COMMODORE 64™ EXPANSION GUIDE

GARY PHILLIPS

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GARY PHILLIPS

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Video-80 80 Column Adapter
Koala Pad Touch Tablet
Promenade Model C1 EPROM Programmer
MT/2 Tuner
JE520-CM Speech Synthesizer

Cartridge-Maker-64
PowerPad Touch Tablet
Relax Biofeedback Device
COMvoice Speech Synthesizer
Magnacomp-64 Numeric Keypad and Console
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Portions of this book were adapted from *Commodore 64 Hardware Tips* copyright 1984 Gary Phillips.

Introduction

This book is the tool needed by every Commodore 64 owner who wants to buy expansion hardware. I have chosen the best from hundreds of competitive products and reviewed them in an orderly and consistent format. This makes effective comparison shopping possible. One chapter is devoted to each major type of device, providing in-depth background knowledge, a glossary of terms, evaluative reviews of the best available products, and comparative tables of vital statistics and features.

Unlike other catalogs, which reproduce manufacturers brochures, these reflect hands-on use of the products. I point out the flaws and disadvantages of products as well as the strong points and features. The three opening chapters provide a comprehensive overview of Commodore 64 expansion, including how the various devices are connected to the computer. I describe a systematic process for using the reviews and the accompanying tables to find the best expansion products for your special requirements. Hundreds of man hours have gone into the reviewing process, and you can have the benefit of all of this research in a few hours of reading. This book can help you wade through the confusing multitude of products available. Now you can select the products that best suit your needs quickly, accurately, and with confidence. You can be sure to avoid overpriced but underperforming products and get the greatest possible computing power for your money.

Chapter 1



Price, Performance, and Quality

The Commodore 64 is the most amazing bargain in the field of personal computers. Available for a small fraction of the price of computers such as the IBM and Apple, the Commodore provides, in many areas, very nearly the same computing power. In many ways the Commodore 64 is, in fact, superior. For example, in the areas of sound capabilities and sprite graphics, the Commodore 64 leaves IBM and Apple in the dust. Commodore 64 purchasers have typically looked at a number of computers prior to making their purchase. They have come to the concluson that when all factors of price, quality, and performance are considered, the Commodore 64 is an outstanding buy.

A careful comparison of the Commodore 64 to such competitive computers as the Apple *II*e and the IBM PC reveals that more features are built-in to the basic console of the Commodore 64 than to either the *II*e or the IBM PC. The basic IBM PC and Apple *II*e come with no disk drives, no disk controllers, no interface for either a serial or a parallel device (printer, modem, etc.), and no place to attach a disk drive. These must be purchased separately. The Commodore 64, on the other hand, comes with eight ports for directly connecting peripherals and interfaces.

Still, the basic Commodore 64 computer is limited in many ways. It requires significant hardware expansion in order to perform many of the more interesting and valuable tasks that personal computers are capable of, such as printing documents and telecommunications. This is, of course, true of nearly all computers on the market.

INTERFACES AND EXPANSION HARDWARE

The built-in ports of the Commodore 64 operate on their own unique system.

Computer devices (called peripherals) built by Commodore can plug directly into the Commodore 64. This is possible because they have an *interface* compatible with the built-in Commodore 64 ports. An interface may be defined briefly as a standard defining the types of connections (plugs), the electrical specifications, and sequences of control signals that allow a computer and a peripheral to work together.

Most peripherals made for a variety of personal computers comply to interface standards not available on the Commodore 64. Fortunately, this does not present a major problem for Commodore 64 users. A number of independent companies have filled the gap by supplying interfaces that plug directly into the Commodore 64 and allow non-Commodore peripherals, such as Centronics parallel printers and various RS-232C serial devices (including modems and serial printers), to be used with the Commodore 64.

Through the use of the built-in expansion ports and the expansion interfaces available for the Commodore 64, a vast array of accessory hardware products are available for the Commodore 64 user. The problem of making a wise choice is very similar to the problem of choosing a computer. Peripherals span a broad range of prices, performance, and quality. Commodore 64 owners have already learned that in the computer field, price is not always related to quality and performance in any simple way. The most expensive peripherals do not always offer the highest performance or the highest quality. Many peripherals are significantly overpriced, and some have fatal flaws.

In the chapters that follow, I will give you a general background concerning how the various peripherals work, what they are good for, and what the potential purchaser should look for in terms of features and pitfalls. My research team and I have examined a broad cross section of available devices that can be used with the Commodore 64, from a number of different points of view.

I have rated the various devices in six basic categories. The overall rating is our subjective summary of all of the pluses and minuses for the particular device as contrasted to the others that are available. The price/performance rating measures the performance of the device in view of its price. The software compatibility rating in view of its price. The software compatibility rating reflects the extent to which the device will work with most of the popular programs for the Commodore 64. The ease of installation rating contrasts those devices that required significant labor to install with those that simply plug in. The documentation is rated as to its clarity, completeness, and overall quality. I have also provided a rating for the quality of vendor support, including such factors as repair, warranty and availability of technical advice.

The various features for each type of device are listed in a consistent format. All of the information for a given type of device is summarized in a tabular format, allowing rapid and easy comparison of all the devices of a certain type. In addition, for each type of device, such as printers and disk drives, etc., I will give you my personal recommendations. In some cases there is one device that is so outstanding in all respects that I can simply recommend it as the device to purchase. In other cases which device will be of greatest value to you will depend on what you need to use it for. For example, many fine dot matrix printers will not adequately do the job of presenting an acceptable letter-quality letter. Similarly, the price of a color monitor is only justified for those who have a definite need for color.

Because price, quality, and performance are not as closely related as they may appear, there are many pitfalls the purchaser of expansion products should be aware of. The other side of this coin is that there are many bargains the informed purchaser can take advantage of. I have listed the devices from least expensive to most expensive in order to emphasize the surprisingly high quality of many of the less expensive products. The purpose of this book is to give you the necessary background information, including data on specific products and our own recommendations, to make knowledgeable hardware expansion choices.

DIFFERENT SYSTEMS FOR DIFFERENT PURPOSES

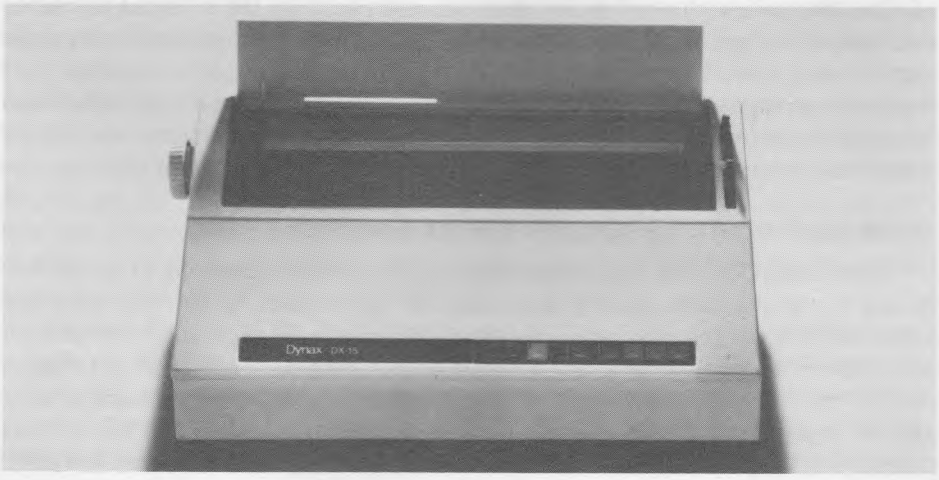
The Commodore 64 has almost unlimited potential for assisting in the performance of various tasks ranging from business applications to entertainment and education. For any particular application that you might wish to pursue, you will need to acquire appropriate peripherals. There is no particular peripheral that all Commodore 64 users would need to have. Which peripherals you will want to add to your system depends totally on what you want to do. For example, if you are an avid computer game player, you will certainly want to add a joystick, and possibly a color monitor and other game-related items to your computer. A disk drive would also be a good choice because many games are available only on disk, and all games can be loaded much more quickly from disk.

If you are interested in music, you may want to add a piano-type keyboard to the Commodore 64. If you are interested in speech generation and recognition, you will want devices for these purposes. If your primary interest is programming, you will definitely want a disk drive for saving and loading your programs and a printer to print program listings. If your main application is word processing, you probably will also want a good quality printer, possibly letter quality, and disk drive on which to save the documents you create. Business applications will generally require a disk drive and a printer. Users of both word processors and business applications can benefit from the more readable characters presented by a monitor used in place of a TV set.

Finally, your interest may be in tapping the many on-line databases and the community of personal computer users available through the use of a modem and phone lines by telecommunications. Telecommunications and the use of a modem may also play an important role in programming, word processing, business applications and other uses of the Commodore 64. Having a modem opens up a whole world of possibilities, including knowledge, interaction, and free software available in the public domain.

Whatever your major purpose for expanding your Commodore 64, there will be many "candidates" available to be purchased. This book will guide you in finding the best value for your money and help you avoid the agony of paying good money for a device that does not work properly.

Chapter 2



Commodore 64 Hardware Shopper's Guide

In addition to deciding which peripherals to buy, you also need to give some thought to where and how to purchase the equipment. There are at least four major alternatives.

The most obvious and simple alternative is to go to a local retail store and purchase the item you want. Even within this area, there is a substantial amount of variability in prices and service. There are discount stores, special sales, and so on. Another alternative is to order expansion products from a mail order source, where prices can be substantially lower than a retail outlet. Computer fairs often offer an unusual opportunity to do comparison shopping and purchase items at substantial discounts. Finally, you can find used equipment through the want ads, user groups, and the like.

SMART SHOPPING AT RETAIL STORES

Shopping at local retail outlets is perhaps the simplest and most common way of purchasing expansion products for the Commodore 64. In addition to computer specialty stores that carry the Commodore 64, expansion products are also available at mass merchandisers such as K-Mart, various discount chains, and some other specialty stores such as video stores and record stores. There is substantial variability in the retail prices of expansion products at these outlets, which may or may not be related to the levels of service that they can offer. If a device has good documentation and good vendor support and is relatively easy to install, support from the retail organization may not be critical. An important factor here is your own level of familiarity with electronic devices in general and of the Commodore 64 computer

particularly. If you are not technically inclined, it may well be worth the extra price to purchase from a speciality store that can show you how to install and use the device. On the other hand, if you are relatively familiar with the Commodore 64 and expansion devices for it, you will probably want to get the very best price you can and count on getting any support you need directly from the vendor.

In addition to variability in prices from one store to another, many stores have occasional sales during which they will mark down prices significantly, sometimes by as much as 40 percent or more. In many cases, sales personnel at these stores are willing to give you some information as to the frequency of their sales and any sales coming up in the near future that might include products that you are interested in. It may be worth waiting to make your purchase at the sale price, or you may be able to convince the salesperson to give you the sales price now.

Keep in mind also that while there are often suggested retail prices for various products, sales people and store management nearly always have some flexibility on price. If you are making a major purchase, such as a printer or a disk drive, it may well be worth your while to negotiate the price, that is, to make an offer less than the store's asking price. While some stores will indignantly refuse to consider such an offer, others may very well agree to a negotiated price lower than their standard asking price. In other cases while the store may be inflexible on price for a particular product, they may be willing to throw in a box of paper, a box of disks, or some other item that you would otherwise have had to purchase. This "sweetening the deal" may make it possible for you to get what amounts to a discount on the product without the store personnel's bending their rules on the pricing.

A factor to be considered in deciding how much you are willing to pay is the degree to which the vendor can support you. The clerk at a discount chain will in most cases not be able to give you much help if you run into difficulties attaching or using a product. The personnel at some computer specialty stores may be able to give you some advice. But they may also be unable to assist you, particulary with lesser known devices. The last resort for support concerning devices is the manufacturer or vendor of the product themselves.

SMART MAIL ORDER SHOPPING

An alternative to shopping in retail stores is to examine the mail order advertisements in the various Commodore magazine that are available at newsstands or by subscripton (see the list in Appendix D). Mail order prices are typically significantly lower than standard retail prices. Some mail order houses have acquired an excellent reputation for prompt delivery, and in many cases, they even provide excellent support by telephone. Examining the ads will typically make it clear to you what support features they have to offer. If you are at the point of considering making a purchase, you can call the vendor concerning the product and inquire about their support policies at that time.

Keep in mind, that some purchasers have had difficulties with mail order sources. Products have sometimes been delivered after long delays or never delivered at all. Products different from those which were ordered have sometimes been delivered. The best way to find out about a particular mail order organization is to talk with other Commodore 64 users who have made purchases from them or with users of

other computers who have made purchases from those mail order houses that carry devices for many different kinds of computers. I have chosen not to report on the reputations of specific mail order vendors because this is subject to rapid change through time. A vendor that has an excellent reputation at one moment may encounter some difficulties, or a vendor who has a good reputation in one area may have a different reputation in another part of the country. Therefore, check with local computer users about their experience with particular mail order vendors before you make a purchase.

There are a few steps you can take to help protect yourself. Wherever possible, use your charge card, such as VISA, MasterCard, in making purchases. The use of a charge card provides additional protection if merchandise is never delivered or is faulty in some way when delivered. This protection varies from one state to another. You may need to consult the agency that issued your credit card in order to learn exactly what your rights as a credit card purchaser are. I would like to emphasize that while there are potential difficulties with purchasing items by mail order, there are also many advantages. Many of the devices that I use in my personal Commodore 64 systems were purchased by mail order, and I have often been delighted with the delivery, service, and prices offered by mail order firms.

SMART SHOPPING AT COMPUTER FAIRS

A third way of purchasing Commodore 64 products is to visit a computer fair held in your vicinity. There are many different types of computer fairs, but there is one particular type that is strongly oriented toward making retail sales possible. Watch the calender of events in Commodore magazines and general personal computer magazines such as *Byte* and *Infoworld* for announcements of these computer fairs. Consumer-oriented fairs are often attended by mail order firms who make direct, over-the-counter sales at mail order prices. This gives you the advantage of getting your equipment immediately. You can make certain that you are getting the correct items, and you have the opportunity to look at the exact item that you are purchasing and ask questions about the products and the support offered by the mail order house. Computer fairs offer an extraordinary opportunity to comparison shopping between various competitive products that are often all available for inspection on working computer systems. You can also go from vendor to vendor to compare prices and levels of support. Pricing at computer fairs is typically significantly discounted from standard retail prices. There may be some flexibility for bargaining, particularly on the very last day of the fair. In the closing few hours of the fair, many vendors will offer extraordinary bargains on products that they would have to carry back to their places of businesses if they are not sold. This is one area of special bargains that you can lookout for.

SMART SHOPPING FOR USED EQUIPMENT

Another way of acquiring Commodore 64 equipment is to look for used equipment. Used equipment is often advertised in the want ads of local papers, in computer specialty newsletters that circulate in many areas of the country, in club newsletters, or at the meetings of various users groups (see Appendix B for a list of user groups). There may also be computer swap meets in your area. Individuals can bring used

equipment to these meets to be offered for sale to the attendees.

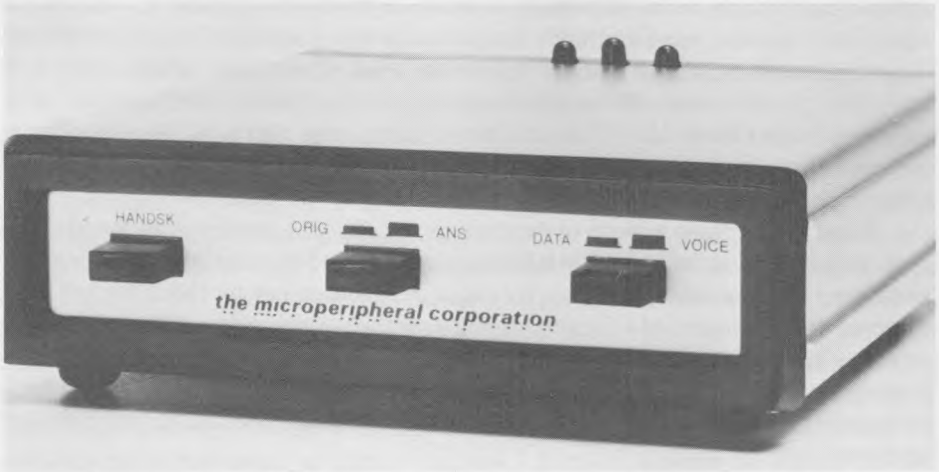
There are obviously special precautions to be taken in buying used equipment. Unless you know the seller personally, it would be unwise to purchase any peripheral equipment without seeing it actually function correctly. Even then it would be wise to insist on a brief written warranty of at least one week. The reason for this is that it is altogether possible that a device may function correctly during a brief test, but fail in some other situation or type of use, or to stop functioning after a period of use. If you buy used equipment at a swap meet, be sure to obtain the sellers' name, address, and phone number so you may contact them if any problems arise.

If you do purchase a piece of used equipment, try it extensively in the kinds of applications that you will be using it for during the period that has been warranted for and return it if any problems arise. It is also desirable to pay by check for any used equipment. In the event of a dispute arising over the serviceability of the equipment, you have the option of stopping payment on the check as a way of acquiring some leverage in the negotiations over the sale of the equipment. It would be wise to check on the legality of this measure in your particular state as the laws on this are different from one state to another.

When you are buying used equipment, there are several factors that will help you decide whether or not the price is reasonable. One factor is that many devices have moving parts and have a finite working life. If a printer has printed many thousands of pages, some part of its useful life has been used up. This should be taken into account in its pricing. Similar considerations apply to all other devices that are subject to wear and tear. Additionally, you should be sure that you are getting all of the components that come with the new equipment, especially the documentation. Attempting to use a piece of equipment without the documentation can be very frustrating. While it may be possible to secure a copy of the documentation from the manufacturer if it has been misplaced, this may take a long time. It may not even be possible based on the manufacturer's policy or discontinuation of particular products or versions of products.

Whatever avenue you choose for purchasing Commodore 64 expansion hardware, it will be useful to you to have background information about the particular product. The introductions to the chapter that cover particular products are intended to give you the necessary background to make an informed and intelligent purchase, whether you purchase used equipment or buy from a retail store, by mail order, or at a computer fair.

Chapter 3



Methods of Evaluation and the Selection Process

The following chapters provide you with a complete guide to peripherals for the Commodore 64. Each chapter is devoted to one type of hardware device and consists of four sections:

- Background information
- Glossary of frequently used terms
- Reviews of available products
- Worksheet for reviewing additional products
- Comparative tables of ratings and features

The main focus is on the five major peripherals of interest to Commodore 64 users: interfaces, printers, disk drives, monitors, and modems. Other devices are also reviewed in the chapter on special devices.

BACKGROUND INFORMATION ON A TYPE OF DEVICE

The first step towards making an intelligent choice of a peripheral is to have a general understanding of it. Each of the following chapters opens with a tutorial on one type of device. This will give you the background information and understanding you need to digest the reviews that follow. It also allows you to find the best value for your particular peripheral needs. I have tried to provide you with a short course in the nature, function, and value of each major type of peripheral.

GLOSSARY OF TERMS FOR A TYPE OF DEVICE

Each major type of peripheral has its own special vocabulary of descriptive terms. In each chapter, there is a glossary of terms that gives definitions of new terms that will be encountered in our reviews and in reviews you read in various magazines and books, or in documentation that accompanies the products. The glossaries will include definitions of all of the features listed for each device as well as many other relevant terms.

THE REVIEWS: METHODS OF EVALUATION

I have used a combination of methods in evaluating and reviewing the various hardware expansion products for the Commodore 64. While the main part of the evaluation has always been first-hand use of the products described, I have not felt that this was adequate. In spending a few hours using and testing a piece of hardware, it is altogether possible that either major advantages or disadvantages of the product will be overlooked. Many such advantages or disadvantages would show up only with extended use in a broad variety of situations. Because of this, I have used information from a number of other sources.

Whenever a review written by another reviewer exists, I have read their comments and reverified any points they have made concerning strengths and weaknesses of the products. I have also relied very heavily on informal reports provided by my associates who have used the products over long periods of time. While these Commodore 64 users did not write reviews of the products, they did supply me with their experiences as they related to the strengths, weaknesses, and features of the products. The final reviews are a combination of the results of the testing of the products by members of my review team, the information collected from other reviews and the manufacturer's literature, and the interviews with long-term and intensive users of the products wherever possible.

THE RATING SYSTEM AND THE LIST OF FEATURES

I have rated each product on the same six criteria. In addition, I have provided a consistent list of features for each of the five major types of product for comparative purposes. The criteria for each product were evaluated on the basis of written definitions, and the ratings are on an A through D scale. The A rating was given only to products that were truly outstanding. B indicates excellent performance without serious flaws. C indicates that there are at least a few weaknesses in this area. D means that the product was unacceptable for some reason.

There are five major peripherals of interest to every Commodore 64 owner. They are interfaces, printers, modems, monitors and disk drives. The features of the major peripherals are listed as either numerical values, such as 80 column versus 40 column, or as a plus or minus. Plus (+) denotes that the feature is present, minus (–) that it is absent. Wherever special circumstances require, I have noted additional features or deficiencies of the various products. The more highly specialized peripherals, such as light pens, expansion units and game adaptors, have such diverse characteristics that a direct comparison of features is not possible.

THE SELECTION OF PRODUCTS FOR REVIEW

Many products were not reviewed because they were not available at the time the book went to press or because I felt that either their price or performance did not make them significant candidates for purchase by Commodore 64 users. It is also possible that I may not have been aware of the existence of some products not advertised in major Commodore 64 publications.

I have reviewed most of the products that will be frequently encountered in retail outlets or in advertisements from the manufacturers and other vendors in the popular Commodore magazines. There are a vast number of products that I have not reviewed, particularly in the case of modems and monitors. To provide an overview of how the monitors and modems I have reviewed relate to the vast number of other available products, I have provided a summarized comparison chart including the devices I have reviewed and a sample of other devices. The chapter introductions reflect my own knowledge and experience with the various devices and their characteristics, as well as research in numerous publications concerning the various types of products.

THE SIX CRITERIA USED IN EVALUATING PRODUCTS

The overall rating is an indication of the review team's general impression of the quality and performance of the device when all factors are taken into consideration. This includes quality, price/performance, support, documentation, ease of installation, and any special characteristics that might not have been otherwise rated.

The price/performance rating indicates how much performance you're getting for your dollar. An especially cheap peripheral might rate an A price/performance rating even though its overall rating might only be a B. This indicates that while it is by no means outstanding among products of its type, it is an outstanding bargain at its price.

Software compatibility indicates the extent to which the device is compatible with various popular programs. In many instances I have reported how well the device functions with particular pieces of software. The rating reflects a general consensus of the extent to which the device will work with a broad variety of Commodore 64 programs.

Ease of installation refers to the simplicity with which the device can be attached to and used with the Commodore 64. An A rating would apply to device that attaches in an extremely simple and straightforward way and is also convenient to operate once installed. Peripherals that require complex assembly steps and/or multiple switch settings would receive a lower rating. A D rating would ordinarily indicate that some fabrication steps such as soldering, adjustment of parts or acquisition of parts not supplied with the device were required in order to make it work.

The documentation rating reflects the quality of the documentation supplied with the device in terms of its completeness and comprehensibility, and the degree to which it enables an untrained user to efficiently utilize the device.

Vendor support reflects warranty terms, availability of technical support (whether from retailers or directly from the manufacturer), and availability of service both during and after the warranty period.

THE STRUCTURE OF THE REVIEWS

Within a review itself, the product summary gives a description of the product and its general features. Price/performance may be mentioned here to give you a general idea of the value of the product.

Installation and interfacing cover whether the device plugs directly into the Commodore 64, has its own interface, or requires purchase of a separate interface. How difficult or easy the product is to install or to interface with the Commodore 64 is also discussed. Brief mention of the type of interface used may help you determine if the device will fit easily into your existing system.

Quality and performance deal with the general quality of the device and how it performs in terms of speed, durability, software compatibility, and so on. High quality features are mentioned, as well as any problems or disadvantages. The overall usefulness and the best possible application of the product is sometimes described.

The vendor support section reviews warranty terms, technical support, and any other relevant information about getting answers to questions or help with problems.

Within the section concerning any particular product, additional sections may cover topics of interest to potential buyers of that product only. For example, when dealing with printers I cover features for word processing and features for graphics.

GROUPS OF RELATED PRODUCTS REVIEWED TOGETHER

Often a family of related products differ only in one or two particulars and in price. An example involves printers, where two or more models often differ only in the width of the paper carriage and in price. All other specifications tend to be identical. In such cases I have covered the group of related products in a single review. In the Table of Contents and in the comparative tables at the end of each chapter, each product is listed separately by price. Those that were reviewed as part of a group of closely related products are indicated in the tables by the notation (G1) for all the products in the first group review, (G2) for all the products in the second group, and so forth. The first (lowest priced) product in each group is marked with an asterisk (G1*) to help you find the group review. The reviews are in order from lowest to highest price, so the price of the least expensive product in a group review determines the location of the entire group's review.

THE WORKSHEET FOR REVIEWING ADDITIONAL PRODUCTS

New expansion products for the Commodore 64 appear each month. A new product could represent a better price/performance value than any of the products reviewed in this book, or it may be overpriced. I have provided a blank review form in each chapter to allow you to organize information about a new product for easy comparison to the products reviewed in the book. This will make it easy for you to include new expansion products in your search for the best values for your growing Commodore 64 system.

THE COMPARATIVE TABLE OF RATINGS AND FEATURES

It is often difficult to keep the ratings and features of a number of products in mind

for comparison. I have, therefore, provided a comparative table of the ratings and features of all products in a chapter. This allows you to compare a feature or rating for various devices quickly. You may easily eliminate those that do not have features you need or that are rated as inferior.

THE HARDWARE SELECTION PROCESS

Selecting hardware is one of your most important undertakings as a Commodore 64 owner. Your computer can do marvelous things with good expansion hardware. Without good expansion products, it is very limited. Three fundamental assumptions underlie my discussion of hardware selection:

- You have a goal in mind that you expect the hardware and your Commodore 64 will help you to accomplish.
- Your time is limited and valuable.
- You have a limited budget for computer hardware.

These assumptions will not apply to everyone. If you are a computer hobbyist, you may enjoy spending ten hours reading and researching each of dozens of hardware devices, keeping careful notes on each of them. Or perhaps you can afford to buy hundreds or thousands of dollars worth of hardware to compare. But if you are like most Commodore 64 users, your time and budget are limited. You will need to conduct a systematic and efficient survey that will enable you to quickly find a device that will serve your ultimate purpose at a reasonable price. Your time will then be spent learning to use this device and accomplishing your larger goals.

An excellent way to start your search for a suitable device is to separate the features for the type of device (as listed in the review section of this book) into three groups, based on your particular objectives in using the device:

- Features required to achieve your goals.
- Features that might be useful but are not required.
- Features that would be a nuisance or dangerous (i.e., exposed electrical components).

You probably do not have time to carefully examine each of a large number of hardware devices of a given type, nor would you want to clutter your mind with all the special features and options of all these devices. The first step in the selection process might will be to eliminate from consideration as many devices as possible. The comparison chart at the end of each chapter allows a simple and rapid elimination of devices that lack features you have identified as necessary for your intended purpose. Similarly, a device which offers objectionable features may be eliminated, and any that are clearly beyond your budget limitations can be crossed off.

From among the survivors, you can pick the ones that have the highest ratings and the most additional features. Read the detailed descriptions of these, and select a small number, which you can realistically expect to examine in detail. You may want to write to the manufacturers of these devices for more detailed data. With some perseverance, you may be able to try out all of these at retail stores and make your

final decision based on first-hand use of the device. You may also want to compare notes with users of the final contenders.

I trust that you will find the following chapters useful in acquiring a general orientation toward and overview of a particular kind of product, and in providing an evaluative review of each product and a comparative presentation of the various products of a given type.

Chapter 4



Interfaces

An interface is a device that attaches to the Commodore 64 and supplies a "plug" for another device that could not be plugged directly into the Commodore 64. Obviously, this increases the versatility of the computer by increasing the number of peripherals you can choose from. A more versatile computer is a more valuable computer.

One example is a *Centronics parallel interface*. Centronics parallel printers are the most common type of printers available for personal computers. They cannot plug directly into the Commodore 64. By using a Centronics parallel interface, the Commodore 64 is able to use this type of printer. A Centronics parallel interface makes it possible to use any of the many Centronics parallel printers available, including the Epson and Okidata printers.

Similarly, an *RS-232C interface* attaches to the Commodore 64 and allows you to attach many of the RS-232C devices available for personal computers. Some examples are modems, many printers, home appliance controllers, and other types of devices.

An *IEEE* (Institute of Electrical Electronics Engineering) interface allows the attachment of IEEE devices including many types of laboratory and special purpose devices, and the fast Commodore disk drives.

The selection of an interface is the first step in expanding your Commodore 64, because the type of interface you chose determines which additional peripherals are available for your consideration. From this point of view, there are three main strategies you can adopt toward Commodore 64 expansion.

The first strategy is to stick to devices that do not require an interface. For

almost every type of device you could consider adding to your Commodore 64, there is a version available that does not require any interface and will plug directly into the Commodore 64. The advantage of choosing this approach is that you avoid the necessity of choosing an interface, the expense of purchasing one, and the time required to learn how to use it. The disadvantage is that you are severely restricted in the range of peripherals you can choose from.

The second approach is to select peripherals based on their particular advantages and disadvantages without regard to their interfacing. Then, having selected a peripheral device as the one that you want, you can determine what interface it needs and purchase the interface as well. The advantage to this method is that every conceivable peripheral is available for your selection. The disadvantage is that you may have to purchase a number of interfaces, and it may not be possible to use all of the devices you have purchased concurrently. It may be necessary to turn the computer off, unplug one peripheral and plug in another in order to switch from one peripheral to another.

The third strategy is to get a multi-purpose interface that will make a broad variety of devices available to you. Two interfaces that give you access to the three major standards for interfaces (Centronics parallel, RS-232C serial, and IEEE) are currently available. These will be discussed in depth later on.

While the particular type of Commodore 64 system you are building will determine which one of these strategies will work best for you, I think that the most effective strategy, from a long term point of view is to get a multipurpose interface that will make all three types of interfaces available to you.

I will define the three major interfaces only briefly here. If you are interested in learning the mechanical and electrical details of these interfaces, you will need to consult a technical reference or computer interfacing guide. (See the list of magazines in Appendix D.)

THE RS-232C SERIAL INTERFACE

The RS-232C standard is used by most modems, many printers, and other devices such as plotters, graphics tablets, and so on. The RS-232C standard defines a method of connecting a device serially to a computer. An interface is required for the Commodore 64 because none of the expansion ports provide a true RS-232C type connection. The serial port of the Commodore 64 comes very close to being an RS-232C port. It deviates from the standard sufficently that some RS-232C devices will work directly with the serial port, while others require an interface adaptor to bring the signal levels and protocols exactly within the standard.

Most recently manufactured modems will work directly from the serial port on recent Commodore 64s with an appropriate cable. The older Commodore 64s with KERNAL 2 (the old version of the Commodore 64 operating system) will have more trouble running a modem without an RS-232C interface adaptor. This is caused by errors in the code for KERNAL 2 that are corrected in KERNAL 3. Some interface cards (such as C64-Link II) provide KERNAL 3 for owners of older Commodore 64s. This kind of interface bridges the gap between the RS-232C device and the Commodore 64, making any necessary electrical conversions and adapting the different types of connectors used by the Commodore 64 and the device.

THE CENTRONICS PARALLEL INTERFACE

The Centronics parallel interface is used by most common personal computer printers. Many of these printers are also available with an RS-232C interface. This is usually an extra cost option, and printers with this option are often not in stock at retail outlets, and must be specially ordered. However, letter-quality printers often come with a standard RS-232C interface with a parallel interface sometimes available as an extra cost option.

THE IEEE INTERFACE

The IEEE interface is the standard for many of the peripherals designed for the larger Commodore systems. Of particular interest to the Commodore 64 user is access to the faster Commodore disk drives, such as 2031, 4040, 8050, and 8250 disk drives. The IEEE interface also allows connection of the 9060 and 9090 hard disks. While these disks are no longer manufactured by Commodore, they are occasionally available on the used equipment market.

CASSETTE INTERFACES

Several interfaces that convert the signals common to the Commodore Datasette into signals that can function with any home tape recorder are available. Because these interfaces are of such a specialized nature, they have been reviewed under special devices rather than with the rest of the interfaces.

OTHER TYPES OF INTERFACES

Some "interfaces" cannot be classified strictly as interfaces. One example is the BusCard II, which provides expansion of the built-in BASIC to the more powerful BASIC 4.0. Another example is the APV Centronics parallel interface with a built-in 300-baud modem for micro peripherals. This is an unusual combination that could be reviewed as a moderm or as an interface. It is included here with the interfaces. Another unusual item is the Reunion by HyTech, which allows you to connect the Commodore 64 with a VIC 20 to a shared cassette. This is a little different from what most interfaces do, but it is characteristic of an interface in that it allows two significantly different devices to cooperate with each other.

It is important to keep in mind that stating that a peripheral or an interface complies with a certain interface standard, such as Centronics parallel, RS-232C serial, or IEEE, does not necessarily mean you will have no problems in using the devices together. Most peripherals have features that go far beyond what is defined by most interface standards. For this reason it is necessary to look closely at what devices you intend to utilize, what interface you chose to use them with, and even what software you want to use with this interface/peripheral combination.

The only guarantee that a piece of software, interface, and device will work together properly is to try the combination. I have tried a number of interfaces with a number of peripherals and can give you some feedback on the adaptability and generality of these varous combinations. I have also included some information about how the peripherals work with various interfaces.

It is possible, however, that you could encounter difficulties not discussed in the

reviews with a particular piece of software, interface, or device. As previously mentioned, the only absolute proof that the software, interface, and peripheral will work together properly with the Commodore 64 is to put the combination together and try it; however, the general guidelines here should serve you well in this regard.

PET GRAPHICS CONSIDERATIONS

There are two peculiarities of the Commodore 64 as compared to most other personal computers that require special mention with respect to interfaces. The first is that the Commodore 64 does not use the same ASCII character codes used by most personal computer peripherals and by most other personal computers. The character codes used by the Commodore 64 are similar to the other ASCII codes, but not identical. The code is called Commodore ASCII. One valuable feature of an interface is its ability to selectively convert Commodore ASCII to standard ASCII. It is important that this feature can be selective because many software packages for the Commodore 64 already peform this conversion. If it is performed twice, the results are garbled. In addition some Commodore devices expect to receive Commodore ASCII rather than standard ASCII character codes.

The second peculiarity of the Commodore 64 is the ability to generate from the keyboard a number of special codes that represent the PET graphic symbols. These are listed on the Commodore 64 screen graphically. However, most printers are not able to print them in their graphic representation. This creates two separate kinds of problems. The first is that certain material with these codes in them, especially BASIC programs, will not print out in a recognizable manner. Because these graphic symbols are used frequently in BASIC programs, this presents a problem for those who are involved in using BASIC. The second problem is that some of the codes used to represent the PET graphic symbols are interpreted as special printer commands by some printers. This can lead to either strange looking printouts or the "hanging up" of the printer, which will require that you restart the printer to reset the default printer values. The ability of the interface to emulate PET graphics so they are printed out in their true form is a tremendous advantage for BASIC programmers and makes it easier to avoid problems with the printer.

The next best thing to being able to print the PET graphics characters as displayed on the screen is to have them converted into some alternate representation. Some interfaces use a three character conversion, and some have other ways of making this conversion. It is not as valuable as a direct graphic representation, but it is certainly better than having the printer respond to these characters as control codes. In some instances, the three or four character representations are easier to see than one screen character generated by the printer.

The third method of handling the PET graphics is for the interface to have the ability to convert any codes outside of the usual ASCII character set to blanks or some other harmless character. While this loses the information as to which particular codes were embedded in the material being printed it does prevent the printer from hanging up. A few interfaces provide none of these features and could cause some printers to hang-up upon encounter graphics characters .

GLOSSARY

alphanumeric—A set of characters that includes letters of the alphabet, spaces, and

numbers. This is sometimes expanded to include a few special symbols commonly used in English text, such as the period, colon, semi-colon, exclamation point, hyphen, left and right parenthesis, and dollar sign.

ASCII—American Standard Code for Information Interchange. A code that is used to represent alphanumeric characters with numbers. There are variants of this code such as Commodore ASCII, which is similar to the standard ASCII but not identical.

asynchronous—An event or device that does not have the same timing as the central processing unit. In communications, the timing of data transmission is controlled by the presence of one or more start- and stop-bits.

baud rate—The number of bits transmitted per second. Common baud rates include 300 and 1200.

bit—A contraction of binary digit. The smallest segment of data, expressed as a physical unit with two possible states called 1 and 0. Bits are combined to form larger units called nibbles (4 bits), bytes (8 bits), and words (8, 16, 24, 32, 96 or more bits).

buffer—A memory structure that provides for the storage of data. Buffers are often used with printers to store the data to be printed so the computer can perform other functions.

byte—A group of 8 bits, which is universally used to represent a character.

carrier-detect—One of 8 signals used in RS-232C data transmissions.

Centronics—A name for a type of parallel data transmissin standard that is used in many printers and other devices. It is usually called *Centronics parallel.*

clear to send—One of 8 signals used in RS-232C data transmissions.

command interception—Many programs send control characters to the printer that are specifically for the Commodore 1525 printer. Some printers will have trouble handling these codes. Command interception means that commands that are not appropriate to the printer the interface is attached to are either translated or simply deleted by the interface so they will not cause problems for the printer.

dataset ready—One of 8 signals used in RS-232C data transmissions.

data terminal ready—One of 8 signals used in RS-232C data transmissions.

DCE—Data Communications Equipment. A term for equipment used in RS-232C communications that interfaces with the data terminal equipment (DTE). This device is generally a modem or printer.

device number switch—The standard device number for printers is 4. Many interfaces have a switch to change the device number for the printer to 5. Some allow other values as well. The switch may be located on the interface or may be internal and controlled by software. Some interfaces have both an external switch and a software controllable switch.

DTE—Data Terminal Equipment. A term for equipment used in RS-232C communications that interfaces with the data communications equipment. This usually refers to the computer. A DTE must be work with a DCE. See DCE.

duplex—A bidirectional data transmission method, using separate or multiple lines, which causes data transfer in two directions at one time.

emulation—The simulation of a device or program in real time. A device emulates another when it behaves in the same manner and can, therefore, carry out the same functions. Problems sometimes occur because emulations do not create the exact environment of the original device or program.

handshaking—A data transfer synchronizing technique used after the establishment of a connection between two data communication devices. It uses two signals: 1 for ready ?, and 2 for yes or no acknowledgement.

IEEE—An industry standard communications protocol often referred to as IEEE8-4888. This allows parallel data transmission between multiple devices, each identified by a unique identification number.

input—Sending data to the computer from an input device such as a keyboard, cassette tape, joystick, or disk drive, modem.

output—Sending data out of the computer to an output device such as a printer or video screen.

parallel—A method of transmitting 8 bits of data simultaneously. Parallel connections have 8 wires to carry each of the 8 bits of a byte. Contrast this method with serial.

parity—An error detection procedure that uses an odd or even one-bit indicator at the end of a word. If a parity error occurs the device may hang up or retry the transmission.

peripheral—An external device connected to a computer. Monitors, printers, disk drives, and modems are all peripherals.

protocol—The rules used to control the exchange of data between devices.

RAM—Random Access Memory. RAM is general purpose, erasable, reusable memory.

receive—One of 8 signals used in RS-232C data transmissions.

request to send—One of 8 signals used in RS-232C data transmissions.

ring indicator—One of 8 signals used in RS-232C data transmissions.

RS-232C—The name of the electrical standard for serial data communication between devices. This type of connection is widely used in modems and some other input/output devices.

self-test—A procedure whereby a device verifies whether or not it is working properly and notifies the user appropriately.

seral—Transmission of data where one wire is used to send one bit at a time. A serial device must collect all 8 bits to form one byte. Contract this method with parallel.

special characters—Nonalphanumeric characters. Some examples include punctuation, braces, PET graphics, and control characters.

start-bit—A bit indicating the beginning of asynchronous serial transmission.
stop-bit—A bit indicating the end of asynchronous serial transmission.

transmit—One of 8 signals used in RS-232C data transmission.

MFJ-1238 RS-232C interface $39.95

MFJ Enterprises

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Centronics parallel:	–
RS-232C serial:	+
IEEE:	–
Dot graphics:	–
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The MFJ-1238 by MFJ Enterprises is a RS-232C serial interface. It plugs directly into the Commodore user port. A switch is provided to set the interface for operation with a DTE (data terminal) or DCE (data communications) configured modem or other device. The MFJ-1238 draws its power from the C-64 and provides a standard 25 pin D connector for the cable from the serial device. The cable is not provided. The unit does not come with a protective case so the components are exposed to the environment.

QUALITY AND PERFORMANCE

Because the MFJ-1238 does not have its own power supply, the voltage levels tend toward the low side of the levels allowed by the RS-232C standard.

VENDOR SUPPORT

MFJ Enterprises provides a one year unconditional guarantee for this interface and will refund the purchase price wthin 30 days if the buyer is not completely satisfied.

RS-232C interface

$39.95

Omnitronix

RATINGS

C Overall rating
C Price/performance
B Software compatibility
B Ease of installation
B Documentation
B Vendor support

FEATURES

Centronics parallel:	–
RS-232C serial:	+
IEEE:	–
Dot graphics:	–
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The RS-232C Interface from Omnitronix provides a standard serial interface by plugging into the user port of the Commodore 64. It provides 8 signals: transmit, receive, request to send, clear to send, dataset ready, carrier detect, data terminal ready, and ring indicator. It provides a male type DB25 connector, which will not require an additional cable for most devices.

QUALITY AND PERFORMANCE

Unfortunately, the Omnitronix RS232C Interface does not provide for power regulation and the voltages are only within minimal specifications.

The documentation provides instructions for setting up RS-232C devices with the Commodore 64 by using BASIC. It also gives some clues on modifying the interface for printers that deviate from RS-232C standards. Some adaptors for this purpose are included with the device.

VENDOR SUPPORT

Omnitronix's interface is warranted for 6 months. After the warranty expiration date, they will repair the interface for $5, plus parts and shipping.

JE-232CM RS-232C interface $39.95

Jameco Electronics

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
C	Ease of installation
C	Documentation
C	Vendor support

FEATURES	
Centronics parallel:	–
RS-232C serial:	+
IEEE:	–
Dot graphics:	–
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The JE-232CM RS-232C interface for the Commodore 64 has a number of desirable features including the ability to reverse polarity of the clear to send/request, and to send data terminal ready, and dataset ready lines. It lacks a protective cover, which leaves the electrical components exposed to the environment.

Because the connector provided for the peripheral is a female connector, rather than the standard male connector, an addition cable will usually be required. Jameco will supply a cable for an additional price of $14.00. This should be considered as a possible addition to the cost of this interface because other interfaces of this type do not require a cable.

QUALITY AND PERFORMANCE

This is a good quality RS-232C interface, which is available at a reasonable cost, especially if you do not need the additional cable. This interface works well with a number of serial devices. Some consideration must be given to the fact that the electronic components of this unit are exposed. You may need to devise some means of protecting the interface in order to assure that its life will be long and useful. The documentation is clearly written but is rather skimpy.

VENDOR SUPPORT

The JE-232CM is warranted for 6 months for defects and 90 days for replacement or repair free of charge.

RS-232C interface with reset button $44.95

Batteries Included

RATINGS	
A	Overall rating
A	Price/performance
A	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Centronics parallel:	–
RS-232C serial:	+
IEEE:	–
Dot graphics:	–
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The RS-232C Interface with Reset Button from Batteries Included is completely compatible with the Commodore 1011A interface and will, therefore, work with the same devices. It will also function properly with the Commodore portable, the SX-64. It plugs into the user port and provides a DB25 female type connector. This means you will need a cable to attach most serial devices. The price of the cable should be considered in the total price of the interface. The interface has full power amplification and jumpers to change between data terminal and data set formats when using a modem. The reset button will perform a warm start of the computer.

QUALITY AND PERFORMANCE

This interface works well with all of the Commodore compatible serial devices and includes several useful features at a reasonable price. It can be used in conjunction with the BusCard II Centronic parallel and IEEE interface, also from Batteries Included. This interface is useful for anyone who plans on using their peripheral extensively.

VENDOR SUPPORT

A technical support number is available, and the Batteries Included personnel are helpful and friendly.

V-232 RS-232C interface $49.95

MSD Systems

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
Centronics parallel:	–
RS-232C serial:	+
IEEE:	–
Dot graphics:	–
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The V-232 is an RS-232C serial interface for the Commodore 64. It inserts directly into the user port and provides standard RS-232C signals to a female type DB25 connector. It will, therefore, require an addition cable wth a male connector for most devices. The cost of this cable should be considered in the total cost of the interface.

The V-232 is covered with a protective plastic case. Inside the case are a series of jumpers that are configured for a standard RS-232C interface. The documentation includes instructions for modifying the jumpers to configure the interface for serial versions of the Okidata 82A, the TI 810, the Commodore 8300p, and the Epson MX-100 printers. The documentation also includes information on solving timing problems between the Commodore 64, the interface, and the printer.

QUALITY AND PERFORMANCE

The V-232 worked well with many serial devices. We did not attempt modification on the jumpers that require soldering. The documentation provided is adequate and quite easy to use.

VENDOR SUPPORT

The V-232 is warranted for the lifetime of the original purchaser.

CX-6402 RS-232C interface

$59.95

ECX Computers

RATINGS

C Overall rating
D Price/performance
B Software compatibility
C Ease of installation
C Documentation
C Vendor support

FEATURES

Centronics parallel:	–
RS-232C serial:	+
IEEE:	–
Dot graphics:	–
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The CX-6402 is a minimally functional RS-232C serial interface. It inserts directly into the Commodore 64 user port and provides a male DB25 cable for connecting with the peripheral. A major flaw of the CX-6402 is that it is not enclosed in a housing, and the components are directly exposed to contact with the user and items in the work area.

QUALITY AND PERFORMANCE

The electrical specification for this interface are unnecessarily close to the lower limits of the RS-232C standard. The lack of electrical shielding of the components and of any substantial documentation makes this device a poor competitor against similar devices.

VENDOR SUPPORT

The CX-6402 is warranted for 90 days.

Card?+B Centronics parallel interface

$59.95

Cardco, Inc.

RATINGS

B Overall rating
A Price/performance

FEATURES

Centronics parallel:	+
RS-232C serial:	–

RATINGS	
B	Software compatibility
A	Ease of installation
C	Documentation
C	Vendor support

FEATURES	
IEEE:	–
Dot graphics:	+
ASCII conversion:	+
PET graphics emulation:	C
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	+
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The Card?+B is Cardco's limited function Centronics parallel interface. It is designed to work with a variety of Centronics parallel printers. It provides dot addressable graphics, conversion from Commodore ASCII to standard ASCII, automatic line feed, and conversion of PET graphic symbols into a symbolic representation. It does not, however, print the PET graphics in their standard graphics form. It has a very limited ability to convert printer codes, interchanging only CHR$(20) with CHR$(15). This feature will be useful to Prowriter users, because Prowriter assumes that you are using a VIC printer.

The Card?+B can function in several different modes depending upon the address at which the interface is activated. It can function in the uppercase mode with or without a line feed, in the graphics mode with or without a line feed, and in a special listing mode that converts the PET graphics characters into corresponding but slightly different symbols. The three DIP switches on this interface allow you to turn on and off the auto line feed, the ASCII conversion, and the interchanging of CHR$(20) and CHR$(15).

QUALITY AND PERFORMANCE

The Card?+B has several shortcomings but these are essentially design and price considerations. The features omitted from this interface are included in Cardco's more expensive Card?+G interface. This interface works well with my standard software group. It allows access to the special print modes of various printers by sending the control codes needed. It also does an acceptable job of printing the control codes needed. It also does an acceptable job of printing graphics screens using a standard graphics package. The major short comings of the Card?+B include its inability to print PET graphics n their standard format, although they may be printed in an alternate format, and its inability to fully emulate the Commodore 1525 printer. These features are, however, provided in the Card?+G. The documentation is poorly written and often difficult to understand.

VENDOR SUPPORT

Cardco warrants its products for the lifetime of the original purchaser. A phone number is provided for technical assistance; however, it is of limited value because it is almost always busy. When this interface was used with an Olympia Electronic printer, the Card?+B case had to be modified.

SPI and SPI/B Centronics parallel interface

$59.95 (SPI)

XETEC

$69.96 (SPI/B)

RATINGS

A	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
B	Documentation
A	Vendor support

FEATURES

Centronics parallel:	+
RS-232C serial:	–
IEEE:	–
Dot graphics:	–
ASCII conversion:	+
PET graphics emulation:	C
Commodore 1525 emulation:	–
Self test:	+
Device number switch:	+
Command interception:	+
Auto line feed:	+
Buffer:	2K
RAM used:	0

PRODUCT SUMMARY

The SPI and SPI/B are Centronics parallel interfaces. The SPI/B version is different only in that it has a 2K buffer. These interfaces offer 10 additional printing commands and can produce ultra high-quality letters on Star, Delta, Epson, and Panasonic printers (correspondence quality). They do not provide true emulation of PET graphics or of the 1525 printer. These features are found on XETEC's graphics printer interface (GPI). They will, however, produce alternate representation for PET graphics: a mnemonic representation such as SPD for the spade symbol, the Commodore ASCII code for the graphics symbols, and the letters of the keys pressed such as SQ for SHIFT/Q. The true emulation capabilities are available on XETEC's graphics printer interface (GPI).

QUALITY AND PERFORMANCE

The SPI and SPI/B interfaces are compatible with most software for the Commodore 64 and work well with most of the popular printers. The correspondence quality print feature is of particular value.

VENDOR SUPPORT

A one year warranty is provided for both interfaces. After one year, XETEC will repair the units at the cost of parts and minimum wage for labor. Technical questions are answered by knowledgeable, friendly personnel.

CPI Centronics parallel interface $79.95

MSD Systems

RATINGS		FEATURES	
B	Overall rating	Centronics parallel:	+
B	Price/performance	RS-232C serial:	–
B	Software compatibility	IEEE:	–
A	Ease of installation	Dot graphics:	+
C	Documentation	ASCII conversion:	+
C	Vendor support	PET graphics emulation:	C (three letters)
		Commodore 1525 emulation:	–
		Self test:	+
		Device number switch:	+
		Command interception:	+
		Auto line feed:	+
		Buffer:	–
		RAM used:	0

PRODUCT SUMMARY

CPI is a Centronics parallel interface designed to support any Centronics parallel device. It will support dot addressable graphics on dot matrix printers. It does not provide for emulation of the Commodore 1525 printer and will not print PET graphics characters in their full graphics form. It will, however, convert PET graphics symbols into a three letter code and print them in place of the PET graphics symbol. CPI has a built-in self test and six options controlled by DIP switches. These options include:

Switch 1	Turns ASCII conversion on or off
Switch 2	Uppercase only on or off
Switch 3	Automatic line feed on or off
Switch 4	Printer device #4 or #5
Switch 5	Intercept control characters
Switch 6	Allows control of CPI through secondary addressing

QUALITY AND PERFORMANCE

The CPI worked well with most Centronics parallel printers and with my standard software group. With switch 5 in the off position, it will print graphics images

quite well and can be used with many of the standard graphics packages. The documentation is not well written.

VENDOR SUPPORT

CPI is warranted for the life of the original purchaser. Micro Systems Development provides a toll-free number for technical support. It is only manned for a few hours each day and it is very difficult to get through on this line.

MW-302C Centronics parallel interface $79.95

Micro World Electronix

RATINGS	
B	Overall rating
C	Price/performance
B	Software compatibility
A	Ease of installation
A	Documentation
A	Vendor support

FEATURES	
Centronics parallel:	+
RS-232C serial:	–
IEEE:	–
Dot graphics:	+
ASCII conversion:	+
PET graphics emulation:	–
Self test:	–
Device number switch:	+
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The MW-302C is a Centronics parallel interface for the Commodore 64. This interface is based on the new CMOS technology, which has lower power consumption and therefore does not require a separate power supply from the printer. It supports dot graphics, ASCII conversion, and changes to the device number. It provides a switch for changing from a 7 to an 8 bit data line, which is useful with some printers. It does not emulate the Commodore 1525 printer and will not print PET graphics. Many of the features not included in the MW-302C are available in the upgraded version, the MX-250.

QUALITY AND PERFORMANCE

The MW-302C is an exceptionally well-made interface. The connectors are made of steel rather than the usual plastic. This interface functioned well in word processing and dot graphics modes with a variety of printers. The documentation is very well written, clearly indicating the settings and functions of all the switches. It also includes a series of BASIC programs used to test all the functions of the interface.

VENDOR SUPPORT

Micro World Electronix warrants the MW-302C for 90 days. A phone number is provided for technical support, and the personnel are friendly and helpful.

GPI Centronics parallel interface $89.95

XETEC

RATINGS		FEATURES	
A	Overall rating	Centronics parallel:	+
B	Price/performance	RS-232C serial:	–
A	Software compatibility	IEEE:	–
A	Ease of installation	Dot graphics:	+
B	Documentation	ASCII conversion:	+
A	Vendor support	PET graphics emulation:	+
		Commodore 1525 emulation:	+
		Self test:	+ (power on)
		Device number switch:	+ (4/5 or software)
		Command interception:	+
		Auto line feed:	+
		Buffer:	2K
		RAM used:	0

PRODUCT SUMMARY

The GPI interface is a Centronics parallel interface for the Commodore 64. It provides 22 additional graphics commands and can be configured for 21 different printers. One of its special features is a high-speed (under 1 minute), high-resolution screen dump. It also has complete emulation of the Commodore 1525 printer and PET graphics. A 2K buffer and a command channel with 7 different printing modes is provided.

QUALITY AND PERFORMANCE

The GPI interface is compatible with most software for the Commodore 64 and works well with most of the popular printers.

VENDOR SUPPORT

XETEC provides a one year warranty and will repair the interface after one year at minimum cost. Technical support is provided by knowledgeable personnel.

CX-6401 Centronics parallel interface $89.95

ECX Computers

RATINGS		FEATURES	
C	Overall rating	Centronics parallel:	+
C	Price/performance	RS-232C serial:	–

RATINGS	
C	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
IEEE:	–
Dot graphics:	–
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The CX-6401 is a Centronics parallel interface. It provides a minimum number of features. The only switch setting is a toggle switch for uppercase (for program listing) and upper/lowercase (for text). All other characteristics of this device are fixed. It does not print PET graphics characters and is likely to cause difficulties with your printer if you print a program with these characters. The manual for this interface recommends that you replace PET graphics characters in your BASIC programs with the corresponding CHR$ codes.

QUALITY AND PERFORMANCE

For simple text printing using no advanced features, the CX-6401 works well with a variety of Centronics parallel devices. It will do plain vanilla word processing applications quite well.

The manual is difficult to follow and seems to be incomplete. It also assumes a high level of technical expertise on the part of the reader.

VENDOR SUPPORT

The CX-6401 is covered by a 90 day warranty on parts and labor.

Card?+G Centronics parallel interface $99.95

Cardco, Inc.

RATINGS	
B	Overall rating
A	Price/performance
B	Software compatibility
A	Ease of installation
C	Documentation

FEATURES	
Centronics parallel:	+
RS-232C serial:	–
IEEE:	–
Dot graphics:	+
ASCII conversion:	+

RATINGS		FEATURES	
C	Vendor support	PET graphics emulation:	+
		Commodore 1525 emulation:	+
		Self test:	–
		Device number switch:	+
		Command interception:	–
		Auto line feed:	+
		Buffer:	–
		RAM used:	0

PRODUCT SUMMARY

The Card?+G interface is Cardco's top end interface. It is widely used among Commodore 64 and VIC 20 owners. The Card?+G has all the features of the Card?+B, plus several other important features. The Card?+G provides PET graphics emulation, printing them in their actual graphics form. It also provides complete emulation of the Commodore 1525 printer, the ability to change the device number from four to five, and the conversion of a number of common printer commands such as TAB. The Card?+G can be specifically configured to support a number of commonly used printers including the Epson MX, RX, and FX printers, the Star Gemini 10X and Delta 10 printers, and Prowriter printer, the C.Itoh 8510 printer, the NEC 8023 printer, the Okidata 82, 83, 84, 92, 93, and 94 printers, the Mannesman Talley Spirit and OT 160 printers, the Seikosha GX-100 printer, the BMC BX-80 printer and the Gorilla Banana printer. It prints the full Commodore character set, graphics characters on all of the above printers. For most other Centronics parallel printers, the Card?+G will handle most of the standard functions. Like the Card?+B, this interface can be accessed through alternate addresses to provide a number of optional print formats. These include uppercase only, upper and lowercase, and with or without line feeds. Another useful feature is the ability to print the hexadecimal equivalents of data sent to the printer instead of the standard ASCII characters. This is useful in debugging programs.

QUALITY AND PERFORMANCE

The Card?+G worked well with a number of printers we tested. It emulated the Commodore 1525 printer exactly and provides true program listings of BASIC programs that contain the PET graphics symbols. It will also work with many other Centronics parallel printers. It can, however, only produce PET and block graphics images with those printers for which it was specifically designed. The documentation is poorly written and often difficult to understand.

VENDOR SUPPORT

Cardco warrants its products for the lifetime of the original purchaser. A phone number is provided for technical assistance; however, it is of limited value because it is almost always busy.

C-64-Link Compatibility Board

$100.00

Richvale Telecommunication

RATINGS	
C	Overall rating
D	Price/performance
B	Software compatibility
B	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
Centronics parallel:	–
RS-232C serial:	–
IEEE:	–
Dot graphics:	–
ASCII conversion:	+
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The C64-Link Compatibility Board attaches to the C64-Link to upgrade it almost completely to a C64-Link II. See the reviews of these two interfaces for details.

QUALITY AND PERFORMANCE

With the current price structure of $119.00 for a new C64-Link II and $100.00 for the compatibility board, it seems wiser to buy the new C64-Link II rather than upgrading your existing C64-Link.

VENDOR SUPPORT

The C64-Link Compatibility Board will be replaced free of charge during the first 90 days. After that it will be repaired for a fee.

CIE IEEE interface

$109.95

MSD Systems

RATINGS	
B	Overall rating
B	Price/performance
C	Software compatibility
B	Ease of installation
D	Documentation

FEATURES	
Centronics parallel:	–
RS-232C serial:	–
IEEE:	+
Dot graphics:	–
ASCII conversion:	–

RATINGS		FEATURES	
B	Vendor support	PET graphics emulation:	–
		Commodore 1525 emulation:	–
		Self test:	–
		Device number switch:	–
		Command interception:	–
		Auto line feed:	–
		Buffer:	–
		RAM used:	1K

PRODUCT SUMMARY

CIE is an IEEE interface from Micro Systems Development. It provides the same IEEE 488 bus that is used with the larger Commodore computers. This makes it possible to use disk drives such as the discontinued Commodore 4040, the MSD Drives, the Commodore 8050, and other large Commodore disk drives and dot matrix printers. The CIE loads 1K of software into the Commodore 64's RAM at location 39936. Using programs provided with the interface, the software may be relocated to begin at 52224 or 31744. In any of these cases there is a possibility of a conflict between the CIE software and commercial software packages. You will need to experiment to see which of these three configurations will be compatible with the applications software you plan to us. The CIE plugs into the cartridge slot on the Commodore 64 and provides another carridge slot so you can still use a cartridge. A special CBM to IEEE cable is required to connect many devices such as MSD's Super Disk Drive.

QUALITY AND PERFORMANCE

In spite of the problems created by the 1K of memory used by the CIE software, this is a popular interface. It provides access to the much faster and larger capacity disk drives. The documentation is poorly written.

VENDOR SUPPORT

The CIE interface carries a lifetime warranty. An 800 number is available for technical support questions.

C-64-Link II

$119.00

Richvale Telecommunication

RATINGS		FEATURES	
A	Overall rating	Centronics parallel:	+
A	Price/performance	RS-232C serial:	+
A	Software compatibility	IEEE:	+
B	Ease of installation	Dot graphics:	–

RATINGS		FEATURES	
B	Documentation	ASCII conversion:	+
B	Vendor support	PET graphics emulation:	–
		Commodore 1525 emulation:	–
		Self test:	–
		Device number switch:	–
		Command interception:	–
		Auto line feed:	–
		Buffer:	–
		RAM used:	0

PRODUCT SUMMARY

C64-Link II is a significantly upgraded version of Richvale's C64-Link. It will eventually be a replacement, but for now both products are available. The C64-Link II uses no RAM, where the original Link used 8K. This makes the C64-Link II compatible with a much wider variety of software. The C64-Link II has the new KERNAL 3 in ROM. While this will not help owners of Commodore 64s manufactured after approximately October 1983, it is invaluable for owners of older Commodore 64s. KERNAL 3 corrects a number of bugs in KERNAL 2, including problems with parity on the serial port and screen editing. Another strong feature of the C64-Link II is its ability to redirect unit 15 to unit 8 on the opposite disk interface. This allows you to copy from a 1541 to an IEEE disk (such as 4040) or vise versa. Programs such as Copyall can do this.

QUALITY AND PERFORMANCE

If you own an older Commodore 64, the C64-Link II is a good buy just to get KERNAL 3 on your machine. For owners of newer Commodore 64s with KERNAL 3 installed, the C64-Link II probably only makes sense if you need the IEEE interface for a 4040 disk drive or other IEEE peripherals. The parallel interface is very plain vanilla. It works with most interfaces, but it does not support many of the most valuable features.

VENDOR SUPPORT

C64-Link II will be replaced free of charge during the first 90 days. After that Richvale Telecommunication will repair it for a fee.

Grappler CD Centronics parallel interface $119.00

Orange Micro Inc.

RATINGS		FEATURES	
B	Overall rating	Centronics parallel:	+

RATINGS	
B	Price/performance
B	Software compatibility
B	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
RS-232C serial:	–
IEEE:	–
Dot graphics:	+
ASCII conversion:	+
PET graphics emulation:	+
Commodore 1525 emulation:	+
Self test:	–
Device number switch:	–
Command interception:	+
Auto line feed:	+
Buffer:	–
RAM used:	8K

PRODUCT SUMMARY

The Grappler CD, shown in Fig. 4-1, is a new Centronics parallel interface from Orange Micro. It provides PET graphics emulation, ASCII conversions, and Commodore 1525 emulation. It can be configured for Epson, Star, Okidata, Prowriter, and several other popular printers. It has built-in text and graphics screen dump routines. There are several additional unique features including 22 new text and graphics commands for the programmer, and rotated and inverted printouts of the screen.



