AMATEUR RADIO
Kantronics
Microlog Corporation



ASTRONOMY
Celestial Software



BIOLOGY
Conduit



BUSINESS
Bizware
Cardinal Software
Data Equipment Supply Corp.
H & E Computronics
Info Designs
Inventory Manager
Luna Software
Management Accounting System
Micro Spec
Powerbyte Software
Rainbow Computer Corporation
Southern Solutions
TMQ Software
TOTL Software
Valorum



CHEMISTRY
Microcomputer Workshops
Microphys Programs



COMPUTER SCIENCE
Commodore
HesWare
Microgrames, Inc.
Program Design, Inc.



ELEMENTARY MATHEMATICS
Comm Data Computer House, Inc.
JMH Software of Minnesota, Inc.
Microgrames, Inc.



ENERGY
MPA Enterprises
Powerbyte Software
Right On Programs



FARMING AND AGRICULTURE
Microgrames



FOREIGN LANGUAGE
Island Software



HEALTH
Commodore
JMH Software of Minnesota
Microgrames, Inc,



LANGUAGE ARTS
Brainbank, Inc.
CommData Computer House, Inc.
JMH Software of Minnesota, Inc.
Microcomputer Workshops
Microgrames, Inc.
Microphys Programs
Right On Programs



LIBRARY SCIENCE
JMH Software of Minnesota, Inc.
Right On Programs



MAILING LISTS
Commodore
Microphys Programs
Powerbyte
TOTL Software



PHYSICS
Conduit
Microphys Programs



SCHOOL ADMINISTRATION
Software Creations



SOCIAL STUDIES
Comm Data Computer House, Inc.
JMH Software of Minnesota, Inc.
Micrograms, Inc.
RAK Electronics



SPORTS
JMH Software of Minnesota, Inc.
Powerbyte Software
RAK Electronics
3G Company



STATISTICS
Microphys Programs
MPA Enterprises
Powerbyte Software



TAX PREPARATION
Continental

The Blue Book for the Commodore 64 is a good reference work if you are shopping for software. The 1983/84 edition did not quite catch up with the market, however.



Chapter Thirteen

Almost all of today's computers, including your Commodore 64, are *stored program computers.* This means that they store in memory the list of instructions they are to follow in executing a given task. That way they do not have to wait for the next instruction. Your C64 will perform about 100,000 of these machine-language instructions every second!

Such a list of instructions is called a *machine-language* program. They are codes (a series of 0s and 1s) that the computer understands (that's why it's called a "machine language") but makes little sense to anyone but the people who built it. A machine-language program is very tedious to write and debug, so *higher level languages* (codes more similar to those people understand, like English or mathematics) have been developed to simplify the programming task. Each command in a higher level language generates many machine-language instructions.

All programs, no matter how high a level they are written in, eventually end up as machine-language programs. They are converted into machine language by another program called an *interpreter* or a *compiler.* An *interpreter* takes one instruction at a time, translates it, and executes it. A *compiler* takes an entire program and translates it into its equivalent in machine language. Then the entire machine-language program is executed. An *assembler* is a special type of compiler, one that produces machine language from assembly language.

If you wish to write your own programs for the C64, then you will need to learn one of these languages.

Machine Language

Machine language is written in zeros and ones, and you must be an experienced programmer to work with it. You would normally code in machine language for a very short, temporary program.

Figure 13.1. The levels of language.

```
English     "Add A to B"

BASIC       B = B + A

Assembly    LDA A (Load accumulator with memory)
            ADC B (Add memory to accumulator with carry)
            STA B (Store accumulator in memory)

Machine     0011001
            1101001
            0101000
            1101011
            1001111
            1011001
              etc.
```

Each machine-language instruction has two portions, an *operation code*, a string of zeros and ones that tell what instruction to execute, and an *address* portion, that tells where to find the data to operate on. The addresses are also strings of zeros and ones. You have to keep track of where everything is.

Assembler

Assembler, or assembly language, is almost the same as machine language, except that you can use letter combinations for the operations, and letter combinations to represent memory locations. This simplifies the programming task considerably but still requires advanced programming skill.

Each assembler command translates into one machine-language command. The assembler program replaces each of your symbolic memory locations with an actual location.

Included among assembler instructions for the Commodore 64 are instructions to perform addition, subtraction, shifting, and logical operations such as "and" and "or." There are also instructions to send data to and from memory, and instructions to test various conditions.

Available software: Assembler 64, by Commodore.
Manufacturers with helpful products: B & B Systems, Eastern House Software, French Silk (see Appendix A for a list of their products).

BASIC

Your Commodore 64 contains a BASIC interpreter, a machine-language program that resides in one of the 8K ROMs. The BASIC commands are an example of a higher level language. Each command in BASIC generates many machine-language instructions, which execute it. The machine instructions for each command are stored in the ROM, and when it comes time to execute a particular BASIC statement, the block of machine code that does the work is executed. Then the next BASIC statement in your program is interpreted, and its associated machine code is executed.

For more on BASIC, GOTO Chapter 4.



The program that translates your BASIC commands into machine code is called an interpreter because it interprets one BASIC command at a time. A BASIC compiler is something similar, in that it accepts a BASIC program, but it produces, with considerable effort, an entire block of newly created machine code that does the entire job. A compiled program will run many times faster than an interpreted program. If speed is of great importance (as with arcade games, for example) you will want to use a compiler for your programs.

Available software: Interpreter comes with C64 ROM. BASIC Compiler: BASM, by Computer Alliance.

FORTRAN

This is the original scientific programming language. The name is short for Formula Translator, and indeed this indicates the emphasis of the language. BASIC started as a simplified version of FORTRAN. If you have a lot of elaborate mathematical calculations to perform you might want to use FORTRAN.

While we are on the subject of FORTRAN, I was down in the heart of

the city the other night when this strange dude came up to me and said, "Hey man, you know anybody who speaks FORTRAN?" I wanted to avoid trouble so I told him "A(I,J,K) = X**(5*I+J/3.14)-EXP(SQRT(X))." That seemed to satisfy him and he walked down the street toward the corner.

Available software: Sorry, but I have not been able to find any FORTRAN compilers for the C64. If you come across one, please let me know.

COBOL

This is the original business programming language, which is self-documenting. Most commerical accounting packages currently use COBOL, but this could change in the years ahead. Generally you have to pay close attention to detail, and have good programming habits, to succeed in COBOL. It's a very powerful language, and very professional. You can make a good salary programming in COBOL.

Available software: None that I can find.

Pilot

Pilot is a computer-assisted instruction language designed for educators. It is a good beginning language for teachers and students, and it has the same power as most other high-level languages. It has sound and graphics commands, too.

Available software: Pilot 64, by Commodore. Vanilla Pilot, by Tamarack Software.

LOGO

LOGO is a great language, especially for kids. It teaches them many advanced concepts, and they hardly notice it. Sort of like a good dentist.

In LOGO you describe what you want done in a series of steps, and then give that procedure a name. Any time you want a procedure run, you just call its name. You can have lots of procedures, and the language comes with many of the ones you will need.

Available software: LOGO, by Commodore (Terrapin/Krell version).

FORTH

This relatively new language is about as powerful as FORTRAN or BASIC. It generates compact and efficient machine-language code, and is easy to debug. FORTH runs very fast.

FORTH is gaining in popularity all the time. You might want to try it on your C64.

Available software: 64 FORTH, by Commodore and C64 FORTH, by Performance Micro Products, Tiny FORTH, by Abacus.

Pascal

Pascal is a recent but well-respected language. It is designed for all types of computers. Programs in Pascal have a well-organized, understandable structure. It is an excellent language for computer science.

Available software: Zoom Pascal, by Abacus.

COMAL

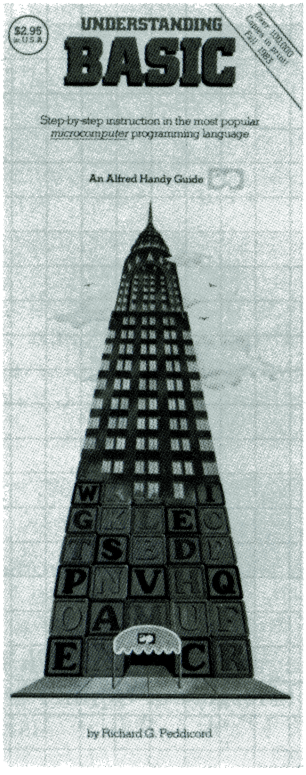
A new language developed in Denmark by Borge Christensen. Similar to Pascal and BASIC. Many feel it is easier to use than either.

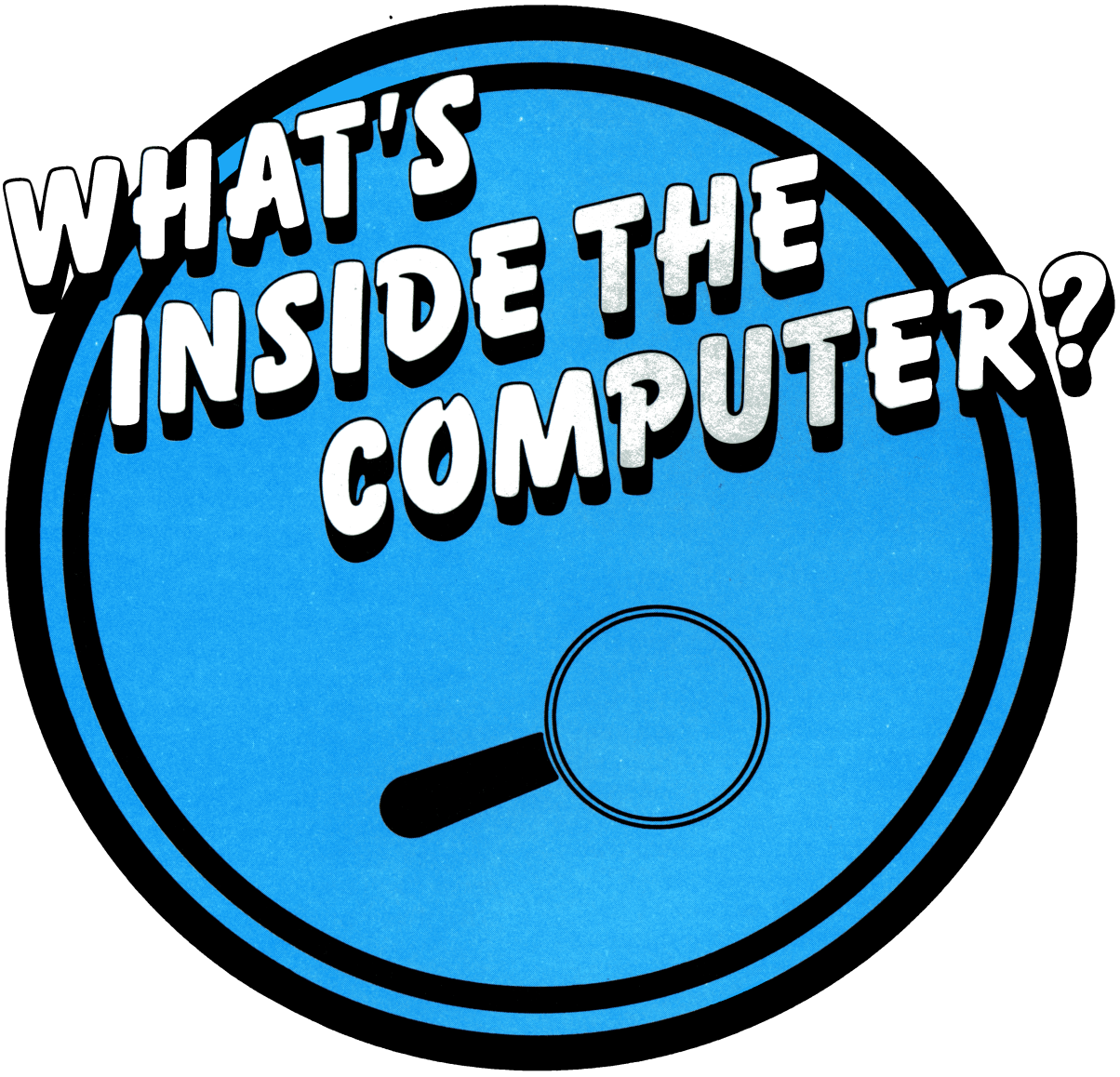
Available software: COMAL, by COMAL Users Group, 5501 Groveland Terr., Madison, WI 53716.

For More Information

For more information on the above languages we recommend you start with one of the Alfred Handy Guides listed below. They are low cost, easy to read, and contain ample references to the literature.

Understanding BASIC
Understanding COBOL
Understanding FORTH
Understanding FORTRAN
Understanding LOGO
Understanding PASCAL
Understanding PILOT





Chapter Fourteen

A computer, like a person or any other complex system, has a body and a mind. The body is what you see, and the mind is what you can't see. Therefore it depends on how closely you look, what is mind and what is body.

Generally speaking the word *hardware* means the physical circuitry and components without any user programs in memory.

Software is programs. The term comes from the fact that the paper associated with programming is soft and pliable compared with the machine.

Something like a *read-only memory chip* (see p. 160) is in between hardware and software in that its software is "frozen" into the circuitry, and theoretically at least you could see the program if you looked at the chip in the right way. These devices are classified as *firmware.*

Your brain is an elaborate machine that assists you in your existence, as no doubt you know. Most people don't like to think of the brain as a machine, but indeed it is one, and considerably more intricate than present-day computers. It is also very efficient and reliable, except when its regulators are defeated, as when you take alcohol, marijuana, a hot bath, and an Oriental massage.

Finding the difference between hardware and software is even more difficult in the brain. Brain is pretty soft stuff to begin with, and very soft informationally, especially during your first few years. That is why it is so efficient for so many years.

For the last eight chapters we've focused on software and what you can do with your Commodore. What follows is a tour of the Commodore's hardware, beginning with the most obvious thing you can see, the keyboard.

The Keyboard

Your Commodore 64 looks like a thick, full-sized keyboard with rounded front and back edges. It appears at first that there is nothing more to your computer than a keyboard. In fact, the keyboard is about the largest part of the C64, and the only thing with moving parts.

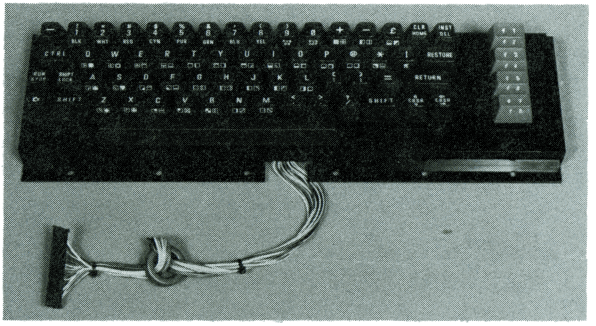


Figure 14.1. The naked keyboard.

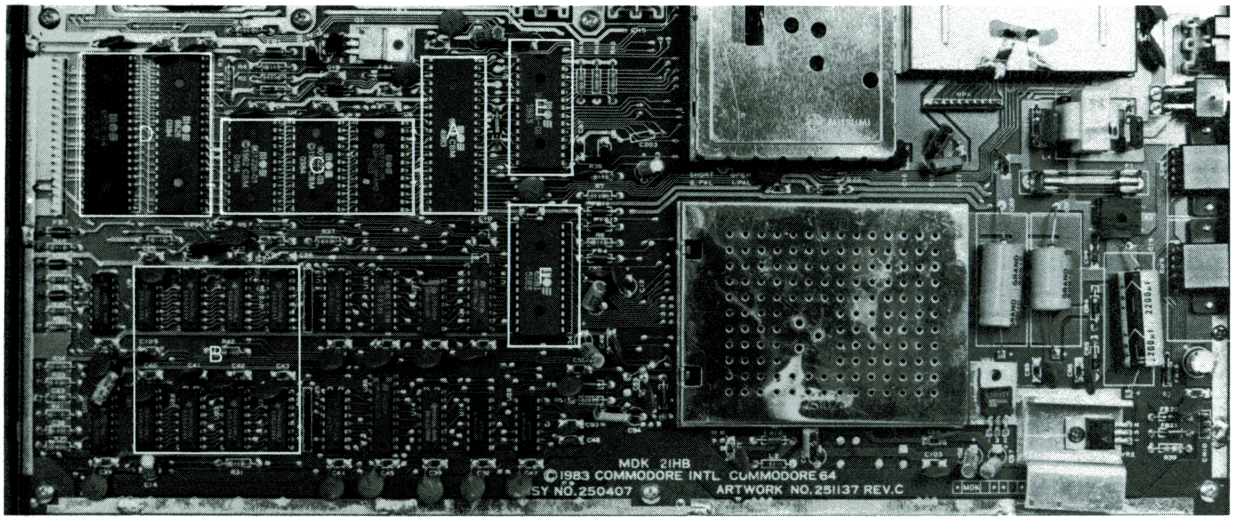
If you count the keys, including the four function keys on the far right, you will get 66 = 64 + 2 = 8*8 + 2. Sixty-four keys are connected to the computer by an 8 by 8 grid of wires. The two special keys are RESTORE and RUN STOP. They each have a wire of their own leading to the computer itself.

The keyboard unit extends about an inch below the top surface of the computer, and it folds up against the computer *motherboard.*

The thick bundle of color-coded wires on the left is the keyboard cable. It tells the computer what keys are being pressed.

The Motherboard

Some day, long after the warranty period has expired, and after you have established a good relationship with your machine, you may want to open it up and look inside. Until then, we will show you what you would be able to see if you did take it apart.



A. Microprocessor Chip
B. Random Access Memory
C. Read Only Memory
D. Complex Interface Adapters
E. The Video Interface Chip
F. The Sound Interface Device

Figure 14.2. The motherboard.

The Commodore splits into two pieces after three screws are removed from the underside. One half of the shell contains the keyboard unit, the other half contains the computer. I think most designers would agree that it is well designed.

The motherboard contains all of the parts of the computer all on one board. That's about 1/20,000 the size of the first electronic computers! And it does more!