Fig. 4-1. The Grappler CD parallel interface will work with many of the most popular printers (courtesy of Orange Micro).

QUALITY AND PERFORMANCE

The Grappler CS is well made and works well with several of the more popular word processors. It dumped the screen successfully on an Epson, an Okidata, and a Star printer.

VENDOR SUPPORT

Orange Micro provides a one year warranty with this interface. There is a phone number available for technical support.

The Connection Centronics parallel interfaces $119.00

Tymac

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Centronics parallel:	+
RS-232C serial:	–
IEEE:	–
Dot graphics:	+
ASCII conversion:	+
PET graphics emulation:	+
Commodore 1525 emulation:	+
Self test:	+
Device number switch:	+
Command interception:	+
Auto line feed:	+
Buffer:	2K
RAM used:	0

PRODUCT SUMMARY

The Connection is a family of Centronics parallel interfaces. One version is a universal printer interface that will work with many Centronics parallel printers. There are specific versions available for some printers including Epson, Gemini, Okidata, Seikosha, and C. Itoh. In these versions, Commodore 1525 and PET graphics emulation are supported. The universal interface may or may not emulate the Commodore 1525 and PET graphics on other printers.

The Connection does intercept special characters and convert them into a three character printable code. It has a self-test feature and a 2K buffer, which will hold about one page of printed material. This is useful because the printer is then freed up for other uses while the document is being printed. The Connection also has special features for printing BASIC program listings including the ability to control the width of the printout, so you can have extra wide margins for comments.

QUALITY AND PERFORMANCE

The specific versions of The Connection for various printers work well with these printers. The only exception was that the Okidata printers would not printout reverse graphic characters. The universal version worked well with a number of Centronic parallel printers for most of the major printing features .

VENDOR SUPPORT

The connection is warranted for one year on parts and labor.

P-Link Centronics parallel interface $129.95

Richvale Telecommunication

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Centronics parallel:	+
RS-232C serial:	–
IEEE:	–
Dot graphics:	+
ASCII conversion:	+
PET graphics emulation:	+
Commodore 1525 emulation:	+
Self test:	–
Device number switch:	–
Command interception:	+
Auto line feed:	+
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The P-Link converts the serial port of the Commodore 64 to a standard Centronics parallel interface. It supports dot graphics, Commodore ASCII to standard ASCII conversion, and the emulation of PET graphics and the 1525 commands on a number of popular printers. It offers an auto line feed option, but lacks a device number switch, buffer, and self test.

QUALITY AND PERFORMANCE

The P-Link provides most of the features omitted from the parallel port of the Richvale C64-Link. It works well with most popular software and printers. It is a solid parallel interface but is not outstanding in any particular way. The documentation is sketchy, particularly on the question of compatibility with other interfaces.

VENDOR SUPPORT

P-Link will be replaced free of charge during the first 90 days. After that the device will be repaired for a fee.

MW-350 Centronics parallel interface $129.00

Micro World Electronix

RATINGS		FEATURES	
A	Overall rating	Centronics parallel:	+
B	Price/performance	RS-232C serial:	–
A	Software compatibility	IEEE:	–
A	Ease of installation	Dot graphics:	+
B	Documentation	ASCII conversion:	+
A	Vendor support	PET graphics emulation:	+
		Commodore 1525 emulation:	+
		Self test:	+
		Device number switch:	+ (4/5 only)
		Command interception:	+
		Auto line feed:	+
		Buffer:	2K or 4K
		RAM used:	0

PRODUCT SUMMARY

The MW-350 is a universal Centronic parallel interface with a switch-selectable graphics mode. It plugs directly into the printer port on the Commodore 64. It provides dot graphics capability, standard ASCII to Commodore ASCII conversion, device number switching, automatic line feed, and a self test. It will emulate the Commodore 1525 printer and PET graphics. It can also convert PET graphic symbols to key press codes (SQ for SHIFT/Q) or to 6 letter abbreviations. A buffer is available at extra cost ($14.95 for 2K or $24.95 for 4K).

QUALITY AND PERFORMANCE

This interface worked well with all the standard software and parallel printers and has all of the desirable features useful in a parallel interface. The 60 page documentation manual includes programming examples.

VENDOR SUPPORT

Micro World Electronix warrants the MX-350 for 90 days on parts and labor. There is a phone number available for technical support calls, and the personnel manning the phone are knowledgeable and friendly.

C-64-Link

$150.00

Richvale Telecommunication

RATINGS	
B	Overall rating
B	Price/performance
C	Software compatibility
B	Ease of installation
D	Documentation
B	Vendor support

FEATURES	
Centronics parallel:	+
RS-232C serial:	+
IEEE:	+
Dot graphics:	+
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	–
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	8K

PRODUCT SUMMARY

The C64-Link is an unusually flexible interface. It provides three basic interface types: IEEE, RS-232C serial, and Centronics parallel. It also has the capability of linking up to 8 Commodore 64s together for sharing disk drives, printers, and other peripherals. In addition, the C64-Link provides additional BASIC statements to bring the built-in Commodore 64 BASIC up to the level of BASIC 4.0. This is the new, more powerful BASIC used on Commodore's new machines, the C-16. It also includes a machine language monitor in the cartridge software. This will assist you in reloading programs and in doing assembly language programming.

The IEEE interface works with such devices as the Commodore 8050 disk drive and dot matrix printers. Many devices can be linked together in the standard IEEE daisy-chain fashion. When the C64-Link is inserted into the Commodore 64's cartridge slot, the serial port is still available for attaching devices such as the Commodore 1541 disk drive or 1525 printer. The Centronics parallel printer port is a plain vanilla, universal parallel printer port with a minimum of functions. The RS-232C port is created by using the user port and special software loaded into RAH from the cartridge when the computer is powered on. This can create software compatibility problems for some application packages.

QUALITY AND PERFORMANCE

The C64-Link provides access to a wide variety of different devices using the appropriate adaptors. While each of the various interfaces provided by the C64-Link tend to be rather simple and missing some of the features available in single-purpose interfaces, this interface will function well in simple, straightforward applications

and carries out its intended functions well. The documentation is adequate but not very well written. The C64-Link will eventually be discontinued and replaced by the C64-Link II, but it may be available from existing inventory for some time.

VENDOR SUPPORT

The C64-Link will be replaced free of charge during the first 90 days. After that, Richvale Telecommunication will repair the unit for a fee.

S-Link RS-232C interface $159.95

Richvale Telecommunication

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Centronics parallel:	–
RS-232C serial:	+
IEEE:	–
Dot graphics:	+
ASCII conversion:	+
PET graphics emulaton:	+
Commodore 1525 emulation:	+
Self test:	–
Device number switch:	–
Command interception:	+
Auto line feed:	+
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The S-Link is a full-featured RS-232C interface for the Commodore 64. It offers many of the features usually found only on parallel interfaces: dot graphics, Commodore ASCII to standard ASCII conversion, PET graphics emulation, and 1525 emulation. S-Link also provides a line feed option. It does not use any RAM and is compatible with most software.

QUALITY AND PERFORMANCE

The S-Link has an unusual array of features for an RS-232C serial interface. If you plan to use the interface with a modem rather than with a serial printer, most of the features will not be used.

VENDOR SUPPORT

S-Link will be replaced free of charge during the first 90 days. After that, the device will be repaired for a fee.

APV Modem with Centronics parallel interface $179.95

RATINGS	
A	Overall rating
A	Price/performance
B	Software compatibility
B	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Centronics parallel:	+
RS-232C serial:	+
IEEE:	–
Dot graphics:	+
ASCII conversion:	–
PET graphics emulation:	–
Commodore 1525 emulation:	+
Self test:	+
Device number switch:	+ (software)
Command interception:	–
Auto line feed:	+
Buffer:	$3—
RAM used:	0

PRODUCT SUMMARY

The APV is a very high quality 300 baud, autodial, autoanswer modem with a Centronics parallel interface included. A Centronics parallel printer cable is included, as is a terminal program on cassette. The terminal program allows you to download from another Commodore 64, but does not support downloading from telecommunications services such as Compuserve or The Source. This software will be upgraded in the future to include this ability, and the upgrade will be available for the cost of the disk. The modem component of the ALV is reviewed in the chapter on modems.

The Centronics parallel interface provides for dot graphics, Commodore 1525 emulation, software-switchable device number, and automatic line feed. However, the interface does not handle ASCII conversion or PET graphics emulation. The APV interface includes a switch to turn handshaking of the printer on and off. The printer switch has an Xon/Xoff technique for controlling transmission of data from the interface and printer. This prevents timing problems. While the APV does provide the necessary interface for the built-in modem, it does not allow the attachment of any other RS-232C devices.

QUALITY AND PERFORMANCE

The APV works well with a number of printers and the popular word processors, especially those that do their own ASCII conversions. It is an extremely well-made device. The inclusion of the cable makes the price very attractive. The documentation includes an introduction to telecommunications and sample programs that utilize many of the special features of the interface and modem.

VENDOR SUPPORT

The APV is backed by a 90 day factory warranty for parts and labor. Repairs

require about a one week turnaround. After the warranty expires, for $50.00 and the return of the modem, Microperipheral Corp. will send you a new modem, which will contain any upgrades. Microperipheral Corp. encourages you to go to the dealer first for support, but will assist you with any problems you encounter.

Interpod dual function interface $189.95

Oxford Computer Systems

RATINGS		FEATURES	
B	Overall rating	Centronics parallel:	–
C	Price/performance	RS-232C serial:	+
B	Software compatibility	IEEE:	+
B	Ease of installation	Dot graphics:	–
B	Documentation	ASCII conversion:	+
B	Vendor support	PET graphics emulation:	–
		Commodore 1525 emulation:	–
		Self test:	–
		Device number switch:	+ (software)
		Command interception:	–
		Auto line feed:	–
		Buffer:	–
		RAM used:	0

PRODUCT SUMMARY

Interpod is a dual function interface. It provides both an RS-232C serial and an IEEE interface for the Commodore 64. It has a number of options that are selected by software switching rather than external switches on the device. You can select baud rate, parity, and 7 or 8 bit character size, convert standard ASCII to Commodore ASCII, and control the device number. The Interpod connects to the Commodore 64 at the 6-pin DIN port. While many IEEE devices can be chained together into the IEEE interface, only one RS-232C device can be connected at one time. This is typical of most RS-232C interfaces. Cables for RS-232C or IEEE connections are required to hook-up the appropriate device.

QUALITY AND PERFORMANCE

Interpod worked well with a variety of devices. However, its higher cost makes it a less-economical choice unless you have a need to use both RS-232C and IEEE devices. The documentation is clearly written and easy to use.

VENDOR SUPPORT

Interpod is warranted for 90 days.

BusCard II dual function interface $199.95

Batteries Included

RATINGS	
A	Overall rating
B	Price/performance
A	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Centronics parallel:	+
RS-232C serial:	–
IEEE:	+
Dot graphics:	–
ASCII conversion:	+
PET graphics emulation:	–
Commodore 1525 emulation:	–
Self test:	–
Device number switch:	+
Command interception:	–
Auto line feed:	–
Buffer:	–
RAM used:	0

PRODUCT SUMMARY

The BusCard II from Batteries Included, shown in Fig. 4-2, is a dual function unit that includes a Centronics parallel interface and an IEEE interface. It plugs into the cartridge port on the back of the Commodore 64 and provides an extended cartridge port so you can still use a cartridge. It will perform standard ASCII to Commodore ASCII conversion and device number switching, and includes a full machine language monitor with a simple built-in assembler. It also provides additional BASIC statements to upgrade the built-in Commodore BASIC to BASIC 4.0. You can use this interface with other interfaces from Batteries Included. It is completely compatible with Commodore 1011A interface and will, therefore, work with the same devices.

QUALITY AND PERFORMANCE

Because this interface plugs into the cartridge port, it works quickly. It works well with many of the popular printers and has many useful features. The high price can be easily justified if you have need of both a Centronics parallel and IEEE interface, and can use one or more of the useful features.

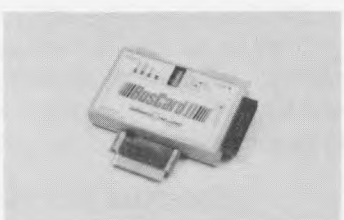


Fig. 4-2. The Batteries Included BusCard II provides an array of expansion features including Centronics parallel and IEEE interface, KERNAL 3, and Extended BASIC (courtesy of Batteries Included).

VENDOR SUPPORT

Batteries Included provides a phone number to call for helpful technical support.

WORKSHEET FOR INTERFACES

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RATINGS

Overall rating
Price/performance
Software compatibility
Ease of installation
Documentation
Vendor support

FEATURES

Centronics parallel:
RS-232C serial:
IEEE:
Dot graphics:
ASCII conversion:
PET graphics emulation:
Commodore 1525 emulation:
Self test:
Device number switch:
Command interception:
Auto line feed:
Buffer:
RAM used:

PRODUCT SUMMARY

QUALITY AND PERFORMANCE

VENDOR SUPPORT

COMPARISONS AT A GLANCE

Table 4-1 shows each interface and the rating it received in each category. The features of each interface are shown in Table 4-2.

Table 4-1. Comparative Ratings for Interfaces

PRICE	INTERFACE	RATINGS	1	2	3	4	5	6
39.95	MFJ-1238		B	B	B	B	C	B
39.95	JE-232CM		B	B	B	C	C	C
44.95	RS-232 Interface w/Reset Button		A	A	A	A	A	A
49.95	V-232		B	B	B	B	B	B
59.95	CX-6402		C	D	B	C	C	C
59.95	Card?+B		B	A	B	A	C	C
59.95	SPI		A	B	B	B	B	A
69.95	SPI/B		A	B	B	B	B	A
79.95	CPI		B	B	B	A	C	C
79.95	MW-302C		B	C	B	A	A	A
89.95	GPI		A	B	A	A	B	A
99.95	Card?+G		B	A	B	A	C	C
100.00	C64-Link Compatibility Board		C	D	B	B	B	B
109.95	CIE		B	B	C	B	D	B
119.00	Grappler CD		B	B	B	B	B	B
119.00	The Connection		B	B	B	B	C	B
119.00	C64-Link II		A	A	A	B	B	B
129.00	MW-350		A	B	A	A	B	A
129.95	P-Link		B	B	B	B	C	B
150.00	C64-Link		B	B	C	B	D	B
159.95	S-Link		B	B	B	B	C	B
179.95	APV		A	A	B	B	B	A
189.00	Inter Pod		B	B	B	A	B	A
199.95	BusCard II		A	B	A	A	B	A

1 = Overall rating
2 = Price/performance
3 = Software compatibility
4 = Ease of installation
5 = Documentation
6 = Vendor support

Table 4-2. Comparative Table for Interface Features

FEATURES	1	2	3	4	5	6	7	8	9	10	11	12	13
C64-Link Comp. Brd.	–	–	–	–	+	–	–	–	–	–	–	–	0
V-232	–	+	–	–	–	–	–	–	–	–	–	–	0
MFJ-1238	–	+	–	–	–	–	–	–	–	–	–	–	0
RS-232C Interface	–	+	–	–	–	–	–	–	–	–	–	–	0
JE-232CM	–	+	–	–	–	–	–	–	–	–	–	–	0
RS-232C w/Reset	–	+	–	–	–	–	–	–	–	–	–	–	0
CX-6402	–	+	–	–	–	–	–	–	–	–	–	–	0
Card?+B	+	–	–	+	+	+	–	–	–	–	+	–	0
SPI	+	–	–	–	+	C	–	+	+	+	+	–	0
SPI/B	+	–	–	–	+	C	–	+	+	+	+	2	0
CPI	+	–	–	+	+	C	–	+	+	+	+	–	0
MW-302C	+	–	–	+	+	–	–	–	+	–	–	–	0
GPI	+	–	–	+	+	+	+	+	+	+	+	2	0
Card?+G	+	–	–	+	+	+	+	–	+	–	+	–	0
CIE	–	–	+	–	–	–	–	–	–	–	–	–	1
C64-Link	+	+	+	–	+	–	–	–	–	–	–	–	0
Grappler CD	+	–	–	+	+	+	+	–	–	+	+	–	8
The Connection	+	–	–	+	+	+	+	+	+	+	+	2	0
MW-350	+	–	–	+	+	+	+	+	+	+	+	2	0
P-Link	+	–	–	+	+	+	+	–	–	+	+	–	0
C64-Link	+	+	+	–	–	–	–	–	–	–	–	–	8
S-Link	–	+	–	+	+	+	+	–	–	+	+	–	0
APV	+	+	–	+	–	–	+	+	+	–	+	–	0
Interpod	–	+	+	–	+	–	–	–	+	–	–	–	0
BusCard II	+	–	+	–	+	–	–	–	+	–	–	–	0

1 = Centronics parallel
2 = RS-232 serial
3 = IEEE
4 = Dot graphics
5 = ASCII conversion
6 = PET graphics emulation (C means that a multi-letter mnemonic is used to represent PET graphic characters.)
7 = Commodore 1525 emulation
8 = Self test
9 = Device number switch
10 = Command interception
11 = Auto line feed
12 = Buffer (in K bytes)
13 = Ram used (in K bytes)

Chapter 5



An Introduction to Printers

Today there are over 200 printers to choose from. They fall into about seven categories: the daisywheel printer, the dot-matrix printer, the thermal printer, the line printer, the ink-jet printer, the plotter (covered in Chapter 11), and the laser printer. The reviews in the following two chapters will cover the daisywheel and dot-matrix printers, under $1,000, which are best suited for use with the Commodore 64. Between these two printer types, you can achieve very good quality print and graphics. The following is some general information on printers and what is needed to put them to use.

CHARACTERS

The standard *pitch* for a printer is ten characters-per-inch (CPI). Some impact printers will have replaceable print heads allowing you to change this pitch to suit your needs.

Most printers have a standard set of 96 ASCII characters, which include the letters of the alphabet, numbers, punctuation marks, and symbols. Some printers feature additional character sets for italic characters, block graphic characters, scientific characters, and foreign language characters. Proportional character sets space characters based on their size; for instance, because I is smaller than M, it takes up less space.

RIBBONS

Printers use cloth ribbons or mylar ribbons, which come in cartridges or on

standard typewriter spools. The cloth ribbon can be used until it needs replacing or reinking. The mylar or carbon ribbon can only be used once, and though the print quality is better with the mylar ribbon, it is more expensive to use and not practical for draft copies.

PAPER

The type of paper you use will depend on the type of printer and its capacity for handling paper. Thermal printers can only use thermal paper; thermal paper is chemically treated and is heat sensitive. If your printer has a *pin-feed* mechanism, you can use *sprocket paper* (with holes on the sides), which comes in roles or fan-fold. Single sheets or rolls of paper are used with *friction feed* printers, which accept the paper just as a typewriter does. Because there are different qualities of paper, use light weight paper for your drafts and heavier weight paper for final presentations. For important printouts, "perforationless" fanfold paper can be purchased at a substantially higher price than normal printer paper. It combines the ease of fanfold paper with the smooth edges of single sheets.

BUFFER

The buffer is a storage area consisting of RAM (Random Access Memory) chips. The amount of storage space depends on the printer and its capacity. The buffer stores each character sequentially as it is sent by the computer and allows the computer to continue operating while the printer is printing at its slower pace, thus saving time.

Buffers can be built in to the printer or added to the system with an interface that is compatible with both the computer and the printer.

INTERFACES

Computers use an interface to connect the computer to the printer. This allows the printer to use a particular standard. These standards will allow you to connect almost any computer to any printer. They specify how information should be transferred, and what types of cables and plugs are needed for the connections.

The most common data format used in the industry for character and command representation is *ASCII* (American Standard Code for Information Interchange). The three hardware standards are the RS-232C (a serial transmission), the Centronics-type, and the IEEE-488 (parallel transmissions).

Standards are used for the *handshaking* signals and for formatting the transmitted data (the *protocol*). In order for two machines made by different manufacturers to work together, they must have the same protocol.

The RS-232C is a standard for serial interfaces for transmission. It designates the specific voltage levels, the required driver, and the receiver characters for 21 circuits. Information moves sequentially, bit by bit, between the computer and the printer. This makes it rather slow. The connection involves 25 different wires each having a defined use; however not all 25 need be used. With this particular standard, some of the parameters, such as baud rate and rate of data transmission, are undefined and must be set by the software.

The parallel Centronics-type interface uses 36 different wires, which send 8-bit

bytes of information simultaneously. It is much quicker than the serial interface. The other wires are used for the handshaking signals. Centronics is a printer manufacturer and was an early user of the parallel transmission; hence, its name has been given to the protocol.

The IEEE-488 is similar to the Centronics-type parallel interface. It was devised by the Institute of Electrical and Electronic Engineers for programmable instruments and controllers. Commodore and Hewlett-Packard are the primary users of this interface. The IEEE-488 uses specific handshaking signals to verify data that has been transmitted and received. Its advantage is that it can accommodate several devices connected together on a common line. Each device is given an ID number that is sent to the computer. The computer then designates which device will send and which will receive data that is to be exchanged.

The Commodore 64 comes equipped with a special serial port to connect multiple devices. It is still a serial port and therefore is slow at transmitting data. There are not many printers that will use this port; however, there are interfaces available that can be connected to this port and then to Centronics-type parallel printers. The data travels serially from the computer to the interface, which translates it into parallel data and initiates the handshaking signals necessary to print the data.

Compatibility of this equipment is a major factor. Because the industry standards vary for plugs and connections, it is important that you verify your choices with someone who has used them.

FUNCTION AND USE

The printer accepts electrical charges sent by the computer. These electrical charges are interpretted as binary numbers, which represent the keyboard characters and some commands. Electrical charges are thus "translated" into understandable print.

In addition to characters, a printer must translate commands such as print modes (normal, condensed, enlarged, double-strike), print functions (underline, superscript, subscript), print actions (carriage return, line feed, vertical tab), and paper formatting (line spacing, form length, page width). These functions use an assigned number or in some cases, two numbers (called escape sequences), to identify them to the printer. These escape sequences are not universal, and you must check your printer manual for each particular function.

STARTING UP WITH BASIC

After all the proper hook-ups have been made, you must first establish contact between the computer and the printer. When the Commodore 64 starts-up it is in the BASIC mode and is looking for BASIC commands. Begin with the OPEN command. This will establish a portion of the memory to channel the data to a peripheral device (a printer). A reference number (from 1 to 127) is assigned to the channel for future access. Further, a device number is included in the OPEN command. Most printers use the number 4, and in cases where more than one printer is used, two numbers are assigned. When a printer has different modes of operation, the OPEN command may include another number (a secondary address) for that particular mode of operation

(such as the type of characters to be printed or the use of all upper or upper and lowercase characters.

Consider the command

OPEN (a), (b), (c)

(a) is the file number (or reference number) from 1 to 127. This number is also used in the BASIC statements CLOSE, CMD, GET#, INPUT#, and PRINT#.
(b) is a number referring to the connected device. Printers are usually 4.
(c) is a number from 1 to 127 that is used to send additional information to the printer.

Using the BASIC approach can be rather complicated and some advanced programming is needed to get a character from the keyboard to the printer. For example to open a channel to the printer with file number 3, type

```
OPEN 3,4,0
PRINT#3, "test"
CLOSE 3
```

This will send the word "test" to the printer.

To send a listing of a BASIC program you would type

```
OPEN 3,4,0
CMD 3
LIST
PRINT 3
CLOSE 3
```

Note: Unless specified by the manufacturer of the interface, use a secondary address of zero.

STARTING UP WITH WORD PROCESSORS

A simpler way of establishing contact between the computer and the printer is through a word processor, which does most of the programming for you. There is a variety of commercially-available word processing software for you to choose from.

The first step is to configure your word processor to the printer. The program may ask you specific questions: for instance, it may ask for the type of printer and the method used to interface it with the Commodore. In some cases you will be presented with a list of commonly-used printers to choose from. After you have answered the initial questions, the program takes over and initiates the routines needed by the computer. Other programs have a list of printer variables that you will have to manually define.

With a word processor, characters are typed on the keyboard and presented on the screen for editing. When the work is complete, a simple one-letter command will print the material. In some cases features like emphasizing or underlining will require special handling and the use of the function keys on the keyboard.

THE TWO MAJOR TYPES OF PRINTERS

There are many different ways to group or classify printers. The classifications most frequently used distinguish printers that produces type that looks exactly like a typewriter's (*letter quality*) from those that simulate typewriter type with patterns of dots (*dot matrix*). The dot matrix printers are discussed further in Chapter 6, and the letter-quality printers are discussed in Chapter 7.

GLOSSARY

ASCII—A commonly used standard list of numbers used to represent alphanumeric characters.

baud rate—The speed at which information is transferred between devices, measured in bits per second.

bidirectional—Moving in two directions. This term indicates the print head prints in both directions. A typewriter prints only in one direction.

buffer—A memory device that stores data until the printer is ready to print it. The buffer is located within the printer or the printer interface and consists of RAM chips. The buffer holds the data from the computer until it can be printed.

control codes—ASCII directives sent to the printer.

correspondence mode—Available on some dot-matrix printers, this mode enables you to print letter quality material. The quality of the print depends on the printer.

descenders—The bottom portion of lowercase characters that are below the print line (g, j, p, q and y). On a 5×7 matrix, upper and lowercase letters use the top seven rows of dots. The letters with descenders need rows 8 and 9 to appear fully formed. On a 5×7 matrix descenders are all above the print line and appear odd.

double-strike—A print mode in which a chararter is printed twice, in the same place. The resulting character appears darker and sharper.

dot-matrix—A method of forming characters by using a rectangular matrix of dots (5×7 dots, 8×8 dots, 9×9 dots, etc.). Characters are created progressively, rather than all at once.

escape sequences—A series of command codes generally starting with ASCII code 27.

expanded mode—A print mode in which the characters are spread out and the acutal width of the character is increased.

condensed mode—A print mode in which the width of the characters is reduced.

fanfold paper—Continuous sheets of paper joined by perforations and folded in a zig-zag fashion. The paper runs through the printer and folds by itself.

font—The style of the characters (for example, Roman Gothic, Carier).

form feed—A button on some printers that automatically advances the paper to the top of the next page. It can also sometimes be activated by sending the printer ASCII code 12.

friction feed—A means to feed paper into the printer using pressure against the roller. Typewriters function in this manner.

high-resolution graphics—A mode available on some printers that is used to create graphic images. Dot density (60×72, 72×72 or 120×72) determines the degree of resolution.

interface—A device used to connect the computer and a printer or other peripheral. This connection is through a serial or parallel port. All parts of this connection must be compatible.

letter quality—The term indicates that the printed characters appear fully formed as on a typewriter, and the printer could be used for important documents.

line feed—A button on some printers that automatically advances the paper one line.

logic-seeking—A feature that examines the content of the next line or two to determine whether to return the carriage or to wait to print the following line backwards across the page. A bidirectional printer without the logic-seeking feature will miss many opportunities to print backwards when a blank line or other formatting feature intervenes.

normal pitch—Ten characters per inch.

on-line—This term indicates that the printer is connected, and data can be sent. This is opposed to off-line, which indicates that the printer is not ready to receive data for some reason.

paper out light—This light indicates the printer is out of paper. It will usually stop at this point until the paper is replaced.

PET graphics—A set of symbols developed for the Commodore computers and appearing on the keyboard.

pin feed—A method of feeding paper that uses pins on either side of the roller to carry paper with holes along the side (sprocket paper).

program listing—A printout of the source code of a computer program. The term often includes diagnostic aids and charts.

protocol—A sequence of handshaking signals along with the format for transmitting data.

self test—A feature on some printers that tests the printing capability and is used to locate a problem area.

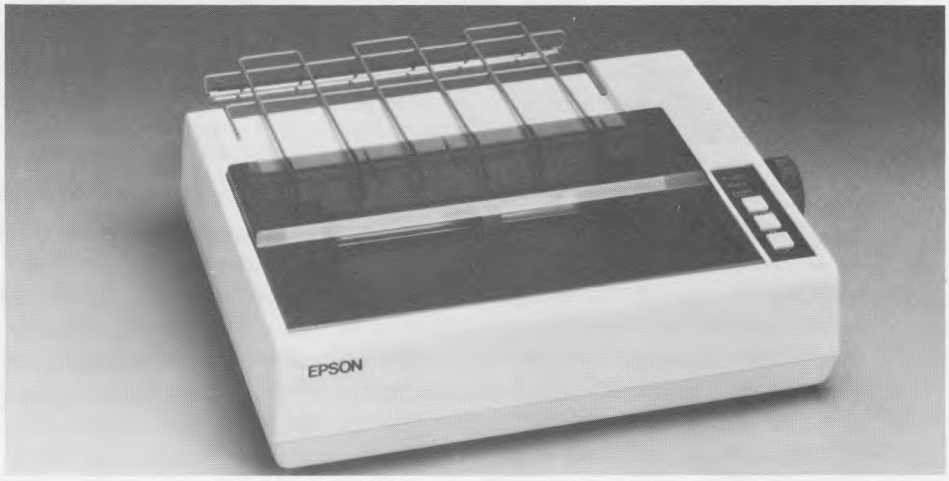
slew rate—The speed at which the print head moves to the next line. It is usually measured in lines per second.

subscript—Characters reduced in size and printed slightly beneath the print line.

superscript—Characters reduced in size and printed slightly above the print line.

tractor feed—A method of accurately positioning and moving fanfold paper through the printer. Perforations along the edge of the paper fit over the sprocket wheels. On some printers this is an optional mechanism.

Chapter 6



Dot-Matrix Printers

The dot-matrix printer forms characters by using a pattern of dots. This pattern is called the matrix, and the dots are made in a variety of ways. For instance, with an impact printer, a column of tiny hammers strike the ribbon to form the character. Only those hammers needed to form the character actually strike the ribbon. With ink-jet printers, the ink is literally sprayed onto the paper through a configuration of channels. These are quiet, fast and can more easily utilize colors than other kinds of printers can. Thermal printers use heat to darken specially-treated paper. Because there is no impact made with thermal printers they are quiet.; however, the thermal paper is expensive. The laser printer burns the characters into the paper. It represents the state of the art in printers and is very expensive. Line printers are extremely fast, printing an entire line at one time. Complete sets of characters are contained on bands or rotating drums which pass above the paper. Each column has an independent hammer that strikes the paper, which strikes the character in front. Our reviews will cover the impact dot-matrix and the thermal printers, as they are under $1,000 and are best suited for the Commodore 64.

Impact dot-matrix and thermal printers form the characters progressively, rather than all at once, and the quality of the characters depends upon the number of dots in the matrix. Most printers will use a matrix of 9 dots across and 9 dots down (9×9), although a larger matrix (10×10, 12×12, or 14×14) is available with some models. The size and style of the characters can be altered through software control. When the matrix size is smaller than 8×8, you start losing quality, and the lower portion of a character with descenders (g, j, p, q, y) is squeezed above the line instead of below.

Some dot-matrix printers improve the print quality with additional modes of operation. In the emphasized mode, characters are struck harder against the paper than they normally are. In the overstrike mode, characters are printed twice, a line at a time. The paper advances slightly so the second set of characters is almost on top of the first set. A few of the dot-matrix printers we reviewed feature a correspondence mode. This is an attempt to create letter-quality printing using dots. Again, it is slower than the standard mode.

Printer speed can be very important for some applications. The dot-matrix printers are in the range of 100 to 200 cps (characters per second) in the standard mode, which is extremely fast compared to the letter-quality printers. However, when using some of the modes, this speed is reduced by almost one-half.

Another factor in determining speed is whether the print head moves bidirectionally or unidirectionally. Bidirectional printing is much faster because printing starts from the left margin, goes to the right margin, and from there prints back to the left margin.

Dot-matrix printers are capable of producing graphic images with the curves and lines formed with the dots. The Commodore 64 features 62 PET graphic symbols available on the keyboard, through the use of the shift and C= keys. The Commodore printers provide the PET graphics symbols; however other printers either need an interface to print these symbols or may not be able to produce them at all. The reviews provide this information. Using a high-resolution mode, even more graphics can be created. Most of the printers we reviewed will create graphs and charts that are useful in reports and other presentations.

Alphacom 81 thermal printer

$169.95

Alphacom

RATINGS

B	Overall rating
A	Price/performance
B	Software compatibility
A	Ease of installation
C	Documentation
B	Vendor support

FEATURES

Type:	Thermal
Matrix size:	8×8
Descenders:	–
Speed:	80 cps
Bidirectional:	+
Logic-seeking:	–
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	+
Dot graphics:	80 dpi
Print:	
Expanded:	+
Compressed:	–
Empasized:	–
Centronics parallel:	–

RATINGS	FEATURES	
	Serial:	+ (included)
	Friction feed:	+
	Pin feed:	–
	Characters per line:	80
	Paper size:	8″
	Paper type:	Thermal

PRODUCT SUMMARY

The Alphacom 81 offers a low-cost solution for printing data in 80 column format on the Commodore 64. It prints bidirectionally at a medium speed of 80 cps, but lacks the logic-seeking feature. Because it will print only on special heat-sensitive paper, it is not possible to use high-quality or preprinted paper. The characters are formed in an 8×8 matrix, and they lack true descenders.

Strong points of the printer are the availability of Commodore ASCII and PET graphics symbols along with bit-mapped graphics at 80 dots per inch.

FEATURES FOR WORD PROCESSING

The Alphacom 81 offers some of the features frequently used in word processing applications. Expanded print, underlining, and reverse printing are supported. Most word processors should work if you stick to the features that the printer suppports.

FEATURES FOR GRAPHICS

The Alphacom 81 provides the PET graphic symbols, a great help for BASIC programmers. Bit-mapped graphics allows production of graphic images under the control of BASIC or of graphic's programs. The quality of the graphics produced is acceptable.

INSTALLATION AND INTERFACING

The Alphacom 81 is particularly easy to install. No separate interface is required. The interface cartridge comes with the printer and plugs directly into the Commodore 64's serial port or into the 1541 disk drive.

QUALITY AND PERFORMANCE

The Alphacom 81 is a good low cost printer for programmers and other home computer users. The printer lacks some features that most serious word processing applications require. The quality of the printed text is not up to general dot matrix standards because of the thermal paper used, the lack of true descenders, and the size of the matrix (8×8). For those who do not need to prepare presentation-quality documents, the availability of PET graphics, the dot addressable graphics, and the built-in interface make this a good choice.

VENDOR SUPPORT

Alphacom provides a standard 90 day warranty. Technical assistance is available through an 800 number.

STX 80 thermal printer $199.00

Star Micronics, Inc.

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatility
A	Ease of installation
A	Documentation
B	Vendor support

FEATURES	
Type:	Thermal dot-matrix
Matrix size:	9×9
Descenders:	+
Speed:	60 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	+
Dot graphics:	+
Print –	
Expanded:	+
Compressed:	–
Emphasized:	–
Centronics parallel:	+
Serial:	–
Friction feed:	+
Pin feed:	–
Characters per line:	40, 80
Paper size:	8″
Paper type:	Thermal

PRODUCT SUMMARY

STX 80, and 80-column thermal printer, is low-cost and geared to the hobbyist, as it has very limited serious applications. The thermal paper comes in blue and black ink and no ribbon is required. Thermal printers are quieter than impact printer.

FEATURES FOR WORD PROCESSING

For word processing applications, the STX 80 uses a 9×9 matrix. There is also a double-width or enlarged mode (selected through a BASIC program or with control codes), and both modes can be printed on the same line. Printer control codes will also allow you to adjust the line feed, the form feed, the tab set and the carriage return.

FEATURES FOR GRAPHICS

This printer features built-in Commodore graphic symbols for block graphics accessed through a BASIC program. For high-resolution graphics there is a dot-addressable graphics mode.

INSTALLATION AND INTERFACING

The STX 80 is equipped with a parallel interface connection (Centronics-type). A special interface for the Commodore 64 is available as an option. This allows you to emulate the VIC 1525E/1526 printers. I also recommend The Card?+G, The Connection, and the MW-302 interfaces.

QUALITY AND PERFORMANCE

The print quality in both text and graphics modes is good. The manual provides sample programs in Commodore BASIC to illustrate the print features. The main disadvantage to the STX 80 is the thermal paper. Otherwise it is a good low-cost printer for light-weight home use.

VENDOR SUPPORT

There is a one-year warranty against defects in materials or workmanship. Technical support is available from the manufacturer or the local distributor.

TTXpress thermal printer $229.00

Teletex Communication Corp.

RATINGS

A	Overall rating
A	Price/performance
B	Software compatibility
A	Ease of installation
C	Documentation
B	Vendor support

FEATURES

Type:	Thermal dot-matrix
Matrix size:	7×9
Descenders:	+
Speed:	50
Bidirectional:	–
Logic-seeking:	–
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	–
Dot graphics:	+
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	–
Friction feed:	+
Pin feed:	–
Characters per line:	80/160

RATINGS	FEATURES	
	Paper size:	8½"
	Paper type:	Thermal

PRODUCT SUMMARY

The TTXpress is a truly unique thermal dot-matrix printer. It weighs only two pounds and will print for two hours on its batteries. In the battery mode, the TTXpress offers a Centronics parallel interface, friction feed of single sheets, and bidirectional paper feeding for graphics. It even has a 2K buffer, which is extraordinary in its price range. The TTXpress is illustrated in Fig. 6-1.

FEATURES FOR WORD PROCESSING

The TTXpress offers the most commonly used word processing features: descenders, compressed print, enlarged print, emphasized print, and underlining. These features will work with most software and parallel interfaces.

FEATURES FOR GRAPHICS

The TTXpress has full graphics capability at 72 dots per inch.

INSTALLATION AND INTERFACING

The TTXpress requires a standard Centronics parallel interface.

QUALITY AND PERFORMANCE

The TTXpress is well-made and provides a surprisingly good quality printout. If



Fig. 6-1. The TTXpress is a unique lightweight, battery-powered thermal printer (courtesy of Teletex Communications Corp.).

portability is a major factor in your printer selection, this may well be the printer for you.

VENDOR SUPPORT

There is a 30 day warranty on parts and labor. Technical support is available through an 800 number.

Microline 82A and 83A impact printers

Okidata

82A—$349.00
83A— 749.00

RATINGS	
A	Overall rating
B	Price/performance
C	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	9×9
Descenders:	+
Speed:	120 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	–
Dot graphics:	–
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per line:	82A — 80, 96, 132 83A — 136, 163, 224
Paper size:	8½″ (sheets) 9½″ (sprocket)

PRODUCT SUMMARY

The Microline 82A is a bidirectional, logic-seeking printer. The Microline 83A features the wide carriage plus the same facets as the 82A. Both friction feed and pin feed mechanisms are available with the printer, and tractor feed is an option. The paper feeds up through the bottom, or up the back. There is a tear bar so paper is torn off an inch from the printed line saving wasted paper. In terms of software, the Okidata printers are not compatible with the Epson/Gemini printers.

FEATURES FOR WORD PROCESSING

For word processing applications, this printer features a 9×9 matrix and a complete set of 96 ASCII characters. Foreign language character sets are also available.

Using the printer control codes and escape sequences, you can use the special functions (enlarge, condense, and boldface), control both the print action (carriage return, line feed, vertical tab) and the paper formatting (page width, line spacing, and form length).

FEATURES FOR GRAPHICS

The Microline 82A comes with 64 graphic characters for block graphics. The Okigraph I card is optional and can be installed for dot-addressable graphics, which allow 60×66 dots per inch. 7/8 bit data is selectable via appropriate DIP switch settings. Many graphics programs such ad Doodle and Flexidraw offer special subroutines that allow them to be used with Okidata printers.

INSTALLATION AND INTERFACING

The Microline printers are relatively easy to install. This printer uses both a parallel interface (a Centronics-type connector) and a serial interface (a RS-232C connector). Another option available from Okidata is a high-speed serial interface, with up to 19.2K baud. The impact printer may be interfaced with the Commodore 64 by using a parallel printer interface. The CARD?+G by Cardco may be used after the proper DIP switches are set. The Connection by Tymac comes with an Okidata ROM chip to be installed (with some difficulty). Two other interfaces were tested with the Microline 82A, the MW-302 interface from Micro World Electronix and the CPI parallel printer interface by MSD. When there are no specific printer driver routines in programs, an Okidata-specific interface will let you use the printer with most available software.

QUALITY AND PERFORMANCE

The print quality is excellent, and the characters are fully-formed. Many useful features are included: a preinstalled pin-feed mechanism, a paper tear bar, bottom and rear paper feeds, and a front panel dial to set the form length. Some useful features are lacking: dot-addressable graphics, italics, and emphasized and double-strike modes. The printers are very well-made and sturdy.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. The printhead is covered for one year. Technical support available through an 800 number (800-OKIDATA).

D-100 impact printer $395.00

Smith Corona

RATINGS	FEATURES	
B Overall rating	Type:	Impact dot-matrix
B Price/performance	Matrix size:	9×9
B Software compatibility	Descenders:	+
B Ease of installation	Speed:	120 cps
B Documentation	Bidirectional:	+
B Vendor support	Logic-seeking:	+
	Correspondence Speed:	–
	Matrix size:	–
	PET graphics:	–
	Dot graphics:	120
	Print –	
	Expanded:	+
	Compressed:	+
	Emphasized:	+
	Centronics parallel:	+
	Serial:	–
	Friction feed:	+
	Pin feed:	+
	Characters per line:	80
	Paper size:	to 11″ wide
	Paper type:	Standard

PRODUCT SUMMARY

The Smith-Corona D-100 is a high-speed, 80-column dot-matrix printer. It is bidirectional and logic-seeking. Friction feed and tractor feed are standard, allowing you to use single sheets or fanfold paper. The printer weighs only 18.7 pounds.

FEATURES FOR WORD PROCESSING

The D-100 uses a 9×9 matrix in normal text mode and a 10×9 in the emphasized and elongated modes. Character sets include the 96 ASCII characters as well as italic and international character sets. Other features include selectable pitch size (10, 12 and 16.7 cpi), emphasized, compressed, and expanded print, and vertical and horizontal tabs.

FEATURES FOR GRAPHICS

Graphics can be created in three densities: 60×72 dpi, 72×72 dpi, and 120×72 dpi. There are no graphics characters for creating block characters.

INSTALLATION AND INTERFACING

The D-100 comes equipped with a Centronics-type parallel interface; the serial (RS-232C) interface is optional.

QUALITY AND PERFORMANCE

This printer offers very good quality printing and is very reliable.

VENDOR SUPPORT

There is a 90-day warranty on parts and labor. Technical support is available through a national service network and an 800 number.

1525E impact printer

$395.00

Commodore Business Machines, Inc.

RATINGS	
C	Overall rating
B	Price/performance
A	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	6×7
Descenders:	–
Speed:	30 cps
Bidirectional:	–
Logic-seeking:	–
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	+
Print –	
Expanded:	–
Compressed:	–
Emphasized:	–
Centronics parallel:	–
Serial:	+
Friction feed:	–
Pin feed:	+
Characters per line:	80
Paper size:	10″
Paper type:	Standard

PRODUCT SUMMARY

The 1525E is an 80-column printer for the Commodore 64 and VIC-20 home computers. It is low-cost and unidirectional. Pin feed is standard but prohibits use of single sheets.

FEATURES FOR WORD PROCESSING

For word processing applications, the 1525E prints on a 6×7 matrix, which does not allow for true descenders. There are no character fonts for italics. Emphasized and double-strike printing is not possible. The character pitch is set at 10 cpi, and the line feed is set at 6 lpi.

FEATURES FOR GRAPHICS

The 1525E offers the built-in PET graphics characters, most useful in obtaining program listings. A BASIC program allows you to print any of the Commodore graphic characters, using the ASCII codes with which they correspond. No special interfacing is required. Optional dot-addressable graphics are available, but they are limited to 7 vertical dots per column.

INSTALLATION AND INTERFACING

This printer connects directly with Commodore computers, using a special cable, which is included, and does not require an interface. Most software for the Commodore 64 will specify the 1525E.

QUALITY AND PERFORMANCE

This printer was made for limited, light-weight use with the Commodore computers. In the interest of economy, many features were omitted. It lacks true descenders and speed, is very noisy, and uses only sprocket paper. The advantages are its ability to print Commodore graphics without interfaces and its compatibility with a large amount of software, although with its limited capabilities you may not be able to use all the print routines in these programs.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available from your local authorized dealer. You may wish to contact them by letter, as the service staff is extremely cooperative and helpful.

RX-80, RX-80FT, RX-100 impact printers

RX-80	$399.00
RX-80FT	599.00
RX-100	749.00

Epson America, Inc.

RATINGS	
A	Overall rating
B	Price/performance
B	Software compatibility
A	Ease of installation
A	Documentation

FEATURES	
Type:	Impact dot-matrix
Matrix size:	9×9
Descenders:	+
Speed:	100 cps
Bidirectional:	+

RATINGS	FEATURES	
C Vendor support	Logic-seeking:	+
	Correspondence	
	Speed:	–
	Matrix size:	–
	PET graphics:	–
	Dot graphics:	+ (FT models)
	Print –	
	Expanded:	+
	Compressed:	+
	Emphasized:	+
	Centronics	
	parallel:	+
	Serial:	+
	Friction feed:	+ (RX-80FT only)
	Pin feed:	+
	Characters per	
	line:	80, 132
	Paper size:	10″
		15″ (FT models)

PRODUCT SUMMARY

The RX-80, shown in Fig. 6-2, is a low-cost, 80 column printer, which is bidirectional and logic-seeking. There is also a quiet mode at 50 cps for office environments. Friction feed is optional on the RX-80, and a wide carriage (14 inch wide paper) is available on the RX-100. The printer also features a tear bar for tearing off paper an inch below the print line to save paper. The FT versions have enhanced graphics capability.

FEATURES FOR WORD PROCESSING

For word processing applications, the RX-80 features a 9×9 matrix (character matrix 5×7), 96 standard and italic ASCII characters, and 11 international characters for use in foreign languages.

Using the printer control codes and escape sequences you can select the print modes (normal, condensed, emphasized, enlarged, and double-strike), the print functions (underline, subscript, and superscript), the print action (carriage return, line feed, vertical tab) and the paper format (line spacing, form length, and page width).

FEATURES FOR GRAPHICS

Epson printers with the FT option are known for their fine graphics. There are 32 graphics symbols for creating block graphics accessed through control codes. These symbols are compatible with the Epson HX-20 computer's graphics. You may select from a variety of dot densities: 480 dots per 8″, 960 dots per 8″ or 1920 dots per 8″.



Fig. 6-2. The RX-80 is a low-cost, good-quality printer from Epson (courtesy of Epson America).

The RX-80 also features a hex dump mode where data sent from the computer is printed in hexadecimal notation.

INSTALLATION AND INTERFACING

Due to their wide popularity, the Epson printers are easily interfaced and many programs for the Commodore 64 provide for their use on Epson printers. In fact, some parallel interfaces specify the Epson printer.

We tested this printer with two interfaces: The Card?+G by Cardco does well, and allows for the use of features such as 1525E emulation, the printing of PET graphics symbols, and a special program listing mode. This unit requires that the DIR switches be set. The Connection by Tymac also does well and allows you to utilize the same features as the Card?. It may be ordered specifically for the Epson printers.

QUALITY AND PERFORMANCE

These printers offer excellent print quality and graphics resolution. The characters appear well-formed, and the printer is quieter than other similar printers. The tear bar is a convenient feature that saves paper.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available from authorized dealers who are trained to handle these problems

Spirit 80 impact printer

Parallel—$399.00

Mannesmann Tally Corp.

Serial — 494.00

RATINGS	
A	Overall rating
B	Price/performance
B	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	9×8
Descenders:	+
Speed:	80 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	–
Dot graphics:	+
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per line:	80, 132
Paper size:	10″
Paper type:	Standard

PRODUCT SUMMARY

This is a low-cost, bidirectional, logic-seeking printer, offering a number of features not found in similarly-priced printers. The Spirit 80 is compatible with the Epson/Gemini printers. This printer is quieter than most, and we tested the optional Quiet-Pak ($80.00), which further reduced the noise level. The tractor feed is preinstalled as opposed to a tractor feed unit that must be installed with each use. Another feature is a ready light, which glows when data cannot be accepted from the computer. Unlike most other dot-matrix printers, the Spirit 80 uses a mylar film ribbon.

FEATURES FOR WORD PROCESSING

For word processing applications, the Spirit 80 features a 9×8 matrix, 96 standard and italic ASCII characters, and foreign language characters, which are located in the block graphics set of characters. We tested the Spirit 80 with the Easy

Script and WordPro3 Plus, and it worked well. Special printing effects (enhanced print, italics, double-strike, and so on) can be accessed.

FEATURES FOR GRAPHICS

Spirit 80 allows you to create bit-mapped graphics either through a program or by using the 32 block graphics characters. In the graphics mode, the printer is unidirectional, and print speed is reduced when it is printing high-resolution graphics. The graphics may be addressed in normal density (80×82) and in high resolution (160×82). We tested the Spirit 80 with the Doodle and Flexidraw graphics programs, which worked well with the printer.

INSTALLATION AND INTERFACING

This printer is available in both parallel and serial interface versions. It may be interfaced with the Commodore 64 using the Card?+G, the MW-302, The Connection, the CX-6401, and the CPI parallel interface. When you are using the Card?+G, the DIP switches must be set for Epson or Gemini printers. This will allow you to utilize the full features of the interface, including the 1525E emulation, the printing PET graphics, and the special program listing mode.

QUALITY AND PERFORMANCE

Although the print size appears smaller with the 9×8 matrix, the characters are fully-formed, and the print quality is excellent, enhanced by the well-developed print head. The mylar ribbon adds to the print quality, but it needs replacing after one use. The printer, however, is slower than models selling for $1,000. Also adding to the delay is the platen, which moves sluggishly. It is suggested that you consider buying a print buffer if you need the speed.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Excellent technical support is available from trained service dealers across the country.

Gemini 10X and 15X impact printers

10X —$399.00

Star Micronics, Inc.

15X — 549.00

RATINGS		FEATURES	
A	Overall rating	Type:	Impact dot-matrix
A	Price/performance	Matrix size:	9×9
B	Software compatibility	Descenders:	+
B	Ease of installation	Speed:	120 cps
A	Documentation	Bidirectional:	+
B	Vendor support	Logic seeking:	+
		Correspondence	

RATINGS

Speed:	–
Matrix size:	–
PET graphics:	–
Dot graphics:	66
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	–
Friction feed:	+
Pin feed:	+
Characters per line:	10X — 80, 96, 136 15X — 136, 164, 232
Paper size:	8" to 15"
Paper type:	Roll or sheets

PRODUCT SUMMARY

These two printers have become very popular because of their low price as well as their excellent quality. The only difference between these two models is the size of the carriage. The Gemini 15X offers a 15.5-inch carriage for 136 column printouts at 10 cpi. They are bidirectional and logic-seeking. Friction feed is used to handle single sheets or rolls of paper. The tractor feed is used to handle sprocket paper, which is fed through the back. The 15X has the bottom-feed capability. There is an 816-byte buffer, which can be expanded to 4K or 8K with RAM chips supplied by Star Micronics. The Gemini printers are Epson-compatible for graphics. The rest of this review will refer to the Gemini 10X unless specifically noted otherwise.

FEATURES FOR WORD PROCESSING

For word processing applications, the Gemini 10X features a 9×9 matrix, 96 standard and italic ASCII characters, 64 special characters, and 88 international characters for foreign language applications. There can be 96 special characters in any application you may create.

Your program provides printer control codes and escape sequences to select print modes including normal, condensed, enlarged, and double-strike. You can select print functions such as underline, superscript, and subscript; print action which includes the carriage return, line feed and vertical tab; and finally, the paper formatting, line spacing, form length, and page width.

FEATURES FOR GRAPHICS

High-resolution graphics are created by sending bit-mapped pictures through your software. There are a number of graphics modes depending on your applications.

Low-resolution dot density is 60×72, high-resolution dot density is 120×144, and ultra-high dot density resolution is 240×144. Block graphics are created with 32 graphic characters.

INSTALLATION AND INTERFACING

The Gemini 10X is easy to install. The later models include informative and easy to understand instructions. To interface this printer with the Commodore-64 use the Card?+G interface for Gemini printers by Cardco and distributed by Star Micronics. We tested a number of programs and found success with Easy Script, PaperClip, WordPro3 Plus/64, Doodle, Smart 64 Term, Super Base, Delphi's Oracle, Mirage Concept's Database Manager, Infomast, Easy Mail, Practicalc and Calc Result. You can set DIP switches inside the box to Gemini or Epson settings. You will also be able to emulate the Commodore's VIC 1525/1526 printers by printing the PET graphic characters, especially in program listings, and by running the printer test available on the test disk with the 1541 disk drive. The MW-302 interface by Micro World Electronix, the CX6401, and The Connection by Tymac (with the Epson ROM installed) were all successfully tested.

QUALITY AND PERFORMANCE

There were a few items discovered during the testing. When you begin to print, the first character was not printed clearly (some type of timing problem), and this occurred regularly. The next item is that the friction feed mechanism does not work well with fan-fold paper. The paper rapidly starts wandering toward the right margin. When you are printing over ten pages, the tractor feed must be used and must be exactly aligned and adjusted for paper tension or the paper will tear or jam.

The Gemini 10X is an excellent investment, producing very high-quality text and excellent graphics.

VENDOR SUPPORT

There is a one year warranty on parts and labor. Technical support is provided by local dealers.

MPS-801 impact printer

$400.00

Commodore Business Machines, Inc.

RATINGS		FEATURES	
B	Overall rating	Type:	Impact dot-matrix
B	Price/performance	Matrix size:	6×7
A	Software compatibility	Descenders:	–
B	Ease of installation	Speed:	50 cps
B	Documentation	Bidirectional:	–
B	Vendor support	Logic-seeking:	–

RATINGS	FEATURES	
	Correspondence	
	Speed:	–
	Matrix size:	–
	PET graphics:	+
	Dot graphics:	–
	Print –	
	Expanded:	–
	Compressed:	–
	Emphasized:	–
	Centronics	
	parallel:	–
	Serial:	+
	Friction feed:	–
	Pin feed:	+
	Characters per	
	line:	80
	Paper size:	4.5 to 10" width
	Paper type:	Standard

PRODUCT SUMMARY

Similar to the 1525E printer, the MPS-801 is an 80-column, inexpensive printer. It is unidirectional and does not have true descenders. The MPS-801 uses pin feed only, which does not allow for the use of single sheets.

FEATURES FOR WORD PROCESSING

This printer lacks important features for word processing, including italics, emphasized and double-strike printing, the small matrix, and the double-width mode. Both the character pitch (10 cpi) and the line feed (6 lpi) are set and cannot be changed. Not all of the special print routines offered by software programs can be used with this unsophisticated model.

FEATURES FOR GRAPHICS

The MPS-801 was developed for the Commodore and offers a set of built-in PET graphics characters. This is helpful in obtaining program listings. Any of the Commodore graphic characters can be printed through a BASIC program when you specify their corresponding ASCII code. Dot-addressable graphics (7 vertical dots per column) is available as an option.

INSTALLATION AND INTERFACING

This printer requires no interface as it connects directly to the Commodore-64 via a cable included with the printer. Software for the Commodore-64 will list the MPS-801 as a printer that can be used with the software.

QUALITY AND PERFORMANCE

The MPS-801 was designed as a low-cost printer for the Commodore computers (C-64 and VIC-20). As a result many features have been left out in the interest of economy. This printer should be used for printing program listings or other light-weight or infrequent use, or for Commodore graphics. It is extremely noisy, lacks speed, and uses only sprocket paper. The MPS-801 is compatible with a large number of software packages.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available from your local authorized dealer. A written letter concerning your problem will get good results. The service staff is very cooperative.

MPS-802 impact printer

$500.00

Commodore Business Machines, Inc.

RATINGS	
C	Overall rating
B	Price/performance
A	Software compatibility
B	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	8×8
Descenders:	+
Speed:	60 cps
Bidirectional:	+
Logic-seeking:	–
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	+
Dot graphics:	–
Print	–
Expanded:	+
Compressed:	–
Emphasized:	–
Centronics parallel:	–
Serial:	+
Friction feed:	–
Pin feed:	+
Characters per line:	80 10″
Paper size:	Standard
Paper type:	

PRODUCT SUMMARY

The MPS-802 is an 80 column printer made for the Commodore 64 and VIC-20 computers. It is bidirectional, and tractor feed is standard.

FEATURES FOR WORD PROCESSING

For word processing applications, the MPS-802 uses an 8×8 matrix, and the standard alphabet and numerals. There is an expanded or double-width mode available. A form control option allows you to control the interpretation of data sent to the printer; for instance, you can choose uppercase/graphics, set the number of lines per inch, format text and numeric output on a page, and reset the printer.

FEATURES FOR GRAPHICS

The MPS-802 offers the built-in PET graphics characters, most useful in obtaining program listings. Any of Commodore's graphic characters may be printed through a BASIC program with no special interfacing. You can specify the ASCII code with which they correspond, or you can type in the graphic character in a print statement. There is an option available that allows you to program custom characters in special applications.

INSTALLATION AND INTERFACING

This printer is directly connected to the Commodore computer without an interface, via a cable included with the printer.

QUALITY AND PERFORMANCE

The print quality is acceptable; however there are limited features due to the printer's low cost. It would be a good buy if you print only program listings or other lightweight material. It lacks speed, but it does have a moderate noise level. Its main advantage is the availability of Commodore graphics, which can be used without an interface. It is compatible with a large amount of software, but because of a lack of sophisticated features, you may not always be able to use the special print routines.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available through local authorized dealers or by writing to their very cooperative service staff.

Delta 10 and Delta 15 impact printers

10—$549.00

Star Micronics, Inc.

15—$795.00

RATINGS	FEATURES	
B Overall rating	Type:	Impact dot-matrix
A Price/performance	Matrix size:	9×9
B Software compatibility	Descenders:	+

RATINGS	
B	Ease of installation
A	Documentation
B	Vendor support

FEATURES	
Speed:	160 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	–
Dot graphics:	66
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics	
parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per	
line: 10 –	80, 96, 136
15 –	136, 164, 232
Paper size:	10″-15″
Paper type:	Standard

PRODUCT SUMMARY

The Delta 10 and Delta 15 (15.5-) inch carriage) are bidirectional, high-speed dot-matrix printers. They are considered Epson-compatible. Both models are logic-seeking and represent Star Micronics attempt to compete with the Epson FX-80 and FX-100 printers. Unless otherwise noted, this review will deal specifically with the Delta 10 model. Rolls and single sheets of paper are inserted from the back, and either standard friction feed or tractor feed can be used. The Delta 15 has an option for paper to be fed from the bottom.

FEATURES FOR WORD PROCESSING

The Delta 10 uses a 9×9 matrix. Character sets include the 96 standard ASCII characters, 64 special characters, and 88 international characters for foreign language applications. Other features include a selection of fonts, (standard, italic or foreign language characters), a selection of print pitches (pica, elite, condensed, or enlarged) and special print functions (super/subscript, underline, or double-strike). An 8K buffer is available for downloading 96 special characters for any applications you may have.

FEATURES FOR GRAPHICS

High-resolution graphics are created by sending bit-mapped pictures through software. A variety of modes and densities are available: low resolution (60×72), high

resolution (120×44), or ultra-high resolution (240×144). For creating block graphics, there are 32 graphic characters available.

INSTALLATION AND INTERFACING

Installation is relatively easy. The manufacturer has provided clear instructions, which are both informative and understandable. The Delta 10 provides both serial (RS-232C) and standard parallel (Centronics-type) interface connectors. To interface the Delta 10 with the Commodore 64, a parallel interface is required, and the Card?+G by Cardco (in the Epson or Gemini model) is recommended. With this you can print the PET graphic characters (like the Commodore 1525/1526) and run the self-test available on the test disk that comes with the 1541 disk drive. With the Connection interface by Tymac (with the Epson ROM installed), most Epson-designed software will run on the Delta 10. Another compatible interface is the MW-302 by Micro World Electronix.

QUALITY AND PERFORMANCE

The Delta 10 provides high-speed and very good quality text. It also has an excellent capacity for graphics.

VENDOR SUPPORT

There is a one year warranty on parts and labor. Technical support from local dealers is available.

D-200 impact printer

$595.00

Smith-Corona

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	9×9
Descenders:	+
Speed:	120 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	60 cps
Matrix size:	17×18
PET graphics:	–
Dot graphics:	120
Print –	
Expanded:	+
Compressed:	+
Emphasized:	–

RATINGS

FEATURES

Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	–
Characters per line:	80
Paper size;	to 11″ wide
Paper type:	Standard

PRODUCT SUMMARY

This is a lightweight, bidirectional, logic-seeking printer featuring the Smith-Corona NLQ (near letter quality) mode. Friction feed and tractor feed are standard. The D-200 comes equipped with 2K bytes buffer to store data for input into the printer.

FEATURES FOR WORD PROCESSING

For word processing applications there is a character matrix of 9×9 in normal text mode and 17×18 in the correspondence or NLQ mode. There are a complete set of 96 ASCII characters and a set of international characters. Print modes include enlarged, compressed, emphasized, and italic. Print functions allow you to use superscripts and subscripts. Vertical and horizontal tabs are also included.

FEATURES FOR GRAPHICS

Graphics can be created in three densities: 60×72 dpi, 72×72 dpi, and 120×72 dpi. There are no block graphic characters included with this model.

INSTALLATION AND INTERFACING

Both the serial (RS-232C) and the parallel (centronics-type) interfaces are standard with the D-200 printer.

QUALITY AND PERFORMANCE

Smith-Corona enjoys a wide reputation for outstanding quality and reliability. The NLQ mode print is very good for a printer in this price range. The D-200 is very quiet. The correspondence quality print is good, but it will not pass for letter quality.

VENDOR SUPPORT

There is a one-year warrant on Smith-Corona printers. Technical support is provided through a national service network, and there is an 800 number available.

Microline 92 and 93 impact printers

Okidata

ML92—parallel $599.00
serial 698.00
ML93—parallel 899.00
serial 998.00

RATINGS	
B	Overall rating
B	Price/performance
C	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	9×9
Descenders:	+
Speed:	160 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	40
Matrix size:	9×17
PET graphics:	–
Dot graphics:	72
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per line: ML92	80, 96, 136
ML93	136, 163, 233
Paper size:	10″-15″
Paper type:	Standard

PRODUCT SUMMARY

The two models are identical, except that Microline 93 has the wide carriage. This printer features two modes, normal text and a correspondence quality mode; both are bidirectional and logic-seeking. Pin feed and friction feed are provided with the unit, and tractor feed is optional. Okidata printers are not compatible with Epson/Gemini printers; however, some software programs offer special subroutines for the Okidata.

FEATURES FOR WORD PROCESSING

For word processing applications, the Microline 92 and 93 feature a 9×9 matrix, or a 9×17 matrix in the correspondence mode. There is a complete set of 96 ASCII characters, and foreign language character sets are available with the proper DIP switch settings. There are no italics available.

Software programs such as PaperClip offer special subroutines for use with the Okidata printer.

Using printer control codes and escape sequences, you can select print modes (normal, emphasized, enhanced, double-width, boldface), print functions (underline, superscript, subscript), print action (carriage return, line feed, vertical tab), and paper formatting (page width, line spacing, form length). In the correspondence mode, proportional spacing effects can be achieved by varying the spacing of the characters.

Also available is an optional cut-sheet feeder, which allows you to print letters without having to feed in single sheets one at a time.

FEATURES FOR GRAPHICS

The Microline 92 and 93 come with dot-addressable graphics. For high-resolution, there are two dot densities: 60×60 dpi and 72×72 dpi. Graphics and text may be mixed on the same line when you use the start-graphics and end-graphics sequences. There are no characters to create block graphics; however, there are up to 96 characters available for use in special applications. They are created in an 11×7 matrix and are used with the DLCG (Down-line Loaded Character Generator).

Software programs like Doodle and Flexidraw offer special subroutines for use with the Okidata printer.

INSTALLATION AND INTERFACING

Both parallel (Centronics-type) and serial (RS-232) interfaces come with the unit, and there is an optional high-speed (19.2K Baud) serial interface available.

To interface the Microline 92 and 93 with the Commodore 64, you could use either the Card?+G by Cardco (after setting the proper DIP switches), or The Connection by Tymac (includes a not-easily-installed specific Okidata ROM chip). Two other interfaces were tested: the CPI, a parallel printer interface from MSD, and the MW-302, an interface from Micro World Electronix. There is a specific Okidata interface that enables you to use the printer with software programs that have no specific driver routines for the Okidata printers.

QUALITY AND PERFORMANCE

Compared to other printers, the quality of the Okidata printers is outstanding. Even at top speeds, the letters are fully formed, and the draft quality is good. The bottom feed provides you with the convenience of using multiple forms, and the tear bar saves a lot of wasted paper. However, the graphics resolution and the correspondence quality mode leave a little to be desired. We did use the Doodle program to draw bit-mapped pictures and got acceptable printouts.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. The print head is covered for one year. Technical support is provided through an 800 number (800-OKIDATA).

FX-80 and FX-100 impact printers

Epson America, Inc.

FX-80	$699.00
FX-100	895.00

RATINGS	
A	Overall rating
B	Price/performance
A	Software compatibility
A	Ease of installation
A	Documentation
C	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	9×11
Descenders:	+
Speed:	160 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	–
Matrix size:	–
PET graphics:	–
Dot graphics:	120
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	–
Pin feed:	+
Characters per line: FX-80-	80, 132
FX-100-	136, 233
Paper size:	8″ to 14″
Paper type:	Standard

PRODUCT SUMMARY

These printers are Epson's top of the line and reflect the state of the art. The FX-80 has 80 columns in normal mode, and is bidirectional and logic-seeking. A quiet mode for the office environment is on the market. An optional 15″ wide carriage (Model FX-100) allows you to use 14-inch paper. The Epson printers are well known for their print quality and graphics capabilities.

FEATURES FOR WORD PROCESSING

For word processing applications, the FX-80 features a 11×9 matrix (character matrix 5×7), 96 standard and italic ASCII characters, and 9 international character sets. There is a 2K buffer area for storing a maximum of 255 characters for special applications, reverse line feed, and a proportional spacing mode.

Your program provides printer control codes and escape sequences allowing you to select print modes including normal, condensed, enlarged, and double-strike. You can select print functions, such as underline, superscript, and subscript; the print

actions, which include the carriage return, line feed and vertical tab; and finally the paper formatting, line spacing, form length, and page width.

FEATURES FOR GRAPHICS

There are two modes available. The 8-pin bit image mode features a range of dot density from 480 dots per 8 inches (normal) to 1920 dots per 8 inches (quadruple). The 9-pin bit image mode features two dot densities, normal and dual (960 dots per 8 inches). The brightness of the dots may be controlled by changing the dot densities within a picture. There are no graphics characters for block graphics provided, as it is recommended you use the RAM for this data.

INSTALLATION AND INTERFACING

The FX-80 printer interfaces easily and is quite compatible with the Commodore 64. There were a number of interfaces tested with the FX-80. The Card?+G by Cardco may be specifically configured so you can use, for instance, Commodore's 1525E emulation, a special program listing mode, and PET graphics symbols. It does require the setting of DIP switches. The Connection by Tymac also may be configured for use with the FX-80 and may be ordered specifically for the printer. The serial interface (RS-232C) is optional. Many programs for the Commodore 64, as well as some parallel interfaces, refer to the FX-80 printer specifically.

QUALITY AND PERFORMANCE

The Epson printers are an excellent investment by virtue of their outstanding graphics and print quality. All the characters are well-formed. There is a feature on this printer allowing you to tear off a page one inch from the last print position. This reduces the waste of having to move the paper up a few inches before tearing it off. Still another feature eliminates the struggle to install the tractor unit when you want to use fan-fold paper. This is done by a pre-installed pin-feed mechanism. The printer is noticeably quieter than other dot-matrix printers.

VENDOR SUPPORT

These printers are known for their durability, and our experience with them has proven this. There is a 90 day warranty on parts and labor. Service and breakdown problems are usually handled by the authorized dealers who are trained to handle them.

D-300 impact printer $795.00

Smith-Corona

RATINGS	FEATURES	
B Overall rating	Type:	Impact dot-matrix

RATINGS	
B	Price/performance
B	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Matrix size:	9×9
Descenders:	+
Speed:	140 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	70
Matrix size:	17×18
PET graphics:	–
Dot graphics:	120
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	–
Characters per line:	132
Paper size:	to 15″ wide
Paper type:	Standard

PRODUCT SUMMARY

The D-300 is a bidirectional, logic-seeking printer. It features the 15-inch wide carriage. Friction feed and tractor feed are standard. This printer features a 2K buffer for storage. This is a very quiet printer. The near letter-quality print is not very convincing. Emphasized with near letter-quality does a better job but is very slow.

FEATURES FOR WORD PROCESSING

For word processing applications this printer uses a 9×9 matrix or 17×18 for the correspondence mode, referred to as NLQ (near letter-quality). It uses the standard 96 ASCII character set plus international characters. The special features include emphasized, italic, emphasized italic, enlarged, superscript, and subscript. Pitch can be set at 10, 12 or 16.7 cpi. plus proportional spacing. Two adjust buttons on the front panel allow you to reposition the paper in the printer. Cut sheet paper, fanfold paper, or forms may be used.

FEATURES FOR GRAPHICS

Although there are no block graphic characters, dot graphics can be produced in three densities: 60×72 dpi, 72×72 dpi, and 120×72 dpi.

INSTALLATION AND INTERFACING

The D-300 comes equipped with both parallel (Centronics-type) and serial (RS-232C) interfaces.

QUALITY AND PERFORMANCE

The manufacturer has a very good reputation for the quality and reliability of its products.

VENDOR SUPPORT

There is a one-year warranty on the D-300. Technical support is available from a national service network or through an 800 number.

MT 160L and MT 180L impact printers

160L—$798.00

Mannesmann Tally Corp.

180L—1098.00

RATINGS	
A	Overall rating
B	Price/performance
B	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	7×9
Descenders:	+
Speed:	160 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	40 cps
Matrix size:	20×18
PET graphics:	–
Dot graphics:	128
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per line: 160L	80, 96, 132, 160
180L	132, 158, 218, 264
Paper size: 160L	10″
180L	15″
Paper type:	Standard

PRODUCT SUMMARY

These models are high-speed printers offering two modes, the text mode and the correspondence-quality mode. The MT 180L is the same as the MT 160L except it has a wide carriage. This printer is bidirectional and logic-seeking in the standard text mode only. Friction feed is standard; an attachment can be clipped on to provide tractor feed and roll paper feed.

On the front panel there is a YES and a NO switch pad that are used when the printer asks you for specific information to set print functions and parameters (lines per inch, characters per inch, alternate character sets). There is also a test button, and a fault button in addition to the regular buttons for on line, off line, line feed and form feed.

FEATURES FOR WORD PROCESSING

For word processing applications, the MT 160 features a 7×9 matrix, a full set of 96 matrix, a full set of 96 ASCII characters, and foreign language characters. The 7×9 matrix creates smaller characters but they are fully formed with true descenders. Special word processing features include auto text centering, right margin justification, and proportional spacing. You can program the printer to use a variety of fonts by selecting the proper parameters. Special print functions (enhanced, emphasized, double-stike) are available. We tested the Easy Script and WordPro3 Plus/64 software and found them to work well.

Using the printer control codes and escape sequences you can select print modes (normal condensed, enlarged, double-strike), print functions (superscript, subscript, underline), print action (carriage return, line feed, vertical tab), and paper formatting (page width, form length, line spacing).

The correspondence quality mode uses a 20×18 matrix to produce an excellent print. Use this mode in conjunction with proportional space to enhance the correspondence-quality effect. Make your selection on the front panel or through your software.

FEATURES FOR GRAPHICS

High-resolution graphics are available with the following dot densities: 64×50 dpi or 64×100 dpi. There are 31 scientific symbols for special applications. The manufacturer has conveniently used Epson (or Gemini) compatible graphics, to give you use of a wider range of compatible programs. (If a program does not specify Mannesmann Tally in the printer installation menu, select Epson or Gemini.) We tested the MT 160 with the Doodle and Flexidraw graphics programs and found them to work well.

INSTALLATION AND INTERFACING

Both models are equipped with a serial (RS-232C) and parallel (Centronics-type) interfaces. We tested this printer with the Card?+G by Cardco, the MW-302 by Micro World Electronix, The Connection by Tymac, the Parallel printer interface (ECX computers), and the CPI parallel interface from MSD. When using the Card?+G interface, you must set the DIP switches for Epson printers to make use of all the

features of the interface, such as Commodore's 1525E printer emulation and the ability to print PET graphic characters.

QUALITY AND PERFORMANCE

This is a well-built printer. It is the correspondence-quality mode that makes this an outstanding printer. Excellent print quality is provided by the 20×18 matrix and the elevated square print needles. In the text mode the quality is also good, and the fully-formed characters are comparable to higher-priced printers.

We printed high-resolution graphics (using the Doodle program) and found the graphics to be very good. The printer is about one-third smaller than other similar printers. The noise level is low to moderate.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. The MT-160 is well-made and sturdy. The manufacturer offers good support for its printers. Technical support is available from service dealers across the country.

Microline 84 Step 2 impact printer

Parallel—$1099.00

Okidata

Serial — 1219.00

RATINGS	
B	Overall rating
B	Price/performance
C	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor support

FEATURES	
Type:	Impact dot-matrix
Matrix size:	9×9
Descenders:	+
Speed:	200 cps
Bidirectional:	+
Logic-seeking:	+
Correspondence	
Speed:	50 cps
Matrix size:	13×17
PET graphics:	–
Dot graphics:	144
Print –	
Expanded:	+
Compressed:	+
Emphasized:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per line:	136, 163, 231

RATINGS	FEATURES	
	Paper size:	15″ (sheets) 16″ (sprocket)
	Paper type:	Standard

PRODUCT SUMMARY

This is a high-speed, wide-carriage printer. It features two modes, normal text and correspondence quality. In the text mode it is bidirectional and logic-seeking. Friction feed and tractor feed are standard with the Microline 84. The Okidata printers are not compatible with Epson/Gemini printers.

FEATURES FOR WORD PROCESSING

For word processing applications in the normal text mode, the character matrix is 9×9. In the correspondence mode the matrix is 17×18. There is a complete set of 96 ASCII characters; foreign language character sets are available with the proper DIP switch settings.

By using the printer control codes and escape sequences, you can select print modes (enlarged, condensed, double-strije, boldface), print functions (underline, superscript, and subscript), print action (carriage return, line feed, and vertical tab), and paper formatting (page width, line spacing, and form length).

There is an optional cut-sheet feeder. This allows you to print letters without feeding each single sheet of paper into the printer. Many software programs offer special subroutines for use in word processing applications. PaperClip is one example.

FEATURES FOR GRAPHICS

The Microline 84 comes with dot-addressable graphics, and 64 graphic characters are included for creating block graphics. There are three dot densities available for the creation of high-resolution graphics: 60×72 dpi, 72×72 dpi, and 103×72 dpi. You may also create your own characters for use in special applications in a 11×7 matrix using the DLCG feature (Down-line Loaded Character Generator).

Because of its incompatibility with other printers, many graphics programs, including the Doodle and Flexidraw programs, offer special subroutines for use with the Okidata printers.

INSTALLATION AND INTERFACING

This printer is equipped with both parallel and serial interfaces. There is an optional high-speed (19.2K Baud) interface available. To interface this printer with a Commodore 64 use either the Card?+G from Cardco (after making the proper DIP switch settings), or The Connection by Tymac, (which comes with a not-easily-installed Okidata specific ROM chip). Also tested were the CPI parallel interface from MSD, and the MW-302 interface from Micro World Electronix.

When software programs lack the specific printer driver routines, the Okidata-specific interface will let you use most available software.

QUALITY AND PERFORMANCE

This printer was chosen for review because of its very high speed, even though it may not be the most practical printer for use with the Commodore 64. The printer falls below standard with the correspondence-quality mode. The Okidata 84, however, features very good print quality, and the characters are well-formed. There are a number of helpful features including the tractor feed, bottom rear paper path, and the front panel dial for setting form length.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. The print head is covered for one year. Technical support is available by calling an 800 number (800-OKIDATA).

LQ-1500 impact printer

$1395.00

Epson America, Inc.

RATINGS	FEATURES	
A Overall rating	Type:	Impact dot-matrix
A Price/performance	Matrix size:	9×17
A Software compatibility	Descenders:	+
A Ease of installation	Speed:	200 cps
A Documentation	Bidirectional:	+
A Vendor support	Logic-seeking:	+
	Correspondence	
	Speed:	67 cps
	Matrix size:	37×17
	PET graphics:	–
	Dot graphics:	+
	Print –	
	Expanded:	+
	Compressed:	+
	Emphasized:	+
	Centronics parallel:	+
	Friction feed:	+
	Pin feed:	–
	Characters per line:	136
	Paper size:	to 16" wide
	Paper type:	Standard

PRODUCT SUMMARY

This is a high-speed new printer from Epson that offers many features. It is the

most expensive dot-matrix printer we reviewed. We have included the LQ-1500 because it is the only dot-matrix printer in this price range that produces a correspondence quality print that is acceptable for letter-quality documents. It is bidirectional and logic-seeking. There is a 2K buffer for storage. Friction feed is standard, and an adjustable tractor is optional.

FEATURES FOR WORD PROCESSING

For word processing applications there is a 9×17 matrix, which expands to 37×17. This printer uses the standard 96 ASCII character set and includes 32 international characters and 96 italic characters. Features include 128 characters that can be down loaded, vertical and horizontal incremental motion, proportional spacing, expanded, compressed, and emphasized print, double-strike print, underlining, superscripts, subscripts, and automatic skips over perforations. An automatic single-sheet paper guide saves you from having to feed sheets in one at a time. The near letter-quality mode is very fast, and the print is very good.

FEATURES FOR GRAPHICS

Block graphic characters are not available; however dot graphics are produced with 10 different bit image modes.

INSTALLATION AND INTERFACING

A Centronics-type parallel interface is standard. Serial (RS-232C) and IEEE-488 interfaces are optional.

QUALITY AND PERFORMANCE

The correspondence mode allows you to print excellent near letter-quality material.

VENDOR SUPPORT

There is a one-year warranty. Technical support is available from authorized dealers trained to handle your problems.

WORKSHEET FOR DOT-MATRIX PRINTERS

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RATINGS

Overall rating
Price/performance
Software compatibility
Ease of installation
Documentation
Vendor support

FEATURES

Type:
Matrix size:
Descenders:
Speed:
Bidirectional:
Logic-seeking:
Correspondence
  Speed:
  Matrix size:
PET graphics:
Dot graphics:
Print –
  Expanded:
  Compressed:
  Emphasized:
Centronics
  parallel:
Serial:
Friction feed:
Pine feed:
Characters per
  line:
Paper size:
Paper type:

PRODUCT SUMMARY

FEATURES FOR WORD PROCESSING

FEATURES FOR GRAPHICS

INSTALLATION AND INTERFACING

QUALITY AND PERFORMANCE

VENDOR SUPPORT

COMPARISONS AT A GLANCE

Table 6-1 shows each dot-matrix printer and the rating it received in each category. The features of each printer are shown in Table 6-2.

Table 6-1. Comparative Ratings for Dot Matrix Printers

PRICE	PRINTER	RATINGS	1	2	3	4	5	6
$169.95	Alphacom 81		B	A	B	A	C	B
199.00	STX 80		B	B	B	A	A	B
229.00	TTXpress		A	A	B	A	C	B
349.00	Microline 82A (G1*)		A	B	C	A	B	A
395.00	D-100		B	B	B	B	B	B
395.00	1525E		C	B	A	B	C	B
399.00	RX-80 (G2*)		A	B	B	A	A	C
399.00	Spirit 80 (parallel) (G3*)		A	B	B	A	B	A
399.00	Gemini 10X (G4*)		A	A	B	B	A	B
400.00	MPS-801		B	B	A	B	B	B
494.00	Spirit 80 (serial) (G3)		A	B	B	A	B	A
500.00	MPS-802		C	B	A	B	B	B
549.00	Delta 10 (G5*)		B	A	B	B	A	B
549.00	Gemini 15X (G4)		A	A	B	B	A	B
595.00	D-200		B	B	B	B	C	B
599.00	Microline 92 (parallel) (G6*)		B	B	C	A	B	A
599.00	RX-80FT (G2)		A	B	B	A	A	C
698.00	Microline 92 (serial) (G6)		B	B	C	A	B	A
699.00	FX-80 (G7*)		A	B	A	A	A	C
749.00	RX-100 (G2)		A	B	B	A	A	C
749.00	Microline 83A (G1)		A	B	C	A	B	A
795.00	Delta 15 (G5)		B	A	B	B	A	B
795.00	D-300		B	B	B	B	C	B
798.00	MT 160L (G8*)		A	B	B	A	B	A
895.00	FX-100 (G7)		A	B	A	A	A	C
899.00	Microline 93 (parallel) (G6)		B	B	C	A	B	A
998.00	Microline 93 (serial) (G6)		B	B	C	A	B	A
1098.00	MT 180L (G8)		A	B	B	A	B	A
1099.00	Microline 84 (parallel) (G9*)		B	B	C	A	B	A
1219.00	Microline 84 (serial) (G9)		B	B	C	A	B	A
1395.00	LQ-1500		A	A	A	A	A	A

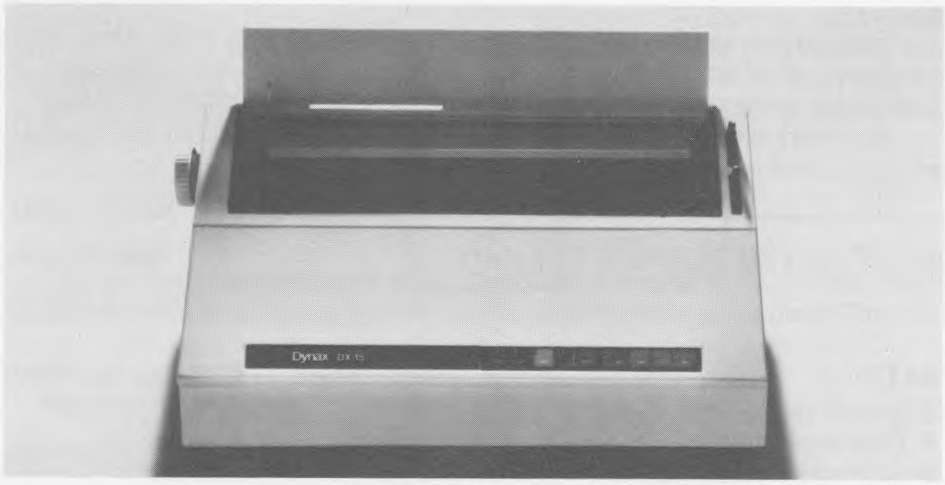
1 = Overall rating
2 = Price/performance
3 = Software compatibility
4 = Ease of installation
5 = Documentation
6 = Vendor support
(Gn) = Member of review group n
(Gn*) = First (lowest priced) member of review group n

Table 6-2. Comparative Table for Printer Features

FEATURES	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Alphacom 81	T	8×8	–	80	+	–	–	–	+	80	+	–	–	–	+	+	–	80	8	T
STX-80	T	9×9	+	60	+	+	–	–	+	66	+	–	–	+	–	+	–	80	8	T
TTXpress	T	7×9	+	50	–	×	×	×	–	+	+	+	+	+	–	+	–	80	8	T
Micr 82A	I	9×9	+	120	+	+	–	–	–	–	+	+	+	+	+	+	+	80	8	S
D-100	I	9×9	+	120	+	+	–	×	–	120	+	+	+	+	–	+	+	80	11	S
1525E	I	6×7	–	30	–	–	–	–	+	–	–	–	–	–	+	–	+	80	10	S
RX-80	I	9×9	+	100	+	+	–	–	–	240	+	+	+	+	+	–	+	80	10	S
Sprt 80 (P)	I	9×8	+	80	+	+	–	–	–	–	+	+	+	+	–	+	+	80	10	S
Gemini 10X	I	9×9	+	120	+	+	–	–	–	240	+	+	+	+	+	+	+	80	8	S
MPS-801	I	6×7	–	50	–	–	–	–	+	–	–	–	–	–	+	–	+	80	10	S
Sprt 80 (S)	I	9×8	+	80	+	–	–	–	–	–	+	+	+	–	+	+	+	80	10	S
MPS-802	I	8×8	+	60	+	–	–	–	+	–	+	–	–	–	+	–	+	80	10	S
Delta 10	I	9×9	+	160	+	+	–	–	–	60	+	+	+	+	+	+	+	80	10	S
Gemini 15X	I	9×9	+	120	+	+	–	–	–	240	+	+	+	+	+	+	+	80	8	S
D-200	I	9×9	+	120	+	+	60	17×18	+	120	+	+	+	+	+	+	+	80	11	S
Micr 92 (P)	I	9×9	+	160	+	+	40	9×17	–	72	+	+	+	+	–	+	+	80	10	S
RX-80 FT	I	9×9	+	120	+	+	–	–	–	240	+	+	+	+	+	+	+	80	11	S
Micr 92 (S)	I	9×9	+	160	+	+	40	9×17	–	72	+	+	+	–	+	+	+	80	11	S
FX-80	I	9×11	+	160	+	+	–	–	–	240	+	+	+	+	–	+	+	80	8	S
RX-100	I	9×9	+	120	+	+	–	–	–	240	+	+	+	+	+	+	+	80	11	S
Micro. 83A	I	9×9	+	120	+	+	–	–	–	–	+	+	+	+	+	+	+	136	8	S
Delta 15	I	9×9	+	160	+	+	–	–	–	60	+	+	+	+	+	+	+	80	10	S
D-300	I	9×9	+	140	+	+	70	17×18	–	120	+	+	+	+	+	+	+	132	15	S
MT 160L	I	7×9	+	160	+	+	40	20×18	–	128	+	+	+	+	+	+	+	80	10	S
FX-100	I	9×11	+	160	+	+	–	–	–	240	+	+	+	+	–	+	+	136	15	S
Micr 93 (P)	I	9×9	+	160	+	+	40	9×17	–	72	+	+	+	+	–	+	+	136	15	S
Micr 93 (S)	I	9×9	+	160	+	+	40	9×17	–	72	+	+	+	–	+	+	+	136	15	S
MT 180L	I	7×9	+	160	+	+	40	20×18	–	128	+	+	+	+	+	+	+	132	15	S
Micr 84 (P)	I	9×9	+	200	+	+	50	13×17	–	144	+	+	+	+	–	+	+	136	15	S
Micr 84 (S)	I	9×9	+	200	+	+	50	13×17	–	144	+	+	+	–	+	+	+	136	15	S
LQ-1500	I	9×17	+	200	+	+	67	37×17	–	var	+	+	+	+	+	+	+	136	16	S

1 = Type (T=Thermal, I=Impact, J=Ink Jet)
2 = Matrix size (width × height)
3 = Desenders
4 = Speed (characters per second)
5 = Bidirectional
6 = Logic seeking
7 = Correspondence speed (characters per second)
8 = Correspondence matrix size (width × height)
9 = Pet graphics
10 = Dot graphics (dots per inch)
11 = Expanded print
12 = Compressed print
13 = Emphasized print
14 = Centronics parallel
15 = Serial
16 = Friction feed
17 = Pin feed
18 = Characters per line
19 = Paper size (inches)
20 = Paper type (S=Standard, T=Special thermal)

Chapter 7



Letter Quality Printers

Letter quality printers are used for correspondence in situations where good looks are more important than speed. The print speed is much slower than a dot matrix because of the time it takes to access fully-formed characters. The letter quality printer works in much the same fashion as the electric typewriter.

Our reviews will cover the daisywheel type printers. The characters are fixed on a wheel resembling a daisy. The wheel moves horizontally across the page and rotates until the desired character is lined up. The character is then struck against an inked ribbon. The wheels are removable and allow you to change the style of the print easily. Some printers offer more of a variety in print styles than others, and our reviews will note this fact.

Print speeds range from 12 to 50 cps (characters-per-second) depending on price and features.

Some of the other features of a daisywheel printer include buffers, to hold data from the computer for input to the printer when needed. A sheet feeder option allows you to automatically feed single sheets of paper to the printer. In some cases the printer enables you to use the keyboard as a regular typewriter.

For word processing there are even more features available; they include special printing effects (boldface, shadow print, full line and word underline, superscript, and subscript), print functions (line space, carriage return, form feed, and backspace), a variety of character pitches (10, 12 or 15 cpi), automatic proportional spacing, double-strike printing, and forward and backward print modes. Some of these features are accessible from the front panel; others are controlled through the printer control codes and escape sequences or the setting of the DIP switches.

The graphics mode is limited on these printers, but they do allow you to create graphs and charts through your program or by using the plot mode on some models.

Some models use friction feed paper similar to a typewriter, while others use a continuous roll of paper, which tends to creep over to one edge after a few pages. A good quality printer will offer both options. A tractor feed is optional in some cases.

A glossary of terms used in describing all printers, including letter quality printers, is included in Chapter 5.

Transtar 120 daisywheel printer

Serial-$328.00

Vivitar/Transtar

Parallel- 378.00

RATINGS	
B	Overall rating
A	Price/performance
B	Software compatibility
A	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Type:	Daisywheel
Speed:	14 cps
Bidirectional:	+
Logic-seeking:	+
Centronics parallel:	+
Serial:	–
Friction feed:	+
Pin feed:	–
Characters per line:	101-151
Paper size:	12″ wide

PRODUCT SUMMARY

The Transtar 120 is called portable because it is light and easy to move around. It is bidirectional, logic-seeking and low-priced.

FEATURES FOR WORD PROCESSING

To fully utilize the word processing features, configure your software for the Diablo 1610/1620 protocol, which is compatible with this printer. Select print pitch (10, 12, or 15 cpi), autoload, and auto line feed with the DIP switches. The autoload function automatically feeds the paper to a predetermined line for printing. With software support, other features are available, including boldface, underline, superscript, and subscript. By using escape sequences or appropriate software you may also control the horizontal and vertical print positions, tabs, line feed, and the forward and backward print modes.

FEATURES FOR GRAPHICS

A limited graphics mode is available through your software programs, which may allow you to create graphs and charts by controlling the movement of the carriage both vertically (1/48″) and horizontally (1/120″).

INSTALLATION AND INTERFACING

This printer has both the parallel and serial interfaces. To interface with the Commodore-64, use the parallel version. We recommend the Card? by Cardco, the MW-302 by Micro World Electronix, the CPI by Micro Systems Development, and The Connection by Tymac with the Universal ROM installed. When it is available, select the Diablo option. Otherwise choose the universal parallel printer if it is offered.

QUALITY AND PERFORMANCE

The print quality is good and the unit is conveniently lightweight and compact, making the Transtar 120 a good value. The owner's manual is sketchy and needs clarification.

VENDOR SUPPORT

There is a six-months warranty on parts and labor. Technical support is available through local dealers.

Transtar 130 daisywheel printer

Serial-$448.00

Vivitar/Transtar

Parallel- 478.00

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
A	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Type:	Daisywheel
Speed:	18 cps
Bidirectional:	+
Logic-seeking:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	–
Characters per line:	150, 180
Paper size:	17″ wide

PRODUCT SUMMARY

This is the wide-carriage version of the Transtar 120. It is bidirectional and logic-seeking. The Transtar 130 is compatible with the Diablo 1610/1620 protocol. There are eight print wheels available for special applications and a 2K buffer is offered with the serial interface. Tractor feed is available as an option.

FEATURES FOR WORD PROCESSING

For word processing applications, Vivitar has built in a wide array of features.

Configure your software for the Diablo protocol to make full use of them. DIP switches are used for print pitch (10 or 12 cpi, or proportional spacing), autoload (feeds paper to a predetermined line automatically), and auto line feed. Also included are boldface, underline, superscript, and subscript. An optional tractor feed is required to access these last two functions. Send the appropriate escape sequences to control the horizontal and vertical print positions (tabs, line feed, and backward and forward print modes).

When necessary, select the Diablo option or the universal parallel printer option in that order.

FEATURES FOR GRAPHICS

Select the limited graphics mode through your program to control the horizontal and vertical movement of the carriage to create graphs and charts.

INSTALLATION AND INTERFACING

This printer is equipped with both parallel and serial interfaces. To interface with the Commodore-64, use the parallel version. We also recommend the Card?+G, MW-302, CPI, and The Connection.

QUALITY AND PERFORMANCE

The Transtar 130 has good print quality and offers most features that come with daisywheel printers. We recommend this unit for light use.

The owner's manual needs clarification.

VENDOR SUPPORT

There is a six month warranty on parts and labor. Technical support is available from local dealers.

DX-15 daisywheel printer

Serial or parallel-$499.00

Brother

RATINGS	
A	Overall rating
A	Price/performance
B	Software compatibility
A	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
Type:	Daisywheel
Speed:	13 cps
Bidirectional:	+
Logic-seeking:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	–
Characters per line:	110
Paper size:	13.5" wide

PRODUCT SUMMARY

This popular low-cost model is loaded with special features. It is bidirectional and comes with a standard 3K buffer. There is an optional 5K buffer, for holding pages of text. This buffer enables you to print multiple copies using the COPY switch. Another option is a keyboard which can be used as a typewriter ($195). There is a large variety of print wheels available. The DX-15 is compatible with Diablo 630 software. An optional sheet feeder is available for $250, and a tractor feed is available for $120. The DX-15 is illustrated in Fig. 7-1.

FEATURES FOR WORD PROCESSING

This printer has a wide range of features that can be used with word processing software, including automatic proportional spacing, shadow print and double-strike modes, auto underline, superscripts and subscripts, and programmable pitch, which can also be controlled by a switch. A front panel can be used to set the proportional spacing and the print pitch.

FEATURES FOR GRAPHICS

The DX-15 has limited graphics capabilities. With the appropriate options, you may initiate the plot mode using proper escape sequences. This allows the print head to move in various directions. You can create very good graphs and charts by



Fig. 7-1. The DX-15 is a popular, low-cost daisywheel printer (courtesy of Dynax).

controlling the movement and position of the print head and by printing the desired text or graphics character.

INSTALLATION AND INTERFACING

Most interfaces will work adequately in their individual word processing modes. The DX-15 can be interfaced with the Commodore-64 with a number of parallel printer interfaces. We tested the MW-302, The Connection, Card?+G, and CPI. For these tests we used three word processors, Easy Script, WordPro3 Plus/64, and Write Now. See the interfaces chapter for more details. When given options on a printer set-up menu, select the Diablo option if it exists. Otherwise, use general parallel printers.

QUALITY AND PERFORMANCE

This is an excellent low-cost printer. Because it uses the Brother print wheel, there is a wide selection of types available. The buffer is a unique feature, although it is too small for any sophisticated applications. The sheet feeder option saves time and energy. The graphics, though limited, would allow you to enhance any report with graphs and charts.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available from local dealers.

Power Type daisywheel printer $499.00

Star Micronics

RATINGS	
B	Overall rating
A	Price/performance
B	Software compatibility
B	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
Type:	Daisywheel
Speed	18 cps
Bidirectional:	+
Logic-seeking:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per line:	110, 132, 165
Paper size:	8½" wide

PRODUCT SUMMARY

Power Type is a low-cost daisywheel letter quality printer. At 18 CPS its speed

is moderate, and it is slightly faster than some of its more expensive competitors. Type may be 10, 12 or 15 cpi, with over 100 different font wheels available. Two functional modes are available: standard and word processing (which accepts commands in the format of the Qume printer).

FEATURES FOR WORD PROCESSING

Power Type offers all the features of the Qume printer in its word processing mode. Proportional spacing is also supported.

FEATURES FOR GRAPHICS

There are no graphics available on this printer.

INSTALLATION AND INTERFACING

This printer requires a Centronics-type parallel or RS-232C serial interface for use with the Commodore 64.

QUALITY AND PERFORMANCE

Power Type does an adequate job. It is relatively slow and noisy, but no more so than other letter quality printers in this price range. For $499, it is an excellent buy for low-volume letter quality printing.

VENDOR SUPPORT

There is a one year warranty on parts and labor. Technical assistance is available through the manufacturer or local distributors.

TTX-1014 daisywheel printer — $499.00

Teltex Communications Corp.

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
B	Ease of installation
C	Documentation
B	Vendor support

FEATURES	
Type:	Daisywheel
Speed:	14 cps
Bidirectional:	+
Logic-seeking:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	+
Characters per line:	115 to 173
Paper size:	to 14⅞"

PRODUCT SUMMARY

The TTX-1014 printer is bidirectional and logic-seeking. Friction feed and pin feed are standard. There is an optional cut sheet feeder, holding up to 250 sheets, available from the manufacturer. The TTX-1014 is shown in Fig. 7-2.

FEATURES FOR WORD PROCESSING

The TTX-1014 offers many features for word processing applications. Character pitch can be selected from within a program or with a switch and allows you to choose from 10 cpi, 12 cpi, or 15 cpi. For special print effects, there are boldface, shadow print, full line and word underline, superscripts, and subscripts accessed with the printer control codes. You can use escape sequences for print functions like the line space, carriage return, form feed, and backspace. For word processing settings, you could use the interface from a dot-matrix printer. Most word processing programs that allow you to send escape sequences through the program to access special print functions will work with this printer. Teltex offers a number of different types of print wheels.

FEATURES FOR GRAPHICS

The manual does not mention graphics; however, you can create limited graphics by using the print action control commands.

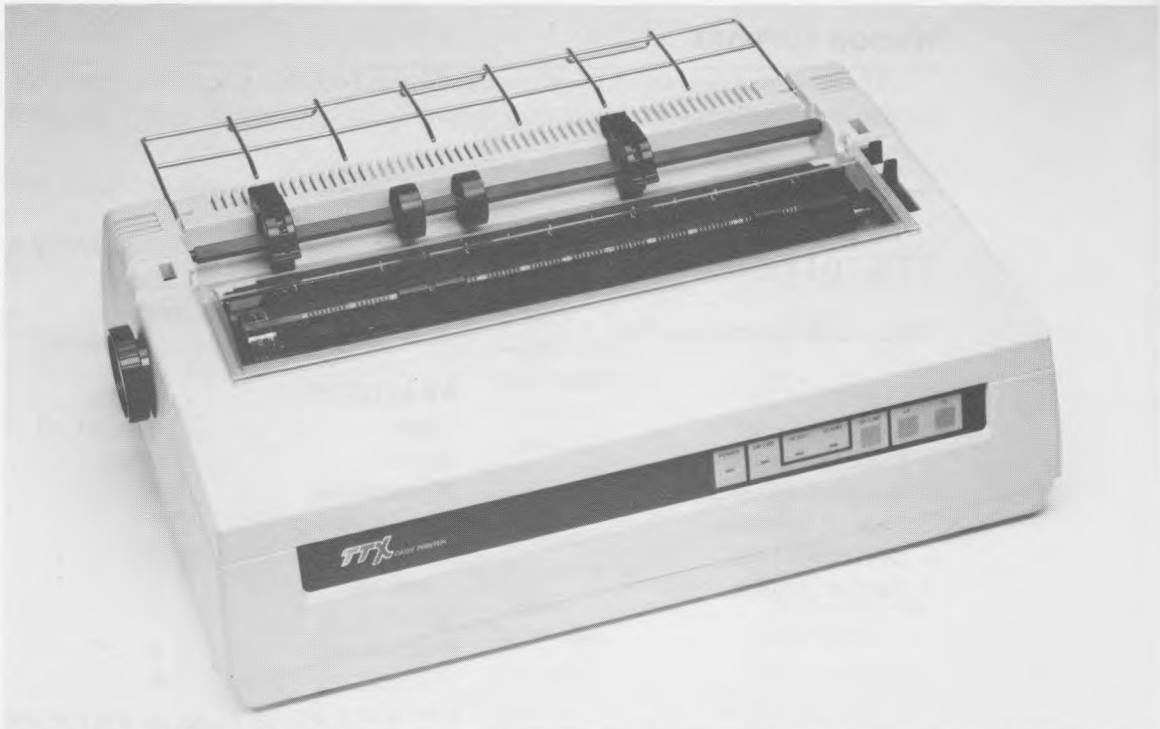


Fig. 7-2. The TTX-1014 daisywheel printer offers outstanding features for its price (courtesy of Teletex Communication Corp.).

INSTALLATION AND INTERFACING

Both serial (RS-232C) and parallel (Centronics-type) inferfaces are standard with the TTX-1014. The serial interface adds to the cost for Commodore users who are not apt to use it. To use the printer with the Commodore-64, we recommend either the Card?+G or the MW-302 interface.

QUALITY AND PERFORMANCE

Although the print quality is good, this printer lacks some of the important features for both word processing and graphics. There is no proportional spacing or plot mode.

VENDOR SUPPORT

There is a 30 day warranty on parts and labor. Technical support is available through an 800 number.

EXP-500 daisywheel printer

Serial or parallel-$549.00

Silver Reed Corp. of America

RATINGS	
B	Overall rating
B	Price/performance
B	Software compatibility
A	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
Type:	Daisywheel
Speed:	16 cps
Bidirectional:	+
Logic-seeking:	+
Centronics Parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	–
Characters per line:	101
Paper size:	to 17″ wide

PRODUCT SUMMARY

The EXP-500 is a bidirectional (in the line print mode) logic-seeking printer. It offers a serial mode (for printing data as received from the computer), and a line print mode, in which the received data is input into a buffer and printed one line at a time. The modes are selected with the proper DIP switches. Friction feed is standard; a tractor feed unit is optional ($159).

FEATURES FOR WORD PROCESSING

Many useful features are available, including character pitch (10, 12 or 15 cpi). Using the printer control codes, you may select boldface, underline, subscript, and

superscript. Using escape sequences, you can access print motion control functions such as line spacing, form feed, carriage return and backspace. Most word processing programs that allow you to send escape sequences to access the special print functions will work with this printer.

FEATURES FOR GRAPHICS

The EXP-500 has limited graphics; however, using the proper escape sequences will allow you to move the print head around. When you control the movement and position of the print head in this manner and print the desired text or graphics character, you can create very good graphs and charts. The manual describes how the vertical and horizontal motion index (HMI and VMI) can create graphic effects through your software.

INSTALLATION AND INTERFACING

This printer comes equipped with a parallel interface, and we recommend the use of either the Card?, or the MW-302 parallel printer interfaces. You could use a dot-matrix printer interface for word processing settings.

QUALITY AND PERFORMANCE

This is a good printer with a wide selection of print wheels for any application. The serial and line printer modes are useful and unique. Though the graphics are limited, they would enhance your reports with graphs and charts.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available through local dealers or an 800 number.

CR-II daisywheel printer

Parallel-$599.00

Comrex International, Inc.

Serial- 649.00

RATINGS		FEATURES	
A	Overall rating	Type:	Daisywheel
A	Price/performance	Speed:	12 cps
B	Software compatibility	Bidirectional:	+
A	Ease of installation	Logic seeking:	+
B	Documentation	Centronics parallel:	+
B	Vendor support	Serial:	+
		Friction feed:	+
		Pin feed:	–
		Characters per line:	110
		Paper size:	to 13.5″ wide

PRODUCT SUMMARY

This printer is low-cost and bidirectional in the text mode. There is a standard 5K buffer so you can make multiple copies (it reprints the contents of the buffer) using the COPY switch. a large variety of print wheels are available, and this printer is compatible with the Diablo 1640/1650 software. Tractor feed and sheet feed are options. An optional keyboard can be used as a typewriter. You can also use multicolor ribbons and correction tape.

FEATURES FOR WORD PROCESSING

For word processing applications there are many features such as automatic proportional spacing, shadow print and double-strike modes, auto underline, super and subscripts, and programmable pitch, which also comes with a switch control. You can set the proportional spacing and print pitch from the front control panel.

FEATURES FOR GRAPHICS

You can overcome the limited graphics using the escape sequences for the plot mode, which allows you to move the print head. By controlling this movement and by printing the desired text or graphic characters, you can create very good charts and graphs.

INSTALLATION AND INTERFACING

Most interfaces work adequately in their individualized word processing modes. To interface this printer with the Commodore-64, use any parallel printer interface, or select the Diablo option if it is available. We tested the MW-302, The Connection, the Card?+G, and the CPI interfaces with three word processors—Easy Script, WordPro3 Plus/64, and Write Now—to determine various switch settings. More detail on this is provided in the chapter on interfaces.

QUALITY AND PERFORMANCE

The CR-II is a very good printer and uses the Brother print wheel. The buffer is small but is a very attractive feature as it is not standard on many printers. With the sheet feeder option, single sheet can be automatically fed into the printer. The graphics may be limited, but they could be used to enhance any report with graphs and charts.

VENDOR SUPPORT

There is a limited 90 day warranty against defects in material and workmanship. Technical support is available from local dealers.

HR 25 daisywheel printer $845.00

Brother

RATINGS	
A	Overall rating
A	Price/performance
B	Software compatibility
B	Ease of installation
B	Documentation
B	Vendor support

FEATURES	
Type:	Daisywheel
Speed:	23 cps
Bidirectional:	+
Logic-seeking:	+
Centronics parallel:	+
Serial:	+
Friction feed:	+
Pin feed:	–
Characters per line:	165
Paper size:	16.5″ wide

PRODUCT SUMMARY

The Brother HR 25 is a wide-carriage printer, which is bidirectional and logic-seeking. An optional sheet feeder is available for $269. An optional tractor feed ($149) is also available. There is a 3K buffer, which is capable of holding about three to four pages of material. Using this buffer you can make multiple copies using the COPY switch. There are a large number of print wheel types available. This printer is compatible with the Diablo 630 software. The HR-25 is illustrated in Fig. 7-3.

FEATURES FOR WORD PROCESSING

For word processing applications there is an impressive array of features including automatic proportional spacing shadow print, double-strike, programmable pitch (10, 12 or 15 cpi), auto underline, superscripts, and subscripts. There is a front panel for setting the proportional spacing and the pitch.

Using printer control codes, you may select print formatting (margin set), horizontal and vertical spacing, and paper length. Using DIP switches, other features, including specific foreign language character sets, are available.

When a printer set-up menu in a word processing program lists the Diablo option, use that option. Otherwise select the general parallel printers option.

FEATURES FOR GRAPHICS

This printer provides limited graphics. Using the proper escape sequences, you can access the plot mode. By manipulating the print head and printing the desired graphics or text character, you can achieve some success with graphs and charts.

INSTALLATION AND INTERFACING

Both serial (RS-232C) and parallel (Centronics-type) interfaces come with this

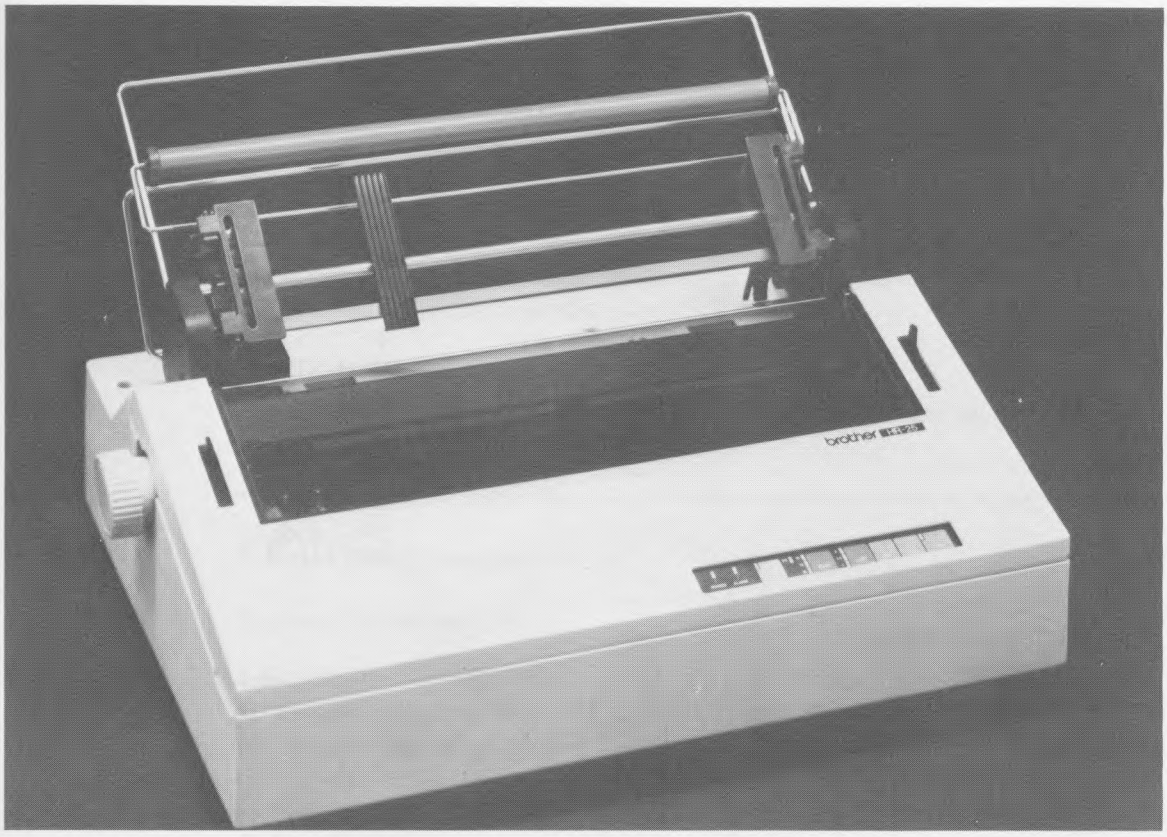


Fig. 7-3. The HR-25 is an excellent, wide carriage printer for the Commodore 64 (courtesy of Dynax).

printer. To interface it with the Commodore-64, use a parallel printer interface. Most interfaces should work in their individual word processing modes (auto line feed, 7-bit data transfer, CBM ASCII to standard ASCII conversion). We tested this unit with the MW-302 interface from Micro World Electronix, The Connection interface from Tymac, the Card?+G interface from Cardco, and the CPI parallel printer interface from MSD, using three word processing programs, Easy Script, WordPro 3 Plus/64, and Write Now. See the interface chapter for further details.

QUALITY AND PERFORMANCE

This is an excellent printer with a wide range of applications. The buffer is too small, and graphics too limited for sophisticated applications.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available through local dealers.

Style Writer daisywheel printer $899.00

Data Terminal & Communications

RATINGS	
A	Overall rating
B	Price/performance
B	Software compatibility
A	Ease of installation
A	Documentation
A	Vendor support

FEATURES	
Type:	Daisywheel
Speed:	20 cps
Bidirectional:	+
Logic-seeking:	+
Centronics parallel:	+
Serial:	–
Friction feed:	+
Pin feed:	–
Characters per line:	177
Paper size:	17¾" wide

PRODUCT SUMMARY

This printer is excellent and loaded with features. It is bidirectional (text mode). It also comes with a standard 35K buffer (large enough to hold some 20 pages of text), which can be reprinted using the COPY switch. A 67K buffer is optional. Another option is a keyboard that can be used as a typewriter. A large variety of print wheels are available. The Style Writer is compatible with the Diablo 1640/1650 software.

FEATURES FOR WORD PROCESSING

For word processing applications there are many features such as automatic proportional spacing, shadow print and double-strike modes, auto-underline, superscripts and subscripts, and programmable pitch, which also has a switch control. Some features, which may be selected using the printer control codes or through DIP switch settings, include print formatting features (margins, spacing, and paper length) and foreign language character sets.

FEATURES FOR GRAPHICS

Graphs and charts for reports can be created by using the plot mode to move the print head around.

INSTALLATION AND INTERFACING

To interface the Style Writer with the Commodore-64, use a parallel printer interface. Most interfaces will work adequately on daisywheel printers in their individual word processing modes. This printer was tested with the MW-302, The Connection, the Card?+G, and the CPI parallel printer interface; these were used with three word processors, Easy Script, WordPro3 Plus/64, and Write Now. For further details see the chapter on interfaces. When given a choice of options, select

the Diablo option if it is available; otherwise chose the option for general parallel printers.

QUALITY AND PERFORMANCE

The Style Writer is a very good printer. The features available for word processing are impressive. The printer uses the Brother print wheel, which expands its capabilities. The 32K buffer is very useful for word processing applications, and the sheet feeder option saves a lot of time and energy. The graphics, although limited, could be used to enhance any report with graphs and charts. DTC is known for its long-lasting and reliable products.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available through an 800 number.

CR-III daisywheel printer

Parallel-$995.00

Comrex International Inc.

Serial-1045.00

RATINGS	FEATURES	
A Overall rating	Type:	Daisywheel
A Price/performance	Speed:	23 cps
B Software compatibility	Bidirectional:	+
B Ease of installation	Logic-seeking:	+
B Documentation	Centronics parallel:	+
B Vendor support	Serial:	+
	Friction feed:	+
	Pin feed:	–
	Characters per line:	132
	Paper size:	14⅞" wide

PRODUCT SUMMARY

This the wide-carriage model from Comrex. It is bidirectional and logic-seeking in the text mode, and is equipped with a 5K buffer to hold three to four pages. Multiple copies can then be made by using the COPY switch to reprint the buffer contents. There is a large variety of print wheels available. There is an optional cut sheet feeder and a tractor feed mechanism, and an automatic paper loading feature to load single sheets at a specific position.

FEATURES FOR WORD PROCESSING

For word processing applications, the CR-III has a wide range of features,

including automatic proportional spacing, shadow print and double-strike modes, auto-underline, programmable pitch (available also with switch control), subscripts and superscripts. The front panel is used to set the proportional spacing and print pitch. Printer control codes select the print formatting features such as margins, vertical and horizontal spacing, and paper length. DIP switches are used to select certain features and specific foreign language character sets. The CR-III comes with two-color ribbons for color printing.

FEATURES FOR GRAPHICS

This printer has limited graphics capabilities; however by using the proper escape sequences, you can select the plot mode to move the print head. The movement of the print head combined with the printing of the desired text or graphics character can create very good graphics for charts and graphs.

INSTALLATION AND INTERFACING

Because the CR-III is compatible with the Diablo 630 software, the Diablo option should be your first choice, and the general parallel printer option your second. To interface this printer with the Commodore-64, you may use any parallel printer interface; most will work adequately in their individual modes. We tested the MW-302, The Connection, the Card?+G, and the CPI. Each of these interfaces were tested with three word processors, Easy Script, WordPro3 Plus/64, and Write Now. More information is available in the chapter on interfaces.

QUALITY AND PERFORMANCE

This is an excellent printer that uses the Brother print wheel. Though too small for extensive word processing, the buffer is a unique and useful feature. The sheet feeder option lets you automatically feed single sheets into the printer. The graphics are limited but would enable you to enhance your reports with charts and graphs.

VENDOR SUPPORT

There is a limited 90 day warranty against defects in materials and workmanship. Technical support is available through local dealers.

WORKSHEET FOR LETTER QUALITY PRINTERS

. $

.

RATINGS

Overall rating
Price/performance
Software compatibility
Ease of installation
Documentation
Vendor support

FEATURES

Type:
Speed:
Bidirectional:
Logic-seeking:
Centronics parallel:
Serial:
Friction feed:
Pin feed:
Characters per line:
Paper size:

PRODUCT SUMMARY

FEATURES FOR WORD PROCESSING

FEATURES FOR GRAPHICS

INSTALLATION AND INTERFACING

QUALITY AND PERFORMANCE

VENDOR SUPPORT

COMPARISONS AT A GLANCE

Table 7-1 shows each daisywheel printer and the rating it received in each category. The features of each printer are shown in Table 7-2.

Table 7-1. Comparative Ratings for Letter Quality Printers

PRICE	PRINTER	RATINGS	1	2	3	4	5	6
$328.00	Transtar 120 (parallel)		B	A	B	A	C	B
378.00	Transtar 120 (serial)		B	A	B	A	C	B
448.00	Transtar 130 (parallel)		B	B	B	A	C	B
478.00	Transtar 130 (serial)		B	B	B	A	C	B
499.00	DX-15		A	A	B	A	B	B
499.00	Power Type		B	A	B	B	B	B
499.00	TTX-1014		B	B	B	B	C	B
549.00	EXP-500		B	B	B	A	B	B
599.00	CR-II (parallel)		A	A	B	A	B	B
649.00	CR-II (serial)		A	A	B	A	B	B
845.00	HR 25		A	A	B	B	B	B
899.00	Style Writer		A	B	B	A	A	A
995.00	CR-III (parallel)		A	A	B	B	B	B
1045.00	CR-III (serial)		A	A	B	B	B	B

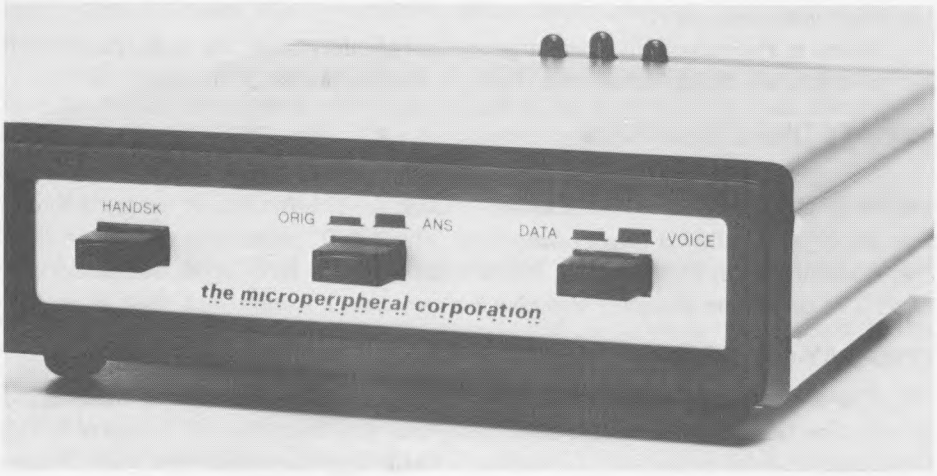
1 = Overall rating
2 = Price/performance
3 = Software compatibility
4 = Ease of installation
5 = Documentation
6 = Vendor support

Table 7-2. Comparative Table for Printer Features

FEATURES	1	2	3	4	5	6	7	8	9	10
Transtar 120 (P)	D	14	+	+	+	–	+	–	101	12
Transtar 120 (S)	D	14	+	+	–	+	+	–	101	12
Transtar 130 (P)	D	18	+	+	+	–	+	–	150	17
Transtar 130 (S)	D	18	+	+	–	+	+	–	150	17
DX-15	D	13	+	+	+	+	+	–	110	13.5
Power Type	D	18	+	+	+	+	+	+	110	8.5
TTX-1014	D	14	+	+	+	+	+	+	115	14.8
EXP-500	D	16	+	+	+	+	+	–	101	17
CR-II (P)	D	12	+	+	+	–	+	–	110	13.5
CR-II (S)	D	12	+	+	–	+	+	–	110	13.5
HR 25	D	23	+	+	+	+	+	–	165	16.5
Style Writer	D	20	+	+	+	–	+	–	177	17.75
CR-III (P)	D	23	+	+	+	–	+	–	132	14.8
CR-III (S)	D	23	+	+	–	+	+	–	132	14.8

1 = Type (D=Daisywheel)
2 = Speed
3 = Bidirectional
4 = Logic seeking
5 = Centronics parallel
6 = Serial
7 = Friction Feed
8 = Pin feed
9 = Characters per line
10 = Paper size

Chapter 8



Modems

A *modem* is a device that enables your computer to communicate with another computer many miles away, using the public telephone lines. Modem is an acronym for MOdulate-DEModulate, which also explains what it does. Because computers talk in digital codes and telephone lines listen in analog codes, the data from the computer must first be translated before it goes over the telephone lines. The modem modulates the digital signals into the analog signals, and demodulates the analog signals into digital signals.

A modem requires communications software that will enable you to send data from the keyboard and display incoming data on the screen. Some of this software is provided with the Commodore 64, including the commands for setting protocols not included in the RS-232C. The sending and receiving computers must agree on a number of items including the speed of transmission, required parity, duplex mode, the Bell prototype, etc.), and this is accomplished with software. You may purchase additional software to provide you with convenient features for the modem, depending on your individual needs.

The main questions for a modem buyer are: how fast can it transmit data, how does the modem connect to the computer, and is the data transmitted one-way or two-ways.

TRANSMISSION SPEED

The two most popular speeds for home computer users are 300 bits per second (or baud) and 1200 bits per second (or baud). Speed is important for two reasons.

First, the companies with which you communicate charge by the hour and by the baud. For example, CompuServe charges $5/hour for 300 baud, or $17.50/hour for 1200 baud in off hours. It takes about one minute to transfer 2000 bytes of text at 300 baud. Anything under 600 baud is considered low speed and this is more than sufficient for the Commodore 64 user.

Speed is also important when large amount of information are to be transferred. Because you are using phone lines, there is the telephone bill to consider.

CONNECTING THE MODEM

There are two ways to connect the modem. Either the telephone receiver is placed in a cradling called an *acoustic coupler*, or the modem is plugged into a telephone jack, called a *direct connection*. The direct connection offers the best transmission, is less expensive, and more than meets the needs of the Commodore 64 user. The telephone company will check to see that it meets with regulations.

ONE-WAY OR TWO-WAY TRANSMISSION

One and two-way transmission refers to whether or not data can be transmitted in both directions received at the same time. One-way transmission is referred to as *half-duplex* and works like a CB radio transmission: only one person can talk at a time. Two-way, or *full-duplex*, works like a telephone on which two people can talk simultaneously. (Computers, however, do a better job of receiving while transmitting than people do of listening while talking.)

All of this relates to the modem's compatibility with the telephone lines. Modems are either compatible with the Bell 103/113 standard, the Bell 202 standard, or the Bell 212A standard, and in some cases with two of these. There are one or two others; however, the Commodore 64 user will be interested in the ones we have mentioned. Some information utilities with which you want to receive information will only use one of these. The Bell 212A is the fastest and most expensive of the three.

FEATURES

A manufacturer might indicate that its modem is full-featured, even though it does not contain all the possible modem features. Here is a list and brief description of the modem features:

Auto answer. An auto answer modem will answer its own calls automatically; you do not have to be there.

Auto dial. An auto dial modem can access the telephone line and dial a telephone number in either pulse or Touch Tone™ format. This circuitry checks for errors and evaluates the modem's capability to send and receive data. The test modes include analog loop-back, digital loop-back and remote digital loop.

Busy mode. This feature can be used when you want to use your system for something else and do not want receive calls. It is like taking the phone off the hook.

Command abort. This signal interrupts the transmission before the call is completed. Some modems will use the carriage return (or two) for this purpose.

Command mode. This allows you to use software to direct the modem's operation.

Command recognition. This term refers to the ability of the modem to accept

commands at different speeds or parity. Some modems require specific speeds for commands, while others do not.

Dialing directory. This feature lets you store frequently used telephone numbers and 20 to 60 explanation characters. If the directory is stored in memory in the modem, a battery will be needed to retain the numbers if the power is disconnected.

Dial tones. Your local telephone company may use pulse or touch tones. The tone put out by the modem must correspond to the tone used by your telephone.

Directory modification. This term refers to the ability to change the phone numbers listed in the directory.

Help command. This feature gives you access to the help files by typing either an H or HELP.

Last number redial. This feature enables the modem to automatically redial the last number dialed.

Manual dial. This feature permits you to dial a number by typing it in from the keyboard.

Modem register contents. This feature can be used to check or modify the contents of the modem's internal memory register.

Modem switches. These switches required by some software for the program to function properly. These are set either through the software or manually.

Name selection dialing. Used for typing in a name on the keyboard which corresponds to a directory number to be dialed.

Number linking—indicates a second number to be dialed if the first number dialed is busy.

Originate/Answer. An originate/answer modem can operate in both the originate and answer modes.

Originate Only. An originate-only modem can only operate in the mode normally used by the modem that is used to initiate the communication. The modem at the other end of the line must be operating in the *answer* mode.

Protocol detect and switch. This feature determines the protocol of the incoming call and switches its protocol to match it.

Quit command. This feature allows the user to turn off the internal monitor programs.

Repeat dialing. This feature allows for the repeated dialing of a phone number a specific number of times.

Set answerback string. This feature can be used to eliminate typing in the appropriate code words (answerback string) each time communication is initialized.

Set attention character. This feature allows the user to get the modem's attention to give it further commands while it is transmitting or receiving data.

Set backspace character. This feature allows you to select any character and designate it as a backspace key.

Set disconnect character. This feature enables you to designate one to two characters that will cause the modem to break the connection.