We will take up the various systems one at a time, starting with the one that does most of the work.

Microprocessor Chip

The MPU or Microprocessor Unit of the C64 is a 6510 microprocessor chip. It is located below the cassette port, about six inches from the left side of the motherboard. As you can see, it is only one of many systems on that board.

The MPU performs the arithmetic called for in your programs. It can add, subtract, multiply, and divide, and can work with integers (numbers without decimals) or decimal-type numbers. It also does many other things, including moving data to and from memory.

The 6510 is an eight-bit microprocessor. This means that it works with

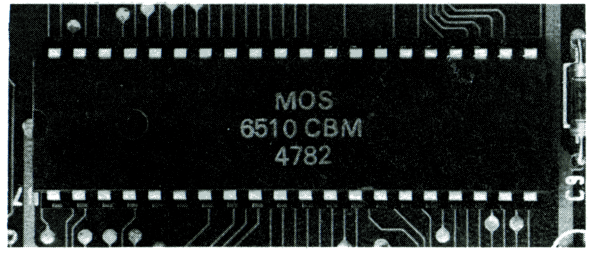


Figure 14.3. The 6510 microprocessor.

eight bits at a time. Most personal computers are also eight-bit machines.

You can specify 256 different things with an eight-bit word. This follows from the fact that every time you add one bit to the length of your word you multiply by two the number of things you can represent. If you have only one bit you can specify two different things, one of them named zero, the other named one.

Random-Access Memory (RAM)

Sooner or later you are going to learn the secret to your computer's memory. It might as well be now.

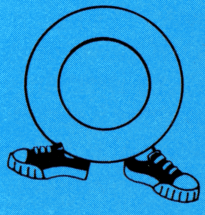
All the programs that your machine runs are stored in bits. A bit is a zero or a one. One bit of information is thus a yes or a no answer. Does your parrot have a sore throat today? The answer takes one bit to record.

Figure 14.4. Bits and binary code.

A computer thinks in *bits,* and every bit is either an "on" or an "off." Pretty strange, but think of an "on" as a 1 and an "off" as a 0. Then we can say that the computer thinks in 1s and 0s.



A Bit



Another Bit

Still pretty strange, until you understand *binary code.* Binary code is a way of combining 1s and 0s to represent meaningful things. We do the same thing everyday when we use digits and letters. The digits 0 through 9 are used in our decimal system to represent numbers. The 26 letters in our alphabet can be combined to represent thoughts and objects. So it is with 1s and 0s.

To understand binary code consider the following:

decimal			*binary*
0	=	0	
1	=	1	
2	=	10	
3	=	11	
4	=	100	
5	=	101	
6	=	110	
7	=	111	
8	=	1000	

The idea is that each column move to the left represents a power of 2 (1s, then 2s, then 4s, then 8s, then 16s, etc.). Thus, the binary code representation of 7 consists of one 1, plus one 2, plus one 3 (111). We do the same thing in decimal notation in powers of 10s. So any number expressible in decimal notation can be expressed in binary (but it's a much longer number!).

The same holds for letters. By grouping bits together, you can represent as many letters or symbols as you like. For example, 01000001 represents the letter "A" and 00100100 represents "$". How does the computer know whether the code represents a number or symbol? By preceding the group of bits with another code that says whether what follows is a number or symbol.

One little bit is not a large enough amount to move around, so computers are designed with a minimum word length (that's the number of bits in a binary word you are moving around) of eight bits. Such a sequence of eight bits is called a *byte*. Memory size, diskette size, and other memory capacity is measured and advertised in bytes. They named it the Commodore 64 because it has about 64 thousand bytes of memory. Since it takes one byte to represent a character, you can think of your C64 as being able to remember around 64,000 different characters at once.

Part of the computer's memory is called *random access* because it takes the same amount of time to read or write to or from a particular memory location. It is understood when you say random-access memory that you can read and write into that memory.

The random-access memory is contained in eight chips located in the lower left corner of the motherboard. Each chip is a 4164-2, and stores one bit of the eight-bit data word.

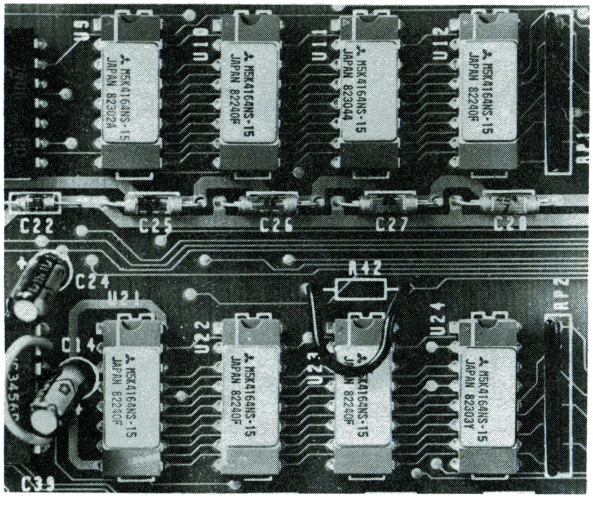


Figure 14.5. Random access memory.

Read-Only Memory

The other kind of high-speed memory is *read-only memory* (ROM). It contains programs that are written once and for all, and never need to be changed. There are three chips, located just to the left of the MPU:

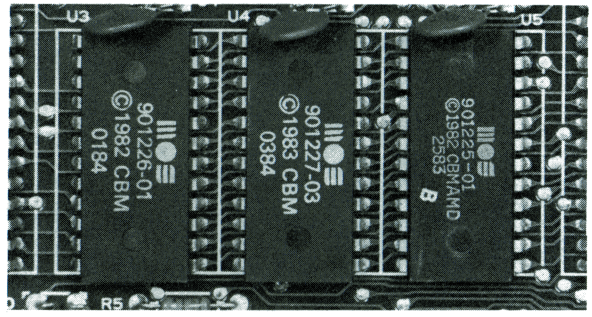


Figure 14.6. Read only memory.

It's a lot easier to make read-only memory than it is to make random-access memory, and it consumes less power. Therefore your C64 comes with its BASIC interpreter in read-only memory. Also in read-only memory is the character set that is displayed on the screen, and the programs that operate your computer.

The Complex Interface Adapters

Those long chips at the far left of the motherboard are the Complex Interface Adapters. One of them interfaces primarily with the keyboard, the other one primarily with the user port.

Each interface adapter contains the timing circuits, shift registers, buffers, and logic necessary for serial to parallel data conversion, input output buffering, data path selection, and interrupt handling.

Innocent-looking though they are, these chips give your Commodore 64 a lot of input-output flexibility (the ability to communicate with other devices like printers and storage devices).

The Video Interface Chip

Located immediately to the right of the MPU, the Video Interface Chip, or VIC II as it is sometimes called, generates the composite video signal from information fed to it from a variety of systems.

It contains an onboard memory of 1,000 bytes, one byte for each of the 1,000 character locations on the screen. The byte at a particular location tells which of the 256 possible characters to display.

There is a separate color memory that stores the color for each of the 1,000 characters. It is located immediately to the left of the sound interface chip, discussed next.

The Sound Interface Device.

The Sound Interface Device, or SID for short, is the chip right below the VIC. It is a three-voice synthesizer/sound effects generator that can make quite a few different sounds, including the mating song of the Norwegian bumblebee.

The SID works very much like the human voice, except that it can produce three separate pitches at a time. The vocal cords can vibrate at only one frequency, but the harmonic content can be regulated by how you shape your mouth.

In the SID you program when the note starts and stops, the shape of the volume with time (the envelope), and the filtering that is applied to the original tone.

Other Motherboard Systems.

Just forget about the other stuff on the motherboard and go on to the next chapter.

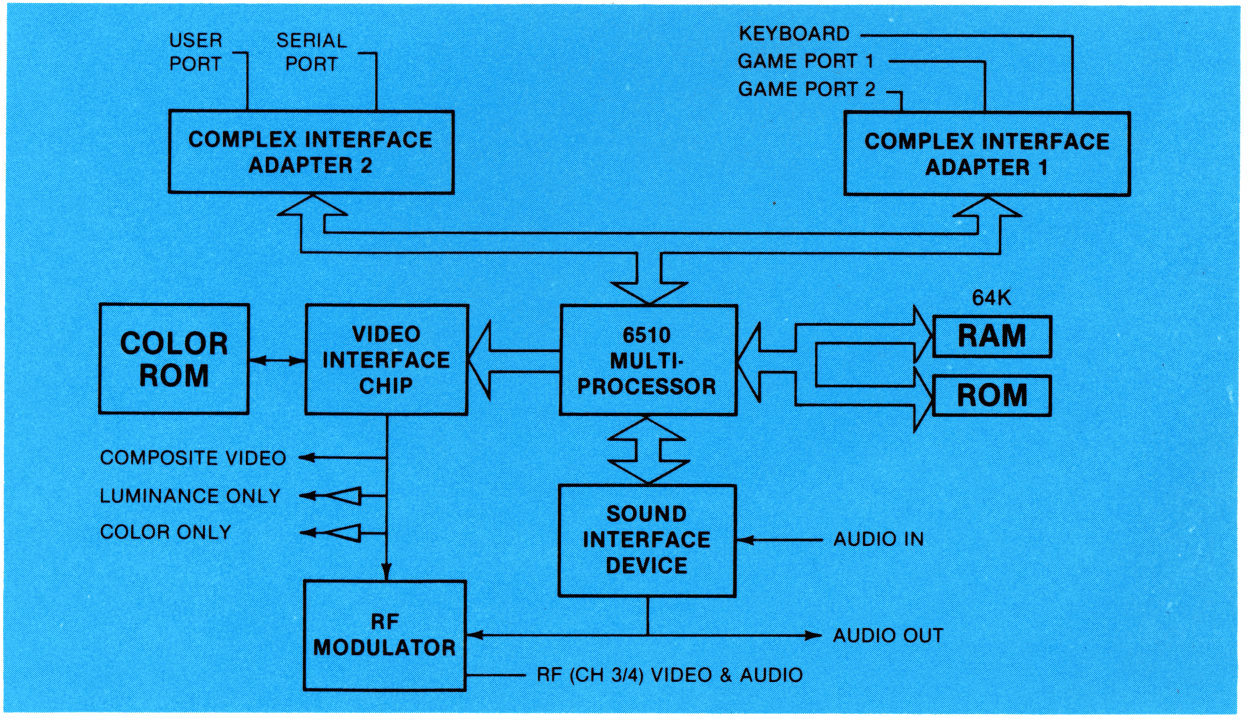
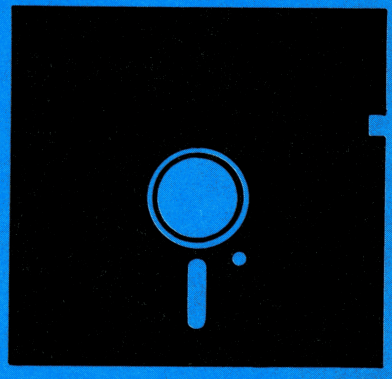


Figure 14.7. For those who want to know, here's the Commodore 64 block diagram. (Looks liked the block I grew up on.)

OTHER PERIPHERALS



Chapter Fifteen

In Chapter 5 we talked about the standard peripherals that you will probably want to add to your system: cassette or disk, printer, and monitor. As you probably know, there are many other devices that you can hook to your Commodore 64. In fact, you will be surprised at all the devices currently available.

CASSETTE INTERFACES	
PRODUCT	MANUFACTURER
Cassette Interface	Bytesize Micro Technology

Cassette Interfaces



(Courtesy of Omnitronix.)

These handy devices allow you to use your home hi-fi cassette recorder instead of laying out money for the Datassette. The interface may cost you more than the Datassette, however.

A cassette interface plugs into the cassette port of your C64, and into the play and record inputs of your cassette tape recorder. Simple.

Adding a printer to your computer gives it the ability to create *hard copy*—print that won't disappear the moment you switch off your computer. A good printer can print out listings of your programs, letters to friends or business associates, mailing labels, manuscripts, and many other documents. It's one of the most useful peripherals available. Since there is a large selection of printers which will work with the C64, it's very important to know what you want your printer to be able to do before you buy it.

Printers

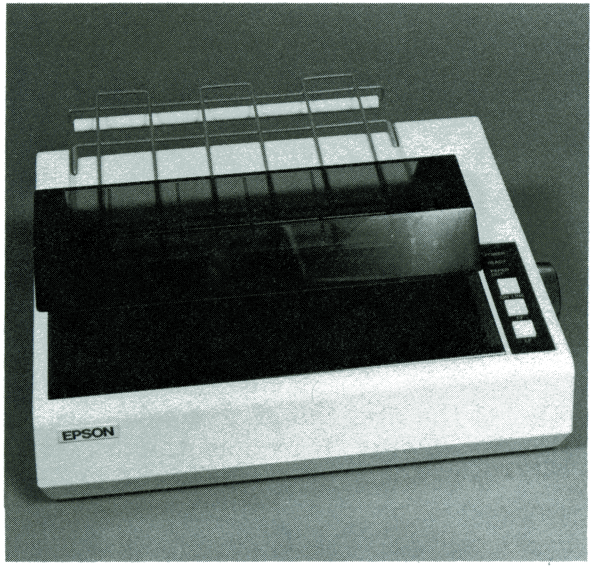
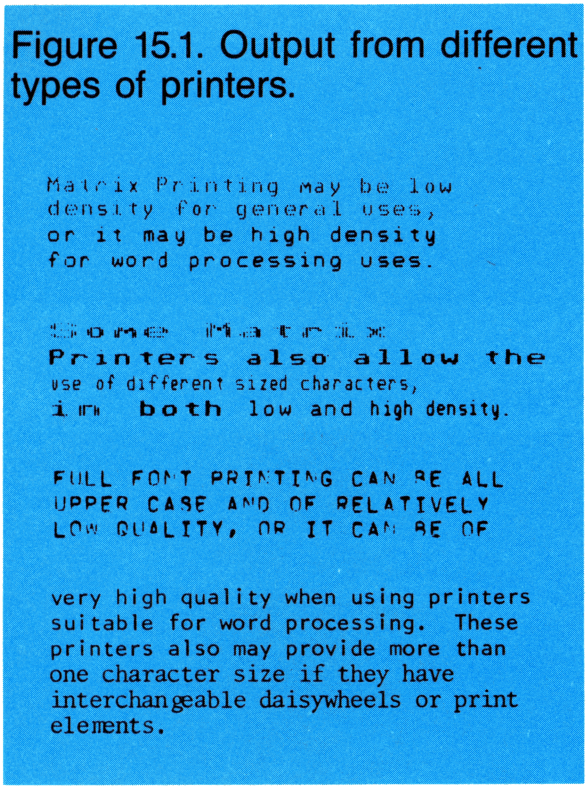


Figure 15.1. Output from different types of printers.



One of the first things to consider is character quality. How does the printer form the characters that it prints on paper? Most computer printers are *dot matrix* printers. Dot matrix characters are formed by a small comb of pins which sweeps across the paper for each line of print. The pins hammer against an inked ribbon in the correct combination to create whatever kind of character is desired. The more pins there are, the more complex and well-formed the characters can be. Although dot matrix print does not look as nice as typewritten text, it's much faster, and usually offers a choice of different character styles called *fonts*, such as pica, elite, boldface, and elongated. Quality of print changes quite a bit from printer to printer, and usually varies according to price.

A cheaper form of dot matrix printer is called the *thermal* printer. The thermal printer uses specially coated paper, and prints by using hot pins that burn the characters into the chemical coating instead of hammering them on with a ribbon. The disadvantage of the thermal printer is that it must use special paper, and the print quality is not usually good. However, it is much quieter than any other kind of printer.

For high quality print, most people use a *letter quality* printer. The letter quality printer creates letters the same way that a typewriter does—it hammers the characters on the paper using a ribbon and a set of fully-formed characters. While it's possible to actually hook up an electric typewriter to the C64 (with considerable difficulty unless the typewriter is specially designed for a computer interface), it's usually preferable to use a *daisy wheel* or *thimble* printer. The daisy wheel printer has a small rotating wheel (the daisy wheel) with many flexible hubs. Each of the hubs ends with a character which strikes ribbon paper to print a character. A daisy wheel printer prints much faster than a typewriter, but with equivalent print quality. You can change fonts by physically changing the daisy wheel. (The thimble works in virtually the same way.)

A letter quality printer's high print quality is offset by its slow speed, high noise output, and inability to reproduce graphics. Many of them are also quite expensive, but some recent models have been quite reasonably priced.

There are several other things to consider when buying a printer.

Is it *bidirectional* (able to print across the page from right to left as well as left to right)? Bidirectional printers are faster than unidirectional printers.

Is it a 40-column, 80-column, or 132-column printer? It usually takes 80 columns to fill an average 8½ x 11 inch piece of paper. Forty-column printers are usually used to print on a small roll of adding machine paper; 132-column printers can print on extra wide financial forms.

Does it have friction feed, tractor feed, or both? Tractor feed uses toothed gears or belts to feed fanfold paper (special computer printer paper) through the printer without you worrying about putting each page in separately. Friction feed lets you put in individual sheets of paper, such as letterhead stationery.

How big is its *buffer*? Your C64 feeds text to the printer very quickly. The printer uses it very slowly, which forces your computer to wait. A buffer is memory in the printer which stores the text from the computer and feeds it to the print head. The larger the buffer is, the sooner your computer can finish feeding text to the printer so you can use it again.

Is it capable of graphics? In other words, if it's a dot matrix printer, you can control each individual dot printed to create detailed pictures instead of characters? Also, there are now available reasonably priced *ink-jet* printers that can produce beautiful full-color graphics.

When you shop for a printer, you'll have many choices. Commodore makes several printers which are designed to hook up directly to the C64 and which will print out the special graphics characters available on your keyboard (see pp. 19-21).

Other companies produce printers with special features or quality that you may want. Before you buy, though, make sure the printer you want will work with your software or the software you might eventually want to purchase. Just about any model will work with your C64, but you will probably need a special interface to enable the printer to connect to the computer (see p. 168).