INFORMATION SERVICES

There are a number of information services available to the Commodore 64 user.

They include stock market prices, encyclopedia references, current news and weather, and movie and book reviews. There is a charge for these services, as well as a registration fee, which varies. The most popular information services are described below.

The Source, 1616 Anderson Rd., McLean, VA 22102. The Source provides daily news, excerpts from financial publications, financial reports on over 3,000 companies, bond and commodity prices, and movie and restaurant reviews. It also provides an electronic catalogue for purchasing items, electronic mail, and games. The registration fee is $100 and connection costs run from $7.75 to $20.75/hr.

The Dow Jones News/Retrieval, Box 300, Princeton, NJ 08540. This service provides stock prices for all companies on the major exchanges for current or prior years. It also provides financial disclosures and news affecting particular companies. It offers access to articles from the Wall Street Journal and Barrons, as well as a 20-volume encyclopedia. A free subscription to this service is included with some modems, and the connection cost ranges from 15 cents to $1.20/minute.

Dialog's Knowledge Index, 3460 Hillview Avenue, Palo Alto, CA 94304. This service provides technical information and includes summaries and complete copies of over 7 million articles, reports, and books. Over 25,000 publications by the US Government Printing Office are available. The registration fee is $35.00, and the connection cost is $24/hour.

CompuServe Information Service, 5000 Arlington Center Blvd., Columbus, OH 43320. This service provides investor-oriented information, including stock quotes, historical data for over 40,000 companies, and data from Standard & Poors and Value Line. There is also a service that provides you with technical assistance for operating your computer. Registration is $40 and may be free with the purchase of some modems.

Locally operated bulletin boards offer information concerning topics such as consumer products, local meetings, dating services, and ride sharing. A modem can also be used to access electronic mail, which permits you to send a message that is held until retrieved by the recipient (by modem). There is a postal service that allows you to type in a letter and send it; it is then printed and delivered on the receiving end. In some cases they can guarantee delivery within for hours.

You may use your modem for your banking and bill paying needs. Funds can be transferred between accounts and bills can be paid; you can also receive current statements electronically.

School work can be sent and received with a modem, and you can carry on a remote chess game and never leave your home.

GLOSSARY

accoustic coupler—A cradle device used to connect the telephone receiver to the modem.

answerback—The specific character (or two) from a computer indicating it is ready for data transmission. This character can be typed in manually by the operator or the modem may have an automatic answerback feature.

auto answer—A feature on some modems that automatically answers and responds to incoming calls.

auto-dial—A feature on some modems for automatically dialing a telephone number.

baud rate—The speed of data transmission usually measured in bits per second (bpi).

Bell 103—A low-speed modem developed by Bell Laboratories and considered a standard.

Bell 212A—A high-speed modem developed by Bell Laboratories and considered a standard.

bps—Bits per second.

bulletin board—A computerized information center providing local information and other services.

control character—Any character that has been assigned a specific purpose, such as beginning or ending the transmission of data or responding to an incoming call.

data communication—Transmitting and receiving data to or from remote systems.

direct connect—Indicates the modem is connected directly to the telephone line.

full duplex—The ability of the modem to send and receive information simultaneously.

half duplex—The ability of the modem to either send or receive data, but not do both at the same time.

loopback—A test to see if the modem is correctly transmitting data.

modem—MOdulate/DEModulate. The device that modulates digital signals into analog signals and demodulates analog signals into digital signals.

modulation—The conversion of serial bits (on or off states) to frequencies.

network—A group of computers that communicate over telephone lines or other wires.

parity—One of the simplest techniques for detecting bit-errors in transmission.

protocol—The format and procedures for data transmission.

remote database—An information source that can be accessed only with a modem or other telecommunications equipment.

RS-232C—A widely-used standard for serially connecting computer components.

serial—A format for transmitting data, one bit at a time.

stand-alone modem—Indicates the modem is a separate unit.

telecomputing—Using telephone lines to send and receive data between two computers.

terminal emulators—Communications software enabling you to type information from the keyboard and send it through the modem.

timesharing—Dividing a large computer's processor between several users, who share the processing time.

VICmodem 1600 $69.95

Commodore Business Machines

RATING	FEATURES	
B Overall rating	Connection:	Direct

RATING	
B	Price/performance
C	Ease of installation
A	Documentation
B	Vendor support

FEATURES	
Bell	
Prototype:	Bell 103
Operations:	Originate/ Answer
Voice:	–
Baud Rate:	300
Duplex:	Full
Dialing:	Pulse

PRODUCT SUMMARY

This modem was originally designed to be used with the VIC-20, and the documentation for the early models include a short program to enable them to function with the Commodore 64. Later models include this program with the software to eliminate the typing. The VIC modem will not function with Trimline telephones, which use the touch tones, or with telephones with short keystroke number pads. The 1600 must be directly connected to the handset of a modular phone, via the cable. For data communications, this cable must be disconnected and plugged into the modem each time a number is dialed. There is a switch for manually selecting either the originate or answer mode.

INTERFACE

Because the 1600 is powered by the computer, no additional outlets are required. It requires a modular phone (RJ11C) with a full (as opposed to short) keystroke number pad.

PERFORMANCE

With the 1600 you can begin basic telecommunicating for a low price, as it contains everything necessary for essential operation. It also includes software and free memberships in the Dow Jones News/Retrieval Service and the CompuServe Information Service.

Disadvantages, other than those already mentioned, include the facts that the modem, hanging from the user port, could become disconnected, and that there are no provisions for downloading, uploading, or auto logging. These features are available on separately purchased software (Vidtex, Superterm, or Easy Comm 64).

VENDOR SUPPORT

There is a 90-day warranty, and the modem can be returned and replaced for a small fee at authorized service centers.

Volksmodem

$79.95

Anchor Automation, Inc.

RATING

B Overall rating
B Price/performance
B Ease of installation
C Documentation
B Vendor support

FEATURES

Connection:	Direct
Bell	
Prototype:	Bell 103
Operations:	Originate/ Answer
Voice:	+
Baud Rate:	300
Duplex:	Full/Half
Dialing:	Pulse

PRODUCT SUMMARY

The Volksmodem, shown in Fig. 8-1, provides a toggle switch for either phone mode (conversation) or data mode (transmission of data), and a tone sounds if the battery is working. With the switch set to phone mode, there is no drain on the battery, and you can use your telephone for normal conversations. There is another switch for either full or half duplex (the setting must be compatible with the software settings). There is a second port for connecting the modem to the base of the telephone. Communications software must be purchased for this modem. The answer or originate mode is selected automatically.

INTERFACE

The cable to connect the phone to the modem is included, however, an additional cable ($20) is needed to connect the modem to the computer using the user port. The Volksmodem also requires a 9-volt battery for internal power.



Fig. 8-1. The Volksmodem is a low-cost 300 baud modem (courtesy of Anchor Automation).

PERFORMANCE

The documentation for other than the basics is sketchy, although installation is done quickly. You will need to purchase communications software to set other parameters.

VENDOR SUPPORT

There is a lifetime warranty on this modem for normal use. Technical support is available from local distributors or the manufacturer.

Mitey Mo modem $99.95

USI

RATING	
A	Overall rating
A	Price/performance
A	Ease of installation
A	Documentation
A	Vendor support

FEATURES	
Connection:	Direct
Bell	
Prototype:	Bell 103
Operations:	Auto Answer/ Originate
Voice:	+
Baud Rate:	300
Duplex:	Full/Half
Dialing:	Pulse

PRODUCT SUMMARY

Mitey Mo is an advanced technology modem for the Commodore 64. It is highly-miniaturized (about the size of a cartridge), and offers advanced features, including auto answer, smooth screen-scrolling, and continuous redialing to reach busy numbers. The Mitey Mo includes an outstanding array of supporting materials: software on cassette and disk, a function key template, an excellent manual, and both cables required for telephone connection.

The menu-based software provided is also excellent and supports downloading (24K buffer), printing, and automatic controlling of the modem's features. The only manual switch toggles between the talk mode and the data mode; everything else is software-controlled through menus.

INTERFACE

The interface is built-in.

PERFORMANCE

Largely because of the advanced software/hardware interaction, performance of the Mitey Mo is outstanding. The modem functions in an "intelligent" manner. It automatically sets most of the values needed for successful communications. Other

options are chosen from easy-to-use menus.

VENDOR SUPPORT

There is a 3-year warranty on this modem. Technical support is available from local distributors or the manufacturer.

Automodem 1650

$120.00

Commodore Business Machines

RATING		FEATURES	
B	Overall rating	Connection:	Direct
B	Price/performance	Bell	
B	Ease of installation	Prototype:	Bell 103
B	Documentation	Operations:	Auto Answer/ Auto Dial
B	Vendor support	Voice:	–
		Baud rate:	300
		Duplex:	Half/Full
		Dialing:	Pulse

PRODUCT SUMMARY

The 1650 works well with the Commodore 64 and includes software (TERM 64) for essential communications. The auto dial and auto answer features are included. This modem is inserted into the user port, making this connection somewhat precarious. There is a switch for selecting the conversation mode or the data transmission mode. The phone adapter, which is built-in, allows you to use the 1650 with any modular phone, including the Trimline.

A cable from the wall to the phone is inserted into the modem and another cable connects the modem to the phone. The T-adapter for this connection is built into the modem connected to the user port.

INTERFACE

The interface is built-in.

PERFORMANCE

The modem needs no additional hardware or software to begin telecommunicating. The advantages of this modem include the auto answer and auto dial features, and the switch that allows you to carry on a phone conversation (conversation mode) or to transmit/receive data (data mode). Another advantage is the switch for full or half duplex, which must be compatible with the software option selected. The third switch, which allows you to choose between originating a transmission and answering an incoming call from another computer, is also an important feature. You can enter up to ten different telephone numbers through the keyboard, save them, and then have

them dialed automatically at your request. You can also enter telephone numbers on the keyboard and have them automatically dialed. Note, however, that the alternative long distance systems, such as MCI and Sprint, must be dialed manually.

This modem does not provide for downloading or uploading; if this is important to you, you must purchase separate software.

VENDOR SUPPORT

There is a 90-day warranty, and the modem can usually be returned and replaced at an authorized service center for a reasonable fee.

Auto Print APV modem and interface $179.95

The Microperipheral Corporation

RATING		FEATURES	
B	Overall rating	Connection:	Direct
C	Price/performance	Bell	
B	Ease of installation	Prototype:	Bell 103/113 and 212
B	Documentation	Operations:	Originate/ Auto Answer
B	Vendor support	Voice:	+
		Baud Rate:	300
		Duplex:	Full/Half
		Dialing:	Pulse/Tone

PRODUCT SUMMARY

The Auto Print APV is a combination 300 baud modem and Centronics-type parallel interface. The interface portion is more fully described in the chapter on interfaces. The major advantage to this combination is that your printer and your modem will definitely work together. The printer cable is supplied along with software on cassette. The modem is fully-compatible with the Commodore 1650 printer. There are LEDs that glow to indicate power on, carrier detect, and dialing in process. A telephone is not required for printer operation. The Auto Print APV is illustrated in Fig. 8-2.

INTERFACE

The interfaces (both Centronics-type parallel and RS-232C for the modem) are built-in and connect to the user port.

PERFORMANCE

This is a well-made unit, which is easy to install and use. The parallel interface works with most printers and word processors. A disadvantage is that the printer is limited to 30 characters per second (cps), slower than most printers are capable of printing. The extra speed of a faster printer is wasted.

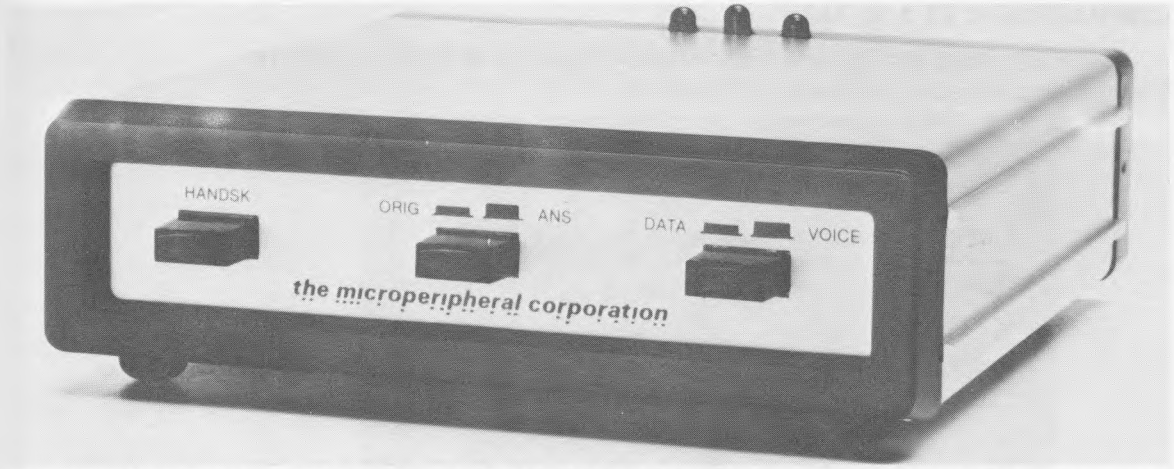


Fig. 8-2. The Microperipheral APV is a unique combination of Centronics parallel interface and 300 baud modem (courtesy of the Microperipheral Corp.).

VENDOR SUPPORT

There is a 90 day warranty against defects in parts of workmanship.

WORKSHEET FOR MODEMS

. $

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RATING	FEATURES
Overall rating	Connection:
Price/performance	Bell
Ease of installation	Prototype:
Documentation	Operations:
Vendor support	Voice:
	Baud Rate:
	Duplex:
	Dialing:

PRODUCT SUMMARY

INTERFACE

PERFORMANCE

SUPPORT

COMPARISONS AT A GLANCE

Table 8-1 shows each modem and the rating it received in each category. The features of each modem are shown in Table 8-2.

Table 8-1. Comparative Ratings for Modems

PRICE	MODEMS	RATINGS	1	2	3	4	5
$69.00	VICmodem 1600		B	B	C	A	B
79.95	Volksmodem		B	B	B	C	B
99.95	Mitey Mo		A	A	A	A	A
120.00	Automodem 1650		B	B	B	B	B
179.00	Auto Print APV		B	C	B	B	B

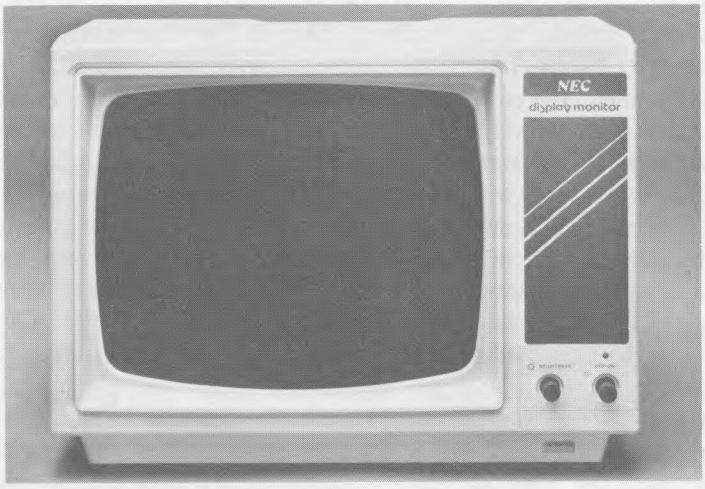
1 = Overall rating
2 = Price/performance
3 = Ease of installation
4 = Documentation
5 = Vendor support

Table 8-2. Comparative Table for Modem Features

FEATURES	1	2	3	4	5	6	7
VICmodem	D	1	M	–	300	2	1
Volksmodem	D	1	M	+	300	3	1
Mitey Mo	D	1	A	+	300	3	1
Automodem 1650	D	1	A	+	300	3	1
Auto Print APV	D	3	A	+	300	3	3

1 = Connection (A=Acoustic, D=Direct connect)
2 = Bell prototype (1=Bell 103, 2=Bell 212A, 3=both)
3 = Operations (A=Autodial/Autoanswer, M=Manual dial/answer)
4 = Voice
5 = Baud rate
6 = Duplex (1=half, 2=full, 3=both)
7 = Dialing (1=pulse, 2=tone, 3=both)

Chapter 9



Monitors

A *monitor* is a viewing screen. Although some computers have built-in monitors, the Commodore 64 is connected to the monitor with a cable. Monitors are either color or monochrome. The Commodore 64 will operate with a monitor or a television set and creates a blank margin on all sides of the screen to avoid distorted characters on the edge.

GENERAL

A monitor is very similar to a television. Its main component is a cathode ray tube (CRT), which acts like an old TV picture tube. The CRT puts out an electron beam (or three beams for a color monitor) which repeatedly scans the screen from top to bottom in a zig-zag fashion, switching on and off. The back of the monochrome screen is coated with phosphorus which lights up when beam shines on it. An image is displayed by switching the beam on and off at the right places.

On the color monitor, there are three sets of three kinds of phosphorus dots. A perforated mask, the shadow mask, filters the colored beams so each reaches its own set of dots. The space between these perforations is called the dot pitch. The smaller the distance, the better the resolution.

In the Commodore 64, this beam is switched on and off from the computer with the VIC-II chip. Each time the beam scans the screen, the chip sends out information through the luminance (luma) line to each section of the screen to either turn on and create an image or turn off for a blank space. These sections are called pixels. There are 200 rows of them with 320 sections to a row displayed by a Commodore 64. The greater the number of pixels, the sharper the image.

The image is affected by the amount of time the pixels remain on the screen. This is referred to as the phosphor persistence. A short persistence will create a flickering of the characters, while a long persistence will create a ghost image.

The pixels are turned on or lit up by the program you are running. In the standard mode, the alphanumeric characters are displayed. The character generator in the memory contains instructions for displaying these characters, and no further programming is needed. You could change the bits in the character generator or create your own characters following the instructions given in the programmer's reference guide. In the high resolution mode you can individually program each of these pixels, 64,000 in all.

The Commodore 64 transmits video information at a rate of 14 million bits per second. The monitor can only accept this information at a certain rate. This is called the *bandwidth* and is measured in MegaHertz (MHz). For example, a television has a 4.5 MHz band width, or accepts 4.5 million bits per second. At 14 MHz, the characters transmitted by the Commodore 64 are a little fuzzy. The greater the bandwidth the sharper the characters.

The size of the screen is very important for two reasons. First, a small screen, 5 to 9 inches, can be very hard on the eyes for prolonged period. Secondly, a small screen compacts the material. An 80-column display gets pretty crowded on a five-inch screen. But if you have to carry your computer around, the five-inch screen may be more advantageous than a nineteen-inch screen. The size of the screen you choose will depend on the amount of use and the degree of portability you desire.

MONOCHROME MONITORS

Monochrome monitors are best used for word processing. There are three main variations, amber on black, green on black, and white on black. Of these three, the amber and the green are easiest on the eyes, and some people feel the amber is more restful than the green.

When you are using Commodore 64 programs in color, the monochrome monitor will display only one color, which may make the program useless.

COLOR MONITORS

The Commodore 64 can only use a composite video color monitor. Color monitors are used primarily for graphics. There are three beams, red, blue and green. By varying the intensity of the three beams, the monitor can create all the colors of the spectrum. The color of each character is determined by the screen color memory, and the information travels to the screen on the chroma line.

Many of the Commodore 64 programs are designed for use with color monitors.

There are two types of color monitors, RGB (red, green, blue) and composite video. An RGB unit needs three lines for each of the colors, while the composite video monitor receives the color information through one line, the chroma line.

USING A TV

Your television set will work well with the Commodore 64. The only disadvantage is the minor distortion created because the nature of the TV. The circuitry in the

TV is geared to receive a signal carried over radio waves from a transmitter. Computer information must be modulated to resemble this signal. Channel 3 is usually used for this purpose. You might also experience interference when your television picks up the real Channel 3 signals. (At this point you could try Channel 4.)

If you plan to spend lots of time using your computer, consider the fact that the characters on the television screen are a little blurred, which will strain and tire your eyes rapidly.

If cost is a factor, the main advantage to using the TV set is the fact that you already have the set in your home, and the Commodore 64 comes with the cable and switch box needed to connect it to the TV. A monitor and the necessary cable must be purchased separately from the computer.

BUYING TIPS AND TRICKS

After you decide whether you need a color or monochrome monitor, start shopping around for the best image quality produced. Try to compare the images on two screens side by side. Next, fill the screen up with an image and step back and check the following:

Are the characters all lined up evenly?
Are the vertical columns and the horizontal rows even?
Are the characters at the edges of the screen clear?
Do the color characters have fringe around their edges?
Is the intensity of the characters equal?
Are the characters in the middle of the screen brighter than those on the edges?
Are there buttons or knobs on the monitor to adjust the contrast, vertical/horizontal lines, and brightness; to what extent can these be adjusted (move the knobs to check)?
If you hold a key down so the cursor moves across the screen, is there a trail after the letter?

If you are looking at monochrome monitors, check all three varieties, amber, green, and white. When looking at a spec sheet for a monitor, check these items:

How many pixels are there? What is the screen resolution? More pixels equal sharper images.
What is the dot pitch? The smaller the distance the better the resolution.
What is the bandwidth? The greater the bandwidth the sharper the image.
What is the phosphor persistence? Do you get flickering characters (too short) or ghost characters (too long)?
What is the size of the screen? Unless portability is your aim, a 5″ to 9″ screen is pretty small and hard on the eyes.

GLOSSARY

bandwidth—The maximum rate at which a monitor or television set can accept data from the computer. It is measured in MHz (MegaHertz).

beam convergence—The precise meeting of the beams that strike the pixels.

character generator—The section in ROM memory that contains the information and instructions needed to create characters on the screen.

chroma line—The path along which information for creating images in color is sent to the computer.

color memory—The portion of the computer's memory that stores information on how to create the color at each point on the screen.

composite video—A type of color monitor where information for the images is sent from the computer through only one line, the chroma line.

contrast—A knob on the monitor to vary the difference between the intensity of the light of the image and the intensity of the background.

CRT—Cathode Ray Tube. The most common form of computer display screen; the "picture tube" used to display images.

dot pitch—The distance between the perforations on the shadow mask.

electron gun—The device that shoots the beam through the tube to the screen.

high resolution mode—The mode in which the computer can display highly detailed graphics.

horizontal—A line parallel to the horizon.

luma line—The path along which monochrome information is sent to the screen.

monitor—The screen used to display images generated by the computer.

monochrome—Using one color or shades of one color.

pixel—The tiny section of the screen on which a fraction of a character or image is created.

phosphor persistence—The length of time the glow of each character on the screen lasts.

raster scan—The technique of creating images by having the beam repeatedly passing the screen.

refresh rate—The length of time it takes the electron gun to scan the entire screen.

RGB—Red, Green, Blue: a type of color monitor that uses three signals to control three electron guns, instead of one.

screen resolution—Indicates the number of pixels that a screen is able to display.

shadow mask—A perforated filter set behind the screen, through which the beams pass on their way to the pixels.

standard mode—The ability of the computer to generate characters or images which have already been established in Read Only Memory (ROM).

VDU—Video Display Unit. Another name for the screen, which applies to both monitors and televisions.

VIC-II chip—The chip in the Commodore 64 which is responsible for handling graphics.

video controller—The device that organizes the video information in the computer.

CR-5400 monochrome monitor

$100.00

Comrex International

RATING	FEATURES	
B Overall rating	Type:	Composite Video

RATINGS	FEATURES	
B Price/performance	Size:	9″
A Ease of installation	Pixel	
A Documentation	Resolution:	650 lines
C Vendor Support	Text	
	Resolution:	80×25
	Sound	
	Channel:	–

PRODUCT SUMMARY

This is a 9-inch composite video monitor, with a bandwidth of 20 MHz. It has 800 lines at the center and 650 lines at the corner. The CR-5400 is available in green, yellow-green, or amber. Controls for brightness and contrast are on the front panel, while the controls for vertical/horizontal and vertical size, and data in and out connector are in the back. Should you want to link multiple monitors to the same computer, there is a 75 ohm impedance switch, which can be set to HIGH.

INTERFACING

To connect this monitor to the Commodore 64, a 5-pin DIN to RCA video cable is necessary. Use the standard RCA jacks in the back for the data in and data out connection.

PERFORMANCE

The CR-5400 performs very well. The resolution is good, giving you a clear, crisp display. With a moderate phosphor persistence, there is no flickering in the display. The characters around the border were a little distorted, and we were told that this was due to the monitor being in constant use.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available from local distributors or the manufacturer.

12EU monochrome monitor

BMC USA, Inc. $129.00

RATING	FEATURES	
B Overall rating	Type:	Composite Video
B Price/performance	Size—	12″
A Ease of installation	Pixel	
B Documentation	Resolution:	400 × 168
B Vendor Support	Text	
	Resolution:	80×24 (5×7 dots)
	Sound	
	Channel:	–

PRODUCT SUMMARY

The 12EU monitor comes with a green display, and amber and black/green are available for a little more. This monitor features a bandwidth of 20 MHz and a high resolution mode. Controls for power indicator, on/off switch, contrast, brightness, horizontal/vertical hold height, and vertical linearity are in the back of the monitor. There is a convenient carrying handle and a tinted glare shield.

INTERFACING

To connect this monitor with the Commodore 64, use the 5-pin DIN to RCA video cable. There is an RCA jack for video input.

PERFORMANCE

This monitor offers a sharp display at a relatively low price. It is an excellent choice for sophisticated word processing uses, although its low resolution makes it not that good for high resolution graphics. The phosphor persistence is moderate, leaving no flicker on the screen.

VENDOR SUPPORT

There is a one year warranty on parts and labor, and a 90-day over the counter exchange option. Technical support is available through local distributors and through the manufacturer by calling an 800 number.

SG-1000 monochrome monitor $129.00

Sakata USA Corp.

RATING	
A	Overall rating
A	Price/performance
A	Ease of installation
B	Documentation
B	Vendor Support

FEATURES	
Type:	Composite Video
Size:	12"
Pixel Resolution:	800 lines
Text Resolution:	80×25 (5×7 dots)
Sound Channel:	–

PRODUCT SUMMARY

The SG-1000 features a 12-inch screen and a high resolution display. There are

2000 characters maximum in a 80×25 format. Pixel resolution is 900 at the center and 800 at the corner, and the display is green. The on/off switch, and brightness and contrast knobs are on the front panel, and the monitor is equipped with a nonglare face plate.

INTERFACING

To connect the Commodore 64 you need a 5-pin DIN to RCA cable. The SG-1000 uses the RCA jack for video input.

PERFORMANCE

This monitor gives you crisp, sharp characters and does equally well in word processing and high-resolution graphics applications. With a moderate phosphor persistence, there is no flickering of the characters on the screen.

VENDOR SUPPORT

There is a one-year warranty on parts and labor. Technical support is available through local distributors or through the manufacturer by calling their 800 number.

JB-1260MA monochrome monitor $149.95

NEC Home Electronics, Inc.

RATING	
A	Overall rating
B	Price/performance
A	Ease of installation
B	Documentation
A	Vendor Support

FEATURES	
Type:	Composite Video
Size:	12″
Pixel Resolution:	600×230
Text Resolution:	80×25 (8×8 dots)
Sound Channel:	–

PRODUCT SUMMARY

The JB-1260MA, shown in Fig. 9-1, features a 12-inch screen with the brightness knob and the on/off switches in the front. The switches or knobs for the contrast, vertical/horizontal hold, vertical movement, size, and linearity are in the back. The monitor comes with a handle for easy carrying.

INTERFACING

To connect the Commodore 64 to this monitor you will need a 5-pin DIN to RCA cable. It uses the RCA phono jack for video input.

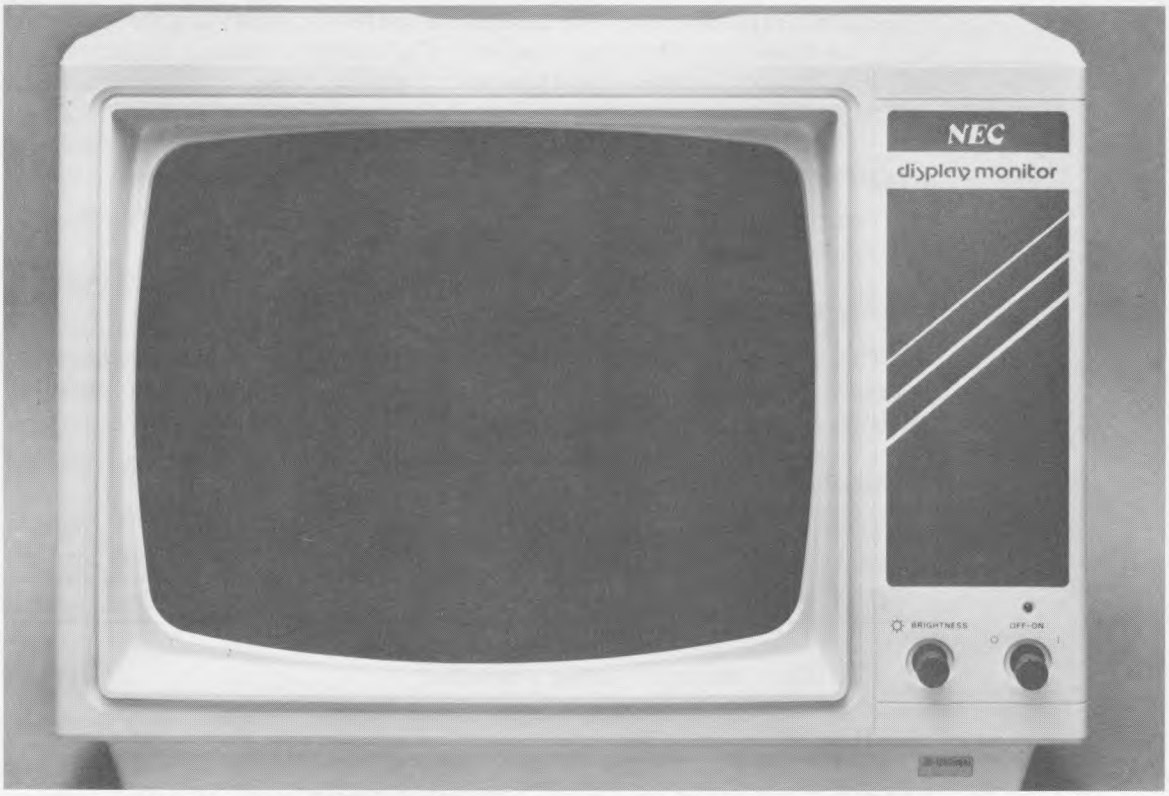


Fig. 9-1. The NEC JB-1260MA is a high-quality, monochrome display for the Commodore 64 (courtesy of NEC Home Electronics).

PERFORMANCE

This model provides a clear, crisp display. With moderate phosphor persistence, characters do not flicker. It is suitable for sprite animation, although the color monitors provide better resolution for this.

VENDOR SUPPORT

There is a one year warranty on labor and two year warranty on parts. Technical support is available through local distributors and the manufacturer or through their 800 number.

CR-5600 monochrome monitor $150.00

Comrex International

RATING		FEATURES	
B	Overall rating	Type:	Composite Video
B	Price/performance	Size:	12″

RATINGS		FEATURES	
A	Ease of installation	Pixel	
A	Documentation	Resolution:	800 pixels
C	Vendor Support	Text	
		Resolution:	80×25
		Sound	
		Channel:	–

PRODUCT SUMMARY

The CR-5600 is a 12-inch monitor with green, yellow/green, or amber displays. The bandwidth is 20 MHz. Brightness and contrast knobs and switches are in the front, while the vertical/horizontal hold and vertical size knobs, and the Data In and Data Out connectors are in the back. To link more than one monitor to the same computer, you set the 75 Ohm impedance switch to HIGH.

INTERFACING

To connect the Commodore 64 use a 5-pin DIN to RCA cable. The RCA jacks in the back are used for video input.

PERFORMANCE

This model provides clear, crisp characters and good resolution. There is a slight flicker of the characters because the phosphor persistence level is low. Characters around the edges were a little distorted; however, it may have been due to overuse of the monitor we reviewed.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available through local distributors or the manufacturer.

Pi 1, Pi 2, Pi 3, Pi 4 monochrome monitors

Pi 1&4 $159.00
Pi 2&3 $219.00

USI International

RATING		FEATURES	
B	Overall rating	Type:	Composite Video
B	Price/performance	Size:	9″ and 12″
A	Ease of installation	Pixel	
B	Documentation	Resolution:	800 pixels
B	Vendor Support	Text	
		Resolution:	80×25
		Sound	
		Channel:	–

PRODUCT SUMMARY

The Pi 1 and Pi 2 offer the green screen, while the Pi 3 and Pi 4 offer the amber

screen. The Pi 1 and Pi 4 have 9-inch screens, and the Pi 2 and Pi 3 have 12-inch screens. All models offer a 20 MHz band width, high resolution, and controls are conveniently located in the front. A polarity switch, located in the back, enables you to view a normal or reverse display. On the 9-inch models, there is a 12-volt dc input for portability. The DC restorer switch locks in the black background, which is then unaffected by any adjustment in brightness. When the switch is turned to OFF, the black background displays all the shades of gray through the adjustment of the brightness knobs.

With these models you may daisy chain more than one monitor using the video input/output connection.

INTERFACING

To connect the Commodore 64, you will need the 5-pin DIN to RCA cable. Use the RCA jack in the back for video input.

PERFORMANCE

These monitors all deliver clear, crisp characters; with a moderate phosphor persistence level, there was no flickering.

VENDOR SUPPORT

There is a 90-day warranty on parts and labor. Technical support is available through local distributors or from the manufacturer.

CBM-1702 color monitor

$300.00

Commodore Business Machines

RATING		FEATURES	
B	Overall rating	Type:	Composite Video
B	Price/performance	Size:	13″
A	Ease of installation	Pixel	
B	Documentation	Resolution:	320×200
B	Vendor Support	Text	
		Resolution:	40×25
		Sound	
		Channel:	+

PRODUCT SUMMARY

This monitor was designed specifically to be used with the Commodore 64. The CBM-1702 features a 13-inch screen. The knobs to adjust tint, color, brightness, contrast, horizontal/vertical hold, and volume are all conveniently located on the front panel.

INTERFACING

To connect the Commodore 64 to this model use the 5-pin DIN cable with the three (luma, chroma, audio) RCA plugs. This method provides the best resolution. Otherwise, you can use the video input/output jacks in the front, which can also be used for a video camera, a VCR, or a TV tuner. There is a switch in the back so you can select either of these two options.

PERFORMANCE

This is an excellent monitor for the Commodore 64. The resolution is good and there was no flickering of characters.

VENDOR SUPPORT

There is a 90 day warranty against defects in materials or workmanship. Technical support is available from local distributors or from the manufacturer.

SC-100 color monitor

$329.00

Sakata USA Corp.

RATING		FEATURES	
A	Overall rating	Type:	Composite Video
A	Price/performance	Size:	13"
A	Ease of installation	Pixel	
B	Documentation	Resolution:	300×280
B	Vendor Support	Text	
		Resolution:	40×24
		Sound	
		Channel:	+

PRODUCT SUMMARY

The SC-100 features a large screen and an earphone jack on the front panel for private listening. The power on/off switch, volume, and contrast knobs are on the front panel; however, brightness, color, and tint adjustment and the input/output jacks are in the back.

INTERFACING

To connect this monitor to the Commodore 64 you will need the 5-pin DIN to RCA cable. The RCA jack in the back is used for both video and audio input.

PERFORMANCE

This is one of the best color monitors on the market for the Commodore 64. The resolution and color contrast are quite good, making it suitable for graphics and games. It is not, however, suitable for heavy word processing.

With a low to moderate phosphor persistence, there is some flicker with light colors.

VENDOR SUPPORT

There is a one-year warranty on parts and labor. Technical support is available through local distributors or the manufacturer's 800 number.

Color I color monitor

$329.00

Amdek Corp.

RATING		FEATURES	
A	Overall rating	Type:	Composite Video
A	Price/performance	Size:	13"
A	Ease of installation	Pixel	
B	Documentation	Resolution:	300×260
A	Vendor Support	Text	
		Resolution:	32×24
		Sound	
		Channel:	+

PRODUCT SUMMARY

This monitor features a large screen and controls on the front panel for adjusting brightness, tint, color, contrast, vertical hold, and power on/off, which is also used for the volume. The vertical size, focus, and sub brightness controls are accessible from the back of the monitor. There are seven colors, red, green, blue, yellow, cyan, magenta and white, from which you can create an infinite number of shades.

INTERFACING

For the Commodore 64, you will need the 5-pin DIN cable, and additional video cables are available to connect the Color I to the Comrex-6500 monitor. The audio input requires a miniature earphone jack. The RCA phono-jack is used for the video input.

PERFORMANCE

This monitor recommends a maximum of 768 characters in an 8×8 matrix on the screen. The Commodore 64 transmits 1000 characters using the same size matrix. This limits the quality of the resolution, especially for any word processing applications. The phosphor persistence is low, creating flickering characters.

VENDOR SUPPORT

There is a 2 year warranty on the monitor electronics and a 3 year warranty on the CRT. Technical support is available from local distributors or the manufacturer.

JC-1212 color monitor

$349.00

NEC Home Electronics, Inc.

RATING	
A	Overall rating
B	Price/performance
B	Ease of installation
C	Documentation
B	Vendor Support

FEATURES	
Type:	Composite Video
Size:	12"
Pixel	
Resolution:	250×240
Text	
Resolution:	40×25
Sound	
Channel:	–

PRODUCT SUMMARY

The JC-1212 is a high quality 12 inch composite color monitor. It produces especially sharp display for certain games because of its fast decay phosphor. It features brightness, contrast, and vertical hold knobs, plus controls for color, tint and sharpness. The JC-1212 is illustrated in Fig. 9-2.

INTERFACING

To connect the Commodore 64 to this monitor you will need a DIN to RCA cable. It uses the RCA phono jack for video input.

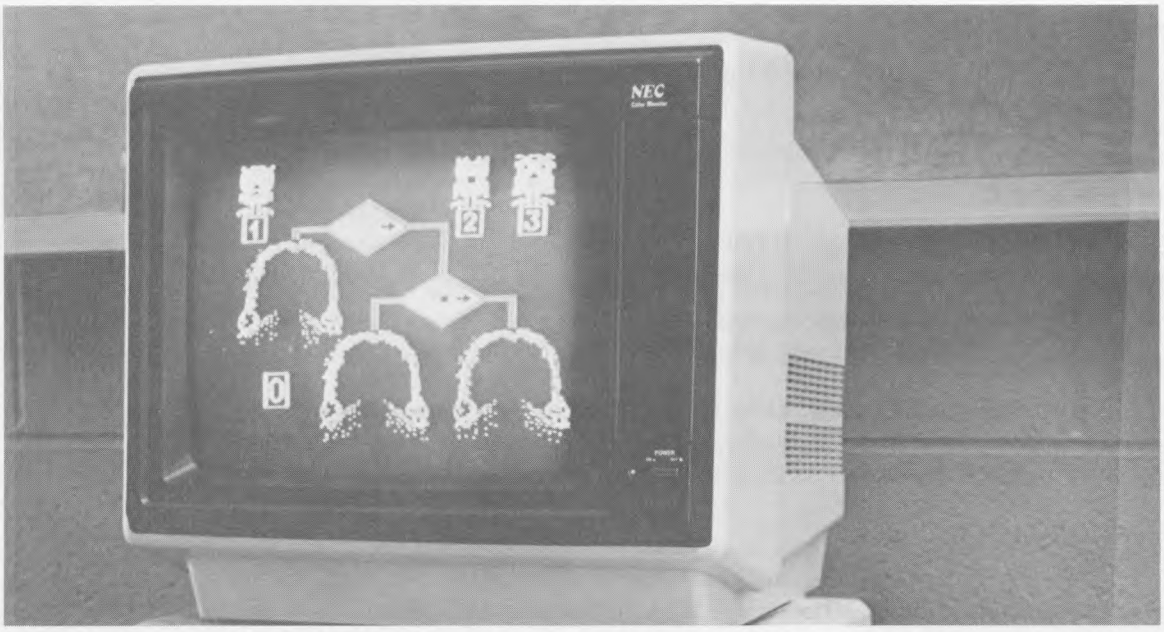


Fig. 9-2. The NEC JC-1212 provides excellent color and crisp graphics for Commodore 64 programs (courtesy of NEC).

PERFORMANCE

This model does an excellent job with game and graphic images. The text is also sharp in 40 columns. This monitor does not support an 80 column text display.

VENDOR SUPPORT

There is a one year warranty on labor and a two year warranty on parts. Technical support is available through local distribuors and the manufacturer or through their 800 number.

AU 9191 U color monitor $349.00

BMC USA, Inc.

RATING		FEATURES	
B	Overall rating	Type:	Composite Video
B	Price/lerformance	Size:	13
A	Ease of installation	Pixel	
B	Documentation	Resolution;	350×350
B	Vendor Support	Text	
		Resolution:	80×25 (5×7 dots)
		Sound	
		Channel:	+

PRODUCT SUMMARY

The AU 9191 U color monitor features high level performance on a large screen. Controls for power on, volume, color, tint, contrast, brightness, horizontal center, and vertical hold are all conveniently located on the front panel.

INTERFACING

To connect the Commodore 64 you will need a 5-pin DIN to RCA cable with both audio and video output plugs. There are RCA jacks in the back for video and audio inputs.

PERFORMANCE

This model provides clear, crisp characters. Although the number of pixels indicate a high resolution, the display did not show this to be true. With a low phosphor persistence, characters flickered on the screen.

VENDOR SUPPORT

There is a 90 day over the counter exchange for this monitor. Technical support is available through local distributors or from the manufacturer.

CR-6500 color monitor

$350.00

Comrex International

RATING	
B	Overall rating
B	Price/performance
A	Ease of installation
A	Documentation
C	Vendor Support

FEATURES	
Type:	Composite Video
Size:	13"
Pixel	
Resolution:	300×260
Text	
Resolution:	40×24
Sound	
Channel:	+

PRODUCT SUMMARY

The CR-6500 provides a large screen and a black matrix picture tube for higher contrast and is thus easier on the eyes. There is a built-in 2-watt amplifier with a weak internal speaker. A flip-down front panel provides contrast, brightness, tint, color, and vertical hold knobs. The on/off knob is located on the lower right front for easy access, and a power indicator prevents accidentally leaving the monitor on. This is a very heavy monitor (25+ lbs) that will need its own stand. Do not place it on top of a computer.

An infinite number of shades can be created from the seven available colors, red, green, blue, yellow, cyan, magenta and white.

INTERFACING

For the Commodore 64 you will need the 5-pin DIN cable. Special video cables are available for use with the Amdek Color I monitor. The audio input requires a miniature earphone jack. The RCA phono-jack is used for video input.

PERFORMANCE

Like the Color I, the maximum recommended characters displayed by the CR-6500 is 768, while the Commodore 64 transmits 1000 on an 8×8 matrix. This will create poor resolution, especially for word processing applications. There is a considerable amount of flicker due to low phosphor persistence.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available from local distributors or the manufacturer.

1400/C color monitor $399.00

USI International

RATING	
B	Overall rating
B	Price/performance
A	Ease of installation
B	Documentation
B	Vendor Support

FEATURES	
Type:	Composite Video
Size:	14"
Pixel Resolution:	260×300
Text Resolution:	40×25
Sound Channel:	+

PRODUCT SUMMARY

The 1400/C offers a large 14-inch screen and 1000 character screen display. The front panel provides adjustment controls for contrast, brightness, tint, color and vertical hold. The volume is controlled by the power on/off button. There is a pair of A/C output jacks for daisy chaining other monitors. Set the impedance switch at HIGH to accomplish this.

INTERFACING

For the Commodore 64 you will need the 5-pin DIN to RCA cable with a separate sound cable. RCA jacks are used for both audio and video input.

PERFORMANCE

The 1400/C provides high-quality, and the fast decay phosphor allows you to create animated graphics with no smearing of colors. This fast decay does, however, cause considerable flicker.

VENDOR SUPPORT

There is a 90 day warranty on parts and labor. Technical support is available through local distributors or from the manufacturer.

WORKSHEET FOR MONITORS

$

RATING

Overall rating
Price/performance
Ease of installation
Documentation
Vendor Support

FEATURES

Type:
Size:
Pixel
  Resolution:
Text
  Resolution:
Sound
  Channel:

PRODUCT SUMMARY

INTERFACING

PERFORMANCE

VENDOR SUPPORT

COMPARISONS AT A GLANCE

Tables 9-1 and 9-2 show each monitor and the rating it received in each category. The features of each monitor are shown in Tables 9-3 and 9-4.

Table 9-1. Comparative Ratings for Monochrome Monitors

PRICE	MONITOR	RATINGS	1	2	3	4	5
$100.00	CR-5400		B	B	A	A	C
129.00	12EU		B	B	A	B	B
129.00	SG-1000		A	A	A	B	B
149.95	JB-1260MA		A	B	A	B	A
150.00	CR-5600		B	B	A	A	C
159.00	Pi 1		B	B	A	B	B
159.00	Pi 4		B	B	A	B	B
219.00	Pi 2		B	B	A	B	B
219.00	Pi 3		B	B	A	B	B

1 = Overall rating
2 = Price/performance
3 = Ease of installation
4 = Documentation
5 = Vendor support

Table 9-2. Comparative Table for Monochrome Monitor Features

FEATURES	1	2	3	4	5	
CR-5400	C	9	650	80×25	–	
12EU	C	12	400×168	80×24	–	
SG-1000	C	12	400×175	80×25	–	
JB-01260MA	C	12	600×230	80×25	–	
CR-5600	C	12	650	80×25	–	
Pi 1	C	9	800	80×25	–	
Pi 4	C	9	800	80×25	–	
Pi 2	C	12	800	80×25	–	
Pi 3	C	12	800	80×25	–	

1 = Type (C=Composite video)
2 = Size
3 = Pixel resolution
4 = Text resolution
5 = Sound channel

Table 9-3. Comparative Ratings for Color Monitors

PRICE	MONITOR	RATINGS	1	2	3	4	5	
$300.00	CBM-1702		B	B	A	B	B	
329.00	SC-100		A	A	A	B	B	
329.00	Color I		A	A	A	B	A	
349.00	JC-1212		A	B	B	C	B	
349.00	AI 9191 U		B	B	A	B	B	
350.00	CR-6500		B	B	A	A	C	
399.00	1400/C		B	B	A	B	B	

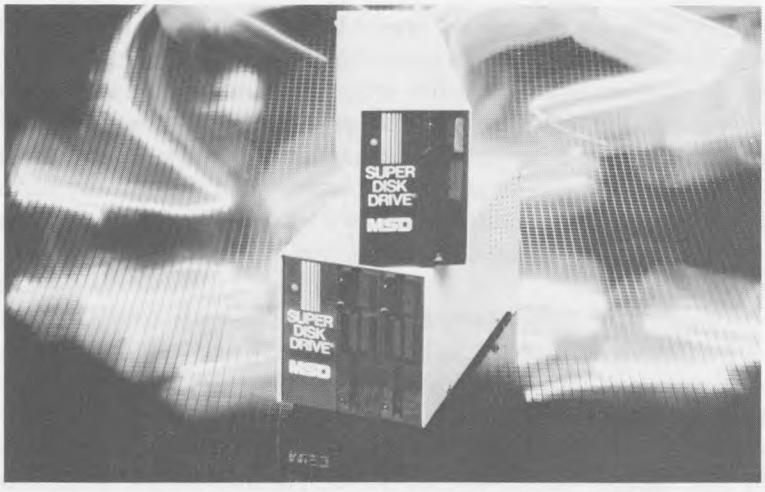
1 = Overall rating
2 = Price/performance
3 = Ease of installation
4 = Documentation
5 = Vendor support

Table 9-4. Comparative Table for Color Monitor Features

FEATURES	1	2	3	4	5	
CBM-1702	C	13	320×200	40×25	+	
SC-100	C	13	300×320	*****	+	
Color I	C	13	300×260	32×24	+	
JC-1212	C	12	250×240	40×25	–	
AU 9191 U	C	13	350×350	80×25	+	
CR-6500	C	13	300×260	40×24	+	
1400/C	C	14	260×300	40×25	+	

1 = Type (C=Composite video)
2 = Size
3 = Pixel resolution
4 = Text resolution
5 = Sound channel

Chapter 10



Disk Drives

Most programs for the Commodore 64 are written on disks; disks are more efficient than cassettes or cartridges. For this reason, I will only deal with disks and disk drives in this book. I will assume you are familiar with floppy disks containing data and how they are inserted into the disk drive.

A disk drive looks for information randomly (vs. sequentially), and therefore operates up to ten times faster than cassettes. For example, with a disk drive you can go directly to a specific file without having to run through all the files ahead of it on the disk. This makes it very efficient and eliminates time spent searching through unwanted material.

A disk is a permanent record of data until it is erased, whereas the computer memory is a temporary record that is lost when the computer is turned off. Copies of disks are easily made so you will be able to permanently store your information in more than one place.

DISK DRIVE OPERATION

The disk drive must be compatible with your computer. The disk drive performs a number of different jobs. These jobs are controlled and managed either by the *disk operating system* (DOS), a set of programs, or by the disk controller, which is a set of integrated circuits. In some cases both of these are located within the drive itself, while in other cases they will be located on separate boards. The commands used by DOS will vary with each system. For example one system may use the command SAVE while another system will refer to this same action as STORE.

Using the DOS, the disk drive will perform many functions including storing programs or files on a disk, searching for and retrieving a particular program or file on a disk, copying the file, erasing material, and keeping a directory of the disks contents.

The directory is a record of a file and its location on the disk. When you want to work with a particular file, you use the proper DOS command and the file name. The disk drive refers to the directory and locates the file for you. After you create a file, and write it onto the free space on the disk, it is automatically entered in the directory.

Another function of the disk drive is the preparation of the disk for use. This is called formatting the disk. It prepares the disk to accept certain data structures. Each new disk must be formatted before use. If you format a used disk, all information on it is erased.

DISKS IN GENERAL

For the purposes of this book and with respect to the Commodore 64, I refer to a disk that is 5¼ inch square (other disks may be larger or smaller) and has a hole in the center. It is made out of mylar and is specially coated with iron oxide particles, which act as magnets. This magnetic surface is acted upon by the disk drive in recording, transferring, or reading information. The disk itself is enclosed in a vinyl jacket with an opening that exposes a small part of the disk. The disk must be compatible with your disk drive.

There is a small notch cut into the side of the disk jacket. When this notch is covered over with an adhesive tab, you are prevented from writing more information on this disk or erasing any information from it. You can, however, read the disk. Covering the notch is referred to as write protection, and is mainly used to keep you from accidentally erasing the contents of the disk.

When the disk is inserted and the disk drive door closed, a hub rises and fills the hole in the disk. Then a gripper lowers and spins the disk. The read/write head reads or writes information on the disk through the opening in the jacket.

Like the grooves on a record, a disk contains tracks to hold information. The number of tracks will vary with each disk drive. On the 1541 disk drive for instance, there are 35 tracks. These are divided into sectors. Each sector contains 256 bytes, and each byte is made up of 8 bits. Some disks are double-sided and information can be recorded on both sides of the disk.

COMMODORE'S 1541 DISK DRIVE

This is the disk drive most Commodore users will purchase for their computer, and programs designed for the Commodore 64 are created on disks that are compatible to this disk drive. Even though disks from other computers may appear similar, the 1541 DOS format is different.

REVIEWS

We have reviewed the drives which are compatible with the Commodore 64, and you may judge which model suits your particular needs. We have also provided information on the type of disk compatible with each disk drive.

When you are looking for a disk drive, remember to check the number of

characters that can be stored on the disk. One page of single spaced typing will use up about 4,000 bytes. Also consider the number of files or programs that the disk can store.

GLOSSARY

BAM—Block Availability Map. Used by the disk drive controller to check the disk for available space.

cartridge—A device that stores prerecorded programs. On the Commodore 64 there is an expansion port in the rear of the keyboard to insert cartridges. Cartridges do not require a disk drive.

cassette—A device that permanently stores data. It requires a recorder, which plugs into the cassette port on the Commodore 64. Information is transferred sequentially and it is therefore a slow process.

directory—A listing of each file and program on a disk.

disk—Also called diskette. A flat, flexible (floppy) mylar device on which data is recorded magnetically.

disk drive—The peripheral device used to either record data on the disk or read data from the disk.

DOS—Disk operating system. A set of programs used with a disk drive, which tell the central processor how to communicate with all the peripherals connected to the computer.

double density—Indicates that the storage medium is capable of storing twice the amount of data as a single disk density storage medium can.

double sided—Indicates that both sides of the disk are capable of storing data.

error message—A message displayed on the screen to inform the user that some problem has occurred while the drive was functioning.

floppy—Refers to the flexible mylar disk used for mass storage.

format—A technique for labeling the file marks, track marks, address marks, checksums, and headers on a disk. Formats are not the same in each system.

hard sectored—Indicates that the recording surface of the disk is permanently divided into sectors marked by holes in the disk itself.

load—A term indicating the transfer of data from storage (disk or tape) into the computer's memory.

quad density—Indicates the disk is capable of storing four times the amount of data as a single-density disk.

random access—A technique for going directly to a particular item (address) in memory without having to start at the beginning and go through each item in sequence.

read—To sense the data which has been recorded on a disk or other storage medium, so it can be transmitted to internal memory or copied.

save—To permanently store data onto a disk or other medium.

sector—A section of a track on a disk.

sequential access—A method of scanning data starting at the beginning of the data.

single sided—Indicates that only one side of the disk is capable of storing data.

soft sectored—Indicates that the recording surface of the disk is marked magnetically at the beginning of each sector.

tracks—The concentric rings on the disk surface.
write—To store data onto a disk or other permanent storage medium.
write protect—To ensure a disk is not erased. This is done by placing an adhesive tab over the notch on the disk.

CBM 1541 disk drive

$400.00

Commodore Business Machines

RATINGS		FEATURES	
B	Overall rating	Type:	Single Drive
B	Price/performance	Size:	5-¼"
A	Ease of installation	Capacity:	174K bytes
C	Docamentation	Density:	dual
B	Vendor support	Sides:	single

PRODUCT SUMMARY

The 1541 is the most popular disk drive for Commodore 64 users mainly because all of the software developed for the Commodore is compatible with it. It uses the 5¼" single-sided, single-density, floppy disks. The 1541 connects directly with the computer through the 6-pin DIN socket in the back. A second port in the back of the 1541 allows you to daisy chain up to four disk drives and one printer. The drive contains its own controller and includes 16K of ROM and 2K of RAM memory. Information is transmitted serially to and from the computer.

INTERFACING

The 1541 connects directly to the Commodore 64 and therefore no other interface is necessary. For daisy chaining additional disk drives or a printer, you will find a serial port on the back of the disk drive. Use the 6-pin DIN cable for this connection.

PERFORMANCE

This is a good value for the light weight Commodore 64 user. Although it is very slow compared with the disk drives of more expensive computers, we understand that there will be devices on the market shortly that will vastly improve this situation. The following commands are available on the 1541.

NEW formats the disk into 35 tracks with 17 to 21 sectors per track (256 bytes per sector).
LOAD loads the program or file into the computer's memory from the disk where it is stored.
SAVE permanently stores the material onto the disk.
VERIFY allows you to check to see that the program or file you stored is the same as the one in memory.
SCRATCH erases a program or file from a disk.

COPY duplicates a program or file under a different filename on the same drive.
RENAME changes the name of the program or file.
VALIDATE reorganizes the disk space, eliminates small gaps, and moves files so that you can get the most from the space available.

There are sixteen channels for opening disk files. Zero and 1 are used by DOS while saving and loading. Two through 14 can be used for the transfer of data to and from files. Fifteen is the command channel. Some commands can be executed while the computer is performing other tasks.

The 1541 can hold a maximum of 144 files per disk, and is able to store five different types of files. The *program files* are listed as PRG in the directory. They consist of any program created in BASIC, which is then saved on the disk. Random files are not given file names and are hidden on the disk. The Block Availability Map (BAM) keeps a record of the blocks used by these files. They hold blocks of data which are stored by drive, track, and sector number. The *relative files* are similar to the random files; however with Relative Files you can change the length of the record or the name of the file. The *sequential files* (SEQ) hold data that is moved through the buffer in exactly the same order each time it is accessed. *User files* (USR) are functionally identical to SEQ files.

Some of the commands used in file handling include the following:

OPEN/CLOSE—to open or close data or command channels.
GET#, INPUT#, PRINT#—used to read or write data to the sequential files.
BLOCK-READ, BLOCK-WRITE—used with the Random and Relative Files.

VENDOR SUPPORT

There is a 90-day warranty against defects in materials and workmanship. Technical support is available through local distributors or the manufacturer.

Super Disk I and II

$399.00 (I)

MSD

695.00 (II)

RATINGS		FEATURES	
B	Overall rating	Type:	Dual Drive
B	Price/performance	Size:	5¼ inch
A	Ease of installation	Capacity:	174K bytes
C	Documentation	Density:	double
B	Vendor support	Sides:	single

PRODUCT SUMMARY

The Super Disk I and II can provide the speed that the 1541 does not have. Super Disk I is available in either single or dual drive format, serial or IEEE interface, and is

read/write compatible with the 1541 disk drive. Super Disk II comes with two drives. You are able to change the disk drive number either by changing the jumper inside the unit or through the proper software. The disk drive number is preset at 0 (for the default drive) and 1 (for the second drive). The Super Disk is very versatile because of the parallel interface, which provides the speed of operation required for heavy use. The following programs were successfully tested in the serial mode: Easy Script, Word Pro3 Plus (for word processing), Doodle, and Kpaint (for graphics). These did not work in the parallel mode, and a relocation of the CIE software would be advisable. A valuable feature of the Dual Drive Super Disk (SD II) is the under-2-minute-backup. By placing the master disk in Drive 0 and the slave in Drive 1, and giving the DUPLICATE COMMAND, you can copy a complete disk in 1 minute and 55 seconds—and that includes formatting of the slave disk. Also, both drives allow you to format a standard disk in 17 seconds flat.

Even though SD II has two drives, 0 and 1, they are both looked at as the same device. For example, if you type LOAD "Test", 8, both drives will be searched for the program. This is especially handy for anyone who does a lot of disk swapping.

Commands on the Super Disk are the same as for the 1541. The Super Disk will also respond to BASIC version 490 commands, providing this version has been installed on your Commodore 64 with the proper software.

Like the 1541, there are sixteen channels available for opening disk files. There are a maximum of 144 files per disk, and a maximum of 683 blocks, although only 664 are available for user files. There are 35 tracks per disk with 17 to 21 sectors on each track (256 bytes per sector). The Super Disk 1 handles the same type of files as the 1541, program files (PRG), random and relative files, sequential files (SEQ), and User (USR) files.

The design of the Super Disk allows programmers to access the 6511Q Microprocessor and the memory. The user's manual provides instructions for this as well as information on the memory organization.

Error messages appear on the screen to indicate that DOS has encountered a problem that needs solving. The users manual describes both the meaning of the message and the remedy to the problem. A number of these messages are available from DOS on request by opening the command channel. The Super Disk I and II is illustrated in Fig. 10-1.

INTERFACING

The Super Disks are equipped with the serial interfaces that plug into the serial port in the rear of the Commodore 64.

For high-speed operation the Super Disk provides for an IEEE parallel connection. This requires a special cartridge interface and a PET-IEEE cable at an added cost. MSD provides the CIE interface for this purpose. This interface takes up space in the computer's RAM memory, which may interfere with applications software, which also occupies this space. The users manual provides instructions for relocating the IEEE software using BASIC subroutines. You should also read the review of the CIE interface in the chapter on interfaces in this book.

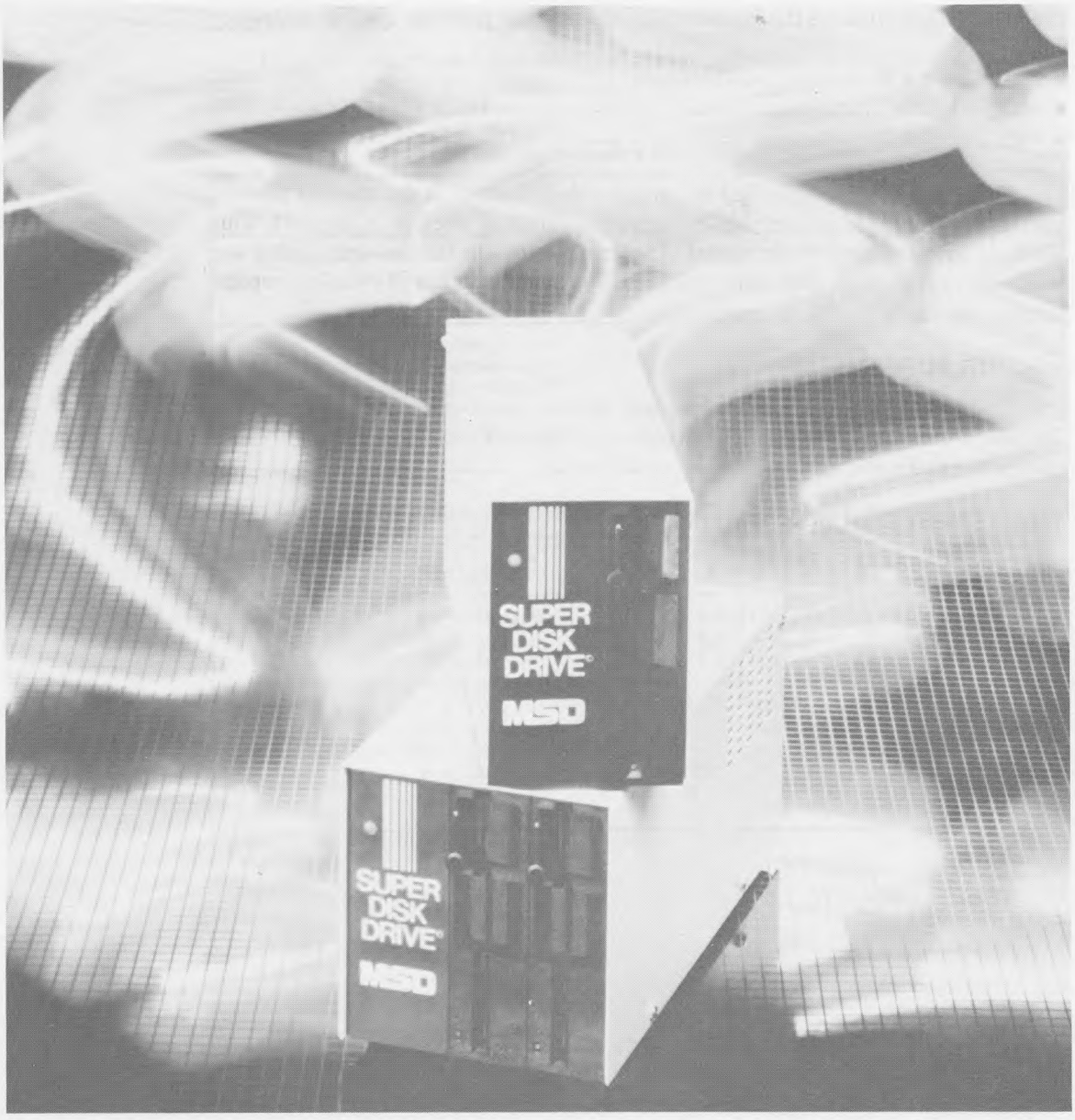


Fig. 10-1. The Super Disk I & II offer a Commodore 64 user an alternative to Commodore's 1541 disk drive (courtesy of MSD Systems).