I recommend the *Epson MX-80*, or a newer version, for solid printer performance, especially for schools. This particular printer is totally professional, and it never breaks down. If you plan on heavy use, get an Epson. They cost twice as much as a Commodore 1525, but as with all things, you get what you pay for, unless of course you steal. In those situations you get more than what you pay, and often more than you bargain for.

PRINTER MANUFACTURERS

Comrex International, Inc.
3701 Skypark Drive
Suite 120
Torrence, CA 90505

Epson American Incorporated
3415 Kashiwa Street
Torrence, CA 90505

Okidata Corporation
1111 Gaither Drive
Mount Laurel, NJ 08054

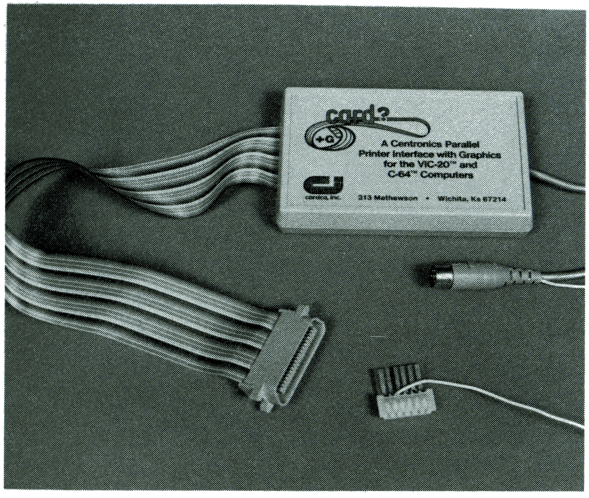
Star Micronics, Inc.
1120 Empire Central Place
Suite 216
Dallas, TX 75247

Toshiba America, Inc.
2441 Michelle Drive
Tustin, CA 92680

The manufactures listed have both serial and parallel printers in matrix and letter quality.

Price range for printers is $500.00 or less.

Printer Interfaces



Most general purpose printers have a cable with many conductors that attaches to the computer. They are called *parallel* printers because the information for each character is sent at the same time, along eight separate conductors. The character information is sent "parallel," as it were.

In order to connect a parallel printer to your 64, you will need a *serial-to-parallel converter,* because the Commodore 1525 is a *serial* printer, and it connects to the serial port on your C64.

A serial port sends each bit of the eight-bit character one after the other, that is, in serial. It only takes one conductor, but it takes more time. Parallel printers like the Epson MX-80 require a serial-to-parallel interface. Any of the following will work.

PARALLEL PRINTER INTERFACES

PRODUCT	MANUFACTURER
Card/Print	Cardco
The Connection	Micro-Ware Dist.
Data 20	Data 20 Corp.

Modems



(Courtesy of Commodore Electronics Ltd.)

If you want to use your telephone to send information to and from your Commodore 64, you will need a modem. The name modem is short for *modulator/demodulator.*

The telephone wires that must carry the signal at least part of the way were not designed for high-speed data. They were designed for talking with your grandparents over long distance as the ads show you should.

Human speech and the singing of birthday greetings require an audio channel from about 200 cycles per second (see Appendix D) to about 3,000

cycles per second. Therefore, whatever signal system you plan to use, it cannot have frequencies below or above those limits, otherwise your message might not get through.

The system that is used to send digital data through standard telephone lines, the thing inside your modem, uses two tones to send "true" and "false." This is the same kind of signal that radioteletype uses. It's called frequency-shift keying. To hear what it sounds like pick up a touch-tone phone and press any two digits back and forth. If you connect two touch-tone phones together you can send secret messages back and forth.

Most modems receive ASCII (see the Glossary) characters from the computer, translate these into teletype (serial) two-tone messages, and send them down the line. Incoming audio signals are analyzed to see if they contain any energy at the two specified frequencies and if they contain a lot at one, and none at the other, and not much anyplace else, then the receiving demodulator knows that a logic signal is present, and which of the two it is. These incoming "bits" are assembled into eight-bit words, and sent to the computer.

Modems can be acoustically coupled (you use the handset) or directly coupled (the modem plugs directly into the telephone jack on the wall).

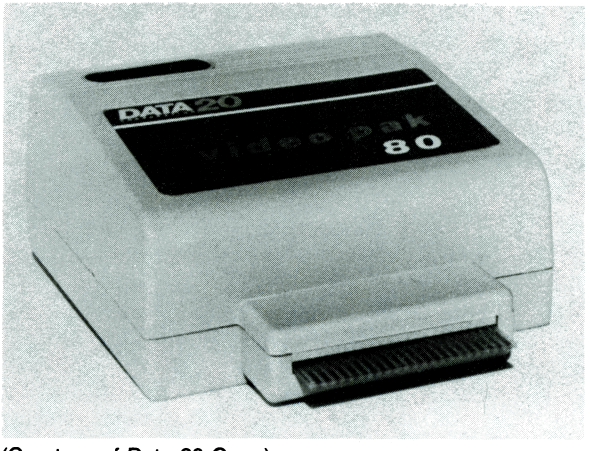
The modems below will connect your Commodore 64 to a standard telephone jack. They contain all the necessary interfacing.

MODEMS

PRODUCT	MANUFACTURER
1600 Modem	Commodore
AutoModem	Commodore
HESModem I	HesWare
1080 Versa Modem	Bizware
Modem Interface	Omnitronix
Lex-11 Accoustic	Lexicon Corp.

For more information on Modems and Communication, GOTO Chapter 11.

Eighty-Column Screen Expanders



(Courtesy of Data 20 Corp.)

For certain applications you may want to display eighty characters across the screen, rather than the forty characters that the C64 generates by itself.

Spreadsheets are best with eighty columns, because you never have enough horizontal room with a spreadsheet. Financial work and word processing, especially at the professional level, is best carried out with an eighty-column screen.

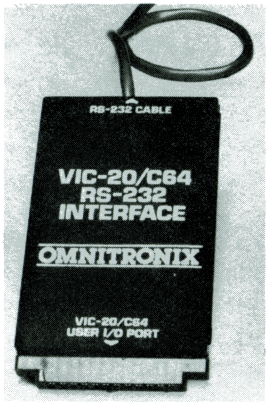
The following products will display eighty characters on a line. You may not

be able to see them clearly on a color television set, or even on a 1701 color monitor with separate luminance and color signals. Therefore, plan to use a monochrome monitor for eighty-column work, and test both the monitor and the eighty-column expander before you buy them. It will do you no good to have eighty characters on a line if you can't read them.

COLUMN SCREEN EXPANDERS

PRODUCT	MANUFACTURER
Video Pak 80	Data 20 Corp.
Buss Card II	Batteries Included

RS232 and IEEE Interfaces



(Courtesy of Omnitronix.)

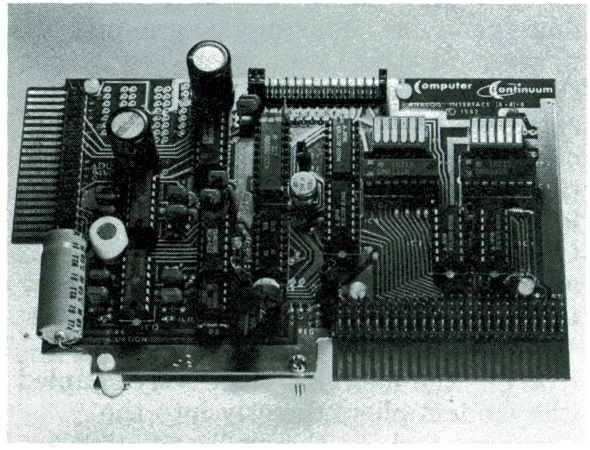
The Commodore 64 uses two standard communications channels to talk with other machines: an RS232 interface standard, and an IEEE standard. The IEEE standard is more flexible and faster, but its processing circuits cost more. It is convenient to list both standards together, because some of the newer products can use either standard.

The interfaces are used for connecting other devices to your C64, like modems, printers, and storage devices.

RS232 AND IEEE INTERFACES

PRODUCT	MANUFACTURER
STCP	Eastern House Software
Telstar 64	Eastern House Software
Anchor Signalman	Leading Edge
Interpod	Limbic Systems
IEEE 488	Micro Systems Development, Inc.
RS232	Micro Systems Development, Inc.
RS232	Omnitronix
C-64 Link	Richvale Telecommunications

A/D and D/A Converters



(Courtesy of Computer Continuum.)

A/D stands for analog-to-digital, and D/A stands for (you guessed it) digital-to-analog. These devices are called converters because they convert from one form of information carrying to the other.

Read Appendix D to find out what analog and digital signals look like.

The typical analog-to-digital converter accepts a voltage from a wire coming in, reads this voltage, converts the value

read to a binary number, and makes this number available as a parallel string of bits. The computer then grabs up the binary number and does things with it. The typical digital-to-analog converter takes a parallel binary number from the computer and converts it to a voltage that is placed on a wire leading to the outside world. This enables the computer to receive data from non-digital devices.

You can use A/D and D/A converters for lots of different things, such as digital music, weather stations, laboratory experiments, process control, slow-scan television, engine diagnosis, medical diagnosis, and horse racing.

Listed below are the D/A or A/D converters that we know about.

A/D AND D CONVERTERS

PRODUCT	MANUFACTURER
D/A Converter	Computer Continuum
A/D Converter	Computer Continuum

Speech Synthesizers



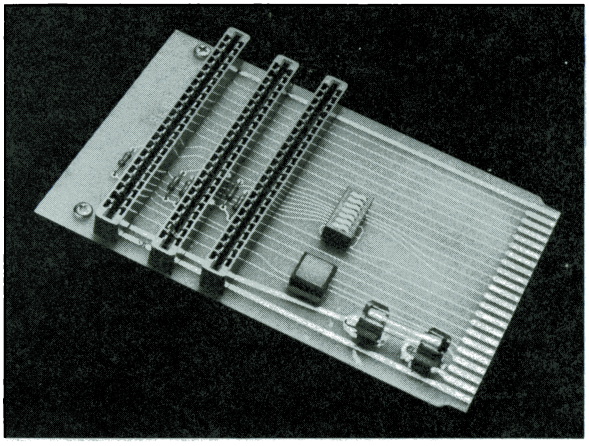
(Courtesy of The Alien Group.)

Speech synthesizer create human-compatible speech sounds from digital information furnished by your computer. The following products will work with your Commodore 64:

SPEECH SYNTHESIZERS

PRODUCT	MANUFACTURER
Voicebox	The Alien Group

Port Expanders



(Courtesy of CardCo, Inc.)

These devices run the edge connectors in your user and cartridge ports out to where they can connect to several user devices or cartridges. You don't have to plug things in and out so much.

PORT EXPANDERS

PRODUCT	MANUFACTURER
Cardboard/3	Cardco
Expandoport 4	Micro Systems Development, Inc.
Four Slot Expander	Precision Technology

Networking Devices

This is a broad category of devices used to link several Commodore 64s to other devices and to other 64s. This differs from modems in that the connection is made through special cables that enable high-speed transmission of data. This is useful for an office or classroom setting. Expect many more products soon.

NETWORKING DEVICES

PRODUCT	MANUFACTURER
Sci Switch	Computer Marketing Services, Inc.



Chapter Sixteen

This machine is similar to the Commodore 64, except that it is styled differently and has slightly different features. Like the C64, the C264 has 64K of RAM, 60K of which is available for BASIC programs.

The C264



Figure 16.1. The Commodore 264. (Courtesy of Commodore Electronics Ltd.)

The concept behind these newer machines is to put more ROM in them and allow users to select the built-in software they want. The C264 comes with 32K or ROM, and you can add another 32K of ROM later.

The C264 has eight luminance levels for the same sixteen colors that the C64 has. This gives a total of 121 effective colors, an improvement over the 64. The C264 has a built-in machine language monitor, and a BASIC with more commands, including the same graphics and sound commands that the 64 has.

One nice feature of the 264 is the four cursor controls, arranged in a diamond. You don't have to use the SHIFT key to move the cursor up and leftward as you do on the 64.

There is built-in software for the C264, including 264 Magic Desk, 264 Word Processor, 264 3-plus-1 integrated software package, and others.

The C264 will work with the following Commodore peripherals:

Figure 16.2 COMMODORE C264 PERIPHERALS

264 Modem	
SFS 481	Super fast disk drive
C1541	Disk drive
C1542	Disk drive
C1531	Datassette
MCS 801	Color dot matrix printer
MPS 802	Dot matrix printer
DPS 1101	Daisy wheel printer
C1520	Plotter/printer
C1526	Dot matrix printer
C1701	Color video monitor
C1702	Color video monitor

The peripherals listed above are not necessarily compatible with your Commmodore 64; some require interface adapters. So make sure they work while you are still in the store, and before you have paid for them.

As the C264 is thinner than the 64, you may be able to slip one under your coat and walk out with it. Don't have this book with you if you plan to do something like that, however.

The CV364



Figure 16.3. The Commodore V364. (Commodore Electronics Ltd.)

This machine is an upgraded version of the C264. It starts with 48K of ROM and goes up to an additional 48K of ROM. In other words, you can have more built-in software.

An additional feature is the speech synthesizer. It has a vocabulary of 150 words. That's more words than both of my older sisters know put together.

SFS 481 Fast Disk Drive



Figure 16.4. The Commodore SFS 481 Fast Disk Drive. (Courtesy of Commodore Electronics Ltd.)

This disk drive uses the same format as the C1541 drive, but it will not plug into the C64. It is meant for either the C264 or the CV364.

As with the C1541, the SFS 481 stores 170K characters of data or programs, and it can handle up to 144 files in its disk directory.

The data transfer rate is 1,675 characters per second, considerably faster than the C1541's data transfer rate.

Access time, that is, the time it takes, on the average, to find the right track on the diskette, read it, and store it in the C64's memory, is about one third of a second.

The SFS 481, despite its name, is not a particularly fast disk drive. Naturally, compared with the C1541, one of the slowest drives in the world, anything seems fast.

C1531 Cassette Drive Unit



Figure 16.5. The Commodore C1531 Cassette (Courtesy of Commodore Electronics Ltd.)

This cassette recorder is similar to the Datassette, but is made for the C264 and the CV364. It will not work with your Commodore 64.

The C1531 has the same tape format as the Datassette, and it also uses standard audio cassettes.

The C1531 has two new features: a built-in tape counter and a built-in sensor for software detection of key press.

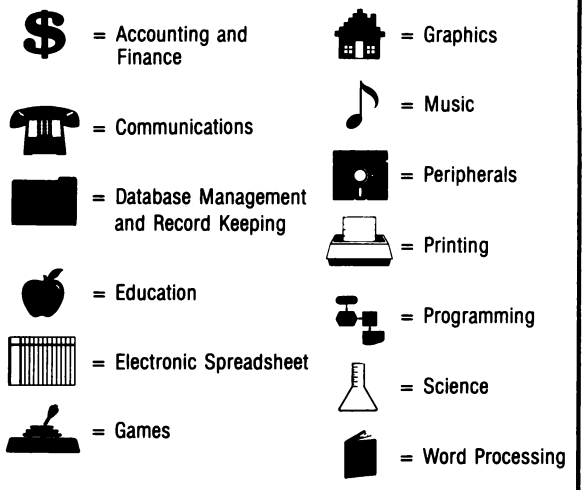

THE APPENDIX
A: PRODUCT DIRECTORY
B: RECOMMENDED READING
C: COMMODORE 64 USERS GROUPS
D: THE 6502 INSTRUCTIONS SET
E: AUDIO, VIDEO, AND BINARY SIGNALS

APPENDIX A: Product Directory

Names, Addresses, and Phone Numbers of Commodore 64 Software and Hardware Manufacturers

The following list of manufacturers and their products was obtained from several sources, including the advertisements in popular microcomputer magazines. The information is presented for you to check out; no attempt has been made to substantiate any of the claims made by the manufacturers. Remember that the Commodore 64 is a relatively new machine, and it will take some time for many of the products mentioned below to be tested and reviewed.

The following icons should help you to quickly find the hardware & software you need:



Abacus Software, P.O. Box 7211, Grand Rapids, MI 49510, 616-241-5510.

Ultra Basic, an extension of BASIC, *Chartpak-64*, a charts generator, and *Synthy-64*, a music and sound synthesizer. *Sprite-Aid*, for making sprites. *Tiny Forth*. *Budgeteer*, a financial program. Popular products.

AB Computers, 252 Bethlehem Pike, Colmar, PA 18915, 215-822-7727.

PageMate, a word processor with right-margin justification, headings, page numbering, menu selection, full-screen editing. *Flex File 2*, a database program that connects to *PageMate*. Also, compilers for Pascal and FORTH.

Academy Software, P.O. Box 6277, San Rafael, CA 94903, 415-499-0850.

Typing Tutor/Word Invaders, educational software. *Sprite Designer*, a sprite editor. *IFR* and *Shakespear Writer*.

Alfred Software, P.O. Box 5964, Sherman Oaks, CA 91413, 818-995-8811.



Music Made Easy, an educational program that teaches music fundamentals.

The Alien Group, 27 W. 23rd St., New York, NY 10010, 212-741-1770.



Voicebox, a low-cost, powerful speech synthesizer. Software support includes vocabulary control and music and singing system.

American Peripherals, 122 Bangor St., Lindenhurst, NY 11757, 516-226-5849.



Games: *Hooper, Swarm, Intruder-Scramble, Kongo Kong. Dataman-64,* a database package. Lots of educational software and many more games.

B & B Systems, P.O. Box 60313, Reno, NV 89506, 702-972-4834.



Maxmon, an enhanced machine-language monitor on ROM. *Analyser,* to better structure your assembly-language programs. Good products for the serious progammer.

Batteries Included, 71 McCaul St., Toronto, Ontario, Canada M5T 2X1, 416-596-1405.



Paper Clip, a professional word processor. Lots of features. *The Consultant,* a data base manager (see Chapter 9). *Buss Card II,* an eighty-column board.

Bizcomp Corporation, 532 Mercury Dr., Sunnyvale, CA 94086, 408-745-1616.



Bizcomp 1080 Versa Modem.

Bizware, Inc., 5014 Highway 29, Lilburn, GA 30247, 800-221-7171 or 404-925-4686.



Business software package. Contains accounting ledger, inventory control, letter writer, mail-out.

Brainbank Inc., 220 Fifth Ave., New York, NY 10001, 212-686-6565.



Educational software. *Reading Comprehension 1 and 2, The Human Body, The Skeletal System,* and others.

Broderbund Software Inc., 17 Paul Dr., San Rafael, CA 94903, 415-479-1170.



Games: *Spare Change, Serpentine, Choplifter, Lode Runner, Apple Panic, Bank Street Writer,* a word processor.

Byte by Byte, 1183 West 1380 North, Provo, Utah 84604.



Educational software, all grade levels. Free catalogue.

Cardco, Inc., 300 S. Topeka, Wichita, KS 67202, 316-267-6525.



Card/Print is a parallel printer interface for many different printers. *Cardboard/3 Economy Expansion Interface* gives users access to more than one memory or utility cartridge. New: *16 Key Keypad.*

Cardinal Software, 13646 Jeff Davis Hwy, Woodbridge, VA 22191, 703-491-6502.



Banner Machine, Microbroker, File Organizer, Formulator, Home Finance, Screen Dump 64, plus games and preschool educational programs.

Chalkboard, Inc., 3772 Pleasantdale Rd., Suite 140, Atlanta, GA 30340, 404-496-0101, 800-241-3989.



Magic Wand and *Power Pad,* graphic tablets. *MicroMaestro,* a music program.

Championship Electronics, 1025 Grandview Dr., South San Francisco, CA 94080, 415-588-3015.



SuperChamp and *MiniChamp,* joysticks.

City Software, 735 West Wisconsin Ave., Milwaukee, WI 53233, 414-291-5125.



Doodle, a graphics package (see Chapter 6).

Comm Data Computer House Inc., 320 Summit, Milford, MI 48042, 313-685-0113.



Educational software, mainly in the language arts.

Commodore Business Machines, 487 Devon Park Drive, Wayne, PA 19087, 215-431-9100.





Easy Script 64, Easy Spell 64, Easy Calc 64, The Manager, SuperExpander 64, Easy Finance I (Loan Analysis), *Easy Finance II* (Basic Investment Analysis), *Easy Finance III* (Advanced Investment Analysis), *Easy Finance IV* (Business Mangement),*Easy Finance V* (Statistics and Forecasting), *Accounts Payable/Checkwriting, Accounts Receivable/Billing, General Ledger, Inventory Management, Payroll.* Arcade action games: *Pinball Spectacular, Supersmash, Tooth Invaders, Star Post, Avenger, Jupiter Lander, Radar Rat Race, LeMans, Star Ranger, Frogmaster.* Children's Series: *Introduction to BASIC I, Zortek and the Microchips, Easy Lesson/Easy Quiz, Number Nabber/Shape Grabber, Visible Solar System, Speed/Bingo Math.* Bally Midway: *Gorf, Wizard of WOR,*

Seawolf, Omega Race, Clowns, Kickman, Blueprint, Lazarian. Adventure Games: *Zork I, II, III, Suspended, Starcross, Deadline.* Music Series: *Music Machine, Music Composer. Magic Desk I,* a simple word processor. And a whole host of peripherals.

Compu Sense, P.O. Box 18765, Wichita, KS 67218, 316-263-1095.



Cribbage, Flight 64, games, and *Sprite Generator.*

ComputerMat, Box 1664, Lake Havasu, AZ 86403, 602-855-3357.



Music Maker, a music program.

Computer Alliance, 10730 White Oak Ave., Granada Hills, CA 91344, 818-368-4089.



BASM, a BASIC compiler. Looks good.

Computer Continuum, 301 Sixteenth Ave., San Francisco, CA 94118, 415-752-6294.



Eight-bit digital-to-analog and analog-to-digital converters. Also fast *Scape/FFT* transform software.

Computer Marketing Services Inc., 26 Springdale Rd., Cherry Hill, NJ 08003, 609-424-5055.



CalcResult, a three-dimensional spreadsheet with thirty-two pages of 63 times 254 cells. *SCI Switch* connects up to eight 64s to the same disk or printer.

Computermat, Box 1664, Lake Havasu City, AZ 86403, 602-855-3357.



Arcade Pak: *Head On, Alien Invasion, Target Command.* Education Pak: *Geography Match, Math Adventure, Ruler & Micro.* Treasure Pak: *Adventure, Caves of Silver, Shuttle Voyage.* Game Pak: *Dragon Chase, Deflect, Flip It.*

Conduit, Conduit University of Iowa, Oakdale Campus, Iowa City, IA 52242, 319-353-5789.



Educational software. Requires a PET emulator available from Commodore.

Consumer Products, Vaisala, 2 Tower Office Park, Woburn, MA 01801, 617-933-4500.



Home Automatic Weather Station.

Continental Software, 11223 S. Hindry Ave., Los Angeles, CA 90045, 213-417-3003.



The Home Accountant, a powerful integrated accounting package. *The Home Cataloger,* an inventory program. *FCM,* filing, cataloging, and mailing. *The Tax Advantage.*

Creative Software, 230 E. Caribbean Dr., Sunnyvale, CA 94089, 408-745-1655.



In the Chips and Pipes, home education games. *Home Inventory,* a database program. *Car Costs and Loan Analyzer,* financial programs. *Trashman and Astroblitz,* games.

Data Equipment Supply Corp., 8315 E. Firestone Blvd., Downey, CA 90241, 213-923-9361.



ACC/SYS GA 1600 Accounting System. Conforms to professional standards.

Datamost, Inc., 20660 Nordoff St., Chatsworth, CA 91311, 213-709-1202.



Games to make you go out of your mind: *Cosmic Tunnels, Monster Smash, Nightraiders, Roundabout, Cohen's Towers, Mr. Robot,* and many others.

Datasoft, 19808 Nordoff Pl., Chatsworth, CA 91311, 213-701-5161.



Hottest arcade games and educational programs in town.

Data 20 Corporation, 23011 Moulton Pkwy, Suite B10, Laguna Hills, CA 92653, 714-770-2366.



Video Pak 80, an 80-column screen enhancer.

Design Ware Inc., 185 Berry St., San Francisco, CA 94107, 415-546-1866, 800-572-7767.



Very popular education and game software.

Discwasher, 1407 North Providence Rd., Columbia, MD 65205.



Pointmaster, a competition joystick.

Eastern House Software, 3239 Linda Dr., Winston-Salem, NC 27104, 919-924-2889 or 919-748-8446.



CBM 64 Rabbit Cartridge, a system to speed up cassette load and save. *STCP,* a standard terminal communications package including RS-232 interface board. *MAE,* a macro assembler and text editor. *Telstar 64,* a sophisticated terminal communications cartridge for the C64. *Machine Language Monitor Cartridge.*

Educational Software, 4565 Cherryvale Ave., Soquel, CA 95073, 800-692-9520.



Sprite Graphics, a sprite generator. Other educational programs.

Electronic Arts, 2755 Campus Drive, San Mateo, CA 94403, 415-571-7171.



Spectacular games, educational programs, *Cut & Paste Word Processing, Financial Cookbook, Music Construction Set.*

Epyx, Inc., 1043 Kiel Ct., Sunnyvale, CA 94089, 408-745-0700.



Great educational and game software.

French Silk, P.O. Box 7096, Minneapolis, MN 55407, 612-871-4505.



Develop-64, and *Decode-64,* plus *Inside the Commodore 64:* a complete software development package.

Geneva Technologies Corp., 225 Christiani St., Cranford, NJ 07016, 201-276-1144.



TaxQuick, a professional-grade tax program.

Gryphon Systems, P.O. Box 755, Cardiff by the Sea, CA 92007, 619-436-1455.



Fas-File, a database system.

H & E Computronics Inc,, 50 N. Pascack Road, Spring Valley, NY 10977, 914-425-1535.



Business Pac 100, 100 ready-to-run business programs. *VersaLedger II,* a complete business accounting system. *VersaReceivables, VersaPayables, Versa Payroll,* and *VersaInventory.* Free catalogue if you mention this book.

Hayden Software, 600 Suffolk St., Lowell, MA 01853, 800-343-1218.



MicroAddition, MicroSubtraction, MicroMultiplication and *MicroDivision.* Math learning games. Also SAT trainers.

HesWare, 150 North Hill Dr., Brisbane, CA 94005, 800-227-6703, 415-468-4111.



OmniWriter/OmniSpell, 64 FORTH, Magic Music, Tri Math, games and *HESModem I,* a modem.

Info Designs, 6905 Telegraph Rd., Birmingham, MI 48010, 313-540-4010.



Management Acconting System, an integrated accounting package for the small business.

Infocom, Inc., P.O. Box 855, Garden City, NY 11530.



Zork, Deadline, The Witness, Infidel, Planet-Fall, Enchanter. Adventure games: all words, no pictures, but very intriguing.

International Tri Micro, 1010 N. Batavia, Suite G, Orange, CA 92667, 714-771-4038.



Easy Tutor, The Write File, an integrated word processor and data base. *Your Home Office,* a spreadsheet, *The Master Key,* and games.

Island Software, P.O. Box 300, Dept. G, Lake Grove, NY 11755, 516-585-3755.



Mind Stretcher, I Love America, French, Italian, Spanish, Young Folk Series: educational software. Free catalogue.

Jini Micro-Systems, P.O. Box 274, Riverdale, NY 10463, 212-796-6200.



MiniJini, a database system in cartridge form, with storage on disk or cassette.

JMH Software of Minnesota Inc., 7200 Hemlock Ln., Maple Grove, MN 55369, 612-424-5464.



Educational software for math, drivers education, and anatomy.

Kantronics, 1202 E. 23rd St., Lawrence, KS 66044, 913-842-7745.



Hamtext, an advanced CW/RTTY/ASCII program for the C64. *Amtorsoft,* an amateur radioteletype program for use with the *Interface,* a radioteletype modem.

Krell Software, 21 Millbrook Dr., Stonybrook, NY 11790, 516-751-5139.



Connections, a database for children,*College Board SAT Exam Preparation Series, LOGO, Alexander the Great,* a game for word and arithmetic skills, and *Plato's Cave,* a science game. Quality products.

Leading Edge, 225 Turnpike St., Canton, MA 02021, 800-343-6833.



The Connection, an intelligent interface for the C64.

Lexicon Corp., 1541 NW 65th Ave., Fort Lauderdale, FL 33313, 305-792-4400.



Lex-11, an acoustically coupled modem.

Limbic Systems Inc., 560 San Antonio, Suite 202, Palo Alto, CA 94306, 415-424-0168.



Interpod, a multiple (RS232 and IEEE) interface for your C64's serial port.

Logos Software, Dept. A, 3192 Laurel Canyon Road, Santa Barbara, CA 93105.



Educational software: *Quiz Kit, Spell It!, Boldface, Mathpak, Character Generator, Mailing List.*

Luna Software, P.O. Box 26922, San Jose, CA 95159-6922, 408-378-7793.



Business: *Mailing List, Finance Package, Inventory Package.* Utility: *Sprite Editor, Game Graphics Editor, Characer Editor 64.* Games: *Pedestrian, Firefighter, Money Minefield, Wallbanger, Hyper-Hen,* and many more.

Madison Computer, 1825 Monroe St., Madison, WI 53711, 608-255-5552.



McPen, a high-resolution light pen. *McTerm 64,* a modem.

M.I.K. Inc., P.O. Box 4383, N. Hollywood, CA 91607, 213-982-3403.



Hardware, software, games, and books. List your interests and equipment and send them a line.

Micro Spec, P.O. Box 863085, Plano, TX 75086, 214-867-1333.



Disk Data Manger, Payroll System, Mailing List, Inventory Package, General Ledger, Checkbook Manager.

Micro Systems Development, Inc., 10031 Monroe Dr., Dallas, TX 75229, 214-357-7051.



Three interfaces: IEEE 488, RS232, and Parallel. *Expandoport 4,* a four-port expansion board. *Terminal Emulator* turns your C64 into a terminal. *Monitor Link* is a cable to use with TV monitors.

Microlog Corporation, 18713 Mooney Drive, Gaithersburg, MD 20879, 301-258-8400.



AIR-1, a radioteletype and CW terminal that plugs into the C64 user port.

Microcomputer Workshops, 225 Westchester Ave., Port Chester, NY 10573, 914-937-5440.



Flash Spell Helicopter, Consonant-Vowel-Consonant, learning games. Also math programs.

Micrograms Inc. P.O. Box 2146, Loves Park, IL 61130, 815-965-2464.



Educational health-related software:*Looking and Feeling Your Best, Nutrition, Emergencies and First Aid, Smoking, Drugs and Alcohol.*

Microphys Programs, 2048 Fort St., Brooklyn, NY 11229, 212-646-0140.



Educational software: physics, chemistry, mathematics, and language arts at junior and senior high school level. Exam analysis and attendance systems.

Micro-W Dist. Inc., 1342-B Route 23, Butler, NJ 07405, 201-838-9027.



MW 350 Graphic Printer Interface, Clone Machine, Ungard, Fantastic Filer, Fantastic Forms, Screen Dumper 64, MicTester.

Midwest Micro Associates, 311 W. 72nd St., Kansas City, MO 64114, 816-333-7200.



64 Terminal, a word processor, *SuperTerm,* a communications package, *Grafix Sampler,* a graphics package, *64 Panorama,* digitized pictures, and *Banner/Headliner,* for generating banners and posters. *Smart ASCII,* a software interface.

Midwest Software, Box 214, Farmington, MI 48024, 313-477-0897.



TestMaster. Master Grades, a complete grading system for teachers. *Football Scout and Basketball Stats,* sports programs.

Mirage Concepts, 2519 W. Shaw, #106, Fresno, CA 93711, 209-227-8369.



The Word Professional. Database Manager, a professional data base package. See Chapter 9.

MPA Enterprises, Box 6020, Wyomissing, PA 19610, 215-775-2600.



Finance I, a finance program. Wood Heat-1, energy calculator for wood heat.

New Leaf Inc., 120 Lynnhaven, Bellville, IL 62223.



ESPCalc, an easy-to-use spreadsheet. *Biorhythm,* a biorythm calculator.

Omnitronix, P.O. Box 43, Mercer Island, WA 98040, 206-236-BYTE.



Cassette interface connects to standard audio cassette recorder. Modem interface connects to standard modem. Useful hardware products.

Pacific Coast Software, 3220 S. Brea Canyon Rd., Diamond Bar, CA 91765.



CalcPak, a home budget program. Games: *Skiman* and *Knockout.*

Performance Micro Products, 770 Dedham St., S-2, Canton, MA 02021, 617-828-1209.



C64 Forth, a complete Forth package including screen editor and assembler.

Powerbyte Software, P.O. Box 579, Gwynedd Valley, PA 19437, 215-643-7666.



Business and home applicaton software, including accounting, inventory, business calendar, billing, bar charts, net worth statement, home budget, medical records, diary, recipe file, word processor. Some include: *The Savings Account Miser, Checkbook Booky, The Budgeter, Accounts Receivable and Payable, The Accountant, Cash Flow Model, Net Worth Statement, The Investment Analyst.*

PractiCorp, The Silk Mill, 44 Oak Street, Newton Upper Falls, MA 02164, 617-965-9871.



PractiCalc 64, a complete spreadsheet package (see Chapter 11), *Inventory 64, Zeppelin,* an arcade game. Coming soon: *PractiWord, PractiFile,, PractiBase,* and *PractiPlot.*

Professional Software Inc., 51 Fremont St., Needham, MA 02194, 617-444-5224.

WordPro, a professional word processing system. See Chapter 6.

Program Design, 95 E. Putnam Ave., Greenwich, CT 06830, 203-661-8799.



Step-by-Step, Pre-School I, Picture Blocks, Vocabulary I & II, Analogies, Number Series.

Programmer's Institute, Future House, 310 W. Franklin St., Chapel Hill, NC 27514, 919-967-0861.



The Complete Personal Accountant, a financial program, *Finance #4, The Light Pen, Peripheral Vision, Alphabet Construction Set.*

Protecto Enterprises, Box 550, Barrington, IL 60010, 312-382-5244.



Eighty-column board. Free catalogue. New: *Programmers Aid,* eighty-column screen (color) program.

Quality Educational Designs, P.O. Box 12486, Portland, OR 97212, 503-287-8137.



Factoring Whole Numbers, Fractions, Factoring Whole Numbers & Fractions, Arith-Magic, Decimals. Elementary school learning materials by Joanne Benton.

Quick Brown Fox, 536 Broadway, New York, NY 10012, 212-925-3856.



Quick Brown Fox, a very popular word processor.

R A K Electronics, P.O. Box 1585, Orange Park, FL 32067, 904-264-6777.



Super Budget and Super Checkbook. Morse Code Terminal. C-64 File, C-64 Typewriter, C-64 Mail List.

RKS Industries Inc., 4865 Scotts Valley Drive, Scotts Valley, CA 95066, 408-438-5760.



Surge Centro, a surge protector.

Rockware Data Corporation, 10525 Barrywood Drive, Dallas, TX 75230, 214-739-1100.



Supertax, a complete set of tax programs.

Sam's Software, Howard W. Sams & Co., Inc., 4300 W. 62th St., Indianapolis, IN 46268, 317-298-5400.



Commodore 64 BASIC Programs on cassette. *CP/M primer, BASIC primer, Graphics primer, PASCAL primer,* many more.

Scarborough Systems, Inc., 25 North Broadway, Tarrytown, NY 10591, 914-332-4545.



Songwriter, a song composer. *MasterType,* a typing instruction program. *Phi Beta Filer.*

Scholastic, Inc., 730 Broadway, New York, NY 10003, 212-505-3000.