PERFORMANCE

The Super Disk is not noticeably faster than the 1541 when used with the serial port. To benefit from its speed, it must be attained through an IEEE interface. The speed improvement over the 1541 then depends on the particular IEEE interface

used. The Super Disk has the following speed advantage over the 1541 in our tests:

- with BusCard II ..... 30% faster
- with C64-Link ..... 100% faster (twice as fast)
- with CIE ..... 370% faster (3.7 times as fast).

The Super Disk is contained in a metal cabinet, which is designed to prevent overheating. The spindle is driven directly rather than by a belt as in the 1541. This allows a greater accuracy in speed. The components in the head assembly are heavy-duty to minimize alignment problems. The Super Disk has an excellent reputation for reliability among its many users.

VENDOR SUPPORT

There is a 6-month warranty against defects in material and workmanship. Technical support is available from local distributors and the manufacturer, or through an 800 number.

WORKSHEET FOR DISK DRIVES

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RATINGS	FEATURES
Overall rating	Type:
Price/performance	Size:
Ease of installation	Capacity:
Documentation	Density:
Vendor support	Sides:

PRODUCT SUMMARY

INTERFACING

PERFORMANCE

VENDOR SUPPORT

COMPARISONS AT A GLANCE

Table 10-1 shows each disk drive and the rating it received in each category. The features of each drive are shown in Table 10-2.

Table 10-1. Comparative Ratings for Disk Drives

PRICE	DISK DRIVES	RATINGS	1	2	3	4	5	
$399.00	Super Disk I		B	B	A	C	B	
400.00	CMB 1541		B	B	A	C	B	
695.00	Super Disk II		B	B	A	C	B	

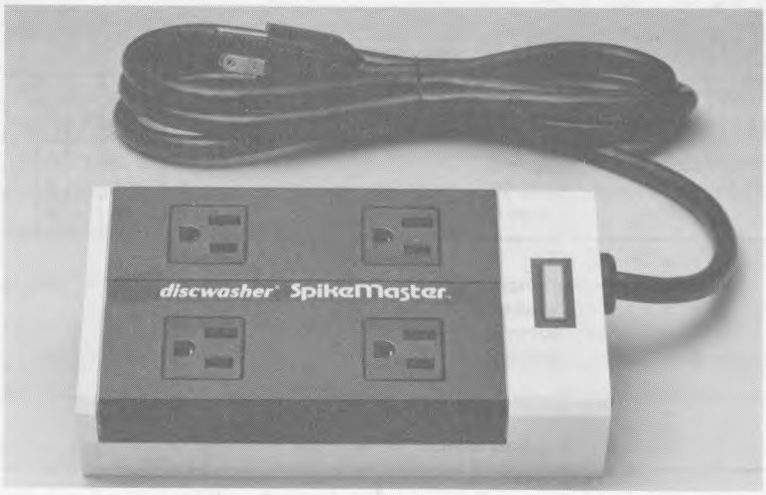
1 = Overall rating
2 = Price/performance
3 = Ease of installation
4 = Documentation
5 = Vendor support

Table 10-2. Comparative Table for Disk Drive Features

FEATURES	1	2	3	4	5	
Super Disk I	S	5.25	174	D	S	
CMB 1541	S	5.25	174	D	S	
Super Disk II	D	5.25	174	D	S	

1 = Type (S=Single Drive unit, D=Dual Drive unit)
2 = Size
3 = Capacity (in K bytes)
4 = Density (S=Single, D=Dual)
5 = Sides (S=Single, D=Dual)

Chapter 11



Specialized Peripherals

In the preceding chapters I have covered the "meat and potatoes" of Commodore 64 expansion. Interfaces, printers, disk drives, monitors, and modems are the major expensive items that nearly all Commodore 64 owners will consider adding to their computers. Beyond these major expansion devices lies a whole world of highly specialized peripherals. They are so diverse in their nature and uses that I will describe them briefly in the sections that follow, and then list all of the reviews in order by price. This allows you to consider what types of products you might like to add to your Commodore 64, within the budget you have allocated for specialized expansion products. The tables at the end of the chapter will summarize the ratings for all of the products for quick comparison.

BIOFEEDBACK MONITORING

A number of devices are available that will allow biofeedback data from the user to be sensed by the Commodore 64. Programs can respond by placing graphs on the screen, altering a tone that is being generated, or otherwise giving processed feedback about how your biological indicators are changing through time. By using programs to analyze the input from simple sensing devices, you have the ability to simulate very expensive and sophisticated biofeedback equipment. A biofeedback peripheral is reviewed on page 171.

CARTRIDGE SLOT EXPANSION

Cartridge slot expanders plug into the cartridge slot of the Commodore 64 and

provide two or more cartridge slots. These often have a switch that allows you to switch from one cartridge to another without turning the machine off. This is handy if you like to play a variety of games and want to be able to switch quickly from one to another. This also saves wear and tear on the slot connector and your cartridges. Reviews of cartridge slot expanders are found on pages 163 and 166.

CASSETTE DRIVES

There are a number of cassette tape drives that are competitive with the Commodore Datasette available. Some of these are less expensive versions of the Datasette while others have more advanced features. A review is found on page 159.

CASSETTE INTERFACES

The Commodore Datasette is significantly different from ordinary tape recorders. In order to use a normal household tape recorder with your Commodore 64, you will need a special interface that converts the signals provided by the Commodore 64 to those expected by an ordinary cassette player. A cassette interface is reviewed on page 158.

CP/M CARTRIDGE

CP/M is an operating system widely used on a number of different computers that use the Z-80 microprocessor. A CP/M cartridge contains a Z-80 microprocessor and allows you to use your Commodore keyboard, memory, and other components under the control of the Z-80, and enables you to run software designed for use with the CP/M operating system. This can make a very broad range of software available to you, including both commercial software for CP/M and the large library of public domain CP/M software. A CP/M cartridge is reviewed on page 164.

EPROM PROGRAMMERS

EPROM programmers allow you to make your own cartridges. You develop the program, and use the EPROM programmer to load the program permanently or semipermanently into a cartridge. Having programmed the cartridge, you can use it as you would any commercial cartridge. This can be extremely convenient when you are doing assembly programming; having a monitor or assembler on a cartridge will save you hours in program loading time. An EPROM programmer is reviewed on page 169, and a cartridge maker is reviewed on page 169.

GRAPHICS TABLETS

Graphics tablets allow you to produce graphic images by sketching on the tablet with a stylus. With most graphics tablets, whatever you sketch on the sensitive surface on the tablet will appear on the screen of the Commodore 64. With appropriate software you can erase, modify, and gradually sharpen the image to the form you want, and then save it on disk for later use. Some software will allow you to use your graphics tablet to calculate distances on maps, compute the area under a curve, and find the area of an irregular shape. A graphics tablet is reviewed on page 168.

HOME APPLIANCE CONTROL

A number of devices that allow you to control household appliances are available. They require the installation of special plugs on the receptacles the appliances are plugged into, as well as the use of the interface for the Commodore 64. A home appliance controller is reviewed on page 163, and home alarm systems are reviewed on pages 162 and 173.

JOYSTICKS AND OTHER GAME CONTROLLERS

Joysticks are essential to the exciting action of a number of arcade style games. Other game controllers include paddle wheels and trackballs. Commodore 64 owners are fortunate in that their computer uses joysticks, trackballs, and other game controllers conforming to the very popular ATARI format. Joysticks are reviewed on pages 155 and 156.

LIGHT PENS

A light pen is a device that senses the timing of the pixels displayed on the screen of the Commodore 64 and makes information concerning the location of the tip of the light pen relative to the screen available to a program. This allows the program to decide where you are pointing the pen and to use this information in graphics, applications, menu selections and so on. Light pens are reviewed on pages 157 and 158.

MONITOR TUNER

If you own a good quality color monitor, it is possible to use it as a TV set with a monitor tuner. The tuner connects to an antenna, selects a particular channel, and converts the antenna signal into a form which can produce a normal TV image on a monitor. Monitor tuners are reviewed on pages 166 and 169.

MUSIC GENERATION/KEYBOARDS

The Commodore 64 has excellent music generation capabilities. Music devices for the Commodore 64 typically may include a high quality speaker and/or an electronic piano keyboard. Some keyboards are free standing, while others attach over the keyboard of the Commodore 64 and use the electric piano style keys to depress selective keys on the Commodore 64 keyboard. A keyboard is reviewed on page 176, and a synthesizer interface is reviewed on page 173. A musical touch pad is shown in Fig. 11-1.

NUMERIC KEYPADS

For those who are proficient at using the type of keypads found on a normal adding machine, a numeric keypad provides the familiar location of the numbers for increased speed and accuracy in entering numeric data for spreadsheets, databases, and other number-intensive tasks. Numeric keypads are reviewed on pages 161 and 172.



Fig. 11-1. The PowerPad touch tablet's large size makes it especially easy for children to use (courtesy of Chalkboard).

PLOTTERS

With appropriate software, plotters provide high quality, frequently multicolored graphics in the form of drawings, bar charts, pie charts, line graphs, and the like. Because many of the dot matrix printers now available include the ability to create good quality graphics the use of plotters has declined except for very special applications. Plotters are reviewed on pages 174 and 176.

POWER LINE FILTERS AND SURGE PROTECTORS

Spikes, surges, and other fluctuations in electrical power can damage electrical appliances such the Commodore 64 and its peripherals. Power line filters and surge protectors plug into the normal outlets of your house and accept the power plugs of the Commodore 64 and its peripherals. The line filters/surge protector filters out and eliminates the fluctuations in the power; thereby protecting your computer components from damage. Power lines filters and surge protectors are found on pages 160, 162, 164, and 165.

SPEECH GENERATION

While it is possible to produce reasonable quality speech from the Commodore 64 under software control through the normal sound channels, a number of peripherals are available that assist in the production of higher quality speech. Some of these contain built-in vocabularies and high quality speakers. Others assume that you will provide a speaker and have their vocabularies stored in software or on a disk. Speech generators are reviewed on pages 156, 167, 170, and 172.

SPEECH RECOGNITION

Speech recognition equipment typically includes a microphone and an interface that will convert the signals from the microphone into a form recognizable to software running on the Commodore 64. A speech recognition peripheral is reviewed on page 167.

EIGHTY COLUMN ADAPTORS

For spreadsheets, major database applications, and word processing, an eighty column display can be very helpful. Because the Commodore 64 provides only a forty column display, a number of companies have produced eighty column adaptors, which convert the forty column display signals from the Commodore 64 into the signals that a monitor expects in order to display eighty columns. Ordinarily a monitor rather than a TV set is required to produce a legible eighty column display. Eighty column adaptors are reviewed on pages 168 and 175..

GLOSSARY

A/D—Analog to digital converter. A circuit that translates an analog signal into digital quantities.

ADSR—Relating to sound, this stands for attack, decay, sustain, and release, which are described below.

analog—Any process that changes steadily and may appear to be irregular and sudden, but is never instantaneous.

attack—The period of time necessary for a sound to acquire its full intensity after initialization.

BDOS—Basic Disk Operating System. BDOS manages disk files, file storage, file retrieval, and file allocation, and is one of three components of CP/M.

BIOS—Basic Input Output System. BIOS facilitates the exchange of status information and data between the console command processor (CCP) and a peripheral device, and is one of three functional components of CP/M.

CCP—Console Command Processor. A part of the CPM system, the CCP performs internal processing and interprets commands from the keyboard. Sources for status and data information are BDOS and BIOS.

CIA—Complex Interface Adapter. The CIA has the mechanism to inform the microprocessor when data has been received and transmitted. It temporarily stores data that is to be input or output from the computer.

control ports—Connectors used for connecting light pens, most game adaptors, and some control devices. There are two, nine pin connectors located on the right edge of the Commodore 64; five of the pins are wired directly to the CIA.

CP/M—Control Program for Microcomputers. Designed for the Z-80 based microcomputers, this is a single user, disk-based operating system.

CRT—Cathode-ray Tube. The principle component of most monitors and televisions, which creates luminous images by scanning its electron beam across the entire screen and varying its intensity.

D/A—Digital to analog converter. Converts digital signals to analog signals.

digital—Combinations of discrete binary units, as contrasted with representation by a continuously changing function.

digital recording—Recording sound from sound intensity samples, represented by discrete multiples of unitary value.

DOS—Disk operating system. A collection of commands designed to make it easy for you to create and manage files, run programs, and use the system devices attached to the computer.

dot pitch—The amount of space between the holes in a color CRT's shadow mask.

filter—A device used in telecommunications. It allows signals of specific frequencies to pass without significant attenuation, whereas other frequencies are strongly attenuated.

formant synthesis—Simulates electronically simple frequencies and then modifies them through filters to simulate complex sounds. Depending on the nature of the material vibrating, different objects emphasize particular harmonics over others. Harmonics are integral multiples of primary frequency and the dominant harmonics are called *formants.*

graphics tablet—A device for inputting graphics. Using a stylus, diagrams, maps,

charts, and free-hand drawings can be created and appear instantaneously on a display screen. The tablet can also be used to manipulate the image, or to direct it to a storage device for subsequent recall or transmission.

harmonic—A sinusoidal wave whose frequency is a multiple of the fundamental frequency, which determines the tone or quality of sound.

high-pass filter—A wave filter that allows those frequencies above a certain critical frequency to pass and excludes all those below this point.

horizontal register—A register, when activated by a signal from the light pen, that latches in the horizontal location of the electron beam. It is located at address 53267 on the Commodore 64.

input device—Any item of equipment which permits data and instructions to be entered into a computer's central memory; keyboards, terminals, joystick and light pens, are all input devices.

interrupt—Without destroying its ongoing work, interrupt allows the microprocessor to take in and deal with fresh data, noting where it left off, so that it can resume there again afterwards.

joystick—A handheld lever whose motions can be read by software.

linear predictive coding—A technique for analyzing speech and converting it into digital code.

low-pass filter—A wave filter that allows those frequencies below a certain critical frequency to pass and excludes all those above this point.

noise—In telecommunications, noise refers to unwanted (usually random) electronic signals.

numeric keypad—A device to facilitate the entry of numeric values. It can be included with a keyboard or purchased separately.

operating system—Programming that allows a computer to control the sequencing and processing of programs, and so respond correctly to user requests. For example, to store a file of data or to run a program.

output device—Any device capable of receiving information from a central processor. It may be some form of storage or a peripheral unit that "translates" information into another medium.

phosphor persistance—The of time a given area of a CRT screen continues to glow after electrons stop striking it.

pixel—A picture element on a visual display unit (VDU).

port—An input/output connection on a computer facilitating the direct connection of a peripheral.

refresh rate—The rate at which a CRT's electron gun makes a complete scan of the screen.

release—The amount of time required for a sound to become silent from a mid-range intensity.

resonance—The condition of a circuit in which the capacitive- and inductive-reactance components are equal. This condition is attained only for a comparatively narrow band of frequencies for given component values.

sound waves—An alteration in pressure at an audible rate and propagated through any medium capable of vibrating.

sustain—The effect produced by a circuit that causes a note to diminish gradually after the sound registers are initialized.

TPA—Transient Program Area. CP/M's area of memory allocated for loading user programs.

trackball—A sphere mounted within a case, with the direction and speed of movement being transferred to and interpretted within the computer.

user port—Wired directly to the CIA, the user port is located on the right side of the Commodore 64 when viewed from the back Interface cartridges as well as a number of modems usually plug in there.

vertical register—A register, when activated by the signal from a light pen, that latches in the vertical location of the electron beam and is located at address 53268.

VIC-II chip—Commodore 64's video control circuit, which controls screen display information.

video controller—Organizes and sends information from computer to television or monitor.

waveform —A graphic representation of a wave showing the shape and the variations in amplitude with time.

wavelength—Distance between two points of the corresponding phase of two consecutive cycles, equal to the phase velocity divided by the frequency, and corresponding to the distance traveled by the wave in one cycle.

Competition PRO-1000/ PRO-3000/PRO-5000 joysticks

$12.95 (PRO-1000)

Coin Controls

16.95 (PRO-3000)

19.95 (PRO-5000)

RATINGS TYPE: Joystick

A Overall rating
A Price/performance
B Software compatibility

A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The PRO series consists of three joysticks for the Commodore 64 made by Coin Controls. The PRO-1000 is a simple, low-cost joystick for the occasional game player. It features a narrow stick, a wide fire button and a five foot cord. The PRO-3000 is a well-made joystick that features a wide stick and two sets of fire buttons. The PRO-5000 is an arcade style joystick with a knobbed handle, two fire buttons, and a 5 foot cord.

Smoothtalker speech synthesizer

$19.95

Personal Peripheral Products

RATINGS TYPE: Speech synthesizer

B Overall rating
A Price/performance
C Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

Smoothtalker is a good quality, low-cost speech synthesizer for the Commodore 64. It features an unlimited vocabulary, word customization, and four inflection levels. It also has an additional BASIC statement, SAY, to use in your programs. A software package called Speakeasy is available for $59.00. It requires an adaptor for the Commodore 64, which is priced at $12.95.

Prostick II joystick

$24.95

G.A.M.E.S.

RATINGS TYPE: Joystick

A Overall rating
B Price/performance
A Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Prostick II is a good quality joystick from G.A.M.E.S. It features left and right firing buttons and a switchable gateplate. It comes with a five year limited warranty. This is one of our favorites. It has an excellent "feel," which adds to the enjoyment of fast-paced games.

The Reunion interface

$29.95

HyTech

RATINGS

TYPE: VIC-20 to C-64 interface

B Overall rating
A Price/performance
A Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The Reunion interface is used to connect a Commodore 64 and a VIC-20 to the same disk drive and/or printer. You can easily switch between the two systems and can load and save VIC-20 and C-64 programs on the same disk. This is a tremendous advantage if you use both machines, or if a close friend or family member uses the other type of Commodore home computer.

Edumate light pen

$34.95

Futurehouse

RATINGS

TYPE: Light pen

A Overall rating
B Price/performance
B Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Edumate Light Pen is easy to install and use. You can do graphics, play games, and use educational software with this device. This pen is used in conjunction

with the keyboard for executing specific functions. Futurehouse has a complete line of disk or tape software to go with the light pen. The light pen is especially useful for introducing young children to the computer. Many children can learn to point with the light pen earlier than they can learn to use the keyboard to interact with the Commodore 64.

VIC Dubber cassette interface

$34.95

Omnitronix

RATINGS

TYPE: Cassette interface

B Overall rating
B Price/performance
NA Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The VIC Dubber, shown in Fig. 11-2, for the Commodore 64 is a good interface for most standard cassette players. It plugs into the Commodore 64 cassette port. It comes with 3 cables for controlling the player functions and has an LED indicator to signal loading or saving. You may also use the VIC Dubber to copy cassettes for backup or other purposes. If you cannot find this product in your area, Omnitronix has a mail order service and a free catalog.

LP-10S light pen

$39.95

Tech-Sketch, Inc.

RATINGS

TYPE: Light pen

B Overall rating
B Price/performance
A Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The LP-10S is a low-cost, easy-to-use light pen. It comes with Paint 'N Sketch software, or for an extra $30.00, a more advanced graphics package called MicroIllus-



Fig. 11-2. The VIC Dubber will interface your Commodore 64 to most standard cassette players (courtesy of Omnitronix).

trator. This light pen plugs into the joystick port and has a trigger button on the barrel. Tech-Sketch has a number of educational software packages that utilize the LP-10S, and it will also work with software from many other vendors.

MTR PM-4401C cassette recorder

$39.95

E Mart, Inc.

RATINGS

TYPE: Cassette recorder

B Overall rating
A Price/performance
NA Software compatibility

A Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The MTR PM-4401C is good quality cassette recorder that works with the Commodore 64. It features a preset playback level, auto stop, and tape counter. An LED lights when the unit is saving or loading data. This is a good choice for the price.

The Rabbit cassette tape speed up

$39.95

Eastern House

RATINGS

TYPE: Cassette tape speed up

A Overall rating
A Price/performance
B Software compatibility
A Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The Rabbit is a useful cartridge unit that allows you to load and save files on the Commodore datasette in a fraction of the time this normally takes. An 8K program can be transferred in approximately 30 seconds. It allows you to append BASIC programs, has two data file modes, and works with memory expansion units. If you use cassette as your only storage media, The Rabbit is an excellent addition to your Commodore 64 system. The seconds it saves will quickly add up to hours through the months—to say nothing of the frustration it will help you avoid.

Lemon/Lime/Peach/Orange surge protectors

$ 59.95 Lemon
89.50 Lime
97.50 Peach
139.95 Orange

EPD, Inc.

RATINGS

TYPE: Surge protectors

A Overall rating
B Price/performance

NA Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Lemon, Lime, Peach, and Orange are good quality surge protectors from EPD, Inc. They represent a small expense to protect your increasingly valuable complex of Commodore 64 peripherals, all of which are subject to damage by power surges. Line filtering also helps prevent interference between any pair of devices. Many "mysterious" hardware problems go away when a filtering surge protector is used with the system. The Lemon is attached directly into the wall socket and has six plug receptacles. The Lime sits on the floor, has a power cord to plug into the wall socket, and has six plug receptacles. Neither of these units feature line filtering. However, the Peach and the Orange surge protectors do. The Peach attaches directly to the wall and has three receptacles. The Orange is a floor model and has six receptacles.

Numeric Keypad

$59.95

Bear Technologies

RATINGS

TYPE: Numeric keypad

B Overall rating
B Price/performance
B Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The Numeric Key Pad by Bear Technologies is a numeric keypad for the Commodore 64. It features full cursor control, has 38 built-in functions, and can be programmed to perform additional functions. It works with a number of commonly used software packages. If you are a high-speed, ten-key machine user this may be just what you need to enter numbers for spreadsheets, databases, or other numeric programs rapidly.

Model V100 intruder alarm

$69.00

VIN Systems

RATINGS

TYPE: Alarm system

B Overall rating
B Price/performance
NA Software compatibility
C Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The Model V100 Intruder Alarm is a complete alarm system for the home or office. It plugs into the user port and features a 95 decibel siren. The system comes with 4 magnetic switches and 100 feet of wire. It can be expanded to use vibration detectors, pressure switches, and panic buttons. The software needed to operate the system is available on disk or cassette. With computer theft on the increase, this may be a wise investment (not to mention the other valuables it could protect). For some users, protection of confidential data may be the issue rather than theft.

Datashield Model 100 surge protector

$69.95

Jameco Electronics

RATINGS

TYPE: Surge protector

B Overall rating
B Price/performance
NA Software compatibility
B Ease of installation
C Documentation
C Vendor Support

PRODUCT SUMMARY

The Datashield Model 100 surge protector will eliminate voltage spikes and electrical interference noise that can damage the Commodore 64 or its peripherals. It has six outlets that allow you to plug in your computer and up to five other devices. The unit is warranted for 6 months and can handle large power demands from monitors and printer.

VIController

$69.95

Genesis Computer Corp.

RATINGS

TYPE: Home appliance control

A Overall rating
A Price/performance
NA Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The VIController is used to control a variety of electrical devices in your home. The VIController is attached to user port of the computer and then plugged in a wall socket. Each device to be controlled is attached to a BSR control switch. The VICcontroller is attached to a BSR control switch. The VIController communicates with each device through the unique address of the BSR switch. You can control the amount of power to dim and brighten lights and turn appliances on and off. The VIController can work in a manual mode for individual control from the computer or in time schedule mode for automatic 24 hour control. All of the software necessary to run the system is supplied, but the BSR switches must be purchased separately. By using a voice recognition unit and doing your own programming, you can set up your house to obey voice commands such as "light" and "dark"—Talk about living in the computer age!

CEX-4 cartridge slot expansion

$69.95

MSD Systems

RATINGS

TYPE: Cartridge slot expansion

C Overall rating
B Price/performance
B Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The CEX-4 cartridge slot expansion device allows you to attach up to four

cartridges at a time to your Commodore 64. It features toggle switches to activate the slots and a reset button for convenient program start-up. It plugs directly into the cartridge slot on the Commodore 64. It does not come with a protective cover, leaving the components exposed to the environment.

CP/M operating system

$69.99

Commodore Business Machines

RATINGS

TYPE: CP/M operating system

B Overall rating
A Price/performance
C Software compatibility
B Ease of installation
A Documentation
B Vendor Support

PRODUCT SUMMARY

CP/M from Commodore is a cartridge based version of the popular CP/M operating system. The cartridge plugs into the user or expansion ports of the Commodore 64 and contains the processor and circuitry needed. It also comes with a disk containing the operating system and some utility programs. This is a 40 column, 48K memory version of CP/M. There are only a few CP/M programs that will run using this cartridge without some modification.

The MAX SS/2 surge protector

$79.00

Panamax

RATINGS

TYPE: Surge protector

B Overall rating
B Price/performance
NA Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

Panamax has a whole line of good quality surge protectors. The MAX SS/2 has two plug receptacles, plugs directly into the wall socket and protects against power

surges and noise interference. Some of the other units from Panamax include the UltraMAX with four plug receptacles, a power cord to plug into the socket, an on/off switch, brown out protection, a circuit breaker, and an undervoltage alarm ($159.00); the SS/6 LCS with six plug receptacles, an on/off switch, a circuit breaker, and a power cord to plug into the socket ($119.00); the TeleMAX with one plug receptacle and two phone jack hook-ups ($89.00). All of the units come with a five year warranty.

Spikemaster surge protector

$79.95

discwasher

RATINGS

TYPE: Surge protector

A	Overall rating
A	Price/performance
NA	Software compatibility
A	Ease of installation
B	Documentation
A	Vendor Support



Fig. 11-3. Spikemaster is a high-quality line filter and spike guard (courtesy of discwasher).

PRODUCT SUMMARY

The Spikemaster, shown in Fig. 11-3, is a very high quality spike protector and line filter. It is built of heavy duty components and offers a circuit breaker, five way filtering, and an on/off switch with an indicator light. It can handle a total load of 15 amps, more than enough for a large Commodore 64 system. Spikemaster is the most heavily built spike/surge protector we have seen, and it works well in areas with notoriously bad power supply.

Cardboard 5 cartridge slot expansion $79.95

Cardco, Inc.

RATINGS

TYPE: Cartridge slot expansion

B Overall rating
A Price/performance
B Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Cardboard 5 is a cartridge slot expansion device with five slots. It plugs into the cartridge slot and can accommodate use of up to three cartridges at one time. It features toggle switches for switching between slots, LED status indicator lights for each slot, and a reset button for convenient program switching or restart. The interface comes in a protective plastic case.

MTR 8401 tuner $85.85

E Mart, Inc.

RATINGS

TYPE: Color TV tuner

B Overall rating
B Price/performance
NA Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The MTR 8401 Color TV Tuner can be used to turn any composite color monitor into a TV set. It can easily switch back and forth between computer monitor and TV screen. It includes UHF and VHF tuners. If computing is higher on your priority list than TV viewing, it makes sense to have your color monitor do double duty as a TV rather than the other way around.

Voice Master speech generator $89.95

Covox, Inc.

RATINGS TYPE: Speech recognition/ generation

B Overall rating
B Price/performance
A Software compatibility
B Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Voice Master will record your voice and store it on tape or disk for replay through a BASIC program. The software provided includes new BASIC statements to use when you are programming speech responses. You can also sing and create any special effects. The Voice Master plugs into the expansion slot and comes with its own microphone.

1541 Express disk speed up $89.95

Blue Sky

RATINGS TYPE: Disk speed up

A Overall rating
A Price/performance
C Software compatibility
B Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The 1541 Express is a device that speeds up the 1541 disk drive by 200 to 300

percent. While the 1541 Express is invisible to most software, it has problems with software from Electronic Arts and Datasoft. This probably reflects specific programming techniques used by these companies. You can always run these programs without the Express. We consider the 1541 Express an outstanding buy for the 1541 disk users. There are programs available that speed up the 1541 without hardware. Most of these programs interfere with use of other software more than the 1541 Express does.

VIDEO-80 80 column adaptor

$99.00

P Technologies

RATINGS TYPE: 80 column adaptor

B Overall rating
A Price/performance
B Software compatibility
C Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The VIDEO-80 by P Technologies is a good quality, cartridge-based 80 column adaptor. It plugs into the expansion port (with an extended board) and can be switched easily between 40 and 80 column mode. It comes with the necessary software and a video cable. It works well many of the popular software packages requiring 80 columns.

Koala Pad touch tablet

$ 99.95 Disk

Koala Technologies Corp.

110.00 Cartridge

RATINGS TYPE: Touch tablet

A Overall rating
B Price/performance
B Software compatibility
B Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Koala Pad is a good quality touch tablet. It transforms pressure applied to a

point on the table to a point on the monitor screen. The tablet provides the location of the pressure to a program that converts this information into a bright spot on the screen. You can use it to do graphics and drawings, which can be saved to disk or printed. The Koala Pad comes with the software (on disk or cartridge) necessary to use it, and it can be used with many other graphics packages.

Promenade Model C1 EPROM programmer

$99.50

Jason-Ranheim

RATINGS

TYPE: EPROM programmer

B Overall rating
A Price/performance
NA Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Promenade Model C1 is an EPROM programmer. You can write your own programs onto an EPROM chip to be used in making a cartridge or to be used with the Promenade as an input device. The software provided controls all functions including create, modify, and scratch. The unit plugs into the user port and can be used with many of the commonly available EPROMs. The Promenade Model C1 includes 15 bit chip addressing, 3 programming algorithms, and 4 programming voltages.

MT/2 tuner

$99.95

Cardco, Inc.

RATINGS

TYPE: Monitor tuner

B Overall rating
B Price/performance
NA Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The MT/2 is a well-made monitor turner from Cardco, Inc. It is used to turn a composite monitor into a TV. It features a convenient monitor/TV switch, UHF and

VHF tuners, and a cable/antenna input port. Cardco also has a more advanced version called MT/1, which sells for $199.95. It has remote control, a digital-display 60 channel cable tuner, and separate audio and video output. Both can be used with color or monochrome monitors.

JE520-CM speech synthesizer

$114.95

Jameco Electronics

RATINGS

TYPE: Speech synthesizer

B Overall rating
B Price/performance
B Software compatibility
A Ease of installation
B Documentation
C Vendor Support

PRODUCT SUMMARY

The JE520-CM is a speech synthesizer from Jameco Electronics. It can produce over 250 words plus letters and numbers, and "speaks" in a relatively natural sounding male voice. You can control the timing and volume, and create sound effects. "COMvoice" is plugged into the expansion port and comes with its own built-in speaker and adaptor plug for larger speakers. You can purchase the disk version of the program needed or type the program in from the printed listing supplied.

Cartridge-Maker-64

$129.00

Custom Programming Group, Inc.

RATINGS

TYPE: Cartridge maker

B Overall rating
B Price/performance
NA Software compatibility
A Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

You can use the Cartridge-Maker-64 to create your own cartridges for the Commodore 64. It attaches to the cartridge slot and can be used to copy from RAM, disk, cassette, or another cartridge onto a blank 16K cartridge. You can also copy from

the cartridge onto cassette or disk, and you can also erase cartridges and reuse them. Blank cartridges are available for 25.00 each or 5 for 115.00, and the cartridge eraser is available for 59.00. All the software needed to run the unit is provided.

PowerPad touch tablet

$129.00

Chalkboard

RATINGS

TYPE: Touch tablet

B Overall rating
B Price/performance
A Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The PowrPad is a touch tablet especially good for children. It features a large (12 × 12) touch sensitive surface for doing many applications such as color graphics, drawing, games, and music. It works well with a number of popular software packages. Compare this unit to the Koala Pad.

Relax biofeedback device

$149.95

Synapse

RATINGS

TYPE: Biofeedback

B Overall rating
C Price/performance
NA Software compatibility
B Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

Relax by Synapse is a hardware/software package that offers biofeedback and relaxation techniques. It comes with a control unit, a sensor headband, an audio tape, and a menu-driven program. Using the headband, your stress level is displayed graphically on the screen and can be dumped to the printer. The audio tape and subliminal messages displayed on the screen help you to relax.

COMvoice speech synthesizer

$149.95

Genesis Computer Corporation

RATINGS

TYPE: Speech synthesizer

B Overall rating
B Price/performance
B NA Software compatibility
A Ease of installation
A Documentation
B Vendor Support

PRODUCT SUMMARY

COMvoice by Genesis Computer Corporation is a speech synthesizer for the Commodore 64. It can "speak" an unlimited number of words, letters, and numbers when you use a new BASIC command, SPEAK, and the phonetic spelling. You can also control the pitch and timing of the speech within the BASIC program. COMvoice plugs into the Commodore 64 expansion port. It comes with an external speaker, an attachment for a larger speaker, and all the necessary software.

Magnacomp-64 numeric keypad and console

$149.00

Arkey/Magnacomp

RATINGS

TYPE: Numeric keypad and console

A Overall rating
A Price/performance
NA Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Magnacomp-64 Integrator Console is a well-made, multipurpose console/housing for the Commodore 64. The computer inserts directly into the Magnacomp-64 and is attached to the 20 pin connector inside the console. The console features a hard-wired, full-function numeric keypad located on the right side of the keyboard, which requires no additional software. It allows you to set the monitor on top of the unit, provides four surge protector outlets and provides room to hide all wires, 80 column cards, and expansion units.

MIDI Interface Card

$149.00

Waveform Corp.

RATINGS

TYPE: Synthesizer interface

B Overall rating
B Price/performance
B Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The MIDI Interface Card will allow you to use any synthesizer using the MIDI (Musical Instrument Digital Interface) standard. It is connected to the Commodore 64 user port. By using software designed to work with this interface (such as MusiCalc I from Waveform), you can control a synthesizer or the keyboard to produce musical compositions, which can be saved to disk.

Security/Control System

$195.00

Jance Associates, Inc.

RATINGS

TYPE: Alarm system

A Overall rating
B Price/performance
NA Software compatibility
B Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Security/Control System by Jance Associates is an intruder alarm system. It uses wires, which are connected to any entry point in your home or office, and is controlled by programmable software that is included in the package. The wires are connected to the control unit, which is connected to the Commodore 64. It comes with an indoor and outdoor alarm, two switches for turning the alarm off, and a panic button. Three door and ten window switches, a power adaptor, and 200 feet of wire are also included. You can also have the unit automatically dial an emergency telephone number. Jance Associates also has a wireless security system available for $349.00. It uses an infrared motion detector.

VIC-1520 plotter

$199.00

Commodore Business Machines

RATINGS

TYPE: Ballpoint pen plotter

A Overall rating
B Price/performance
A Software compatibility
A Ease of installation
A Documentation
B Vendor Support

PRODUCT SUMMARY

The VIC-1520 is a printer/plotter made for the Commodore 64 and the VIC-20. The plotter uses ballpoint pens in four colors (black, blue, green, and red) and paper 4.5 inches wide. It will draw images on the x-y coordinates with 0.2mm resolution. You can select the x-y axis, color, character size and rotation, upper and lowercase, scribe mode, pen position, and so on, either through your own BASIC program or by using commercial software. It connects to the computer with a 6-pin DIN cable via the serial port.

RAMDISK-64

$199.95

P Technologies

RATINGS

TYPE: Memory expansion and drive emulator

A Overall rating
B Price/performance
A Software compatibility
C Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The RAMDISK-64 can expand the memory of your Commodore 64 by 64K. This device plugs into the expansion slot (with an extender board) and can be used as extra memory or as a second disk using the disk emulation software supplied. RAMDISK-64 has a wonderful effect on the speed of databases and other programs that make heavy use of disk. The limitation is that the file you are using must be smaller than 64K so it can be loaded into RAMDISK for processing.

B. I.-80 80 column display

$199.95

Batteries Included

RATINGS

TYPE: 80 column display

B Overall rating
B Price/performance
B Software compatibility
A Ease of installation
A Documentation
A Vendor Support

PRODUCT SUMMARY

The B.I.-80 adaptor will convert your Commodore 64 display screen to 80 columns. It will work with the Commodore color monitor or any monochrome monitor. It is self-initializing and plugs into the cartridge slot. This adaptor works well with most of the word processors and other software for the Commodore 64 that require 80 columns. It includes the new upgraded BASIC 4.0 and can be switched back and forth between 40 and 80 columns. The B.I.-80 is illustrated in Fig. 11-4.

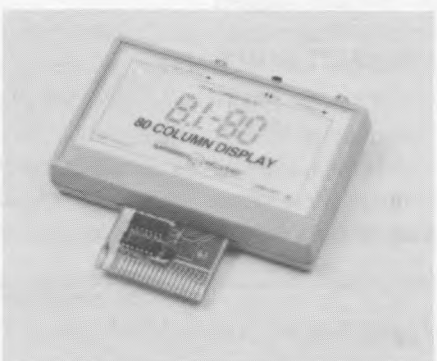


Fig. 11-4. The Batteries Included B.I.-80 provides an 80 column display and BASIC 4.0 commands (courtesy of Batteries Included).

MX-6407 expansion interface

$199.95

ECX Computers

RATINGS

TYPE: Expansion interface

B Overall rating
B Price/performance
B Software compatibility
B Ease of installation
C Documentation
B Vendor Support

PRODUCT SUMMARY

The MX-6407 is an expansion interface for connecting up to four Commodore 64s to a peripheral. You can connect the computers to most serial devices including the VIC-1541 disk drive, printers, and modems. You can daisy-chain the disk drive and a printer together. The MX-6407 comes with six cables: four to attach the computers, one to attach the device, and one to draw power from the Commodore 64 via the cassette port. This unit is very useful for schools, user group meetings, and classes.

Melodian Keyboard

$200.00

Melodian

RATINGS

TYPE: Organ keyboard

B Overall rating
B Price/performance
C Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Melodian Keyboard is a 37 key organ keyboard. It plugs directly into the Commodore 64, has a three octave range, and can produce sounds of strings, brass, woodwinds, and synthesizers. A menu-driven software package called Concertmaster displays the notes on screen and is included in the package. Two additional software packages from Melodian are available at extra cost.

Maxi-Plot

$249.00

Maxiplot, Inc.

RATINGS

TYPE: Plotter

B Overall rating
B Price/performance
B Software compatibility
A Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

The Maxi-Plot is a good quality, flat bed plotter for the Commodore 64. It has a 16

× 9 inch plotting surface, .004 inch-per-step resolution, works with most pens and markers, and plugs into the user port. The software to run the plotter comes on disk or tape and provides seven new BASIC commands for programming, function key control of the pen, continuous screen updates of the x and y axis, and a variable size character set. It comes with all the hardware (power supply, cables, etc.) needed to use the plotter.

Multi-Link multiuser system

$418.00

Richvale Telecommunication

RATINGS

TYPE: Multi user system

A Overall rating
A Price/performance
A Software compatibility
B Ease of installation
B Documentation
B Vendor Support

PRODUCT SUMMARY

Multi-Link allows a master teacher's Commodore 64 to observe and/or control up to 48 student Commodore 64s. The disk drives (up to 4) and printers (up to 2) are attached to the master Commodore 64 and are available for shared use by the student Commodore 64s. The teacher can request any of the following functions:

- View what is on a selected students screen.
- Load a program from teacher's Commodore 64 to selected (or all) student's Commodore 64s.
- Load student's program into master Commodore 64.
- Allow/restrict access to disk, printer, or message facilities on a student by student basis.
- Send messages to or receive messages from students.
- Students may send/receive message to and from each other (when allow by the teacher).

The price is $299.00 for the master unit and $119.00 for each student unit, including software and cable. The data is transferred in parallel, providing a fast link of 5-6K bytes per second.

This is an excellent way for a school to set up a learning lab with disk and printers available to all students without astronomical costs.

WORKSHEET FOR SPECIAL DEVICES

$

RATINGS TYPE:

Overall rating
Price/performance
Software compatibility
Ease of installation
Documentation
Vendor Support

PRODUCT SUMMARY

COMPARISONS AT A GLANCE

Table 11-1 shows each device and the rating it received in each category.

Table 11-1. Comparative Ratings for Specialized Peripherals

PRICE	DEVICE	TYPE	1	2	3	4	5	6	
$12.95	PRO-1000	Joy	A	A	B	A	B	B	
16.95	PRO-3000	Joy	A	A	B	A	B	B	
19.95	PRO-5000	Joy	A	A	B	A	Z	B	
19.95	Smoothtalker	SSN	B	A	C	B	C	B	
24.95	Prostick II	Joy	A	B	A	A	B	B	
29.95	The Reunion	VCI	B	A	A	B	C	B	
34.95	Edumate Light Pen	LP	A	B	B	A	B	B	
34.95	VIC Dubber	CI	B	B	–	B	C	B	
39.95	LP-10S Light Pen	LP	B	B	A	A	B	B	
39.95	MTR PM-4401C	CR	B	A	–	A	C	B	
39.95	The Rabbit	CSU	A	A	B	A	C	B	
59.95	Lemon (G1*)	SP	A	B	–	A	B	B	
59.95	Numeric Key Pad	NKP	B	B	B	B	C	B	
69.00	Model V100 Intruder Alarm	ALM	B	B	–	B	C	C	
69.95	VIController	AC	A	A	–	A	B	B	
69.95	CEX-4	CSE	C	B	B	B	C	B	
69.99	CP/M	CPM	B	A	C	B	A	B	
79.00	The MAX SS/2	SP	B	B	–	A	B	B	
79.95	Spikemaster	SP	A	A	–	A	B	A	
79.95	Cardboard 5	CSE	B	A	B	A	B	B	
85.85	MTR 8401	CTT	B	B	–	B	C	B	
89.50	Lime (G1)	SP	A	B	–	A	B	B	
89.95	Voice Master	SRG	B	B	A	B	B	B	
89.95	1541 Express	DSU	A	A	C	B	B	B	
97.50	Peach (G1)	SP	A	B	–	A	B	B	
99.00	VIDEO-80	80	B	A	B	C	B	B	
99.95	Koala Pad	TT	A	B	B	B	B	B	
99.50	Promenade Model C1	EP	B	A	–	A	B	B	
99.95	MT/2	CTT	B	B	–	B	C	B	
114.95	JE520-CM	SSN	B	B	B	A	B	C	
129.00	Cartridge Maker 64	CM	B	B	–	A	C	B	
129.00	Chalkboard	TT	B	B	A	B	C	B	
139.95	Orange (G1)	SP	A	B	–	A	B	B	
149.00	Relax	BIO	B	C	–	B	B	B	

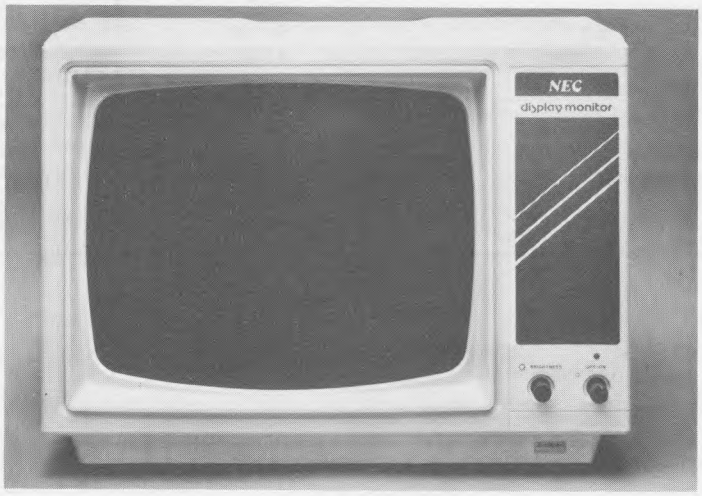
PRICE	DEVICE	TYPE	1	2	3	4	5	6	
149.00	COMvoice	SSN	B	B	B	A	A	B	
149.00	Magnacomp-64	NKP	A	A	–	A	B	B	
149.00	MIDI Interface Card	SI	B	B	B	A	B	B	
195.00	Security/Control System	ACM	A	B	–	B	B	B	
199.00	VIC-1520E	PLO	A	B	A	A	A	B	
199.95	RAMDISK-64	MEDE	A	B	A	C	B	B	
199.95	B.I.-80	80	B	B	B	A	A	A	
199.95	MX-6407	EI	B	B	B	B	C	D	
200.00	Melodian Keyboard	OK	B	B	C	A	B	B	
249.00	Maxi-plot	PLO	B	B	B	A	B	B	
418.00	Multi-Link	MUS	A	A	A	B	B	B	

1 = Overall rating
2 = Price/performance
3 = Software Compatibility
4 = Ease of installation
5 = Documentation
6 = Vendor support
(G1) = Lemon, Lime, Peach, and Orange surge protectors reviewed as a group.
– = Rating not applicable to this product

KEY OF ABBREVIATIONS

ALM = Alarm system
AC = Appliance control
BIO = Biofeedback
CI = Cassette interface
CSV = Cassette tape speed up
CR = Cassette recorder
CSE = Cartridge slot expansion
CTT = Color TV tuner
CPM = CP/M
DSU = Disk Speed Up
EI = Expansion Interface
EP = Eprom Programmer
Joy = Joystick
LP = Light Pen
MEDE = Memory Expansion and Drive Emulator
MUS = Multi-user system
NKP = Numeric key pad
OK = Organ Keyboard
PLO = Pen Plotter
SI = Synthesizer Interface
SRG = Speech Recognition/Generation
SSN = Speech Synthesizer
SP = Surge protector
TT = Touch Tablet
VCI = VIC-20/C-64 interface
80 = eighty column adapter

Appendix A



Vendor Addresses

Alphacom, Inc.
2323 S. Bascom Ave.
Campbell, CA 95008

Arkay/Magnacomp
1319 E. California
Glendale, CA 91206

Batteries Included
186 Queen St. W.
Toronto, Ontario
Canada M5V 1Z1

Bear Technologies
3417 Roger B. Chaffee Blvd.
Grand Rapids, MI 49508

BMC USA, Inc.
16830 S. Avalon Blvd.
Carson, CA 90746

Cardco, Inc.
313 Matheson
Wichita, KS 67214

Coin Controls, Inc.
2609 Greenleaf Ave.
Elk Grove Village, IL 60007

Commodore Business Machines
1200 Wilson Drive
West Chester, PA 19380

Covox Inc.
675-D Conger St.
Eugene, OR 97402

Custom Programming Group, Inc.
47 Marchwood Rd. Suite 2A
Exton, PA 19341

Data Terminals & Communications
590 Division St.
Campbell, CA 95008

Data 20 Corporation
23011 Moulton Parkway
Suite B10
Laguna Hills, CA 92653

discwasher
1407 N. Providence Rd.
P.O.B. 6021
Columbia, MO 65205

Dynax, Inc.
5698 Bandini Blvd.
Bell, CA 90201

E Mart, Inc.
1401-2 Capital Ave.
P.O.B. 1328
Plano, TX 75074

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

EPD, Inc.
P.O.B. 673
Waltham, MA 02254

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

Futurehouse
P.O.B. 3470
Chapel Hill, NC 27514

G.A.M.E.S.
6626 Valijian St.
Van Nuys, CA 91406

Genesis Computer Corp.
P.O.B. 1143
Bethlehem, PA 18018

HyTech
P.O.B. 466
Bay Pines, FL 33504

Jameco Electronics
1355 Shoreway Rd.
Belmont, CA 94002

Jason-Ranheim
580 Parrott St.
San Jose, CA 95112

Koala Technologies Corp.
3100 Patrick Henry Dr.
Santa Clara, CA 95052

MAXI-PLOT
839 Sea Foam
Houston, TX 77062

MFJ Enterprises Inc.
921 Louisville Rd.
Starkville, MS 39759

Microperipheral Corp.
2565 152nd Ave. NE
Redmond, WA 98052

Micro Ware
1342B Rt. 23
Butler, NJ 07045

Micro World Electronix, Inc.
3333 S. Wadsworth Blvd. #C105
Lakewood, CO 80227

MSD Systems, Inc.
10031 Monroe Dr. Suite 206
Dallas, TX 75229

Okidata
Mt. Laurel, NY 08054

Orange Micro Inc.
1400 N. Lakeview Ave.
Anaheim, CA 92807

P Technologies
6905 Speckle Way
Sacramento, CA 95842

Panamax
150 Mitchell Blvd.
San Rafael, CA 94903

Personal Peripheral Products
OS200 Winfield Rd.
Winfield, IL 60190

Silver Reed America, Inc.
19600 S. Vermont Ave.
Torrance, CA 90502

Smith-Corona
65 Locust Ave.
New Canaan, CT 06840

Star Micronics Inc.
200 Park Ave.
New York, NY 10166

Synapse Software
5221 Central Ave.
Richmand, CA 94804

Tech-Sketch Inc.
26 Just Road
Fairfield, NJ 07006

TTX, Inc.
3420 E. Third Ave.
Foster City, CA 94404

Tymac, Inc.
127 Main St.
Franklin, NJ 07416

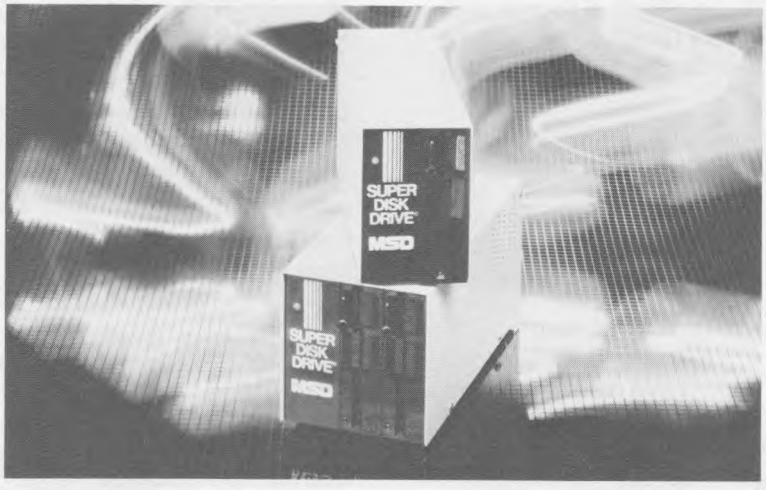
USI
71 Park Lane
Brisbane, CA 94005

VIN Systems (U.S.A.)
P.O.B. 31
Boone, IA 50036

Waveform, Inc.
1912 Bonita Way
Berkeley, CA 94704

Xetec, Inc.
3010 Arnold
Salina, KS 67401

Appendix B



Commodore Users Groups

Alabama
The Birmingham Commodore
Computer Club
Birmingham, AL
(205) 923-9260
Contact: Harry Jones

Commodore Club of Mobile
3868-H Rue Maison
Mobile, AL 36608
(205) 343-1178
Contact: Tom Wyatt
Meets: 3rd Thurs. of month

Huntsville PET Users Club
9002 Berclair Rd.
Huntsville, AL 35802
Contact: Hal Carey
Meets: every 2nd Thurs.

Riverchase Commodore Users Group
617 Grove St.
Birmingham, AL 35209
(205) 988-1078
Contact: Ken Browning

Shoals Commodore Users Group
(SCUG)
209 Lakeshore Dr.
Muscle Shoals, AL 35661
Contact: George Taylor
Meets: 2nd & 4th Tues of month

Tiger Byte
E. Alabama CBM 64 Users Group
c/o The Computer Store, Inc.
Midway Plaza
Opelika, AL 36801
Jack Parsons
Meets: 1st & 3rd Wed. of month

Wiregrass Micro-Computer Society
Commodore SIG
109 Key Bend Rd.
Enterprise, AL 36330
(205) 347-7564
Contact: Bill Brown

Mobile Commodore Club
1920-A Avenue C
Mobile, AL 36615
(205) 661-1973
Contact: Howard Crider

Alaska
Alaska 84 Computer Club
c/o Line 49 Management
P.O. Box 6043
Anchorage, AK 99502

COMPOOH-T
c/o Box 118
Old Harbor, AK 99643
(907) 286-2213

First City Users Group
P.O. Box 6692
Ketchikan, AK 99901
(907) 225-5695
Contact: James Llanos

Arizona
ACUG
c/o Home Computer Service
2028 W. Camelback Rd.
Phoenix, AZ 85015
(602) 249-1186
Contact: Dan Deacon
Meets: 1st Wed. of month

Arizona VIC 20-64 Users Club
232 W. 9th Place North
Mesa, AZ 85201
Contact: Donald Kipp

Arizona VIC & 64 Users
904 W. Marlboro Circle
Chandler, AZ 85224
(602) 963-6149
Contact: Tom Monson

Catalina Commodore Computer Club
2012 Avenida Guillermo
Tucson, AZ 85710
(602) 296-6766
Contact: George Pope
Meets: 1st Tues. 7:30 p.m.

Central Arizona PET People
842 W. Calle del Norte
Chandler, AZ 85224
(602) 899-3622
Contact: Roy Schahrer

Arkansas
Arkansas River Valley
Commodore Users
401 S. Arlington Dr.
Russellville, AR 72801
(501) 967-1868
Contact: Bob Brazeal

Booneville 64 Club
c/o A. R. Hederich
Elementary School
401 West 5th St.
Booneville, AR 72927
Contact: Mary Taff

Conway Middle School
Davis Street
Conway, AR 72032
Contact: Geneva Bowlin

Russellville Commodore User Group
401 S. Arlington Dr.
Russellville, AR 72801
(501) 967-1868
Contact: Bob Brazeal

The Siloam Commodore
Computer Club
P.O. Box 88
Siloam Springs, AR 72761
(501) 524-5624
Contact: Ken Emanualson

California

Amateurs and Artesians Computing
P.O. Box 682
Cobb, CA 95426

Antelope Valley Commodore
Users Group
P.O. Box 4436
Lancaster, CA 93539
(805) 942-2626
Contact: James Haner
Meets: 1st Saturday

Bay Area Home Computer Asso.
1332 Pine St.
Walnut Creek, CA 94598
(415) 932-5447
Contact: Cliff Downing

BAMBUG
1450 53rd Street
Emeryville, CA
(415) 523-7396

C-64/VIC 20 Users Group
Pasadena City College
Cicadian Room
Pasadena, CA
(714) 593-4880
Contact: Chuck Cypher
Meets: 1st & 3rd Thurs. 7 p.m.

C-64 West Orange County
Users Group
P.O. Box 1457
Huntington Beach, CA 92647
(714) 842-4484
Contact: Philip Putman
Meets: 2nd & 4th Tues of month

CA. Area Commodore Terminal
Users Society
C.A.C.T.U.S.
P.O. Box 1277
Alta Loma, CA 91701
Contact: Darrell Hall

Commodore 64 West Computer Club
2917 Colorado Ave.
Santa Monica, CA 90404
(213) 828-9308
Contact: Don Campbell

Commodore Connection
11652 Valverde Ave.
Riverside, CA 92505
(714) 689-7447
Contact: Tony Alvarez

Commodore Interest Association
c/o Computer Data
14660 La Paz Dr.
Victorville, CA 92392
Contact: Mark Finley

Commodore Users Club
5237 Pulmeria Ct.
Santa Maria, CA 93455
(805) 937-4174
Contact: Gilbert Vela

Computer Barn Computer Club
319 Main St.
Suite #2
Salinas, CA 93901
(408) 757-0788
Contact: S. Mark Vanderbilt

Computer Palace
User Group
1029 E. Broadway
Glendale, CA 91205
(213) 241-2551

Diablo Valley Commodore
Users Group
762 Ruth Dr.
Pleasant Hill, CA 94523
(415) 671-0145
Contact: Ben Braver
Meets: 2nd & 4th Thurs. 7:30 p.m.

Humboldt Commodore Group
P.O. Box 570
Arcata, CA 95521
Contact: R. Turner

Jurupa Wizards
8700 Galena St.
Riverside, CA 92509
Contact: Walter J. Scott

Lawrence Hall of Science
UC Berkeley
Computer Project
Room 254
Berkeley, CA 94720

Lincoln Computer Club
750 E. Yosemite
Manteca, CA 95336
Contact: John Fung, Advisor

Marin Commodore Computer Club
620 Del Ganado Rd.
San Rafael, CA
(415) 479-0426
Meets: 2nd Wed. of month 7:30 p.m.

Napa Valley Commodore
Computer Club
c/o Liberty Computerware
2680 Jefferson St.
Napa, CA 94558
(707) 252-6281
Contact: Mick Winter
Meets: 1st & 3rd Mon. of month

North Orange County Computer Club
3030 Topaz, Apt. A
Fullerton, CA 92361
Contact: Dave Smith

PALS (Pets around Livermore Society)
886 South K
Livermore, CA 94550
(415) 449-1084
Meets: Every 3rd Wednesday 7:30 p.m.
Contact: J. Johnson

Peninsula Commodore Users Group
549 Old County Rd.
San Carlos, CA 94070
(415) 593-7697
Contact: Timothy Very
Meets: 2nd Thurs of month

PET/CBM/VIC User Club
c/o General Computer Store
22323 Sherman Way #9
Canoga Park, CA 91303
(213) 889-2218
Contact: Tom Lynch

PET on the Air
525 Crestlake Drive
San Francisco, CA 94132
Contact; Max J. Babin, secretary

Pomona Valley Commodore
Users Group
1401 W. 9th, #77
Pomona, CA 91766
(714) 620-8889
Contact: Mark Joerger
Meets: 1st & 3rd Wed. of month 7 p.m.

PUG of Silicon Valley
22355 Rancho Ventura Road
Cupertino, CA 95014

Sacramento Commodore Users Group
8120 Sundance Dr.
Orangevale, CA 95662
(916) 969-2028
Contact: Robyn Graves

S.D. East County
C-64 User Group
6353 Lake Apopka Place
San Diego, CA 92119
(619) 698-7814
Contact: Linda Schwartz

San Diego PUG
c/o D. Costarakis
3562 Union Street.
San Diego, CA 92119
(714) 235-7626

San Fernando Valley
Commodore Users Group
21208 Nashville
Chatsworth, CA 91311
(213) 709-4736
Contact: Tom Lynch
Meets: 2nd Wed. 7:30

S.F. Commodore User Group
278 27th Ave, Suite 103
San Francisco, CA 94121
(415) 387-0225
Contact: Roger Tierce

SCPUG Southern California
PET Users Group
c/o Data Equipment Supply Corp.
8315 Firestone Blvd.
Downey, CA 90241
(213) 923-9361
Meets: 1st Tues. each month

Sixty Fourum
4413 E. Iowa
Fresno, CA 93702
(209) 252-0392
Contact: Deb Christensen

SLO VIC 20/64 Computer Club
1766 9th St.
Los Osos, CA

Software 64
353 California Dr.
Burlingame, CA 94010
(415) 340-7115
Contact: Mario Abad

South Bay Commodore Users Group
1402 W. 218th St.
Torrance, CA 90501
Contact: Earl Evans

South Bay Commodore 64
Users Group
P.O. Box 3193
San Ysidro, CA 95073

SPHINX
7615 Leviston Ave.
El Cerrito, CA 94530
(415) 527-9286
Meets: 2nd and 4th Thurs.
Contact: Bill MacCracken

The Commodore Connection
2301 Mission Street
Santa Cruz, CA 95060
(408) 425-8054
Contact: Bud Massey

The Commodore Tech. Users
of Orange Co.
P.O. Box 1497
Costa Mesa, CA 92626
(714) 731-5195
Contact: Roger Fisher

The Diamond Bar R.O.P. Users Club
2644 Amelgado
Haciendo Hgts. CA 91745
(213) 333-2645
Contact: Don McIntosh

The Valley Computer Club
2006 Magnolia Blvd.
Burbank, CA 91506
Meets: 1st Wed. 7 p.m.

VACUUM
277 E. 10th Ave.
Chico, CA 95926
(916) 891-8085
Contact: Mike Casella
Meets: 2nd Monday of month

Valley Computer Club
2006 Magnolia Blvd.
Burbank, CA
(213) 849-4094
Meets: 1st Wed of month, 6 pm

Valley Computer Club
1913 Booth Road
Ceres, CA 95307

Walnut Creek PET Users Club
1815 Ygnacio Valley Road
Walnut Creek, CA 94546

20/64
P.O. Box 18473
San Jose, CA 95158
(408) 978-0546
Meets: 1st Sun. of month (6-9 p.m.)