Turtle Tracks, Square Pairs, Electronic Party, and *Microzine.* Learning software.

Sentient Software, Inc., P.O. Box 4929, Aspen, CO 81612, 303-925-9293.



CYBORG, a science-fiction adventure game with a true plot.

SimplexSoft Ltd., 617 N. Property Lane, Marion, IA 52302.



Financial Record System for Commodore 64.

Sirius Software Inc., 10364 Rockingham Dr., Sacramento, CA 95827, 916-366-1195.



Type Attack, Turmoil, Fast Eddie, Deadly Duck, Squish'em, games. New: *Snake Byte, The Blade of Blackpoole.*

Skyles Electric Works, 231E South Wishman Road, Mountain View, CA 94041, 415-965-1735.



The *VicTree* is a hardware and software package, which updates CBM BASIC to BASIC 4.0 and has an optional Centronics standard printer cable. *Busiwriter* is a popular word processor. *Busicalc 64* is a spreadsheet.

Southern Solutions, P.O. Box P, McKinney, TX 75069, 214-542-0278.



Business software: accounts receivable, accounts payable, general ledger, payroll, inventory, much more.

Spinnaker Software Corp., One Kendall Square, Cambridge, MA 02139, 617-494-1200.



Early Learning Series: *Alphabet Zoo, Kindercomp, Kids on Keys, Facemaker, Story Machine. Delta Drawing Learning Program.* Family Learning Games: *Fraction Fever, Up for Grabs, Cosmic Life. Hey Diddle Diddle, Rhymes & Riddles.*

Sublogic Corp., 713 Edgebrook Dr., Champaign, IL 61820, 217-359-8482.



Flight Simulator II, a best-selling flight simulation package.

Suncom Inc., 650 E. Anthony Trail, Northbrook, Il 60062.



Tac-2, a joystick.

Synapse, 5221 Central Ave., Richmond, CA 94804, 415-527-7751.



Fort Apocalypse, Pharoah's Curse, Zaxxon, Slamball, Sentinel, Zeppelin, and many more great games.

Tamarack Software, Water St., P.O. Box 247, Darby, MT 59829, 406-821-4596.



Vanilla PILOT, an easy-to-learn programming language, and *GradeCalc,* a grade and attendance management system for teachers.

Taylormade Software, 8053 E. Avon La, Lincoln, NE 68505, 402-488-0196.



Educational and consumer software.

Terrapin Inc., 222 3rd St., Cambridge, MA 02142, 617-492-8816.



LOGO, a language for kids. *The Terrapin.*

Timeworks, Inc., 444 Lake Cook Rd., Deerfield, IL 60015, 312-948-9200.



Word Writer, a word processor. *Data Manager 2,* a cross between a spreadsheet and a database program. Other programs include inventory management, sales analysis, accounts payable, and check writing.

3G Company Incorporated, Rte. 3, Box 28A, Gaston, OR 97119, 503-662-4492.



3G Lightpen.

TOTL Software, 1555 3rd Ave., Walnut Creek, CA 94596, 415-943-7877.



Totl.Text, a word processor. *Research Assistant,* a database system. *Totl.Business,* a financial program. *Totl.Time Manager, Totl.Speller, Totl.Money Minder, Totl.Infomaster.*

Valorum, 441 Clyde Ave., Mountain View, CA 94043.



Spreadsheet, File Manager, and other business programs.

Version I Software, P.O. Box 5535, Coralville, IA 52241, 319-337-8357.



Home applications and games. *Home Pak #2.*

Wunderware, P.O. Box 1287, Jacksonville, OR 97530, 503-899-7549.



Games: *Killer Caterpillar, Mad Painter,* and *Snake.*

APPENDIX B: Recomended Reading

The following books and periodicals are recommended reading for C64 owners. Except for the periodicals they are all specifically for the C64. They can safely be consumed by children, adults, and goats.

Books

Howard Adler, *Commodore 64 Computer Programs for Beginners,* ARCsoft Publishers, Woodsboro, MD, 1984.

Contains forty tested and easy-to-use programs in a variety of areas. Includes home finance, games, learning programs, math helpers, and many others.

Michael Boom, *How To Use the Commodore 64,* Alfred Publishing Co., Sherman Oaks, CA, 1983.

A good intoduction to the things you can do with your C64. A lower cost, smaller version of this book. Well written and informative.

Commodore Business Machines, *Commodore 64 User's Guide,* CBM & Howard W. Sams, 1983.

The manual that comes with the C64. Contains installation and operating instructions and lots of examples in BASIC. A good reference manual for beginners in C64 BASIC.

Commodore Business Machines, *Commodore 64 Programmer's Reference Guide,* CBM & Howard W. Sams, 1983.

A must for the serious programmer, this book has all the information you need about your C64. Includes BASIC, assembly language, operating system, hardware and software, wiring diagrams, applications, everything.

Commodore Business Machines, *Commodore Software Encyclopedia,* Commodore CBM, 1983.

A comprehensive guide to available software and hardware. Very useful!

COMPUTE! Staff, *COMPUTE!'s First Book of Commodore 64,* COMPUTE! Publications, Inc., Greensboro, NC, 1983.

For beginners and experts, this book starts from elementary BASIC and proceeds to the more advanced topics of video, sprites and joysticks, games, peripherals, memory management. It even contains a machine-language editor. Lots of goodies in this book.

COMPUTE! Staff, *COMPUTE!'s First Book of Commodore 64 Sound and Graphics, COMPUTE!* Publications, Inc., Greensboro, NC, 1983.

Written for both beginners and advanced progammers, this book moves from simple to advanced graphics and sound. Many of the programs are from *COMPUTE!* magazine and *COMPUTE!*'s Gazette. Programs include MusicMaster and High-resolution Sketchpad, both of them fun and useful. About a dozen different writers contributed to the book.

Consumers Guide, *The User's Guide to Commodore 64 and Vic 20: Computers, Software, & Peripherals,* Pocket Books, Simon & Schuster Inc., New York, NY, 1983.

This book is a step-by-step guide to connecting and using the Commodore 64. Directions are clear and detailed, with lots of photographs. Use of the keyboard is discussed in depth, as are periperals. The more popular applications software is discussed.

John Heilborn, *Commodore 64 Graphics,* COMPUTE! Publications, Inc., Greensboro, NC, 1983.

This book is a definite must for those who want to program their own graphics in BASIC. Contents include Designing Graphic Shapes, Color, Animation and Advanced Graphics. Sprites and bit mapping are discussed in detail. The book assumes that you are familiar with BASIC.

John Heilborn and Ron Talbott, *Your Commodore 64; A Guide to the Commodore 64 Computer,* Osborne/McGraw-Hill, Berkeley, CA, 1983.

A very useful book. Shows you how to program your C64 in BASIC. Covers games, graphics, sound, operating techniques, system architecture, hardware, and much more.

Ron Jeffries, Glen Fisher, Brian Sawyer, *Commodore 64 Fun and Games,* Osborne/McGraw-Hill, Berkeley, CA, 1984.

A collection of fairly elaborate and unusual games for your Commodore 64, including Roadhog, Piano, Bets, Safe, Hanoi (the towers of Hanoi problem), Mad (madlibs), Yahtzee, Lawn, Bjack, Fire, and many others. What sets this book apart is its choice of games: you won't find these games elsewhere, and there is very little violence. A good collection.

Joseph Kascmer, *The Easy Guide to Your Commodore 64,* Sybex Inc., Berkeley, CA, 1983.

For the beginner, this book takes an interesting, hands-on approach to teaching you BASIC, with emphasis on string manipulation rather than graphics. It is well written, and it gets you programming right away.

Donald C. Kreutner, *Commodore 64, Favorite Programs Explained,* Que Corporation, Indianapolis, IN, 1983.

Contains forty practical and entertaining programs covering math and problem solving, games, business, educational, and miscellaneous. Each program is explained in detail, something that most other books of this kind do not do. You will learn a lot of BASIC from this book.

Stan Krute, *Commodore 64 Graphics and Sound Progamming,* Tab Books Inc., Blue Ridge Summit, PA, 1983.

Written for the advanced beginner/intermediate programmer who wants to learn about graphics and sound. It covers all of the material you would expect in a solid course on graphics and sound, and then some. Designed for hands-on approach, each topic is introduced with a practical example. You are expected to learn elementary BASIC from some other source. A well-written, useful, high-powered book.

Sally Greenwood Larsen, *Sprite Graphics for the Commodore 64,* Micro Text Publications, Inc., Prentice-Hall, Inc., Englewood Cliffs, NJ, 1983.

This book is entirely about sprite graphics! It is a clear introduction to the subject, written for beginners, and guaranteed to help you understand what is going on. Contains lots of easy-to-follow programs. If you have had trouble understanding sprites, this book is for you.

David Lawrence and Mark England, *Commodore 64 Machine Code Master,* Sunshine Books, London, England, 1983.

This is a fun book for those who really want to understand what is going on inside the C64. It presents the code and explanation for a monitor, disassembler, file editor, and BASIC extender. Well written and extremely informative. It is not for the beginner.

Hank Librach and Bill L. Behrendt, *Using the Commodore 64 in the Home,* Prentice-Hall, Inc., Englewood Cliffs, NJ, 1983.

Contains twenty programs, including explanations and tips, for just about everything you can think of around the home.

Tim Onosko, *Commodore 64: Getting the Most from It,* Robert J. Brady Co. (Prentice-Hall), Bowie, MD, 1983.

Very similar to the book you are reading, this one covers more BASIC, graphics, and sound, and less applications. Written for the serious beginner, this book is full of useful information. Several appendices cover bit mapping, the sound interface device, memory management, and other topics. It's a good book to have.

Timothy Orr Knight and Darren LaBatt, *Commodore 64 BASIC Programs,* Howard W. Sams, Inc., 1983.

An excellent book for C64 owners, it contains examples in BASIC for all the things you can do with C64 color graphics and sound. Contains games, educational programs, home programs, utility programs. Comes with a cassette of all the programs.

Richard Peddicord, *Beginning BASIC on the Commodore 64,* Alfred Publishing Co., Sherman Oaks, CA, 1984.

A Handy Disk version of *Understanding Commodore 64 BASIC,* this package contains a book and a diskette. The diskette has all the examples used in the text, solutions to the exercises, and many useful programs. Contains additional, more advanced material than the associated Handy Guide. A fun, practical way to learn. Requires a disk drive.

Richard Peddicord, *Creating Graphics and Music on the Commodore 64,* Alfred Publishing Co., Sherman Oaks, CA, 1984.

A Handy Disk. The diskette has all the examples used in the text, solutions to the exercises, and many useful programs. Contains additional, more advanced materials than the associated Handy Guide, including bit mapping and animation techniques. Requires a disk drive.

Richard Peddicord and Nancy van Hee, *Understanding Commodore 64 BASIC,* Alfred Publishing Co., Sherman Oaks, CA, 1984.

An introduction to BASIC on the C64 for those with no prior experience with computers. Easy to read, lots of exercises.

Richard Peddicord and Ian Kluft, *Understanding Commodore 64 Graphics,* Alfred Publishing Co., Sherman Oaks, CA, 1984.

For C64 owners who wish to do their own BASIC programming in games, graphics, and sound. Covers the programming aspects, including sprites and character generation. For serious beginners.

Clifford Ramshaw and Mark Ramshaw, *Comodore 64 Games Book.* Melbourne House Publishers, Nashville, TN, 1983.

A solid book of game programs in BASIC. Each program has checksums that allow you to detect errors in your program entry. Games include Cats & Dogs, Sea Harrier, Horse Racing, Cosmic Bugs, Martian Invasion, Castle of Doom, and many others. Looks like a lot of fun.

Tom Rugg, Phil Feldman, and the Western Systems Group, *More than 32 BASIC Programs for the Commodore 64 Computer,* dilithium Press, Beaverton, OR, 1983.

A book of BASIC programs for your C64. Excellent documentation and many different kinds of programs. You should know some BASIC before you start this book, since it jumps right in. A good book to have.

Nevin B. Scrimshaw and James Vogel, *An Introduction to the Commodore 64: Adventures in Programming,* Birkhauser, Boston, MA, 1983.

For the beginner, this book provides an introduction to the keyboard, screen editor, and the basic language. Topics include sound and graphics and number theory. The programs are short and easy to follow. A good introduction to the Commodore 64.

Charles D. Sternberg, *Commodore 64 Programs for the Home,* Hayden Book Company, Inc., Hasbrouck Heights, NJ, 1983.

A collection of short and useful programs for home use. Categories include financial, household helpers, home worker programs, children's work and play, schoolwork, outside activities and recreation. A good book of programs that the beginner can enter and use.

Weber Systems Incorporated Staff, *Commodore 64 User's Handbook,* Weber Systems, Inc., Cleveland, OH, 1983.

A convenient user's guide for C64 owners. Covers installation, operation, and BASIC instuctions for the C64 and several of its peripherals, including the Datasette and 1541 disk drive. Covers sound and graphics and use of sprites. Appendices on error messages and character codes. Integrates information hitherto available only from separate sources.

WIDL Staff, *The Blue Book for the Commodore Computer,* WIDL Video Publications, Chicago, IL, 1983/84.

A comprehensive guide to the software, hardware and literature for the Commodore 64 (and the Pet, Vic 20, and some of their business machines). A most useful book if you are shopping for these things.

Jerry Willis and Deborrah Willis, *How To Use the Commodore 64,* Dilithium Press, Beaverton, OR, 1984.

For the novice computer user, this book covers the basic components and their use, elementary BASIC programming, including sound and graphics. Available hardware, software, and publications are discussed. Well written and informative.

Periodicals

***Ahoy!*, Ion International Inc., 45 W. 34th St., Room 407, New York, NY 10001.**

A monthly magazine devoted to Commodore users. Independently published, it gives a balanced view of the hardware and software products available for Commodore machines. Contains programming tips too.

***Commander,* Micro Systems Specialties.**

A monthly magazine for Commodore users.

***Commodore Microcomputer Magazine,* Commodore Business Machines.**

The magazine for in-depth information for Commodore users. Lots of technical information and programming techniques. A must for serious programmers and other brainy types. Six issues per year.

***Commodore Power/Play,* Commodore Business Machines.**

A lighter, home computing-oriented quarterly. Features include games and entertrainment, users groups, software reviews, programming tips for beginners.

***Commodore West,* San Fancisco Commodore Users Group.**

A monthly newsletter, typical of a large user's group.

***COMPUTE!* (The Journal for Progressive Computing), COMPUTE! Publications, P.O. Box 5406, Greensboro, NC 27409.**

A thick monthly magazine covering all the popular microcomputers. Good articles and an even-handed treatment of the different manufacturers. You should read it as much as you can.

***COMPUTE! GAZETTE,* COMPUTE! Publications, P.O. Box 5406, Greensboro, NC 27409.**

Similar to *COMPUTE!* but dedicated entirely to the C-64.

***Computer Buyer's Guide and Handbook,* Computer Information Publishing, Inc., Box 1563, FDR Station, New York, NY 10150.**

Everything you need to know to buy the right computer system for business, education, and the home. What they do, how they do it, what they cost. A bimonthly covering all popular microcomputers.

***Computer Graphics World,* PennWell Publishing Company Advanced Technology Group, 1421 South Sheridan, Tulsa, OK 74112.**

This is a heavywieght magazine for people who care about computer graphics. If you are at all interested in graphics, look through copies of this magazine. It shows you the state of the art.

***Computers & Electronics,* Ziff-Davis Publishing Company, One Park Ave., New York, NY 10016.**

This used to be *Popular Electronics* and it was devoted only to that subject. Now the emphasis is on personal computing and electronics. A good synthesis of these two directions. A very popular magazine.

***Creative Computing,* Ahl Computing (Ziff-Davis), P.O. Box 789-M, Morristown, MJ 07960.**

Another thick, useful magazine covering personal computers. Contents include evaluations and profiles, articles, applications and software. Everyone buys this one.

Electronic Games, **Rees Communications Incorporated, 460 West 34th St., New York, NY 10001.**

A monthly magazine for electronic and computer game enthusiasts. Covers personal microcomputer game software and game-only computers.

Family Computing, **Scholastic Inc., 730 Broadway, New York, NY 20003.**

A monthly magazine devoted to applications and hardware that are of interest to families that share their computer. Lots of educational material is reviewed. A good publication for teachers, too.

Hampton's Buyer's Guide to Small Computers, **Hampton International Communications, 60 East 42nd St., Suite 3415, New York, NY 10017.**

A quarterly, well-researched buyer's guide.

Personal Software, **Hayden Publishing Company, 10 Mulholand Drive, Hasbrouck Heights, NJ 07604.**

A monthly review of the best software packages for personal computers. Contains buyer's guides. Check this publication before you buy any software.

Popular Computing, **McGraw-Hill Publications Company, 70 Main Street, Peterborough, NH 03458.**

A thick, useful monthly magazine covering personal computers. A good cross section of what's happening.

Run, **Wayne Green, Inc., 80 Pine St., Peterborough, NH 03458.**

A monthly magazine devoted to the Commodore 64 and VIC-20.

APPENDIX C: Commodore Users Groups

Users groups are just that: a collection of people who get together to share their common interest in the C64. They usually conduct regular meetings, offer electronic bulletin boards, and some publish newsletters. If you have a problem you can't solve or are looking for new uses for your C64, someone in the group might just have the answer.

ALABAMA
Huntsville PET Users Group, 9002 Berclair Rd., Huntsville, AL 35802.

ALASKA
COMPOOH-T, Box 118, Old Harbor, AK 99643.

ARIZONA
VIC Users Group, 2612 E. Covina, Mesa, AZ 85203.

Catalina Commodore Computer Club, 2012 Avenida Guillermo, Tucson, AZ 85710.

Central Arizona PET People, 842 W. Calle del Norte, Chandler, AZ 85224.

ACUG, c/o Home Computer Service, 2028 W. Camelback Rd., Phoenix, AZ 85015.

West Mesa VIC, 2351 S. Standage, Mesa, AZ 85202.

ARKANSAS
Commodore/Pet Users Club, Conway Middle School, Davis St., Conway, AR 72032.

Boonville 64 Club, c/o A.R. Hederick Elementary School, 401 W. 5th St., Booneville, AR 72927.

CALIFORNIA
SCPUG Southern California, PET Users Group, c/o Data Equipment Supply Corp., 8315 Firestone Blvd., Downey, CA 90241.

California VIC Users Group, c/o Data Equipment Supply Corp., 8315 Firestone Blvd., Downey, CA 90241.

Commodore Users Clubs, 1041 Foxenwoods Dr., Santa Maria, CA 93455.

Valley Computer Club, 2006 Magnolia Blvd., Burbank, CA 91506.

Valley Computer Club, 1913 Booth Rd., Ceres, CA 95307.

PUG of Silicon Valley, 22355 Rancho Ventura Rd., Cupertino, CA 95014.

Lincoln Computer Club, 750 E. Yosemite, Manteca, CA 95334.

PET on the Air, 525 Crestlake Dr., San Francisco, CA 94132.

PALS (Pets Around), Livermore Society, 886 South K, Livermore, CA 94550.

SPHINX, 7615 Leviston Ave., El Cerrito, CA 94530.

San Diego PUG, c/o D. Costarakis, 3562 Union St., San Diego, CA.

Walnut Creek PET Users Club, 1815 Ygnacio Valley Rd., Walnut Creek, CA 94596.

Jurupa Wizards, 4526 Kingsbury Pl., Riverside, CA 92503.

The Commodore Connection, 2301 Mission St., Santa Cruz, CA 95060.

San Fernando Valley Commodore Users Group, 21208 Nashville, Chatsworth, CA 91311.

VACUUM, 277 E. 10th Ave., Chico, CA 95926.

VIC 20 Users Group, 2791 McBride Ln. #121, Santa Rosa, CA 95401.

South Bay Commodore Users Group, 1402 W. 218th St., Torrance, CA 90501.

Slo VIC 20/64 Computer Club, 1766 9th St., Los Osos, CA 93402.

The Diamond Bar R.O.P. Users Club, c/o Rincom School, 2800 Hollingworth, West Covina, CA 91792.

Commodore Interest Association, c/o Computer Data, 14660 La Paz Dr., Victorville, CA 92392.

Fairfield VIC 20 Club, 1336 McKinley St., Fairfield, CA 94533.

Computer Barn Computer Club, 319 Main St., Suite #2, Salinas, CA 93901.

Humboldt Commodore Club, P.O. Box 570, Arcata, CA 95521.

Napa Valley Commodore Computer Club, c/o Liberty Computerware, 2680 Jefferson St., Napa, CA 94558.

S.D. Eastcounty C-64 Users Group, 6353 Lake Apopka Pl., San Diego, CA 92119.

COLORADO

VICKIMPET Users Group, 4 Waring Lane, Greenwood Village, Littleton, CO 80227.

Colorado Commodore Computer Club, 2187 S. Golden Ct., Denver, CO 80227.

CONNECTICUT

John F. Garbarino, Skiff Lane, Masons Island, Mystic, CT 06355.

Commodore Users Club, Wethersfield High School, 411 Wolcott Hill Rd., Wethersfield, CT 06109.

VIC Users Club, c/o Edward Barszczewski, 22 Tunxis Rd., West Hartford, CT 06107.

New London County Commodore Club, Doolittle Rd., Preston, CT 06360.

FLORIDA

Jacksonville Area PET Society, 401 Monument Rd., #177, Jacksonville, FL 32211.

Richard Prestien, 6278 SW 14th St., Miami, FL 33144.

South Florida PET Users Group, Dave Young, 7170 S.W. 11th, West Hollywood, FL 33023.

VIC Users Club, c/o Ray Thigpen, 4071 Edgewater Dr., Orlando, FL 32804.

PETs and Friends, 129 NE 44 St., Miami, FL 33137.

Sun Coast VICs, P.O. Box 1042, Indian Rocks Beach, FL 33535.

Bay Commodore Users Group, c/o Gulf Coast Computer Exchange, 241 N. Tyndall Pkwy., P.O. Box 6215, Panama City, FL 32401.

Gainesville Commodore Users Club, 3604-20A SW 31st Dr., Gainesville, FL 32608.

64 Users Group, P.O. Box 561689, Miami, FL 33156.

Brandon Users Group, 108 Anglewood Dr., Brandon, FL 33511.

Commodore 64/VIC 20 Users Group, Martin Marietta Aerospace, P.O. Box 5837, MP 142, Orlando, FL 32855.

Brandon Commodore Users Group, 414 E. Lumsden Rd., Brandon, FL 33511.

Gainesville Commodore Users Group, Santa Fe Community College, Gainesville, FL 32602.

Commodore Computer Club, P.O. Box 21138, St. Petersburg, FL 33742.

GEORGIA
VIC Education Users Group, Cherokee County Schools, 110 Academy St., Canton, GA 30114.

VIC-tims, P.O. Box 467052, Atlanta, GA 30346.

HAWAII
Commodore Users Group of Honolulu, c/o PSH, 824 Bannister St., Honolulu, HI 96819.

IDAHO
GHS Computer, c/o Grangeville High School, 910 S.D. St., Grangeville, ID 83530.

S.R.H.S. Computer Club, c/o Salmon River High School, Riggins, ID 83549.

Commodore Users, 548 E. Center, Pocatello, ID 83201.

Eagle Rock Commodore Users Group, 900 S. Emerson, Idaho Falls, ID 83401.

ILLINOIS
Shelly Wernikoff, 2731 N. Milwaukee Ave., Chicago, IL 60647.

VIC 20/64 Users Support Group, c/o David R. Tarvin, 114 S. Clark St., Pana, IL 62557.

Central Illinois PET User Group, 635 Maple, Mt. Zion, IL 62549.

ASM/TED User Group, 200 S. Century, Rantoul, IL 61866.

PET VIC Club (PVC), 40 S. Lincoln, Mundelein, IL 60060.

Rockford Area PET Users Group, 1608 Benton St., Rockford, IL 61107.

Commodore Users Club, 1707 East Main St., Olney, IL 62450.

VIC Chicago Club, 3822 N. Bell Ave., Chicago, IL 60618.

Chicago Commodore 64 Users & Exchange Group, P.O. Box 14233, Chicago, IL 60614.

Fox Valley PET Users Group, 833 Willow St., Lake in the Hills, IL 60102.

The Commodore 64 Users Group, 4200 Commerce Ct., Suite 100, Lisle, IL 60532.

Oak Lawn Commodore Users Group, The Computer Store, 11004 S. Cicero Ave., Oak Lawn, IL 60453.

INDIANA
PET/64 Users, 10136 E. 96th St., Indianapolis, IN 46256.

Cardinal Sales, 6225 Coffman Rd. Indianapolis, IN 46268.

CHUG (Commodore Hardware Users Group), 12104 Meadow Lane, Oaklandon, IN 46236.

VIC Indy Club, P.O. Box 11543, Indianapolis, IN 46201.

Northern Indiana Commodore Enthusiasts, 927 S. 26th St., South Bend, IN 46615.

Commodore Users Group, 1020 Michigan Ave., Logansport, IN 46947.

Computer Workshop VIC 20/64 Club, 282 S. 600 W., Hebron, IN 46341.

The National Science Clubs of America Commodore Users Division, 7704 Taft St., Merrillville, IN 46410.

East Central Indiana VIC User Group, Rural Route #2, Portland, IN 47371.

National VIC 20 Program Exchange, 102 Hickory Court, Portland, IN 47371.

IOWA
Commodore Users Group, 114 8th St., Ames, IA 50010.

Quad City Commodore Club, 1721 Grant St., Bettendorf, IA 52722.

Commodore Users Group, 965 2nd St., Marion, IA 52302.

Siouxland Commodore Club, 2700 Sheridan St., Sioux City, IA 51104.

Commodore Computer Users Group of Iowa, Box 3140, Des Moines, IA 50316.

KANSAS
Wichita Area PET Users Group, 2231 Bullinger, Wichita, KS 67204.

Kansas Commodore Computer Club, 101 S. Burch, Olathe, KS 66061.

Commodore Users Group, 6050 S. 183 St. West, Viola, KS 67149.

KENTUCKY
VIC Connection, 1010 S. Elm, Henderson, KY 42420.

LOUISIANA
Franklin Parish Computer Club, #3 Fair Ave., Winnisboro, LA 71295.

NOVA, 917 Gordon St., New Orleans, LA 70117.

VIC 20 Users Group, 5064 Bowdon St., Marrero, LA 70072.

MARYLAND
Association of Personal Computer Users, 5014 Rodman Rd., Bethesda, MD 20016.

Blue TUSK, 700 East Joppa Rd., Baltimore, MD 21204.

House of Commodore, 8835 Satyr Hill Rd., Baltimore, MD 21234.

Long Lines Computer Club, 323 N. Charles St., Rm. 201, Baltimore, MD 21201.

VIC & 64 Users Group, The Boyds Connection, 21000 Clarksburg Rd., Boyds, MD 20841.

VIC 20 Users Group, 23 Coventry Lane, Hagerstown, MD 21740.

Hagerstown Users Group, 1201-B Marshall St., Hagerstown, MD 21740.

Rockville VIC/64 Users Group, 13013 Evanstown St., Rockville, MD 20853.

MASSACHUSETTS
Eastern Massachusetts VIC Users Group, c/o Frank Ordway, 7 Flagg Rd., Marlboro, MA 02173.

VIC Users Group, c/o Ilene Hoffman-Sholar, 193 Garden St., Needham, MA 02129.

Commodore Users Club, Stoughton High School, Stoughton, MA 02072.

Berkshire PET Lovers CBM Users Group, Taconic High School, Pittsfield, MA 0120l.

The Boston Computer Society, Three Center Plaza, Boston, MA 02108.

VIC Interface Club, c/o Procter & Gamble Inst. Shop, 780 Washington St., Quincy, MA 02169.

Masspet Commodore Users Group, P.O. Box 307, East Taunton, MA 02718.

Raytheon Commodore Users Group, Raytheon Company, Hartwell Rd. GRA-6, Bedford, MA 01730.

Commodore 64 Users Group of The Berkshires, 184 Highland Ave., Pittsfield, MA 01201.

MICHIGAN
David Liem, 14361 Warwick St., Detroit, MI 48223.

VIC Users Group, University of Michgan School of Public Health, Ann Arbor, MI 48109.

Commodore User Club, 32303 Columbus Dr., Warren, MI 48093.

Commodore Users Group, c/o Family Computer, 3947 W. 12 Mile Rd., Berkley, MI 48072.

W. Michigan VIC 20-64 Users, 1311 Portland NE, Grand Rapids, MI 49505.

VIC for Business, 6027 Orchard Ct., Lansing, MI 48910.

South Computer Club, South Jr. High School, 45201 Owen, Belleville, MI 48111.

Commodore Users Group, c/o Eaton Rapids Medical Clinic, 101 Spicerville Hwy., Eaton Rapids, MI 48827.

South East Michigan Pet Users Group, H. Dow High School, Rm 226, Midland, MI 48640.

VIC 64, PET Users Group, 8439 Arlis Rd., Union Lake, MI 48085.

MINNESOTA
MUPET (Minnesota Users of PET), P.O. Box 179, Annandale, MN 55302.

Twin Cities Commodore Computer Club, 6623 Ives Lane, Maple Grove, MN 55369.

MISSOURI
KCPUG, 5214 Blue Ridge Blvd., Kansas City, MO 64133.

PET SET Club of St. Louis, 633 Bent Oak Dr., Lake St. Louis, MO 63367.

VIC INFONET, P.O. Box 1069, Branson, MO 65616.

Worth County PET Users Group, Grant City, MO.

Mid-Missouri Commodore Club, 1804 Vandiver Dr., Columbia, MO 65201.

MONTANA
Powder River Computer Club, Powder River County High School, Broadus, MT 59317.

Commodore User Club, 1109 West Broadway, Butte, MT 59701.

NEVADA
Las Vegas PET Users, 4884 Iron Ave., Las Vegas, NV 89110.

NEW JERSEY
Amateur Computer Group, 18 Alpine Dr. Wayne, NJ 07470.

Somerset Users Club, 49 Marcy St., Somerset, NJ 08873.

Educators Advisory, P.O. Box 186, Medford, NJ 08055.

VIC-TIMES, 46 Wayne St., Edison, NJ 08817.

VIC 20 User Group, 67 Distler Ave., W. Caldwell, NJ 07006.

VIC Software Development Club, 77 Fomalhaut Ave., Sewell, NJ 08080.

ACGNJ PET/VIC/CBM Users Group, 30 Riverview Terr., Belle Mead, NJ 08502.

South Jersey Commodore Computer Users Club, 46-B Monroe Park, Maple Shade, NJ 08052.

Parsippany Computer Group, 51 Ferncliff Rd., Morris Plains, NJ 07950.

NEW HAMPSHIRE
Northern New England Computer Society, P.O. Box 69, Berlin, NH 03570.

TBH VIC-NICs, P.O. Box 981, Salem, NH 03079.

NEW MEXICO
Commodore Users Group, 6212 Karlson, NE, Albuquerque, NM 87113.

NEW YORK
Capital District 64/VIC 20 Users Group, 363 Hamilton St., Albany, NY 12210.

Long Island PET Society, Harborfields High School, Taylor Ave., Greenlawn, NY 11740.

PET User Club of Westchester, P.O. Box 1280, White Plains, NY 10602.

LIVE (Long Island VIC Enthusiasts), 17 Picadilly Rd., Great Neck, NY 11023.

Commodore Masters, 25 Croton Ave., Staten Island, NY 10301.

VIC Users Club, 76 Radford St., Staten Island, NY 10314.

Rockland County Commodore Users Group, c/o Ross Garber, 14 Hillside Court, Suffern, NY 10901.

West Chester County VIC Users Group, P.O. Box 146, Pelham, NY 10552.

SPUG, 4782 Boston Post Rd., Pelham, NY 10803.

VIC 20 User Club, 151-28 22nd Ave., Whitestone, NY 11357.

VIC 20 User Club, 339 Park Ave., Babylon, NY 11702.

VIC Users Group, 1250 Ocean Ave., Brooklyn, NY 11230.

L&M Computer Club VIC 20 & 64, 4 Clinton St., Tully, NY 13159.

Commodore Users Group, 1 Corwin Pl., Lake Katrine, NY 12449.

8*8 Enthusiasts, P.O. Box 28, Rhodes Rd., Apalachin, NY 13732.

VIC 20/Commodore 64 Users Group, 31 Maple Dr., Lindenhurst, NY 11757.

VIC Information Exchange Club, 336 W. 23 St., Deer Park, NY 11729.

New York Commodore Users Group, 380 Riverside Dr., 7Q, New York, NY 10025.

Hudson Valley Commodore Club, 1 Manor Dr., Woodstock, NY 12498.

LIVICS (Long Island VIC Society), 20 Spyglass Lane, East Setauket, NY 11733.

VIC Users Group, c/o Stoney Brook Learning Center, 1424 Stoney Brook Rd., Stoney Brook, NY 11790.

NORTH CAROLINA

Amateur Radio PET Users Group, P.O. Box 30694, Raleigh, NC 27622.

VIC Users Club, c/o David C. Fonenberry, Route 3, Box 351, Lincolnton, NC 28092.

Microcomputer Users Club, Box 17142 Bethabara Sta., Winston-Salem, NC 27116.

VIC Users Club, RT.11, Box 686, Hickory, NC 28601.

OHIO

Dayton Area PET User Group, 933 Livingston Dr., Xenia, OH 45385.

Central Ohio PET Users Group, 107 S. Westmoor Ave., Columbus, OH 43204.

Chillicothe Commodore Users Group, P.O. Box 211, Chillicothe, OH 45601.

Licking County 64 Users Group, 323 Schuler St., Newark, OH 43055.

OKLAHOMA

Southwest Oklahoma Computer Club, P.O. Box 6646, Lawton, OK 73504.

Tulsa Area Commodore Users Group, Tulsa Computer Society, P.O. Box 15238, Tulsa, OK 74112.

Commodore Oklahoma Users Club, 4000 NW 14th St., Oklahoma City, OK 73107.

OREGON

NW PET Users Group, c/o John F. Jones, 2134 N.E. 45th Ave., Portland, OR 97213.

PENNSYLVANIA

PET User Group, c/o Gene Beals, P.O. Box 371, Montgomeryville, PA 18936.

Penn Conference Computer Club, c/o Penn Conference of SDA, 720 Museum Rd., Reading, PA 19611.

PACS PET Users Group, 20th & Olney Street, Philadelphia, PA 19120.

Glen Schwartz, 807 Avon, Philadelphia, PA 19116.

Gene Planchak, 4820 Anne Lane, Sharpsville, PA 15150.

PPG (Pittsburgh PET Group), c/o Joel A. Casar, 2015 Garrick Dr., Pittsburgh, PA 15235.

Westmoreland Commodore Users Club, c/o DJ & Son Electronics, Colonial Plaza, Latrobe, PA 15650.

COMPSTARS, 440 Manatawny St., Pottstown, PA 19464.

Commodore Users Club, 3021 Ben Venue Dr., Greensburg, PA 15601.

VIC 20 Programmers, Inc., c/o Watson Woods, 115 Old Spring Rd., Coatesville, PA 19320.

G.R.C. User Club, 300 Whitten Hollow Rd., New Kensington, PA 15068.

NADC Commodore Users Club, 248 Oakdale Ave., Horsham, PA 19044.

CCAC (Capital Area Commodore Club), 134 College Hill Rd., Enola, PA 17025.

G/C Computer Owners Group, P.O. Box 1498, Reading, PA 19607.

PUERTO RICO
CUG of Puerto Rico, RFD #1, Box 13, San Juan, PR 00914.

VIC 20 User Group, 655 Hernandez St., Miramar, PR 00907.

RHODE ISLAND
Irving B. Silverman, 160 Taunton Ave., E. Providence, RI 02914.