Colorado
Colorado Commodore
Computer Club
2187 S. Golden Ct.
Denver, CO 80121
(303) 986-0577
Meets: 2nd Wed.
Contact: Jack Moss

Commodore Users Group
Box 377
Aspen, CO 81612
(303) 925-5604
Meets: first Mon. evenings
Contact: Ray Brooks

VICKIMPET Users Group
4 Waring La.
Greenwood Village
Littleton, CO 80121
Contact: Louis Roehrs

Connecticut
The Commodore East Users Group
165 B S. Bigleow Rd.
Hampton, CT 06247
(203) 455-0108

Commodore User Club
Wethersfield High School
411 Wolcott Hill Road
Wethersfield, CT 06109
Contact: Daniel G. Spaneas

John F. Garbarino
Skiff Lane Masons Island
Mystic, CT 06355
(203) 536-9789

New London County
Commodore Club
Doolittle Rd.
Preston, CT 06360
Contact: Dr. Walter Doolittle

District of Columbia
USO Computer Club
USO Outreach Center
207 Beyer Rd. SW
Washington, D.C. 20332
Contact: Steven Guenther

Florida
Bay Commodore Users Group
c/o Gulf Coast Computer Exchange
241 N. Tyndal Pkwy.
P.O. Box 6215
Panama City, FL 32401
(904) 785-6441
Contact: Richard Scofield

Brandon Users Group
108 Anglewood Dr.
Brandon, FL 33511
(813) 685-5138
Contact: Paul Daugherty

Brandon Commodore Users Group
414 E. Lumsden Rd.
Brandon, FL 33511

Broward Commodore Users Group
13 Spinning Wheel Lane
Tamarac, FL 33319
(305) 726-4390
Contact: Lewis Horn

Commodore Computer Club
P.O. Box 21138
St. Petersburg, FL 33742
(813) 522-2547
Contact; Chuck Fechko

Commodore Computer Club
P.O. Box 9726
Jacksonville, FL 32208
(904) 764-5457
Contact: David Phillips
Meets: 2nd & 4th Tues of month

The Commodore Connection
P.O. Box 6684
West Palm Beach, FL 33405

Commodore Users Group
P.O. Box 21138
St. Petersburg, FL 33742
(813) 522-2547
Contact: Chuck Fechko

Commodore Users Group
545 E. Park Ave. Apt. #2
Tallahassee, FL 32301
(904) 224-6286
Contact: Jim Neill

El Shift OH
P.O.Box 548
Cocoa, FL 32922
Contact: Mike Schnoke
Meets: Sat. mornings every 4 to 6 weeks

Gainesville Commodore
Users Group
Santa Fe Community College
Gainesville, FL 32602
Contact: James E. Birdsell

Gainesville Commodore Users Club
3604-20A SW 31st Dr.
Gainesville, FL 32608
Contact: Louis Wallace

Jacksonville Area
PET Society
401 Monument Rd #177
Jacksonville, FL 32211

Miami 20/64
12911 S. W. 49th St.
Miami, FL 33175
(305) 226-1185

PETs and Friends
129 NE 44 St.
Miami, FL 33137
Contact: Richard Plumer

Richard Prestien
6278 SW 14th Street
Miami, FL 33144

South Florida PET
Users Group
7170 SW 11th
West Hollywood, FL 33023
(305) 987-6982
Contact: Dave Young

Suncoast 64S
c/o Little Professor Book Center
2395 U.S. 19 North
Palm Harbor, FL 33563
(813) 785-1036
Contact: Curtis Miller

Tampa Bay Commodore
Computer Club
10208 N. 30th St.
Tampa, FL 33612
(813) 977-0877

VIC/64 Heartland Users Group
1220 Bartow Rd. #23
Lakeland, FL 33801
(813) 666-2132
Contact: Tom Keough
Meets: 4th Wed. of month at PRC

64 Educators Users Group North
16330 N. E. 2nd Ave.
North Miami Beach, FL 33162
(305) 944-5548
Contact: Robert Figueroa

64 Educators Users Group South
FDLRS South
9220 S. W. 52nd Terrace
Miami, FL 33165
(305) 274-3501
Contact: Dr. Eydie Sloane

Georgia
Commodore Club of Augusta
1011 River Ridge Rd.
Apt. #14-A
Augusta, GA 30909
Contact: David Duman

Dataswapper Users Group
1794 Alabama Ave.
Albany, GA 31705
(912) 436-5596
Contact: David Via

Golden Isles Commodore
Users Club
Bldg. 68, FLETC
Glynco, GA 31524
Contact: Richard L. Young

Hawaii
Commodore Users Group of Honolulu
c/o PSH
824 Bannister St.
Honolulu, HI
(808) 848-2088
Meets: 3rd Fri. every month

Commodore Users Group of Honolulu
1626 Wilder #701
Honolulu, HI 96822
(808) 848-2088
Contact: Jay Calvin (808) 944-9380

20/64 Hawaii
P.O. Box 966
Kailua, HI 96734
Contact: Wes Goodpaster

Idaho
Commodore Users
548 E. Center
Pocatello, ID 83201
(208) 233-0670
Contact: Leroy Jones

Eagle Rock Commodore Users Group
900 S. Emerson
Idaho Falls, ID 83401
Contact: Nancy J. Picker

GHS Computer Club
c/o Grangeville High School
910 D Street
Grangeville, ID 83530
(208) 983-0580
Contact: Don Kissinger

S.R.H.S. Computer Club
c/o Salmon River H.S.
Riggins, ID 83549
Contact: Barney Foster

64 Bug (Boise Users Group)
P.O. Box 276
Boise, ID 83701
(208) 344-6302
Contact: John Rosecrans

Illinois
ASM/TED User Group
200 S. Century
Rantoul, IL 61866
(217) 893-4577
Contact: Brant Anderson

Central Illinois PET
User Group
635 Maple
Mt. Zion, IL 62549
(217) 864-5320
Contact: Jim Oldfield
Meets: 3rd Friday each month

Chicago Commodore 64
Users & Exchange Group
P.O. Box 14233
Chicago, IL 60614
Contact: Jim Robinson

Commodore 64 Users Group
P.O. Box 572
Glen Ellyn, IL 60137
(312) 790-4320
Contact: Gus Pagnotta

Commodore Users Club
1707 E. Main St.
Olney, IL 62450
Contact: David E. Lawless

Fox Valley PET Users Group
833 Willow St.
Lake in the Hills, IL 60102
(312) 658-7321
Contact: Art DeKneef

The Kankakee Hackers
RR #1, Box 279
St. Anne, IL 60964
(815) 933-4407
Contact: Rich Westerman

McHenry County Commodore Club
4900 S. Route 31
Crystal Lake, IL 60014
(815) 455-3942
Contact: John Katkus
Meets: 2nd Sat. of month 9 to 12 a.m.

Papug-Peoria Area Pet Users Group
6 Apple Tree Lane
East Peoria, IL 61611
(309) 673-6635
Contact: Max Taylor
Meets: 2nd Fri. of month

RAP 64/VIC Regional
Assoc. of Programmers
10721 S. Lamon
Oak Lawn, IL 60453
Contact: Bob Hughes

Rockford Area PET Users Group
1608 Benton Street
Rockford, IL 61107

VIC 20/64 Users Support Group
114 S. Clark St.
Pana, IL 62557
(217) 562-4568

Shelly Wernikoff
2731 N. Milwaukee Avenue
Chicago, IL 60647

WIPUG
Rt. 5, Box 75
Quincy, IL 62301
(217) 656-3671
Contact: Edward Mills

Indiana

Cardinal Sales
6225 Coffman Road
Indianapolis, IN 46268
(317) 298-9650
Contact: Carol Wheeler

CHUG (Commodore
Hardware Users Group)
12104 Meadow Lane
Oaklandon, IN 46236
Contact: Ted Powell

Commodore Computer Club
3814 Terra Trace
Evansville, IN 47711
(812) 477-0739
Contact: John Patrick, President

Commodore 64 Users Group
912 South Brown Ave.
Terre Haute, IN 47803
(812) 234-5099
Contact: Dennis Graham

Commodore Users Group
1020 Michigan Ave.
Logansport, IN 46947
(219) 722-5205
Contact: Mark Bender

Computer Workshop VIC 20/64 Club
282 S. 600 W.
Hebron, IN 46341
(219) 988-4535
Contact: Mary O'Bringer

The National Science Clubs of America
Commodore Users Division
7704 Taft St.
Merrillville, IN 46410
Contact: Brian Lepley or Tom Vlasic

Northern Indiana Commodore
Enthusiasts
927 S. 26th St.
South Bend, IN 46615
Contact: Eric R. Bean

PET/64 Users
10136 E. 96th St.
Indianapolis, IN 46256
(317) 842-6353
Contact: Jerry Brinson

Seymour Peekers
c/o D&L Camera Shop
108 N. Chestnut
Seymour, IN 47274
Contact: Dennis Peters

Iowa

Commodore Computer Users
Group of Iowa
Box 3140
Des Moines, IA 50316
(515) 263-0963 or (515) 287-1378
Contact: Laura Miller

Commo-Hawk Commodore
Users Group
P.O. Box 2724
Cedar Rapids, IA 52406
Contact: Vern Rotert

Commodore User Group
114 8th St.
Ames, IA 50010

PET Users Group
c/o Don Vorhies
1321 42 St., SE
Cedar Rapids, IA 52403

Quad City Commodore Club
1721 Grant Street
Bettendorf, IA 52722
(319) 355-2641
Contact: John Yigas

Siouxland Commodore Club
2700 Sheridan St.
Sioux City, IA 51104
(712) 258-7903
Contact: Gary Johnson
Meets: 1st & 3rd Monday of month

Commodore User Group
421 W. 6th St.
Waterloo, IA 50702
(319) 232-1062
Contact: Frederick Volker

Kansas

Commodore User Group
6050 S. 183 St. W.
Viola, KS 67149
Contact: Walter Lounsbery

Kansas Commodore Computer Club
101 S. Burch
Olathe, KS 66061
Contact: Paul B. Howard

Walnut Valley
Commodore Users Group
1003 S. 2nd St.
Arkansas City, KS 67005
Contact: Bob Morris

Wichita Area PET Users Group
2231 Bullinger
Wichita, KS 67204
(316) 838-0518
Contact: Mel Zandler

Kentucky

The Bowling Green
Commodore Users Group
Route 11, Creekside Apt. #6
Bowling Green, KY 42101
(502) 781-9098
Contact: Alex Fitzpatrick

Louisville Users
of Commodore KY (LUCKY)
P.O. Box 22244
Louisville, KY 40222
(502) 425-2847
Meets: 2nd Tues. of month

Louisiana

Ark-LA-TEX Commodore 64 Club
198 India Dr.
Shreveport, LA 71115
(318) 797-9702
Contact: Pete Whaley

Commodore 64 Users Group
P.O. Box 1422
Baton Rouge, LA 70821
Contact: Richard Hood
Meets: 3rd Tues. of month

Commodore Users Group of Oachita
P.O. Box 175
Swaric, LA 71281
(318) 343-8044
Contact: Beckie Walker

Franklin Parish Computer Club
#3 Fair Ave.
Winnsboro, LA 71295
Contact: James D. Mays, Sr.

NOVA
917 Gordon St.
New Orleans, LA 70117
(504) 948-7643
Contact: Kenneth McGruder, Sr.

64-Club News
5551 Corporate Blvd.
Suite 3L
Baton Rouge, LA 70808
(504) 766-7408
Contact: Tom Parsons
Meets: 3rd Tues of month. at CWA

Maine

COM-VICS
(Commodore/VIC Users Group)
RFD #1, Box 2086
Hebron, ME 04238
(207) 966-3641
Contact: Paul Lodge
Meets: 1st Wed. & 3rd Thurs.

Your Commodore Users Group
Box 611
Westbrook, ME 04092
(207) 854-4579
Contact: Mike Procise

Maryland

Association of Personal Computer Users
5014 Rodman Road
Bethesda, MD 20016

Blue TUSK
700 E. Joppa Rd.
Baltimore, MD 21204
Contact: Jim Hauff

Commodore Users Group of Annapolis
P.O. Box 9726
Arnold, MD 21012
(301) 974-4548

The Compucats' Commodore Computer Club
680 W. Bel Air Ave.
Aberdeen, MD 21001
(301) 272-0472
Contact: Betty Jane Schueler

House of Commodore
8835 Satyr Hill Rd.
Baltimore, MD 21234
Contact: Ernest J. Fischer

HUG (Hagerstown Users Group)
23 Coventry Lane
Hagerstown, MD 21740
(301) 797-9728
Contact: Joseph Rutkowski

Long Lines Computer Club
323 N. Charles St. Rm 201
Baltimore, MD 21201
Contact: Gene Moff

The Montgomery Ct. Commodore
Computer Society
P.O. Box 6444
Silver Springs, MD 20906
(301) 946-1564
Contact: Meryle Pounds

Rockville VIC/64 Users Group
P.O.Box 8805
Rockville, MD 20856
(301) 231-7823
Contact: Tom Pounds

VIC & 64 Users Group
The Boyds Connection
21000 Clarksburg Rd.
Boyds, MD 20841
(301) 428-3174
Contact: Tom DeReggi

Westinghouse BWI
Commodore User Group
Attn: L. Barron Mall Stop 5156
P.O. Box 1693
Baltimore, MD 21203

Massachusetts

Berkshire PET
Lovers CBO Users Group
Taconic High
Pittsfield, MA 01201

The Boston Computer Society
Three Center Plaza
Boston, MA 02108
(617) 367-8080
Contact: Mary E. McCann

Cape Code 64 Users Group
358 Forrest Rd.
S. Yarmouth, MA 02664
1 (800) 225-7136
Contact: Jim Close
(In MA. call) 1 (800) 352-7787

Commodore Users Club
Stoughton High School
Stoughton, MA 02072
Contact: Mike Lennon

Commodore 64 Users
Group of The Berkshires
184 Highland Ave.
Pittsfield, MA 01201
Contact: Ed Rucinski

The Cursor Club
442 Mulpuf Rd.
Lunenburg, MA 01462
(617) 582-0529

Masspet Commodore Users Group
P.O. Box 307
East Taunton, MA 02718
Contact: David Rogers

Pioneer Valley VIC/64 Club
34 Bates St.
Westfield, MA 01085
(413) 562-1027
Contact: Marvin Yale
Meets: 3rd Thurs. of month

Raytheon Commodore Users Group
Raytheon Company
Hartwell Rd. GRA-6
Bedford, MA 01730
Contact: John Rudy

Michigan

Ann Arbor Commodore Users Group
Ann Arbor, MI 48103
(313) 994-4751
Contact: Art Shaw
Meets: 3rd Tues 7:30-10:00

C.A.T.O.
17606 Valade
Riverview, MI 48192
Contact: Dean Tidewell

Commodore Computer Club
4106 Eastman Rd.
Midland, MI 48640
(517) 835-5130
Contact: John Walley
Meets: 9:30 p.m. Sept/May

Commodore User Club
32303 Columbus Drive
Warren, MI 48093
Contact: Robert Steinbrecher

Commodore Users Group
c/o Family Computer
3947 W 12 Mile Rd
Berkley, MI 48072

Commodore Users Group
c/o Eaton Rapids Medical Clinic
101 Spicerville Hwy.
Eaton Rapids, MI 48827
Contact: Albert Meinke III, MD

COMP
486 Michigan Ave.
Marysville, MI 48040
(313) 364-6804
Contact: M. Gauthier

DAB Computer Club
P.O. Box 542
Watervliet, MI 49098
(616) 463-5457
Contact: Dennis Burlingham

Debug
P.O. Box 196
Berrien Springs, MI 49103
(616) 471-1882
Contact: Herbert Edward
Meets: Last Thurs. of month

Jackson Commodore Computer Club
201 S. Grinnell St.
Jackson, MI 49203
Contact: Alfred Bruey
Meets: Last Thurs. of month 7:30 p.m.

David Liem
14361 Warwick Street
Detroit, MI 48223

SEM 64
25015 Five Mile #3
Redford, MI 48239
(313) 537-4163
Contact: Gary Groeller

SMCUG
1002 Pfau St.
Mankato, MI 56001
(507) 625-6942
Contact: Dean Otto

South Computer Club
South Jr. High School
45201 Owen
Belleville, MI 48111
Contact: Ronald Ruppert

South East Michigan Pet Users Group
Box 214
Farmington, MI 48024
Contact: Norm Eisenberg

Toledo PETs
734 Donna Drive
Temperance, MI 48182
Contact: Gerald Carter, Pres.

VIC Commodore Club
2765 Bristol Rd.
Bowling, MI 49050
Contact: Bill Kelley

VIC, 64, PET Users Group
8439 Arlis Rd.
Union Lake, MI 48085
(313) 363-8539
Contact: Bert Searing

West Michigan Commodores
c/o R. Taber
1952 Cleveland Ave., SW
Wyoming, MI 49509
(616) 458-9724
Contact: Gene Traas

Minnesota

Brainerd Area Commodore Users Group
1219 S. E. 11th St.
Brainerd, MN 56401
(218) 829-0805
Contact: Norm Saavedra
Meets: 1st Thurs. 6 p.m. & 3rd Sat. 10 a.m.

MUPET (Minnesota Users of PET)
P.O. Box 179
Annandale, MN 55302
Contact: Jon T. Minerich

Twin Cities Commodore Computer Club
6623 Ives Lane
Maple Grove, MN 55369
(612) 424-2425
Contact: Rollie Schmidt

Mississippi

Commodore Biloxi
User Group (ComBUG)
Universal Computer Services
3002 Hwy. 90 East
Ocean Springs, MS 39564
(601) 875-1173
Contact: John Lassen

Missouri

Clearwater Club
Clearwater School
Star Route
Piedmont, MO 63957
Contact: Carolyn Polk

Commodore User Group of St. Louis
Box 6653
St. Louis, MO 63125-0653
Dan Weidman, New Members
1541 Swallowtail Dr.
St. Louis, MO 63125

Joplin Commodore
Computers Users Group
422 S. Florida Ave.
Joplin, MO 64801
Contact: R. D. Connely

KCPUG (Commodore User Group of Kansas City)
P.O. Box 36492
Kansas City, MO 64111
(816) 252-7628
Contact: Salvadore

Mid-Missouri Commodore Club
1804 Vandiver Dr.
Columbia, MO 65201
(314) 474-4511
Contact: Phil Bishop

PETSET Club of St. Louis
1501 Carman Rd.
Manchester, MO 63011
(314) 527-3236
Contact: Ed or Til Keil

Worth County PET Users Group
Grant City, MO
(816) 564-3551
Contact: David Hardy

Montana
Commodore User Club
1109 West Broadway
Butte, MT 59701
Contact: Mike McCarthy

Powder River Computer Club
Powder River County High School
Broadus, MT 59317
Contact: Jim Sampson

Nebraska
Greater Omaha
Commodore 64 Users Group
2932 Leawood Dr.
Omaha, NE 68123
(402) 292-2753
Contact: Bob Quisenberry

Nevada
Compu Club 64
4220 S. Maryland Parkway
Bldg. B-Suite 403
Las Vegas, NV 89109
(702) 369-7354
Contact: Cindy Springfield

Las Vegas PET Users
Suite 5-315
5130 E. Charleston Blvd.
Las Vegas, NV 89122
Contact: Gerald Hasty

New Hampshire
C-64 U.S.E.R.S. (User
Software Exchange Pro)
P.O. Box 4022
Rochester, NH 03867
Contact: Paul Kyle

Northern New England
Computer Society
P.O. Box 69
Berlin, NH 03570

TBH VIC-NICs
P.O. Box 981
Salem, NH 03079

New Jersey
ACGNJ PET/VIC/CBM User Group
30 Riverview Terr.
Bell Mead, NJ 08502
(201) 359-3862
Contact: J. M. Pylka

Amateur Computer Group
18 Alpine Dr.
Wayne, NJ 07470

Commodore Friendly User Group
49 Hershey Rd.
Wayne, NJ 07470
(201) 696-8043
Contact: Rich Pinto/Colin Campbell

Educators Advisory
P.O. Box 186
Medford, NJ 08055
(609) 953-1200
Contact: John Handfield

Information 64
16 W. Ridgewood Ave.
Ridgewood, NJ 07450
(201) 447-4432
Contact: Dave Garaffa

Parsippany Computer Group
51 Ferncliff Rd.
Morris Plains, NJ 07950
(201) 267-5231
Contact: Bob Searing

Somerset Users Club
49 Marcy Street
Somerset, NJ 08873
Contact: Robert Holzer

South Jersey Commodore
Users Club
46-B Monroe Path
Maple Shade, NJ 08052
(609) 667-9758
Contact: Mark Orthner

New Mexico

Commodore Users Group
6212 Karlson, NE
Albuquerque, NM 87113
(505) 821-5812
Contact: Danny Byrne

New York

Adirondack Commodore 64
Users Group
205 Woodlawn Ave.
Saratoga Springs, NY
(518) 584-8960
Contact: Paul Klompas

Capital District 64/VIC 20
Users Group
363 Hamilton St.
Albany, NY 12210
(518) 436-1190
Contact: Bill Pizer

Commodore Computer Club
Publications Dept.
Grumman Aerospace
1111 Stewart Ave.
Bethpage, NY 11714
(516) 575-9558
Contact: Neil Threulsen

Commodore Masters
25 Croton Ave.
Staten Island, NY 10301
Contact: Stephen Farkouh

Commodore Users Group
1 Corwin P1
Lake Katrine, NY 12449
Contact: J. Richard Wright

The Commodore Users Group Rochester
78 Hardison Rd.
Rochester, NY 14617
(716) 544-5251
Contact: Tom Werenski
Phone evenings between 7-10

Commodore 64 Users Group
S.U.N.Y. at Oswego
Dept. of Industrial Arts
Oswego, NY 13126
Contact: John R. Boronkay

CTA CIV Users Group
183 Avondale Dr.
Centereach, NY 11720
Contact: Bernie Schlesinger

Finger Lakes Commodore Users Group
c/o Rose City Computer Associates
229 West Union St.
Newark, NY 14513
(315) 331-1185

Hello, Central!
76-12 35th Ave.
Jackson Heights, NY 11372
Contact: Jared Sherman

Hudson Valley Commodore Club
1 Manor Dr.
Woodstock, NY 12498
Contact: F.S. Goh
Meets: 1st Wed. of month

L&M Computer Club
VIC 20 & 64
4 Clinton St.
Tully, NY 13159
(315) 696-8904
Contact: Dick Mickelson

Long Island PET Society
Harborfields H.S.
Taylor Avenue
Greenlawn, NY 11740
Contact: Ralph Bressler

Manhattan 64
c/o Steve Lazarowitz
1440 Freeport Loop
Brooklyn, NY 11239
(212) 647-4266
Contact: Larry Thompson

New York Commodore Users Group
380 Riverside Dr. 7Q
New York, NY 10025
(212) 566-6250
Contact: Ben Tunkelang

New York 64 Users Group
222 Thompson St.
New York, NY 10012
(212) 673-7241
Contact: Bruce Cohen

PET Users Club of Westchester
Box 1280
White Plains, NY 10602
Contact: Ben Meyer

PUG of Rockland County
14 Hillside Ct.
Suffern, NY 10901
(914) 354-7439
Contact: Ross Garber

Rockland County Commodore
Users Group
P.O. Box 573
Nanuet, NY 10965
Contact: Ross Garber

SCUG (Schenectady Commodore
Users Group)
c/o the Video Connection
Canal Square
Schenectady, NY 12305
Contact: Timothy Davis
Meets: 1st Mon. of month

SuperPET User Group
4782 Boston Post Rd.
Pelham, NY 10803
Contact: Paul Skipski

VIC 20/Commodore 64 Users Group
31 Maple Dr.
Lindenhurst, NY 11757
(516) 957-1512
Contact: Pete Lobol

VIC 20/64 Users Group
NYU Waverly Place
New York, NY 10003
(212) 358-5155
Contact: Lawrence Schulman

North Carolina
Amateur Radio PET User's Group
P.O. Box 30694
Raleigh, NC 27622
Contact: Hank Roth

Commodore Users Club
4241 Castleton Road
Charlotte, NC 28211
Contact: Ed Harns

Down East Commodores
302 Belltown Rd.
Havelock, NC 28532
(919) 447-4536
Contact: Bruce Thedin

Microcomputer Users Group
Box 17142
Bethabara Sta.
Winston-Salem, NC 27116
Contact: Joel D. Brown

Raleigh VIC 20/64 Users Group
410-D Delta Court
Cary, NC 27511
(919) 469-3862
Contact: Larry Diener

Tyron Commodore 64 Club
P.O. Box 1016
Tyron, NC 28782
(704) 859-6340
Contact: Robin Michael
Meets: 1st Mon. of month at 7 p.m.

Ohio

Central Ohio PET Users Group
107 S. Westmoor Avenue
Columbus, OH 43204
(614) 274-0304
Contact: Philip H. Lynch

Chillicothe Commodore Users Group
P.O. Box 211
Chillicothe, OH 45601
Contact: William A. Chaney

Commodore Computer Club of Toledo
734 Donna Drive
Temperance, OH 48182
Contact: Gerald Carter

Commodore Users of Blue
Chip (Cincinnati)
816 Beecher St.
Cincinnati, OH 45206
(513) 961-6582
Contact: Ted Stalets

C.P.U. Connection
P.O. Box 42032
Brook Park, OH 44142
Contact: Danni Hudak

Dayton Area PET User Group
933 Livingston Drive
Xenia, OH 45385
(513) 848-2065
Contact: B. Worby, Pres.
(513) 848-2065 or
J. Watson, Secretary
(513) 373-2052

Licking County 64 Users Group
323 Schuler St.
Newark, OH 43055
(614) 345-1327

SE Cleveland Commodore Crazies
18813 Harlan Dr.
Maple Heights, OH 44137
(216) 581-3099
Contact: Carl Skala

Southwestern Ohio Commodore
Users Group
P.O. Box 399117
Cincinnati, OH 45239
Meets: 2nd Wed. of month at 7 p.m.

S.W.O.C.U.G. (SW Ohio
Commodore Users Gp.)
8401 Wicklow Ave.
Cincinnati, OH 45236
Contact: Joe Beresford

Strongville Commodore Club
11433 Pearl Rd.
Strongville, OH 44136
Contact: Paul M. Warner

Oklahoma

Commodore Oklahoma Users Club
4000 NW 14th St.
Oklahoma City, OK 73107
(405) 943-1370
Contact: Stanley B. Dow

Commodore Users
Box 268
Oklahoma City, OK 73101
Contact: Monte Maker, President

Commodore Users Group
Muskogee Computer Society
202 S. 12th St.
Muskogee, OK 74401
Contact: Steve Ford

Commodore Users of Norman
209 Brookwood
Noble, OK 73068
Contact: Matt Hager

Southwest Oklahoma Computer Club
c/o Commodore Chapter
P.O. Box 6646
Lawton, OK 73504
Meets: 1:30 at Lawton City Library

Tulsa Area Commodore Users Group
Tulsa Computer Society
P.O. Box 15238
Tulsa, OK 74112
Contact: Annette Hinshaw

Oregon

NW PET Users Group
2134 N.E. 45th Avenue
Portland, OR 97213
Contact: John F. Jones

Southern Oregon VIC/64
Users Group
3600 Madrona Lane
Medford, OR 97501
(503) 779-7631
Contact: James Powell

U.S. Commodore Users Group
P.O. Box 2310
Roseburg, OR 97470
(503) 672-7591
Contact: Richerd Tsukji

Pennsylvania

Bits & Bytes
1015 Dale Rd.
Secane, PA 19018
(215) 544-5875
Contact: Dave Boodey

Boeing Employees Personal
Computer Club
The Boeing Vertol Co.
P.O. Box 16858
Philadelphia, PA 19142
(215) 522-2257
Contact: Jim McLaughlin

Bucks County Commodore
User Group
72 East Rambler Drive
Holland, PA 18966
(215) 322-0394
Contact: Jim Dubrouillet

CACC (Capitol Area Commodore Club)
134 College Hill Rd.
Enola, PA 17025
(717) 732-2123
Contact: Lewis Buttery
Meets: Union Deposit Mall at 7 p.m.

CACCC-Centre Area Commodore
Computer Club
214 Computer Bldg.
University Park, PA 16802
(814) 237-5912
Contact: Bill Hillner

Clifton Heights Users Group
P.O. Box 235
Clifton Heights, PA 19018

Commodore Users Club
3021 Ben Venue Dr.
Greensburg, PA 15601
(412) 836-2224
Contact: Jim Mathers

The Commodore Users Club of
S.E. Pittsburgh
c/o Groves Appliance & TV
2407 Pennsylvania Ave.
West Mifflin, PA 15122
Contact: Charles Groves

Commodore Users Group
781 Dick Ave.
Waminster,PA 18974
Contact: Matt Matulaitis

Compstars
130 Blue Teal Circle
Audubon, PA 19403
Contact: Mike Norm
Meets: Audio Video Junct.

G/C Computer Owners Group
c/o Gilbert Associates, Inc.
P.O. Box 1498
Reading, PA 19607
Extension 6472
Contact: Jo Lambert (215) 775-2600

G.R.C. User Club
300 Whitten Hollow Rd.
New Kensington, PA 15068
Contact: Bill Bolt

Main Line Commodore Users Group (MLCUG)
c/o Main Line Computer Center
1046 General Allen Lane
West Chester, PA 19380
(215) 388-1581
Contact: Emil Volcheck

NADC Commodore Users Club
248 Oakdale Ave.
Horsham, PA 19044
Contact: Norman McCrary

Oxford Circle 64 Users Group
Frankford Cong. Un. Church Of Christ
Oxford Ave. & Pratt St.
Philadelphia, PA 19124
(215) 743-8999
Contact: Roger Nazeley (215) 535-9021
Meets: 4th Wed. of month

PACS Commodore Users Group
LaSalle College
20th & Olney Ave.
Philadelphia, PA 19141
(215) 951-1258
Contact: Stephen Longo

Penn Conference Computer Club
c/o Penn Conference of SDA
720 Museum Road
Reading, PA 19611
Contact: Dan R. Knepp

PET User Group
P.O. Box 371
Montgomeryville, PA 18936
Contact: Gene Beals

PPG (Pittsburgh PET Group)
2015 Garrick Dr.
Pittsburgh, PA 15235
(412) 371-2882
Contact: Joel A. Casar DMD

Commodore Group
Gene Planchak
4820 Anne Lane
Sharpesville, PA 15150
(412) 962-9682

Commodore Club
Glen Schwartz
807 Avon
Philadelphia, PA 19116

Scranton Commodore Users Group
P.O. Box 211
Clarks Summit, PA 18411

South Central PA Commodore Club
2109 Cedar Run Dr.
Camp Hill, PA 17011
(717) 763-4219
Contact: David Persing

Westmoreland Commodore Users Club
c/o DJ & Son Electronics
Colonial Plaza
Latrobe, PA 15650
Contact: Jim Mathers

Puerto Rico
CUG of Puerto Rico
RFD #1, Box 13
San Juan, PR 00914
Contact: Ken Burch

Rhode Island
Commodore Users Group
c/o Data Co.
978 Tiogue Ave.
Coventry, RI 02816
(401) 828-7385
Contact: Victor Moffett

Newport VIC/64 Users
10 Maitland Ct.
Newport, RI 02840
(401) 849-2684
Contact: Dr. Matt McConeghy

Commodore Club
Irving B. Silverman, CPA
160 Taunton Ave.
E. Providence, RI 02914
Contact: Michelle Chavanne

South Carolina
Beaufort Technical College
100 S. Ribaut Rd.
Beaufort, SC 29902
Contact: Dean of Instruction

Commodore Computer Club
of Columbia
318 Quincannon Dr.
Columbia, SC 29210
Contact: Buster White, Sect/Treas.

Computer Users Society of
Greenville (CUS)
Horizon Records-Home Computers
347 S. Pleasantburg Dr.
Greenville, SC 29607
(803) 235-7922
Contact: Bo Jeanes

Spartanburg Commodore
Users Group
803 Lucerne Dr.
Spartanburg, SC 29302
(803) 582-5897
Contact: James Pasley

South Dakota
PET User Group
515 South Duff
Mitchell, SD 57301
(605) 996-8277
Contact: Jim Dallas

VIC/64 Users Club
608 West 5th
Pierre, SD 57501
(605) 224-4863
Contact: Larry Lundeen

Tennessee
Commodore User Club
Metro Computer Center
1800 Dayton Blvd.
Chattanooga, TN 37405
Meets: Mondays 7:30 p.m.

Memphis Commodore Users Group
2476 Redvers Ave.
Memphis, TN 38127
(901) 358-5823
Contact: Harry Ewart

Metro-Knoxville Commodore Users Club
7405 Oxmoor Rd., Rt. #20
Knoxville, TN 37921
(615) 938-3773
Contact: Ed Pritchard

Nashville Commodore Users Group
P.O. Box 121282
Nashville, TN 37212
(615) 331-5408
Contact: Dave Rushing
Meets: 3rd Thurs. at Cumberland Mus.

River City Computer Hobbyists
Memphis, TN
Meets: 1st Mon. at Main Library

Texas
CHUG (Commodore Houston Users Group)
8738 Wildforest
Houston, TX 77088
(713) 999-3650
Contact: John Walker

Commodore Computer Club (C3)
c/o Lamar Full Gospel Assembly
1200 S. Sumner
Pampa, TX 79065
(806) 665-3444
Contact: Randy Mills
Meets: every other Thursday 7 p.m.

Commodore Users Group
5326 Cameron Rd.
Austin, TX 78723
(512) 459-1220
Contact: Dr. Jerry D. Frazee

Corpus Christi Commodores
3650 Topeka St.
Corpus Christi, TX 78411
(512) 852-7665
Contact: Bob McKelvy

Gulf Coast Commodore Users Group
P.O. Box 128
Corpus Christi, TX 78403
(512) 887-4577
Contact: Lawrence Hernandez

Interface Computer Club
814 North Sabinas
San Antonio, TX 78207
Contact: M.E. Garza, President

ICUG (Irving Commodore
Users Group)
3237 Northgate #1289
Irving, TX 75062
(214) 252-7017
Contact: Robert Hayes

Mid-Cities Commodore Club
413 Chisolm Trail
Hurst, TX 76053
Contact: Garry Wordelmen
/Bruce Nelson

PET Users
2001 Bryan Tower
Suite 3800
Dallas, TX 75201

PET User Group
Texas A & M
Microcomputer Club
Texas A & M, TX
Contact: John Bowen

Savid Computer Club
312 West Alabama Suite 2
Houston, TX 77006
Contact: Davi Jordan, Chairman

Larry Williams
P.O. Box 652
San Antonio, TX 78293

64 Users Group
2421 Midnight Circle
Plano, TX 75075
Contact: S. G. Grodin

Utah
The Commodore Users Club
742 Taylor Avenue
Ogden, UT 84404
Contact: Todd Woods Kap/David Shreeve

The Commodore Users Group
652 West 700 North
Clearfield, UT 84015
(801) 776-3950
Contact: Rodney Keller, Richard Brenchly

Mountain Computer Society
P.O. Box 1154
Sandy, UT 84091
Contact: Dave Tigner

Northern Utah VIC & 64 Users Group
P.O. Box 533
Garland, UT 84312
Contact: David Sanders

Utah PUG
2236 Washington Blvd.
Ogden, UT 84401
Contact: Jack Fleck

Virginia
Commodore Users of Franklin
1201 N. High St.
Franklin, VA 23851
(804) 562-6823
Contact: D. Bruce Powell

Dale City Commodore Users Group
P.O. Box 2004
Dale City, VA 22193
(703) 680-2270
Contact: James Hogler

Fredericksburg Area Computer Enthusiasts
P.O. Box 324
Locust Grove, VA 22508
(703) 972-7195
Contact: Michael Parker

Norfolk Users Group
1030 West 43rd St. B-4
Norfolk, VA 23508
(804) 489-8292
Contact: Larry Pearson

Northern VA PET Users
2045 Eakins Court
Reston, VA 22091
(703) 860-9116
Contact: Bob Karpen

Peninsula Commodore 64 Users Group
124 Burnham Place
Newport News, VA 23606
(804) 595-7315
Contact: Richard G. Wilmoth

R.A.C.E. Commodore Users Group
4726 Horseman Dr.
Roanoke, VA 24091
(703) 362-3960
Contact: Larry Rackow

Tidewater Commodore Users Group
4917 Westgrove Rd.
Virginia Beach, VA 23455
Contact: Fred Monson

Danville Commodore Club
135 Beverley Rd.
Danville, VA 24541
Contact: David Gray

Washington

Blue Mountain Commodore Users Club
15 Stone St.
Walla Walla, WA 99362
(509) 525-5452
Contact: Keith Rodue

CBM Users Group
803 Euclid Way
Centralia, WA 98531
(206) 736-4085
Contact: Rick Beaber

Central Washington Commodore Users Group
1222 S. 1st St.
Yakima, WA 98902
Contact: Tim McElroy

Computer Club
c/o Honeywell, Inc.
5303 Shishole Ave. NW
Seattle, WA 98107
(206) 789-2000
Contact: John Goddard

NW PET Users Group
2565 Dexter N. 3203
Seattle, WA 98109
Contact: Richard Ball

PET Users Group
1800 Taylor Ave., N102
Seattle, WA 98102
Contact: Kenneth Tong

Spokane Commodore User Group
N. 4311 Whitehouse
Spokane, WA 99205
(509) 328-1464
Contact: Stan White

Whidbey Island Commodore Computer Club
947 N. Burroughs Ave.
Oak Harbor, WA 98277
Contact: Michael D. Clark

West Virginia

Commodore User Group
73 Pine Hill Estates
Kenova, WV 25530
(304) 453-2124
Contact: Marc Hutton

Personal Computer Club
P.O. Box 1301
Charleston, WV 25235
Contact: Cam Cravens

TriState Commodore Users
73 Pine Hill Estates
Kenova, WV 25530
Contact: Marc Hutton

Wisconsin

C.L.U.B. 84
6156 Douglas Ave.
Caledonia, WI 53108
(414) 835-4645 pm
Contact: Jack White
Meets: 2nd Sat. every month 10 a.m.

Commodore 64 Software Exchange Group
P.O. Box 224
Oregon, WI 53575
Contact: E. J. Rosenber

Commodore User Group
1130 Elm Grove St.
Elm Grove, WI 53122
Contact: Tony Hunter

C.U.S.S.H.
3614 Sovereign Dr.
Racine, WI 53406
(414) 554-0156
Contact: Tim Tremmel
Meets: 3rd Sat. of month

The Eau Claire CBM64 Users Group
Rt. 5, Box 179A
Eau Claire, WI 54703
(715) 874-5972
Contact: John Slavsky, Jr.
Meets: 2nd Thurs. 7 p.m.

Madison Area Commodore Users Group
1552 Park St.
Middleton, WI 53562
(608) 831-4852
Contact: John Carvin
Meets: 3rd Thurs. each month

Menomonie Area Commodore Users Group
510 12th St.
Menomonie, WI 54751
(715) 235-4987
Contact: Mike Williams

Milwaukee Area CBM64 Enthusiasts (M.A.C.E.)
P.O. Box 340
Elm Grove, WI 53122
(414) 259-5991
Contact: Kevin Wilde

Sewpus
c/o Theodore J. Polozynski
P.O. Box 21851
Milwaukee, WI 53221

S.W.I.T.C.H.
W156 N8834 Pilgrim Rd.
Menomonie Falls, WI 53051
(414) 255-7044
Contact: Len Lutz

VIC-20 & 64 User Group
522 West Bergen Dr.
Milwaukee, WI 53217
(414) 476-8125
Contact: Mr. Wachtl

Waukesha Area Commodore Users Group
256 ½ W. Broadway
Waukesha, WI 53186
(414) 547-9391
Contact: Walter Sadler

WAVE
P.O. Box 0641
Waukesha, WI 53187

Wyoming
Commodore Users Club
c/o Video Station
670 North 3rd #B
Laramie, WY 82070
(307) 721-5908
Contact: Pamela Nash

Australia
WA VIC-Ups (VIC-20/CBM 64 Users)
14 Glengariff Dr.
Floreat Park 6014
Western Australia
Contact: B. J. Cook

Austria
Commodore Users Club
Postfach 5026
Salzburg
Austria
062-222-5391
Contact: D.A. Stagg

Canada
Arva Hackers
Medway High School
Arva, Ontario
Canada NOM 1CO
Contact: D. Lerch

Calgary Commodore Users Group
37 Castleridge Dr. N.E.
Calgary, Alberta
Canada T3J 1P4
Contact: John Hazard

CCC (Canadian Commodore
Computer Club)
c/o Strictly Commodore
47 Coachwood Place
Calgary, Alberta
Canada T3H 1E1
Contact: Roger Olanson

Commodore Users Club of Sudbury
938 Brookfield Ave.
Sudbury, Ontario
Canada P2A 4K4

COMVIC
P.O. Box 1688
St. Laurent
Montreal, Quebec
Canada H4L 4Z2

Fledging Barrie User Group (BUG)
58 Steel St.
Barrie, Ontario
Canada L4M 2E9

Nova Scotia Commodore Computer
Users Group
66 Landrace Cres.
Dartmouth, N.S.
Canada B2W 2P9
Contact: Andrew Cornwall

PET Educators Group
P.O. Box 454
Station A
Windsor, Ontario
Canada N9A 6L7

PET Users Club
R.R 6
Simcoe, Ontario
Canada N3Y 4K5

PET Users Club
c/o Mr. Brown
Valley Heights Secondary School
Box 159
Langton, Ontario
Canada NOE 1G0

Toronto Pet Users Group Inc.
1912A Avenue Rd., Ste 1
Toronto, Ontario
Canada M5M 4A1
(416) 782-8900 or
(416) 782-9252
Contact: Chris Bennett

Vancouver PET Users Group
P.O. Box 91164
West Vancouver, British Columbia
Canada V7V 3N6

W.P.U.G.
9-300 Enniskillen Ave.
Winnipeg, Manitoba
Canada R2V 0H9
Contact: Larry Neufeld

Germany
Kettenberg 24
D 5880 Lueden Scheid
West Germany
Contact: Rudy Ferrari

Italy
Commodore 64 Club
Universita di Studi shan
V. Avigliana 13/1
10138 Torino
Italy

Korea
Commodore Users Club
K.P.O. Box 1437
Seoul, Korea
Contact: S.K. Cha

Mexico
Asociacion De Usarios Commodore
c/o Alejandro Lopez
Arechiga
Holbein 174-6 Piso
Mexico 18, D.F.

Club de Usarios Commodore
Sigma del Norte
Mol del Valle, Local 44
Garza Garcia, N.L.
Mexico 66220

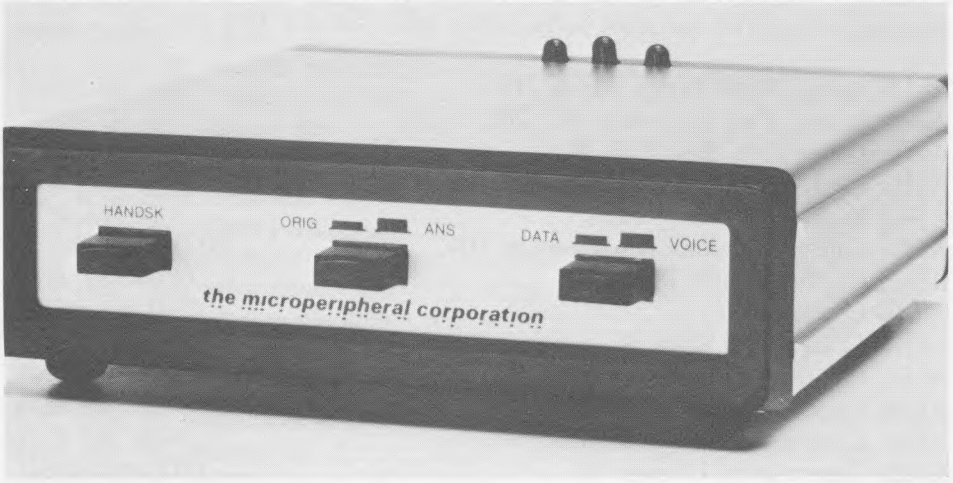
New Zealand
Commodore Users Group
Meet at VHF Clubrooms
Hazel Ave.
Mount Roskill
New Zealand
Meets: 3rd Wed. of month, 7:30 p.m.
Contact: Roger Altena 278-5262

E.R. Kennedy
c/o New Zealand Synthetic
Fuels Corp, Ltd.
Private Bag
New Plymouth
New Zealand

United Kingdom
Croydon Microcomputer Club
111 Selhurst R.
Selhurst, London SE25 6LH
01-653-3207
Contact: Vernon Gifford

North London Hobby Computer Club
Dept. of Electronics &
Communications Engineering
The Polytechnic of North London
Holloway Rd.
London N7 8D8
England

Appendix C



Bulletin Boards

PUBLIC ACCESS MESSAGE (and file transfer) SYSTEMS
(P.A.M.S.)

Compliments of Peoples' Message System, Santee CA.
(6 1 9) 5 6 1 - 7 2 7 7
Compiled and maintained by Bill Blue
(with a lot of help from his friends)

Please send updates/corrections to:
P M S Santee, TCB117, 70315,1305 or BBLUE

*	denotes 24-hour operation
+	denotes 8-12 hour DAYTIME operation ONLY
–	denotes 8-12 hour NIGHTTIME operation ONLY
!	new system or new number to existing system
$	Supports VADIC 1200 baud operation
&	Supports 212A 1200 baud operation
%	Supports BAUDOT operation
#1	denotes original system of that type
dd.	denotes game oriented messages
dl.	download/program exchange system
ml.	mail/information exchange only
rb.	denotes call, let ring once and call back

rl. religious orientation
so. sexually oriented messages

Regular updates of this list may be found on CompuServe MAUG XA4, The Source PUBLIC 112, and most participating independent P M S systems.

ABBS Akron Digital Group, Akron, OH .....(216) 745 7855*
ABBS Analog, Port Coquitlam, BC, CN .....! (604) 941 0041*
ABBS Apple-Mate, New York, NY.....(201) 864 5345
ABBS Byte Shop, Ft. Lauderdale, FL.....(305) 486 2983
ABBS Byte Shop, Miami, FL.....(305) 261 3639
ABBS Calvary Mission Church, Mnpls, MN.....(612) 472 3985*rl.
ABBS CCNJ, Pompton Plains, NJ .....(201) 835 7228
ABBS Charlotte, NC .....(704) 364 5245*
ABBS CODE, Glen Ellyn, IL .....(312) 882 2926*
ABBS Colortron Computer, Racine, WI.....(414) 637 9990*
ABBS Compumart, Ottawa, Ontario, CN.....(613) 725 2243
ABBS Computer Room, Kalamazoo, MI.....(616) 382 0101
ABBS Gamemaster, Chicago, IL .....(312) 475 4884*
ABBS Ketchikan, AK.....(907) 225 6789
ABBS LINX, Lincoln, NE.....(402) 476 1177*dl.
ABBS New York, NY.....! (516) 473 1005*
ABBS New York, NY.....! (212) 877 7703*
ABBS Nessy Game System, Itasca, IL.....(312) 773 3308*
ABBS Nessy Flynn's BBS, Crystal Lake, IL.....(815) 455 2406
ABBS Omaha, NE .....(402) 339 7809
ABBS Pacific Palisades, Los Angeles, CA .....(213) 459 6400
ABBS Peoria, IL.....(309) 692 6502
ABBS Phoenix, AZ .....(602) 898 0891
ABBS Pirates Cove, Long Island, NY .....(516) 698 4008
ABBS Rogers Park, Chicago, IL .....(312) 973 2227
ABBS Software Sorcery, Herndon, VA.....&(703) 471 06101
ABBS South of Market, San Francisco, CA .....(415) 469 8111 so.
ABBS The Pulse, Dallas, TX.....(214) 631 7747*so.
ABBS Teledunjon III, Dallas, TX.....(214) 960 7654
ABBS Turnersville, NJ .....(609) 228 1149
ABBS Vancouver, BC, CN.....(604) 437 7001
ABBS Vermont, Essex Junction, VT .....(802) 879 4981*
ABBS Video Adv. Movie Marquee, Evanston, IL.....(312) 475 5282
ABBS West Palm Beach, FL .....(305) 848 3802
ACS Arlington Heights, IL.....#1 (312) 392 2403
ACS Chicago, IL.....(312) 445 1130
A-C-C-E-S-S Annapolis, MD .....(301) 267 7666*
A-C-C-E-S-S Phoenix, AZ .....&(602) 957 4428*
A-C-C-E-S-S Call-A-Lawyer, Phoenix, AZ .....(602) 275 6644
A-C-C-E-S-S Scotsdale, AZ.....(602) 998 9411*
A-C-C-E-S-S Wyckoff, NJ.....(201) 891 7441*

AMIS A.R.C.A.D.E. Sterling Heights, MI .....(313) 978 8087*
AMIS Clarendon Hills, IL .....(312) 789 3610*
AMIS GRAFEX Cupertino, CA .....(408) 253 5216
AMIS G.R.A.S.S. Grand Rapids, MI .....(616) 241 1971*
AMIS IBBBS San Jose, CA .....(408) 298 6930
AMIS M.A.C.E. Detroit, MI .....#1! (313) 589 0996*
AMIS T.A.B.B.S. Sunnyvale, CA .....(408) 942 6975
ARMUDIC Washington, DC .....#1 (202) 276 8342
ARMUDIC Computer Age, Baltimore, MD .....(301) 587 2132
BBS IBM Hostcomm Atlanta, GA .....(404) 252 4146
BBS IBM Hostcomm Fairfax, VA .....(703) 978 9592*
BBS IBM Hostcomm Fairfax, VA .....!(703) 385 7373*
BBS IBM Hostcomm Fairfax, VA .....!(703) 385 8384*
BBS IBM Hostcomm Springfield, VA .....(703) 425 7229*
BBS IBM Hostcomm Houston, TX .....(713) 890 0310*
BBS IBM Hostcomm Toronto, Ontario, CN .....(416) 499 7023*
BBS IBM PC Annandale, VA .....(703) 560 0979*
BBS IBM PC Atlanta, GA .....!(404) 928 3005
BBS IBM PC Atlanta, GA .....(404) 252 9438*
BBS IBM PC Beltsville, MD .....(301) 937 4339*
BBS IBM PC Bethesda, MD .....(301) 460 0538*
BBS IBM PC Charlotte, NC .....(704) 365 4311*
BBS IBM PC Computer Society, Boston, MA .....(617) 353 9312-
BBS IBM PC Culver City, CA .....&(213) 649 1489*
BBS IBM PC Niles, IL .....(312) 991 8887*
BBS IBM PC Dale City, VA .....(703) 680 5220*
BBS IBM PC Gaithersburg, MD .....(301) 251 6293*
BBS IBM PC Great Falls, VA .....&(703) 759 5049*
BBS IBM PC Madison, WI .....(608) 262 4939*
BBS IBM PC Rockville, MD .....(301) 949 8848*
BBS IBM PC Vienna, VA .....(703) 560 7803*
BBS IBM PCmodem Chicago, IL .....&(312) 882 4227*
BBS IBM PCmodem Chicago, IL .....(312) 376 7598*
BBS IBM PC SIG, San Diego, CA .....!(619) 268 0437*
BULLET-80 Boston, MA .....&(617) 266 7789*
BULLET-80 Chesterland, OH .....(216) 729 2769
BULLET-80 Danbury, CT .....#1(203) 744 4644
BULLET-80 El Paso, TX .....(915) 565 9903*
BULLET-80 Fayetteville, GA .....(404) 461 9686
BULLET-80 Hattiesburg, MS .....(601) 264 2361*
BULLET-80 Holstein, IA .....(712) 368 2651
BULLET-80 Langhorne, PA .....(215) 364 2180
BULLET-80 New York, NY .....(212) 740 5680*
BULLET-80 Orange County, Anaheim, CA .....(714) 952 2110
BULLET-80 Seymour, CT .....(203) 888 7952
BULLET-80 Springfield, IL .....(217) 529 1113

BULLET-80 Waterford, MI.....!(313) 628 4350*
BULLET-80 Pirate Place, Newport Beach, CA.....(714) 644 7942
CBBS AMRAD, Washington, DC .....(703) 734 1387*
CBBS Aurora Computer Peripherals, Aurora, CO .....(312) 897 9037*
CBBS Baton Rouge, LA.....(504) 273 3116*
CBBS Boston, MA.....(617) 646 3610*
CBBS Cedar Rapids, IA .....(319) 364 0811*
CBBS Chicago, IL .....#1(312) 545 8086*
CBBS CPEUG/ICST Gaithersburg, MD .....(301) 948 5717
CBBS Lambda, Berkeley, CA.....(415) 658 2919 so.
CBBS Lawrence General Hospital, Boston, MA.....(617) 683 2119
CBBS LICA LIMBS, Long Island, NY.....(516) 561 6590*
CBBS London, England . . (European standard) .....(044) 1 399 2136
CBBS Long Island, NY.....(516) 334 3134*
CBBS MAUDE Milwaukee, WI .....(414) 241 8364*
CBBS MicroStar, Worcester, MA.....(617) 752 7284
CBBS NW, Portland, OR .....(503) 646 5510*
CBBS PACC, Pittsburgh, PA .....(412) 822 7176*
CBBS Prince George, B.C., CN.....(604) 562 9515
CBBS Proxima, Berkeley, CA .....(415) 357 1130
CBBS RAMS, Rochester, NY .....(716) 244 9531
CBBS Rosemont, MN.....(612) 423 5016
CBBS St. Petersburg, FL.....(813) 866 9945*
CBBS Strictly Software, Honolulu, HI .....(808) 944 0562
CBBS TSG, Tucson, AZ.....!(602) 574 0327*
COMNET-80 Akron, OH.....&(216) 645 0827*
COMNET-80 Las Vegas, NV.....&(702) 870 9986
COMNET-80 Mt. Clemens, MI.....&(313) 465 9531
COMNET-80 North Wales, PA.....(215) 855 3809 so.
COMNET-80 Riverside, CA .....&(714) 359 3189
COMNET-80 Riverside, CA .....&(714) 877 2253
COMNET-80 Wichita Falls, TX.....(817) 767 5847
CONNECTION-80 Centereach, NY .....(516) 588 5836
CONNECTION-80 Fremont, CA.....(415) 651 4147*
CONNECTION-80 Gaithersburg, MD .....!(301) 946 1252*
CONNECTION-80 JACS, Jacksonville, FL .....(904) 353 5227*
CONNECTION-80 Lansing, MI .....(517) 339 3367
CONNECTION-80 Laval BELE, Laval, Quebec, CN .....(514) 622 1274*
CONNECTION-80 Manhattan, NY.....(212) 991 1664
CONNECTION-80 Orlando, FL .....(305) 644 8327*
CONNECTION-80 Peterborough, NH.....(603) 924 7920
CONNECTION-80 Winter Garden, FL.....(305) 894 1886*
CONNECTION-80 Woodhaven, NY.....(212) 441 3755*
CONNECTION-80 Tampa, FL.....(813) 977 0989
CONFERENCE-TREE Berkeley, CA .....(408) 475 7101
CONFERENCE-TREE Computerland, Honolulu, HI .....(808) 487 2001*

CONFERENCE-TREE Cookville, TN.....!(615) 528 5039*
CONFERENCE-TREE Flagship, Rockaway, NJ.....(201) 627 5151*
CONFERENCE-TREE Hayward, CA.....(415) 538 3580
CONFERENCE-TREE Kelp Bed, Los Angeles, CA.....(213) 372 4800
CONFERENCE-TREE Minneapolis, MN.....(612) 854 9691
CONFERENCE-TREE Phoenix, AZ.....(602) 931 1829*
CONFERENCE-TREE San Francisco, CA.....#1(415) 861 6489
CONFERENCE-TREE Santa Monica, CA.....(213) 394 1505
CONFERENCE-TREE Sausalito, CA.....(415) 332 8115
CONFERENCE-TREE Tacoma, WA.....!(206) 759 0615*
DIAL-YOUR-MATCH #1.....(213) 842 3322 so.
DIAL-YOUR-MATCH #3.....(912) 233 0863 so.
DIAL-YOUR-MATCH #4.....(213) 783 2305 so.
DIAL-YOUR-MATCH #8, San Francisco, CA.....(415) 467 2588 so.
DIAL-YOUR-MATCH #9.....(213) 345 1047 so.
DIAL-YOUR-MATCH #11, Carlsbad, CA.....(619) 434 4600*so.
DIAL-YOUR-MATCH #12, Houston, TX.....(713) 556 1531*so.
DIAL-YOUR-MATCH #14.....(201) 272 3686 so.
DIAL-YOUR-MATCH #16.....(206) 256 6624 so.
DIAL-YOUR-MATCH #17.....(415) 991 4911 so.
DIAL-YOUR-MATCH #18.....(617) 334 6369 so.
DIAL-YOUR-MATCH #20.....(919) 362 0676 so.
DIAL-YOUR-MATCH #21, Freehold, NJ.....(201) 462 0435 so.
DIAL-YOUR-MATCH #22.....(213) 990 6830 so.
DIAL-YOUR-MATCH #23, Omaha, NE.....(402) 571 8942 so.
DIAL-YOUR-MATCH #26, Clovis, CA.....(209) 298 1328 so.
DIAL-YOUR-MATCH #33, Poway, CA.....(619) 748 8746*so.
DIAL-YOUR-MATCH #37, Flint, MI.....(313) 736 1398 so.
DIAL-YOUR-MATCH #38, Austin, TX.....(512) 451 8747 so.
DIAL-YOUR-MATCH #39, Chicago, IL.....(312) 243 1046 so.
DIAL-YOUR-MATCH #46,.....!(318) 222 2032-so.
FORUM-80 Augusta, GA.....(803) 279 5392
FORUM-80 Cleveland, OH.....&(216) 486 4176
FORUM-80 El Paso, TX.....(915) 755 1000*
FORUM-80 Ft. Lauderdale, FL.....(305) 772 4444*
FORUM-80 Hull, England.....(011) 44 482 859169
FORUM-80 Kansas City, MO.....&(816) 931 9316
FORUM-80 Las Vegas, NV.....(702) 362 3609*
FORUM-80 Linden, NJ.....(201) 486 2956*
FORUM-80 Medford, OR.....(503) 535 6883*
FORUM-80 Medical, Memphis, TN.....(901) 276 8196*
FORUM-80 Monmouth, Brielle, NJ.....(201) 974 1196*
FORUM-80 Montgomery, AL.....(205) 272 5069
FORUM-80 Prince William County, VA.....(703) 670 5881*
FORUM-80 San Mateo, CA.....&(415) 348 2139
FORUM-80 Seattle, WA.....(206) 723 3282

FORUM-80 Sierra Vista, AZ.....(602) 458 3850*
FORUM-80 Westford, MA.....(617) 692 3973
FORUM-80 Wichita, KS.....&(316) 682 2113*
GABBS Armadillo Media, Houston, TX.....(713) 444 7098*
GABBS Food for Thought, Omaha, NE.....!(402) 551 4618*
GABBS Mindstore, Terre Haute, IN.....!(812) 235 0909*
GABBS The Great Apple, Houston, TX.....(713) 455 9502*
GABBS Vox Populi, Houston, TX.....!(713) 772 6096*
GREENE MACHINE Golden State BBS, Novato, GA.....(415) 897 2783
GREENE MACHINE Riverside, CA.....(714) 354 8004
GREENE MACHINE Chicago, IL.....(312) 622 4442 so.
GREENE MACHINE Corsair, WPB, FL.....(305) 968 8653
GREENE MACHINE Rome, NY.....(315) 337 7720
GREENE MACHINE Sunnymead, CA.....!(714) 924 2229*
GREENE MACHINE Yuma, AZ.....&(602) 726 7533*
HBBS Heath/Zenith, Grand Rapids, MI.....&(616) 531 0890
HBBS MOG-UR, Granada Hills, CA.....&(213) 366 1238*
MCMS C.A.M.S. Chicago, IL.....#1&(312) 927 1020*
MCMS J.A.M.S. Lockport, IL.....(815) 838 1020*
MCMS P.C.M.S. Wheaton, IL.....&(312) 462 7560*
MCMS Goliath, Minneapolis, MN.....(612) 753 3082
MCMS NC Software, Minneapolis, MN.....(612) 533 1957*
MCMS WACO Hot Line, Schaumburg, IL..<pvt>.....(312) 351 4374*
MCMS Word Exchange, Springfield, IL.....(217) $53 4309*
NET-WORKS ABC, Kansas City, MO.....(816) 483 2526
NET-WORKS Adventure's Inn, Lake Forest, IL.....(312) 295 7284*
NET-WORKS AGS, Augusta, GA.....(404) 733 3461*
NET-WORKS Apple Gumbo, Shreveport, LA.....(318) 861 1012*
NET-WORKS Apple Juice, Drien, IL.....(312) 685 9573
NET-WORKS Apple Net, Chicago, IL.....(312) 963 5384
NET-WORKS Apple-Technical, Chicago, IL.....(312) 935 3091
NET-WORKS Armadillo, Grand Forks, ND.....(701) 746 4959
NET-WORKS Assembly Line, Louisville, KY.....(502) 459 5531-
NET-WORKS Asylum, Edwardsville, IL.....(618) 692 0742
NET-WORKS Baud-ville, Louisville, KY.....(502) 423 0695-
NET-WORKS Beach BBS, Pensacola, FL.....(904) 932 8271
NET-WORKS Big Apple, Miami, FL.....(305) 948 8000
NET-WORKS Briar-Net, Houston, TX.....(713) 782 5706*
NET-WORKS Brooklyn, NY.....(212) 410 0949
NET-WORKS C.A.M.S., Decautur, IL.....!(217) 875 7114*
NET-WORKS Charleston, WV.....(304) 345 8280
NET-WORKS Chipmunk, Hinsdale, IL.....(312) 323 3741*
NET-WORKS Coin Games, Los Angeles, CA.....(213) 336 5535
NET-WORKS COMM Center NW3NAGAD, Laurel, MD.....(301) 953 3341
NET-WORKS Computer Market, Honolulu, HI.....(808) 524 6668-
NET-WORKS Computer Pro, Ft. Worth, TX.....(817) 732 1787