Newport VIC/64 Users, 10 Maitland Ct., Newport, RI 02840.

The VIC 20 Users Club, Warwick, RI 02886.

SOUTH CAROLINA
Beauford Technical College, 100 S. Ribaut Rd., Beauford, SC 29902.

SOUTH DAKOTA
PET User Group, 515 South Duff, Mitchell, SD 57301.

VIC/64 Users Club, 203 E. Sioux Ave., Pierre, SD 57501.

TENNESSEE
River City Computer Hobbyists, Memphis, TN.

Nashville Commodore Users Group, P.O. Box 121282, Nashville, TN 37212.

Commodore User Club, Metro Computer Center, 1800 Dayton Blvd., Chattanooga, TN 37405.

Metro-Knoxville 64 Users Club, 7405 Oxmoor Rd., Rt. #20, Knoxville, TN 37921.

TEXAS
SCOPE, 1020 Summit Circle, Carrolton, TX 75006.

PET Users, 2001 Bryan Tower, Suite 3800, Dallas, TX 75201.

Larry Williams, P.O. Box 652, San Antonio, TX 78293.

PET User Group, John Bowen Texas A & M Microcomputer Club, Texas A & M, College Station, TX 77843.

CHUG (Commodore Houston Users Group), 8738 Wildforest, Houston, TX 77088.

Corpus Christi Commodores, 3650 Topeka St., Corpus Christi, TX 78411.

Commodore Users Group, 5326 Cameron Rd., Austin, TX 78723.

VIC Users Group, 3817 64th Dr., Lubbock, TX 79413.

Southwest Houston VIC Users Group, 11423 Kirk Valley Dr., Houston, TX 77089.

64 Users Group, 2421 Midnight Circle, Plana, TX 75075.

UTAH
Utah PUG, Jack Fleck, 2236 Washington Blvd., Ogden, UT 84401.

The Commodore Users Club, 742 Taylor Ave., Ogden, UT 84404.

The VIClic, 799 Ponderosa Dr., Sandy, UT 84070.

VIC 20 Users, 324 N. 300 W. Smithfield, UT 84335.

Northern Utah VIC & 64 Users Group, P.O. Box 533, Garland, UT 84312.

The Utah Commodore Users Group, 652 West 700 North, Clearfield, UT 84015.

VIRGINIA
Northern VA PET Users, c/o Bob Karpen, 2045 Eakins Court, Reston, VA 22091.

VIC Users Group, Rt. 2, Box 180, Lynchburg, VA 24501.

Dale City Commodore Users Group, P.O. Box 2004, Dale City, VA 22193.

Tidewater Commodore Users Group, 4917 Westgrove Rd., Virginia Beach, VA 23455.

Fredericksburg Area Computer Enthusiasts, P.O. Box 324, Locust Grove, VA 22508.

Commonwealth 20/64 Users Group, 1773 Wainwright Dr., Reston, VA 22090.

VIC 20 Victims, 4301 Columbia Pike #410, Arlington, VA 22204.

Peninsula Commodore 64 Users Group, 124 Burnham Place, Newport News, VA 23606.

WASHINGTON
NW PET Users Group, 2565 Dexter N. 3203, Seattle, WA 98109.

PET Users Group, c/o Kenneth Tong, 1800 Taylor Ave. N102, Seattle, WA 98102.

Whidbey Island Commodore Computer Club, 947 N. Burroughs Ave., Oak Harbor, WA 98277.

Central Washington Commodore Users Group, 1222 S. 1st St., Yakima, WA 98902.

Blue Mountain Commodore Users Club, 667 Canary Dr., Walla Walla, WA 99362.

WEST VIRGINIA
Personal Computer Club, P.O. Box 1301, Charleston, WV 25325.

WISCONSIN
Sewpus, c/o Theodore J. Polozynski, P.O. Box 21851, Milwaukee, WI 53221.

Waukesha Area Commodore Users Group (WACUG), 256.5 W. Broadway, Waukesha, WI 53186.

Commodore User Group, 1130 Elm Grove, WI 53122.

Comodore 64 Software Exchange Group, P.O. Box 224, Oregon, WI 53575.

C.L.U.B 84, 6156 Douglas Ave., Caledonia, WI 53108.

VIC-20 & 64 User Group, 522 West Bergen Dr., Milwaukee, WI 53217.

CANADA
Toronto PET Users Group, 381 Lawrence Ave. West, Toronto, Ontario, Canada M5M 1B9.

PET Users Club, c/o Mr. Brown, Valley Heights Secondary School, Box 159, Langton, Ontario, Canada N0E 1G0.

Vancouver PET Users Group, P.O. Box 91164, West Vancouver, British Columbia, Canada V7V 3N6.

CCCC (Canadian Commodore Computer Club), c/o Strictly Commodore, 47 Coachwood Pl., Calgary, Alberta, Canada T3H 1E1.

W.P.U.G., 9-300 Enniskillen Ave., Winnipeg, Manitoba, Canada R2V 0H9.

VIC-TIMS, 2-830 Helena St., Trail, British Columbia, Canada V1R 3X2.

Arva Hackers, Medway High School, Arva, Ontario, Canada N0M 1C0.

Nova Scotia Commodore Computer Users Group, 66 Landrace Cres., Dartmouth, Novia Scotia, Canada B2W 2P9.

Bonnyville VIC Cursors, Box 2100, Bonnyville, Alberta, Canada T0A 0L0.

FINLAND
VIC-Club in Helsinki, Linnustajankj 2B7, SF-02940 ESP0094, Finalnd.

GERMANY
Kettenberg 24, D 5880 Lueden Scheid, West Germany.

ITALY
Commodore 64 Club, Universita di Studi shan, V. Avigliana 13/1, 10138 Torino, Italy.

KOREA
Commodore User's Club, K.P.O. Box 1437, Seoul, Korea.

MEXICO
Asociacion de Usarios Commodore, Holbein 174-6 Piso, Mexico 18, D.F.

Club de Usarios Commodore, Sigma del Norte, Mol del Valle, Local 44, Garza Garcia, N.L. 66220.

APPENDIX D: Audio, Video, and Binary Signals

Your Commodore 64 uses electrical signals to communicate with the various devices attached to it. These signals fall into three categories: audio, video, and binary. Humans communicate with their machines using mainly touch, sight, and sound. A keyboard and a joystick are touch systems. Your TV set or monitor and its speaker are sight and sound systems.

Audio Signals

As you probably know, sound only works when there is a physical media to conduct the sound waves. Sound, and just about everything else, is made of vibrations, that is, cycles per second. Today we use the unit *hertz* for cycles per second, in honor of a great radio head.

You can hear down to about sixteen hertz and up to about 15,000 hertz. Whales and dolphins communicating as a unit have the widest audio channel, from way below one hertz to way above 80 KHz. The whales can deliver enormous power into the water at low frequencies with their huge bodies, and they can vibrate their throat area at frequencies in our singing range. The songs of whales are heard thousands of miles away by other whales and sea creatures. Naturally some whales sing better than others, and there is always competition for lead singer of the group.

In a physical medium sound travels by compression waves. If you measure the pressure at a particular point in the media against time you will get patterns something like these shown in Figure D.1.

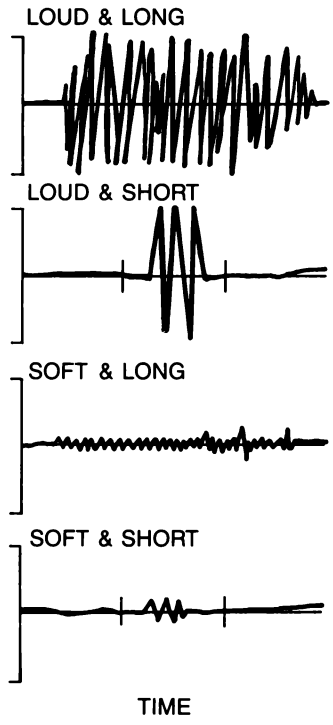


Figure D.I. Kinds of sounds

The Sound Interface Device in your Commodore 64 controls the frequency (pitch), the volume, and the tone of three separate sound sources. It's like having three singing dolphins with underwater tambourines.

How do these pressure signals get back and forth into electrical circuits so that they can carry messages to and from your Commodore 64? They use transducers. These devices, like microphones and speakers, couple mechanical energy with electrical energy by having the mechanical energy move a magnet across many turns of wire. Conversely, if there is sufficient electrical energy available, the electrons running through the wire will push the magnet, which will create mechanical energy.

You may have discovered that intercom systems use the same speaker as a microphone. This shows that the energy conversion can go in both directions.

So if you attach a transducer between air and an electrical line you can communicate with systems attached to the line. Inside the wires we measure electron pressure, not in pounds per square inch or millimeters of mercury, but in a nice short unit, the *volt,* named after the Italian physicist Alessandro Volta.

There is a useful device called an oscilloscope that displays these electrical signals against time. The phrase "no respect, no respect . . ." by Rodney Dangerfield is shown in Figure D.2.

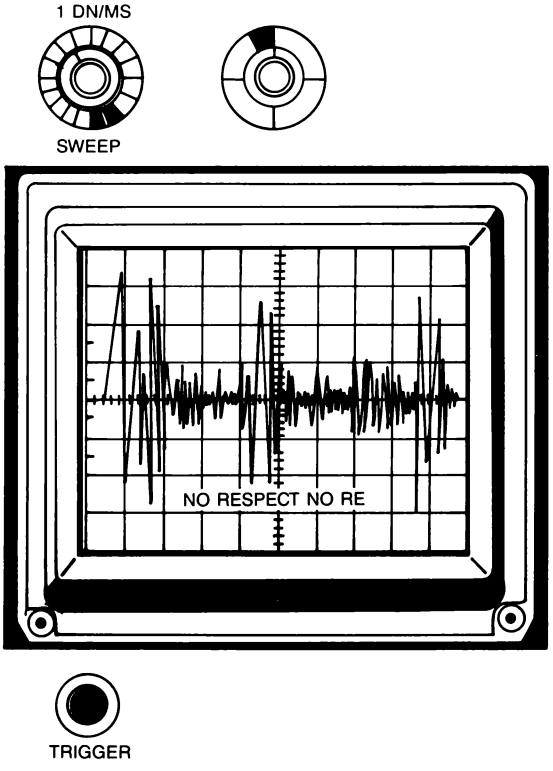


Figure D.2. Audio signal on oscilloscope

Your Commodore 64 can generate signals from about thirty hertz to about 15 KHz. This covers your range of hearing. There is no point in making the audio electronics process higher frequencies.

Image Transmission

Transmitting pictures is harder than transmitting sounds, because so much more information must be sent per second. The standard television channel requires frequencies from zero hertz to about 4,200,000 hertz, or 4.2 megahertz, abbreviated 4.2MHz.

How does a real scene get converted into an electrical signal that can be sent across great distances?

It's really very simple. Something has to scan the image on the transmitting end while something reconstructs it on the other end.

Television is a way of converting an endless sequence of "snapshots" into a radio signal to send to distant sets. The "snapshots" are like the single frames in a movie camera film, except they shine on electrically sensitive surfaces and are stored electronically.

To understand how TV works, pretend you are a crop duster flying over a huge field on which a picture has been painted by local high school students.

Now suppose you want to recreate this same image on a field somewhere else. One way to do it would be to hire two crop-dusters from the same company, one to scan the source image, and one to reconstruct an object image.

You have to section the source image into rows along which the source plane flies, and do the same with the object image. Both pilots must fly the exact same scanning pattern, so as to be over similar spots of each image at the same time.

The source plane would have three light meters, one with a red filter, one with blue, one with green. As the pilot flies low over the source image, her assistant calls out the red, blue, and green readings.

The object plan has three huge cans of paint, one red, one green, and one blue. As the copilot hears the readings from the source plane copilot, he turns the valves on the three paint cans.

You can see that if the reconstructed picture is to make any visual sense at all, the two pilots must be flying the same pattern, each being over the same "spot" of

the image area. When both pilots are done, the object image will be a copy of the source image. How good a copy depends on all the factors involved.

The Color Television Signal

Color television uses the same three primary colors as did our cropdusters: red, blue, and green. If you look very closely at your color TV screen you will see that it is made up of a mosaic of red, blue, and green dots. All kinds of mosaic patterns are used, but they all have about 500 rows and 700 columns, with each of the 35,000 picture elements having a red, blue, and green area.

In the United States and Canada the electrical power is delivered to homes at exactly sixty hertz, plus or minus much less than one hertz. This is because modern technology permits very close regulation of the speed at which the generators turn.

Because all early TV sets had access to this sixty hertz power, it was decided to synchronize the TV signal with the power company signal. The standard that was established, and still used today, called for thirty complete pictures to be sent per second, each picture containing 525 lines. If you multiply 525 by 30 you get 15,750. This is how many rows the "electron cropdusters" must fly over every second. This frequency, 15,750 Hz, called, incidentally, the horitontal line frequency, is just at the limit of human hearing. In older TV sets you can sometimes hear it, caused by the flyback transformers vibrating. Nowadays they do it all solid state and you can't hear them.

The TV signal has special markers in it, called sync pulses, which synchronize the source and object beams so that they are over the same spot on the image. When the source beam gets to the end of a horizontal row it sends a sharp-edge pulse, and this signals the retrace circuits in the object set to get the beam back to the beginning of the next line.

Another way of defining the color value of a picture element, besides how much red, blue, or green it is to contain, is by specifying certain visual properties.

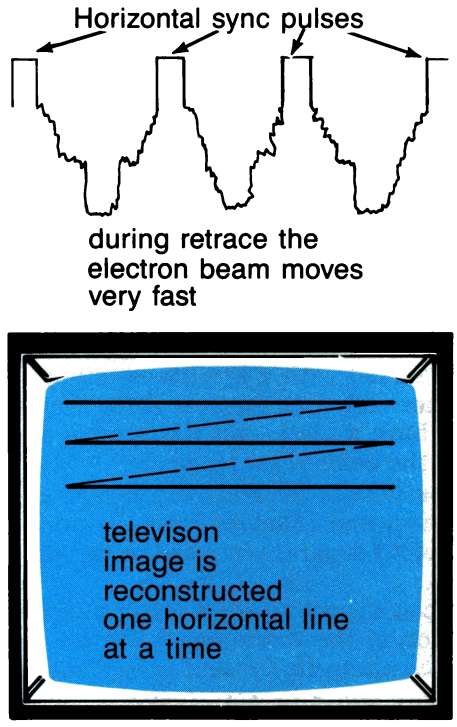


Figure D.3. Three horizontal lines

Television measures three things: (1) brightness, or luminance, (2) saturation (how much color), and (3) hue or tint. These correspond to the adjustment controls that most color TV sets have. Try them out.

The television signal is sent in terms of brightness, saturation, and color. The brightness information, which is the main signal, is coded separately. It was coded separately so that black and white TV sets would see a perfect picture when they turned in a color TV signal.

If you happen to be using a Commodore 1701 color monitor with separate brightness and color cables, disconnect the color cable for a moment. You will see a perfect black and white picture.

How is the color information sent? Very cleverly indeed.

The designers of the NSTS system, as it is called, noticed that although they needed all frequencies out to 4.5 Mhz to carry picture information, much of the available spectrum

(as it is called) was not being used. Most scenes have large shapes that don't carry that much detail information.

It was also noticed that human observers can infer the color of an object if it has a sharp boundary and its color is suggested in a wash type of presentation. You know those black and white photographs that were hand-colored? Some of them looked pretty real. The same basic principle is involved with coloring black and white television signals.

The color information is sent in a separate signal, mixed with a brightness signal. At the other end your receiver sorts them out. If you have a black and white set it never knows the color signal is there.

If you have a color set the separate brightness and color information come together to separate into red, blue, and green signals.

You can expect to see a lot of changes in television in the years ahead. We are in the age of component TV, and pretty soon people are going to want brighter, better, clearer pictures.

Binary Signals

The signals that your Commodore 64 sends between its various components are called digital, or binary, signals. They are characterized by a signal voltage that has two possible values (except when it is going from one to the other). One of these values corresponds to logic zero, false, off, etc., and the other value corresponds to logic one, true, on, etc. A digital signal might look like Figure D.4.

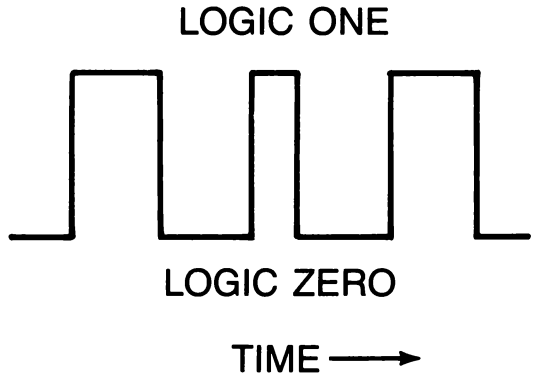


Figure D.4. Binary signals

APPENDIX E: Commodore BASIC Reserved Words

ABS	FRE	NEXT	SGN
ASC	GET	ON	SIN
ATN	GET#	OPEN	SPC
CHR$	GOSUB	PEEK	SQR
CLOSE	IF	POKE	STEP
CLR	INPUT	POS	STOP
CMD	INPUT#	PRINT	STR$
CONT	INT	PRINT#	SYS
COS	LEFT$	READ	TAB
DATA	LEN	REM	TAN
DEF FN	LET	RESTORE	THEN
DIM	LIST	RETURN	TO
END	LOAD	RIGHT$	USR
EXP	LOG	RND	VAL
FN	MID$	RUN	VERIFY
FOR	NEW	SAVE	WAIT

acronym A word from the first or first few letters of several words. Many computer terms are acronyms.

ALGOL ALGOrithmic Language, one of the first and most important developments in higher-level programming languages. Used mainly for describing algorithms and as the notation of choice for presenting computer-programming concepts in print.

algorithm A precise sequence of steps that define a specific computation. Also, it is a general method of solution to a computable problem.