NET-WORKS Computer World, Los Angeles, CA.....(213) 859 0894*
NET-WORKS Dayton, OH.....(513) 223 3672
NET-WORKS Eclectic Computer Sys., Dallas, TX.....(214) 239 5842
NET-WORKS Fourth Dimension, St. Louis, MO.....(314) 532 4652
NET-WORKS GBBS Metro Detroit, MI.....(313) 455 4227 so.
NET-WORKS Greenfield, IN.....!(317) 326 4152*
NET-WORKS Honolulu, HI.....!(808) 524 6652
NET-WORKS Hawaii Connection, Honolulu, HI.....(808) 423 1593*
NET-WORKS Jolly Roger, Houston, TX.....(713) 468 0174*
NET-WORKS Livingston, NJ.....(201) 994 9620*
NET-WORKS MAGIE, Galesburg, IL.....(309) 342 7178
NET-WORKS Magnetic Fantasies, Los Angeles, CA.....(213) 388 5198
NET-WORKS MicroBBS, Chelmsford, MA.....!(617) 889 4330
NET-WORKS Micro Ideas, Glenview, IL.....(312) 998 5066
NET-WORKS Mines of Moria, Houston, TX.....(713) 871 8577*
NET-WORKS N A G S, Alton, IL.....(618) 466 9497
NET-WORKS Nick Naimo, Newburgh, IN.....#1(812) 858 5405
NET-WORKS Pirate's Harbor, Boston, MA.....(617) 720 3600
NET-WORKS Pirate's Harbor, Cambridge, MA.....(617) 494 1985
NET-WORKS Pirate's Lodge, New City, NY.....(914) 634 1268
NET-WORKS Portsmouth, NH.....(603) 436 3461
NET-WORKS RJNET, Warnville, IL.....(312) 393 4755
NET-WORKS Softworx, West Los Angeles, CA.....(213) 473 2754
NET-WORKS The Dark Realm, Houston, TX.....(713) 333 2309*dd.
NET-WORKS The Dragon's La r NW, San Jose, CA.....(408) 996 7464
NET-WORKS The Shadow World, Houston, TX.....(713) 777 8608*
NET-WORKS The Silver Tongue, St. Joseph, MO.....(816) 232 3153
NET-WORKS The System, Houston, TX.....(713) 785 7996-
NET-WORKS The Weekender, Houston, TX.....(713) 492 8700*
NET-WORKS Toronto, Ontario, CN.....(416) 445 6696*
NET-WORKS Warlock's Castle St. Louis, MO.....(618) 345 6638
NET-WORKS Zachary*Net, Houston, TX.....(713) 933 7353*
ONLINE Dickinsons Movie Guide, Mission, KS.....(913) 432 5544*
ONLINE Omega, Chicago, IL.....(312) 648 4867*
ONLINE Saba, San Diego, CA.....(619) 692 1961*
P.dBMS #1 - Lakeside, CA.....$&(619) 561 7271*ml.
P.dBMS #2 - Denver, CO.....$&!(303) 755 5380*ml.
PET BBS Commodore, Largo, FL.....(813) 391 5219+
PET BBS Commodore, Chicago, IL.....(312) 397 0871*
PET BBS AVC Comline, Indianapolis, IN.....(317) 255 5435*
PET BBS S.E.W.P.U.G., Racine, WI.....(414) 554 9520*
PET BBS SE Wyoming PUG, Cheyenne, WY.....(307) 637 6045*
PET BBS PSI WordPro, Ontario, CN.....#1(416) 624 5431*
PET BBS TPUG, Toronto, Ontario, CN.....(416) 223 2625*
PMS - **IF**, Anaheim, CA.....(714) 772 8868*
PMS - Anchorage, AK.....(907) 344 8558

PMS - Apple Bits, Kansas City, MO .....(816) 252 0232*
PMS - Century 23, Las Vegas, NV .....(702) 878 9106*
PMS - Chicago, IL .....(312) 373 8057*
PMS - Computer Merchant, San Diego, CA .....(619) 582 9557*ml.
PMS - Computer Solutions, Eugene, OR .....(503) 689 2655*
PMS - Chicago Public Library, Chicago, IL .....!(312) 235 3200-
PMS - Datel Systems Inc., Sand Diego, CA .....(619) 271 8613*
PMS - Downers Grove/SRT, Downers, Grove, IL .....(312) 964 6513
PMS - Ed Tech, San Diego, CA .....(619) 265 3428
PMS - Ellicott City, MD .....(301) 465 3176
PMS - Escondido, CA .....(619) 746 0667-
PMS - Floppy House, San Diego, CA .....(619) 579 7036*
PMS - Ft. Smith Comp. Club, Ft. Smith, AK .....(501) 646 0197
PMS - Gulfcoast, Freeport, TX .....(409) 233 7943*
PMS - Indianapolis, IN .....(317) 787 5486*
PMS - Kid's Message System, San Diego, CA .....(619) 578 2646*
PMS - Logic Inc., Toronto, Ontario, CN .....(416) 447 8458*
PMS - Los Angeles, CA .....(213) 331 3574*
PMS - Massillon, OH .....(216) 832 8392*
PMS - McGraw-Hill Books, New York, NY .....(212) 997 2488
PMS - Minneapolis, MN .....(612) 929 6699*
PMS - I.A.C., Lake Forest, IL .....(312) 295 6926*
PMS - Pikesville, MD .....(301) 653 3413
PMS - Pleasanton, CA .....(415) 462 7419*
PMS - Portland, OR .....(503) 245 2536*
PMS - Portola Valley, CA .....(415) 851 3453*
PMS - RAUG, Akron, OH .....(216) 867 7463*
PMS - Rutgers Univ. Microlab, Piscataway, NJ .....(201) 932 3887
PMS - San Marcos, CA .....(619) 727 7500*
PMS - Santee, CA .....#1(619) 561 7277*ml.
PMS - SEB Computer, Jacksonville, FL .....(904) 743 7050
PMS - Software Unltd, Kenmore, WA .....(206) 486 2368*
PMS - Teen-Line, Del Mar, CA .....!(619) 755 5006
PMS - Twin Cities, Minneapolis, MN .....(612) 929 8966
PSBBS Baltimore, MD .....(301) 994 0399*
PSBBS Washington, DC .....(202) 337 4694*
RATS Wenonah, NJ .....(609) 468 5293
RATS Wenonah #2, NJ .....!(609) 853 8268
RCP/M A.B. Dick Co., Niles, IL .....&(312) 647 7636*
RCP/M Anchorage, AK .....(907) 337 1984-
RCP/M Arlington, VA .....(703) 536 3769-
RCP/M Astronomy, Titusville, FL .....!&(305) 268 8576*
RCP/M Barstow, CA .....$(619) 256 3914*
RCP/M Beaverton, OR .....(503) 641 7276*
RCP/M Blue Ridge, Missouri City, TX .....(713) 438 2247*
RCP/M Boulder, CO .....(303) 499 9169-

RCP/M Bridreport, IL .....(312) 326 4392*
RCP/M CBBS ANAHUG, Anaheim, CA.....(714) 774 7860*
RCP/M CBBS Columbus, OH .....(614) 272 2227*
RCP/M Dallas, TB.....(214) 931 8274-
RCP/M CBBS Frog Hollow, Vancouver, BC, CN.....(604) 937 0906*
RCP/M CBBS Maxicom, Farmers Branch, TX.....&$(214) 241 1939*
RCP/M CBBS MICOM, Melbourne, VIC, Australia.....61 3 762 5088*
RCP/M CBBS Pasadena, CA.....(213) 799 1632*
RCP/M CBBS Technical, Detroit, MI.....&(313) 846 6127*
RCP/M Chuck Forsberg, OR.....$&(503) 621 3193*
RCP/M Colossal Oxgate, San Jose, CA .....(408) 263 2588
RCP/M CUG-NOTE, Denver, CO .....(303) 781 4937*
RCP/M CUG-NOTE, PA State College, PA.....(814) 238 4857*
RCP/M Dave McCrady, Edmonton, Alberta, CN .....$&(403) 454 6093*
RCP/M DBASE II, San Jose, CA .....(408) 378 8733*
RCP/M EI Division, Argonne, IL .....(312) 972 6979
RCP/M Flanders, NJ.....&(201) 584 9227*
RCP/M Geneseo, IL.....(309) 944 5455
RCP/M Glen Ellyn, Chicago, IL.....(312) 469 2597*
RCP/M Granada Hills, CA.....(213) 360 5053*
RCP/M Ham Radio, Morton Grove, IL.....(312) 967 0052
RCP/M Hackers BBS, Melbourne, FL .....!&(305) 676 3573*
RCP/M Logan Square, Chicago, IL .....(312) 252 2136*
RCP/M Los Angeles, CA.....(213) 296 5927*
RCP/M MCBBS Keith Petersen, Royal Oak, MI .....(313) 759 6569 rb.
RCP/M Mid-Suffolk, Long Island, NY.....(516) 751 5639-
RCP/M Mission, KA.....$(913) 362 9583*
RCP/M Mississauga HUG, Toronto, Ont., CN .....$&(416) 232 2644*
RCP/M NEI, Chicago, IL .....&(312) 949 6189-
RCP/M North Chicago, Chicago, IL.....(312) 937 5639
RCP/M Olympia, WA .....(206) 357 7400*
RCP/M Oxgate College Station, TX .....(409) 845 0509*
RCP/M Oxgate 001, Saratoga, CA.....!$&(408) 354 5934*
RCP/M Oxgate 007, Grafton, VA.....(804) 898 7493*
RCP/M Programmers Anonymous, Gorham, ME.....&(207) 839 2337*
RCP/M Providence, Providence, RI .....(401) 751 5025 rb.
RCP/M RBBS AIMS, Hinsdale, IL.....(312) 789 0499**
RCP/M RBBS Allentown, PA .....(215) 398 3937*
RCP/M RBBS AlphaNet, Lawrence, KA .....(913) 843 4259-
RCP/M RBBS Arvada Elect., Colorado Springs, CO .....!(303) 598 4662*
RCP/M RBBS Bethesda, MD .....(301) 229 3196
RCP/M RBBS BHEC, Baltimore, MD .....(301) 661 2175*
RCP/M RBBS Cincinnati, OH .....(513) 489 0149-
RCP/M RBBS Comp. Tech. Assoc., El Paso, TX.....(915) 533 2202*
RCP/M RBBS Computron, Edmonton, Alberta, CN .....(403) 482 6854*
RCP/M RBBS Cranford, NJ .....(201) 272 1874*

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RCP/M RBBS EPSON, Bristol, PA.<pw=Epson> .....!(215) 788 5614
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RCP/M RBBS EPSON, Placentia, CA.<pw=Amber> .....!(714) 632 8332
RCP/M RBBS EPSON, San Francisco, CA.<Epson> .....!(415) 589 5062
RCP/M RBBS EPSON, Torrance, CA.<pw=Toledo> .....!(213) 618 8674
RCP/M RBBS Fairfield, CA .....!(707) 422 7256*
RCP/M RBBS Fort Mill, SC .....(803) 548 0900*
RCP/M RBBS GFRN Dta Exch. Garden Grove, CA .....$&(714) 534 1547*
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RCP/M RBBS Napa Valley, CA .....(707) 257 6502*
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RCP/M RBBS Pegasus, Houston, TX .....(713) 862 1624*
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RCP/M RBBS SDCS San Diego, CA .....(619) 236 0742*
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RCP/M RBBS Yelm, Olympia, WA .....(206) 458 3086 rb.
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RCP/M RBBS SJBBS Johnson City, NY.....(607) 797 6416-
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RCP/M Superbrain, Lexington, MA.....$&(617) 862 0781*
RCP/M System One, Toronto, CN.....&(416) 231 9538*
RCP/M System Two, Toronto, CN.....&(416) 231 1262*
RCP/M Technical, Houston, TX.....(713) 522 3805 rb.
RCP/M Technical, Thousand Oaks, CA.....&(805) 492 5472*
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RCP/M W. Carrolton, Dayton, OH.....(513) 435 5201*
Remote Northstar Denver, CO.....(303) 444 7231
Remote Northstar NASA, Greenbelt, MD.....(301) 344 9156
Remote Northstar Santa Barbara, CA.....(805) 964 4115
Remote Northstar Virginia Beach, VA.....(804) 340 5246
ST80-CC Lance Micklus, Inc. Burlington, VT.#1.....(802) 862 7023*
ST80-PBB Monroe Camera Shop, Monroe, NY.....(914) 782 7605
TCBBS Astrocom, New York, NY.....#1(212) 799 4649*
TCBBS B.A.M.S. New York, NY.....(212) 362 1040*
T-NET Central Processing Unit, Plymouth, MI.....(313) 453 5146*
T-NET Delta Connection, Lawrenceville, NJ.....(609) 896 2436*
T-NET Special Corp., W. Bloomfield, MI.....(313) 855 6321*
T-NET Twilight Phone, Warren, MI.....#1(313) 775 1649*
TBBS Aurora, CO.....#1(303) 690 4566
TBBS Austin, TX.....#1(512) 385 1102*
TBBS Beer City, Milwaukee, WI.....&(414) 355 8839*
TBBS Canopus, Milwaukee, WI.....(414) 281 0545*
TBBS Exity 2000, Houston, TX.....&(713) 442 7644*
TBBS Freelancin' Alvin, Houston, TX.....&(713) 331 2599*
TBBS Freelancin', Huston, TX-d.&(713) 488 2003*
TBBS Hawkins, TX.....&(214) 769 3036*
TBBS Noah's Ark, Fremont, CA.....(415) 490 8083*so.
TBBS Pizza-Net, Orlando, FL.....(305) 645 5543*
TBBS Shreveport, LA.....(318) 635 8660*
TBBS Tulsa, OK.....(918) 749 0059*
TRADE-80 Albany, GA.....(912) 439 7440*
TRADE-80 Ft. Lauderdale, FL.....#1(305) 525 1192
TRADE-80 Omaha, NE.....(402) 292 6184
Access-80, Tampa, FL.....(813) 884 1506*
(?) Queens, NY.....(212) 896 0519
Adventure BBS, Roslyn, NY.....(516) 621 9296
Alpha, Tampa, FL. .<acct#=ABCDOO, pw=TRYIT>.....(813) 969 0512*
Aphrodite-E, Patterson, NJ.....!(201) 831 1042 so.
Apollo's Chariot, Apollo, FL.....(813) 645 3669
Applecrackers, Columbus, OH.....(614) 475 9791*
Apple Crunch, Houston, TX.....(713) 468 3122

ARBB Seattle, WA.....(206) 546 6239
Atatcom/80 San Leandro, CA.....(415) 895 8980*
Atari BBS, Virginia Beach, VA.....(804) 491 1437*
Austin Party Board, Austin, TX.....(512) 442 1116*
Aviators Bulletin Board, Sacramento, CA.....(916) 393 4459
Blax-80 BBS, Phoenix, AZ.....(602) 952 1382*
BBS Apollo, Phoenix, AZ.....(602) 246 1432*
BBS Atari AMIS, Kansas City, MO.....(816) 587 9543*
BBS B.R., Los Angeles, CA.....(213) 394 5950*
BBS Colornet, Providence, RI.....$(401) 521 2626-
BBS Commodore, San Juan, PR.....(809) 781 0350-
BBS Computer Apptications Co., Poland, OH.....(216) 757 3711
BBS Gandalf #2, Heightstown, NJ.....!(609) 448 8244
BBS Heathkit Store, Warwick, RI.....(401) 738 5152-
BBS Homestead, FL.....(305) 246 1111
BBS MCUA, Houston, TX.....(713) 661 5428*
BBS Pensacola, FL.....(904) 477 8783
BBS-16 Santa Rosa, CA.....(707) 527 5908
BBS SUE Milwaukee, WI.....!(414) 327 6010
BBS The BULL, Toronto, CN.....(416) 423 3265 so.
BBS The Safehouse, Minneapolis, MN.....(612) 724 7066*
BBS-80 DALTRUG, Dallas, TX.....(214) 289 1386*
BBS Syslink, Providence, RI.....(401) 272 1138*
Big Top Games Systems, Milwaukee, WI.....(414) 259 9475
Bird House, San Jose, CA.....(408) 267 7399
Boston Information Exchange, Boston, MA.....&(617) 423 6985*
Bradley Computer BBS, Tampa, FL.....(813) 734 7103
BSBB Tampa, FL.....(813) 885 6187
Capital City BBS, Albany, NY.....(518) 346 3596*
Cass-80 Hickory Hills, IL.....(312) 598 4861
C.M.M.S. Chicago, IL.....(312) 957 3924*
C-HUG Bulletin Board, Fairfax, VA.....(703) 360 3812*
Cohoes Forum, Cohoes, NY.....(518) 235 9073
COLOUR-80, Orange Park, FL.....(904) 264 0335*
Commodore Video King, Skokie, IL.....(312) 674 6502
Compuque-80, Houston, TX.....&(713) 444 7041*
Compusystems, Columbia, SC.....(803) 771 0922
Computer Connection, Beverly Hills, CA.....(213) 657 1799
Computers for Christ, Ontario, CA.....(714) 983 9923*
Creepy Corridors, Phoenix, AZ.....(602) 956 5021-
CVBBS #1, San Diego, CA.....(619) 691 8367*
CVBBS #2, San Diego, CA.....(619) 278 9114
Datamate, Canoga Park, CA.....#1(213) 998 7992 so.
Diamond III, Phoenix, AZ.....(602) 890 0972*
Dimension-80 Orange, CA.....(714) 974 9788
Download-80 Mojo's, Forest Knolls, CA.....&(415) 488 9145*

Dragon's Lair, Long Beach, CA.....(213) 428 5206
Drummer, San Francisco, CA.....(415) 552 7671 so.
EMC-80 St. Louis, MO.....(314) 645 1047
Experimental-80 Kansas City, MO.....(913) 676 3613
FBBS #1, Purdue, IN.....&$(317) 494 6643*
Future Tech, Alexandria, VA.....!(703) 451 4893*
GBBSII Sullivan, CO.....(303) 693 1064-
GBBSII Apple PI, Bloomfield, CO.....(303) 469 7541*
GBBSII Aurora-Net, Denver, CO.....(303) 343 8401*
GBBSII Eamon, Sullivan, CO.....$(303) 750 3783-
GBBSII Off The Wall, Boulder, CO.....(303) 443 3367*.
Genesys, Phoenix, AZ.....(602) 967 4529*
Grape Line BBS, Napa Valley, CA.....(707) 538 9124*
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H&S Microsystems, Burnaby, B.C.....!(604) 430 4145-
IBM PC No-Name, San Lorenzo, CA.....!(415) 481 0252*
INFOEX-80 West Palm Beach, FL.....(305) 683 6044*
INFOEX-80 Akron, OH.....(216) 724 2125*
INFOEX-80 Tulsa, OK.....(918) 838 8698*
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Irvine Line, Irvine, CA.....(714) 551 4336
JCTS Redmond, WA.....(206) 883 0403*
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Lethbridge Gaming system, Lethbridge, AB.....(403) 320 6923
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Mail Board-82 Seattle, WA.....(206) 527 0897*
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MBBS, Mission, BC, CN.....!(604) 462 8633-
Micro-Com, Cincinnati, OH.....!(513) 671 2753
Micro-Com, Louisville, OH.....(216) 875 4582*
Micro-80 West Palm Beach, FL.....(305) 686 3695
Micro Informer, Tampa, FL.....(813) 875 3331
Microsystems, Phoenix, AZ.....(602) 938 4508*
Midwest, St. Louis, MO.....(314) 227 4312 so.
Mini-Bin Seattle, WA.....(206) 762 5141*
MMMMMM#1, Santa Monica, CA.....(213) 390 3239-so.
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MMMMMM#4, Lawndale, CA.....(213) 821 2257-so.
Motherboard, San Leandro, CA.....(415) 352 8442
MRC BBS, Mountain View, CA.....!(415) 968 1093
NBBS Norfolk, VA.....(804) 444 3392
North Orange Country Computer Club, Orange, CA.....(714) 633 5240

Novation CO., Los Angeles, CA . . . .<pass=CAT>.....(213) 881 6880
Nibble One, Schenectady, NY.....(518) 370 8343
NWLAIBMPCUG, Shreveport, LA.....(318) 688 7078
NWWCUG Edmunds, Seatle, WA.....(206) 743 6021
Nybbles-80, Queens, NY.....(212) 626 0375
OACPM Omaha, NE.....(402) 292 9598*
OARCS Portland, OR.....(503) 641 2798
OCTUG Orange County, Garden Grove, CA.....(714) 530 8226
Omega, Phoenix, AZ.....(602) 952 2018*
Oracle North Hollywood, CA.....(213) 980 5643 so.
Orange County Dta Exchange, Garden Grove, CA.....(714) 537 7913
OS-9 6809 BBS, Palatine, IL.....(312) 397 8308
PBBS Arc-Net, Little Rock, AR.....(501) 372 0576*
PBBS Co-operative Comp Svc, Palatine, IL.....(312) 359 9450*
Personal Msg. System-80, Deerfield Bch, FL.....&(305) 427 6300*
PHOTO-80, Haledon, NJ.....(201) 790 6795
PMBBS, Humble, TX.....(713) 441 4032
RACS V Fullerton, CA.....(714) 524 1228
RBBS Milwaukee-Chicago Line, IL.....(312) 876 0974
RBBS The Meeting Place, Omaha, NE.....!&(402) 734 6959*dl.
RBBS Upland, CA.....!(714) 981 3787*dl.
RIBBS Houston, TX.....(713) 497 5433
R.I.C.A.M.I.S., Kingston, RI.....(401) 456 8250*
RI Tandy Users Group, Cranston, RI.....(401) 944 4689*
RS-CPM Clarksville, MI.....(616) 693 2648
SATUG BBS, San Antonio, TX.....(512) 494 0285
Satyricon, Burnaby, BC, CN.....!(604) 438 2468*
S.D.A.C.E., La Mesa, CA.....!(619) 447 8143
Seacomm-80 Seattle, WA.....(206) 763 8879*
SIGNON Reno, NV.....<pw=FREE>.....(702) 826 7234
$(702) 826 7277
SISTER Staten Island, NY.....(212) 442 3874*
SOBBS Poor Man's BBS, Houston, TX.....(713) 453 7931*
SOBBS Test Mode, Houston, TX.....(713) 522 5516
Stellar III, Phoenix, AZ.....(602) 833 0740*
Steve's BBS/Game Palace, Shawnee Mission, KS.....(913) 648 5301*
Stuart II BBS, Boulder Creek, CA.....!(408) 338 9511*
Sunrise Omega-80, Oakland, CA.....(415) 452 0350
Switchboard, Alexandria, VA.....(703) 765 2161*
System/80 San Leandro, CA.....!(415) 782 4402
Talk-80 ROBB, Portsmouth, VA.....(804) 484 9636
TCUG BBS, Washington, DC.....(703) 836 0384*
Tech-Link, Forest Glen, MD.....(301) 565 9051*
TECOM-80, Tampa, FL.....(813) 839 6746
Telcom 7 New Fairfield, CT.....(203) 746 5763*
Telemessage-80, Atlanta, GA.....(404) 962 0616

The Garden of Eden, Phoenix, AZ .....(602) 991 0144*
The Interface, Los Angeles, CA .....(213) 477 4605
The Software Bank, Northridge, CA .....!(213) 701 7670
Toledo Apple Users BBS, Toledo, OH .....!(419) 537 9777*
Treasure Island, Royal Oak, MI .....(313) 547 7903
TVG Systems, Burnaby, BC, CN .....!(604) 738 1640*
Vanmil, Milwaukee, WI .....(414) 271 7580*
VERGA 80, Santa Ana, CA .....(714) 547 6220
Voyager, Phoenix, AZ .....(602) 247 6034
Vic-20 Online, Houston, TX .....(713) 944 6597*
Visiboard, Wellesley, MA .....(617) 235 5082
WAPABBS, Charlotte, NC .....(704) 373 7966*
Westside Download, Detroit, MI .....!(313) 348 4479
XIO, Houston, TX .....(713) 495 1422-/ex

Appendix D

Magazines

Ahoy!
P.O. Box 341
Mt. Morris, IL 61054

Commander
P.O. Box 98827
Tacoma, WA 98498
800-426-1830

Commodore Computer Magazine, The
Computer Systems Division
Commodore Business Machines, Inc.
1200 Wilson Dr.
West Chester, PA 19380
800-345-8112

Compute!
Circulation Dept.
P.O. Box 5406
Greensboro, NC 27403
800-334-0868

Compute!'s Gazette
Circulation Dept.
P.O. Box 961
Farmingdale, NY 11737
800-334-0868

Home Computer Magazine
P.O. Box 5537
Eugene, OR 97405
800-828-2212

Power/Play
Commodore Business Machines
Magazine Subscription Dept.
Box 651
Holmes, OH 19043
800-345-8112

RUN
CW Communications
80 Pine St.
Peterborough, NH 03458

Glossary

A—A diagram symbol meaning accumulator. A also stands for address line and is the hexadecimal sign for the decimal integer 10.

abort—The process of ending a program that has encountered an error condition in an orderly manner. An abort returns the control to an operator or operating system.

absolute value—The value of a number expressed as a positive number. An absolute value is denoted by enclosure in vertical bars (|). Thus, if a number is positive or zero $|x| = x$. If x is negative, $|x| = -x$.

a-bus—The primary internal source-bus to the arithmetic logical unit in any processor.

AC—Alternating electrical current.

AC or ACC—ACcumulator or Access time: The time it requires to retrieve a word from memory of any type.

accumulator—A register located on the microprocessor. It is used to transfer data and to receive the results of logical and arithmetic operations during the implementation of machine code. All data passing through the microprocessor invariably pass through the accumulator. The contents of the accumulator on the 6510 at any given time can be found at address 780.

ACK—The ACKnowledge character in ASCII, a 06 base 16. This is used in communications to complete a handshaking sequence. The ACK signal indicates that the information has been accepted.

ACM—Association for Computing Machinery
11 W. 42nd St. 3rd Floor
New York, NY 10036
212-869-7440

The major international society for computer technology is the ACM. Through its numerous publications and special interest groups, ACM will be of interest to many C-64 users. For more information write to ACM or find the Journal of the ACM at your library.

acoustic coupler—A mechanical instrument for connecting the telephone handset to a computer through a modem. The modem converts the data to tones, usually audible, for transmission over the phone lines.

A/D—(A to D, or Analog to Digital). The conversion from a sensor's analog voltages and currents to their digital representation used by computer systems. The computer can then process data directly from the external world.

adder—A processor unit that performs binary arithmetic.

add on—A system or circuitry attached to a computer to increase memory or improve performance. For the Commodore 64, add ons include ROM cartridges, and peripherals such as disk drives, printers, and modems etc.

address—The positive of a byte in memory, expressed by a number. In the Commodore 64, the address range is from 0 to 65535. The address is used in programs to alter the content(s) of a specific memory location as well as for retrieving contents from a specific memory location. Often the hardware functions are controlled by addressing specific bytes in memory. This is done in BASIC using PEEKS and POKES.

address bus—An address bus is the wiring involved in selecting where data is being transmitted. The actual data is transferred on another set of wires (data bus). In the Commodore 64 the address bus is comprised of 16 separate lines originating on the 6510 microprocessor. Setting different lines high or low offers a total of over 64 thousand different combinations. Each combination accesses a different location. Some of the locations are on the RAM chips, some are ROM locations, and still others are in the CIA and VIC II chips.

adhesive tab—A tab used for disk write protection. A disk is write protected if the write protect notch is covered over with an adhesive tab. The notch is located about one inch down on the left hand side of the disk. Attempts to alter the contents of a write protected disk result in an error message. The purpose of the write-protect tab is to prevent accidental loss of the only copy of programs or data. It is a good practice to put an adhesive tab (supplied with boxes of disks) over the write protect notch of any important disk before you back it up. Then if you ask for the backup in the wrong direction (from the destination disk to the source disk), you will get a second chance to make the backup rather than losing your data.

algorithm—A mathematical or logical process that will return the solution to a given problem. A problem is first stated then an algorithm is developed for its solution. The solution steps are then flowcharted and the program is developed from the flowchart.

allocation of space—The assignment of particular areas of memory (internal or on

disk) to particular files, programs, or functions. Allocation is sometimes done by a programmer and sometimes done automatically by a program such as the disk operating system (DOS).

alpha test site vs. beta test site—A test site participates with the originators of a hardware of software product to test it in a real world situation. An alpha test usually involves only a very few companies or individuals who realize that the product is incomplete or may have flaws. Alpha testers are often internal to the originating company or otherwise closely related. Beta test sites are generally larger in number. They expect that the product is essentially complete and correct, and agree to use it in a real world production situation. If errors are discovered, the originators ordinarily attempt to fix them rapidly so the Beta sites can stay "on the air" with the new product. If numerous or serious bugs are found, the product may have to go back to alpha testing until an improved version can be presented for another round of Beta testing.

alphanumeric—A set of characters composed of all alphabetic and numeric characters.

alterable memory—Storage media that can be written onto or changed.

alternating current—Any electrical signal not constant is considered alternating current. However, this term usually means that the current changes polarity during time.

ampere—A measurement of electrical current; the actual number of electrons moving past a stated point per second.

amplifier—A device or circuit that increases the power or strength of a signal.

analog—An analog signal has a continuous range of voltage or current values. Contrast with digital.

analyser/analyzer—Any device that checks or regulates a component, board, or system and presents the data for review.

animation—The use of movements in graphics to simulate realism or demonstrate action. In most computers, animation is created with multiple graphic displays in succession. The microprocessor looks at one RAM area for its screen display and is then commanded to look to another and so on creating the illusion of movement. The C-64 has a sprite system that facilitates and greatly simplifies animation. A sprite is created once and can be moved using specific addresses.

ANSI—American National Standards Institute.

APL—A programming language (APL) invented by Kenneth Iverson. It is used for algorithmic interactive programming.

append—To add to the end of a character string or list.

applications software—A software package is a group of computer programs, possibly including data files and documentation, that perform a function or group of related functions on the computer. These are called applications software when the programs are devoted to an end-user task. Examples would be word processing packages and accounting packages. Programs are called systems software packages when they facilitate the use of the machinery; examples are disk operating systems and program development packages.

arbitration—Management of various claims of competing systems or processes for a limited resource. Bus arbitration allocates a system bus among the subsystem

components, such as the CPU, the memory, disk controllers, and other external devices.

architecture—The design, and interconnection of the principal components of a system. In a microprocessing unit the architecture could include the number and function of registers, the instruction addressing modes, and the bus structure and timing.

arithmetic logic unit (ALU)—The element in the central processor that performs the basic data manipulations, such as add, subtract, complement, negate, rotate, AND, and OR.

arithmetic operations—Arithmetic operations are performed on a priority basis on the C-64. When executing calculations on a particular line first priority goes to performing exponentiation from left to right. Once those calculations have been done, multiplication and division are performed from left to right on the line. Finally addition and subtraction are performed.

arithmetic statement—An instruction specifying an arithmetic operation.

ASCII—American Standard Code for Information Interchange.

assembler—A program that reads the mnemonic representation of an instruction and converts it into machine language (binary code) for program execution. The binary code is referred to as the object code.

asynchronous—An event or device which does not have the same timing as the central processing unit.

attack (sound)—This is the rate at which the volume of a note rises from the moment it is first struck to the moment it reaches the maximum value. Attack is a component of the envelope that the SID chip of the Commodore 64 implements for each note.

attenuation—The reduction in strength of an electrical impulse.

audio/video port—The Commodore 64 comes with a 5 pin DIN socket in the rear of the computer that serves as an audio/video port. This port can be utilized if the user decides to use a monitor or an alternate sound system with the computer. Except for the 1701 monitor from Commodore, this port is not generally plug compatible with most monitors. It is, however, possible to utilize an adaptor to convert the 5 pin din to the RCA jack used by most monitors.

B—An abbreviation for bytes or baud. B is used as an abbreviation for bytes when referring to memory, or baud rate when referring to communications.

B—Bus line. Also, the hexadecimal symbol for the decimal number 11.

backplane—Also called a motherboard, it is the physical area in a system where the boards plug in. It usually contains the buses of the system either in printed circuit or wire-wrap form.

backup copy—A duplicate copy of a program or data stored on a different disk or cassette in case of loss or damage to the original.

bad sector—A sector on a disk that will not record data correctly. A bad sector is usually due to a minor physical flaw in the disk. One or two bad sectors will not seriously effect the diskette's use—they will be marked as bad and not used. More then a few bad sectors indicates the disk should be used as a frisbee rather than to hold your valuable data.

bank—The 64K of memory in the Commodore 64 is divided into 4 banks (sections) of 16K each. The VIC-II chip can only access the memory one bank (16K) at a time for video display information.

BASIC—Beginner's All Purpose Symbolic Instruction Code. A popular computer language invented at Dartmouth for educational purposes. While most similar to the FORTRAN programming language it is easy to use, learn and is now on almost all microcomputer systems.

BASIC compiler—Programs written in a high-level language such as BASIC are converted into the machine code equivalent by a program called the compiler. Once compiled, the machine code form of the program can be stored and executed at any time with up to 300 times the speed of the original BASIC program. This is different from an interpreter which translates or interprets each program instruction as it is executed and every time it is executed.

BASIC interpreter—The Commodore 64 is equipped with an 8K CBM BASIC interpreter that converts (interprets) Commodore BASIC into machine language step by step as it executes the BASIC program. The interpreter is located at address 40960 up to 49151.

batch processing—A program or a series of programs is run to completion or aborted with no interaction between the user and the program possible.

battery backup—Auxillary power is provided through batteries to the processor so volatile information is stored during a power failure.

baud rate—The rate of data transfer between devices measured in bits per second. For example, the C-64 transfers data through the VIC 1600 modem at a rate of 300 baud. In addition to the 8 bits transmitted for every byte, there is also a start-bit and a stop-bit associated with each byte, thus resulting in a transfer of 30 characters per second.

baud rate generator—An oscillator, usually adjustable, providing clock signals for connection of a peripheral. Typical rates are 110, 300, 1200 and up to 9600 baud.

B-bus—The second source-bus to the arithmetic logical unit in a 2 or 3 bus processor.

beta test site—See alpha test site.

BDOS—The CP/M Basic Disk Operating System, one of the three functional components of CP/M. BDOS manages disk files, file storage, file retrieval, and, allocation.

bidirectional—Data flow may go in either direction on a wire. At each end of the wire there are transceivers to both receive and transmit. Common bidirectional buses are tristate or open collector transistor-transistor logic.

bidirectional printing—Alternately printing in either direction. A line printed left to right is followed by a line printed right to left, avoiding a carriage return delay and greatly increasing output.

binary counter—An electronic device that outputs a sequence of ascending or descending binary numbers.

binary number—A representation of an integer as a sum of powers of 2, using a sequence of zeros and ones.

BIOS—The CP/M. Basic Input Output Operating System, one of the three functional components of CP/M. BIOS facilitates the exchange of data and status information

between the CCP (Console Command Processor) and a peripheral device.

BISYNC ("by-sink")—BInary SYNchronous Communications protocol.

bit—A contraction of binary digit. A bit is a 0 or a 1. Bits are used in computer systems to code information, instructions, and data. Larger units of bits are nibbles (4), bytes (8), or words (16, 24, 32, 96 or more).

bit map mode—The bit map mode in the Commodore 64 allows the programmer to address each bit or pixel on the screen individually, thereby increasing the resolution to 320 × 200 bits in high resolution mode or 192 × 200 in multicolor mode. The bit map mode allows the creation of highly detailed images or graphics. The bit map mode is turned on by setting bit 5 of the VIC-II control register to a 1 at location 53265 (hex Doll).

bit/parallel—A data transmission method in which each digit of binary number is sent over a separate wire simultaneously.

blanking—On the monitor screen, not displaying a character (leaving a space).

block—Within a logical record, information is stored in units or blocks. Block is also sometimes used to mean a collection of logical records. The block size is usually expressed in bytes.

BLOCK-ALLOCATE—A disk command, the BLOCK-ALLOCATE command, when sent through the command channel, checks to see if a block on the disk is free to be used. It does not destroy data on the block, but if the block is already in use an error condition will be revealed on the command channel. The BLOCK ALLOCATE command is used only on random files. The format is

```
OPEN15,8,15
PRINT#15,"BLOCK-ALLOCATE:"drive,track,block
```

drive disk drive number (0 if there is only one drive).
track track number on the block being checked.
block sector number of block being checked.

block availability map—BAM. A checklist of used blocks on a disk. The BAM is physically located on track 18 sector 0 of the disk; it is updated every time a file is saved or closed.

BLOCK-FREE—A disk command, the BLOCK-FREE command, when sent through the command channel, will change the BAM and thereby make available a block that may or may not have data on it. It effectively erases that block. Used only on random files, the format for the BLOCK FREE command is

```
OPEN15,8,15
PRINT#15,"Block-Free:"drive,track,block
```

drive disk drive number (0 if only one drive).
track track number to be freed.
block sector number to be freed.

BLOCK-READ—A disk command, the BLOCK-READ command, when sent

through the command channel, will move one block of data from the track, sector, and drive specified by the user to a channel assigned by the user. The command is only applicable to random files. The format is

```
OPEN15,8,15
PRINT#15,"BLOCK-WRITE."channel,drive,track,sector
```

channel—arbitrary channel 2 through 14 (previously opened) in which data will be sent.
drive—drive number (0 if only one drive).
sector—sector number of block to be moved.

BLOCK-WRITE—A disk command, the BLOCK-WRITE command, when sent through the command channel, will move one block of data from a channel previously opened to a location on the disk specified by user. The command is used only for random access files. The format is

```
OPEN15,8,15
PRINT#15,"BLOCK-READ."channel,drive,track,sector
```

channel—an arbitrary channel 2 through 14 previously opened by user in which data has already been entered.
drive—number of disk drive being used (0 if only one drive).
track—track number where the block of data will be sent.
sector—sector number where the block of data will be sent.

block of memory—a series of consecutively numbered bytes in a memory device, usually internal memory.

board-tester—A computer controlled device that performs electronic tests on printed circuit boards.

Boolean logic—Named after George Boole, who defined an algebra of logical operations such as And, Or, and Not, on the two values true and false.

boot—To use a bootstrap—generally used to describe starting up a computer.

bootstrap—A program used for starting the computer, which usually clears memory, sets up I/O devices, and loads the operating system from ROM, disk or cassette.

BOP—Bit-Oriented Protocol.

bouncing—Short intermittent conduction from the vibration of switch contracts after closure. Bounce is usually present in keyboard input and eliminated by special hardware or software (debouncing).

branch—A programming instruction that causes transfer of control to another program sequence. In BASIC, for example, the GOTO statement.

breakpoint—A point at which the processor will stop a program sequence and display the current machine status, implemented through hardware, software, or a combination of both.

bubble memory—Memory utilizing microscopic magnetic domains in an aluminum garnet substrate. Future devices should boast better than 1 million bit storage density per chip.

buffer—Printer buffers. A printer buffer is a device that connects between the printer and the computer and stores any incoming data from the computer into its own memory, thereby freeing the computer for other processing. The data stored in the buffer memory is then fed to the printer. This way a programmer does not waste time waiting for a text or a program to finish printing before he can start processing again. It takes a few seconds for the buffer to download data from the computer and the controls are returned to the user. Printer buffers may also be used for connecting modems with computers. For reviews on printer buffers, see under the specific product name.

buffer—In software, any memory structure provided for the temporary storage of data. In hardware, a device which restores logic drive signal levels in order to drive a bus or a large number of inputs.

buffering—The delaying and temporary storage of data in a data communications path.

BUFFER-POINTER—A disk command, the BUFFER-POINTER command, when sent through the command channel, allows you to selectively access individual bytes of information from a random file buffer. The BUFFER-POINTER command is used in random files only. The format is

```
OPEN15,8,15
PRINT#15,"BUFFER-POINTER:", channel, location
```

channel—arbitrary channel number 2 through 14 previously opened by the user. Effectively this is a buffer, because data in this channel must be moved to or from the disk one block at a time.

location—byte number 0 through 255 within the block in channel.

bug—Errors in a program. A programmer must ensure that a program will correctly process all of the types of data it is intended for. Samples of the data are prepared (test data) and the program is executed using this data (a test run). The program's outputs (reports, screen displays, files, etc.) are then verified using the program specifications. An error in the processing logic of a program is called a bug; hence the terms *debug* and *bug-free.*

bulk storage—Large capacity data storage that is generally long term.

burn-in—A phase oc component testing where basic flaws or early failures are screened out by running the circuit for a specified length of time generally at elevated temperatures in some sort of oven.

bus—Path for signals having a common function. Every standard MPU creates three buses: the data bus, the address bus, and the control bus.

bus controller—The unit in charge of generating bus commands and control signals.

bus extender—A device that allows additional cards to be plugged into a computer's bus; also known as an expansion chassis.

bus termination—An electrical means of preventing reflections at the end of a bus that is only necessary in high-speed systems or some designed low-speed systems.

byte—A group of 8 bits. A byte is universally used to represent a character. Microcomputer instructions generally require one, two, or three bytes. One byte has two nibbles (4 bits).

C—Symbol for the carry bit, the clock, and the hexadecimal notation for the decimal number 12.

C= key—The special key with the Commodore logo is located in the bottom left of the keyboard. In addition to upper and lowercase letters, the C-64 can display a set of PET graphic symbols. When the system is powered on, each letter from the keyboard is in uppercase. If a character is pressed in conjunction with the SHIFT key, the graphic symbol on the right front of the key is displayed. If the C= key is pressed in conjunction with the SHIFT key, the display mode changes. Now any key pressed is in lowercase, and in conjunction with the C= key, the graphic symbol to the left of the key is displayed. The key can also be pressed in conjunction with any of the color keys to change the color of the cursor and any subsequent characters entered.

CAD—Computer-Aided Design.

CAI—Computer-Assisted Instruction.

CAM—Content Addressable Memory, associative memory, addressed by contents rather than location.

CAMAC—Computer Automated Measurement and Control.

Can't Continue—An error message from the C-64 indicating that you can not use the CONT command at this time. If you have not run the program yet and you inadvertently enter CONT, this message will appear.

card cage—A rack designed to support the printed-circuit boards in a computer.

carriage return—A standard typewriter key causing the printing element to move back to the beginning of the line. To move the paper up a separate line feed must be added. Frequently the microprocessor interprets a carriage return to mean end of line or end of command.

carrier—A frequency used to "carry" information, which is modulated to denote 0 or 1.

carry—In the status register of the central processor a carry is a flag bit which indicates an operation overflow by the arithmetic logic unit. The carry is also used during shifts.

cassette—If information from the C-64 is to be saved permanently, it must be transferred from the internal memory to a mass storage device. The C2N Datasette Unit model 1530 from Commodore is one such device. Data is saved sequentially on magnetic tape. Data is transferred at about 50 bytes per second. The cassette has a device number of 1. The load and save commands are used to load and save program files. Sequential files can be saved after first opening the channel to the cassette. Ones and zeros are saved on tape using square waves of different lengths. When a program is saved on tape, the address in memory where it began is saved into a header on tape. The program can then be loaded at the exact address from which it came.

cassette—A small plastic cartridge containing two spools of ⅛" magnetic tape frequently used in audio recorders. Applied to the mass storage requirements of microcomputers and minicomputers, a "digital" cassette meets standards for digital recording.

CCP—The CP/M Console Command Processor is the "intelligent" component of the three functional modules (BIOS, BDOS & CCP). It is user-interactive (interprets

commands typed at the keyboard) and performs internal processing using BIOS and BDOS as sources for status and data information.

cell—A repeated unit in a RAM chip storing one unit of information and returning it in response to a particular address signal.

central processing unit—The CPU of a computer is essentially the "brain" of a system. It serves to fetch and execute each instruction from memory. It also performs all of the arithmetic and logical functions of the system. In some systems, it may be comprised of several chips. In the C-64 the 6510 microprocessor serves as the CPU.

chaining—A method of allowing the execution of programs larger than the main memory of a computer by loading and executing modules of the same program sequentially.

channel—Logical connection from a CPU to an I/O device. Channels may be multiplexed, have dedicated ports, or have a dedicated channel processor to optimize communications.

channel selector—A small switch in the back of the C-64 that allows the user to switch between channel 3 and 4. In areas where one of those stations is extremely strong, the user is likely to experience interference on that channel while using their computer. This switch allows you to switch to the alternate channel. The user must also make the appropriate change on the TV channel.

character generator—A section of ROM occupying memory locations 53248 to 57343 that contains the data that will actually create a character on the screen. Any character on screen is comprised of small dots or pixels in a particular pattern. Eight bytes of data are required to create any character on the screen. All characters and PET graphic symbols are kept in the character generator. The VIC II chip makes use of ROM imaging to gain access to the character generator, even though it may be accessing a bank of memory not including 53248 through 57343. The standard character set for the Commodore 64 is built in the character ROM at location 53248 through 57343. In the normal display mode the VIC-II chip gets its information from the character generator table also known as the character base.

character set—The collection of characters available for display or processing on a particular computer or peripheral.

character string—A one-dimensional array or sequence of characters, encoded as bytes. Character strings have a length field or are terminated by the zero byte.

characters (programmable)—Usually the data required to form the image of a character on the screen is brought from the character generator in ROM. To use characters you design yourself you must list the values that define each character in RAM memory, and then to instruct the computer to look to RAM instead of to the generator when a key is pressed. In this manner you can create your own characters.

CHAREN—The name of a control line that banks a 4K byte of ROM containing the character generator in and out of the microprocessors memory. When CHAREN is low the microprocessor sees the character generator at address $DOOO to $DFFF. When it is high a group of I/O register appears in that location.

checksum—A field of one or more bytes appended to a block of n words containing a truncated binary sum or some other function value based on the contents of that

block. The sum is used to verify the integrity of data.

chip—A chip is a small electronic device generally of silicon that contains tiny microscopic circuits.

CIA—The 6526 Complex Interface Adapter chip #2, which contains the bank select bits that allow a programmer to select the 16K memory bank that the VIC-II chip will be able to "see" (access).

clear—Signal to place a device or a circuit in an initial, usually zero state.

clock frequency—The oscillation rate of a clock, usually expressed in Megahertz, also known as the clock rate.

color adjustment—With the C-64 some color combinations result in a very poor display. It is possible to change the background color by poking different numbers from 0 to 15 in address 53281. The character colors can be changed by changing the cursor color from the keyboard.

color code—The C-64 is capable of generating 16 different colors. The different colors can be generated by poking the code for a color into the particular memory location desired by the user. The color and code are as follows:

black	0	white	1	red	2
cyan	3	purple	4	green	5
blue	6	yellow	7	orange	8
brown	9	light red	10	gray1	11
gray2	12	light green	13	light blue	14
gray3	15				

color keys—The color of the cursor and subsequent characters printed on the screen can be altered from the keyboard. The different colors can be implemented using the CTRL key and the particular color keys along the top row simultaneously. A second set colors can be implemented using the special Commodore key in the bottom left part of the keyboard with the color keys along the top row.

color memory or color RAM—A section of RAM from address 55296 to 56295. In the standard character mode, these addresses contain the color value of the characters displayed on the screen. Poking different values at these addresses will change the color of the characters displayed. In the multicolor character mode combinations of four different values can be placed in each address to use as many as four colors for each character.

combinational logic—A circuit with Boolean logic functions and no memory.

command—A statement to cause a computer to carry out a specific action. Commands differ from instructions in several ways. A command is usually a complete specification of an action, while instructions must usually be combined in dozens or hundreds to make a useful program. Commands are usually acted upon immediately by the computer, while instructions are saved for later execution in a program. Commands are acted on by the basic operating system of the computer, while instructions must be processed by a particular program, such as the BASIC interpreter or a FORTRAN or PASCAL compiler.

command processor—A program that accepts a command (usually from a keyboard) and causes it to be carried out. Some command processors contain the

programming required for all the commands they process. Others do not carry out any commands directly. Instead, these examine the command, determine what other program (if any) can carry out the command, locate the required program, and start it running. Still another type of command processor carries out some commands directly (internal commands), but locates and runs other programs for some commands (external commands).

compatible (upward)—The term *upward compatible* indicates that programs developed for one version of a programming language, operating system, application software package, or computer will work without alterations on an expanded, more powerful version of the same language, system, or package. In hardware, upward compatibility refers to the possibility of building up to more powerful models without reprogramming.

compiler—A translation program that converts high-level instructions into binary instructions for direct processor execution. Any high-level language, such as BASIC or COBOL, requires a compiler or an interpreter. An interpreter translates each statement of the program each time the statement is executed, whereas a compiler translates the complete program once, producing *object* code that can be executed repeatedly. Any change in the program requires recompilation. The code produced by compilers may be longer and/or slower than the code generated from assembly-language source code.

complementing—The action of changing each 1 to a 0, and each 0 to a 1.

Complex Interface Adapter—The C-64 contains two CIA chips that serve as mediating devices between the microprocessor and any peripheral devices. All data from the disk drives, users port, and even the keyboard first moves into registers within the CIA chips. When the CIA chips are told by peripheral devices that data is ready (through interrupt sequences) the CIA sends its own interrupt IRQ to the microprocessor. The microprocessor (6510) finishes executing whatever instruction it is working on and then looks to the CIA chips to see where the interrupt is coming from. Once the microprocessor receives that information, it jumps to the operating system to see what to do next. The operating system will tell the microprocessor where to get the data coming in and where to put it. The CIA maintains several registers that can be addressed directly by user to set up input output ports and handshaking operations.

computer—A general purpose computing system incorporating a central processing unit, memory, I/O facilities, power supply, and cabinet.

concatenation of data (or programs)—Adding one item on at the end of the others to produce one longer data or program item.

condensed—A print function available on some dot-matrix printers. When the appropriate control code sequence is sent to the printer, the size of subsequent characters to be printed is reduced to 17 character per inch from 10 characters per inch in the standard mode.

console—The part that has the most control in a system. For a microcomputer, the keyboard or the front panel is the console.

constant—An explicit value in a program instruction or statement rather than a symbolic value. The value is fixed throughout a program.

control bus—The set of control lines in a computer system that carry the necessary

synchronization and control information throughout the system. Examples of signals carried on these lines are orders such as read or write, and sync signals such as interrupt, hold, or acknowledge.

control characters—Characters having specific system-dependent meanings.

control register—Although the C-64 there are a number of registers used for control, the one located at 659 for controlling the RS-232C port is sometimes referred to as the control register.

control registers—A control register generally refers to an identifiable and programmable byte or series of bytes that control some function of a computer. For example the byte located at 53265 can be poked with appropriate data to turn the high resolution mode on.

controller—A circuit board or boards that interface a peripheral to the computer, having complex circuitry to maintain device control.

control unit—The module that fetches and decodes instructions. The CU requires an instruction register and a program counter. It generates control signals and manages the control bus.

counter—Binary counter.

CP/M—Operating System. CP/M (Control Program/Microcomputers) is a popular single-user operating system for the 8080, Z80, and 8085-based microcomputers created by Digital Research. It is a collection of programs available on the system disk that once loaded into the system using either a bootstrap loader or the resident monitor, will take over the system operation, communications with peripheral devices (such as the drives or the printer), and over all management of computer memory space as well as disk files. The main advantage of using this operating system versus the computer's operating system lies in the universal nature of CP/M (it can run on any microcomputer and has an extensive software support from third party vendors). CP/M can be implemented on the 6502 based systems (such as the Commodore 64) with the aid of the plug-in cartridge and a system disk that will be available soon from Commodore. CP/M is organized in the form of logical components or software modules. The three functional modules are called BIOS (BASIC Input/Output System). BDOS (BASIC Disk Operating System) and the CCP (Console Command Processor).

CPS—Characters Per Second or Cycles Per Second.

CPU—Central Processing Unit. The computer device in charge of fetching, decoding, and executing instructions. The CPU contains a control unit, an ALU, and other related facilities including registers, clocks, or drivers. The Commodore 64 uses the 6510 CPU chip.

crash—A situation in which the system becomes inoperative due to a hardware or software malfunction. A head crash refers to the accidental impact of the read/write head upon the disk surface.

crosstalk—Two signals interfering with one another.

CRT—Cathode Ray Tube. A computer terminal uses a CRT that displays characters or pictures.

CRTC—CRT Controller.

crunch—A term used to describe the process of removing unnecessary information in a program and thus reducing the amount of memory required to store it.

Removing remark statements and spaces between words, and putting multiple commands on one line are examples of crunching.

crystal—Quartz crystal whose piezoelectric vibrational modes issue extremely accurate frequency for clock timing.

CS—Chip Select or Code Segment.

CTRL key—This key is used in combination with the numbered keys to produce a change in color of the cursor. It can be used in combination with key 9 to produce reverse character images of subsequent characters. You can return to the normal character mode by using the CTRL key with key 0.

CTS—Clear To Send. A signal or the control line from the modem to the terminal stating the data may be sent because the carrier is present. RS-232C is standard.

cursor—On the C-64, the cursor is a flashing square. It is actually produced by setting the reverse character image mode on and off. The cursor is the location of the next character to be entered.

CW—Control Word.

cycle-stealing—The process through which another processor gains access to a microprocessor bus for one cycle. the second processor may be an internal subsidiary processor as in direct memory access.

cycle time—The total time a device needs to complete one internal cycle before becoming available again.

D—Data line or the hexadecimal symbol for the decimal number 13.

D/A—Digital to analog. Conversion from the digital representation used in computers to the analog signals used to drive speakers, motors, etc.

DAC—Digital to analog converter.

daisy chain—A method for prioritizing interrupts. Units capable of interrupting the system can either pass on a processor acknowledge signal or block it. The highest priority is given to the unit electrically closest to the processor.

daisy/wheel printer—An impact printer that has a wheel with radial spokes bearing type. The daisy-wheel printer produces letter-quality output.

DAS—Data acquisition system.

data acquisition—The collection of data from external sensors, usually in analog form.

database—A systematic organization of data files for central access, retrieval and update.

data bus—The set of lines carrying data. All system components are normally connected to the data bus.

data file—A named collection of information, usually stored on magnetic media.

data separator—A circuit in disk controllers that separates the data from the carrier in the signals read from the disk surface.

data set—File or a group of related data elements.

data tablet—A graphic input peripheral that digitizes the position of a stylus on a special sensory surface.

data-transfer rate—The rate of transfer of data from one place to another, such as from disk to memory or from memory to memory.

d-bus—Internal destination bus in a CPU, from the ALU to the registers.

DCE—Data communications equipment. Equipment used to interface with a data communications network; generally, a modem.

DCM—Data communication multiplexer.

DC motor—A type of motor designed to operate with a direct current power source, often used in variable speed applications.

DCO—Digitally controlled oscillator.

deadlock—A situation in which two processes wait indefinitely for each other.

debouncing—Eliminating the rapid signal fluctuations that accompany a change of state in mechanical switches. Mechanical springs bounce repeatedly until the contact is finally closed or opened. Typical debounce time is 5 to 10 ms. for stable contact. Debouncing may be preformed by hardware (latch) or software (delay).

debug or test a program—A programmer must ensure that a program will correctly process all of the types of data for which it is intended. Samples of the data are prepared (test data), and the program is executed using this data (a test run). The program's outputs (reports, screen displays, files, etc.) are then verified using the program specifications. An error in the processing logic of a program is called a *bug*; hence the terms *debug* and *bug-free*. BASIC includes debugging aids for BASIC programs.

debugger—An essential program designed to facilitate software debugging. At a minimum, it provides breakpoints, dump facilities, register and memory examine/modify, preferably in symbolic form.

decay (sound)—This is the rate at which the volume of a note falls from peak value to the mid range value at which the volume is maintained for the duration. Decay is one of four components of the envelope that the SID chip implements for each note.

decode (cycle)—The second cycle of the fetch-decode-execute sequence of instruction execution. The instruction is decoded into a set, or a sequence, of control signals to all the required elements of the system, such as register gates, ALU functions, or external devices.

dedicated register—A register used exclusively to contain a specific item.

default parameters—The parameter values supplied by a computer system or a program when no explicit values are provided by a program or a user.

delay loop—A programming technique used to freeze or hold the screen display. To freeze the screen briefly while the operator using your program reads a message, just write a delay loop after you print the message:

```
1000  FOR Y = 1 to 2000
1010  NEXT Y
```

delimiter—A character that indicates the end of a sequence of characters. In English a space is the common delimiter that indicates the end of a word.

demultiplexer—A logical circuit that can route digital signals from one source to many different destinations. The unit distributes information to many locations or devices in the system.

descenders—The parts of printed or displayed characters that extend below the baseline.

development system—A computer system with a capabilities required for efficient hardware and solfware application development for a given microprocessor.

Such a system typically includes a microcomputer, monitor, printer mass-storage (often disk or hard disk). PROM programmer, and an in-circuit emulator. Software is often developed on a system totally different from the system it will run on. This can be because the target system does not have enough memory or other resources to support development or because the system is not actually available yet.

development tools—Hardware and software aids intended for use in developing programs and/or hardware systems.

Device Not Present—Error message indicating that the device specified in a OPEN, CLOSE, CMD, PRINT#, INPUT# or GET# statement was not available. The message often indicates that you forgot to turn on your printer or disk drive. Ocassionally poor cable connection or a faulty circuit in a peripheral will cause this message.

device number—A device number is a number assigned to a peripheral (cassette, modem, screen, printer, or disk drive). The device number is used to identify the peripheral to the C-64 and is referenced to OPEN, LOAD, and SAVE commands.

Diablo—A Xerox-owned company that makes computer peripherals and computer systems—a supplier of daisywheel printers.

digital—Having discrete states. Digital logic may have from two to sixteen states. Most logic is binary logic, with two states, on or off.

digital analyzers—Troubleshooting tools which allow the user to locate timing or logic errors.

digitzer—A device that converts analog information to its digital equivalent. Often used for devices obtaining input from a plotting surface and providing coordinates as output, such as a graphics tablet.

diode—A device that allows current to flow in one direction only.

DIP ("dip")—Dual In-Line Package. A standard IC package with two rows of pins 0.1" apart.

DIP switches—A collection of small switches on a DIP, used to select options on a circuit board without modifying the hardware.

direct addressing (short addressing)—An addressing technique that allows short instructions with the address field limited to 8 rather than 16 bits. Used in assembly language programming.

direct mode—BASIC commands can be implemented in one of two ways. Either in direct, or immediate, mode or in program mode. In direct mode a BASIC command is entered without a line number preceding it. When the user follows the entry with a carriage return, the line is immediately executed.

directory—A list of all programs and files on a diskette. Each directory entry on the 1541 contains the name of the file assigned by the user, the type of file, the number of blocks used and the starting block location of the file.

directory error—An error message from 1541 disk drive generated when there is a problem with the block availability map. The BAM keeps track of the blocks used on the disk and is kept on the disk. It is also kept in disk memory when the drive is on. If the BAM becomes corrupted in disk memory, the error above may be generated. It is necessary to use the INITIALIZE command to correct the situation.

disk—A flat, circular magnetic storage medium that is rotated while in use.

disk drive (1541)—The 1541 disk drive is the upgraded 1540 disk drive manufactured by Commodore. It is the disk drive designed to be directly compatible wth the Commodore 64 and connects directly with the 6-pin DIN socket in back of the C-64. It is compatible with the VIC 20 after you send the USER Command UI.

The 1541 accepts standard 5¼ inch single side density disk. It has a capacity of storing up to 170K of bytes of information and up to 144 different programs and/or files on a single disk. The drive contains its own controller and includes 16K of ROM and 2K of RAM memory. Two ports in the back of the drive enable you to daisy-chain up to 5 drives and one printer together. Following the NEW command the drive formats the disk into 35 tracks, 683 blocks, with 17 to 21 sectors per track (depending on distance from center) and 256 bytes per sector. Information is accessed one bit at a time and transmitted serially to and from the computer, which greatly reduces its relative speed. Its internal ROM and RAM allow for some degree of efficiency because some commands can be executing while the computer continues to work. The disk drive has a green and a red LED in front. Because data may be exchanged when the red LED is on, the disk should not be removed while the LED is red. A flashing red LED indicates an error condition. The 1541 stores four types of files: program files, sequential files, random files, and relative files.

disk controller—A printed circuit board used to interface disk storage drives to the CPU of a computer.

disk file—A file residing on a disk.

Disk Full—An error message from the 1541 disk drive generated if the user attempts to add data to a disk that does not have enough room or already contains 144 files.

Disk ID Mismatch—An error message from the 1541 produced when the drive attempts to access a disk that has not been formatted. It can also result from a bad disk.

Division by Zero—Division by zero is not mathematically possible and causes this error message on the C-64. Be careful with variables that might end up with a value of zero after some computations—if you divide by that variable you will get this message.

display—A computer output device that displays graphics and/or alphanumeric information, such as a CRT.

DMA—Direct Memory Access. A method used to provide high-speed data transfers between a peripheral and the main memory. Data is exchanged at maximum memory speed. Several means for accessing the memory are possible. DMA is preformed under the control of a DMAC.

DMAC—Direct Memory Access Controller. A device available as a single chip, used to automate DMA transfers. A DMAC is a specialized block-transfer processor that can take bus control away from the microprocessing unit and can transfer one or more memory words. A typical DMAC can connect to 4 or 8 devices.

DO-loop—A feature of a high-level language (i.e., Fortran) that allows a segment of a program to be executed repeatedly while or until a certain logical or arithmetic condition is fulfilled.

DOS (D-O-S or "doss")—Disk Operating System. A program or collection of programs functioning as an operating system, whose main secondary storage

medium is disk. It usually supplies facilities such as symbolic files, automatic space allocation, dynamic memory allocation, program relocation and loading, and utilities.

dot matrix—A method of forming characters by using small dots. Usually patterns are 5 by 7, or 7 by 9, though for very high quality characters, patterns of 11 by 13 dots or more are required. Dot matrix applies to displays, printers, and other output devices.

double density—The techniques used to store data at double bit density on a magnetic storage medium.

double precision arithmetic—Arithmetic operations in which the precision is doubled through the use of twice as many bits to represent numbers.

double-sided disk—A type of disk with both surfaces (sides) used for data storage.

download—The process by which a device such as a modem or a buffer receives the data or text file from another device (a computer, modem or I/O device).

DP—Data Processing.

DPSK—Digital Phase Shift Keying. Encoding digital data with phase differences on a carrier.

drive (device)—A mechanical and electrical/electronic device which operates a tape transport or a floppy disk. It may include several motors for rotation, and head positioning, as well as position sensors, control circuits, lights and switches.

drive (source)—The disk drive from which information/data is coming. The target drive is the disk drive to which information/data is going.

drive (destination)—The disk drive to which information/data is going. The source drive is the disk drive from which information/data is coming.

driver—An amplifier circuit required to reshape the signals on a bus when more than one TTL load is in use.

drum—Rotating magnetic memory similar to disk but using the surface of a cylinder.

DS—Data Strobe. Enters data into a holding register.

DSR—Data-Set Ready (RS-232C standard). A line on a modem indicating to the data terminal that the received carrier is normal.

DTE—Data terminal equipment. Equipment that receives or originates data, as opposed to data communications equipment, which merely transmits data from one device to another.

DTL—Diode Transistor Logic.

DTR—Data Terminal Ready (RS-232C standard). A line on a terminal indicating to the modem that it is ready to send data.

dual intensity—A printer or display device that can reproduce symbols in regular or bold-faced or high-lighted formats.

dual-port memory—Memory equipped with dual data and address connections, plus a binary priority circuit. Primarily used for simple communication between multiple processors. Available in single-chip form for small memory sizes.

dual processors—A computer with two CPUs. Used to provide redundancy for increased reliability or increasing throughout with a division of tasks that can proceed independently.

dumb terminal—A low-cost data terminal, ordinarily a CRT, which does not have advanced features such as editing keys or local processing.

dump—The transfer of the contents of one memory device to another. Internal registers may be dumped to memory, memory can be dumped to disk, printer, or screen.

duplex—A bidirectional communication method allowing simultaneous data transfers in both directions. It may use separate lines or multiplex a single line.

dyadic—An operation with two operands, such as addition or multiplication. Contrast to a monadic operation with one operand such as negation.

dynamic—Circuitry that stores information as charges on MOS capacitors. Dynamic memory is usually volatile and requires periodic refreshing.

dynamic memory—MOS RAM memory using dynamic circuits. Every bit is stored as a charge on a single MOS transistor. This allows very high density (only one transistor is used per bit). Because the stored charge leaks, a typical dynamic memory must be refreshed every 2 ms. by rewriting its entire contents. This does not slow down the system, but does require additional memory refresh logic. Dynamic memory chips are cheaper than static ones, and are generally preferred for memory sizes over 16K. The C-64's RAM memory is dynamic. Dynamic memory is also volatile—the data stored is lost when power is turned off or interrupted.

E—Enable. Also the hexadecimal symbol for the decimal number 14.

echo—A loop-back or "echo" technique is used to test the circuits for an input/output device by "looping" whatever is sent out back into the computer as if it were input. In this way the circuits inside the computer are tested in isolation from the circuits in the external device to help isolate where a fault lies. Echo also describes the process of sending characters keyed on the keyboard to the screen for a visual confirmation of what has been typed. There are no hardwired connections between the keyboard and the screen. The keyboard simply enters characters into memory.

ECL—Emitter coupled logic.

ECM—Electronic counter measures.

editor—A program that facilitates the entry and maintenance of text in a computer system. Typical operations include insert word/line, delete word/line, append, search for "string," and substitute. An editor is designed to allow creation and modification of data. Various word processors provide editing capability for any line displayed on the screen (full screen editors). Their basic function is to create and change text data such as letters, reports, programs, or books.

EDP—Electronic Data Processing.

EFL—Emitter-Follower Logic.

EIA—Electronic Industries Association.

EIA-RS-232C—The EIA standard for serial data transmission interfaces for asynchronous communications. Data is sent in 10- or 11-bit serial bundles. The first bit is called the start bit. It signals the beginning of the data. The data bits follow, from least to most significant. Following the last data bit comes the stop bit.

electron—The elementary unit of negative electrical charge. An electron is often conceived as a particle circling around the nucleus of an atom. The flow of electrons is an electrical current.

electronic communications—This refers to the ability of a computer to communi-

cate with other computers over the phone lines. Electronic communications are made feasible by the use of modems.

ELINT—ELectronic INTelligence.

EMI—Electro-Magnetic Interference. Interference caused by electrical fields produced by capacitive coupling, magnetic fields produced by mutual inductance; or electromagnetic fields (radio waves).

emphasize—A print function available on some dot-matrix printers. When the appropriate control code sequence is sent to the printer, it prints each character with a greater impact.

emulation—Simulation in real time. Computer A emulates computer B by executing an emulator program that makes it behave like computer B.

ENQ—ENQuiry control character.

Environment—The state of all registers, memory locations, and other conditions in a system. Also used to refer to a software environment such as BASIC.

EOB—End of block.

EOC—End of character, also end of conversion for an ADC.

EOF—End of file.

EOT—End of transmission.

EPROM ("ee-prom")—Erasable Programmable Read-Only Memory. A PROM that can be reprogrammed several times. Typically an ultraviolet-erasable PROM that can be erased by exposing it for several seconds to hard ultraviolet light. It is then reprogrammed with a special PROM programmer, and will retain contents for years. An ultraviolet-erasable EPROM may be recognized by the quartz window over the chip. Other EPROMs are electrically erasable.

error correcting code—A data storage or transmission code using extra bits that will automatically detect and correct single or multiple-bit errors.

error correction—Methods used to correct erroneous data produced by defective or unreliable data storage and transmission systems.

error message—A statement or code printed out or displayed on the screen to let you know something about what has gone wrong.

ESC—ESCape. A character that causes the terminal and/or processor to interpret subsequent characters differently than they normally would. Escape codes are used to indicate a sequence of control messages in ASCII. For example, ASCII 27 is an escape code that tells the Epson dot matrix printer to interpret one or more following bytes as control information rather than as data to be printed.

ETB—End of transmission block.

ETX—End of Text.

EUROMICRO—European Association for Microprocessing and Microprogramming.

even parity—A parity bit added to a byte or word that makes the total number of 1 bits even.

execute (cycle)—The third of three cycles for program instruction execution. During this cycle the actual operation is performed.

execute—To cause a program or batch file to start functioning or to "run".

execution time—The time required to execute an instruction, including fetch-decode-execute. Also used to refer to the point in the processing of a program

when it is given control of the CPU, as contrasted with compile time, link time, and load time.

exerciser—A test system or program designed to detect malfunctions in memory, disk, tape, or other device prior to shipping to customers or during a maintenance operation.

expansion board—A printed circuit board that accommodates extra components or cards for the purpose of expanding a computer. It is called an expansion chassis if it connects an additional cabinet to the system.

expansion port—Located in the rear of the C-64, the 44 pin expansion port allows access to the address bus as well as the data bus within the computer. CP/M modules can be inserted in this slot.

extended arithmetic—Double-precision floating point operations. Also used to refer to expanded capabilities, such as built-in trigonometric functions.

extended background color mode—The C-64 formats the screen in one of two ways—either in a high resolution mode or a character mode. In the character mode, the screen is divided into 1000 squares, 40 columns by 25 lines. In standard character mode each character must be one of sixteen colors, and the background is set as one color for the entire screen. In extended background color mode, the background for each character can be set independently of the others. In extended background color mode, only the character ROM are available to the user. This mode is enabled by setting bit 6 of address 53265.

F—The hexadecimal symbol for the decimal number 15.

fanfold paper—Continuous sheets of paper joined along perforations and folded in a zigzag fashion. This paper is often used with printers because it can be continuously fed and folded without operator assistance.

farad—The unit of electrical capacitance. A one volt per second change in voltage across a one farad capacitor will require one ampere of current flow.

fatal error—A condition occurring during the execution of a program that requires termination of the program.

fault-tolerant—A program or system capable of correct operation even when one or more of its components have failed. Also called error-tolerant or fail-soft.

FCC—Federal Communications Commission.

FDM—Frequency Division Multiplexing.

FDOS—In CP/M, the Full Disk Operating system is the collective name for BIOS (Basic Input Output System) and BDOS (Basic Disk Operating System).

feedback—One or more outputs of a system that are also used as inputs in a control loop.

FET ("fett")—Field Effect Transistor.

fetch (cycle)—The first cycle in the fetch-decode-execute sequence of instruction execution. During the fetch cycle, the contents of the program counter are placed on the address bus, a read signal is generated, and the instruction pointer is incremented. The data bytes arriving from the memory, that is the instruction that has been fetched, will be gated into the instruction register of the control unit.

FFFF—The hexadecimal representation of the maximum simple address value on 8-bit microcomputers: FFFF in base 16 = 65535 in base 10 or 1111111111111111 in base 2.

field—A logical grouping of data. This could be a group of related characters in a record (name field), a work area in memory or in the CPU, or a zone within an instruction, such as the opcode, address, or comment zone.

FIFO ("fife-oh")—First-In-First-Out structure. Data is added at one end and removed from the other, like cars lined up at a gas station. A FIFO buffer is used to connect two devices operating asynchronously at different speeds. Each device is connected to one end of the FIFO buffer.

file—A logical grouping of information with an identifying name, and considered as a unit by a user. A file may be divided into records, blocks, or other units as required by the memory device.

File Control Block—In CP/M, the File Control Block (FCB) is a 32 byte long area associated with the disk directory that is used to keep track of each file on the disk.

File Exists—An error message from the 1541 disk drive incurred when the user attempts to save a program by a name that already exists on the disk.

file handling—File handling includes the saving or loading files on disk or tape. The files may be saved as fill files, ranged blocks, or linked files. The load feature may allot appending, overwriting, or merging text files. These features have applications in linking a number of files on disk (to process large documents) as well as in mailing programs (which provide an easy way of personalizing standard letters for a large number of people). Other features include the use disk operations while in the program mode. This allows the use of many file manipulation features that are available with the Commodore disk drive.

File not found—If you attempt to load a file from disk or cassette, and the file cannot be found from disk or cassette, and the file cannot be found this message will appear. Be careful when specifying the filename. A name with a capital letter is different from one with a lower case letter, and an extra space between words will change the name.

File not open—If you attempt to use the commands CLOSE, CMD, PRINT#, INPUT#, or GET# with a file that has not been properly opened, this message will appear.

File open—This indicates that you attempted to open a file using a number that was already used to open a file. Remember to keep file numbers, device numbers, and channel numbers straight.

File too large—An error message from the 1541 disk drive indicating that a disk overflow will occur.

File type mismatch—An error message from the 1541 disk drive incurred when the user attempts to open a file that is stored as one type using a different type identification.

firmware—A program stored in a ROM. Many kinds of programs reside in ROM, and firmware designates any ROM implemented program.

fixed-head disk—A disk system with a head over each track. By eliminating the head positioning delay time it, provides very high speed but at high cost.

fixed media—The physical devices for recording of information such as programs and data files are called media. The main media for the C-64 is the disk, but cassette, hard disk, RAM, ROM and other devices are also used. Media are often classified as

- removable media—such as disks, cassettes and some hard disks
- fixed media—such as most hard disks. Fixed media are not removable from the device that drives them, so unless you also have a removable disk system, there is no ability to store additional data or backup copies off-line (outside the computing system) for insertion when needed.

fixed-point—Integer representation with the decimal point assumed to be in a fixed position. Contrast with floating point.

flag—A status indicator for a special condition. A flag is normally stored in a flip-flop or in a register. Typically, a microprocessor provides at least the following status flags: carry, zero, sign, overflow, and half-carry or auxiliary carry.

flip-flop—A circuit used to store one bit of information. An FF is bistable with two stable states (0 and 1). Registers are generally assembled out of flip-flops.

floating-point—Representation of numbers in a fixed length format, such as 24 or 32 bits. The number N is normalized and encoded as a mantissa field M and an exponent field. The name reflects the fact that the representation remains fixed as the decimal point floats, that is, the changes in magnitude are reflected by adjustment of the exponent field with renormalization of the mantissa field. The precision of the representation is limited by the number of bits allocated to the manitissa field. Contrast with fixed point.

floating point constants—The C-64 represents numbers as either integers (whole numbers 1, 2, 3, etc.) or floating point numbers that may contain fractions. A floating point number is expressed in decimal notation or in scientific notation. In decimal notation up to nine digits can be displayed on the screen giving a maximum value of 999999999. If you do not include a decimal point, one is presumed to follow the last digit. Numbers larger than 999999999, or smaller than .01 are printed on the screen in scientific notation. The smallest number represented in 2.93873588E-39.

floppy disk—A mass-storage device using a flexible (floppy) mylar disk (disk) to record information. The disk is sealed in a square plastic jacket lined with a soft material that cleans the diskette as it rotates. A cutout slot provides access for the moving head. Other holes in the jacket provide access to sector index holes in hard-sectored disk. Disks are hard-sectored if the sector start points are marked by holes in the disk. Soft-sectored disks have only one (or a few) holes to mark the start of the track. The sector start marks are placed on the soft-sectored disk under software control in a process known as formatting the disk. The C-64 uses soft sectored 5¼ inch diskettes in its standard drives.

flowchart—A symbolic representation of a process. Boxes represent commands of computations. Diamonds represent tests and decisions (branches). A flowchart is a useful step between process specification and program writing. It can facilitate understanding and debugging the program by segmenting it into logical, sequential steps.

flyback—The time delay while the spot on a CRT comes back to the beginning of a frame.

forth—A programming language and operating system. Forth is characterized by threaded code and postfix, or reverse Polish, notation. Forth is an extensible

language. You can create new commands, defined in terms of the existing commands or in machine language code. Your new commands then become part of the FORTH language in exactly the same way as the standard commands. This feature allows you to build up exactly the commands you would request if you were designing a language especially to suit a particular application or type of problem. FORTH is also highly transportable from one microcomputer to another—more so than BASIC and most other languages. FORTH tends to run fast, closer to machine code than to higher level languages like BASIC. FORTH may be somewhat harder to master than BASIC, but it offers many advantages.

FORTRAN—FORmula TRANslator. One of the first high level languages, still widely used especially by scientists and engineers. BASIC is largely based on FORTRAN, using statement numbers and a similar set of commands. FORTRAN is rich in mathematical functions and supports an extended-precision calculations mode for scientific problems requiring high precision. FORTRAN is a compiled language, not interpreted like BASIC. A program is edited in a file, then submitted to a compiler for translation into executable object code. This is later executed.

fragmentation—A situation in which space in mass memory (disk or hard disk) has been allocated in such a way that it has many unallocated areas (fragments) that are too small to be useful or to allow optimum performance. The remedy for fragmentation is the moving of all the allocated areas into a single area to make the space once occupied by fragments available in one large block.

frequency—The number of cycles per second. F=1/T where T is the period in seconds over which cycles are counted.

front-end processor—A processor that acts as an interface with a user or a process. The front-end may perform preprocessing translations or file handling, while the main processor performs interpretation, execution, or other processing.

full duplex—A communication technique that allows data to be transmitted and received simultaneously.

function keys—The four keys located to the right of the keyboard labeled F1, F2, F3, F4, F5, F6, F7, F8 are available for user assigned functions. Each key has a separate code number from 133 to 144 inclusive. A user can press a function key and compare it to the code numbers. If there is a match the program will know that one of the function keys has been pressed and will branch to an appropriate subroutine. As example:

```
10  GET A$
20  IF ASC(A$)=133 THEN GOTO 400:REM
```

400 is subroutine that may, for example print hello. If F1 is pressed at this time the word hello will appear on the screen.

fundamental—The base or carrier signal on which a data signal will be superimposed. It is usually a pure sine wave with no distortion.

F/V—Frequency to Voltage Converter

G—Ground. Also Generate signal, which is the output from an adder connected to a carry look-ahead circuit. It requires a propagate signal.

gain—The output to input amplification ratio.

game ports—There are two 9 pin game ports located on the side of the C-64 and labeled control port 1 and control port 2. They can be used for compatible joysticks, game paddles, and light pens. Information as to the position of the joysticks or whether or not a fire button has been pressed is sent through the port to the 6526 CIA chip. That information can be read by accessing memory address 56320 for port A and 56321 for port B.

gap—The space between two records or two blocks of information on a magnetic media. A gap is usually set to a predetermined value, such as all ones. It allows blocks to be rewritten in a slightly expanded or reduced format, due to speed variations of the drive.

garbage collection—A technique for collecting unavailable, unused space in a mass memory and making it available for reuse by any of several schemes.

gate—A single logic function. The NAND, NOR, AND, OR, XOR, and NOT functions are examples of gates.

glitch—A pulse or burst of noise. A small pulse of noise is called a snivitz. The word glitch is usually reserved for the more dangerous types of noise pulses that cause crashes and failures.

global variable—A variable whose name and value are accessible throughout the program or application system. Contrast with a local variable, accessible only within the block where it is defined.

GND—Ground.

GPIB—General Purpose Interface Bus. The IEEE 488-1975 interface bus standard. Also called ANSI Standard MC 1.1– 1975, or the IEC Bus in Europe.

graphics—Graphics generally refers to the generation of pictures or diagrams onto the screen or printer. The quality of a graphic display depends on the resolution available for display. The Commodore 64 has a high resolution mode in which 320 by 200 dots of light (pixels) are displayed on the screen. Each one of these pixels can be turned on or off to generate high quality graphic images.

graphics characters—The C-64 has incorporated in its system a series of special graphic characters. Each character is actually a small picture that can be combined to create larger more complex pictures or diagrams. The characters can be input from the keyboard or generated in a program using the appropriate CHR$ reference.

ground—The point of reference in an electrical circuit (not necessarily the physical ground). The ground point is considered at nominal zero potential, and all other potentials in the circuit are compared with it.

GT—Greater Than (also represented by >).

half-duplex—A mode of communication in which data can travel in only one direction at a time.

handler—A program used to control or communicate with an external device such as a disk drive.

handshaking—A basic communications synchronizing technique using two signals: 1—ready ?; 2—yes/no acknowledgment. The handshaking procedure is carried

out when establishing a connection between two data communication devices prior to any data transfer.

hard copy—Computer output printed on paper.

hard disk—A disk composed of a magnetic coating applied to a rigid substrate, such as aluminum or ceramic. The term is generally used to contrast with soft (floppy) disks, which are flexible. Floppy disks are slower and have less storage capacity.

hard-sectored—Describes a disk on which the recording surface has been divided into sectors using nonalterable methods, such as a ring of holes in the disk itself. Contrast this to soft sectoring as used with the C-64, where sectoring is done using this NEW command, which writes the information on the disk.

hardware versus software—Computer programs of all kinds are called software. Usually software is contrasted to hardware, the actual chips, wires, boards, and so on that make up the computer. A special case is Read-Only Memory (ROM), which is hardware that contains a permanent copy of software. Shorthand terminology here could be confusing: "BASIC ROM", means a ROM (hardware) containing a copy of a BASIC interpreter program (software). Such ROMs are often called firmware to distinguish them from nonprogrammed hardware and from software in changeable media (RAM, disk, or cassette).

harmonic—An integer multiple of a fundamental frequency.

harmonic distortion—Distortion due to the signal's nonlinear characteristics, resulting in output that includes harmonics of a harmonic-free sine input.

harmonics—The sine waves that are related to the fundamental frequency of a note in that they are integer multiples of the fundamental frequency. Depending upon the harmonics in a wave, the wave can be classified as *triangular, rectangular,* or *sawtooth*.

high resolution graphics—The C-64 has two modes of video display, the standard character mode and the high resolution mode. High resolution mode (Bit Map Mode) on the Commodore 64 is selected by poking the appropriate value at address 53265 (the VIC II control register). It may be used to draw highly detailed pictures on the screen. It has useful applications in art or business. In high resolution mode the screen is transformed into 64,000 dots of light (pixels) that are individually programmable.

HIRAM—The name of a control line that banks an 8K block of memory in and out of the micrprocessors memory. When HIRAM is high, the microprocessor sees 8K of KERNAL ROM from $EOOO to $FFFF. When it is low, the microprocessor sees 8K of RAM in that space.

IC—Integrated Circuit. An IC is a device that combines several electronic components into single package. Often the components, typically transistors, are simulated with microscopic gating structures and may number in the tens of thousands on a single circuit.

Illegal System T or S—An error message from the 1541 disk drive incurred when the user attempts to access an illegal track or sector.

Illegal Track and Sector—An error message from the 1541 disk drive incurred when the drive attempts to access a track or sector is not available or does not exist.

index registers—The 6510 contains two 8 bit registers: the X register and the Y register. These two registers are involved in many of the machine code instructions. In some instructions these registers are used as automatic offsets to some specified address, and they are therefore referred to as index registers.

INITALIZE—A disk command, the INITIALIZE command, when sent through the command channel, returns the disk drive to the same state as when powered up. The command is useful when an error condition is preventing you from proceeding with disk operating. The format is:

```
OPEN15,8,15
PRINT#15,"INITIALIZE"
```

instructions—A statement normally used within a program to cause a computer to carry out a specific action. See Commands.

interference—Occasionally a television that is serving as a video display unit is subject to interference that produces wavy patterns or lines on the screen. This can sometimes be remedied by moving the TV, keyboard, or power supply. The C-64 allows for two channel selections (3 or 4). If one channel is receiving interference, the situation may be remedied by shifting the small switch in the back of the C-64 and selecting the appropriate channel on the TV.

K—The symbol for 10^3. When K is used to refer to the amount of memory in a computer, it refers to a unit of 1024 bytes. 64K is equal to 65,536 bytes.

KERNAL—The KERNAL is a part of the operating system found in the ROM of the C-64. It handles most of the interrupt level processing and controls the actual input and output of data.

LISP—A programming language that is oriented towards symbols in the way that other languages are oriented towards numbers. The type of object it handles best is ideally suited to the representation of information whose structure cannot be completely specified in advance. LISP permits the building of intermediate structures and the discarding of them without causing the user any worries about how to find and later reuse the space necessary for their storage. The syntax of LISP is simple and elegantly defined. The natural method of building programs in LISP by function composition encourages good programming style and facilitates modular programming.

listener—The C-64 utilizes a serial bus to connect to the 1541 disk drive and some printers. Because more than one device may be present on the serial bus, it is important that only the intended device receive data. The C-64 arranges for this by making a particular device a listener by sending appropriate command signals with a specific device number. All data sent across the serial data line are received only by the listener until the unlisten command is sent.

LSB—Least Significant Bit.

maintenance—A computer itself requires no active maintenance beyond keeping it free from dirt and moisture. Any integrated circuit will last longer if you leave

vents under the system unobstructed. Avoid repeatedly connecting and disconnecting cables if possible, this will eventually lead to poor connections and intermittent problems. The disk drive should also be well ventilated and out of direct sunlight. The heads within the disk have a tendency to build up oxide deposits from the disk. It is advisable to periodically use a commercially-available head cleaner to help remove the deposits.

manual—A process done by hand, not automated or programmed. Also a reference book, booklet, or other document.

media—The physical devices for recording information. See *Fixed Media*.

memory—Any device that can store information and allow it to be retrieved when needed. The C-64 relies primarily on random access memory (RAM), read-only memory (ROM), disk, and cassettes. Memory, by itself, is usually a reference to RAM. This is the general purposes, erasable and reusable memory located inside the C-64. ROM (read-only) memory contains fixed data, usually programs such as the C-64's cassette BASIC ROMs and its ROM KERNAL. The KERNAL contains the fundamental machine language programs to run the various devices attached to the C-64 such as the monitor, printer, disk drive, and cassette player. ROM and RAM together make up the internal memory or main memory of the C-64, or any other computer.

MEMORY-EXECUTE—A disk command, the memory execute command given through the command channel will begin executing any machine code instructions in ROM or RAM of the disk drive beginning at the address specified. The format is

```
OPEN15,8,15
PRINT#15,"M-E:"CHR$(LS)CHR$(MS)
```

LS—decimal number for least significant byte of the address.
MS—decimal number for most significant byte of the address.

memory management—The internal memory of the C-64 consists of 64K RAM and 20K ROM (operating system and BASIC interpreter). Because there are 16 address lines, only 64K addresses are possible at any given time. The C-64 manages this memory scheme by banking blocks of ROM in and out of the configuration. Control of this operation is maintained at address 0000. As an example, the 8K of BASIC memory ROM can be found at address $A000—$BFFF when bit 0 of address 0000 is set to 1. When the bit is set to 0, 8K of RAM are seen at address $A0000—$BFFF. In the same fashion, 8K of KERNAL ROM can be banked in and out of the picture, as well as 4K of input output registers. When first powered on, the C-64 sets address $0000 in such a way that the system sees 8K of BASIC, 8K of KERNAL, and 4K of I/O registers.

memory map—A memory map consists of a table of addresses (locations in memory) and the functions of those addresses. Often an aspect of the hardware of a computer is essentially controlled by a specific memory location. Changing the value in that specific location will change the setting in the hardware. As example, location 53281 controls the color of the screen. Poking appropriate numbers into the address will change the color of the screen.

MEMORY-READ—Disk Command. This command, given through the command channel, enables you to read any address in the 16K ROM or 2K RAM within the 1541 disk drive. The command itself locates the specific address. The data at that address can be obtained with a GET statement through the error channel. The format is

```
OPEN 15,8,15
PRINT#15,"M-R:"CHR$(LB)CHR$(HB)
GET#15,A$
```

LB—Low byte of address. The address is expressed in decimal and can be computed as follows: LB = decimal address – HB * 256

HB—High byte of address. The address is expressed in decimal: HB = INT (decimal address/256).

MEMORY-WRITE—Disk Command. The Memory Write command enables you to write into the RAM within the 1541 Disc Drive. The command specifies a starting address for the data to be entered and is followed by the data. Up to 34 bytes of data can be written in one command. The format is

```
OPEN15,8,15,"M-W:"CHR$(LS)CHR$(MS);CHR$(n);CHR$(D)
```

LS—decimal number for least significant part of address.
LS=Decimal Address–HS*256
HS—decimal number for most significant part of address.
HS=Decimal Address/256
n = number of characters in data to follow.
d = decimal number for machine code of data.

menu—A menu is a screen display that lists a number of possible options and asks the user to select one. When a selection is made by keying in an identifying number or letter (or positioning the cursor beside the desired item, using a light pen, joystick, or cursor keys) the selected function is performed. This may require either a branch or subroutine call to the code for the function, or the program to carry out this function may be loaded into memory and executed. Many application packages use a system of multiple menus. A *master menu* lists the major functions allowed. Selection of an option on the Master Menu causes another menu, showing more detailed options, to be displayed. This can be followed by even more detailed menus, and so on. Often the completion of a function will cause the Master Menu to be displayed again. Such a system is called a *menu driven* system.

message—A statement or code printed out or displayed on the screen to let you know what is happening. Examples include prompts, which are displayed when the program expects you to input something, error messages, which tell you something about what went wrong, and informational messages, such as "Copy Complete".

microprocessor—A microprocessor is an integrated circuit that performs most of

the functions of a computer. On the C-64 the 6510 chip is the microprocessor;, it performs all of the logical, arithmetic, and controlling functions of the computer.

mode—A general term used to describe a condition of computer system with the implication that alternative conditions exist. In the C-64 the video interface chip can format the screen into 1000 blocks (the character display mode) or 64000 dots (the bit map mode). The user must decide which mode he wishes for his application and poke the appropriate value into bit 5 of memory address 53565. If he makes no entry at that location the computer automatically sets the mode as the character display mode.

modem—Modulator DEModulator. A device to convert the digital voltage level signals of the computer to modulated (frequency or tune) signals for transmission overphone lines. A modem is required at both ends of a phone line for telecommunications.

modulator, RF—A computer is designed to connect directly to a monitor. To connect a computer to a television set, an RF (radio frequency) modulator is needed to make the necessary corrections on the signals generated. The C-64 comes with a modulator and can be connected directly to any black and white or color TV. There is also an audio/video port to connect directly to a monitor.

monitor, video—A monitor is a cathode ray tube designed to receive signals by cable directly from a source. A television set receives its signals by utilizing high frequency radio signals. You must use an RF modulator to connect a T.V. to a computer, whereas a monitor can be connected directly to the computer. A monitor has better resolution with much less interference than a T.V., but it usually does not have a built-in speaker. The C-64 has a audio video port in the back to connect directly with a monitor and also comes with a RF modulator to connect to a T.V.

multi-color character mode—The C-64 formats the screen in one of two ways, the high resolution mode or the character mode. In character mode the screen is divided into 1000 squares, 40 columns by 25 lines. In standard character mode, each character must be one of 16 colors. In multi-color character mode, each character can be made up of four different colors (including the background screen colors). The multi-color character mode is enabled by setting bit 4 of address 53270. Multi-color character mode sacrifices some resolution because colors are set in groups of two pixels.

NAND—Logical NOT-AND.

native compiler—A compiler for the processor on which it runs.

NBS—National Bureau of Standards.

NC—No Connection.

NDAC—Not Data Accepted.

NE—Stands for Not Equal. Also represented by <>.

negative logic—Normally true state voltage in the computer system represents a logically false state. A normally false state voltage in the computer system represents a logically true state.

nested subroutine—A subroutine that is within another subroutine. The inner subroutine (nested) is completed first, with the outer subroutine being completed after the nested subroutine has finished.

network—Computers can be connected together to form a system that is interconnected—a network.

NEW—The NEW command, when sent through the command channel, erases the entire disk, puts timing and block markers on the disk, and creates the directory and BAM. The format is

```
OPEN15,8,15
PRINT#15,"NEWO:name,id"
```

name—arbitrary name assigned by user.
id—arbitrary identification by user consisting of two character. ID is placed in the directory an on all blocks on disk.

nibble—Half a byte or 4 bits.

No Block—An error message from the 1541 disk drive incurred when a user attempts to use the BLOCK-ALLOCATE command to allocate a block that is already in use. The error channel #15 returns this message as well as the track and sector of the next available block.

No Channel—An error message from the 1541 disk drive incurred when a user attempts to open more than the allowed number of channels. Up to 5 sequential files or 6 direct access channels may be opened simultaneously.

noise—Interference on a system communications line or random unknown signals.

nondestructive read-out—The memory contents are not erased or displaced when the data is read.

NOR—Logical NOT-OR.

NOT—Negative operation which changes every 1 in a byte to 0 and every 0 in a byte to 0. Also used as a logical operator to reverse the outcome of a conditional test in many languages (If ccNOT = 1).

Not Input File—This is an error message from the C-64 is encountered when a program attempts to INPUT or GET data from a file that was specifically opened as an output file.

notch—A write-protection devise on a disk. A disk is write protected if it does not have a notch about one inch down on the right hand side. The notch may be absent or covered with an adhesive tab. When the notch is absent or covered, it is mechanically impossible to write to the disk. The disk can still be read, and the files can be loaded from the disk to the computer. Attempting to write to a protected disk will give a WRITE PROTECTION error. See *adhesive tab*.

numeric data—Numeric variables and constants refer to numbers. These numbers can be added, subtracted, multiplied, divided, compared, and so on. Numeric variables can be recognized because the variable name is followed by a % symbol for integers or no symbol for floating point numbers. This is in contrast to string data, which can be recognized by the $ symbol following the variable. String constants are always in quotation marks. String data can also be comprised of numbers, but the computer sees them only as symbols and can not perform arithmetic operations on them. The expressions A=27 and A$="27" are viewed by the computer as two completely different expressions.

NSEC—Stands for NanoSECond. 1 nanosecond is equal to one billionth of a second.

null detector—A circuit that registers when current is not flowing or when voltage is not present.

null string or file—A string or file with no contents at this time.

number crunching—The performance of complex arithmetic operations and computations.

O—Stands for Output or Overflow.

object code—The code produced by a compiler or assembler program. It is in fact the only code that can be directly executed by the computer.

object program—A program written in machine language. Most programs are written first in a higher-level language such as BASIC. The program is referred to as a source program. A microprocessor such as the 6510 in the C-64 does not recognize BASIC words. They must first be translated into a machine language program. This translated version that is ready to be used by the microprocessor is called the object program, and the process of translating is called compiling or interpreting.

odd parity—The parity bit is added to a word so that the total number of 1 bit becomes odd. This is contrasted with even parity, where the total number of bit becomes even.

off-line—Outside of or disconnected from the computer system. Off-line means that a device or media is outside of or disconnected from the computer system. Contrast with on-line that means that a device or media is inside or connected. A disk is off-line when it is in a box, and on-line when it is in a working disk drive. A printer is on-line if it is attached, powered on, and ready to print. The printer is off-line if it is disconnected, powered off, or switched to its "off-line" state.

on-line—Inside of or connected to the computer system. See off-line.

operand—Operations are performed upon entities called the operands. For example, LET A=B+C statements specifies that the operation of addition be performed on the operands B and C.

operating system—The software and hardware responsible for organizing the memory of a computer and orchestrating the various activities of the computer. It is built into the ROM of the C-64.

operation—Action of a program resulting in a defined instruction being executed and carried out.

operation code—Part of the assembler or machine language program that specifies what operation is to be performed.

operator—Person using a program (user).

operator—Symbols within a program, such as * for multiplication, – for subtraction, or + for addition, which specify what operation is to be performed.

optimization—Changing either the software or the hardware of a computer system so that it operates faster or more efficiently.

options—A menu is a screen display which lists a number of possible options and asks the user to select one. See *menu.*

OR—A logical operation performed between two numbers. The result of a logical OR between two bits is one, if either of the bits is one. The result is zero if both bits are zero.

OR—OverRun—The status flag of the Universal Synchronous/asynchronous Receiver/Transmitter (UART), which goes to one if a new character is written on top of an old one.

OS—Stands for Operating System.

oscillator—The Commodore 64 has three independently controlled voices produced by circuits known as oscillators.

Out of Data—This is an error message from the C-64 encountered when a program attempts to READ from a DATA statement but runs out of data. Remember to separate data properly in a DATA statement, and make sure there is a one to one correspondence between the number of READs and the amount of data.

Out of Memory—This is an error message from the C-64 indicating there is no more RAM memory available. It also occurs when too many FOR loops are used or when there are too many GOSUBs used. Remember arrays though they may only take one line to dimension often occupy vast areas in RAM.

output—Information coming out of a program. It may be going to a screen, printer, disk, speaker, modem, or other device.

OV—Stands for Overflow.

Overflow In Record Print#—An error message in the 1541 disk drive incurred when more than the defined or allowable number of characters is PRINT#ed to the drive. Remember the carriage return is included in the characters sent.

Overflow—An error message indicating that a value computed has exceeded the maximum value allowable on the C-64 1.70141884E+38

overflow—The result of the arithmetic operation was too large for the register specified.

overlay—Different routines within a program which occupy the same memory location. They are loaded as needed during the operation of a program. Conflict can occur if two routines with different overlays try to use the same location at the same time.

over-striking—The printer returns to a position where a previous character was struck and strikes a new character on top of it producing a combination character.

over-voltage protection—The computer's circuitry is protected from undesirable increases in the AC lower line voltage.

P—Stands for Parity

package (software)—A software package is a group of computer programs, possibly including data files and documentation, used to perform a function or group of related functions on the computer. When the programs are devoted to an end user task, these packages are called applications software. Examples would be a word processing package and an accounting package. These programs are called systems software packages when they facilitate the use of the machinery, such as a disk operating system, or program development package.

packet—A short set of data that fits into a particular location and of a prefixed length. The set is then transferred in a network of devices.

pad—The rectangular base where the wire of a computer chip is connected.

pad—To fill a data field with blanks.

page length—Usually refers to the number of lines that can be printed onto a sheet

of paper. On a standard sheet, 66 lines of data can be typed using a standard line format.

paging—On the screen, especially in a word processing program, paging is to switch from one full screen of information to another. You can page either backwards or forwards. In memory, a page is a logical set of storage used for the management of memory; in a paging system, the memory location is designated by the page number or address and an address within the page.

parallel—Simultaneous handling of processes, transmissions or storage of data. In most microcomputers, parallel I/O connections have 8 wires to carry 8 bits of a byte simultaneously (or in parallel). Contrast this with a serial interface, where only one data wire is available. The 8 bits of a byte are transmitted one after another (or serially). The I/O device must collect all 8 bits through time back into one 8 bit byte.

parity—An error detection technique that uses a one-bit indicator at the end of a word. Odd parity sets the parity bit to make the total number of 1 bits odd. Even parity sets the parity bit to make the total number of 1 bits even.

Pascal—This is a structured computer language, a descendant of ALGOL 60. It adds new features, such as *records* (data structure definition) and *sets*. It is a language suitable for a wide variety of chores, from systems to application programming. It is both explicit and verbose, making it easy for relatively naive readers and for those other than the original programmer to understand the function of a Pascal program.

password—A word used for identification and security purposes on a computer system. Each user is assigned a specific set of alphanumeric characters to gain entrance to the entire computer system or to portions of the system.

patch—For debugging or alteration of a software program, a section of code is inserted into the program, which changes the control functions of the program.

PC—Program counter, printed circuit, or personal computer.

PCS—Personal Computing System.

PE—Parity Error. If the parity status bit indicates that the parity is not what was specified, an error message is produced, a flag set, and hopefully a message displayed.

peripheral—Any external device connected to a computer and controlled by it.

personal computer—Generally, a single-user computer system that is inexpensive and can fit on a desktop.

phase—Measured in degrees, the phase is the difference between the zero crossing point of the reference waveform and that of the measured waveform.

PILOT—An acronym for Programmed Inquiry, Learning, Or Teaching. A higher-level language available for many microcomputers including the Commodore 64. It was developed to allow creation of computer assisted instructions for beginners. It differs from BASIC in that it has single character commands. It incorporates many features such as word manipulation and graphics that are valuable to teachers and novice computer enthusiasts interested in learning to design their own programs. Depending upon the specific version, the PILOT interpreter may be available with enhanced features such as an editor, autoline numbering, and extension commands that will aid in designing sophisticated programs.

pin-compatible—Computer systems that have integrated circuits with leads or pins with identical functions.

pixel—The word pixel refers to a single dot of light displayed on a CRT screen. The C-64 display is comprised of 64000 pixels.

plotter—A computer controlled mechanical device for drawing lines.

plug-compatible—Devices or components that use the same plugs and therefore can be used interchangeably without modification within the computer system.

pointer—A data item whose contents is the address of another data item.

polling—A technique where the status of each device is investigated according to a schedule.

port—A physical I/O connection that provides a connection between the computer's internal processor and an external device. Lorts are used to attach input and output devices.

positive logic—The voltage level most positive in the computer system is the true level; the false level is the voltage level closest to zero.

power down—The steps a computer may take to preserve the state of the processor and to prevent damage to it or to connected peripherals when the power fails or is shut off.

power-fail restart—A device that detects a drop in the voltage and signals the processor. The processor still has several milliseconds to preserve the registers in a battery backup memory, allowing automatic resumption of processing when the power is restored.

power on—The act of turning the power switch to the ON position or otherwise supplying electric current to a device.

power supply—The unit that converts the voltage from the electrical supply (normally 120 volts) to the voltages the computer elements use (5 volts on the C-64).

power up—The steps taken by a computer processor when the power is turned on or restored after a power failure. The processor and peripherals are initialized so that program execution may be started.

preprocessor—A program or mechanical device that prepares data for further processing.

printer buffer—A device that stores data from the computer in its memory, and when the memory is full, sends the data to the printer or modem.

priority—When sprites encounter each other, the one given the highest priority will appear in front of the other. Sprite 0 has the highest priority, sprite 7 has the lowest.

probe—An electrical device that, when touching a circuit point, will allow a test meter to test the circuit's connection and power.

program—A sequence of instructions that specify a process for manipulating data. Programs can be written in many languages, which are given level ratings according to how much additional work the processor must do before the program can be executed. BASIC is a high level language that requires that all programs be run through a compiler or interpreter. A mid-range language is assembly language, which is closer to the binary code of the computer, but still needs some processing through an assembler before executing. The lowest level are programs written in binary code which are directly executable by the microprocessor. Before assem-

bler programs were developed, all programs were written in binary code.

program file—Any program created in BASIC in the program mode is saved on to disk as a program file. A program file on disk includes the location in C-64 memory that it came from, and the file can be returned to that specific location using the load instruction with a 1 in the address argument. A program file is saved on disk one block at a time, with the first two bytes of each block pointing to the track and sector of the next block used. Program files are labeled as PRG files in the directory.

program integrity—The act of ensuring that programs (or data) cannot be altered improperly. For example, in a payroll system, steps must be taken to ensure that employees cannot alter their pay rates or hours worked. Data security consists of guaranteeing both data integrity and data secrecy or privacy.

program—The complete sequence of machine instructions and routines necessary to solve a problem.

program (version or release)—Programs and software packages are changed from time to time to correct errors or add new capabilities. To keep programs from being in a constant state of flux and to simplify distributing modified programs to users, a number of changes are made, tested, and packaged as a new version or release of the program. Versions or releases are typically numbered: 1.0 for the first version, 1.1 for the first minor revision and 1.2 for the second minor revision. When a major change or large number of minor changes have been made, a new number may be assigned, as Version 2.0.

programmable characters—Usually the data required to form the image of a character on the screen is brought from the character generator in ROM. The character generator is simply a list of values that define each character. With the C-64 it is possible to define your character in RAM memory and then to instruct the computer to look to RAM instead of to the generator when a key is pressed. In this manner you can create your own characters.

programming language—A set of rules specifying a language that can be translated into machine language and cause the computer to carry out functions.

PROM—Programmable Read-Only Memory. ROM which can be modified by the user using a device designed for this purpose.

PROM programmer—An external device or module used to write user modified ROMs.

proportional spacing—A print format in which the amount of horizontal spacing allowed for a character is dependent upon the width of the character. Proportional spacing is more readable that fixed width type and appears to be typeset.

protected field—Upon some data entry screens, certain areas are reserved and cannot be modified or changed by the user with keyboard entry.

pulse—A square or gaussian shaped voltage or current lasting a short period of time.

PUSH—An assembler instruction used to put a word on the top of a stack.

pushdown list—Another name for a stack.

QA—Quality Assurance.

QC—Quality Control.

quad—Involving four entities, or a multiple of four.

queue—A data structure that contains data or tasks waiting to be processed.

QUIP—QUad-In-line Package. An IC package with two rows of pins on each side, which is much smaller than a comparable DIP.

Qwerty—The traditional typewriter keyboard layout, in which the keys for these six letters appear in order in one of the rows.

R—Reset. Also, Register, Request, Ring Indicator.

rack mountable—Describes equipment packaged for installation in a metal cabinet called a rack.

radiation hardening—A quality assurance process used in the production of integrated circuits to select circuits that are better able to withstand radiation.

RAM—Random Access Memory. Memory is any device which can store information and allow it to be retrieved when needed. The C-64 relies primarily on random access memory, read only memory (ROM), disk, and cassettes. The term memory by itself is usually a reference to RAM.

random access—An access method where each data item can be retrieved directly by an address computed from the data.

random file—A type of disk file in which blocks of data are stored and recalled by drive, track, and sector number. Random files are not given names and essentially are hidden on the disk. It is up to the user to keep a record of track and sector number of data being stored on the disk (often by using a sequential file). Only the block availability map has a record of blocks used and there is no way to know which block is being used by which file. You can access a block of data within a random file directly withtout having to first access the blocks that were written before it. This is much faster and more efficient than accessing information sequentially.

raster register—The electron beam of a CRT moves across each row and then moves down a row and scans again across the next row. It continues this process until the entire screen is displayed. The position of the beam is reflected in a number called the raster count. The raster register can be peeked to find the last 8 bits of the raster count. The raster register can be written to with a POKE in order to generate an interrupt when the raster count equals the value on the register.

raster scan (CRT display)—A standard TV display technique where an image is built from aggregates of dots of varying brightness.

RD—Received Data (RS-232C standard).

RDE—Received Data Enable. A status flag in a UART.

RDY—A control signal used with slow memory or devices to indicate valid data is available.

Read Error—An error message from the 1541 drive incurred when the drive is unable to read correctly data on the disk. The 1541 drive is capable of being more specific by reading the error channel (#15) and decoding the error number.

real-time—An action or system capable of action at a speed that keeps pace with the occurrence of an actual process.

Real-Time Operating System—An operating system capable of real-time task management, including event scheduling, interrupt management, and real-time event counters.

read/write—Describes the nature of an operation, that is, the direction of data flow.

reasonable test—A test that assures that the value of a variable falls within a bracket defined as reasonable. It is used to detect and filter noisy inputs or erroneous outputs.

record—A unit of information, either read, written, or stored.

Record Not Present—An error message from the 1541 disk drive incurred when the user attempts to INPUT# or GET# data beyond the last record in a file. It can also occur if the user attempts to use the position commands beyond the last record of a relative file.

rectangular waveform—A rectangular waveform consists primarily of odd harmonics (like the triangular waveform), but the proportion of the harmonics is the reciprocal of the harmonic number.

recursive—Refers to a function, routine, or procedure that calls itself.

Redo From Start—An error message from the C-64 encountered when user enters string data into an INPUT when the computer was expecting numeric data.

redundancy—The use of more than one of the same item to increase reliability or performance.

reentrant code—A single segment of code and data that is not modified during execution, so that it may be called by multiple programs.

refresh—The logic necessary to rewrite the contents of the dynamic RAM periodically, typically every millisecond.

refresh circuitry—Electronic circuitry that periodically reads and rewrites the contents of dynamic memory to prevent loss of data.

register—One word of memory, usually implemented in fast flip-flops, directly accessible to a processor. Most central processing units include a set of internal registers that can be accessed much faster than the main memory.

register select—One or more lines used to select one register out of a given number within a device. Register select pins are normally connected to the address bus.

relative addressing—A method of memory addressing in which the information desired is located by adding a displacement to a pointer. Addresses are expressed relative to some base address or pointer.

relative file—A type of disk file that allows you to access blocks of information directly. Relative files are similar to random files, but they give you the advantage of being able to alter the record length and of being able to name the file. Data handling is made easier through the establishment of *side sectors* that point to the beginning of each record.

release—Program or Software. Programs and software packages are changed from time to time to correct errors or add new capabilities. To keep programs from being in a constant state of flux and to simplify distributing modified programs to users, a number of changes are made, tested, and packaged as a new version or release of the program. See *version.*

release—In the terminology of sound, this is the time a note takes to go from sustain level to zero level (silence).

relocatable—The load module or object form of a program or routine that does not contain fixed addresses or that is structured so that it can be "relocated" and executed anywhere in the memory.

relocating loader—Machine coded programs that can work in any part of memory or relocatable. Most machine codes can not do this because the program references specific addresses. A locatable loader goes through the program and changes the relevant addresses so the program can be placed anywhere in RAM.

REM—A remark or comment in a BASIC program.

RENAME—The Rename command, when sent through the command channel, changes the name of a file in the disk directory. The format is

```
OPEN15,8,15
PRINT#15,"RENAMEO:newname=oldname"
```

newname—New name of a file arbitrarily assigned by the user.
oldname—The name of the file being changed.

RES—RESet signal.

reserved device numbers—The C-64 has assigned certain numbers to specific devices. These numbers must be used to reference when opening a channel to a device. The printer is device 4; the cassette is device 1; the screen is device 0. A single 1541 disk drive is device 8. If more than one 1541 are used, it is necessary to change the device number by software or hardware means.

reset—To return to zero, or to some arbitrarily selected beginning point. Powering on the C-64 performs a reset.

reside—Be recorded in. A program may reside on a disk, or in memory (RAM or ROM).

resident (software)—A program that resides in the main memory of the system.

restart—To restart a program after it has been stopped.

retrofit—To improve or change software or hardware by making additions.

reverse video—The ability of some CRT terminals to display dark characters on a light background as opposed to the standard light on dark. On the C-64 the character color forms a block that surrounds the character, which is printed in the background color. Also called *inverse video.*

RFI—Radio-Frequency Interference.

RF modulator—A device which encodes a composite video signal, as required for most monitors, into a radio frequency signal for display on a standard television set.

RFP—Request For Proposals.

RFQ—Request For Quotes.

rise time—The time required to complete the low-to-high transition of a pulse.

rollover—Depressing two or more keys on a keyboard simultaneously. A good keyboard controller will include debouncing and multiple-key rollover protection.

ROM—Read Only Memory. Memory that can be written only once. ROM cannot be altered once the memory has been burned into it. The C-64 comes with over 20K of ROM, which contains the operating system, the BASIC interpreter, and the KERNAL for the system.

ROMable—Describes code that will execute properly when placed in ROM memory: segments of ROMable code have no temporary data storage areas and do not use instruction modification techniques.

round-robin—A scheduling technique in which a task list is cycled through from top to bottom and back again. In round-robin scheduling each process or device corresponding to a task is guaranteed periodic service whatever the actual task traffic may be.

routine—A section of code written to perform a specific action, such as an input character routine or a disk write routine.

RPG—Report Program Generator. A business-oriented programming language that uses a highly structured system of preformatted commands.

RPM—Rotations Per Minute.

RPN—Reverse Polish Notation.

RPROM—Reprogrammable Read Only Memory.

RS—Register Select.

R-S flip flop—A flip-flop using two cross-coupled NAND gates.

RS-232C—The widely used standard for connecting computer system components, especially for serial communication of control codes and data between computers and serial input/output peripheral devices. The RS-232C is an electrical standard for connecting data terminal equipment such as modems or network data concentrators. It allows substantial variation as to what signals are passed. The C-64 has a built in RS-232C interface accessed through the users port. The voltages of the port are not standard RS-232C voltages, and an interface is required before connecting to most RS-232C devices.

RTOS—Real Time Operating System.

RTS—Ready To Send (RS-232C standard signal).

R/W—Read/Write.

RZ—Return to Zero. A recording technique often used on continuous magnetic media, especially tape.

S-100—An extremely widespread 100-line microcomputer system bus.

sampling—Measuring an input value at intervals.

sawtooth waveform—A sawtooth waveform consists of all harmonics, each in proportion to the reciprocal of the harmonic number. For example, the third harmonic will be only ⅓ as loud as the fundamental frequency.

SCRATCH—A disk command that is sent through the command channel and erases files and programs on the disk. Programs can be erased one at a time or in groups using pattern matching. The format is

```
OPEN15,8,15
PRINT#15,"SCRATCHO:name"
```

name—name of file to be erased from the disk.

screen—The surface of a monitor or TV set on which characters are displayed.

screen editor—The screen editor is a program that arranges the display of characters entered from the keyboard to the screen. It allows for inserting and deleting of characters and is built into the ROM of the Commodore 64.

screen memory—A 1024 byte area starting at address 1024 to 2047 (hex $0400 to

07FF). Each of these locations is 8 bits wide. Each location can hold any integer up to 255 and controls what will appear on the screen at the corresponding spot.

screen size—A measure of the size of a CRT screen. Screens may be measured diagonally, as TV sets, or by the number of vertical and horizontal dot or character positions.

scrolling—Scrolling is the movement of the entire screen in one direction one pixel at a time. The VIC-II chip on the C-64 supports scrolling in both the vertical and horizontal direction. Address 53270 enables scrolling in the X direction and 53265 enables scrolling in the Y direction.

sector—A contiguous section of a disk track. A block of data on a disk is addressed by its track and sector numbers. Typical disk sector sizes are 128, 256, or 512 bytes od data. Consecutively numbered sectors may or may not be physically adjacent within a track. The 1541 Disk Drive use 256 byte sectors written 17 to 21 per track.

sector (bad)—A sector on the disk that will not read/write data correctly, usually due to a minor physical flaw in the disk. One or two bad sectors will not seriously effect the disk's use; they will be marked as bad and not used. More than a few sectors indicates the disk should be used as a frisbee rather than to hold your valuable data.

sectors(disk)—The 1541 saves data onto a disk in a very specific format. Data is saved in concentric rings called tracks. Each ring or track is divided into sections called sectors. Each sector contains 256 bytes of information, and there are a total of 683 sectors on a disk. Because the circumference of the rings are smaller towards the center, there are fewer sectors per track near the center of the disk.

segment—A continuous block of memory addresses, such as 0 to 64.

sequential access—An access method in which items may be accessed in a fixed order only. The standard example of a sequentially accessed medium is magnetic tape. Here, in order to access a particular record, all records before it must be scanned first.

sequential file—A file whose elements may only be accessed in ascending order. In order to read an element of a sequential file, all of the preceding elements must be accessed. Sequential file data is moved through a buffer in the same order each time it is accessed.

serial—Bit by bit handling of processes, transmissions or storage of data. With a serial interface, only one data wire is available. The 8 bits of a byte are transmitted one after another (or serially). The I/O device must collect all 8 bits through time back into one 8 bit byte. See parallel.

serial bus—The serial bus of the C-64 is accessed through the 6 pin DIN socket on the rear of the computer. It is connected directly to the 1541 disk drive or 1525 printer. Some companies manufacture interfaces that are compatible with the serial bus and convert data transmitted to more common formats. The serial bus can be used to daisy chain up to 4 disk drives and a printer. Each device must have its own device number to avoid confusion when data is transmitted.

serial data—Data transmitted sequentially, one bit at a time.

serial port—An I/O port through which data is transmitted and received serially.

The C-64 utilizes a serial port to connect to the 1541 disk drive a compatible printer. The port is a 6 pin DIN socket located in the back of the C-64. The port gives access to the serial bus, which connects to the CIA (complex interface adapter). Up to 5 drives can be connected to each other, with the last one connecting to the port in a daisy chain configuration. Each drive must be programmed to have a different device number.

serial printer—Any printer that receives data serially is called a serial printer. Although there may be more than one line to the printer, data is sent to the printer one bit at a time. The 1525 printer is a serial printer.

Silicon Valley—The area around Sunnyvale, in the Santa Clara Valley south of San Francisco, California, where many semiconductor manufacturers are located. More generally, it contains the greatest concentration of electronics industries in the U.S. It is also called Silicon Gulch, but please, never Silicone Valley.

simulator—A program that has the same input/output behavior as the device it simulates, but is generally slower. A CPU is easily simulated by a program on a different machine, but I/O cannot be precisely simulated because of timing considerations, so only the logic of a program can be tested with a simulator.

single density—The 1541 disk drive utilizes a single density, single-sided disk. Single density simple refers to how closely the bits are packed. Double density would place the bits twice as close as single density and therefore store twice as much data as a comparable single density drive.

single-sided—The 1541 disk drive is a single density side drive. Single-sided refers to the fact that the internal mechanism of the drive can only access one side of a diskette for a read or write operation at a time. Double sided drives can access both sides of the disk. Therefore they can access twice as much information per disk.

single-stepping—Refers to the execution of a program one statement or step at a time. It is a useful technique for debugging.

SLSI—Super Large Scale Integration. A technology that enables a chip to hold up to 100,000 transistors.

soft-sectored—A disk format in which the beginning of each sector is signified by a magnetic mark on the disk. This is in contrast to *hard-sectored* where each sector's origin is marked by a physical hole.

software—Computer programs of all kinds are termed software. Usually software is contrasted to hardware, the actual chips, wires, boards, etc., which make up the computer. See *hardware.*

software-compatible—Describes CPUs that execute the same instructions (that is have the same machine language).

sort—To arrange items according to defined criteria, such as alphabetical or numerical order.

source code—A synonym for source program.

source drive—The disk drive from which information or data is coming. The *target* drive is the disk drive to which information or data is going.

source language—The original language used by the programmer. A translator program operates on the source language to produce a version in the language used by the machine.

source program—A program written in a source language. It can be translated into machine language by a language processor.

spikes—Sharp, temporary increases in a signal or voltage.

split screen—Division of a CRT screen into two or more separate areas, or windows, in which distinct information is displayed.

spool—Simultaneous Peripheral Operating On-Line. A method of increasing system throughput by allowing programs using slow output devices to complete execution rapidly. Program output data is placed in queues on highspeed mass storage devices or in a part of main memory dedicated to storing throughput low-speed transmission. The system can then be used for normal operation while the printing (for example) is being done.

sprites—A sprite is a programmable character, also known as MOB (moveable object block). Its color, position, and movement are under the direct control of the VIC-II chip. It may be used in either normal or high resolution graphics modes. A sprite may either be standard or multicolor. Up to 8 sprites may be controlled on the screen simultaneously.

SSI—Small Scale Integration. A technology in which each element holds a few gates.

stand-alone—A device that can be operated by itself, without any other equipment.

start-bit—A bit indicating the beginning of asynchronous serial transmission.

statement—A string of characters that is a syntactically complete instruction with respect to a high-level language translator.

STATUS—After each input operation the KERNAL automatically checks for any errors incurred with that operation. The errors are coded and put in the system-defined variable ST. The user can use ST to check on the status of a peripheral device operation.

status—The present condition of a device, usually indicated by flag flip-flops in special registers.

status bit handshaking—The delegation of certain bits of a parallel I/O port to coordinate information transfer with a peripheral device. Status bits are used to indicate device ready, buffer full, printer out of paper, and so on.

stepper motor—A mechanical device that rotates by a fixed amount each time it is pulsed, often used in disk drives.

stop—KERNAL routine to scan stop key.

stop-bit—A bit indicating the end of asynchronous serial transmission.

storage—A synonym for memory.

string—An ordered sequence of data items, such as characters. For example, the word "string" is a string of six characters.

structured language—A computer language designed to aid or enforce structured programming. Control structures, such as IF . . . THEN . . . ELSE, DO . . . WHILE, CASE, and REPEAT . . . UNTIL, together with provisions for declaring logically separate program modules, such as procedures, and provisions for limiting the scope of variables all lend a modular structure to programs. Unconditional control transfer statements (GOTOs) are often left unimplemented. Popular structured languages are PASCAL, ALGOL, and C.

structured programming—A set of techniques designed to increase the reliability and comprehensibility of programs by increasing programmer discipline. Struc-

tured programming involves precise problem specification, top-down or stepwise program design, and block-structured or modular programs.

sub-harmonic—A fractional multiple of the fundamental frequency.

subroutine—A program segment identified by name and often bracketed by a "subroutine" and a "return" statement. Execution is transferred to a subroutine when a subroutine call occurs. Subroutines improve program modularity and save memory space at a minimal cost in the overhead required to process the call/return sequence.

sustain sound—The level at which the volume of a note is maintained until it falls off to zero.

symbolic—Describes the use of characters or character strings in a defined syntax to stand for machine-related entities such as instructions or data.

synchronous—Operation controlled by a mutually sensed clock pulse.

syntax—The set of grammatical rules defining valid constructs (sentences or statements) of a language.

system—Any aggregate of two or more interconnected electronic components. Also used to mean a group of programs that accomplishes some function (for example, a database management system).

T—An electrical network shaped like the letter T, with one input, one output and one ground lead.

table look-up—A method of converting one variable to a corresponding value or of verifying its accuracy by searching a list of table of entries for the known keyword or value.

talker—The C-64 utilizes a serial bus to connect to the 1541 disk drive and some printers. Because more than one device may be present on the serial bus at one time, it is important that only one be transmitting data at a time. When data is INPUT# from a particular device, the C-64, using appropriate command signals and the specific device number, sets that device as a talker. Only that device can put data onto the data lines until the C-64 sends the UNTALK command to it.

tape (magnetic)—An inexpensive mass storage medium with the disadvantage of requiring sequential access. It is convenient for large files or archival storage. Tape is often the only external storage on very low priced systems and is used as a backup for disk on larger systems.

task—A particular function of a program.

**Time$**—The C-64 has an internal timer (jiffy clock) to synchronize much of the activity within the system. When the computer is turned on, the jiffy clock begins setting the variable TI$ with six characters corresponding to the hour, minute, and second since power was established. The user can refer to this variable any time to receive that data. The user can reset TI$ by letting TI$="000000". Using tape I/O alters TI$. TI$ is a reserved variable and cannot be used for any other purpose.

tksa—A KERNAL routine to send secondary address after talk.

TPA—Transient Program Area. Under CP/M this is the area in memory that is allocated for loading user programs to be executed. Often a program may take up more memory by occupying CCP and related areas used by various CP/M subroutines until it finishes execution, when the command is given back to the CCP.

track—The 1541 disk drive saves data onto a diskette in a very specific format. Data is saved in concentric rings called tracks. See *sectros*.

triangular waveform—A triangular wave consists of its fundamental frequency and the odd harmonics, each in proportion determined by the reciprocal of the square of its harmonic number. Therefore the third harmonic is only 1/9th as loud, and the fifth harmonic is only 1/25 as loud as the fundamental frequency.

upward compatible—The term upward compatible indicates that programs developed for one version of a programming language, operating system, application software package, or computer will work without alterations on an expanded, more powerful version of the same language, system, or package.

user—A User is a person who uses a computer.

user friendly—For programs you write, the operator will often be you. But if others will ever use your program, you need to give some thought to issues such as giving clear prompts for every item of input data, freezing the screen long enough for them to read or act on the information displayed, and providing clear error messages if anything is entered incorrectly or error situations arise. This is often referred to as *human engineering*—making the program easy to use as well as technically correct. Another term for this side of programming is making the program user friendly. Several other guidelines exist for writing user friendly programs. If a complex series of data items has been typed in, and some entries turn out to be invalid, the user should be able to reenter only the bad items. Error messages should indicate not only that an entry is invalid, but also in just what way it is invalid and, if at all possible, some hints as to how to correct it (such as a list of possible correct values).

user group—A group or club focused on an aspect of computers. Some clubs direct their attention on one particular computer, such as the Commodore. Other groups focus on a language (FORTH User's Group, PASCAL User's Group, etc), on an Operating System (CP/M, etc.), on an area of application (accounting, education, science, graphics, etc.), or other aspects of computing. Many magazines on computing carry lists of clubs/groups and report on their activities. User groups provide a valuable opportunity to get and give advice on hardware, software, and applications. Often you can talk to someone who used a product you are considering buying. User group newsletters may also offer useful information. If you need a programmer or consultant, you may meet or hear about a good one at a user group meeting.

users port—Located in the rear of the C-64, the users port allows the computer to interface with a variety of peripheral devices including RS-232C devices. The bottom row of connectors through the port include 8 lines that can be accessed through address 56577 of memory. You can receive or send data through those lines to any peripheral that is voltage compatable. Each line can be programmed to send or receive data by programming the data direction register address 56579 with the appropriate value.

utilities—The software used for routine tasks. Utilities are designed to facilitate or aid the operation and use of the computer for a number of different applications and uses. Examples of utilities are an editor, a sort, a debugger, and a file handler.

VALIDATE—The validate command, when sent through the command channel, reorganizes your disk by eliminating gaps and moving files to create larger sections of free space on your disk. It also eliminates any files that were opened but not properly closed. The command should not be used on disks that have random files as, they will be deallocated by the command. The format is

```
OPEN15,8,15
PRINT#15,"VALIDATE"
```

variable—A symbolically named entity that may assume an assigned value or a number of values.

vector—A KERNAL routine to read or set vectored I/O.

VIC-II—The 6567 Video Interface Chip (the VIC II Chip) is responsible for the video output of the C-64. The chip is located at address 53248 through 53294 (hex $D000 to $D02E) and contains 47 control registers that control the video output. These registers are accessed via a standard 8 bit microprocessor bus (65XX). The chip is capable of accessing up to 16K of memory for display information.

wildcard—The symbol ? is used as a wildcard character when the C-64 is loading a program. The ? is used to represent any letter. For example if you entered LOAD 4"A??",8 the first program with a three letter name beginning with A would be loaded. The command LOAD"$0:A?t", 8 would list from the directory all three letter files beginning with A and ending with t.

Winchester disk—A hard disk system characterized by very light read/write heads, low head-to-disk clearance, and complete enclosure of the magnetic media in a dust-free environment. This technology achieves high information density and fast access-time.

window—A section of a CRT screen dedicated to displaying specific types of information.

word processor—A computer-based system for writing, editing, and formatting documents such as letters, reports, and books. It may be either a specialized hardware system dedicated to these tasks or a program package run on a general purpose computer.

write-protect—Describes the act of preventing information from being written onto a storage medium. Floppy disk jackets often have notches that can be covered by adhesive tabs to write-protect the disk. These tabs disable the disk drive's write circuitry. Cassettes have a similar plastic tab that can be broken out to write-protect the tape.

x-y plotter—A device that draws points or lines on a sheet of paper based on X and Y coordinates received from a computer.

6502 chip—An 8-bit microprocessor widely used in mass-marketed computer systems, such as Commodore, Apple, and Atari. Made by MOS Technology.

6510 chip—The main microprocessor used in the Commodore 64.

6581 chip—The sound interface processor used in the Commodore 64.
6567 chip—Also called the VIC II chip, this is the video interface processor used in the Commodore 64.

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