APL A Programming Language, a powerful, array operations-oriented higher-level programming language.

array A set of related items, usually variables, that are grouped together under a single name.

ASCII American Standard Code for Information Interchange, a standard way in which character sets are encoded on (mostly non-IBM) computers.

assembler A low-level symbolic programming language that uses mnemonics instead of the numeric instructions the computer's own machine code uses.

assignment statement A statement, found in all programming languages, which involves the transfer of a value to a variable.

attack A rate at which a musical note goes from no volume to peak volume.

base The number of digits used in a number system. The decimal number system uses base 10. The binary system uses base 2.

BASIC The simplest and easiest to learn of the higher-level programming languages. It's an acronym for Beginner's All-purpose Symbolic Instruction Code.

bit Binary digit, a 0 or a 1.

bit mapping A method by which a pixel on the screen is assigned a bit location in memory.

blank The visible character that represents a single vertical space in any string.

boolean A value that may be either *true* or *false*. Also referred to as *logical*. Named in honor of the English mathematician George Boole.

brightness The average amount of light in a screen image.

bug An error that prevents a program from running, or from running correctly. To rid a program of such errors, programmers perform a ritual called "debugging."

byte A sequence of bits, usually 8 bits. Two bytes form a "half-word" in computer memory; and 4 bytes, a full (32-bit) word. Word size, however, depends on computer design.

C An algorithmic language developed at the Bell Laboratories.

card A computer data-storage medium in which data are represented by rectangular punched holes usually in 80 vertical columns.

card reader A device that inputs information stored on computer cards.

central processing unit *See* CPU.

character set A symbol representable in computer memory. It may be alphabetic (like a letter), numeric (like a digit), or special alphanumeric (like a punctuation sign or any other special symbol.)

chip A rectangular piece die-cut from the silicon wafer. Every LSI package is referred to as a "chip."

COBOL COmmon Business-Oriented Language, the most widely used programming language for commercial applications.

code A specific way for representing information and for manipulating symbols.

coding Writing a program in code, that is, in a specific programming language, and, usually, on special sheets called "coding forms."

collating sequence The order in which a list of items is sorted, such as ascending numerical order (for numbers), or alphabetical order (for names).

color The amount of tint present.

compiler A special program that translates the complete user's program (written in a higher-level programming language) into machine language. The user's program is referred to as "source code," which the compiler converts into "object code," strings of 0s and 1s (binary instructions) that can be executed directly by the CPU.

composite video A television signal that goes directly to a video monitor rather than to a standard television set.

computer A system consisting of (at least) a CPU, memory, I/O units, and a power supply.

contrast the range of brightness levels in a screen image.

core Magnetic memory made of ferrous doughtnut-shaped rings strung on wires. As electric current goes through the wires, the rings are magnetized in one direction or the other, the two magnetic states being represented by 0 and 1. Core memory is also referred to as principal, main, or primary memory (or store), and it is not volatile.

CPU Central Processing Unit, the part of the computer that executes the program. Also called *central processor* or *mainframe.*

CRT Cathode Ray Tube, the video display (television-like) part of a computer terminal.

cursor An often-blinking underscore marking the position at which the next character is to be entered on a CRT screen.

data Coded information.

data base The complete set of data that can be used to make decisions, calculations, and tabulations. Its importance to the organization that collected it is measured by how much the organization's operations depend on frequent access to a continually updated data base.

data processing The activity of using computers and other devices to deal with the acquisition, storage, and manipulation of information.

debugging The process of eliminating errors that prevent a program from running, or prevent it from running correctly.

decay The rate at which musical notes fall from peak volume to sustained volume.

decimal A number with one or more digits after the decimal point.

digits Symbols used to represent numbers in a particular system. In the binary system, there are two digits, called bits: 0 and 1. In the decimal system, there are ten digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

direct mode Entered when you place no line number in front of a statement (statement is executed as soon as you press RETURN).

disk An auxiliary (secondary) memory device that resembles a long-playing hi-fi record.

diskette A thin magnetically coated circular object that is almost always kept in a square envelope or sleeve, and used as a low-cost mass storage medium for smaller computer systems, especially microcomputers. It is also called *floppy disk.*

EDP Electronic Data Processing.

envelope A shape of the volume of a musical note over time.

EPROM Erasable Programmable Read-Only Memory. Also referred to as EROM.

execute To run a program: to make the computer accept the program and carry out the program's instructions.

field A set of spaces, within a record, in which each space is dedicated to a specific purpose. For example, an employee's record may contain name and address fields.

file A collection of records.

firmware Software stored in a fixed way, on a ROM, PROM, or EPROM. Firmware is software "firmed" in hardware.

floppy disk Diskette.

flowchart A diagram or schematic drawing of the steps to be executed in a program. The flowchart uses standard symbols, such as arrows (to indicate flow of control), connectors, rectangles, and diamonds, to make the purpose of and relationship among the steps more visually understandable.

FORTRAN FORmula TRANslation, the first and most widely used higher-level programming language for engineering and scientific applications.

GIGO Garbage In, Garbage Out (when the input is bad, the output will likely be bad also).

graphics system Hardware and software that enable the computer to deal with drawings and pictures.

handshake Initial protocal exchange to set-up communication between two or more devices.

hardcopy Printout produced on paper, or on any tangible, permanent medium.

hardware The physical components and parts of a computer system (the chips, CRTS, wires, nuts, bolts, keyboards, panels, lights, tapes, disks, etc.).

hex Base-16 arithmetic notation that uses hexadecimal digits (the ten decimal digits and the first six letters: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F).

high-level language A language that is used to program computers which incorporates English-like statements and mathematical notation. APL, BASIC, COBOL, FORTRAN, LISP, PASCAL, PL/1, and many others are examples of high-level languages.

IC Integrated Circuit.

ID IDentification.

identifier The name of an object in a program or of the output to improve readability and visual appeal.

increment Amount by which a given quantity is increased.

indenting Setting-off portions of a program or of the output to improve readability and visual appeal.

initialization The process of assigning initial values to variables.

input Data entered into the computer through a peripheral device, such as a card reader or a terminal.

instruction A single order within a program. It may be a statement, a command, a subprogram call, or some other order that requires the program to perform a particular task.

integer A whole number with no digits after the decimal point.

interactive Conversational, the case in which the computer responds when it is prompted with a proper request.

interface The (shared) connection or relationship (or boundary) between two components of a system, such as the hardware-software interface. Also, the point at which two components are joined together.

interpreter A special program that translates each one of the statements of the user's program (written in a high-level programming language) into machine language as the program is entered, executing each statement immediately.

I/O Input/Output.

ISAM Indexes Sequential Access Method, one of several ways in which data may be organized into files.

iteration Looping, repetition.

JCL Job Control Language, a language used to make the computer perform system tasks. An example of a system task is to load a program into main memory.

jiffy clock The internal Commodore 64 clock that counts in units of 1/60th of a second (a jiffy).

joystick A stick or bar located on or near a terminal keyboard. Moving the stick moves a dot on the terminal's screen.

jump Branch, detour, skip, or transfer. Change the order of execution of a sequence of statements, due to a condition requiring that change. Normally, statements are executed in sequential order, one after another; but a certain condition may require a change in this order of execution, and a jump will result.

K A shorthand for $1024=2^{10}$. So a 16K memory is usually 16K bytes=16384 bytes of memory. Note that because 2^{10} is approximately 1000, K may be used to mean roughly a factor of a 1000.

kernel The Commodore 64 operating system.

keyboard The portion of a terminal that contains the keys. Terminal keyboards are very much like electric typewriter keyboards. The action of pressing a single key is a "keystroke."

keypunch A keyboard-operated device that punches holes in computer cards.

keyword A name, usually appearing in a programming language, that has been expressly reserved to have some unique purpose. Also referred to as "reserved word."

LED Light-Emitting Diode, common technology used to display characters by glowing light (usually red or green) in the readout area of electronic calculators.

line printer An output device that prints an entire line (80 to 144 characters) at a time.

LISP LISt Processor, a powerful high-level programming language commonly used in artificial intelligence and word-processing applications.

list A data structure: a sequence of data items.

logging on or in The act of starting a session at a computer terminal, or of alerting the computer to the beginning of an oncoming job.

loop Repetition (of a list of statements located between the beginning and the end of the loop).

LSI Large Scale Integration. Technology by which many thousands of electronic components are built on a single silicon chip.

machine language Low-level programming language, specific to each computer, and consisting of strings of 0s and 1s. Also called binary code.

mainframe The computer body that houses the central processor, *or* the central processor itself. *See* CPU.

memory The part of a computer system whose function is to store data or instructions. Memory may be primary (main, core, or principal) or secondary (auxiliary or peripheral).

MICR Magnetic Ink Character Recognition, a technique associated with the printing and reading of characters using a special magnetic ink. (See the bottom of your bank checks for an example.)

microcomputer A small computer built around a microprocessor.

microprocessor A central processor usually implemented on a single LSI IC chip.

minicomputer A small computer, larger than a microcomputer but smaller than the regular mainframe computer.

MIS Management Information Systems.

mnemonic Memory-aiding. An abbreviated name that helps remember the actual longer name. For example, HRDWRE may be a mnemonic for hardware.

mode The form of operation, such as execution mode.

modem MOdulator-DEModulator. A data set – a device that connects data-processing equipment to a communications channel.

module An independent and usually self-contained portion of the whole, such as a program segment that can be executed apart from the entire program itself.

multiplex To simultaneously transmit two or more messages or instructions through a single channel of communication.

network A set of devices interconnected with each other through communications channels.

OCR Optical Character Recognition: characters printed in a special type font readable by both people and computers.

octal Base-8 arithmetic notation that uses the eight octal digits (0, 1, 2, 3, 4, 5, 6, and 7).

off-line Method of processing without being in direct communication with or under the direct control of the CPU.

operating system OS, software that controls the execution of computer programs. Examples are: Disk Operating Systems (DOS), Time-Sharing Operating Systems (TSOS).

operation Any action defined by a single computer instruction or higher-level programming language statement. Examples of arithmetic operations are addition, subtraction, multiplication, and division.

output Data transmitted by the computer to a peripheral device, such as a line printer or a terminal.

overflow Condition encountered when specified limits are exceeded. Usually applies to memory capacity.

paper printer Peripheral device that outputs on paper.

Pascal A higher-level programming language devised for teaching computer science and good programming habits. It is a simple language yet rich in data-typing and data-structuring facilities.

password Special word used to restrict access, for security reasons, to a computer system.

PC Printer Circuit.

peripheral Any device or component that can be connected to the computer

pixel A picture element, the smallest dot on the screen.

program A sequence of instructions, written in a programming language, and according to the requirements of a specific computer system, which it will direct to carry out the necessary tasks for solving a problem.

program mode Entered by placing a line number in front of a statement (the statement is not exectued until you enter RUN).

programming The process of writing a program in a particular programming language. Also, the process of reducing the solution of a problem to a program.

PROM Programmable Read Only Memory.

protocol In communications, the predetermined sequence of signals used in transmitting and receiving data.

punch cards Cardboard cards, usually of 80 vertical columns each, in which characters are entered by way of combinations of punched holes.

query Request, question, inquiry (for information). Query languages have been developed to deal with data bases.

queue A data structure: a list of data items, in which list deletions are made at the head (front) and additions at the tail (back) of the queue. A queue is a First-In-First-Out (FIFO) or Last-In-Last.

screen editor A feature of the Commodore 64 which permits direct editing of text material on the screen.

SID Sound Interface Device.

software The programs used by a computer system.

sprite A movable graphic object 24 pixels wide by 21 pixels high.

statement The fundamental unit of a computer program written in a higher-level programming language. A statement usually consists of a single instruction, such as an assignment, input, or output.

storage, store Memory.

string A string of characters.

subprogram A portion of a program.

subroutine A group of statements that may be treated as a unit and "called" when needed by the main program.

sustain The constant volume level of a musical note.

syntax The form of a command (rather than its meaning).

system The conglomerate of devices, people, data, methods, practices, and whatever else may be needed to accomplish certain objectives.

systems analysis The study of systems, specifically business-oriented computer systems.

table The arrangement of data into rows and columns.

tabulation The act of arranging data to form a table.

tape Either paper tape or magnetic tape: a storage medium for data or instructions.

terminal A peripheral device through which a person may communicate with a computer, and which can be used to send and receive information.

timesharing A method of processing in which the computer is shared (or, due to its fast response time, appears to be shared) by several users simultaneously.

A

Accounting software, 125-130
Adventure games, see Games
Analog/Digital converter, 170-171
Arcade games, see Games
Assembler, 151, 152
Attack, 77
Audio/Video
  cable, 59-60
  port, 13
AutoModem (Commodore 1650), 141

B

BASIC
  described, 151, 152
  programming in, 29-43
BASIC statement, 29
Baud rate, 141
Bit, 159
Boolean expressions, 37
Bulletin boards, 142, 143
Byte, 160

C

C-64 Wedge, 58
Cartridge, 11
Cassette
  compared to diskette, 47-49
  interfaces, 165
  port, 11, 13
  storage tips, 52
  saving programs on, 50-53
Character keys, 18-19
CLR/HOME key, 18, 21-22
CMD, 62-63
COBOL, 153
Color
  background, 25
  border, 25-26
  text, 25
COMAL, 153-154
Comma
  in the PRINT statement, 40-41
Commodore Information Network, 142
Commodore key, 18, 20
Communications, 139-144
Comparison operators, 37
Compiler, 151
Complex interface adapters, 160
CompuServe, 142
Consultant, The, 121
CRSR key, 18, 21
CTRL key, 18, 21
Cursor, 14,17

D

Digital/Analog converters, 170-171
DATA, 39-43
Database, 113
Database Manager, 117-121
Datasette, 13, 47-50
Decay, 77
Delay loop, 39
Direct mode, 34
Disk drive
  compared to cassette, 47-49
  described, 54
Diskette
  care, 55
  deleting files on, 57
  directory, 57
  formatting, 56
  saving files on, 56-57
  storage tips, 58
  using, 55
Doodle, 70-71
Dot matrix printers, see Printers

E

Easy Script, 101-103
Editing keys, 18-22

Educational games, see Games
Educational software, 89-92
Eighty column screen
  expanders, 97-98, 169-170
Executive keys, 18, 22-23

F

Field, 48, 111-113
Filename, 47
Files
  changing, 57-58
  deleting, 57
  duplicating on cassette, 52
  explained, 48, 11-113
  renaming, 57
  saving on cassette, 51-53
  saving on disk, 56-57
  write protecting on
    cassette, 52
  write protecting on disk, 58
Financial programs, 125-135
Firmware, 157
FOR...NEXT, 38-39
Formatting a diskette, 56
FORTH, 153
FORTRAN, 152-153
Function keys, 18, 23

G

Game software
  adventure, 67
  arcade, 67
  educational, 67
  manufacturers, 68
  simulations, 90
Gameballs, 69
Gate, 80
GOTO, 36
Graphic tablets, 69-70
Graphics modes, 19
Graphics programming aids,
  72-73

H

Hardware
  explained, 157
Higher-level languages, 151
Home Accountant, 127-130

I

IEEE 488 interface, 139, 170
IF...THEN, 37
Index file, 115
INPUT, 29, 31
INST/DEL key, 18, 22
Interpreter, 151

J

Joystick, 68

K

Koala Pad, 69-70

L

Languages, 151-154
Letter quality printers, see
  Printers
Light pen, 71-72
Line numbers, 31
LIST, 31
Logical expressions, 37
LOGO, 153

M

Machine language program, 6
Magic Desk, 6
Microprocessor, 7
Modem, 6

Monitors, see Video monitor
Motherboard, 7
Music software, 75-85
MusiCalc, 80-83
MusiCalc 2 Scorewriter, 83-84
MusiCalc 3 Keyboard Makers, 84-85

N

Networking devices, 172
NEW, 29
NEXT, 38-39
Noise waveform, 77

O

OPEN, 62

P

Pascal, 153
Peripherals, 47-63, 165-172
Pilot, 153
POKE, 24-25
Port expanders, 171-172
Power supply, 10
PowerPad, 70
PractiCalc, 132-135
Precedence, 36
PRINT, 29-31, 40-41
Printer interfaces, 168
Printers
  choosing, 97, 165-167
  described, 165-167
  dot-matrix, 166
  letter-quality, 166
  thermal, 166
  using, 60-63
protocol, 139-141
Pulse waveform, 77

Q

Quote mode, 24

R

Random access, 49
Random Access Memory (RAM), 159-160
READ, 39, 42-43
Read Only Memory (ROM), 11, 160
Records
  explained, 111-113
  selecting, 115
  sorting, 114-115
  storing, 114
Record keeping, 111-122
Release, 77
REM, 31-32
RESTORE key, 17, 23
RETURN key, 22
Reverse character feature, 21
RS232 interface, 139-140, 170
RUN, 31
RUN/STOP key, 17, 23

S

Saving
  multiple files on cassette, 53
  programs on cassette, 51-53
  programs on diskette, 56-57
Sawtooth waveform, 77
Screen expanders, see Eighty-column screen expanders
Secondary address, 63
Selecting records, 115
Sequential access, 47, 49
Serial interface, 13, 139
SHIFT key, 18-19
SHIFT lock key, 19-20
SID (Sound Interface Device), 74, 161

Simulations, 90
Software
  explained, 157
Sorting records, 114-115
Sound, see Music software
Speech synthesizers, 171
Spell Right, 105-106
Spreadsheets, 131-135
Sprite, 72-73
Sprite editors, 72-73
STEP, 38
Storing records, 114
Strings, 32-35
Study courses, 90
Surge protection, 8
Sustain, 77
Synthy-64, 76-80

T

Thermal printers, see Printers
Trackball, 69
Triangular waveform, 77

U

Ultra BASIC-64, 72

V

Variables, 32-35
VIC (Video Interface Chip), 161
Video monitor, 11, 59-60

W

Word processing, 95-107
Word processing software, 98-107
WordPro, 103-105
Wraparound, 17, 95
Write protecting
  on cassette, 52
  on disk, 58

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